Fukushima Daiichi Decommissioning Policy and Japan's Nuclear Energy Policy

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Ryoji Doi

Agency for Natural Resources and Energy, METI

METI
Ministry of Economy, Trade and Industry

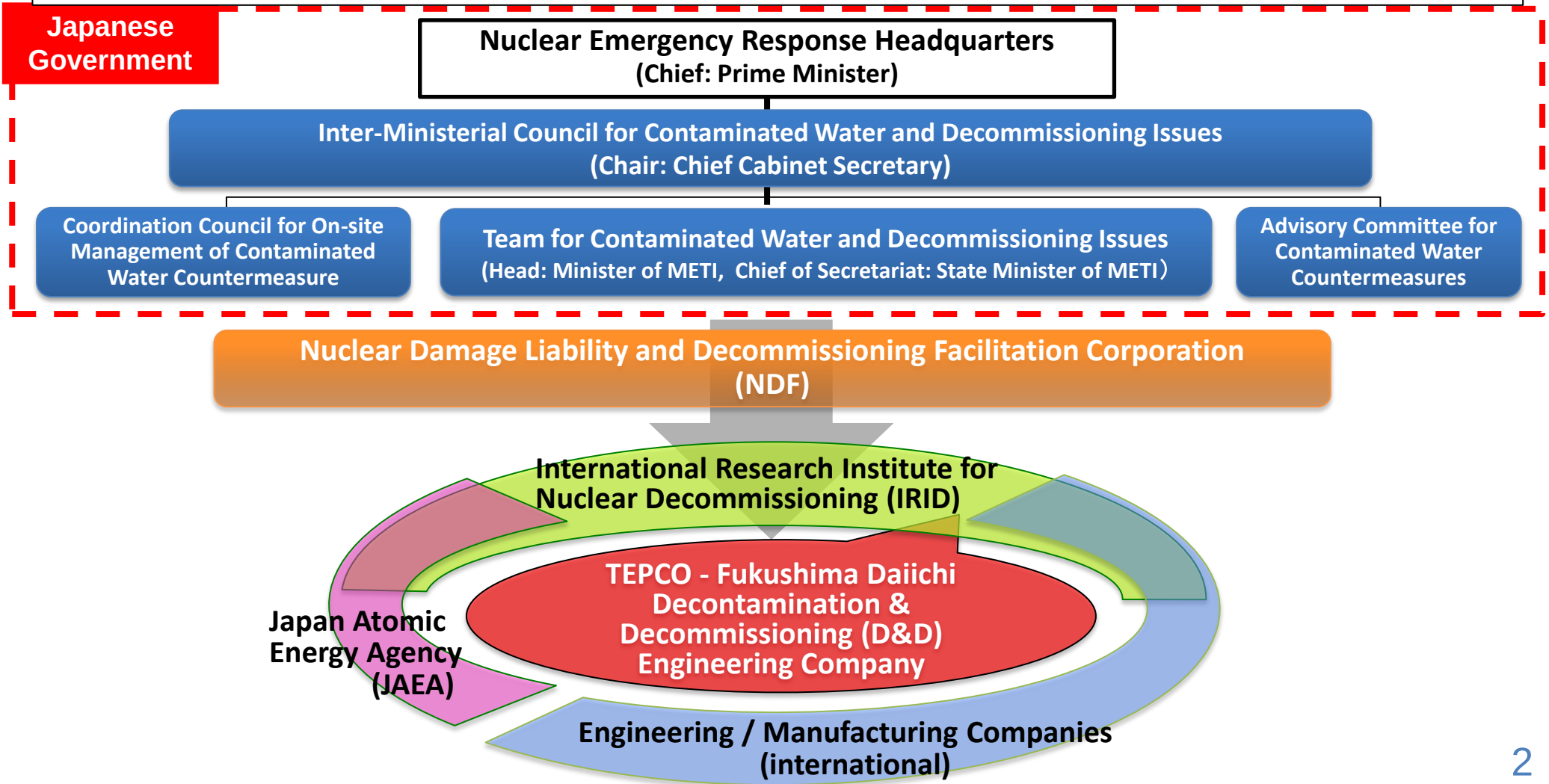
Ⅰ. Fukushima Daiichi Decommissioning Policy

1. Governmental Response to Strengthen Integrated Management
2. Current Status of Each Unit at Fukushima Daiichi NPPs
3. Mid-and-Long Term Roadmap towards the Decommissioning
4. Management of Contaminated Water
5. Comprehensive Countermeasures to Manage Contaminated Water
6. R&D Activities for Decommissioning

1. Governmental Response to Strengthen Integrated Management

In order to strengthen the governmental response and the technical capability of total management,

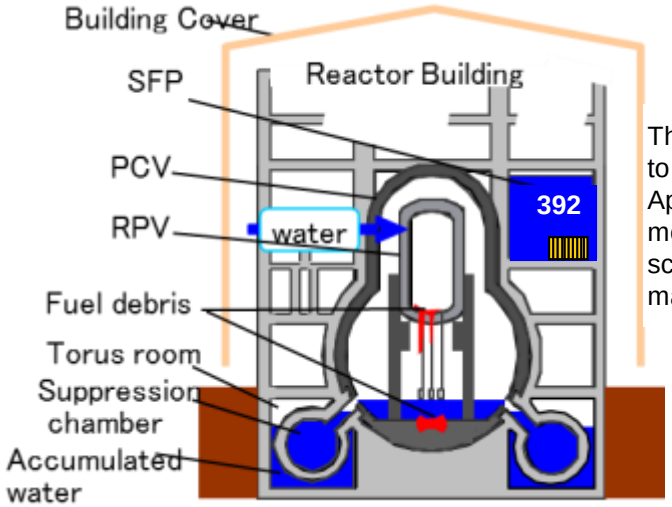
- The Government of Japan established "Inter-Ministerial Council for Contaminated Water and Decommissioning Issues" and inter-agency "Team for Contaminated Water and Decommissioning Issues" under the Nuclear Emergency Response Headquarters. (September 2013)
- "Nuclear Damage Compensation and Decommissioning Facilitation Corporation" was constituted in August 2014 by law amended by parliament.



2. Current Status of Each Unit at Fukushima Daiichi NPPs

Unit 1

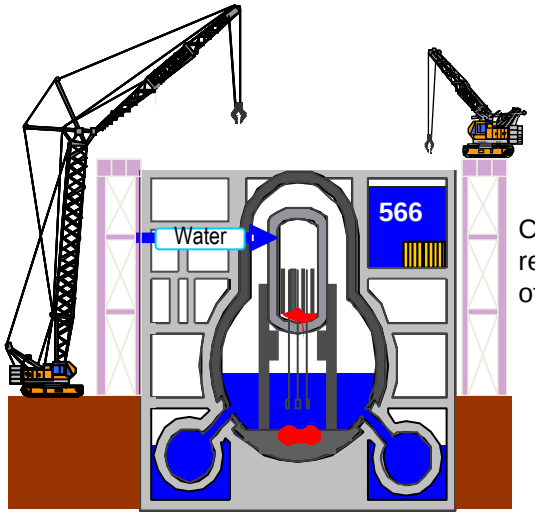
Hydrogen explosion
Core melt



The building cover is planed to be dismantled around April 2015, with sufficient measures to prevent the scattering of radioactive materials.

Unit 3

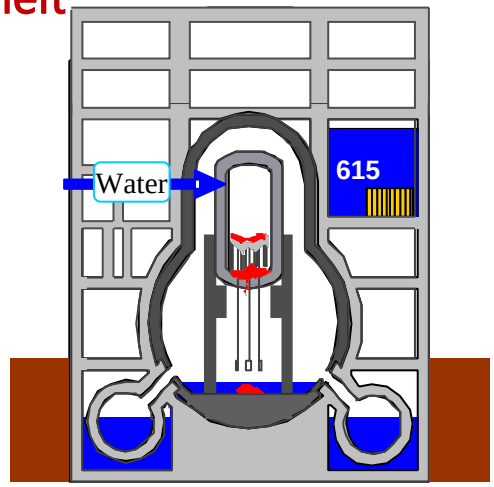
Hydrogen explosion
Core melt



Currently, toward the fuel removal from SPF, removal of rubbles is underway.

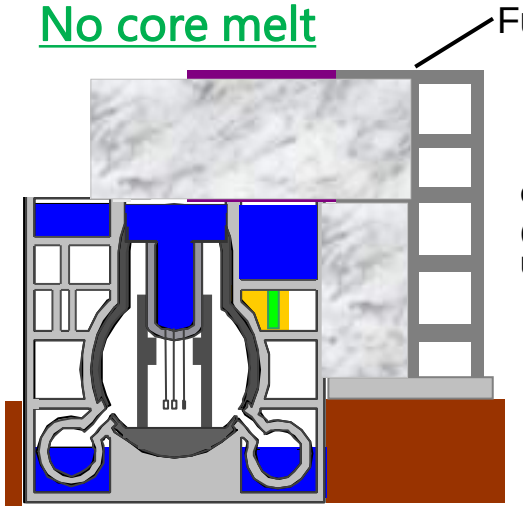
Unit 2

No hydrogen explosion
Core melt



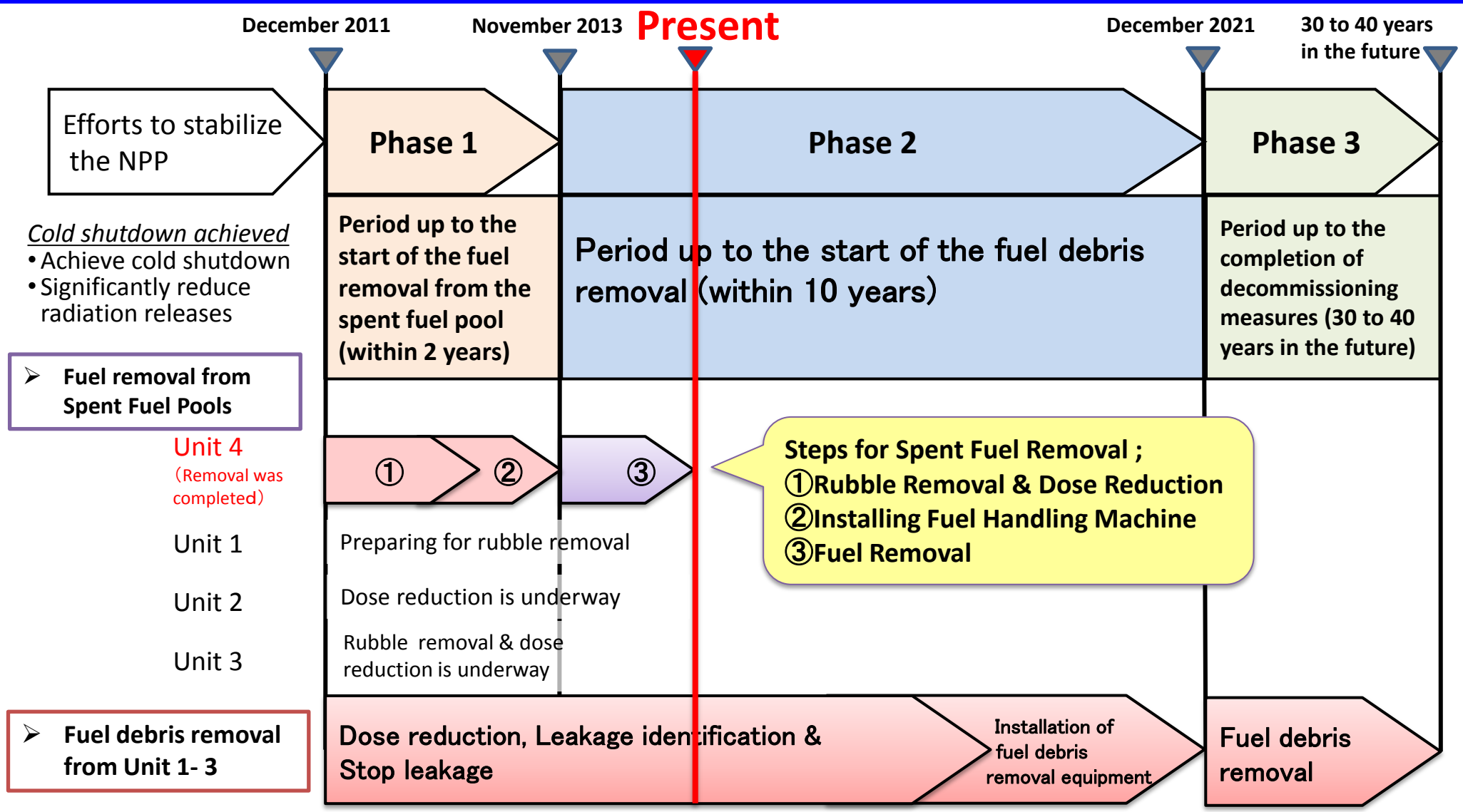
Unit 4

Hydrogen explosion
No core melt



On December 22, 2014, all (**1533**) fuel removal from Unit 4 SPF was completed.

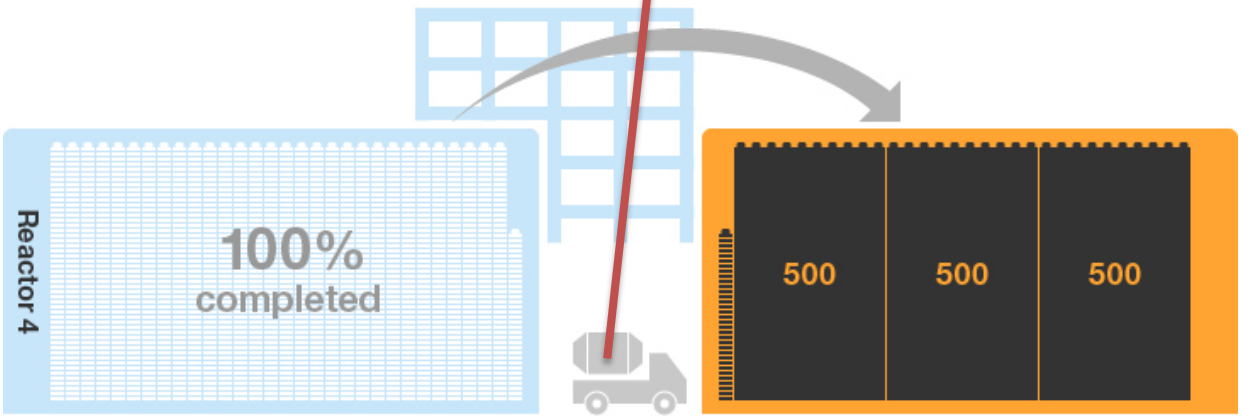
3. Mid-and-Long Term Roadmap towards the Decommissioning



◇ The current Roadmap was revised in June, 2013.
◇ The Government of Japan is now in the process of the revision, taking account of the "Strategic Plan" which NDF is developing.

[Reference] Fuel Rods Removal from Unit 4 SFP

Fuel removal from Unit 4 Spent Fuel Pool was completed on December 22, 2014.



* After November 15, the new fuel assemblies are transferred to the Unit 6 spent fuel pool.

Number of Transferred Assemblies 1533/1533

○Breakdown of transferred assemblies by kind

Spent fuel	1,331
Unirradiated (New) fuel	202

○Number of times of cask transportation: 71 times

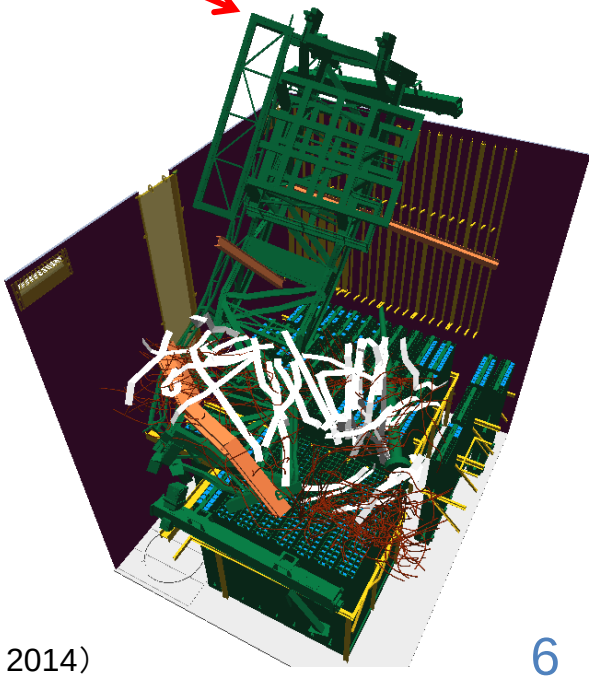
(Source: TEPCO's website)

[Reference] Removal of Rubble from Unit 3

- Removal of rubble such as steel, roof materials, concrete and the fuel handling machine on the operation floor is implemented by remotely controlled equipment.
- Removal of rubble on the operating floor has already completed. Removal of rubble inside the pool is underway since December 2013.

