



Australian Government

Australian Radiation Protection and Nuclear Safety Agency

Japan Nuclear Accident

Senate Community Affairs Legislation Committee
Budget Estimates 2011–2012

Department: *Health & Ageing.*

Tabled document no: 3

By: *ARPANSAR*

Date: *31/5/2011.*

Natural disasters



11 March 2011 (14:46 JST)

- Magnitude 9.0 earthquake ~72 km east (offshore) of the Oshika Peninsula, Miyagi prefecture.
- The earthquake triggered a destructive tsunami with waves striking the coast in minutes.
- 11 nuclear reactors shut down automatically along the coast.
- A 14 m tsunami knocks out regular and backup cooling systems and electronics at the six-reactor Fukushima Dai-ichi nuclear power plant. Cooling has not been restored to several facilities.
- Cooling systems at the Fukushima Daini nuclear power plant are also impacted.

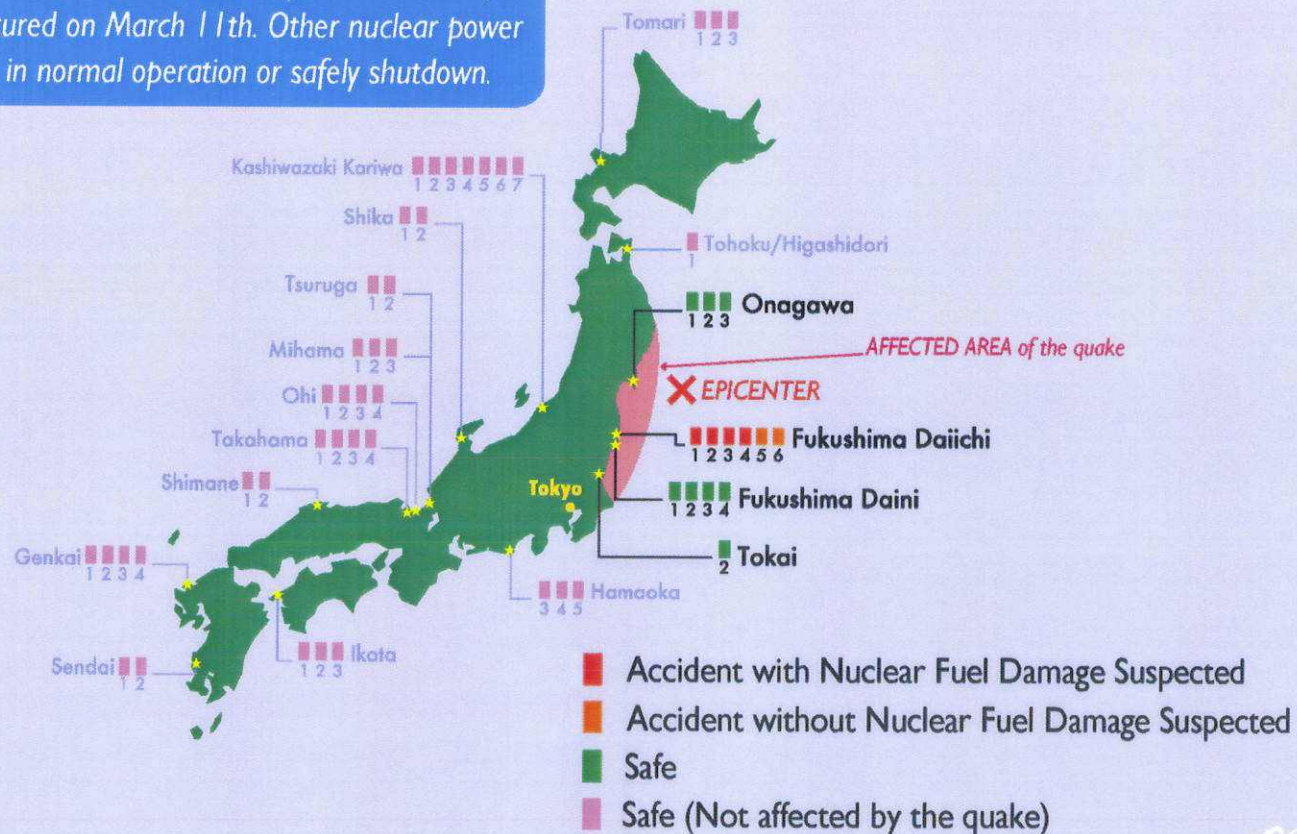
Before and After



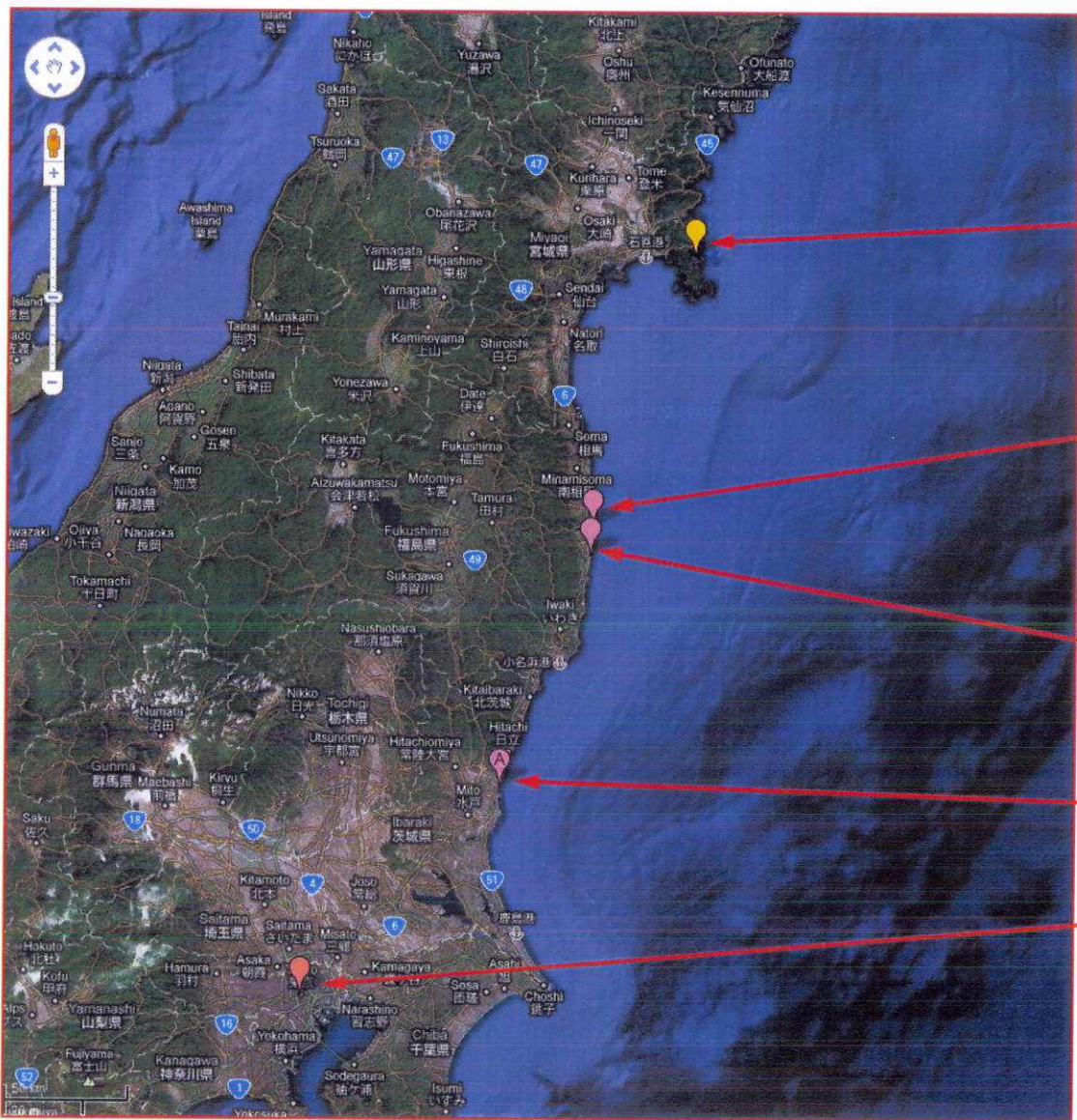
Tsunami floods rage through the Daiichi plant on March 11

Status of the Nuclear Power Plants after the Earthquake

The accident that brings environmental impact is going on at several units in Fukushima Daiichi nuclear power Station after the earthquake occurred on March 11th. Other nuclear power plants in Japan are in normal operation or safely shutdown.



