

Recent Progress of the Decommissioning of Fukushima Daiichi NPP

How Japan is tackling the challenge

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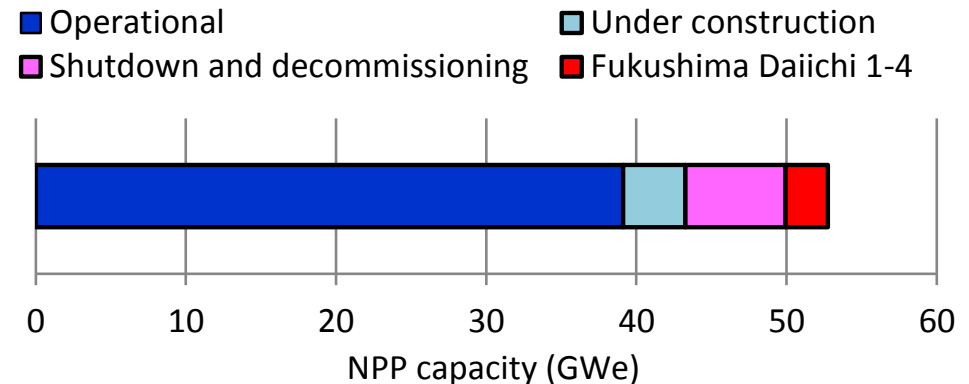
Commercial power reactors and decommissioning in Japan

Nuclear power generation in Japan

- Japanese basic energy policy 2014 :
20-22% of the total electricity in 2030
expected by nuclear power
- Current capacity:
40 commercial reactors (22 BWRs and
18 PWRs) operational; 39.122 GWe
- Re-started:
5 reactors in power generation

Decommissioning of the retired reactors

- Legal reactor lifetime:
40 years or 60 years at the maximum
- Shut-down reactors:
9 aged reactors shut-down
2 units in decommissioning
- Safety regulation on decommissioning:
Required by Nuclear Reactor
Regulation law



D&D of Fukushima Daiichi Reactors

- Successful decommissioning of the four damaged units of Fukushima Daiichi is an indispensable prerequisite for Japanese nuclear power generation
- Risk reduction of contaminated reactors and site is necessary for the revitalization of the suffered society
- Fukushima Daiichi unit-1, 2, 3, and 4 are subject to the special safety regulation as the specified nuclear facility (accident reactors)

Latest status of Fukushima Daiichi NPP

Site: stabilized and improved

High risk sources: removed

Spent Fuels removal: ongoing

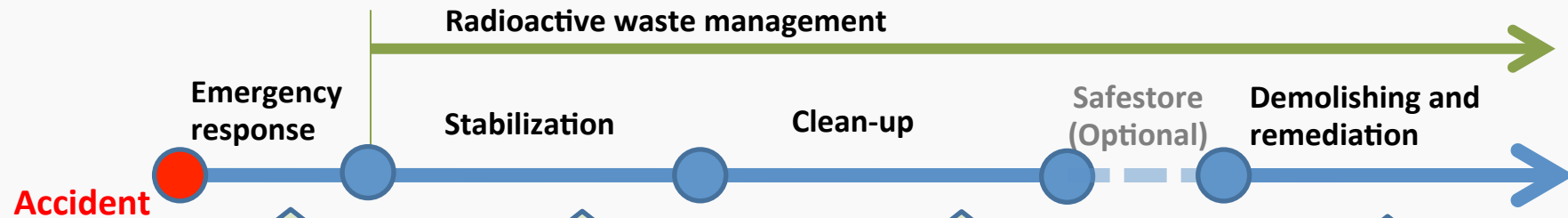
Safe storage of wastes: progressing

In-reactor inspection: undertaken



Decommissioning of Fukushima Daiichi NPP

D&D process for accident nuclear facility generally understood (**IAEA NW-T-2.7**)



Fukushima Daiichi D&D

Urgent stabilization of the damaged facilities (Core cooling, highly contaminated water removal, etc.)

