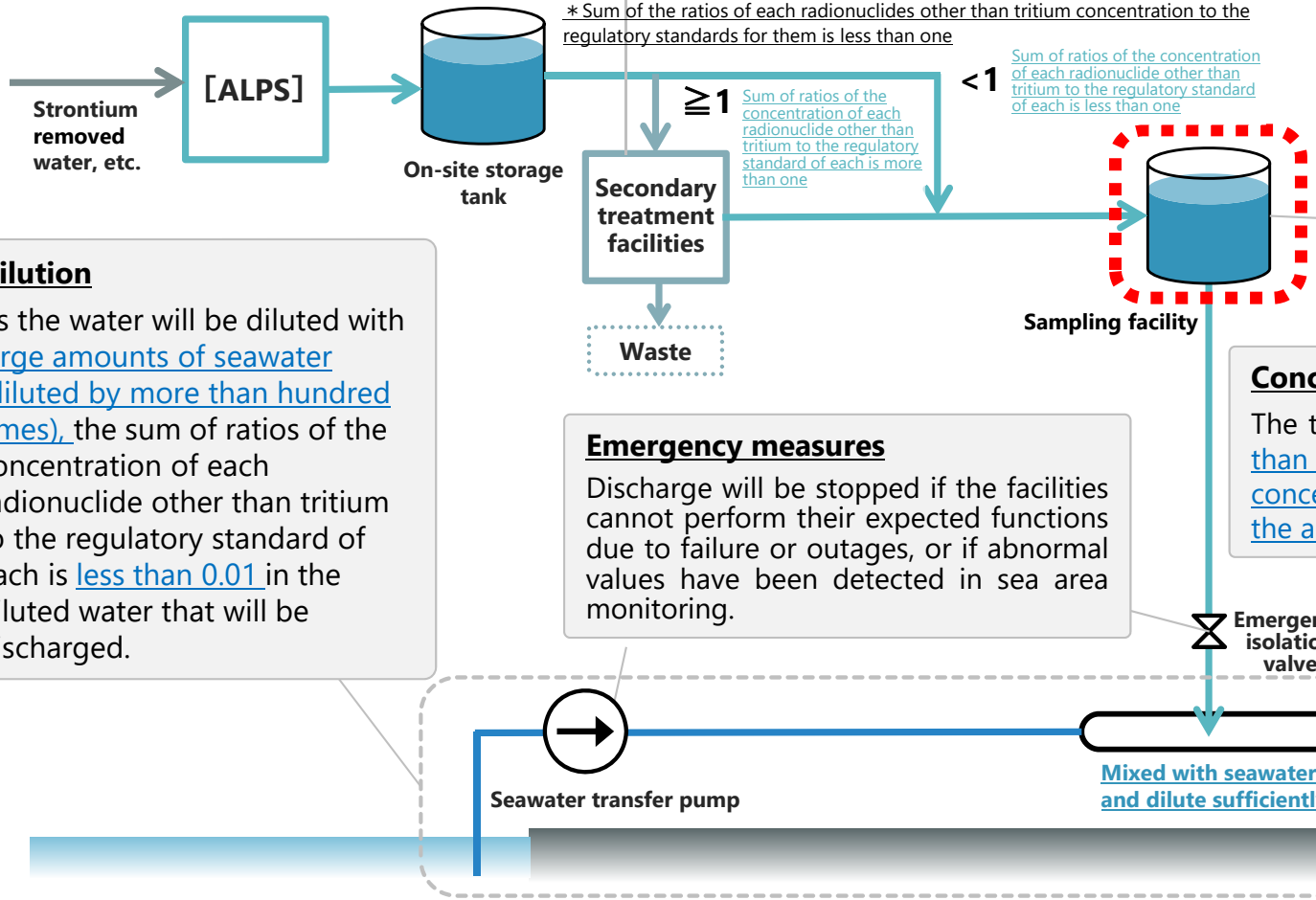
# Facilities Necessary to Perform Thorough Measurements/Assessments of Radiation Concentrations

May 27, 2021

Tokyo Electric Power Company Holdings, Inc.

# 1 .Design and Operation of Necessary Facilities

Various preparations are underway for the plans for design and operation of facilities needed for sea discharge, keeping compliance with laws such as the Nuclear Reactor Regulation Law. While listening to the opinions of parties concerned, we will receive required approval from the Nuclear Regulation Authority for the plans.
This is a report on how facilities necessary for measuring and assessing radiation concentration will be designed and used.




**Secondary treatment**
Secondary treatment will be conducted as necessary to ensure that the level of radioactive materials excluding tritium is lower* than the regulatory standard value for safety

**Site use plan**

In order to discharge ALPS treated water in a stable manner and move forward with the construction of facilities required for decommissioning, we are examining sampling facility, substitute tank construction and the dismantling of storage tanks that will become empty.

**Analysis of ALPS treated water**

TEPCO will publish the concentration of tritium, 62 nuclides (nuclides subject to removal by ALPS), and carbon-14 in ALPS treated water and the results of assessments as well as the 3rd parties' measurement and assessment results.

