Results of Verification Test in Fundamental Technology Development for Robots to Measure Water Levels inside Suppression Chambers (S/C)

October 1, 2013

Tokyo Electric Power Company

1. Purpose

To verify a technology for measuring the S/C (pressure suppression chamber) internal water level by remote control using ultrasonic waves from the external surface of the S/C in the **Units 5 and 2 Reactor Buildings**. This technology was developed in a **FY2012 technology platform establishment project subsidized by the Agency for Natural Resources and Energy for containing power nuclear reactor accidents (development of a remote technology platform for water-level measurement inside a cylindrical container)** with the support of "**S/C Internal Water Level Measurement WG (Project Manager: Prof. Matsuhira from Shibaura Institute of Technology)**".

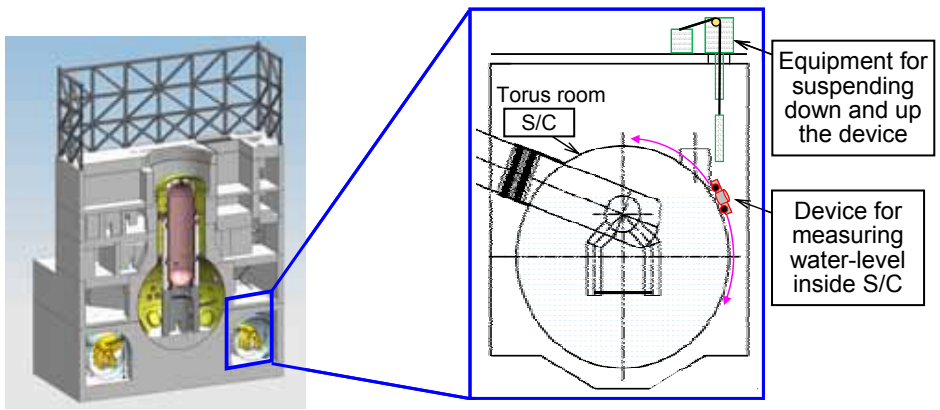
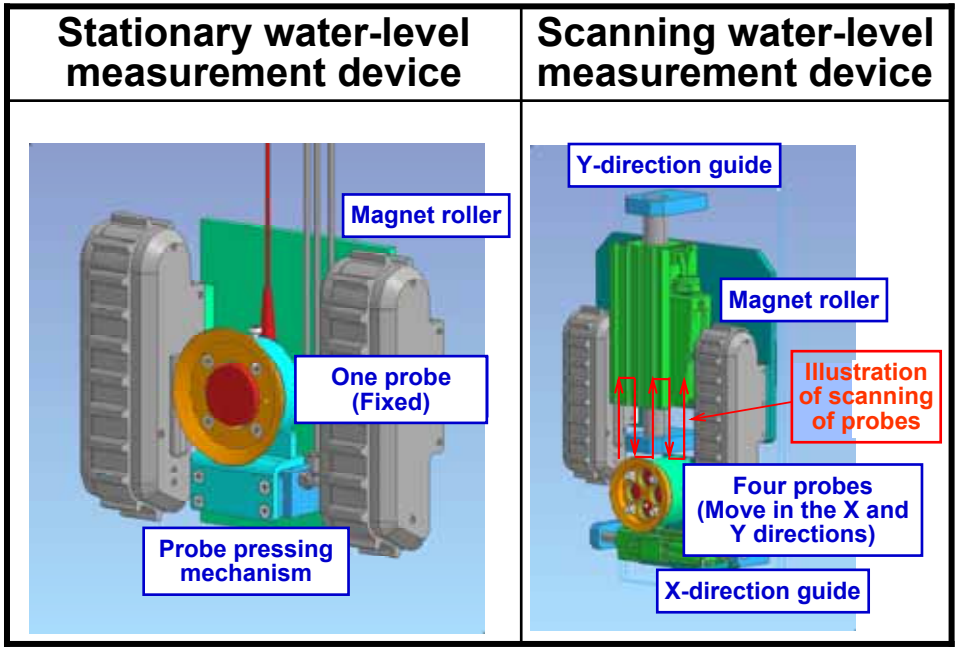