Contaminated water measures, ensuring cooling circuit, rubble removal, spent fuel removal, improvement of worker's condition

Mid and long-term operations

- Spent fuel removal (extended)
- **Fuel-debris retrieval**
- **Waste storage and treatment**
- Ground water management (continued)

Demolishing and waste disposal

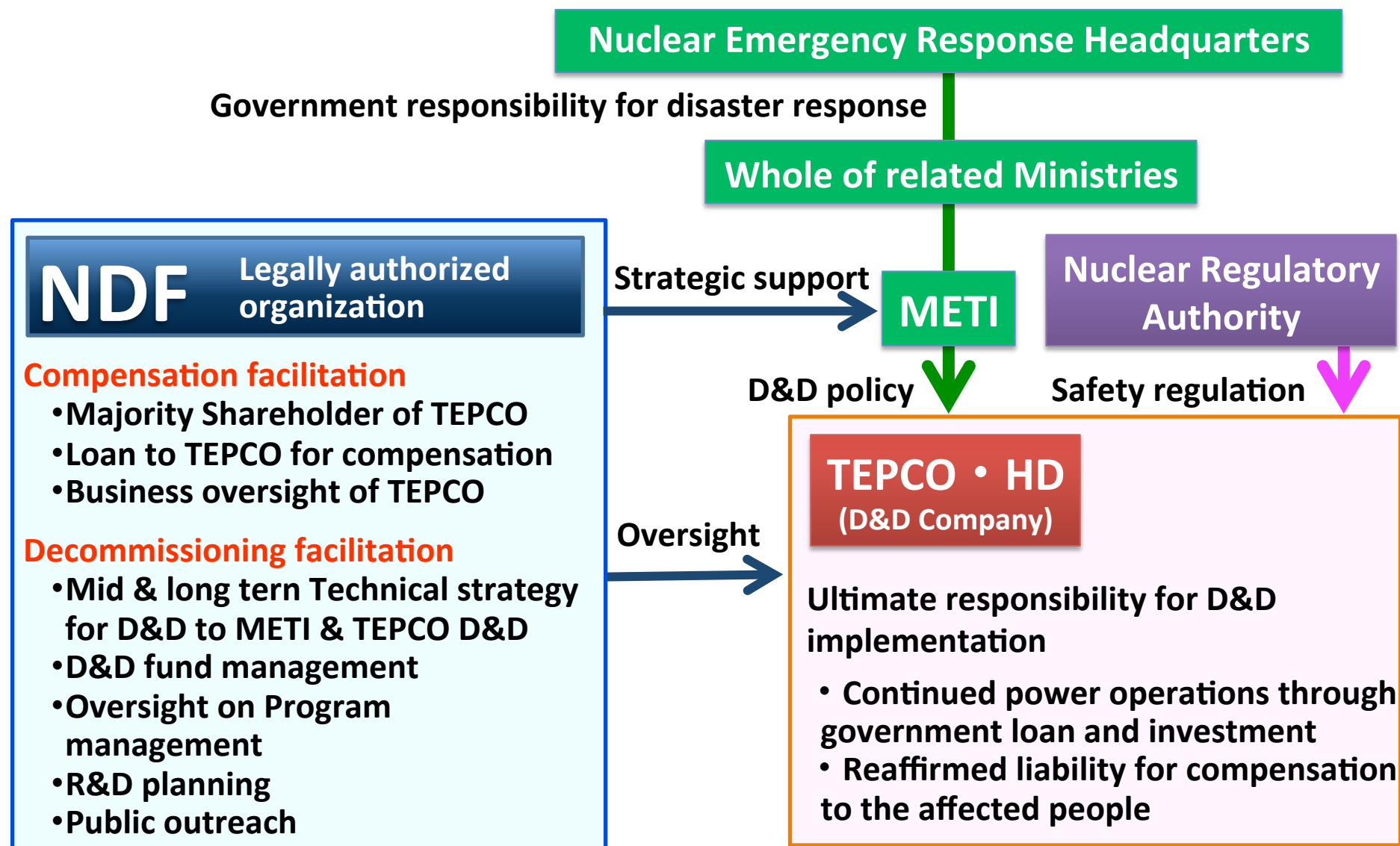
2011-2016

