(Provisional Translation) # Measures for Mid-term Risk Reduction at TEPCO's Fukushima Daiichi NPS (as of March 2022)

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Nuclear Regulation Authority Japan

Areas for Risk Reduction	Major Measures (Measures for 10 years from now)
Liquid Radioactive Material	【Conditions to be realized】Treat all the liquid radioactive material including those remaining in tanks ・Progress the treatment of stagnant water containing α nuclides in buildings and maintain the buildings as drainage completed area except for reactor buildings. ・Decrease rainwater and groundwater flowing into buildings to prevent the increase of stagnant water in buildings and complete the treatment of all stagnant water. ・Decrease water in S/C of Unit 1 and 3 to the level at which the water will not leak out of the buildings
Spent Fuel	【Conditions to be realized】Store all spent fuels in dry storage casks ・Complete removing all fuels from spent fuel pools of each Unit ・Expand dry storage cask area and secure the storage for all the spent fuels together with the capacity of common pool ・Transfer fuels stored in common pool, into dry storage casks as early as possible
Solid Radioactive Material	【Conditions to be realized】Stabilize high dose waste by processing such as dehydration ・Removal of high-dose zeolite sandbags in Process Main Building and sludge from Decontamination Facility, and treatment to prevent scattering or leakage ・Dehydration of slurry stored inside HIC (High Integrity Container) 【Conditions to be realized】Store and manage the waste appropriately depending on classification by radioactivity concentration and characteristics ・Classify the materials generated from decommissioning process, e.g. dismantle of buildings, by radioactivity concentration and characteristics, and store and manage them properly ・Store and manage spent Cesium adsorption vessel stably inside facilities ・Proceed with volume reduction and incineration of solid waste such as rubble to reduce the amount of solid waste and dissolve temporary storage outside 【Conditions to be realized】Install analytical facility and strengthen analytical capacity to advance the decommissioning process ・Install comprehensive analytical facility which can analyze wide variety and large amount of radioactive materials, and install analytical facility which is necessary to understand the characteristics of debris ・Evaluate the needs of radioactive material analysis and ensure the staffs and their ability to conduct it certainly 【Conditions to be realized】Store fuel debris stably ・Take safety measures in removing fuel debris and store debris in stable state
Countermeasures for External Events	・Seal outer wall of buildings and restrain inflow of groundwater into buildings significantly ・Repair damaged parts such as building roof to prevent rainwater inflow ・Take measures against deterioration and damage of building structures, etc.
Important Areas to Progress Decommissioning	・Reinforce organizational structure to progress risk reduction swiftly, and strengthen quality management ・Reduce radiation doses by removal of high-dose radiation sources such as lower part of Exhaust stack of Unit 1 and 2 or shielding against them, and take measures for suppressing dust scattering during operation inside R/B ・Discharge the ALPS treated water into the sea according to the plan ・Consider the impact of the contamination beneath the shield plugs to each decommissioning work

Measures for Mid-term Risk Reduction at TEPCO's Fukushima Daiichi NPS（Main Goals）

Area / Fiscal Year	Liquid Radioactive Material	Spent Fuel	Solid Radioactive Material	Countermeasures for External Events	Important Areas to Progress Decommissioning
2022	Approach toward stopping water injection to reactor Approach to decrease the water level in S/C of Unit 1 and 3 Determine the treatment method of untreated water in tanks	Start fuel removal from Unit 6 Provide shielding in Unit2 R/B Operating Floor and suppress dust scattering (to be completed in FY2023)	Start operation of analytical facility "Laboratory-1" Install volume reduction treatment facility Develop an analysis plan (include facility and human resources) Investigate inside Unit 1 PCV Retrieve fuel debris from Unit 2 experimentally, investigate inside PCV and analyze debris Start installation of crane for large waste storage facility (Cs adsorption vessel) Start installation of ALPS slurry (HIC) stabilization facility	Widen the paving area around buildings【against rainwater】(to be completed in FY2023) Install seismograph in Unit 1 and 2	Remove high-dose SGTS pipes in lower part of exhaust stack of Unit 1 and 2 Consider the impact of the contamination beneath the shield plugs to each decommissioning work Improve workplace environment continuously Reinforce quality management structure of Decommissioning Project Reduction of exposure under high-dose environment
2023	Start treatment of untreated water in tanks Half the amount and treat stagnant water in R/B		Start removal of Zeolite etc. in Process Main Building, etc. Start removing Sludge from Decontamination Facility Start operation of solid waste storage facility 10（First half of 2023FY） Safety measures for stepwise expansion of retrieval of fuel debris inside Unit 2 Install large waste storage facility (Cs adsorption vessel)		Take measures to suppress dust scattering from buildings, etc. Start the ALPS treated water discharge into the sea
2024		Install Unit 1 R/B cover Start fuel removal from Unit 5	Install ALPS slurry (HIC) stabilization facility	Establish the evaluation method to check the soundness of Buildings	
Further Goals 2025 ～ 2033	Dry up Process Main Building, etc. Treat all stagnant water in R/B	Expand dry storage cask area to install additional dry casks Fuel removal from Unit 1 and 2 Fuel removal from spent fuel pool of all units	Install analytical facility "Laboratory-2" and other fuel debris analytical facility Dissolve outside storage of rubbles Store retrieved fuel debris in stable state Control waste in safer and more stable state Install comprehensive analytical facility	Seal outer wall of buildings【against groundwater】	

