

Evaluation of the report of Tokyo Electric Power Company regarding the inflow of water that accumulated in the process main building into the incineration building at the Fukushima Daiichi Nuclear Power Station

15 April 2015
Nuclear Regulation Authority, Japan

1. Overview

Around 12:00 p.m. on 11 April 2014, periodic water level monitoring found that the water level in the on-site bunker building was rising while that in the process main building was declining, despite the ongoing transfer of water accumulated in the on-site bunker building to the process main building (refer to Figures 1-1 to 1-4).

Subsequently, on 13 April 2014 from 11:30 to 14:30 workers confirmed that the four pumps on the transfer line were in operation, and the four transfer pumps were shut down from 17:02 to 17:22 on that same day. Later, around 21:20, water accumulation was confirmed on the floor surface of the first level of the basement of the incineration building. Storing accumulated water in the incineration building during ordinary times is not covered in the “Implementation Plan for the Specified Nuclear Facilities at Fukushima Daiichi Nuclear Power Station,” which includes a plan to “prepare for transfer to the incineration building and other buildings to secure capacity to accept accumulated water” in order to prevent such accumulated water from leaking outside the systems in the event of an emergency (loss of function to treat accumulated water).

In the same day, the Nuclear Regulation Authority (hereinafter, referred to as “NRA”) received the report regarding accidents and failures based on the Article 62-3 of the Act on Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors from Tokyo Electric Power Company (hereinafter, referred to as “TEPCO”).

Subsequently, the NRA received the report regarding causes and countermeasures of the aforementioned event (the final report) from TEPCO as of 30 June 2014 (partially corrected on 12 December 2014) and the NRA reviewed the contents and summarized the evaluation result.

Report from TEPCO

<https://www.nsr.go.jp/activity/bousai/trouble/20141212-3.html>

2. Overview of the report submitted by TEPCO

(1) Environmental impact assessment (expansion of contaminated water)

Based on the results of surveys of environmental impacts, TEPCO concluded that the accumulated water did not leak outside the incineration building and thus had no impact on the environment due to the three reasons described below.

- (i) The accumulated water levels did not change during the period between the confirmation of the accumulated water in the incineration building and the start of the transfer of the water (refer to Figure 2).
- (ii) No significant change was observed in the analysis results of the sub-drain water around the incineration building during the period between the confirmation of the accumulated water in the incineration building and the completion of the transfer of the water (refer to Figure 3).
- (iii) The sub-drain water levels around the incineration building were higher than the level of the accumulated water transferred to the incineration building (refer to Figure 4).

(2) Survey on the unintended activation of transfer pumps

It is highly likely that the circuit breakers for the transfer pumps mounted on the N-1 distribution panel in the process main building and the N-2 distribution panel in the incineration building were closed by mistake during restoration after the work related to shutdown of the power distribution panel (C system) in the process main building, which was conducted on 20 March 2014 (refer to Figure 5). This mistake has four potential causes.

- (i) Workers threw the circuit breakers, referring to the document, including the load list and skeleton diagram. However, it did not contain information to ensure confirmation and recording of work locations and results.
- (ii) The power distribution panel had multiple circuit breakers that had been assigned numbers but were not identified by load equipment names or other means.
- (iii) There were no records of the operations thrown with the circuit breakers to shut down the power distribution panel (C system).

- (iv) Despite installation of some lighting equipment, the work environment (illumination) around the circuit breakers was dimly lit, making the circuit breaker numbers difficult to recognize for the worker.
- (3) Survey on the power system structure that permitted water transfer to start when the circuit breakers were closed

No protective measures against misoperation existed for the transfer line because it was a temporary facility installed immediately after the 2011 disaster. In addition, the water gauge installed in the incineration building was not subject to water level monitoring because the building was not expected to be used to store accumulated water at the time it was constructed. This is why the transfer pumps were automatically activated and started transferring accumulated water to the incinerator workshop and other buildings when the circuit breakers were closed, as well as why it took TEPCO some time before discovering that the transfer pumps were running and that accumulated water was being transferred.

(4) Countermeasures

(i) Countermeasures against mistakes in operation

- Identification labels (for example, indicating load equipment names) were added to the power distribution panels, and skeleton diagrams were made available near the power distribution panels (at 770 locations). The power distribution panels supplying power to particularly important facilities¹ are now subjected to PTW² or other reviews to ensure the management of operating results, in addition to labeling (for example, indicating load equipment names) the power distribution panels.
- The work environment's lighting has been improved (in the process main building and elsewhere³).
- To prevent workers from accessing the facilities without permission, the power distribution panels, control panels, and control boards are kept under lock (401 keys had been locked; this time, 391 keys were additionally locked as of Dec? 2014)

- To strengthen field management, surveillance cameras were installed in buildings and areas with particularly important facilities.

