The Solution of stop the Contaminated Water and The Safety of Fishery Products at TEPCO's Fukushima Daiichi Nuclear Power Station (provisional translation)

Dec. 2016

Fisheries Agency of Japan

Framework for Radioactive Cesium Monitoring for Fishery Products

- Target species : Major commercial species and species that has record of detection with more than 50 Bq/kg (Cs-134 and 137) in the previous year. Due consideration is given to, inter alia: ① living layers of species (surface, mid water and bottom), ② fishing season, ③ results of neighboring prefectures' monitoring
- Monitoring is strengthened when detected level of contamination is a smaller, but approximate to the standard limit (100 Bq/kg) , or detected levels of contamination exceed the limit in the neighboring prefectures.
- In case of exceeding the limit, a relevant local government requires distribution restriction of the species and/or the Nuclear Emergency Response Headquarters directs distribution suspension order to the species.

Monitoring plan developed mainly by local governments

Monitoring Area
- Local government divides its area into several areas
- Inspection at the main landing ports in each area

Target species
- Major species
- Species that has record of detection with more than 50 Bq/kg

Frequency
- Once a week
- Before fishing season (skipjack, saury .etc.)

Strengthen monitoring

Results of neighboring monitoring

Monitoring

>100 Bq/kg

- Distribution restriction in case the excess of the limit is found only in one area
- Distribution suspension order in case more than one area show the excess.

≦100 Bq/kg

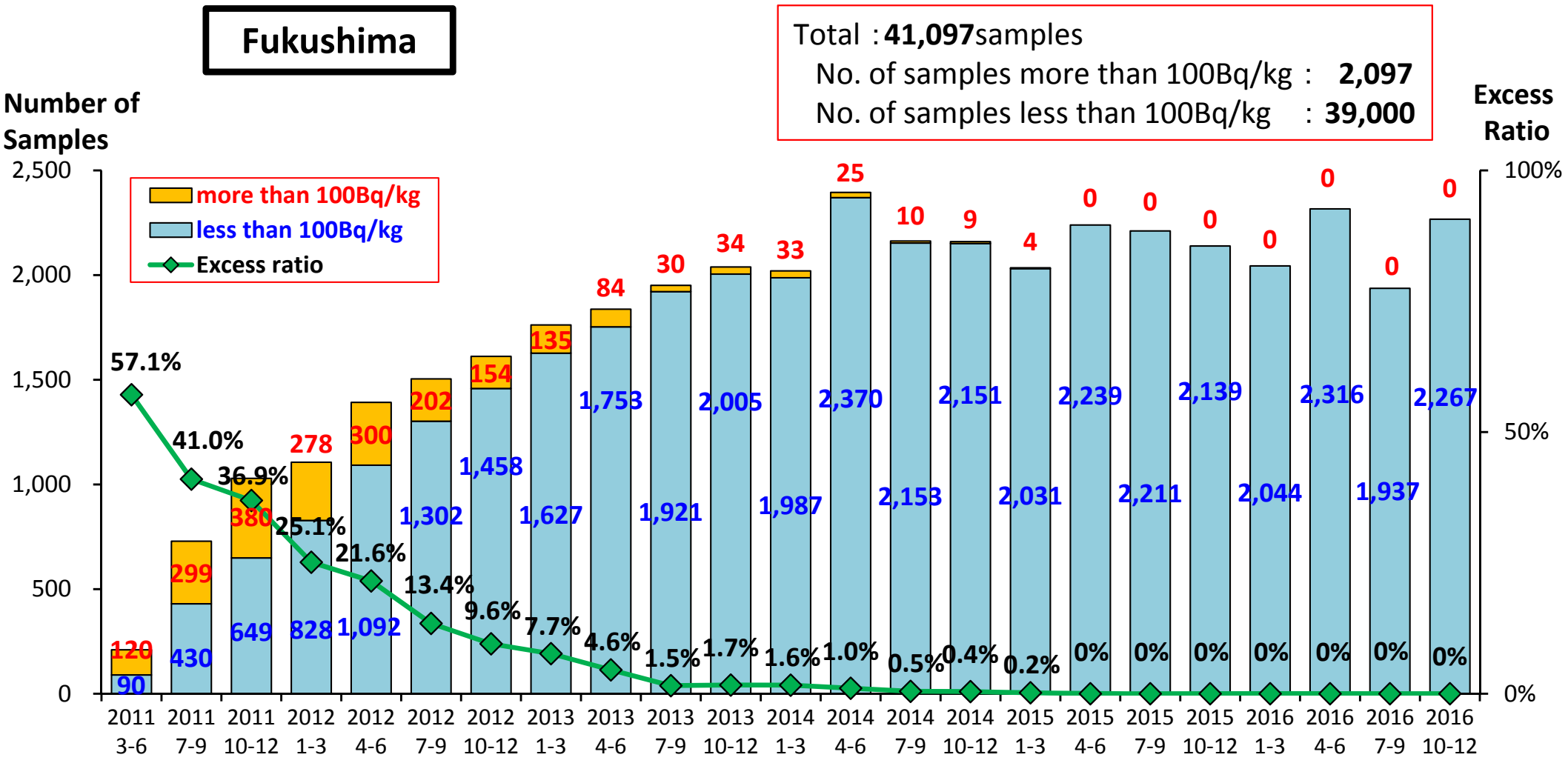
Distribution for consumption (when the monitoring result is close to the limit, a prefecture may require distribution restriction.)

