Nuclear Damage Compensation & Decommissioning Facilitation Corporation (NDF) and "Strategic Plan for Decommissioning of Fukushima Daiichi NPS."

March 18, 2015

Kazuhiro Suzuki

Nuclear Damage Compensation & Decommissioning Facilitation Corporation

Nuclear Damage Compensation & Decommissioning Facilitation Corporation (NDF)

Support for decommissioning of damaged reactors has been assigned to Nuclear Damage Compensation Facilitation Corporation, which facilitates compensation and supervises the management of TEPCO.

- Legal Basis: Act on Establishment of Nuclear Damage Compensation & Nuclear Decommissioning Facilitation Corporation (NDF)
- Competent Ministers: Prime Minister, Minister of Education, Culture, Sports, Science and Technology, Minister of Economy, Trade and Industry
- Location: Headquarters (Tokyo), Fukushima Office (Koriyama), Fukushima Daiichi Nuclear Power Plant Field Office (Naraha)
- President: Takehiko Sugiyama (former President of Hitotsubashi University: left side)
  Vice President: Hajimu Yamana (former President of International Research Institute for Nuclear Decommissioning: right side)
- Capital: 14 billion yen (Government: utilities = 1:1)

Establishment of Nuclear Damage Compensation & Decommissioning Facilitation Corporation (NDF)

Starting from December 2011, Japanese Government developed structure to implement TEPCO's decommissioning process based on master plan described in Government's Mid and Long-Term Roadmap.

Government

Determine Mid and Long-Term Roadmap.
(Developed in December 2011, revised in June 2013)

Dec 2011 [Roadmap development]	Dec 2013 [2 years later]	Dec 2021 [10 years later]	[30 to 40 years later]
Stabilization activities	Phase 1	Phase 2	Phase 3
	Period until start of fuel removal from spent fuel pool	Period until start of fuel debris retrieval	Period until end of decommissioning of Units 1 to 4

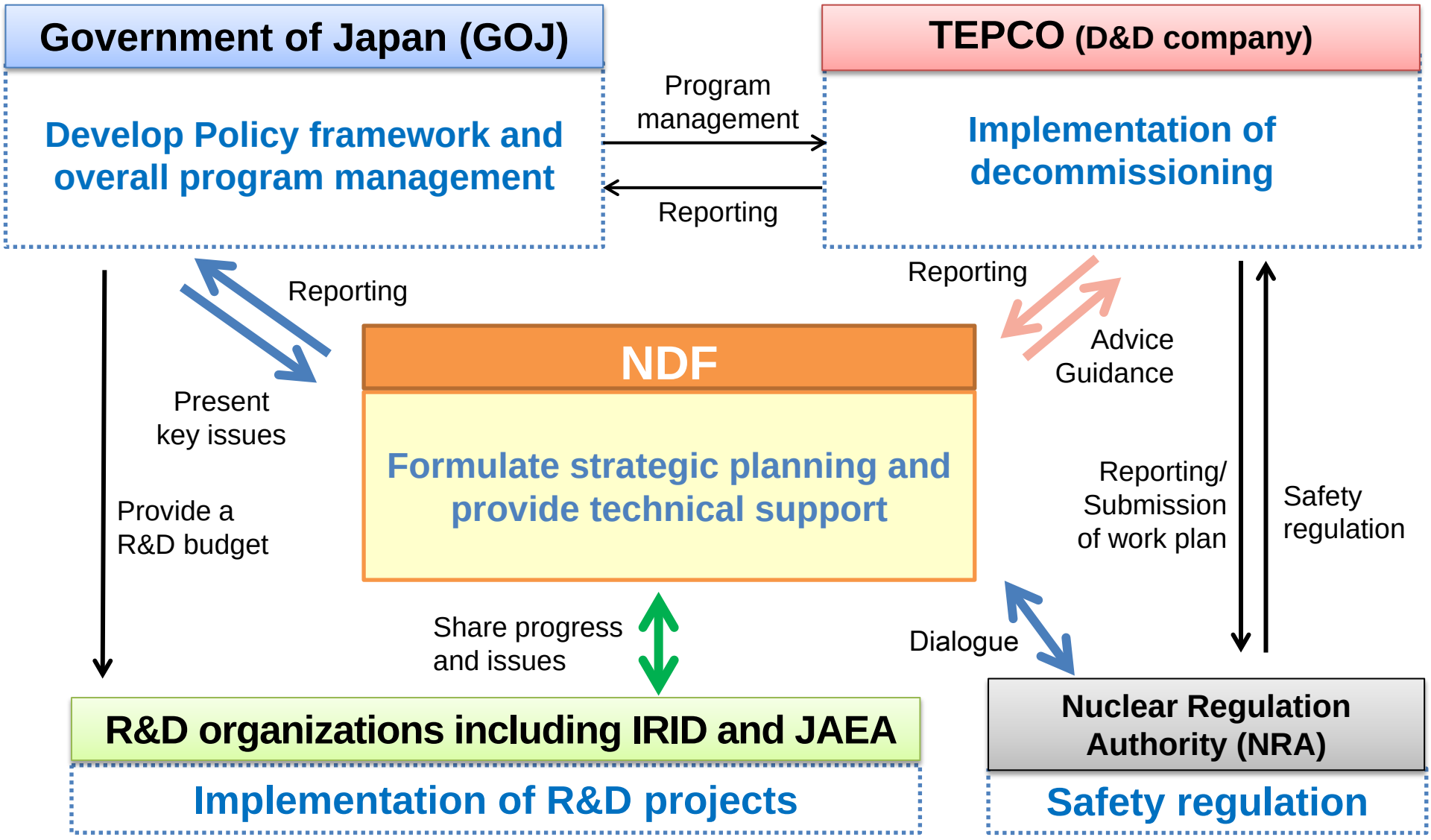
TEPCO

Implement decommissioning

Source: TEPCO website

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

Fukushima Decommissioning & Contaminated Water Management



Purpose of Strategic Plan and Relationship with Mid and Long-Term Roadmap

Goals and policies presented by Government
Key elements of strategies, policies and plans

→ Government Roadmap

Strategy
- Provides approach to conducting activities
- Decision making and priority setting in achieving goals

Criteria for implementation of strategy

Integrated plan for implementation of strategy
- Field work
- Research and Development

→ NDF Strategic Plan

Delivery of decommissioning by TEPCO;
R&D undertaken by IRID, JAEA etc.

