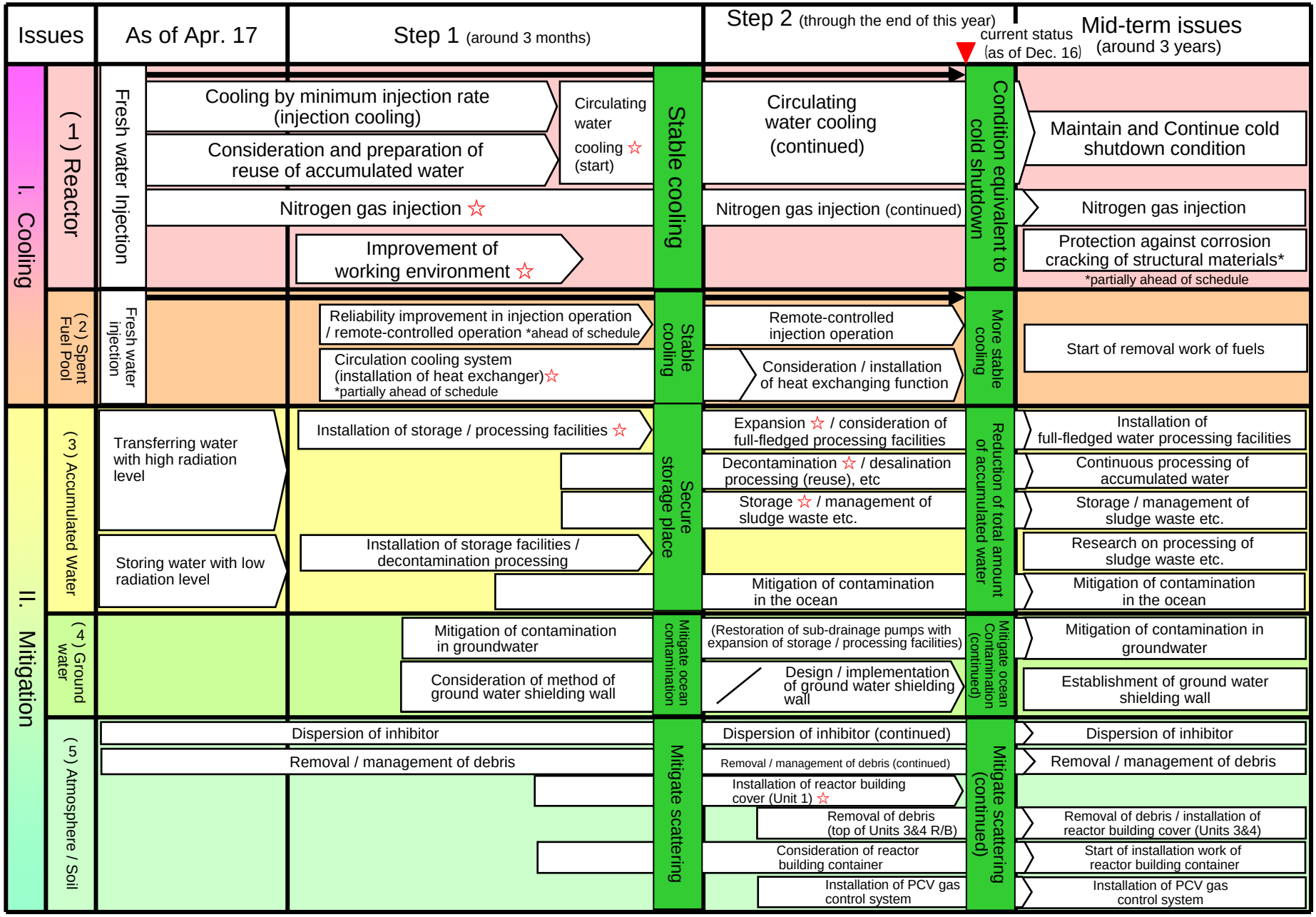
Current Status of "Roadmap towards Restoration from the Accident at Fukushima Daiichi Nuclear Power Station, TEPCO" (Step2 completion)

