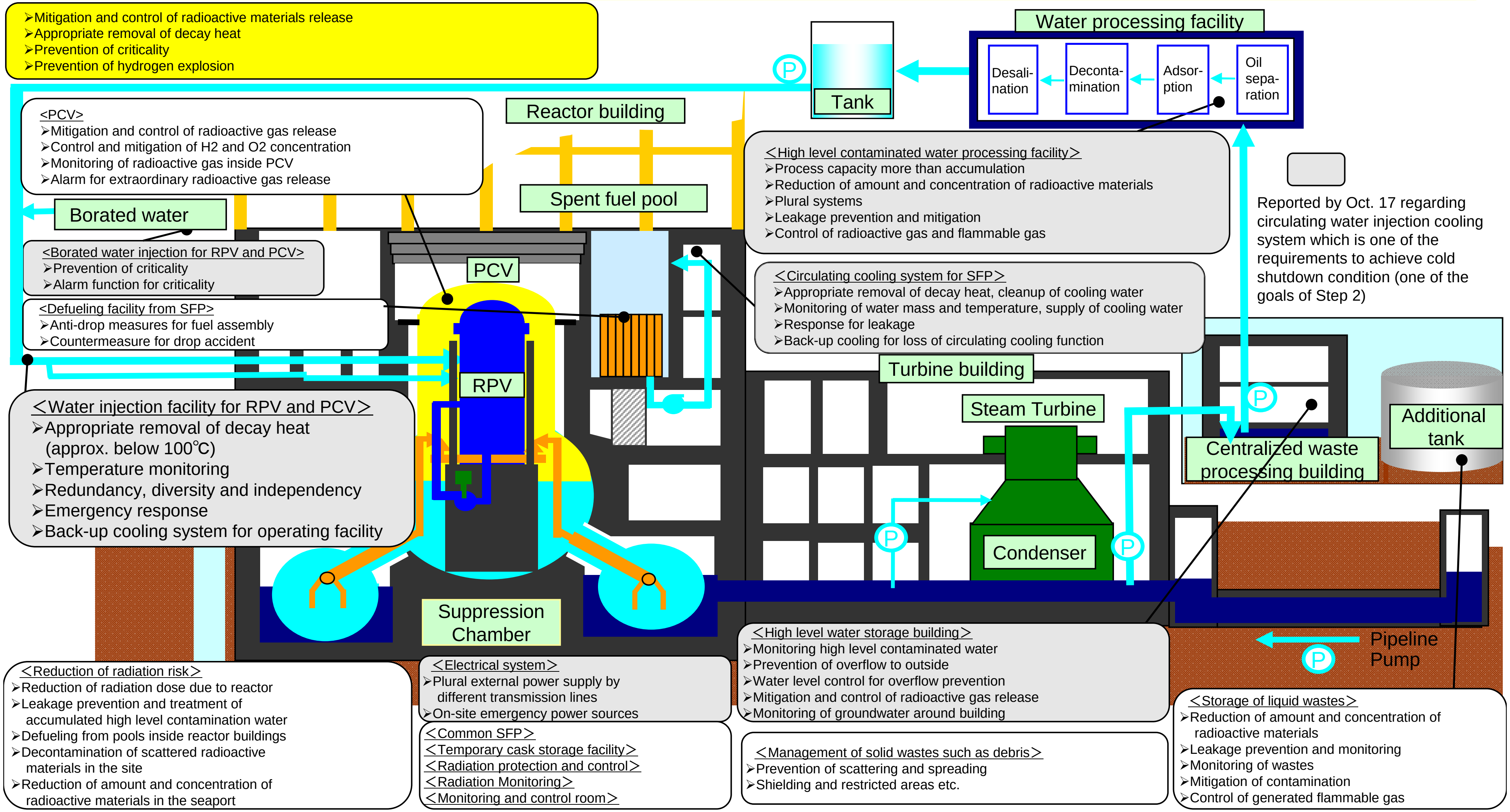
3. Mid-and-long Term Roadmap

Concept for Mid-term Safety Security (Basic Target Outline)

- NISA released “Concept for Mid-term Safety Security” on Oct. 3, 2011, which covered the safety security concept until the start of decommissioning work.
- We reported to NISA on the operating plan as well as the safety assessment results regarding the circulating water cooling system. Other systems etc. shall be reported on as well in a timely manner.



Story Behind the Mid-and-long-term Roadmap, Safety Securement

Per the order issued on November 9, 2011 by Mr. Edano, the Minister of Economy, Trade and Industry and Mr. Hosono, the Minister for the Restoration from and Prevention of Nuclear Accident, this roadmap was drafted by TEPCO, ANRE and NISA and finalized at the government and TEPCO's mid-and-long-term countermeasure conference on December 21, 2011.

<Basic Policy towards Addressing the Mid-and-long Term Issues>

[Policy 1] Systematically tackle the issues while placing the top priority on the safety of local citizens and workers.

[Policy 2] Move forward while maintaining transparent communications with local and national citizens to gain their understanding and respect.

[Policy 3] Continuously update this roadmap based on the on-site situation and the latest R&D results etc.

[Policy 4] Harmonize the respective efforts of TEPCO, ANRE, and NISA to achieve our goal.

<The Overall Plan to Secure Mid-and-long-term Safety>

- In the upcoming three years, TEPCO will implement the operation and management plan for their facilities based on "SAFETY DIRECTIVE "Ensuring Mid-term Safety"" issued by NISA. NISA will review and assess TEPCO's reports based on their investigative standards and thus will secure safety.
- Mid-and-long-term actions will be implemented as well. TEPCO will conduct safety and environmental impact assessment at each juncture when TEPCO consider concrete work procedures for each task. NISA will assess and confirm these procedures prior to implementation, thus ensuring safety.

Mid-and-long Term Roadmap

<Primary Target>

Present all possible schedules pertaining to the main on-site works and R&D.

<Target Timeline and Holding Points>

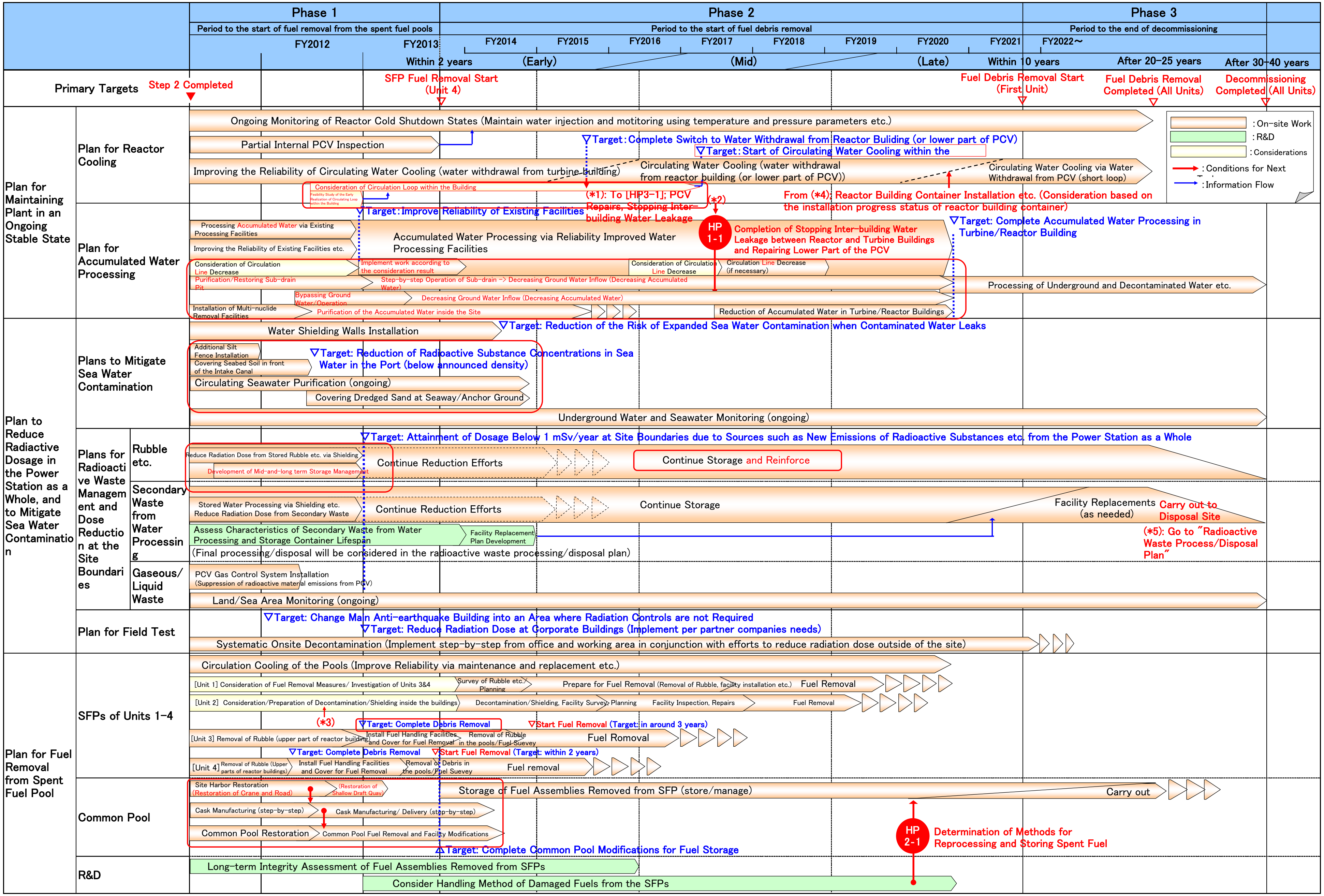
- Established all possible target timelines in the upcoming 3 years, which are updated and released on a yearly basis.
- Regarding the schedules after 3 years, established holding points, which are significant to judge whether to go ahead in accordance with the schedule, to implement additional R&D, or to re-schedule the process.

Present（Completion of Step 2） — ***Within 2 Years*** — ***Within 10 Years*** — ***After 30-40 Years***

