<Reference>

Assessment for Strontium-90 Analysis in Fukushima Daiichi Nuclear Power Station

February 5, 2014

Tokyo Electric Power Company

TEPCO 東京電力

1. Overview

- At the end of July, 2013, in a sampling* analysis, the Strontium 90 (hereinafter, referred to as ‘Sr-90’) density exceeded the Gross-ß density several times (Reverse of data). And hence, a investigation was conducted for specifying the cause.
(*The seawater samplings were obtained inside the port in June, 2013.)

- As a result of investigation, it became clear that the reverse of data occurred exclusively in the Sr-90 analysis by the Gas Flow Proportional Counter (LBC) at a hot laboratory in Units 5 and 6.

- Further investigation into the data, the counter device etc. were conducted.

2. Results analysis

- The following three respects are estimated to possibly have influence on results of the Sr-90 analysis, in cooperation with Japan Nuclear Fuel Limited.

1. The density of strontium standard solution produced by analysis
2. The density of yttrium standard solution produced by analysis
3. The measurement efficiency of Yttrium-90

3. Results of analysis

- Both standard strontium solution and standard yttrium solution were correctly created, if we follow the procedure manual.
- It became clear that the value measured by the counter (LBC) at Units 5 and 6 was higher than that of Environment Management Building in the measuring of the same groundwater sampling.
- After that, it also revealed that the Yttrium-90 efficiency* (*the conversion constant used when calculating Sr-90 density) was higher than the efficiency adopted by the initial operation, using the standard source. The detection efficiency at Environment management Building was the same as the one adopted by the initial operation.

<table>
<tr><th></th><th colspan="2">Units 5 and 6 Hot Laboratory</th><th colspan="2">Environment Management Building</th></tr>
<tr><td>Detection efficiency
(As of the initial operation)</td><td colspan="2">47.8%
(December, 2003)</td><td colspan="2">48.8%
(December, 2007)</td></tr>
<tr><td>Current detection efficiency
(January, 2014)</td><td colspan="2">Same as above</td><td colspan="2">Same as above</td></tr>
<tr><td rowspan="3">Appropriate detection efficiency* (confirmed from the standard source)
(January, 2014)</td><td rowspan="3">60.4%</td><td>60.5%</td><td rowspan="3">49.8%</td><td>51.2%</td></tr>
<tr><td>59.1%</td><td>49.0%</td></tr>
<tr><td>61.7%</td><td>49.3%</td></tr>
</table>

*The mean value of the three measurements

4. Reasons for the adoption of the low LBC efficiency

As direct reasons, the following aspects were confirmed after hearing surveys conducted among those who were involved with measuring.

- The evaluation for the Yttrium-90 efficiency by LBC solely followed the procedure fixed by the initial operation at the time when the equipment was introduced.

- As a result of efficiency measurement, the value of 'Sr-90 and Yttrium-90' was lower than the former counter, and hence we measured Yttrium-90 again with the same samples. The value of Yttrium-90 was low.

  * Measuring are conducted for the 3 kinds of samples as follows: 'Sr-89', 'Sr-90 and Yttrium-90', and 'Yttrium-90'. The value of 'Sr-90 and Yttrium-90' was low.

- Another two measurements were conducted for Yttrium-90 (in all, 4 times). The third and fourth measurements produced the similar efficiency. Therefore, the fourth efficiency was adopted as a detection efficiency for counter (LBC).

- The Yttrium-90 efficiency obtained by the counter (LBC) was lower than that obtained by the former equipment. However, we attributed the lower efficiency to the characteristics of the counter (LBC) at that time (when the equipment was introduced).

- At that time, we did not think of conducting a further investigation for the discrepancy of the efficiency, though the 4 measurements showed somewhat different value of efficiency (50 to 70%).

5. Influence on the past analysis results

- All the nuclear wastes (755 samplings) which were analyzed with the Gas Flow Proportional Counter (LBC) before the earthquake were reanalyzed.
  Sr-90 was found in one sampling[*1].
  The analysis value of Sr-90 was 1.4 E-10Bq/cm^3.

  *1 This sampling was obtained from the Units 1 and 2 Exhaust stack in January, 2004.

- All the other samplings were found to be ‘below the detection limit value’, and hence had no influence.

- Collection will me made concerning the sample where Sr-90 was found.

6. Action plan in future

- We will resume the fix of the analyses* as soon as possible.

*The fix of the analyses was suspended because it came clear that Sr-90 exceeded Gross-ß.

- We will conduct on a regular basis 1) a cross-check between the analysis rooms and 2) a cross-check by the third party, for the purpose of enhancing the quality of sample analysis, and making sure that the quality of sample analysis is maintained to a certain level.

