

# **Technical Strategic Plan 2017 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc.**

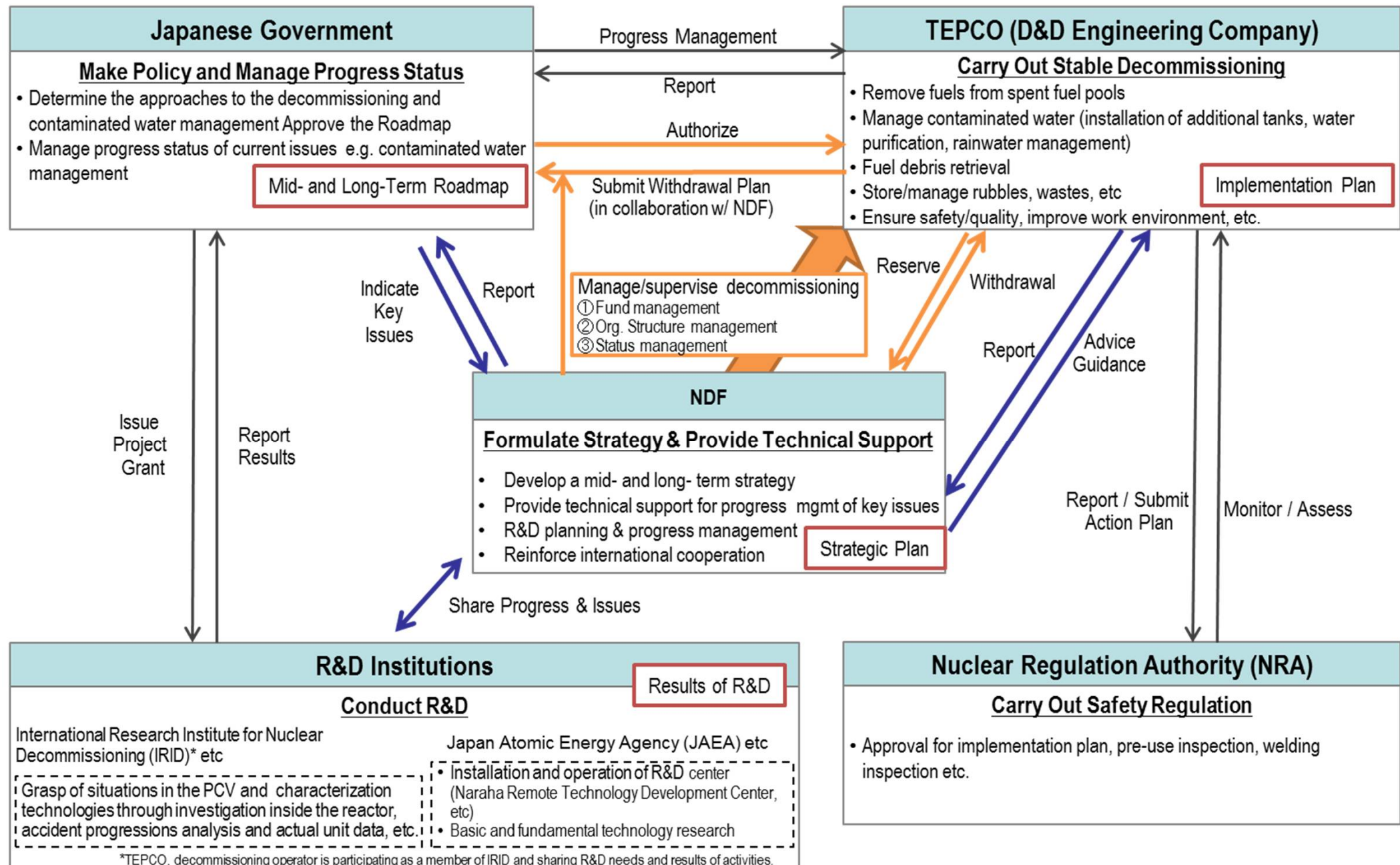
August, 2017

**Nuclear Damage Compensation and  
Decommissioning Facilitation Corporation  
NDF**

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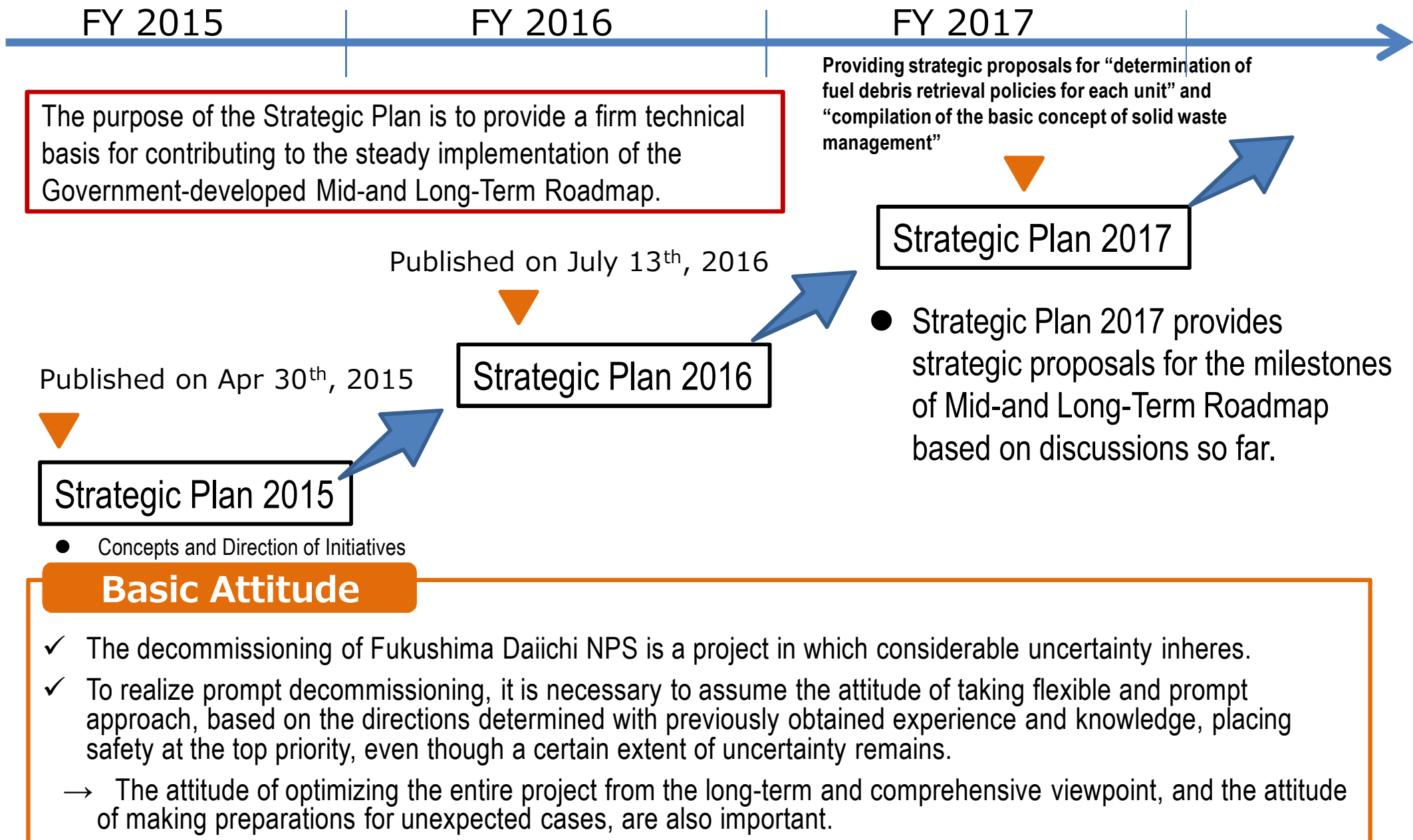
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# 1. Roles & Responsibilities of Organizations Relevant to Fukushima Daiichi NPS Decommissioning



