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Demonstration Testing of a System for the High Speed Monitoring of the Radioactive Concentration of Wastewater *In Situ*

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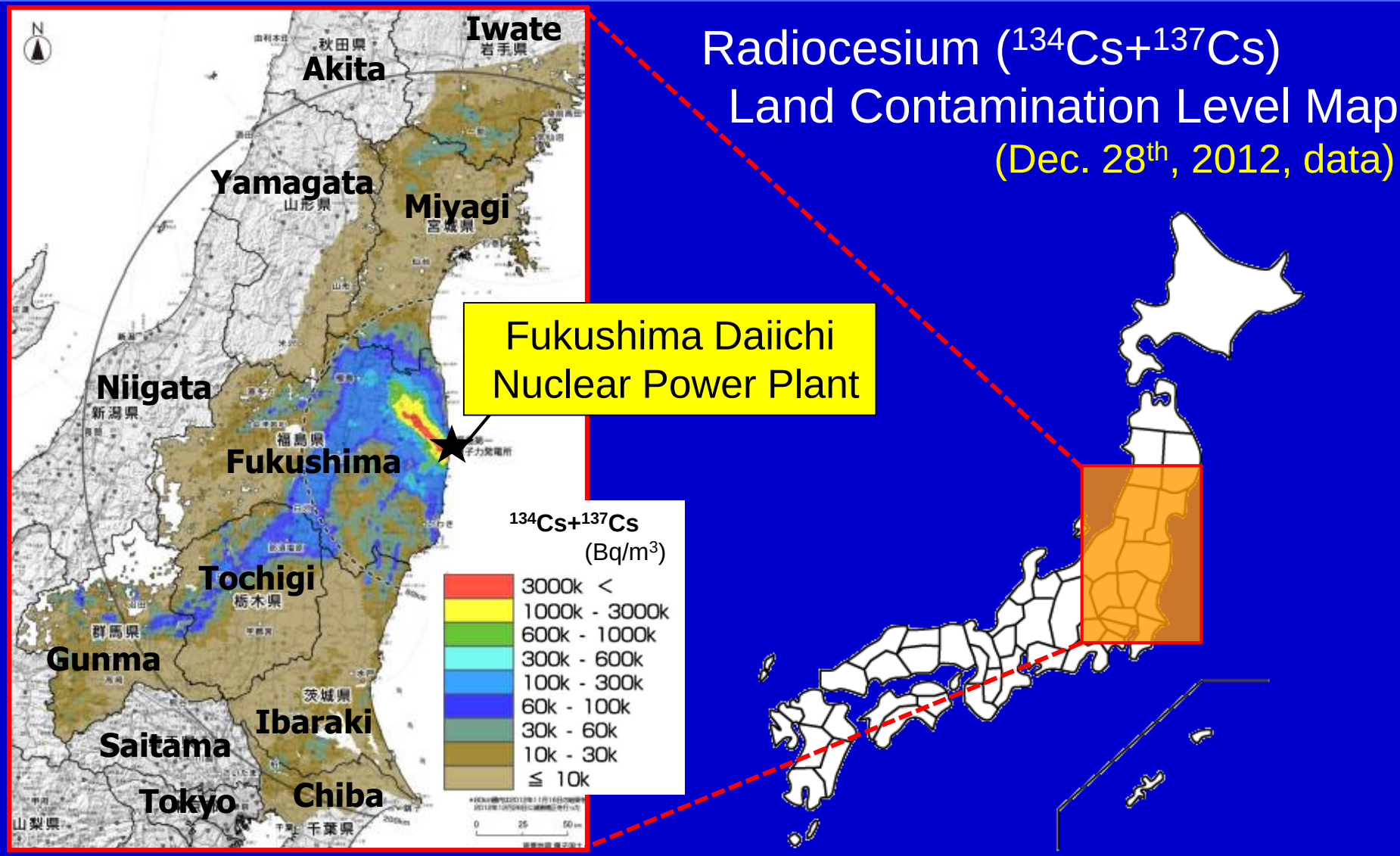
Background of the R&D

Radioactive Land Contamination



Source: The Ministry of Education, Culture, Sports, Science and Technology Japan

Radioactive Decontamination Work

Japanese government blockaded the radioactive contaminated area, and various decontamination works have been conducted.

Stripping work of contaminated soil and leaves

High-pressure water decontamination vehicle

Wastewater Treatment Flow

Decontamination Work

Wastewater collection

Radioactive contaminated wastewater Treatment

In the decontamination work, wastewater containing radiocesium is generally treated using some sort of radiocesium-removal system in addition to a conventional wastewater treatment process.

The treated wastewater is transferred to a temporary storage effluent tank.

Wastewater Treatment Flow

Decontamination Work

Wastewater collection

Radioactive contaminated wastewater Treatment

Approximately 2 liters of the water is collected from the effluent tank and analyzed by a germanium semiconductor detector.

Sampling only a portion of treated water

Marinelli type vessel (2l)

Analyzing

Wastewater Treatment Flow

Decontamination Work

The treated water can be discharged to a public water area if the analytical results satisfy the regulations.