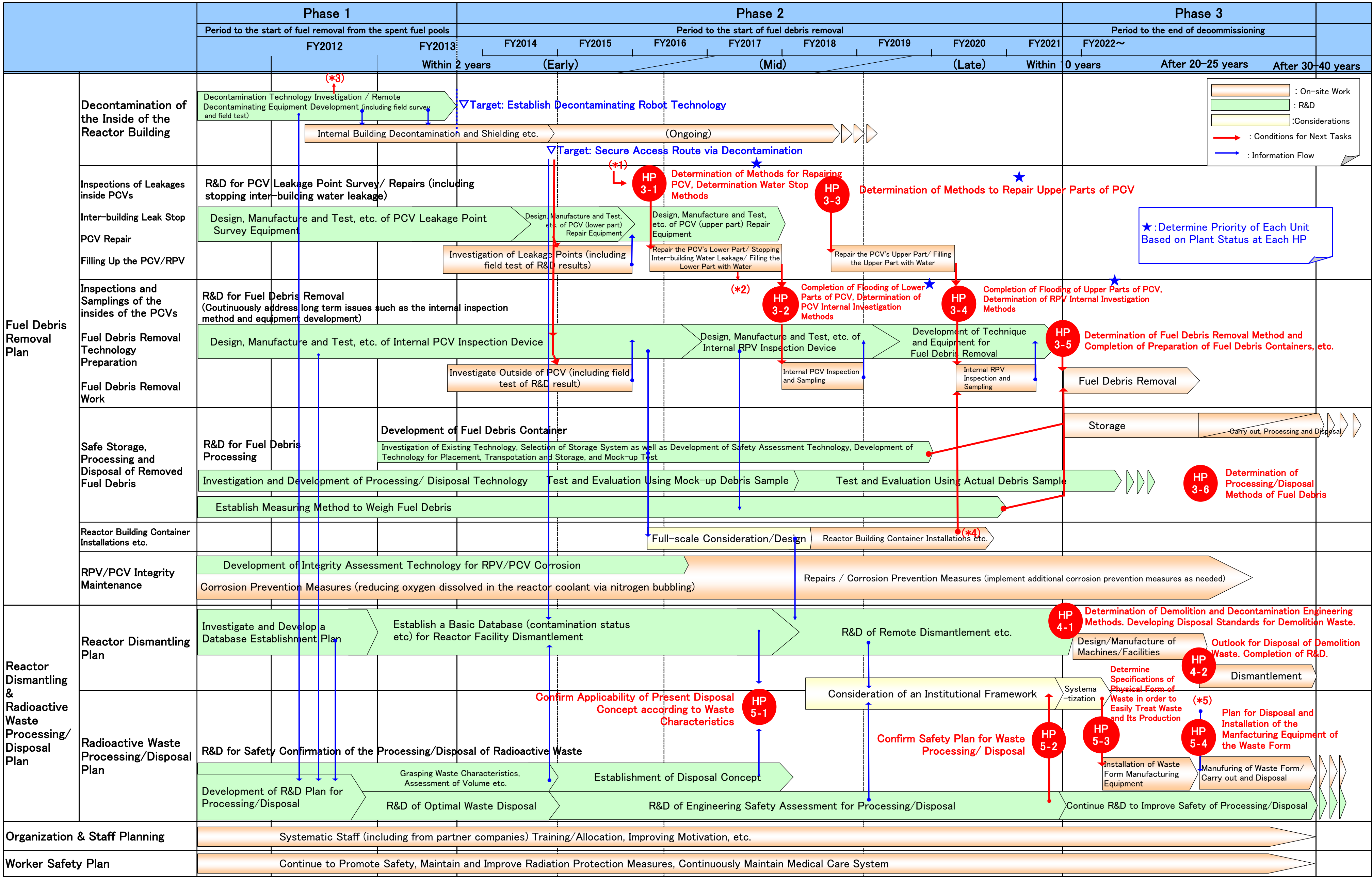
Step 1, 2	Phase 1	Phase 2	Phase 3
<Achieved Stable Conditions> -Condition equivalent to cold shutdown -Significant Suppression of Emissions	Period to the start of fuel removal from the spent fuel pool (Within 2 years)	Period to the start of fuel debris removal (Within 10 years)	Period to the end of decommissioning (After 30-40 years)
	-Commence the removal of fuels from the spent fuel pools (Unit 4 in 2 years) -Reduce the radiation impact due to additional emissions from the whole site and radioactive waste generated after the accident (secondary waste materials via water processing and debris etc.) Thus maintain the effective radiation dose to be less than 1 mSv / year at the site boundaries caused by the aforementioned. -Maintain stable reactor cooling and accumulated water processing and improve their credibility. -Commence R&D and decontamination towards the removal of fuel debris -Commence R&D of radioactive waste processing and disposal	-Complete the fuel removal from the spent fuel pools at all Units -Complete preparations for the removal of fuel debris such as decontamination of the insides of buildings, restoring PCVs and filling PCVs with water. Then commence the removal of fuel debris (Target: within 10 years) -Continue stable reactor cooling -Complete the processing of accumulated water -Continue R&D on radioactive waste processing and disposal, and commence R&D on the reactor facilities decommission	-Complete the fuel debris removal (in 20-25 years) -Complete the decommission (in 30-40 years) -Implement radioactive waste processing and disposal

Actions towards systematic staff training and allocation, motivation improvement, and securing of workers' safety will be continuously implemented.

Main Schedule of Mid-and-long Term Roadmap (1/2)



Main Schedule of Mid-and-long Term Roadmap (2/2)



Organizational Structure of the Mid-and-long Term Roadmap

- Established “Steering Committee” and “R&D Promotion Headquarters” under Government and TEPCO Mid-and-long Term Countermeasures Committee on December 21 2012 which is held every month to monitor the progress to ensure steady implementation of the mid-and-long term roadmap.

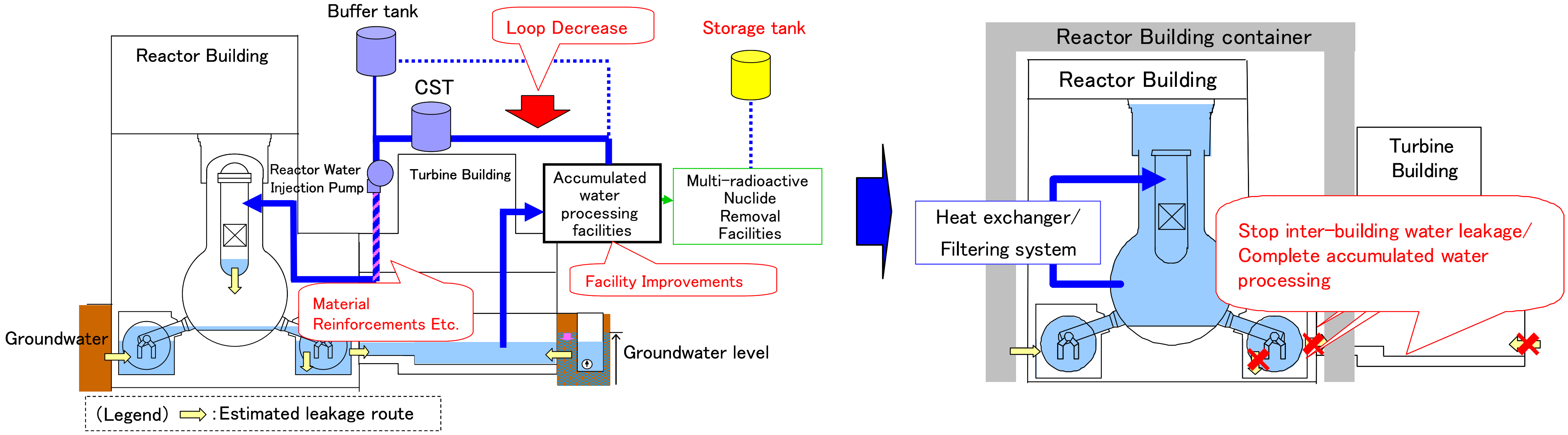
- As we are facing many difficulties in research and development that are unprecedented and challenging even from a world-wide perspective, we will work hand-in-hand with our domestic and overseas partners, and compile wisdom and knowledge from all over the world as we move forward.

- Concerning the onsite work, TEPCO will maintain the current structure with approximately 400 partner companies and established “Fukushima Daiichi Countermeasures Project Team” in February 2012 at Headquarters as a specialized organization to deal with mid-and-long term roadmap issues. Improvement of the work environment and systematic staff training will contribute to securing the performable organization and staff.

- Further enhancement of R&D promotion framework including preparation of R&D facilities will continue to establish the best framework to deal with challenges becoming clearer so far.

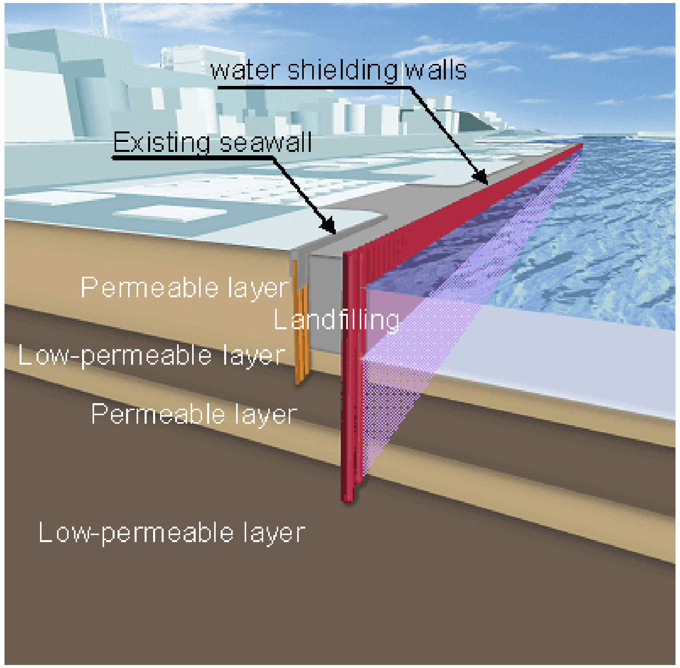
Target Timeline: 1) Reactor Cooling, Accumulated Water Processing

- By examining the reliability of the system, system improvements will be continuously implemented such as polyethylene pressure-proof hoses for injection and circulation lines.
- Since the excess water volume is increasing due to groundwater inflow to the buildings, we will take countermeasures to reduce the excess water: pumping up groundwater to bypass its outflow route to the sea, installing Advanced Liquid Processing System (ALPS) and so on. In addition, we will develop a tank operation plan to store the processed water without overflow.
- During Phase 2, after stopping the water leakage between the turbine and reactor buildings and completing the repair work of the lower parts of the PCVs, we will finish the processing of water accumulated inside the building. In order to achieve more stable cooling, scaling down of the circulation loop is being considered.

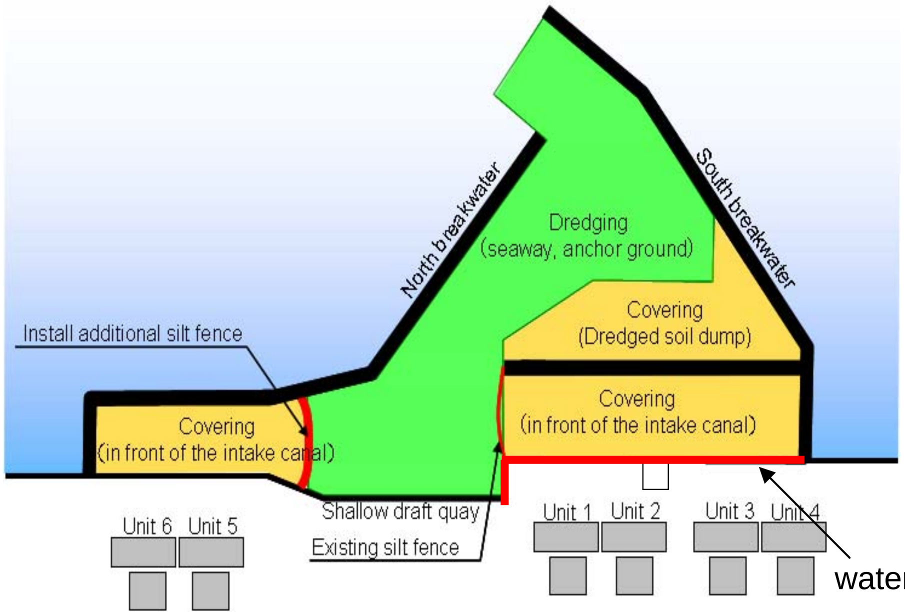


Target Timeline: 2) Plans to Mitigate Sea Water Contamination

- In case underground water be contaminated, water shielding walls will be built by mid FY2014 in order to prevent underground water from flowing into the ocean.
- Covering and solidifying seabed soil in front of the intake canal will prevent the diffusion of radioactive materials in the soil (completed in July 2012). By the end of the first half of FY2012, we will reduce radioactive materials in the seawater inside the site port to the level below the limit for the outside of environment surveillance areas as determined by a notification of the government.
- Afterwards, while maintaining the installed facilities, underground water and sea water etc. will be continuously monitored.



Water Shielding walls (Image)



Harbor's Seabed Soil Image

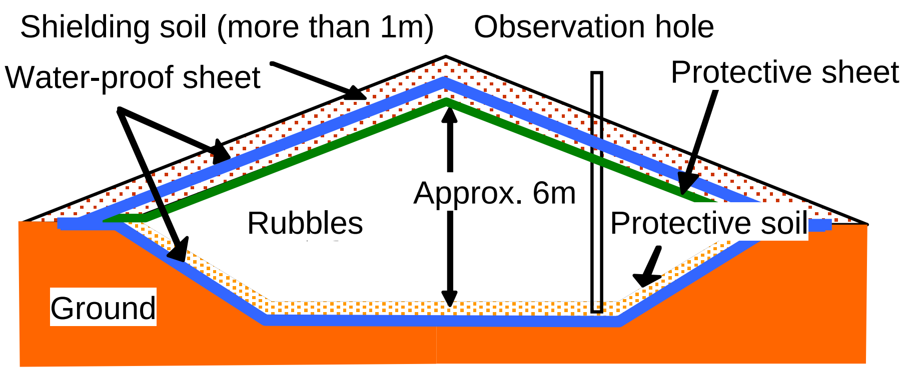
Seabed before solidifying in front of Units 1 - 4 (February 26, 2012)

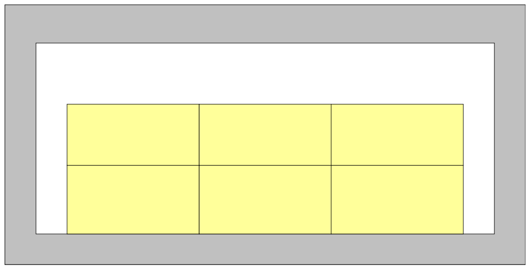
(April 29, 2012)

Target Timeline: 3) Radioactive Waste Management and Dose Reduction at the Site Boundaries, 4) Onsite Decontamination Plan

- By the end of FY 2012, we will reduce the effective radiation dose at the site boundaries, stemming from additional emissions from the whole site and radioactive waste stored on the site after the accident (secondary waste materials via water processing and rubble etc.), to below 1 mSv / year. Target of radiation dose reduction is set for each released radioactive material and stored radioactive waste, and its reduction effect and additional countermeasure are considered every quarter.
- By around the end of 2012, we will develop a mid-to-long term plan to manage and secure storage areas which is estimated from the past records and future work plan. The plan also will cover how we minimize the radiation effect at the site boundaries: shifting the temporary facility to the one that withstands long term usage.
- In order to reduce the radiation exposure of the public and site workers and to improve work environment, systematically and in a step-by-step manner, we will implement decontamination work in accordance with the area classification: administration area, work area and access area.