Approximate to standard limit

For the effective implementation, landing of the species subject to the restriction and /or suspension is prohibited (except samples for monitoring). In addition, market people confirm that the species are not sold at ports.

Monitoring Results for Marine Fishery Products in Fukushima

- In Fukushima, Apr.–Jun., 2011, excess ratio (No. of samples more than 100 Bq/kg/Total No. of samples) was 57.1 % but was reduced by half in 1st quarter 2012. After 2nd quarter of 2012, monitoring has been focusing on species that have records more than 50 Bq/kg. The excess ratio still shows constant decrease, and it was 0% from Apr.-Jun., 2015 on.
- Coastal fishing and trawl fishing off Fukushima have been suspended except trial fishing.

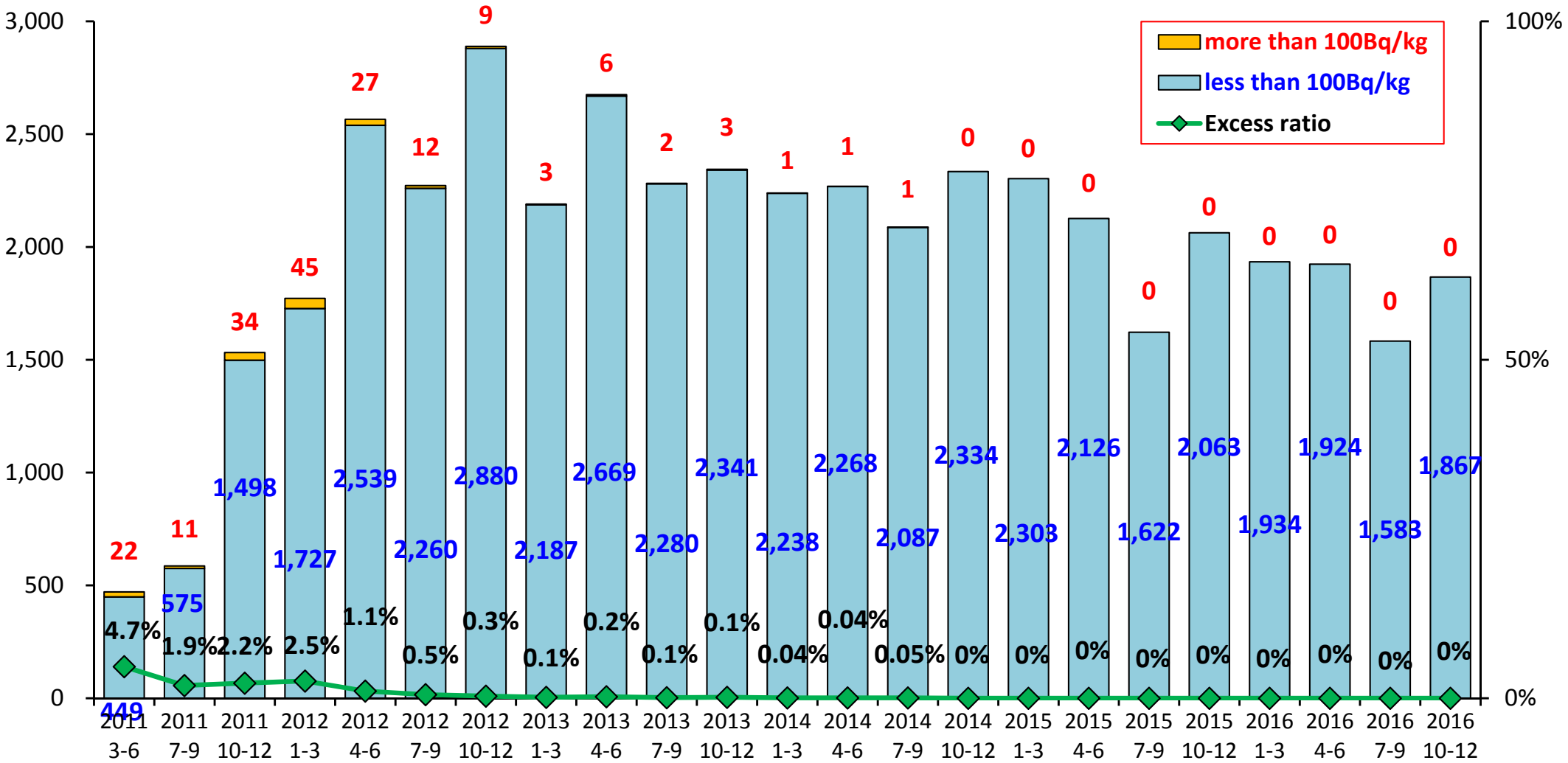


Monitoring Results for Marine Fishery Products in Other Prefectures

- In prefecture other than Fukushima, excess ratio (No. of samples more than 100 Bq/kg/Total No. of samples) has been gradually decreasing to 0% from 4th quarter of 2014 on.

Other prefectures

Total : **45,931**samples
No. of samples more than 100Bq/kg: **177**
No. of samples less than 100Bq/kg : **45,754**



Monitoring Results for Fishery Products

As a results of radioactive cesium monitoring, almost all main fishery products are confirmed to be under the Standard Limit in whole Japan including Fukushima prefecture.

Main fishery products have confirmed to be under the Standard limit in all prefectures since 1 April 2012

Algae	All species					
Mollusks	All species					
Squid/Octopus	All species					
Crustaceans	All species					
Pelagic fish	Sardines	Saury	Juvenile Japanese Sand lance	Juvenile Anchovy	Barracuda	Flying Fish
Mid-water pelagic fish	Mackerel	Swordfish	Skipjack	Tunas	Coho Salmon	Chum Salmon