1. Certain stability achieved through 7 years operations for emergency response and stabilization

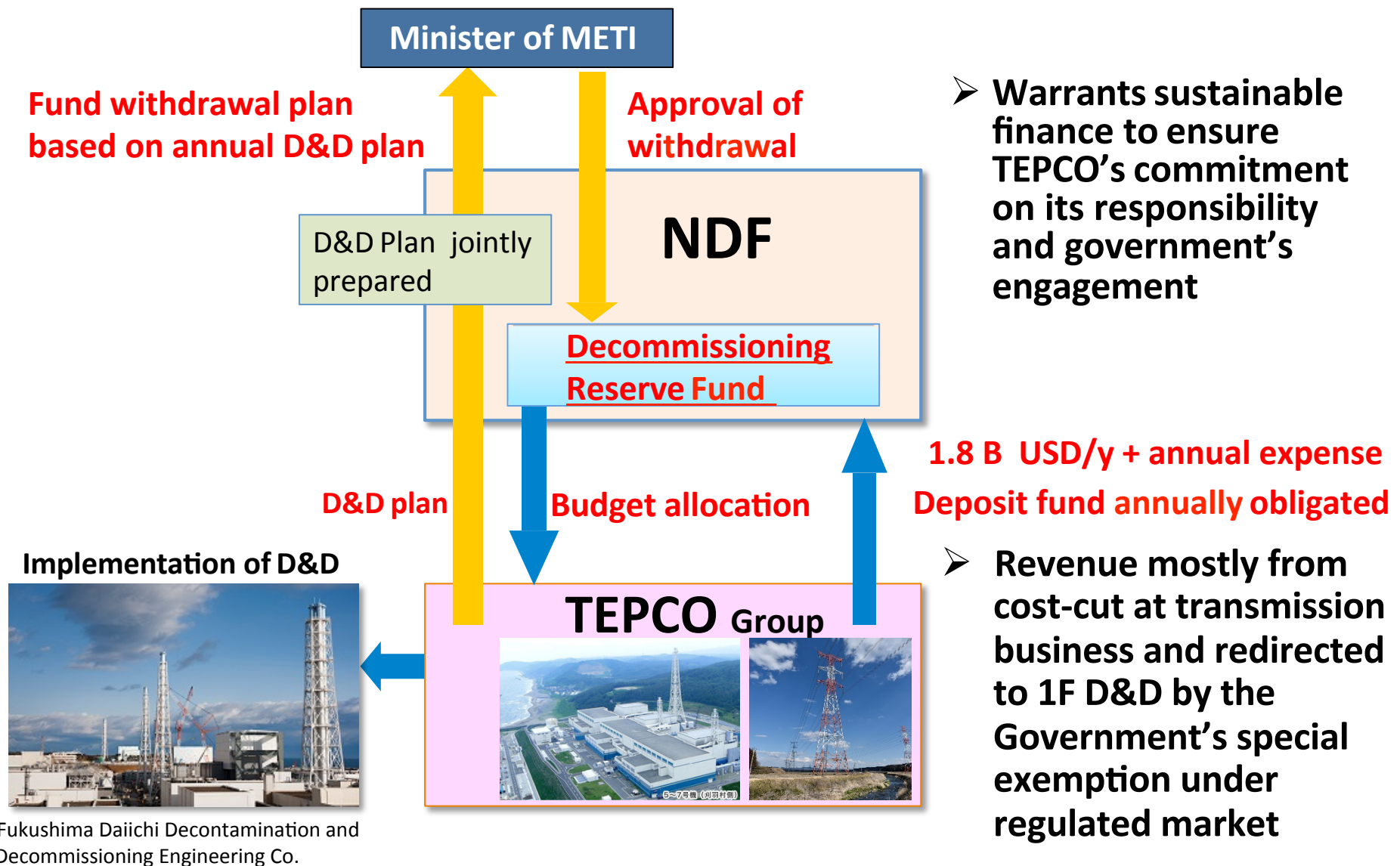
2017-2021 and future

2. Institutional enhancement of the roles and responsibility of government and TEPCO
3. Start mid and long-term operations in line with solid technical strategy and achievable schedule
4. Enhance public communication
5. Keep international cooperation

