Multi-nuclide Removal Equipment (ALPS)

Confirmatory Testing, Installation and Characteristics of Radioactive Waste

June 25, 2012

Tokyo Electric Power Company

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TEPCO

Purpose of the Confirmatory Testing

The purpose of the confirmatory testing is to reconfirm the basic test results which indicated that the radioactivity densities of the 62 nuclides have reduced to below the density limit specified by the Reactor Regulation. The detected β nuclides (Sr-89, Sr-90 and Y-90) are also tested utilizing a testing equipment* which has a similar equipment structure to that of the actual equipment. The performance goal will be set for ALPS based on the results of the confirmatory testing and the water flow test using the actual equipment and contaminated water. Furthermore, the optimum amount of medical agent used in the pretreatment will be examined in order to reduce the sludge amount.

* In order to improve performance to remove Sr-89, Sr-90 and Y-90 (in a colloidal state), the hole size of the filter used after pretreatment (coprecipitation) has been reduced to 0.02 μm from 0.45 μm (hole size of the filter used in the basic test).

Confirmatory Testing Schedule

	May 2012	June			July
	Late	Early	Mid	Late	Early
Confirmatory Testing	Confirmatory testing (Adjustments of the testing equipment, water flow test)				
		Measurement, evaluation of test results			

: Schedule to be determined

<u>Current status as of June 25</u>

<u>Adjustments of the testing equipment and water flow test</u>: Completed

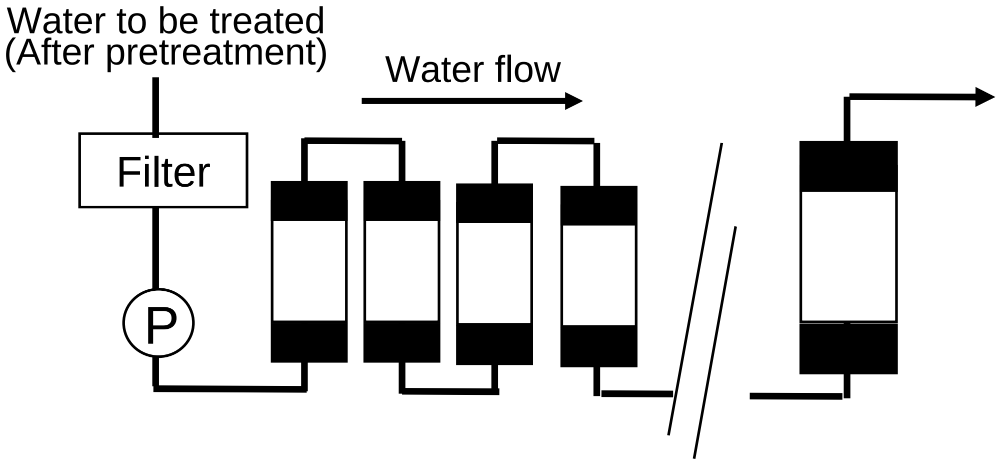
<u>Measurement/Evaluation of test results</u>

-Though the measurement results of Sr-89, Sr-89 and Y-90 are being evaluated, a substantial amount of time is needed for closely examining the results as the measurement results are in low density. The evaluation result will be summarized in early July.

-Since it has already been confirmed that the radioactivity densities of other nuclides were sufficiently reduced in the basic test, the confirmatory test results will be summarized once the evaluation of Sr-89, Sr-90 and Y-90 results is completed.

Outline of the Water Flow Test

At the water flow test, the equipment capability to remove radioactive materials is verified by passing water (after pretreatment using medical agent and sludge removal with a filter) through the testing equipment.