	Japanese Amberjack	Mako Shark	Blue Shark	Amberjack	konoshiro gizzard shad	Japanese Spanish Mackerel
	Mahi mahi,	Capelin	Crimson Sea Bream	Yellowtail Amberjack		
Demersal fish	Blackthroat Seaperch	Horse Mackerel	Chlorophthalmus albatrossis	Striped Beakfish	Threadfin Hakeling	Black Scraper
	Red Bream (Beryx splendens)	Broadbanded Thornyhead (Sebastolobus macrochir)	Tiger Puffer	Herring	Yellowfin Goby	Purple Puffer
	Dexises rikuzenius	Japanese Flounder				
Marine mammal	Whales					

The list of fishery products and area subject to distribution suspension order as of 31 December 2016

Species	Japanese black porgy	Seabass etc.(14 species)
Part of Iwate Prefecture[b]	× [a]	
Miyagi Prefecture	×	
Fukushima Prefecture	×	×

Notice: a) × : Species and Area subject to distribution suspension order by the Chief for the Nuclear Emergency Response Headquarters (Prime Minister)

b) South of the latitude of the boundary between Iwate Prefecture and Miyagi Prifecture

Efforts toward the Food Safety of Fishery Products in Waters off Fukushima Prefecture

The State of the fishery off Fukushima Prefecture

- After the Great East Japan Earthquake, Fukushima Prefectural Federation of Fisheries Co-operative Association has decided to stop fishing activities of all the coastal and trawl fisheries off Fukushima Prefecture.
- Fukushima prefectural government conducts particularly intensive monitoring. It carries out monitoring for 200 samples of major marine species in every week.
- Fish species and sea area covered by the trial fishing operation must be determined after confirming that: 1) the species is not under distribution suspension order by the Chief of the Nuclear Emergency Response Headquarters, and 2) the levels of radioactive cesium remain lower than the Standard for a certain time period.