Roles and responsibility of 1F related organizations



Decommissioning reserve fund at NDF by revision of NDF Law



Before/After, Fukushima-Daiichi NPP



Improved site condition of Fukushima-Daiichi NPP site

Unit-3 Spent fuel removal ready to start



Unit-4 Spent fuel removal accomplished



New solid waste storage facility



ALPS



New Administration building



Port area



Unit-1 Rubble removal ongoing



Unit-3 Spent fuel handling machines installed

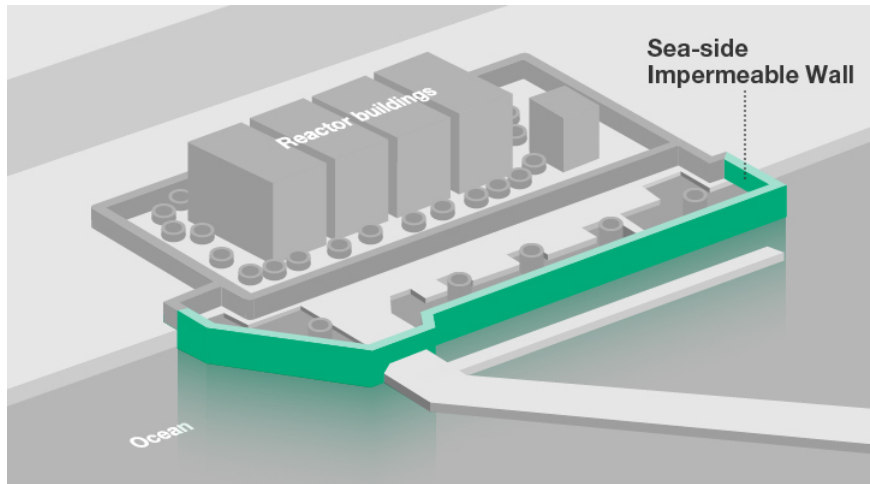


Tanks for treated water storage

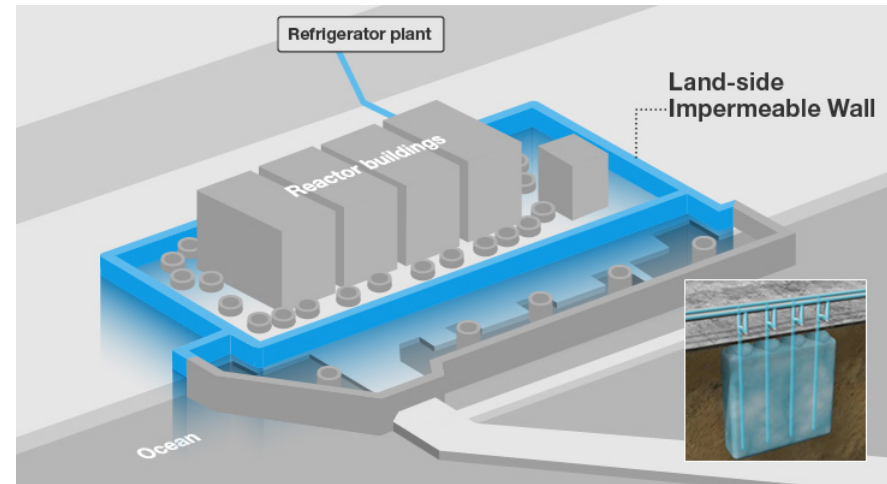


Contaminated water is successfully confined

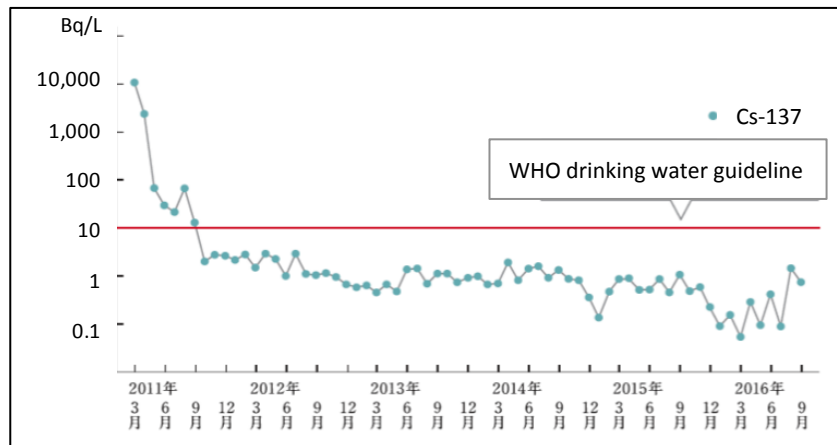
Sea-side impermeable wall



Land-side impermeable wall (Frozen soil)



Cs-137 concentration at south part of port (month average)