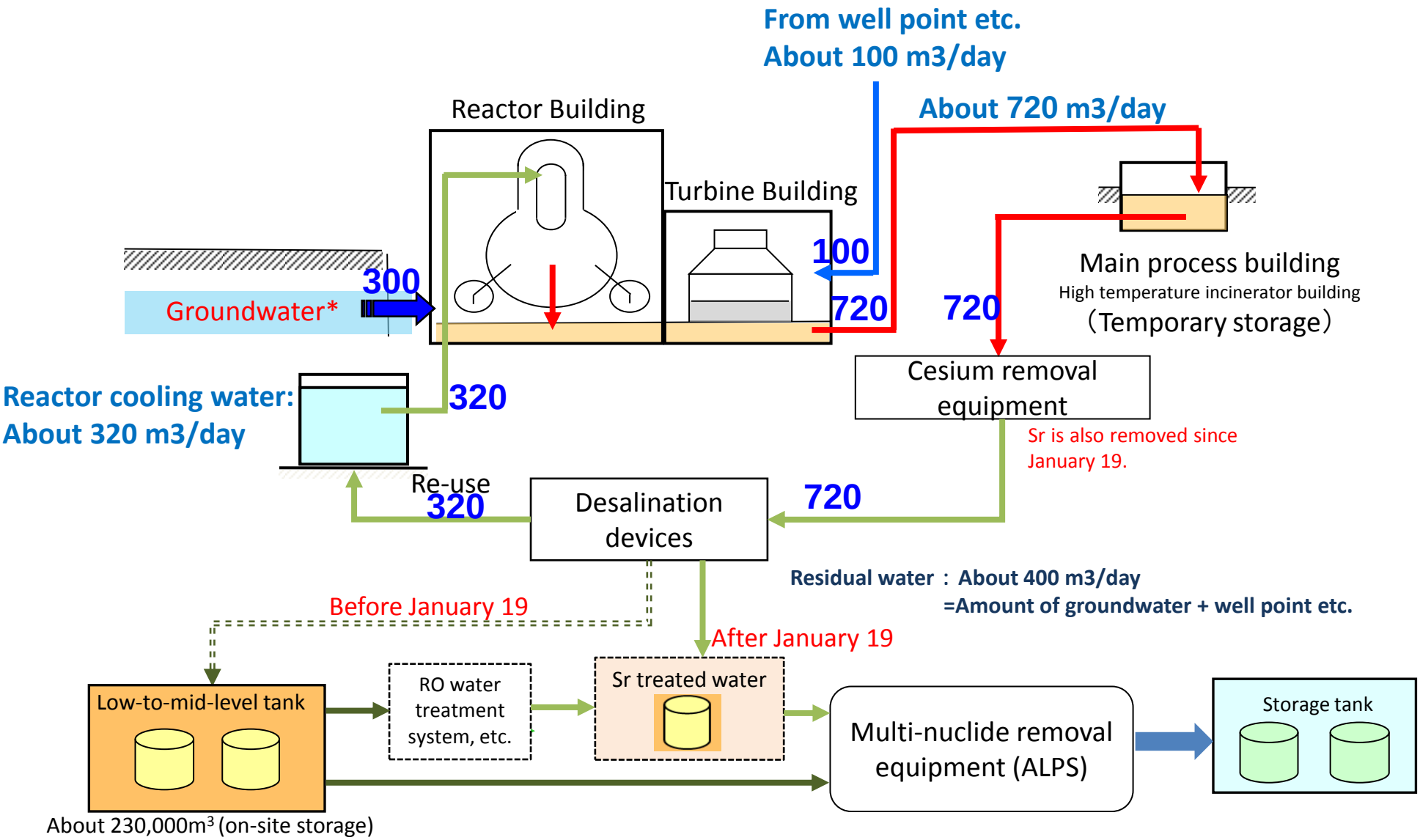
Remote Control Large-Scale Crane

Rubble inside the pool
(Fuel Handling Machine)



Operational floor of the reactor building at Unit 3（January 31, 2014）

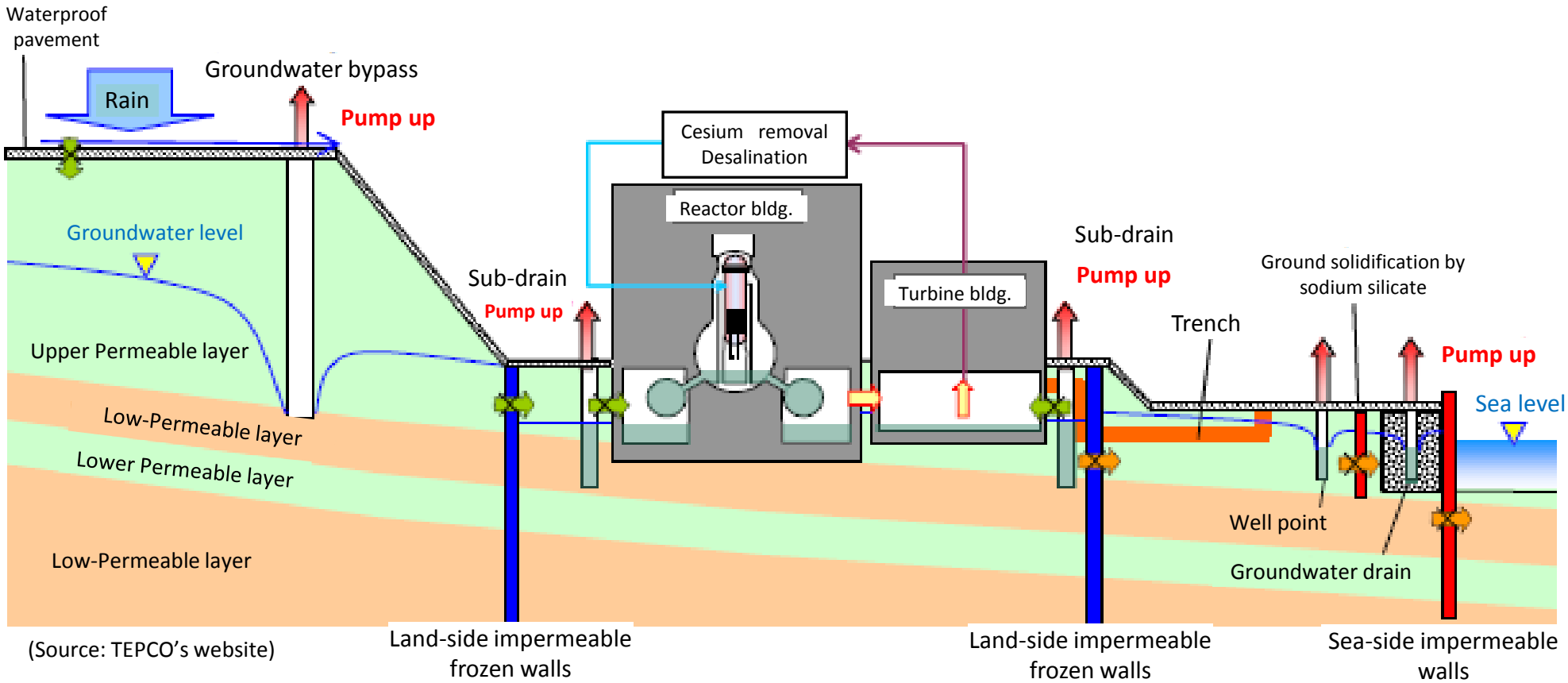
4. Management of Contaminated Water - (1) Overview of the System



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

4. Management of Contaminated Water ~ (2) Cross-sectional Image

- The water level inside the buildings is constantly kept lower than the underground water level around the buildings in order to prevent the leakage.
- In order to minimize the inflow of groundwater to the buildings, combination of countermeasures are taken in multi-protective manner.



(Source: TEPCO's website)

5. Comprehensive Countermeasures to Manage Contaminated Water

Three major policy

1. Removing the contamination source

- ◆Pump-up of contaminated water from trench
- ◆Clean-up of contaminated water by ALPS (Multi-nuclide removal equipment)
- ◆Removal of Sr from contaminated water by additional treatment facilities

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.

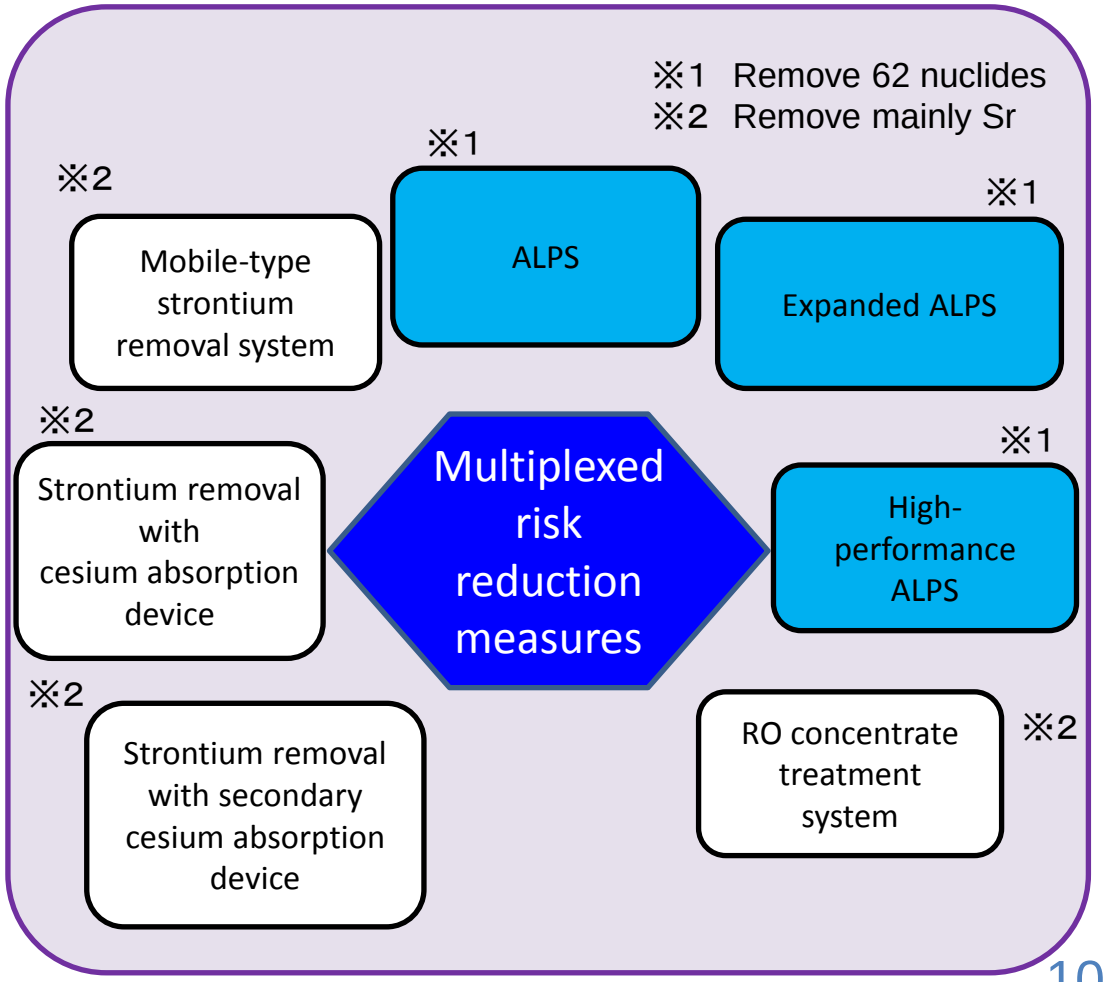
5. (1) Multi-Nuclide Removal Equipment [Removing]

- ◇ In order to comply with the requirement by the Nuclear Regulation Authority (NRA), 7 contaminated water treatment facilities have been installed.
- ◇ It is estimated that the first round of the treatment of water stored in tanks will be completed around the end of May, 2015.

Target level of the effective dose at the site boundary, required by NRA

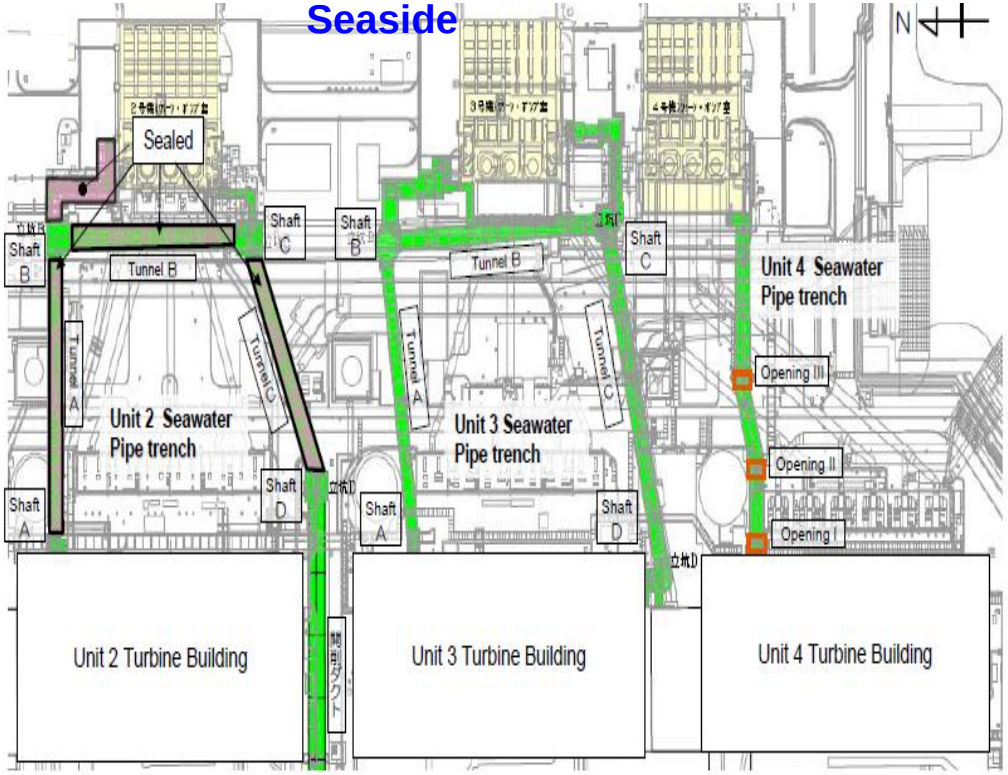
Period	End of March, 2015	End of March, 2016
Target	Under 2mSv/year※	Under 1mSv/year

※Reduce the effective dose (evaluated value) at the site boundary, due to the contaminated water in tanks, to 1mSv/year by the end of March, 2015.



5. (2) Removal of contaminated water seawater pipe trenches [Removing]

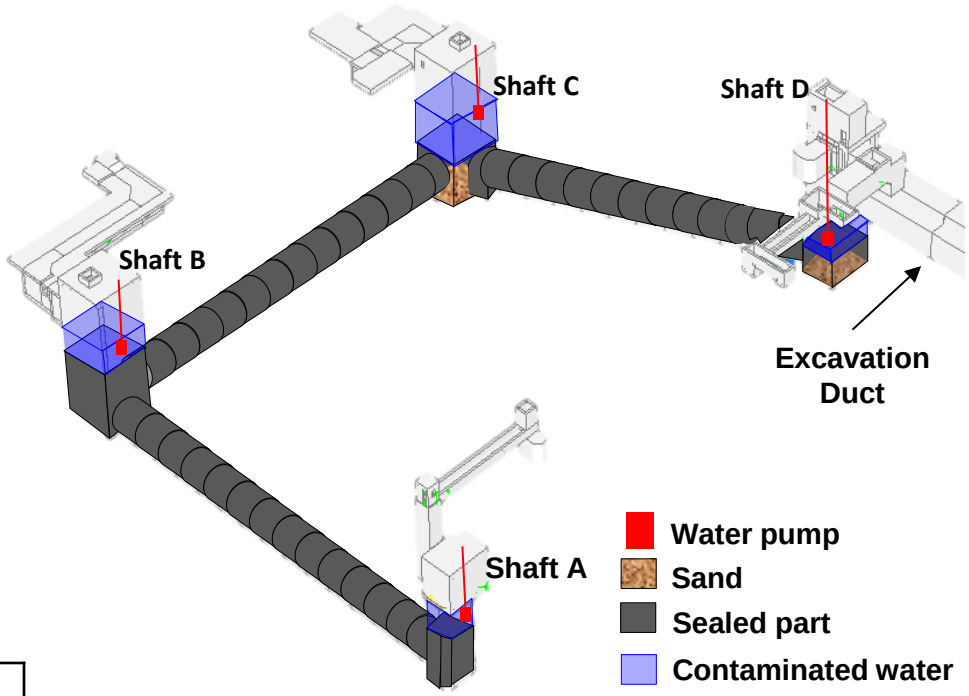
- ◇ High-density contaminated water at the time of accident still remains in the underground tunnel (Trench) beside the turbine building. （High risk in case of the leakage）
- ◇ From November 2014, contaminated water is being removed from seawater pipe trenches, and the trenches are being filled with cement based materials.
- ◇ It is estimated that removal of the contaminated water in trenches will be completed by the end of June.



Removed 2640/4500m³	Removed 2887/5800m³	Removed 460/900m³

(As of April 6)

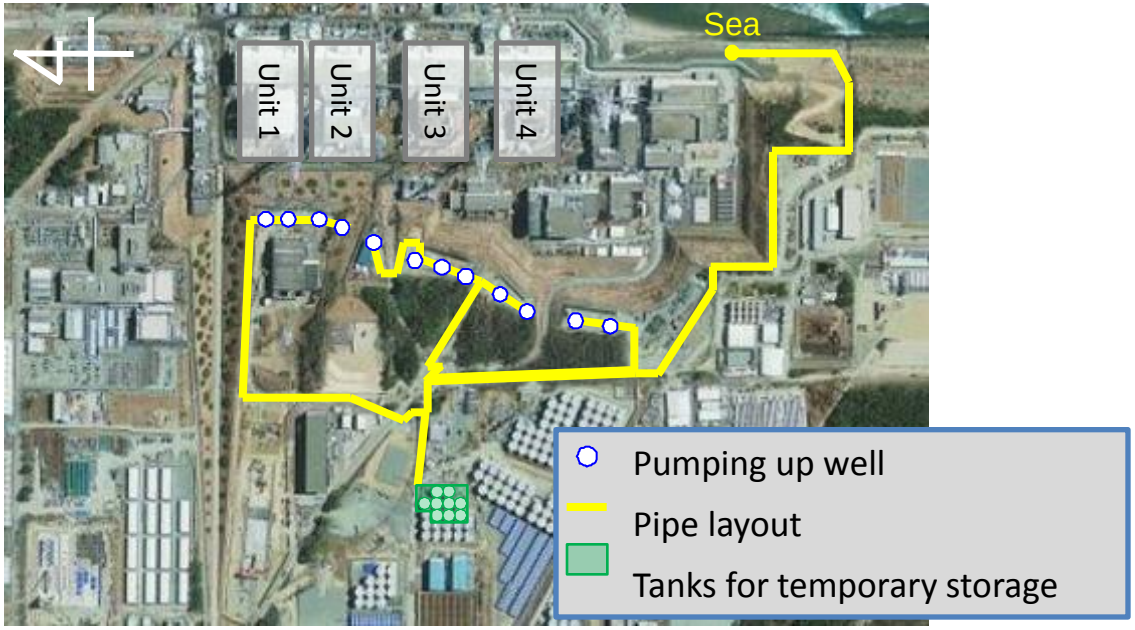
Birds eye view of Unit 2 Trench



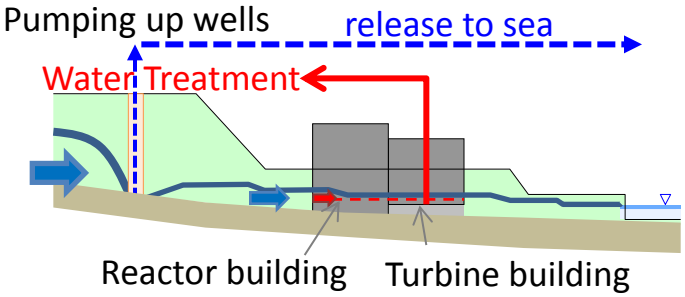
5. (3) Groundwater Bypassing at Up-stream Side [Isolating]

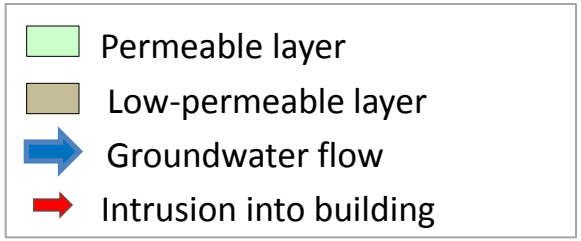
- In order to reduce the volume of groundwater flowing into the buildings, several hundred tons of groundwater will be pumped up on the mountain side of the buildings, and will be released into the sea (bypassing) since May 21, 2014.
- The groundwater pumped up is released after confirming that the level of radio activities is lower than operational targets. (1/40 of legal discharged limit)

<Layout of groundwater bypassing system>



<Cross-sectional image>





[Reference] Detailed Analysis of Released Water

- Total amount of groundwater discharged by 57 times is 92,713m^3, since the start of the operation. (As of April 5)
- The effect of this measure together with water stoppage of an incineration building has been observed as reduction of groundwater inflow to the buildings by approximately 100 tons/day.
- The radioactive levels of sampled water are substantially below the operational targets.