→ Implementation plans by TEPCO and research institutes

Decommissioning Support Activities by NDF

(i) Development of strategic plan
- Fuel debris Retrieval
- Management of radioactive waste

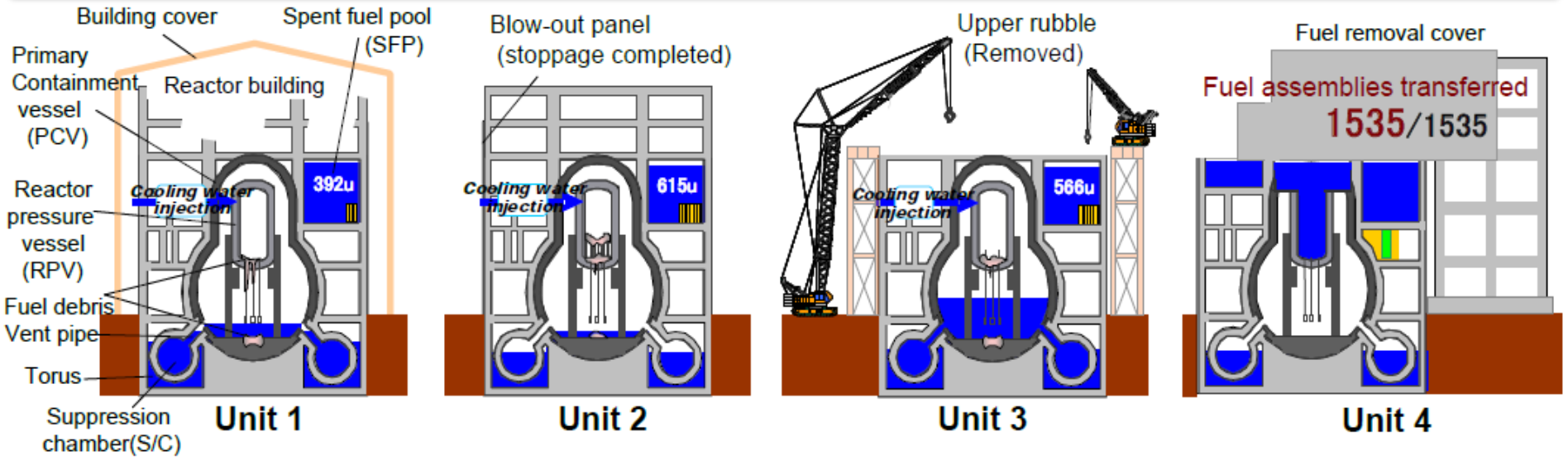
(iii) Planning of R&D and progress management
- Planning of R&D
- Management of projects and evaluation of results of R&D

(ii) Technical support for key issues
- Provide technical support for current activities of Government and TEPCO, such as contaminated water management

(iv) International cooperation
- Bring together domestic and overseas technology and experience
- Information exchange

Status of Reactors at Fukushima Daiichi

- **All Units in cold shutdown (Units 1 to 6)**



Strategic Plan

- **Five (5) Guiding Principles** for Risk Reduction:

✓ Principle 1: **Safety**	Reduction in risk of radioactive materials (Impact on off-site environment; workers exposure)
✓ Principle 2: **Reliability**	Reliable and flexible technology
✓ Principle 3: **Reasonable**	Effective utilization of resources (human, capital, money, space)
✓ Principle 4: **Speediness**	Awareness of time
✓ Principle 5: **Site reality-oriented**	Emphasis on actual place, actual parts and actual situation

- Areas specifically addressed for risk reduction purposes:

  - **Fuel Debris Retrieval**
    - Develop workable scenario for fuel debris retrieval assuming several methods (submersion, wet) and combination of the methods, taking into account status of each Unit.
  - **Waste Management**
    - Develop policy for storage management, treatment and disposal from mid to long-term perspective, based on principles for safe waste disposal and appropriate waste treatment.

