Technical Strategic Plan 2016 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of TEPCO, Inc.

“Summary”

July, 2016

Nuclear Damage Compensation and Decommissioning Facilitation Corporation

Overall Structure of the Strategic Plan 2016

1. Introduction

2. The Strategic Plan

3. Risk reduction strategy

4. Strategic plan for fuel debris retrieval

5. Strategic plan for radioactive waste management

6. Approach to the R&D projects

7. Future Actions

1. Establishment of NDF

The structure for TEPCO to reliably address the decommissioning was established after Dec. 2011 based on the major policies described in "the Mid-and-Long-Term Roadmap" determined by the Japanese Government.

Government

Determine Mid and Long-Term Roadmap

(Developed in Dec. 2011, revised in Jun. 2013 and Jun. 2015)

Stabilization	Phase 1	Phase 2	Phase 3
Dec 2011 Establishment of the Roadmap	Dec 2013 2 years later	Dec 2021 10 years later	30 to 40 years later
	Period until the commencement of fuel removal from SFP	Period until commencement of fuel debris retrieval	Period until the end of decommissioning of Units 1 to 4

TEPCO

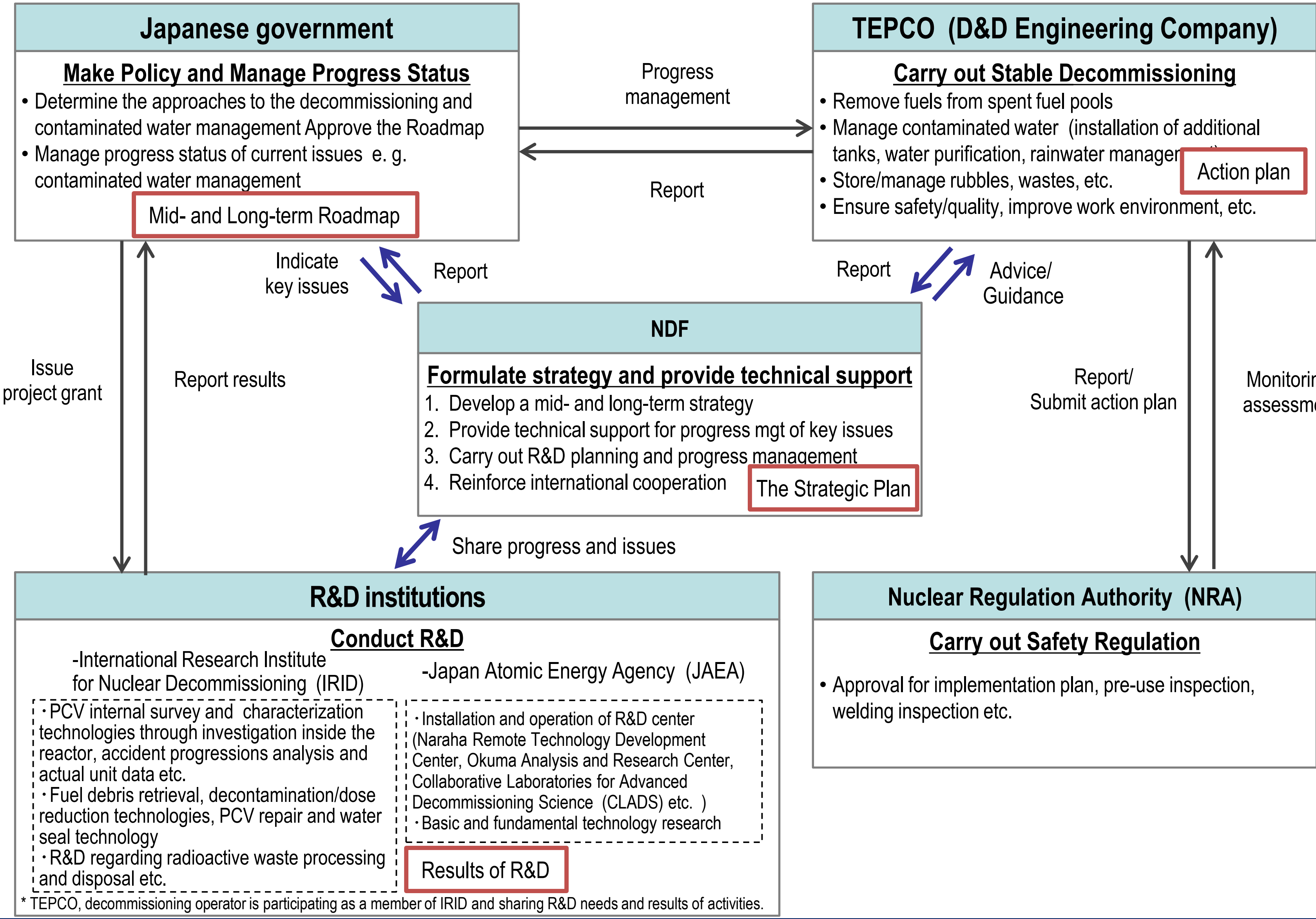
Implement decommissioning

Source: TEPCO's website

Strengthening the framework so that the Japanese Government at the forefront to make steady progress in the decommissioning of the Fukushima Daiichi NPS.

Nuclear Damage Compensation & Decommissioning Facilitation Corporation established on August 18, 2014.
(Reorganization of Nuclear Damage Compensation Facilitation Corporation)

1. Role Sharing of Decommissioning and Contaminated Water Management



1. Purpose of the Strategic Plan and Relationship with the Roadmap

Goals and policies presented by the Government

Key elements of strategies, policies and plans determined by the Government

"Roadmap" determined by the Government

1. Strategy

- The approach toward the objectives, concept of the decision-making and order of priorities

2. Specific policies to implement the strategy

- Concrete policies and requirements to conduct activities and make decisions

3. An integrated plan to implement the strategy

- A comprehensive plan to conduct field work and R&D

Strategic Plan developed by NDF

Official name: Technical Strategic Plan 2016 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc.

Detailed decommissioning plan by TEPCO and research institutions (field work, engineering and R&D)

- Decommissioning performed by TEPCO
- R&D by research institutions

1. Positioning and Purpose of the Strategic Plan 2016

FY 2015 | FY 2016 | FY 2017 | FY 2018

Milestones of Mid-and-Long-Term Roadmap.

Determination of fuel debris retrieval policies for each unit

Establishment of basic concept of processing/disposal

Determination of fuel debris retrieval methods for the first implementing unit

Purpose: To contribute to steady implementation and revision of the Roadmap in order to facilitate appropriate and steady decommissioning of the Fukushima Daiichi NPS and to provide a firm technical base to the Roadmap.

Published Apr. 30, 2015

Strategic Plan 2015

- Concept and approaches

Publication Jul. 13, 2016

Strategic Plan 2016

Strategic Plan 2017

- Fuel debris retrieval policies for each unit
- Outline of basic concept of processing/disposal for solid radioactive wastes

Strategic Plan 2018

- Fuel debris retrieval methods for the first implementing unit

The strategic Plan 2016 develops the detailed method and studies according to the concept and approaches of the Strategic Plan 2015 towards 2017 and 2018.

2. Progress over the Last One Year

- Management of contaminated water
  - [Remove] Water purification using Advanced Liquid Processing System and water leakage prevention from the sea water piping trenches are underway.
  - [Isolating] Groundwater bypassing, reduction of the amount of water flowing into the R/B by subdrain systems, and the freezing operation of the land-side impermeable walls started.
  - [Preventing leakage] Pumping out the groundwater through the subdrain system with the sea-side impermeable walls closed.
- Spent fuel removal from SFP
  - Unit 1 : Dismantling the building cover and removing rubble.
  - Unit 2 : All the upper part of the R/B will be disassembled.
  - Unit 3 : Completed removal of large sized rubbles in the Spent Fuel Pool (SFP).

