

Causes and Measures for deviation from LCO of Subdrain Operation at 1F

November 20, 2017



Fukushima Daiichi D&D Engineering Company
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- 1. Water Level Decrease in Subdrain No. 51**
- 2. LCO Entry Following a Setting Error in the Water Level Gauge for the New Subdrain**

1. Water Level Decrease in Subdrain No. 51

TEPCO

At around 18:31 on August 2, 2017, a “Unit 4 R/B and Unit 4 Rw/B water level deviation small” alarm was generated.

When the relevant parameters were checked, it was found that the water levels of the No. 51 subdrain (hereafter “Subdrain”) installed on the southwest side of the Unit 4 Reactor Building had rapidly decreased, and was below the accumulated water levels of the Unit 4 Reactor Building and Radwaste Building (hereafter, “accumulated water levels of the buildings”).

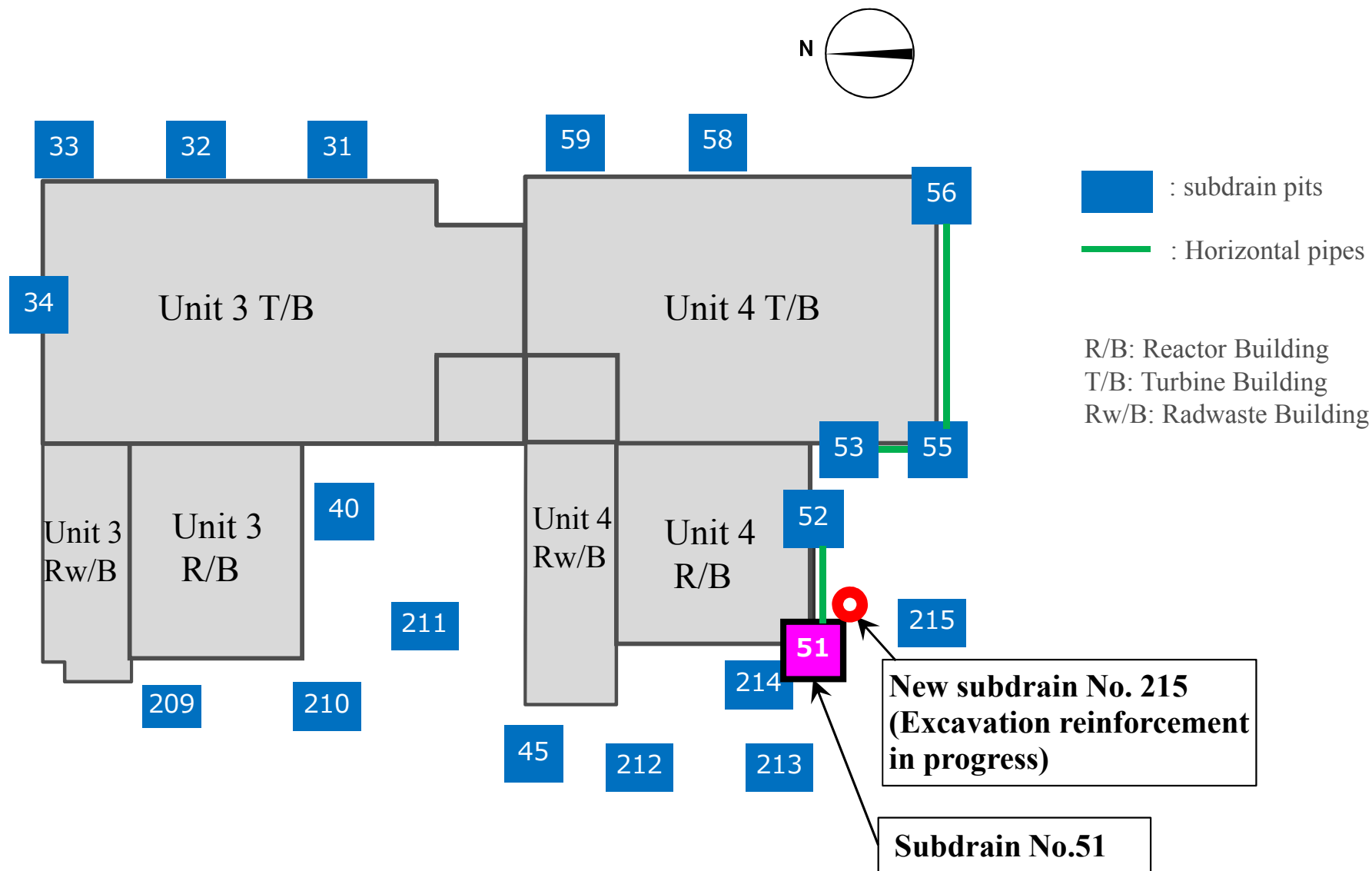
When the event occurred, the Shift Supervisor determined that the water level gauge of Subdrain was defective rather than it being an actual event, due to the fact that the subdrain water level had rapidly decreased and there was no significant change in the water levels of other subdrains near Subdrain as well as the accumulated water levels of the buildings.

