ALPS treated water

(Measures for Decommissioning of Fukushima Daiichi Nuclear Power Station)

This material is provided in response to questions and concerns received to date regarding ALPS treated water.

December, 2020

Ministry of Economy, Trade and Industry

1. Why should treated water be discharged? P1-

1-i. Why is discharge of ALPS treated water needed ?

◇At FDNPS, water used for cooling fuel debris (contaminated water) has been treated, and the **treated water is stored in tanks on site.**

- ✓ **Storage tanks are predicted to reach full capacity around summer of 2022.**

◇**Decommissioning of FDNPS is essential for reconstruction of Fukushima**.

- ✓ To secure reconstruction work such as retrieving fuel debris and storing waste temporarily, **installation of additional tanks on the site cannot be continued at this rate**.

◇Until the end of decommissioning, tanks are needed to be removed.

- ✓ Therefore, the issue on disposal of treated water cannot be left forever.

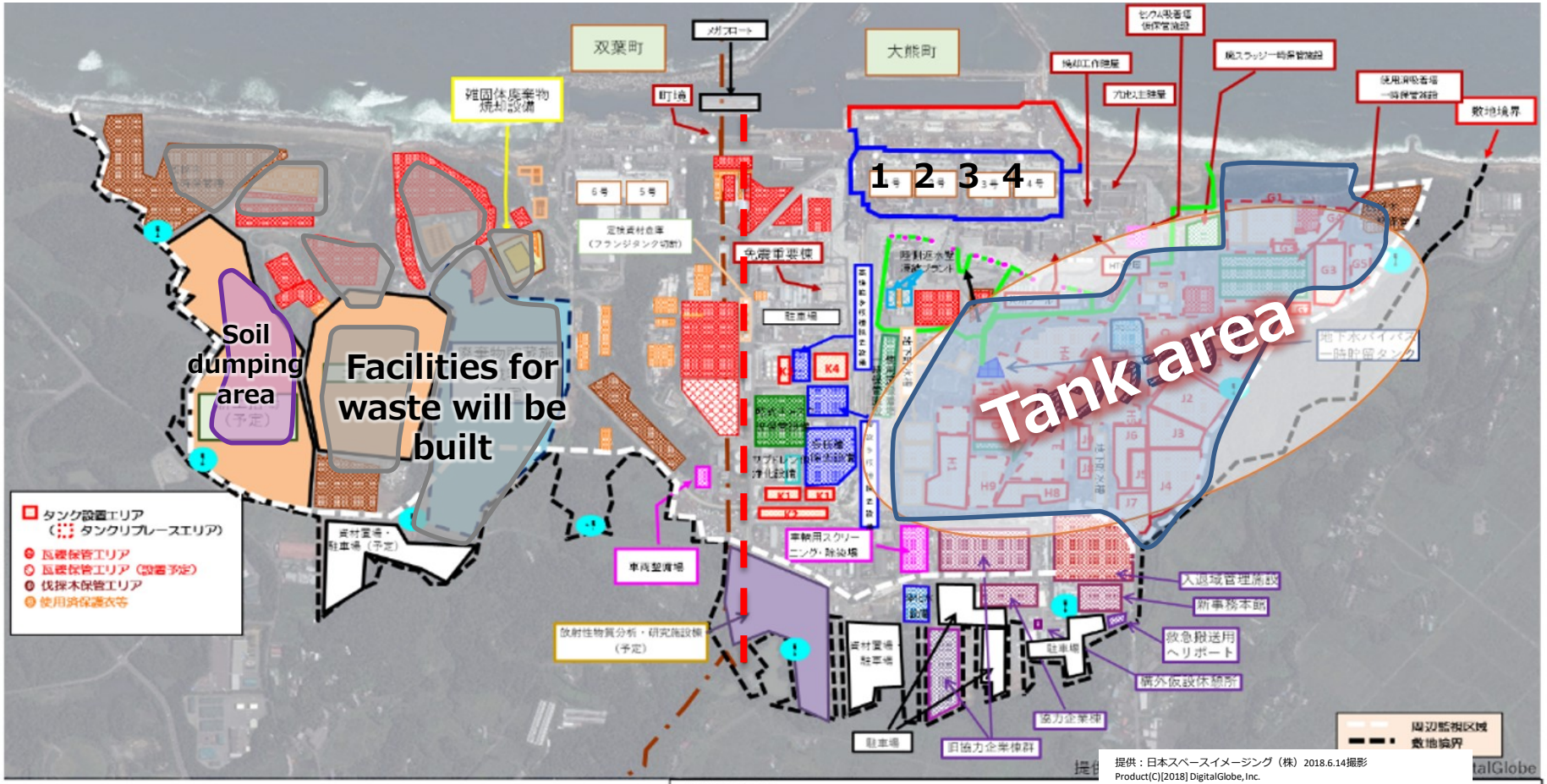
Tank groups storing treated water

Status of treated water in FDNPS (As of September 17, 2020)	
Tank storage volume	About 1.23 million ㎥
Tank capacity (at the end of 2020)	About 1.37million ㎥
Increase of treated water	About 50,000 to 60,000 ㎥/year

(Ref.) Site Layout of Fukushima Daiichi

◇ Tanks as well as a variety of **facilities are needed to be built**.

