

Fukushima Field Trip for ICU PRI

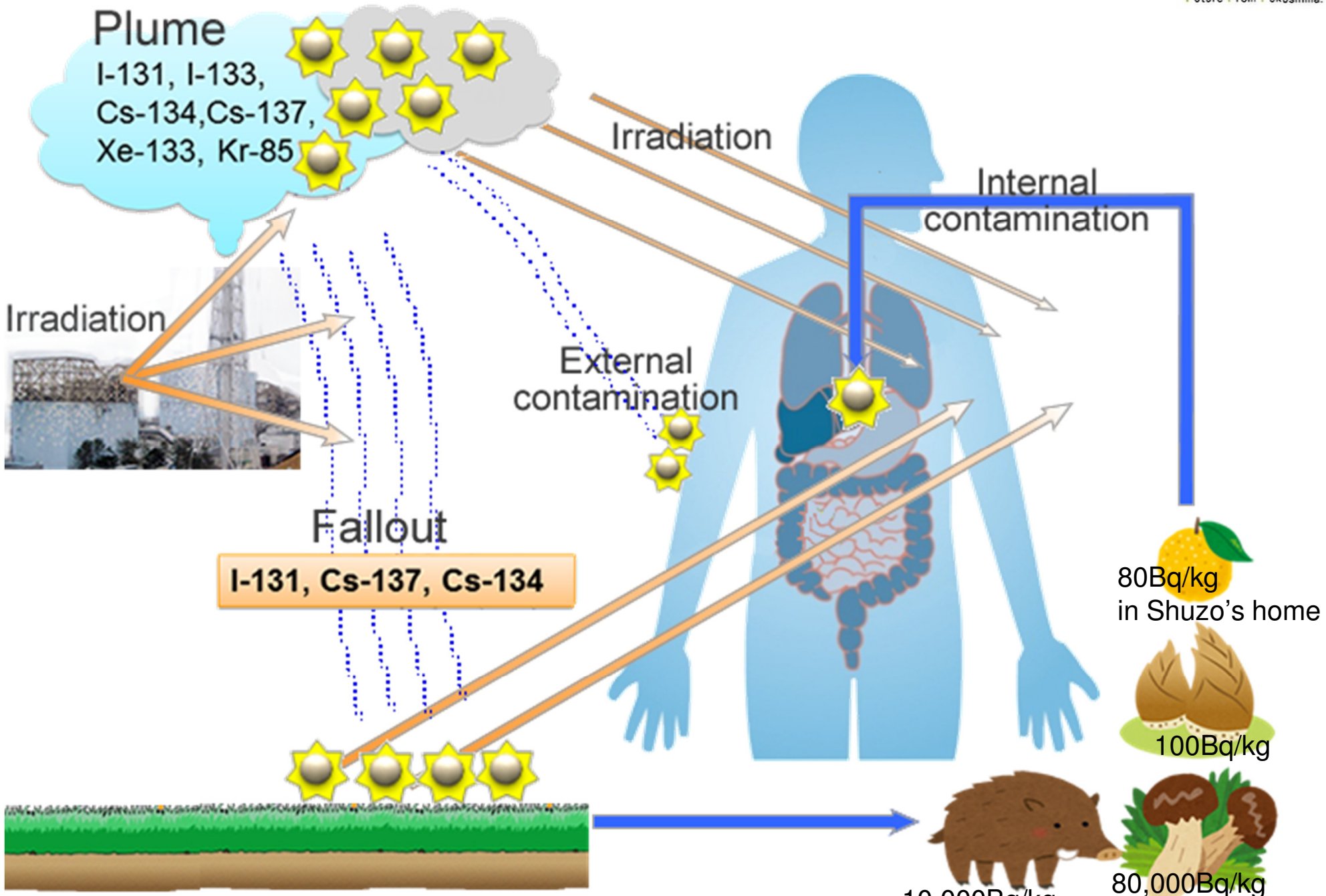
Friday, October 30th
8:00 Leave ICU --> 12:00 Lunch at J Village --> Drive around Daiichi NPP -->Meet Mr Isuke Takakura --> Ukedo Elementary School --> Futabaya Ryokan --> Walk around Odaka Town -->Dinner --> Q&A Session with the guide

Saturday, October 31st
8:00 Leave the inn --> Mr Issei Hangui --> Meet Shizue chan --> Shuzo's home --> Ranch of Hope --> Lunch at Roadside Station Namie --> Meet Mr Norio Kimura --> Futabaya Ryokan --> Our Art Museum --> Dinner --> Watch Fukushima 50

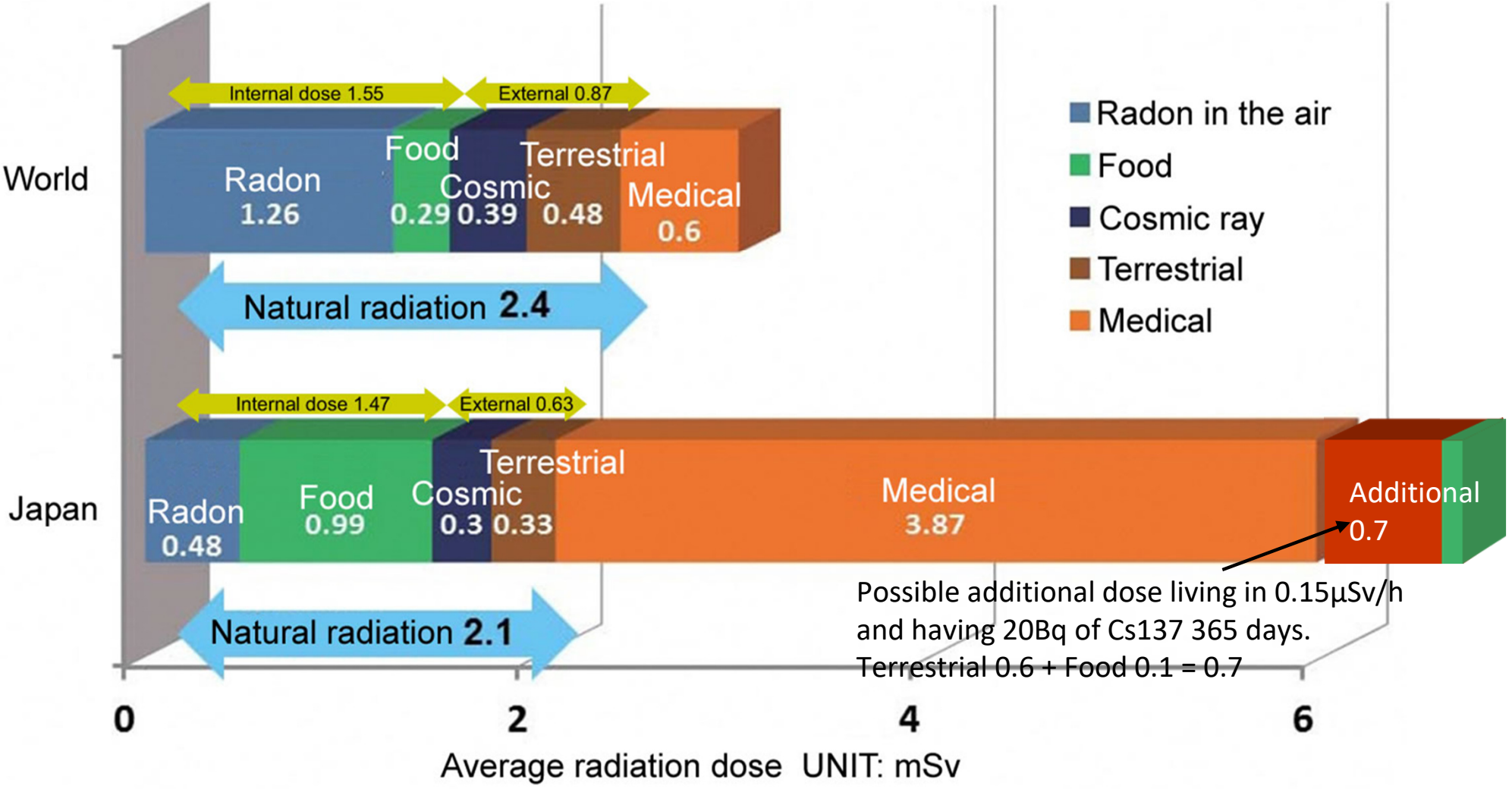
Sunday, November 1st
8:00 Leave the inn --> Futaba St. --> Memorial Museum --> Meet Mr Ikuo Izawa --> Lunch at Okuma New Town Center --> 13:00 Kiwifruite farm -->1345 Leave Fukushima for Tokyo -->18:00 ICU