**Dilution**

As the water will be diluted with large amounts of seawater (diluted by more than hundred times), the sum of ratios of the concentration of each radionuclide other than tritium to the regulatory standard of each is less than 0.01 in the diluted water that will be discharged.

**Emergency measures**

Discharge will be stopped if the facilities cannot perform their expected functions due to failure or outages, or if abnormal values have been detected in sea area monitoring.

**Concentration of tritium inside discharged water**

The tritium concentration of the discharged water will be less than 1500 Bq/L. This will be assessed based on the tritium concentration in the ALPS treated water before discharge and the amount of water it was diluted by.

**Amount discharged**

In the near term, discharge amounts will be within the threshold of 22 trillion Bq/year which is the target discharge management value for Fukushima Daiichi before the accident. This amount will be reviewed as needed based on progress made in decommissioning.

# 2. Design approach

1. An important task when discharging ALPS treated water into the sea is to properly measure/assess the radiation concentration of tritium, 62 nuclides (nuclides subject to removal by ALPS), and carbon-14 prior to dilution and discharge in order to confirm that the sum of ratios of legally required concentrations for the 62 nuclides (nuclides subject to removal by ALPS) and carbon-14 is less than 1 (including assessment by third parties).

2. When engaging in this task the following two conditions must be considered.
   - Considerable time is required to measure/assess the radiation concentration of some nuclides
   - The storage capacity for ALPS treated water, etc. will be reduced in a planned manner in order to move forward with decommissioning

3. In order to achieve above conditions, three sets of tank groups will be prepared. Each tank group has three roles (receiving, measurement/assessment, and discharge) and has a capacity of approximately 10,000m$^3$ (Total: approximately 30,000m$^3$.)

# 3. Approach to tank capacity (1/2)

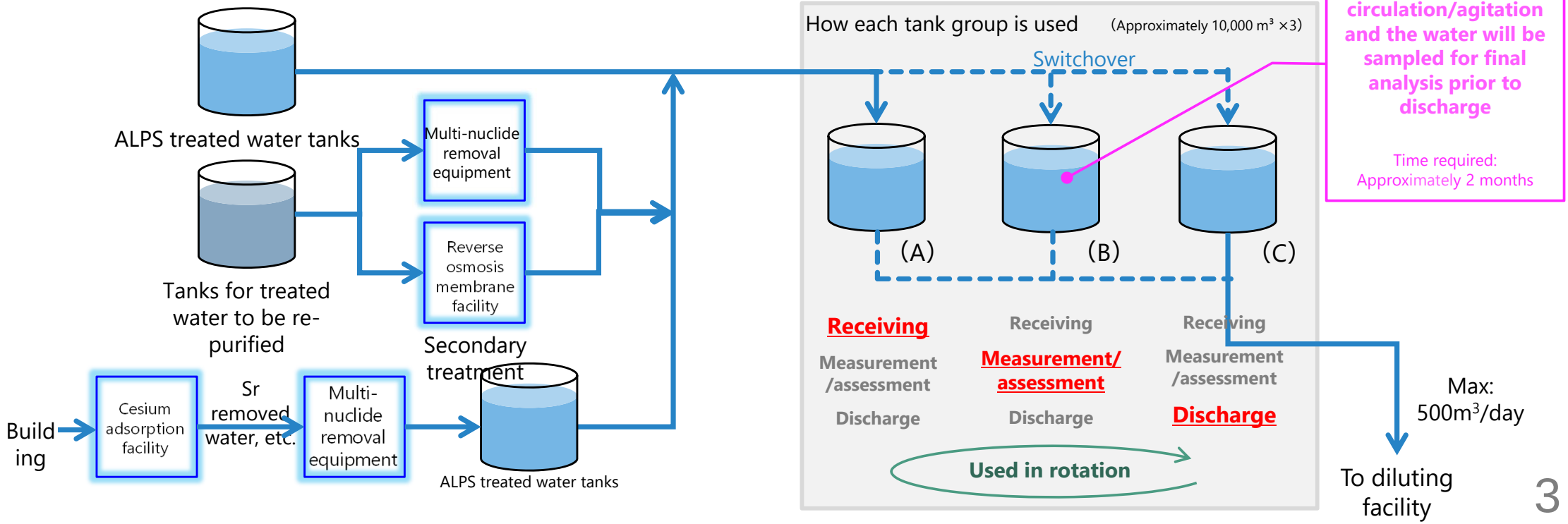
Prior to dilution and discharge, the measured/assessed radiation concentrations of tritium, the 62 nuclides (nuclides subject to removal by ALPS) and carbon-14 in ALPS treated water will be published and also checked by third parties.

Some of these 62 nuclides take time to be measured/assessed. Secondary treatment performance confirmation tests* showed that some nuclides **required approximately two months for the measurement/assessment****. That makes us to secure **approximately 10,000m³** of storage capacity (equal to the amount of water generated for two months (150m³/day)).