Appendix 1-3

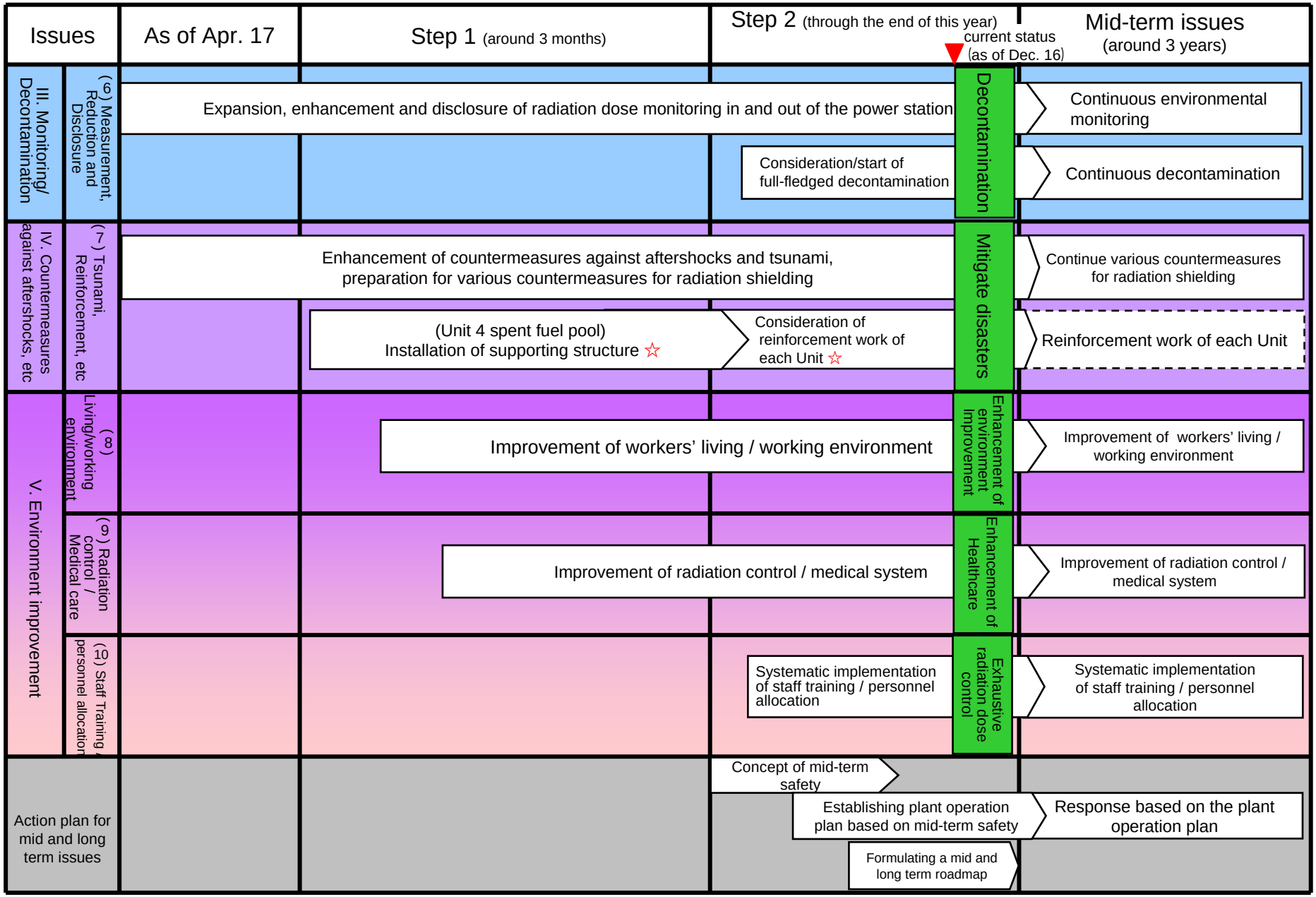
December 16, 2011
Nuclear Emergency Response Headquarters
Government-TEPCO Integrated Response Office

☆: already reported to the government, Green colored shading: achieved target



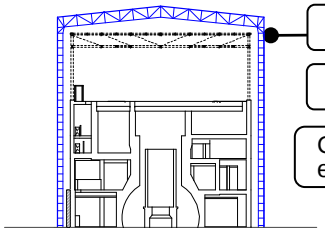
Current Status of "Roadmap towards Restoration from the Accident at Fukushima Daiichi Nuclear Power Station, TEPCO" (Step2 Completion)