Risk Reduction in Strategic Plan

1. Principle

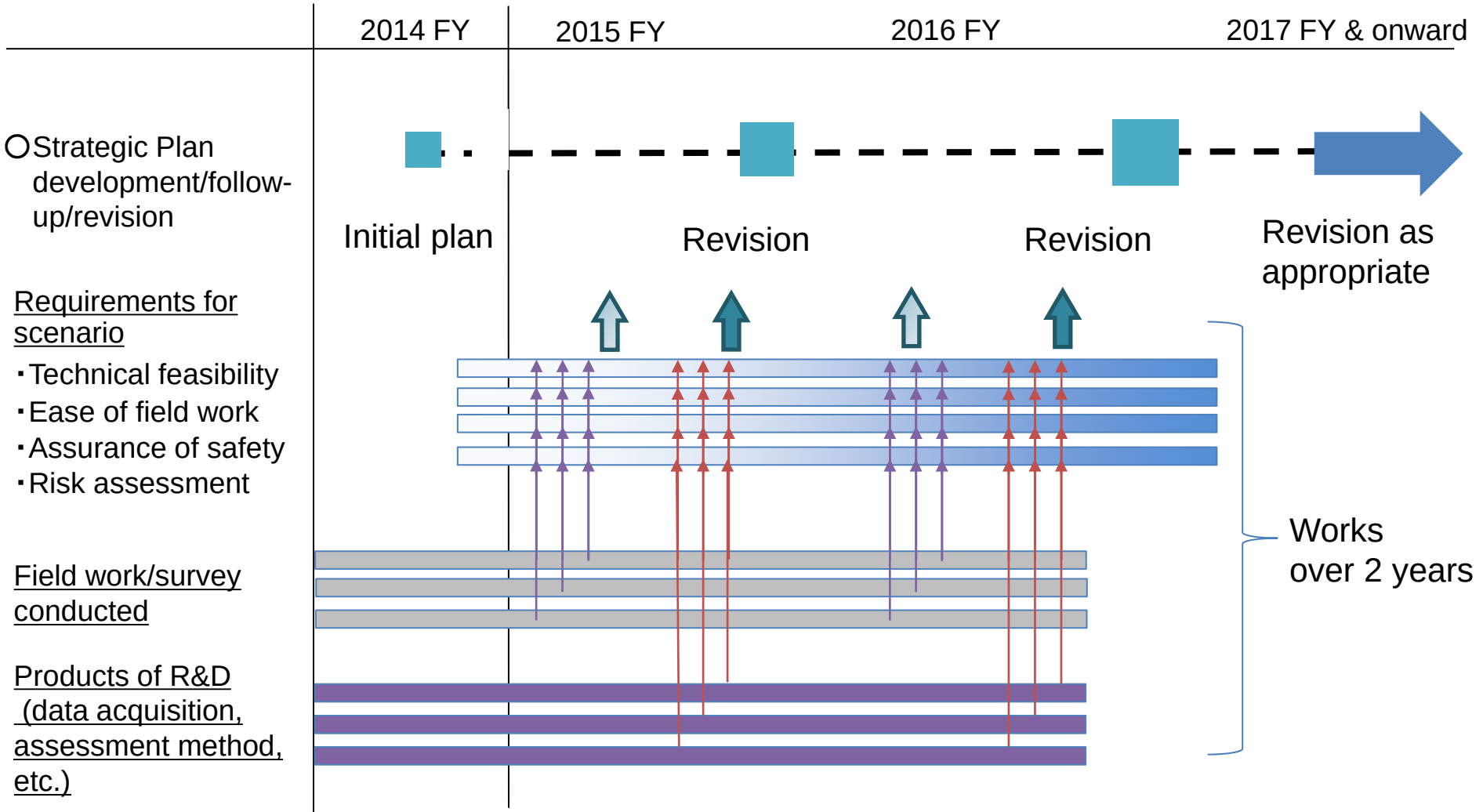
- The decommissioning of Fukushima Daiichi Nuclear Power Plant is a continuous risk reduction activity to protect people and the environment from the risk of radioactive materials
- A risk reduction strategy following mid to long-term timeline will be defined in the Strategic Plan

2. Sources of risk

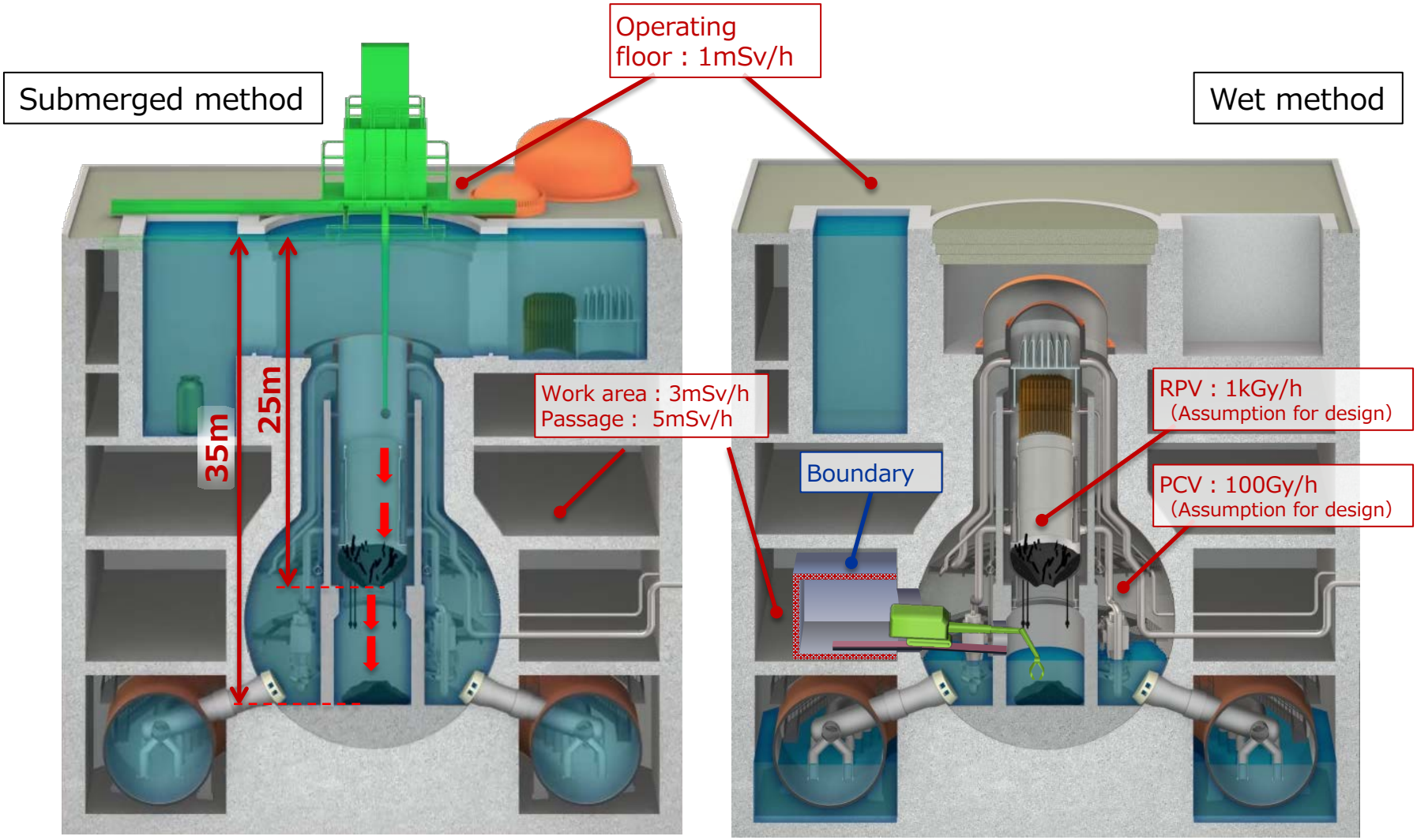
- Contaminated water
- Fuel in spent fuel pool
- Fuel debris
- Sludge from water treatment
- Waste stored in container
- Solid waste