Cleanup for the periphery of Unit 2 building


Muon detection equipment (Small device)

- PCV internal survey
  - Unit 1 : Performing investigation using muon detection system and PCV internal survey using the robots.
  - Unit 2 : Preparing measurement using muon detection system and PCV internal survey using the robots.
  - Unit 3 : Obtained information using inspection device.
- Radioactive waste
  - Increased in the stored inventory because of the secondary waste generated due to the progress of contaminated water treatment and solid radioactive waste caused by removal of rubble.
  - Reinforced the system of the waste management department and reduced the generated amount of radioactive waste.
  - Released waste storage plan for the next decade.
- Work environment
  - Reduced on-site radiation dose (additional effective dose of less than 1mSv/year at the site boundary).
  - Performing decontamination but it takes time to reduce dose rate in the high radiation area of the building.
- R&D activities
  - Established the Decommissioning R&D Partnership Council in the NDF, enhancing R&D through the promotion of collaboration with the relevant institutions.
  - Established Collaborative Laboratories for Advanced Decommissioning Science (CLADS) by JAEA as an international R&D organisation.
  - Started the operation of "Naraha Remote Technology Development Center" where development/demonstration tests are performed for remotely controlled device (robotics etc.)

2. Guiding Principles for the Strategic Plan

- **<u>Fundamental policy for the "decommissioning" of the Fukushima Daiichi NPS</u>**
  - ➢ The decommissioning of the Fukushima Daiichi NPS is to continuously and promptly reduce the risks associated with the radioactive materials generated by the accidents.
  - ➢ The Strategic Plan is "a design of risk reduction strategy" on a mid- and long- term basis.

- **<u>Five Guiding Principles for Risk Reduction</u>**

✓ Principle 1: **<u>Safe</u>**	Reduction of risks posed by radioactive materials* and ensuring work safety (*Environmental impact and worker's exposure)
✓ Principle 2: **<u>Proven</u>**	Highly reliable and flexible technologies
✓ Principle 3: **<u>Efficient</u>**	Effective utilization of resources (e.g. human, physical, financial and space)
✓ Principle 4: **<u>Timely</u>**	Awareness of time axis
✓ Principle 5: **<u>Field-oriented</u>**	Thorough application of Three Actuals (actual field, actual things and actual situation)

3. Risk Reduction Strategy (1)

Basic concept

- Decide the measures for risk reduction by identifying various radioactive materials, performing analysis and evaluation based on their characteristics, and then deciding priorities.
- Identify and appropriately manage “the project risks” that can significantly affect the progress of the decommissioning project.
- It is important to proceed with decommissioning in cooperation with the community, through gaining the understanding by the stakeholders, including the local residents.

Major risk source

- The major risk sources at the Fukushima Daiichi NPS include as follows.
  - Fuel debris
  - Pooled fuels, common pooled fuels and fuels in dry cask
  - Contaminated water in the buildings and concentrated liquid waste
  - Secondary waste generated from the water treatment (waste adsorption column, waste sludge and HIC slurry)
  - Radioactive solid waste
  - Contaminated PCV internal structures and R/B internal, activated reactor internals (e.g. "PCV internal structures")

3. Risk Reduction Strategy (2)

(1) Risk of radioactive materials (Risk level)

- Determined by (2) "Consequence," which is the impact caused when radioactive materials are released and (3)"Likelihood of occurrence".
- Analyze risks referencing the SED score* developed by Nuclear Decommissioning Authority in the U. K. (NDA)
  *Safety and Environmental Detriment Score

(2) Hazard Potential (Index of "Consequence")

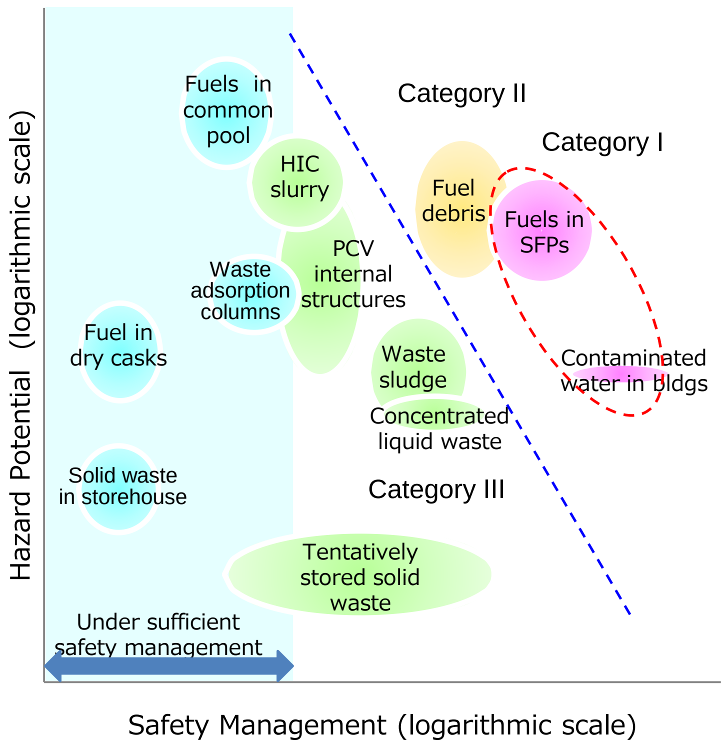
- Use SED score as it is.
- Consider the amount of all radioactive materials, properties (e.g. gaseous, liquid and solid) and the time allowable until recovery in the event of a loss of safety function.

(3) Safety Management (Likelihood of loss of containment function)

- Partially revised to flexibly cope with the situation of the Fukushima Daiichi NPS referencing the SED score.
- Graded and quantified the risk sources by the factors of likelihood relating to the integrity of the facilities and monitoring state.

Sample of risk analysis of the Fukushima Daiichi

*Impact of uncertainties is expressed by "extent. "



3. Risk Reduction Strategy (3)

● Risk source category and action policy

Category I : Risk sources to be addressed as soon as practicable (Pooled fuels and contaminated water in the buildings)

- Transfer the pooled fuels to the common pool which has a sufficiently small Safety Management.
- Process the contaminated water in the buildings and store radioactive materials in a safe manner as a secondary waste generated from the water treatment.

Category II : Risk source to be addressed safely, effectively and carefully with thorough preparations and technologies to realize a more stable condition (Fuel debris)

- Collect retrieved fuel debris in the storage canister designed from the safety perspective and store them in more stable condition.

Category III : Risk source that requires actions to be taken for a more stable condition (e.g. Concentrated liquid waste, waste sludge, HIC slurry, part of tentatively stored solid waste and PCV internal structures)

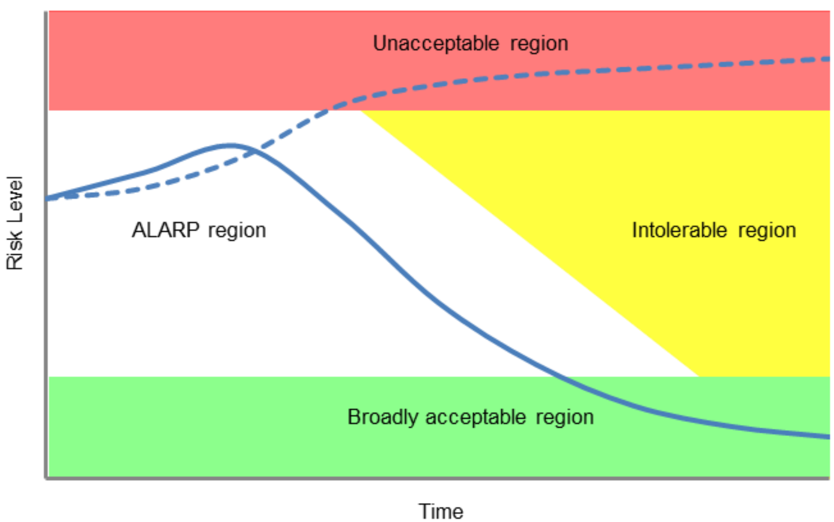
- Risk level is small but measures needs to be taken so as to ensure a stable storage over a long period of time.

Others : The common pooled fuels, fuels in dry casks, solid waste in the storage and waste adsorption column are in a sufficient safe and stable state, maintaining a sufficiently low level of risk by ensuring continuous management.