☆: already reported to the government, Green colored shading: achieved target



Overview of Major Countermeasures in the Power Station, Final Edition

Underlined: deleted countermeasures, ☆: already reported to the government



Reactor building cover (5, 50, 54, 55, 84) ☆

Full-fledged container (50, 56)

Cooling of spent fuel pool by external water injection (18, 22, 28)

Sampling of steam/pool water and measurement of radioactive materials (19)

Circulation cooling of spent fuel pool (23, 24, 25, 27) ☆

piping

pumps

heat exchangers, water processing facilities

Water processing facility

Desalination

De-contamination

Adsorption

Oil separation

Tank

Storage/process of low radiation-level water (33, 34, 35, 40, 41, 44, 46)

Storage: tanks, megafloats
Process: decontamination by zeolite

Lower the amount of steam generated (4)
Maintain and enhance countermeasures in Step 1 if needed (17)

Nitrogen gas injection (2, 11, 15) ☆

Reactor Building

PCV gas control (86)

PCV venting (with filtration) (10)

Primary Containment Vessel (PCV)

Flooding up to top of active fuel (3, 9)

Reactor Pressure Vessel (RPV)

Cooling at minimum water injection rate (7, 12, 14)
Reuse of processed water (45)
(Implement circulating water cooling) ☆

Processing high radiation-level water (31, 38, 43) ☆

Storage / management of sludge waste etc. (81) ☆

Consideration of full-fledged water processing facilities (82)

Storage of high radiation-level water (30, 32, 37, 39, 42) ☆

Turbine Building

Steam Turbine

Additionally-installed Tank

Centralized Waste Processing Building

Heat Exchanger

Injection of fresh water with pumps (1)

Installation of heat exchangers (13)

Condenser

Ground water shielding wall

Suppression Chamber

Processing of sub-drainage water after being pumped up (36)

Sealing the leakage location (6, 16)

Dispersion of inhibitor (47, 48, 52)
Removal / management of debris (49, 53, 87)
Consideration of countermeasures for contaminated soil (51)

Preventive measures against leakage of high radiation-level water (29)
Prevent contamination in the ocean (64)
Isolation of high-level radioactive water (65)

Seismic assessment (20) ☆,Continued monitoring (21),
(Unit 4) Installation of supporting structure under the bottom of spent fuel pool (26) ☆

Prevent contamination of groundwater (66, 67)
Consideration of impermeable wall against groundwater(68, 83)

Improvement of living/working environment of workers(74, 75)
Improvement of site environment(76) ☆

Enhancement of radiation control and medical system (77, 78, 79, 80)
Systematic implementation of staff training / personnel allocation (85)

Install various interconnecting lines of offsite power(8)
Enhance countermeasures against tsunami (69, 70)
Consideration of reinforcement work of each Unit (71) ☆
Various countermeasures of radiation shielding (72, 73)

Continue/Enhance monitoring (55-62),
Consideration / start of full-fledged decontamination (63)

Current Status of Countermeasures (1)

Red frame: progressed countermeasures from the previous version, ☆: already reported to the government

I. Cooling

(1) Reactor

Issues

Unit

<Step 2 (through the end of this year)>: Release of radioactive materials is under control and radiation doses are being significantly held down

Start of Step 2 (Jul. 17)

Current status (as of Dec. 16)

Term to keep the amount of accumulated water and to improve reliability | **Term to complete measures to improve reliability and reduce the amount of accumulated water** | **Term to inject enough water for cold shutdown condition without increasing the amount of accumulated water**

Target [㎥] Condition equivalent to cold shutdown

1

Implementation of circulating water cooling [Countermeasures 12,14,45] ☆

- Establishment of centralized monitoring system in the main anti-earthquake building (Sep. 30)
- Injection of water required to achieve "stable cooling"
- Injection toward cold shutdown condition without increasing the amount of accumulated water

Nitrogen gas injection [Countermeasure 11] ☆ Started nitrogen gas injection into RPV in addition to PCV (Nov. 30)

2

Implementation of circulating water cooling [Countermeasures 12,14,45] ☆

- Establishment of centralized monitoring system in the main anti-earthquake building (Sep. 30)
- Injection of water required to achieve "stable cooling" (Inject water through core spray line in addition to feed water line (Sep. 14))
- Change injection flow rate experimentally, and verify transition of reactor temperatures
- Injection toward cold shutdown condition without increasing the amount of accumulated water

