

*NRA presentation*

- **B Major principles and safety objectives**

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IAEA Regulatory Review Mission on ALPS Treated Water Handling  
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# 1. Regulatory perspectives on ALPS treated water discharge

- Designation of the TEPCO Fukushima Daiichi NPS as *Specified Nuclear Facility*
- The NRA recognizes that Fukushima Daiichi is *in an existing exposure situation*.
- *Additional effective dose at the site boundaries should be less than 1 mSv/y.*
- In this regulatory framework, TEPCO has optimized the protection associated with the decommissioning activities (see Fig.1).

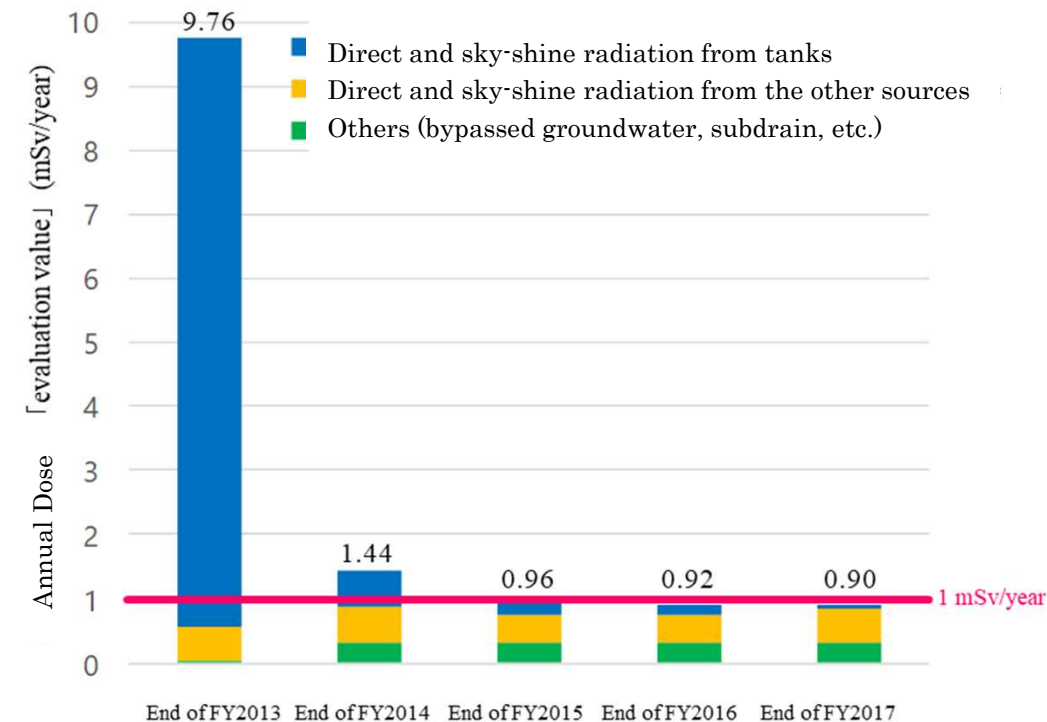


Fig.1. Site boundary dose (evaluation value) \*

\* Source: TEPCO's presentation on 2021.09.28 "Past and current status regarding ALPS treated water, etc", Edited by the NRA



# 1. Regulatory perspectives on ALPS treated water discharge

## ***The regulatory requirements for TEPCO Fukushima Daiichi NPS***

***“Items required for Measures which should be taken at Tokyo Electric Power Co., Inc.’s Fukushima Daiichi Nuclear Power Station in line with the Designation as the Specified Nuclear Facility”***

***II.11 Radiation protection, etc. in the area surrounding the site by restricting release of radioactive materials, etc.***

- Radiation dose in the area surrounding the site shall be reduced as low as reasonably achievable, taking appropriate measures to restrict release of radioactive materials from the Specified Nuclear Facility into environment (atmosphere, ocean, etc.).
- Specifically, **effective dose (estimated value taking into account additional releases of radioactive materials from the overall Facility due to rubble and contaminated water, etc. generated after the accident, which are stored in the Facility) along the site boundaries shall be reduced less than 1mSv/year by March 2013.**