Reactor Locations



Onagawa
Approx. 390 km from Tokyo
3 Reactors

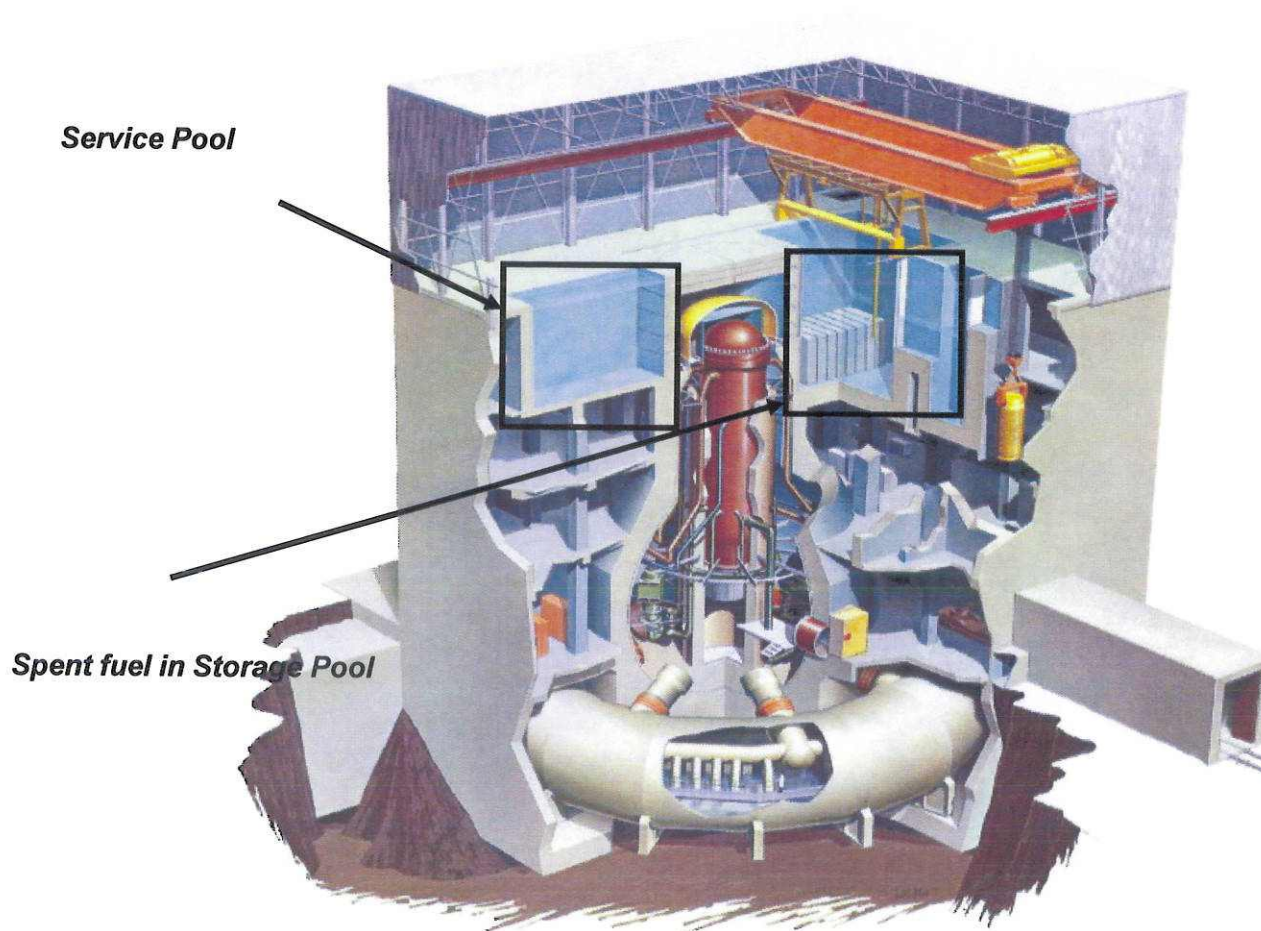
Fukushima Dai-ichi
Approx. 260 km from Tokyo
6 Reactors

Fukushima Daini
Approx. 240 km from Tokyo
4 Reactors

Tokai
Approx. 130 km from Tokyo
1 Reactor

Tokyo

BWR of Fukushima Dai-ichi NPP



- Safety design based on probable impossibilities.