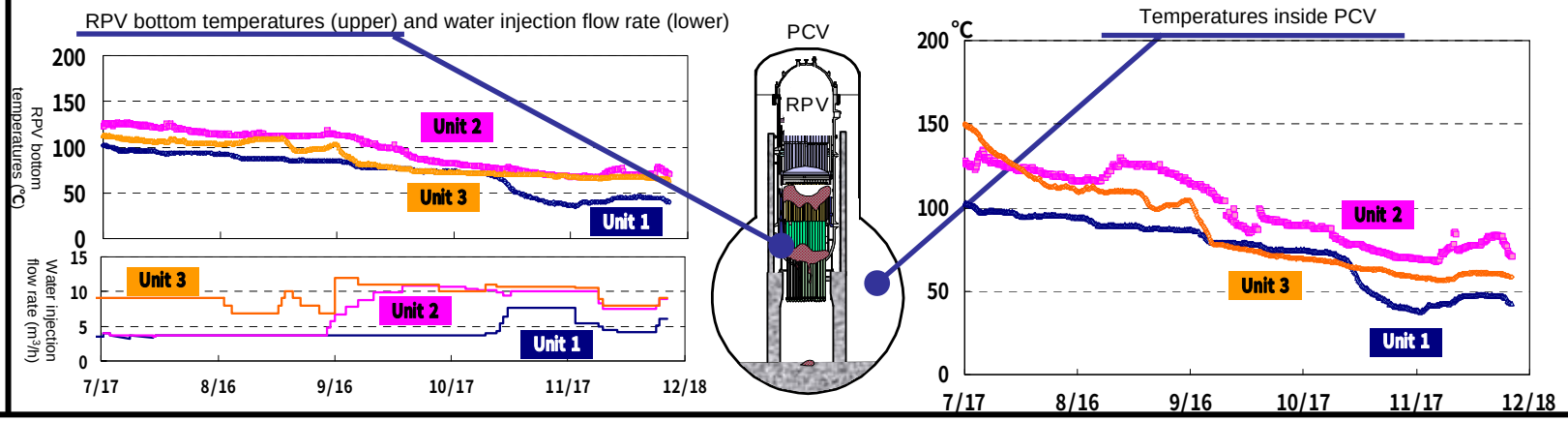
Nitrogen gas injection [Countermeasure 11] ☆ Started nitrogen gas injection into RPV in addition to PCV (Dec. 1)

3

Implementation of circulating water cooling [Countermeasures 12,14,45] ☆

- Establishment of centralized monitoring system in the main anti-earthquake building (Sep. 30)
- Injection of water required to achieve "stable cooling" (Inject water through core spray line in addition to feed water line (Sep. 1))
- Change injection flow rate experimentally, and verify transition of reactor temperatures
- Injection toward cold shutdown condition without increasing the amount of accumulated water

Nitrogen gas injection [Countermeasure 11] ☆ Started nitrogen gas injection into RPV in addition to PCV (Nov. 30)