¹ “Particularly important facilities” are facilities essential for keeping the plants in stable condition—namely, alternative cooling equipment for the spent fuel pools, common pool cooling equipment, reactor water-injection equipment, primary containment vessel gas control equipment, nitrogen injection equipment, station power supply systems, emergency power systems for the seismic isolated building, and contaminated water treatment systems.

² PTW is an abbreviation of “permit to work.” Under this system, before performing maintenance, the equipment maintenance department submits a description of the safety measures to be taken for the work to the equipment management department and obtains a permit to perform the work.

³ In Units 1-4, where access to power supplies is limited, temporary lighting has been installed by each work team.

(ii) Countermeasures against transfer errors

- To prevent misuse of temporary facilities that have been installed to transfer accumulated water but have remained unused for the time being, 5 transfer pumps have been disconnected from the power supply and 22 transfer pump outlet valves have been closed
- In addition to the buildings currently storing contaminated water, the incineration building has been subject to water level monitoring since 13 April 2014.

3. NRA’s evaluation with regard to the report submitted by TEPCO and the future response

(1) Environmental impact (spread of contaminated water) and exposure radiation dose

Both the nuclide analysis results and the fact that the accumulated water in the incineration building did not exceed the sub-drain water level indicate that the accumulated water did not leak outside the building. Based on this determination, the NRA concludes that there has been neither environmental contamination that raises any concerns about effects on health or the environment nor exposure leading to concern.

(2) Countermeasures (refer to Table 1)

TEPCO indicated the cause assumed from the obtained information and presented countermeasures against mistakes in operation and transfer errors. The NRA has evaluated them as follows.

(i) Countermeasures against mistakes in operation

The mistake in operation occurred when the worker operating the power distribution panels in the process main building unintentionally closed the circuit breakers for the transfer pumps. The NRA confirmed that, to prevent such a mistake in operation, TEPCO implemented countermeasures such as affixing labels indicating load equipment names for identification, managing operating results, and strengthening monitoring. The NRA has determined that these countermeasures address the main cause of the mistake in operation in question and will effectively prevent recurrence if implemented appropriately. Further checks shall be made to ensure continued progress in implementing the countermeasures by safety inspections and other means in the future.

(ii) Countermeasures against transfer errors

The transfer error occurred when the worker unintentionally activated the transfer pumps and TEPCO took too much time before detecting the error. For preventing such an event, TEPCO has implemented countermeasures for temporary facilities for accumulated water transfer that will remain unused for the time being. These countermeasures are disconnecting the transfer pumps from the power supply, closing transfer pump outlet valves, and starting water level monitoring of the incineration building; they include reinforcement of the management and monitoring necessary to prevent unscheduled operations to start pumps and monitoring of the contaminated water level in buildings where contaminated water may be transferred. Considering these facts, the NRA has determined that the countermeasures address the main cause of the transfer error in question and will effectively prevent recurrence if implemented properly. Countermeasures summarized by TEPCO shall be checked about its implementation situation at an appropriate timing by safety inspection, etc.