- **Considering the time axis:**
  Even if the risk source is currently in a certain stable condition, the level of the risk may arise due to degradation of facilities. Measures need to be taken in advance.
- **Risk during the work:**
  The level of the risk may arise temporarily due to the changes in the conditions of facilities and process itself during the risk reduction work. Comparison with current risk reduction effect obtained by the work should be considered.

3. Changes in the Risk Over Time

- Even if a level of risk is present in the ALARP region, it cannot remain there permanently (the yellow zone). In addition, as time passes, the level of risk could increase due to deterioration of the facilities and the risk source (Solid line).
- On the other hand, Although the level of risk may increase temporarily, the risk sources should be prevented from entering the unacceptable region (Red zone). Thus, it should be targeted to reduce the level of risk without entering the unacceptable or intolerable regions. (solid line).



- Unacceptable region
  - Risks are significant, and cannot be justified except in extraordinary circumstances.
- ALARP region (or tolerable region)
  - Risks are tolerable only when risk reduction is impracticable, or the cost incurred with risk reduction is disproportionate to the effect acquired by risk reduction.
  - As the lower a risk becomes, the higher the cost that is commensurate with the effect of risk reduction becomes, the risk should be reduced to a level as low as reasonably practicable.
- Broadly acceptable region
  - The risk is sufficiently low; it should be continuously ensured that the risk stays at this level.

Reference：V. Roberts, G. Jonsson and P. Hallington, "Collaborative Working Is Driving Progress in Hazard and Risk Reduction Delivery at Sellafield" 16387, WM2016 Conference, March 6-10, 2016.
M. Weightman, "The Regulation of Decommissioning and Associated Waste Management" Management "The 1st International Forum on the Decommissioning of the Fukushima Daiichi Nuclear Power Station (April 2016)

3. Risk Reduction Strategy (4)

● Steady progress in decommissioning project

- ◆ To make steady progress in the designed risk reduction strategy and to accomplish the fundamental policy, risks affecting the progress of decommissioning should be identified and measures against significant risks should be prepared.
- ◆ It is essential to make a clear explanation to society about the prospect of decommissioning work and to share various risks with the local residents.

(1) Project risk management

- ➢ In addition to the deployment of the concrete approach to the risk through the Strategic Plan, systematic risk management methodology is to be applied.

(2) Basic concept for ensuring safety

- ➢ To prevent the rework, the basic concept for ensuring safety is to be shared by the relevant parties in advance.

(3) Relationship with the society

- ➢ It is important to make a decision through the communication with local residents by dissemination and sharing information in timely manner.
- ➢ It is important to develop common understanding with local residents regarding that the risks required to be removed as soon as practicable from those requiring careful actions.
- ➢ To prevent further occurrence of such reputational damage, it is important to control and reduce risks and continuously provide accurate information.

4. Strategic Plan for Fuel Debris Retrieval (1)

● Study plan for fuel debris retrieval (risk reduction)

- In order to continuously and promptly reduce the risks associated with fuel debris, which is the fundamental policy, the strategy to reduce risks from two points of view from mid-and long-term will be required.
- The mid-term risk reduction is required to be focused in the initial operation of fuel debris retrieval.
- If mid-term risk is reduced and safety of the R/B is maintained by a passive method, "a low risk level widely accepted by the society" can be considered to have been achieved.

Mid-term risk

- **A risk of a deviation from "a certain stable state" which is currently maintained for the fuel debris**

Long-term risk

- **A risk of environmental contamination caused by the leakage of highly toxic nuclear fuel materials due to the deterioration of the buildings**

4. Strategy of fuel debris retrieval (2)

● Logic tree on risk reduction for fuel debris

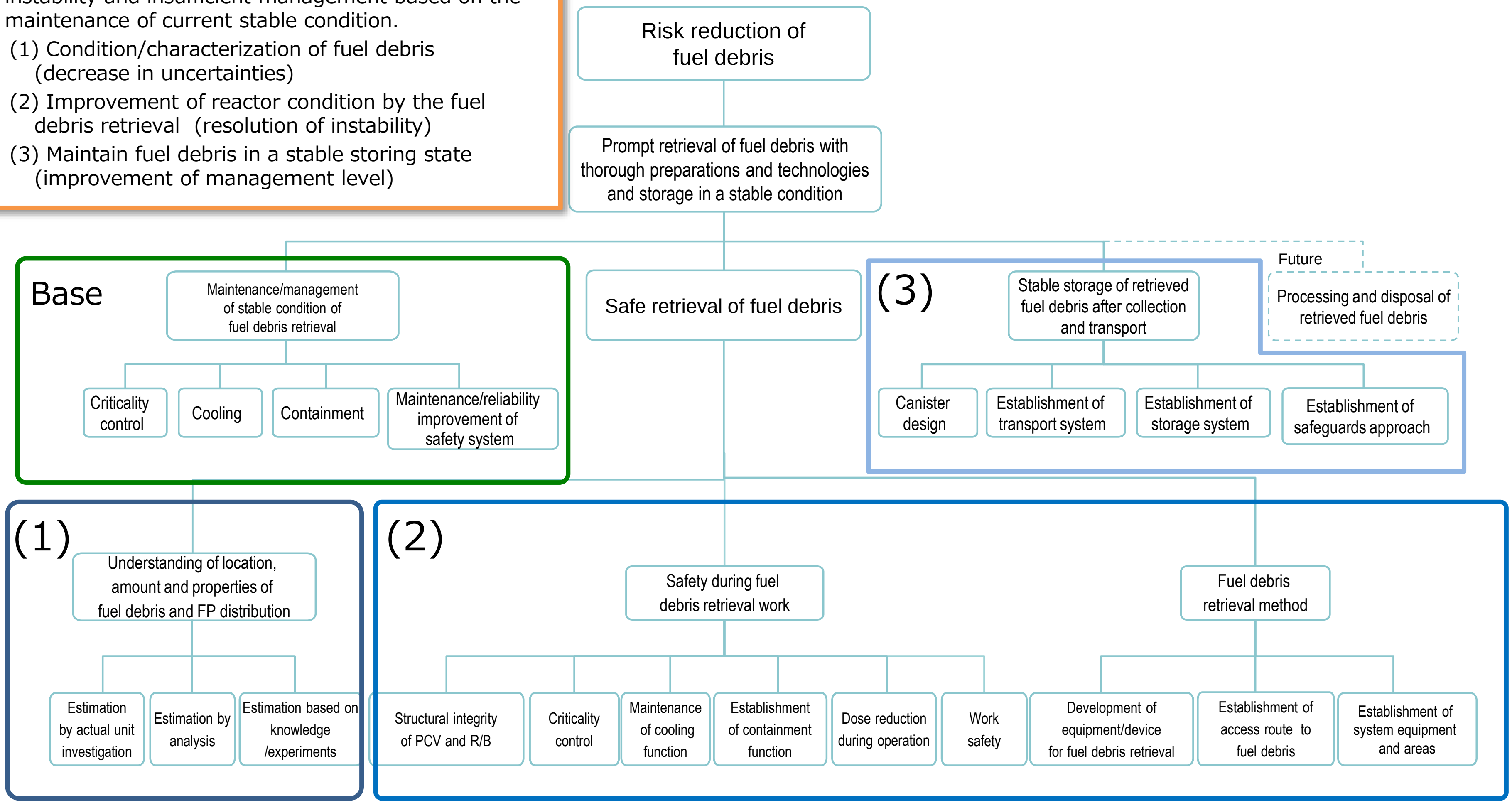
➢ Strategy to reduce mid-term risk

Studies to solve the difficulties in uncertainties, instability and insufficient management based on the maintenance of current stable condition.