**Three sets of tank groups** will be secured in order to make the measurement/assessment process smoothly. **Each tank group, with a capacity of approximately 10,000m³** and **with three roles (receiving, measurement/assessment and discharge) will be used on a rotating basis.** (Total capacity for all three set of tank groups: Approximately 30,000m³)

Furthermore, **the water in each tank group will be homogenized by circulation/agitation and the water will be sampled for final analysis prior to discharge**. Therefore, the tank groups for the measurement/assessment differ from tanks for storing ALPS treated water, etc. in that they must be renovated and equipped with pumps for circulating and agitating the water, valves, piping for sampling materials, power sources, and control units.

* Secondary treatment performance confirmation tests (September - December 2020): https://www4.tepco.co.jp/en/decommission/progress/watertreatment/images/201224.pdf
** Methods for shortening this time are being deliberated.



# 3. Approach to tank capacity (2/2)

As in the page 3, **three sets of tank groups, each with three roles (receiving, measurement/assessment and discharge) and with a capacity of approximately 10,000m$^3$ (Total for all three sets of tank groups: Approximately 30,000m$^3$) will be used on a rotating basis (it will take six months for a rotation cycle of receiving, measurement/assessment and discharge)**. The amount of water to be generated daily is assumed to be 150m$^3$/day to ensure that the amount of ALPS treated water, etc. being stored does not increase any more.

- The amount of contaminated water being generated will be reduced to lower than 100m$^3$/day during 2025.
- Methods for shortening the time required to measure/assess the 62 nuclides will be examined in order to shorten the rotation cycle.

We will continue to engage in efforts above, in order to reduce the amount of ALPS treated water, etc. that has already accumulated.

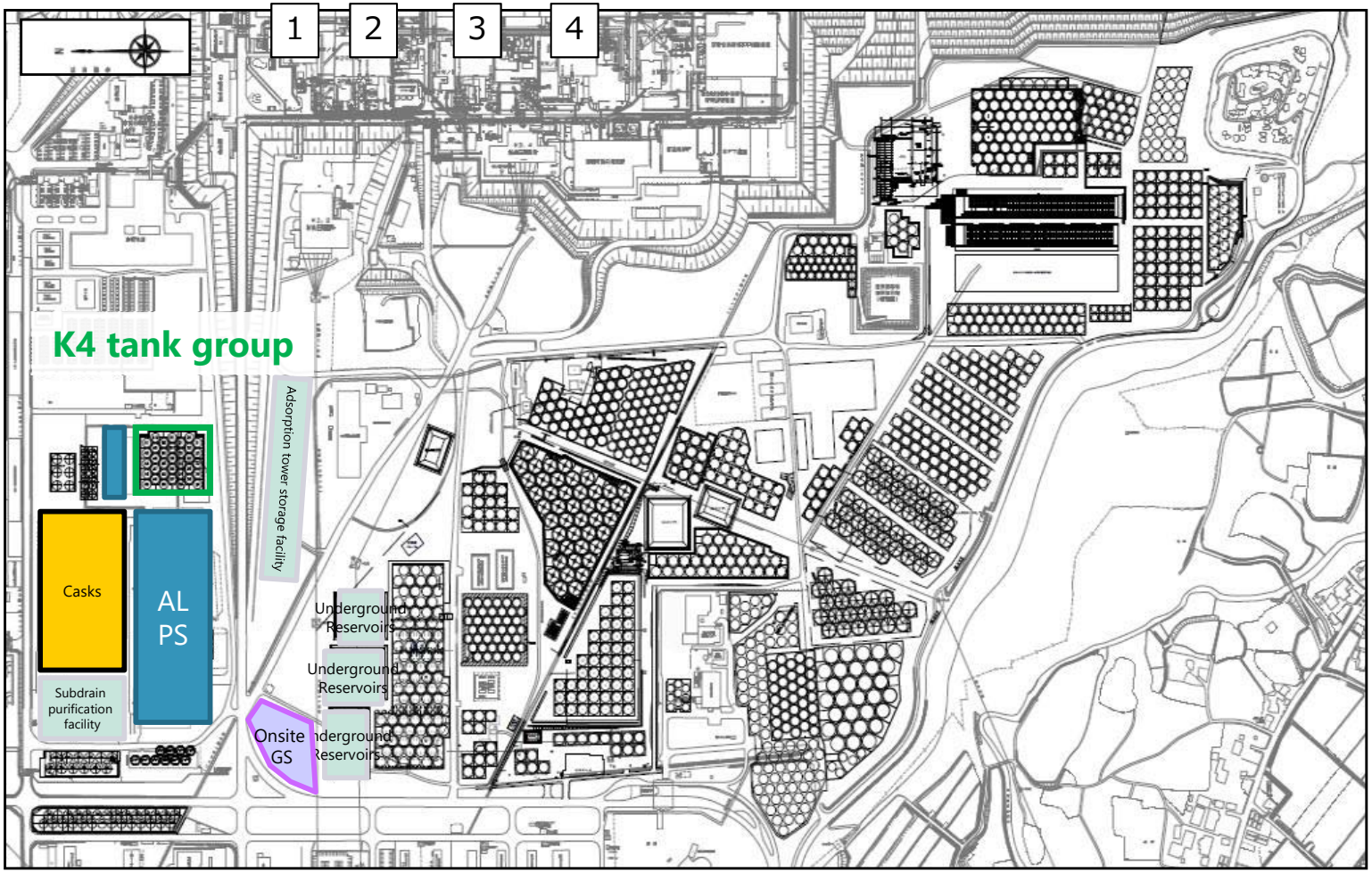
Furthermore, we understand that there is a need to develop a wider perspective on operations, considering the fact including i) we need to consider certain operating rates for possible breakdowns and regular inspections of necessary facility for sea discharge, ii) the amount of stored ALPS treated water, etc. will be reduced in a planned manner. The following points will also be examined.