- ✓ (e.g.) **temporary storage facilities for spent fuel and fuel debris**
- ✓ analytical facilities for various samples

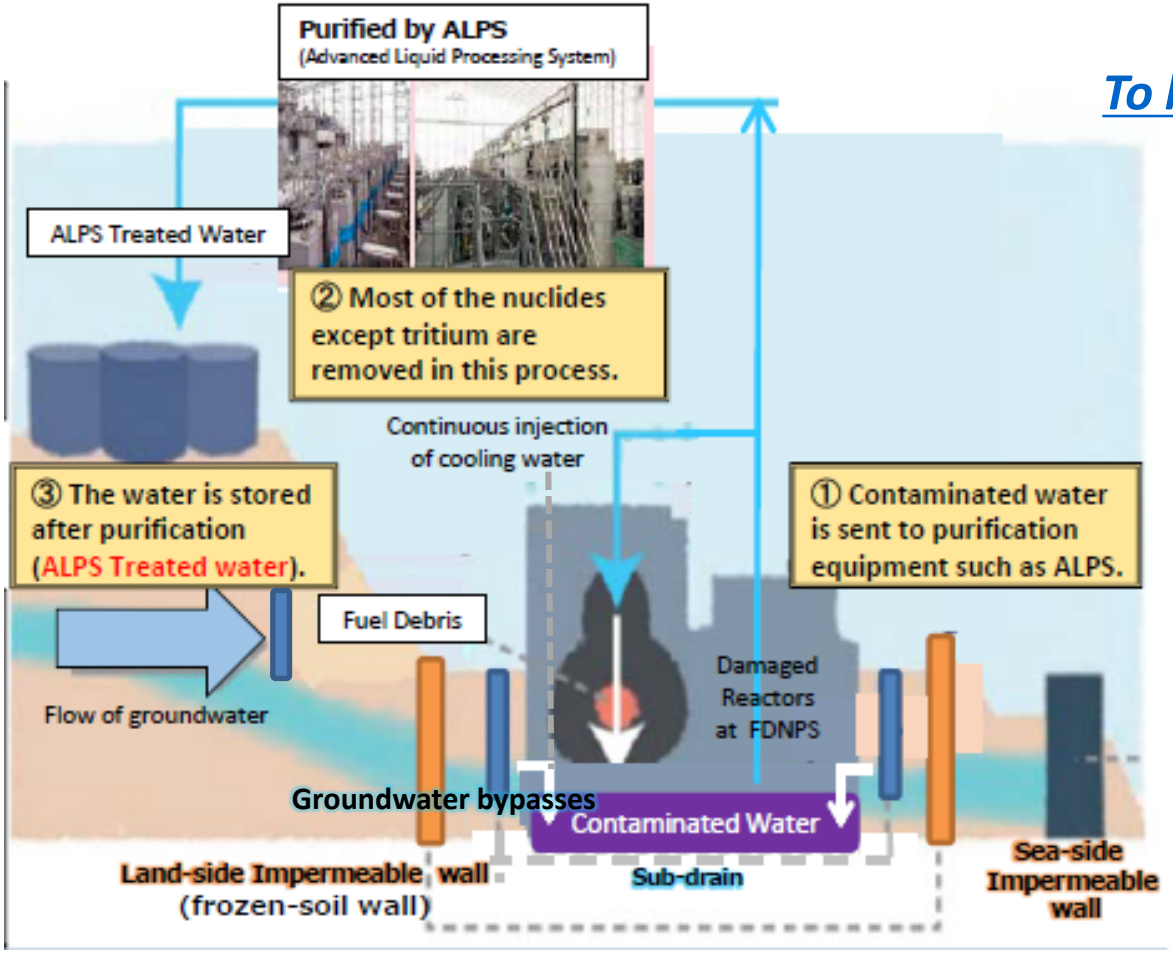


【補足事項】
○本配置図は，現状（2017年9月）の敷地の利用状況と現段階の利用計画に基づき作成。
○また、将来の廃炉作業の進捗に応じて、施設の設置・廃止が必要となることから、適宜計画の見直しを実施。

1-ii. What is “contaminated water” and “treated water” ?

◇The water for cooling fuel debris gets contaminated and stagnates in the buildings.

- ✓ **The level of groundwater outside is controlled to be higher** than that of water inside the buildings, to prevent the contaminated water from flowing out.
- ✓ As a result, **groundwater keeps flowing into the buildings** and **contaminated water keeps generated in the buildings** every day.



To know more about “treated water”, please see PP12-13

- ***Sub-drains*** *are wells located near the buildings, from which groundwater is pumped up to reduce the level of groundwater.*
- ***Frozen-soil walls*** *surround the buildings to redirect the groundwater’s flow.*

(Ref.) Decrease in volume of treated water stored per day

◇**The frequency of an additional tank installation has decreased to “once a week”, compared to “every two days” around 2014.**

✓ The volume of treated water stored in tanks par day has been decreased through countermeasures such as installation of frozen-soil walls and sub-drains (see the details in P3).

*(Ref.) rate of contaminated water generation** (par day)*

*** rate of contaminated water generation has a correlation to that of treated water stored in tanks par day.*

around 540m³/day *(in May 2014, before measures were taken)* → ***around 180m³/day*** *(in FY2019)*

1-iii. Why are two options suggested by the expert committee feasible?

◇**"1) Vapor release" and "2) discharge into the sea"** are suggested by the committee.

- ✓ **Both option 1) and 2) are recommended to be realistic**, because of the **precedents and track records** for them.
- ✓ **"2) Discharge into the sea" can be implemented more reliably**, considering the ease of discharge facilities operation and proper monitoring methods.

◇**The International Atomic Energy Agency (IAEA)** acknowledged that the options suggested by expert committee is **"based on a sound scientific and technical basis of analysis".**

Comparison of "vapor release" and "discharge into the sea"

1) Vapor release	2) Discharge into the sea
● A precedent in case of accident at NPP overseas * Vapor is also released from reactors in normal operations at the time of ventilation. ● Difficult to predict how the released vapor is diffused into the air and to establish proper monitoring method	● Precedents exist world-wide ● Relatively easy to predict how discharged water is diffused in the ocean and easy to examine proper monitoring method

(Ref.) What are the IAEA's findings on the disposal options of the ALPS treated water ?

■ Statements made by IAEA Director General Rafael Grossi in February 2020:

"The IAEA considers the disposal options (discharge into the sea and vapor release) as technically feasible and in line with international practice."

"Once a decision is taken on the way forward, the IAEA would be ready to assist in its implementation, for example in radiation monitoring. It could help provide reassurance to the public – in Japan and elsewhere – that any releases of water would be within international standards."

