Corrected

We replaced the photo for physical protection of nuclear materials. (September 4, 2012)

Results of the Second Soundness Inspection of Unit 4 Reactor Building at Fukushima Daiichi Nuclear Power Station

August 30, 2012

Tokyo Electric Power Company

東京電力 TEPCO

1. Purpose of Inspection

Unit 4 Reactor Building and Spent Fuel Pool are inspected regularly for soundness. In the second regular inspection (August 20-28, 2012), the partial bulge on the exterior walls found during the first inspection was inspected in detail in addition to the measurement points set the last time.

What we have reported so far

1. The first regular inspection (May 17-25, 2012)

[Inspection items]

(1) Building tilt measurement (Water level), (2) Building tilt measurement (Exterior wall), (3) Visual inspection, (4) Concrete strength

[Results]

- Though the upper part of exterior wall is partially damaged, no crack or tilt was found on the frame of the spent fuel pool (140-185cm thick). With a sufficient level of concrete strength maintained, the spent fuel pool is capable of safely storing the spent fuel.
- Partial bulge found on the exterior walls.

2. Detailed inspection of the partial bulge found on the exterior wall (June 6-21, 2012/ Result reported to NISA on June 25, 2012)

[Inspection items]

(1) Deformation characteristics of the exterior wall, (2) Concrete strength, (3) Visual inspection

[Results]

- Though partial bulge was found on the west and south exterior walls, no significant damage which would affect structural strength was found as a result of concrete strength evaluation and visual inspection for cracks.

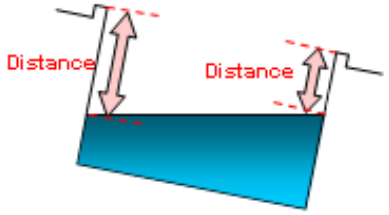
2. Results (1) Building Tilt Measurement (Water Level)

The distances between the 5th floor surface and the water levels of the reactor well and spent fuel pool were measured to check if the building is tilted or not. (It has already been confirmed that the building is not tilted based on the measurement results obtained on February 7, April 12 and May 18, 2012).

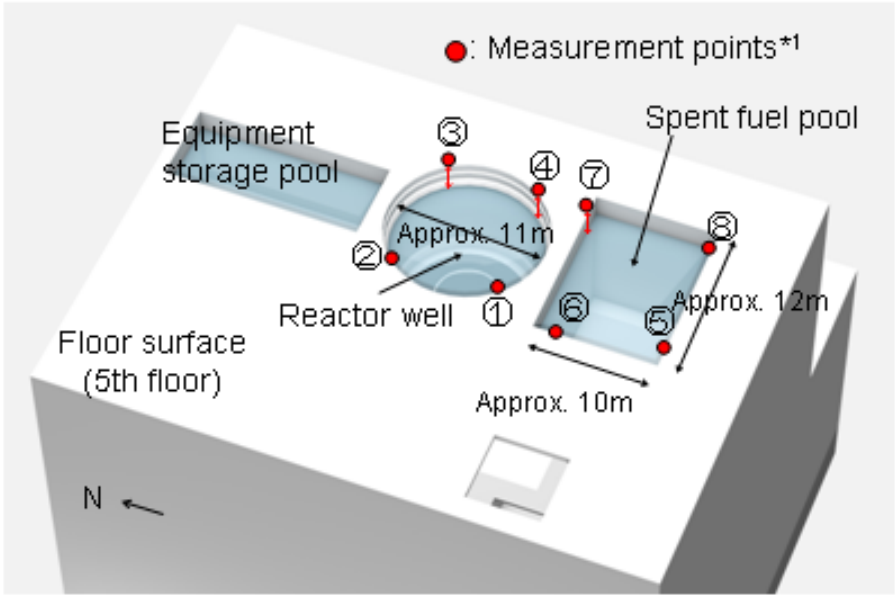
1) Building not tilted

The distances are the same

2) Building tilted



Difference in the distances

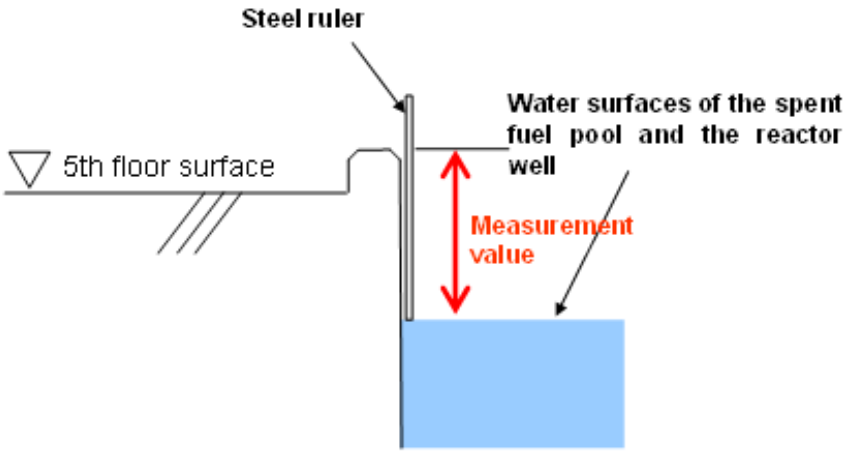


Measurement points (Floor surface of the 5th floor)