Testing equipment (with adsorbent filled)

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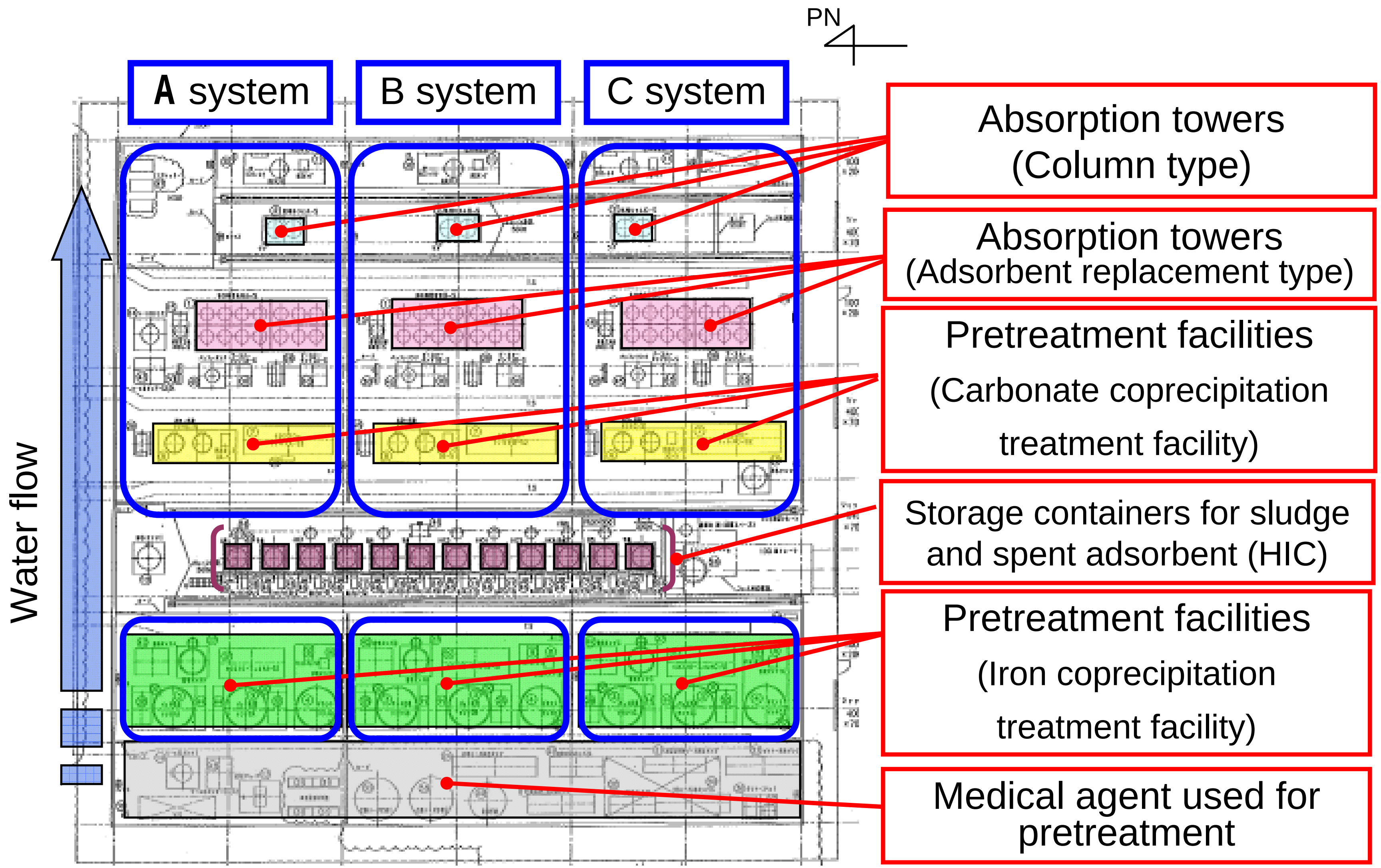
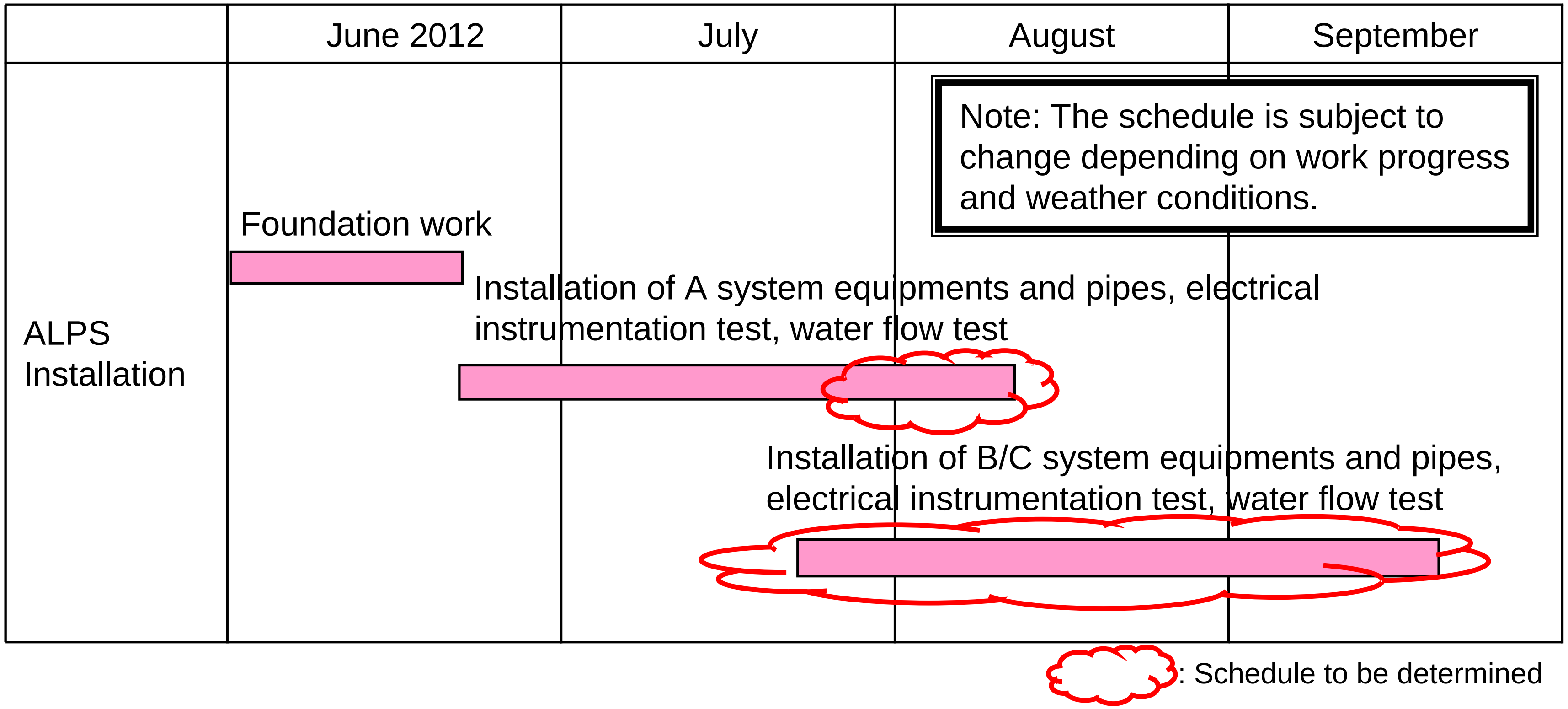
Equipment Installation Locations