■ IAEA Review Report on the ALPS Subcommittee Report etc. (2 April 2020)

- The two options selected (discharge into the sea and vapor release) are technically feasible and would allow the timeline objective to be achieved. *(Acknowledgement 4)*
- The IAEA Review Team also notes that the ALPS treated water will be further purified as necessary to meet the regulatory standards for discharge before dilution. *(Acknowledgement 4)*
- The IAEA Review Team is not aware of a solution currently available for the separation of tritium commensurate with the concentration and the volume of ALPS treated water. *(Acknowledgement 3)*
- The IAEA Review Team holds the view that a decision on the disposition path for the stored ALPS treated water must be taken urgently, considering safety aspects and engaging all stakeholders. *(Advisory Point 1)*

Photo Credit: Dean Calma / IAEA

■ Fukushima Status Update at IAEA website https://www.iaea.org/newscenter/focus/fukushima/status-update

(Ref.) Basic approach for handling of ALPS treated water (TEPCO)

◇TEPCO published the “draft study responding to the ‘subcommittee report on handling of ALPS treated water’” on March 24, 2020.

Regarding the two disposal methods (vapor release and discharge into the sea), which were classified as "practical options both of which have precedents in current practice" in the Subcommittee report, TEPCO has compiled the current conceptual study, so that it can serve as a reference for the general public and the parties concerned.

- The annual tritium release rate will be set by referencing those of the existing nuclear facilities and making effective use of the period of 30 to 40 years required for decommissioning, instead of releasing a large amount at once.
- The amount of radioactive materials other than tritium will be reduced as much as possible (implementation of secondary treatment).
- The tritium concentration will be lowered as much as possible.
- Disposal will be stopped immediately if an abnormality is detected.
- Monitoring will be enhanced by increase in sampling points and frequencies and the results will be published promptly.

https://www.tepco.co.jp/en/decommission/progress/watertreatment/images/200324.pdf

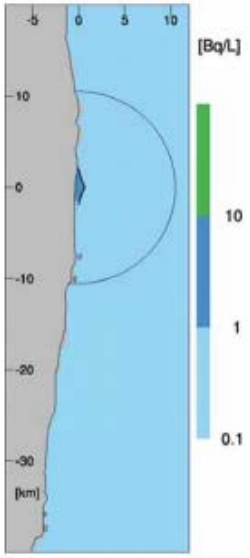
(Ref.) Simulation of diffusion (TEPCO's draft study report March 24, 2020)

Vapor release

- There is no diffusion simulation model available for vapor.
  - i. Simple evaluation is difficult: It requires consideration of morphological changes in vapor due to weather conditions, advection caused by groundwater or rivers, re-release, and transpiration from plants
  - ii. Knowledge of continuous simulation is not available

Discharge into the sea

22 Trillion Becquerel / year

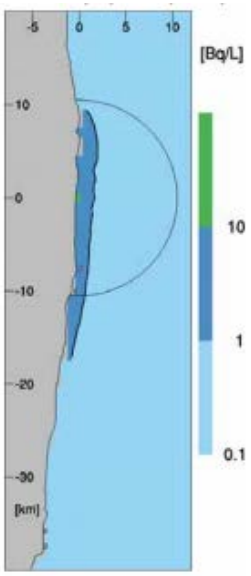


* The same amount as the operational standard value set before the accident

Area above 1 Bq/L

- To about 1.5 km to the north
- To about 1.5 km to the south
- To about 0.7 km to offshore

100 Trillion Becquerel / year



Area above 1 Bq/L

- To about 10 km to the north
- To about 20 km to the south
- To about 2 km to offshore

- Areas where the tritium concentration exceeds its background level (0,1 to 1 Becquerel/Litre) are limited around the Fukushima Daiichi NPS
- The level of tritium concentration around the NPS is far lower than that set by WHO drinking water guideline (10,000 Bq/L)

(Ref.) Examination at expert committees (2013 to 2020)

2014年 2015年 2016年 2017年 2018年 2019年 2020年

Tritiated Water Taskforce
From Dec. 2013 to June 2016 (15 meetings)

- Compiled basic information on tritium
- Evaluated 5 options from technical aspects
- Heard experience from overseas expert

1. Dec. 2013; Issues to be examined under the Taskforce
2. Jan. 2014; Contaminated water treatment and its status, tritium separation technology, and underground burial
3. Feb. 2014; Environmental dynamics and impact of tritium
4. Feb. 2014; Diffusion in environment
5. March 2014; Experience in overseas
6. March 2014; Experience in overseas
7. April 2014; Experience in overseas
8 April 2014; Issues to be examined further
9. July 2014 Technical feasibility of Options
10. Oct. 2014: Underground burial of tritiated water
11. Jan. 2015: Communication
12. June 2015: Examination of Options
13. Dec 2015: Examination of Options including their conceptual designs
14. April 2016: Evaluations of options, verification test projects of tritium separation, Taskforce report
15 May 2016: Tritiated water taskforce report

Subcommittee on handling ALPS treated water
From Nov. 2016 to Feb. 2020 (17 meetings)

- Examined options comprehensively
  - from the viewpoint of technical aspects and countermeasures for reputational damage
- Held site visit, public explanatory and hearing mtgs

1. Nov. 2016; Tritiated Water Task Force Report
2. Dec. 2016; Hearing from members, operational target for groundwater discharge
3. Feb. 2017; Hearing from a member, Fukushima Prefecture, and Fisheries Agency
4. Apr. 2017; Hearing from experts (Hokkai Gakuen Univ. Prof Hamada, JA Fukushima)
5. June 2017; Hearing from members and York Benimaru Co., Ltd
6. Oct. 2017; Hearing from Litera Japan Corporation
7 Feb. 2018; Strategy and action plan against reputational damage and tritium
8 May 2018; characteristics of tritium, and approach to social influence
9. Jul. 2018; Reputational damage countermeasures and public explanatory and hearing meeting
● Public Expranatory and hearing meeting
10. Oct. 2018; Explanatory and public hearing meetings and treated water characteristics
11 Nov. 2018; Biological impact of tritium, regulatory standards, monitoring, etc.
12 Dec. 2018; Monitoring, etc. and social impact neutralization measures
13. Aug. 2019; WTO Appellate Body's decision, international communications, and disposition path
14. Sep. 2019; Facts concerning continued storage, disposition path, reputational damage measures
15. Nov. 2019; Review of discussion at earlier meetings and issues to be examined further
16/17. Dec. 2019/Jan. 2020; Issues to be examined further, and discussion on the report

1-iv. Is it possible to store or discharge treated water outside of Fukushima Daiichi NPS (FDNPS)?