- Each risk is evaluated. Priority is determined based on risk level and policy for risk management is developed

Milestones for Strategic Plan Development



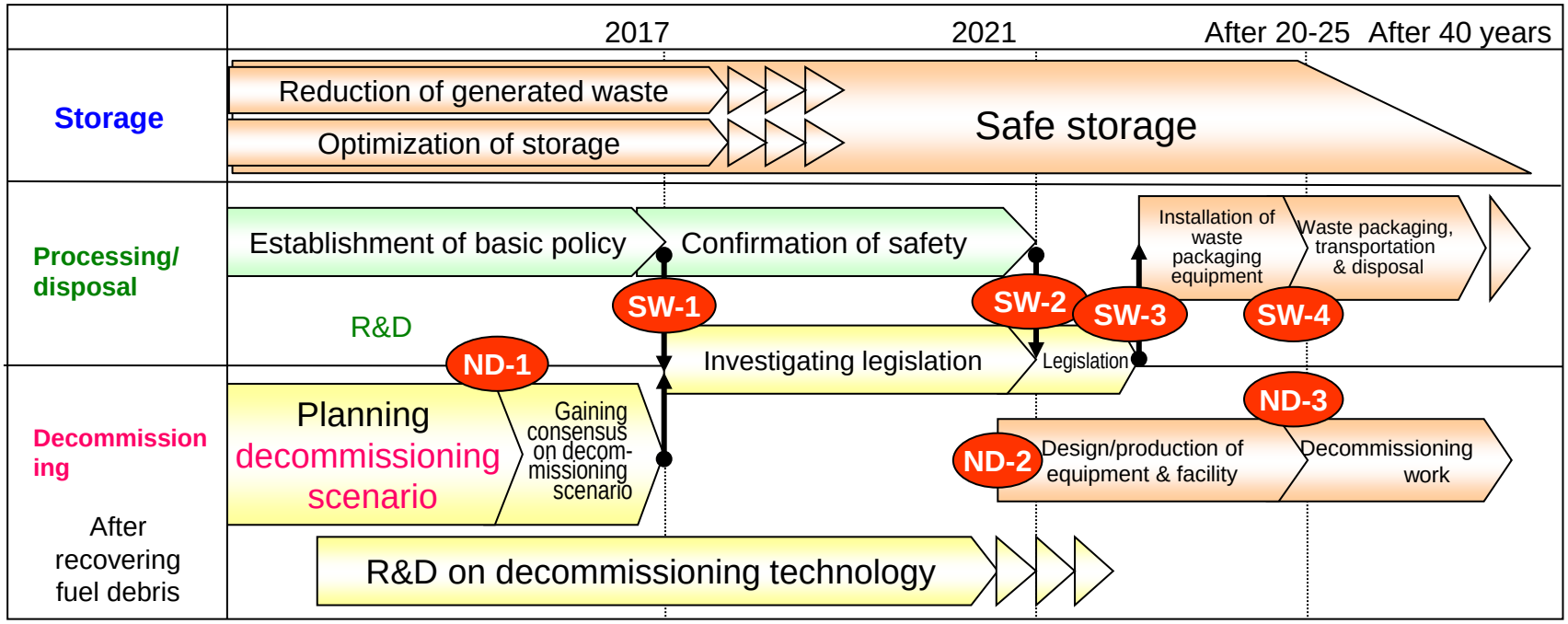
Options to Retrieve Fuel Debris (Submerged or Wet, and from Top or from Side)



Mid and Long-term Roadmap for Radioactive Waste Management

Waste Generation → Storage & management → Processing (Conditioning) → Disposal

Depends on decommissioning scenario | Segregation, volume reduction, storage | Research & development based on properties of waste



HP Point of decision for next step. Additional R&D and review of schedule and work to be discussed / decided.