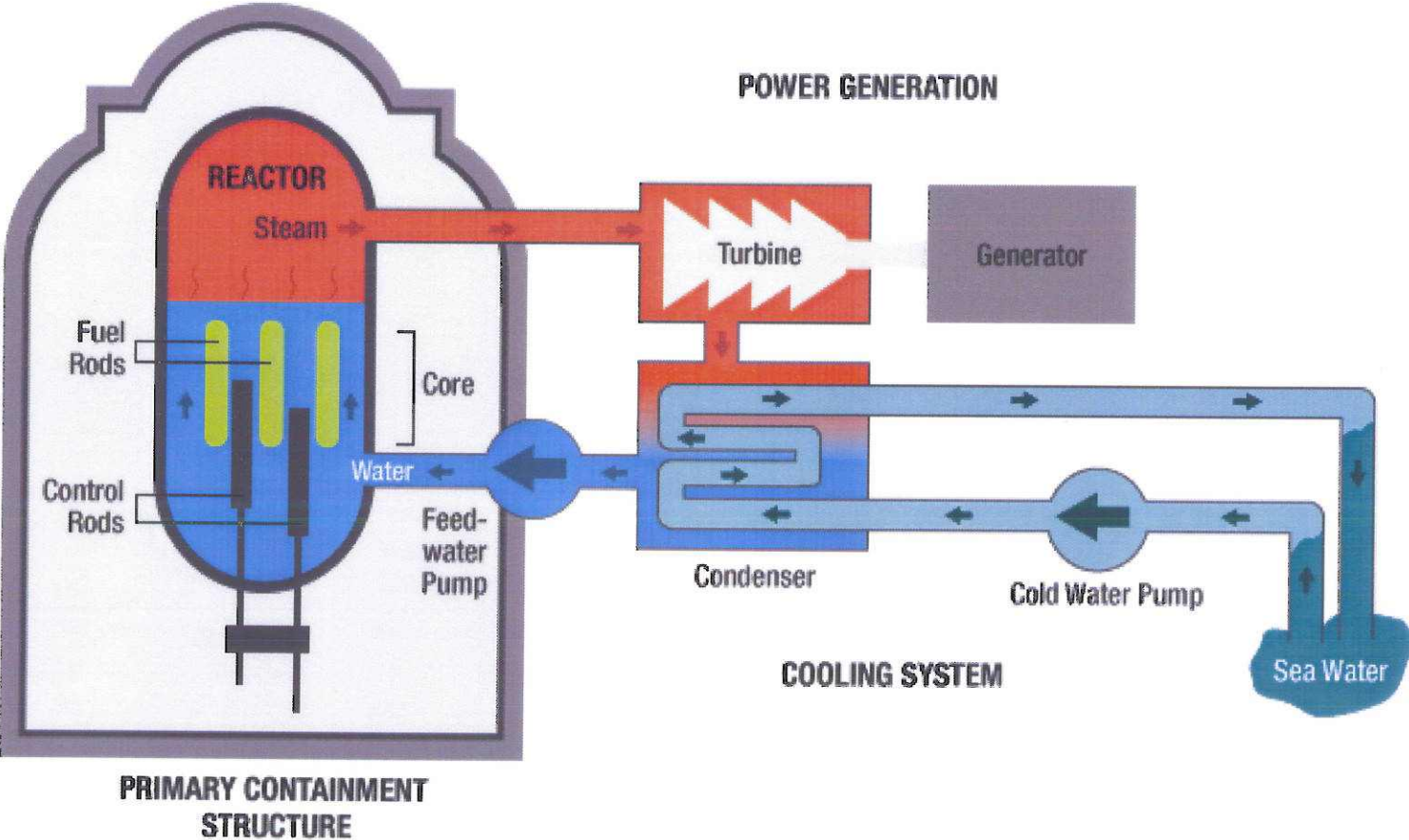
- Designed to survive a 8.0 magnitude earthquake and protection for a 5.5 metre tsunami.