On August 3, when the water level gauge of Subdrain was inspected (measured) , it was found that the actual measured water level was the same as the reading on the water meter. Afterwards, a Trouble Review Committee meeting was held, and based on the inspection results of the water level gauge , it was determined that there was a low possibility of the water level gauge being defective and a high possibility that the water level of Subdrain actually decreased.

Therefore, it was determined that the limiting conditions of operation (hereafter “LCO”) had been entered from the time that the subdrain water level had rapidly decreased, to the time that it surpassed the accumulated water levels of the buildings.

2. Circumstances of occurrence

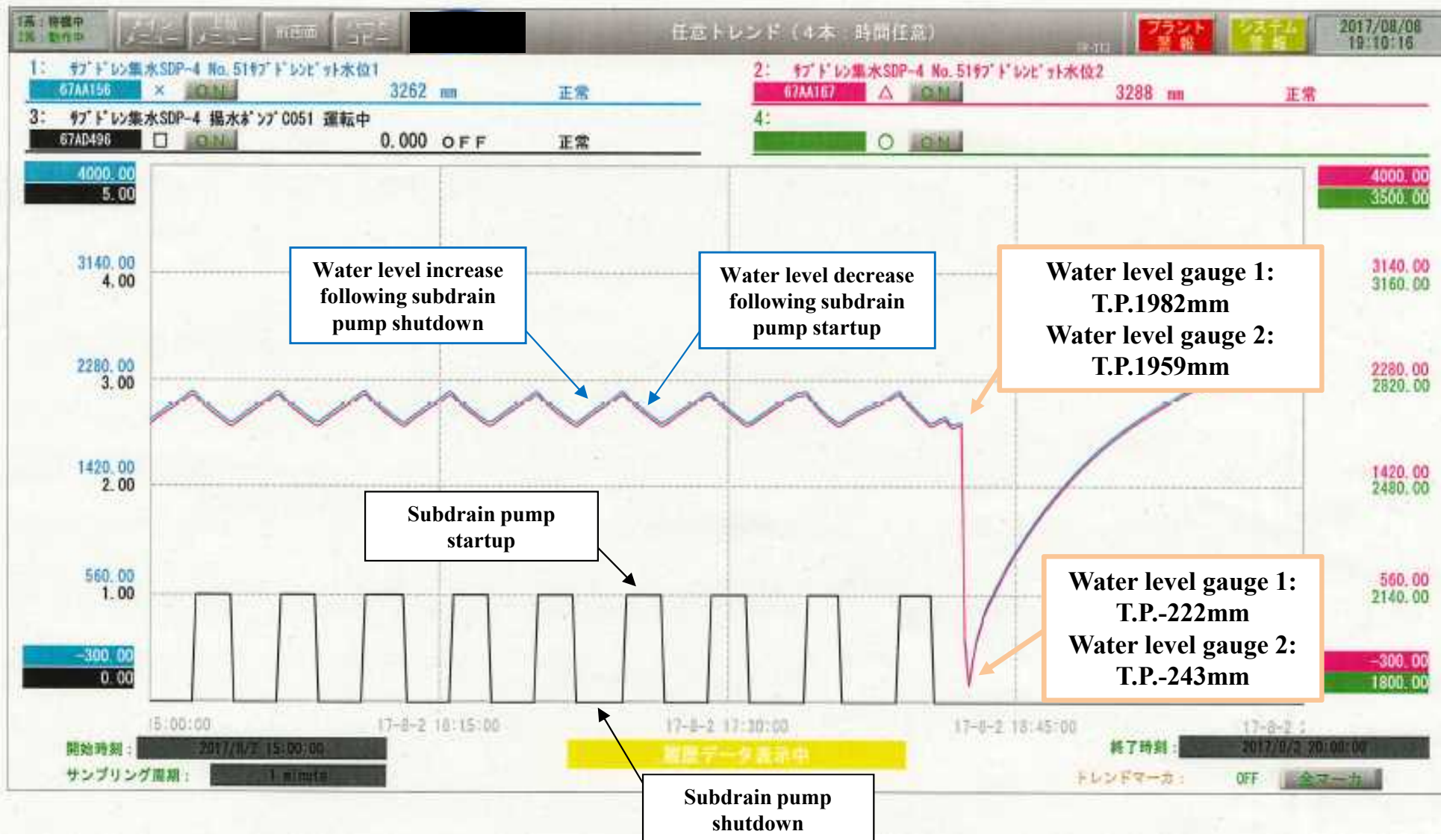
(1) Location of occurrence



Unit 3 & 4 peripheral subdrain pit layout plan

2. Circumstances of occurrence

(2) Trend of water levels of subdrain in question before and after the event



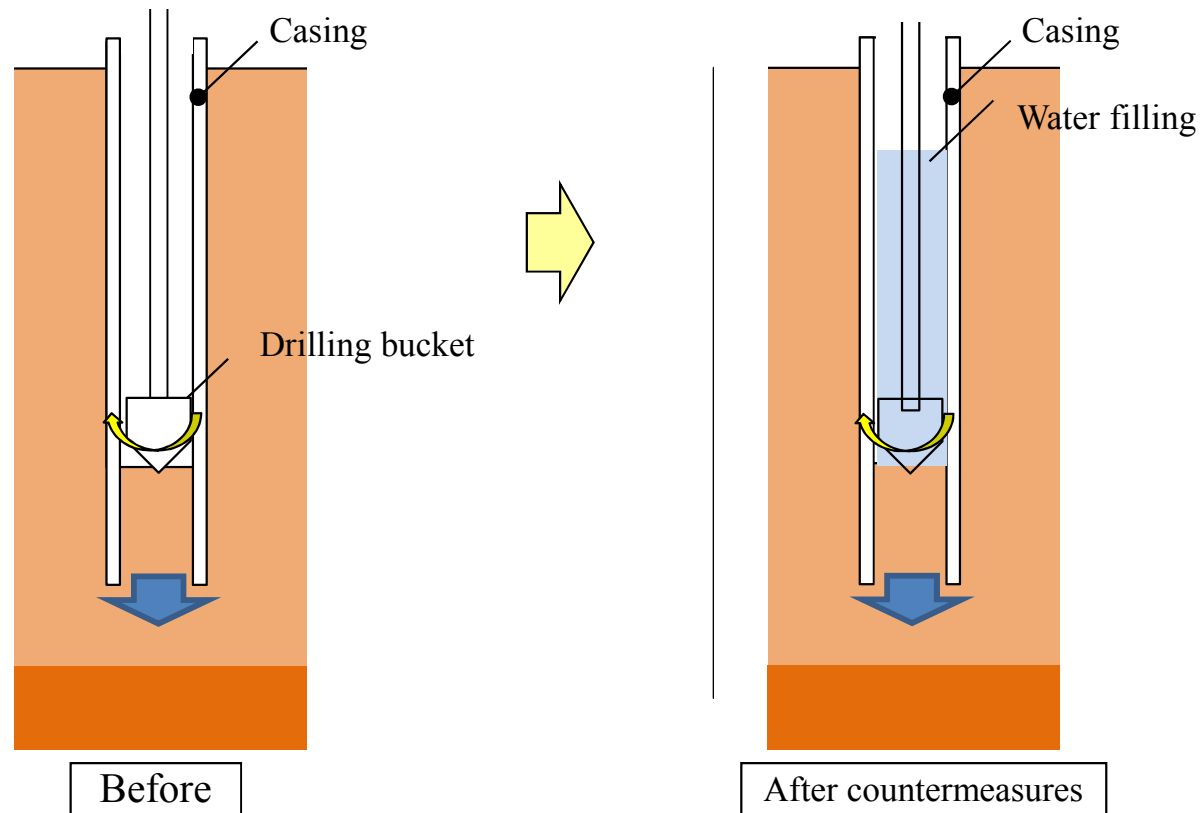
3. Countermeasures for the water level decrease

(Recurrence prevention measures for the construction methods)

As the drastic decrease in No.51 water levels on August 2 is presumed to have been caused by nearby excavation work, construction shall be resumed after the following recurrence prevention measures are taken.