https://fks-ab.co.jp/icu-fukushima/

Mode of radiation exposure



Natural and medical radiation dose



- Radiation from food is high in Japan because of high polonium intake from seafood.
- Inhalation of radon is low in Japan because of natural ventilation of housing

Radiation in daily life

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Natural Radiation



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Unusually high natural radiation dose in downtown Guarapari, Brazil

Average annual dose to aircrew flying 800 hours per year **5**



Food/drinks



Radon gas from ground



Cosmic rays



Buildings/soil

2.4
Annual natural background radiation



0.08
Air passage from Hong Kong to North American

Researchers say if you receive 100 millisieverts your cancer death risk would rise 0.5% in your lifetime.

Effective dose (mSv)

10
1
0.1

Man-made Radiation

20
Annual dose limit for radiation worker



6.6
Average effective dose from CT scan



1.0
Annual dose limit for general public (except medical exposure)



0.6
Average effective dose from single abdominal x-ray



0.13
Average effective dose from mammogram



0.05
Average effective dose from single chest x-ray



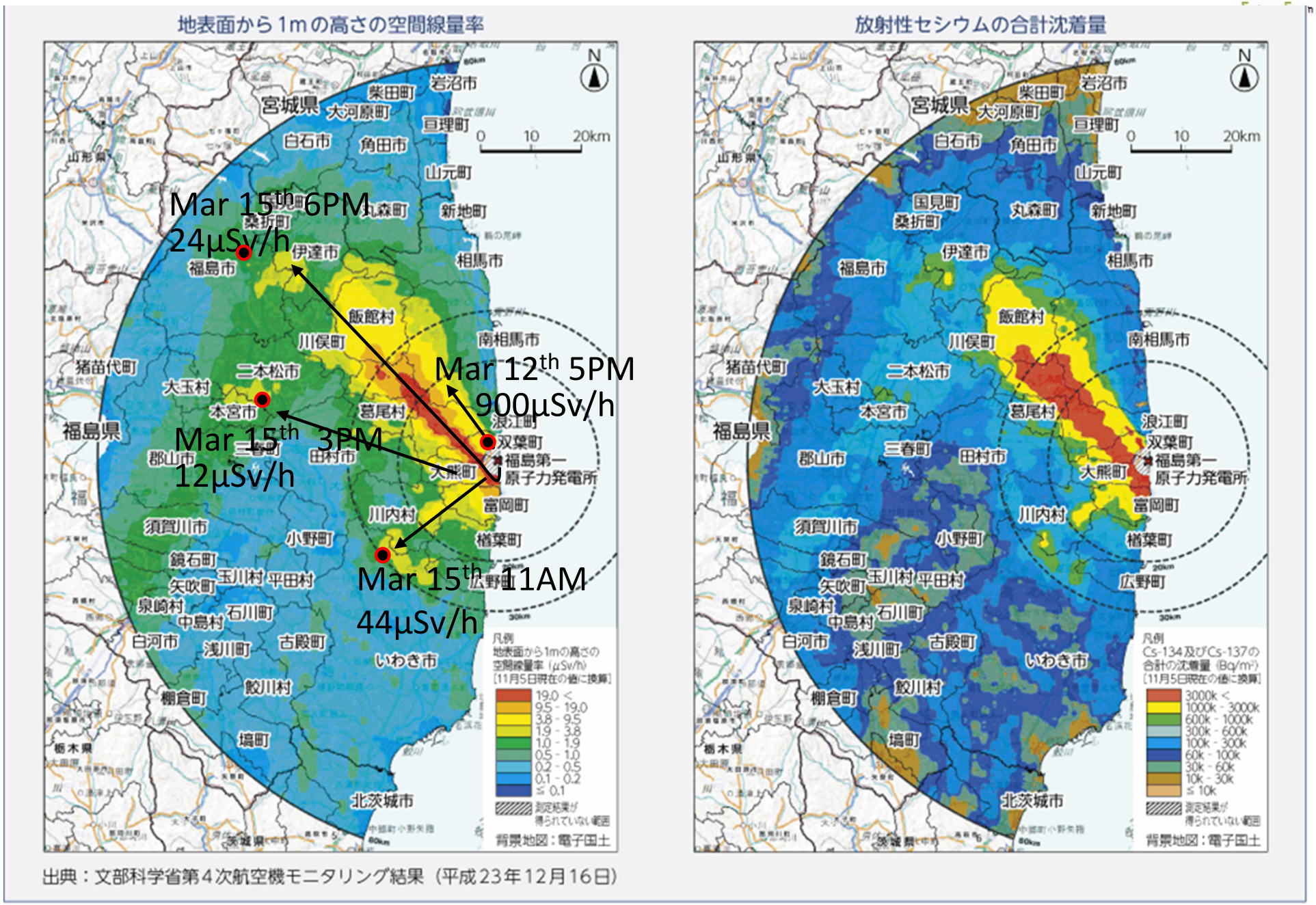
0.01
Dental x-ray

10,000
Death in a week

3,000
Survival rate 50%

250
Dose limit for Fukushima Daiichi 2011 workers

Time and direction of the radioactive emission



The radioactive emission on March 12th caused contamination of body surface to more than 100 people.