	For 1st Release			For 2nd Release		Reference		
	JAEA	Japan Chemical Analysis Center	TEPCO	Japan Chemical Analysis Center	TEPCO	Operational targets	Legal discharge limit	WHO Guidelines for Drinking Water Quality
CS-134	0.015	0.022	0.016	ND (0.49)	ND (0.67)	1	60	10
Cs-137	0.044	0.039	0.047	ND (0.38)	ND (0.51)	1	90	10
Gross β	ND (0.1)	ND (0.61)	ND (0.88)	ND (0.89)	ND (0.55)	5(1)*	30	10
H-3	240	230	220	150	150	1,500	60,000	10,000

(Note)
Unit: Bq/L
ND represents a value below the detection limit; values in ( ) represent the detection limit
*The operational target of Gross β is 1 Bq/L in the survey which is conducted once every ten days.

5. (4) Sub-Drains [Isolating]

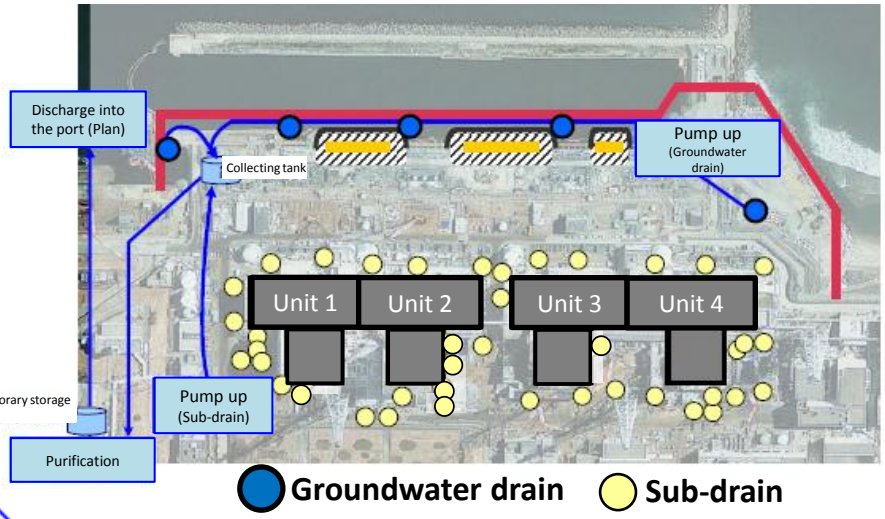
- The Sub-drains of about 40 wells surrounding the buildings and the Ground-water drains before the Sea-side impermeable walls will pump up the groundwater significantly.
- The final consultation with relevant stakeholders such as fishermen's associations is now on going, concerning the discharge of the decontaminated water from the wells to the sea.

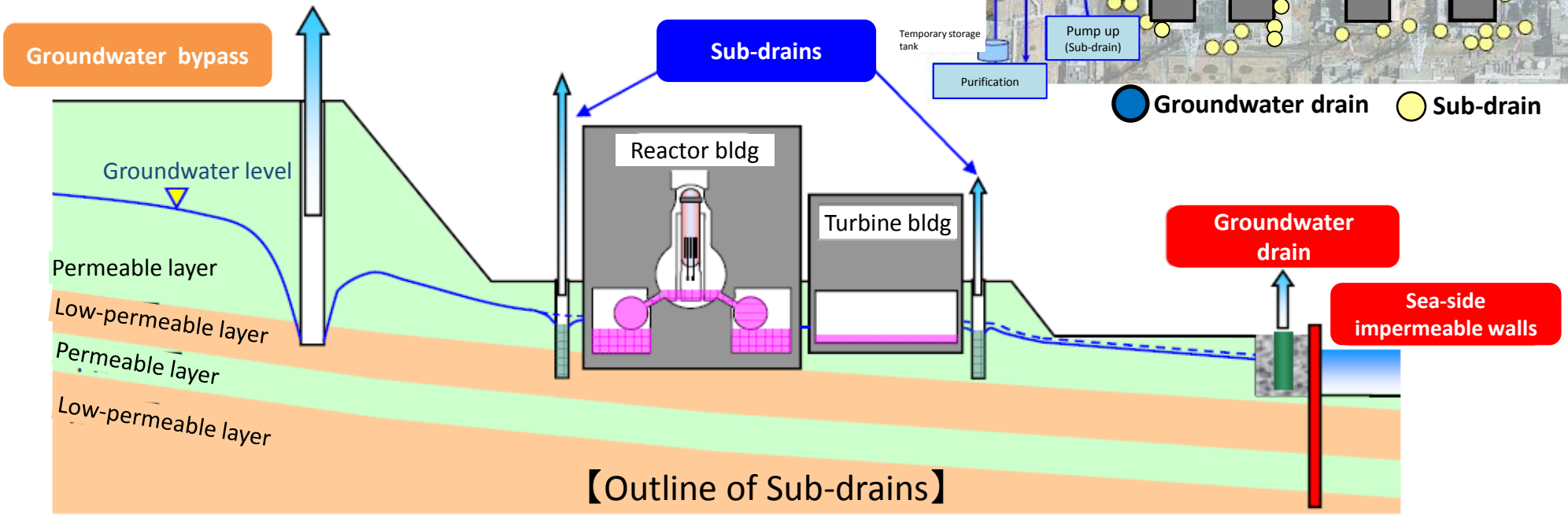
Operational target of Sub-drain and Groundwater drain, regulation

(Unit: Bq / L)

	Cs 134	Cs 137	Gross β	Tritium
Operational target	1	1	3(1)	1, 500
Legal discharge limit	60	90	30	60, 000
WHO Guidelines for Drinking Water Quality	10	10	10	10, 000

Layout of Sub-drain and Groundwater drain



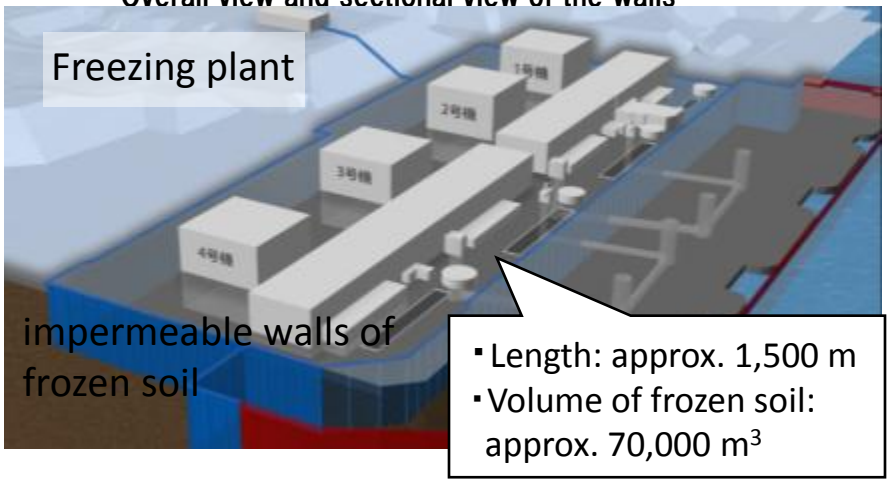


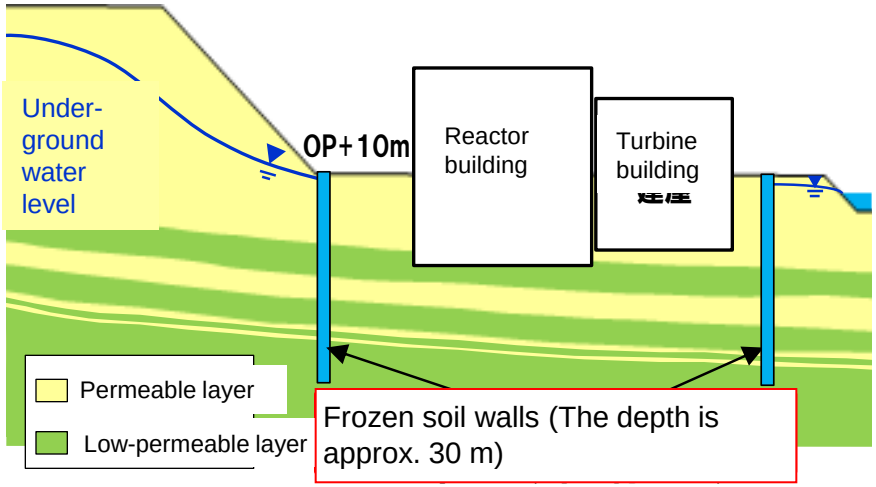
【Outline of Sub-drains】

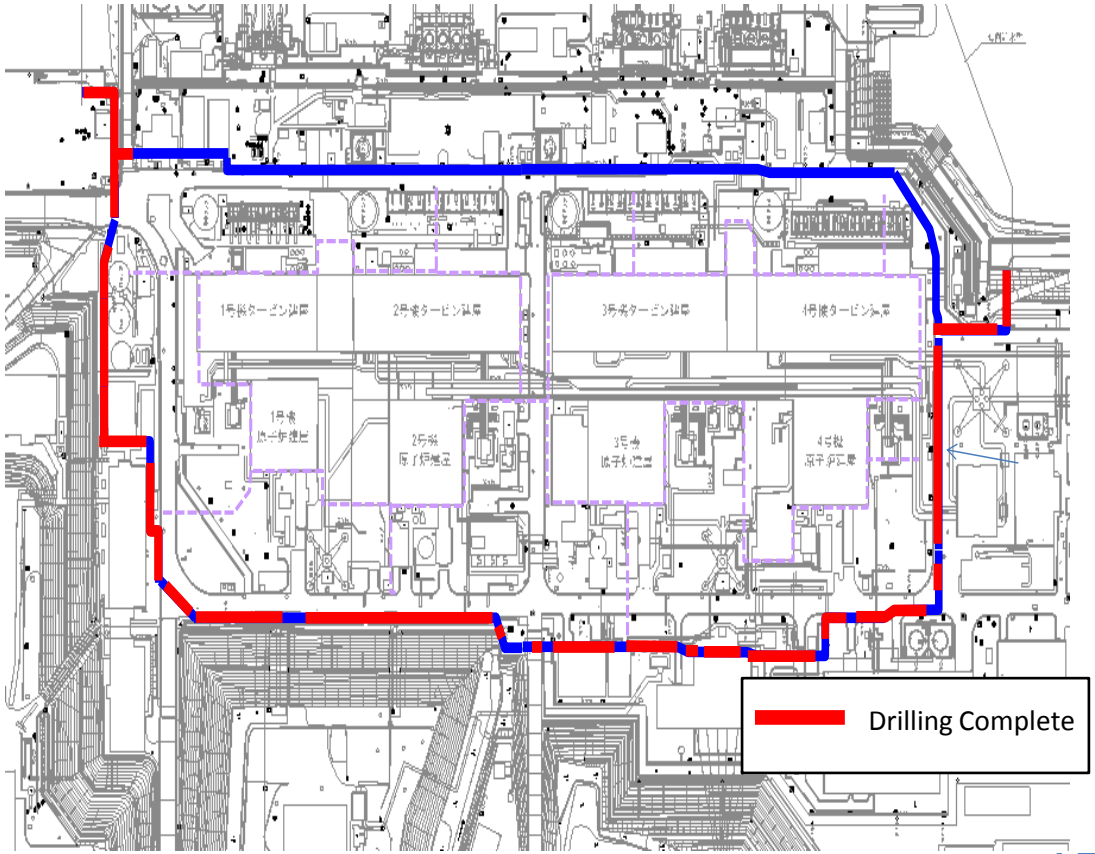
5. (5) Land-side impermeable walls of frozen-soil method [Isolating]

- This measure aims to reduce the volume of groundwater inflow into the buildings by surrounding the buildings with froze-soil walls (approx. 1,500m).
- As of April 4, drilling at 1,084 of 1,551 points (approx. 70%) is completed. Regarding the mountain side, drilling at 1,024 of 1,036 point (approx. 99%) is completed, planning to start the freezing operation promptly..

Overall view and sectional view of the walls





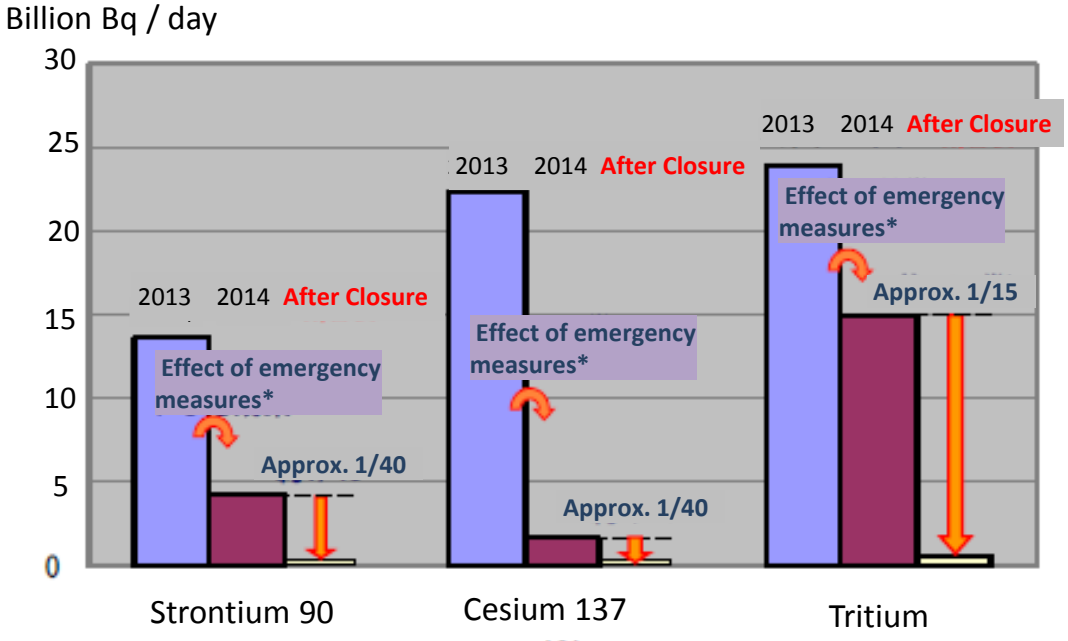


5. (6) Sea-side impermeable walls [Preventing leakage]

- Water shut-off walls will be installed outside of the shore protection in order to prevent contaminated groundwater flow into the sea.
- The construction work started in October 2011, and installation of steel sheet piles has almost been completed (approx. 98% completion).
- Commencement of the operation is planned simultaneously with the start of the pump-up from sub-drains

Recent situation of the sea-side impermeable walls

Suppressing effect for the radioactive material's outflow to the sea by Sub-drain, Groundwater drain and Sea-side impermeable wall



* Ground improvement of contaminated seawall and pumping up at well points, etc.

[Reference] Seawater Monitoring around the Port ① (the highest and latest values)

(The latest values sampled during March 16-24)

Unit (Bq/L); ND represents a value below the detection limit; values in ( ) represent the detection limit; ND (2013) represents ND throughout 2013

【Northeast side of port entrance(offshore 1km)】

Cesium-134:	ND (2013)	→ ND (0.55)	
Cesium-137:	ND (2013)	→ ND (0.65)	
Gross β:	ND (2013)	→ 17	
Tritium:	ND (2013)	→ ND (1.6)	

【East side of port entrance (offshore 1km)】

Cesium-134:	ND (2013)	→ ND (0.66)	
Cesium-137:	1.6 (2013/10/18)	→ ND (0.67)	Below 1/2
Gross β:	ND (2013)	→ ND (15)	
Tritium:	6.4 (2013/10/18)	→ ND(1.6)	Below 1/4

【Southeast side of port entrance(offshore 1km)】

Cesium-134:	ND (2013)	→ ND (0.74)
Cesium-137:	ND (2013)	→ ND (0.59)
Gross β:	ND (2013)	→ ND (15)
Tritium:	ND (2013)	→ ND (1.6)

Cesium-134:	ND (2013)	→ ND (0.71)	
Cesium-137:	ND (2013)	→ ND (0.74)	
Gross β:	ND (2013)	→ 18	
Tritium:	4.7 (2013/ 8/18)	→ ND(1.6)	Below 1/2

【North side of north breakwater(offshore 0.5km)】

【Port entrance】

Cesium-134:	3.3 (2013/12/24)	→ ND (1.2)	Below 1/2
Cesium-137:	7.3 (2013/10/11)	→ ND (1.2)	Below 1/6
Gross β:	69 (2013/ 8/19)	→ ND (17)	Below 1/4
Tritium:	68 (2013/ 8/19)	→ 5.9	Below 1/10

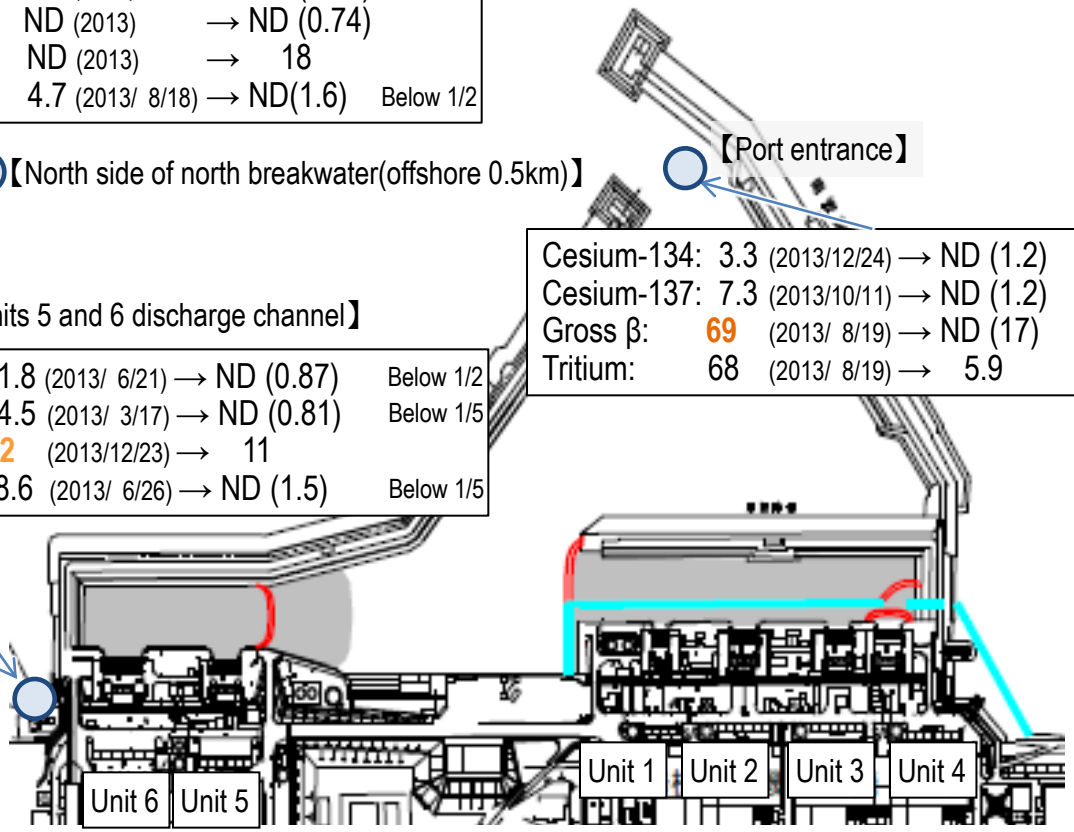
【South side of south breakwater(offshore 0.5km)】