  In May 2012, office area in the seismic isolation building became non-controlled area. Within 2012, commuting bus stop and work area where main gate security guards are stationed will be decontaminated and taken shielding measures, etc. From 2nd phase, we will move forward with the decontamination work inside the site in coordination with the outside dosage reduction.



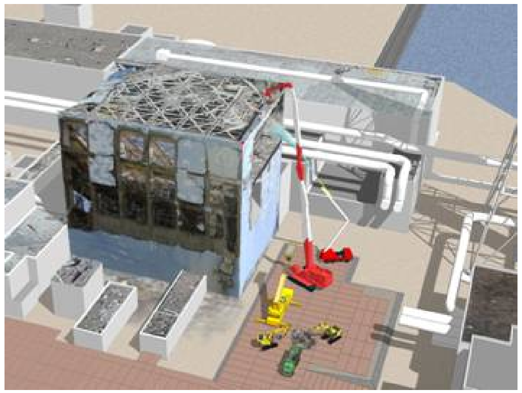


Shielding by building (rubble)

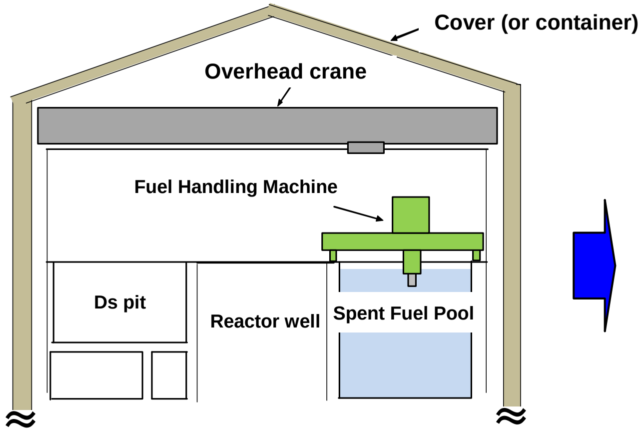
Preparation work for temporary storage facilities shielded by soil (completed)

Target Timeline: 5) Plans to Remove Fuels from Spent Fuel Pools

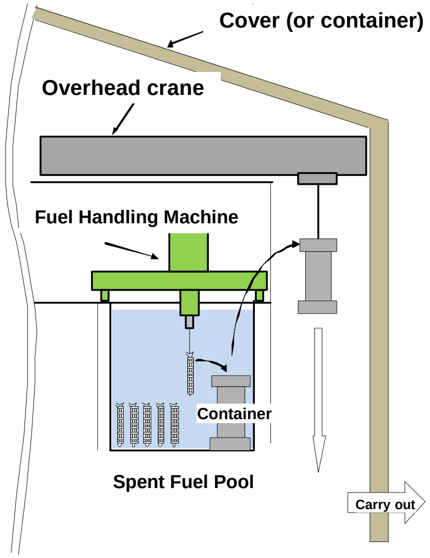
- To start fuel removal from Unit 4 within 2 years after completing Step 2 (within 2013).
- To start fuel removal from Unit 3 approximately 3 years after completing Step 2 (end of 2014).
- To develop a fuel removal plan from Unit 1 based on the experiences in Units 3 & 4 and investigations of the rubble situation, and will complete fuel removal during the Phase 2.
- To develop a fuel removal plan from Unit 2 in light of the investigation results of the installed facilities to be conducted in consideration of decontamination results inside the buildings and will complete fuel removal during Phase 2.
- To complete fuel removal from all Units during Phase 2.
- To determine reprocessing and storing methods for removed fuels during Phase 2.



Debris removal from the upper part of reactor building



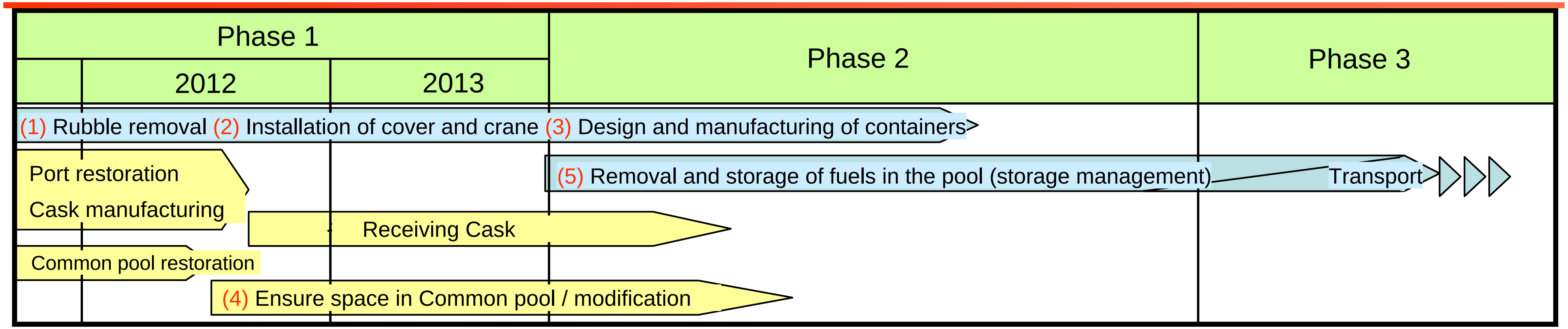
Installation of cover (or container) / crane

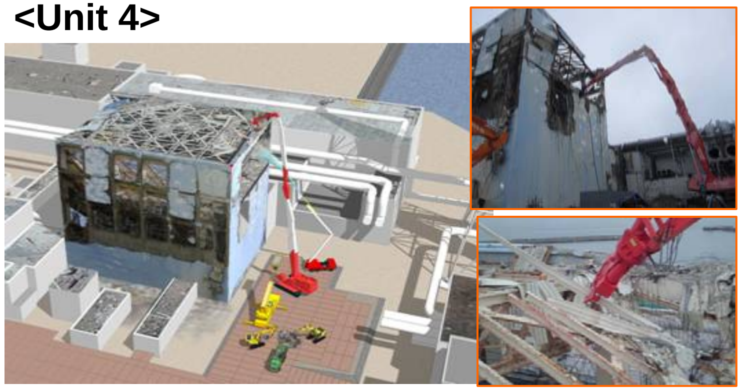
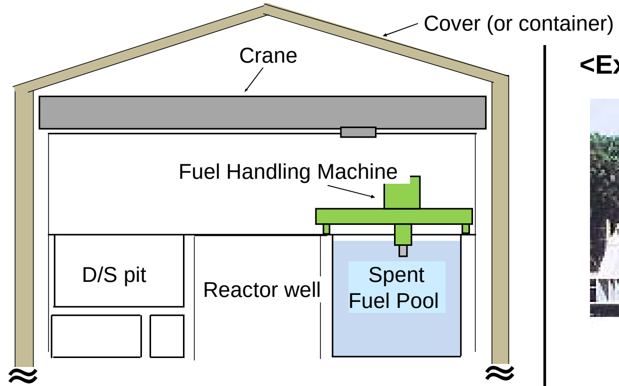


Fuel removal work

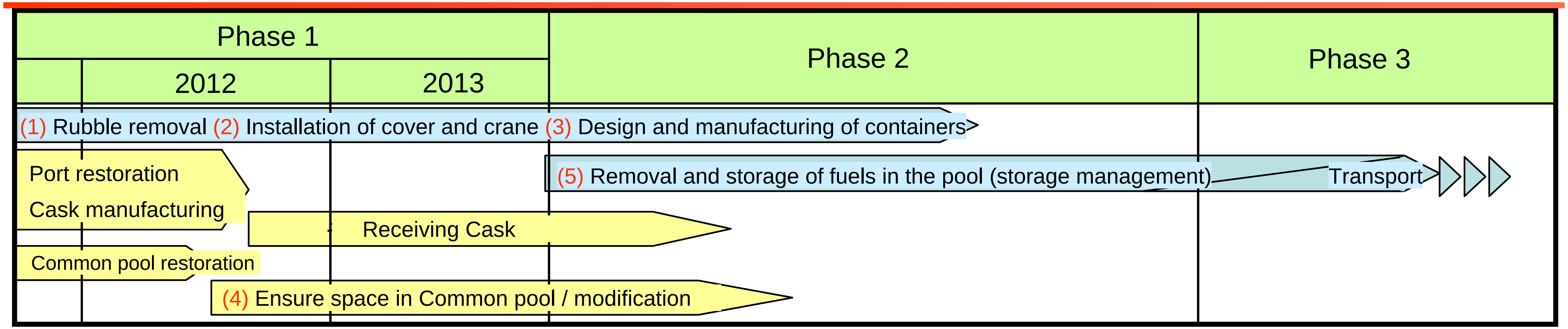
Figure 6: Fuel removal work (image)

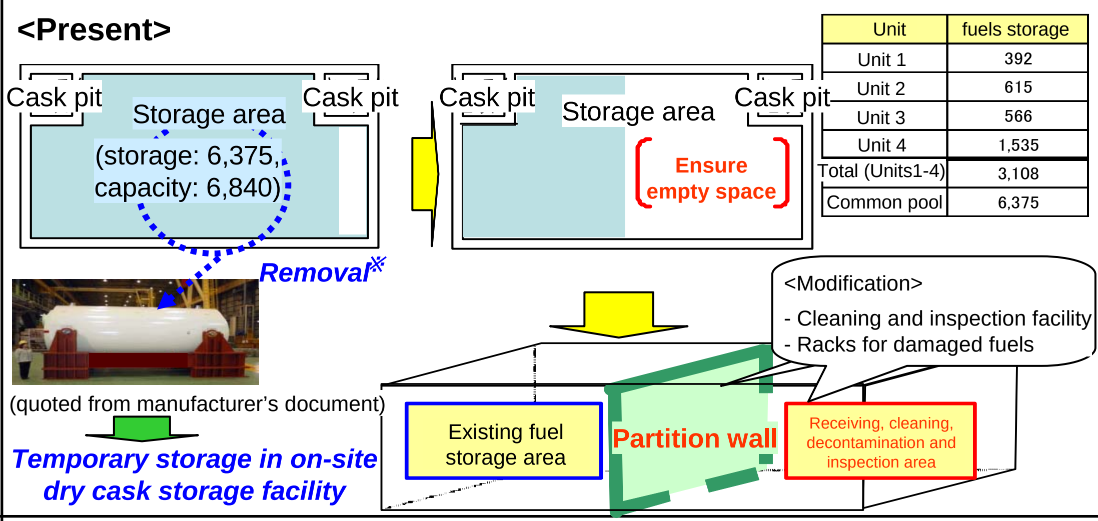
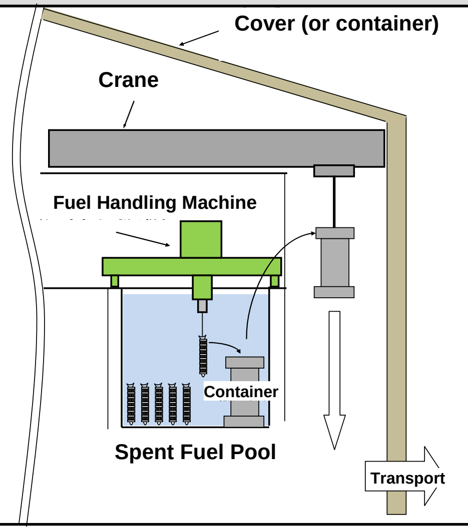
Target Timeline: 5) Fuel Removal Step from Spent Fuel Pool (1/2)