Population of evacuation zone

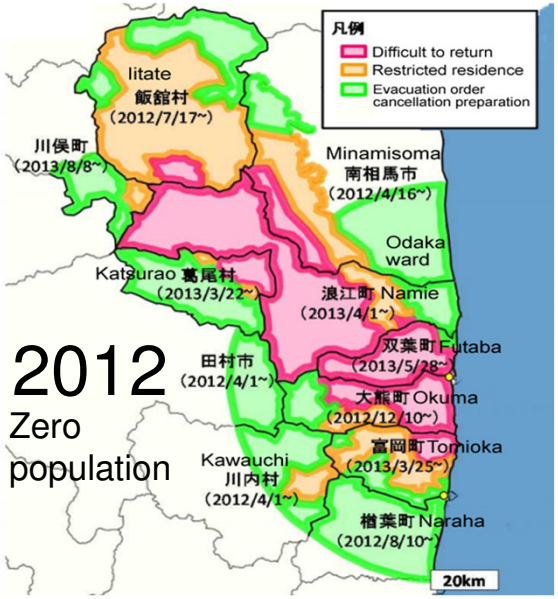
88,000 before the accident

19,000 at June 2025

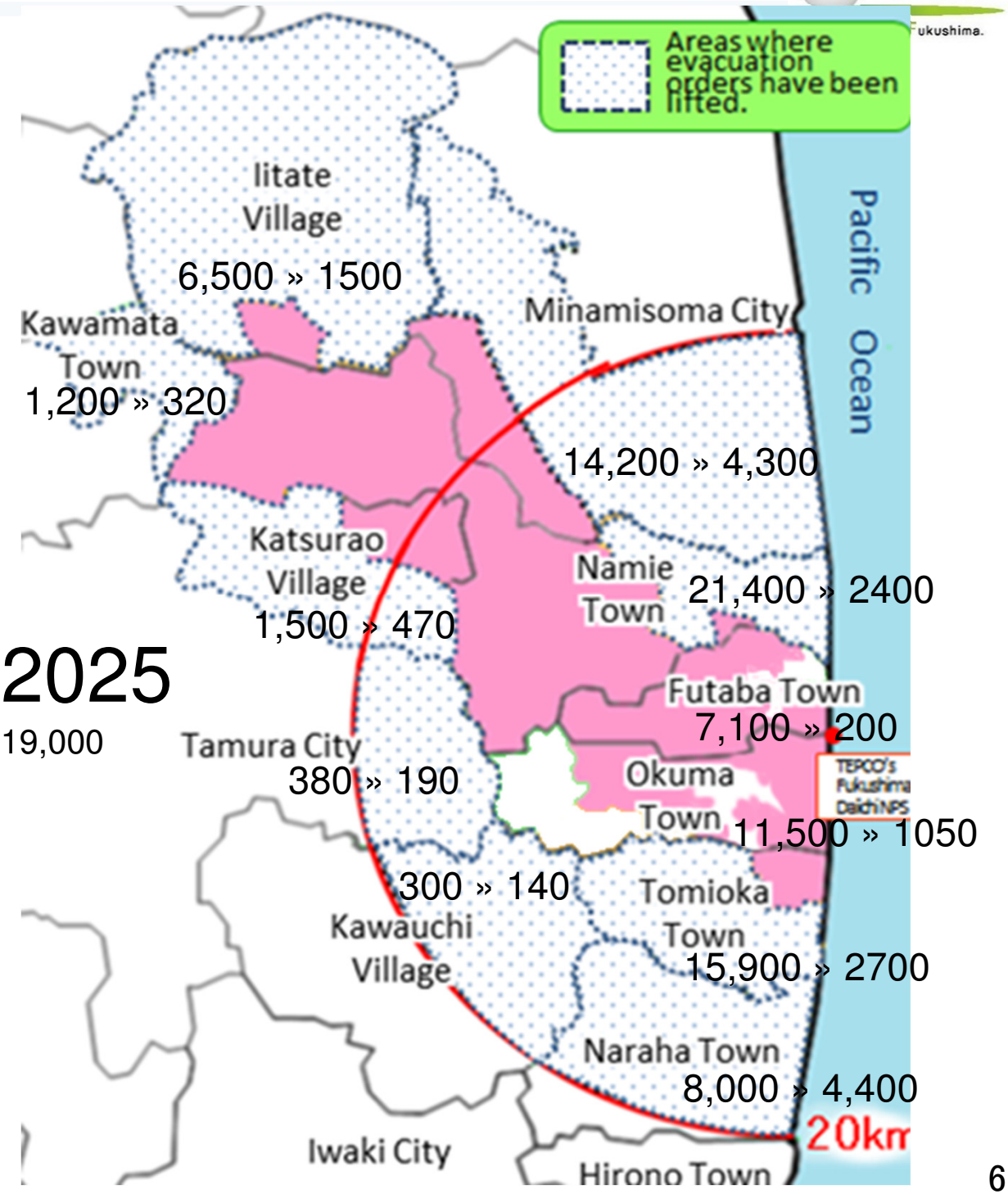


2011
Zero population

Completely shut off area



2012
Zero population



2025
19,000

311 disaster Timeline

March 11th 14:46 Earthquake



50 minutes later 15:37 Tsunami



March 12th, 14:30 Vent from Unit 1



March 12th 15:36 Explosion at Unit 1



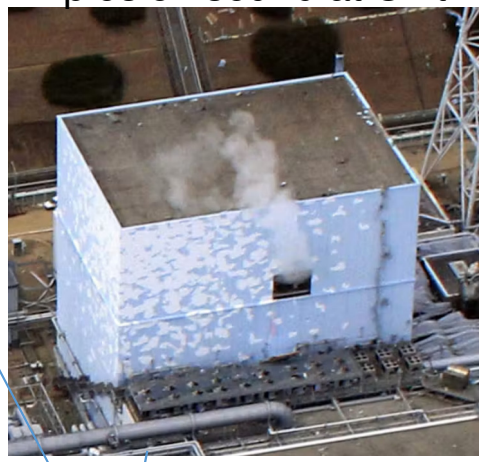
March 14th 11:01 Explosion at Unit 3

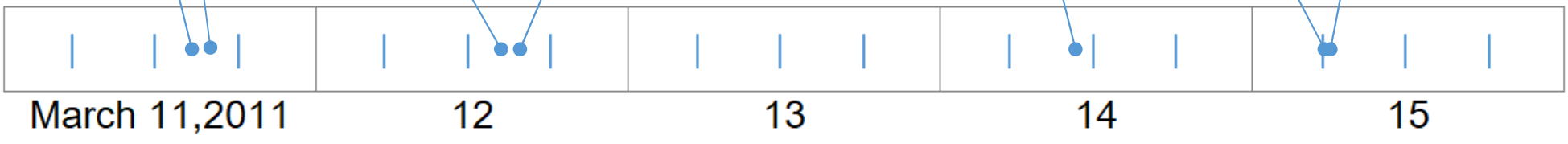


March 15th 6:12 Explosion at Unit 4



15th 6:14 Explosion sound at Unit 2





Radioactivity air dose rate at eight points



R1 exploded 3/12/15:36



R3 exp. 3/14/11:01



R4 exp. 3/15/06:14



R1 vented 3/12 14:30



R2 leakage made major contamination

- Radioactive plume passed over Minamisoma and Iwaki several times. Maybe main content was gas like radioactive Xenon and Iodine131.
- Plume got down to the ground in Fukushima City and Iitate. It contained Iodine131 and Cesium137/134.



Now and Then

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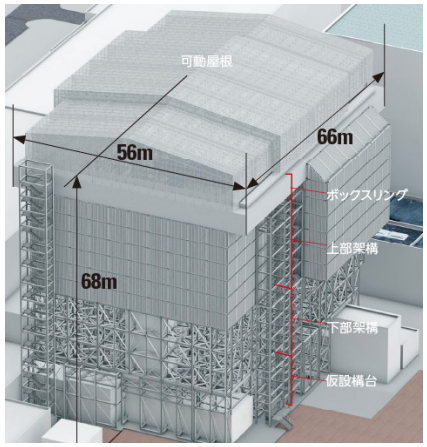
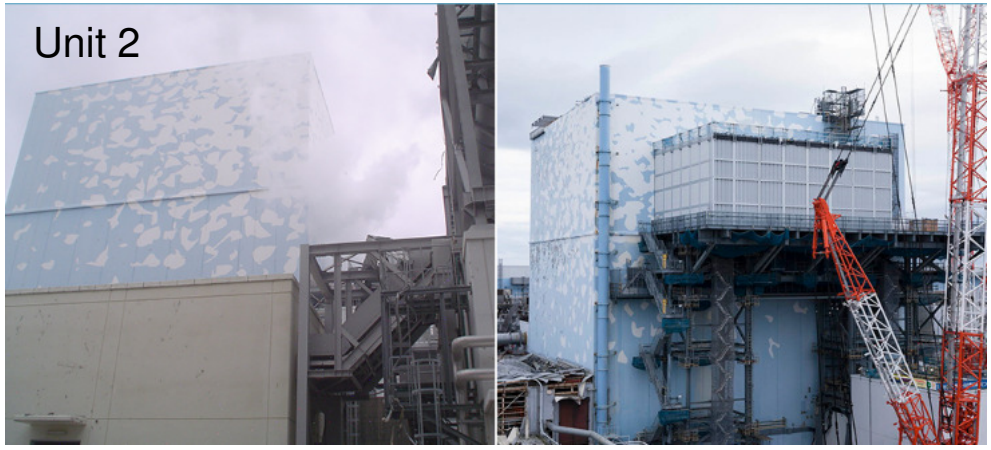
Unit 1