Countermeasures for Risks which would have an effect on the human and the environment

Countermeasures for Risks which effect on offsite is relatively small, but still need attention

Measures for Mid-term Risk Reduction at TEPCO's Fukushima Daiichi NPS（Other Tasks）

◯Liquid Radioactive Material		Timing
To be conducted	Transfer ALPS slurry stored inside HIC to new HIC	Within FY2023
	※Transfer 45 units of HIC, whose accumulated absorbed dose exceeded the limit(5,000 kGy) by the end of January 2022	Within FY2022
Timing has not been decided	Remove underground cisterns	
	Treatment of sludge etc. remaining in dried up buildings	

◯Spent Fuel		Timing
To be conducted	Begin to remove spent control rods	Within FY2022

◯Solid Radioactive Material		Timing
To be conducted	Dissolve the temporary storage areas	Within FY2022

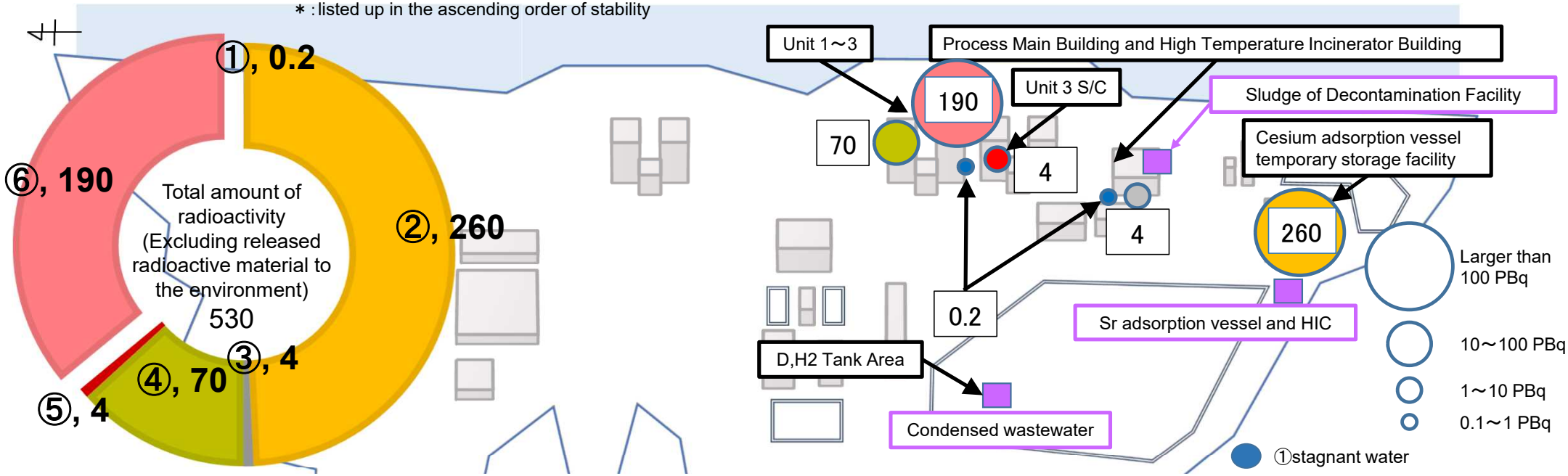
◯Countermeasures for external events		Timing
To be conducted	Restrain the inflow of rainwater into radioactive waste treatment buildings of Unit 1 and 2	Within FY2022
	Expansion works of D drainage【measures against heavy rains】	Within FY2022
	Install tide embankment against Nihon-trench Tsunami	Within FY2023