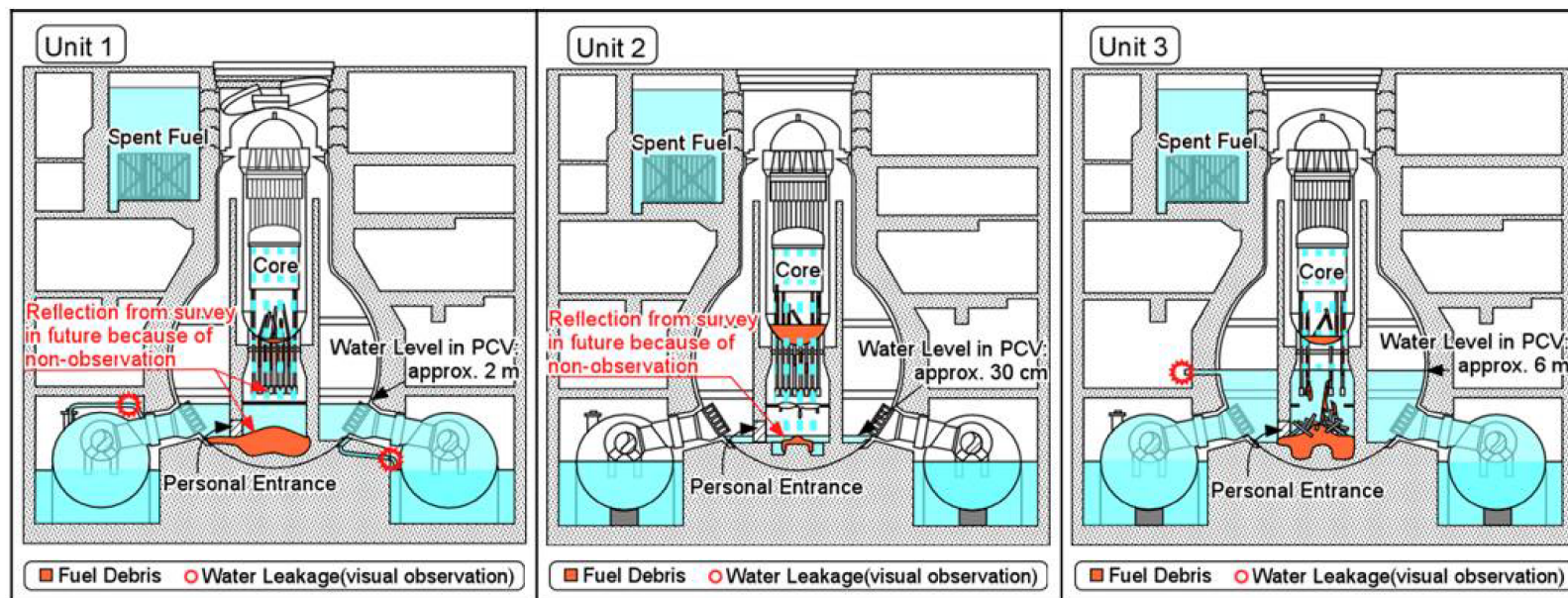
Sea-side wall



Refrigeration facility



Revised Mid and Long-term Roadmap and strategy



| | Phase-1 | Phase-2 | | | | Phase-3 | | | |
|---|-----------------------|---------|--|------|------|---------|--|----------------------|------|
| | 2011 | | | 2016 | 2017 | | | 2021 | 2023 |
| New milestones by the revised Mid and Long-term Roadmap | Spent fuel removal | | | | | | | Unit 1 removal start | |
| | Fuel-debris retrieval | | | | | | | Unit 2 removal start | |
| | Waste management | | | | | | | | |
| | | | | | | | | | |