(1) Condition/characterization of fuel debris (decrease in uncertainties)

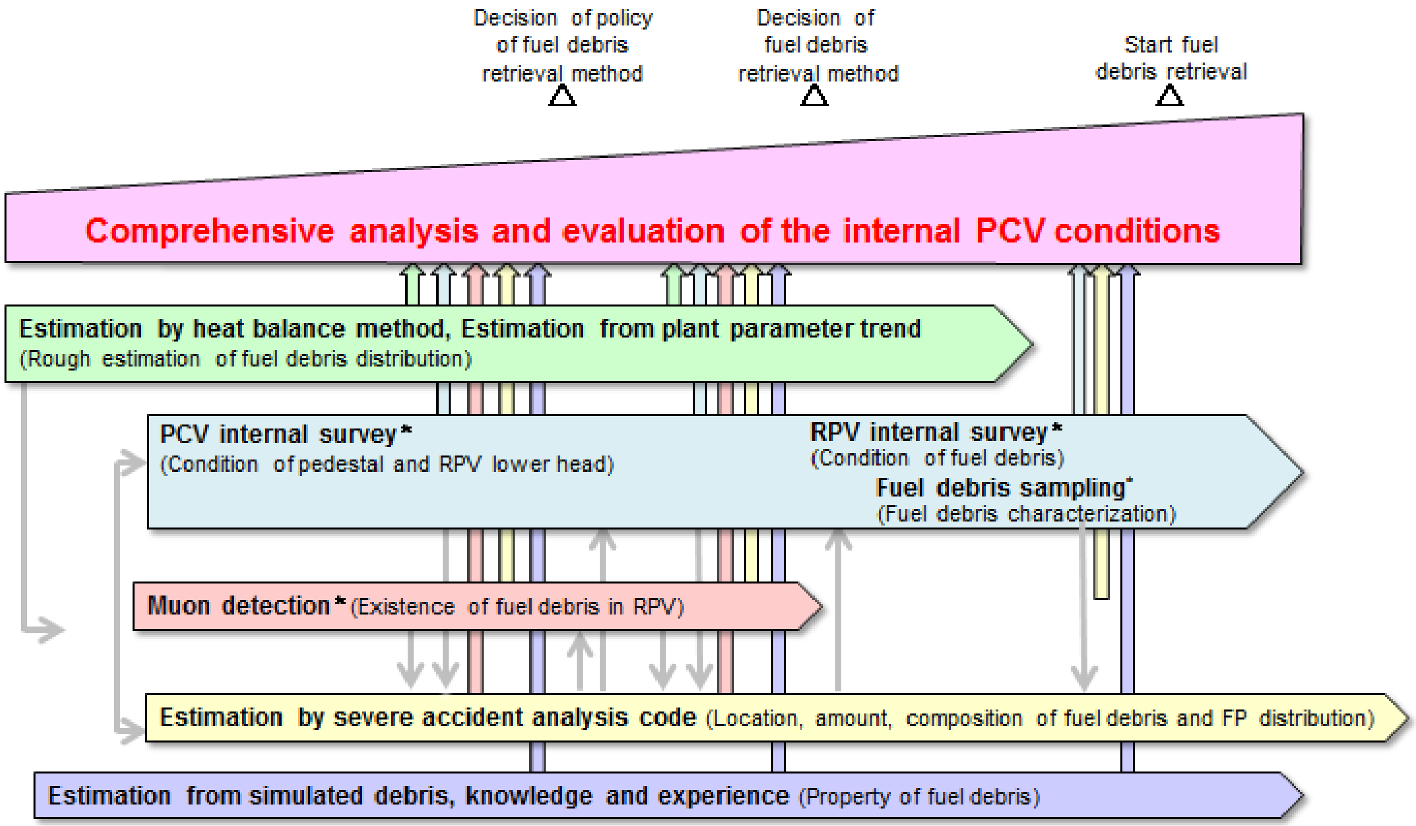
(2) Improvement of reactor condition by the fuel debris retrieval (resolution of instability)

(3) Maintain fuel debris in a stable storing state (improvement of management level)



4. Strategy of fuel debris retrieval (3)

It is extremely important to carry out the studies on the fuel debris retrieval method to understand the internal PCV conditions including plant conditions and fuel debris.



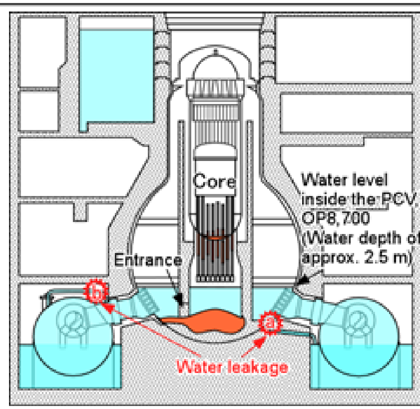
* Determine the survey contents considering the balance of cost of development/survey, period, exposure dose and the obtained information

➢ Based on the new findings, continuously improve the comprehensive analysis/evaluation

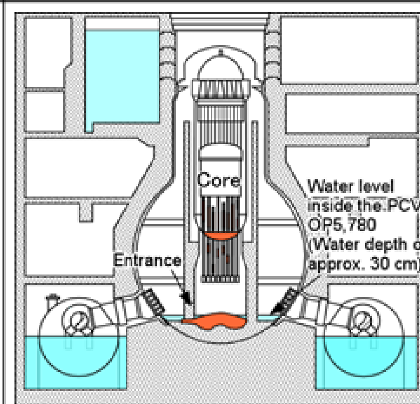
4. Strategy of fuel debris retrieval (4)

Plant conditions of Units 1-3 (including the estimation of fuel debris distribution)

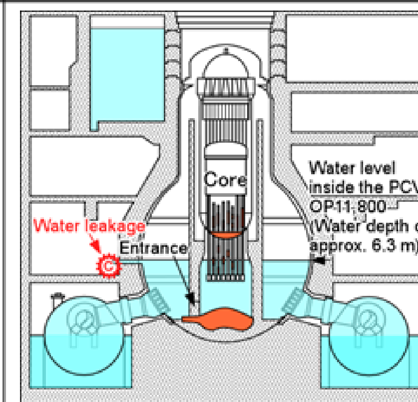
Unit 1



Unit 2



Unit 3



[Unit: ton]

		Unit 1		Unit 2		Unit 3	
Estimated Distribution	Location	Range of Estimation*1	Typical Value*2	Range of Estimation*1	Typical Value*2	Range of Estimation*1	Typical Value*2
	Core	0-3	0	0-51	0	0-31	0
	RPV Lower Head	7-20	15	25-85	42	21-79	21
	Inside RPV Pedestal	120-209	157	102-223	145	92-227	213
	Outside RPV Pedestal	70-153	107	3-142	49	0-146	130
	Total	232-357	279	189-390	237	188-394	364
Current Status	Dose Rate measured in PCV	Approx. 5-10 Sv/h (measured on Apr. 10-16, 2015, in gas phase of 0.7 m from the water level, on the grating)		Approx. 31-73 Sv/h (measured on Mar. 27, 2012, in gas phase of 3.7 to 6.7 m from the water level, around X-53 penetration)		Approx. 0.75-1 Sv/h (measured on Oct. 20, 2015, in gas phase of 0.55 m from the water level, around X-53 penetration)	
	Observed water leakage points	Water flows were detected from one sand cushion drain pipe (ⓐ) and one expansion joint cover (ⓑ) of the S/C vacuum break line.		It is expected water flow from somewhere below water level inside the torus room, since there is no trace of water leakage in gas phase.		Water flow was detected from the expansion joint (ⓒ) of the MS Line D in the MSIV room.	
	PCV internal survey	-No large scale damage on the existing facilities (e.g. PLR pump, wall inside the PCV and HVH). -Deposits are scattered over a wide range. -PLR piping shielding units fallen.		-The structures of the RPV bottom was confirmed by the photographs taken from RPV pedestal opening. Breakage of the RPV bottom is unlikely to be a large.		-PCV internal survey using inspection device inserted from PCV penetration indicated that no damage of the walls and PCV was found within the scope of the survey.	