Step	(1) Rubble removal on top of R/B (ongoing in Units 3&4)	(2) Installation of cover (or container) / crane etc.	(3) Design and manufacturing of transportation / storage containers
Image	<Unit 4> 		<Example: NH-25>  (quoted from manufacturer's document)
Work	Rubble removal from top of R/B by large crane and heavy equipment.	Install R/B cover (or container) and necessary crane or fuel handling unit to remove fuels in the pool.	Design and manufacture transportation / storage containers to transfer fuels from the pool to Common pool.
R&D challenge	—	—	—
Points for safety	- Maintain stable cooling of pool water - Prevention of airborne radioactivity during rubble removal - Environmental monitoring - Reduction of workers' exposure (remote-control work etc.)	- Maintain stable cooling of pool water - Reduction of workers' exposure (airborne radiation dose reduction etc.)	—

Target Timeline: 5) Fuel Removal Step from Spent Fuel Pool (2/2)



<table>
<tr><th>Step</th><th>(4) Ensure space in Common pool / modification</th><th>(5) Removal of fuels in the pool</th></tr>
<tr><td>Image</td><td>
</td><td>
</td></tr>
<tr><td>Work</td><td>Remove existing fuels in Common pool and ensure empty space. Then install necessary partition wall, cleaning and inspection facilities and racks for damaged fuels.</td><td>Confirm fuels are intact (observation and load test etc). Put damaged fuels into containers. Transport removed fuels with transportation containers.</td></tr>
<tr><td>R&D challenge</td><td>- Methods of cleaning, decontamination and inspection for fuels with salt or leakage.</td><td>—</td></tr>
<tr><td>Points for safety</td><td>- Reduction of workers' exposure (normal management)</td><td>- Maintain stable cooling of pool water
- Prevention of drop of fuels
- Reduction of workers' exposure (remote control, reduction of airborne radiation dose etc.)</td></tr>
</table>

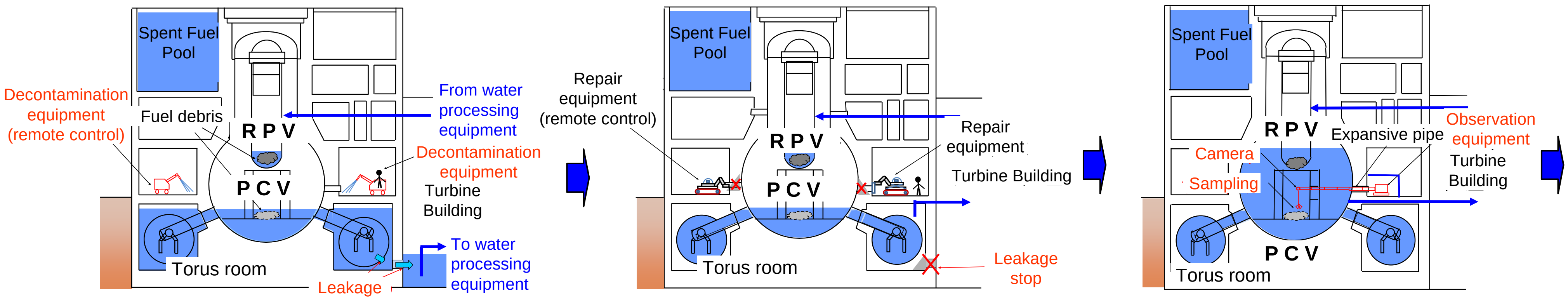
Target Timeline: 6) Fuel Debris Removal Plan

- To start fuel debris removal in the first unit within 10 years after completion of Step 2.
- Fuel Debris Removal will be implemented in accordance with the following steps in light of the site situation, safety requirements, and R&D progress of the remote control technologies required in the operations.

a) By the end of FY2014, start a full investigation of the leaking points while applying newly developed technologies to the site and starting decontamination of the insides of reactor buildings.

b) By around the end of FY2015, plan to complete verification of “PCVs (lower part) repair technology” at the site. Plan to stop water leakage at the parts (lower part) identified in step “a)” by applying the new technologies. After this, the bottom part of PCVs will be flooded.

c) By the end of FY2016, plan to complete verification of “PCVs inside investigation technology” at the site after flooding the bottom part of PCVs, and then fully investigate the insides of PCVs.



a) Decontamination inside R/B

b) Repair and leakage stop between buildings and PCV

c) Inspection and sampling inside PCV

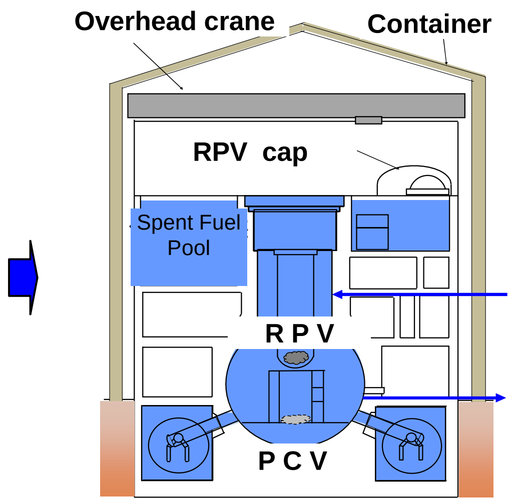
Fuel debris removal work (image)

Target Timeline: 6) Fuel Debris Removal Plan

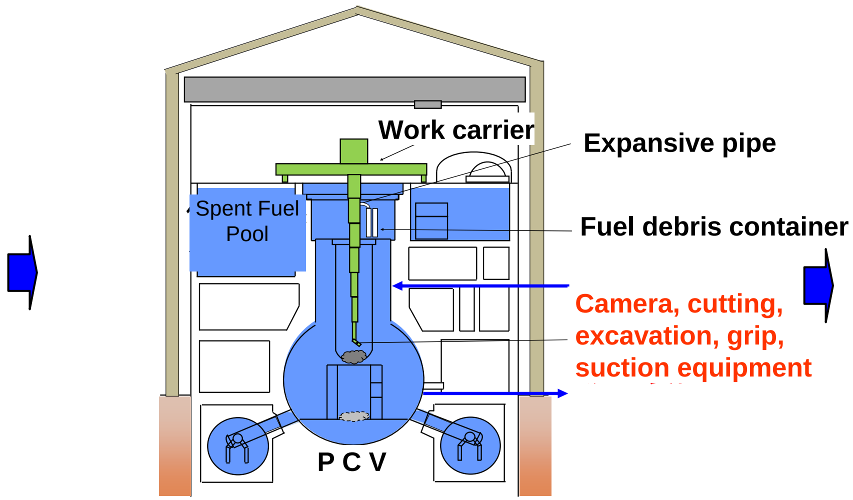
d) Plan to repair PCVs (upper part) and proceed with flooding. The RPV caps will be opened after installation of reactor building containers (or modified covers) to secure enclosed spaces.

e) By around mid 2019, plan to complete verification of “RPVs inside investigation technology” at the site, and implement a full investigation of the insides of RPVs.

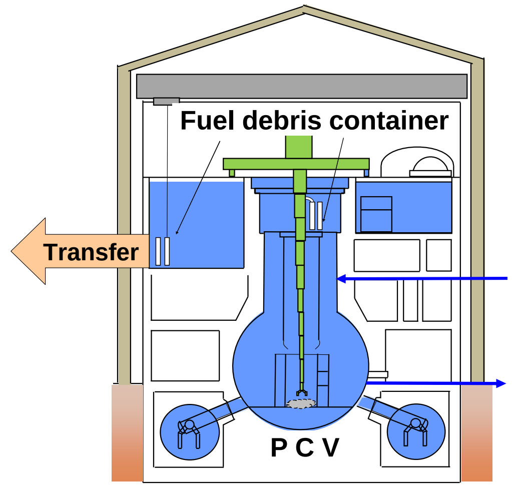
f) Following the establishment of methodologies for debris removal, the development of debris containers, and the establishment of a measuring methods to weigh fuel debris based on the results of PCVs and RPVs investigations, fuel debris removal will be commenced within 10 years after Step 2 completion.



d) Flooding, opening of RPV cap



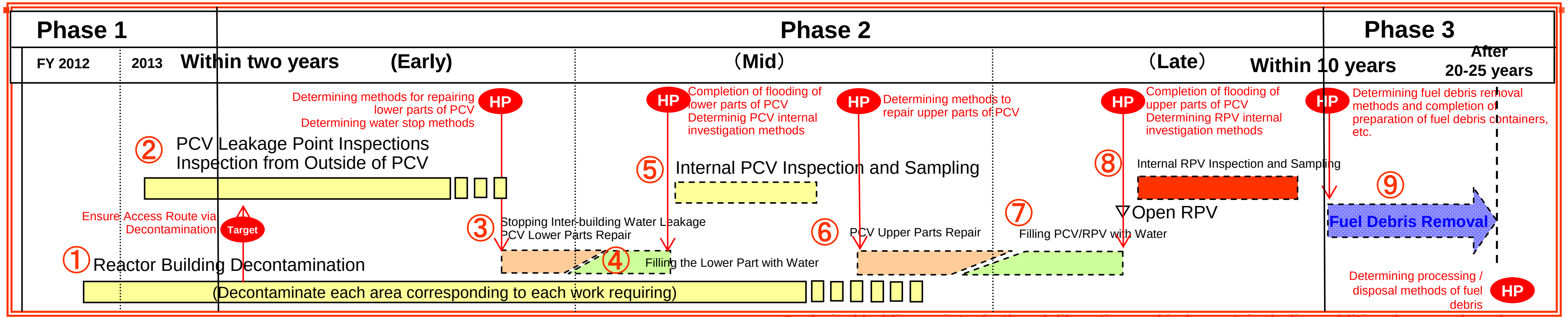
e) Inspection and sampling inside RPV



f) Removal of fuel debris

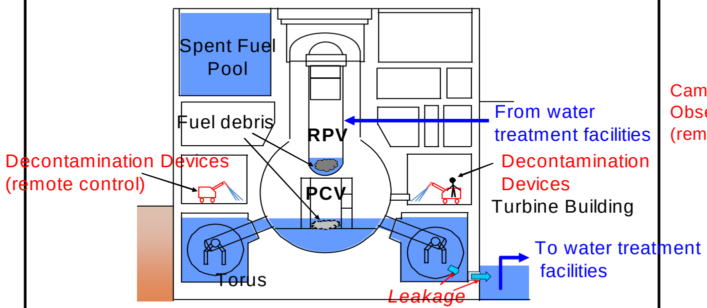
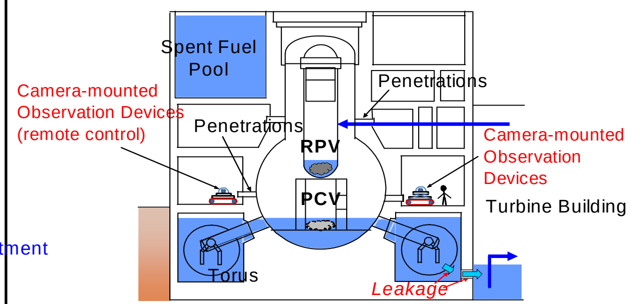
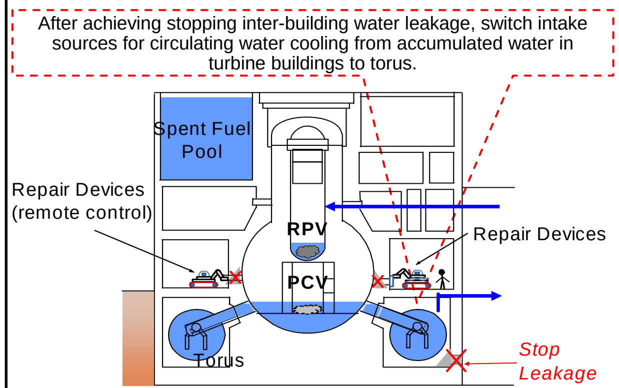
Fuel debris removal work (image)

Target Timeline: 6) Work Steps Involved in Fuel Debris Removal (1/3)

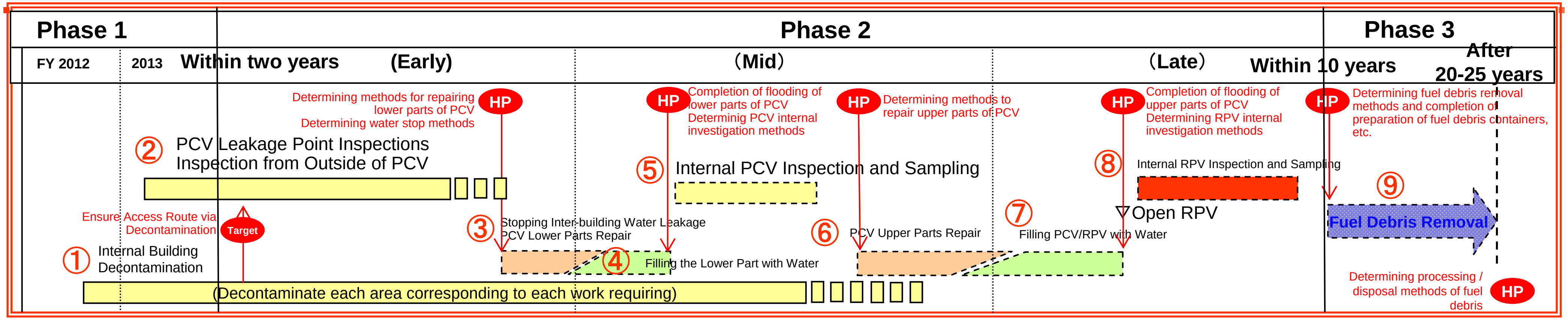


※ Work steps of removing the fuel debris underwater (as was done at TMI-2)