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# 2 – 1. Purpose and Positioning of the Strategic Plan



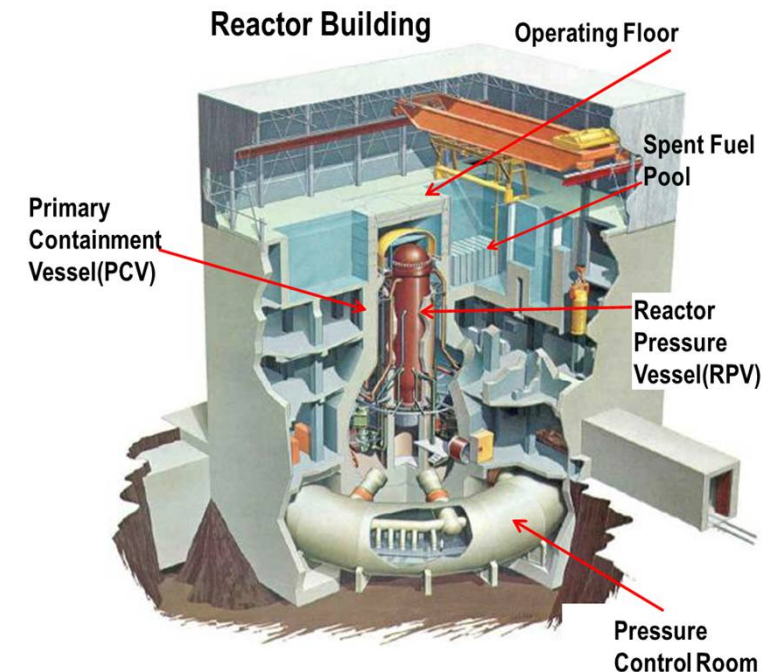
# 2 – 2. Basic Concept of the Strategic Plan

## Fundamental Policy

To continuously and promptly reduce the risks associated with the radioactive materials generated by the accidents

## Five Guiding Principles

- ◆ Principle 1 : **Safe**
  - Reduction of risks \* posed by radioactive materials and ensuring work safety (\* ) Environmental impacts and exposure to the workers
- ◆ Principle 2 : **Proven**
  - Highly reliable and flexible technologies
- ◆ Principle 3 : **Efficient**
  - Effective utilization of resources (e.g. human, physical, financial and space)
- ◆ Principle 4 : **Timely**
  - Awareness of time axis
- ◆ Principle 5 : **Field Oriented**
  - Thorough application of Three Actuals (actual field, actual things and actual situation)



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# 3 – 1. Progress in Decommissioning of Fukushima Daiichi NPS

- Over the last year, progress has been made in the following areas.

## Contaminated Water Management

【Removal】 Removal of contamination resources is underway using advanced multi-nuclide removal system.

【Keeping Away】 Freezing operation of the land-side impermeable walls has been extended; The operation on the mountain side is yet to be completed only at one location. After the operation on the sea side was completed in October 2016, the amount of groundwater pumped up from the area of 4.0m above sea level was reduced to one-third (an average of about 118 m<sup>3</sup>/day in March 2017). As a result of implementing preventive/multi-layered measures such as subdrain, the amount of groundwater flowing into the buildings decreased to an average of about 120 m<sup>3</sup>/day in March 2017.

【Preventing Leakage】 The concentration of radioactive materials in the surrounding sea area is constantly low.

【R/B Stagnant Water Management】 The stagnant water level in the Unit 1 Turbine Building was reduced to the lowest floor level in March 2017.

## Removal of Spent Fuel from Spent Fuel Pool

- Unit 1: The removal of the cover wall panels for the Reactor Building was completed. Information gathering for developing a rubble removal plan is in progress.
- Unit 2: A yard around the Reactor Building was prepared and a working platform for access to the operating floor was constructed.
- Unit 3: Measures to reduce the dose rates on the operating floor were completed. Installation of a cover for fuel removal is underway.

## Fuel Debris Retrieval

- Unit 1: An investigation using a robot in the basement outside the pedestal and in the vicinity of the access in PCV was conducted.
- Unit 2: A survey inside the pedestal in PCV using a robot and other devices was conducted.
- Unit 3: An investigation using muon detection system and an investigation in PCV using a robot were performed.

## Waste Management

- The waste reduction measures are continued to be in place. An operation to reduce waste protective clothing with an incinerator was started.
- The Solid Waste Storage Management Plan was updated.
- Sampling and analysis is underway in order to characterize the solid waste.

## Other Specific Measures

- Since the rubble removal and facing in the area 4m above sea intended for improving site environment have resulted in the reduced risks of contamination, the classification for the protective equipment has been changed to “ordinary clothing area”.





## 3 – 2. Basic Thought in Reducing Risk of Radioactive Materials

### Principle for Risk Reduction

- ✓ Combining the activities/means for reducing “the level of impact” and “the likelihood of impact” in order to promptly reduce the risk levels and ensure/retain the risk levels be adequately low
- Level of Impact: significance of negative impacts on human health and environment caused by the risk sources
- Likelihood of Impact: possibility of being affected by the negative impacts
- Risk Level: magnitude of the risk caused by the risk sources



It is important to develop optimal risk reduction measures based on the “Five Guiding Principles”.

### Major Risk Sources

- ✓ The major risk sources to be studied at the Fukushima Daiichi NPS are as follows:
- ◆ Fuel debris in Units 1-3, fuel assemblies stored in Units 1-3 SFP, fuel assemblies in the common pool and fuel assemblies in the dry casks
- ◆ Stagnant water in buildings, concentrated liquid waste and etc.
- ◆ Solid waste: secondary waste generated from the water treatment system (waste adsorption columns, waste sludge and HIC slurry), rubble and etc.
- ◆ Contaminated structures in building: structures, pipes, equipment and other components in the R/B, PCV and the RPV that were contaminated, and activated structures.

# 3 – 3. Risk Estimation and Evaluation

- Risk level defined by the combination of the level of the impact in case of the release of radioactive materials and the likelihood of impact
- Risk estimation and evaluation is performed based on the SED score\* developed by the U.K. Nuclear Decommissioning Authority (NDA)

\*Safety and Environmental Detriment Score

## (1) Hazard Potential (Index of the level of impact)

- Use SED score as it is.
- Consider the amount of all radioactive materials, the form of risk sources (e.g. gas, liquid and solid) and the available time for recovery in the event of a loss of safety function.

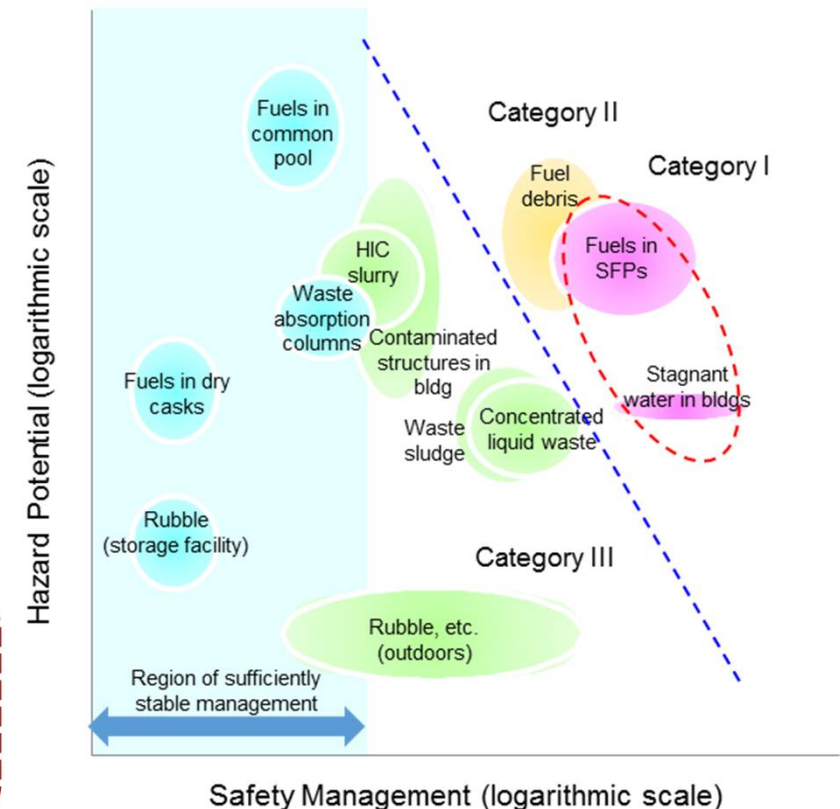
Sample of risk analysis of the Fukushima Daiichi

## (2) Safety Management (Index of the likelihood of impact)

- 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 integrity of the facility, containment function and a possibility of change in the state of the risk sources.

