

< Reference >

# Results of Building Frame Inspection on Fukushima Daiichi NPS Unit 3 Reactor Building after Debris Removal at Upper Part

February 14, 2014

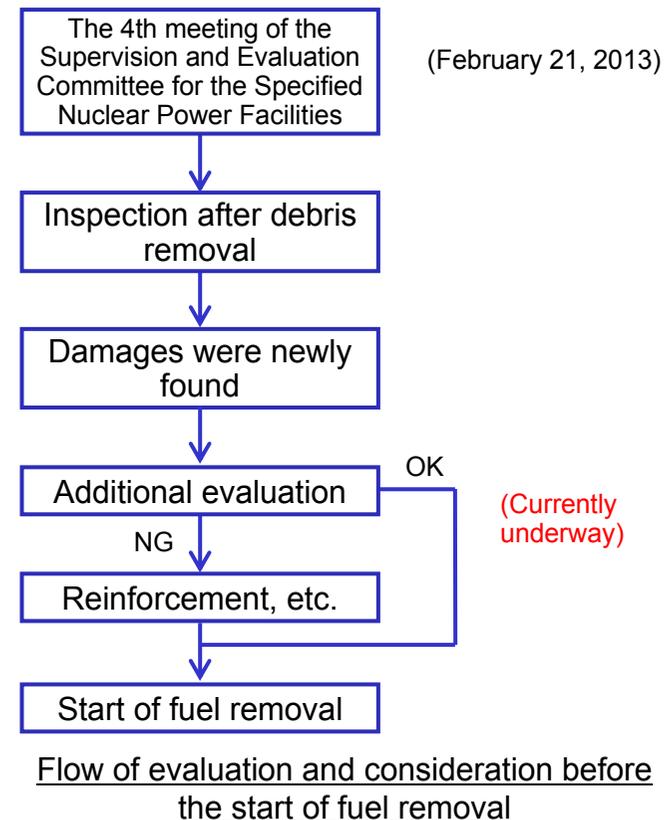
Tokyo Electric Power Company

# 1. Introduction

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## (1) Overview

- In the 4th meeting of the Supervision and Evaluation Committee for the Specified Nuclear Power Facilities (on February 21, 2013), “Structural strength and earthquake resistance of the cover for fuel removal of Unit 3” was discussed.
- Because the debris removal for the Reactor Building had not been completed when the above meeting was held, an inspection of the conditions around the floor of the operating floor after the debris removal was conducted this time.
- The results are herein reported along with the results of the so far conducted inspections on the building interior.



## (2) Inspection method

- The floor of the operation floor, and the equipment hatch interior: Inspection using a camera attached to a crane
- The building interior: Inspections through video analysis obtained in the so far conducted building-interior inspections using robots.

## 2. Inspection results and schedule of next activities

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### (1) Inspection results

#### ● Conditions of the building

- ・ With respect to the floor of the operating floor, no severe damage was observed, although damages were found in some parts. [\[Attachment 1\]](#)
- ・ The building interior was found to have no remarkable damages. [\[Reference\]](#)

### (2) Schedule of next activity

- ・ Based on the results of this inspection, we scheduled an earthquake safety evaluation to be conducted by the end of FY2013.

