Current State of Decommissioning and Contaminated Water Countermeasures at the Fukushima Daiichi Nuclear Power Station

December 1, 2014

Fukushima Daiichi D & D Engineering Company

東京電力
TEPCO

Concept image of roadmap for reactor decommissioning

- **At Unit 4 the removal of spent fuel from the spent fuel pool was completed on November 5 thereby greatly reducing the risks associated with Unit 4. Along with continuing to remove new fuel with the aim of completion by the end of the year preparations to remove fuel from Unit 1~3 will continue.**
- **In preparation for the removal of fuel debris from Unit 1~3 building decontamination and containment vessel leak surveys will proceed in an orderly fashion.**

Fuel removal from spent fuel pool

Fuel used in the past is stored in the spent fuel pools in the reactor buildings. Work to remove the spent fuel from the spent fuel pools is continuing because it is safer to store all of the spent fuel in the common pool rather than in pools for each unit.

Unit 1, 2 ▽ Unit 3 ▽ Unit 4 ▽

Debris removal, decontamination

Debris from the top of the reactor building is removed using large cranes and heavy machinery

Removing the Unit 1 cover roof

Fuel removal equipment installation

Installation of the building cover (container) then fuel handling machinery

Unit 4 Building cover construction

Fuel removal

Fuel is removed from the spent fuel pool and moved to the common pool

Unit 4 pool Fuel removal

Storage/Carry-out

Remote fuel is moved to the common pool and stored. Is then put into dry casks and temporarily stored in an on-site storage facility.

Stored in dry casks (pre-disaster photo)

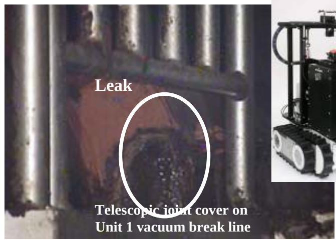
Fuel debris (melted fuel) removal

In Units 1~3, fuel has melted, fallen and solidified to form fuel debris. This field debris must be removed in order to make Fukushima Daiichi safer. There are many challenges involved with fuel debris removal work so this task will be completed by prioritizing safety while surveying building conditions and developing new technology.

Unit 1~3 ▽

Building decontamination and leak survey

A robot for decontaminating the reactor building has been developed and is currently being subjected to demonstration tests. In conjunction with this, a robot for checking for leaks in the containment vessel is also being developed.



Waterproofing and filling with water

The vessel must be filled with water, which acts as a radiation shield, in order to safely remove melted fuel

Fuel debris removal

Fuel debris will be removed after developing specialized equipment. Knowledge from overseas is being gathered as deliberation of this issue continues.

Storage/Carry-out

Removed fuel will be put into specialized containers but the method for storing in the containers thereafter is currently being deliberated

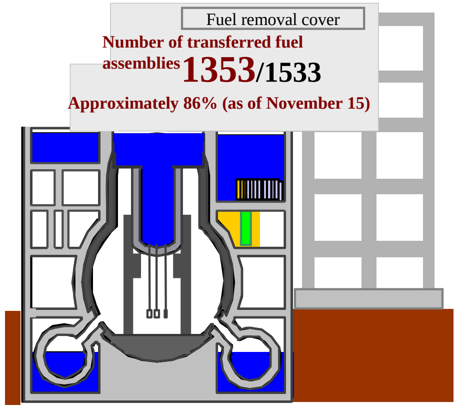
Reactor facility dismantling, etc.

Scenarios/ technology deliberation → **Equipment design/ manufacturing** → **Dismantling, etc.**

*Fuel debris: Refers to the melting of the fuel and the fuel cladding and the subsequent cooling and solidification of these substances

Fuel Removal from Unit 4 Spent Fuel Pool

- The removal of fuel from the spent fuel pool began on November 18, 2013 and has continued without any large problems.
- **Risks associated with Unit 4 were greatly decreased when the removal of all spent fuel was completed on November 5, 2014.**
- Since new fuel generates hardly any heat the pool no longer needs to be cooled. Surface dose levels are also extremely small thereby contributing to decreases in the risk of exposure.
- The completion of spent fuel removal was a big step in the reduction of risks associated with Unit 4 and it provided much confidence as similar work commences at Units 1~3.



Fuel pool temperature (October 16, 2014)	18.7℃
Rate of temperature increase if cooling were to shut down (Prior to disaster)	34℃/day (Assessment value)
Rate of temperature increase if cooling were to shut down (November 5, 2014)	—*

*Completion of the removal of spent fuel that emanates heat

Schedule

FY2013	FY2014	FY2015	FY2016
Fuel removal cover/ equipment installation			
Fuel removal	Fuel removal ▽ Removal should be completed by the middle of December 2014		


Taken on November 4, 2014

Storing spent fuel in the common pool (deformed fuel)


Taken in September 2011

Prior to Debris removal


Taken in July 2012

After Debris removal


Taken in August 2013

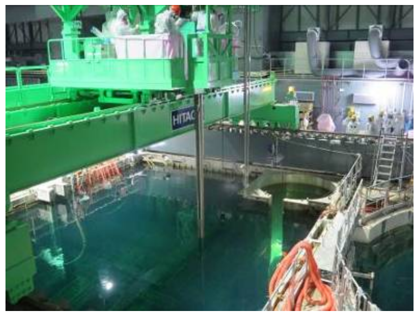
After Fuel removal cover installation

Fuel removal

- There has been no large schedule delays and work has proceeded without incident or accident.
- Since debris that had accumulated in the pool was removed prior to fuel removal the fuel assemblies did not get snagged* and the fuel was removed smoothly. *Fuels gets caught on fuel rack and does not move
- Deformed fuel was inspected carefully and then moved to the common pool as planned using specialized jigs

Debris removal/Fuel removal cover installation

- The fuel removal cover supports fuel handling equipment and ensures that fuel removal work is not hindered by wind and rain, etc. while also suppressing the dispersion of radioactive material. First debris around the reactor building and on the refueling level was removed and the foundation for the fuel removal cover was constructed. After that a steel girder frame was built and wall and roofing panels attached thereby enabling the structure to be built in only approximately two years.
- This fuel cover is in the shape of an upside down L (cantilever-type) and is approximately 69m (NS) X approx. 31m (EW) X approx. 53m (height). Approximately 4,000 tons of steel was used for the crane support platform, which is almost the same amount as that used for the Tokyo Tower. Worker exposure was greatly reduced by employing bolts to connect steel frame to steel frame from the inside of thick pillars and bringing in wall/roof panels in large units thereby enabling construction to finish without any large accidents or disasters.