It will be appropriate to develop risk reduction measures based on the classification such as Category I ~ III.

[the interim goal] To bring their risk levels to the “region of sufficiently stable management”



# 3 – 4 . Current Status and Challenges of Risk Reduction Measures

## Current Status of Risk Reduction Measures

### Category I : Risk source to be addressed as soon as practicable

- ✓ Fuels in Spent Fuel Pool and stagnant water in buildings
- ⇒ The government and TEPCO have been working on

### Category II : Risk source to be addressed safely, effectively and carefully with thorough preparation and technologies to realize a more stable condition

- ✓ Fuel debris
- ⇒ Technological studies/developments are underway

### Category III : Risk source that requires actions to be taken for a more stable condition

- ✓ Concentrated liquid waste, waste sludge, HIC slurry, solid wastes (outdoor ) and contaminated structures in buildings
- ⇒ To make continuous effort toward reduction of risk levels and implement appropriate measures in planned manner

## Challenges during Risk Reduction

- It is necessary to consider a temporary change in the risk level and the exposure of workers when implementing risk reduction measures.
- Even if the risk source is currently in a certain stable condition, it will not be tolerated for a long period of time.
  - ⇒ The level of the risk may rise due to degradation of facilities and changes in the conditions of risk source, unless any measures are taken.
- To avoid this, risk reduction measures should be implemented by an appropriate time.

Strategy for Reducing Risks are shown at Chapter4 for CategoryⅡ, Chapter5 for CategoryⅢ

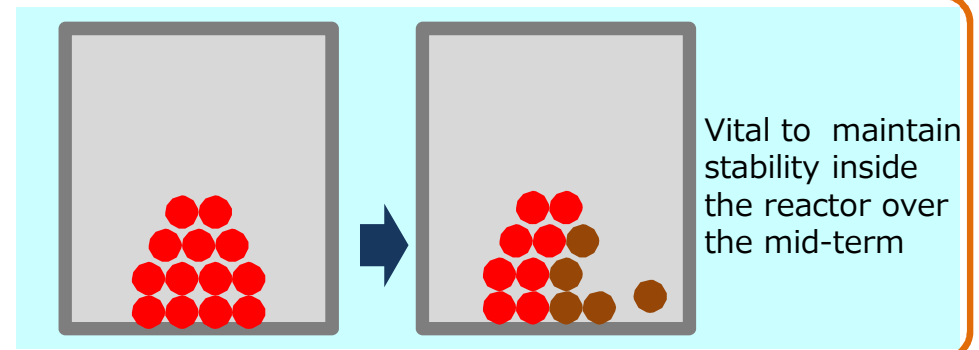
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## 4 – 1 . Study Plan for Fuel Debris Retrieval

- The current stable state is just supported by the temporary measures.
- However, having risk management issues such as “uncertainty”, “instability” and “inadequate management”.
- The purpose of fuel debris retrieval is to fundamentally improve this situation and to bring the reactor and the fuel debris into safer and more stable condition.
- And it requires two different strategies: reducing “medium-term” risks and “long-term” ones.

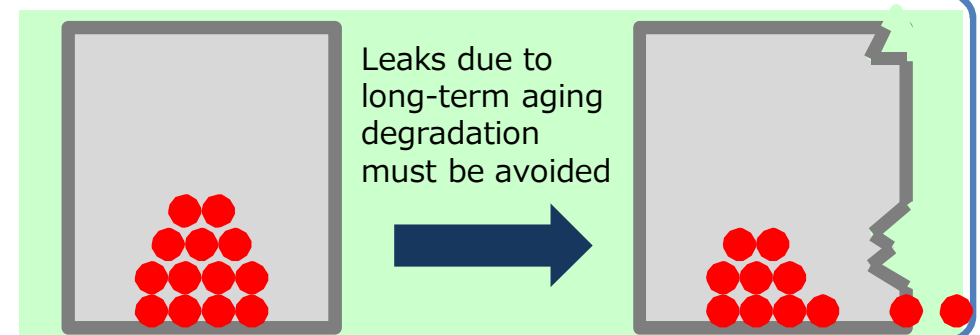
### Medium-Term Risks

- ✓ *‘A certain level of stability’ of fuel debris may be lost.*



### Long-Term Risks

- ✓ *Environmental contamination due to the leakage of highly toxic nuclear fuel materials may occur as a result of aging degradation of the buildings.*



## 4 – 2. Basic Concept for Ensuring Safety in the Fuel Debris Retrieval Operation

- “Concept of safety function” and “principles for realizing safety functions” have been developed
- Taking into account factors, such as the international safety fundamentals, the safety-related characteristics of the Fukushima Daiichi NPS and the risk associated with the fuel debris retrieval operation

### Concept of safety function

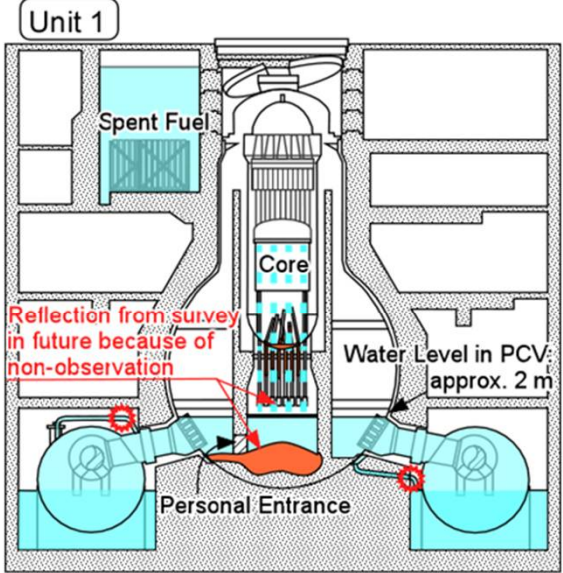
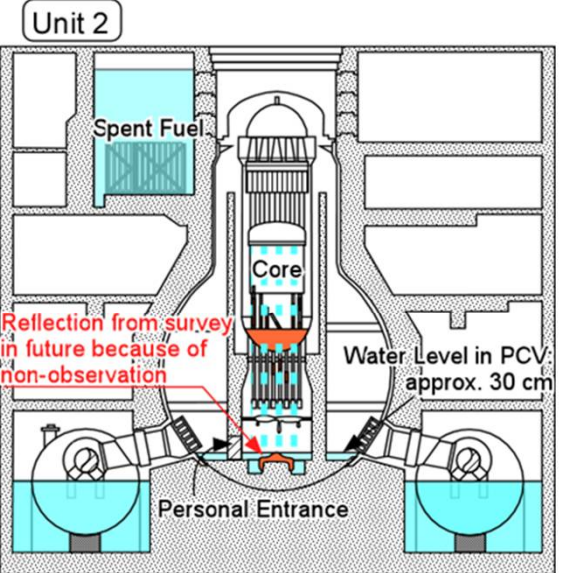
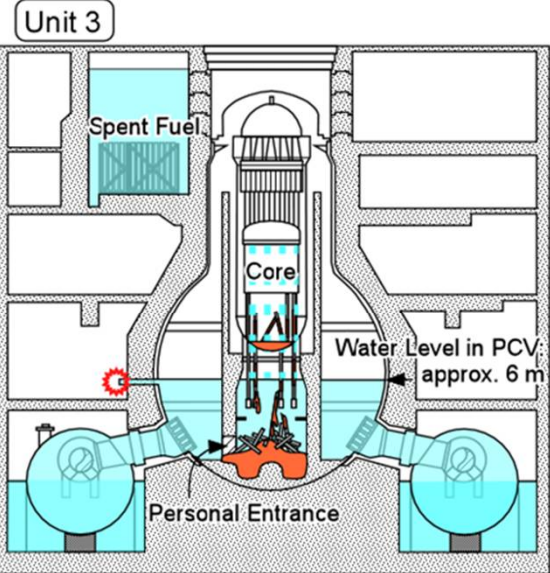
- ✓ Features to ensure the containment function (release prevention and management) and measures to prevent loss of the features are necessary.
- ✓ Decay heat removal and criticality control, as well as prevention of pulverization and spread of fuel debris to the extent possible should be considered.
- ✓ Preparedness for normal operations as well as for anticipated external events, such as earthquakes and tsunamis, and internal events, such as failures and operator errors, is required.
- ✓ It is necessary to observe the dose limits for workers under normal operating conditions to reduce the exposure of workers to the extent possible, and to observe the emergency dose limits for workers engaged in emergency response activities.