Unit 4



Unit 2



Unit 5 and 6



Unit 3



Fukushima Daiichi(No.1) Nuclear Power Station

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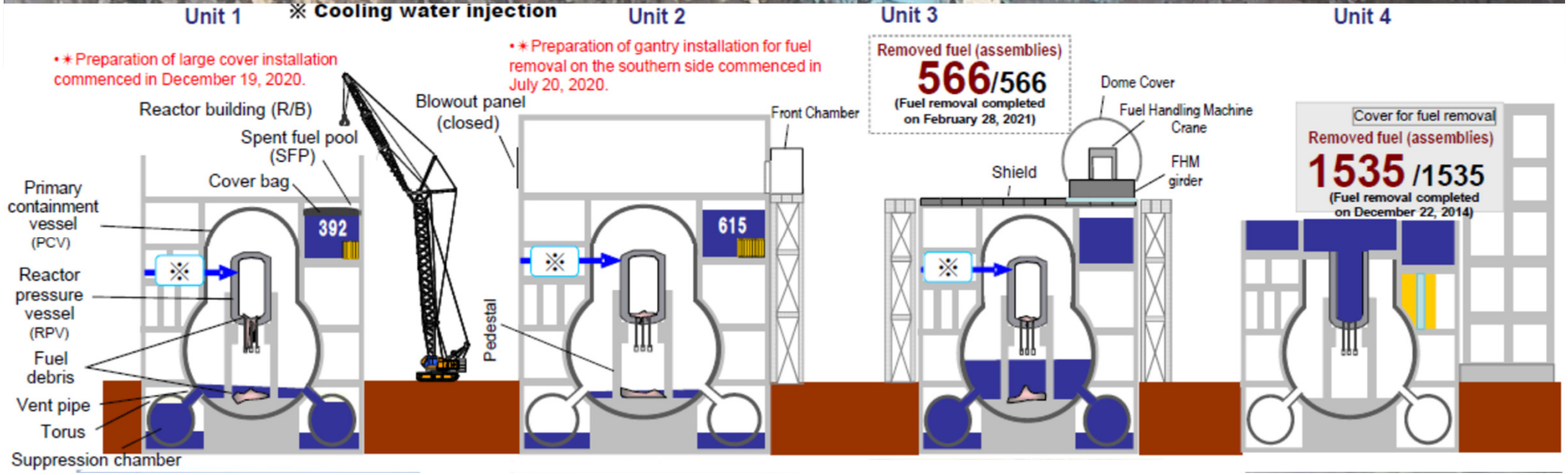

-meltdown & exploded





-meltdown





-meltdown & exploded





-exploded





Behavior of Cesium

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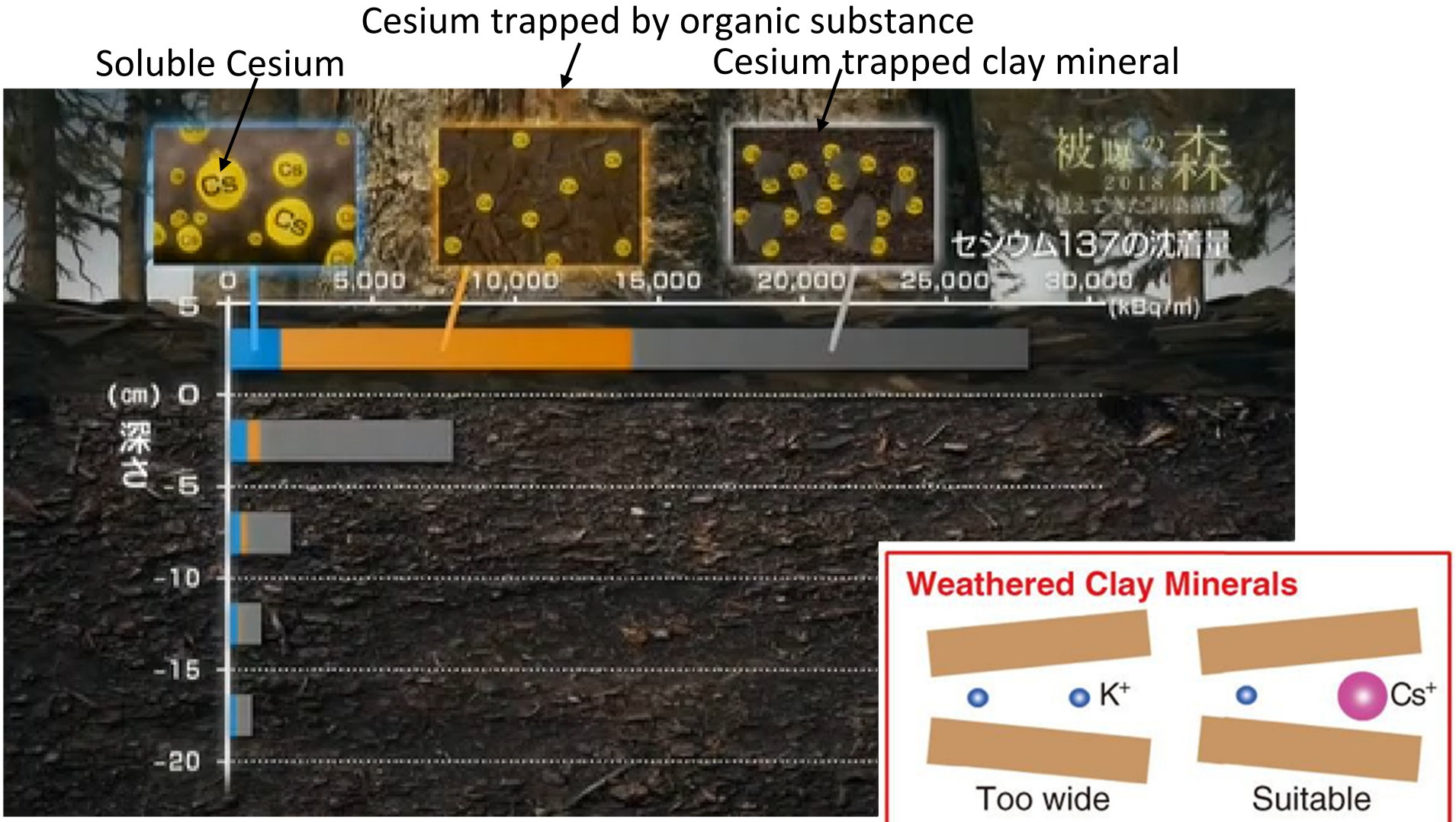
Cesium137 stays in surface of the ground.