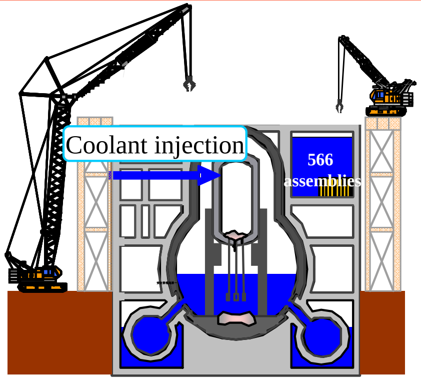


Fuel Removal from Unit 4 Spent Fuel Pool

Loading a cask onto the trailer

Fuel Removal from Unit 3 Spent Fuel Pool

- **Dose reduction countermeasures for the refueling level (decontamination, shielding) commenced on October 15, 2013 in preparation for fuel removal cover and fuel handling equipment installation.**
- **Decontamination has not reduced doses as much as originally predicted thereby hindering workers from working on the refueling level, so additional countermeasures are being implemented.**
- **Furthermore, spent fuel pool debris removal commenced on December 17, 2013. The work is being done via remote operation and there was the incident involving the dropping of the fuel charger operation console, but at current time the only large debris left is the fuel charger.**



Fuel pool temperature (October 16, 2014)	18.7℃
Rate of temperature increase if cooling were to shut down (Prior to disaster)	7.5℃/day (Assessment value)
Rate of temperature increase if cooling were to shut down (October 16, 2014)	2.7℃/day

This schedule is a draft by TEPCO and details will be deliberated in conjunction with revision of the roadmap

Schedule

	FY2013	FY2014	FY2015	FY2016	FY2017
Debris removal	Debris removal				
Refueling level decontamination/shielding	Refueling level decontamination/shielding	Refueling level decontamination/shielding			
Debris removal from inside pool	Debris removal from inside pool	Debris removal from inside pool			
Fuel removal cover and equipment installation (being deliberated)			Fuel removal cover and equipment installation (being deliberated)	Fuel removal cover and equipment installation (being deliberated)	
Fuel removal (being deliberated)				Fuel removal (being deliberated)	Fuel removal (being deliberated)

Prior to debris removal

After Debris removal

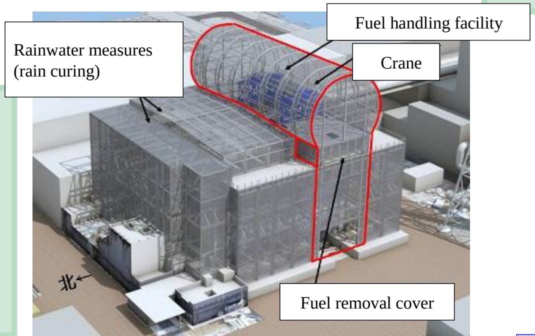
Cover manufacturing (Onahama yard)

Debris removal/Decontamination/Shielding

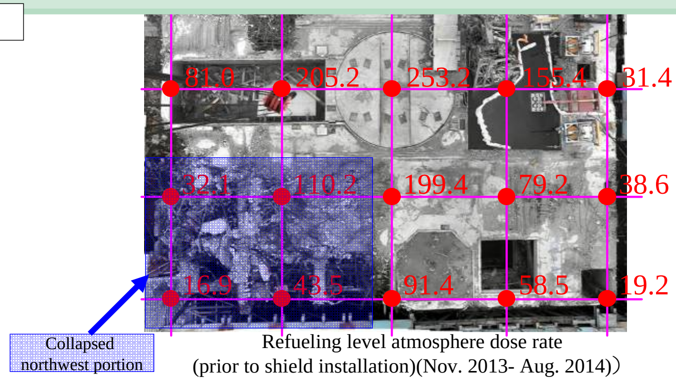
- The removal of debris from around the reactor building and the refueling level was completed in October 2013 and at current time decontamination is underway using self-propelled decontamination equipment and stationary decontamination equipment.
- The atmospheric dose rate of the refueling level is being measured (at a height of 5m from the surface of the refueling level) in conjunction with the progress of decontamination.
- Current assessments predict that it will be difficult to achieve the dose reduction goal of less than 1mSv/h through decontamination and shielding, so additional shielding measures, such as filling in the gaps between shields around the collapsed northwest portion of the building and other areas are being deliberated.

Fuel removal cover and equipment installation

- As with Unit 4, the Unit 3 reactor building fuel removal cover will support fuel handling equipment and prevent fuel removal work from being hindered by wind and rain while suppressing the dispersion of radioactive material.
- To construct the cover, materials are assembled into large units in the Onahama yard outside of the 1F site, thereby reducing the amount of manned work required on the refueling level.
- Large units of the cover are currently being assembled in the Onahama yard outside of the 1F site.
- Fuel handling machine and crane are being assembled at the manufacturers factory after which operation training will be conducted at the factory.
- After training, the equipment will be transported as a complete unit in order to reduce exposure.



Fuel removal cover concept drawing

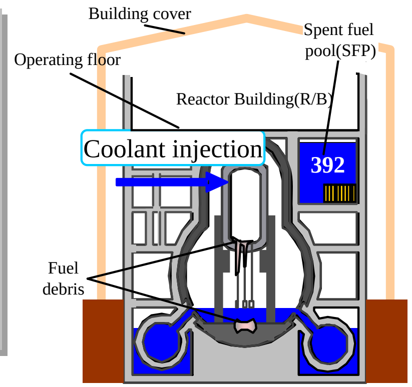


※Units: mSv/h
Measurement location: 5m above the floor

Refueling level atmosphere dose rate (prior to shield installation)(Nov. 2013- Aug. 2014))

Fuel Removal from Unit 1 Spent Fuel Pool

- There is still debris on the top of the reactor building (refueling level) underneath the building cover which needs to be removed before fuel can be removed from the spent fuel pool.
- Spraying of a dispersion prevention agent began on October 22, 2014 along with surveys as the first step in decommissioning work that will start with the removal of spent fuel and continue with the removal of fuel debris.
- An examination of the fuel removal plan has determined that constructing a specialized pool fuel removal platform is the best method for reducing risk by quickly removing spent fuel from the fuel pool and moving it to the common pool that can be cooled in a stable manner.