# 1. Regulatory perspectives on ALPS treated water discharge

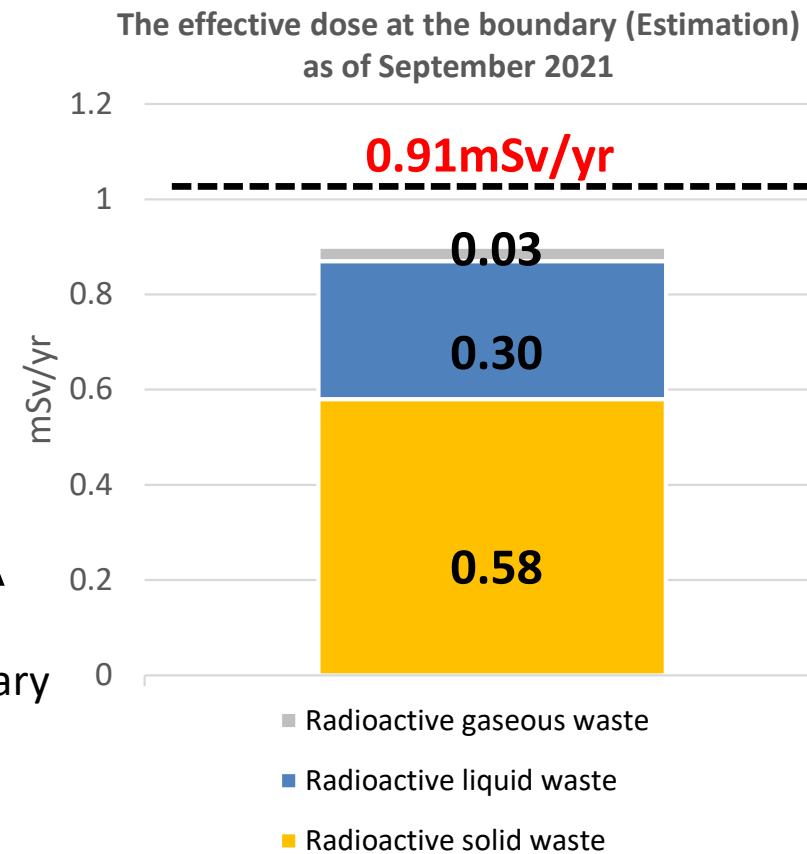
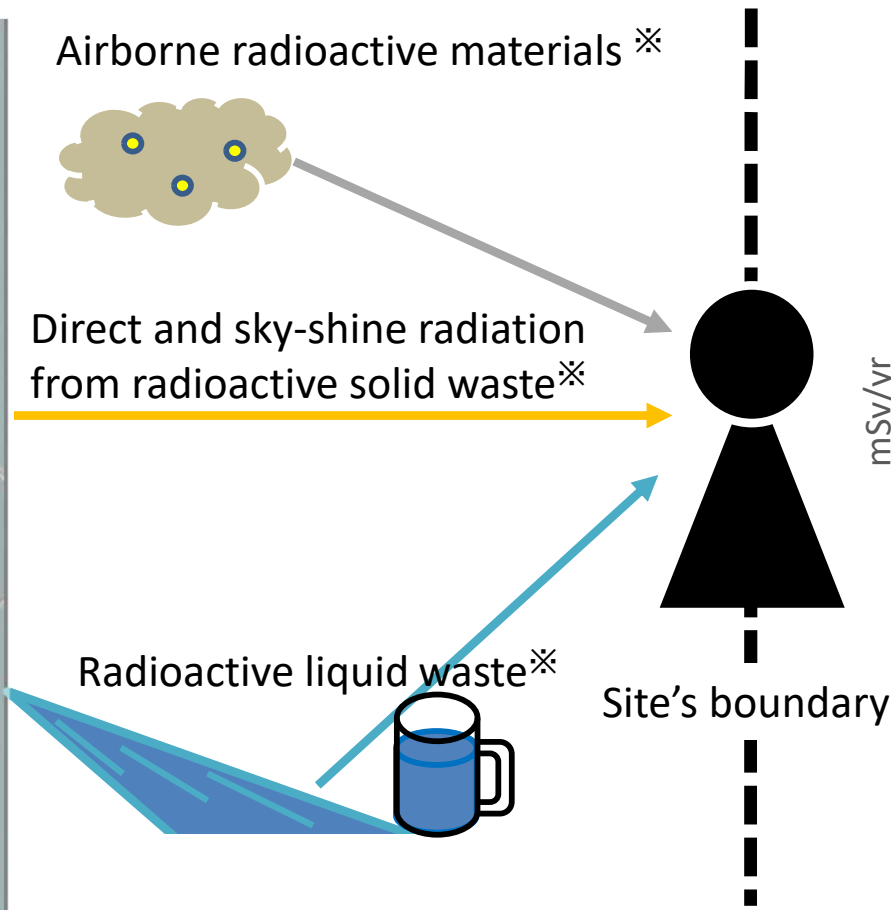
## **Concept of the regulatory requirement: additional effective dose less than 1mSv/y**