Decontamination work

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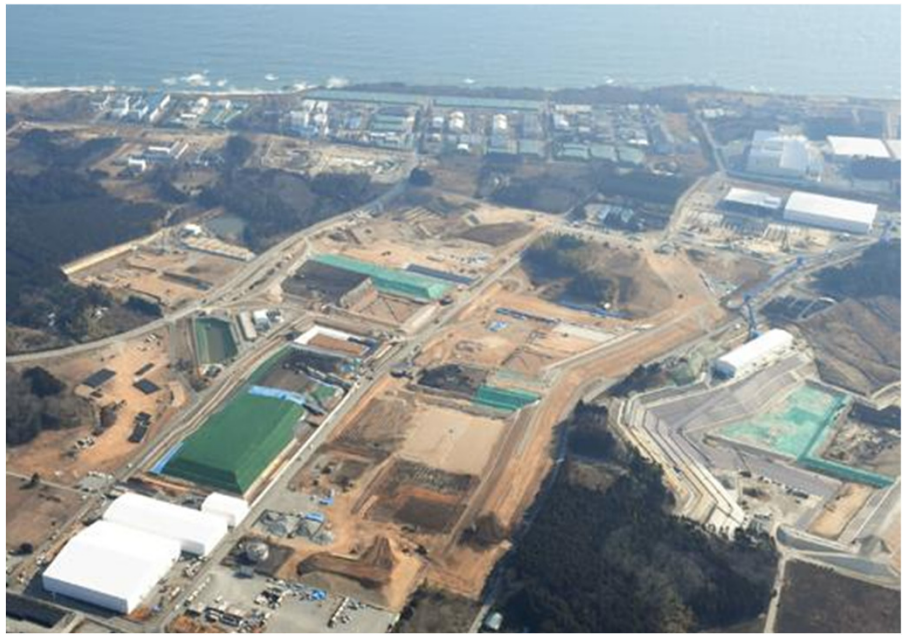


