September 17, 2011
Tokyo Electric Power Company

The status of measuring instruments at Reactor Pressure Vessel and Primary Containment Vessel

[Preface]

- We are cooling Reactors of Units 1 to 3 of Fukushima Daiichi NPS in order to achieve cold shutdown.
- In this paper, we would like to explain the measurement principle and the soundness of measuring instruments (water level, pressure and temperature) installed at Reactor Pressure Vessel and Primary Containment Vessel used to determine whether cold shutdown is achieved.
- We are announcing the actual measurement data on our website “ plant related parameters ” .

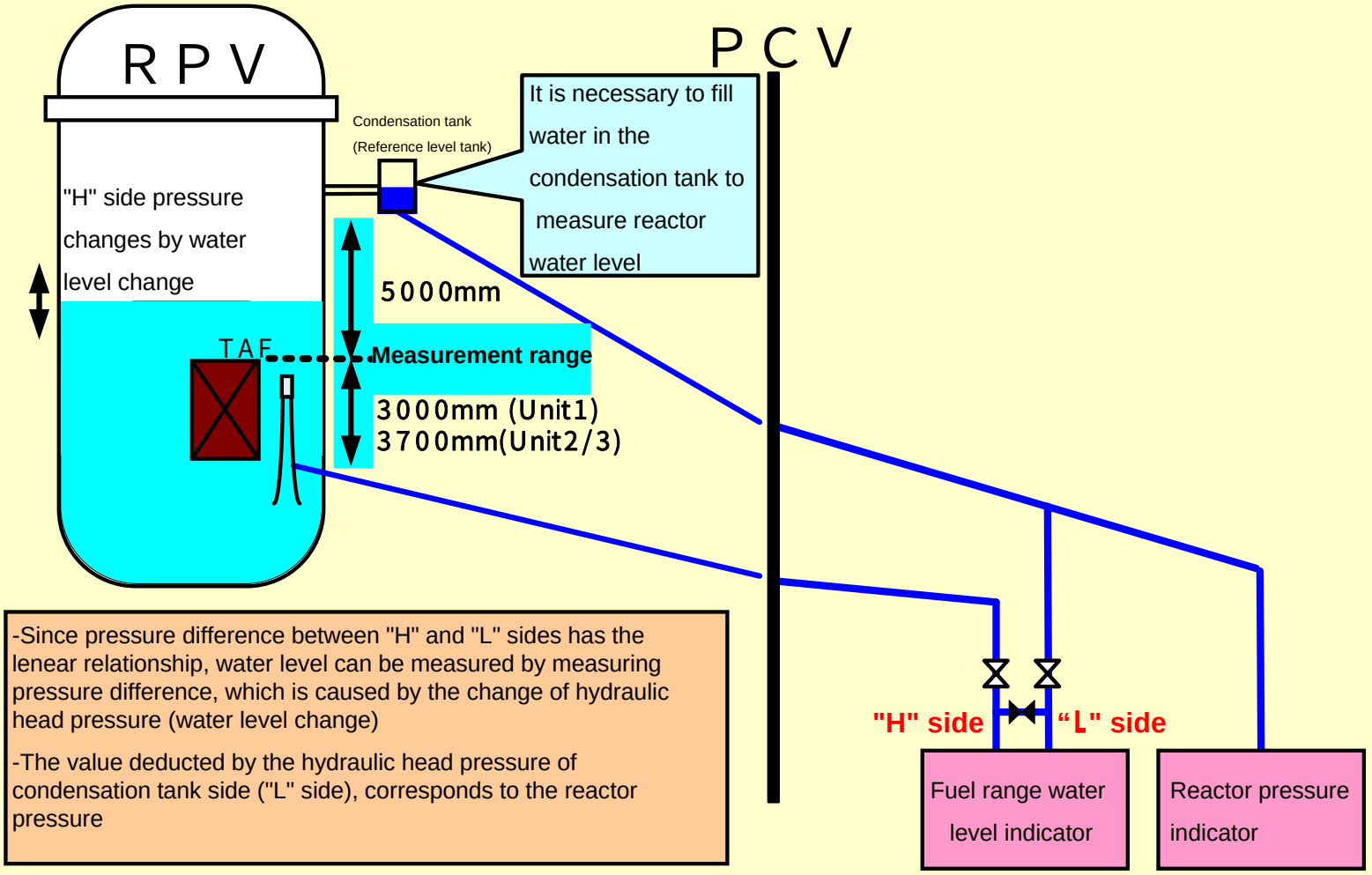
The status of measuring instruments at Reactor Pressure Vessel and Primary Containment Vessel