Effluent regulation

$$^{134}Cs_{(Bq/l)} / 60 + {}^{137}Cs_{(Bq/l)} / 90 \leqq 1$$

Wastewater collection

Radioactive contaminated wastewater Treatment

Sampling only a portion of treated water

Marinelli type vessel (2l)

Analyzing

Needs in wastewater treatment plant

Decontamination Work

Effluent regulation

$^{134}Cs_{(Bq/l)}$ /60 + $^{137}Cs_{(Bq/l)}$ / 90 ≦ 1

Wastewater collection

Radioactive contaminated wastewater Treatment

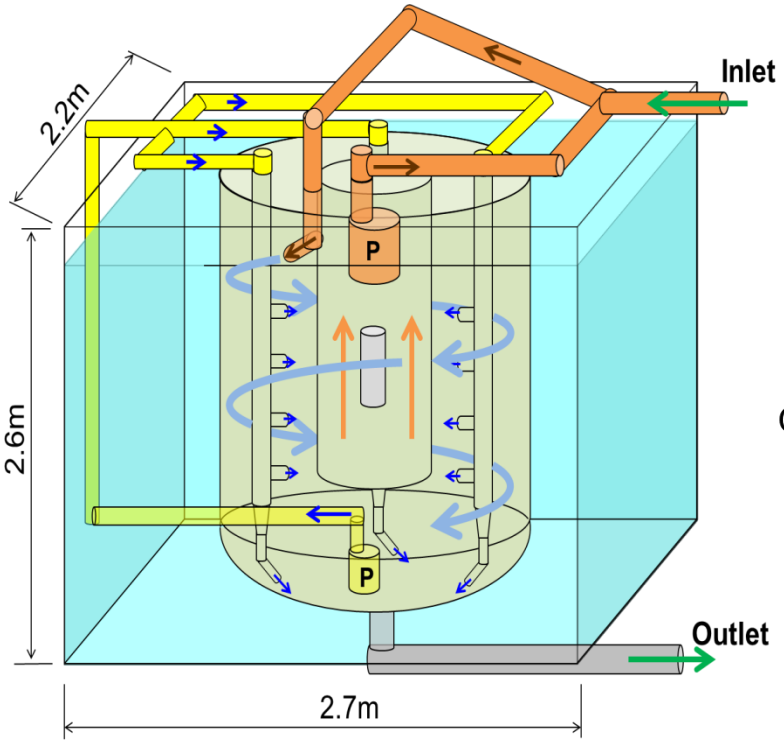
In the decontamination working site, the measurement system of the total amount of wastewater was needed for the environmental safety.

Outline of Cesimoni-water®

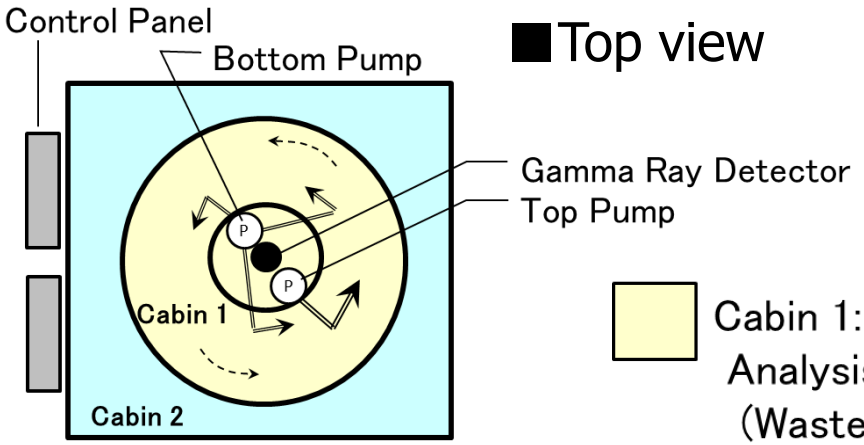
Photo of Cesimoni-water®

Cesimoni-water®

■Bird's eye view



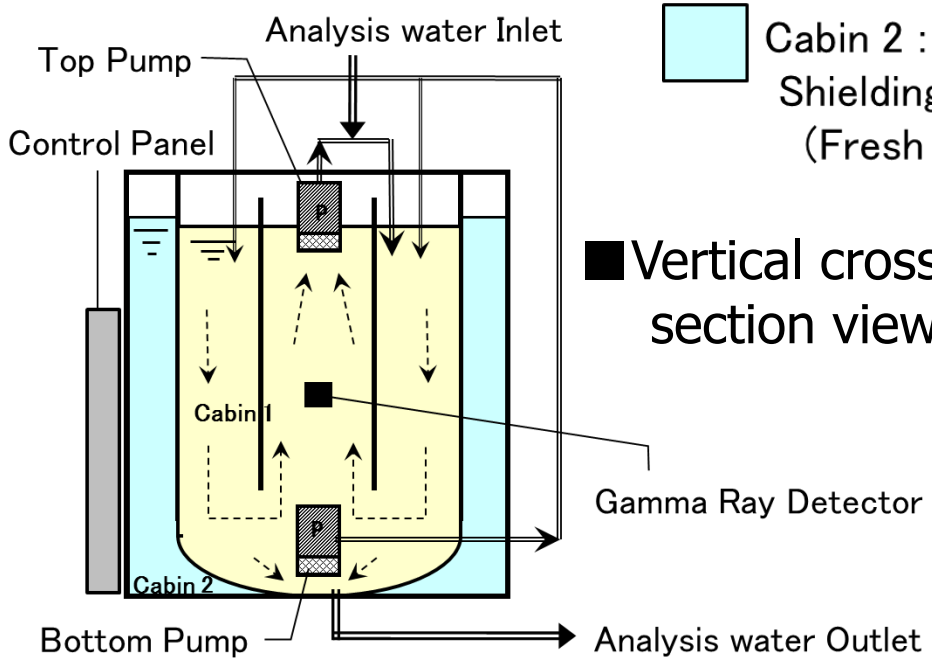
■Top view



Cabin 1: Analysis water (Wastewater)

Cabin 2 : Shielding water (Fresh water)

■Vertical cross section view

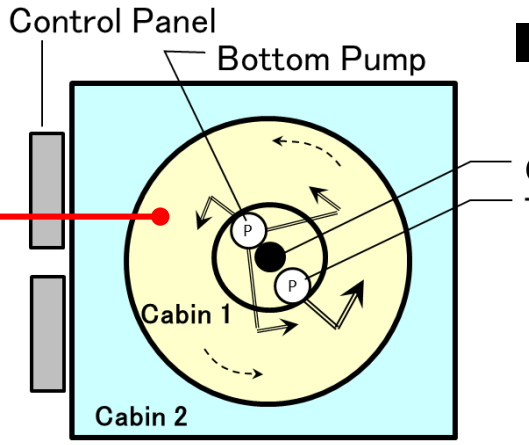


Cesimoni-water®

Cabin1 is the cylindrical shape with a capacity of 3.5 m^3. The analysis water sample is poured into Cabin1 and then measured the radioactivity by the gamma ray detector centered in the water tank.