*1: Range of results based on Severe Accident codes
*2: The most reliable value by a plurality of analysis results in the current

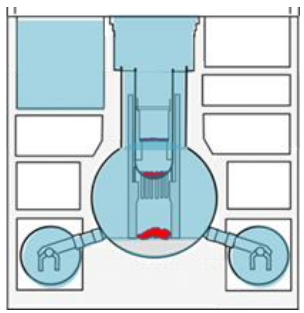
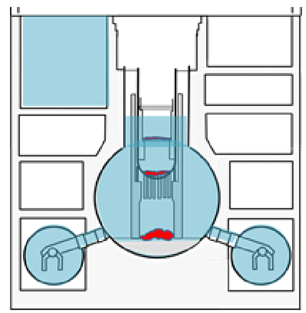
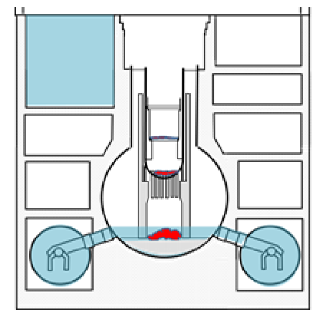
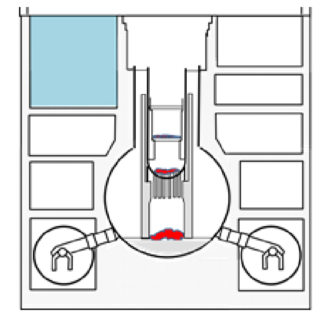
4. Strategic plan for fuel debris retrieval (5)

● Results and findings of PCV internal survey

- Most of the fuel debris had fallen to the bottom of the reactor and D/W. The amount at the bottom of the D/W is larger than that of reactor. Very little fuel remaining in the core region; therefore risk caused by criticality due to stub-shaped fuels is small.
- In the evaluation of Unit 2, it is desired to obtain the confirmation through the visual inspection with remote devices, since the changes in the amount of the fuel debris remain at the bottom of the RPV is large due to the amount of injected water at the time of accident.
- Also, due to high degree of uncertainties, further analysis and evaluation will be required for the erosion of the concrete at the bottom of the D/W caused by MCCI and the properties of the products, ratio of the fuel debris in and outside the RPV pedestal including visual inspection with remote devices.
- When studying the fuel debris retrieval method, it is necessary to take into account that the internal structures may be deformed as the results of experience of the high-temperature state during the accident.
- Further study will be necessary for FP distribution since there is a large difference between the analysis codes.
- According to the PCV internal survey for Units 1 and 3, there were some deposits on the structures in the accumulated water in the PCV, and those should be considered in the future internal survey and the studies of fuel debris retrieval methods.

4. Strategy of fuel debris retrieval (6)

● Narrow down of the methods based on the PCV water level and access direction

		Full submersion	Submersion	Partial submersion	Dry
Water level		 A method in which water fills to the top of the reactor well.	 A method in which the water fills to a level above the highest point of the fuel debris distribution	 A method in which the water is filled t o a level below the highest part of the fuel debris distribution. (with poring water to the fuel debris)	 All the areas where fuel debris is scattered are exposed to the air, and neither water cooling nor water pouring is involved
Access direction	Top	a.		b.	
	Side			c.	
	Bottom				

Methods to be focused

a. Submersion method (including full submersion)[1]
b. Partial submersion – Top access method
c. Partial submersion – Side access method[2]

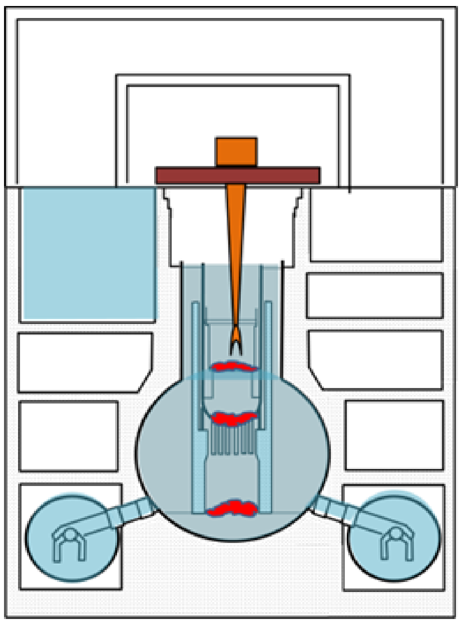
(shaded): Possibility of water flowing out from the openings
(green dashed box): Difficulty of constructing new access route
(orange dashed box): Difficulty of evaluating cooling performance

1 : Including the Full submersion
2 : The water level is lower than the access hole.

4. Strategy of fuel debris retrieval (7)

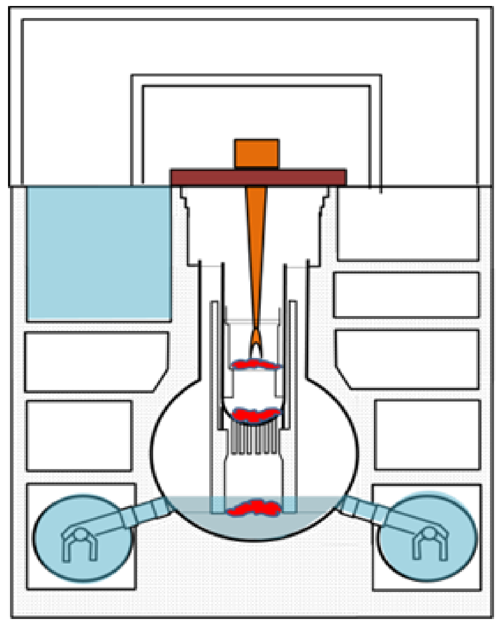
Three Methods of Fuel Debris Retrieval to be focused

Individual method from the following three methods or combined method will be applied according to the distribution of the fuel debris.



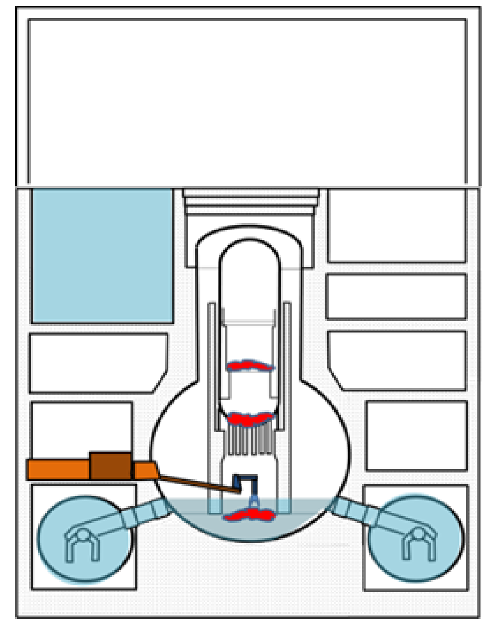
Submersion-Top access method

Assuming the in-core structures above the fuel debris are removed



Partial submersion -Top access method

Assuming that the in-core structures above the fuel debris are removed



Partial submersion - Side access method

Assuming that the equipment and other objects outside the RPV pedestal in PCV are removed

4.　Strategic plan for fuel debris retrieval (8)

Ensuring safety during the fuel debris retrieval work

The purpose of ensuring safety is to protect (1) Residents and environment, and (2) Workers from the impact caused by radioactive materials. The objective is to reduce risks by fuel debris retrieval from the current level of conditions, where the severe accident occurred.

Important technical issues	Action status
1. Securing the structural integrity of the PCV and R/B	◆ The evaluation of design basis seismic ground motion Ss is currently being conducted for S/C support which are considered to have comparatively small margin. ◆ The impact caused by erosion to the RPV pedestal is being evaluated, as needed, for the fuels which are estimated to have fallen at the bottom of the D/W following the analysis of the spread of fuel debris distribution.
2. Criticality control	◆ The method to maintain sub-criticality state of fuel debris has been studied for each operation step for fuel debris retrieval and water level rising. ◆ Specification of sub-critical control method will be studied from the view point of actual applicability based on the results of evaluation of critical accident.
3. Maintaining the cooling function （PCV repair （water sealing））	◆ The development has been performed to date focusing on the feasibility of the water sealing technology and method for the vent pipe and downcomer at the PCV bottom. ◆ In addition to the solutions of the issues which became apparent, long-term water seal required to confirm the applicability to the actual unit will be studied.
4. Ensuring containment function (Radioactive prevention of radioactive dust scattering)	◆ Dust scattering during fuel debris cutting operation is to be prevented by installing the isolation walls consists of operation cells, PCV and R/B wall, and by maintaining negative pressure inside.
5. Reducing workers' exposure during operation	◆ Decontamination work around the X-6 penetration as a preparation of internal survey for Unit 2 PCV takes significantly longer time than expected. ◆ The decontamination/radiation dose reduction work to be performed in the area closer to the PCV requires more thorough preparation and approaches.
6. Ensuring work safety	◆ The conditions of work place are required to be improved with the strong awareness of the safety shared among the concerned people and the assessment of the safety performed in advance.