Fuel pool temperature（October 16, 2014）	23.0℃
Rate of temperature increase if cooling were to shut down（Prior to disaster）	3.4℃/day (Assessment value)
Rate of temperature increase if cooling were to shut down（October 16, 2014）	1.5℃/day

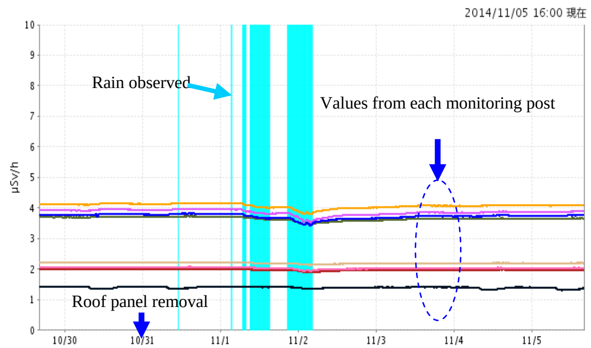
Schedule

This schedule is a draft by TEPCO and details will be deliberated in conjunction with revision of the roadmap

FY2014	FY2015	FY2016	FY2017	FY2018
Refueling level condition survey		Debris removal (being deliberated)		Fuel removal (being deliberated after fiscal year 2019)
Building cover dismantling preparations/pre-work surveys, etc.				Fuel removal building/facility installation (being deliberated)
	Building cover dismantling (being deliberated)			


Spraying of anti-scattering agent

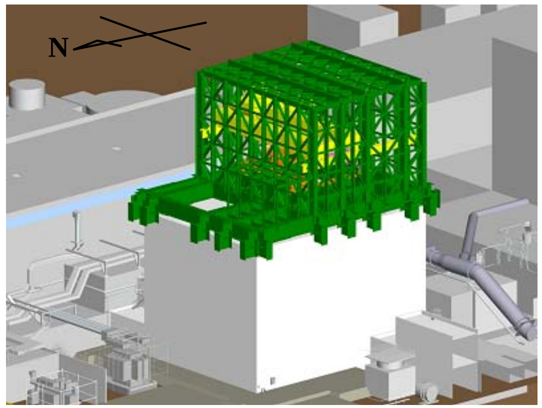

Roof panel removal



Status of monitoring by monitoring posts

Fuel removal plan

- Fuel removed using a platform specialized for pool fuel removal after which a new platform for fuel debris removal will be constructed and used to remove fuel debris
- Exposure reduction, schedule shortening, and waste reduction will be sufficiently considered during plan design



Concept image of pool fuel removal platform

Building cover dismantling preparation/pre-work survey

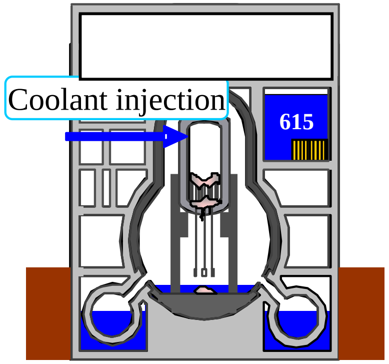
- On October 22, holes started to be drilled in the roof of the building cover in order to spray anti-scattering agent in preparation for building cover dismantling which is scheduled to begin at the end of the fiscal year.
- Afterwards, the first roof panel was removed on October 31, followed by the second roof panel on November 10. The removed roof panels will be temporarily returned to the roof until the beginning of December of this year.
- There have not been any significant fluctuations in dust monitor readings on the refueling level or at monitoring posts.

  Refueling level dust concentration prior to building cover dismantling: 2.1×10^{-6}Bq/cm^3～7.2×10^{-5}Bq/cm^3【Period of measurement: October 17~22】

  Refueling level dust concentration after commencement of building cover dismantling: 1.4×10^{-6}Bq/cm^3～4.4×10^{-5}Bq/cm^3【Period of measurement: October 22~November 10】

Fuel Removal from Unit 2 Spent Fuel Pool

- Surveys to date have shown that radiation levels on the refueling level of Unit 2 are high, thereby preventing any predictions in regards to the feasibility of decontamination of the refueling level and the possibility of restoring fuel handling equipment.
- Since time is required to make preparations for fuel removal, such as renovating the yard, a plan that involves a platform specialized for pool fuel removal, and a plan that comprises a platform that can be used both for pool fuel removal and fuel debris removal shall continue to be deliberated until the middle of FY2016 after which the most optimal plan will be chosen based on the progress of the fuel debris removal plan.
- When deliberating the fuel removal plans, the feasibility of plans to re-use the existing reactor building and implement radiation reduction measures on the refueling level will also be deliberated.



Fuel pool temperature (October 16, 2014)	19.9℃
Rate of temperature increase if cooling were to shut down (Prior to disaster)	9.9℃/day (Assessment value)
Rate of temperature increase if cooling were to shut down (October 16, 2014)	3.6℃/day

Schedule

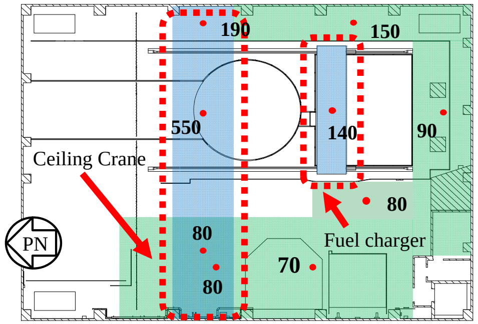
This schedule is a draft by TEPCO and details will be deliberated in conjunction with revision of the roadmap

FY2013	FY2014	FY2015	FY2016	FY2017

- Refueling level survey, etc.
- Renovation of surrounding yard
- Dismantling and renovation of top of reactor building
- Fuel removal plan deliberation
- Fuel removal (Steps after FY2019 are being deliberated)

Unit 2 Reactor Building

Refueling level survey



Refueling level radiation levels distribution

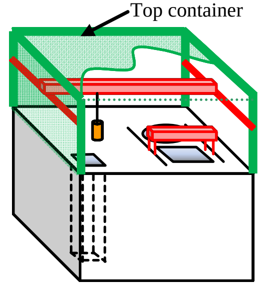
Fuel removal plan

- The following shall be deliberated in order to ensure that pool fuel is removed safely.
  - ✓ Refueling level radiation reduction measures (decontamination/shielding)
  - ✓ Methods for dismantling the building that consider suppressing the dispersion of dust, etc.
- The plan specialized for pool fuel removal also considers the re-use of the top of the reactor building from the perspective of reducing the amount of waste and also suppressing the dispersion of radioactive material

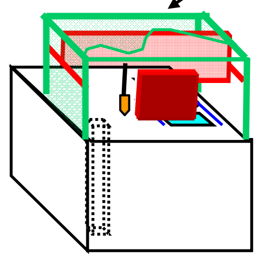
Refueling level・Reactor Building framework survey results

- The reactor building structure survey did not find any damage to the shell wall or outer walls, which are vital for resisting earthquakes.
- When dose rates were measured after contamination using existing decontamination technology based on measured dose distributions, it was found that dose rates were 20~50mSv/h thereby greatly exceeding the objective of 1mSv/h (1m from the floor)
- Even if objective radiation level was achieved, a vast number of workers would be required in consideration of the amount of work that needs to be done.