Responses to the recent Water Leakage

- In response to recent leakage of contaminated water from F1NPS, the trial fishing operation for actual human consumption was not resumed on 1 September 2013 even after the opening of fishery season (please see the next page for more information).
- During the suspension period, Fukushima prefectural government monitored water samples of coastal sea off Fukushima prefecture, and confirmed that the level of radioactive cesium and total beta ray in water samples were the same level before the accident. Fukushima prefectural government also confirmed that concentration of radioactive Cs in fishery products were still in trend of decrease.
- After the confirmation by Fukushima prefectural government, the trial fishing operation for actual human consumption was resumed in offshore bottom trawling fishery on 25 September 2013.

Future of trial fishing operation

- Fukushima Prefectural Federation of Fisheries Co-operative Association intends to expand both species and areas of the trial fishing operation for actual human consumption subject to confirmation of food safety through monitoring.

<Reference> The State of the Trial Fishing Operation for Actual Human Consumption in Fukushima Prefecture

The target species of trial fishing operation: 94 species (exclude overlap), as of 31 Dec. 2016

<Fishes: 68 species> Green ling**,** Greeneyes, Red barracuda, Flathead flounder, Red tongue sole, Rosy seabass, Red scorpionfish, *Salangichthys isikawae*, Scraper, Brown hakeling, Giant sea bass, Dory, Skipjack tuna, Kanagashira (*Lepidotrigla microptera*), Greater yellowtail, Angler fish, Thornhead, Bluefin tuna, Sea raven, Kounago (Juvenile of Japanese sandlance), Southern mackerel, Ocellate spot skate, Finepatterned puffer, Poacher, Roughscale sole, Halfbeak, Japanese Spanish mackerel, Mahi-mahi, Puffer, Noodle fish, Whitebait, Drum, Dogsalmon, Alaska pollock, Pointhead flounder, Beltfish, Crimson sea bream, Tiger Puffer, Long shanny, Nagaremeitagarei(Pleuronicthys japonicus),Nibe croaker, Slime flounder, Takifugu parrdalis, Blackfin flounder, Yellowtail Amberjack, Japanese flounder, Yellowtail, Gurnard, Spotted halibut, Starspotted smooth-hound, Japanese jack mackerel, Conger eel, Sardine, Yellowstriped flounder, Marbled flounder, Flathead, Chub mackerel, Sea bream, Pacific cod, Barfin flounder, John dory, Purple puffer, Rikuzen flounder, Frog flounder, Roundnose flounder, Pacific barrelfish, Willowy flounder and Hilgendorf saucord

<Crustacean: 8 species > Swimming crab, Horsehair crab, Snow crab, Prawn, Hiratsume-gani (*Ovalipes punctatus*), Beni-zuwai crab(Chionoecetes japonicus), Botan shrimp and Deepwater prawn

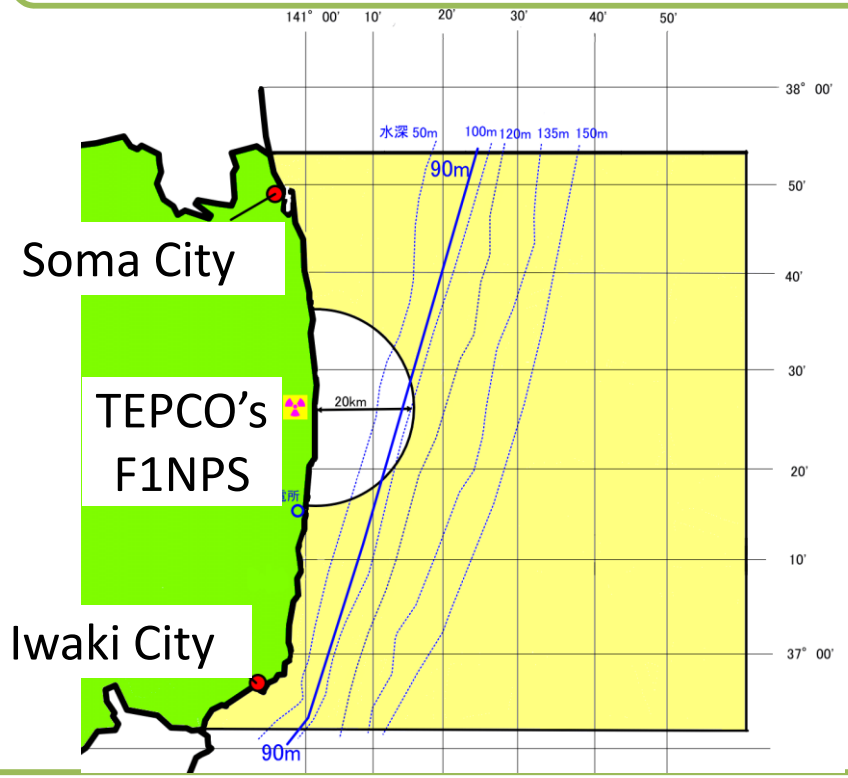
<Squids and Octopuses: 7 species > Swordtip squid, Japanese dwarf squid, Japanese flying squid, Common octopus, Giant Pacific octopus, Chestnut octopus and Spear squid