4. Strategic plan for fuel debris retrieval (9)

● <u>The studies on the important technical issues in the realization of the fuel debris retrieval method</u>

1. Establishment of access route to the fuel debris

- It is important to prevent the release of radioactive materials when establishing the access route to the fuel debris inside the PCV. Element tests are being conducted to confirm the feasibility of key technologies by the time of making a decision on the fuel debris retrieval policy.

- It is necessary to establish the access route to the PCV inside the R/B by conducting detailed study based on the site conditions in early stage, not to affect the schedule.

2. Development of the fuel debris retrieval equipment and devices

- Element tests are being conducted for the equipment and devices for fuel debris retrieval, which are planned to be used for the method to be focused on ito obtain the prospect for the technical feasibility by the time of the determination of fuel debris retrieval policies. Appropriate radiation resistance and allowance of maintenance and inspection will be necessary when applying fuel debris retrieval.

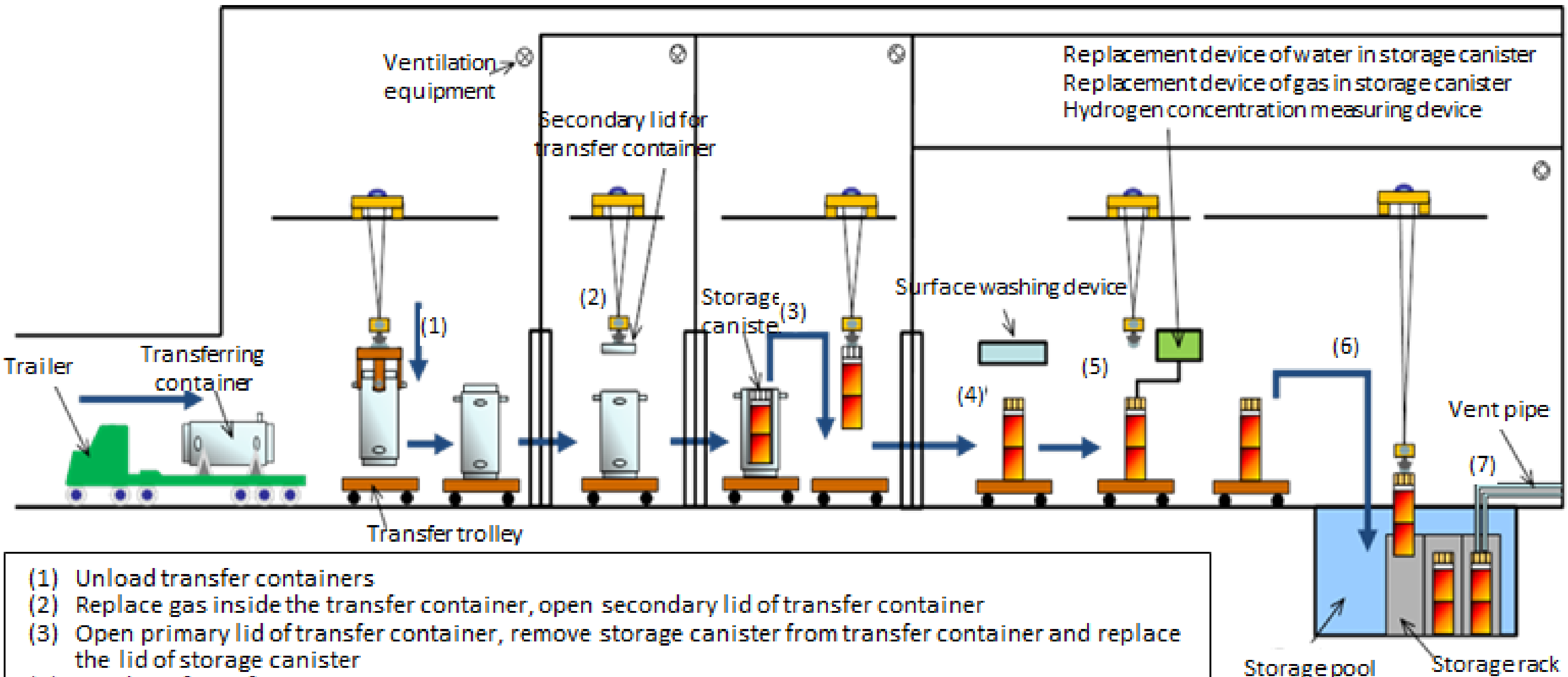
3. Establishment of the system equipment and working areas

- Container and system equipment are required to be installed in the building to retrieve fuel debris. Although the conceptual design is being carried out to confirm the feasibility, it is also required to confirm the on-site plot plan and to make coordination with the situation outside the building(e.g. other constructions, radiation dose reduction plan and ground improvement) that impede the preparation.

4. Strategic plan for fuel debris retrieval (10)

Study of the treatment for the retrieved fuel debris toward stable storage

- Establishment of the system for collection, transport and storage of fuel debris



(1) Unload transfer containers
(2) Replace gas inside the transfer container, open secondary lid of transfer container
(3) Open primary lid of transfer container, remove storage canister from transfer container and replace the lid of storage canister
(4) Wash surface of storage canister
(5) Process before storing in the canister
(6) Load storage canister on the rack in the storage pool
(7) Install vent pipes and connecting them to the wastes system

Flow plan of the wet-type storage for the fuel debris

(Provided by IRID)

- Study on the safeguards for the fuel debris

4. Strategic plan for fuel debris retrieval (11)

● Toward the determination of fuel debris retrieval policies

- ➢ Fuel debris of all Units are estimated to be scattered in the RPV lower plenum and at the bottom of the D/W. The policy may be made by combining multiple methods according to the fuel debris locations.
- ➢ In such case, in parallel with the retrieval work for initial location of retrieval, inspections and studies are required to be performed for the fuel debris in different locations. Operation in the next stage is considered to be continued by improving the fuel debris retrieval method as necessary.
- ➢ In the policies, the results of the studies and findings obtained to date, fuel debris location to be addressed first and the likely method is to be selected for each Unit from the perspective of ensuring safety.

  →In particular, the following studies will be conducted to evaluate, such as the risks that affect the fuel debris retrieval work.

(1)Evaluate the effect of risk reduction through the resolution of the instability of the inside of the PCV/RPV for each unit and fuel debris location

(2)Evaluate access route and retrieval method for each Unit and fuel debris location, including PCV water level are nominated and risk regarding ensuring safety, such as criticality that might be caused by the retrieval work and the leakage of radioactive materials based on the features of three methods and the results the studies.

(3) Select the first fuel debris to be retrieved and its method in a comprehensive consideration of evaluation for the estimative index based on the Five Guiding Principles.

(4) With regard to the fuel debris other than those retrieved at first, the access route and retrieval method depending on the PCV water level are to be studied to make sure that initial retrieval work will not affect the subsequent work.

5. Strategic plan for waste management (1)

● Approach to the study on radioactive waste

- Safe and steady storage of radioactive solid waste and study of the processing method and disposal concept from the mid- to long-term perspective are important.