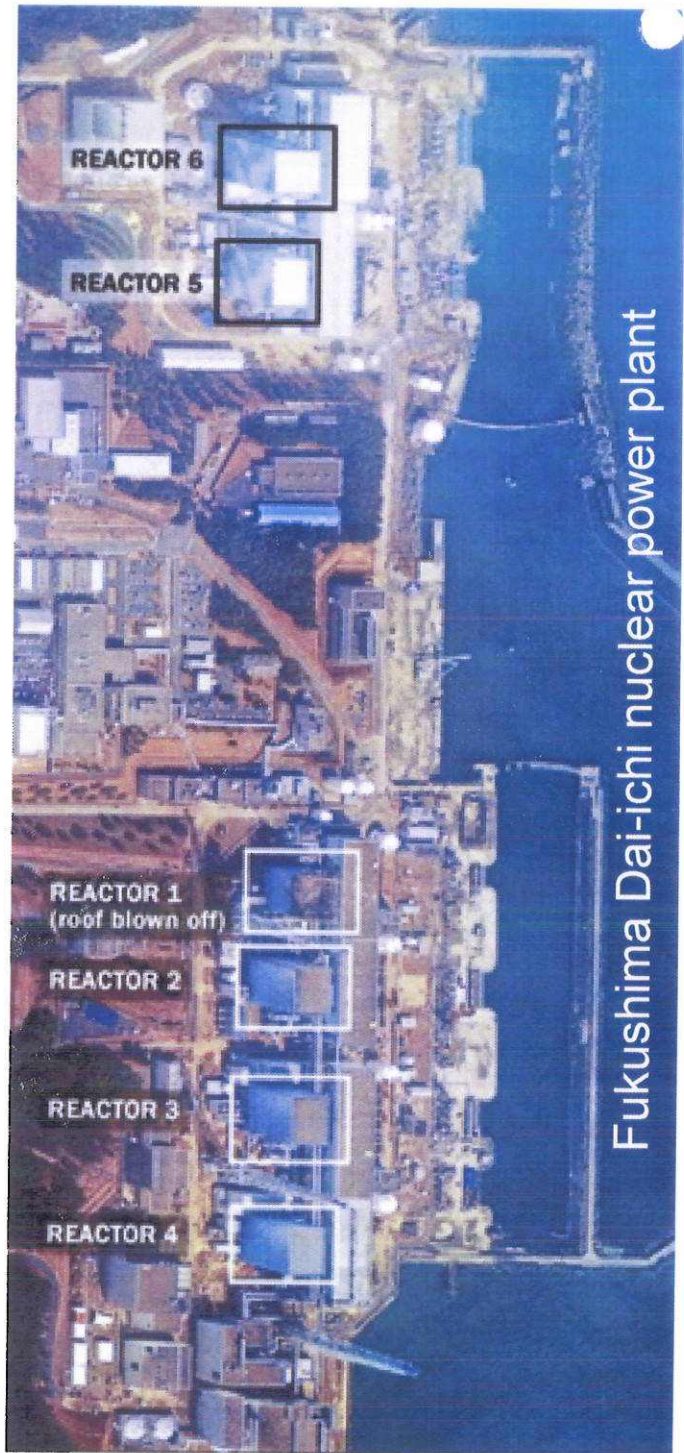
- Seismic Design Reference Value of Unit 3 was 449 gal. Measured ground acceleration was 507 gal.