*1 The measurement points are set according to the progress status of cover installation for fuel removal.

2. Results (1) Building Tilt Measurement (Water Level)

Considering that the measurement values on the four corners were about the same, it has been concluded that the 5th floor surface and the water levels of the spent fuel pool and the reactor well are parallel. (It has already been confirmed that the building is not tilted based on the measurement results acquired on February 7, April 12 and May 18, 2012).



Measurement method*1

*1 Error must be taken into account as the Measurement is done visually by a person

Water level*2 Measurement Results

Unit [mm]

Reactor well	Measurement date			
	Feb. 7, 2012	Apr. 12, 2012	May 18, 2012	Aug. 21, 2012
①	462	476	492	462
②	463	475	492	462
③	462	475	492	461
④	464	475	492	461

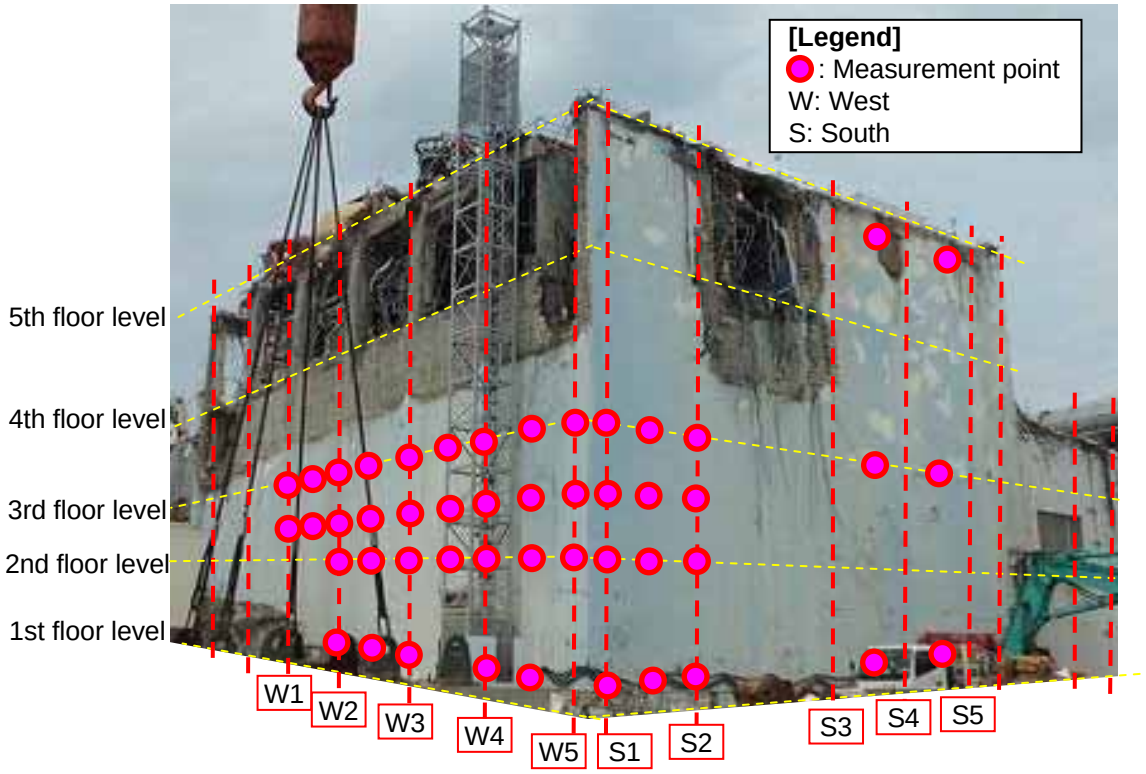
Spent fuel pool	Measurement date			
	Feb. 7, 2012	Apr. 12, 2012	May 18, 2012	Aug. 21, 2012
⑤	— (*3)	468	461	453
⑥		468	461	453
⑦		468	461	452
⑧		468	461	452

*2 Water levels are subject to change daily depending on the operation status of cooling equipments.
*3 On February 7, 2012, measurement was done only on the reactor well.

