
**Comprehensive Risk Review of all the possible risks which
might have an impact outside the site boundary of the
Fukushima Daiichi Nuclear Power Station**

～ Result of Comprehensive Risk Review ～

April 28, 2015

Tokyo Electric Power Company

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0. Overview

- Comprehensive risk review was implemented, considering all the possible risks that might have an impact outside the Fukushima Daiichi NPS site boundary.
- Focusing on liquids and dust, risk sources, leakage paths, and operations were examined. 190 items that need to be targeted were identified.
- The items which had been already known were included and evaluated from a new perspective this time. Necessity of additional measures was examined for these items.
- As a result of the comprehensive risk review, 124 items were classified under ①countermeasures in practice, ②follow-up observation (after implementing countermeasures) in practice, ③no need for additional measures.
- Classification of remaining 66 items;
21 items were classified as the items for which ④countermeasures need to be implemented (one of these 21 items was classified as the item for which additional measures need to be implemented immediately) (to be conducted in May 2015)
45 items were classified as the items which ⑤need further examination
- Details of measures and period of implementing measures will be examined according to its priority etc. Continuous efforts will be made to further reduce the risks which might have an impact outside the site boundary.

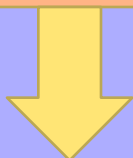
1. Background

<September 2013>

Subsequent actions taken after following incidents

- Increase of contaminated water
→ Installation of bolted-joint tanks and other equipment
- Leakage of contaminated water from tanks or elsewhere
→ Reclaiming contaminated water and contaminated soil

etc.



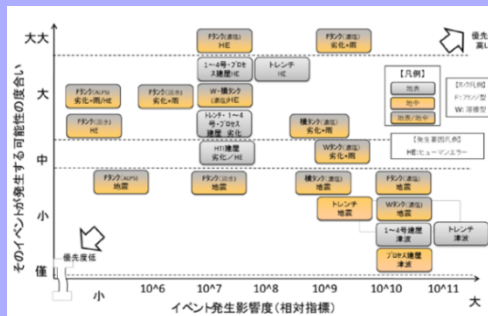
Basic policy for the Contaminated Water Issue at the TEPCO's Fukushima Daiichi Nuclear Power Station
(decision by the Nuclear Emergency Response Headquarters on September 3)

『Beyond the follow up measures like in the past, the preventive and multi-layered measures will be taken through identification of any potential risks.』

<December 2013>

A preventive and multi-layered measures

- ① Removing the contamination source
 - ◆ Treating contaminated water by ALPS (Multi-nuclide removal equipment)
 - ◆ Removing contaminated water from trench
- ② Isolating groundwater from the contamination source
 - ◆ Groundwater bypassing system
 - ◆ Pumping up water from sub-drain around the reactor building
 - ◆ Land-side frozen soil impermeable walls
 - ◆ On - site soil pavement for suppressing groundwater ingress
- ③ Preventing leakage of contaminated water
 - ◆ Ground solidification by water glass
 - ◆ Sea-side impermeable walls
 - ◆ Construction of welding type tanks including replacement from flange (bolt) type etc.

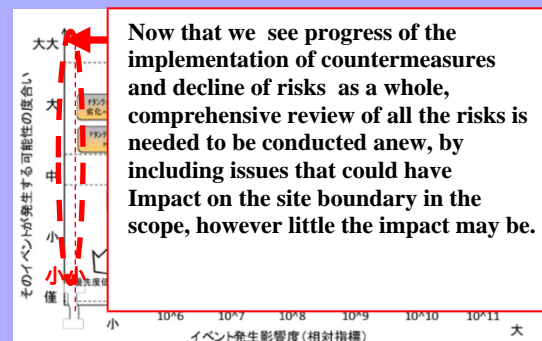


(Risk map)

<February 2015>

Comprehensive risk review

- (Direction from Mr. Takagi, Senior Vice Minister of Economy, Trade and Industry)
- i TEPCO should conduct a new comprehensive risk review covering all the possible risks that could be thought of at Fukushima Daiichi NPS at this moment. It should be done from the perspective of the affected people and the public. In addition, TEPCO should present appropriate countermeasures for the current situation of the site, and provide necessary information.
 - ii In conducting this comprehensive overall review, any risks that could have an impact on the environment outside the site boundary of Fukushima Daiichi NPS should be included in the scope of the review. This scope should be decided by taking into account the progress of the countermeasures.