### Principles for realizing safety functions

- ✓ Considering that the reactors after the accident are decommissioned, it is important to effectively use existing equipment, to provide the necessary equipment and to consider the combination of equipment and work management.
- ✓ In order to reduce the exposure of workers engaged in preparatory work and maintenance work, it is important to ensure the containment function by maintaining the PCV at a negative pressure and to consider agile action using both permanent and mobile equipment.
- ✓ In applying defense-in-depth, it is necessary to carefully consider the hierarchy of defense levels and the need for the independence of each level.
- ✓ It is important to recognize the presence of uncertainty in the conditions in the PCV and to be able to change plans in a flexible manner.
- ✓ In safety assessment, it is important to set a realistic management goal and assessment conditions. For example, actual lifestyles should be considered.



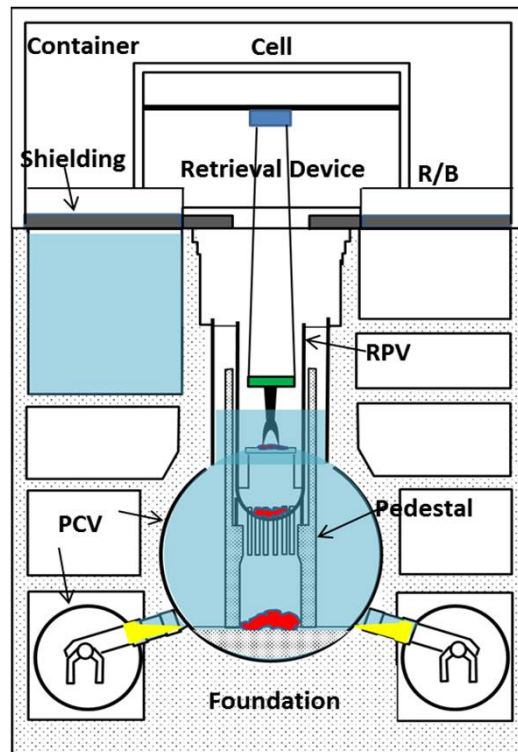
# 4 – 3. Current Status of Each Unit

	Unit 1	Unit 2	Unit 3
	 <p>■ Fuel Debris ○ Water Leakage(visual observation)</p>	 <p>■ Fuel Debris ○ Water Leakage(visual observation)</p>	 <p>■ Fuel Debris ○ Water Leakage(visual observation)</p>
Core Region	<ul style="list-style-type: none"> <li>Little fuel remains.</li> </ul>	<ul style="list-style-type: none"> <li>Little fuel remains.</li> <li>(Stub-shaped fuels might exist in peripheral region.)</li> </ul>	<ul style="list-style-type: none"> <li>Little fuel remains.</li> </ul>
RPV Lower Head	<ul style="list-style-type: none"> <li>A small amount of fuel debris is present.</li> <li>A small amount of fuel debris is present in the inside and on the outer surface of the CRD housing.</li> </ul>	<ul style="list-style-type: none"> <li>Large amount of fuel debris is present.</li> <li>A small amount of fuel debris is present in the inside and on the outer surface of the CRD housing.</li> </ul>	<ul style="list-style-type: none"> <li>Fuel debris remains on the RPV lower head partly.</li> <li>A small amount of fuel debris is present in the inside and on the outer surface of the CRD housing.</li> </ul>
Pedestal Inside	<ul style="list-style-type: none"> <li>Most of fuel debris is present.</li> </ul>	<ul style="list-style-type: none"> <li>A small amount of fuel debris is present.</li> </ul>	<ul style="list-style-type: none"> <li>Amount of fuel debris in Unit 3 is more than that in Unit 2.</li> </ul>
Pedestal Outside	<ul style="list-style-type: none"> <li>Fuel debris may have spread on the pedestal outside through the personal entrance.</li> </ul>	<ul style="list-style-type: none"> <li>The possibility of fuel debris spreading on the pedestal outside through the personal entrance is low.</li> </ul>	<ul style="list-style-type: none"> <li>Fuel debris may have spread on the pedestal outside through the personal entrance.</li> </ul>

\* Based on the document provided by IRID and internal survey performed in 2017.

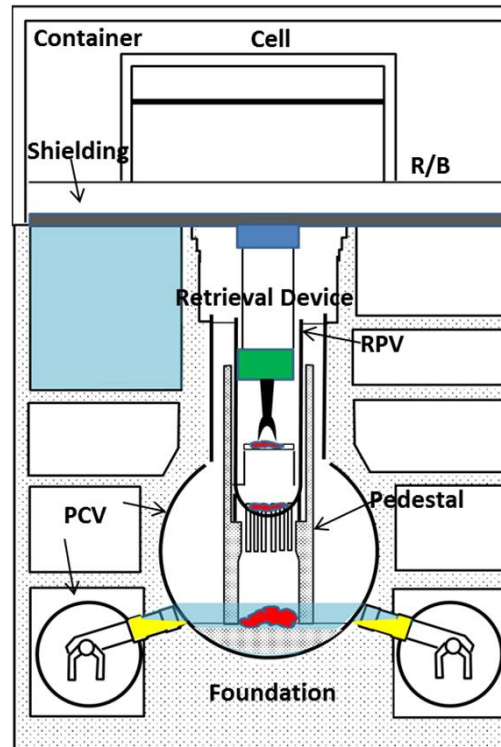
## 4 – 4. Feasibility of the Fuel Debris Retrieval Method

- In order to evaluate the feasibility of the fuel debris retrieval method, which are based on combination of water level and access routes, three priority methods have been selected.



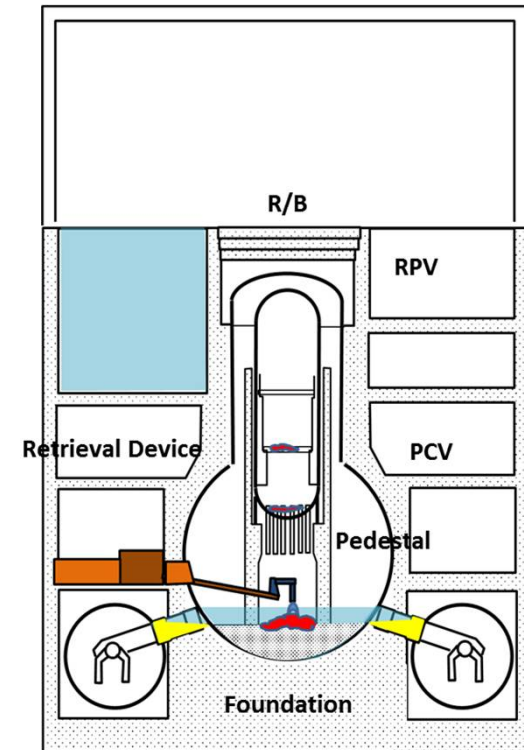
**a. Submersion-  
Top Access method**

Fuel debris is accessed from the top. PCV will be completely filled with water or filled with water to a level at which the fuel debris is present.