Illustration of water-level measurement inside Unit 2 S/C

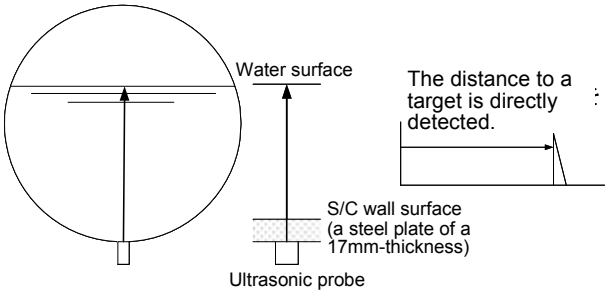
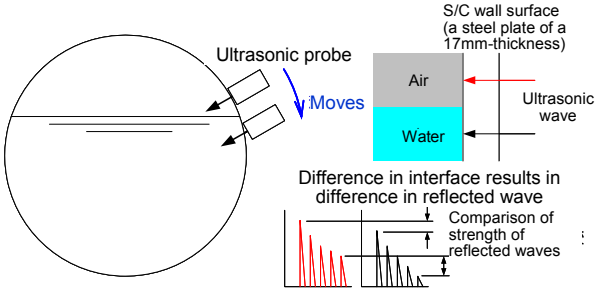
Water-level measurement device that has been developed



2-1. Verification Test Results (Unit 5) – (i)

In the Unit 5, it was verified that the **crawlers** of the stationary device and the scanning device **have favorable traveling performance** and that **measurement results obtained by the respective measurement methods are within a 100 mm difference (the target difference: ±50mm).**

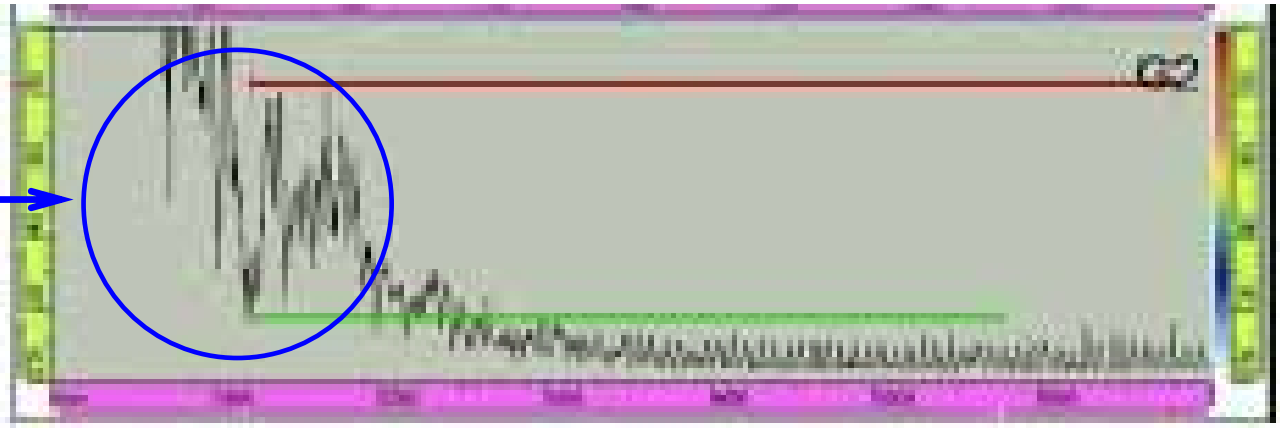
○ **Verification test dates: September 12 to 14**

Water-level measurement device		Stationary		Scanning
Verification test for crawler's traveling performance	Traveling in a straight line and in a circle	Favorable		Favorable
Water-level measurement verification test	Measurement method	Direct distance measurement	Multi-reflection comparison measurement	
				
	Measurement date	Sep. 13	Sep. 13	Sep. 14
	Water-level measurement result*	Approx. OP.4300	Approx. OP.4280	Approx. OP.4220

*: Each of the measurement results is an average of values obtained by measuring the water level three times using the corresponding measurement method. For reference, the S/C internal water-level gauge at the Unit 5 Central Control Room showed readings of OP.4285 on September 14 and 15.