(Risk map with broader targets)

Now that we see progress of the implementation of countermeasures and decline of risks as a whole, comprehensive review of all the risks is needed to be conducted anew, by including issues that could have impact on the site boundary in the scope, however little the impact may be.

2. Implementation of Comprehensive Risk Review

Risks that might have an impact outside the site boundary of the Fukushima Daiichi Nuclear Power Station were broadly included in the review, and **target items for risk reduction were systematically classified**.

[1] Impact of liquids and dust

- Regardless of the source of contamination, all liquids and dust were reviewed

(Note) Leakage due to fire / human factors and leakage of oil / chemicals (such as sulfuric acid / caustic soda) was identified as a risks and detailed evaluation and classification was continued

[2] Low frequency external events

- Tornado, plane crash, earthquake / tsunami
- Risks and measures were *examined* after in-depth discussions with the concerned agencies regarding the approach for ensuring safety

[3] Impact other than liquids and dust

- Debris recriticality, shutdown of cooling of debris/ spent fuel
- The possibility of debris recriticality is extremely low at present.

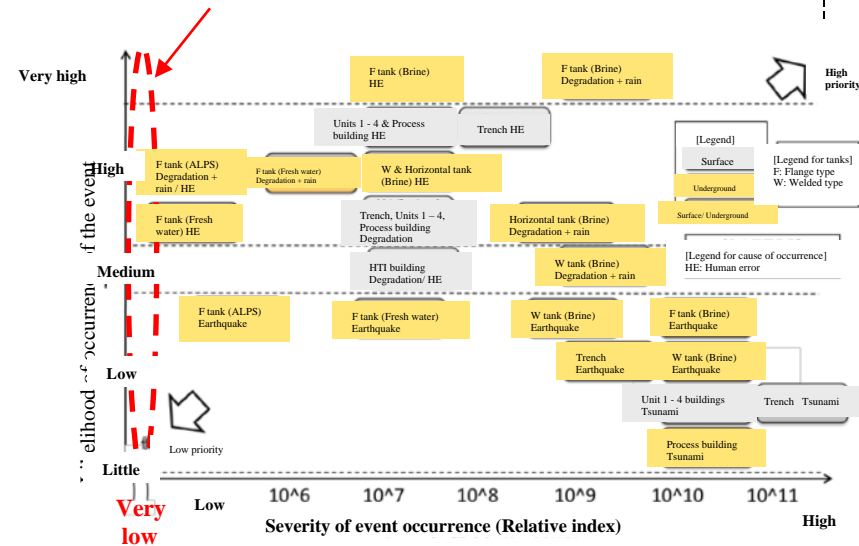
Before carrying out operations that might generate changes (increased water levels and concentration of debris) that would increase recriticality, the individual key issues were verified and measures were taken.

→ Even if there is cooling shutdown, there is sufficient time to take alternative steps. Within this time, it is possible to take action in a flexible manner so that areas outside the site are not affected.

(Debris) For about 63 hours after cooling shutdown, the surrounding public is safe from significant radiation exposure.[Note]

(Spent fuel) It takes 100 hours or more for the pool water temperature to reach the operational limit (65°C) after cooling shutdown

Target items which have potential impact on outside the site boundary including those having very small impact are evaluated in the situation where risks as a whole have been reduced



(Risk map further broadening the target*)

*: Risk map by Committee on Countermeasures for Contaminated Water Treatment
Added in (Dec 2013)

[Note] Annually 5mSv on site boundary.
Evaluated values as of Oct 1, 2014.

3-1. Identification of the target items and evaluation of the necessity for additional measures

n As a part of the comprehensive risk review, target items that might have an impact outside the site boundary were identified (), and the necessity for additional measures for each of the identified items was evaluated ().