2. Results (2) Exterior Wall Measurement (Measurement Points)

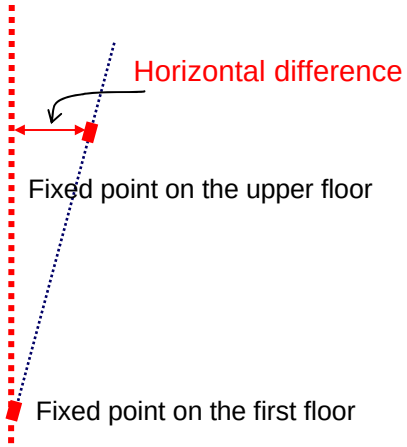
The horizontal differences*1 of the exterior walls were measured by an optical equipment (with fixed points set on the upper and lower sides of the walls) and the deformation characteristics of the exterior walls were evaluated.

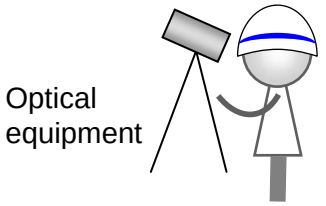
Though partial bulge was found on the exterior walls, it has been confirmed that the building itself is not tilted based on the results of the first inspection (May 2012) and the detailed inspection of exterior walls (June 2012).



Measurement points

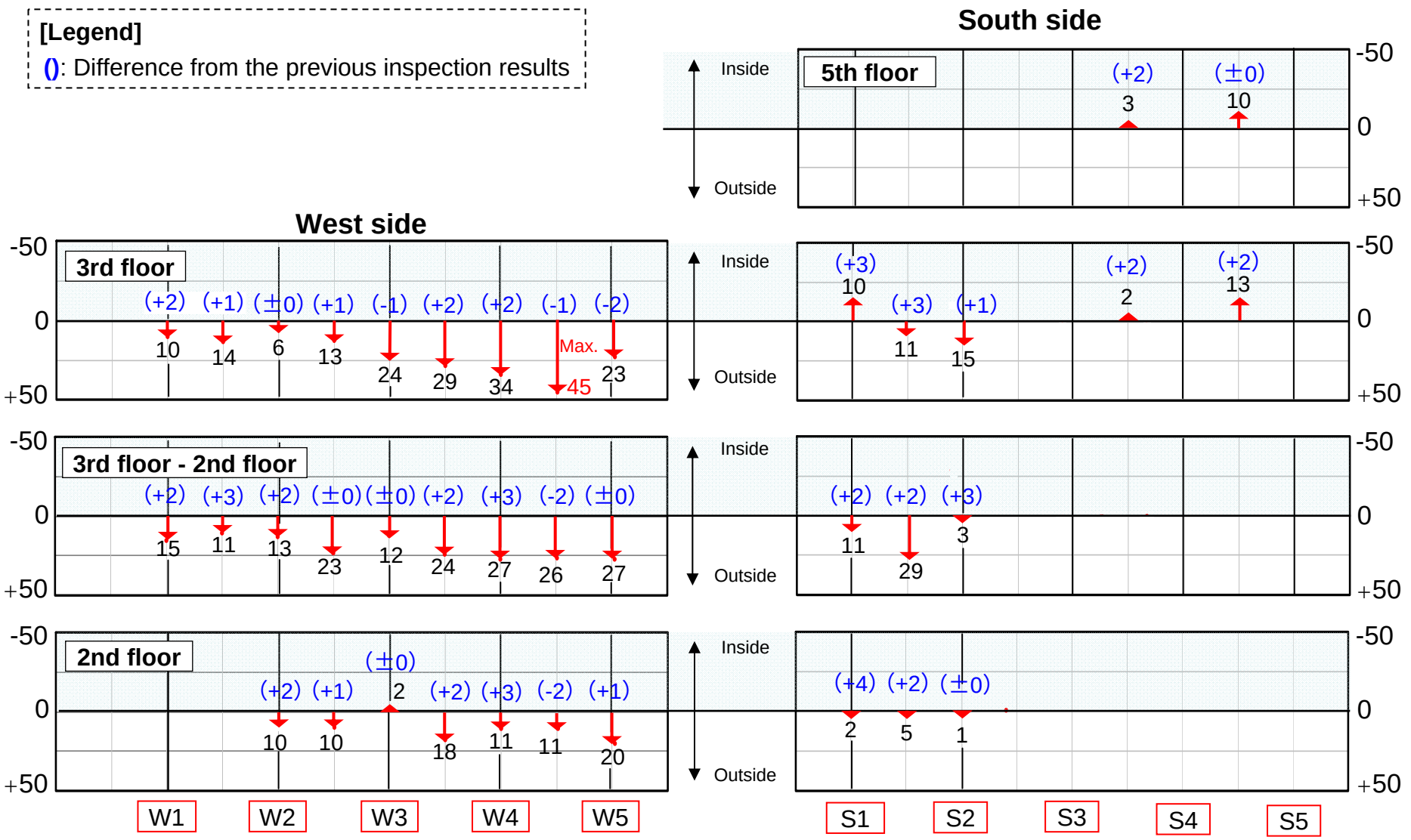
*1 Horizontal distance between the fixed point on the first floor and the fixed point on the upper floor