ALPS Installation Schedule



-A system is installed first in order to install the multi-nuclide removal equipment at an early timing*.

*In accordance with the NISA instruction to install the multi-nuclide removal equipment at an earlier timing (January 10, 2012 NISA No.2)

-Systematic test will be conducted once equipments and pipes are installed in order to verify the equipment capability prior to the commencement of operation.

ALPS Installation

Foundation work: ALPS installation area and crane foundation (June 18)

ALPS Installation

Foundation work: Crane foundation placement (June 18)

ALPS Installation

Foundation work: Full view of ALPS installation area (June 13)

Waste Generated from ALPS

Waste generated from the pretreatment facilities

-Iron coprecipitation treatment facility: Removes α nuclides and organic matters inhibiting the absorption of radioactive materials.

-Carbonate coprecipitation treatment facility: Removes Sr-89, Sr-90 and alkaline-earth metal (Mg, Ca, etc.) inhibiting Sr absorption.

⇨ Sludge generated as waste is filled in the waste storage container (HIC) and stored in the temporary storage facility.

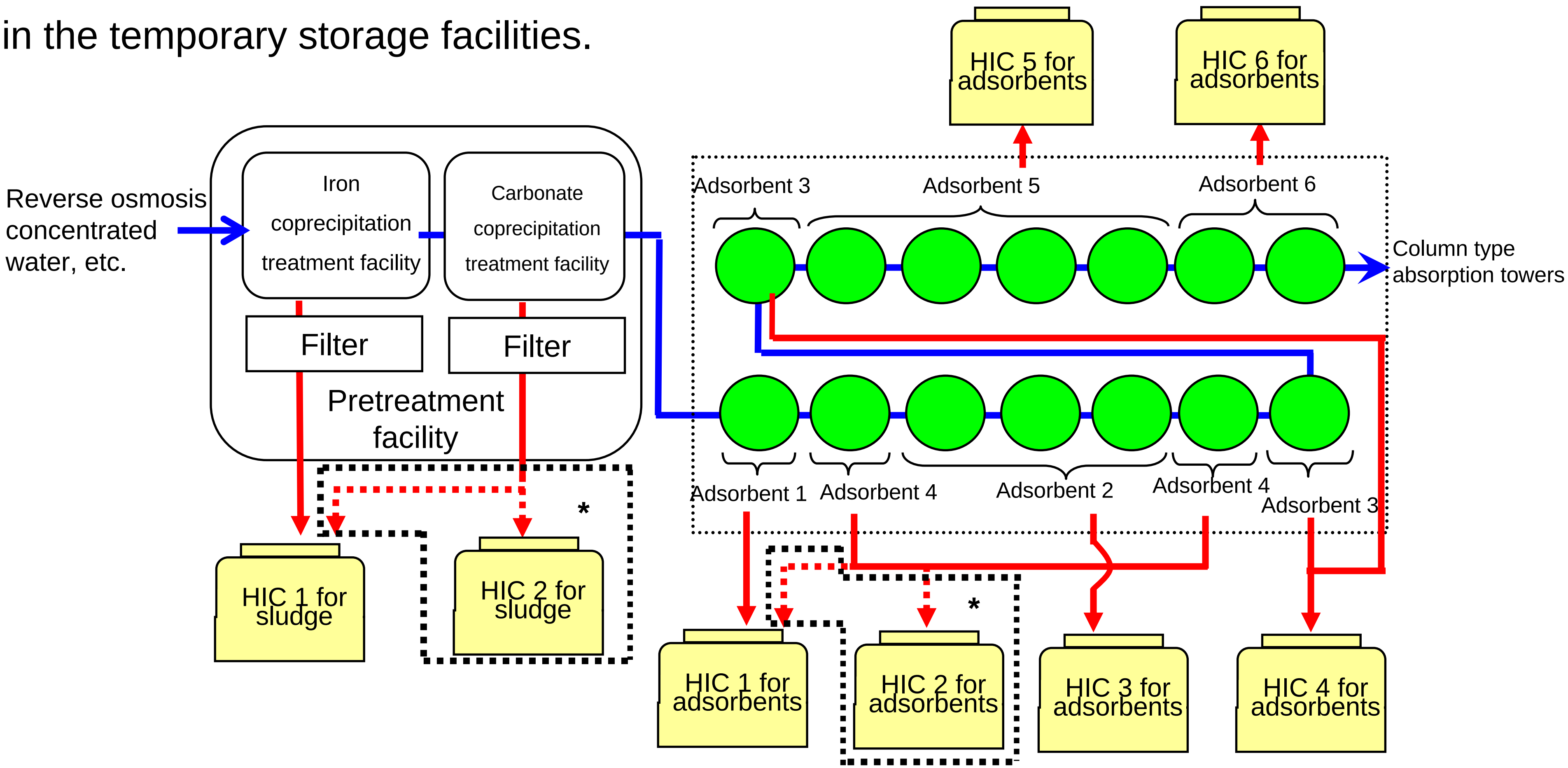
Waste generated from the absorption towers

-Absorption towers (adsorbent replacement type, column type): Removes radioactive materials utilizing adsorbents suited for certain types of radioactive materials.

⇨ Spent adsorbents generated as waste are filled in the waste storage container (HIC) (adsorbents replacement type) or the entire column is replaced (column replacement type) and stored in the temporary storage facility.