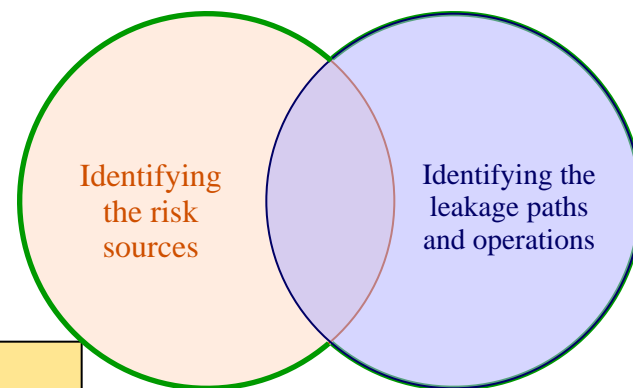
Identification of the target items

- During risk review “risk sources” such as radioactive materials were identified.
- “Leakage paths (liquids)” and “operations (dust)” were identified in parallel.
- Items identified in either of the above were considered as the “target items”.

Evaluation of the necessity for additional measures for each of identified items

- The state of each of the identified target items (presence of data on the amount or concentration of radioactive materials, and implementation status of measures, etc.) was verified, and the future necessity for additional measures was classified as follows:
 - (1) Need further examination
 - (2) Countermeasures *need* to be taken
 - (3) Countermeasures in practice
 - (4) Follow-up observation (after implementing countermeasures) in practice
 - (5) No need for additional measures
- For point (2) above, prioritization was made based on the possibility of impact outside the site and the concentration of radioactive materials.

Identification of the target items



3-2 Identification of the target items

In addition to the items for which measures have been taken, other items that might have an impact outside the site boundary were included in the identification of the target items .

◎Risks that could cause radioactive materials to flow outside the site (including the sea) in the form of liquid

So far, TEPCO has put priority on taking measures for contaminated water issues whose risk is high. Besides them, TEPCO will check the contamination sources and the route of any leakage in order to identify wide range of risks that could have an impact outside the site boundary.

◎Contaminated water with high risks for which TEPCO has been taking measures with high priority

- Accumulated water inside seawater pipe trenches in the Unit 2-4
【Measures】 Removal of contaminated water and filling up of the trenches
- Accumulated water inside buildings
【Measures】 Purification treatment of accumulated water, groundwater bypassing , pumping water up from sub-drain, installation of land-side frozen soil impermeable walls, etc.
- Water stored in tanks
【Measures】 Purification of concentrated salt water, construction of welding type tanks, replacement from flange (bolt) type tanks, elevating the height of and doubling a dike surround each tank, etc.
- Rainwater in tank area dike
【Measures】 Decontaminated water sprinkle
- Contaminated soil in the sea side of turbine buildings
【Measures】 Water improvement with water glass



◎ Identifying remaining risks that could have an impact outside the site boundary

- Accumulated water inside trenches and other places other than seaside pipe trenches in the Unit 2-4
 - Discharge channels
 - Other accumulated water outside buildings
(pits including sump, buried pipes, wells and tanks placed temporarily, etc.)
 - Place where rainwater could be contaminated
(temporal storage for radioactive waste, rubbles, rooftop of buildings, drainage channels and pits including oil barrier dikes)
- Etc.