◇Decommissioning of FDNPS is essential for reconstruction of Fukushima. Every day, **decommissioning measures are taken to reduce risks on the site, while preventing increase in risks at the surrounding areas.**

- ✓ Both to **transfer the treated water to outside the site** and to **store the treated water in tanks outside the site** are the activities which will increase risks outside the site.
- ✓ In addition, it is necessary to obtain understanding from related local governments and local residents, which takes a considerable amount of time.

◇ Regarding offshore release, **to carry the treated water and discharge it from the marine vessel is prohibited by international treaty** (London Convention).

Is it possible to store in intermediate storage facilities*?

◇**The land for the intermediate storage facilities were provided by the landowners for the defined facilities' use only.**

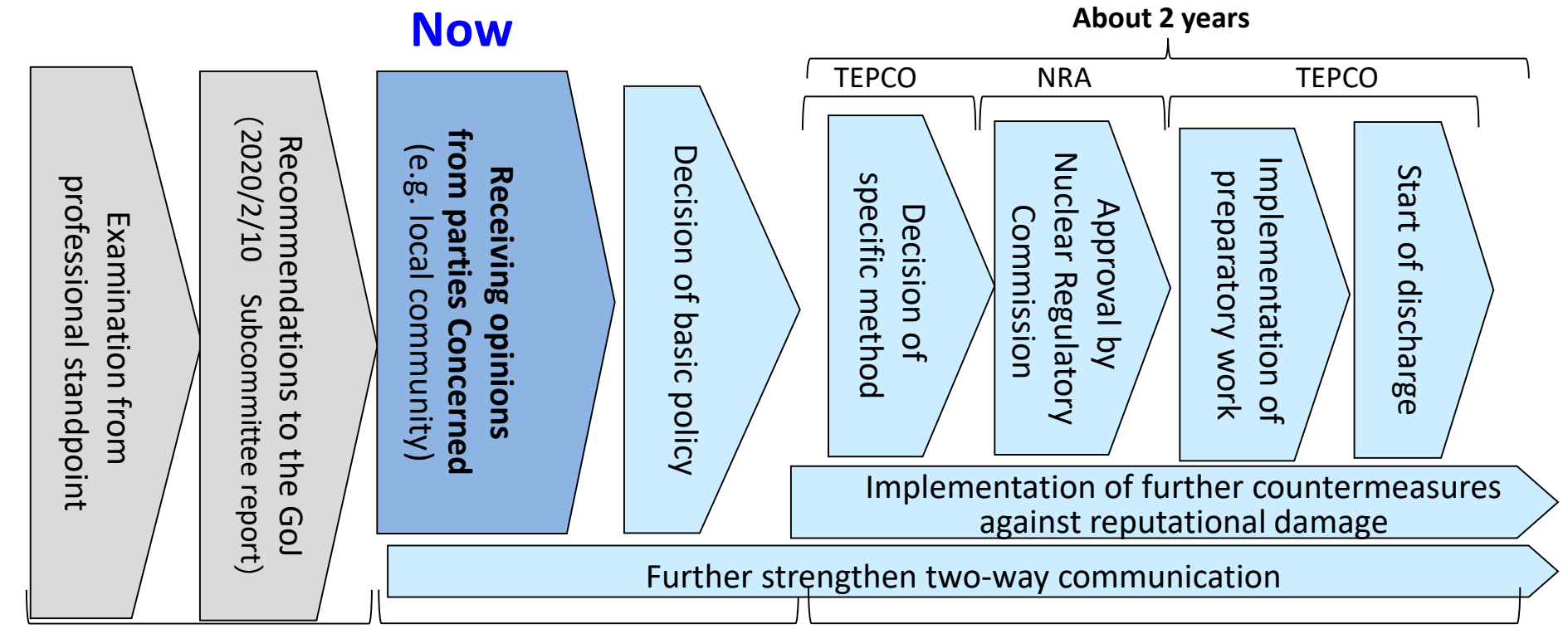
◇Therefore, it is difficult to use for other purposes.

*Intermediate storage facilities are the facilities located at areas adjacent to the FDNPS, in order to temporarily store soil and others which have been collected by decontamination work in Fukushima, and which contain radioactive materials released from the FDNPS at the time of accident.

1-v. What are the steps toward the handling of treated water ?

◇Considering the opinions received, **the GOJ will decide its basic policy including measures against possible reputational damage.**

◇Based on the governmental basic policy, TEPCO will determine the specific method and will obtain an approval from the Nuclear Regulatory Commission, and then will start discharge.



(Ref.) How has the GOJ been providing information to the international community ?

- **Briefing sessions for Diplomatic Missions in Tokyo** have been held 107 times.
- **Technical briefings** on the occasions such as international conventions.
  - ✓ **At WTO/SPS (sanitary and phytosanitary) committee** in November 2020 (online), monitoring results of Japanese foods, treated water management were presented.
  - ✓ **At IAEA General Conference** in Sept. 2020, a **side event by Japan** was held to provide **technical briefing on decontamination and treated water management**.
  - ✓ **At the briefing session and site tour for foreign press**, current situation of FDNPS including treated water management are presented by METI and TEPCO.
- **Reports** on the decommissioning progress and the surrounding environment.

https://www.iaea.org/newscenter/focus/fukushima/status-update

Briefing sessions for Diplomatic Missions in Tokyo (Feb.2020)

Side event at 64th IAEA General Conference (Sep. 2020)