● Principles for ensuring the safety of radioactive waste disposal

- The internationally established safety principles such as by International Commission on Radiological Protection (ICRP) and IAEA on radioactive waste disposal in general are as follows.
  - **To contain the waste;**
  - **To isolate wastes from the accessible biosphere and reduce substantially the likelihood of, and all possible consequences of, inadvertent human access to the waste;**
  - **To inhibit, reduce and delay the migration of radionuclides from the waste to the accessible biosphere at any time;**
  - **To ensure that the amounts of radionuclides reaching the accessible biosphere due to any migration from the disposal facility are such that possible radiological consequences are acceptably low at all times;**
  - **To control the release of radioactive materials to ensure that their concentrations are at the level that will not cause significant effects on health.**

5. Strategic plan for waste management (2)

Appropriate radioactive waste management

- The radioactive waste needs to be characterized and separated into categories in all stages from generation to disposal.
- The main purpose of processing is to produce waste in a form that meets the criteria for the safe processing, transport, storage and disposal of waste and thus to increase the safety of radioactive waste management and ensure the safe disposal of waste.
- The processing shall be based on appropriate consideration of the characteristics of the waste and of the demands imposed by the different stages in its management.
- Quantities, activity and physical and chemical nature, the technologies available, the storage capacity and the availability of a disposal facilities are taken into account in determining the level of waste processing.
- If waste processing is performed before the waste disposal requirements are set, it must be remaining possible to process the waste in a way which meets those requirements once they have been set.
- Proper storage should be provided at all stages in waste processing prior to disposal to ensure waste isolation and environmental protection.
- Waste shall be stored in such a manner that it can be inspected, monitored, retrieved and preserved in a condition suitable for its subsequent management and under passive condition to the extent possible.

5. Strategic plan for waste management (3)

● Evaluation and issues on the action status based on the current Roadmap

Items	Current status and issues
1. Reduction of generated waste	◆ The structure of the waste management department has been improved, and waste management has been driven forward by the involvement of the department from the stage of developing construction project for decommissioning work. ◆ Measures have been taken and driven forward to reduce amount of radioactive solid wastes generation by control of bringing packing, materials and equipment into the site, reuse and recycling.
2. Storage	◆ A 9th solid waste storage facility is being built. ◆ Additional 10 to 13 storage facilities will be built in phases to increase the total storage capacity. The plan that resolve the temporary storage issues, such as solid wastes stored outside and soil-covered interim storage has been indicated.
3. Characterization	◆ With regard to the understanding of the solid waste properties, radiological analysis of rubbles, characterization on secondary waste from water treatment and development of radiological analysis technique for difficult-to-measure nuclides have been implemented. ◆ It is important to characterize the radioactive solid waste generated when retrieving fuel debris and secondary wastes from decontamination. ◆ Since FY 2015, the number of samples that can be radiologically analyzed per year has increased from about 50 to 70 samples through cooperation with institutions joined.
4. Study on processing and disposal management	◆ A series of these waste stream handling processes has been studied to ensure the safety and rationality of the entire radioactive solid waste management process, from waste generation, storage and processing to disposal, and to take an overall view of the entire process from a broader perspective and conduct R&D.

5. Strategic plan for waste management (4)

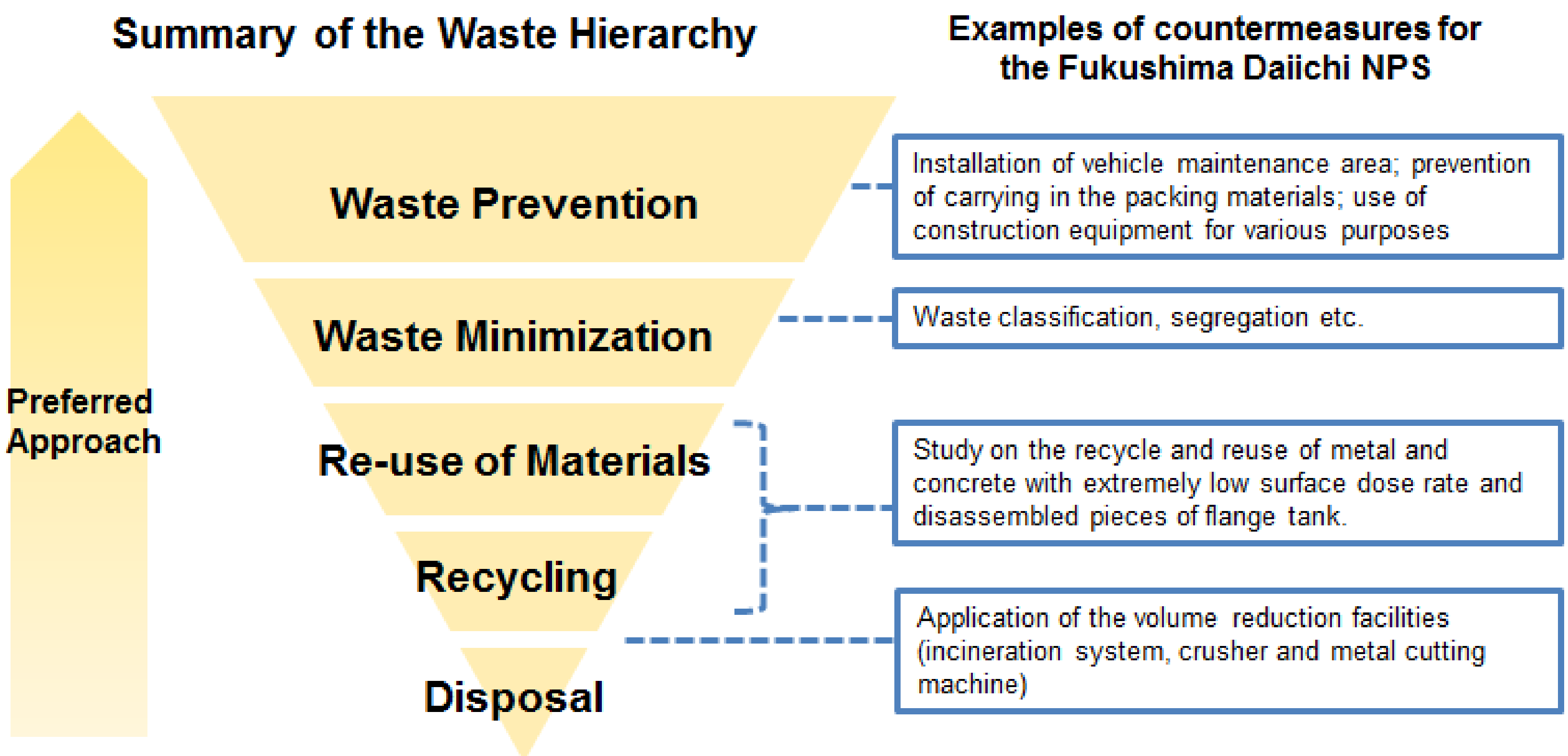
● Mid- and long-term action policy and future actions for waste management

Items	Matters to be addressed or noted
1. Reduction of generated waste	◆ Certain results have been achieved. It is important to study and take the measures continuously to reduce further amount of waste generation. ◆ It is important to select appropriate technology in consideration of the generation of secondary waste in selecting the decontamination and volume reduction method for solid radioactive waste.
2. Storage	◆ The amount of radioactive solid waste from the construction and other activities described in the mid- and long-term Roadmap was projected, and a storage management plan was developed based on the projection. It will be important to implement the plan and reduce the risk. ◆ The prospect of R&D for a dehydration method to stabilize the slurry from the pretreatment system for the multi-radionuclide removal system is in sight at the basic stage. Studies on the stable storage such as for the sludge and concentrated liquid waste should be accelerated. ◆ It is required to examine the appropriate area and method to store the radioactive solid waste generated during the fuel debris retrieval work, in parallel with examination of fuel debris retrieval method.
3. Characterization	◆ To obtain data efficiently, top priority should be given to obtaining data that can contribute to the promotion of the decommissioning process and development of measures for the processing and disposal of radioactive solid waste.
4. Study on processing and disposal management	◆ It is important to retain and manage information on the attributes of radioactive solid waste, such as the history of waste generation, the history of contamination, and the concentration of radioactive materials in the waste, and to separate the waste into categories and manage it accordingly. ◆ It will be necessary to actively provide the regulatory authorities with information related to the progress of studies so that the regulatory system on processing and disposal would be established in a smooth manner.