Cesium-134:	ND (2013)	→ ND (0.73)
Cesium-137:	ND (2013)	→ ND (0.90)
Gross β:	ND (2013)	→ 15
Tritium:	ND (2013)	→ ND (1.6)

【North side of Units 5 and 6 discharge channel】

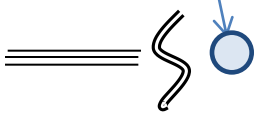
Cesium-134:	1.8 (2013/ 6/21)	→ ND (0.87)	Below 1/2
Cesium-137:	4.5 (2013/ 3/17)	→ ND (0.81)	Below 1/5
Gross β:	12 (2013/12/23)	→ 11	
Tritium:	8.6 (2013/ 6/26)	→ ND (1.5)	Below 1/5

Cesium-134:	ND (2013)	→ ND (0.54)	
Cesium-137:	3.0 (2013/ 7/15)	→ ND (0.58)	Below 1/4
Gross β:	15 (2013/12/23)	→ 9.0	
Tritium:	1.9 (2013/11/25)	→ ND (1.5)	



Sea side impermeable wall

Silt fence



【Around south discharge channel】

Summary of TEPCO data as of March 25

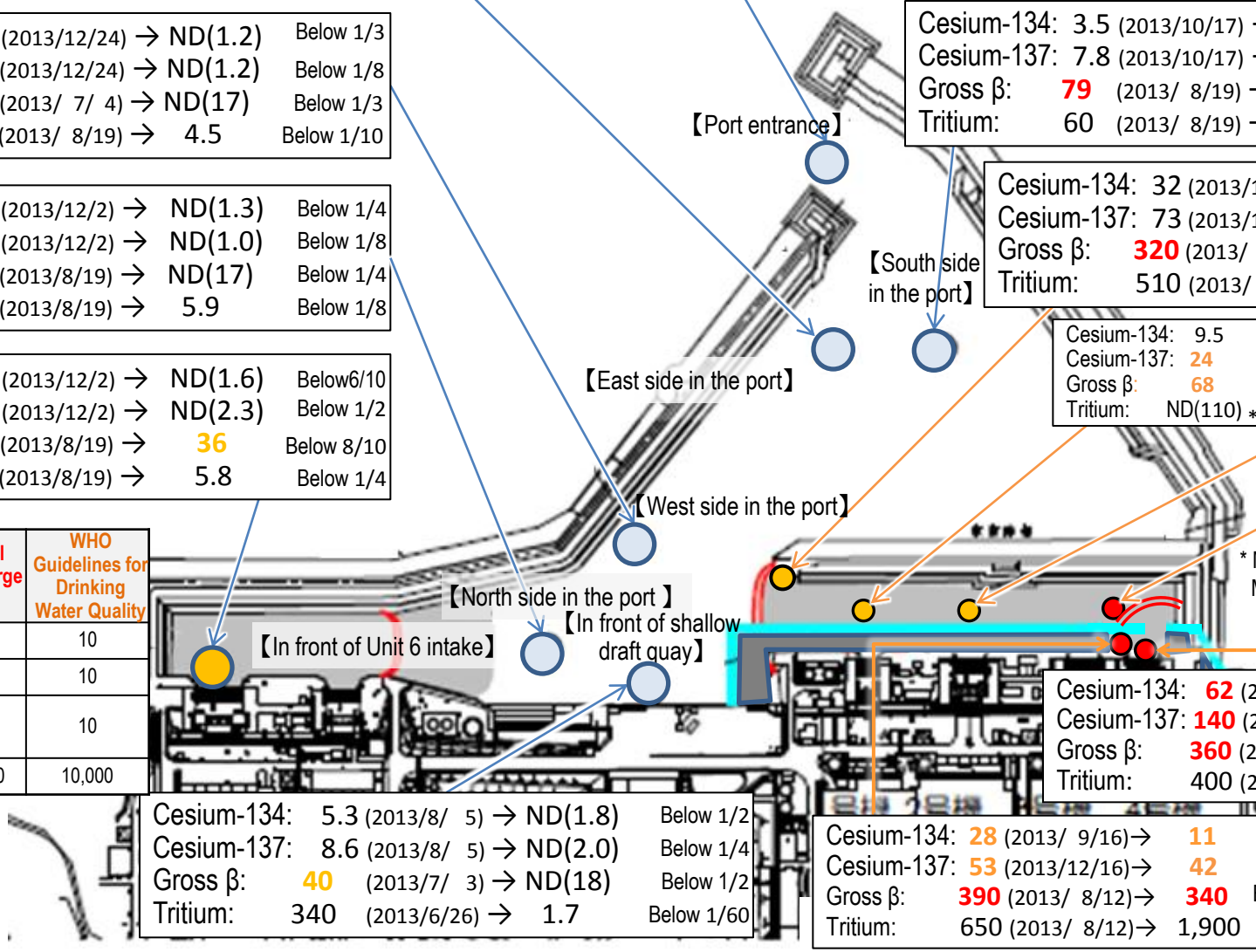
Source: TEPCO website, Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station, http://www.tepco.co.jp/nu/fukushima-np/f1/smp/index-j.html

[Reference] Seawater Monitoring in the Port ② (the highest and latest values)

"The highest value" → "the latest value (sampled during March 16-24)"; unit (Bq/L); ND represents a value below the detection limit

Source: TEPCO website
Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station
http://www.tepco.co.jp/nu/fukushima-np/f1/smp/index-j.html

Sea side impermeable wall
Silt fence



Cesium-134:	3.3	(2013/10/17) →	ND(1.2)	Below 1/2
Cesium-137:	9.0	(2013/10/17) →	ND(1.1)	Below 1/8
Gross β:	74	(2013/ 8/19) →	ND(17)	Below 1/4
Tritium:	67	(2013/ 8/19) →	12	Below 1/5

Cesium-134:	3.3	(2013/12/24) →	ND(1.2)	Below 1/2
Cesium-137:	7.3	(2013/10/11) →	ND(1.2)	Below 1/6
Gross β:	69	(2013/ 8/19) →	ND(17)	Below 1/4
Tritium:	68	(2013/ 8/19) →	5.9	Below 1/10

Cesium-134:	4.4	(2013/12/24) →	ND(1.2)	Below 1/3
Cesium-137:	10	(2013/12/24) →	ND(1.2)	Below 1/8
Gross β:	60	(2013/ 7/ 4) →	ND(17)	Below 1/3
Tritium:	59	(2013/ 8/19) →	4.5	Below 1/10

Cesium-134:	3.5	(2013/10/17) →	ND(1.3)	Below 1/2
Cesium-137:	7.8	(2013/10/17) →	ND(1.0)	Below 1/7
Gross β:	79	(2013/ 8/19) →	ND(17)	Below 1/5
Tritium:	60	(2013/ 8/19) →	5.8	Below 1/10

Cesium-134:	5.0	(2013/12/2) →	ND(1.3)	Below 1/4
Cesium-137:	8.4	(2013/12/2) →	ND(1.0)	Below 1/8
Gross β:	69	(2013/8/19) →	ND(17)	Below 1/4
Tritium:	52	(2013/8/19) →	5.9	Below 1/8

Cesium-134:	32	(2013/10/11) →	ND(2.0)	Below 1/10
Cesium-137:	73	(2013/10/11) →	3.3	Below 1/20
Gross β:	320	(2013/ 8/12) →	42	Below 1/7
Tritium:	510	(2013/ 9/ 2) →	140	Below 1/3

Cesium-134:	2.8	(2013/12/2) →	ND(1.6)	Below6/10
Cesium-137:	5.8	(2013/12/2) →	ND(2.3)	Below 1/2
Gross β:	46	(2013/8/19) →	36	Below 8/10
Tritium:	24	(2013/8/19) →	5.8	Below 1/4

Cesium-134:	9.5
Cesium-137:	24
Gross β:	68
Tritium:	ND(110) *

Cesium-134:	2.2
Cesium-137:	7.4
Gross β:	47
Tritium:	300 *

Cesium-134:	3.5
Cesium-137:	13
Gross β:	84
Tritium:	450 *

* Monitoring commenced in or after March 2014

	Legal discharge limit	WHO Guidelines for Drinking Water Quality
Cesium-134	60	10
Cesium-137	90	10
Strontium-90 (strongly correlate with Gross β)	30	10
Tritium	60,000	10,000

Cesium-134:	62	(2013/ 9/16)→	13	Below 1/6
Cesium-137:	140	(2013/ 9/16)→	42	Below 1/4
Gross β:	360	(2013/ 8/12)→	400	
Tritium:	400	(2013/ 8/12)→	1,600	

Cesium-134:	5.3	(2013/8/ 5) →	ND(1.8)	Below 1/2
Cesium-137:	8.6	(2013/8/ 5) →	ND(2.0)	Below 1/4
Gross β:	40	(2013/7/ 3) →	ND(18)	Below 1/2
Tritium:	340	(2013/6/26) →	1.7	Below 1/60

Cesium-134:	28	(2013/ 9/16)→	11	Below 1/2
Cesium-137:	53	(2013/12/16)→	42	Below 8/10
Gross β:	390	(2013/ 8/12)→	340	Below 9/10
Tritium:	650	(2013/ 8/12)→	1,900	

Summary of TEPCO data as of March 25

[Reference] Information Transmission for the World through IAEA

- GOJ has been regularly providing Comprehensive information supplement to IAEA.
- IAEA assessment on the information is available on IAEA's web-site.

< Examples of IAEA assessment >

<December 2013>

- The monitoring results that have been provided for the surrounding sea region and off shore areas indicated no rise in radionuclide concentrations and remain within the WHO guidelines for drinking water.
- Based on the information that has been made available, the Joint FAO / IAEA Division understands that the measures taken to monitor and rapidly respond to any issues in the food system regarding radionuclide contamination are appropriate and that the public food supply is safe.

<February 2014>

- Based on these reports and the information that has been made available, the IAEA considers the public is safe and sees no reason why this should not continue to be the case in the future.
- Based on the information that has been made available, the Joint FAO / IAEA Division understands that the measures taken to monitor and rapidly respond to any issues in the food system regarding radionuclide contamination are appropriate and that the food supply chain is safely under control. The food supply in Japan remains safe.

<September 2014>

- Based on the sea area radioactivity monitoring results in all five areas and other related information that has been made available, the IAEA considers that the situation in the marine environment is stable but should continue to be monitored.
- The IAEA considers that such multi-layered countermeasures could contribute to reducing the risks associated with groundwater ingress into the basement of the buildings, the continued accumulation of contaminated water to be treated and stored on site and the uncontrolled discharge of radioactivity into the sea.
- Based on the information that has been made available, the Joint FAO / IAEA Division understands that the measures taken to monitor and respond to issues regarding radionuclide contamination of food are appropriate and that the food supply chain is under control.

Governmental budget for Decommissioning & Contaminated Water Management

(1) FY2012 Supplementary budget JPY 85 billion

(2) FY2013 Initial budget JPY 8.7 billion

(3) FY2013 Reserve fund JPY 20.6 billion

(4) FY2013 Supplementary budget JPY 47.9 billion

(5) FY2014 Supplementary budget JPY 23.1 billion

(Unit: billion JPY)

	FY2011 Supplementary budget	FY2012 Initial budget	FY2012 Supplementary budget	FY2013 Initial budget	FY2013 Reserve fund	FY2013 Supplementary budget	FY2014 Supplementary budget	total
R&D	2. 0	2. 0		8. 7		21. 5	19. 8	54. 0
Facility			85. 0				0. 7	85. 7
Frozen soil walls					13. 6	18. 3	2. 6	34. 5
Multi-nuclide removal equipment					7. 0	8. 1		15. 0
total	2. 0	2. 0	85. 0	8. 7	20. 6	47. 9	23. 1	189. 2

6.(2) Collaborate with the World's Excellence（RFI & RFP）

- International Research Institute for Nuclear Decommissioning (IRID) executed a Request for Information (RFI). IRID received 780 responses (over 30% are from abroad) for contaminated water, 194 responses (about 40% are from abroad) for decommissioning.
- Based on the result of RFI, METI executed a Request for Proposal (RFP) and received various kind of proposals from home and abroad.

RFI for Addressing the Contaminated Water Issue	Proposals
1. Accumulation of contaminated water	206
2. Treatment of contaminated water	182
3. Removal of radioactive materials from the seawater in the harbor	151
4. Management of contaminated water inside the buildings	107
5. Management measures to block groundwater from flowing into the site	174
6. Understanding the groundwater flow	115
Others (except 1.～6.)	34

RFI for Innovative Approach for Fuel Debris Retrieval	Proposals
1. Conceptual study on innovative approaches for Inside PCV/RPV investigation	33
2. Technologies required for Internal PCV/RPV investigation	58
3. Conceptual study on innovative approaches to fuel debris	43
4. Technologies required for Fuel debris Retrieval	60

RFP for "Validation of technologies for contaminated water management"

Application Period: March 24, 2014 – May 19, 2014

- Seawater Purification Technologies
- Technologies for capturing radioactive substances from soil
- Technologies for the decontamination of contaminated water tanks
- Unmanned boring technologies

→ Adoption: 11 projects (3 from abroad)

Application Period: May 15, 2014 – July 17, 2014
:November 14 – December 15. 2014

- Tritium Separation Technologies

→ Adoption: 7 projects (2 from abroad)

RFP for "Conceptual Study of Innovative Approach for Fuel Debris Retrieval and Feasibility Study of Essential Technologies"

Application Period: June 27, 2014 – August 27, 2014

- Conceptual Study of Innovative Approach for Fuel Debris Retrieval
- Feasibility Study of Visual and Measurement Technology for Innovative Approach
- Feasibility Study of Fuel Debris Cutting and Dust Collection Technology for Innovative Approach

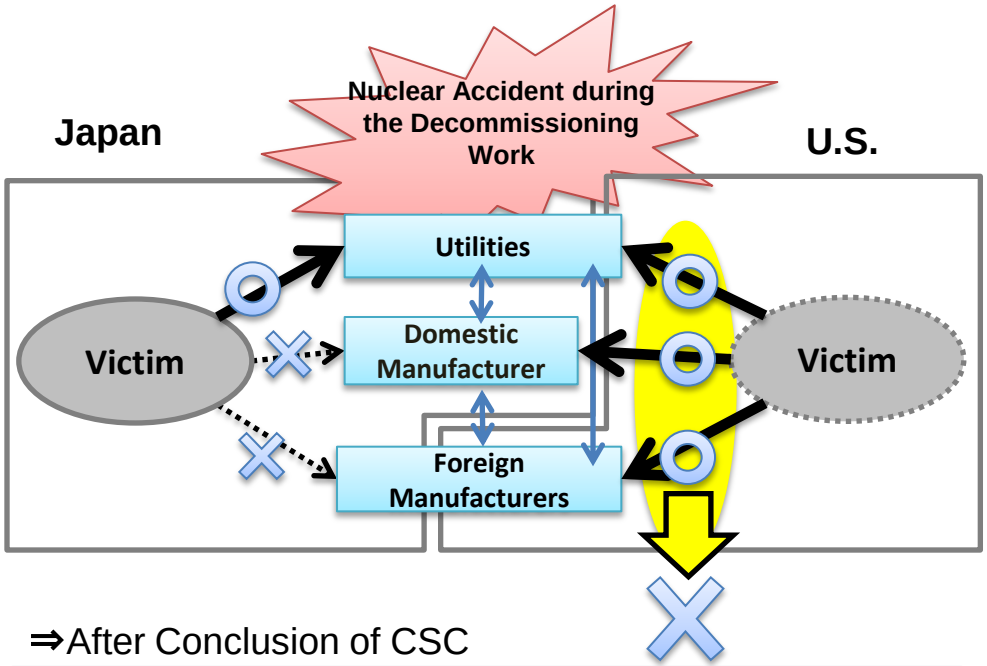
→ Adoption: 11 projects (3 from abroad)

[Reference] Conclusion of the CSC

(1) On **January 15, 2015** Japan signed the Convention on Supplementary Compensation for Nuclear Damage (CSC) and deposited the Instrument of Acceptance on the CSC to IAEA. The CSC is coming into force on **April 15** this year as a result of Japan's conclusion with which the conditions for the effectuation of the CSC are satisfied.

(2) Conclusion of the CSC not only contributes to establish a global nuclear liability regime, but also improves the environment for foreign companies with expertise on decommissioning and contaminated water management at Fukushima Daiichi to participate in related projects.

＜The jurisdiction is concentrated by CSC＞



⇒After Conclusion of CSC

Since the jurisdiction becomes concentrated only in Japan, the lawsuit in the U.S. cannot be permitted.

【Jurisdiction Concentration by Japan's concluding CSC】

➢ In the current situation (non-conclusion of CSC), if a victim of an accident occurred during the nuclear reactor decommissioning work files a suit in the U.S., the lawsuit can be treated under U.S. jurisdiction, and the U.S. manufacturers participating in the decommissioning might be liable for the huge amount of compensation.

➢ If Japan concludes the CSC, the jurisdiction over such a lawsuit is concentrated only in Japan. The foreign manufacturers are immune from the lawsuit risk in the U.S., which provides a favorable condition to the US manufacturers for participating in the decommissioning work.

※The actual application of jurisdiction concentration is subject to the judgment of the court in the country where such a lawsuit is filed.