1. Why should treated water be disposed of? P1

2. What is treated water? Is its safety confirmed? P14-

- **i. What is "treated water"?** P15
- **ii. What is tritium ?**
  - A: Characteristics, B: Can tritium be removed ? P16
    - *(Ref.) Biological impact of tritium* *P17*
  - C: How much tritium is discharged in the environment ? P18
- **iii. Does the treated water contain radioactive materials other than tritium ?** P19
- **iv. How much is the radiation impact of treated water release?** P20
- **v. What regulatory standards are applicable to the discharge ?** P21
  - *(Ref.)What is "regulatory standards for discharge" ?* *PP22-23*

3. If it is disposed of, is there possibility of reputational damage? P24-

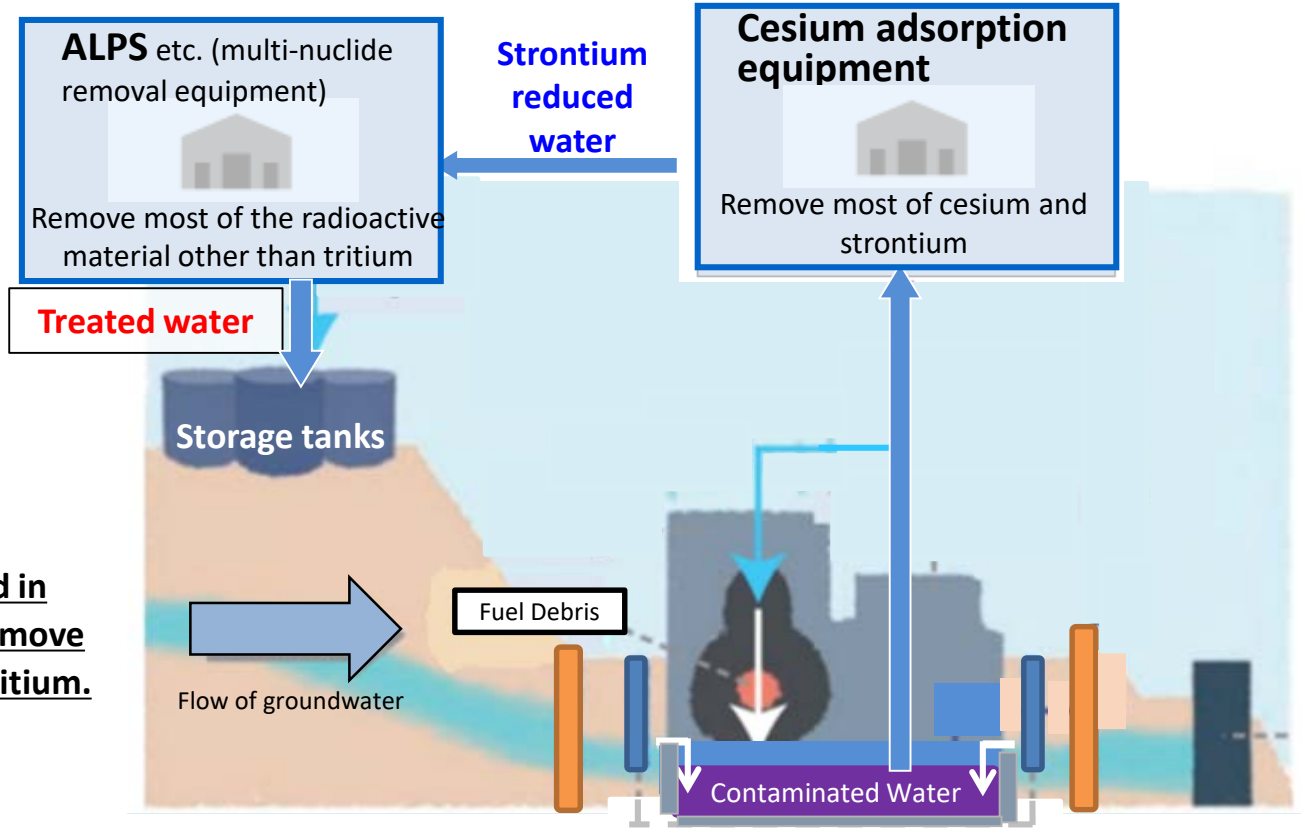
[Information Portal site] PP27-28

2-i. What is “treated water”?

◇**“Contaminated water” and “treated water” are different.**

- ✓ “**Contaminated water**” contains a large amount of radioactive materials, and has been generated in buildings every day since the accident.
- ✓ “**Treated water**” is water in which **most of radionuclides are removed by purification**.

◇However, radioactive material **“tritium” cannot be removed by purification**, and **remains in the treated water**.



* **The treated water will be re-purified in the case of discharge, to further remove radioactive materials other than tritium. (See page19)**

2-ii. What is tritium？ 1) Characteristics

◇Tritium is a relative of hydrogen that **emits weak radiation**.
Tritium exists naturally and is found in rain water, sea water, tap water and inside of human body as a form of tritiated water.

◇Tritium is **taken into the human body** via drinking water and **excreted from the body, and then circulates in nature as the water does**.
It has not been confirmed to be accumulated in humans or specific organisms.

* Tritium concentration for **tap water**: **1 Becquerel/L**
* Amount of Tritium in **human body** : **tens of Becquerel**

What is tritium？ 2) Can tritium be removed ?

◇It is **very difficult to remove tritiated water from water**, as it has the **same properties**.

◇**Experts have concluded** that **there is no tritium separation technology** that is immediately **applicable to the treated water with low concentration and large volume**.

◇**IAEA (International Atomic Energy Agency) is “not aware of a solution currently available** for the separation of tritium commensurate with the concentration and the volume of treated water”.

(Ref.) Biological impact of tritium

◇Animal tests and epidemiologic research to date **have NOT shown "a far greater biological impact from tritium than other radiation or nuclides.**

◇Mouse carcinogenicity experiments showed that even when **mice continue to drink highly concentrated tritiated water** (0.14 bilion becquerels/L), **occurrence probability is about the same as that due to natural cancer occurrence.**

◇**No examples of negative impact attributable to tritium have been commonly seen** among nuclear facilities.

(Ref.) Impact on human health of compound including tritium

● Tritium ingested in human body is excreted by metabolism and will be reduced with time.