**b. Partial Submersion -  
Top Access method**

Fuel debris is accessed from the top. Part of fuel debris will be dealt with in the air without water covering.



**c. Partial Submersion -  
Side Access method**

Fuel debris is accessed from the side of the PCV. Part of fuel debris will be dealt with in the air without water covering.

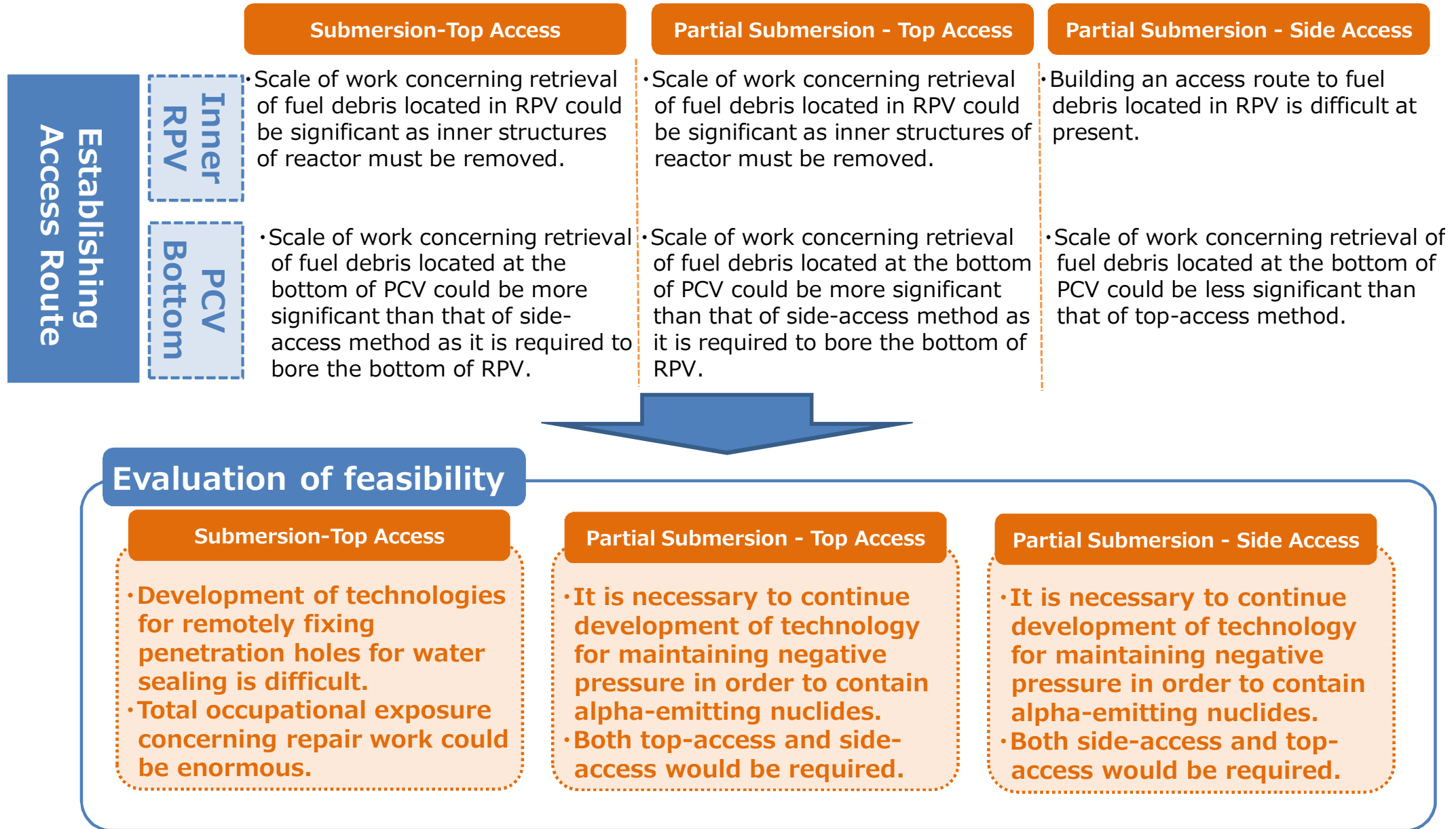
# 4 – 5. Evaluation of Feasibility of the Methods 1

- Evaluate the feasibility based on the status of R&D, occupational radiation exposure and so on.

		Submersion-Top Access	Partial Submersion - Top Access	Partial Submersion - Side Access
Ensuring Containment Capability	Liquid Phase	<ul style="list-style-type: none"> <li>• Hard to ensure water seal capability of resisting hydrostatic pressure when being submerged</li> <li>• Hard to ensure capability to remotely fix penetration holes for upper PCV with lots of holes</li> <li>• Emergency water leak prevention measure is required as a large amount of water is supposed to be kept.</li> </ul>	<ul style="list-style-type: none"> <li>• Technical difficulty is slightly lower as hydrostatic pressure is lower than that of submersion case.</li> <li>• Penetration holes on upper PCV to be fixed are limited.</li> <li>• It is possible to prevent water leakage even on emergencies depending on water level settings.</li> </ul>	<ul style="list-style-type: none"> <li>• Technical difficulty is slightly lower as hydrostatic pressure is lower than that of submersion case.</li> <li>• Penetration holes on upper PCV to be fixed are limited.</li> <li>• It is possible to prevent water leakage even on emergencies depending on water level settings.</li> </ul>
	Gas Phase	<ul style="list-style-type: none"> <li>• Although air conditioning system with capability of maintaining negative pressure is required, small scale equipment may be good enough.</li> </ul>	<ul style="list-style-type: none"> <li>• Air conditioning system with capability of maintaining negative pressure for containing alpha-emitting nuclides is necessary. The scale of the equipment will be large, but it can be feasible.</li> </ul>	<ul style="list-style-type: none"> <li>• Air conditioning system with capability of maintaining negative pressure for containing alpha-emitting nuclides is necessary. The scale of the equipment will be large, but it can be feasible.</li> </ul>
Criticality Management		<ul style="list-style-type: none"> <li>• Preventing criticality when reactor core is covered with water is an issue.</li> </ul>	<ul style="list-style-type: none"> <li>• There is a low probability of re-criticality as reactor core will not be covered with water.</li> </ul>	<ul style="list-style-type: none"> <li>• There is a low probability of re-criticality as reactor core will not be covered with water.</li> </ul>
Structural Soundness / Seismic Resistant Features of PCV and R/B		<ul style="list-style-type: none"> <li>• Although the total weight of coolant in PCV and fuel debris retrieval equipment to be installed at upper R/B increases, seismic margin will be ensured for major components.</li> </ul>	<ul style="list-style-type: none"> <li>• Although the total weight of fuel debris retrieval equipment to be installed at upper R/B increases, seismic margin will be ensured for major components.</li> </ul>	<ul style="list-style-type: none"> <li>• Better seismic margin will be ensured as fuel debris retrieval equipment will be installed on the first floor.</li> </ul>
Reducing Occupational Radiation Exposure		<ul style="list-style-type: none"> <li>• Occupational radiation exposure would be of several times of the past annual total exposure when sealing upper PCV as there are lots of penetration holes on the upper PCV.</li> </ul>	<ul style="list-style-type: none"> <li>• Occupational radiation exposure would be less than the past annual total exposure when sealing lower PCV.</li> </ul>	<ul style="list-style-type: none"> <li>• Occupational radiation exposure would be less than the past annual total exposure when sealing lower PCV.</li> </ul>



# 4 – 6. Evaluation of Feasibility of the Methods 2



# 4 – 7. Comprehensive Evaluation

## Evaluation of the water level during the fuel debris retrieval operation

- ✓ In the partially submersion method, though it is necessary to develop a gas-control system and contain radioactive materials in the gas-phase portion, we should further accelerate the R&D process and evaluate the applicability of the method to work in the field toward materialization of the partially submersion method in all Units 1 to 3.
- ✓ With discussing the feasibility of the submersion method in the future scope, we should also store the knowledge obtained in the R&D process and remaining issues in an appropriate manner to prepare for the possible use of them.