Waste Storage Container (HIC)

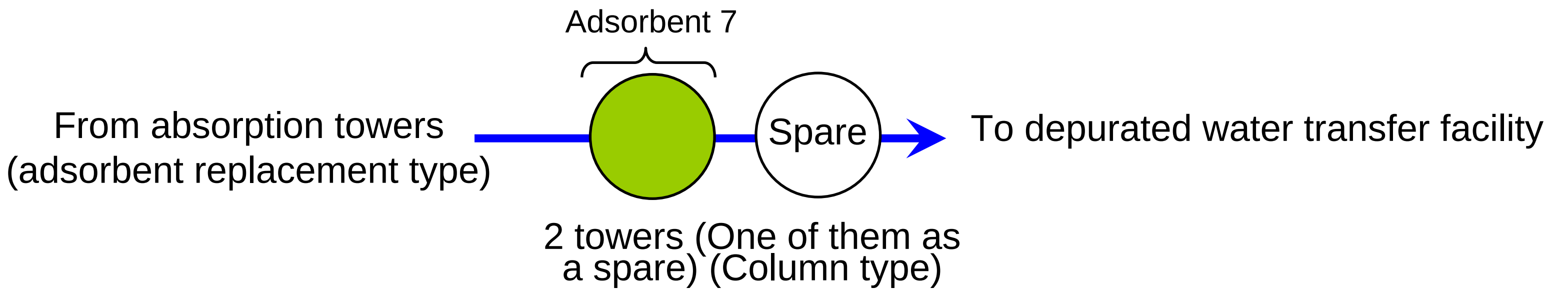
The sludge and spent adsorbents generated in the pretreatment facilities are stored in the waste storage containers (HIC) depending on their characteristics, and then stored in the temporary storage facilities.



* The waste storages for sludge and adsorbent 1 and 4 (stored separately) will be designed in consideration of the characteristics of waste materials.

Storage Method of Columns and Estimated Number of Spent Columns

The adsorbents spent in the absorption towers (column replacement type) are transported from ALPS installation area to the temporary storage facility and stored in the form of the entire column.



Storage method of columns, estimated number of spent columns

-Estimated number of spent columns*: Approx. 10/year

-Storage method: Remove water from the column and store in the temporary storage facility

-Material: SUS316L (Main material)

-Size: Approx. 1.4m (diameter) x approx. 3.0m (height) (cylindrical form)

*The number of spent columns is an estimate calculated based on the basic test result. The actual number of spent columns is subject to change depending on the quality of contaminated water.

Sludge Characteristics

Location where sludge is generated	Main component	Chemical composition	Remark
Iron coprecipitation treatment facility	Ferric hydroxide (III)	$Fe(OH)_3$	Includes other components such as $M(OH)_n$ (Metal element hydroxide) M: Metal element n: Coordination number
Carbonate coprecipitation treatment facility	Calcium carbonate Magnesium carbonate	$CaCO_3$ $MgCO_3$	Ratio of $CaCO_3$ to $MgCO_3$ in sludge is approx. 3:5 (Depends on the contaminated water characteristics). Includes other components such as SrCO3 (Strontium carbonate).