6.(3) Strengthened Capability by "NDF" for Technical Response & Long-term Strategy

- On August 18, 2014, "Amended Nuclear Damage Compensation Facilitation Fund Act" came into force. Thus, "Nuclear Damage Compensation Facilitation Fund" has been reformed to "Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF)". Dr. Hajimu Yamana (Professor of Kyoto Univ.) is appointed to the director in charge of the decommissioning facilitation work as the Vice-president.
- By the law, the NDF is commissioned to give a technical advise, guidance and recommendation for TEPCO and the "Decommissioning Strategy Board" in the NDF plays the leading role as the highest decision-making body on the decommissioning facilitation work as shown below.
  (1) Strategy planning for important issues
  (2) Planning and promotion of R&D
  (3) Supporting the management of important issues
  (4) Strengthening the international cooperation

Decommissioning Strategy Board

Member

Shunsuke KONDO（chairman）	Professor Emeritus, Tokyo Univ. （Former Chairman, Japan Atomic Energy commission)
Hajime ASAMA	Professor, Tokyo Univ.
Yuzo OHNISHI	Professor, Kansai Univ.
Koji OKAMOTO	Professor, Tokyo Univ.
Hirofumi KAMATA	Managing Executive Officer, Chief of Nuclear Facilities Division, Taisei Corporation
Keisuke TAKEUCHI	Principal Corporate Advisor, JGC Corporation
Osamu TOCHIYAMA	Director, Radioactive Waste Disposal SafetyResearch Center, Nuclear Safety Research Association
Shojiro MATSUURA	President, Japan Atomic Energy Agency

International Special Advisor

Christophe Behar (France)	Director, Nuclear Energy Division, CEA
Paul Dickman (USA)	Senior Policy Fellow, Argonne National Laboratory
Mike Weightman (U.K.)	Former Chief Nuclear Inspector, Office for Nuclear Regulation (ONR)
Rosa Yang (USA)	EPRI Fellow Nuclear Power, Electric Power Research Institute (EPRI)

6.(4) Research and Development Project for Fukushima Daiichi Decommissioning

NARAHA Remote Technology Development Center
（Mock-Up Test Facility）

Spent Fuel Management

1 Evaluation of Long-Term Reliability of Spent Fuel

Water Confinement of PCV

2-②-1 Development of Technology for Water Confinement of PCV

2-②-2 Real Scale Mock-Up Test for Water Confinement of PCV

Decontamination inside R/B

2-① Development of Remote Decontamination Machine

Retrieval of Fuel Debris

2-④-1 Development of Retrieval Technology for Fuel Debris and In-Core Structures

2-④-3 Evaluation of Structural Reliability of PCV/RPV

2-④-4 Development of Criticality Control Technology for Fuel Debris

2-④-2 Design and Development of Collecting, Transfer and Storage of Fuel Debris

Investigation and Analysis inside Reactor

<Direct>

2-③-1 Investigation inside PCV

2-③-2 Investigation inside RPV

< Indirect >

2-③-3 Analysis of Reactor inside Condition through Sever Accident Code

2-③-4 Detection of Fuel Debris inside Reactor

2-③-5 Development of Technology for Identifying Properties of Fuel Debris

OKUMA Analysis and Research Center
（Radioactive Material Analysis and Research Facility）

Radioactive Waste Management

3 Treatment and Disposal of Radioactive Waste

[Reference] Core Research Center (Mock-up & Hot lab)

- The Government of Japan sponsored JPY 85 billion to Japan Atomic Energy Agency (JAEA) in FY 2012, in order to establish the fundamental technology of decommissioning. This fund is applied to install the Mock-up facility and Radioactive Materials Analysis & Research Facility (Hot lab).
- Mock-up Facility: In May 2013, the location was decided in Naraha Town (Narahaminami Industrial Park). The construction began in September 2014, and the operation will be started within FY 2015.
- Hot lab: Currently, the preparation is on-going at the candidate site which is located near the Fukushima Daiichi NPS. The operation will be started in 2018.

Radioactive Materials Analysis & Research Facility

- Analyzing and researching of fuel debris and radioactive waste from Fukushima Daiichi NPS, by the aid of glove box and manipulator.
- The location is under review within neighboring area of Fukushima Daiichi. (With consideration for the transportation of samples.)

Mock-up Facility

- Demonstration of the robot for investigating and repairing the leakage point.
- Training the operator.
- The construct began in September 2014.

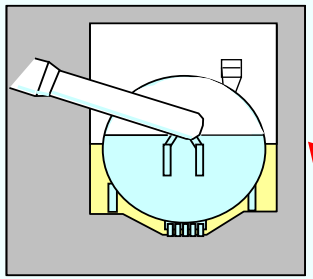
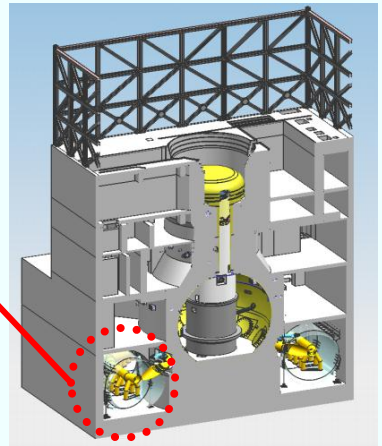


Image of the Mock-up
(In the torus room)



Reactor building

Ⅱ. Japan's Nuclear Energy Policy

1. Policy for Fukushima Recovery
2. Effects of NPPs' Shutdown
3. The Strategic Energy Plan
4. Strengthening Back-End Policy

1. Policy for Fukushima Recovery ～ (1) Support for Evacuees

【Number of evacuees from Fukushima】
About 157 thousand ➔ About 119thousand
（December 2012） （Jan 2015）

【Number of evacuees from the evacuation zone】
About 110 thousand ➔ About 73 thousand
（December 2012） （Jan 2015）

1. Measures for lifting of evacuation orders and return

①Measures for safety and removing anxieties
（Reduction of radiation exposure/health consultation）
② Additional compensation for return
③Improving environment for return by using Subsidy for Accelerating Fukushima Reconstruction
④Decontamination in collaboration with the reconstruction and policy measures after the decontamination work

Materialization of lifting of evacuation orders through dialogues with host municipalities and local residents

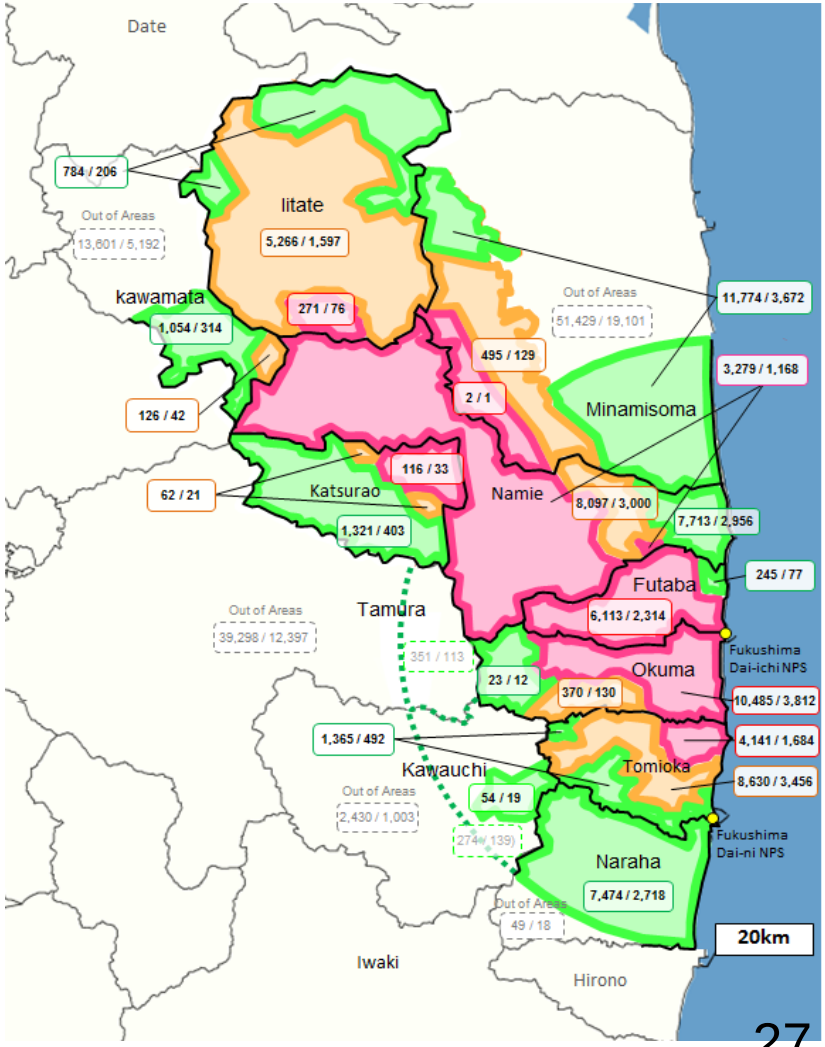
2. Expansion of assistance for launching new life

①Additional compensation necessary for new life
②Developing reconstruction centers in or out of the evacuation zone
③Considering how to implement regional construction and decontamination work in light of future perspectives of decontamination business, etc.

Materialization of mid and long term vision in a wide area through dialogues with host municipalities and residents

Evacuation order areas of Fukushima Dai-ichi Nuclear Power Plant (as of October 2014)

Area1 : Areas to which evacuation orders are ready to be lifted(annual cumulative dose ; ～20mSv/y)
Area2 : Areas in which the residents are not permitted to live(annual cumulative dose ; 20mSv/y～50mSv/y)
Area3 : Areas where it is expected that the residents have difficulties in returning for a long time (annual cumulative dose ; 50mSv/y～)



1.(2) "Fukushima Innovation Coast Vision"

- GOJ has created "Fukushima Innovation Coast Vision" on June, 2014.
- The vision aims to create R&D base for decommissioning and robotics, creating new industries and jobs.
- For realizing the vision, detail plans and measures are being discussed at the promotion council and three sectional committees.

1. International R&D Base for Decommissioning
(Radioactive Materials Analysis & Research Facility)

2. R&D and Demonstration Base for Robots
(1) Mock-up Facility (Indoor Robots)
(2) Fukushima Robot Test Field (Outdoor Robots)

3. International Base for business-academia collaboration

4. New Industry Accumulation
(1) Smart eco-park
(2) Accumulation of the energy-related industry
(3) Projects for agriculture, forestry and fisheries
(4) Base for archives

5. Infrastructure Improvement
(1) Transportation Infrastructure
(2) Industry and Life Infrastructure

1.(3) Support for Business Establishment in Fukushima

Subsidy Program for New Business Establishment in the Areas Recovering from Tsunami and Nuclear Disaster towards Employment Creation

- Facilities Eligible for Subsidy

  Factories, Distribution Facilities, Experiment and Research Facilities

- Subsidized Costs

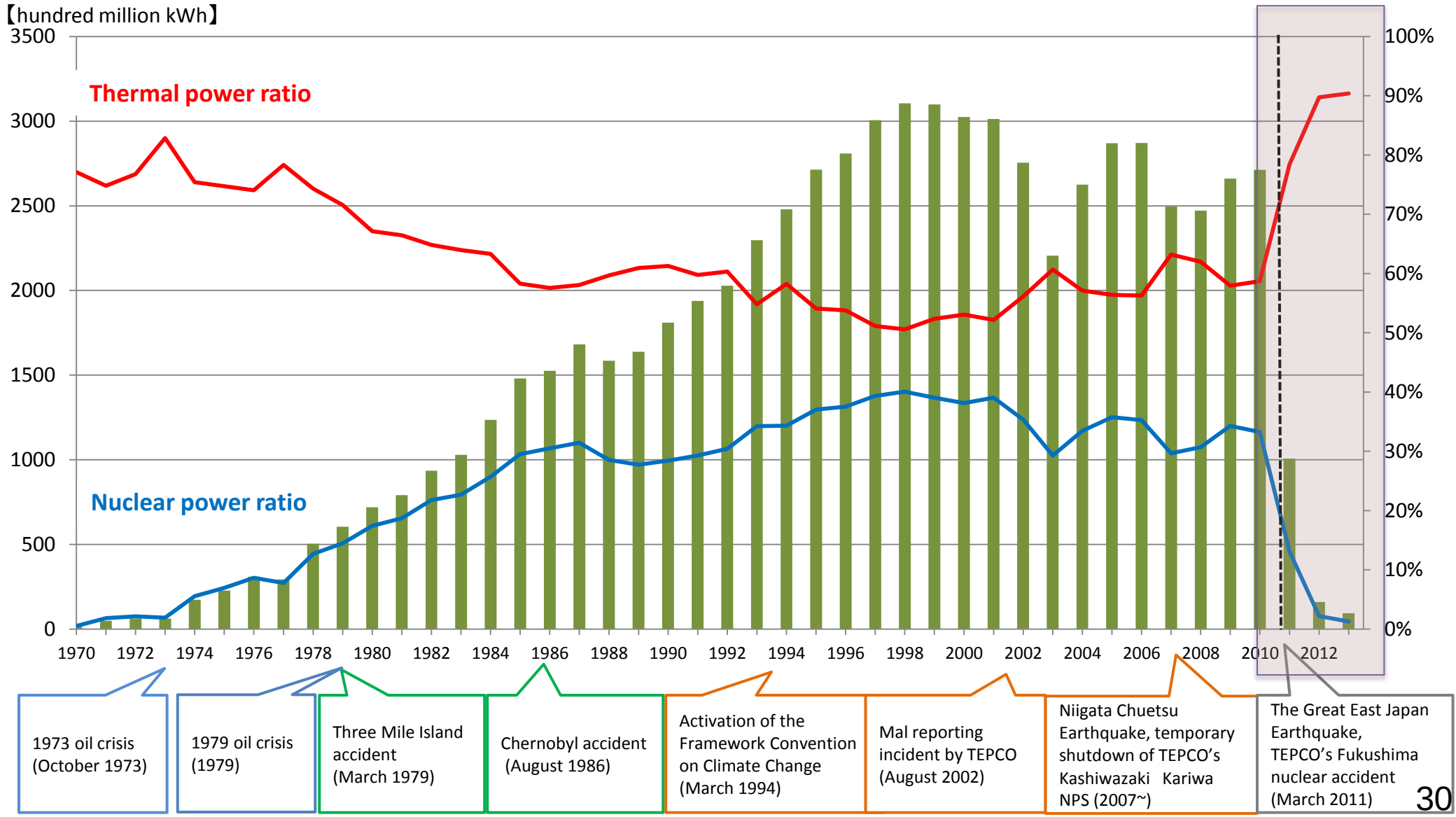
  Land acquisition, Land development, Building acquisition, Equipment

- Subsidy Rate

Areas eligible for subsidy	Area number	Category		Subsidy rate (upper limit)	Subsidy rate (lower limit)
Areas recovering from the nuclear power plant accident	(i)	Former evacuation zone, Areas to which evacuation orders are ready to be lifted, Areas in which the residents are not permitted to live	Large companies	1/2	2/5
				2/3(*)	1/2(*)
			Small/medium-sized companies	2/3	1/2
				3/4(*)	2/3(*)
	(iii)	Entire Fukushima Prefecture (excluding (i), (ii))	Large companies	1/4	1/8
			Small/medium-sized companies	1/3	1/8
Areas inundated by the tsunami	(ii)	Municipalities suffering from the tsunami	Large companies	1/3	1/8
			Small/medium-sized companies	1/2	1/6
	(iv)	Municipalities in a specific zone suffering from the tsunami (Excluding (ii))	Large companies	1/5	1/10
			Small/medium-sized companies	1/4	1/10

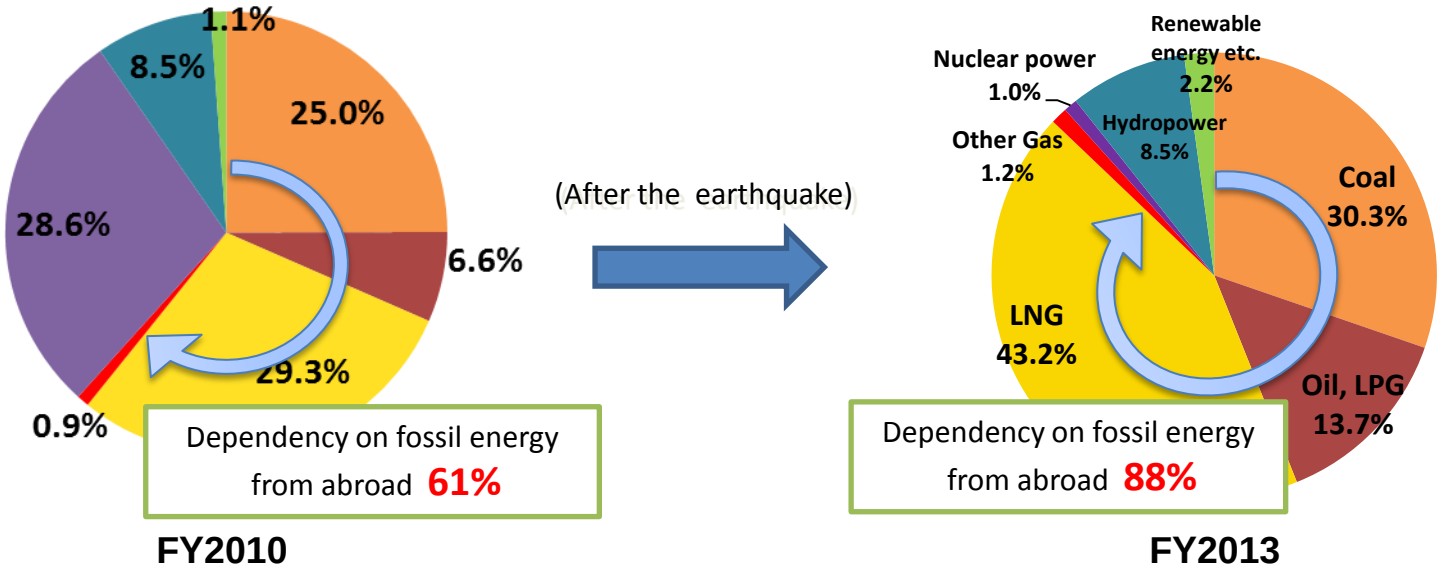
2. Effects of NPPs' Shutdown ～(1) Change of NPP Output in Japan

After the Great East Japan Earthquake and TEPCO's Fukushima Daiichi Nuclear accident in 2011, all nuclear power plants (NPPs) are in a state of temporary shutdown.