Reactor Building framework survey



Plan proposal that includes both pool fuel and fuel debris removal



Plan proposal that is specialized for pool to removal

Fuel removal platform concept drawings

Three basic “contaminated water countermeasure” policies

■ **Water used to cool the melted fuel during the accident has mixed with ground water thereby creating approximately 400 tons※1 of contaminated water each day, so the following countermeasures are being implemented based on the following three basic policies.** ※1：A decreasing trend is being seen as a result of countermeasures such as the groundwater bypass and waterproofing of buildings

Policy 1. Removal of contamination sources

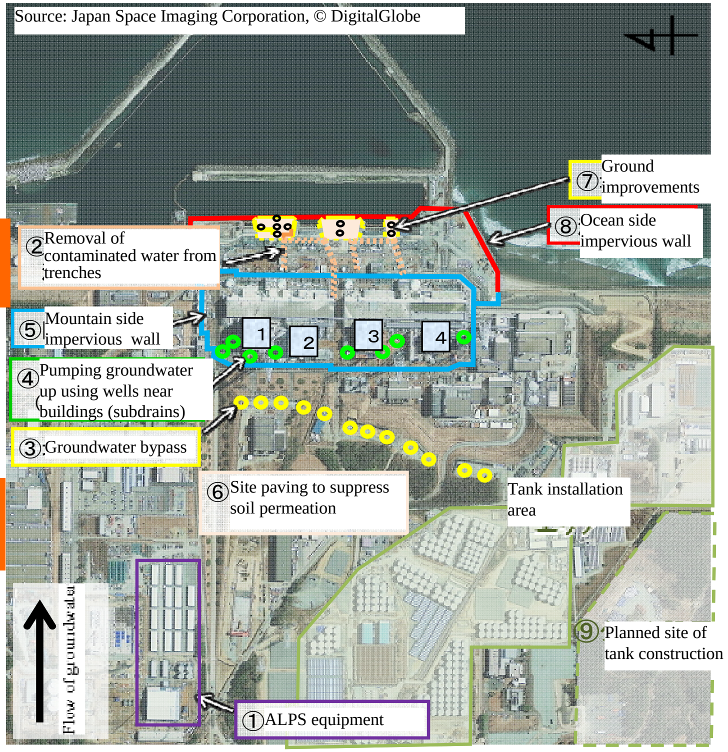
① Contaminated water treatment using ALPS
② Removal of contaminated water from trenches※2
※2：Underground tunnels that have piping

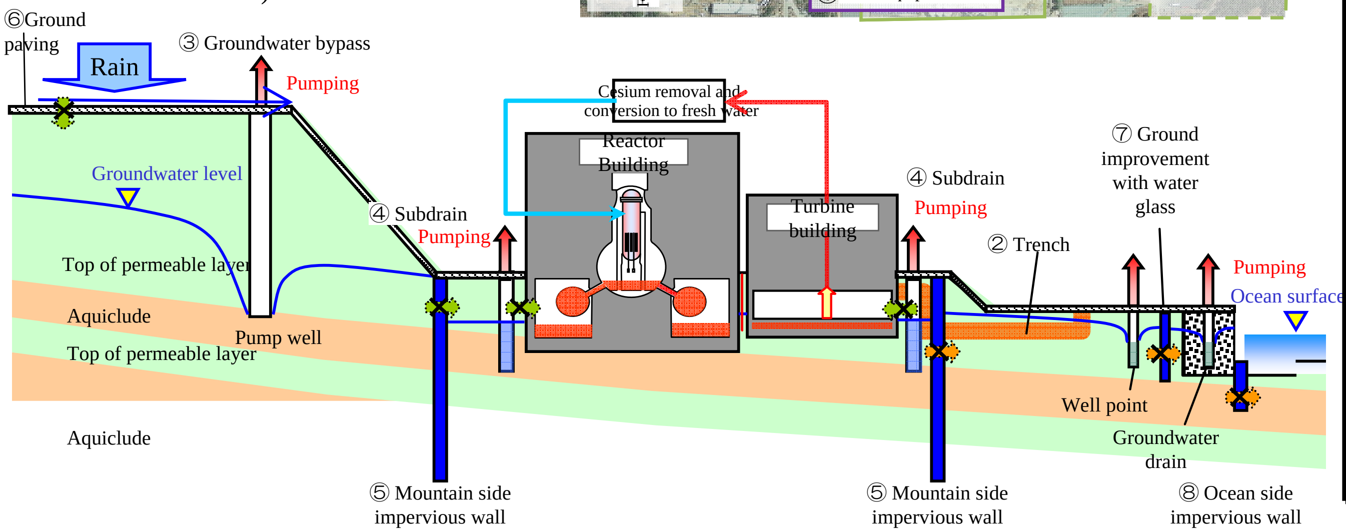
Policy 2. Prevent water from coming close to contamination sources

③ Pumping up groundwater using the groundwater bypass
④ Pumping groundwater up using wells near the buildings
⑤ Construction of a frozen soil impervious wall on the mountain side
⑥ Paving of the ground to hinder the permeation of rainwater into the soil

Policy 3. Preventing contaminated water from leaking

⑦ Ground improvement with water glass
⑧ Construction of impervious wall on the ocean side
⑨ Additional construction of tanks (replacement with welded tanks)