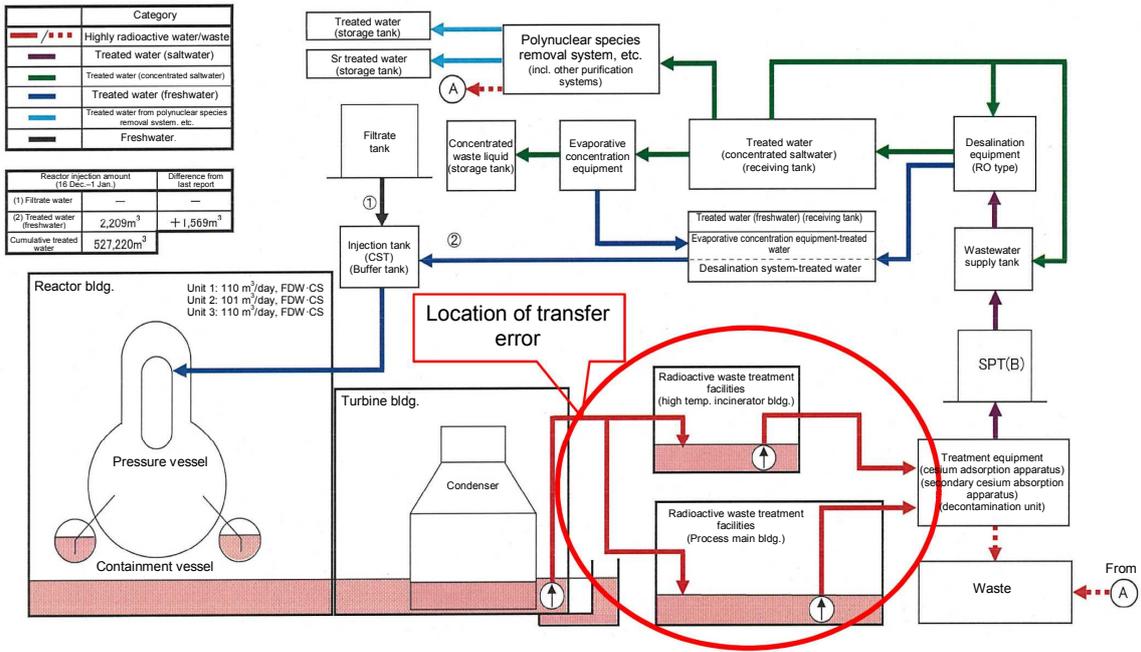


Figure 1-1 Overview of the processing route for accumulated highly radioactive water (based on the Secretariat of the NRA's document for a meeting with TEPCO)

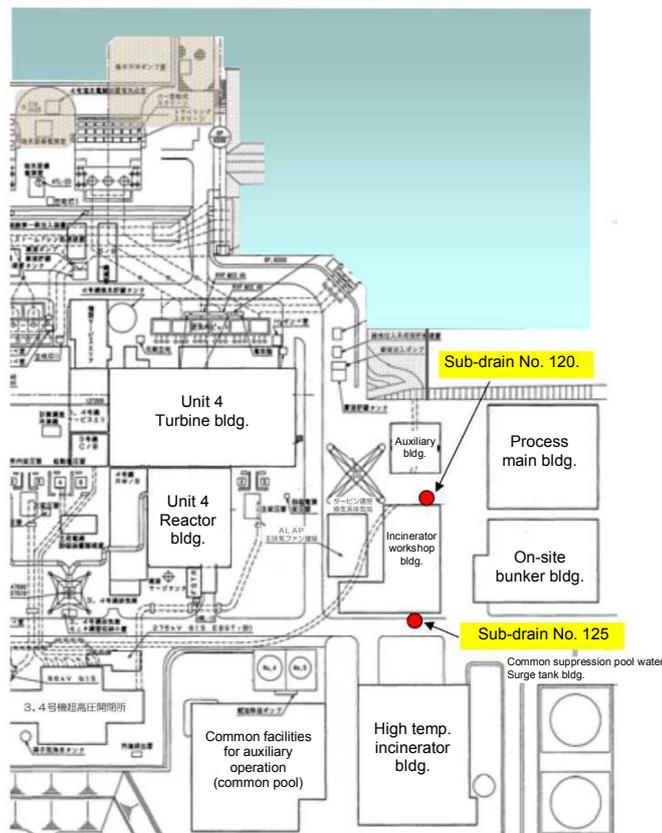


Figure 1-2 Layout of sub-drains around the incineration building (extracted from the TEPCO report)