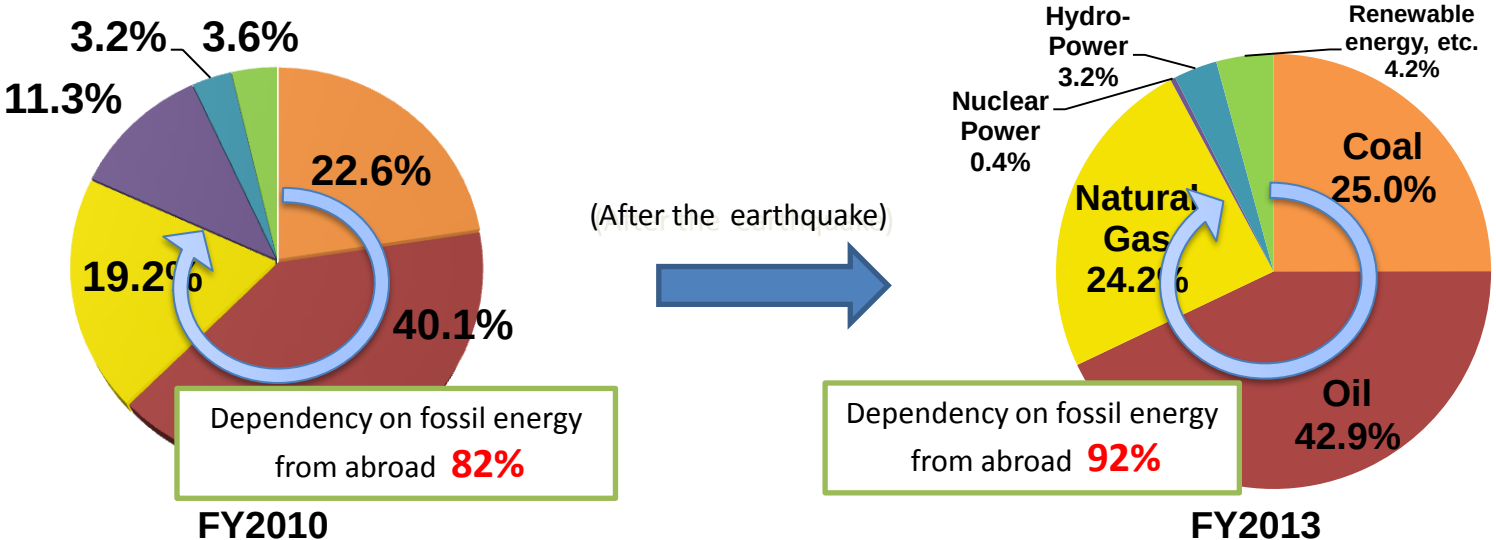


2. (2) Changes in Dependency on Fossil Energy from Abroad

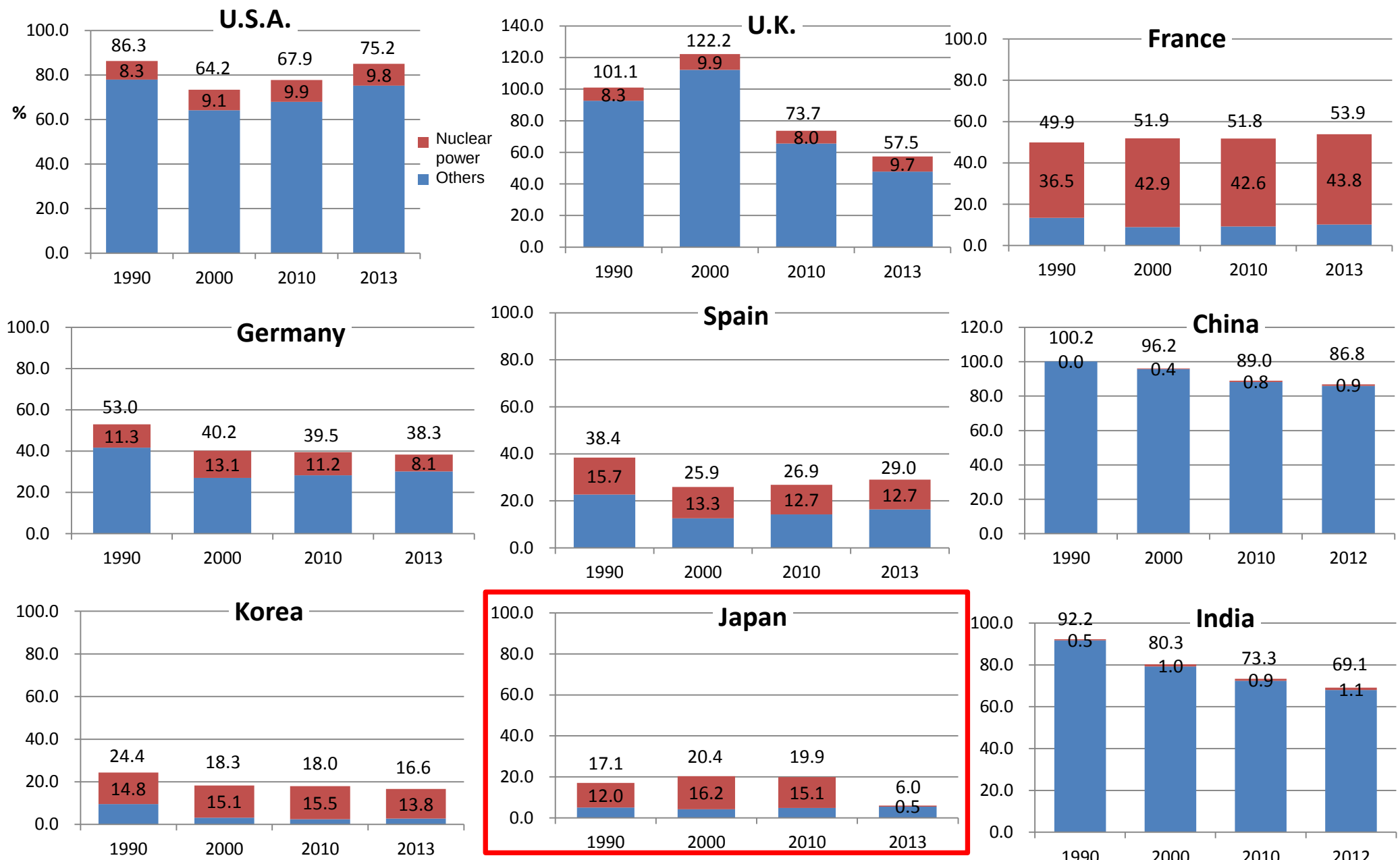
Change in Japan's power source composition



Change in Japan's Primary Energy Supply Structure



2.(3) Changes in Primary Energy Self-Sufficiency Rate of Major Countries



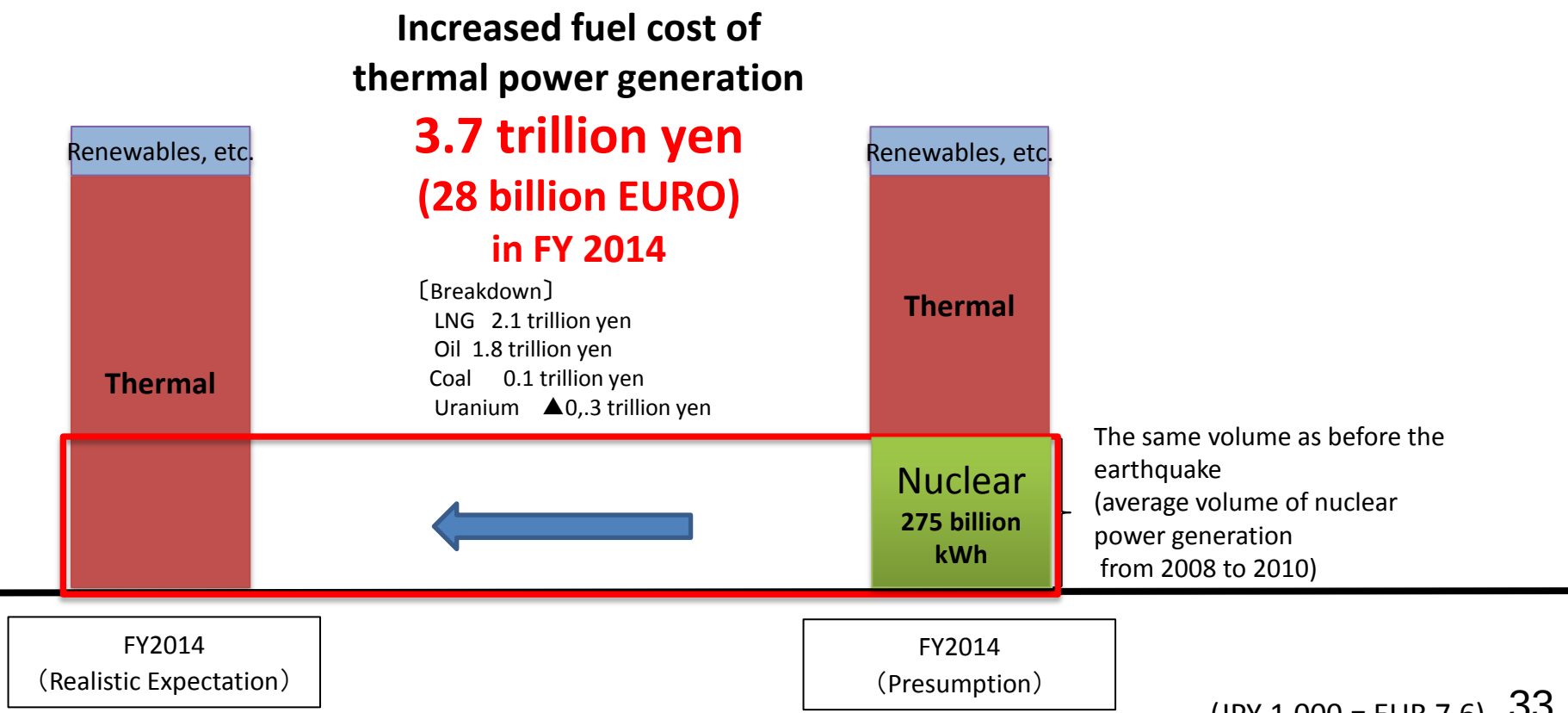
* IEA "Energy Balance of OECD, Non-OECD Countries 2014" (Data is based on the latest estimate of the year 2013 for OECD countries, and the latest estimate of the year 2012 for non-OECD countries).

2.(4) Estimation on Fuel Cost of Increased Thermal Power Generation

Based on the presumption that the volume of nuclear power generation in 2014 was the same level as before the earthquake, it is estimated that Japan could save **3.7 trillion yen** of fuel cost for actual thermal power generation.

＜Basic Idea of the Estimation＞

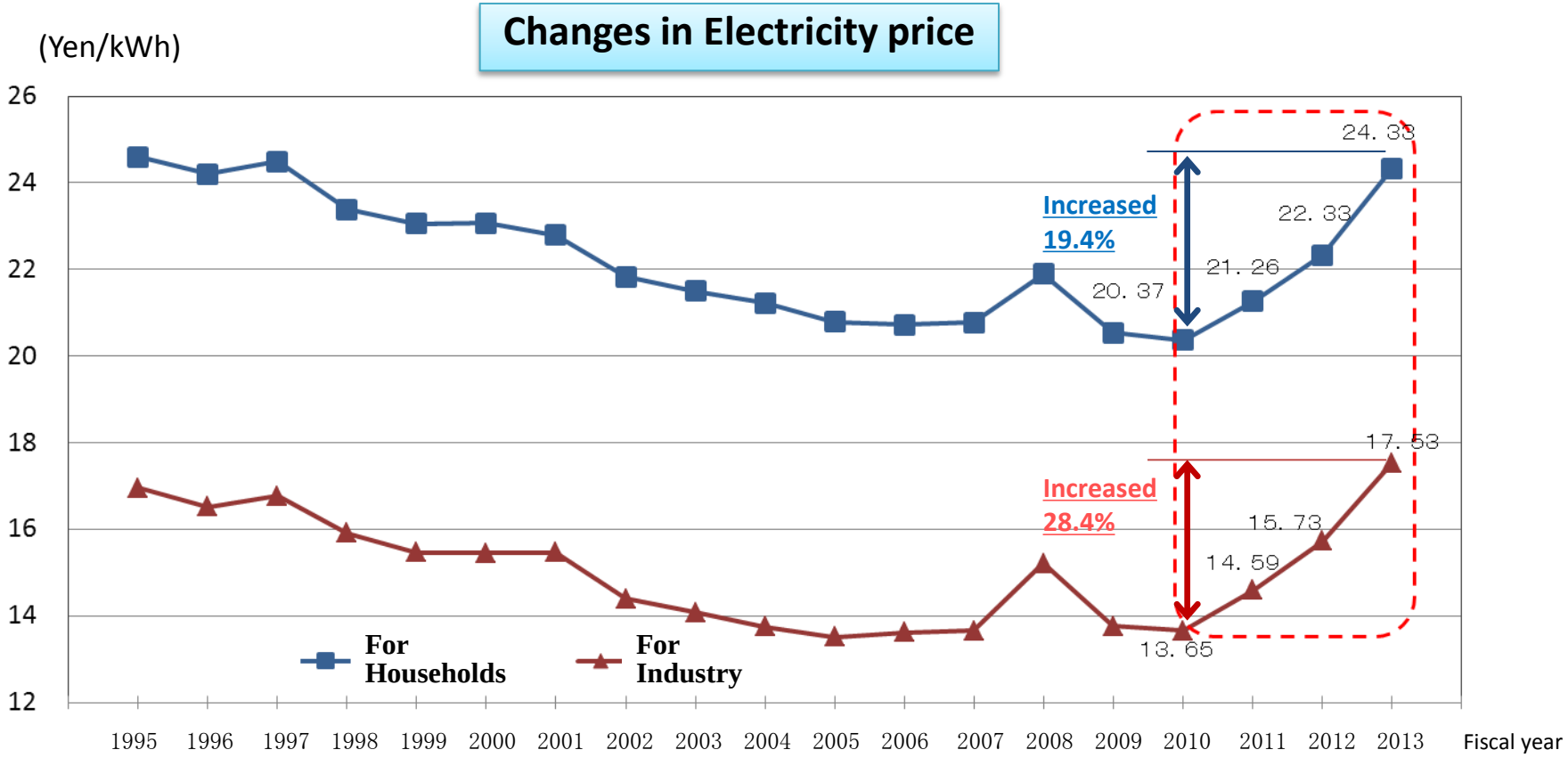
Nuclear was base-load-power source in Japan. If NPPs were operated in 2014, their generation volume would be the same level as before the earthquake regardless of total demand of electricity power.



(JPY 1,000 = EUR 7.6)

2. (5) Changes in Electricity price

◆ Since the Great East Japan Earthquake followed by the nuclear accident, the average electricity price rose by around **20%** for households and around **30%** for industry because of increasing fuel costs and so on.



[Source] Created based on the "Electricity Demand Report" (Federation of Electric Power Companies in Japan) and the materials concerning the power companies' final settlement reports, etc.

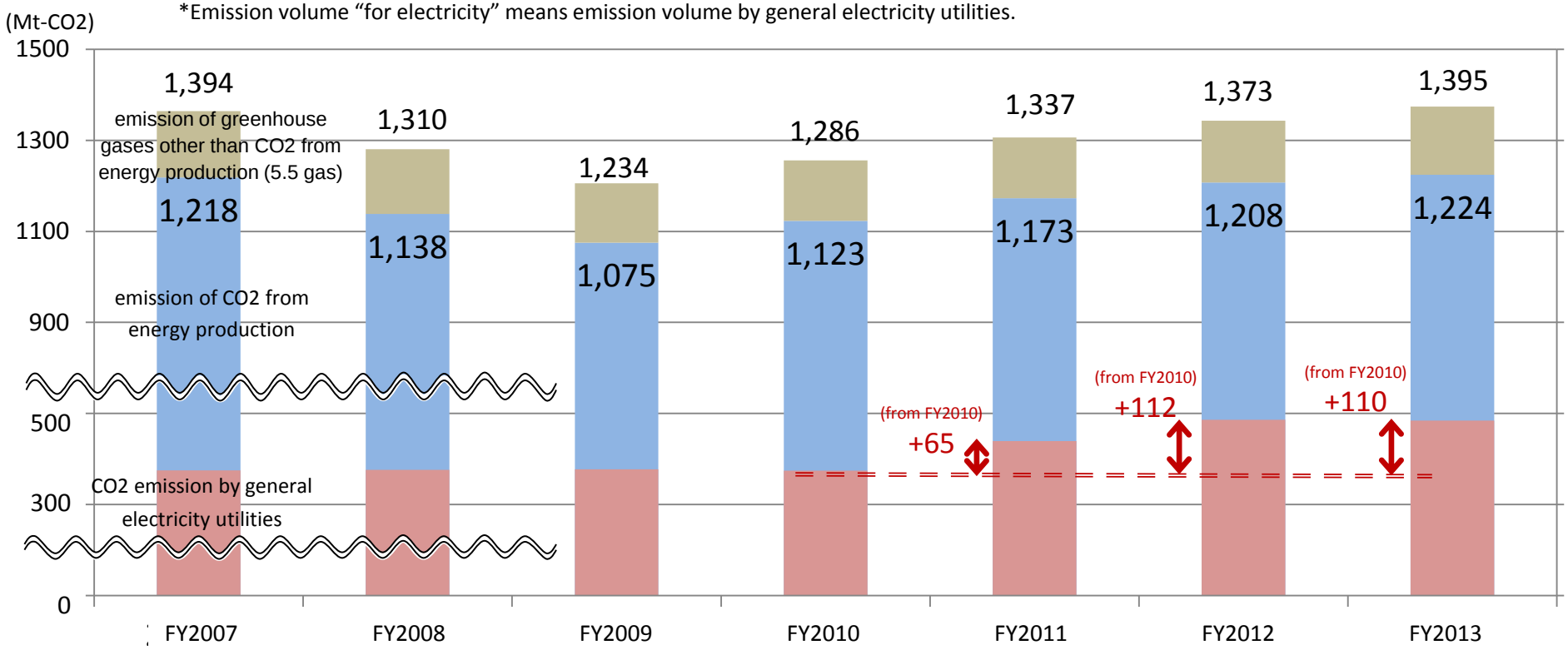
2. (6) CO2 emission before and after the Great East Japan Earthquake

■ CO2 emission for FY2013 increased **101 million tons** compared to FY2010.

■ Although emission except for electricity (*) are decreasing slightly, the emission from electricity production have increased by **110 million tons** compared to FY2010, because of increased use of thermal power generation as this makes up for nuclear power.

(Million t-CO2)	FY2007	FY2008	FY2009	FY2010	FY2011		FY2012		FY2013	
Greenhouse gas emission volume	1, 394	1, 310	1, 234	1, 286	1, 337		1, 373		1, 395	
CO2 emission volume from energy production	1, 218	1, 138	1, 075	1, 123	1, 173	(from FY2010)	1, 208	(from FY2010)	1, 224	(from FY2010)
Of which, for electricity*	375	376	377	374	439	+65	486	+112	484	+110
Of which, except for electricity	843	762	698	749	734	▲15	722	▲28	740	▲9

*Emission volume "for electricity" means emission volume by general electricity utilities.



2.(7) Adverse Effects due to Shutdown of NPPs after the Disaster

(JPY 1,000 = EUR 7.6)

Energy Security

1 . Increase in dependency on fossil fuels from overseas

- Fuel for 88% of total power generation is imported from overseas. 【FY2013】
  Before the Earthquake, it was 61% in FY 2010.