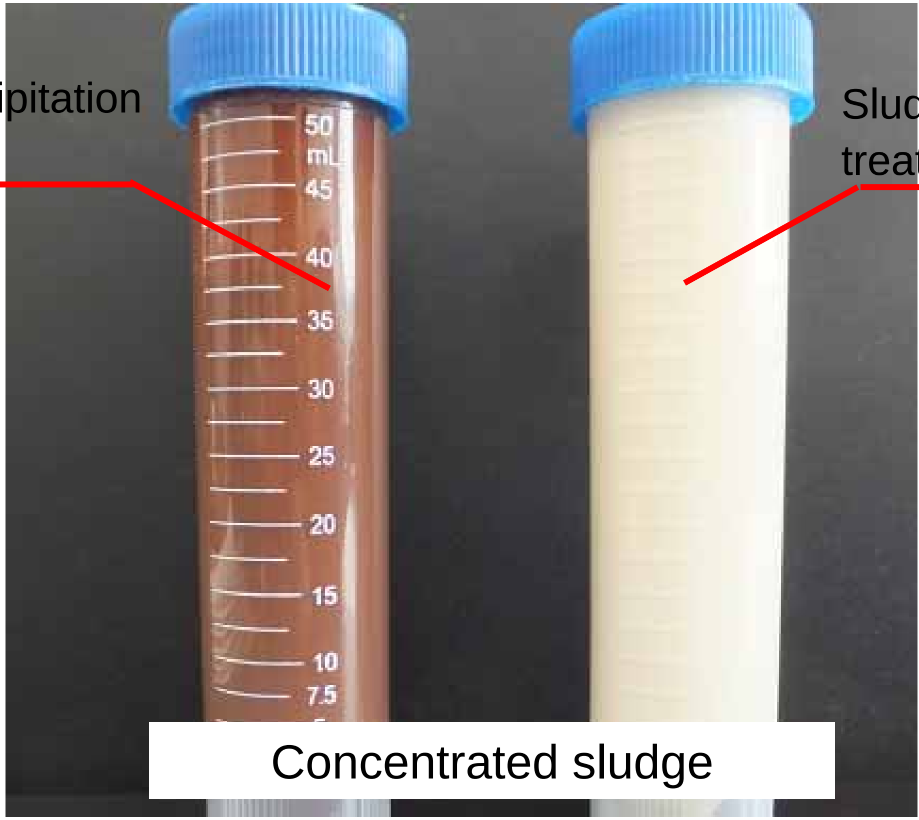
Other Information Related to HIC Storage

Storage of HIC for sludge

Since the particles of sludge are smaller compared to adsorbents, it is difficult to remove water from sludge once it's stored in HIC. Sludge is concentrated in the pretreatment process in order to decrease the water amount before filling it in HIC.

Sludge (Iron coprecipitation treatment facility)

Sludge (Carbonate coprecipitation treatment facility)



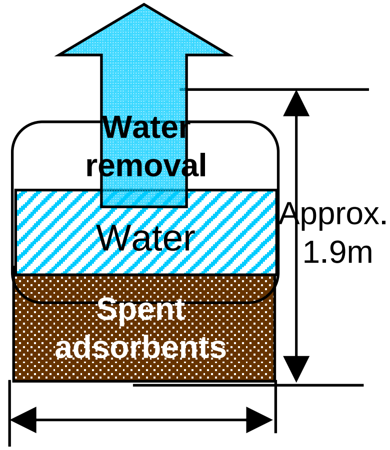
Concentrated sludge

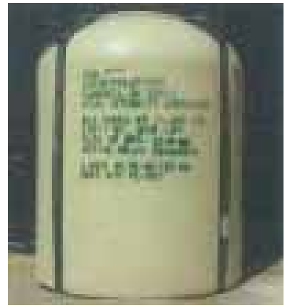
Adsorbent Characteristics

Adsorbent	Composition	Elements subject to removal
Adsorbent 1	Activated carbon	Colloid
Adsorbent 2	Titanate	Sr (M^{2+})
Adsorbent 3	Ferrocyanide compound	Cs (Co, Ru)
Adsorbent 4	Ag impregnated activated carbon	I
Adsorbent 5	Titanium oxide	Sb
Adsorbent 6	Chelate resin	Co (M^{2+}, M^{3+})
Adsorbent 7	Resin adsorbent	Ru, etc. Negatively charged colloid

Storage Method of HIC and Estimated Number of HIC

Waste material to fill in HIC	-Sludge generated from the pretreatment facilities -Adsorbents that absorbed radioactive materials (Adsorbent 1-6)
HIC storage method	-Water is removed after adsorbents are filled into the storage container (until the percentage of water content is approx. 1%). -Water cannot be removed from sludge as the particles are smaller compared to adsorbents. -HIC is stored in the temporary storage facility.
Estimated number of HIC*	-Reverse osmosis membrane concentrated water treatment (with 2 lines operating 100%): Approx. 500/year The number of HIC is subject to change depending on the design progress.
Material and size of HIC	Material: Polyethylene Size: Approx. 1.6m (diameter) x approx. 1.9m (height) (Cylindrical form)
Storage period	Approx. 20 years (Research and development to improve the waste treatment will be done during this time period. The of the storage containers is evaluated to be more than 20 years.