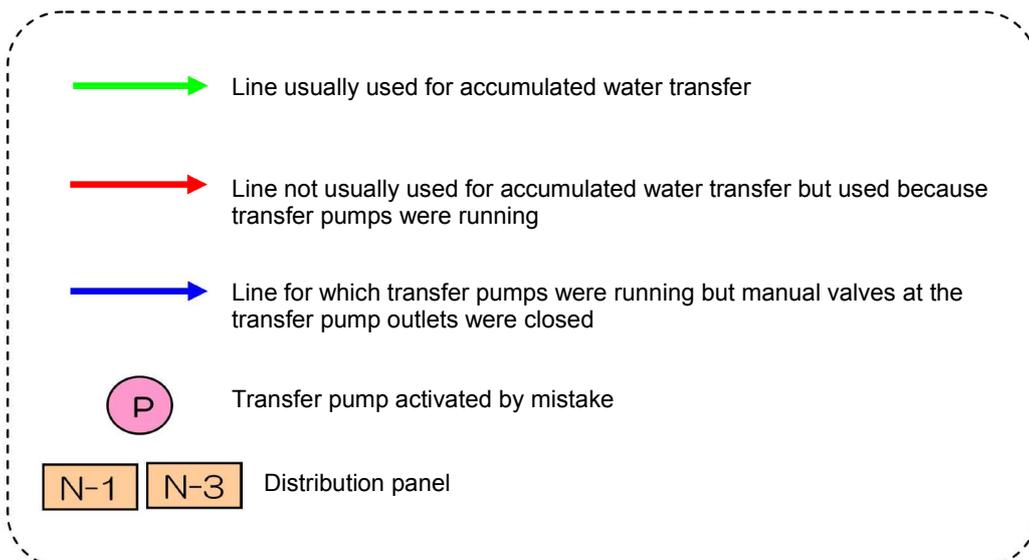
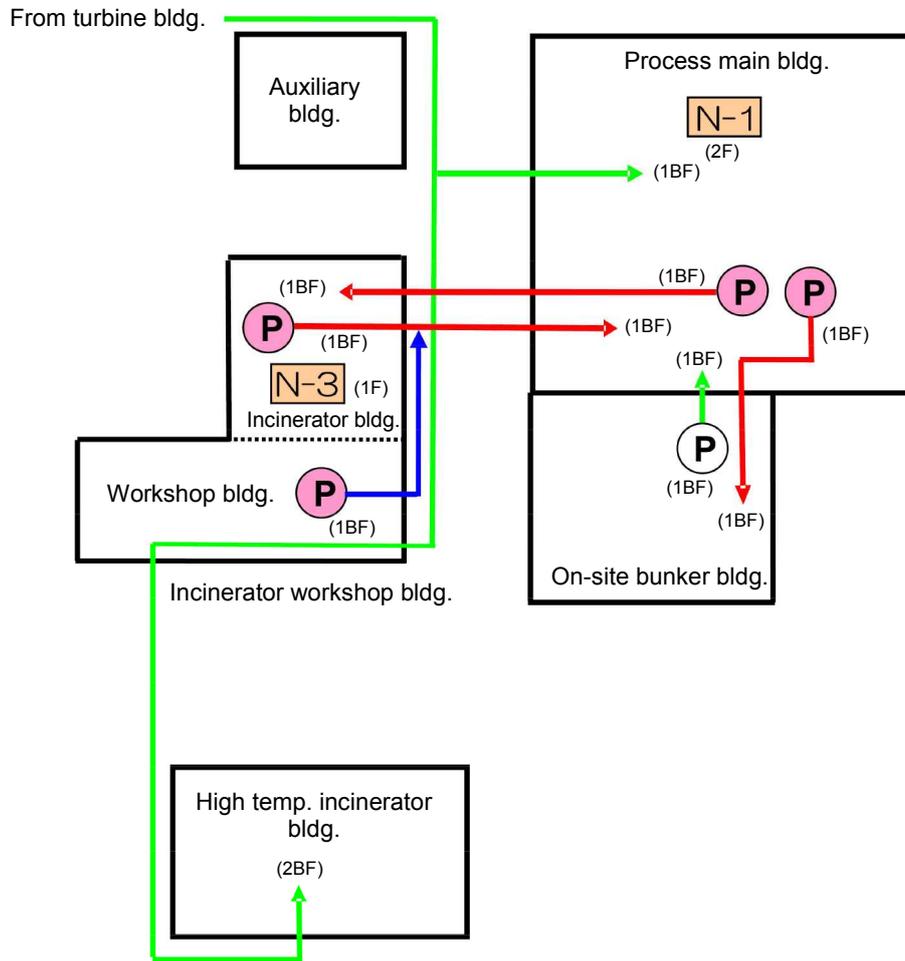
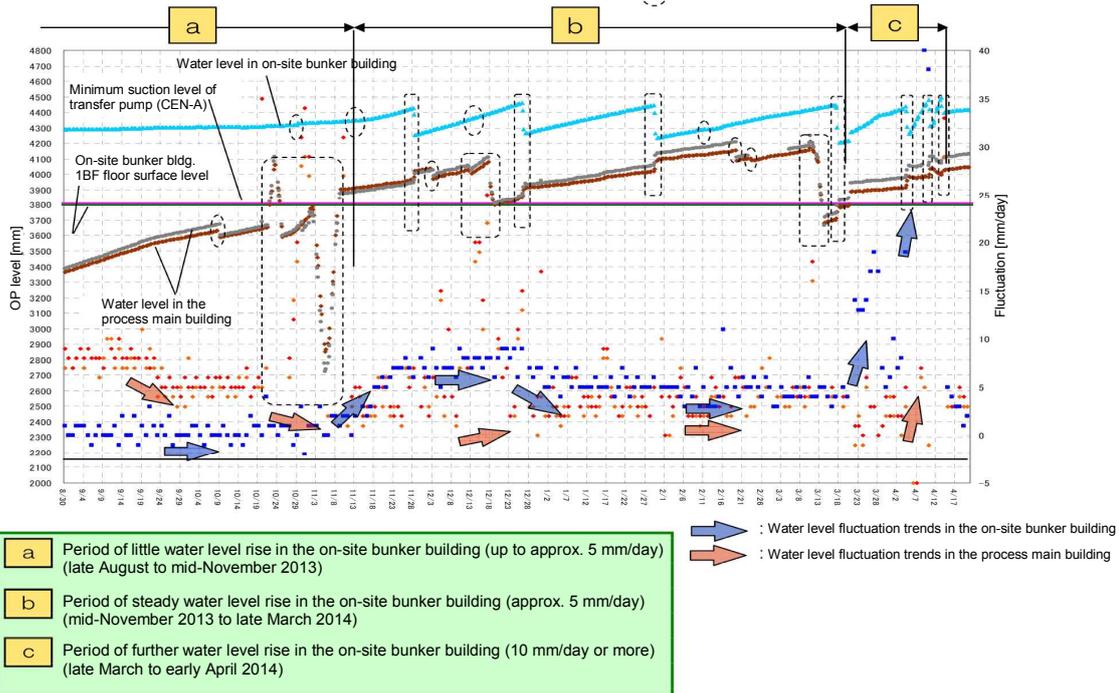