HP :Technical holding points. further deliberation and judgment, including additional research and development and revision of process and task content

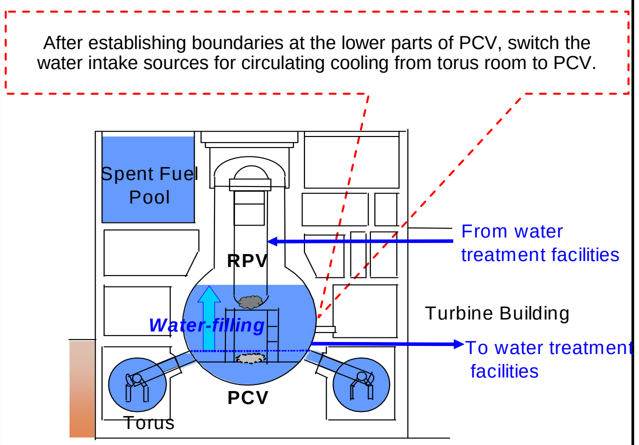
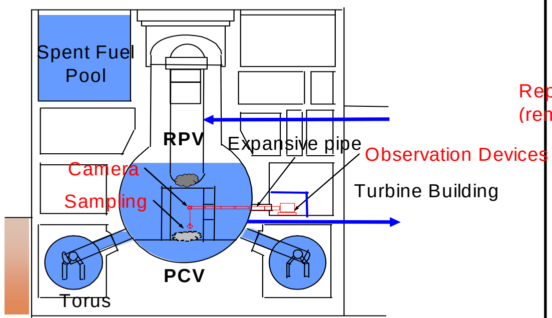
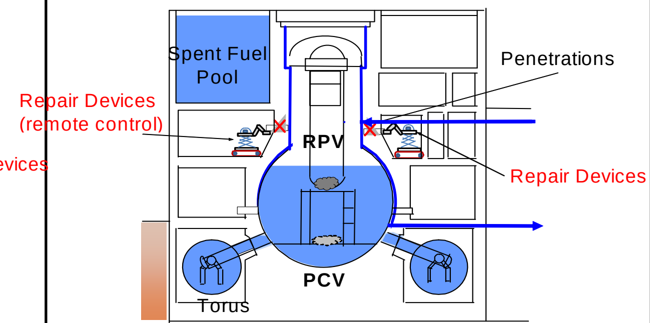
Steps	① Reactor Building Decontamination (Decontaminate each area corresponding to each work following ② sequentially)	② PCV Leakage Point Inspections Inspection from Outside of PCV	③ Stopping Inter-building Water Leakage PCV Lower Parts Repair
Images			
Contents	In order to easily access PCVs, decontaminate work area via high-pressure washing, coating, and scraping, etc.	Inspect leakage points in the PCV and reactor building via manual or remote dose measurement, and camera, etc. Estimate and inspect the status of PCV inside via measurement of gamma ray from outside of PCV, and acoustic inspection, etc.	Repair PCV leakage points and then stop water leakage because it is believed that removing debris while underwater with the radiation shielding advantage will be a reliable method. First, repair points at lower parts of PCV for internal inspection.
Points to Note on Development	◆The existence of areas of high dosage (several hundred to 1,000 mSv/h). ◆Access restriction due to rubble scattered about inside R/B. ・ Remote decontamination methods corresponding to the above need to be considered and established.	◆Inspection areas may be located in highly radioactive environments, under contaminated water, and in narrow space. ・Develop leakage point inspection methods and devices. ・Develop methods and devices for internal inspection from outside of PCV.	◆While continuing water injection for circulating water cooling, stop water leakage under highly radioactive and water flowing conditions. ・Develop technologies and methods to repair leakage points and stop water leakage. ・Consider and develop alternatives.
Points to Note on Ensuring Safety	・Maintain RPV cooling in a stable state ・Prevent radioactive materials scattering during decontamination ・Reduce workers' exposure (remote control, shielding, etc.)	・Maintain RPV cooling in a stable state ・Reduce workers' exposure (remote control, shielding, etc.)	・Maintain RPV cooling in a stable state ・Reduce workers' exposure (remote control, shielding, etc.)

Target Timeline: 6) Work Steps Involved in Fuel Debris Removal (2/3)

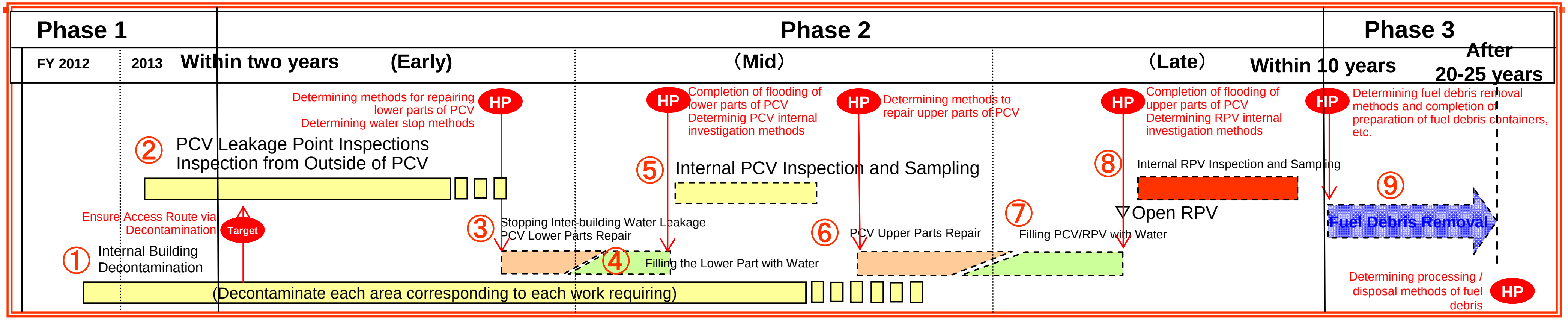


※ Work steps of removing the fuel debris underwater (as was done at TMI-2)

HP :Technical holding points. further deliberation and judgment, including additional research and development and revision of process and task content

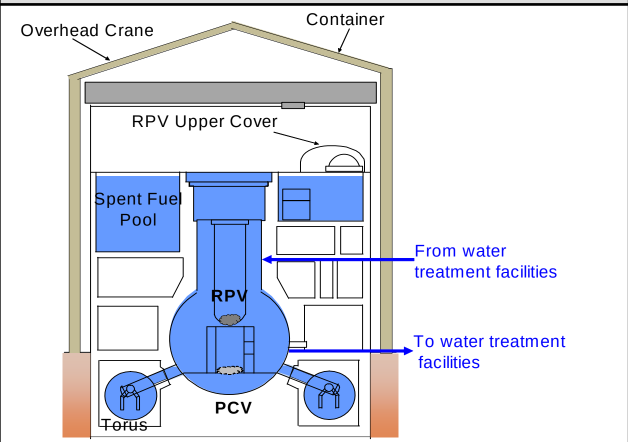
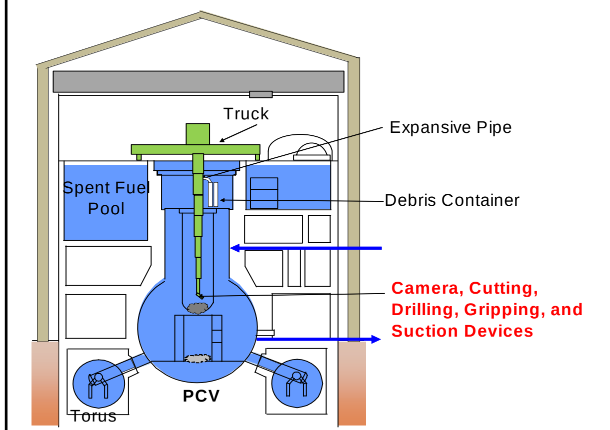
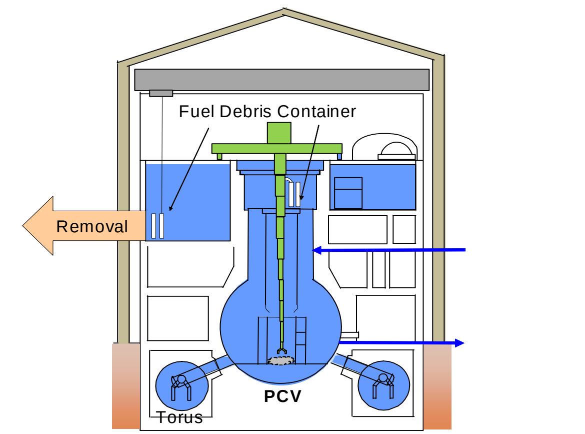
Steps	④ Filling the Lower Part with Water	⑤ Internal PCV Inspection and Sampling	⑥ PCV Upper Parts Repair
Images			
Contents	Partially fill the lower parts of PCV with water before starting PCV internal inspection.	Ascertain distributions of fuel debris flowed from RPV by internal PCV inspections and samplings etc.	In order to fill the PCV full with water, repair leakage points at the upper parts of PCV by manual or remote methods.
Points to Note on Development	◆Same as ③ ・Place top priority on establishing boundaries at the lower parts of PCV (including filling torus room with grout materials).	◆ Access restriction due to high radioactive conditions and unknowing PCV internal conditions (clearness of internal water, existence of debris, etc.) ・Develop remote inspection methods and sampling methods corresponding to the above.	◆ Same as ② ・ Develop technologies and methods to repair PCV leakage points and stop water leakage (same as ③).
Points to Note on Ensuring Safety	・Maintain RPV cooling in a stable state ・Subcritical assessment	・Maintain RPV cooling in a stable state ・Subcritical assessment ・Prevent radioactive substances release from PCVs ・Reduce workers' exposure (remote control, shielding, etc.)	・Maintain RPV cooling in a stable state ・Reduce workers' exposure (remote control, shielding, etc.)

Target Timeline: 6) Work Steps Involved in Fuel Debris Removal (3/3)



※ Work steps of removing the fuel debris underwater (as was done at TMI-2)

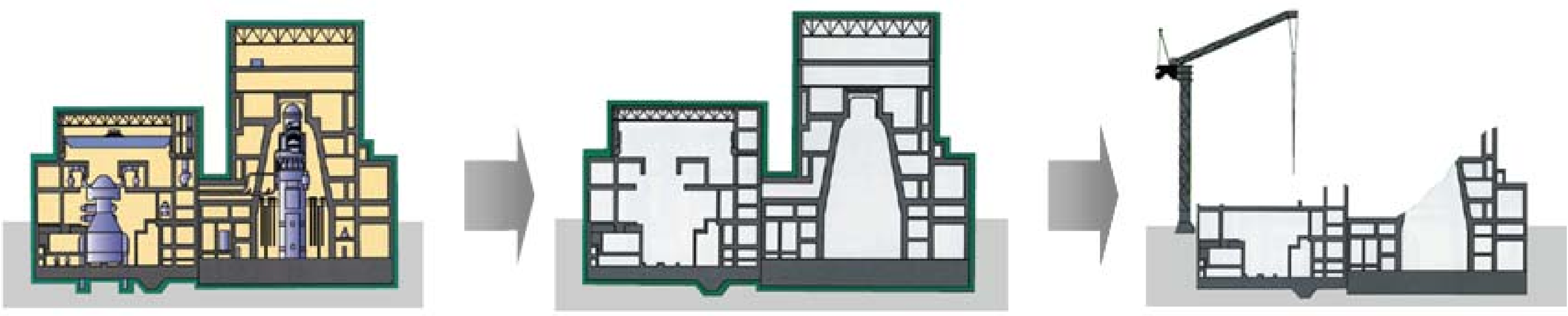
HP :Technical holding points. further deliberation and judgment, including additional research and development and revision of process and task content

Steps	⑦ Filling PCV and RPV with Water ⇒ Open the upper cover on RPV	⑧ Internal RPV Inspection and Sampling	⑨ Fuel Debris Removal
Images			
Contents	After filling PCV/RPV with enough water to ensure shielding, open the upper cover on RPV.	Ascertain conditions of fuel debris and internal RPV structures by internal RPV inspections and samplings etc.	Remove debris inside RPV and PCV
Points to Note on Development	(Place top priority on establishing PCV boundaries as per ⑥)	◆Restricted access route due to high radioactive conditions and unknown internal RPV conditions (clearness of internal water, existence of debris, etc.) ・Develop remote inspection methods and sampling methods based on the above.	◆Expand technology development scope depending on distribution status of fuel debris (No experience of fuel removal of inside PCV at TMI) ・Develop more sophisticated technologies and methods than those of TMI
Points to Note on Ensuring Safety	・Maintain RPV cooling in a stable state ・Subcritical assessment ・Prevent radioactive substances release from PCVs	・Maintain RPV cooling in a stable state ・Subcritical assessment ・Store the removed fuel debris (containment etc.) ・Reduce workers' exposure (remote control, shielding, etc.)	・Maintain RPV cooling in a stable state ・Subcritical assessment ・Store the removed fuel debris (containment etc.) ・Reduce workers' exposure (remote control, shielding, etc.)