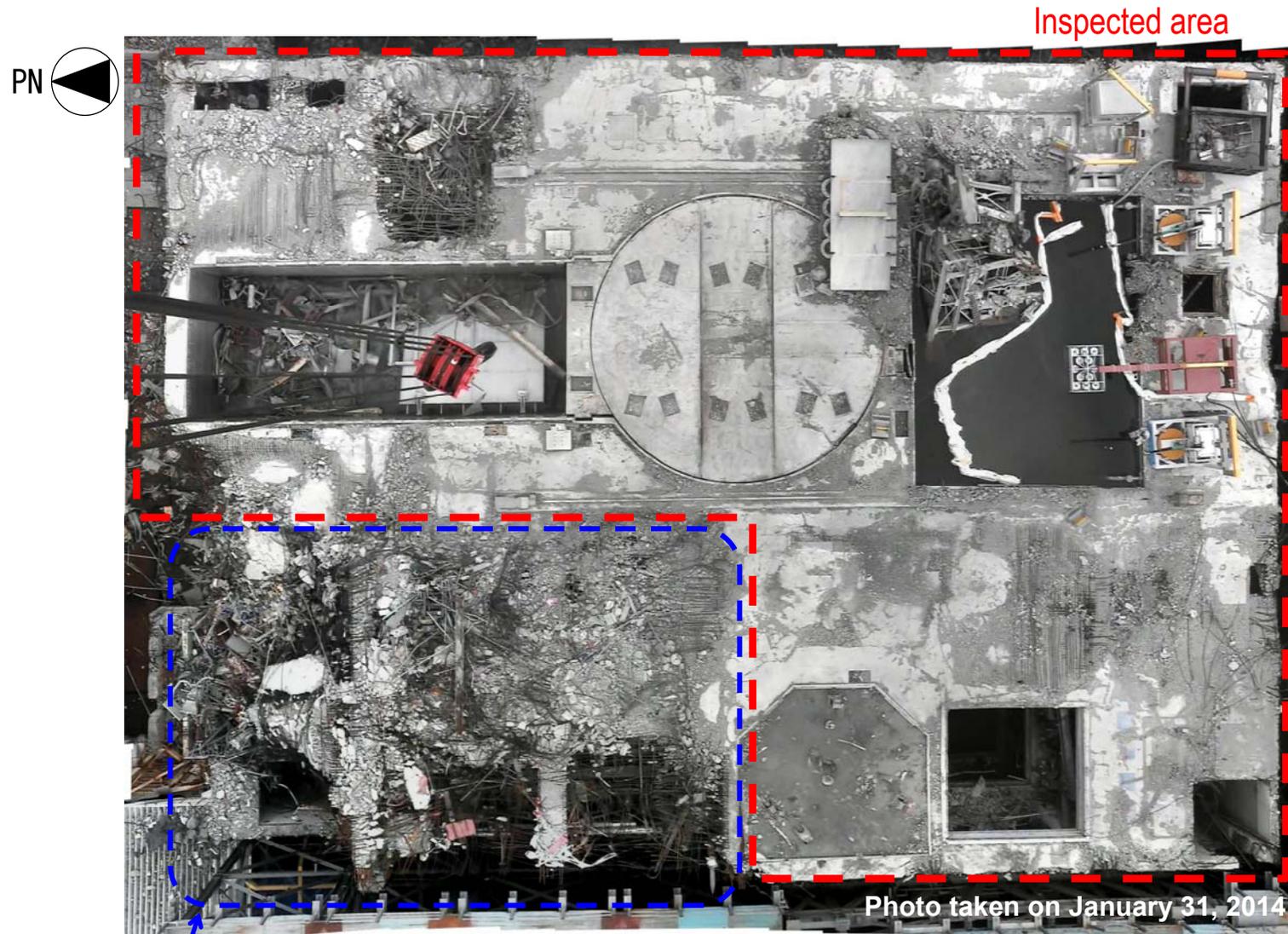
### (3) Other issues

#### ● Shield plug

- ・ Although the shield plug is not a structural member and therefore has no impact on earthquake safety evaluations, deformation of approx. 300mm was found in the central part of the shield plug.
- ・ A load (a main winding hook, debris, etc. weighing at least about 8 tons) that had been mounted on the shield plug was already removed, and further progress of the deformation is therefore thought very unlikely.

[\[Attachment 2\]](#)

# Attachment 1. Inspection results on the operating floor (5th floor)



Already inspected in a condition inspection immediately after the March 11 earthquake.

• This photo is created through synthesis of inspection photos to show a full view.

# Attachment 1. Inspection results on the operating floor (5th floor)

- Shown here are representative damaged parts found through the inspection.



Photo ①: Damage to the floor slab



Photo ②: Reinforcing bars exposed due to damage to the upper end of concrete

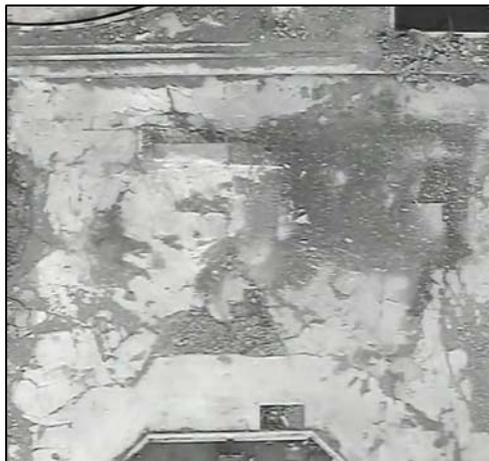
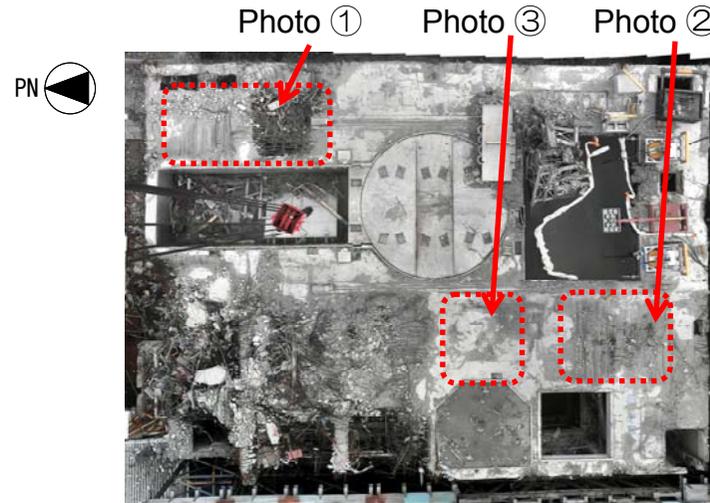