- Shorten the rotation cycle to four months, as only one month each is needed for the “receiving” and “discharge” process. This will lead to the necessity to improve the route of piping between tanks and increased complexity of ALPS treated water, etc. transfer procedures.
- Make the reduction rate of ALPS treated water, etc. stored in tanks larger, by discharging ALPS treated water with low tritium concentrations first. Detailed simulation will be needed for examination.

# 4. Approach to tank placement

In order to transfer ALPS treated water to diluting facility, and also to prepare in any case that the sum of ratios of legally required concentrations, with the exception of tritium, equals, or exceeds, 1 and such water needs to be returned to ALPS for retreatment, **tanks for this purpose need to be built near ALPS**. However, since there is no space to newly construct tanks with a capacity of approximately 30,000m$^3$ near ALPS, **K4 tank groups are considered to use for this purpose**.

In the vicinity of ALPS, the concentrations of a total of 64 nuclides* in K4 tank groups have already been measured/analyzed, and we have found that the sum of the ratios of concentrations required by law, with the exception of tritium in the **K4 tank group** is less than 1. (* tritium, 62 nuclides (nuclides subject to removal by ALPS) and carbon-14)



# 5. Repurposing the K4 tank group (1/2)

1. As previously mentioned, tanks will be prepared to thoroughly measure/assess radiation concentrations and engage in sea discharge in a stable manner. The K4 tank group is being examined for this purpose.

2. Therefore, the intended purpose of the K4 tank group (approximately 30,000$m^3$) will be changed from the long-term storage of ALPS treated water, etc., to part of discharge facility to thoroughly measure/assess of radiation concentrations. Accordingly, the K4 tank group, which will be part of discharge facility, will differ from tanks used to store ALPS treated water, etc. and will be renovated and equipped with pumps for circulating and agitating the water, valves, piping for sampling materials, power sources, and control units (detailed renovation plans and schedules are currently being examined). Substitute tanks with the same capacity as the K4 tank group will be needed temporality to accommodate the water drained from the K4 tank group.

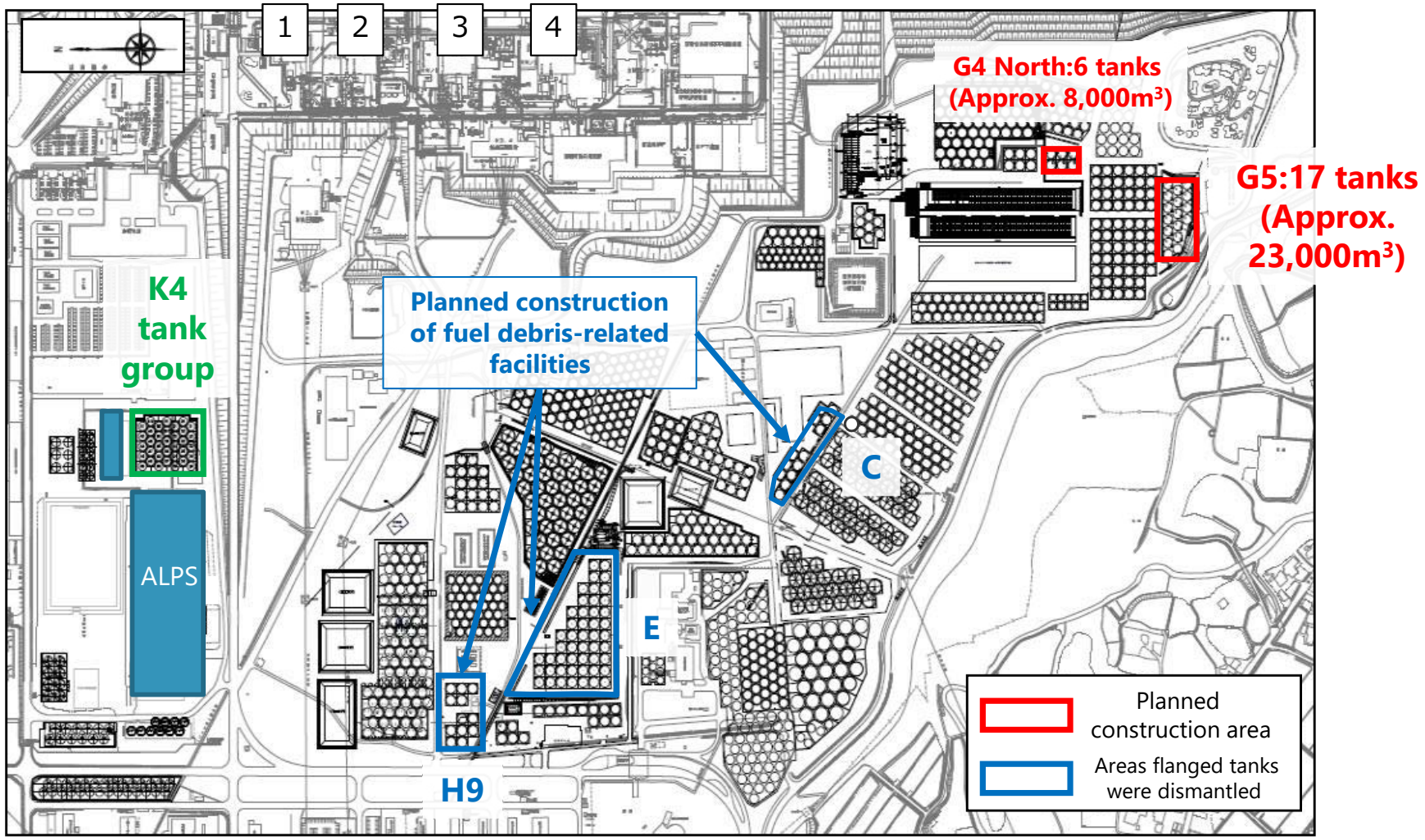
3. These substitute tanks to be built in conjunction with the repurposing of the K4 tank group will be used after the commencement of discharge into the sea as well, to make up for the decrease in the ALPS treated water, etc. storage capacity (approximately 30,000$m^3$; total planned capacity is approximately 1.37 million $m^3$).