※ dependency on the Middle East : Crude oil (83%), Natural gas (30%)

- Ratio of renewable energy : About 2.2% of total power generation (where Hydro power generation is not included) 【FY2013】

Nation's Life and Economy

2 . Increase in fuel cost (due to increase in thermal power generation)

About 3.7 trillion yen (National burden is about 30 thousand yen/person.) 【estimation in FY2014】

3 . Increase in price of electricity

An average of about 20% increase from the level before the disaster
(monthly price of standard family : TEPCO about 6,300yen ⇒ about 8,600yen
KEPCO about 6,400yen ⇒ about 8,200yen)

(Expenditures for the Feed-in-Tariff system of renewables is about 650 billion yen/year which corresponds to 2,700yen/year for standard family) 【FY2014】

Climate Change

4 . Increase in greenhouse gas emissions 【as of FY2013】

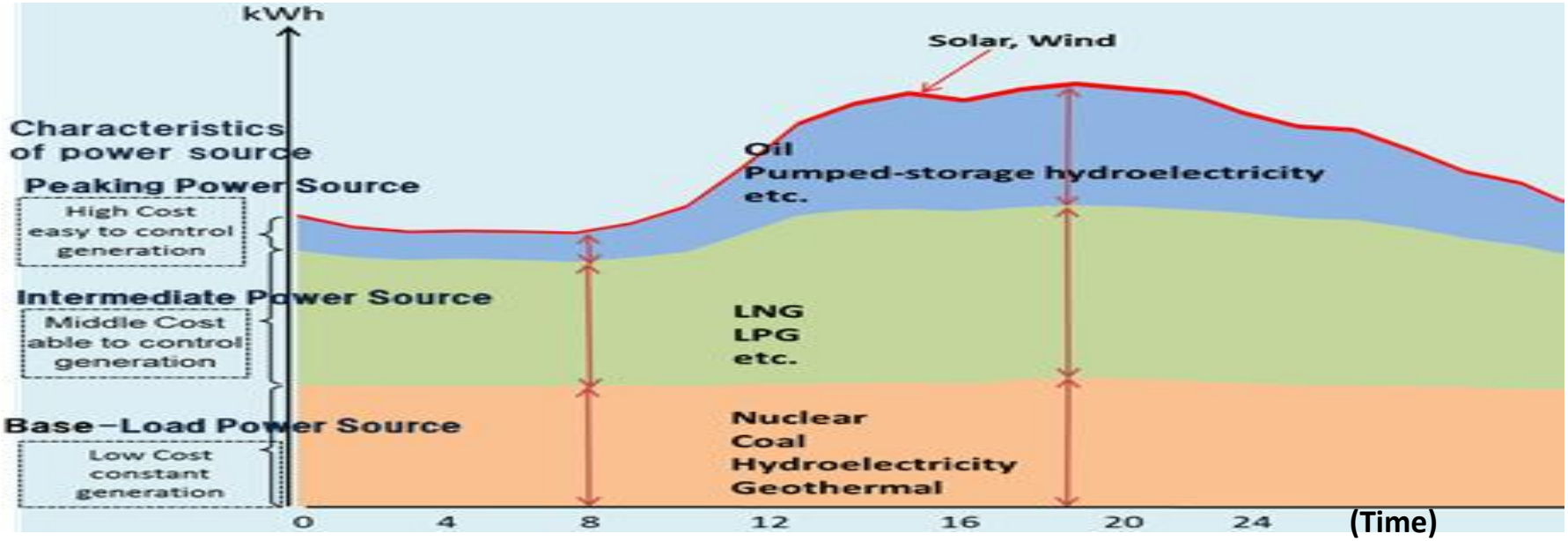
The amount of CO_2 emissions from general electricity utilities increased by about 110 million tons in FY2013 compared to FY2010. (about 9% of the total Japan's CO_2 emission)

1) "**Base-Load Power Source**": Geothermal energy, Hydropower, Nuclear Energy and Coal

2) "**Intermediate Power Source**": Natural Gas, etc.

3) "**Peaking Power Source**": Oil and Pumped-storage Hydropower

* "**Renewable Power Source**": Solar, Wind, etc.



GOJ's Evaluation of Nuclear power :

Important base-load power source, on the major premise of ensuring its safety.

Grounds:

1) Energy Security (i.e. superiority in stability of energy supply and efficiency)

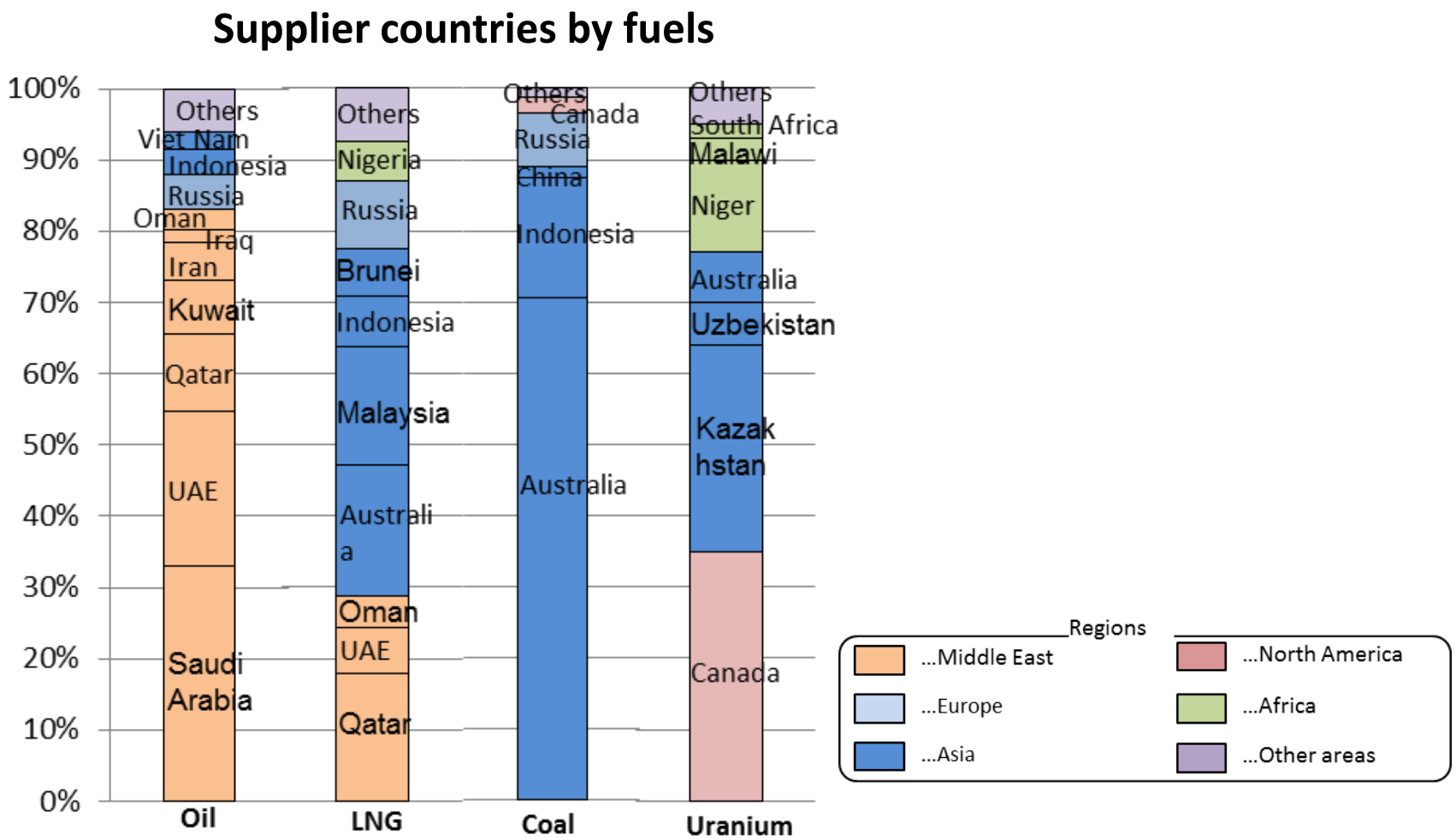
※ Nuclear energy can be evaluated as a quasi-domestic energy source.

2) Economic Efficiency (i.e. low and stable operational cost)

3) Climate Change (i.e. free from GHG emissions during operation)

[Reference] Energy Diversity

- Uranium mines are relatively diversified.



Dependence on ME: 83%
Dependence on Holmes: 80%

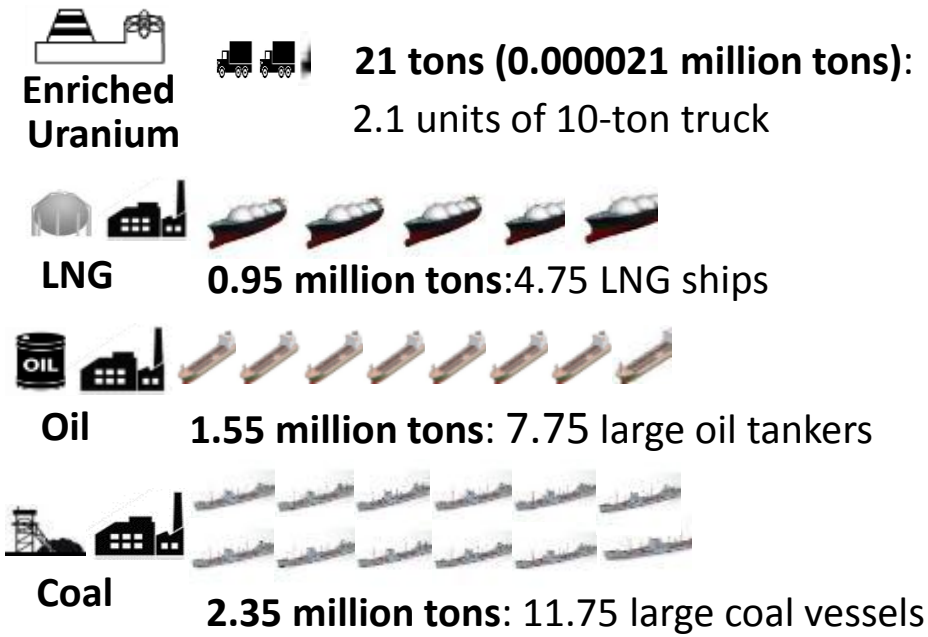
Dependence on ME: 30%
Dependence on Holmes: 25%

Data source: "Trade Statistics 2012" by MOF of Japan

[Reference] Energy Density

- To operate 1,000MW NPP for one year, only 21 tons of enriched uranium is necessary. (In the case of LNG, 0.95 mil ton.)

Necessary Fuel for one-year operation of 1,000MW power plant



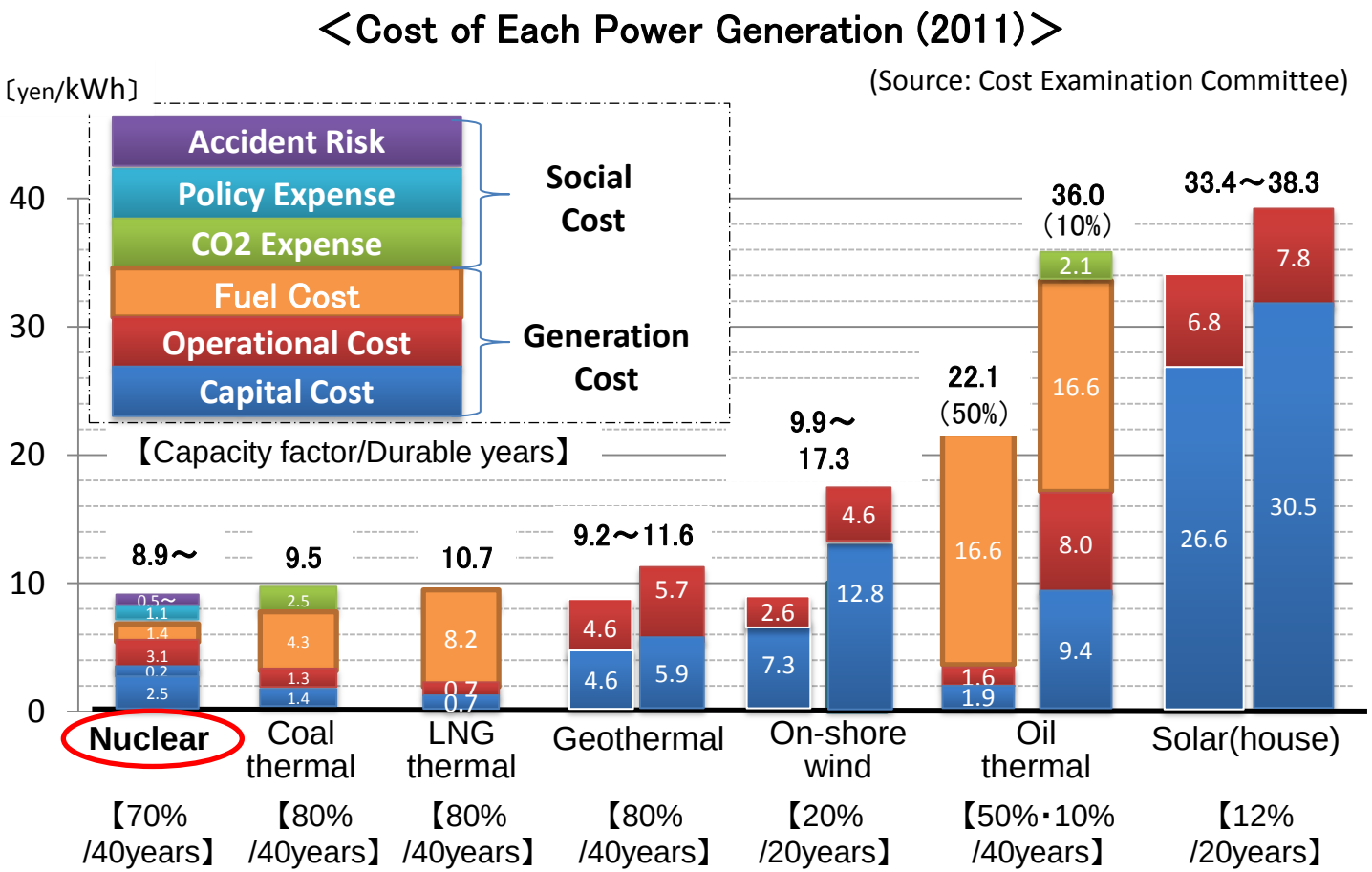
Japan's Fuel Stockpiles by private companies

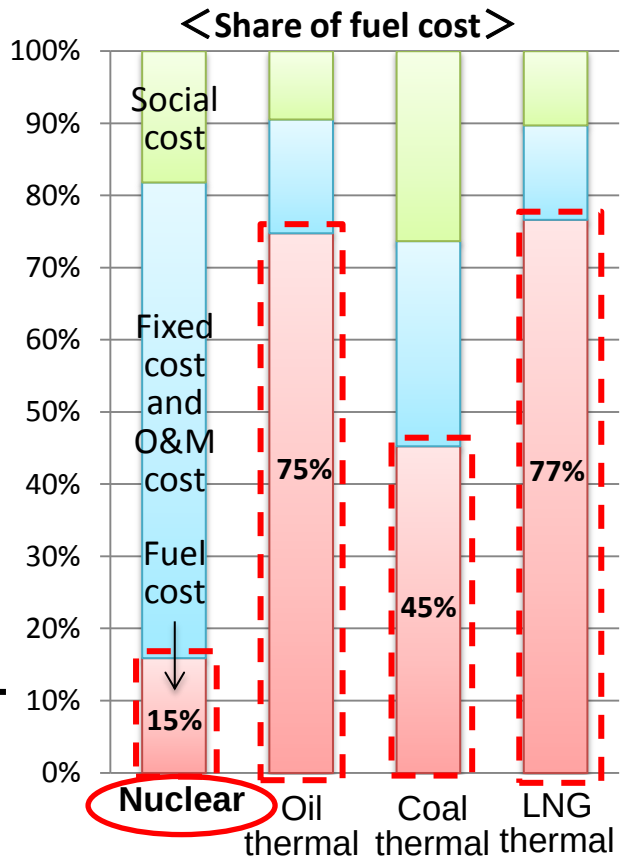
Enriched Uranium	Approx. 2 years
LNG	Approx. 13 days
Oil	Approx. 67 days ※National Stockpile: Approx. 85 days
Coal	Approx. 33 days

※Data Source: "Nuclear 2010" by ANRE

[Reference] Cost Estimation

- The cost of nuclear power generation: JPY 8.9/kWh

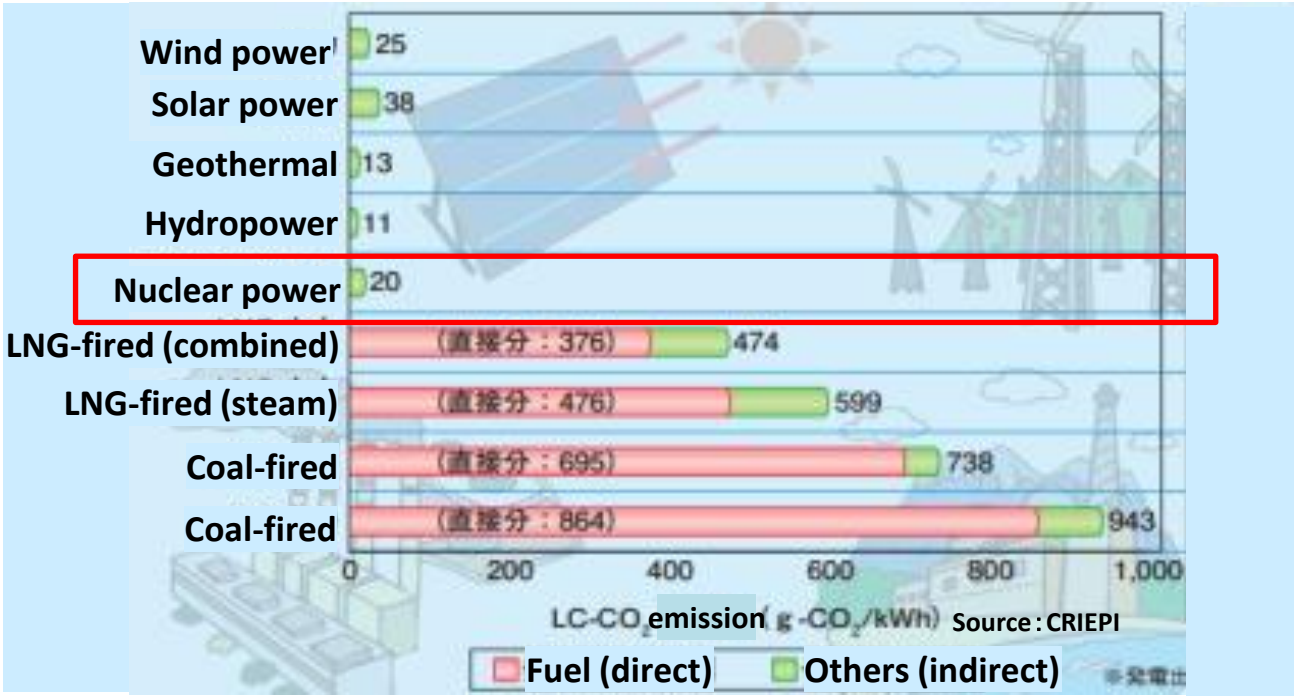




[Reference] CO_2 Emission

● Nuclear power does not emit GHG during operation.

＜Life cycle CO2 emission for each power source＞



＜Intergovernmental Panel on Climate Change（IPCC）WG III report (April 2014)＞

"Nuclear energy is **a mature low-GHG emission source of base-load power**, but its share of global electricity generation has been declining (since 1993). Nuclear energy could make an increasing contribution to low-carbon energy supply, but a variety of barriers and risks exist."