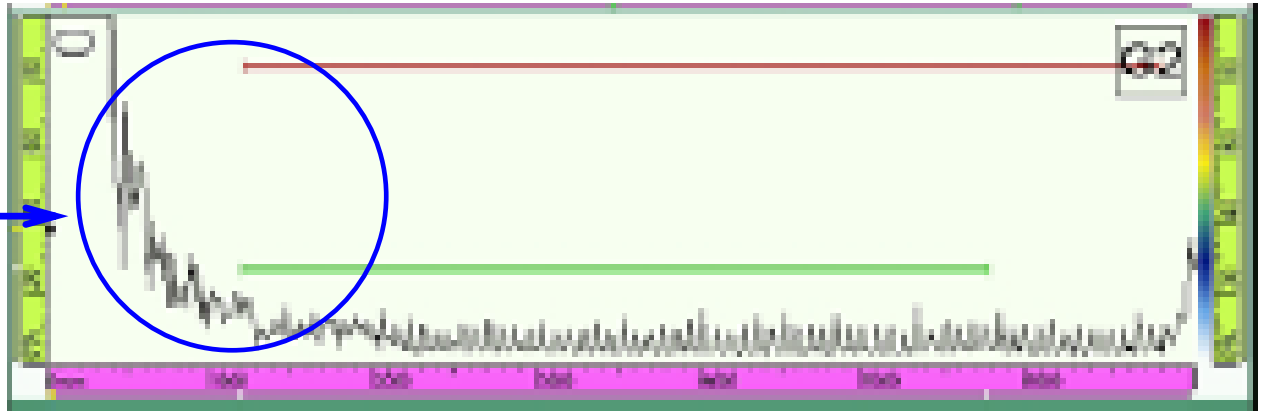
2-1. Verification Test Results (Unit 5) – (ii)

Results of multi-reflection comparison measurement using the stationary device in the Unit 5 are shown below. The water level (a gas-liquid interfacial surface) was determined based on a difference in strength of reflected waves from the water phase part and the gas phase part.



Data obtained from the gas phase part

Reflected waves from the water phase part and the gas phase part are different in strength.