Target Timeline: 7) Reactor Facilities Demolition Plan
8) Radioactive Waste Processing and Disposal Plan

- Plan to complete the reactor facilities demolition in Units 1 to 4 within 30 to 40 years after the completion of Step 2.
- Plan to commence demolition in Phase 3, after confirmation of establishing a basic database of contamination necessary when considering demolition and decontamination methods, R&D progress for remote controlled demolition operations, and an outlook for the waste disposal after demolition with necessary regulatory modifications.

- Characteristic tests by heating and solidifying mockup wastes are ongoing to investigate long-term storage and disposal methodology of secondary waste from the water processing facilities (until 2013).
- Analyses of accumulated water and rubbles etc. are ongoing to estimate radionuclide concentration in wastes which is important in the process of disposal. R&D also started to develop technologies to analyze radionuclide for which appropriate methodology is not established.
- Within FY2012, plan to establish an R&D plan for the post-accident waste, whose contents differ from the ordinary waste. (nuclide composition, salt amount, etc.)
- Plan to determine waste form specifications, after confirmation of safety and applicability to the existing disposal concept as well as developing safety regulations and technical standards based on the result of R&D activities.
- Plan to commence treatment and disposal during Phase 3, after development of disposal facilities and preparation of a prospective disposal plan.



Nuclear Reactor Facilities Demolition (Image)

Target Timeline: 9) Preparation of Organization and Environment for Smooth Work

- Since January 2012, on-site work has not interfered by any lack of personnel.
- Although the engaged personnel in 2012 is expected to exceed the personnel plan (approx. 11,700 persons) finally, there are approx. 24,300 persons registered for work in Fukushima Daiichi Nuclear Power Station as of May 2012 and thus lack of personnel is not expected.
- Countermeasures against heat stroke were introduced from May 2012 to secure workers' safety. Coveralls with better breathability were also introduced from late June 2012.
- Screening and decontamination facilities for vehicles started test operation in Fukushima Daiichi from April 2012 and started full-scale operation after Restricted Area in Naraha was released on August 10, 2012. New entrance management facility (for screening, protective clothing and radiation counters) will be constructed near the main entrance of Fukushima Daiichi by the end of FY2012.
- Following improper use of alarming pocket dosimeter (APD) by some workers, impact assessment on radiation control and consideration/operation of preventive measures are ongoing. Workers are continued to be instructed strictly to comply with radiation control rules.

Fundamental philosophy behind conducting the R&D

(1) Addressing needs in the field

- This R&D aims to address necessary technical issues required to carry out the plan to remove fuels from spent fuel pools, remove fuels debris inside the reactors, and complete other steps in the process of decommissioning the plant.
- The scope of this R&D includes conducting on-site field tests since the results of this R&D will be used directly in works related to the decommissioning.
- When R&D achievements are realized, the determination as to whether or not to proceed to the next stage will be made after evaluating the feasibility and validity of technical development.
- Alternative measures will be considered in advance for challenges such as water shielding techniques that could present considerable technical hurdles.

(2) Desired government involvement and support

- ANRE will play a leading role in R&D plan preparation and project management, and will coordinate closely with the Ministry of Education, Culture, Sports, Science and Technology as they put together an R&D framework utilizing the expertise of those in Japan and around the world.
- NISA (new regulatory agency) will implement safety regulations in accordance with the necessary legislative system for tests and demonstrations performed in the field as part of R&D.
- TEPCO assumes responsibility for field works related to the decommissioning and will be moving steadily forward with the decommissioning plan.

(3) Open and flexible framework for actions which pool wisdom from Japan and abroad

- Will apply technologies and knowledge of experts from Japan and other countries to the R&D.
- Will properly evaluate and assess information and advice as well as feasibility of specific cooperation from government-affiliated organizations in other countries, international organizations, and private enterprises as we build an R&D framework that is effective and efficient.

Organizational Structure for R&D

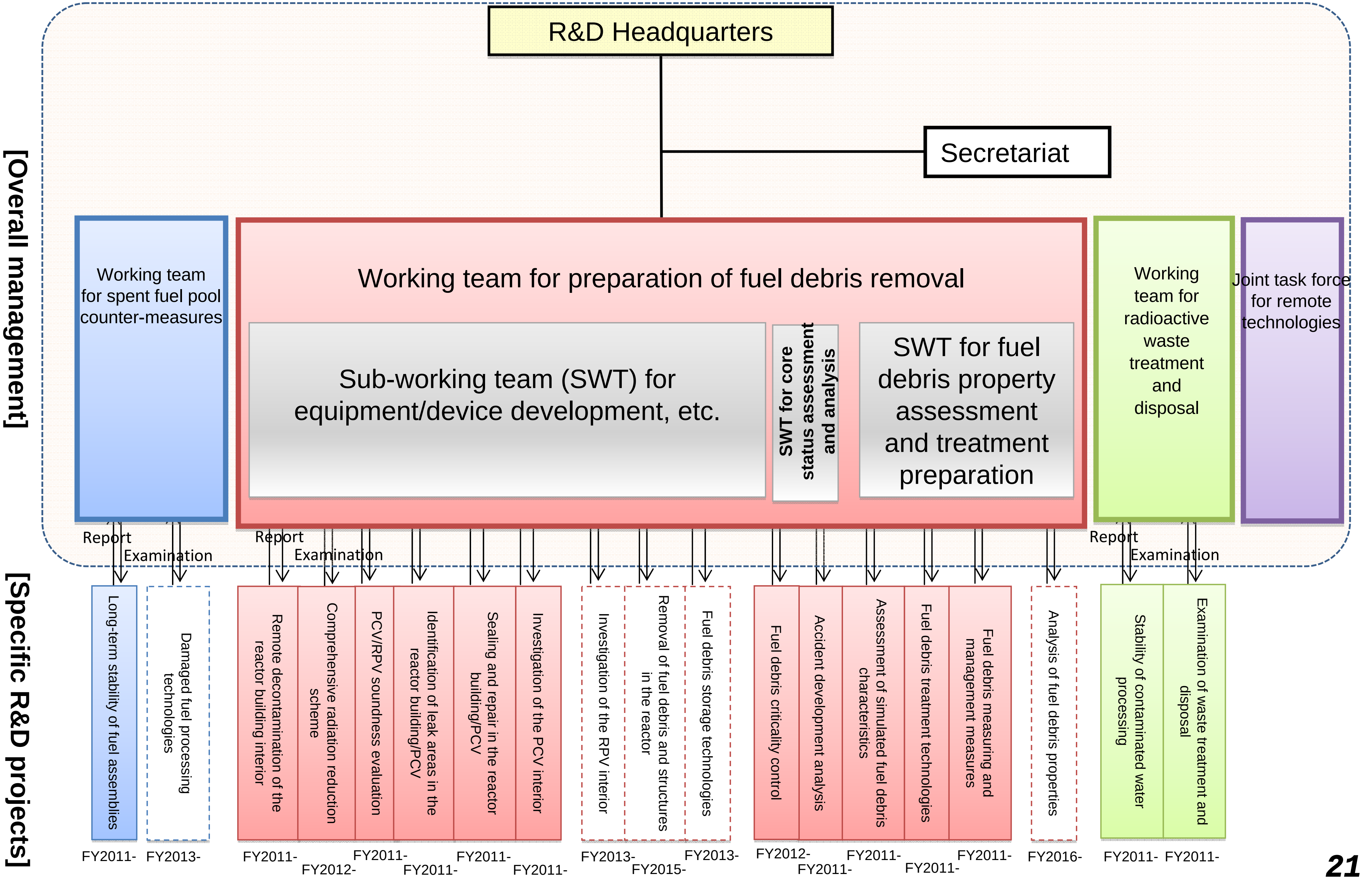


Image of Main R&D Issues related to Fuel Debris Removal

■ Development of technologies for remote decontamination of the reactor building interior

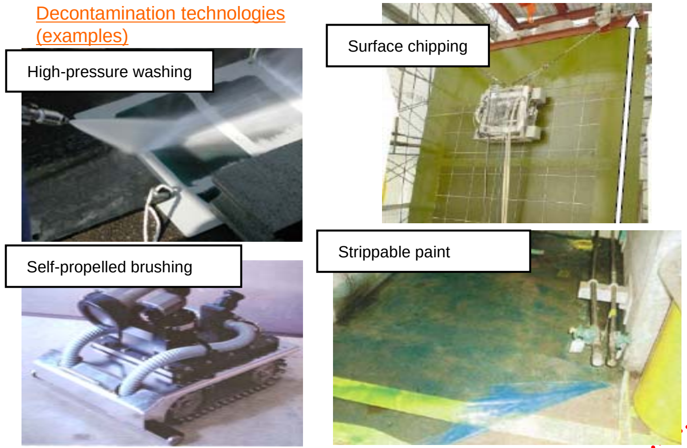
◆ Overview

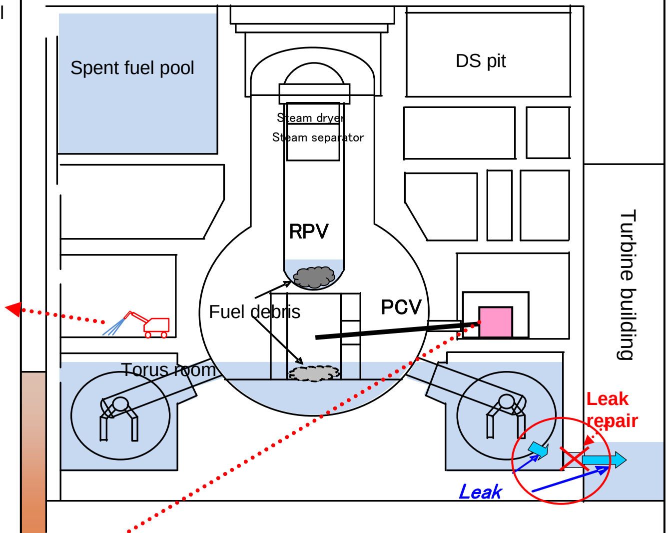
Remote decontamination devices that match onsite contamination conditions will be developed to improve the work environment for surveying and repairing leak areas, etc.

◆ Technical development issues

- Assessment and development of effective decontamination technologies in response to contamination type
- Development of remote decontamination devices for severe environments, such as high-dose areas, narrow spaces, etc.

Decontamination technologies (examples)





■ Development of technologies for identification of leak areas in the PCV

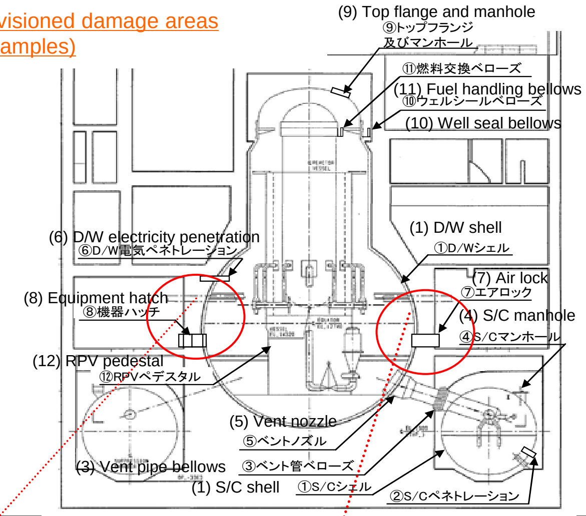
◆ Overview

Technologies for remote identification of leak areas in the PCV, etc. will be developed.