The cylindrical tank is equipped with a small inner cylinder and two submersible stirring pumps. Both pumps discharge the water into the space between the outer and inner cylinders, creating a swirl flow that efficiently circulates the suspended solids.

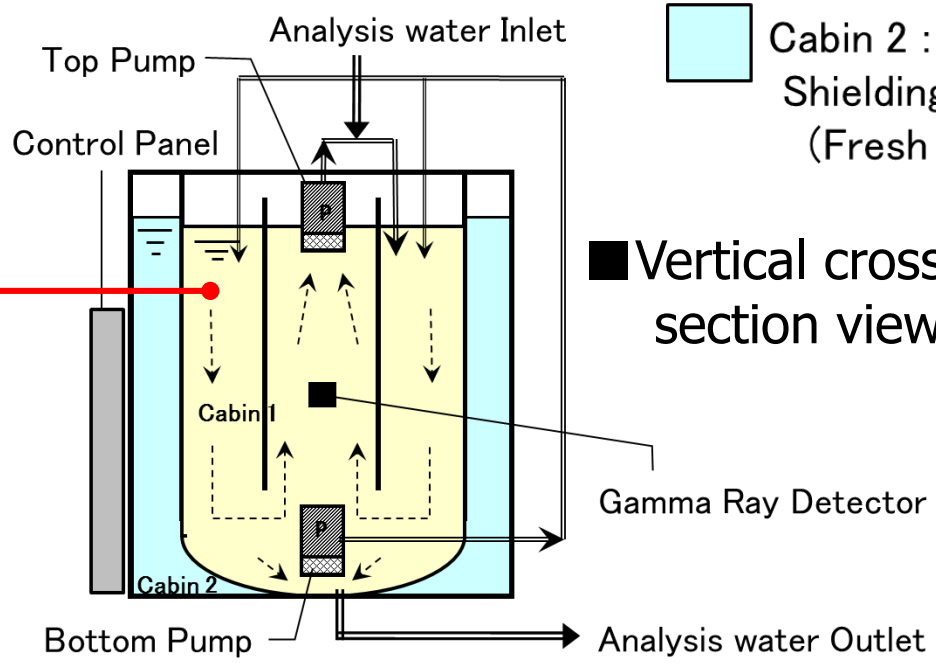
■Top view



Cabin 1: Analysis water (Wastewater)

Cabin 2 : Shielding water (Fresh water)