2. Results (2) Exterior Wall Measurement (Measurement Results)

[Legend]
(): Difference from the previous inspection results



Horizontal difference*1 calculation results

*1 Horizontal distance between the fixed point on the first floor and the fixed point on the upper floor

2. Results (2) Exterior Wall Measurement (Consideration)

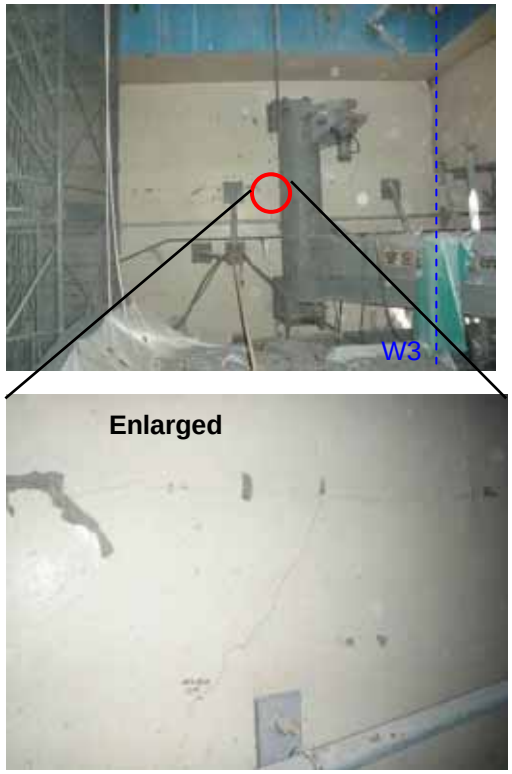
- The horizontal differences measured this time were about the same as those in the first inspection (May 2012) and the detailed inspection of exterior walls (June 2012), and the deformation characteristics on the measurement points were also similar.
- The small difference from the previous measurement results may be due to factors such as error of the optical equipment (Measurement error of ±2mm may cause approx. 4mm (Max.) error in horizontal difference) and thermal expansion of concrete (thermal expansion coefficient: Approx. $7\text{-}13\times10^{-6}$/°C) which may cause approx. 2-4mm error because of the difference of average monthly temperatures of May and July.
- As a result of visual inspection and concrete strength evaluation done on part of the second floor west and south exterior walls where partial bulge was found, no cracks of the width of 1mm or more which would affect the structural strength was found and the concrete strength seems to be maintained. It has also been confirmed that there is no problem with the seismic safety of the Reactor Building based on the analysis evaluation without the wall strength taken into account*1.
- During the detailed inspection for cracks on the second floor west exterior wall conducted in response to comments received at the public hearing*2, cracks of the maximum of 0.3mm wide were found (See the photos on the next page). However, the small cracks found this time should have no significant impact on the durability and strength of the building.

*1 “Report on the seismic safety evaluation of Unit 4 Reactor Building at Fukushima Daiichi Nuclear Power Station in consideration of the partial bulge found on its exterior walls” (June 2012, TEPCO)
*2 “The 11th Public hearing regarding buildings and structures” (August 7, 2012, NISA)

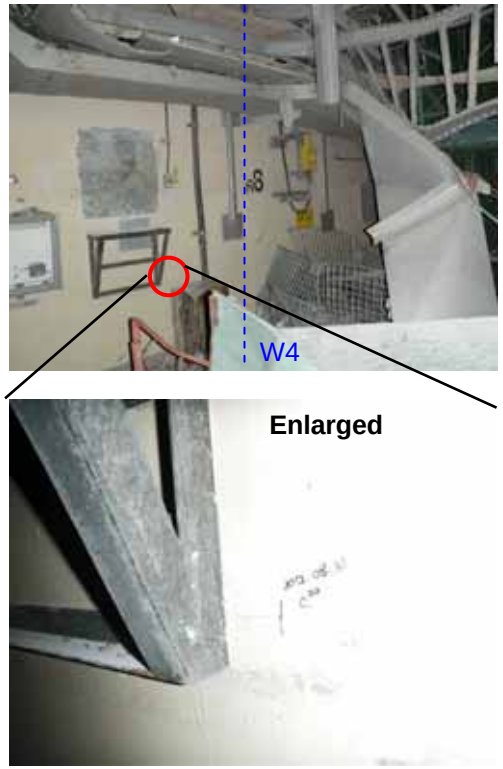
[Reference] Partial Bulge Found on the Exterior Walls

Though cracks of the maximum of 0.3mm wide were found on the second floor west exterior wall where partial bulge was found, the small cracks found this time should have no significant impact on the durability and strength of the building.