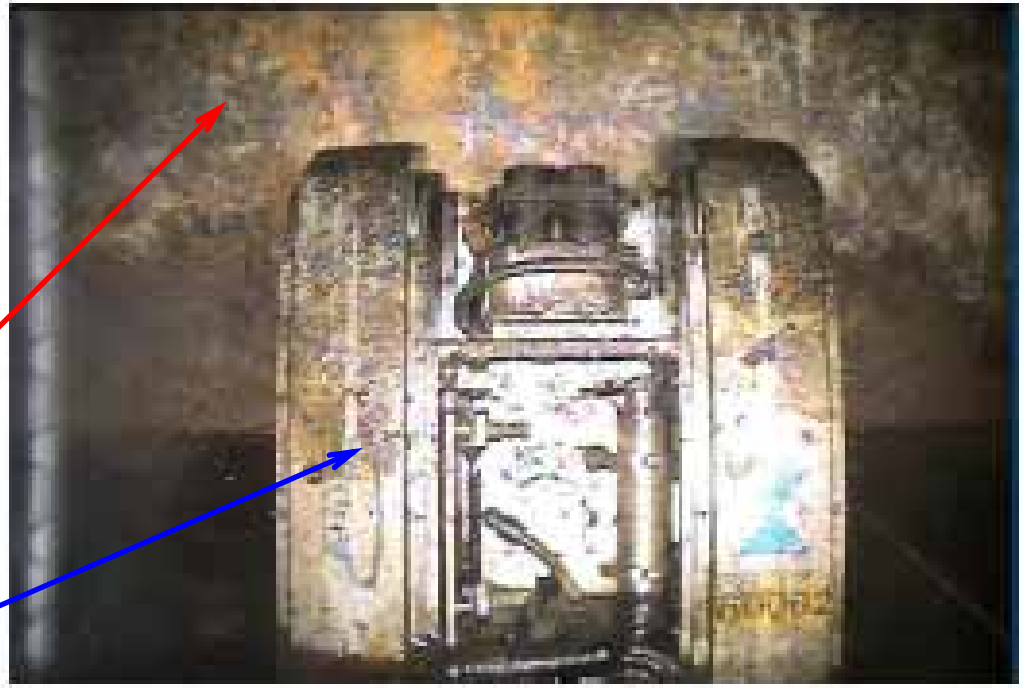
Data obtained from the water phase part

2-2. Verification Test Results (Unit 2) – (i)

In the Unit 2, **S/C internal water-level measurement was conducted through multi-reflection comparison measurement using the stationary water-level measurement device.** We planned to detect a difference in strength of reflected waves from the water phase part and the gas phase part with the stationary water-level measurement device. However, **the surface condition of S/C near the torus room has been unexpectedly deteriorated, so that changes in strength of reflected waves around there were unclear.**

○ **Verification test dates:**
September 20 and 24

○ **S/C internal water-level measurement method:**
Multi-reflection comparison measurement using the stationary water-level measurement device

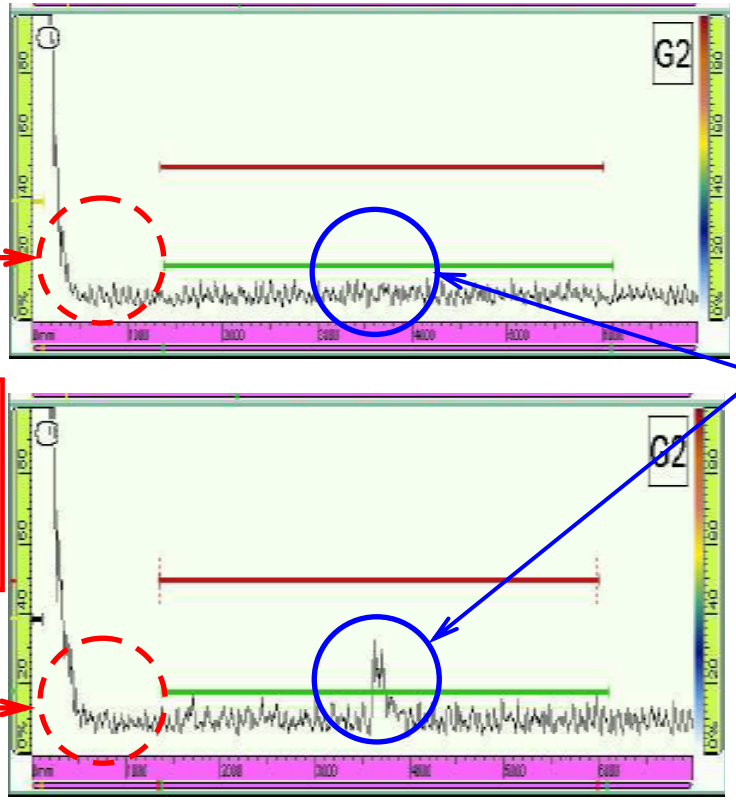


The device during the measurement

(Photographed by a camera installed on a conveyance unit of the equipment for suspending down and up the device)

2-2. Verification Test Results (Unit 2) – (ii)

As a reflected wave from a construction (catwalk) inside S/C was captured, the water level was found to be at least at this height. Then, no reflected wave from the catwalk was captured above this height, indicating a possibility that the gas phase part exists above this height. However, this part of the catwalk may be in the water phase part since an unfavorable angle condition might have weakened a reflected wave or an ultrasonic wave might have become unable to reach the catwalk. For this reason, we consider that we cannot determine this part to be in the gas phase part.