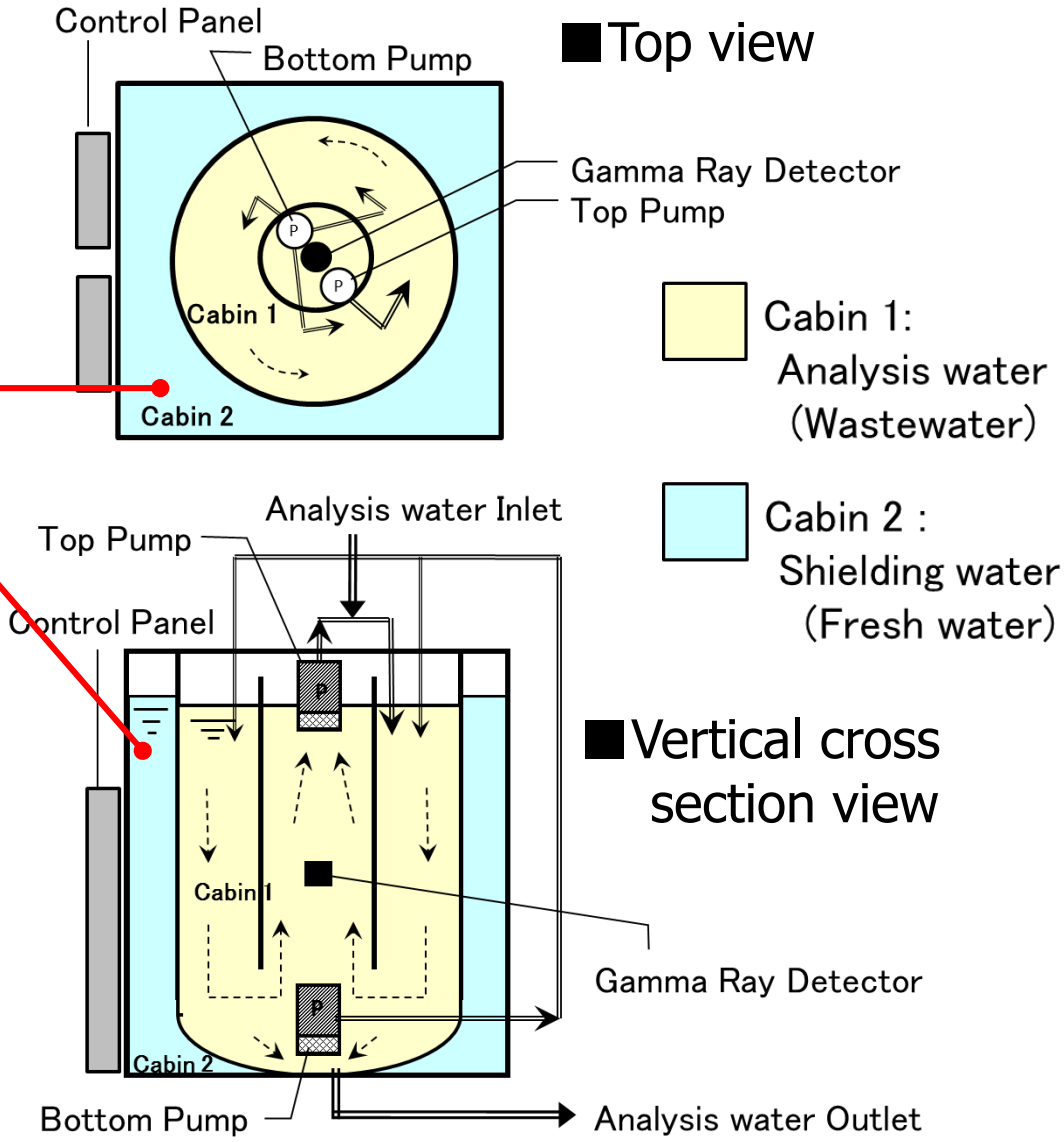
■Vertical cross section view



Cesimoni-water®

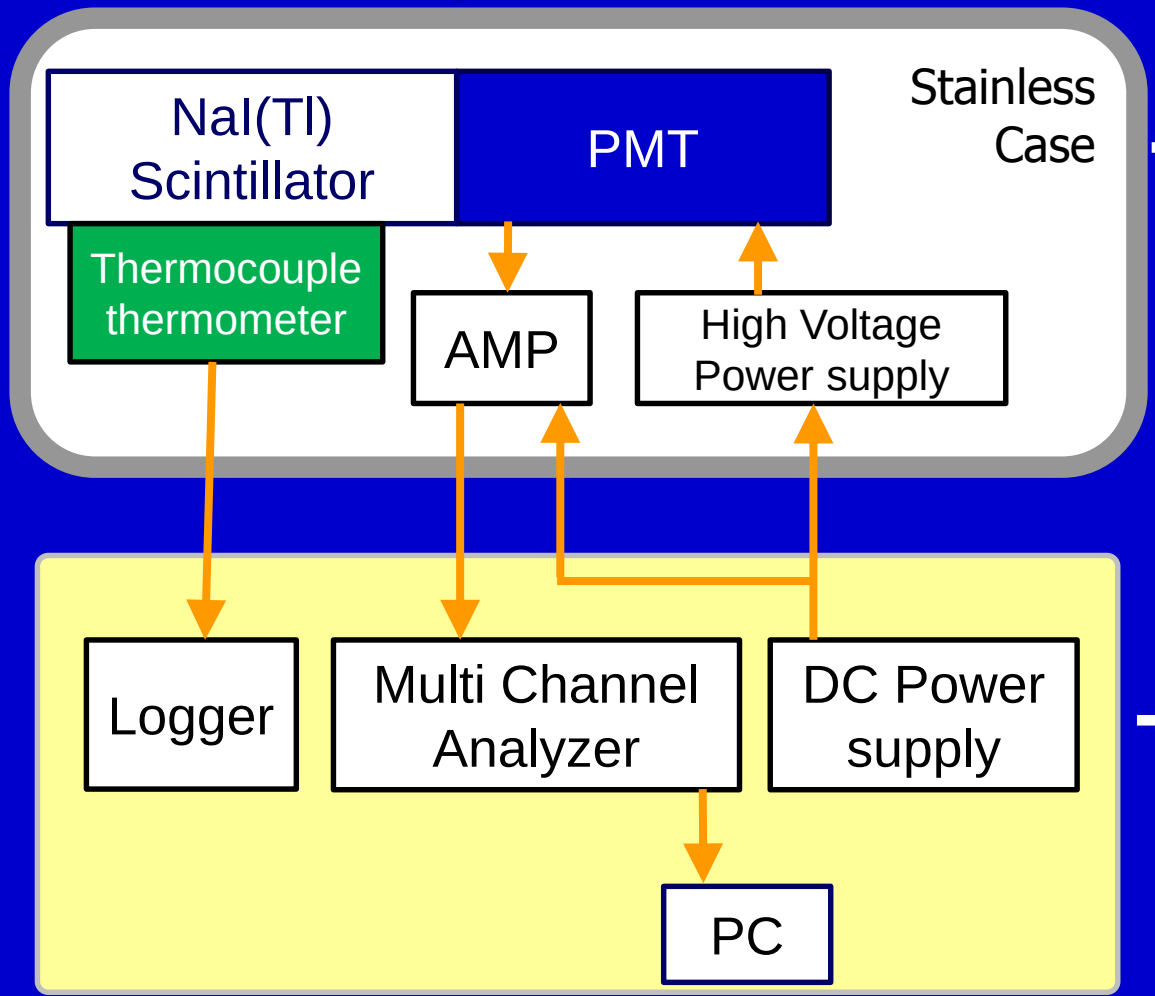
Cabin2 with a capacity of 8 m^3 is consistently filled with fresh water as a shieling water for the external natural background radioactivity.

The gamma ray measurement takes 10 minutes and the overall operational time of a batch, including influent and effluent times, is 18 minutes.