◆ Technical development issue

- Development of remote survey technologies for severe environments, such as high-dose areas, narrow spaces, etc.

Envisioned damage areas (examples)



■ Development of technologies for investigation of the PCV interior

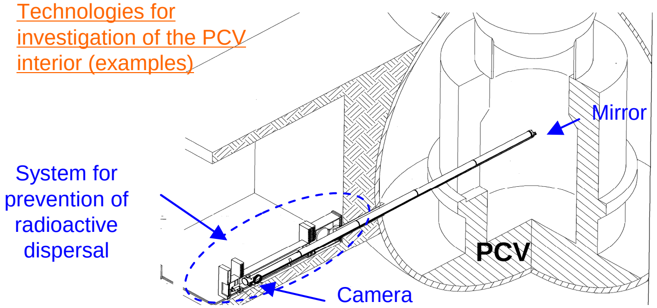
◆ Overview

Remote investigation methods and devices will be developed to grasp the conditions and the state of fuel debris inside the PCV.

◆ Technical development issues

- Development of remote investigation technologies for high-temperature, high-humidity, and high-dose environments
- Development of a system to prevent the dispersal of radioactive materials

Technologies for investigation of the PCV interior (examples)



■ Development of PCV Repair Technologies

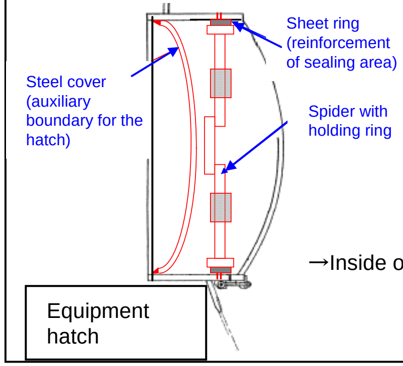
◆ Overview

Remote measures and technologies will be developed to repair and stop leaks in leaking areas (Torus room, PCV, etc.).

◆ Technical development issues

- Development of remote repair technologies for severe environments, such as high-dose areas, narrow spaces, etc.
- Repair technologies applicable to underwater environments (lower part of the PCV, etc.)

Penetration hole repair technologies (examples)



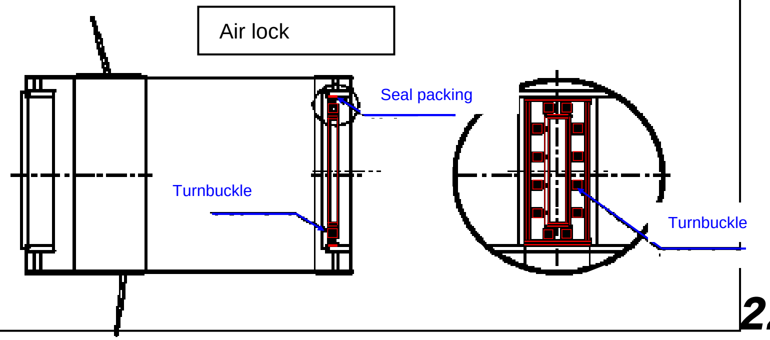


Image of R&D Issues Related to Processing and Disposal of Radioactive Waste

Output flow

1. Properties investigation

Investigation issues
• Properties differ from conventional waste, such as rubble, sludge, and decontaminated waste liquid (nuclide composition, chloride content, etc.)
• Basic information needs to be assessed for development of each technologies

Examples of differences with conventional waste
• Main nuclides: Co-60, C-14, etc.
→Fukushima Daiichi: Cs-137, Sr-90, etc.
• Sodium concentration is 5 times that of the TMI case due to 50-90% contamination by seawater
→Lower Cesium absorption performance, increased waste generation
• Presence of sludge and other materials of unknown chemical composition
→Need to identify these materials through analysis

Sludge sample (made by JAEA)

Zeolite sample

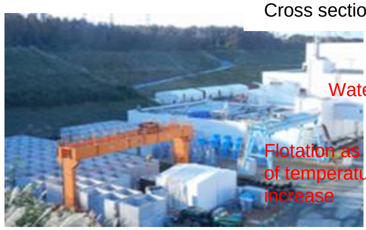
Outputs
• Radioactive concentration of each type of nuclide
• Component content
• Physicochemical characteristics
etc.

The installation of a hot lab near 1F must also be considered, as large volumes of high-dose, untransportable samples are expected to be generated as a result of decontamination and fuel debris removal.

2. Long-term storage technologies

Stabilized storage is necessary until processing/disposal technologies are established.

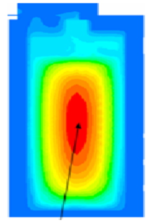
Technical development issues
• Impact of chloride (corrosion) and high radioactivity (heat generation, hydrogen, surface radiation)
• Term of storage: how long should it be?
• Is treatment necessary before storage?



Facility for secondary waste storage after water treatment (example)

Cross section B , A, C

A-A cross section
Temperature distribution



Temperature of zeolite layer
Approx. 170˚C max.
Evaluation of temperature and hydrogen distribution in a KURION absorption vessel (by JAEA)

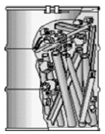
Output
• Long-term storage method for each type of waste

3. Processing technologies

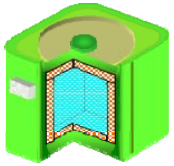
Technical development issues
• Base new technologies on existing processing technologies be applied?

Processing means that waste is placed into the vessel and solidified (cementation ,etc.), so that it can be buried in the disposal site.

Examples of waste package

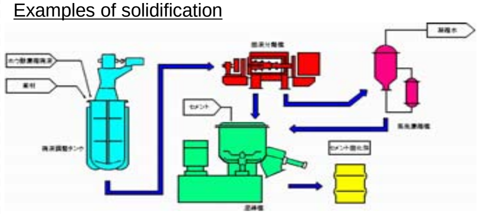


Drums



Square vessels

Examples of solidification



Basic flow in a cementing facility

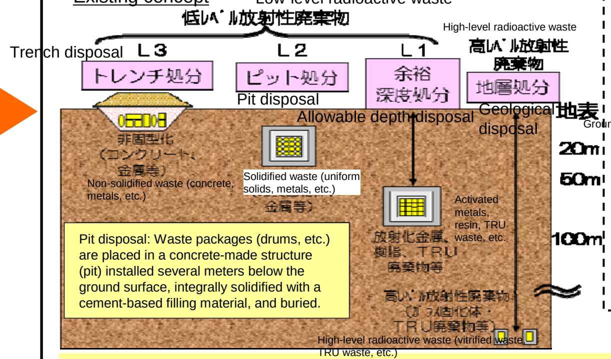
Source: Japan Atomic Industrial Forum Inc. (ed.), *Radioactive Waste Management: Technical Development and Plans in Japan*, July 1997, p.81.

Outputs
• Treatment methods for storage
• Methods for production of waste packages
• Performance of waste packages

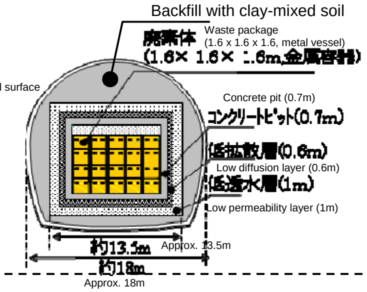
4. Disposal technologies

Technical development issues
• Base new technologies on the existing disposal concept
• Extract and address issues related to safety evaluation and find a solution

Existing concept



Example of an engineered barrier (Yoyusindo disposal)



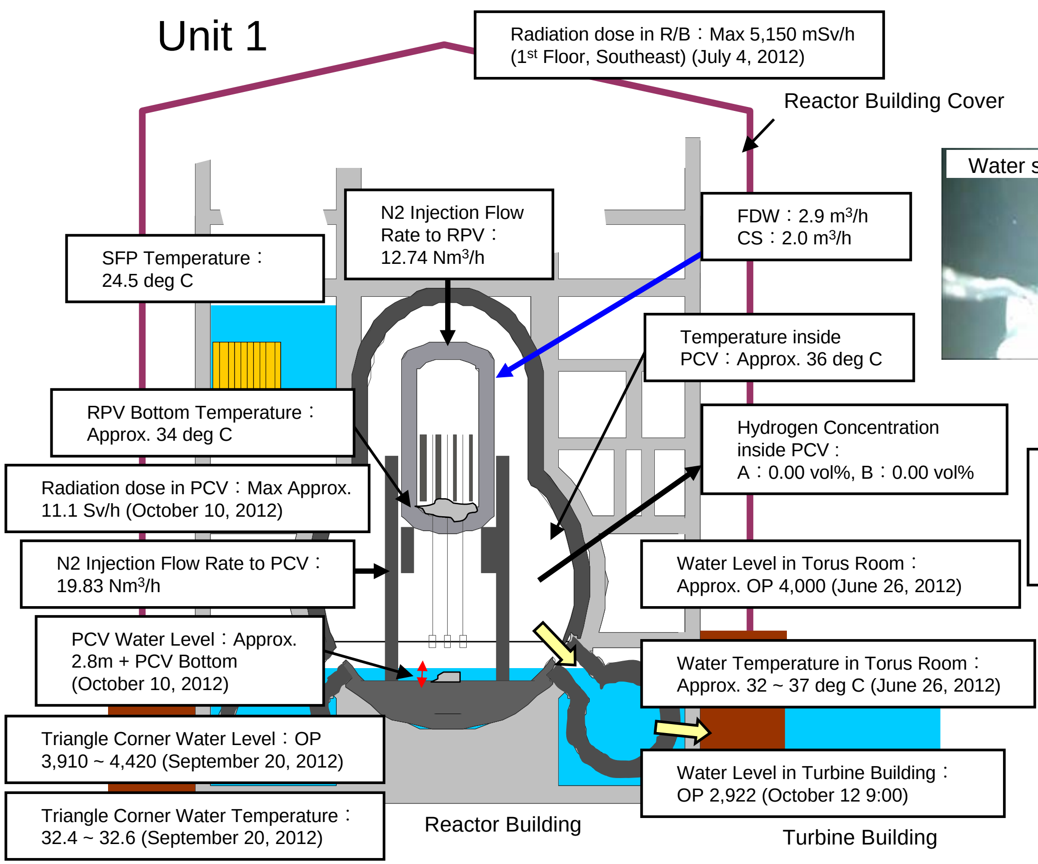
Output
• Waste disposal methods (required burial depth, construction of an engineered barrier, etc.)

New technologies need to be developed for radioactive waste that are difficult to treat with existing technologies, including a new disposal concept.