1. Inner surface of the second floor west exterior wall between W2 and W3 (Crack width: 0.1mm)



2. Inner surface of the second floor west exterior wall between W3 and W4 (Crack width: 0.3mm)

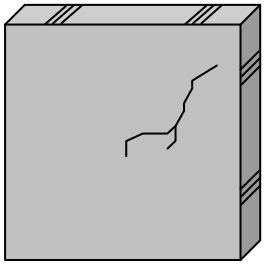


3. Inner surface of the second floor west exterior wall between W4 and W5 (Crack width: 0.2mm)

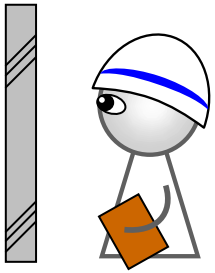
2. Results (3) Visual Inspection

Visual inspection*1 was done on the concrete floor and walls. In the case that a crack with the width of 1mm or more is found, repair must be done as appropriate. (No crack with the width of 1mm or more was found in the first inspection (May 2012) and the detailed inspection of exterior walls (June 2012).)

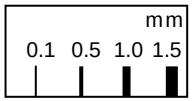
*1 The visual inspection was done while avoiding interference with the cover installation work for fuel removal.



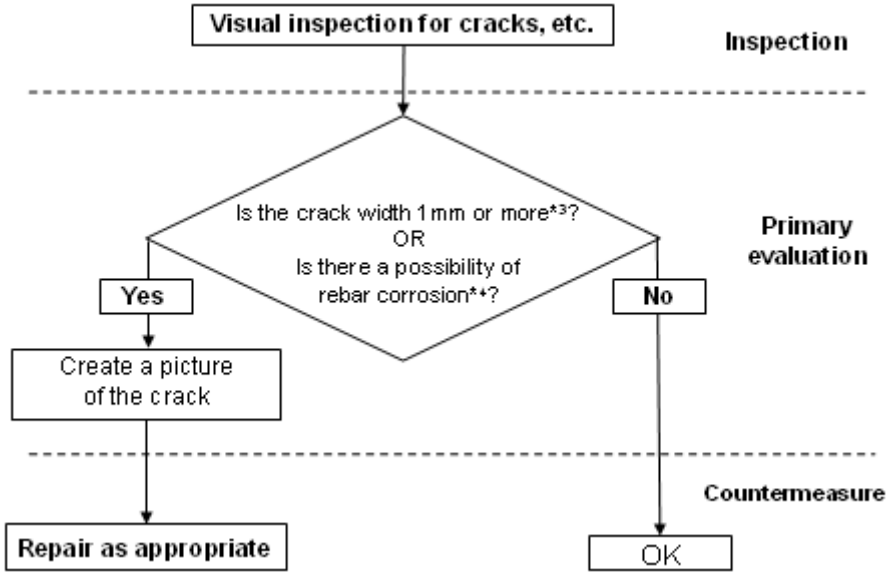
Check for cracks on the walls and the floor



Visual inspection



Crack scale*2



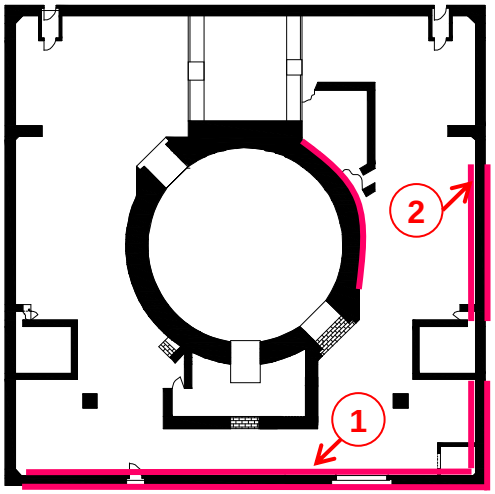
Flow of Visual Inspection

*2 Crack scale: Used to measure the width of a crack. (The scale is placed on a crack to measure its width.)
*3 In the case that the crack width is 1mm or more, the durability of the building must be reviewed in accordance with the "Maintenance and Management of Structures in Nuclear Facilities" specified by the Architectural Institute of Japan.
*4 In the case that rebar corrosion which may affect the building durability is found on the inspected area.