## Access routes

- ✓ At the moment, it is considered difficult to access the fuel debris inside the RPV from the side for retrieval. It is necessary to access it from the operating floor (from the top).
- ✓ It is more realistic to access the fuel debris at the bottom of the PCV and retrieve it from the side of the PCV (on the first floor level of reactor building). In terms of reducing the exposure of workers and performing maintenance work, it is reasonable to access it from the side of the PCV.

## Locations in the reactor from which fuel debris should be retrieved first

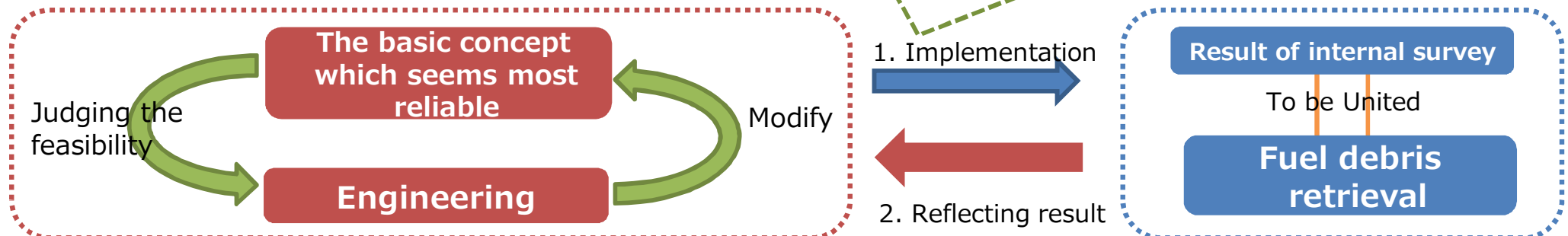
- ✓ It is realistic to retrieve the fuel debris from the bottom of the PCV first by accessing from the side. The reasons are:
  1. The bottom of the PCV in Units 1 to 3 has been investigated and, as a result, a certain amount of knowledge on the routes for accessing the bottom from the side has been accumulated, which can be used for realistic engineering.
  2. The actual time to reach the fuel debris will be longer when accessing the inside of the RPV from the top than when accessing the bottom of the PCV from the side.
  3. In order to streamline the decommissioning process as a whole, preparations for side access to the bottom of the PCV can be made concurrently with the removal of the fuel from the pool.

# 4 – 8. Proposal for Deciding Fuel Debris Retrieval Policies and Approach after Decision (Strategic Proposal) 1

## Proposal for Drafting Fuel Debris Retrieval Policies

- (1) Develop a comprehensive fuel debris retrieval plan aimed to optimize the entire retrieval process, from preparation work and transfer from the site to treatment, storage and cleanup, including coordination with other works in the field.
- (2) Move forward in a flexible manner according to the information gained little by little via a step by step approach after deciding the retrieval method to be focused on.
- (3) Assume that combination of a variety of methods will be required to complete the fuel debris retrieval.
- (4) Promote preliminary engineering and R&D focusing on the partial submersion methods.
- (5) Firstly, focus on retrieving the fuel debris located at the bottom of the PCV and keep reviewing the methods based on the newly gained expertise/experience through the retrieval.
- (6) At first, focus on the route from the side of the PCV (the side-access method) for the first access to the fuel debris located at the bottom of the PCV. The following are the points to be stressed about the method.

At “Uncertainty”, it is important to analyze small but important successful experiences, expand the scope and accumulate useful information gradually (**Step by Step Approach**)





## 4 – 9. Proposal for Deciding Fuel Debris Retrieval Policies and Approach after Decision (Strategic Proposal) 2

- Once the fuel debris retrieval policies have been defined, the following priority issues should be dealt with towards “determination of fuel debris retrieval method for the first implementing unit” and accelerating the development of the actual construction plan.

### Preliminary engineering

- ✓ The applicability of the results of research and development and system concept to the actual field will be evaluated and the processes involved in the retrieval will be specified.
- ✓ As needed, the fuel debris retrieval methods may be revised based on the results of the preliminary engineering.

### Acceleration of technology development based on the selection and prioritization of research and development projects and practical application of technology

- ✓ Extra investigations into internal PCV
- ✓ Investigations into internal RPV
- ✓ Judging feasibility of alpha emitting radionuclides management system required for partial submersion methods
- ✓ Promoting the necessary research and development projects to materialize the side-access method into practical use and discussing the significance of mockup facility
- ✓ Conducting research and development on a system for containing, transferring and storing fuel debris, on the preparation of a storage facility, and on the waste to be generated by fuel debris retrieval

### Path to Commencement of Fuel Debris Retrieval

- ✓ It is important to remember the following when promoting the fuel debris project.  
"Considerations to the continuity of the project", "Optimization of the entire retrieval process" and "Close communication with the local government and community"

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# 5 – 1. Study Policy on the Strategic Plan for Waste Management

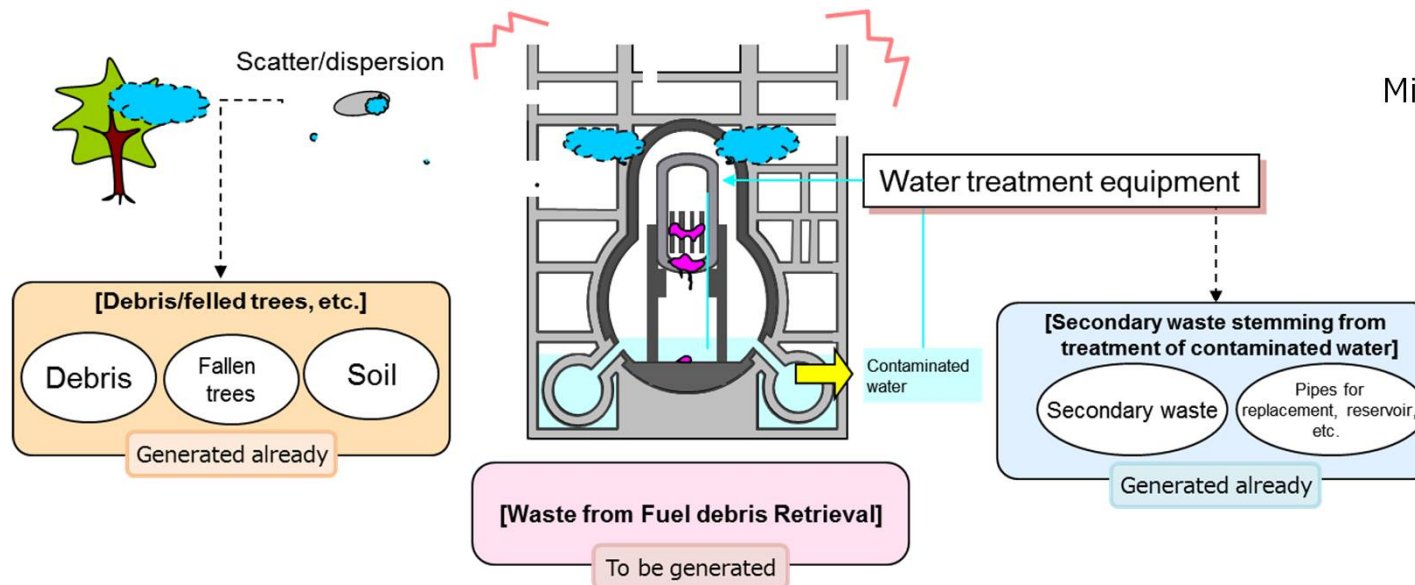
- It is considered that the solid waste generated due to the accident has different characteristics. Hence, characterization of solid waste has been conducted, on the basis of which the study towards processing and disposal has progressed. The management such as storage of solid waste also has been implemented in accordance with risk reduction approach.
- The international safety principles on radioactive waste management are compiled and the policies on solid waste management to be applied are shown, in light of the current state that solid waste characteristics data has been accumulated.