Measured correctly, by conducting correction or setting temporary instrument	Deemed to be measured correctly, by trend observation and so on, in spite of not conducting correction	Instrument is deemed to be sound, but not measured correctly (water filling is needed)	Measurement method is under consideration

No.	No. of Unit	Unit 1	Unit 2	Unit 3
1	Reactor water level (Fuel range)	Correction conducted on May 11	Temporary instrument installed on June 22 (Function did not recover) -> Under investigation for taking measure after the temperature in PCV (Primary Containment Vessel) is improved	Under investigation for taking measure after the environment of R/B (Reactor Building) and the temperature in PCV are improved.
2	Reactor pressure	Temporary instrument installed on June 4	Temporary instrument installed on June 22 (Reference value was collected) -> Under investigation for taking measure after the temperature in PCV is improved	Under investigation for taking measure after the environment of R/B and the temperature in PCV are improved.
3	Temperature around RPV (Reactor Pressure Vessel)	Stable reading (for representative parts *)	Stable reading (for representative parts *)	Stable reading (for representative parts *)
4	Pressure of PCV D/W (Drywell)	Correction conducted on May 11	Conducted on July 15 (by the comparison with pressure indicator of N2 enclosure equipment	Conducted on July 15 (by the comparison with pressure indicator of N2 enclosure equipment
5	Water level of PCV	Computable by calculating (Pressure of N2 enclosure equipment) - (D/W output), (Monitorable when water level is above the line of N2 enclosure equipment)	Under consideration for deriving water level of PCV from calculating (Discharge pressure of RHR (Residual Heat Removal System) pump or CS (Core Spray) pump) - (D/W output)	Under consideration for deriving water level of PCV from calculating (S/C (Suppression chamber) pressure) – (D/W pressure), (Discharge pressure of RHR pump or CS pump) - (D/W output))

•Water feed nozzle and lower part of pressure vessel (Unit 1 and 3: Head of lower part of pressure vessel, Unit 2: Upper head of bottom part of pressure vessel)

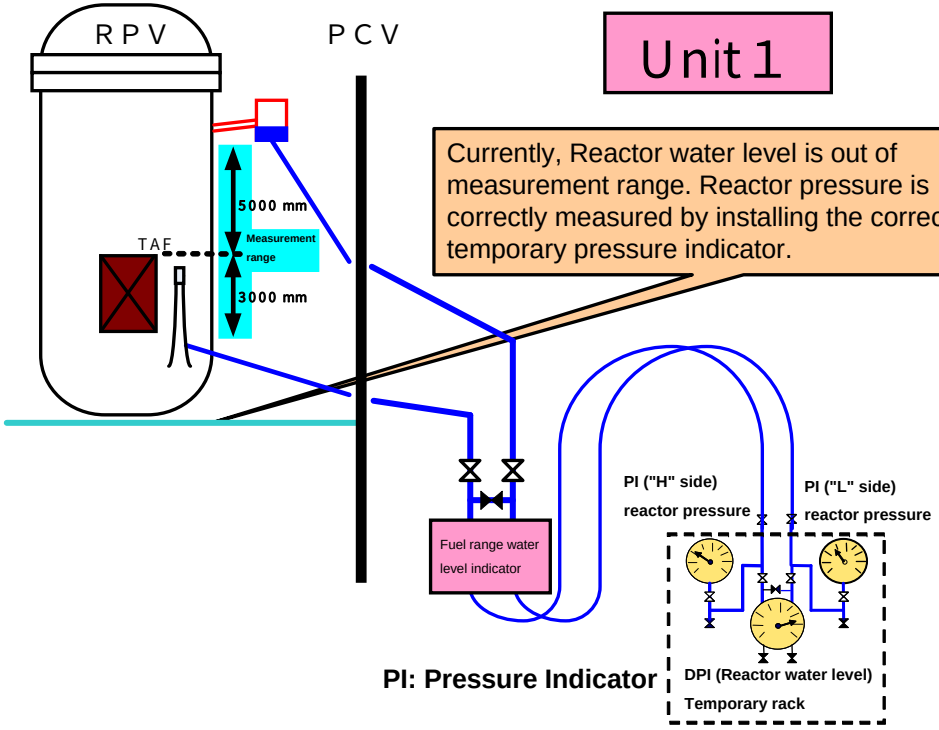
1. Reactor water level / 2. Reactor pressure (1)