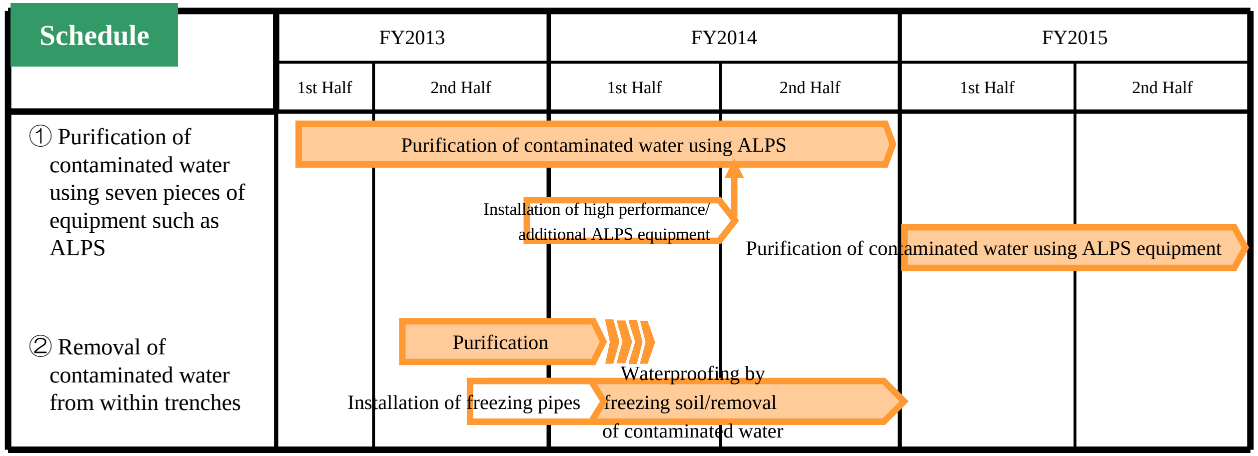


Policy	Item	FY2013 1st Half	FY2013 2nd Half	FY2014 1st Half	FY2014 2nd Half	FY2015 1st Half	FY2015 2nd Half
Policy 1: removal of contamination sources	①Contaminated water treatment using ALPS	Treatment of contaminated water in tanks using ALPS; Installation of high-performance/additional ALPS equipment		purification of water treated with ALPS			
	② Removal of contaminated water from trenches		purification; Freezing pipes	Waterproofing by freezing soil/removal of contaminated water			
Policy 2: Prevent water from coming close to contamination sources	③ Pumping up the groundwater using the groundwater bypass			Pumping up of groundwater on the mountain side of the building			
	④ Pumping groundwater up using well near buildings (Subdrain)	Surveys/restoration	purification equipment installation		Pumping up of groundwater using wells near the buildings		
	⑤ Construction of a frozen soil impervious wall on the mountain side		Small-scale frozen wall tests; Installation and construction			Freezing; Suppression of the flow of groundwater	
	⑥ Paving of the ground to hinder the permeation of rainwater into the soil		Ground paving using asphalt, etc.				
Policy 3: Preventing contaminated water from leaking	⑦ Ground improvement with water glass	Ground improvement using water glass; Pumping up of contaminated water from contaminated areas		Preventing the flow of contaminated groundwater into the ocean			
	⑧ Construction of impervious wall on the ocean side	Installation construction			Preventing the flow of contaminated groundwater into the ocean		
	⑨ Additional construction of tanks (replacement with welded tanks)	Additional tank installation and retention					

Progress status of "Contaminated Water Countermeasures"

Policy 1. Removal of contamination sources

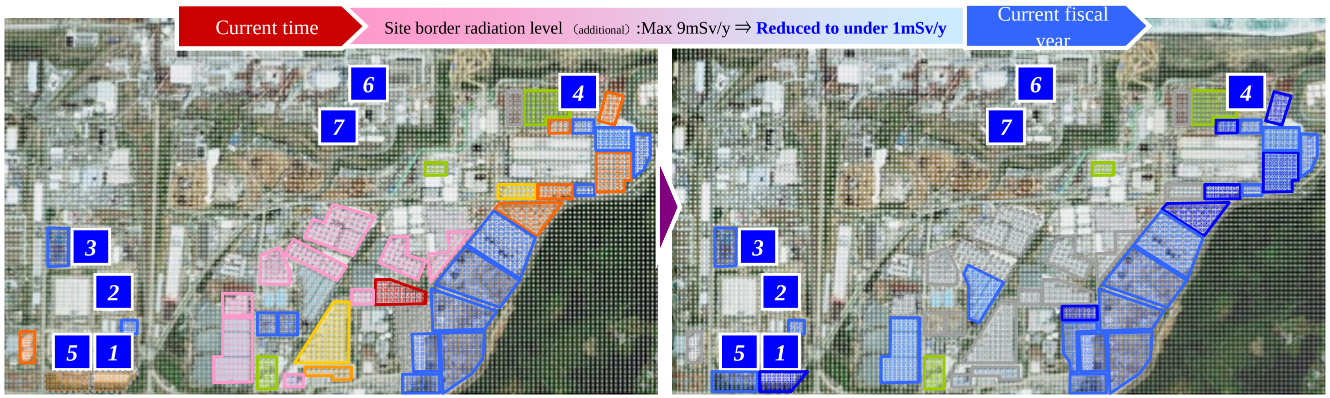
- Purifying highly concentrated contaminated water (contamination source) that has accumulated in the bottom of the reactor building etc. using seven pieces of equipment, such as ALPS, reduces the risks associated with a leak of contaminated water if a leak was to occur.
- **This plan aims to purify contaminated water by the end of FY2014 (RO condensed saltwater ※)**
- In order to prevent highly concentrated contaminated water that is accumulated in sea water pipe trenches on the ocean side from leaking into the ocean efforts are being made to waterproof connections between buildings, transfer accumulated water, and seal off seawater pipe trenches



※：Refers to wastewater from which cesium, which is the primary contaminant, has been removed using treatment equipment (cesium absorbers, secondary cesium absorbers, etc.)

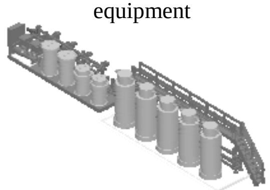
Purification with seven pieces of equipment such as ALPS

- Treatment of water with additional ALPS (3 systems) and high-performance ALPS equipment has begun (trial operation). Treatment has also begun using one system of mobile strontium removal equipment.
- Contaminated water is being continually purified using three types of ALPS equipment and mobile strontium removal equipment. Additional ALPS equipment has been designed based on the operation experience with existing ALPS equipment, thereby enabling continuous treatment at high operation rates without trouble.
- After cesium absorption equipment and secondary cesium absorption equipment has been renovated, RO condensed water treatment equipment will be installed and put into operation before the end of the year.



【Key】All β radiation concentration [Bq/cc]
:5×10⁵～10⁶ :10⁵～5×10⁵ :5×10⁴～10⁵ :10⁴～5×10⁵ :10¹～10³ (RO treated water/fresh water) :Less than 10³ (Sr reduced water) :10⁻¹～10⁻² (ALPS treated water) :Empty :Being installed/replaced

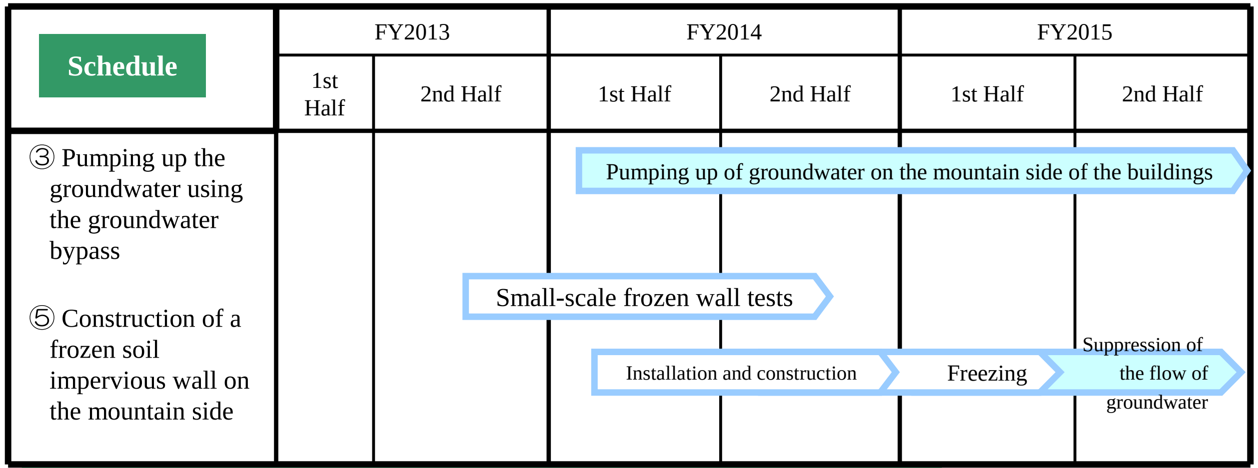
Contaminated water treatment equipment

	1 ALPS	2 Additional ALPS	3 High-performance ALPS	4 Mobile Sr removal equipment	5 RO concentrated water treatment equipment	6 Sr removal using KURION	7 Sr removal using SARRY
							