# 5. Repurposing the K4 tank group (2/2)

4. The area where flanged tanks were dismantled is a potential candidate for the construction location of the tanks with the same capacity as K4 tank group.

5. In consideration of the importance of using the K4 tank group to thoroughly measure/assess radiation concentrations, the plan to use the G4 North and G5 areas for the storage of materials/equipment and equipment used for the accident response shall be abandoned, and these area will instead be used to construct the substitute tanks to hold the water drained from the K4 tank group (**slide 8**). Materials/equipment shall be temporarily placed on the road and equipment used for the accident response will be left in its current location, until the dismantling of welded tanks proceeds.

# 6. Areas for tank construction (K4 tank group substitute)

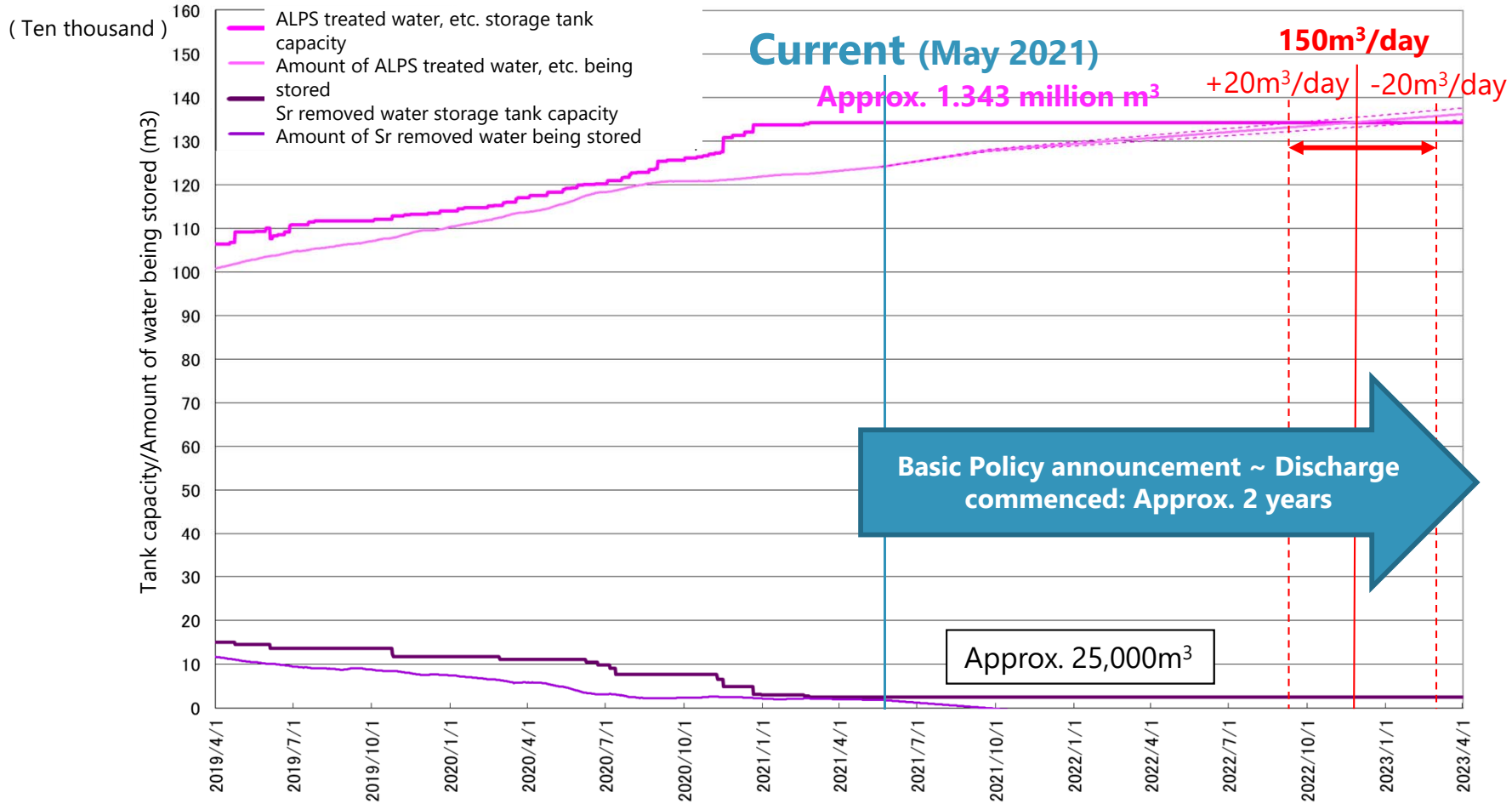