◇Tritiated water

・Impact on human health is about **1/300 of that of Potassium 40**
(* Potassium-40 is a natural radionuclide abundant in foods such as vegetables and fruits.)

・Of the tritiated water that enters the body, **5% to 6% is converted into OBT** (Organically Bound Tritium)

◇OBT (Organically Bound Tritium

・ Impact on human health of the OBT is **less than 1/300 of that of cesium 137**

(Ref.) How much tritium is discharged in the environment ?

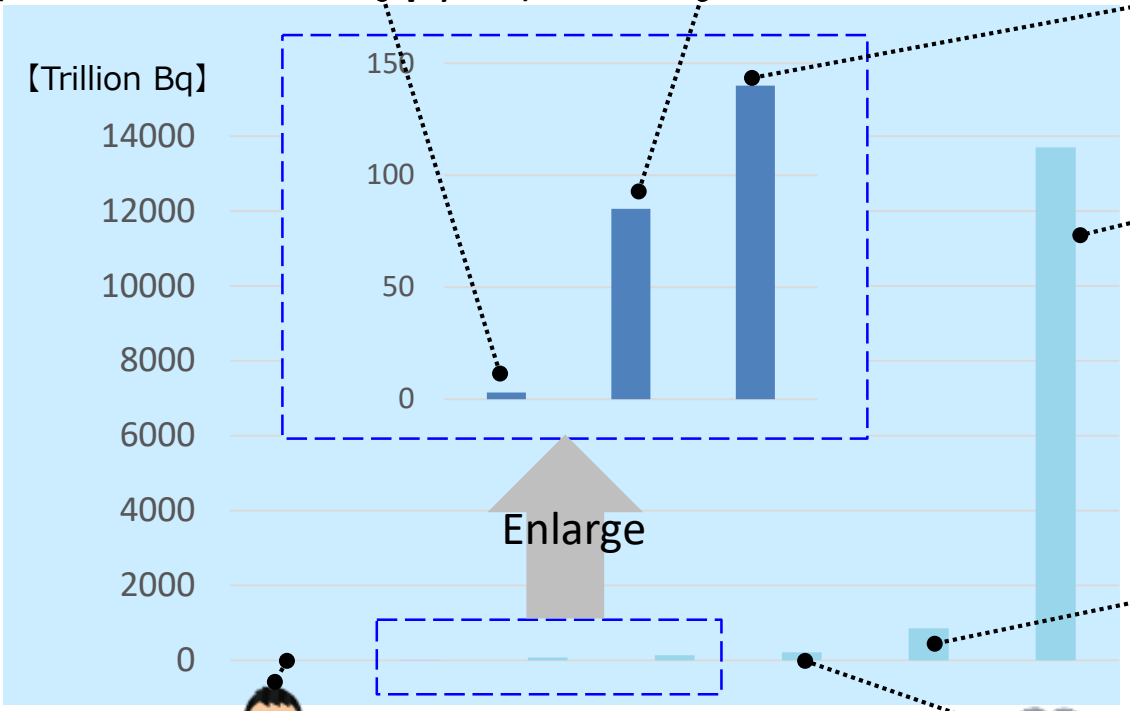
◇**Tritium is discharged from nuclear facilities in and outside Japan, in compliance with the regulatory standards of each country.**

Average amount of Tritium discharged from Boiling Water Reactor type nuclear power plants (NPPs) 【annual】
(less than **2.9 trillion Bq**/year)

Average amount of Tritium discharged from Pressured Water Reactor type NPPs 【annual】
(less than **85 trillion Bq**/year)

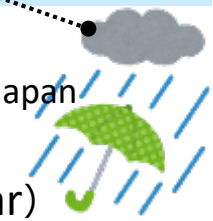
Amount of Tritium discharged from CANDU type NPP 【annual】
(about **140 trillion Bq**/year)

Amount of Tritium discharged from reprocessing plant 【annual】
(less than **13 quadrillion Bq**/year)



Amount of Tritium stored in Fukushima Daiichi NPS
【total】 (about **860 trillion Bq**)

Amount of Tritium in human body 【total】
(**tens of Bq**)



Amount of Tritium in rainwater in Japan 【annual】
(about **220 trillion Bq**/year)

2-iii. Does the treated water contain radioactive materials other than tritium ?

◇**About 70 % of the treated water** stored in tanks **contains radionuclides other than tritium at the concentration which exceeds regulatory standards.**

* In early years, the ALPS treatment has been carried out by **prioritizing the volume of water treatment to quickly reduce the radiation impact to outside the site**. There were also **cross filter permeate troubles and other troubles**.

◇Since FY2020, **re-purification of the treated water will be commenced to meet the regulatory standards other than tritium.**

◇In the case of releasing it to the environment, the **treated water will be sufficiently diluted also to meet the regulatory standard for tritium.**

Status of ALPS treated water (As of August 2020)

1,115,800 m^3

295,000 m^3 (27%)	820,800 m^3 (73%)*

* Including ALPS treated water in reused tanks

27% of the stored water **is below the regulatory standards for discharge** other than tritium.

73% of the total volume of ALPS treated water stored in tanks contains radionuclides other than tritium at the concentration that **exceeds the regulatory standards for discharge. This will be further re-purified to meet the regulatory standards other than tritium**.