- ✓ Due to TEPCO Fukushima Daiichi NPS accident, the broad area was contaminated by the wide spread of radioactive materials released by the accident.
- ✓ Require protection so as to reduce the additional radiological impact from the facility to the outside as low as possible
- ✓ **Additional effective dose at the site boundaries should be less than 1 mSv/y**: the same level as the dose limit for the public during normal operation. The additional effective dose is not the one evaluated for “the representative person”, but for an imaginary extreme situation where a person is constantly exposed to the highest ambient dose, inhales the air and drinks water (about 2 liters per day) containing radioactive materials with the highest concentration for discharge at the same time.
- ✓ Practical measures have been: filtering of gas from the primary containment vessel before airborne discharge, shielding for high-level radioactive rubble placed outside, and measures to prevent leakage of liquid radioactive effluents to the port.



# 1. Regulatory perspectives on ALPS treated water discharge

## Concept of the regulatory requirement: additional effective dose less than 1mSv/y



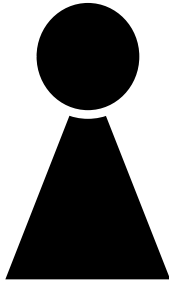
※Generated after the accident and during its decommissioning



# 1. Regulation as an existing exposure situation

## Concept of the regulatory requirement: additional effective dose less than 1mSv/y

for an imaginary extreme situation where a person is **constantly** exposed to the highest ambient dose, inhales the air and **drinks water (about 2 liters per day)** containing radioactive materials with the highest concentration for discharge at the same time.