◯Important issues to progress decommissioning		Timing
To be continued	Survey the contamination situation inside the reactor buildings, etc. (nuclide analysis, etc.)	
	Understand the properties and characteristics of the cooling water after cooling the reactors down (nuclide analysis, etc.)	
	Analyze the flow of contaminated water inside the reactor buildings, etc.	
	Directly observe inside the containment vessel and pressure vessel ※Observation inside the pressure vessel is to be conducted afterwards	
	Reduce concentration of radioactive materials in the water of drainages	
To be conducted	Investigation of other systems of Unit 3 and the other Units considering the case of accumulation of hydrogen in RHR system of Unit 3	Within FY2022
	Investigate contamination on the bottom and around Unit 1and 2 common stack	Within FY2023
To be considered the necessity	Consider methods to improve the environment of ground level 2.5m, such as removal and decontamination of soil, purification of ground water, etc.	

Location of radioactive materials (Mainly Cs-137) (except for spent fuels) (unit；PBq)

	type*	characteristic	Explanation for each type
①	Stagnant water	Liquid	Highly contaminated water stagnating in 1～3 Reactor Buildings, Process Main Building and High Temperature Incinerator Building
⑤	Unit 3 S/C	Liquid	Highly contaminated water in the Unit 3 S/C
③	Zeolite	Liquid/Solid	Precipitation from treatment of contaminated water soon after the accident/Sandbag containing zeolite installed before contaminated water started to be transferred
②	Cs Adsorption vessel	Solid (including water)	Metal container containing adsorbent inside（used vessels are stored temporarily outdoor）
④	Shield plug	Solid（detail is unknown）	Shield cover above PCV of Unit 1～3（large amount of Cs-137 released in the accident is trapped between first and second layer of shield plug）
⑥	Cs-137 not included in any of category ①～⑤ neither Cs-137 released to the environment（fuel debris, etc.）	Solid（detail is unknown）	Fuel debris remaining in 1～3 reactor building, etc.

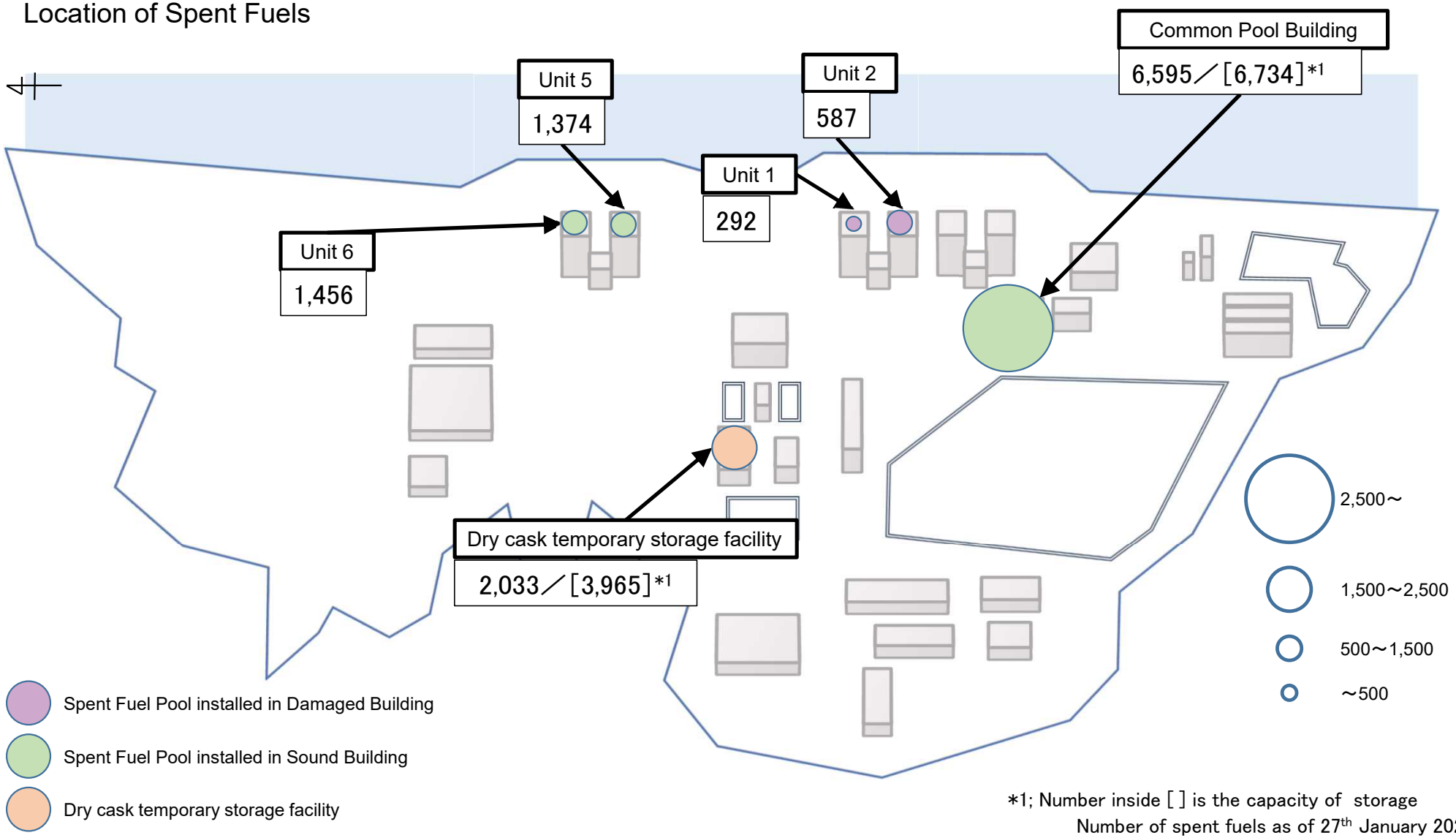
＊：listed up in the ascending order of stability