SW-1: Establishment of basic concept of processing and disposal for solid radioactive waste (2017)
SW-2: Establishment of safety concept of processing and disposal for solid radioactive waste (2021)
SW-3: Determination of specifications and production method of waste package (third term)
SW-4: Installation of waste package production equipment and disposal (third term)

ND-1: Planning decommissioning scenario (2015)
ND-2: Techniques for decontamination and dismantling equipment (third term)
ND-3: Waste disposal / Conclusion of R&D (third term)

Strengthening of International Relationships

(i) Appointment of experts as International Special Advisors
(ii) Participation in international frameworks such as IAEA and OECD/NEA
(iii) Development of cooperative relationship with overseas organizations

International Special Advisors

Dr. Rosa Yang	EPRI Fellow, Nuclear Power, U.S. Electric Power Research Institute (EPRI)
Dr. Mike Weightman	Former Chief Executive, the Office for Nuclear Regulation (ONR)
Mr. Paul Dickman	Senior Policy Fellow, U.S. Argonne National Laboratory
Mr. Christophe Behar	Director of Nuclear Energy Division, Commissariat a l'energie atomique et aux energies alternatives (France) (CEA)

Cooperative Agreements

NDA (UK)

CEA (France)

Roles of Bodies involved in Fukushima Daiichi Plant Decommissioning & Contaminated Water Management

Government of Japan (GOJ)

Develop Policy framework and overall program management

- Adopt the Mid-and-Long-Term Roadmap.
- Project management of emergent issues such as contaminated-water management

Program management →

← Reporting

TEPCO (D&D company)

Deliver decommissioning work

- Fuel removal from the spent fuel pools.
- Contaminated-water management
- Storage of rubble and other solid wastes
- Ensure safety and quality; work environment, etc.

Reporting

Present key issues

NDF

Reporting

Advice Guidance

Reporting/ Submission of work plan

Safety regulation

Dialogue

Formulate strategy and technical support

1. Develop a mid-and-long-term strategy
2. Provide technical support in the program management of key issues
3. R&D Planning, program and project management
4. Promoting international cooperation

Provide a R&D budget

Share progress and issues

Nuclear Regulation Authority (NRA)

Safety regulation

R&D organizations such as

-International Research Institute for Nuclear Decommissioning (IRID)

-Japan Atomic Energy Agency (JAEA)

Implementation R&D projects

Development of Mid and Long-Term Strategy

As an organization of experts in a variety of technological fields, NDF develops a mid-and-long term strategy with the cooperation of external experts.

- Technology experts in NDF's decommissioning department (about 30 experts)
  - Plant engineering
  - Robotics
  - Civil engineering and architecture
  - Materials, analysis, monitoring
  - Fuel and nuclear reactor engineering
- Experts from external organizations (universities, JAEA and other research institutions)

<Decommissioning Strategy Board>

1st	Aug. 21, Thu	4th	Dec. 4, Thu
2nd	Sep. 30, Tue	5th	Jan. 6, Tue
3rd	Oct. 28, Tue*	6th	Jan. 28, Wed
7th	Feb. 23, Mon*		

* With the participation of international special advisors.

<Expert Committee>

- Fuel Debris Retrieval Expert Committee
- Waste Management Expert Committee

Intensive Workshop type Meetings held repeatedly among ANRE, TEPCO and IRID under the Lead by NDF on specific Issues

Planning of Research and Development and Progress Management (1)

Get information on developments in a series of research and development projects on decommissioning in an integrated manner; review the developments; and conduct activities to develop and implement a plan for the following year.

(i) Contaminated Water Treatment Demonstration Project (Agency of Natural Resources and Energy)

- High-Performance Multi-Nuclide Removal System (High-Performance ALPS) Development & Demonstration Project
- Large-Scale Frozen-Soil Shielding Wall Development & Demonstration Project

(ii) Decommissioning & Contaminated Water Management Fund Project (Agency of Natural Resources and Energy)

- Contaminated-Water Management Technology Demonstration Project (the international request for proposal)
- Project for the Evaluation of the Concept of Alternative Fuel Debris Retrieval Method and the Feasibility of Component Technologies (the international request for proposal)
- Technology Development Project

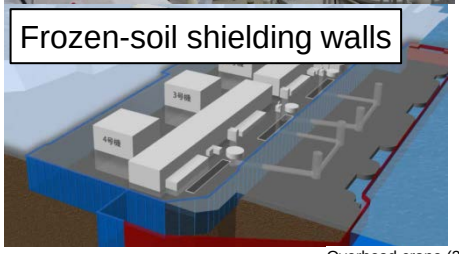
(iii) Research Center Facility Development Project (Agency of Natural Resources and Energy)

- Mock-up test facility
- Analysis and research and development facility

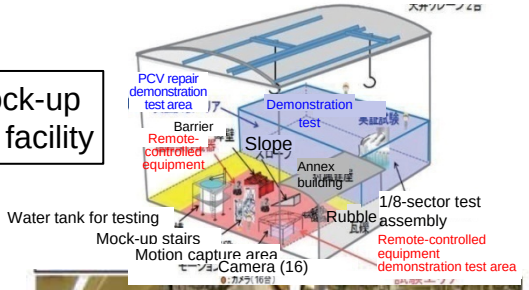
(iv) JAEA-Funded Basic Research & Research Center Development Project (Ministry of Education, Culture, Sports, Science and Technology)

High-performance ALPS

Frozen-soil shielding walls



Mock-up test facility

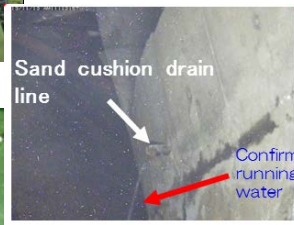


Analysis & R&D facility

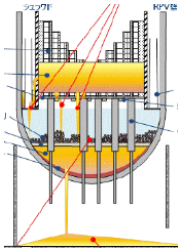
Planning of Research and Development and Progress Management (2)

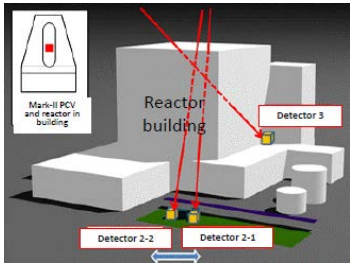
Get information on developments in a series of research and development projects on decommissioning in an integrated manner; review the developments; and conduct activities to develop a plan for the following year.