Removal capability	Can bring 62 nuclides to below concentration limits that require notification by law			Reduce strontium (Sr) levels to 1/100~1/1,000			
Treatment capability	250m³/day×3 systems	250m³/day×3 systems	500m³/day	300m³/day	500～900m³/day	600m³/day	1,200m³/day
Status	Undergoing trial operation			In operation	To begin operation in December	Operation preparations being made	Application submitted to revise implementation plan

Progress status of "Contaminated Water Countermeasures"

Policy 2. Prevent water from coming close to contamination sources

- **A groundwater bypass that consists of pumping of groundwater from wells upstream of the buildings has been created in order to reduce the amount of groundwater flowing into buildings and therefore suppress the increase in contaminated water since some of the groundwater flowing into buildings is coming in contact with contamination sources and becoming contaminated water. And an impervious wall made of frozen soil is also being constructed around the buildings in which contaminated water has accumulated in order to suppress the increase of contaminated water caused by groundwater flowing into the buildings.**
- **The frozen soil impervious wall is formed by sinking freezing pipes into the earth that lower the temperature of the soil around the pipes thereby freezing the soil.**



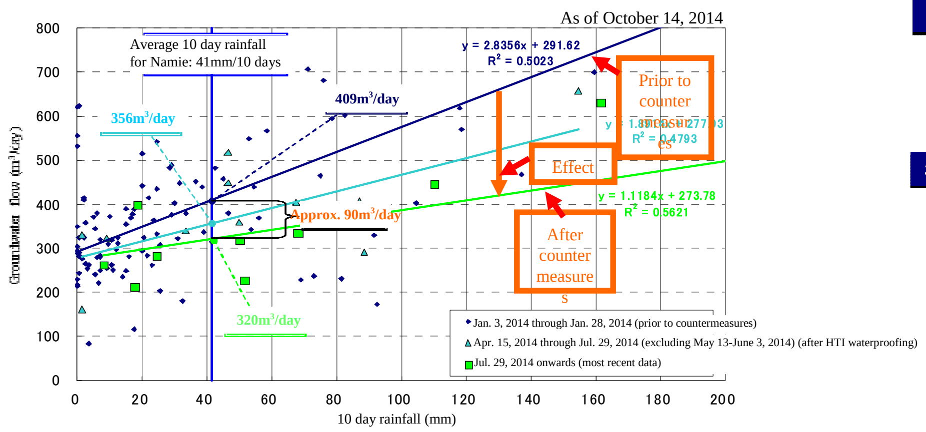
Pumping up water using the groundwater bypass

- As of November 17, 2014, approximately 54,438m^3 of groundwater has been pumped up over a total of 34 times and discharged upon having TEPCO and third-party agencies (Japan Chemical Analysis Center) confirm the water quality meets the objectives of the water.
- Water levels of groundwater around the buildings has decreased by approximately 20~ 25cm compared with before groundwater bypass pumping thereby indicating that the groundwater bypass is having an effect.
- The amount of groundwater flowing into buildings has decreased by approximately 90m^3 per day as a result of countermeasures such as waterproofing the high temperature incinerator building.

【Recent drainage results/analysis results】

Units：Bq/L

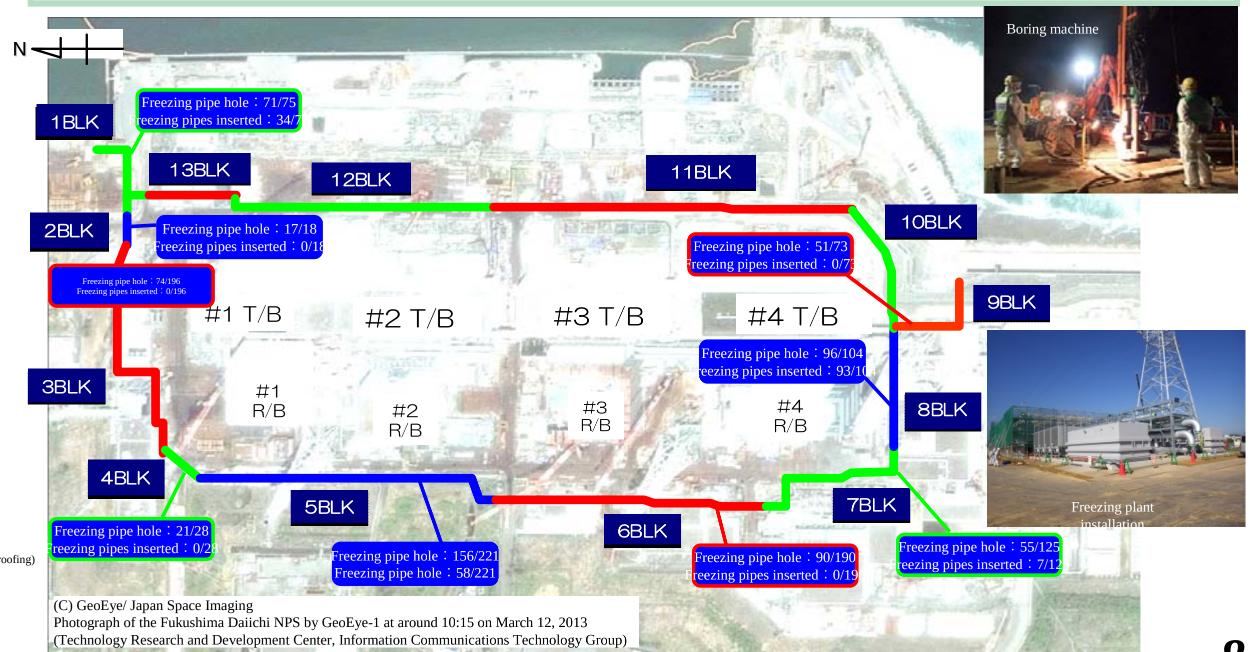
	Cesium 134	Cesium 137	All Beta radiation	Tritium
TEPCO	ND（0.79）	ND（0.58）	ND（0.85）	120
Third-party agency	ND（0.59）	ND（0.53）	ND（0.58）	120
Objectives	1	1	5	1,500



Groundwater bypass effect

Constructing a frozen soil impervious wall on the mountain side

- Holes are currently being bored in order to sink frozen pipes used to form the frozen soil impervious wall around Units 1~4.
- As of November 11, 631 of the 1545 holes have been bored in locations that do not have anything buried or any obstacles and freezing pipes have been sunk into 192 of these holes. Seven of the 165 holes that are in locations of buried objects or other obstacles have been bored.
- Holes to be bored in locations where there are buried objects are being done so upon careful inspection of the objects through which the holes must be bored.