Figure 1-3 Accumulated water transfer system

● Water level changes in the process main building and on-site bunker building

○ : Fluctuations due to transfer by permanent equipment and KURION operation
 ○ : Corrections based on water level measurements



● Water level changes in the process main building and on-site bunker building

- Until 19 March 2014, the water level had barely or modestly risen, indicating fluctuations equal to or smaller than those observed from 14 April 2014 onward, when the transfer pumps were shut down.
- At noon on 20 March 2014, the water levels in the process main building and on-site bunker building began to rise sharply.

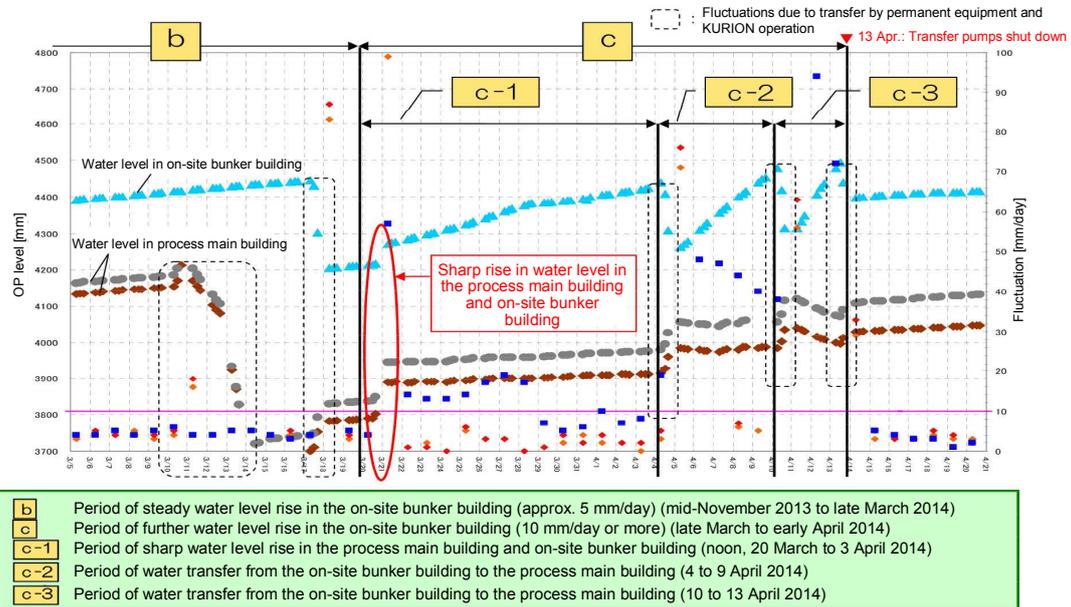


Figure 1-4 Estimating when the transfer pumps were activated

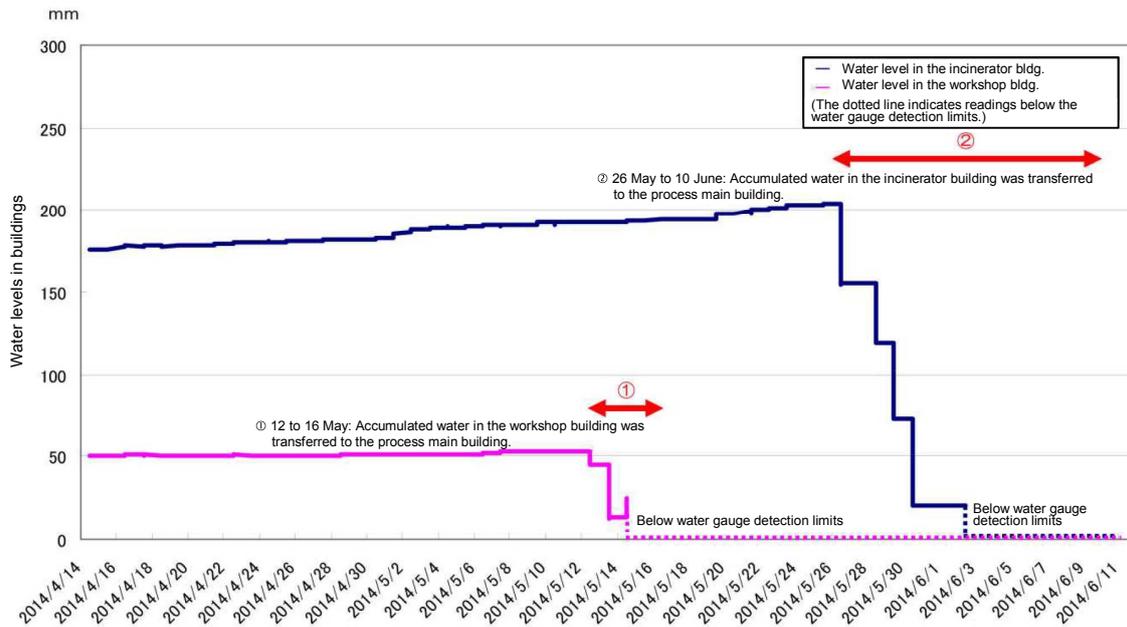
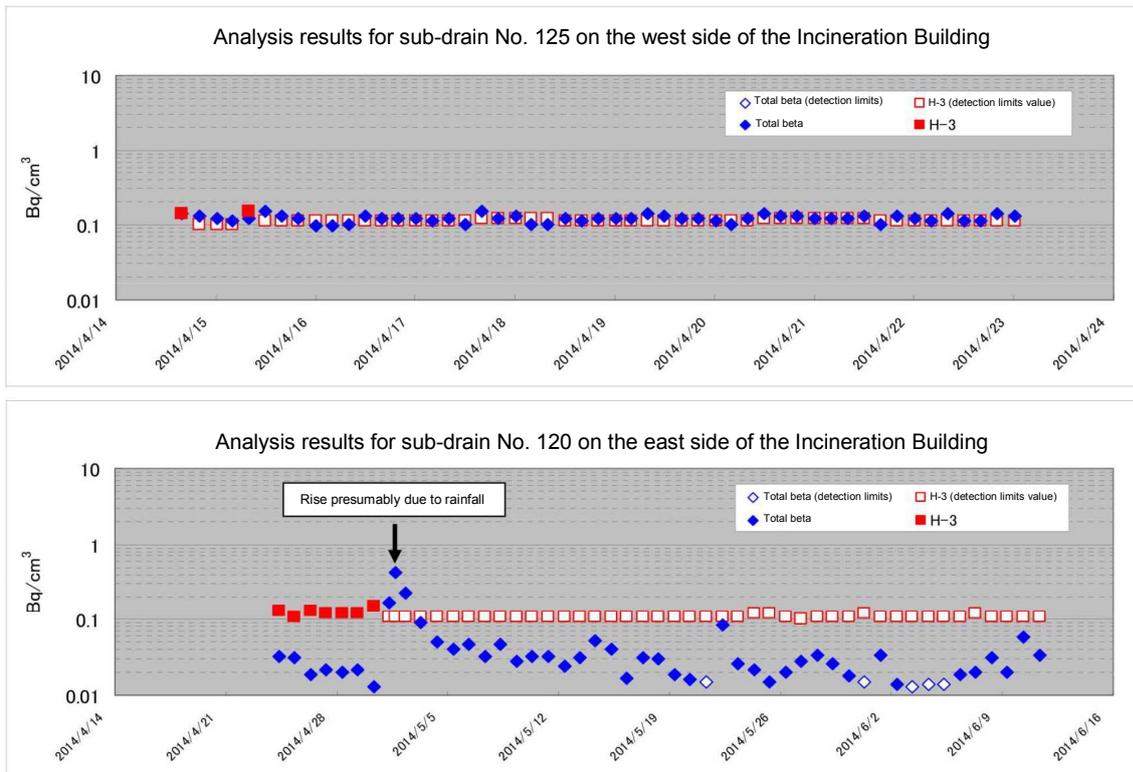


Figure 2 Accumulated water level in the incineration building (extracted from the TEPCO report)



Note: The sub-drain water samplina site was changed from No. 125 to No. 120 starting on 24 April 2014.