5. Strategic plan for waste management (5)

- **Concept of waste hierarchy and countermeasures for the Fukushima Daiichi NPS**

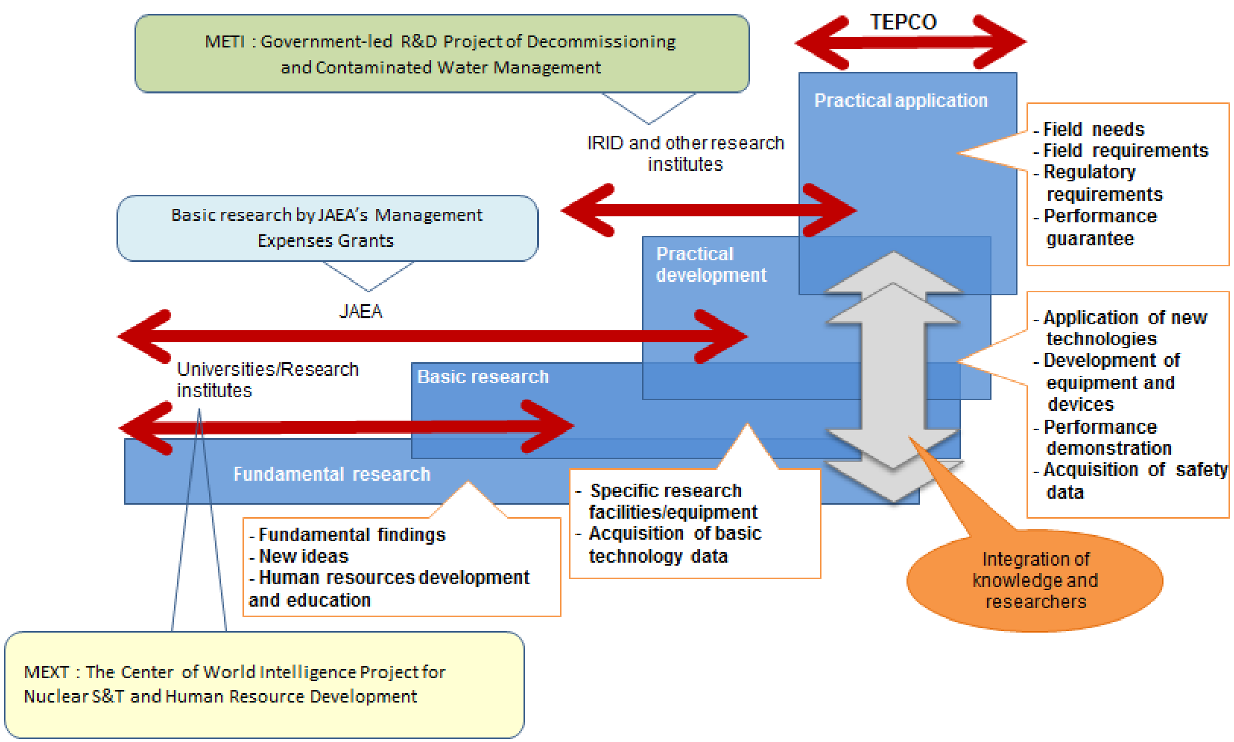
Summary of the Waste Hierarchy



This chart is based on Strategy Effective from April2011 (print friendly version), NDA

6. Approach to the R&D studies (1)

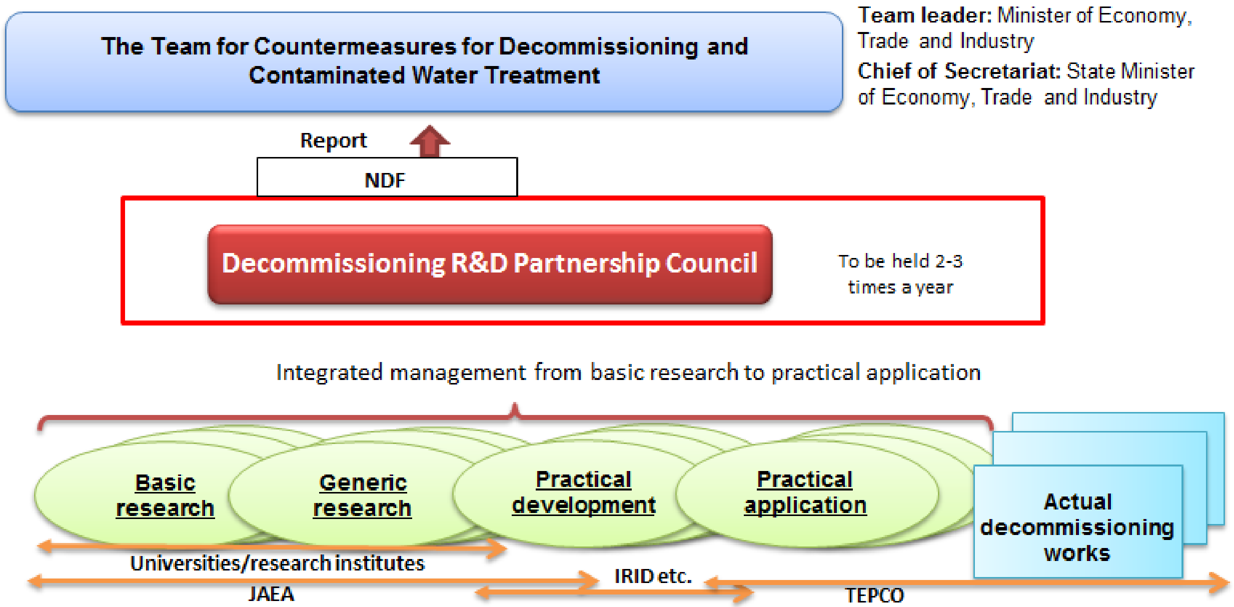
- To deal with the decommissioning of the Fukushima Daiichi NPS that involves many technically challenges, R&D activities on a variety of fronts is being conducted by a number of organizations.
- The NDF comprehensively reviews such R&D activities in order to promote effective and efficient R&D approaches, and seeks the overall optimization of these activities through the promotion of further clarification and adjustment of role sharing based on their special characteristics and the expected results of the R&D they are engaged and also through close cooperation with related organizations.
- Management of R&D will be important for application to the decommissioning.



6. Approach to the R&D studies (2)

Strengthening research cooperation

- The Team for Countermeasures for Decommissioning and Contaminated Water Treatment decided to set up the Decommissioning R&D Partnership Council in the NDF at its meeting held on May 21, 2015, and that strengthened efforts to reflect the results and knowledge obtained through basic and generic research on decommissioning technologies to the decommissioning work and development works.



- **Development of R&D centers (the functions of mockup test facility of JAEA, Radioactive Material Analysis and Research Facility and Collaborative Laboratories for Advanced Decommissioning Science)**
- **Development and recruitment of human resources**

7. Future Actions

- **Risk reduction strategy**
  - The risk reduction strategy is to be reviewed considering the changes of the situation due to the progress of the decommissioning work and internal PCV condition analysis. Also, the countermeasures against various risks are studied to steadily advance the decommissioning.
- **Fuel debris retrieval**
  - The milestone, "Determination of fuel debris retrieval policies for each unit“ will be reached in FY2017.
  - The "spiral-up" of the strategy is aimed to be achieved by repeating the evaluations and reviews in order to contribute to the determination of fuel debris retrieval policies to be made in summer of 2017. The studies on the strategy are also to be carried out towards the subsequent determination of the methodology for fuel debris retrieval and the steady progress of the decommissioning work including actual fuel debris retrieval.
- **Waste management**
  - The milestone, "Establishment of basic concept of processing/disposal for radioactive solid wastes"
    will be reached in FY2017.
  - It is important to describe the specific direction of the resolution of the issues attributable to the features of the wastes at the Fukushima Daiichi NPS, and its outline is aimed to be indicated in the Strategic Plan 2017.
- **R&D**
  - Improvement of the R&D effectiveness, enhancement of cooperation with relevant organizations, cooperation with the organizations overseas are being carried out.