Photo ③: Damage to the surface layer of concrete



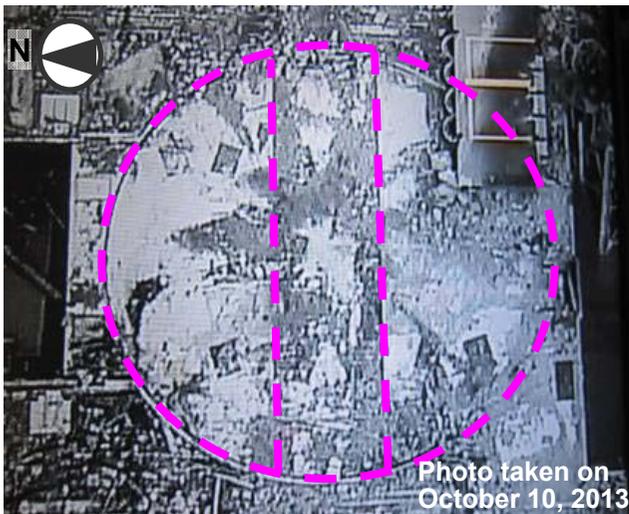
Photos taken on January 31, 2014



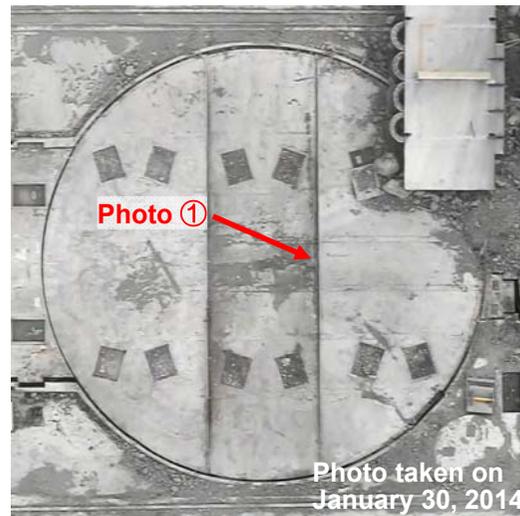
## Attachment 2. Deformation of the shield plug

### ● Conditions

- Before the debris removal work, there were small pieces of debris piled up on the shield plug, and the detailed conditions were unavailable.
- The conditions on the shield plug surface were inspected after the small pieces of debris were collected and removed. Then, the deformation (approx. 300mm) was found in the central part of the shield plug.



Before decontamination was started



After decontamination (collection of small pieces of debris) progressed



Photo ①: Deformation state of the shield plug

## Attachment 2. Deformation of the shield plug

### ● Presumed cause of the deformation

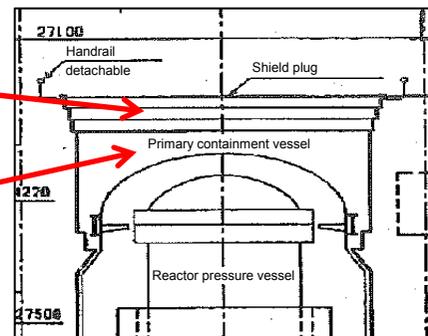
Presumed causes include “a hydrogen explosion” and “falling of something like an overhead traveling crane”. However, it is highly unlikely that a hydrogen explosion resulted in the deformation of the shield plug (made of reinforced concrete and of 3 layers each being approx. 60cm in thickness), based on the fact that the floor slabs (30cm and 60cm in thickness) around the shield plug have no damage. Additionally, although the main body of the overhead traveling crane that fell down did not make direct contact with the shield plug, there was a trolley over the plug. It is therefore presumed that something like a main winding hook hit the plug and deformed the shield plug.

Shield plug includes 3 layers

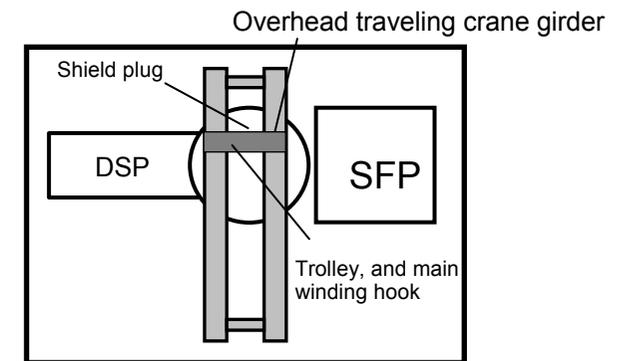
The thickness of 1 layer = approx. 600mm

Each gap in the plug = approx. 10mm

Distance between the shield plug and the PCV head = approx. 1,200mm



Cross-sectional view of the shield plug



Situation that resulted from the falling down of the overhead crane girder

### ● Risk assumptions

The following risks are assumed, and will be considered on the next and subsequent pages:

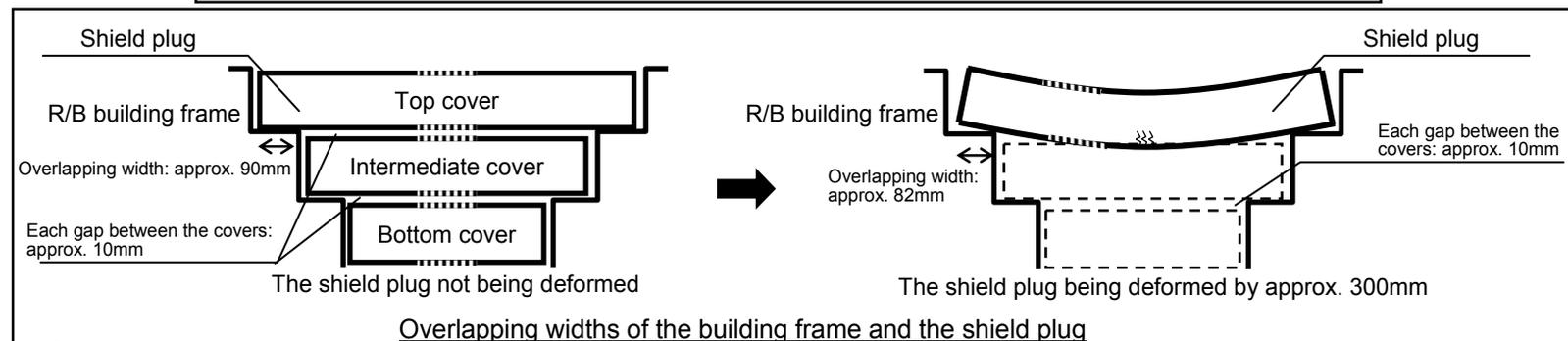
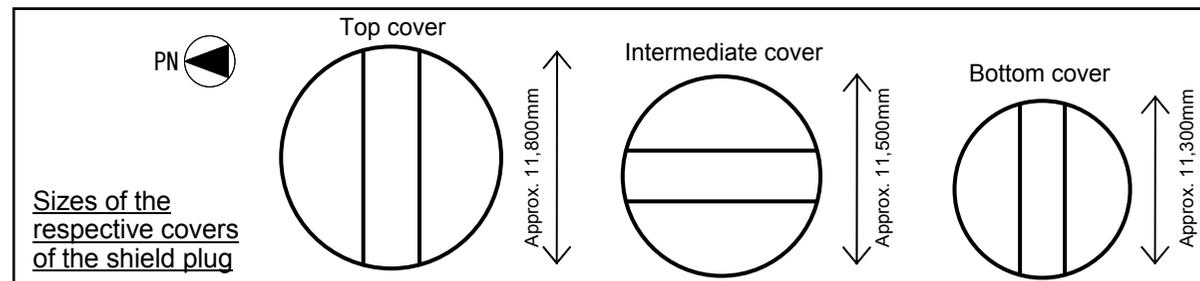
- ① Progress of the deformation, and falling off of the shield plug;
- ② Additional damage to the shield plug due to a fallen object;
- ③ Damage to PCV;
- ④ Increase of dose rates; and
- ⑤ Increase of concentrations in dust

## Attachment 2. Deformation of the shield plug

### Rink ① “Progress of the deformation, and falling off of the shield plug”

#### < Consideration >

- The covers of the shield plug are arranged in parallel crosses, and a gap between each two of the covers is approx. 10mm. Therefore, it is considered that the intermediate cover and the bottom cover remain less damaged than the top cover.
- The overlapping width of the building frame and the shield plug is approx. 90mm under normal conditions, and was reduced by 8mm due to the deformation. Therefore, it is thought unlikely that the shield plug would fall off due to the deformation.
- Even supposing that the central part of the shield plug is under flexural yielding, the shield plug is supposed to be sufficiently durable to a load as heavy as that applied to it when it was deformed. Additionally, the load (a main winding hook, debris, etc. weighing at least about 8 tons) that had been mounted on the shield plug was already removed, and further progress of the deformation is therefore thought very unlikely.



## Attachment 2. Deformation of the shield plug

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Risk ② “Additional damage to the shield plug due to a fallen object”

< Consideration >

- A shield made of steel (250mm in thickness) is to be placed on the shield plug after the completion of decontamination, which is expected to work as a protection against fallen objects. Therefore, additional damage due to a fallen object is thought impossible.

Risk ③ “Damage to PCV”

< Consideration >

- Even with approximately 300mm deformation of all of the 3 shield plug layers, breaking of reinforcing bars inside the concrete is highly unlikely. It is therefore presumed that the shield plug has not fallen off.
- There is an approximately 1,200mm distance between the shield plug and the PCV head. It is therefore presumed that even deformation of all of the 3 shield plug layers would not bring the plug in contact with the PCV head.
- The plant parameters have been stable.

# Attachment 2. Deformation of the shield plug

Risk ④ “Increase of dose rates”

< Consideration >

- Measurement of dose rates on the shield plug has been conducted at certain stages of the progress for checking effects of the decontamination. No significant changes have been found in the gap part that suffered deformation and its surroundings.