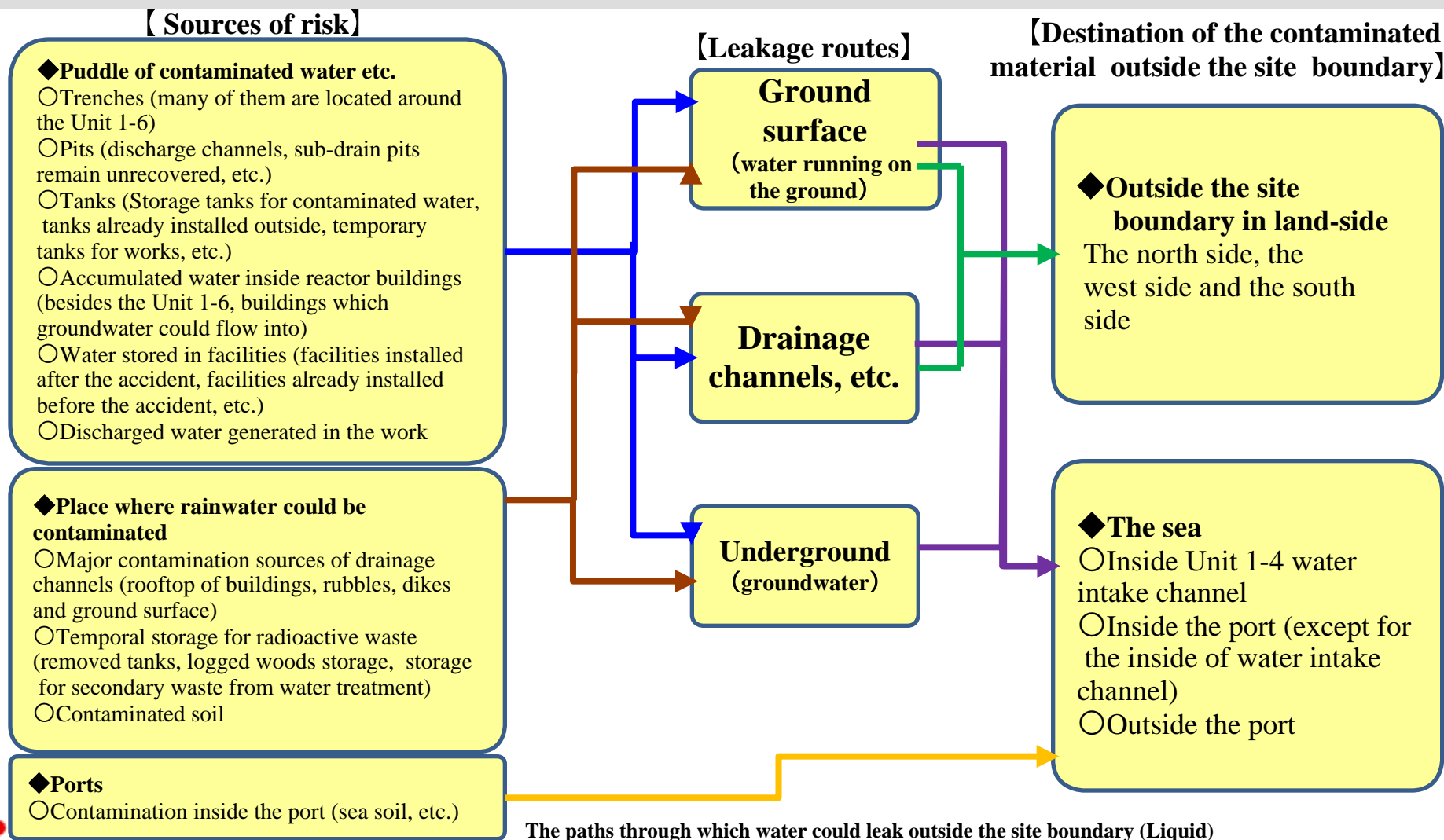
So far, When conducting operations such as removing rubbles in the operating floor of the Unit 3 or dismantling Unit 1 cover, TEPCO has taken measures to prevent scattering of dust. Besides them, TEPCO will check the contamination sources and the process of operations, as dust might scatter in such operations. Wide range of risks that could have an impact outside the site boundary will be identified.

◎Identifying risks that could have an impact outside the site boundary by the scattering of dust

- Removal of rubbles and upper section of reactor buildings
- Temporal storage of radioactive waste
- Operation for dismantling tanks etc.