Thirty year soil storage area - Process

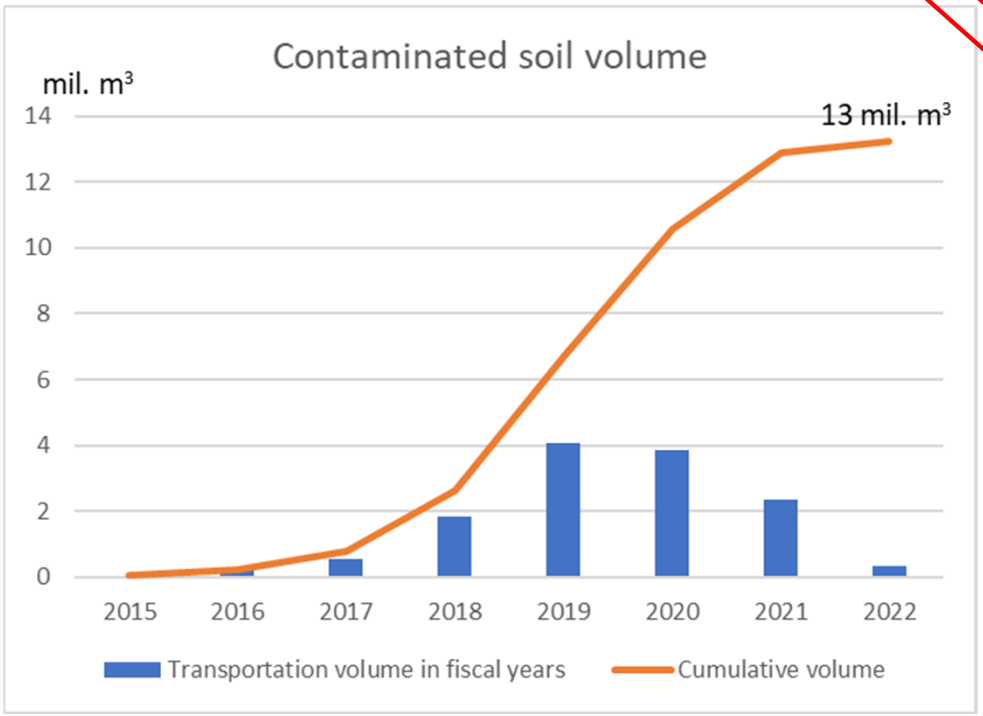


Non burnable



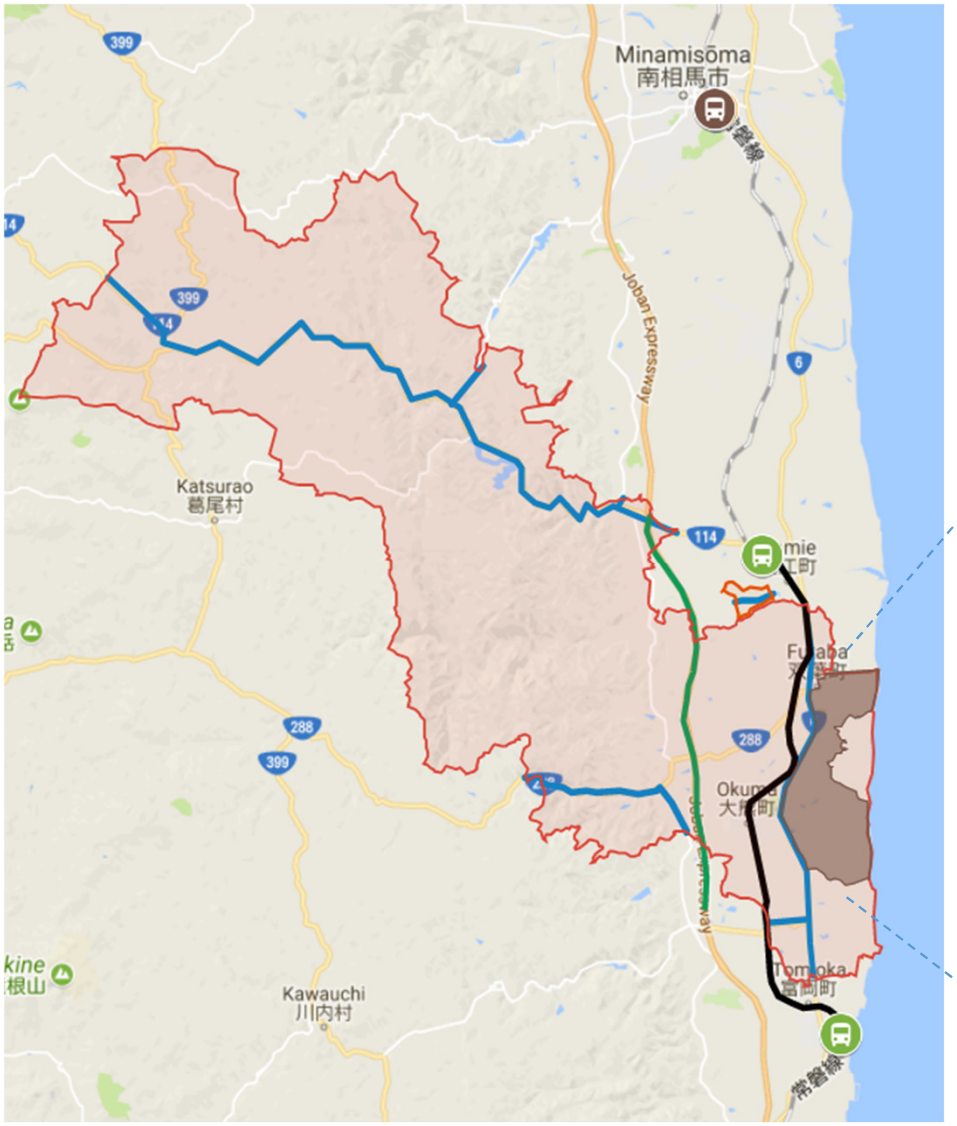
burnable

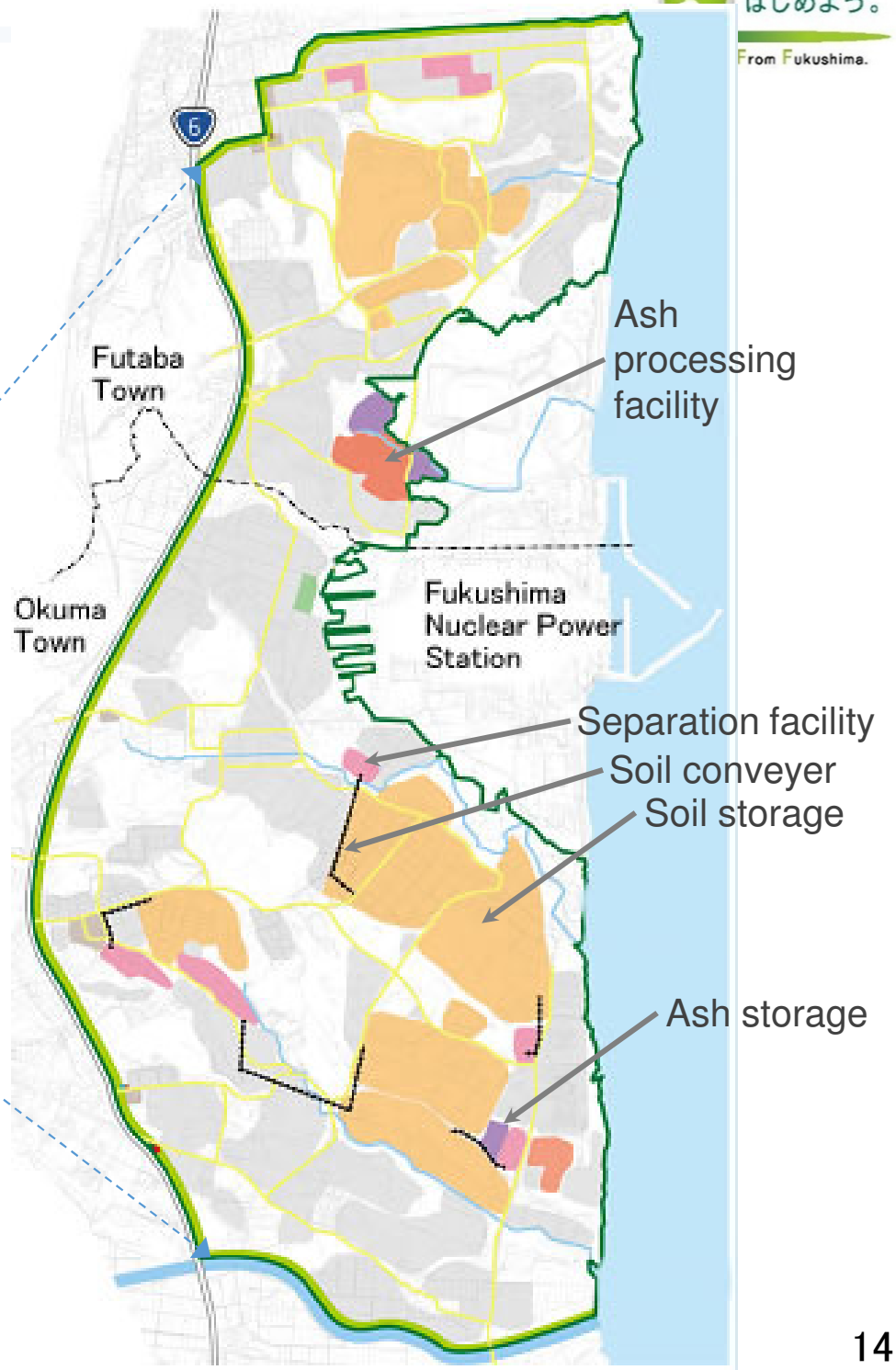
ashes





Thirty year soil storage area





Fukushima Daini (No.2) Nuclear Plant Survived





Daini has 4 reactors with 1.1GW turbine unit each. Tsunami flooded them and cooling systems got down. Evacuation was ordered to 10km radius. Luckily 1 of 4 power lines survived. TEPCO renewed flooded motors of cooling systems and connect them with the survived power line setting 9 km of cables by 200 workers.

It was three hours before the planned vent when the cooling system resumed. TEPCO succeeded to cool down the four reactors on March 15th.
This is called Daini's miracle. It saved east Japan



Tsunami ran up a road and flooded all four reactor units.



Two hundreds of TEPCO workers carried and set 9 km of cable.

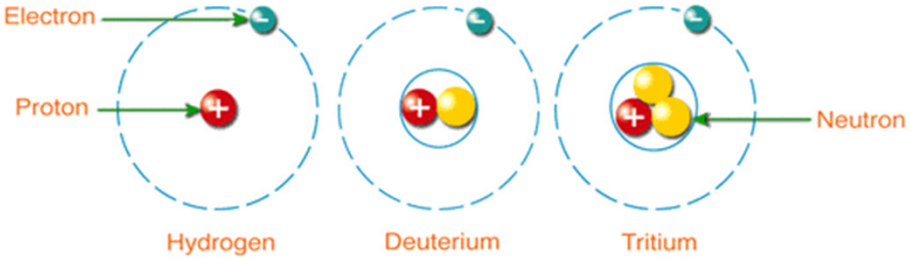


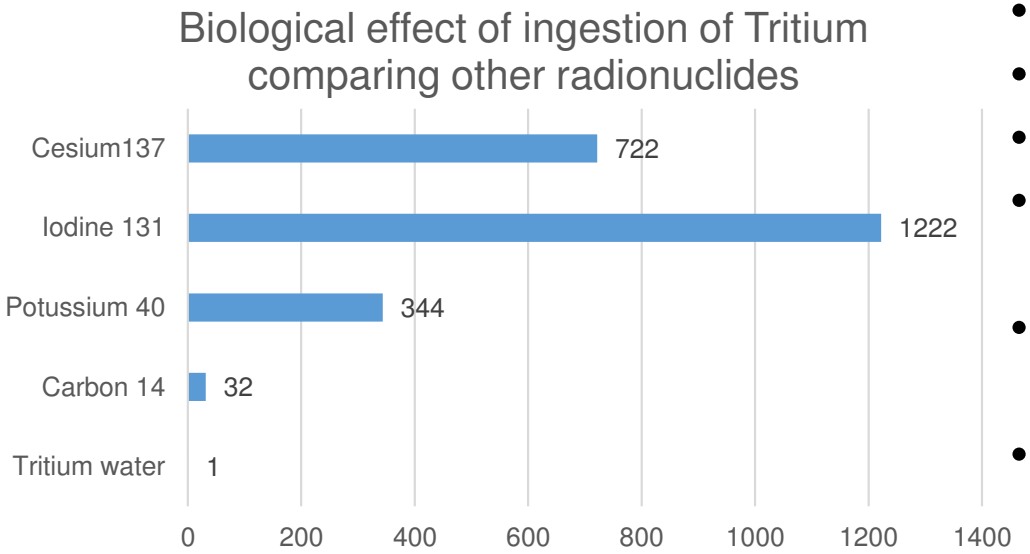
They renewed cooling system motors.

Tritium water tanks occupy the Daiichi site



There are 1000 tanks, which contain 1 million tons of Tritium water. Tritium amounts 1 Peta Bq in the site.