Unit 3 removal

Decision on the method for the 1st unit

Fuel-debris retrieval for the 1st unit

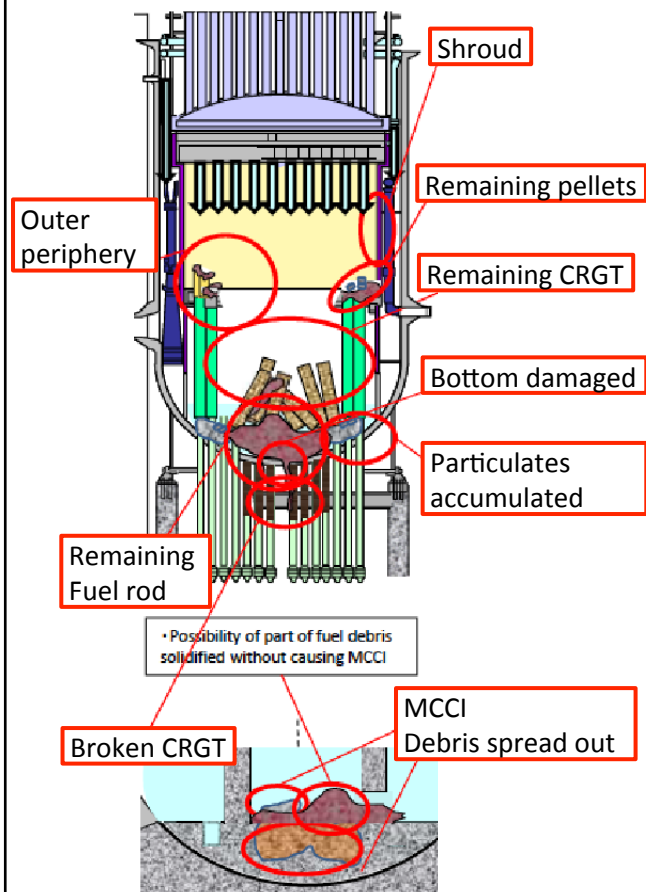
Prospect of processing & disposal

Starting from small scale

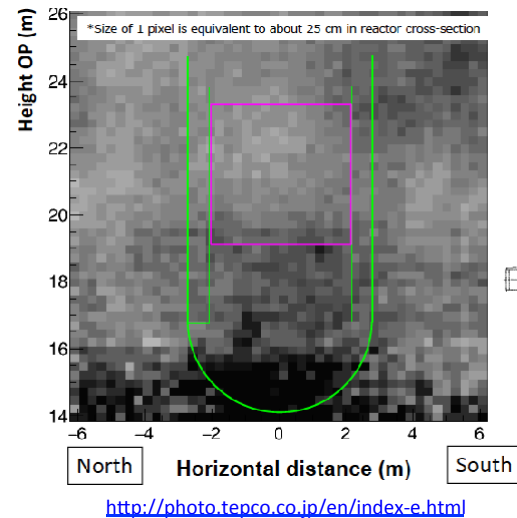
Estimation of the in-reactor situation

SA Analysis code

A probable situation conjectured by MAAP and SAMPSON



Muon tomography



Remote investigation



Unit-2 PCV bottom

Handle of fuel assembly



Unit-2 PCV, inside pedestal

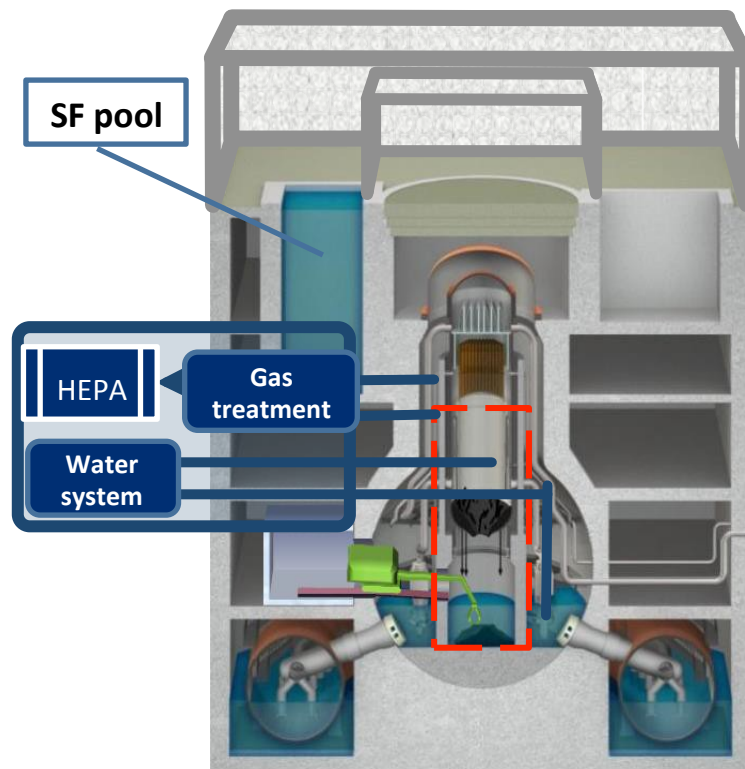


Fuel debris retrieval strategy

Careful and fledged preparation is necessary for the fuel debris retrieval

- 1 Ensure containment
- 2 Minimize exposure to workers
- 3 Safe retrieval of fuel debris

Partially-submerged plus horizontal access method



Requirements

Seismic integrity

Workers safety

Lower worker's dose

Confinement of radioactive materials

Confinement of and access to the debris (Horizontal access)

Fuel debris handling machine

Prevention of re-criticality

Water level control at PCV and building

Final selection of the fuel debris retrieval method



Horizontal Access

Partially-submerged

Rationale;

Too many penetrations at upper part of PCV