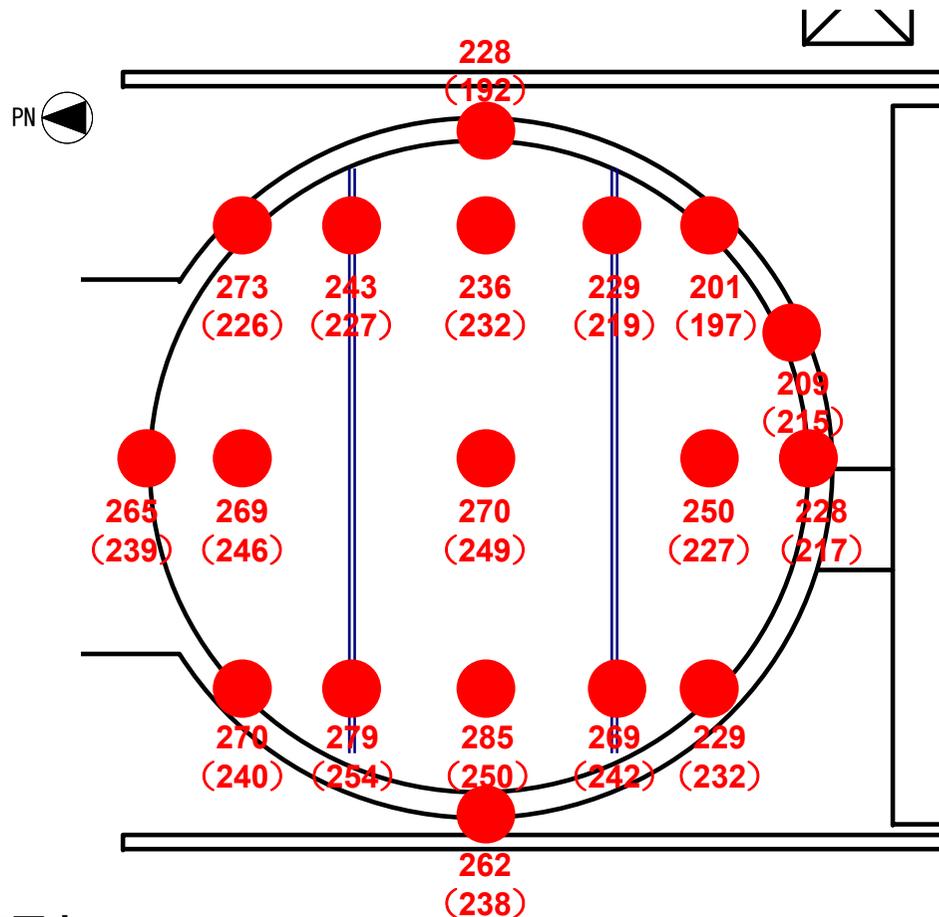


Figure in the upper line:  
Atmosphere dose rate at 5 m (mSV/h)  
measured on December 14, 2013  
Figure in parenthesis in the lower line:  
Atmosphere dose rate at 5 m (mSV/h)  
measured on January 27, 2014

# Attachment 2. Deformation of the shield plug

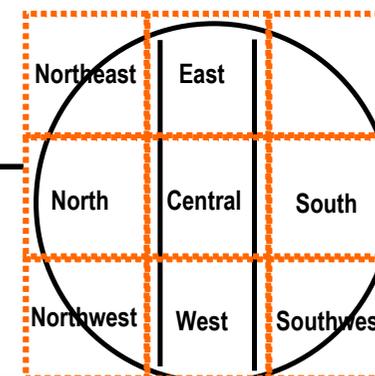
Risk ⑤ “Increase of concentrations in dust”

< Consideration >

- Measurement of the concentrations in dust has been conducted using a tent-form dust sampler, which is 4 meters square, and no significant changes have been found in the gap part that suffered deformation and its surroundings.



(Units: Bq/cm<sup>3</sup>)



Northeast part	Cs-134	2.2E-6	East part	Cs-134	ND(2.4E-6)			
	Cs-137	4.0E-6		Cs-137	3.3E-6			
	Total	<b>6.2E-6</b>		Total	<b>&lt; 5.7E-6</b>			
North part	Cs-134	ND(2.4E-6)	Central part	Cs-134	5.9E-5	South part	Cs-134	9.3E-5
	Cs-137	ND(3.4E-6)		Cs-137	1.4E-4		Cs-137	2.1E-4
	Total	<b>&lt; 5.8E-6</b>		Total	<b>2.0E-4</b>		Total	<b>3.0E-4</b>
Northwest part	Cs-134	3.3E-6	West part	Cs-134	7.7E-5	Southwest part	Cs-134	6.4E-4
	Cs-137	6.7E-6		Cs-137	1.7E-4		Cs-137	1.4E-3
	Total	<b>1.0E-5</b>		Total	<b>2.5E-4</b>		Total	<b>2.0E-3</b>

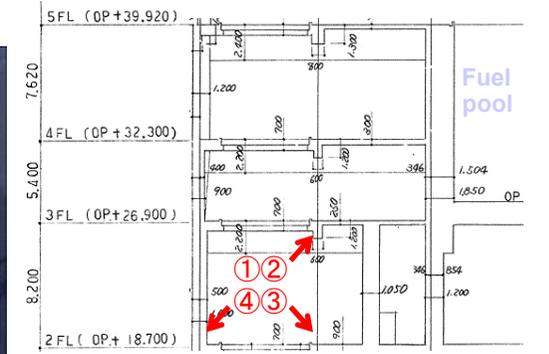
- A part having -6 as the order of magnitude is shaded in pale blue; a part having -5 as the order of magnitude, in yellow; a part having -4 as the order of magnitude, in orange; and a part having -3 as the order of magnitude, in pink.

# Reference 1. Results of the inspection of the equipment hatch (2nd floor)

① Intersection of girders of 3rd floor



② Column of 2nd floor and intersection of girders of 3rd floor



(West) RG RF RE (East)

Cross-sectional view of the large carry-in entrance taken along the west-east line

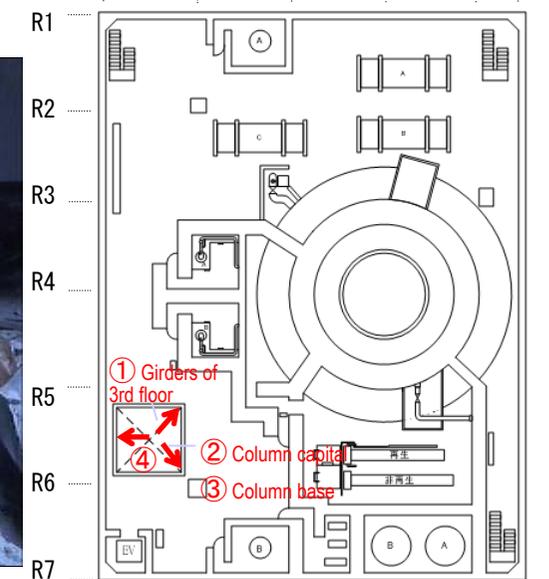
PN

RG RF RE RD RC RBa

④ Conditions of west outer wall and floor surface of 2nd floor



③ Conditions of column base part and floor surface of 2nd floor



Flaming plan of 2nd floor (OP.+18.7m)