Gamma ray detection system

＜Gamma Ray Detector＞



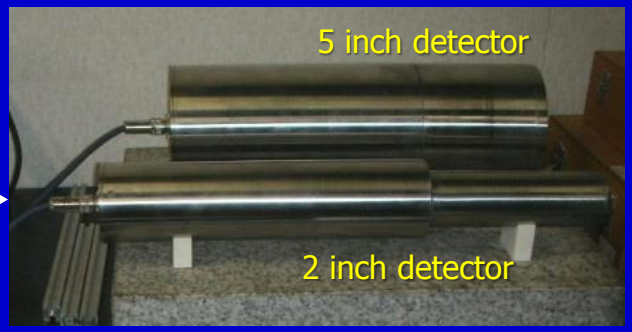


Photo of Gamma ray detectors

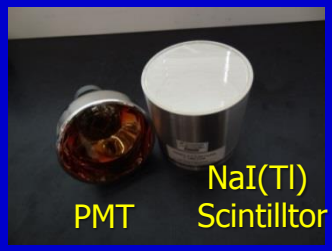
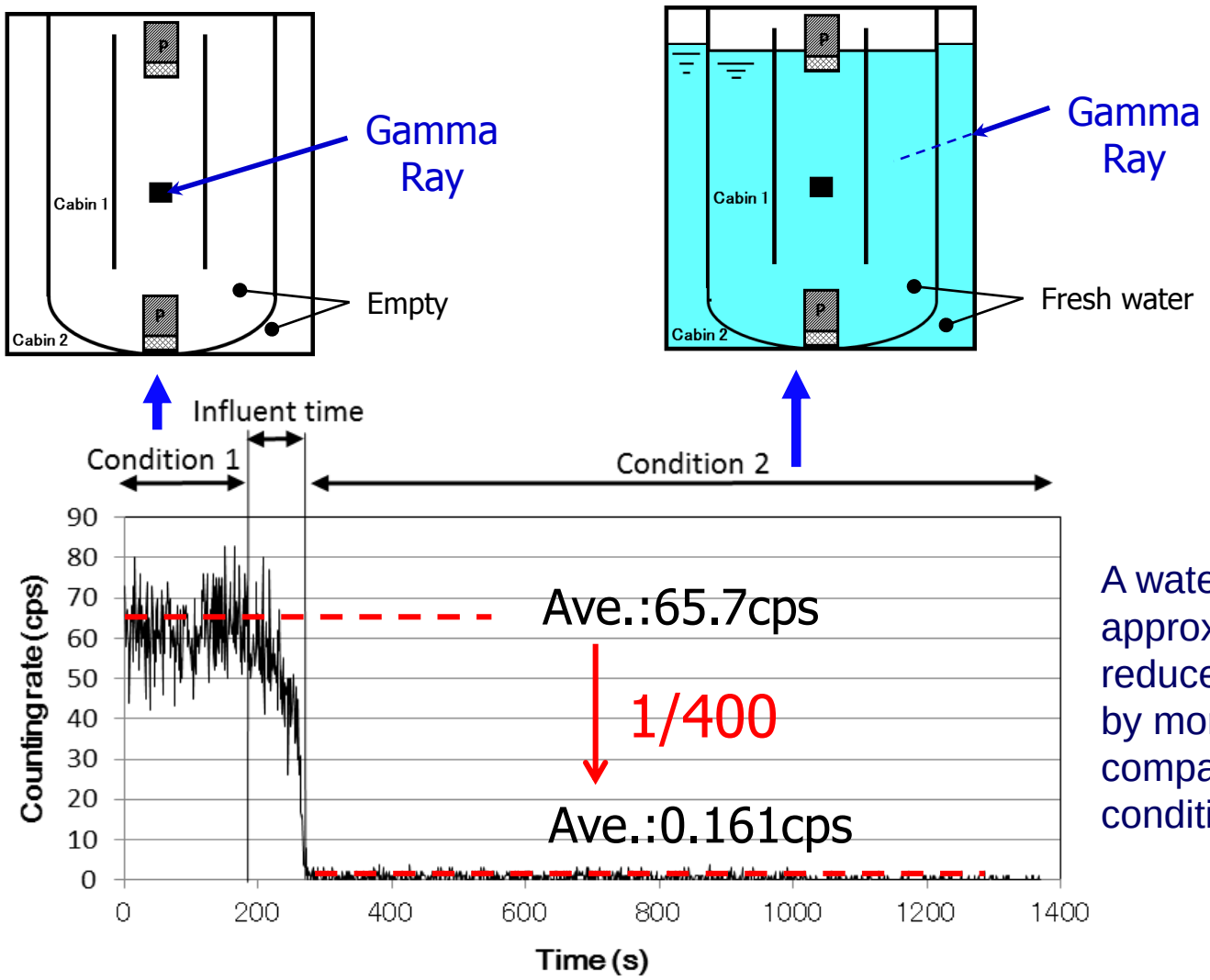