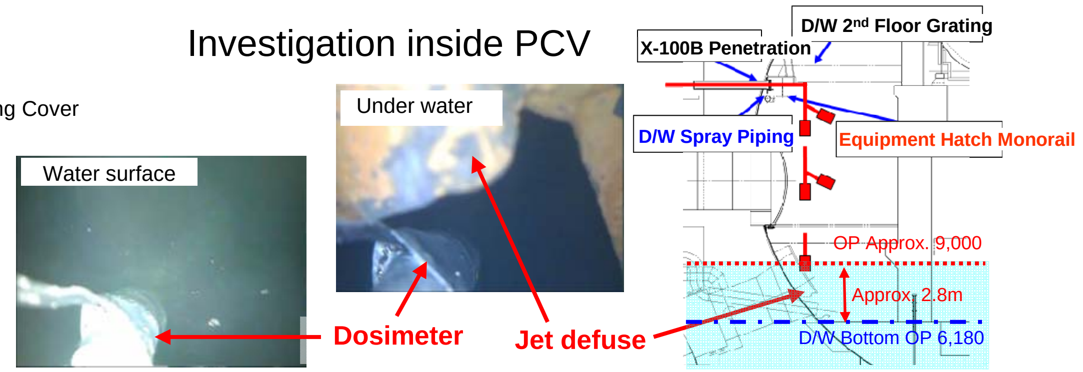
R&D started for monitoring of the reactors and removal of fuel debris

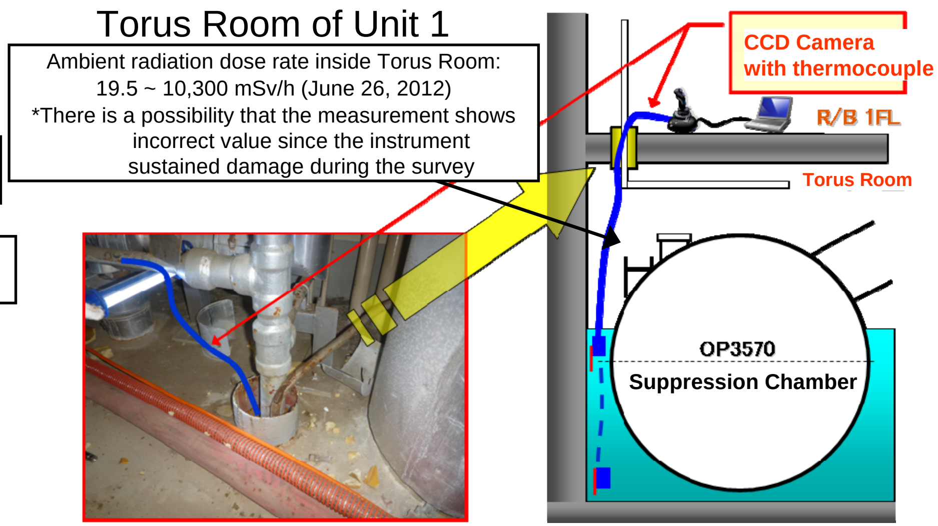
(Unit 1)

- **We investigated internal state of the PCV via inserting survey equipment** in order to obtain photos and to directly measure data; ambient temperatures, radiation dose rate, accumulated water temperatures, water level, sampling and analysis of the water ,etc. (October 10&11, 2012).
- **Investigation and repair of the PCV leakage is being considered.** Inside of Torus Room was **investigated by CCD camera inserted via penetration on the 1st floor of the Reactor Building (June 26, 2012).**



*Parameters as of October 12, 2012 5:00AM

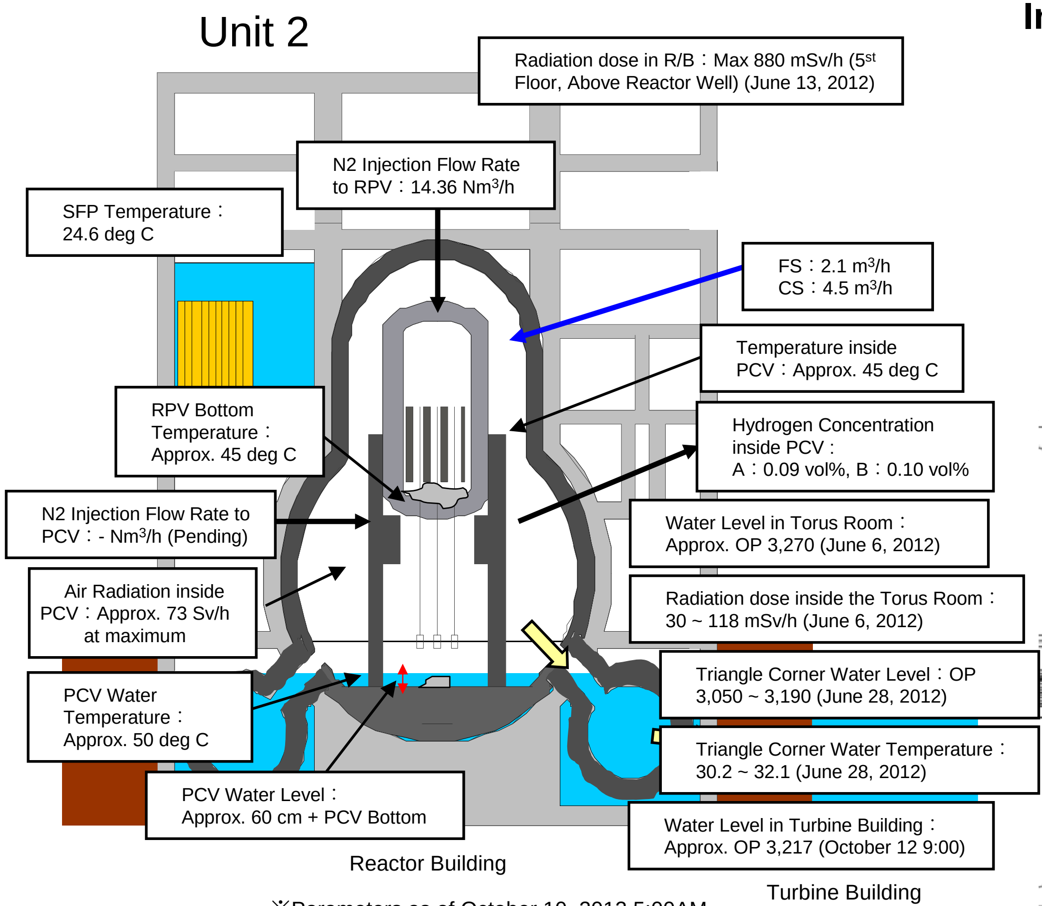




R&D started for monitoring of the reactor and removal of fuel debris

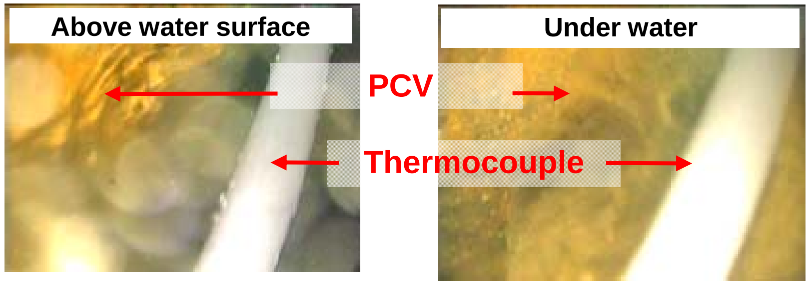
(Unit 2)

- **Investigation inside was carried out** with microscopes etc. via PCV penetration. (January 19 and March 26 & 27, 2012)
- **Investigation inside Torus Room was carried out with robots** (April 18, 2012). **Water level was measured inside Torus Room and staircases area** (June 6 and 28, 2012).

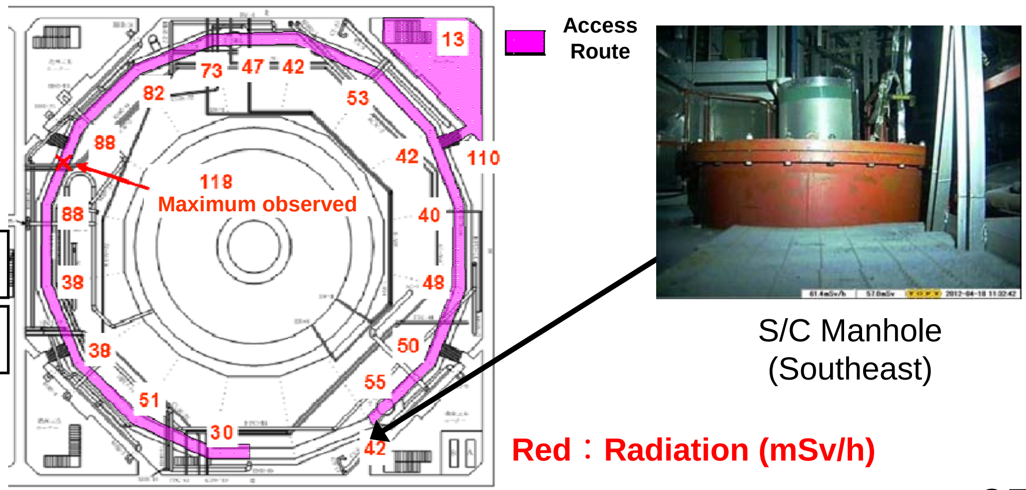


※Parameters as of October 10, 2012 5:00AM

Investigation inside the PCV



Investigation inside Unit 2 Torus (April 18)

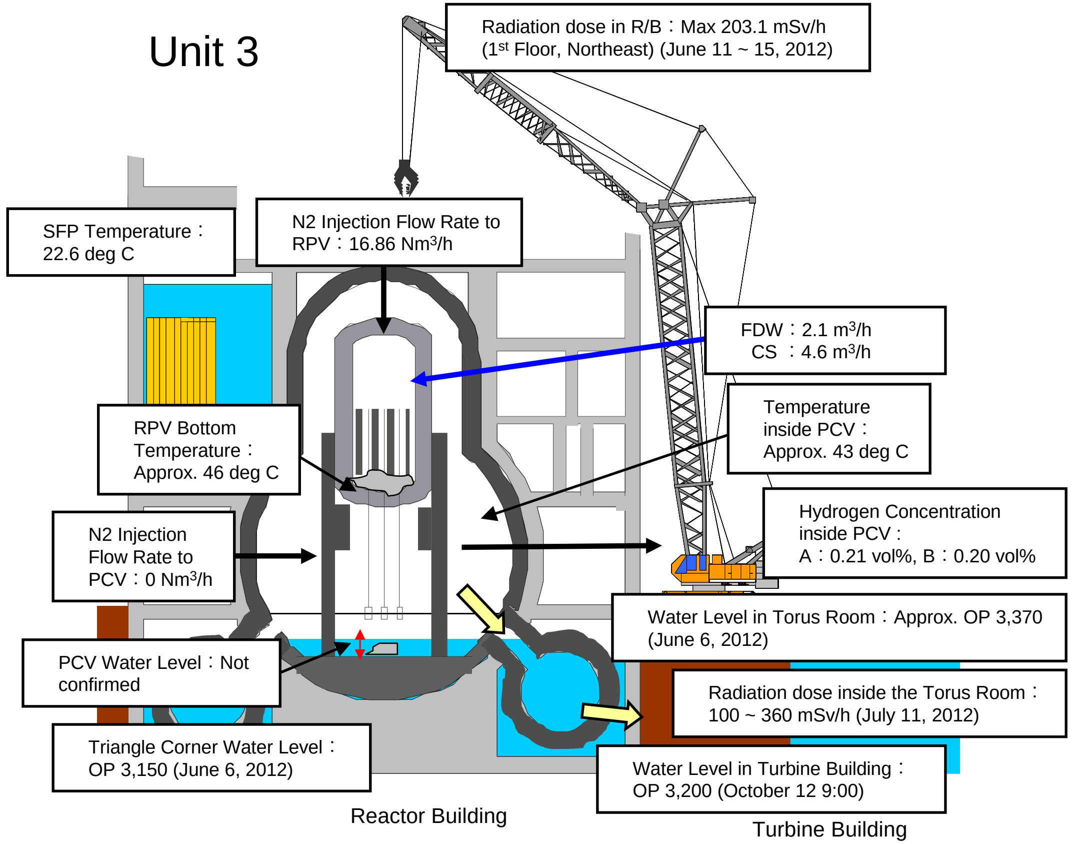


S/C Manhole (Southeast)

R&D started for monitoring of the reactor and removal of fuel debris

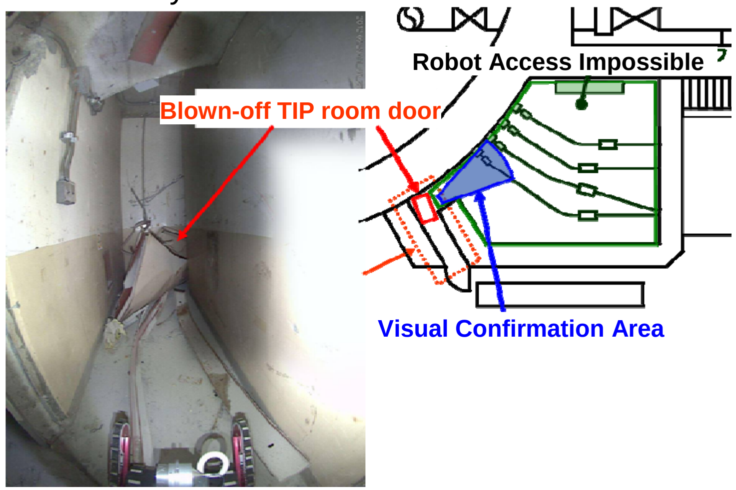
(Unit 3)

- **Work Environment was investigated by robots in TIP room on 1st floor of the Reactor Building** for preparation to investigate inside the PCV (May 23, 2012).
- **Water level was measured inside Torus Room and staircases area** (June 6, 2012). **Torus Room was investigated by a robot** (July 11, 2012).



*Parameters as of October 12, 2012 5:00 AM

Work Environment Survey inside the TIP room



Water Level Survey in Torus and staircases area of Unit 3

Unit 3 staircases area (Northwest)

Water level	Unit 3
Staircases area	OP 3150
Torus Room	OP 3370

Measured water level of accumulated water