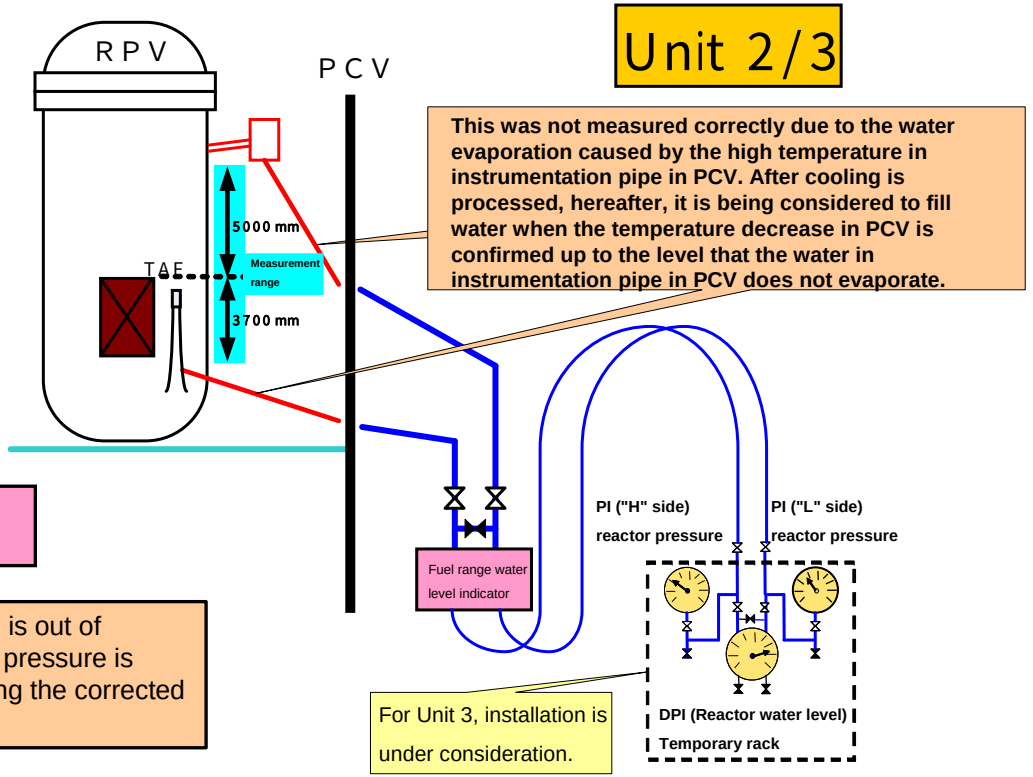


Measurement mechanism of Reactor water level/ Reactor pressure indicator

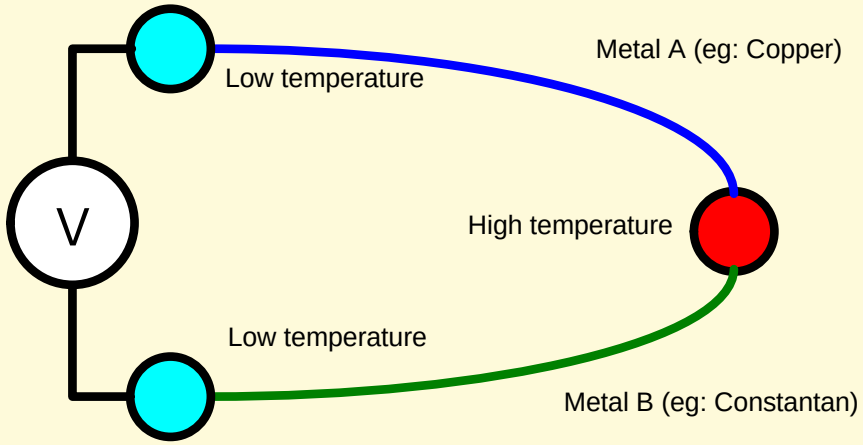
1. Reactor water level / 2. Reactor pressure (2)

Unit 1: Correction of Reactor water level indicator (May 11)





3. RPV / PCV temperature



Thermal sensing device using the phenomenon of producing thermoelectric power by temperature difference at the contact of 2 different metals (Seebeck effect)

Mechanism of Thermal sensing device (thermocouple)

Current status

Although some thermal sensing device are OS/DS (failure) condition, it is considered to be working properly by evaluating in following viewpoints. Trend is monitored hereafter, and its reliability is continuously evaluated.