Photos taken on December 19, 2013

# Reference 1. Results of the inspection of the equipment hatch (3rd floor)

⑤ Intersection of girders of 4th floor



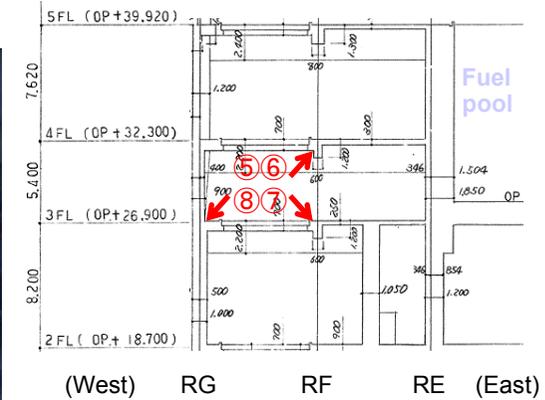
⑥ Column of 3rd floor and intersection of grinders of 4th floor



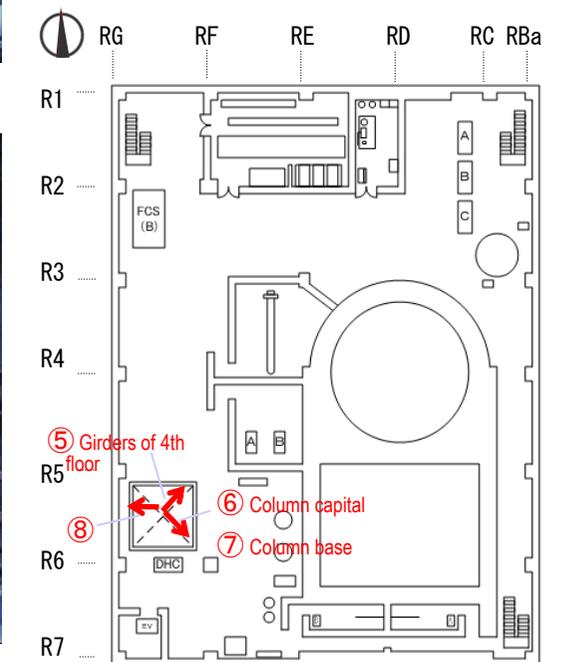
⑧ Conditions of west outer wall base and floor surface of 3rd floor



⑦ Conditions of column base part and floor surface of 3rd floor



(West) RG RF RE (East)  
Cross-sectional view of the large carry-in entrance taken along the west-east line



Flaming plan of 3rd floor (OP.+26.9m)

Photos taken on December 19, 2013

# Reference 1. Results of the inspection of the equipment hatch (4th floor)

⑨ Intersection of grinders of 5th floor



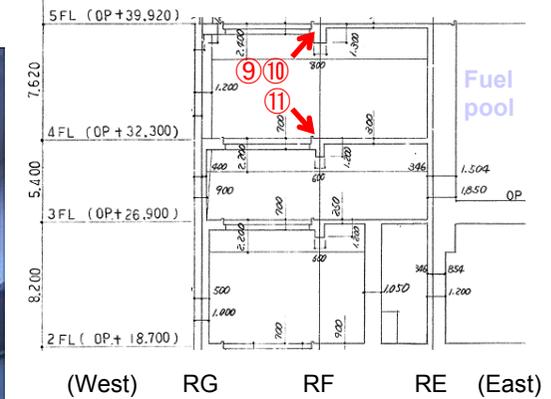
⑩ Column of 4th floor and intersection of grinders of 5th floor



⑪ Conditions of RE pool wall (between R5 and R6)

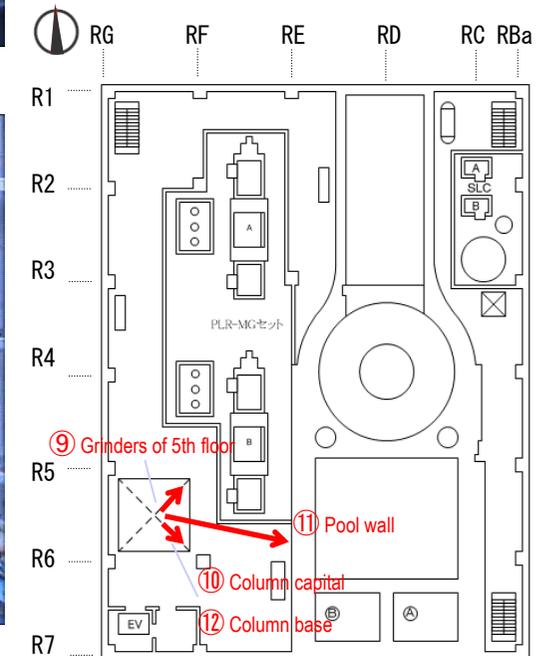


⑫ Conditions of column base part and floor surface of 4th floor



Cross-sectional view of the large carry-in entrance taken along the west-east line