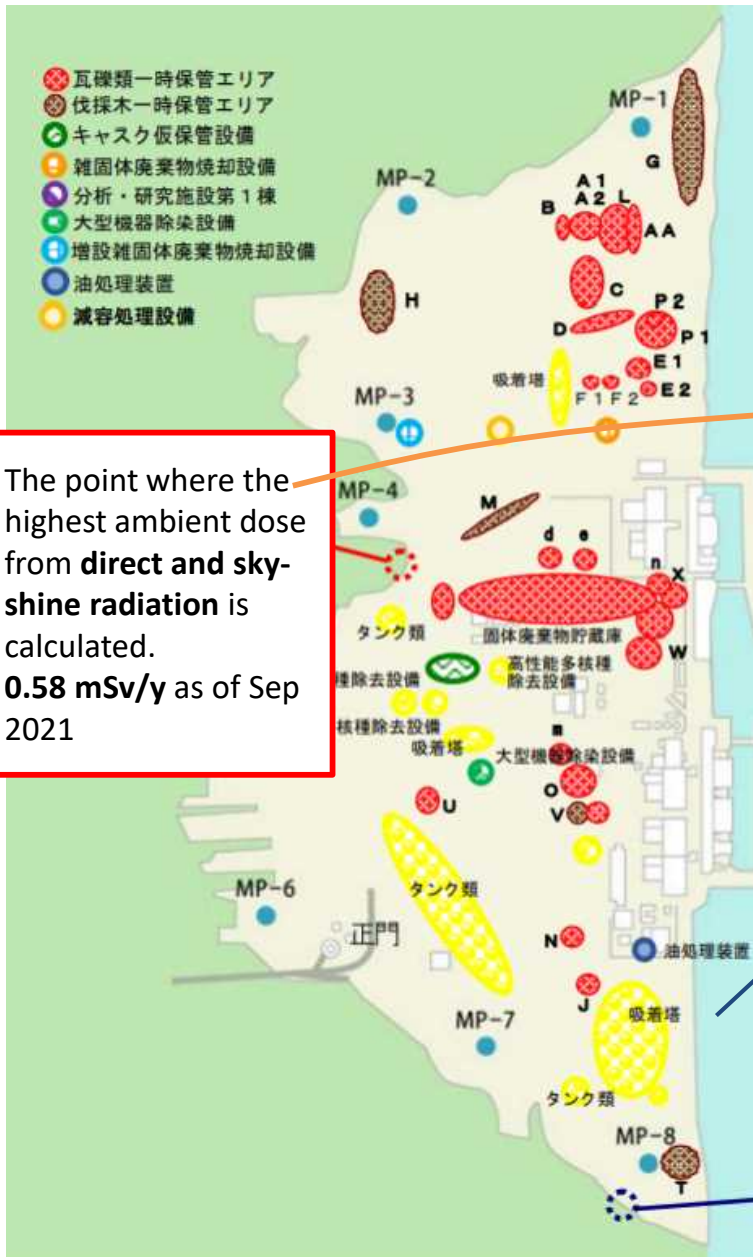


The point where the highest ambient dose from **direct and sky-shine radiation** is calculated.  
**0.58 mSv/y** as of Sep 2021

Effective dose from **radioactive liquid waste** is the sum of:

- **water discharge (0.22mSv/y;** discharged water such as bypassed groundwater and subdrain treated water) and
- **water sprinkle within the site (0.075mSv/y;** sprinkled water such as rainwater and treated Unit 5/6 stagnant water).

The point where the highest dose from **airborne radioactive materials** is calculated.  
**0.03 mSv/y** as of Sep 2021







## 2. Dose constraint for ALPS treated water discharge

- Discharge of ALPS treated water to be conducted in the above framework of regulation as existing exposure situation; therefore, *the impact both on humans and the environment is sufficiently small.*
- *In addition to the regulatory framework under the Reactor Regulation Act, the NRA decided to review ALPS treated water discharge as planned exposure situation considering the potential that discharge of ALPS treated water could give radiological impact to the outside of the area in the existing exposure situation. Thus, **implementation of discharge of ALPS treated water in a way stated in the Government Basic Policy should be acceptable both as existing exposure situation and as planned exposure situation.***
- Accordingly, in light of the framework internationally recognized, the NRA reviews the TEPCO's radiological environmental impact assessment as planned exposure situation.





## 2. Dose constraint for ALPS treated water discharge

- The NRA reviews the TEPCO's radiological environmental impact assessment as planned exposure situation:
  - *whether the assessment methodology is in line with the relevant IAEA Safety Standards;*
  - *whether the assessed impact to humans is sufficiently small. For this review, the NRA has set the criteria "50 $\mu$ Sv/y" which is practically regarded as the dose constraint; and*
  - *whether the assessed impact to the flora and fauna is smaller than the lowest value of **the Derived Consideration Reference Levels**.*



## 2. Dose constraint for ALPS treated water discharge

- Recognizing the practical range for dose constraint shown in the GSG-9, which is “0.1 to <1mSv in a year”, the NRA considers that the dose constraint 50 $\mu$ Sv/y is below, at the same time, comparable to that range. *This is a prudent decision taking into account the fact that the decommissioning work will continue for years and there might be some activities in the future that could potentially give radiological impact to the outside of the area in the existing exposure situation.*
- This values is also sufficiently lower compared to the regional variation in natural radiation in Japan. According to the latest Living Environment Radiation, 3rd Edition (Nuclear Safety Research Association, Nov 2020), the largest difference in effective dose from exposure to gamma rays emitted by naturally occurring radionuclides in the ground surface (including the contribution of gamma rays emitted by radon decay products in the atmosphere) of each prefecture was 0.4 mSv/y between 0.12 mSv/y (Kanagawa) and 0.52 mSv/y (Gifu).