2. Results (3) Visual Inspection

As a result of visual inspection, no cracks with the width of 1mm or more or with possible rebar corrosion were found (similarly to the results obtained at the first inspection (May 2012) and the detailed inspection of the exterior walls (June 2012)).

[Legend] : Inspected areas



First floor

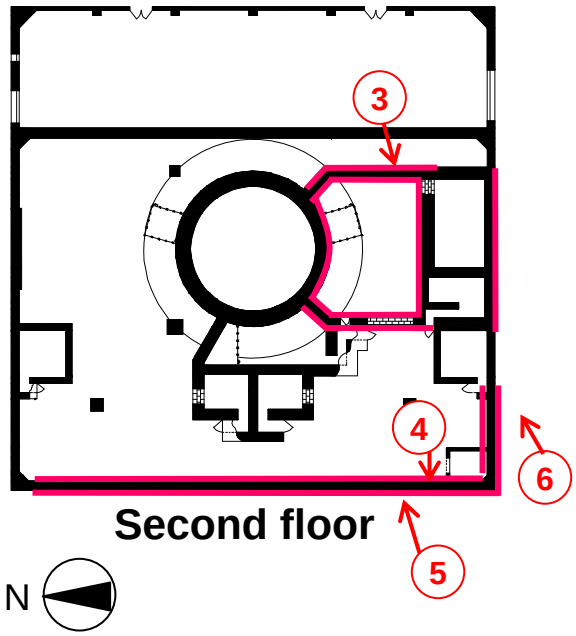
N

① West wall

② South wall

2. Results (3) Visual Inspection

[Legend] : Inspected areas



③ Wall on the SFP side

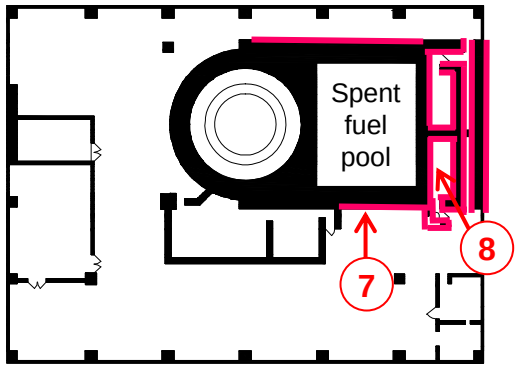
④ West wall (Interior wall)

⑤ West wall (Exterior wall)

⑥ South wall (Exterior wall)

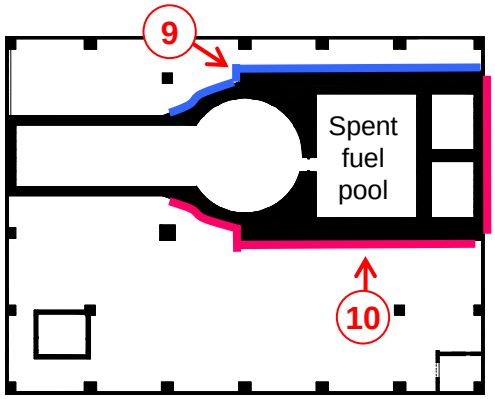
2. Results (3) Visual Inspection

[Legend] : Inspected areas
: Additional inspection areas*1



Third floor

N



Fourth floor

N

⑦ Wall on the SFP side (West)

⑧ Wall on the SFP side (South)

⑨ Wall on the SFP side (East)

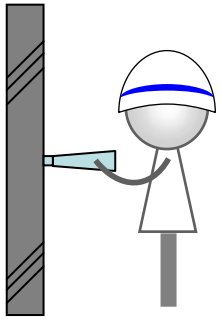
⑩ Wall on the SFP side (West)

*1 Inspection areas added due to improved accessibility

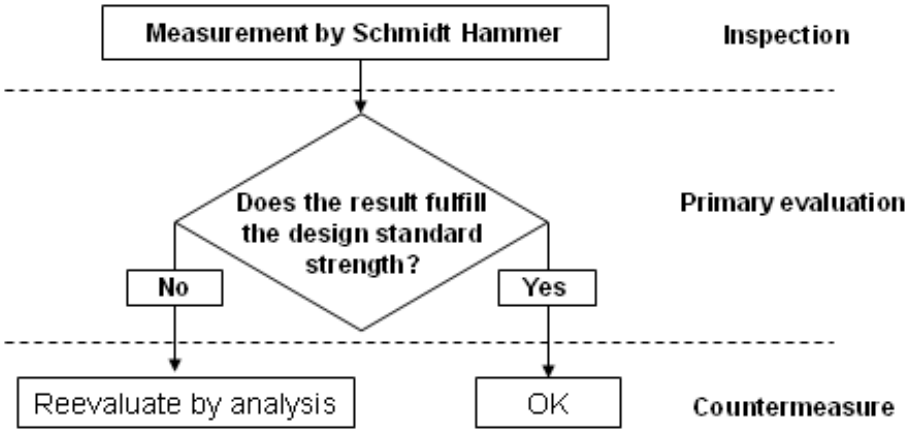
2. Results (4) Concrete Strength Evaluation