# 7． ALPS treated water, etc. stored status

If 150m³ of contaminated water is generated each day, the amount of ALPS treated water, etc. in storage **will reach approximately 1.34 million m³ by around November 2022,** seeing that the volume of stored ALPS treated water, etc. as of May 20, 2021 is approximately 1.26 million m³.

By building substitute tanks to store water drained from K4 tanks and by putting them into use by November 2022, we can continue to store approximately 1.37 million m³ of ALPS treated water, as originally planned.

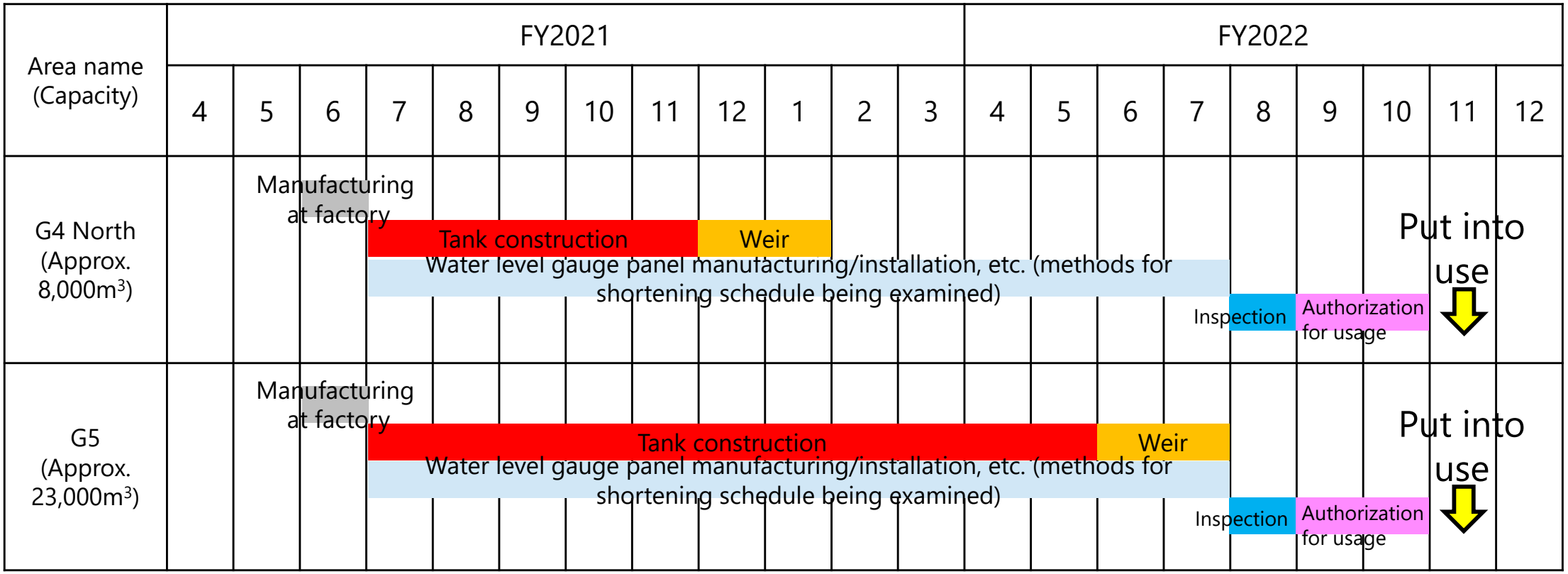
Comparison of total tank capacity with the anticipated amount of water to be stored



# 8．G4 North, G5 area tank construction schedule

The completion of tank construction in the G4 North and G5 area is planned for the end of October 2022 to ensure that ALPS treated water, etc. can be received in around November 2022