Preparation for fuel debris retrieval	Containment examination & repair technology	Development of technology for remotely operated decontamination inside the reactor buildings
		Utilizing the device to identify leak locations that has been developed
		Development of repair and leakage stoppage technology for leakage points inside PCV (including lower PCV mock-ups)
	Fuel debris retrieval technology	Development of technology for investigation inside the PCV
		Development of technology for investigation inside the RPV
		Development of technology for retrieval of fuel debris and in-core structures
		Development of technology for collecting, transferring and storing fuel debris
		Development of technology for controlling fuel debris criticality
	Core/fuel debris evaluation technology	Assessing conditions inside reactor through application of severe accident analysis code
		Development of technology for detection of fuel debris in the reactor (MUON)
		Development of technology for non-destructive detection of radioactive materials accumulated inside the Suppression Chamber
		Development of technology for identifying properties of and treating fuel debris
		(Spent fuel pool management)
	Integrity evaluation technology	(Spent fuel pool management)
		Development of technology for evaluating integrity of the PCV/RPV
Spent fuel pool management		Discussion on treatment of damaged fuel removed from the spent fuel pool
		Long-term integrity evaluation of fuel assemblies removed from the spent fuel pool
Radioactive waste treatment/ disposal		R&D on treatment and disposal of solid waste



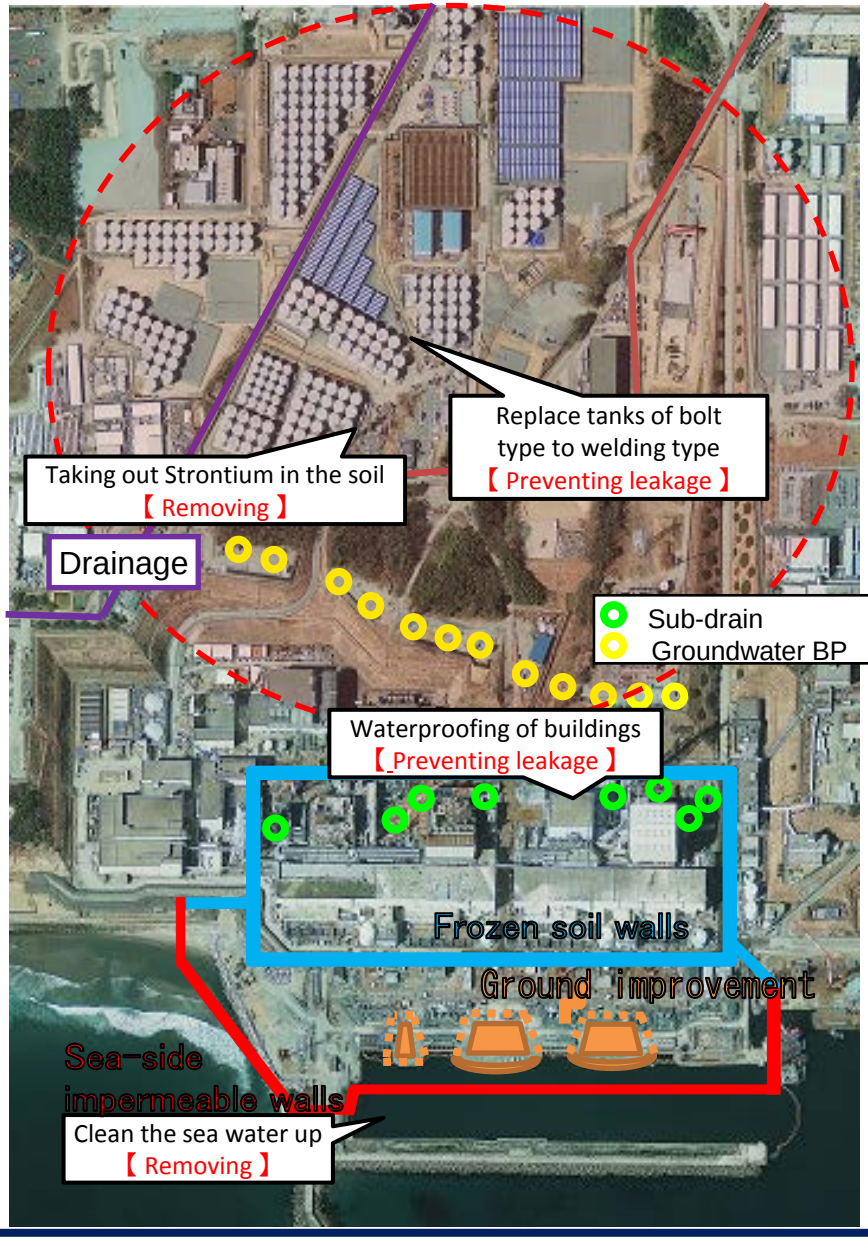
Development of technology to identify containment leak locations





Development of reactor fuel debris detection technology (MUON)

Comprehensive Countermeasures to Manage Contaminated Water



Three measure policy

1. Removing the contamination source

- ◆**Pump-up contaminated water from trench**
- ◆**Clean up of contaminated water by ALPS (Multi-nuclide removal equipment)**
- ◆**Additional and High-performance ALPS**