<Shellfishes: 9 species > Asari clam, Abalone, Double sculptured neptune, Japanese whelk, Whelk(*Neptunea constricta*), Whelk(*Beringius polynematicus*), Arthritic neptune, Sakhalin Surf Clam and Volutharpa

<other spechies: 2 species> Sea slug (*Parastichopus nigripunctatus*), Northern sea urchin

- All 94 species above are targeted by offshore bottom trawlers, coastal gillnet fishery, coastal driftnet fishery, octopus pot fishery, coastal pot fishery Longline fishery and fishing fishery.
- 5 species (*Salangichthys isikawae*, Kounago (Juvenile of Japanese sandlance), Whitebait, Halfbeak and Noodlefish) are targeted by coastal pelagic trawlers.
- 2 species (Abalone and Northern sea urchin) is targeted by diving fishery.
- Sakhalin Surf Clam is targeted by dredge net fishery.
- Asari clam is targeted by Aquacultual fishery.
- Conger eel is targeted by Conger eel Pot and Trap fishery.

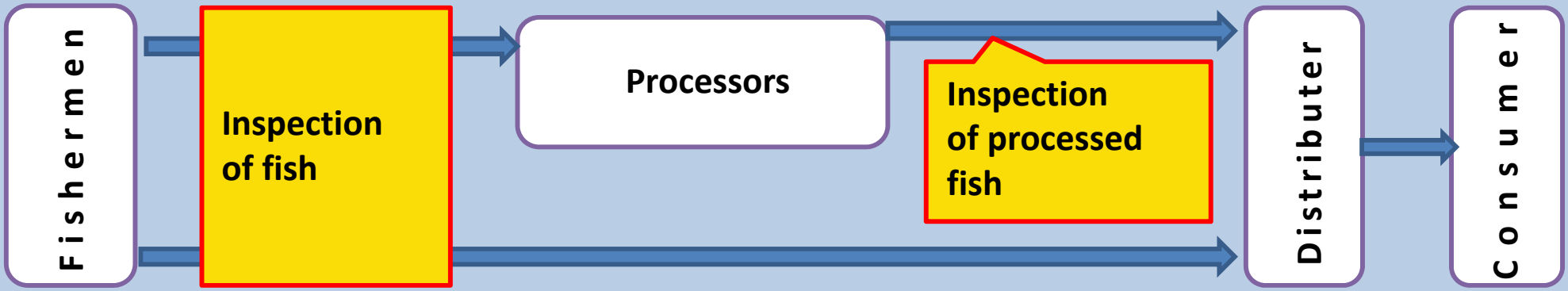
The area of trial fishing operation as of 31 Dec 2016



Distribution of the fish products

- Since June 2012 to Dec 2016, 9,800 products(fresh or boiled) are inspected for radioactive cesium after being landed.
- These results are publicized on the home page of Fukushima Prefectural Federation of Fisheries Co-operative Association.(Japanese only) http://www.jf-net.ne.jp/fsgyoren/siso/sisotop.html

Inspection of radioactive materials and the distribution management of the fish products are conducted under the initiative of the Fukushima Prefectural Federation of Fishery Cooperative Association.



Strontium-90

- The influence of strontium-90 in food to human health was fully considered when the current standard limit for radioactive cesium (100Bq/kg-wet) was established.
- Therefore, there is no need to worry about influence of strontium-90 when the level of radioactive cesium is below 100 Bq/kg-wet.

Concept of standard limit

- The current standard limits were established with full consideration of the influence to human health from both radioactive Cs(134+137) and radionuclides other than Cs (i.e. Sr-90, Ru-106, Pu) because it takes a lot of time to measure those radionuclides other than Cs (ref. Ministry of Health, Labour and Welfare HP).
- The effective dose from radionuclides other than Cs is assumed to be about 12% of the total effective dose from food (i.e. 0.9mSv/year).