The concrete strength of the spent fuel pool frame was evaluated*1 by non-destructive inspection techniques (Schmidt Hammer*2, etc.) to confirm that the strength fulfills the design standard. (The concrete strength fulfilled the design standard in the first inspection (May 2012) and the detailed inspection of the exterior walls (June 2012).)

*1 The evaluation was done while avoiding interference with the cover installation work for fuel removal.



Non-destructive inspection
(Schmidt Hammer*2)

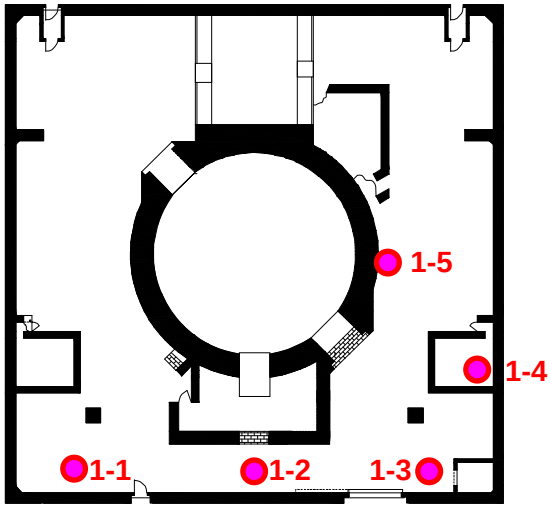


Flow of Non-destructive Inspection

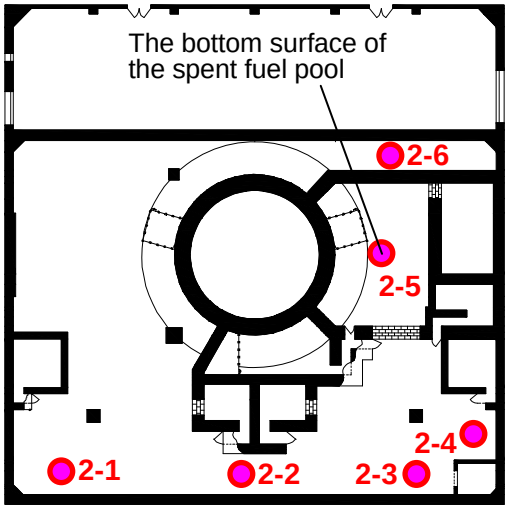
*2 Schmidt Hammer Technique: A non-destructive inspection technique to estimate concrete strength by hammering the concrete and measuring the impact returned.

2. Results (4) Concrete Strength Evaluation

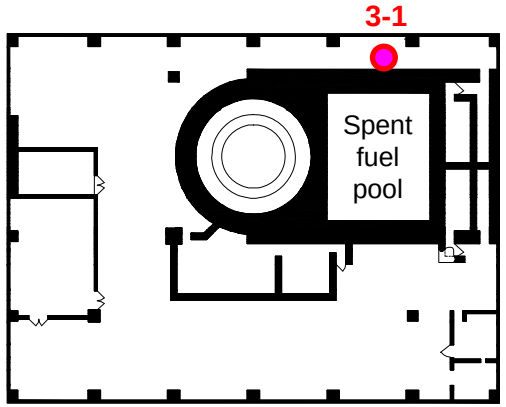
The concrete strength measurement points*1 are indicated below.