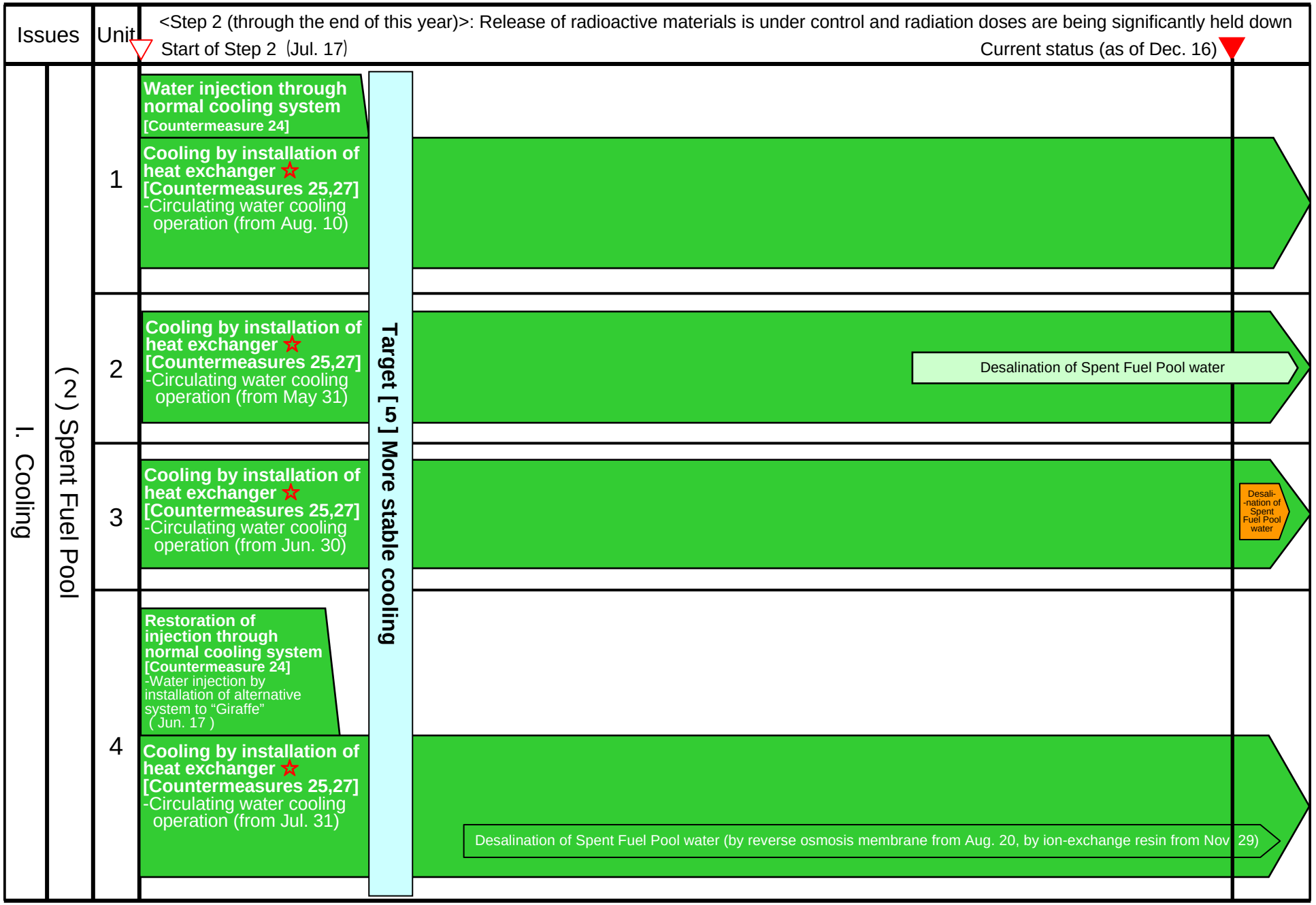


Legend: ☆: Safety check by government (reported) | : Implemented (monitored by government as necessary) | : Under construction | : Field work started | : Field work not started yet

Current Status of Countermeasures (2)

Red frame: progressed countermeasures from the previous version, ☆: already reported to the government