→ 1 mSv (the same value of annual effective dose for food and drink set by Codex ←

Drinking water ca. 0.1mSv	Food ca.0.9 mSv	88%(0.79mSv) of 0.9 mSv from radioactive Cs,12%(0.11mSv) of 0.9 mSv from Radionuclides other than Cs

(Codex : http://www.codexalimentarius.org/)

Strontium-90 in fishery products

- Most of the survey results of Sr-90 ※1 were below the detection limit in the fishery products (especially in fish). In case of the detection of Sr-90, the concentrations of Sr-90 in such samples were low, ranging from 0.015 to 1.2 Bq/kg-wet.
- Based on these Sr-90 levels, and assuming daily consumption of 2.1kg (adult male's average food consumption (except drinking water)) ※2, the annual exposure dose of Sr-90 for human was estimated to be from 0.00032 to 0.026 mSv. These levels do not raise concern, because they are far below 0.11 mSv, which were considered as annual dose from radionuclides other than radio-Cs.

(※1 Strontium data: http://www.jfa.maff.go.jp/j/housyanou/kekka.html, ※2 Average food intake of adult male: http://www.caa.go.jp/jisin/food_s.html)

Strontium-90 and Tritium

Strontium-90 (half-life: 28.8 years)

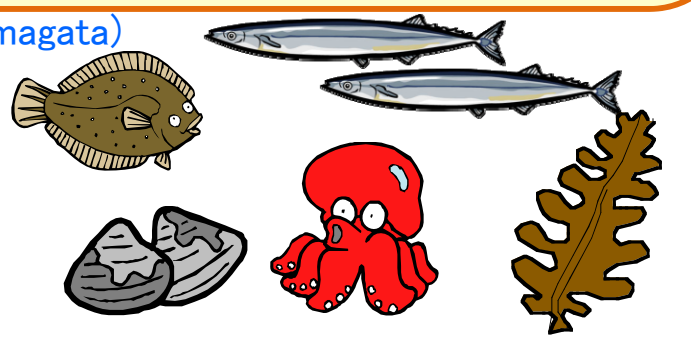
- Conversion factor (Bq to Sv) of effective dose for strontium-90 is about 2.2 times higher than that of cesium-137 (by the factor for adult in ICRP Publication 72).
- However, the concentration factors(the ratio of the concentration in organism to that in water) for strontium-90 in marine aquatic organisms were lower than those for cesium. That indicates that most of strontium-90 taken in organism is rarely absorbed and is excreted out.

Tritium (half-life: 12.3 years)

- The standard limits do not consider effect from tritium because the influence of tritium in food to human health is considered to be sufficiently small (ref. Ministry of Health, Labour and Welfare HP).
- Conversion factor of effective dose for tritium is about 1/700 of that of cesium-137 (by the factor for adult in ICRP Publication 72).
- Tritium mainly exists as water in nature. Therefore, tritium taken in organism is rarely kept in the body and is excreted out promptly. Consequently, the concentration factors for marine organisms are about 1.

Concentration factor (ref. IAEA TRS 422; Bio-concentration, Edit. N. Yamagata)

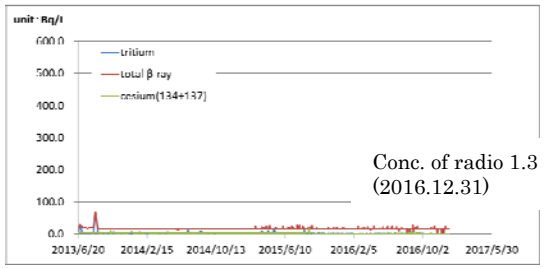
	Fish	Mollusks	Macroalgae
Cesium	5 ～ 100	10 ～ 60	10 ～ 50
Strontium	1 ～ 3	1 ～ 10	10
Tritium	1	1	1