Changes in strength of reflected waves are unclear

Obtained data

Impossible to determine this level to be in the gas phase part

As the measurement device went higher along S/C, reflected waves from the catwalk inside S/C became weaker.

The S/C internal water level was found to be at least at the height (approx. OP.3070) where the water-level measurement device captured this reflected wave.

(Reference) The accumulated water level in the torus room: approx. OP.3360

2-2. Verification Test Results (Unit 2) – (iii)

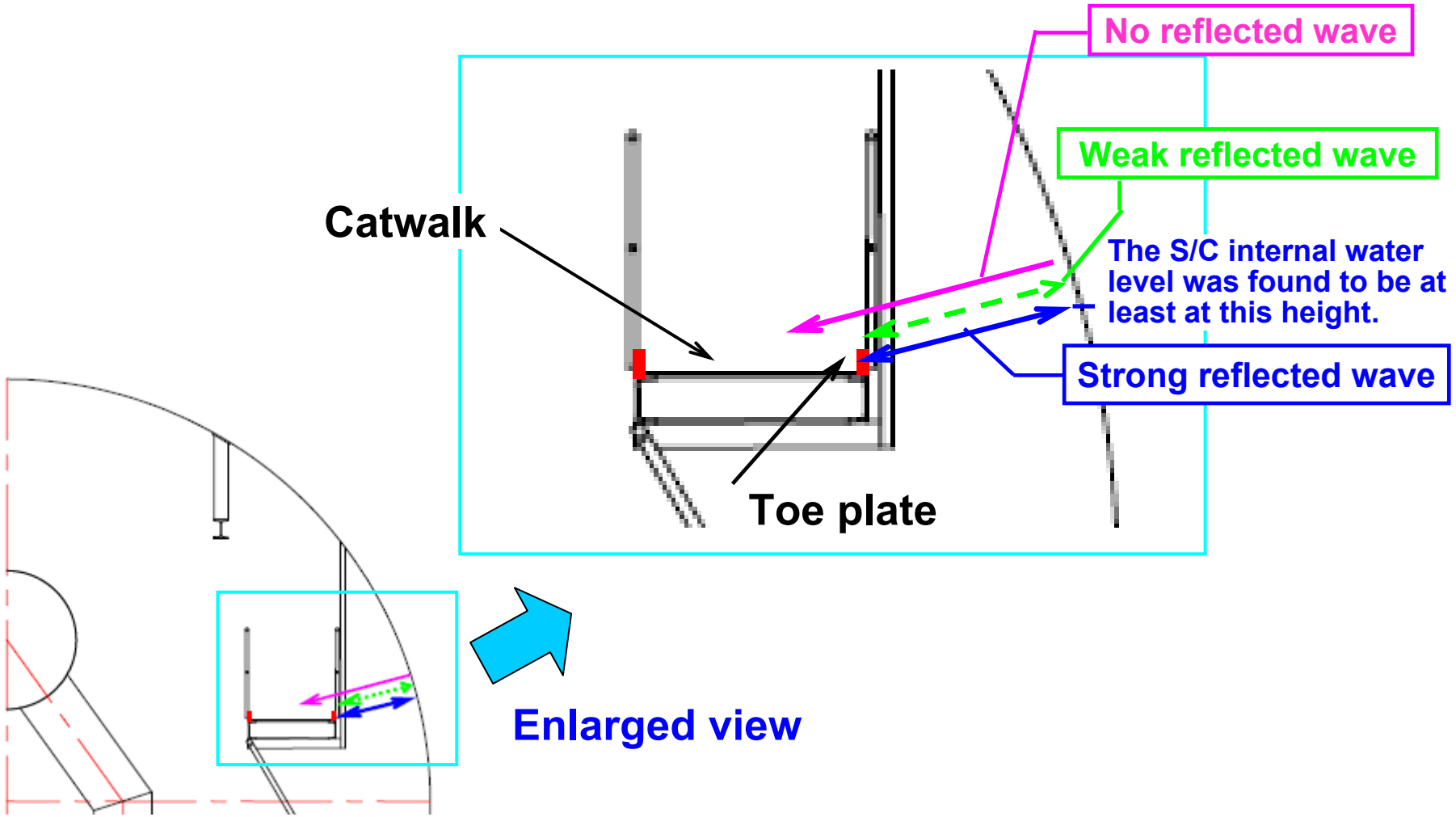
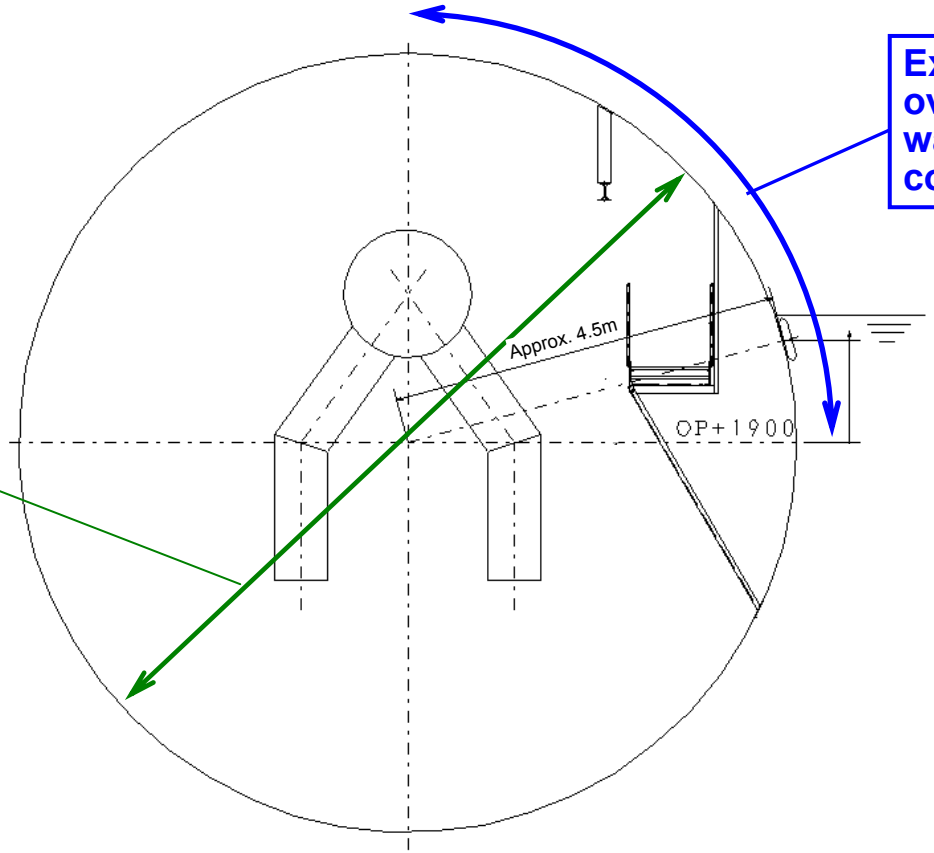


Illustration of reflected waves

3. Actions to Be Taken Following the Test

We are to study improvements to the scanning device and the stationary device for continuous capture of reflected waves over a wider range and grasp of the strong-weak conditions of reflected waves from more constructions inside S/C with the ultrasonic wave beam path length extended to the extent that the beam can reach the surface on the opposite side.
The future schedule is currently under consideration.



Extension of the range over which reflected waves can be continuously captured

Extension of the ultrasonic wave beam path length to the extent that the beam can reach the surface on the opposite side