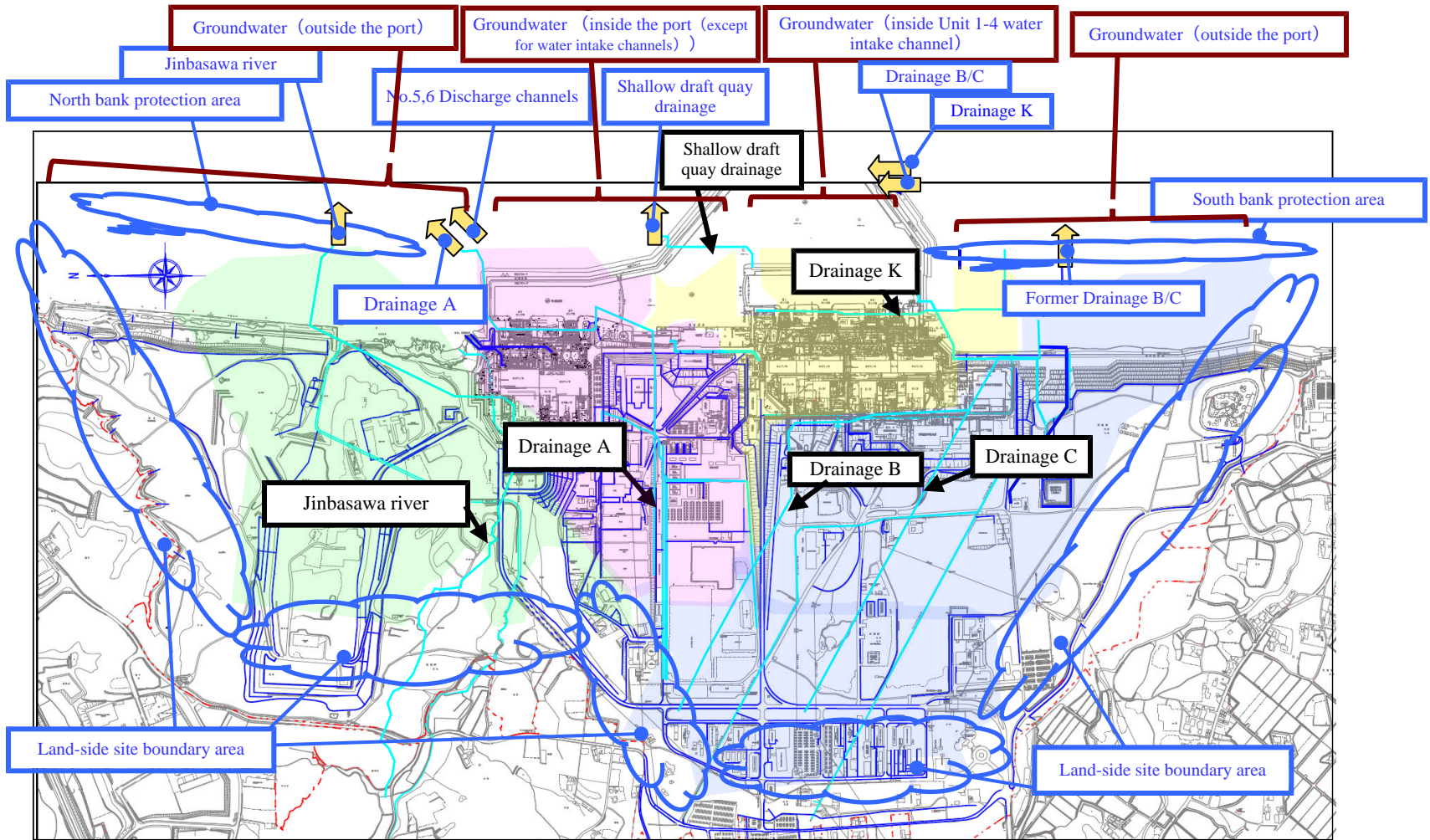
3-3. Identification of the target items (evaluation of the leakage path)

During the identification of target items, paths leading to leakage outside the site boundary were identified taking into account the location of the risk sources and the assumed leakage of these sources.



3-3. Identification of the target items (evaluation of the leakage path)

For the leakage paths, drains around the site were also examined based on field verification.



* Besides this, some liquid run on the ground surface as its routes.

4-1. Results of classification of target items

- n As a result of comprehensive risk review, 190 items were systematically classified.
(Liquid leakage: 159 items, generation of dust: 31 items)
- n For the items for which countermeasures need to be taken, content and period of measures will be considered according to priority, etc.

[Target items newly identified]

(1) Issues for which facts were verified through investigation on site

- Drainage side ditches around the site

For the drains and clay pipes leading from within the site to outside the site, around the site boundary, the location of the drains and clay pipes was identified through investigation on site, and was incorporated into the classification results as the leakage path of rainwater.