Figure 3 Analysis results for sub-drain water from around the incineration building (extracted from the TEPCO report)

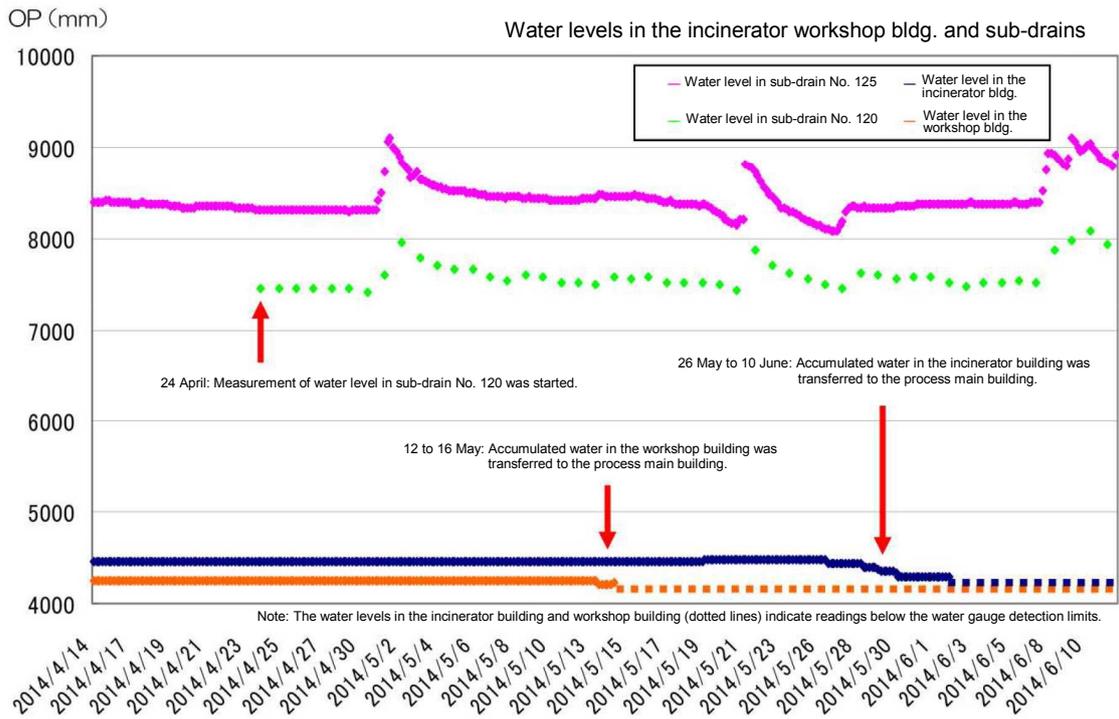
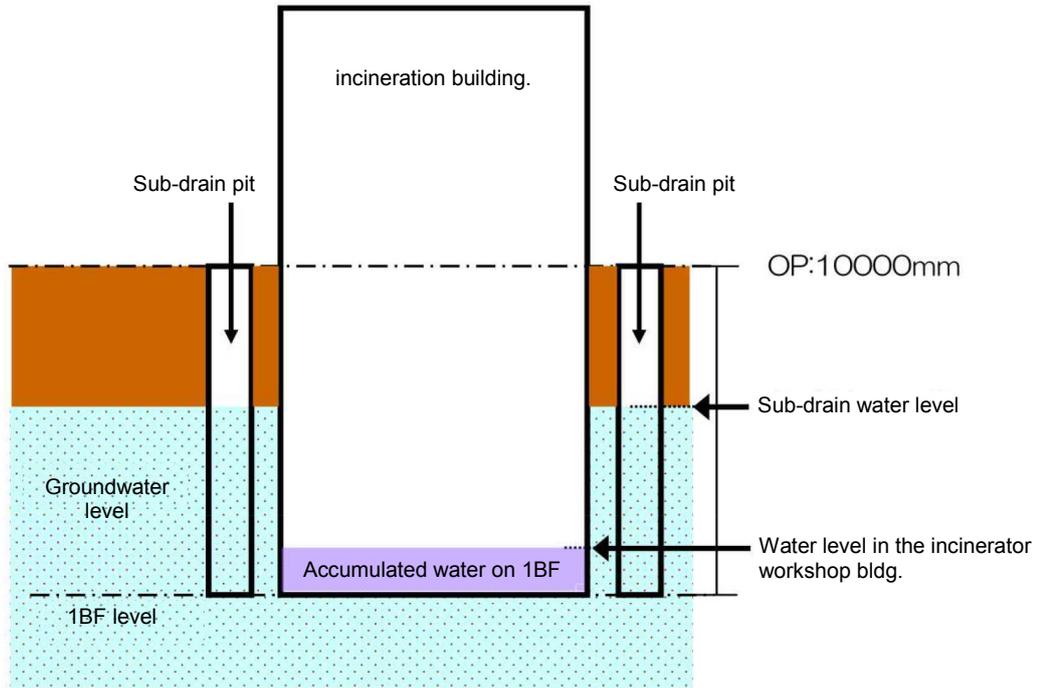