Photo of Control panel

＜Control Panel＞

Measurement Tests of Radioactive Concentration

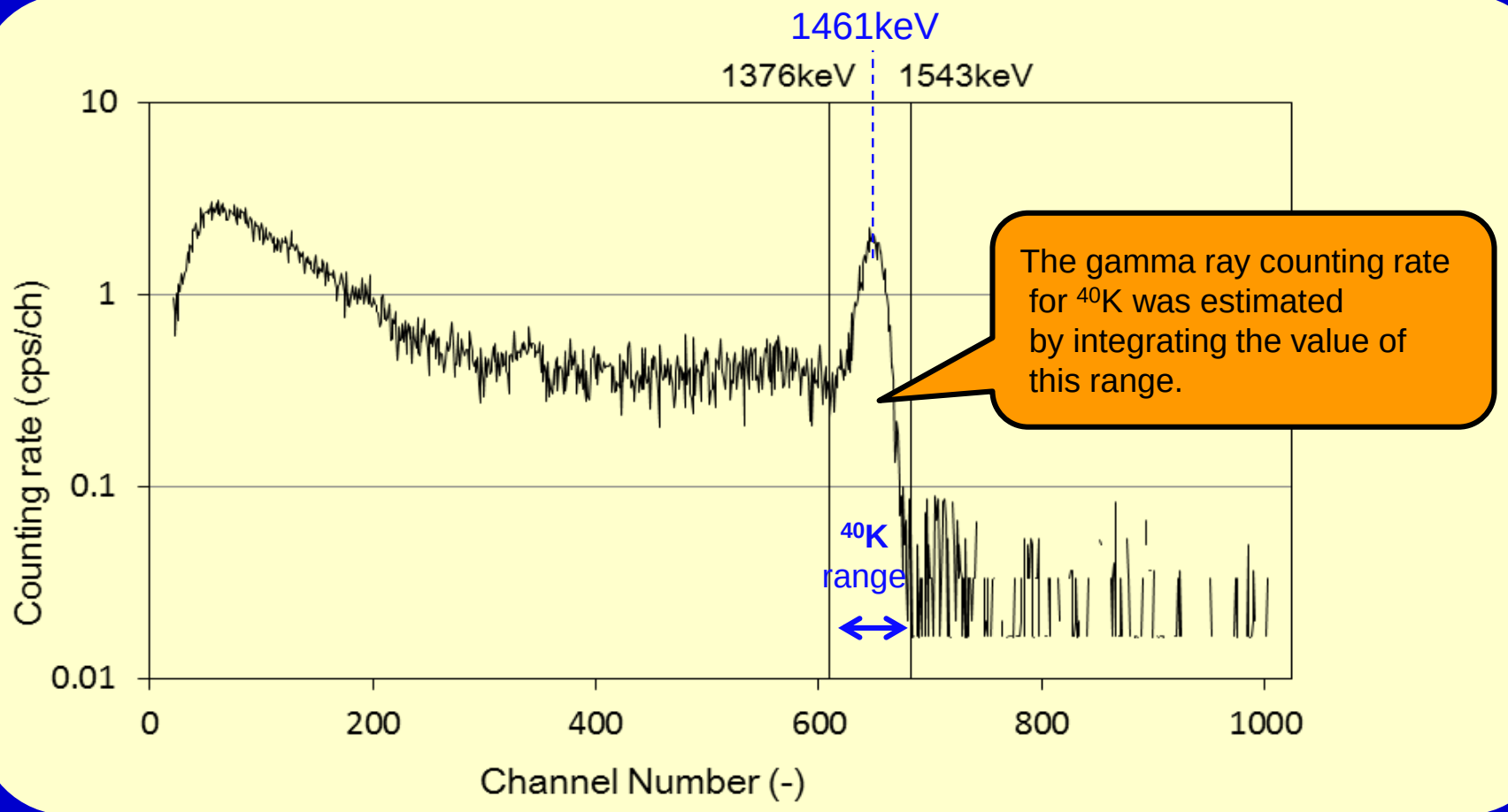
Water Shield Test



A water shield of approximately 1 m can reduce external radiation by more than 400-fold compared to an unshielded condition.

Radiopotassium (^{40}K) solution test

Potassium-40 accounts for 0.0117 % of natural potassium,
and 1g-potassium has a radioactive concentration of 30.4 Bq.



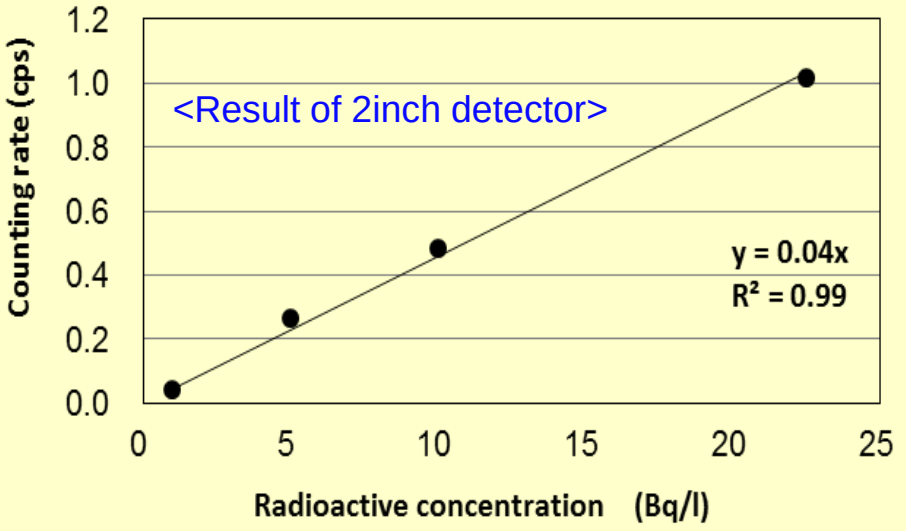
The pulse height spectrum of the radiopotassium solution

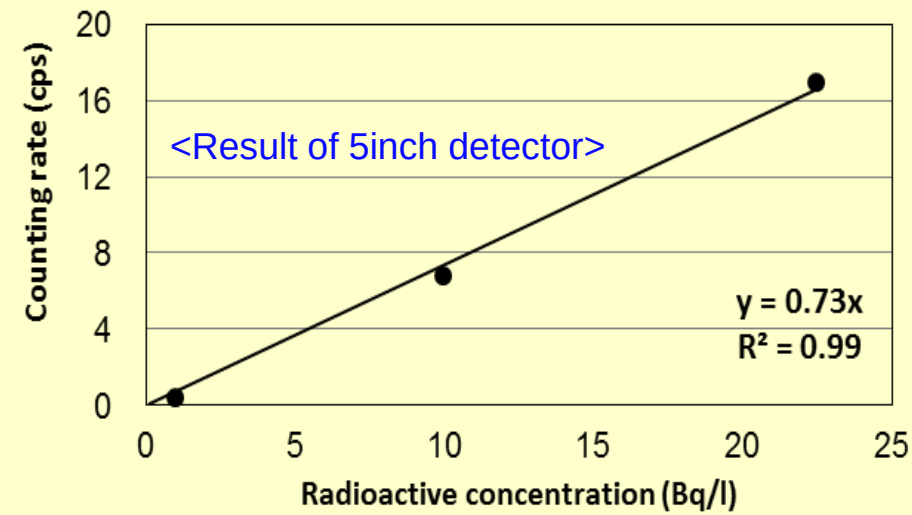
Results of ^{40}K solution test

Several concentrations of KCl solutions were prepared and measured by the Cesimoni-water system.