Influence of the contaminated water in the port of F1NPS

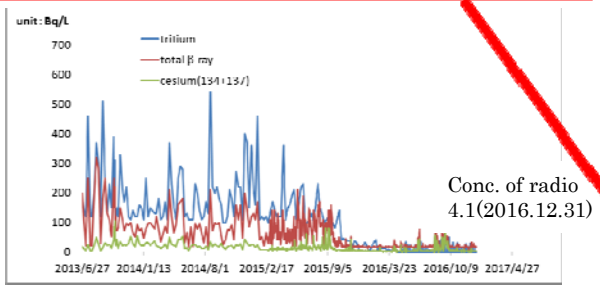
- ○ May 2013, a high level of tritium was detected in ground water at the seawall area between intakes of unit 1 and unit 2（※） of Fukushima Daiichi Nuclear Power Station (F1NPS). TEPCO investigated this case and confirmed that the contaminated water had leaked into the port of F1NPS in July 2013.
- ○ Though a certain level of radionuclides was detected in the seawater within the port, the level in outside is below detection limit at most sampling points. No significant influence of the contaminated water has been detected outside of the port.
- ○ In order to prevent the contaminated fish in the port moving outside, TEPCO constructed the fence and net at the port entrance. TEPCO also have been catching the fish in the port (ref. TEPCO HP).
- ○ After the seaside impermeable wall was constructed in the port in October 2015, the radionuclides in the seawater of the port was futher reduced .

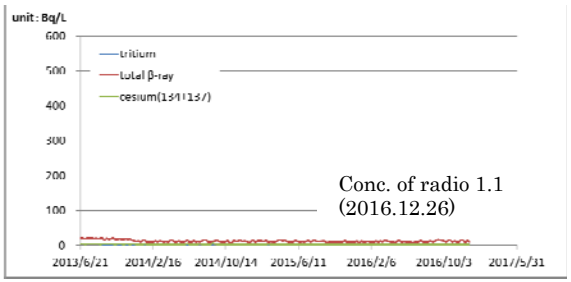
(B)Entrance of the port



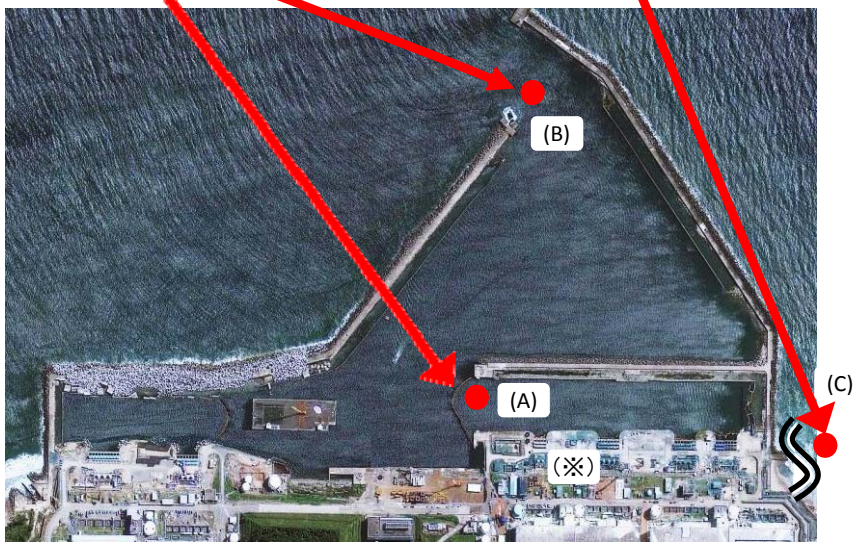
The values of detection limit were plotted in the cases when the detected radioactivity concentration was lower than the limit.

(A)Point north side of Unit1-4 water intake channel (north side of East Seawall Break)





(C)Point near the south discharge channel



Comparison of the amount of radionuclides in the contaminated water leaked in Apr.2011 with that in the contaminated water leaked from May.2011 to Aug.2013, which was estimated by TEPCO.

radionuclides	the amount of radionuclides in the contaminated water leaked in Apr.2011		the amount of radionuclides in the contaminated water leaked since may.2011, which was estimated by TEPCO	
	leak periods	leak amount (unit:Bq)	leak periods	leak amount (unit:Bq)
cesium134+137	6days	ca.18 x 10^{14}	–	
cesium137	6days	ca.9.4 x 10^{14}	ca.800days	ca.1 x 10^{12}～ca.2 x 10^{13}
strontium-90	–		ca.800days	ca.7 x 10^{11}～ca.1 x 10^{13}
tritium	–		ca.800days	ca.2 x 10^{13}～ca.4 x 10^{13}

Note:220 Bq/L(2013/8/19 sampling),49 Bq/L (2013/8/19) and 0.29 Bq/L (2013/6/26) of strontium-90 were detected at the Stns.(A),(B)and(C), respectively.

(prepared by Fisheries Agency based on information from TEPCO)