Storage container (Example)

*The number of HIC is an estimate calculated based on the basic test result. The actual number of HIC is subject to change depending on the quality of contaminated water.

Other Information Related to HIC Storage

Number of HIC used per type of waste

HIC	Estimated number of HIC to be used* per year
HIC for Sludge	Approx. 450
HIC for adsorbent	Approx. 50

*The number of HIC is an estimate calculated based on the basic test result. The actual number of HIC is subject to change depending on the quality of contaminated water.

HIC is stable against water as it is made of polyethylene. Also, the chemical characteristics of sludge are also stable against water. Therefore, storing sludge inside the HIC is not assumed as a significant concern.

Past HIC usage (Reference)

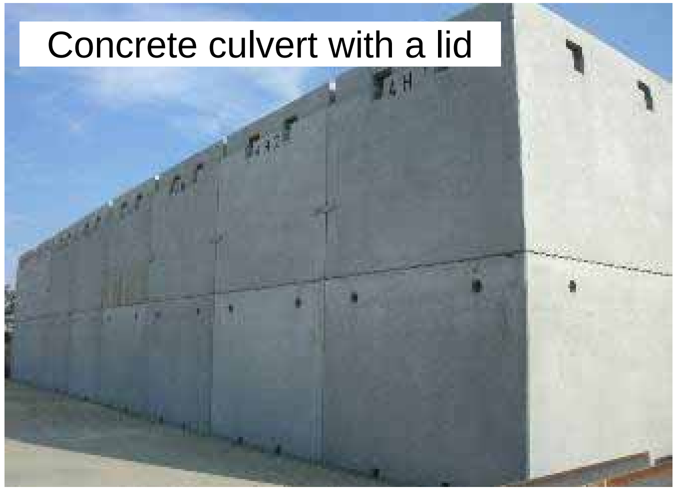
Barnwell Waste Management Facility (United States): 1998-2008

-HIC filled with filters: 1,111

-HIC filled with resin (granular resin, powder resin): 1,865

Temporary Storage Facility for the Waste Storage Containers

The waste storage containers are stored in the existing temporary storage facility where the waste generated in the cesium absorption towers are stored.
Note: The photos below show the existing temporary storage facility for the cesium absorption towers.



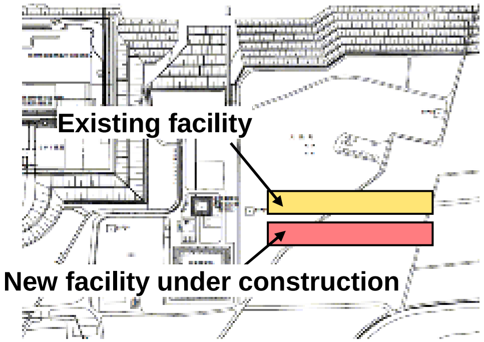
-Ventilation holes are made on the top to prevent hydrogen accumulation

-A hook added on top of HIC allows it to be lifted by remote control (unmanned operation).

*Done with KURION absorption towers

-A concrete lid is added on top to block skyshine, rainwater and ultraviolet rays.

A new temporary storage facility is being built next to the existing temporary storage facility for the cesium absorption towers



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Secondary Waste Treatment and Disposal

The following will be implemented based on the radioactive waste treatment/disposal plan.

-Acquire data on the characteristics of secondary waste generated in the multi-nuclide removal equipment.

-Based on the above data, long-term waste storage measures will be discussed.

	Aug. 2012	Sep.	Oct.	Nov.	Dec.	Jan. 2013	Feb.	Mar.
Understand the characteristics of the secondary waste				Investigation on the adsorbents and sludge generated from SARRY and the multi-nuclide removal equipment				
Discuss the long-term waste storage measures				Discuss the long-term storage measures for the waste generated from the multi-nuclide removal equipment				
Discuss the long-term waste storage measures				Discuss issues on the treatment of the waste generated from the multi-nuclide removal equipment				