### 3. Optimization

**Dose constraint:  $50\mu\text{Sv/y}$**

**Factors to be considered in optimization process**

- The relevant IAEA Safety Standards specifies factors to be taken into account in the optimization process, including:
  - 5.35 “**Societal considerations such as public acceptance** of the type of practice under consideration” of GSG-9
- The GSG-9 also says in the paragraph for “**Involvement of Interested Parties**” that:
  - “Any exchange of information relating to the control of discharge may form part of other decision making processes, for example a governmental decision making process on a major undertaking ...”

The licensee submitted to the NRA the Implementation Plan in which it describes that the annual discharge amount of tritium is controlled within **22 trillion Bq**, the value stated in the Government Basic Policy.



### 3. Optimization

#### How was the value 22 trillion Bq/y for tritium established?

- The NRA understands that in the report of the Subcommittee on Handling of the ALPS Treated Water published in February 2020 before the Government Basic Policy was decided, the following factors are mentioned for consideration in order to make optimal decisions on disposal details such as duration, the amount and timing of commencement;
  - the progress of future decommissioning work (including the necessity of land for new facilities and the limitation of the additional tank installation)
  - the risks associated with the storage of large quantities of liquid waste
  - radioactivity decay
  - **societal impact**
- Then the report also mentions that *discharge within the same amount and concentrations as those conducted in the previous cases is expected to mitigate societal impact* to a certain level.



### 3. Optimization

#### How was the value 22 trillion Bq/y for tritium established?

- In April 2021, the Government decided the Basic Policy taking into consideration the said report, which indicates that *the total annual amount of tritium to be discharged will be at a level below the operational control value for tritium discharge of the Fukushima Daiichi NPS before the accident (22 trillion Bq/year).*
- > *The value 22 trillion Bq/y was decided by the Government.*

The NRA recognizes that the above decision-making process took into account the factors shown for the optimization process in the relevant IAEA Safety Standards including 5.35 and 5.100 in GSG-9. Apparently, *the most influential factor in the decision-making process of the total amount of tritium to be discharged annually was societal impact.*



### 3. Optimization

#### Viewpoints of the NRA on the value 22 trillion Bq/y for tritium

- Is the radiological impact assessed with the value 22 trillion Bq/y lower than the dose constraint 50μSv/y?
- Could the overall risks of Fukushima Daiichi be reduced with this value for discharge? In other words, won't this value hamper the progress of the decommissioning work?
  - The regulatory requirements for Fukushima Daiichi NPS under the Reactor Regulation Act stipulate *that overall risks of the Specified Nuclear Facility shall be reduced through the risk assessment of each process and stage in the entire process toward decommissioning.*
  - The NRA has requested TEPCO to explain the importance of the discharge of ALPS treated water in the overall programme of decommissioning as well as the expected contribution of the Discharge Facility in reducing risks of the Specified Nuclear Facility as a whole, from the perspectives of the necessity of new equipment installation, the risk of leakage associated with storage and human resource allocation.
  - More specifically, TEPCO should indicate the validity of the land allocation plan as well as the consistency between the tank removal plan and the necessity of land for new facilities.