## International Safety Principles on Radioactive Waste Management

- ✓ Described below are some principles in the safety principles on radioactive waste management compiled by ICRP and IAEA for all radioactive waste.
  - To contain all radioactive waste and isolate it from the accessible biosphere
  - To be processed to have stable solid form, and reduced volume to the extent possible and immobilized during the management activity of radioactive waste
  - At various steps in the predisposal management of radioactive waste, the radioactive waste shall be characterized and classified.
  - During the predisposal management, storage is important as a measure to give the management with flexibility.
  - To be stored in such a manner that it can be inspected, monitored, retrieved and preserved in a condition suitable for its subsequent management.
  - The anticipated needs for any future steps in radioactive waste management have to be taken into account as far as possible in making decisions on the processing of the waste.

# 5 – 2. Current State of Solid Waste Management

Effort	Current State
1. Storage	<ul style="list-style-type: none"> <li>◆ Solid waste is safely stored continuously according to its type and surface dose rate. Volume reduction of solid waste such as used protective clothing is being carried out by operation of miscellaneous solid waste incineration facility.</li> <li>◆ In the Solid Waste Storage Management Plan, the amount of solid waste generated in the next ten years is estimated, and a plan is shown to reduce volume of waste stored outdoors as much as possible and transfer to indoor storage in order to achieve further reduction of the risk on storing solid waste.</li> </ul>



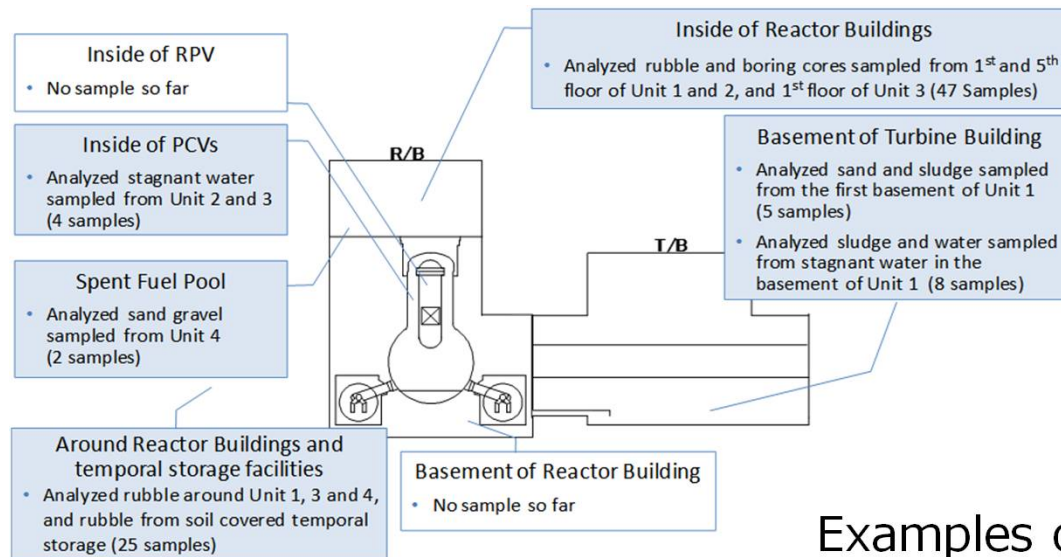
Miscellaneous solid waste incineration facility



Outline of solid waste contamination source and nuclide migration pathway

# 5 – 2. Current State of Solid Waste Management

Effort	Current State
2. Waste Characterization	<ul style="list-style-type: none"> <li>◆ Sampling and analysis were carried out mainly on “rubble, etc.” and secondary waste from water treatment generated after the accident. Analysis results of about 300 samples have been accumulated over the past 6 years.</li> <li>◆ Although some contamination characteristics of solid waste are being estimated based on accumulation of analysis results, further analysis is still required. In addition, in order to promote characterization, a method of understanding the characteristics by using analysis data and nuclide migration model evaluation data is being developed.</li> </ul>
3. Processing and disposal	<ul style="list-style-type: none"> <li>◆ For secondary waste from water treatment system, the technologies for stabilization and immobilization have been developed with priority. In order to narrow down the applicable candidates of conditioning technology, fundamental tests for solidification have been conducted with simulated non-radioactive waste using proven technologies. Through these tests, data was obtained on the possibility of solidification and the soundness of the solidified products.</li> <li>◆ As for disposal, waste classification methodology has been studied on a trial basis for existing disposal concepts as an example.</li> <li>◆ The case-based study of overseas disposal facilities has been conducted in order to contribute to the study on disposal concepts which is based on the characteristics of solid waste.</li> </ul>



Sampling (JAEA)



Examples of sampling location

# 5 – 3 . Proposal for Compilation of the Basic Concept of Solid Waste Management (Strategic Proposal) 1

## Characteristics of Solid Waste

Described below are the characteristics of solid waste that have been presumed.

- ✓ The amount of solid waste is greater than that of radioactive solid waste generated by normal operation of nuclear power stations, and a lot of solid waste have relatively high dose rate.
- ✓ As the major source of contamination is fuel debris, radioactive concentration of nuclides in solid waste does not exceed that of spent fuel.
- ✓ Composition and radioactive concentration of nuclides in solid waste have a lot more varieties compared with those of radioactive solid waste generated by normal operation of nuclear power stations.
- ✓ Secondary waste generated from water treatment has high fluidity, high dose rate that can causes the generation of hydrogen, and the materials/substances which have never been dealt with in Japan.
- ✓ Solid waste generated immediately after the accident include materials/substances whose chemical characteristics might impact on the safety of the predisposal and disposal and/or whose chemical hazard might affect the environment.
- ✓ Information about the total amount of solid waste and their characteristics, which are essential for discussions on disposal, will be revealed sequentially as decommissioning activities proceeds.

## Solid Waste Management Policies

Characterization, storage and preceding processes in predisposal management are mainly focused on until a prospect of disposal is obtained.

- ◇Thorough containment and isolation    ◇Reduction of the amount of solid waste
- ◇Promotion of characterization
  - ⇒ Increasing analytical capability systematically by constructing required facilities/equipment, keeping on analytical talented staff and bringing up analytical staff, and improving characterization by R&D from the perspective of efficiency.
- ◇Thorough storage    ◇Establishment of a selection system of preceding processing methods in consideration of disposal
  - ⇒ Establishment of a selection system of preceding processing methods for stabilization and immobilization of solid waste before technical requirements are set.



# 5 – 3 . Proposal for Compilation of the Basic Concept of Solid Waste Management (Strategic Proposal) 2

## ● Present Efforts/R&D Based on Solid Waste Management Policies

### Thorough containment and isolation

- The measure such as store in containers or immobilization is performed as needed. Solid waste is isolated by storing in the storage place which is set up appropriately.

### Reduction of the amount of solid waste

- Continue such efforts as carry-in control, re-use/recycling and volume reduction.

### Promotion of characterization

【Increasing analytical capability】Construct new facilities/equipment and use existing ones systematically from a mid-to-long term perspective, and establish a system for human resource development (HRD) and technology transfer.