Progress of construction of the frozen soil impervious wall on the mountain side

Progress status of "Contaminated Water Countermeasures"

Policy 3. Preventing contaminated water from leaking

- **Tanks have been constructed onsite in a planned manner in order to safely store increasing amounts of contaminated water and prevent it from leaking outside of the site.**
- **The reliability of tanks is being improved in order to store the water in a stable manner. Flange tanks (flange jointed) are being removed and replaced with welded tanks (welded).**
- **High concentrations of contamination have been confirmed in groundwater at power station levels 4m above sea level. In order to suppress the flow of contaminated water into the ocean, the area where contamination was discovered has been surrounded in order to reduce the risk of a leak of contaminated water.**

Schedule

Schedule	FY2013		FY2014		FY2015	
	1st Half	2nd Half	1st Half	2nd Half	1st Half	2nd Half
⑦Ground improvement with water glass	Ground improvement using water glass → Preventing the flow of contaminated groundwater into the ocean					
	Pumping up of contaminated water from contaminated areas					
⑨Additional construction of tanks (replacement with welded tanks	Additional tank installation and retention					

Tank construction (replacement)

- Highly reliable welded tanks are being used for additional tank installation. A certain degree of margin has been included in the construction plan to ensure that tank space does not run out. Some tanks are being manufactured at the Fukushima Daiini NPS in order to reduce worker exposure and work load.
- Tanks in site areas that have poor use rates are being removed and replaced with welded tanks. (Replacement)
- Implemented countermeasures to suppress rain water (rain gutters, sluice covers, etc.) have prevented water from overflowing from sluices even during the two large typhoons that hit Japan this year.

Tank construction


Tank manufacturing at Fukushima Daini

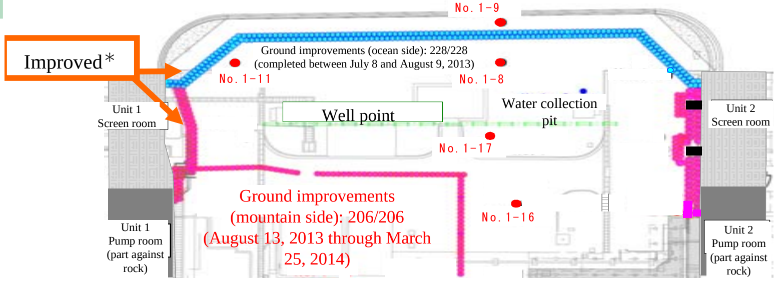
Rain gutter installation on tanks

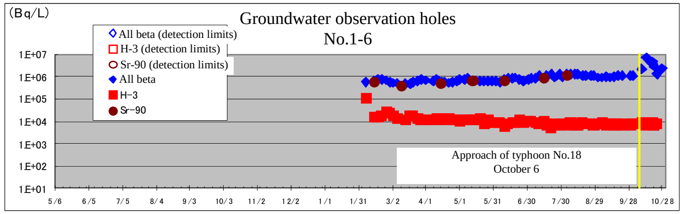

Storage of removed tanks

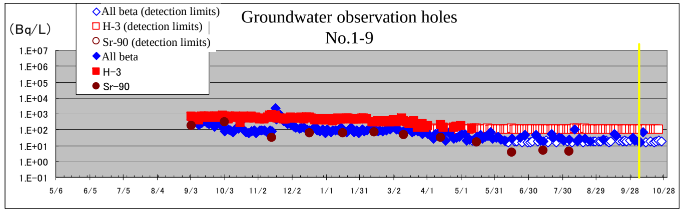
Rain countermeasures for tanks

Ground improvement with waterglass

- Record-breaking all beta concentrations were seen in groundwater after the typhoons had passed in groundwater observation holes No. 1-6
- However, since no increases in concentrations were seen in holes No. 1~9 on the ocean side, which has been subject to ground improvements and well points, it is assumed that there was no impact on the ocean thereby indicating that ground improvements near the seawall are having an effect.





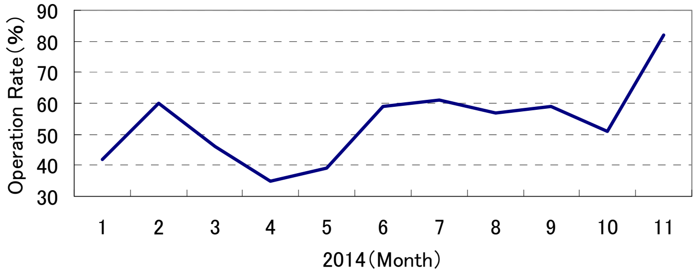


[Recent Issues] ALPS operation status

- Existing ALPS equipment is currently running smoothly. The timing for transition to full-scale operation will be determined based on the level of purification of contaminated water.
- Additional ALPS equipment has been designed/manufactured based on knowledge gained from the operation of existing ALPS equipment and is running smoothly at current time. Preparations are being made to transition to full-scale operation.
- High performance ALPS equipment has been installed for the first time so we will continue carefully with trial operation.

Existing ALPS: Operation record since the commencement of hot tests

- Hot test commencement dates
  System A: March 30, 2013; System B: June 13, 2013; System C: September 27, 2015
- Performance (amount of water stored in treated water tanks as of November 18, 2014): Approx. 167,000m^3
- Equipment operation rate (since January 2014) Rated treatment volume: 750m^3/day
- During initial operation there were human errors and initial troubles, but appropriate equipment/operation countermeasures were put in place.
- In March 2014 damage to the CFF gasket resulted in wide spread contamination of later stages of the equipment. In addition to equipment-related countermeasures, operation checks (enhanced sampling from the system) were enhanced. This enabled early detection of similar events and quick system shutdown to prevent contamination from spreading through the system, which in turn enabled operation of the equipment to recommence quickly.
- As a result of these countermeasures the amount of troubles has decreased and quicker responses to troubles have been enabled which we expect will contribute to improved operation rates in the future.