## 4. Discharge Limit

### -For tritium

- The licensee submitted to the NRA the Implementation Plan in which it describes that the annual discharge amount of tritium is controlled within 22 trillion Bq, the value stated in the Government Basic Policy.
- The NRA reviews whether the radiological impact assessed with the annual discharge amount of tritium is appropriate before giving a judgement on approval.
- After the approval is granted, *TEPCO should comply with the approved Implementation Plan, and therefore 22 trillion Bq/y is to be the discharge limit.*





## 4. Discharge Limit

TEPCO sets the following *operational conditions* to implement discharge of ALPS treated water which are *relevant to discharge limit for the nuclides other than tritium*:

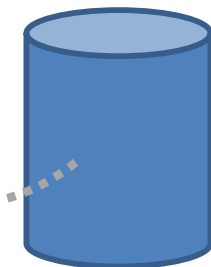
- At K4 confirmation/measurement tanks, TEPCO confirms that the sum of the ratios of the *radionuclides other than tritium* to each concentration limit stipulated in the regulation is *less than 1*. Tritium is excluded because it cannot be removed by ALPS.
- The water which has cleared the criteria above is called “*ALPS treated water*”.
- Since ALPS treated water contains tritium more than the stipulated concentration limit, ALPS treated water will be *diluted by seawater more than 100 times* so that the tritium concentration becomes less than 1,500 Bq/L\* as stated in the Government Basic Policy.

\*The value 1,500 Bq/L is the same as the control criteria described in the implementation plan for the currently conducted discharge of bypassed groundwater and subdrain treated water.

- The annual discharge amount of tritium is controlled within 22 trillion Bq, the value stated in the Government Basic Policy.

“ALPS treated water”

- The ratios of the *radionuclides other than tritium* to each concentration limit stipulated in the regulation is confirmed to be *less than 1*.
- *The concentration of tritium is  $1.5E+5 - 2.16E+6$  Bq/L.*



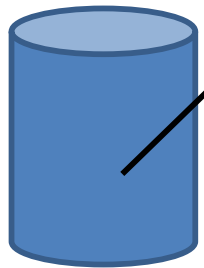
**K-4 tanks**



## 4. Discharge Limit

### -Other than tritium

- With the TEPCO's operational conditions (see slide 15), the annual discharge amounts of radionuclides other than tritium vary depending on the tritium concentration in ALPS treated water to be discharged. Meanwhile *the maximum amounts are associated with the maximum annual discharge amount of tritium.*
- TEPCO has also assessed the impact with the hypothetical source term for the other nuclides conservatively set beyond the amount associated with the amount of tritium in addition to the source terms set from the analytical results, and the NRA reviews whether this result is appropriate.



K-4 tanks

In ALPS treated water, the maximum concentration of the other nuclides is fixed by TEPCO.



When ALPS treated water with **higher concentration tritium** is discharged, **less amount of the other nuclides** is discharged because of **more dilution to achieve 1500Bq/L for tritium.**

When ALPS treated water with **lower concentration** tritium is discharged, **more amount of the other nuclides** is discharged because of **less dilution to achieve 1500Bq/L for tritium.**



## 5. Operational limits and conditions

### ***In the review process before discharge***

the NRA sees whether discharge management necessary to meet the defined discharge conditions, including the operational limits and conditions, is appropriately established in the Implementation Plan. Also, the NRA confirms whether the Implementation Plan includes the description that ***actions to suspend discharge will be taken immediately in the event of exceeding authorized discharge limits or breaching operational limits and conditions*** also TEPCO should report to the NRA promptly.

### ***After the start of discharge***

The NRA has its resident safety inspectors on Fukushima Daiichi site, and they are entitled to ***check the operator's conformity to the Implementation Plan in Operational Safety Inspection anytime.***

### ***Legal authority of the NRA***

In addition, when the NRA finds that the operational safety measures in compliance with the Implementation Plan are **NOT** taken, ***the NRA may order*** TEPCO to take measures necessary for operational safety, including ***suspension of discharge or alteration of the design of the Discharge Facility.*** (Refer to the Reactor Regulation Act, Article 64-3-6.)



## 6. Authorization

The regulatory process for Fukushima Daiichi, which has been designated as Specified Nuclear Facility, is set under the Reactor Regulation Act and the relevant Ordinances.

### **Basic idea of Specified Nuclear Facility**

Allow to conduct tailor made management for damaged nuclear facility:

- NRA designates a facility as **Specified Nuclear Facility** when necessary to take special management after prompt measures.
- NRA directs **necessary measures** for Specified Nuclear Facility.
- Operator shall submit **Implementation Plan** to NRA for managing safety.
- Exemption can be applied when necessary.