- Radioactivity decay is considered for 11 years (as of11th March 2022) from the accident, while some data are calculated without considering decay.
- Total amount of Cs-137 in Unit 1～3 is estimated using「JAEA-DATA／Code2012-2018」considering decay
- Amount of Cs-137 released to the environment is estimated, referring to「Additional report of the Japanese government to IAEA－about the TEPCO Fukushima Daiichi Nuclear Power Station accident －(the second report)」and considering decay
- This material shows the location of Cs-137 except for spent fuels, and for this estimation, the data shown by TEPCO, etc. is used.
- Looking into the secondary waste of water treatment which contains more Sr-90 rather than Cs-137, it is estimated that contained amount of Sr-90 is 44 PBq in HIC, 15PBq in adsorption vessel of Sr, 2PBq in Sludge of decontamination facility, and 1PBq in condensed wastewater.
- Since fraction is rounded up or down. sum of ①～⑥ doesn't match the total amount.

S/C：Suppression Chamber, HIC：High Integrity Container, Sr adsorption vessel：metal container that contains Sr adsorbents,
Sludge of Decontamination Facility：sludge and zeolite sandbags generated from decontamination facility,
condensed wastewater：wastewater and slurry generated after condensed saline was treated by evaporative concentration facility

Location of Spent Fuels



*1; Number inside [ ] is the capacity of storage
Number of spent fuels as of 27th January 2022

List of Major Inventory (Cs-137)

Existing in Buildings or adsorption vessels

Location	Inventory (PBq)
Stagnant water (①)	0.2
Unit 3 S/C (⑤)	4
Zeolite (③)	4
Cs adsorption vessel (②)	260
Shield plug (④)	70
Cs-137 not included in any of category ①～⑤ neither Cs-137 released to the environment (fuel debris, etc.)	190
Total amount of Cs-137 released to the environment (atmosphere and ocean) in a few weeks after the accident	14
Total amount of Cs-137 from Unit 1～3	540

Spent Fuel

Location	Inventory (PBq)
Unit 1 Spent Fuel Pool	130
Unit 2 Spent Fuel Pool	350
Unit 3 Spent Fuel Pool	0
Unit 4 Spent Fuel Pool	0
Unit 5 Spent Fuel Pool	740
Unit 6 Spent Fuel Pool	780
Spent Fuel Common Pool	3,500
Dry Storage Cask	1,100
Total amount	6,600

- Inventory inside the red frame should be taken measures in high priority
- Each value above has a large error, because they are evaluated indirectly such as from the balance of the amount of Cs-137 in stagnant water, extrapolation from single data, estimation from the average amount of Cs-137 inside 1 spent fuel assembly, etc.
- Amount of radioactive material in S/C is listed only for Unit 3, because its analytical data is available.
- Since fraction is rounded up or down, sum of each inventory doesn't match the total amount.