KCl solution concentration (g/l)	Theoretical radioactive concentration (Bq/l)
0.60	1
3.0	5
3.0	10
13.5	22.5

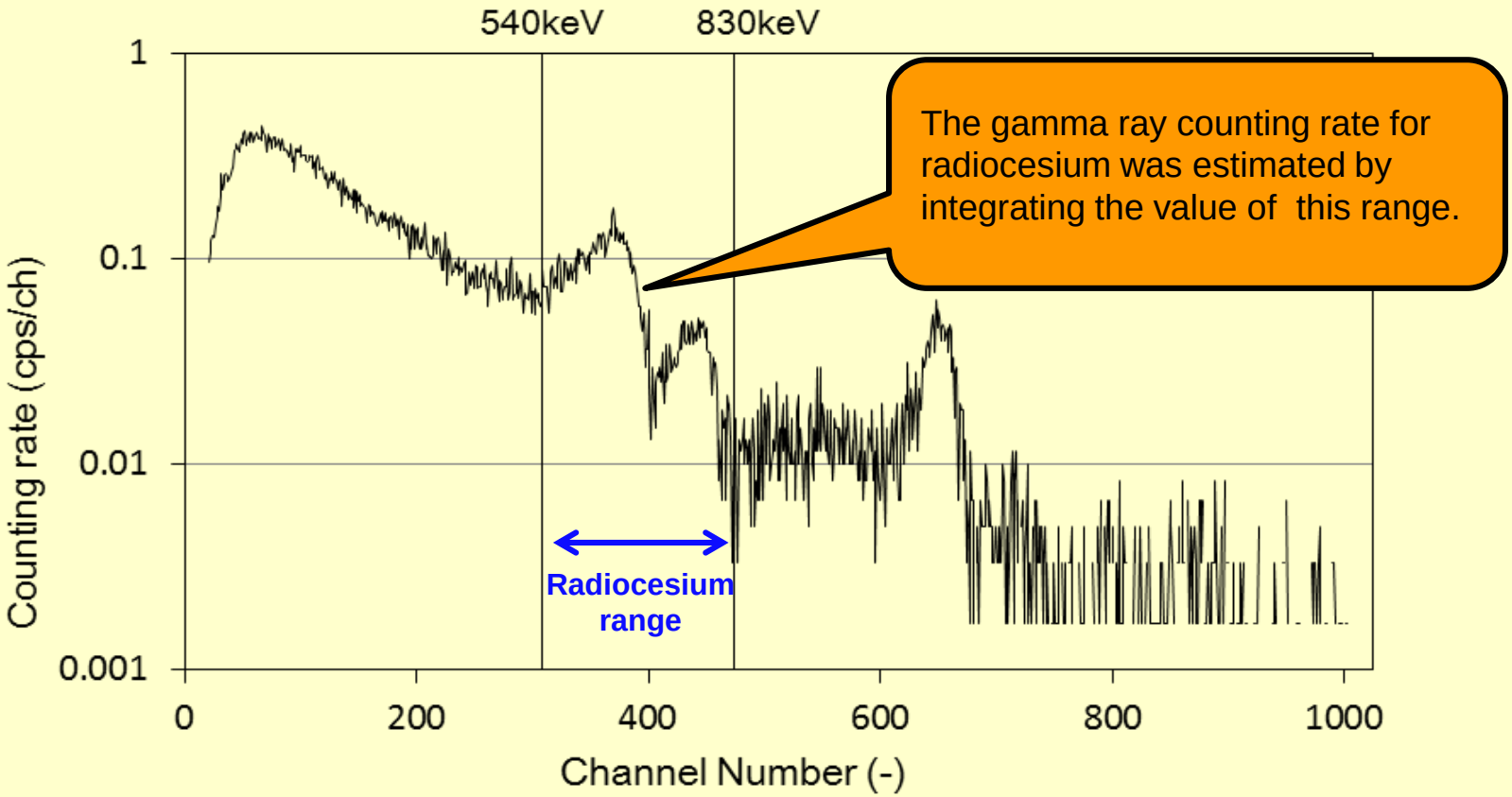
Both regression curves can be regarded as linear.





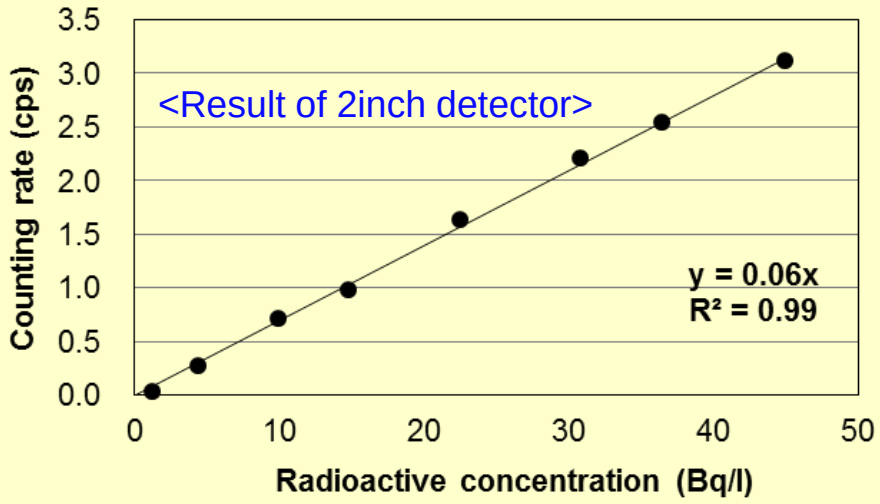
Radiocesium (^{134}Cs+^{137}Cs) solution test