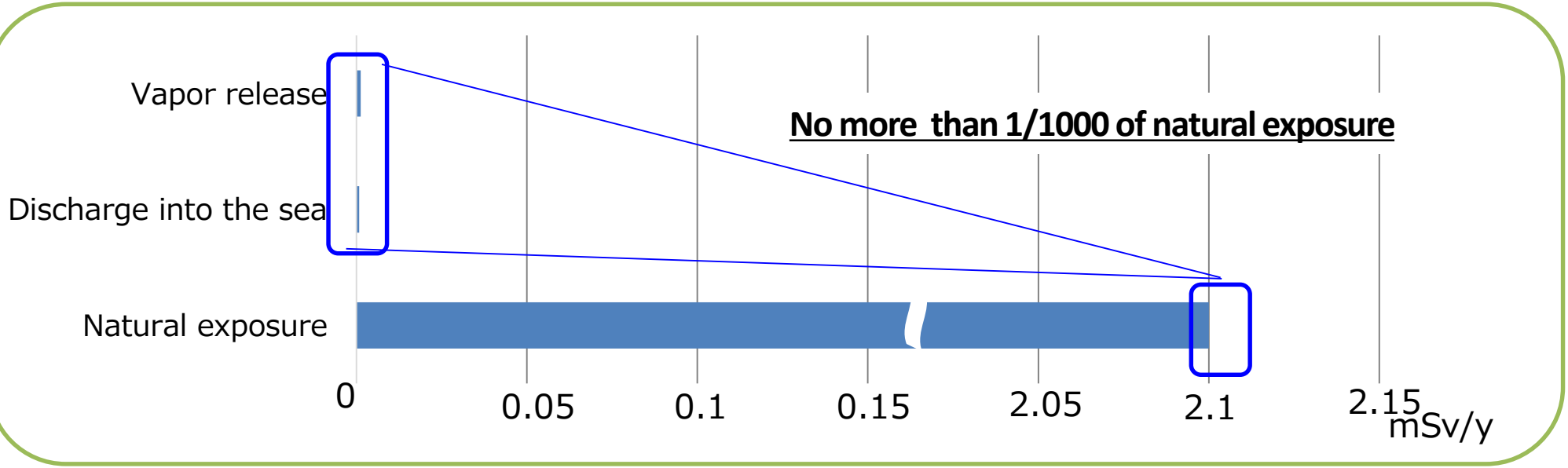
In any case, all ALPS treated water will be sufficiently diluted in the case of discharge to the environment, in order to also meet the standard for tritium.

2-iv. How much is the radiation impact of treated water release?

◇**The impact of the radiation to human health as a result of the discharge is considerably small.**

- ✓ Even if the entire amount of the ALPS treated water containing tritium and other radioactive material were to be disposed of in one year*, the impact would be **no more than 1/1000 of the exposure impact of natural radiation** in Japan.

Comparison of radiation impacts from natural exposure and discharge of whole treated water in one year*



- Based on a UNSCEAR-specified method.
- All volume of the ALPS treated water stored in tanks is discharged in one year, and similar amounts are discharged during following 100 years.
- The treated water contains 860 trillion Bq of tritium and the other radionuclides

2-v. What regulatory standards are applicable to the discharge from Fukushima Daiichi NPS (FDNPS) ?

◇ **Japan's regulatory standards for discharge is set in compliance with the international standards** known as publications of International Commission on Radiological Protection (**ICRP**), keeping additional public radiation dose **not exceeding 1mSv/year.**

◇ **The regulatory standards for tritium discharge** stipulated in **the ordinance of the Reactor Regulation Act** is:

- ✓ **Less than 60,000 Bq/L-water for tritium** discharge into the sea; and
- ✓ **Less than 5 Bq/L-air for tritium** release to the atmosphere.

To know more about "regulatory standards for discharge", please see PP22 - 23

[Ref.] What is “regulatory standards for discharge”? (1)

- Japan’s regulatory standards for discharge is set in compliance with the international standards known as publications of International Commission for Radiological Protection (ICRP), keeping additional public radiation dose not exceeding 1mSv/year.
  (*In the case of Fukushima Daiichi NPS, the dose should not exceed 1mSv/year.)

<Case 1> water which contains one kind of radionuclide

EXAMPLE

Sr-90 (@12Bq/L) < 30 Bq/L

This case meets the standard.

Regulatory standard

“The regulatory standards for discharge” is the limit of concentration* applicable to the discharge of radioactive waste to the environment, which is stipulated in **the ordinance of the Reactor Regulation Act.**

* The concentration should be less than the stipulated limit (Bq/liter-water).

(Ref.) Regulatory standards for discharge in each major radionuclide in Japan (in the case of discharge into the sea)

Nuclide	(Bq/Liter-water)
Tritium (H-3)	60,000
Cesium-137 (Cs-137)	90
Cesium-134 (Cs-134)	60
Cobalt-60 (Co-60)	200
Antimon-125 (Sb-125)	800

Nuclide	(Bq/Liter-water)
Ruthenium-106 (Ru-106)	100
Strontium-90 (Sr-90)	30
Iodine-129 (I-129)	9
Carbon-14 (C-14)	2000
Technetium-99 (Tc-99)	1,000

＜Actual data＞ Actual radiation concentration measurements for each tank group

https://www4.tepco.co.jp/en/sp/decommission/progress/watertreatment/images/tankarea_en.pdf

[Ref.] What is “regulatory standards for discharge”? (2)

<Case 2> water which contains multiple kinds of radionuclides

If the radioactive waste contains multiple radionuclides, **the sum of the ratios of each radionuclide concentration to the regulatory standards for them should be less than 1** (please see the equation below).

$$\frac{\text{concentration of A}}{\text{standard for A}} + \frac{\text{concentration of B}}{\text{standard for B}} + \frac{\text{concentration C}}{\text{standard for C}} \cdots < 1$$

EXAMPLES

Radionuclides (@concentration in the water (Bq/L)) [standard value (Bq/L)]

(1)

I-129 (@0.9Bq/L) [9Bq/L*]
+ Sr-90 (@3Bq/L) [30Bq/L*]
+ Cs-137 (@54Bq/L) [90Bq/L*]

Sum of the ratio

0.9/9 + 3/30 + 54/90
= 0.1+ 0.1 + 0.6
= 0.8 < 1

This case meets the standard

(2)

I-129 (@4.5Bq/L) [9Bq/L*]
+ Sr-90 (@12Bq/L) [30Bq/L*]
+ Cs-137 (@54Bq/L) [90Bq/L*]

Sum of the ratio

4.5/9 + 12/30 + 54/90
= 0.5 + 0.4 + 0.6
= 1.5 ≧ 1

This case exceeds the standard

3. What kind of countermeasures will be taken for possible reputational damage?

◇**The safety of foods produced in Fukushima is confirmed by monitoring mainly before market distribution.**
As the GOJ reaches out and **as the fact is known by overseas government, import regulations have been eased and lifted**.