PN

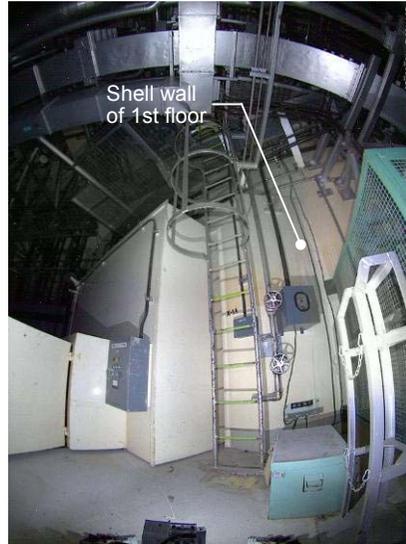


# Reference 2. Results of video analysis on the building interior (1)

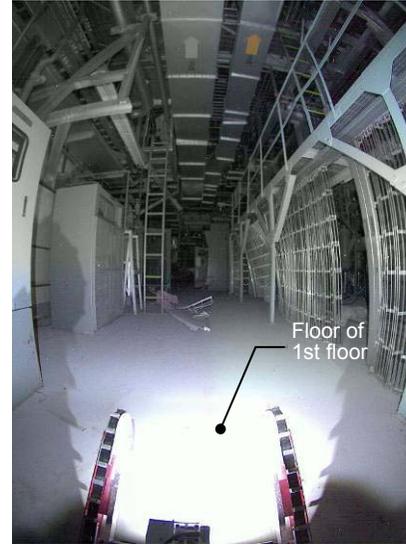
① North outer wall of 1st floor



② Shell wall of 1st floor



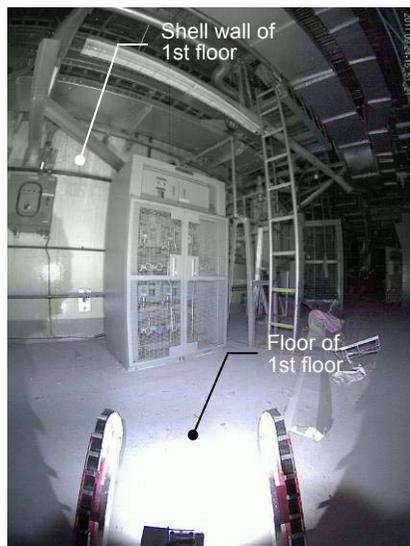
③ Floor of 1st Floor



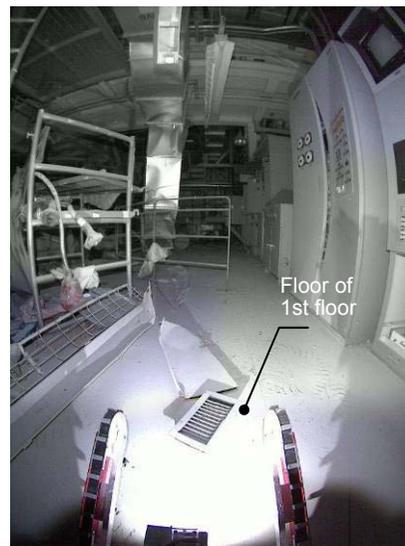
④ Shell wall of 1st floor



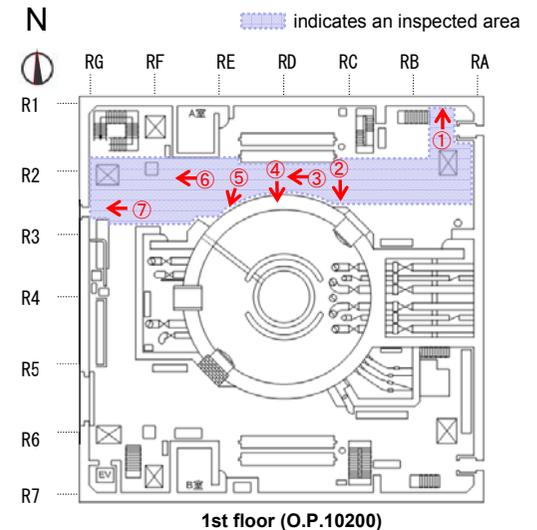
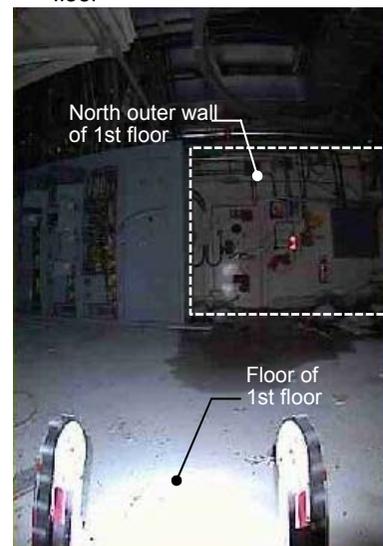
⑤ Shell wall and floor of 1st floor