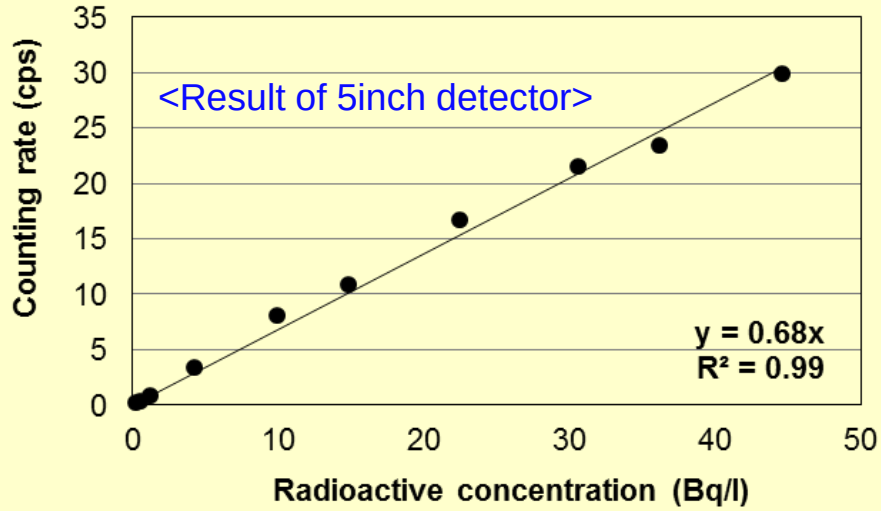
Artificial radiocesium solutions were prepared by diluting a radioactively contaminated dry sludge whose radioactive concentration had been preliminarily measured with a germanium semiconductor detector.



The pulse height spectrum of the radiocesium solution

Results of radiocesium solution test





Both regression curves can be regarded as linear.

After the artificial radiocesium solution tests, a demonstration measurement test was conducted using actual wastewater collected from decontamination work.

In the result, the Cesimoni-water system is also feasible for the radiocesium measurement of actual wastewater.

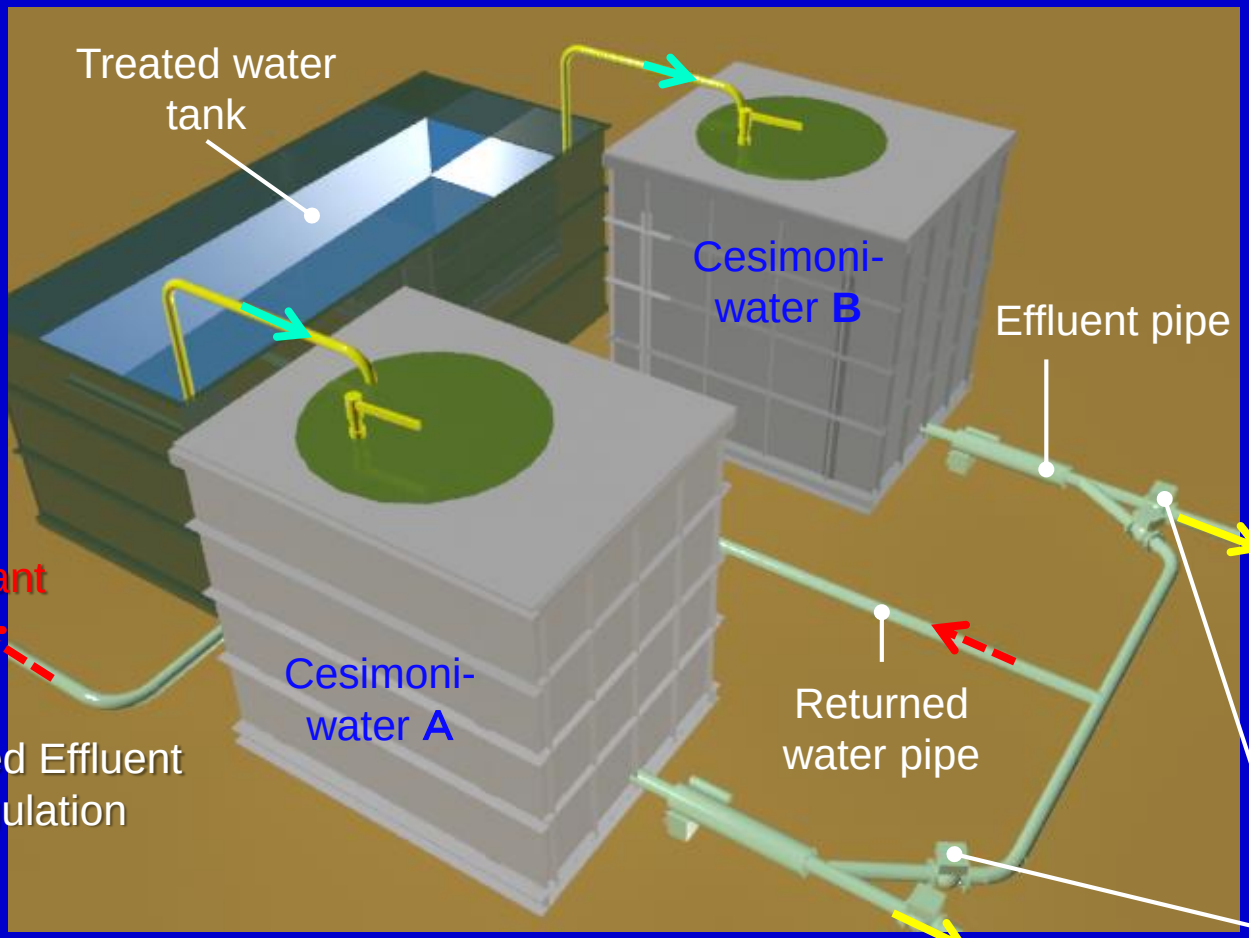
Conclusion

- Radiopotassium and radiocesium solutions were prepared and measured by the Cesimoni-water ® system.
  The regression curves between the radioactive concentration of these solutions and the gamma ray counting rate can be regarded as linear.

- The Cesimoni-water® system is capable of measuring a low radioactive concentration of less than 1 Bq/l as the limit of detection at an operating rate of more than 10 m^3/hour.

- The findings suggest that the Cesimoni-water® system is feasible for the radiocesium measurement and appears to be suitable for use as a continuous monitoring system for radioactive effluent water.

Application Image for Wastewater treatment plant



Continuous monitoring image by the alternate operation using 2 units of Cesimoni-water®

We would like to thank Ministry of the Environment of Japan for providing a place and wastewater for our measurement tests.

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Thank you for your attention

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