V



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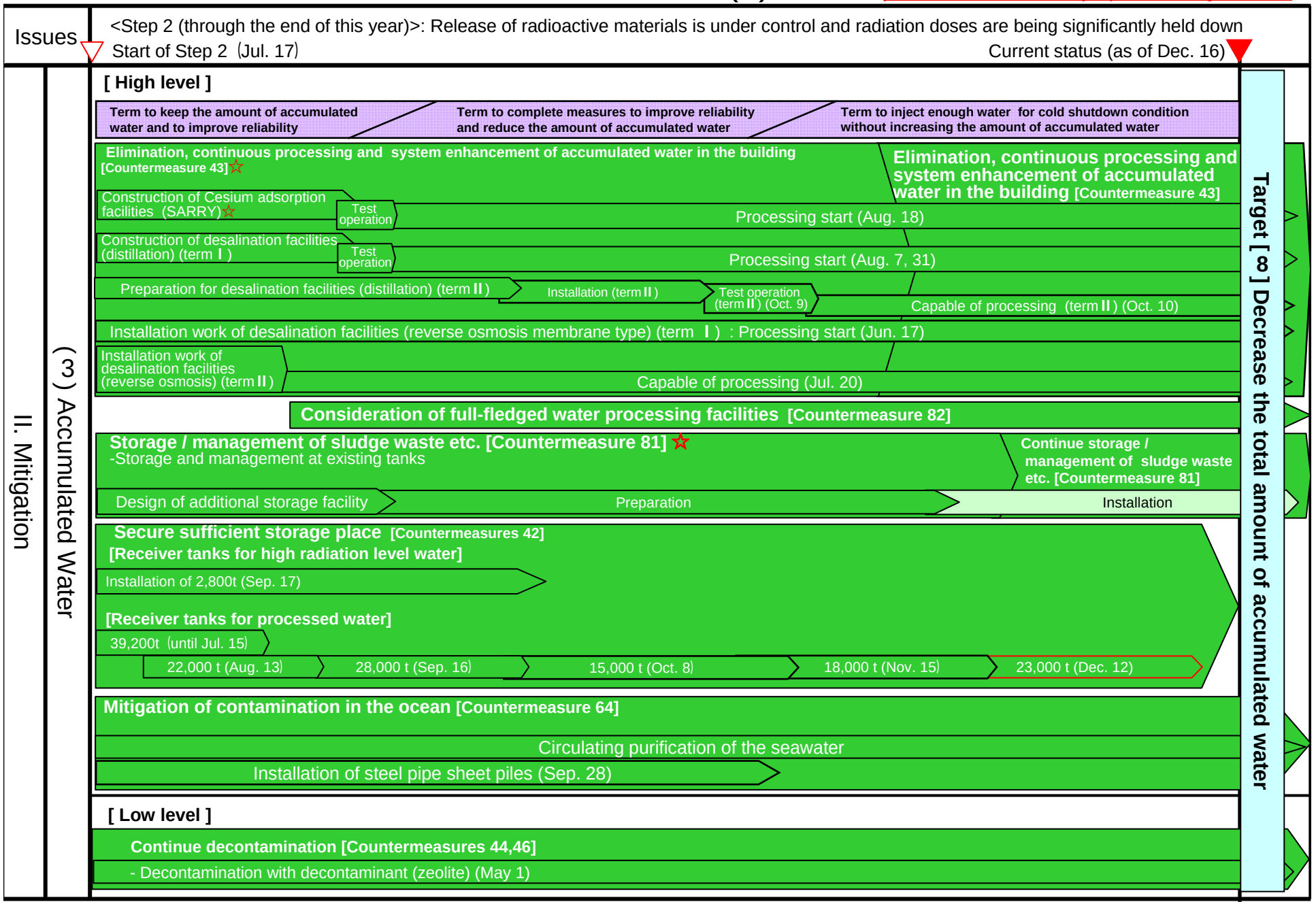
Current Status of Countermeasures (3)

Red frame: progressed countermeasures from the previous version, ☆: already reported to the government



Legend : Implemented (monitored by government as necessary) ☆: Safety check by government (reported) : Under construction : Field work started : Field work not started yet

Current Status of Countermeasures (4)

Red colored letter: newly added countermeasures, Red frame: progressed countermeasures from the previous version, ☆: already reported to the government

Issues

<Step 2 (through the end of this year)>: Release of radioactive materials is under control and radiation doses is being significantly held down

Start of Step 2 (Jul. 17) — Current status (as of Dec. 16)

II. Mitigation

(4) Groundwater

Implementation of preventions against expansion of groundwater contamination [Countermeasure 67]
- Restoration of sub-drainage pumps with expansion of storage / processing facilities

Design of ground water shielding wall [Countermeasure 68]

→ **Start establishment of ground water shielding wall [Countermeasure 83]** (Oct. 28)

(5) Atmosphere / Soil

Confirmation of solidification of inhibitor [Countermeasure 52]

Removal / management of debris [Countermeasures 53, 87]
- -Collected debris (Volume of approx. 29,000 m³, including approx. 6,000 m³ stored in approx. 900 containers (as of Dec.16))
- -Management of collected debris etc. in storage areas

Spraying treated water, which meets the guideline in the bathing area in the NPS to prevent radioactive dust from scattering (Oct. 7)

Installation of reactor building cover (Unit 1) [Countermeasures 54,55] ☆ - Completed (Oct. 28)

Removal of debris at the upper parts of reactor buildings (Units 3&4) [Countermeasure 84]
- Started debris removal at the upper parts of reactor buildings (Unit3: Sep. 10, Unit4: Sep. 21)

Preparation for Unit 3 (Removal of debris on the ground, maintenance of road for crane etc,) → Debris removal at the upper part of reactor building