(2) Target items for whose relations with the impact outside the site was considered taking into account connection between leakage paths and risk sources

- Water retained in the exhaust stack drain sump, waste storage area, and sea water system facility

This was identified as a key issue, but was organized as an item for which leakage paths are drainage channels, Jinbazawa river, and sea water system pipes.

(3) Target items identified as key issues based on newly confirmed facts (cases occurring after Feb 26, 2015)

- Adsorption tower temporary storage facility (HIC)

Puddle water was confirmed in HIC stored in the adsorption tower temporary storage facility, so the re-evaluation of the impact of leakage from HIC outside the site is being re-examined. For this reason, the survey results are being reviewed. (Although it was sorted out as“(4) Observing status after countermeasure had been taken”in this time, additional countermeasures will be implemented depending on the future survey results.)

- Water in the spent fuel pool (SFP)

Based on the pool gate survey results for Unit 3 spent fuel pool (SFP), the key issue of impaired pool boundary function was re-identified.

- Fires and human factors

Based on cases of outdoor fires generated by vehicle fittings and electrical cables, the key issues that might affect the site boundary due to fires and human factors were re-identified as items for which common measures must be considered.

4-2. Results of evaluation of the necessity for additional measures

n The results of evaluation of the necessity for additional measures are as follows:

	Main leakage paths	Necessity of additional measures					Total
		(1) Need further examination	(2) Countermeasures need to be taken	(3) Countermeasures in practice	(4) Follow-up observation (after implementing countermeasures) in practice	(5) No need for additional measures	
Water	Drainage channel K	6	3	2	7	1	19
	Drainage channel A	3	1	1	7	1	13
	Drainage channels B and C	1	2	14	10	1	28
	Other drainage channels	6	1	3	1	3	14
	Groundwater (Inside open culverts of Units 1 - 4)	8	5	20	8	3	44
	Groundwater (inside the port)	5	2	0	3	10	20
	Groundwater (outside the port)	5	2	2	2	2	13
	Water running on the ground	1	0	1	1	0	3
	Port	0	0	1	0	1	2
	Common	1	0	2	0	0	3
Total		36	16	46	39	22	159

Items for which additional measures need to be implemented immediately: 1
 Items for which additional measures need to be implemented at an early stage: 5
 Items for which additional measures need to be implemented subsequently: 10

	Main leakage paths	Necessity of additional measures					Total
		(1) Need further examination	(2) Countermeasures need to be taken	(3) Countermeasures in practice	(4) Follow-up observation (after implementing countermeasures) in practice	(5) No need for additional measures	
Dust	Generated with operations	3	2	5	0	0	10
	Generated with damage	4	2	0	6	0	12
	Other	2	1	2	2	0	7
	Common	0	0	2	0	0	2
Total		9	5	9	8	0	31

Items to which additional measures need to be implemented at an early stage: 5

4-3. Results of evaluation of the necessity for additional measures (Items requiring further examination)

- 45 items were classified as items which need further examination.
- Some of these items, such as contamination source of the drainage channels, are being examined. Meanwhile, there are items which have not been examined due to radiation exposure, difficulty in obtaining samples, and constraints on analytical capability.
- Items that are not apparent currently, but might turn into risks in the future were also identified.
- Further examination will be conducted, while taking into account contamination levels and possible impact outside the site.

[Examples of items that have not been examined]

- ◆ Examples of items that have not been examined because the radiation exposure associated with investigation was high
Exhaust stack drain sump pit (Units 1 and 2)
- ◆ Examples of items that have not been examined because samples were difficult to obtain
Inside the sea water system pipes (Circulating water pipes of Units 1 ~ 4)
- ◆ Examples of items that have not been examined because priority was given to other items with a high contamination level and leakage risk
 - Items with risks assumed to have a low contamination level
Ground surface of the areas away from Units 1~4 / standing trees / building roofs / Unit 5 and 6 pits / drain ditch / Jinbazawa river, scrap yard, yard for fallen trees, and so on.
 - Items with risks assumed to have a low possibility of leakage
Water retained in the facility, water accumulated in the buildings, oil fence, and so on

4-4. Results of evaluation of the necessity for additional measures (Items requiring countermeasures)

- n 21 items were classified as countermeasures need to be taken. Measures will be examined and implemented according to its considering the following priority and relations with reactor decommissioning operations.