- As a reoccurrence prevention system, the calibration for the chemical analysis radiation counter will be conducted by the counter manufacturer who has enough experience with such counters from the point of purchase.

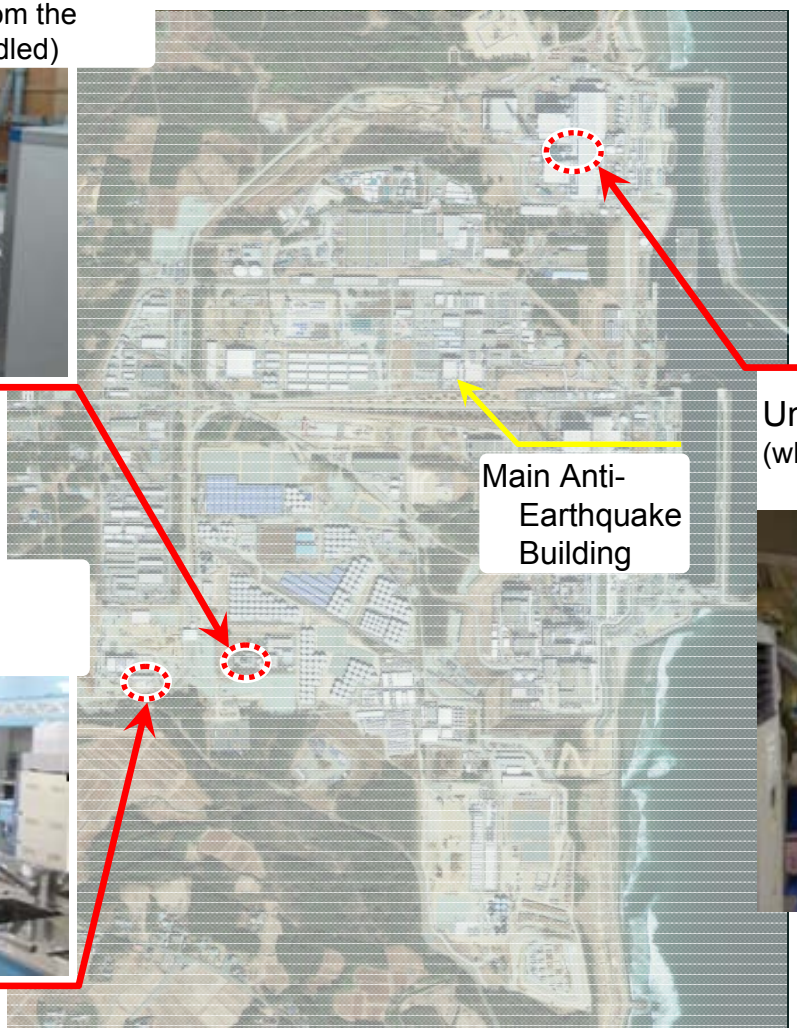
- The analysis results by the Gas Flow Proportional Counter (LBC) will be dealt with as follows:
  - The Units 5 and 6 LBC will not analyze Sr-90 until the calibration is complete.
  - The samples which were analyzed by the LBC before will be reanalyzed with pico-ß.
  - New method which is less influenced by the skill and experience of the analyzer will be examined.

<Reference> Chronological order of events regarding the Gas Flow Proportional Counter (LBC) for Units 5 and 6

Year and month	Incident
August , 2003	Purchase of Gas Flow Proportional Counter (LBC)
Sep. to Dec. 2003	Calibration for the counter (LBC)
March, 2011	Suspension of the operation of the counter (LBC) due to the earthquake
January, 2012	Inspection by the counter manufacturer
October, 2012	Resumption of analysis of SR-90 with the counter (LBC)
July, 2013	1) Suspension of data fixation due to finding an unusual tendency between the Sr-90 density and Gross-ß density of seawater in Fukushima Daiichi NPS 2) Reanalysis of the concerned samples
August, 2013	Verification for validity of Sr-90 analysis due to finding the same unusual tendency in the reanalyzed samples and samples obtained in July
September, 2013	Initial operation of ß-nuclide analysis device
January, 2014	Turnout of the higher Sr-90 efficiency of the counter (LBC) compared to the efficiency in FY 2003

<Reference> Analysis room inside Fukushima Daiichi NPS

Environment Management Building
（where groundwater samplings etc. from the points of 4-meter above sea are handled)



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Units 5 and 6 Chemical Analysis Room
(where accumulating water samplings etc are handled.)

Chemical Analysis Building
(where the samplings etc. from the groundwater bypass are handled.)

Photo source: Tokyo Electric Power Company