⑥ Floor of 1st floor

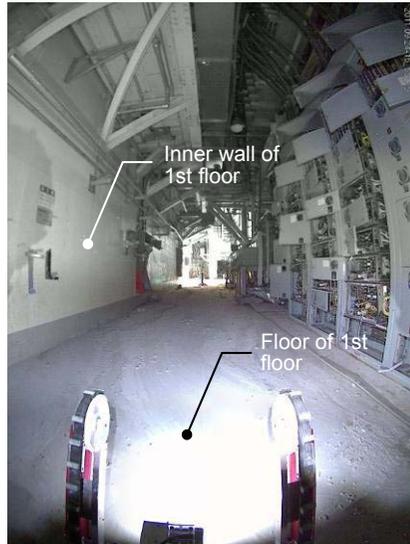


⑦ North outer wall and floor of 1st floor

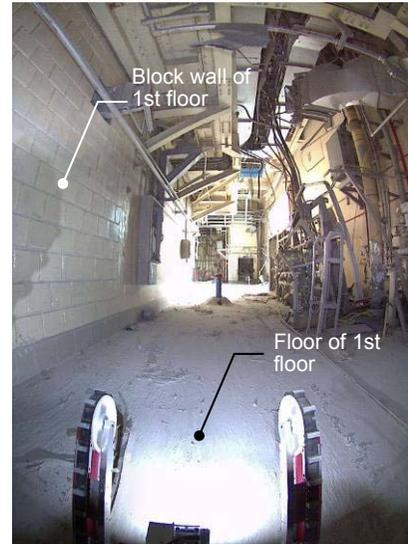


# Reference 2. Results of video analysis on the building interior (2)

① Floor and wall of 1st floor



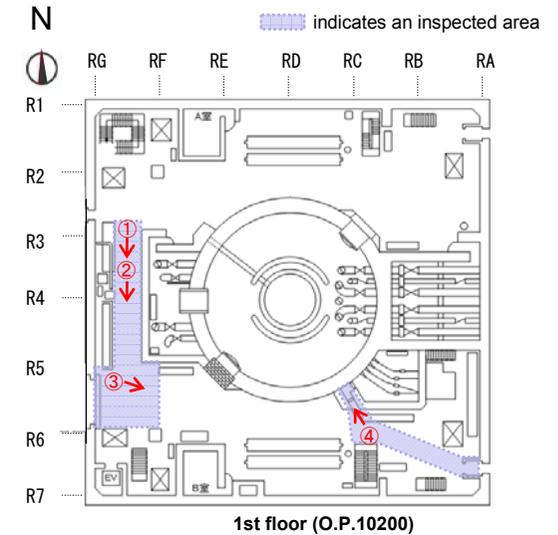
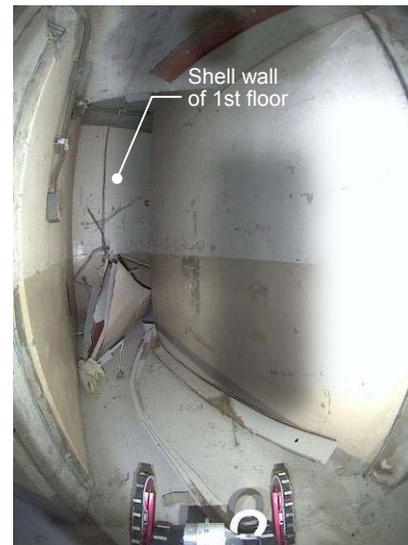
② Floor and wall of 1st floor



③ Surroundings of large carry-in entrance of 1st floor



④ Shell wall of 1st floor

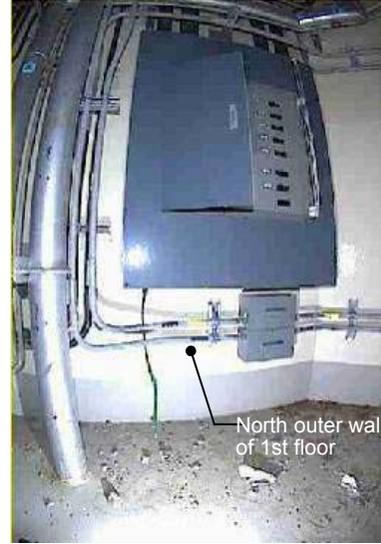


# Reference 2. Results of video analysis on the building interior (3)

① Floor of 1st floor



② North outer wall behind 1st floor stairs



③ East outer wall near stair case landing of 2nd floor



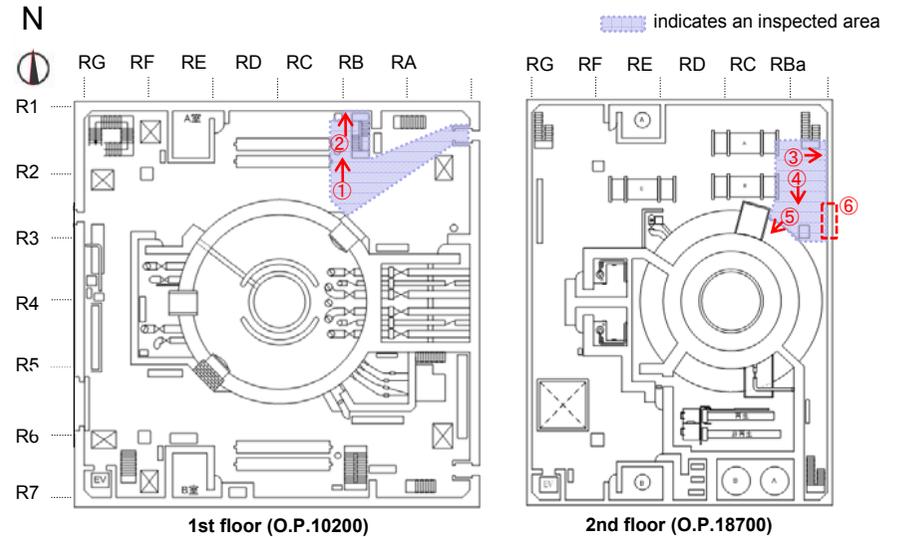
④ Floor and column in intermediary part of 2nd floor



⑤ Shell wall of 2nd floor



⑥ East outer wall of 2nd floor



Photos taken on July 26, 2011