-Same trend is indicated by comparing the circumferential direction data (spare point) and the data of adjacent thermal sensing device

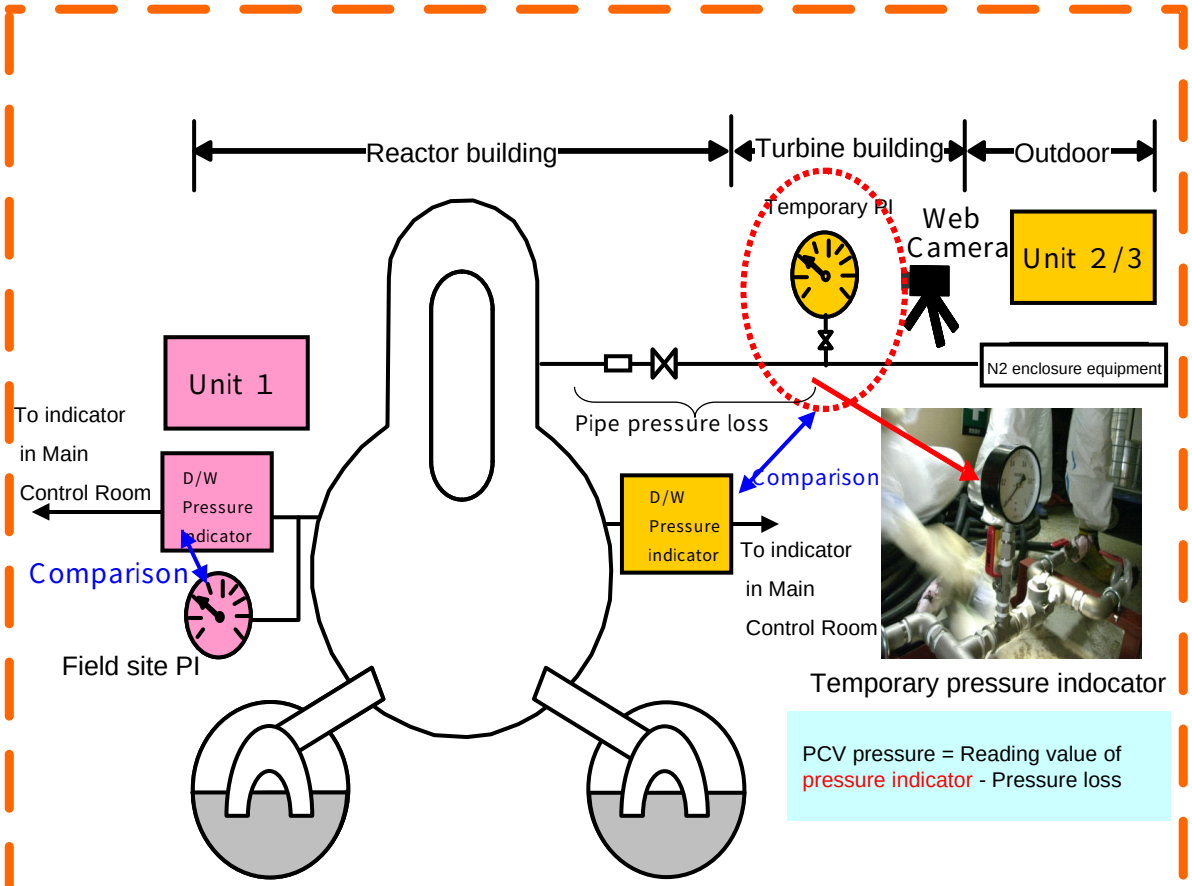
-Reading is stable with no outstanding values for the past one month

-Indication changes in accordance with the change of water injection amount into the reactor

-As shown in the figure, thermocouple has simple mechanism with limited failure modes of disconnection/short-circuit/ grounding/multi circuit failure, and so on. Trend is monitored hereafter, and its reliability is continuously evaluated.