DRYWELL TORUS

BWR of Fukushima Dai-ichi NPP

Inside The Nuclear Reactors





Unit 1 Event timeline

Unit 1 – 460MW (292 fuel assemblies in the core, 40 of which are fresh. The spent fuel pond contains 50 tons of fuel)

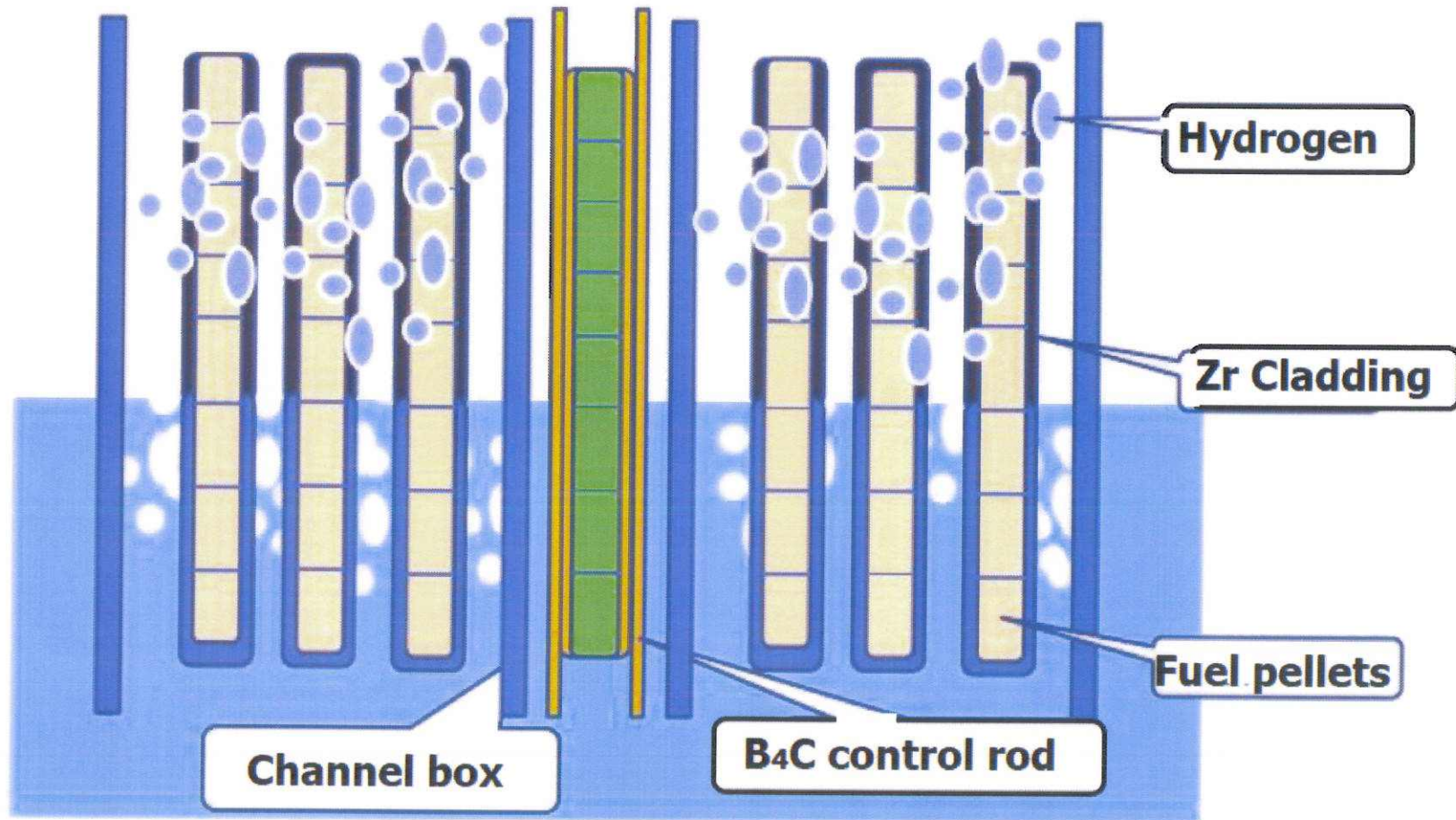
- 11th March Automatic shutdown
 - 12th March Explosion in reactor building
 - 13th March Seawater injected into reactor
 - 24th March Power Restored
 - 25th March Fresh water injected into reactor
 - 26th March Water found in basement of reactor
 - 6th April Nitrogen injected into reactor
-
- Water/nitrogen injection continues
 - Reactor parameters steady