<Recurrence prevention measures>

Casing drilling and inner excavation shall be conducted after filling the casing with water up to a level that does not affect the periphery subdrain pits. This will prevent water from flowing into the casing, preventing changes in the water levels of surrounding subdrain pits.



4. Issues of the LCO entry decision and delays in communication and notification, and countermeasures for these issues

【Issue】

The decrease in reading of the water level gauge was considered to be due to an instrument malfunction and was determined not to satisfy the criteria for LCO entry.

Subject	Causes
Shift Supervisor	<p>【Direct causes】</p> <ul style="list-style-type: none">• A decrease in subdrain water levels is predicated on water being pumped up by a pump, and as this decrease in water level is slow, it was assumed that a drastic decrease was not possible.• It was assumed that the water level of one subdrain alone would not drastically decrease without affecting nearby subdrains.• Without knowledge of detailed information, such as the fact that the transmitters of the two water level gauges were isolated from one another, it was thought that a common part of the two water level gauges (communication system) had malfunctioned, particularly because of past training that involved a case in which it was assumed that both systems of a duplex system failed.• In Implementation Plan III Part 1 Article 26, it states that when confirmation is not possible due to equipment malfunction, etc., the water levels of nearby subdrains should be evaluated, so a LCO entry decision was deemed to be unnecessary. <p>【Underlying contributors】</p> <ul style="list-style-type: none">• A lack of imagination regarding events that had not been experienced resulted in justifying decisions based on one's experiences.

4. Issues of the LCO entry decision and delays in communication and notification, and countermeasures for these issues

【Countermeasures】

- When there is an event that may result in LCO entry, the Shift Supervisor shall determine LCO entry without considering equipment malfunctions, etc. In addition, the following shall be prepared and implemented in order to support confirmation of the event and information sharing.
 - ✓ A document that clarifies the criteria that leads to LCO entry, such as alarms and equipment numbers for each article of the Implementation Plan, shall be prepared.
(Implemented on August 31, 2017)
As a supplement to the abovementioned document, a document to determine whether or not an instrument malfunction has occurred shall be prepared, after organizing the current causes for instrument failure, so that an event requiring a LCO entry decision will not be misidentified as an instrument malfunction (the parts regarding subdrains and accumulated water of buildings were prepared by September 29, 2017, and other parts are scheduled to be prepared in the future.)
The composition of the monitoring system (common parts) shall also be reviewed from the standpoint of enhancing reliability.
 - ✓ In order to improve judgment and enhance collaboration skills, scenarios for LCO entry decisions based on this recent event and scenarios to adequately collect and confirm various information, including site conditions, shall be incorporated into the Operational Shift Team training. (Training started on August 25, 2017)
 - ✓ The responses being undertaken at Fukushima Daiichi Nuclear Power Station are based on the assumption that something that no-one has ever experienced could occur, and therefore the Operational Shift Team training instructs and reaffirms the importance of making conservative decisions that prioritize safety, providing reliable responses, and fulfilling one's duties. (Started on September 8, 2017)

LCO Entry Following a Setting Error in the Water Level Gauge for the New Subdrain