【R&D for improving characterization from the perspective of efficiency】Develop a characterization method with complementarily combining analytical data and evaluation data based on nuclide migration models, and facilitate R&D for optimizing the number of analytical samples and for simplifying analytical methods to speed up analysis.

### Thorough storage

- Reduce the amount of solid waste that have been stored temporarily outside of storage facilities by moving them to storage facilities after volume reduction as much as possible.
- Discuss the methods of evaluating the amount of hydrogen gas generated from the secondary waste from water treatment during the period of storage, estimate the timing of implementing additional safety measures and consider what kind of the measures will be required.
- Study storage method for solid waste to be generated by fuel debris retrieval.

### Establishment of a selection system of preceding processing methods in consideration of disposal

- Establish a selection system of preceding processing methods. In this system, safety assessment of specifications of a provisional waste package is performed relatively in each developed disposal concept. The selection of preceding processing method depends on the result of safety assessment.

### Efficient implementation of R&D projects from the perspective of overall solid waste management

### Development of a system for continuous operations

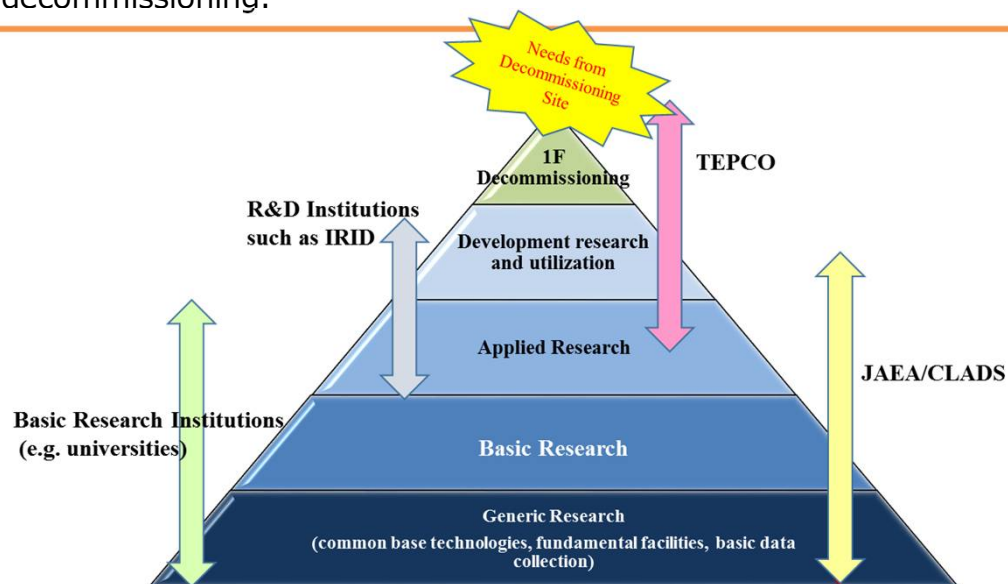
### Measures to reduce the exposure of workers to radiation

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# 6. R&D Initiatives

## Basic Policy

- ✓ As fuel debris retrieval policies for each unit will be fixed, such R&D methodology shall enter a new phase.
- ✓ It is necessary to arrange the division of roles and responsibilities between the government and the operator in an appropriate manner in order to steadily implement R&D results on the decommissioning site.
  - TEPCO is expected to continue actively implementing highly feasible R&D projects necessary for decommissioning, and to promote engineering projects for applying component technologies developed in the Project of Decommissioning and Contaminated Water Management as well.
  - In the Project of Decommissioning and Contaminated Water Management, it is important to flexibly reorganize this kind of R&D projects. Once the fuel debris retrieval policies for each unit are determined, engineering activities, such as application designing for actual units, shall commence. As these processes progress, it is needed to continuously revise R&D projects in order to make it work more closely with engineering processes.
- ✓ It is considered to be further expected that the government and the relevant research institutes should establish a center of basic research/research infrastructure based on a mid-to long-term perspective.
- ✓ Research institutes are expected to enhance the technologies required for decommissioning through considerations on the status of the project and the fundamental R&D activities according to scientific and technological issues (needs) regarding the decommissioning.



A conceptual picture of the division of roles among main R&D Institutions for 1F Decommissioning

- NDF has been hosting the Decommissioning R&D partnership Council meetings and undertaking optimization of R&D activities carried out by each institution for a better effectiveness and efficiency as a whole.
- NDF has built a task force on research collaboration and specified the Essential R&D Themes that should be preferentially and strategically targeted. Now, sectional meetings have been established in the Platform of Basic Research for Decommissioning and discussions to compile R&D strategies for the themes are underway
- It is essential to work on developing R&D infrastructure and accumulating technological knowledge, such as developing generic technologies and collecting basic data, building up research centers, facilities and equipment, and human resource development. Measures to further utilize JAEA/CLADS should be implemented.

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# 7. Enhancement of International Cooperation

- There are a lot of experiences and expertise in the world on decommissioning of nuclear facilities and sites that suffered accidents or contamination. To actively learn and make use of these learnings will help to facilitate safer and faster decommissioning of Fukushima Daiichi NPS, and it is important for the relevant organizations in Japan to proactively enhance international cooperation.

## Integrating and Utilizing Wisdom

- ✓ Participation in the activities of the international organizations such as IAEA and OECD/NEA
  - ✓ Signing the co-operation agreement with NDA, U.K. and memorandum of understanding with Alternative Energies and Atomic Energy Commission (CEA), for information exchange
  - ✓ Participation in the discussions under the governmental framework among U.K., U.S., France, Russia and Japan
  - ✓ Inviting distinguished experts from the U.K., France, Spain, and the U.S. as International Special Advisers to receive advice from them
  - ✓ Holding the Decommissioning R&D Partnership Council, in order to promote effectively and efficiently the research and development projects of individual organizations
- ⇒ As the technically challenging works progress, it is vital to carry out decommissioning of Fukushima Daiichi NPS by integrating wisdom from Japan and overseas such as continuing to collect and utilize knowledge and experiences on decommissioning activities of other countries and to be evaluated against the international standards.

## Active Information Dissemination to International Communities

- ✓ NDF has been participating in a variety of events in close collaboration with the government such as holding The International Forum on the Decommissioning of the Fukushima Daiichi NPS, and a side event at IAEA General Conference and presenting at Waste Management Symposia. Also, NDF has been participating in the activities of OECD/NEA for providing the information on Fukushima Daiichi NPS.
- ⇒ it is essential to disseminate information about the issues, progress and achievements to international communities to receive their advice and assessments as decommissioning proceeds. Efforts need to be made so that the international community have correct understanding, it is necessary to further reinforce dissemination of information that is easy to understand.

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## 8. Future Actions

- The importance of project management will increase as the decommissioning activities at the Fukushima Daiichi NPS progress to an advanced phase and technically difficult activities, such as fuel debris retrieval, are fully performed.

### Enhancing Project Management Capabilities

- ✓ The fuel debris retrieval operation, which is technically difficult and needs to be performed, taking into account the relationship with and the continuity of the activities that have been performed, will be fully performed.
- ✓ Project risk management that identifies the risks which may impact on the implementation of the project, analyzes the significance of the risks and take required actions is essential.
- ✓ TEPCO, as the organization responsible for the implementation of decommission, and NDF, as the organization responsible for the management and supervision of decommission, need to clearly define their roles and accountability, and strengthen project governance in order to facilitate sound progress of the project, respectively.

### Engagement with Stakeholders

- ✓ Based on providing plain and accurate information, it is necessary to have good conversation, make continuous effort mutually in order to reduce the gap between the providers and receivers, and repeat these processes.
- ✓ Just anxiety about potential risks may cause serious harm to the reputation. To avoid further reputational damages, it is more significant, than anything else, to manage radioactive materials in an appropriate manner in order not to let them leak and reduce the existing risks promptly.

### Consideration for the Project Sustainability

- ✓ It is necessary to ensure the mechanism that enables continuous project management, etc. and to secure a large variety of human resources taking the roles in these works.