- Technically difficult for water stoppage
- causing too high dose to workers

More information available on lower part of PCV through recent remote inspections

Possible parallel work with SF removal

Solid waste management approaches

Features of 1F Solid Waste

To date, ca. 400 kt accumulated

- Huge volume
- High radiation
- Variety of nuclide compositions and concentration
- Lack of experiences in managing and disposal of secondary waste generated from highly contaminated water treatment
- Characterisation needed along with progress of 1F D&D

Rubbles (metal, concrete)/Woods & leaves/Soils/Incinerables/Adsorbers and sludge from water treatment /Wastes from fuel-debris retrieval operation/
Wastes from dismantling

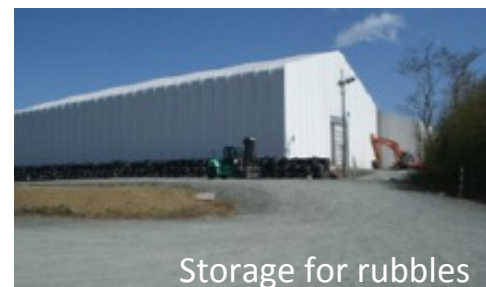
Policy for Solid Waste Management

- ◆ Focus on characterisation, treatment, packaging and storage until determination of disposal approach

Today's Challenges and R&D

- ❖ To minimize the generation of contaminated waste
- ❖ Volume reduction of solid Waste
- ❖ Quick waste characterization
- ❖ Determination future disposal method based on provisional waste form
- ❖ Pursuit of sustainable waste management scheme
- ❖ Reduction of workers dose