TEPCO

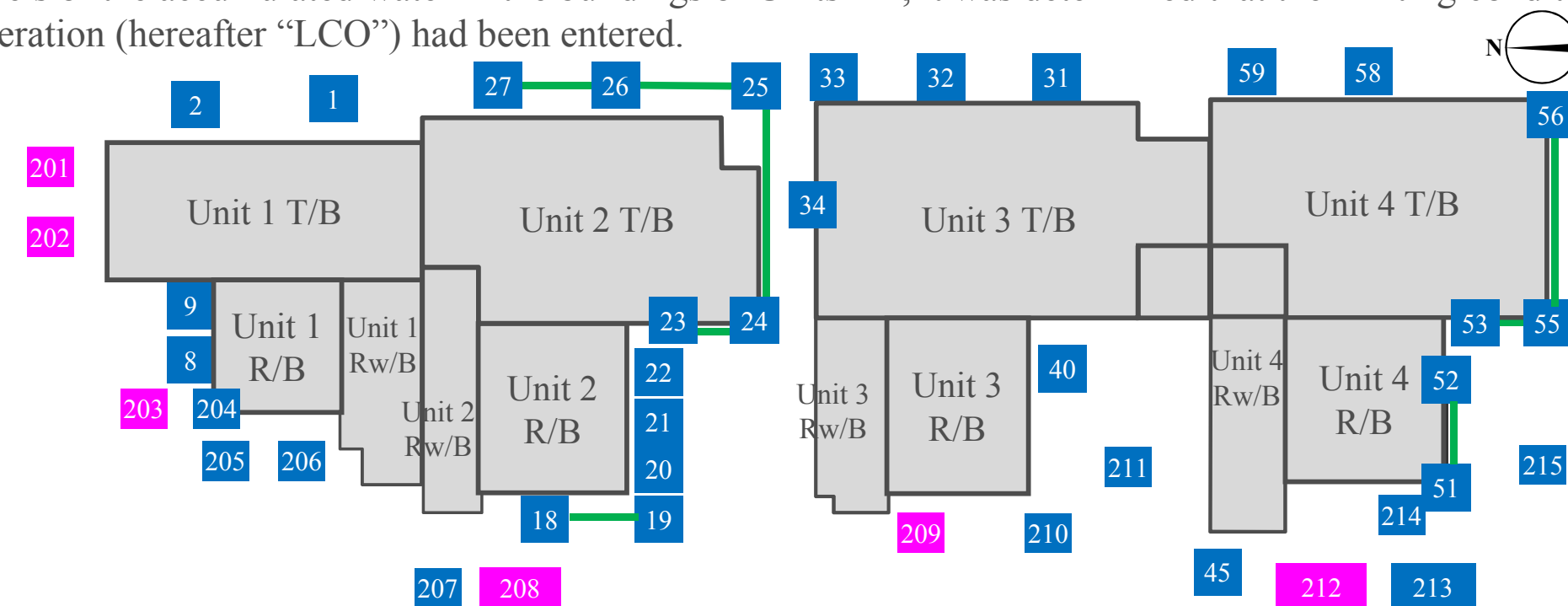
1. Incident overview

Subdrain pits are placed as shown in the diagram below around the Unit 1-4 buildings.

In order to prevent accumulated water in the buildings from leaking outside the buildings, the subdrain water levels are maintained at a level that is at least 800mm higher than the levels of the accumulated water in the nearby buildings. water levels.

Among these, a water level gauge setting error of 690mm was found in the new subdrain pits (6 locations) installed on or after April 19, 2017.

As there was a possibility of reversal in the water levels of the new subdrain pits (6 locations) and the water levels of the accumulated water in the buildings of Units 1-4, it was determined that the limiting conditions of operation (hereafter “LCO”) had been entered.