◇When the GOJ decides its policy on treated water, **countermeasures for reputational damage will be strengthened, such as explaining scientific safety and developing sales channels.**

Monitoring results of foods from Fukushima

<Inspection period> Rice: 21st August,2018-31st May, 2019, Other than rice: 1st April-31st May, 2019

Type of food	Number of tests	Number of samples exceeding the standards	Ratio exceeding standard
Brown rice（produced in 2018）	All package	0	0.00%
Vegetables and fruits	386	0	0.00%
Livestock products	667	0	0.00%
Cultivated wild vegetables and mushrooms	188	0	0.00%
Seafood	859	0	0.00%
Inland water cultivated fish	14	0	0.00%
Wild vegetables and mushrooms	416	0	0.00%
Fish from river and lake	232	2 ※	0.86%

Source; History of Fukushima Reconstruction (ver. 26), amended by Reconstruction Agency ※Sampled of the shipment restriction area

(Ref.) Import measures on Japanese foods has been gradually lifted

◇Of the **54 countries/regions which introduced import measures** on Japanese food after the accident, many have eased the measures and **38 have lifted the restriction**.

Status on food import measures by countries and regions

(As of December 2020)

Type of measures / Number of countries or regions			
Introduced additional measures after the accident	**Lifted all measures**		38
	Remaining measures	Test upon import	1
		Test certificate requirement (EU, Russia, etc.)	9
54	16	Partial import ban (China, Korea, US, etc.)	6

<Recent change in import measures>

Dec. 2020	United Arab Emirates	(Lifted all import measures)
Dec. 2020	Lebanon	(Lifted all import measures)
Nov. 2020	Egypt	(Lifted all import measures)
Sep. 2020	Morocco	(Lifted all import measures)
Jan-Feb, 2020	Indonesia	(Partially lifted test certificates) etc.

[Ref] Information Portal site （1） : Fukushima Daiichi NPS

METI
Ministry of Economy, Trade and Industry

◆ **Decommissioning and Contaminated Water Management at TEPCO's Fukushima Daiichi NPS**

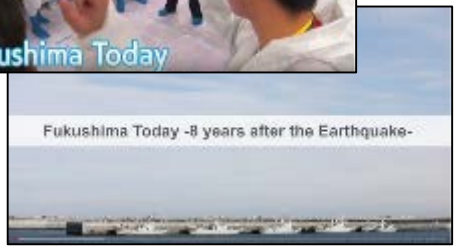
https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/index.html

◆ **Film, Fukushima Today 2019**
- Efforts to Decommission and Reconstruction

https://www.youtube.com/watch?v=v_PeSp--Wuk

◆ **Film, Fukushima Today**
- 8 years after the earthquake -

https://www.youtube.com/watch?v=pKjsSAz5Kws



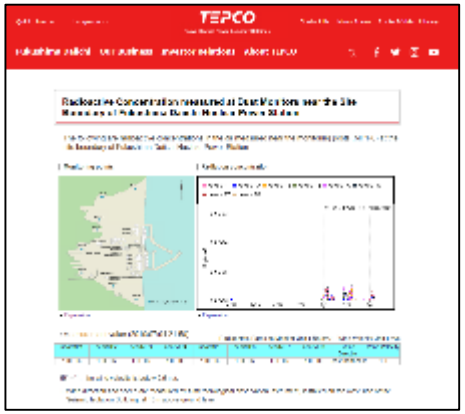
TEPCO
Tokyo Electric Power Company Holdings

◆ **Treated Water Portal Site**

http://www.tepco.co.jp/en/decommission/progress/watertreatment/index-e.html

◆ **Observation Data, Fukushima Daiichi NPS**

https://www7.tepco.co.jp/responsibility/decommissioning/1f_newsroom/data/index-e.html



2-2. Information Portal site （2） : Fukushima Daiichi NPS

IAEA International Atomic Energy Agency

Fukushima Daiichi Status Updates

https://www.iaea.org/newscenter/focus/fukushima/status-update

IAEA Review mission reports (Press release)

*IAEA Follow-up Review of Progress Made on Management of ALPS Treated Water and the Report of the Subcommittee on Handling of ALPS treated water at TEPCO's Fukushima Daiichi Nuclear Power Station

https://www.meti.go.jp/English/earthquake/nuclear/decommissioning/pdf/4fu-report.pdf

*IAEA Reviews Management of Water Stored at Fukushima Daiichi Nuclear Power Station (April 2, 2020)

https://www.iaea.org/newscenter/pressreleases/iaea-reviews-management-of-water-stored-at-fukushima-daiichi-nuclear-power-station

NEA NUCLEAR ENERGY AGENCY

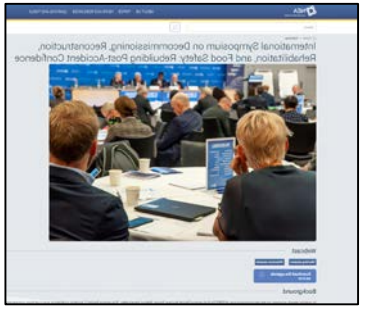
Joint project, Workshop

*Preparatory Study on Analysis of Fuel Debris (PreADES)

https://www.oecd-nea.org/jcms/pl_25169/preparatory-study-on-analysis-of-fuel-debris-preades-project

*International Symposium on Decommissioning, Reconstruction, Rehabilitation, and Food Safety: Rebuilding Post-Accident Confidence (March 26, 2019)

https://www.oecd-nea.org/jcms/pl_27814/international-symposium-on-decommissioning-reconstruction-rehabilitation-and-food-safety-rebuilding-post-accident-confidence



United Nations Scientific Committee on the Effects of Atomic Radiation

UNSCEAR 2016 REPORT

-Sources, effects and risks of ionizing radiation

hhttps://www.unscear.org/unscear/en/publications/2016.html