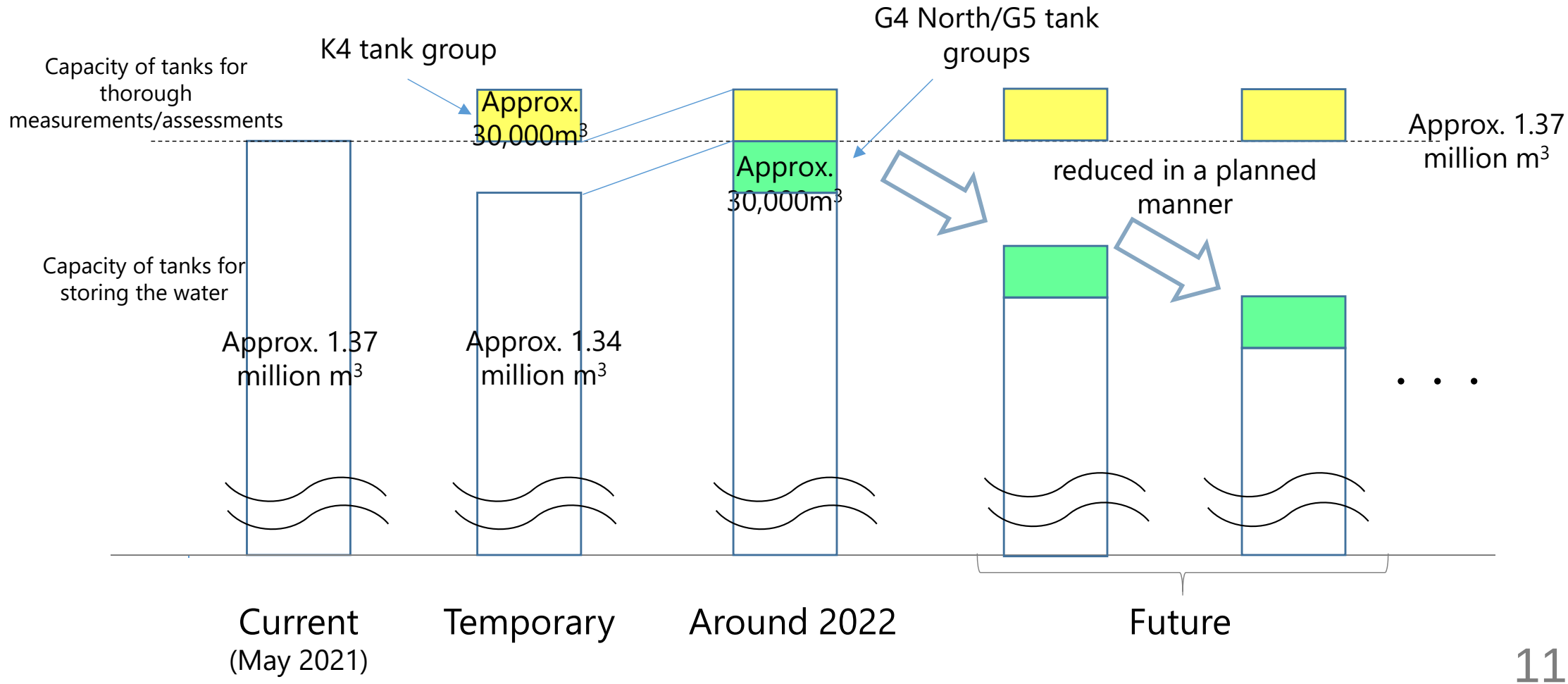
Schedule (tentative)



# 9. Tank area usage outlook

We plan to use the tank area for the construction of facilities required for decommissioning in the future, and the construction of most of these facilities will be commenced during the late 2020's. **So as not to hinder decommissioning works**, we need to discharge ALPS treated water in a planned manner through sea discharge and to **dismantle the tanks by the time that construction of facilities commences**.

If tanks with a capacity of approximately 30,000m³ (The same as the capacity of K4 tank group) will be built in the area where flanged tanks were dismantled*, an equal number of tanks will need to be dismantled during the early 2020s. (* Red colored areas in page 8)