## 6. Authorization

### ***Legislation on regulation of Fukushima Daiichi***

#### Reactor Regulation Act

- Article 64 stipulates obligation for operator to take measures necessary to prevent disaster
- Article 64-2 provides procedure for designation of Specified Nuclear Facility
- Article 64-3 stipulates operator's obligation and regulator's authority and power regarding "Implementation Plan"
- Article 64-4 allows exemptions under certain condition

#### NRA Ordinance for Operational Safety and Protection of Specified Nuclear Fuel Materials of the Nuclear Reactors at TEPCO Fukushima Daiichi NPS

- Regulatory procedures for Fukushima Daiichi

#### Notification to Establish Requirements for Operational Safety and Protection of Specified Nuclear Fuel Materials of the Nuclear Reactors at TEPCO Fukushima Daiichi NPS

- Regulatory procedures and criteria for radiation protection in Fukushima Daiichi

This notification is linked to "Notification to Establish Dose Limits" which stipulates regulatory requirements for dose limits and concentration of radionuclides including for water outside the site area.



## 6. Authorization

### ***Fukushima Daiichi NPS Designation as Specified Nuclear Facility***

- November 7, 2012 Designation
  - The NRA decided ***the regulatory requirements “Items required for Measures which should be taken at Tokyo Electric Power Co., Inc.’s Fukushima Daiichi Nuclear Power Station in line with the Designation as the Specified Nuclear Facility”*** immediately after designation.
- December 7, 2012 Submission of the initial Implementation Plan
  - Several amendments were submitted during review of application
- August 14, 2013 Approval of the initial Implementation Plan
- Till now, along with decommissioning activities, a number of amendments have been submitted by TEPCO and authorized by the NRA after review.

***Implementation Plan covers following items:*** Overall process and risk assessment, Design and SSCs, Operational Safety, Physical Protection, Removal of fuel debris and decommissioning, Public Acceptance, Inspection

To add ALPS treated water discharge into the Implementation Plan, those chapters have been amended and submitted to NRA for review.



## 6. Authorization

For ALPS treated water discharge, there is the following regulatory process:

### -Before the implementation discharge

#### ***(1) Review of the Implementation Plan***

- Installation and operation of the Discharge Facility for ALPS treated water should be added to the Implementation Plan.
- Upon the submission of the application for the amendment of the Implementation Plan, the NRA reviews whether it conforms to ***the regulatory requirements for Fukushima Daiichi*** through discussions with TEPCO at review meetings before making a decision on approval.
- The decision will be notified by written document with the review result document also attached.
- In addition, the Implementation Plan should describe ***items to be confirmed for each structure, system and components of the facility in the operator's pre-service inspection before discharge***. Confirmation items are to be identified as necessary to confirm structure strength, seismic resistance, function or performance, and are subject to the NRA's review.

[Link to pre-service inspection by NRA](#)





## 6. Authorization

-Before the implementation discharge

### **(2) Pre-service Inspection by the NRA**

After the approval of the Implementation Plan, the NRA safety inspectors conduct pre-service inspection on the facility at the following timing to see whether functions or performance described in the Implementation Plan are archived (reference to Article 20 of the Ordinance for Fukushima Daiichi):

- When the facility becomes available for test to confirm structure, strength and leakage,
- When installation of the facility is completed,
- When the entire construction work is completed.



## 6. Authorization

-**After the start of discharge**, the NRA conducts the following inspections:

**(3) Periodic facility inspection:** to see whether the expected performance of the facility is maintained.

**(4) Operational safety inspection:** to see whether operational safety measures are taken in accordance with the Implementation Plan on a day-to-day basis. The NRA has its resident safety inspectors on Fukushima Daiichi site, and they are entitled to check the operator's conformity to the Implementation Plan anytime. The NRA resident inspectors will check in operational safety inspection whether ALPS treated water discharge is operated in way described in the Implementation Plan.