[Priority for items for which countermeasures need to be taken]

Items for which additional measures will be implemented immediately, in addition to the existing measures: 1 item (to be conducted in May 2015)

Target: High-concentration contamination sources in places that are not solid
(Sub-drain pit #16 near Unit 2 reactor building)

Items for which additional measures will be implemented at an early stage: 10 items

Target: Comparatively high-concentration contamination sources in places that are not solid
(Puddle water on roofs, puddle water outdoors, soil verified as contaminated)
Places where dust might be generated due to operations and damage to facilities
(flange tank dismantling operation, sheet curing in temporary debris storage area, and so on)

Items for which additional measures will be implemented subsequently: 10 items

Target: Contamination sources in solid places
Low-concentration contamination sources in places that are not solid
(Puddle water in buildings, puddle water inside facilities, low-concentration outdoor puddle water, low-concentration tank water)

5. Future Plan

- n Measures will be implemented depending on priority for the target items classified in this comprehensive risk review. However, **risks change due to changes in the environment depending on the progress of reactor decommissioning operations**. The measures will **be continuously reviewed taking into account** these changes as appropriate .
- n While continuously reviewing the measures, efforts will be made to reduce risks based on **the opinions of experts and people from the local community**.

Additional measures will be implemented in accordance with the priority

- Regarding risks that are classified as “Countermeasures necessary to be taken”, the details of additional measures will be considered and implemented sequentially while taking its priority into account.
- During implementation of the measures, in addition to the current priority, the period and content of examination and measures will be considered and implemented taking into account key issues in examination (exposure, difficulty in collecting samples, analytical capability), and relations with reactor decommissioning operations and risk reduction measures (such as operation area and resource allocation).

The review will be conducted regularly by reflecting changes that might occur

- The change in on-site condition will be monitored and the risk will be discussed in the On-site Coordination Council for Reactor Decommissioning and Measures against Contaminated Water by taking into account the change of the situation being observed. Based on the discussion held in the council, comprehensive risk review will be regularly conducted and announced.
- By identifying wide range of risks which might be substantiated along with the progress of the decommissioning work, TEPCO aims to reduce risks in the Fukushima Daiichi NPS as a whole.

We sincerely apologize to the society, including everybody from Fukushima Prefecture, for the trouble and inconvenience caused due to the problem of information disclosure related to the drainage channel K at the Fukushima Daiichi Nuclear Power Station site.

1. New Information Disclosure Mechanism <Approach to Information Disclosure>

- 1.All radiation data of Fukushima Daiichi taken by TEPCO will be disclosed
- 2.Data will be disclosed via the TEPCO website and explanations of data of particular concern will be given at press conferences.
- 3.External parties will continually monitor and assess the new information disclosure rules and adherence to these rules in order to maintain transparency and reliability.

2. Communication <Enhancement of RC Monitoring / Function>

3. Enhancing communication with the local stakeholders

- 1.Create new opportunities to exchange opinions based on the “Fukushima Prefecture Nuclear Power Station Town Hall Meeting”^{*1}
- 2.Increased frequency of visits and briefings given to local government administrative districts and temporary housing residents” associations.
- 3.Increased frequency of visits and briefings given to stakeholders^{*2} in the metropolitan region.

<Reference: Example of councils that exist currently>

-”Fukushima Council on the FDEC and Contaminated Water Countermeasures”(Held by the national government, February 2014~)Members: METI Deputy Minister, Fukushima Prefecture/surrounding local Government leaders, local experts and related organizations, regulatory agencies, FDEC/Contaminated Water Countermeasure Team, TEPCO (Executive Vice President Yoshiyuki Ishizaki, CDO Naohiro Masuda)

*1:Meetings at which information on the management of the power station and work being done at it is explained to residents of the siting community and their opinions are gathered.(Started in January 2003)

*2:Intellectuals, economic associations, consumer groups