[What is Tritium]

- H3 – one proton with two neutrons
- Exists as HTO (normal water is HHO)
- Physical half life time - 12 years
- Effective half life time – 12 days
- Emits β particle with 0.0186 MeV
- Sea water contains 0.1Bq/L
- Rain water contains 0.3Bq/L
- Daiichi released 2 Trillion Bq of tritium to the ocearn in a year before the accident.
- Nuclear fuel reprocessing facility in UK or France releases 1-10 Peta Bq in a year
- Biological effect of swallowing Tritium is 1/344 of Potassium 40.

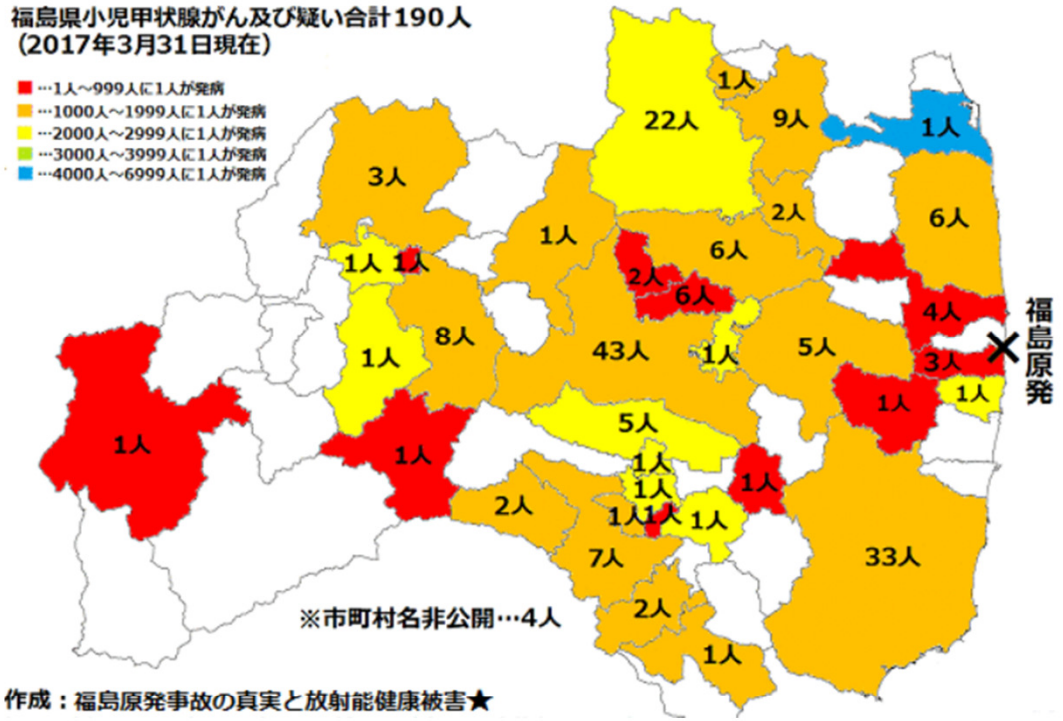
Futaba Hospital

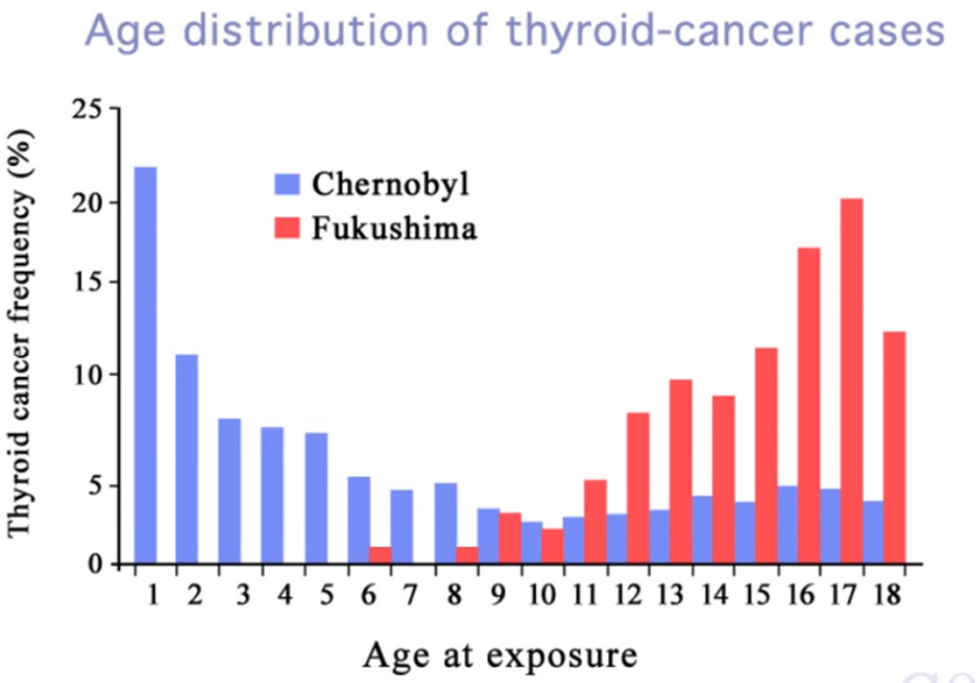
The difficult point in responding to the nuclear accident is that "Few people help the vulnerable.“
Forty-one patients at Futaba Hospital died due to evacuation. Four patients were found dead in the hospital one month after the accident.
There were 338 patients and 149 staff members in the hospital when the earthquake occurred. 209 patients could walk by themselves and were evacuated by bus on March 12th. 34 patients were carried out by bus on the 14th. 90 patients and 4 staff members were left. All staff evacuated at 10 PM on March 14th since reactor #2 seemed so serious. SDF found the 90 patients the next morning. SDF carried them out of town by 0:30 on March 16th.
By March 16th, 21 patients died. About 20 died by the end of March. Four bodies were found in the hospital in April. One patient is still missing.