Additional ALPS: Operation performance since the commencement of hot tests

- From the beginning the operation rate of additional ALPS equipment has been high for several reasons:
  -It was designed based on existing ALPS with knowledge gained from the operation of existing ALPS (human error, aging, operation data)
  -It was designed to enable HIC replacement while the equipment is running
  -Operators are trained on existing equipment beforehand.
- Hot test commencement dates:
  System A: September 17, 2014; System B: September 27, 2014; System C: October 9, 2014
- Performance (amount of water stored in treated water tanks as of November 18, 2014): Approx. 31,000m^3
- Equipment operation rate (3-system operation, since October 9, 2014) Rated treatment volume: 750m^3/day

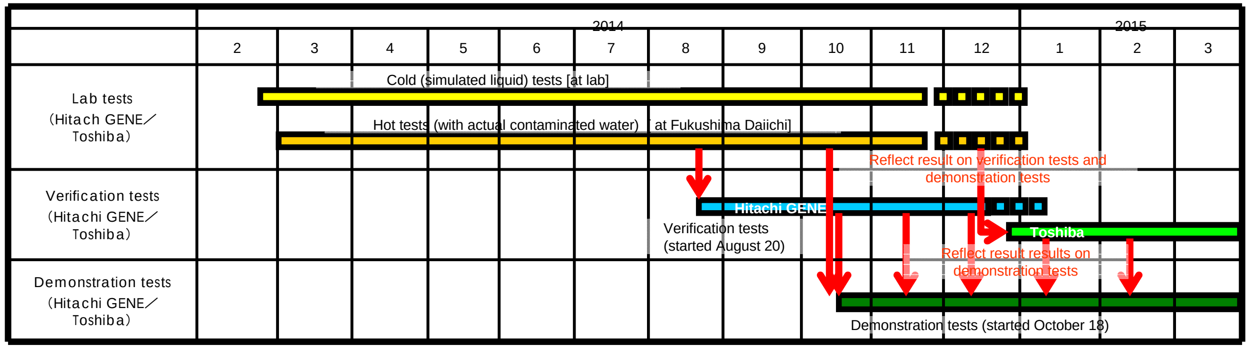
Operation rate (%)		Operation Status (Primary equipment)
October	83	RO control system reconfiguration, etc., no unplanned shutdowns
November	81	CFF cleansing, etc., no unplanned shutdown

The transition to full-scale operation will be made after the installation of additional sampling tanks (2→3)

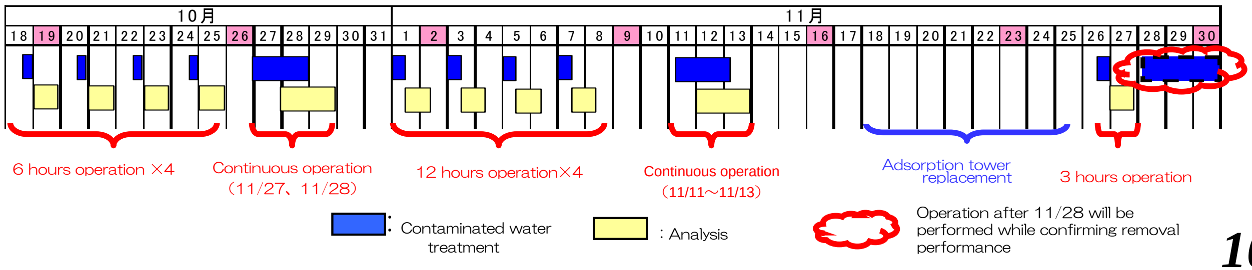
High performance ALPS tests and operation status

- High performance ALPS has been designed to reduce the amount of pre-processing, simplify the equipment and reduce the amount of waste generated.
- Initial radioactive substance removal performance is adequate, however the sustained performance time of Cs/Sr absorption towers is shorter that originally predicted, so countermeasures optimize the overall balance of treatment volume versus absorption material wear will continue to be deliberated.
- The operation rate of existing ALPS, which was the first equipment of this kind installed, is gradually being increased now that we have experience handling troubles that were encountered during initial operation, and high performance ALPS is being run carefully while gradually gaining operating experience.
- Test details
  - ✓ Lab tests: Columns filled with simulated liquid and RO concentrated saline are used to assess absorption removal performance.
  - ✓ Verification tests: A test device 1/10 the scale of demonstration test equipment was created to assess removal performance, sustained performance time and the amount of waste generated. (No problems with initial performance. Sustained performance time is shorter than originally anticipated. The removal rate of Cs/Sr absorption towers after tower 2 is low).
  - ✓ Demonstration tests: Commenced on October 18, 2014. Actual equipment built to assess overall performance. Currently tests are being performed using absorbent materials selected by Hitachi GE as well as those selected by Toshiba. Equipment will be operated intermittently based on the results of lab and verification tests to confirm performance.

【High performance ALPS test implementation status】

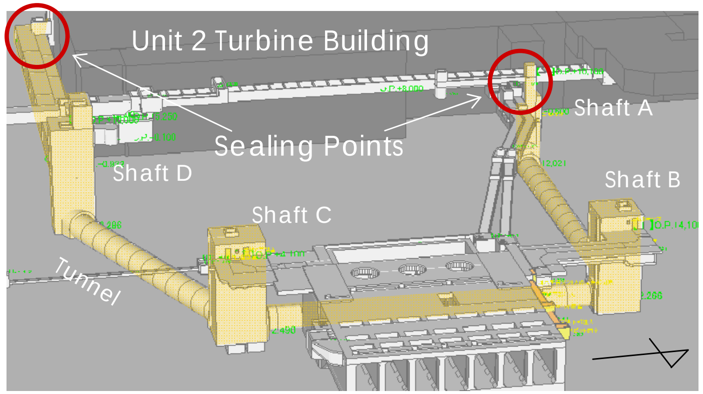


【Operating Performance (Treated volume as of November 30: Approx. 3,400m^3)】



[Recent Issues] Status of removal of highly concentrated contaminated water from seawater pipe trench

Unit 2 Seawater Pipe Trench Top View



- **In order to prevent the risk of a leak into the ocean of highly contaminated water that has accumulated in the seawater pipe trench on the ocean-side of the T/B efforts are being made to remove contaminated water and seal the trench.**
- **The original plan called for sealing the trench after draining it of contaminated water, however this requires cutting of the trench from the T/B from which contaminated water is flowing in and out of, so it was decided to employ the use of a frozen soil wall. (Construction began in November 2015 and freezing began in April 2014)**
- **Freezing did proceed as hoped due to flowing water and other measures were implemented to promote freezing, such as injecting ice and filling in gaps, but at current time100% waterproofing has not been attained. (November 2014)**
- **While continuing waterproofing work simultaneous efforts are underway to develop sealant materials that can be injected through the shaft to seal the inside. Underwater fluidity tests have confirmed that this material has high fluid properties underwater and can be used on the actual facilities. (September 2014)**
- **Unit 2 is currently being sealed. Unit 3 will be sealed after assessing the status of Unit 2. Sealing of both Unit 2 and Unit 3 should be completed by the end of the fiscal year.**