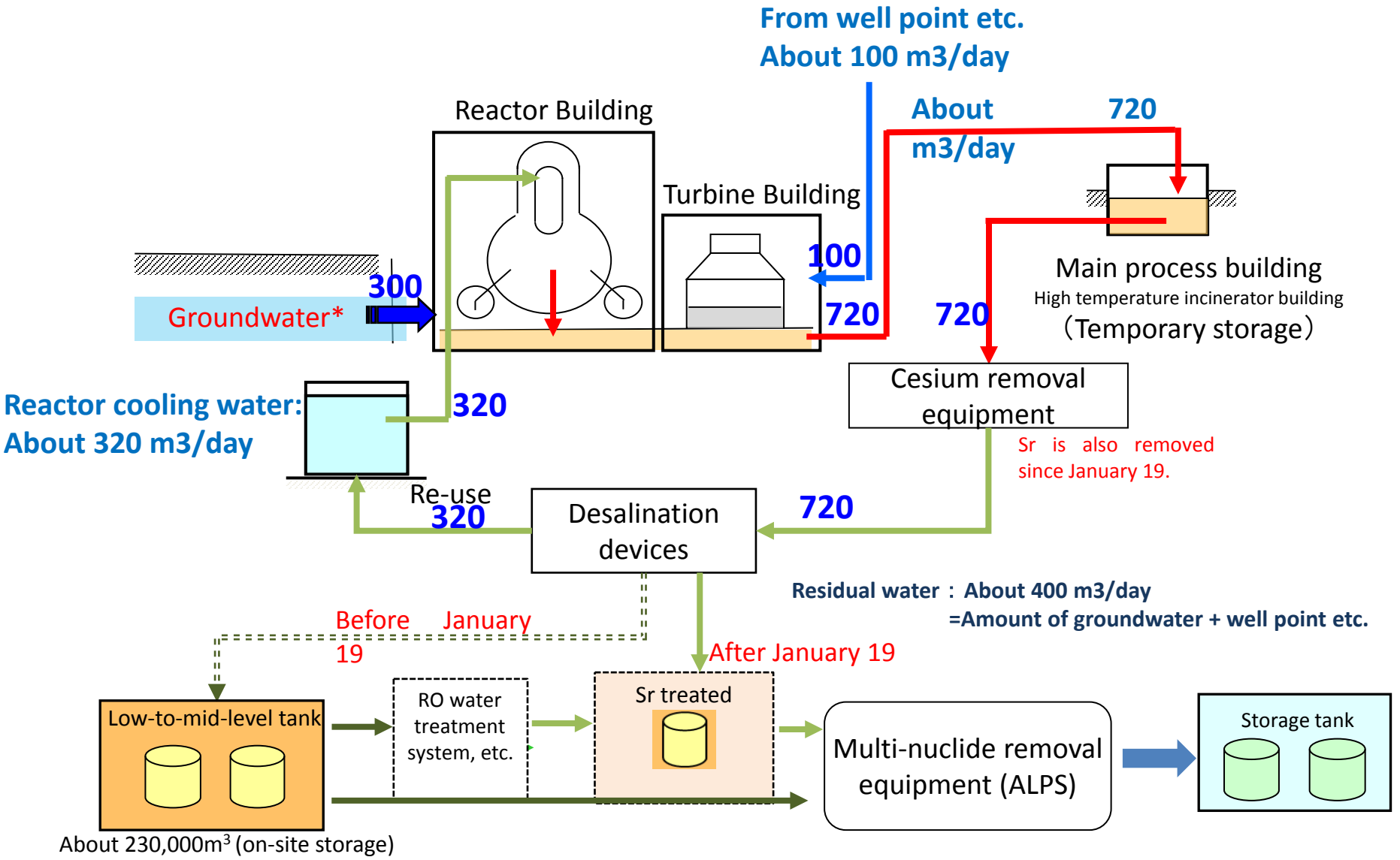
2. Isolating groundwater from the contamination source

- ◆**Land-side frozen soil impermeable walls**
- ◆**Groundwater bypassing system**
- ◆**Pump-up from sub-drain around the reactor building**
- ◆**Waterproof pavement wide area facing etc.**

3. Preventing leakage of contaminated water

- ◆**Ground solidification by sodium silicate**
- ◆**Sea-side impermeable walls**
- ◆**Construction of welding type tanks including replacement from flange (bolt) type etc.**

Management of Contaminated Water - Overview of the System -



* Groundwater inflow has decreased from about 400m3/day to about 300m3/day by the operation of groundwater bypassing system etc.

Multi-Nuclide Removal Equipment [Removing]