Figure 4 Correlations with sub-drain water levels around the incineration building (extracted from the TEPCO report)

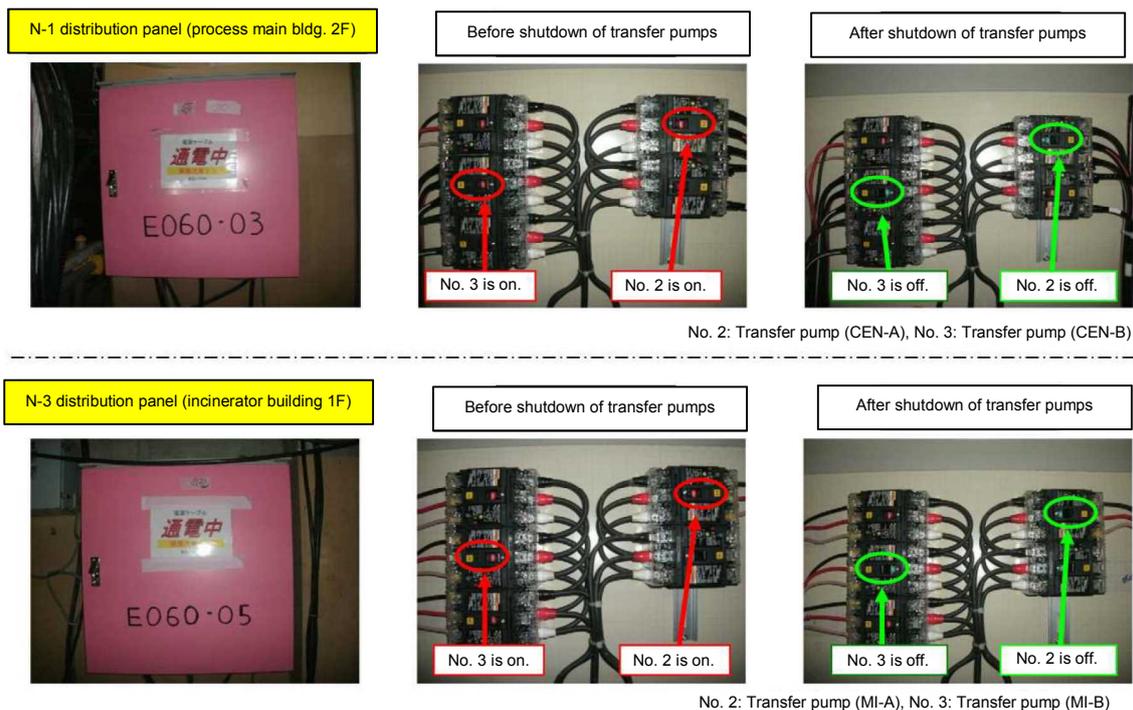


Figure 5 Distribution panels accommodating circuit breakers for transfer pumps (extracted from the TEPCO report)

Table 1 Countermeasures and dates completed (extracted from the Secretariat of the NRA's document for a meeting with TEPCO)

Category	Countermeasure	Date completed
Countermeasures against mistakes in operation	Indicating the load equipment names on power distribution panels for particularly important facilities	15 July 2014
	Managing operating results with operation manuals (checklists), etc.	1 April 2014
	Improving the work environment (illumination) in the building	9 May 2014
	Keeping power distribution panels under lock and key	30 June 2014
	Strengthening field monitoring	7 November 2014
Countermeasures against transfer errors	Disconnecting temporary facilities associated with accumulated water transfer from the power supply	28 May 2014
	Closing outlet valves for temporary facilities associated with accumulated water transfer	10 June 2014
	Monitoring the water level in the incineration building	13 April 2014