Preparation for Unit 4 (Removal of debris on the ground, maintenance of road for crane etc,) → Debris removal at the upper part of reactor building

Consideration of reactor building container [Countermeasure 50]

Installation of PCV gas control system [Countermeasure 86] — Unit 1: Completed (scheduled for Dec. 15), Unit 2: Completed (Oct. 28), Unit 3: Started construction (Sep. 30)

→ **Target [1] Mitigation of ocean contamination**

→ **Target [2] Prevent scattering of radioactive materials**

III. Monitoring / Decontamination

(6) Measurement, Reduction and Disclosure

Continue to assess current release of radioactive materials from PCVs [Countermeasures 60,61]

- The current release rates (Cesium) from PCVs of Units 1 to 3 were assessed based on the airborne radioactivity concentration (dust concentration) at the upper parts of the reactor buildings, etc.
  - The current total release rate from Units 1-3 based on the assessment this time is estimated at approx. 0.06 billion Bq/h at the maximum which is approx. 1/13,000,000 of that at the time of the accident.
  - The radiation exposure per year at the site boundaries is assessed at approx. 0.1 mSv / year at the maximum based on the aforementioned release rate (The target is 1 mSv / year. Excluding the effect of the radioactive materials already released up until now).

Implementation of monitoring in cooperation with the government, prefectures, municipalities and TEPCO [Countermeasure 62]

Consideration / start of full-fledged decontamination [Countermeasure 63]
- Detailed monitoring has begun at the area where the government shall implement decontamination based on the "Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials" (Nov. 7). –"Decontamination model project at the Restricted Area or the Deliberate Evacuation Area, etc." has begun (Nov. 8).
- Basic policy based on the "Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials" was decided in cabinet (Nov. 11).

→ **Target [3] Sufficiently reduce radiation dose**

Legend: : Implemented (monitored by government as necessary) ☆: Safety check by government (reported) : Under construction : Field work started : Field work not started yet

Current Status of Countermeasures (5)

Red colored letter: newly added countermeasures, Red frame: progressed countermeasures from the previous version, ☆: already reported to the government

Issues

<Step 2 (through the end of this year) Release of radioactive materials is under control and radiation doses are being significantly held down

Start of Step 2 (Jul. 17)

Current status (as of Dec. 16)

IV. Countermeasures against aftershocks, etc

(7) Tsunami, reinforcement, etc

(Unit 4) Installation of supporting structure under the bottom of the fuel pool [Countermeasure 26] ☆ (Jul. 30)

Consideration of reinforcement work of each Unit [Countermeasure 71]
- Evaluation of seismic resistance has been completed (Aug.26) ☆

Continue various countermeasures for radiation shielding [Countermeasure 73]

Target [1] Mitigation of disasters

V. Environment improvement

(8) Living / working Environment

Continuation and enhancement of improvement of workers' living / working environment [Countermeasure 75]
- Accommodations for approx. 1,600 people have been prepared. Approx. 1,200 people have already moved in (as of Nov. 1)
-20 on-site rest stations have been established (approx. 4,750m^2 in size with a capacity to accommodate approx. 1,600 people) (as of Nov. 1)

Target [18] Enhancement of environment improvement

(9) Radiation control /Medical care

Continuous improvement of radiation control [Countermeasure 78]
- Reinforcement of radiation control by NISA
- Expansion of whole-body counters, implementation of monthly internal exposure measurement ☆
- Automated recording of personal radiation dose, written notification of exposure dose ☆, introduction of workers' certificates with photos ☆
- Consideration of long-term healthcare such as enhancement of safety training for workers and establishing database etc.

Continuous reinforcement of medical system [Countermeasure 80]
- Install new emergency medical facility, establish organization with resident specialists (on call 24 hours a day), speedy transportation of patients
- Intensive preventive measures against heat stroke ☆ (trainings for new workers), countermeasures for mental health, conducting medical examination, prevention and mitigation of flu
- Establish industrial hygiene system such as preventive healthcare

Target [20] Enhancement of healthcare

(10) Staff Training / personnel allocation

Systematic staff training and personnel allocation [Countermeasure 85]
- Promote human resources training in conjunction with the government and TEPCO

Target [21] Exhaustive radiation dose control

Legend: : Implemented (monitored by government as necessary) ☆: Safety check by government (reported) : Under construction : Field work started : Field work not started yet