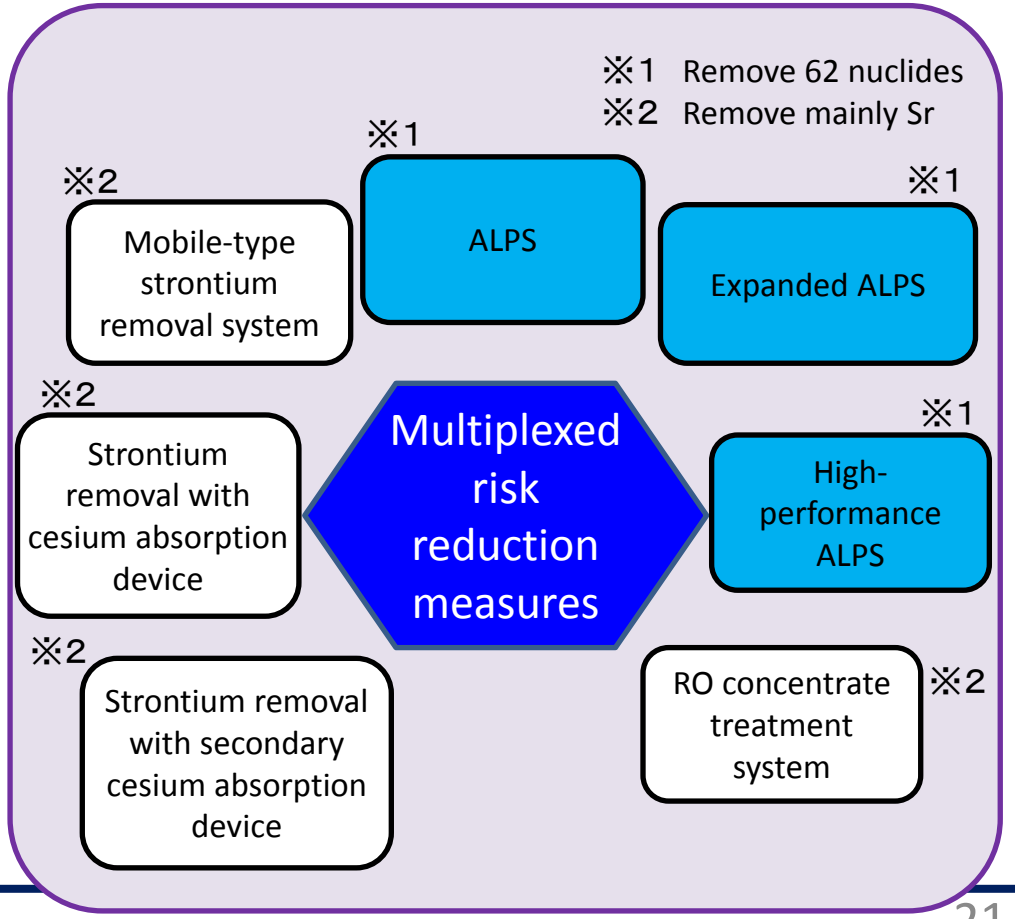
◇ Accelerating the contaminated water treatment by the installation of multiple equipment, and complete the treatment the water in tanks as early as possible.(It is estimated that the treatment will be completed around the end of May, 2015)

◇ By introducing more multiplexed risk reduction measures, accelerate the water treatment and the reduction of the effective dose.

Target level of the effective dose at the site boundary (Nuclear Regulation Authority)

Period	End of March, 2015	End of March, 2016
Target	Under 2mSv/year※	Under 1mSv/year

※Reduce the effective dose (evaluated value) at the site boundary, due to except the contaminated water in tanks, to 1mSv/year by the end of March, 2017.



Principle for Risk Reduction in Strategic Plan

3. Definition of risk

(i) Risk of radioactive materials

- Risk = level of effect x probability of occurrence

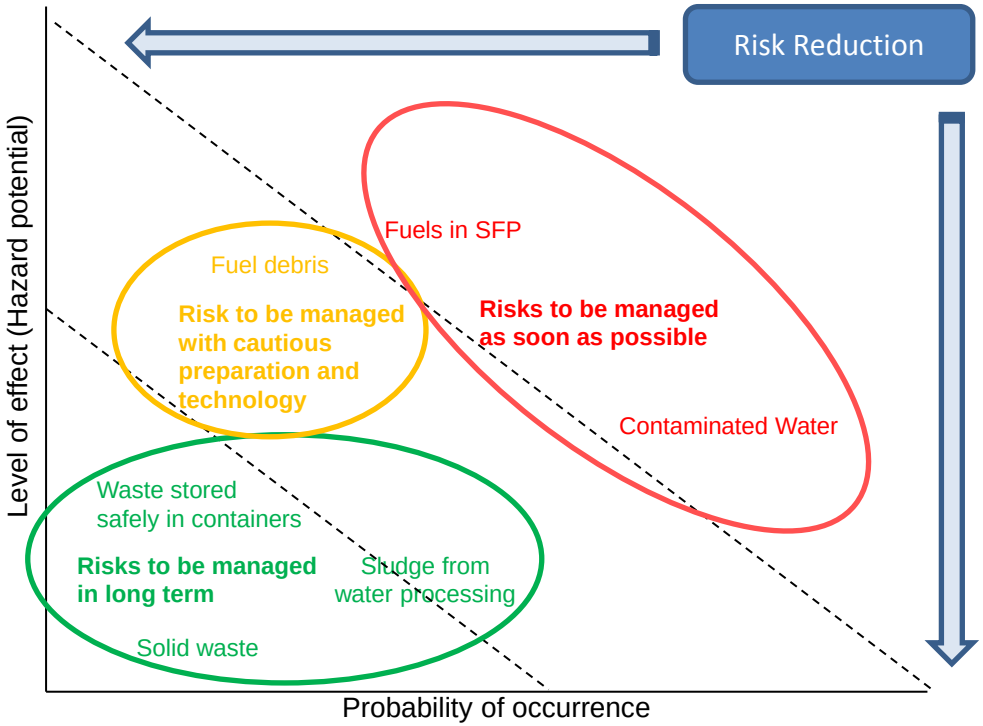
(ii) Level of effect

- If the containment function is lost, radiation effects (exposure, environmental contamination) occur.
- Level of effect = level of activity x physical state (solid, liquid or gas)

(iii) Probability of occurrence

- Factors for the loss of the containment function include natural phenomena, failures and improper operations.
- The vulnerability of the facility to the above factors needs to be considered.
- Probability of occurrence = possibility of occurrence of the factor x vulnerability of the facility

(iv) Risk assessment of Fukushima Daiichi Nuclear Power Plant



(v) How to reduce risk

- Move radioactive materials to a safer and more stable facility.
  → Reduce the probability of occurrence.
- Decay of radioactivity and change in the physical state
  → Reduce the level of effect.