We deleted the image of thermal sensing device (thermocouple) on Feb. 21, 2012.

4. PCV pressure



Mechanism of measurement of PCV pressure

Current status

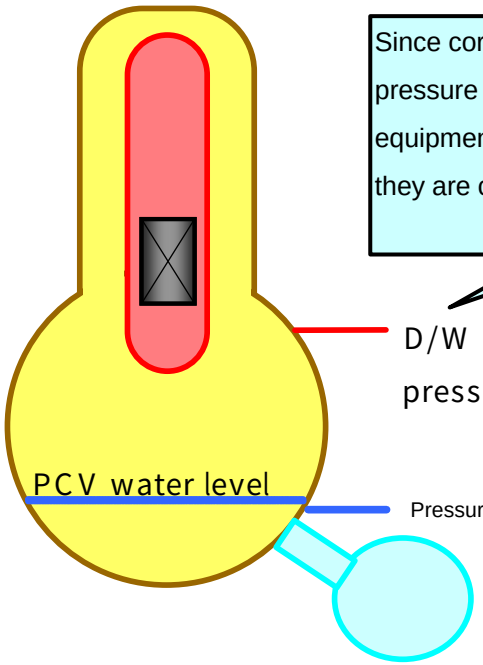
<Unit 1>

Correction of field site PI was conducted on May 11. The indicator in Main Control Room is evaluated to be correctly measured, since conversion value is confirmed from field site PI, of which the correction was conducted.

<Unit 2/3>

It is evaluated to be correctly measured, since properness of instrument was confirmed by comparing the values of temporary PI for comparing N2 enclosure equipment (correction was conducted) and D/W pressure indicator for safety protection system, on July 15.

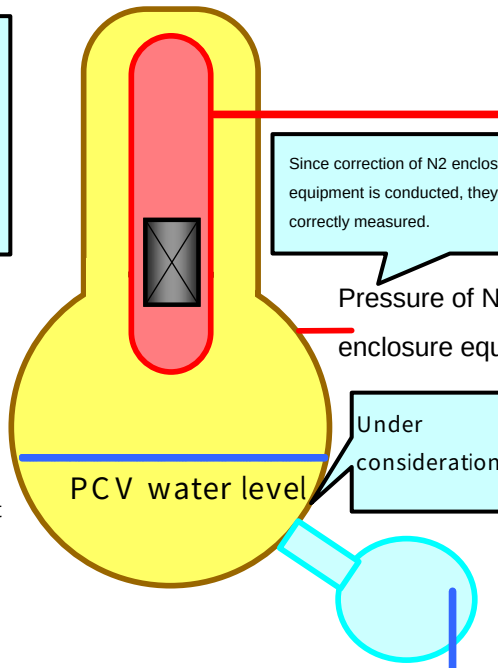
5. PCV water level



Since corrections of both D/W pressure and N2 enclosure equipment are conducted, they are correctly measured.

D/W pressure

Pressure of N2 enclosure equipment



Since correction of N2 enclosure equipment is conducted, they are correctly measured.

Pressure of N2 enclosure equipment

Since there are some similar instruments, it is considered to be correctly measured. *

Discharge pressure of RHR/CS pump

Under consideration

•(S/C pressure) - (D/W pressure) is also being considered for Unit 3

Mechanism of PCV water level measurement

Suppose that D/W pressure (field site pressure indicator) is gas phase part and N2 pressure is liquid part, since N2 pressure indicates the gas phase part pressure and the hydraulic head pressure of liquid, water level is theoretically calculated by deducting the gas phase part pressure.

Unit 1

Mechanism of PCV water level measurement

Suppose that N2 enclosure equipment is gas phase part and RHR discharge pressure is liquid part, since RHR/CS pump discharge pressure indicates the gas phase part pressure and the hydraulic head pressure of liquid, water level is theoretically calculated by deducting the gas phase part pressure.

Unit 2/3

6. Wrap up and future plan

- As for measuring instruments installed at Reactor Pressure Vessel and Primary Containment Vessel, while part of them are not functioning, we are gathering effective plant related data.
- We will continue to measure and monitor the trend of data in order to achieve cold shutdown.
- We intend to fix Reactor water level (units 2 and 3) and Reactor pressure (Unit 3) in the future when the repair work becomes doable.
- As the PCV water level is useful in deducing the status of inside PCV, we would like to prepare for installation of measuring instruments.