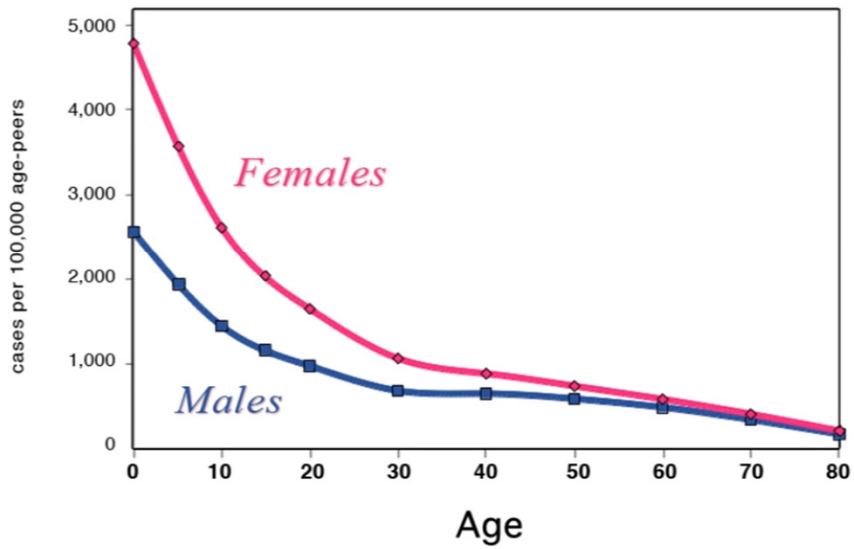


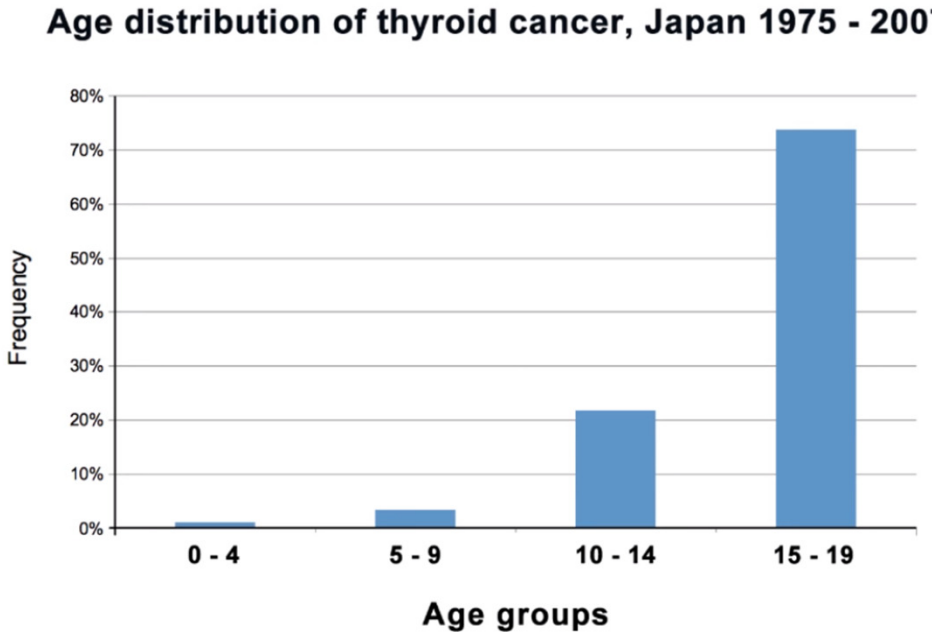
Thyroid cancer and suspected cases – over 200





Increased Cancer Risk by Age at Exposure to 100 mSv Radiation





The estimate of the total cost of the nuclear disaster

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In trillion JPY (billion USD) / GDP of Japan is 5 trillion USD / 1$=109JPY

Who pays?	Decommision	Compensation	Decontamination	Soil storage	Total
TEPCO	¥8 ($75)	¥3.9 ($37)	¥4 ($38)		¥15.6 ($147)
Major electric companies		¥3.7 ($34)			¥3.7 ($34)
New electric companies		¥0.24 ($2)			¥0.24 ($2)
Government				¥1.6 ($15)	¥1.6 ($15)
Total	¥8 ($75)	¥7.9 ($73)	¥4 ($38)	¥1.6 ($15)	¥21.5 ($202)

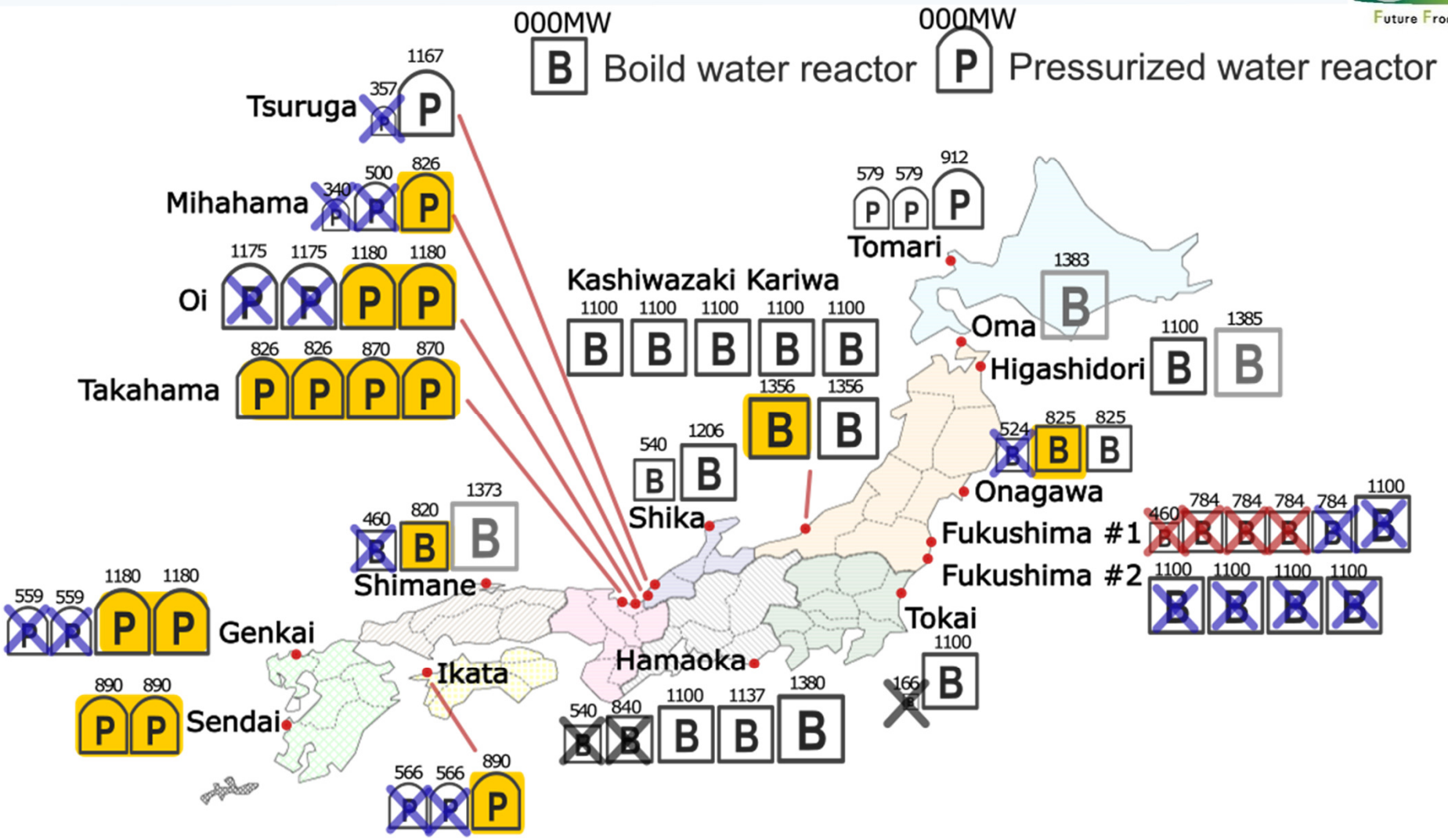
Estimated in 2016

In trillion JPY (billion USD) / GDP of Japan is 4.5 trillion USD / 1$=155JPY

Who pays?	Decommision	Compensation	Decontamination	Soil storage	Total
TEPCO	¥8($51)	¥4.54($29)	¥4.5($29)		¥17.0($109)
Major utilities		¥4.31($28)			¥4.3($28)
New EPCOs		¥0.28($2)			¥0.3($2)
Government				¥1.6($10)	¥1.6($10)
Total	¥8($51)	¥9.2($59)	¥4.5($29)	¥1.6($10)	¥23.4($150)

2023

Nuclear Reactors in Japan



- 4 reactors – Meltdown or exploded
- 17 reactors – Decided to be decommissioned after Fukushima accident
- 3 reactors – Already decided to be decommissioned before Fukushima accident
- 15 reactors – Resumed under new regulation
- 3 reactors – Under new construction
- 18 reactors - Suspended

Fish hatchery before 311 and after 311

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Kumamachi Elementary School before 311