3. (3) GOJ's Stance on the Restart of NPPs

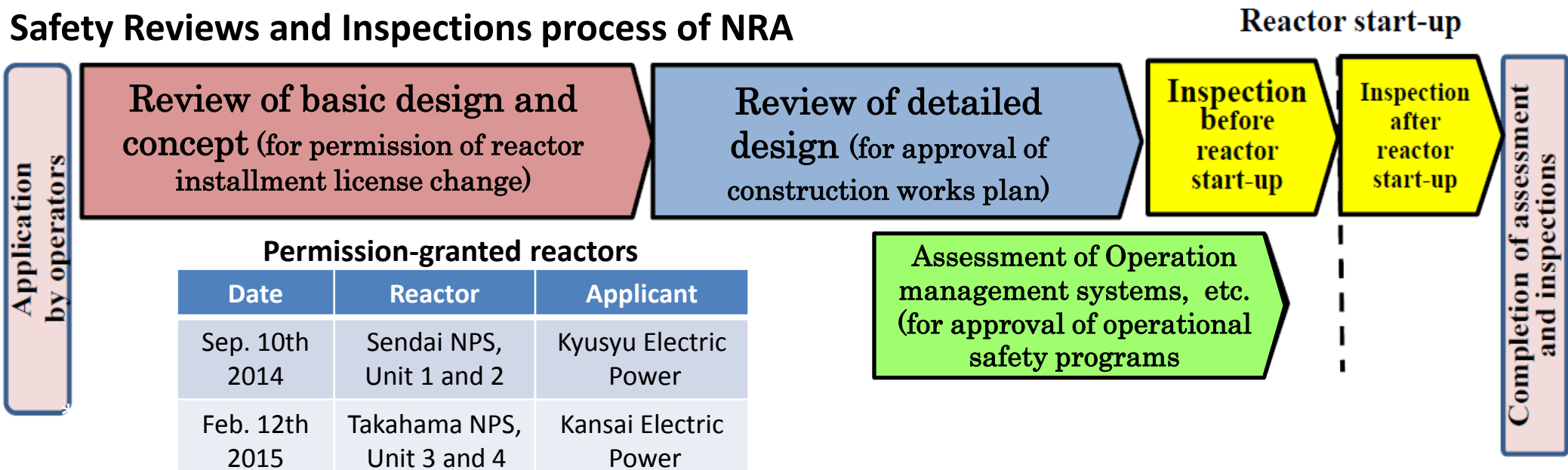
GOJ's Stance on the Restart of NPPs :

GOJ will proceed with the restart of NPPs,

in case that the NRA confirms the conformity of nuclear power plants with the new regulatory requirements (which are of the most stringent level in the world)

[Reference] Outline of processes for restart of NPPs

Safety Reviews and Inspections process of NRA



Permission-granted reactors

Date	Reactor	Applicant
Sep. 10th 2014	Sendai NPS, Unit 1 and 2	Kyusyu Electric Power
Feb. 12th 2015	Takahama NPS, Unit 3 and 4	Kansai Electric Power

Local acceptance process

* Not required by laws

Local acceptance process

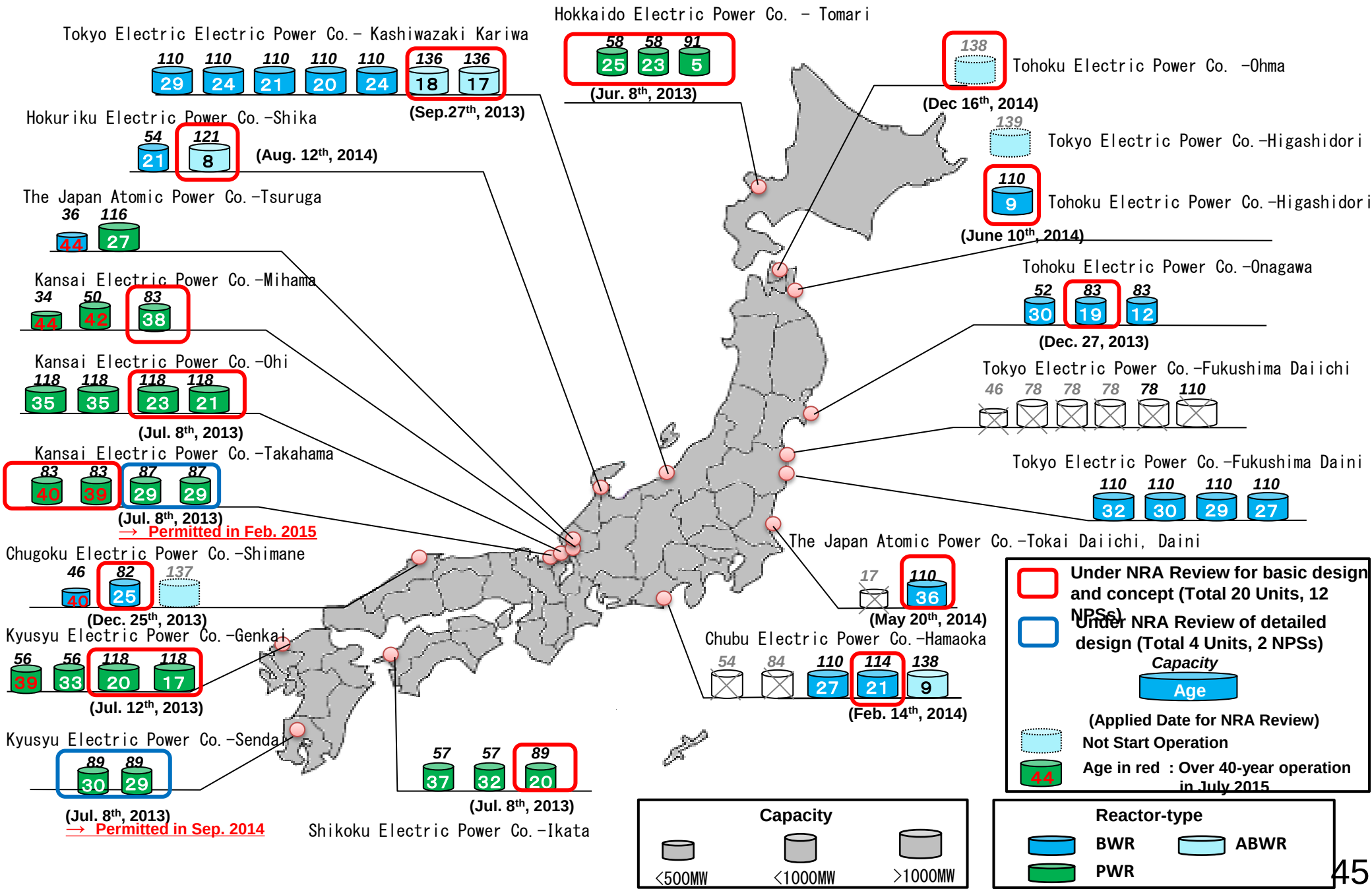
Disaster prevention and evacuation plan

*Not required by the nuclear reactor law

Preparation and enhancement of the disaster prevention and evacuation plan

**Based on "the Basic Act on Disaster Control Measures" and "the Act on Special Measures concerning Nuclear Emergency Preparedness"

[Reference] Nuclear Electric Power Plants in Japan (As of April 13, 2015)



3. (4) "Energy Mix" Policy Making Process

- "The Strategic Energy Plan" is the anchor of energy supply/demand policies in Japan.
- The latest version was approved by the Cabinet in April 2014.
- It evaluates each energy source in Japan's energy supply structure; however, does not include future Energy Mix.
- Deliberation on Japan's future Energy Mix started in this January at the ANRE/METI's Advisory Committee. GOJ will formulate future Energy Mix towards 2030 as soon as possible.

4. Strengthening Back-End Policy ～(1) New Accounting Rules for Decommissioning

○ **In order to solve the financial and accounting problems which make utilities hesitate to decide, METI has taken measures of electricity charges and accounting rules, as follows.(only apply to the decision of decommissioning after 3.13.2015)**

① New accounting rules of Ten-years-Depreciating of the bullet cost (terminal book value of the power plant, dismantling cost of nuclear fuel and decommissioning, etc.).

② With coming the change of accounting rules in effect, the rules of electricity charges has been changed.

（Duration of collecting the cost of decommissioning changed 3 years in ex-system for 10 years. This change levels the burden of customers.） （Revised ministerial decree in effect on 3.13.2015. ）

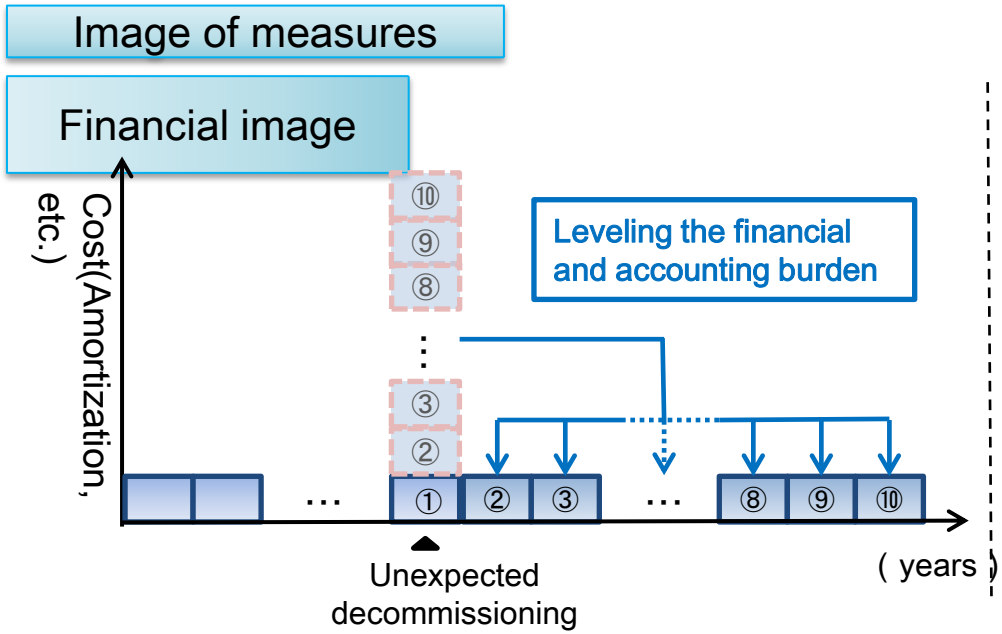
< reference >

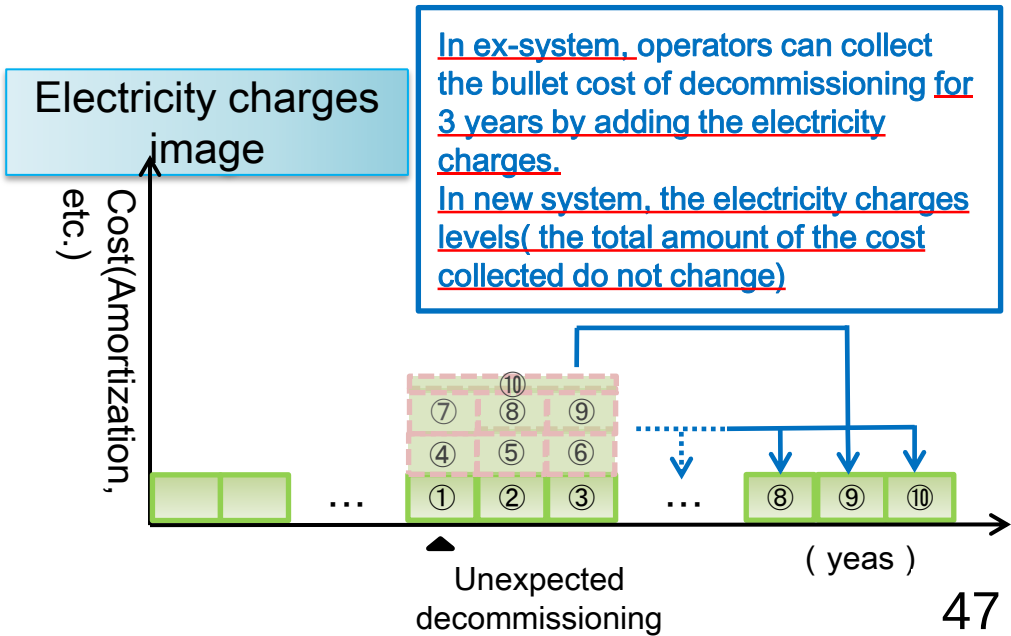
✓ In ex-system, there is the incentive not to decommission for operators.

① Operators have to raise the electricity charges to collect the decommissioning cost. If operators raises the charges, the burden of customer raises.(the total amount of the charges collected do not change.)

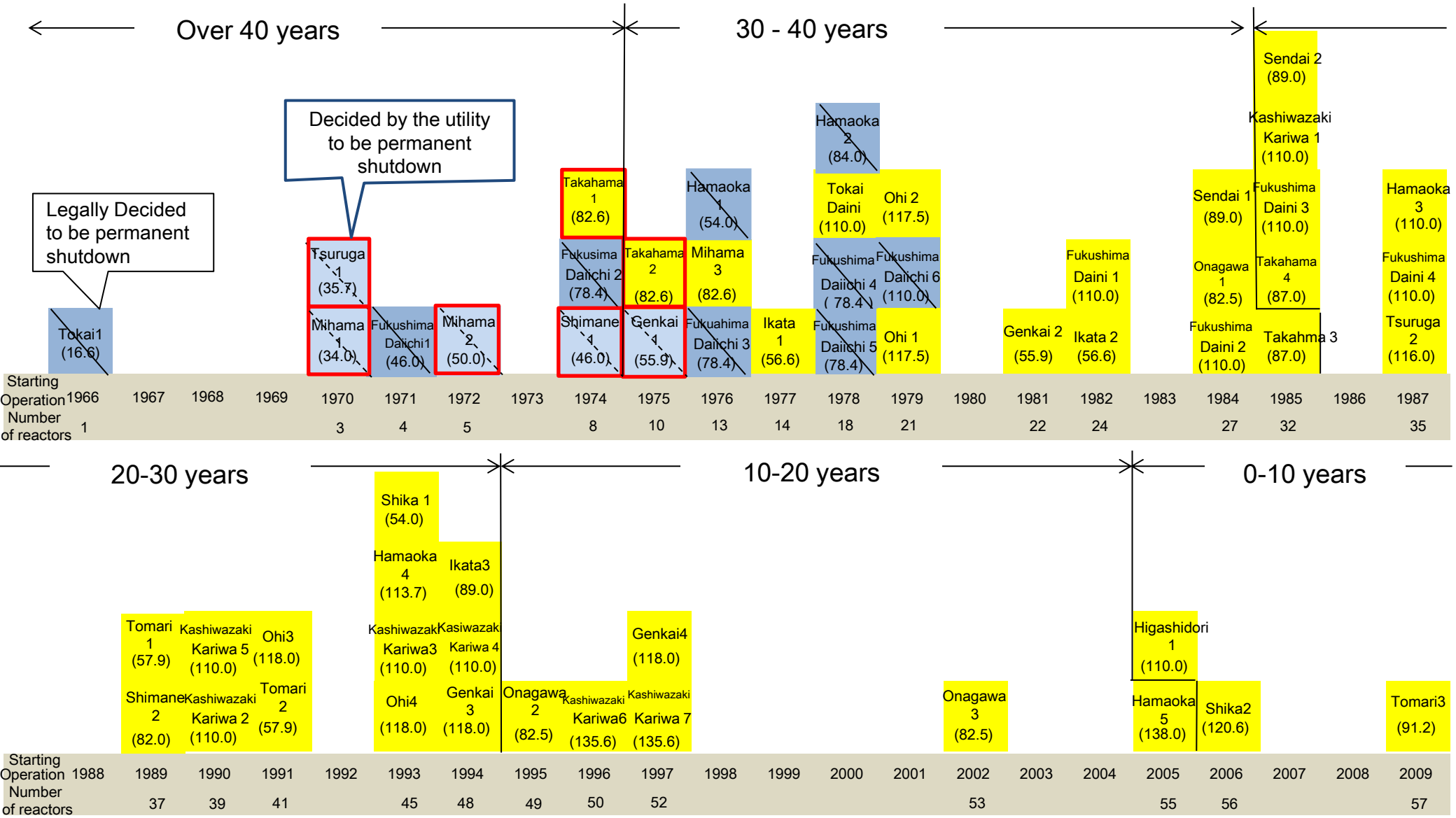
② Financial status gets worse by the accounting bullet cost.

✓ These incentives may interfere with steady decommissioning and stable supply of electric power.





[Reference] Age of Existing Nuclear Reactors in Japan - as of March 2015



Subject to apply for operational license renewal (Period: from April to July, 2015)

Decided by the utility to be permanent shutdown

Legally Decided to be permanent shutdown

(unit: 10,000 k W)

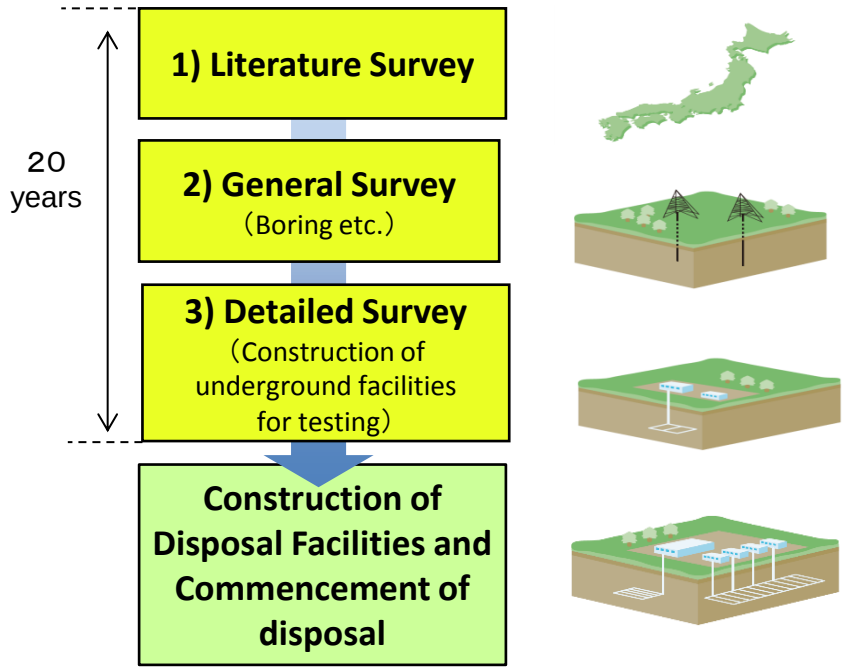
4. (2) Outline of Disposal Site Selection Process

1) "Designated Radioactive Waste Final Disposal Act" was enacted in 2000. Nuclear Waste Management Organization(NUMO), an implementing body of geological disposal for high-level radioactive waste, started the public solicitation of literature survey for disposal site selection in Japan from 2002.
2) However, the site selection process has not been advanced to date. Even literature survey has not been started yet.
3) Under this situation, "Council of Relevant Ministers on Final Disposal" was established in December 2013.
4) In the Council, the Government decided to add a new process for selecting disposal site in which the Government will judge and propose plural suitable candidate areas from the scientific point of view.

The 1st Council of Relevant Ministers on Final Disposal (December 2013)
Decision of an Additional Process led by the government

Selection of scientifically suitable candidate areas by the government (Mapping)

Promotion of Public Understanding (Holding information sessions etc.)

- Application from candidate local municipalities
- **Offer to plural municipalities from the Government**

Final Disposal Site Selection Process under the Act