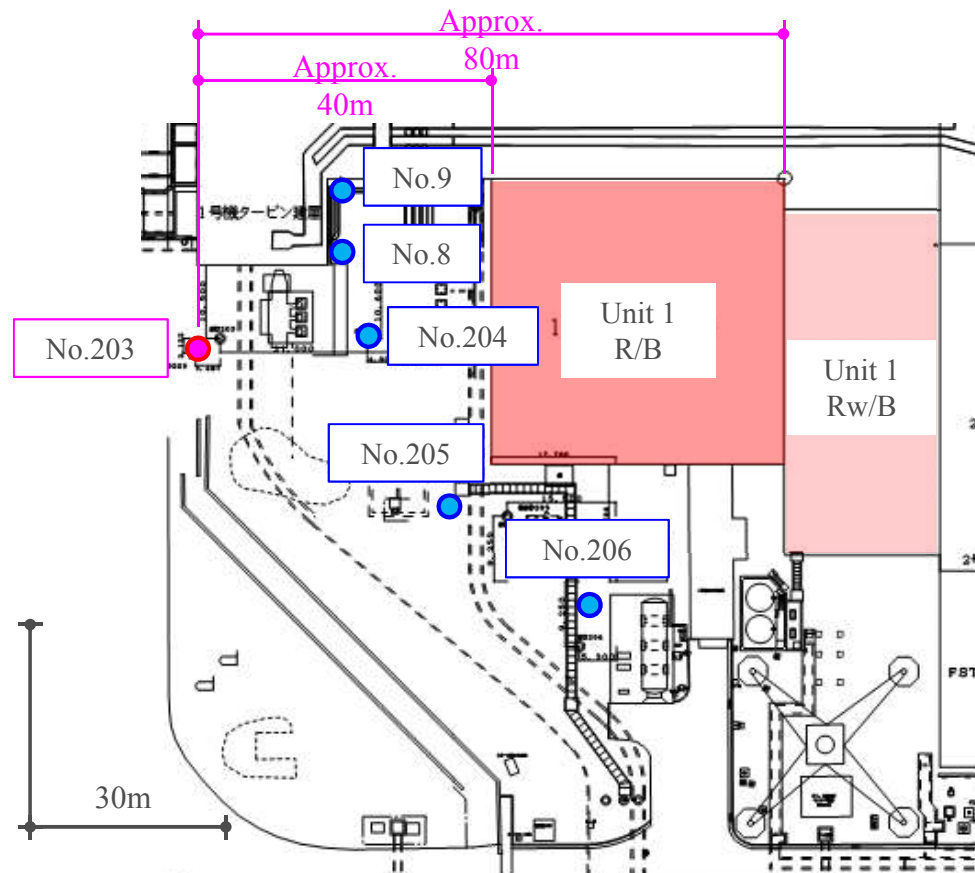
- : New subdrain pits with erroneous water level gauge settings (6 locations)
- : Existing subdrain pits
- : Horizontal pipes

R/B: Reactor Building
T/B: Turbine Building
Rw/B: Radwaste Building

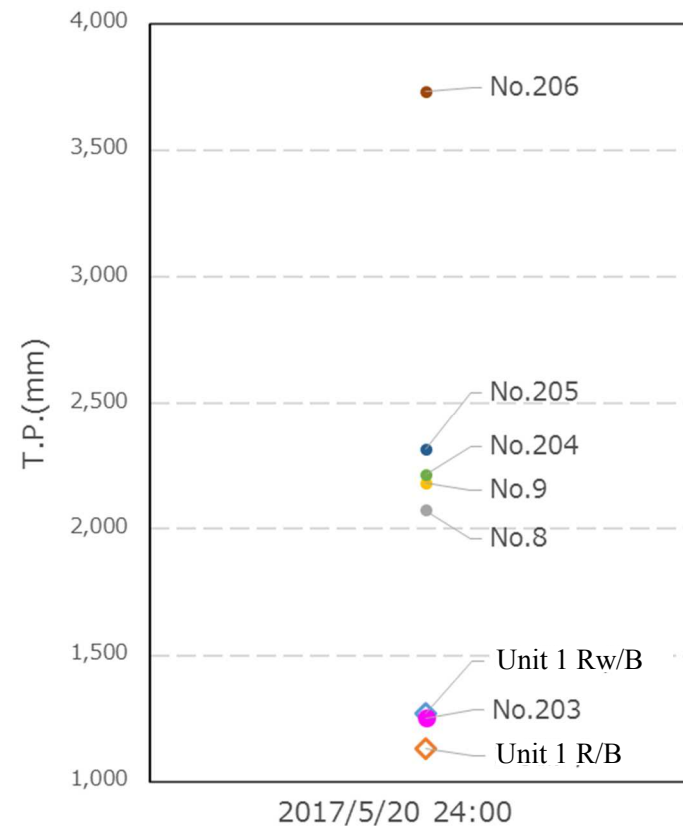
Subdrain pit layout

2. Environmental effects

The water level of subdrain pit No.203 was lower than the level of accumulated water levels in Unit 1 R/B, but as the water levels of subdrain pit No.204, located midway between the two, and the water levels of surrounding subdrain pits No. 8, 9, 205, and 206 were higher than the Unit 1 R/B accumulated water levels, it was determined that there was no leakage from the same building attributable to the low water level of No.203.



