## ⑥ Understanding the groundwater flow

【Current situation】

On reviewing measures to prevent groundwater flow into the buildings, TEPCO is working on groundwater flow at the site and reviewing the effects of the countermeasures taken. To conduct a quantitative and sufficiently accurate review, it is crucial to gather more geological and groundwater-related data.

It is important to continuously monitor data on groundwater levels around the buildings, groundwater flow and water quality. The number of observation holes need to be increased and sampling need to be conducted more frequently. Further accurate analyses of the groundwater flow at the site and groundwater inflow to the reactor buildings etc. should be conducted.
However, many challenges in terms of time and resources rely on adequate data, since for example it takes a certain period of time to dig an observation hole by boring (approximately 1 week/ approximately 30m-hole), and space to dig these holes at the site is limited. For these reasons, technologies to measure geological data (geological structure, permeability) and groundwater data (water level, water pressure, flow speed) through methods other than boring are requested.

In addition, to understand the extent and the situation of the contaminated water, we are conducting periodical surveys (all-beta, strontium, tritium, etc.) at the contaminated areas on the ocean side of the turbine buildings, the tank area where the water leaks have been found, and the passes where there are possibilities of leak to the ocean. At present, analyses of these nuclides are implemented at the analytical facility at the site after the samples have been taken from the measuring points. However, this procedure; from sampling to analysis result issuance takes time. (Refer to Note. 1)

Speedy sampling/analysis technologies are requested so that we can issue water analysis result in more timely and precise manner.

(Note 1)

At present, time required for the analyst to receive the sample and acquire the results is as follows, noted that the time required for taking the sample to the laboratory greatly varies, depending on the sampling locations or the numbers of the samples.

(1) All $\beta$: Approximately 1 hour 30 minutes (preparation: 5 minutes, drying: 60 minutes,

measurement: 5 minutes, evaluation: 20 minutes)
A sample of 10ml is used to perform a measurement by 2 pi gas-flow counter equipment.
The detection limit value of all $\beta$ is approximately 20 Bq/L.

(2) Tritium: Approximately 27 hours (preparation: 5 minutes, distillation: 2 hours, mixing of scintillator: 24 hours, measurement: 40 minutes, evaluation: 20 minutes)
A sample of 6ml is used to perform a measurement by liquid scintillation counter.
The detection limit value of tritium is approximately 80 Bq/L.

(3) Strontium
So far, we have been employing method (a). For the purpose of reducing the time required for analysis, however, we employ method (b) in some cases. We are planning to employ method (c).

(a) A sample of 2000 ml is subjected to pretreatment using the fuming nitric acid method, and then to measurement using a 2 pi gas-flow counter: About 24 days (20 days for generating yttrium from strontium, and 4 days for separating/measuring/evaluating yttrium)
The detection limit value for strontium is approximately 0.1Bq/L.

(b) A sample of 2000 ml is subjected to pretreatment using the fuming nitric acid method, and then to measurement using Pico-beta: About 7 days (6 days for removing disturbing nuclides and precipitating strontium carbonate and one day for measuring/evaluating)
The detection limit value for strontium is approximately 0.8Bq/L.

(c) A sample of 2000 ml is subjected to pretreatment using the ion exchange method and then to measurement using Pico-beta: About 4 days (2 days for strontium extraction, 0.5 days for precipitating strontium carbonate, and one day for measuring/evaluation)
The detection limit value for strontium is approximately 0.8Bq/L

【Technologies needed】

(1) Collect data necessary to investigate groundwater flow (geological condition/ groundwater data measurement system, etc.)

- Investigating area
  Geological structure, water permeability, groundwater level, groundwater pressure, groundwater velocity
- Simple measuring techniques besides the boring system, or an unmanned-controllable boring apparatus

(2) Analyze water quality

- Analyzing radioactivity material density (tritium and strontium) within a couple of hours.
- To be able to administrate sampling apparatus with ease.
- To be able to repair sampling apparatus on the spot, considering the difficulties to convey such apparatus outside the site.

(3) Dig observation holes

- Digging observation holes with minimum numbers of workers and working hours (less than 10 workers *day/ 30-meter-deep hole).
- Preventing the sampling water taken from the observation holes from being mixed with the contaminated materials interfused from the surrounding soil.