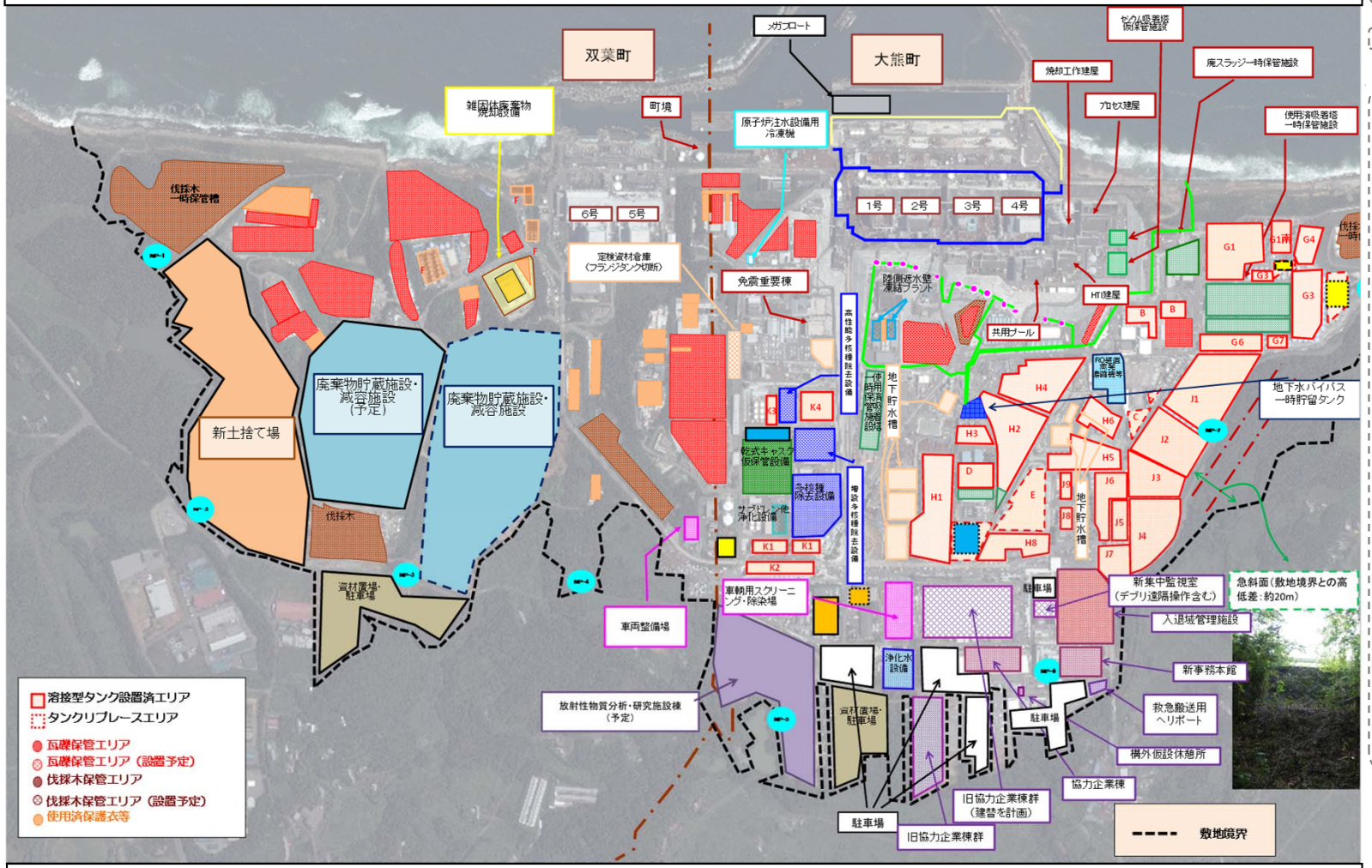


# 【Reference】 Site usage

◇There is limited space at the Fukushima Daiichi Nuclear Power Station for the construction of tanks in addition to what is already planned.
◇The following facilities need to be constructed in order to move forward with decommissioning and remove spent fuel and fuel debris,
which pose a higher risk than ALPS treated water.

- Storage facilities for removed spent fuel
- Storage facilities for removed fuel debris
- Maintenance facilities required for fuel debris removal
- Fuel debris removal training facilities
- Facilities required to store waste generated in the future
- Facilities to analyze various samples
- Fuel debris/radioactive waste-related research facilities
- Waste recycling facilities
- Facilities required to ensure that workers can engage in work safely, etc.

◇ALPS treated water must be disposed of, and tanks dismantled, in order to secure space on site for facilities that will ensure that decommissioning continues safely and smoothly.




【Additional information】
○This diagram was created based upon current site usage and current usage plans.
○Plans will be revised as needed if facilities need to be constructed/dismantled in accordance with the progress of future decommissioning work.

Around FY2021
- equipment used for the accident response storage
- Storage location for equipment/materials related to secondary waste generated from water treatment
- Subdrain water collection facility

Around FY2022
- Removal equipment maintenance facilities, trial removal equipment storage
- Dray cask temporary storage facility (For Units 1~6 SFP)

Around FY2023
- Bioassay facility

After FY2024
- General analysis facility
- Waste recycling facility
- Fuel debris storage facility #1
- Highly radioactive SFP internals storage facility
- Fuel debris storage facility #2
- Removal equipment maintenance facility
- Fuel debris removal training facility
- Fuel debris/waste transfer system
- Storage facility storage containers
- Fuel debris storage facility #3
- Dry cask temporary storage facility (for common pool)
- Volume reduction facility for highly radioactive waste
- Highly radioactive solid waste storage facility
- Fuel debris storage facility (#4 and onward)

※ In addition to facilities required into the 2030s in conjunction with decommissioning

Note 1: Time period when construction needs to commence is indicated. Tank dismantling will take one to two years.
Note 2: A site approximately two times the size will be needed temporarily if you consider the need for a work yard during construction.
Note 3: Facility area is only an estimate and may change in accordance with the progress of future deliberations and new knowledge, etc.