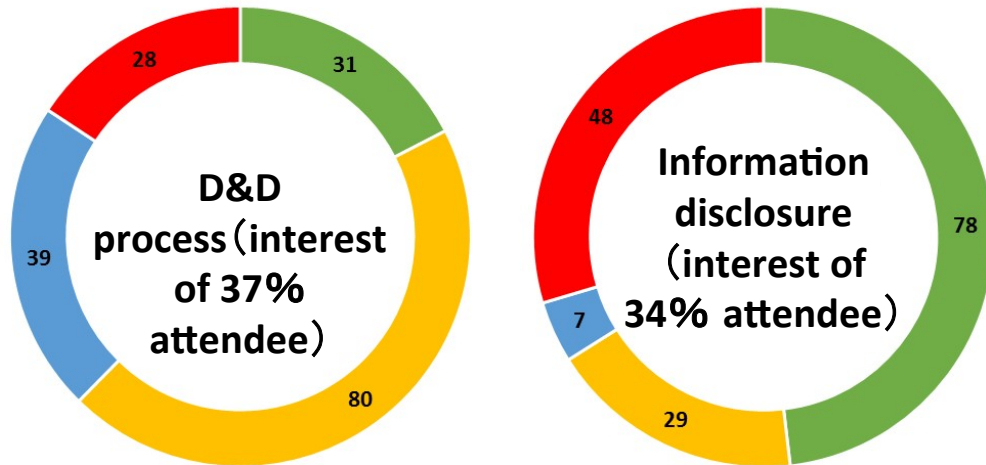
Increasing storage capacity for radioactive wastes



Public outreach activity

Local participants proved to have,

■ Request ■ Question ■ Anxiety ■ Discontent



Public dialogue being attempted

- International Forum on Fukushima Daiichi Decommissioning (NDF)
- Fukushima Council Meeting with local municipalities (government)
- Direct discussion with the staffs of the municipalities (NDF)
- Discussion with prefectural assembly members (NDF)
- NPO-assisted discussion with publics
- Risk communication activity by TEPCO

3rd 1FD-Forum

- DATE: Aug. 5 & 6, 2018
- Venue: Naraha and Iwaki, Fukushima Pref.
- Participants : 800 including local area and foreign countries

Dialogue with local representatives, July 2017



Safety regulation as a challenge

Extremely unique conditions

- Huge amount of Unknown Unknowns (insufficient information)
- Difficult access due to high contamination and heavy damage to the building; enabled only by remote device and operation
- Due care to minimize potential risks and contingency (re-criticality, hydrogen explosion, radioactive dust release, etc.)

Current regulatory environment at Fukushima Daiichi

- Regulated as a “specified nuclear facility” (accident reactor)
- Removal of prioritized high risk sources and reinforcement of temporally installed devices, urged by NRA
- Need of tailored regulation for the existing conditions
- No regulatory standards directly applicable, resulting in improvised regulatory requirements

Safety regulations to be expected

Desired and encouraged approach

- The concept of ALARP to be adopted to optimize the balance of safety, cost, time, goal, etc.; it should be shared by stakeholders including regulatory authority
- Seeking effective D&D delivery with common purpose and with common language
- Learning from safety regulations adopted to the worldwide legacy sites

New framework expected

- Dialogue among stakeholders including the regulatory authority
- Sharing the understanding among stakeholders on the goal and ways
- Quick decision and process in regulatory assessment to save the time
- Ensure data to prove the safety of unique operations
- Transparency should be the first priority

Conclusions

Good progress at Fukushima Daiichi NPP

- The situation of Fukushima Daiichi site has been settled until today.
- Technical progress is attained enabling the establishment of selection of fuel debris retrieval method.
- Distribution of the responsibility among the stakeholders is clearly defined such as the introduction of decommissioning reserve fund and its withdrawal plan.

New framework expected

- A common platform shared among stakeholders including regulatory authority is expected to optimize and accelerate the D&D process with public's understanding.