Development of Core Damage

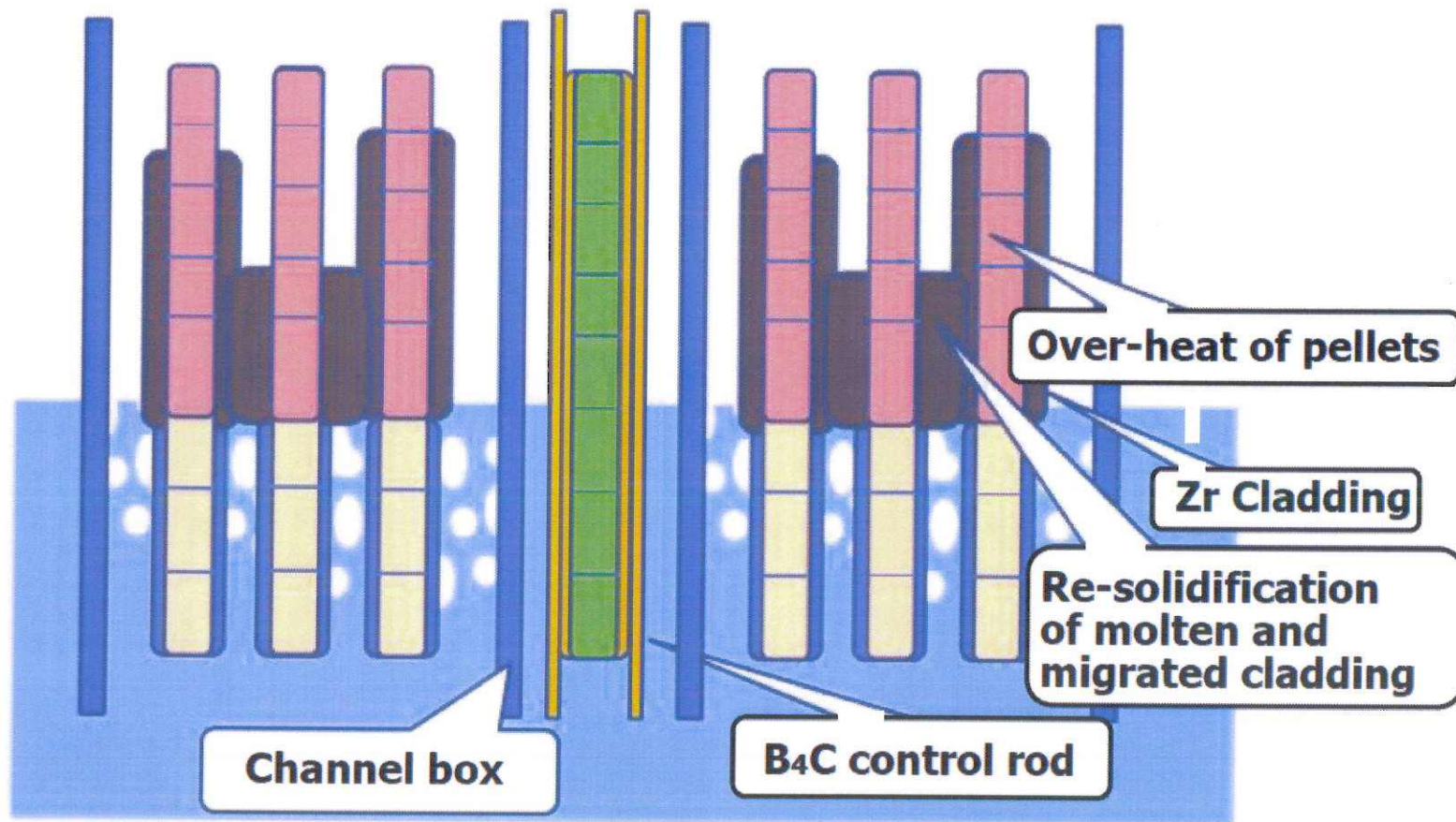
(Melting and Migration of Core Components)

- 1. Oxidization of fuel cladding due to lowered water level**
 - Generation of hydrogen by $Zr+H_2O$ reaction
 - Rapid increase on fuel rod's temperature by reaction heat
 - Release of volatile FPs such as noble gases, iodine, etc. due to damage of cladding
- 2. Melting and migration of fuel cladding**
 - Melting of Zr and Zr(O)
 - Re-solidification in the neighborhood of water surface
- 3. Melting and migration of fuel pellets**
 - Melting of UO_2 -Zr(O) eutectic
 - Re-solidification in the neighborhood of water surface and generation of crusts