Positions of subdrain No.203 and the buildings in relation to one another (plan view)



Relationship between the levels of accumulated water in the buildings and the subdrain water levels

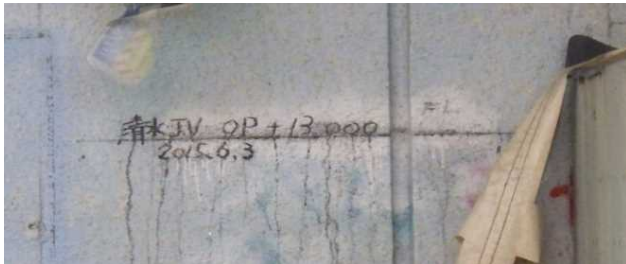
3. Issues and countermeasures (1/4)

1. [Issue of mixed elevation standards]

There was a mixture of elevation standards used; “T.P.,” “new O.P.,” and “old O.P.”

Use “T.P.” as the elevation guideline in the power station.

- All drawings created in the future shall use T.P. notation (to be started promptly)
- O.P. notation used in previous drawings shall not be used as elevation information.
The drawing will be stamped, etc., as a measure to prevent erroneous use of O.P. notation for elevation. (Scheduled to be implemented and completed within the fiscal year.)
- All elevations for the site reference points shall be in T.P. notation, and existing O.P. notation shall be labelled with a note preventing use. (Within the year)



Example of a site reference point:
O.P. notation in the field was corrected to T.P. notation

2. [Issue of insufficient dissemination regarding the use of elevation]

The use of T.P., new O.P. and old O.P for elevation was not sufficiently disseminated in the power station.

Use of T.P. shall be stipulated in the manuals, etc., so that it can be shared among concerned parties both inside and outside the company, and be made into a permanent rule.

- Rules regarding the use of T.P. (reference point locations and notation) shall be added to manuals relating to design, order placement, and construction supervision. (Within the year)
- Power station and contractor personnel shall be notified in writing about this event, the requirement to use “T.P.,” and the difference between “new O.P.” and “old O.P.,” and a briefing session shall be held. (Notification complete, briefing session to be held in November 2017)

3. Issues and countermeasures (2/4)

3. [Issue regarding specifications at time of order placement]

There were no requirements regarding elevation on the specifications at the time of order placement.



For subdrain construction work, requirements such as the reference points, depth of the bottom of the pit, and pit aperture height, etc., shall be specified on the specifications at the time of order placement. (To be implemented from the next order)

The abovementioned requirements for subdrain construction work shall be added on the specifications checklist for the order placement manual. (November)

4. [Issue of record checking during the witness inspection]



As the records were not checked at the time of the witness inspection of the pit aperture height, the measurement error was not identified.

A checklist to verify the measurement record shall be added to the manual for construction supervision when measuring elevation in the power station for all work including subdrain work. (November)

TEPCO shall check that the measurement procedures, witness verification items, and record checking items are listed in the construction implementation summary (created by the construction company). (Implemented from next measurement)

3. Issues and countermeasures (3/4)

5. [Issue of data delivery between departments]

As the format for data delivery had not been established, data was presented using O.P. notation rather than T.P. notation.



A standard format shall be created for the delivery of data regarding building water level management.
(Implemented)

Data shall only be delivered after its content and basis is verified by a superior. (Implemented)

[Other: Change management]

When facilities, etc., are changed or modified, they shall be checked to make sure that they do not differ from the required specifications, and that there are no abnormalities before and after the changes/modifications.


In order to further reduce the possibility of a water level gauge setting error at the subdrain facilities, when setting a water level gauge associated with building water level management, the water level shall be compared with surrounding water levels prior to the start of operation. (To be implemented from the next occasion.)

3. Issues and countermeasures (4/4)

The following general inspection shall be implemented separately from the individual countermeasures.

1. General inspection of all LCO events related to subdrains

In order to improve safety, a general inspection shall be conducted for all LCO target items relating to subdrains.


 After checking that all equipment and facilities required or monitoring subdrains were adequately installed and managed (operation and maintenance), no major errors that would lead to LCO entry were found.

There were two pits which had a large difference in the current water level gauge reference point and the measurement record from 2016, and two pits with clerical errors, etc., in the reference points, and these settings were promptly corrected.

We are preparing full check for LCO related items other than subdrain as well.

2. Implementation of a comprehensive business risk review

A comprehensive review shall be conducted for the potential risks of practices specific to the Fukushima Daiichi Nuclear Power Station that are being conducted as emergency measures after the earthquake, such as the mixture of “new and old O.P.”

 The rules and arrangements that are currently in place shall be checked to see that they are functioning properly, and business risks shall be eliminated by incorporating them into a manual, etc.