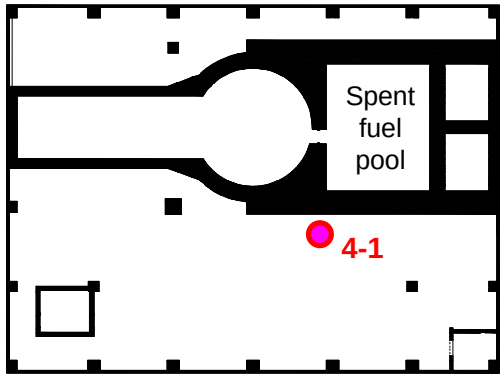
First floor



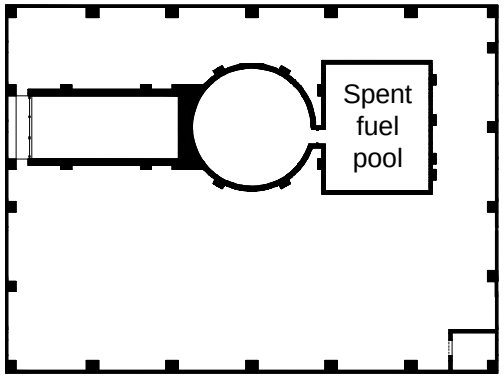
Second floor



Third floor



Fourth floor



Fifth floor

[Legend] ●: Measurement points

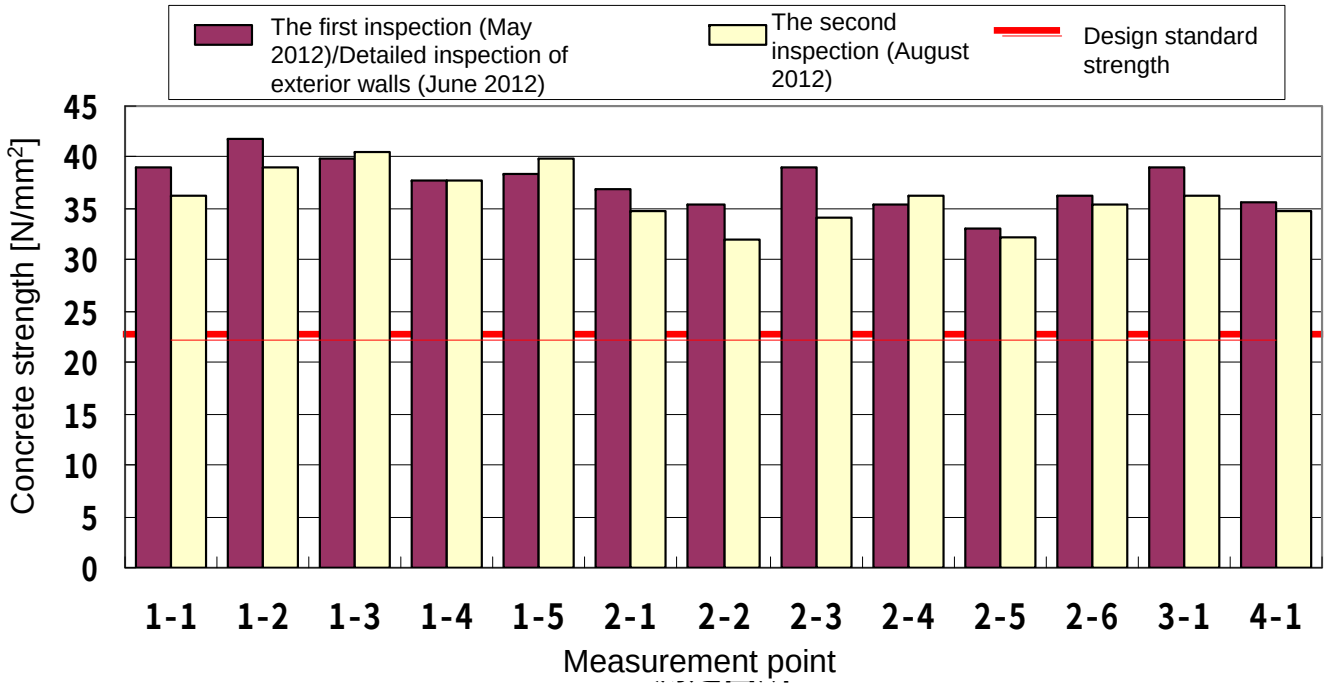
*1 The measurement points were set at different locations near the previous measurement points.

2. Results (4) Concrete Strength Evaluation

As a result of measurement, the concrete strengths on all the measurement points were above the design standard (22.1N/mm^2) similarly to the past results. The results obtained this time are considered to be about the same as the previous results taking into consideration the error of Schmidt Hammer*1 and that the measurement points were set at different locations from the previous ones. (The concrete strength fulfilled the design standard in the first inspection (May 2012) and the detailed inspection of the exterior walls (June 2012).)

*1 Error of approx. 3N/mm^2 is assumed for the experimental value and the strength criterion formula according to the "Guidelines for evaluation of concrete compressive strength by Schmidt Hammer" (August 1958, Material Testing Research Association of Japan).

Concrete strength evaluation results



Summary

- As a result of the second inspection, it has been concluded that the building is not tilted and a sufficient concrete strength is maintained with no cracks that would affect the structural strength of the building.
- The condition of Unit 4 Reactor Building has not changed much since the first inspection and is capable of safely storing the spent fuel pool.
- The inspection will be conducted on a regular basis in order to check for changes over time.