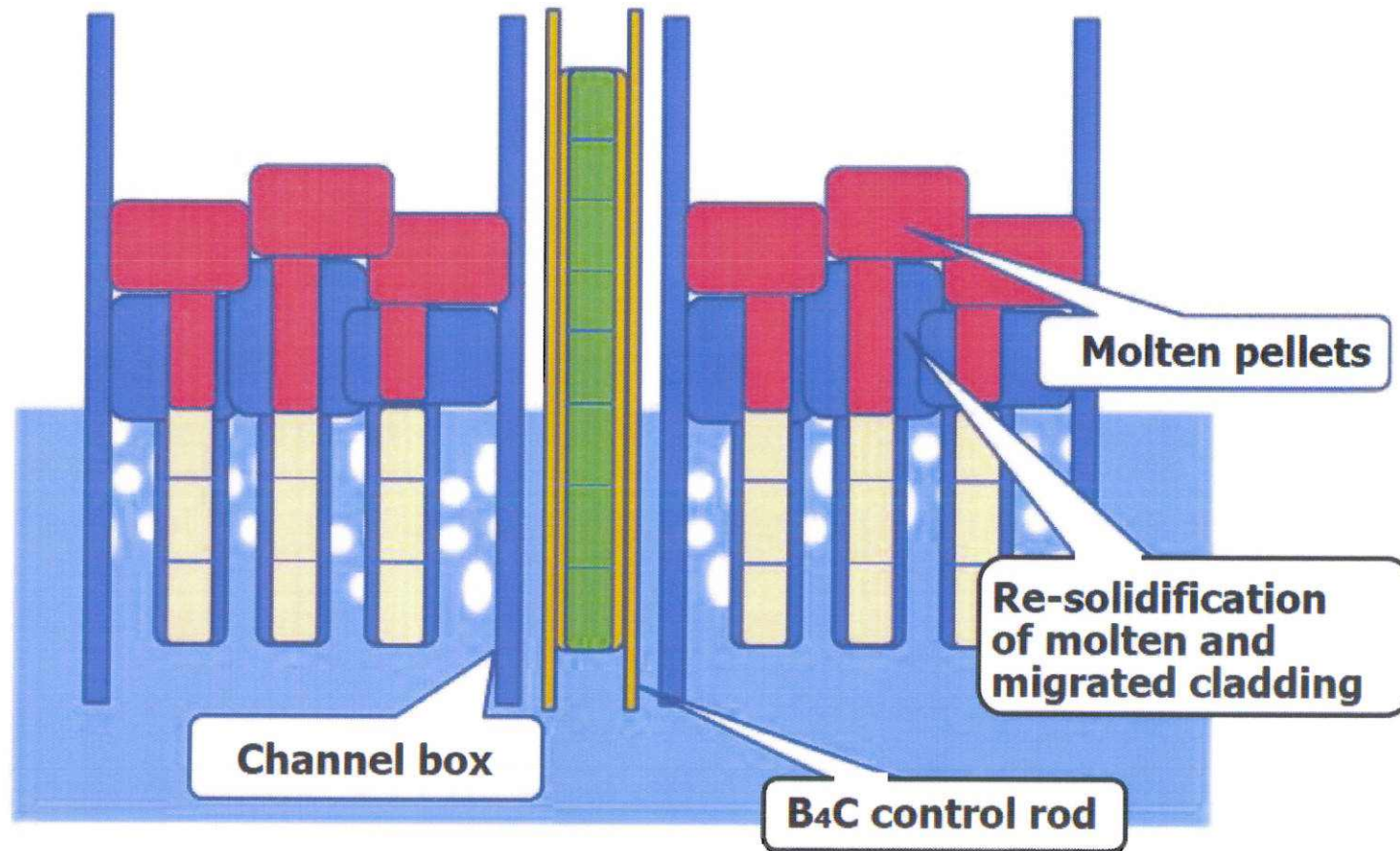
(1) Oxidization of fuel cladding due to lowered water level

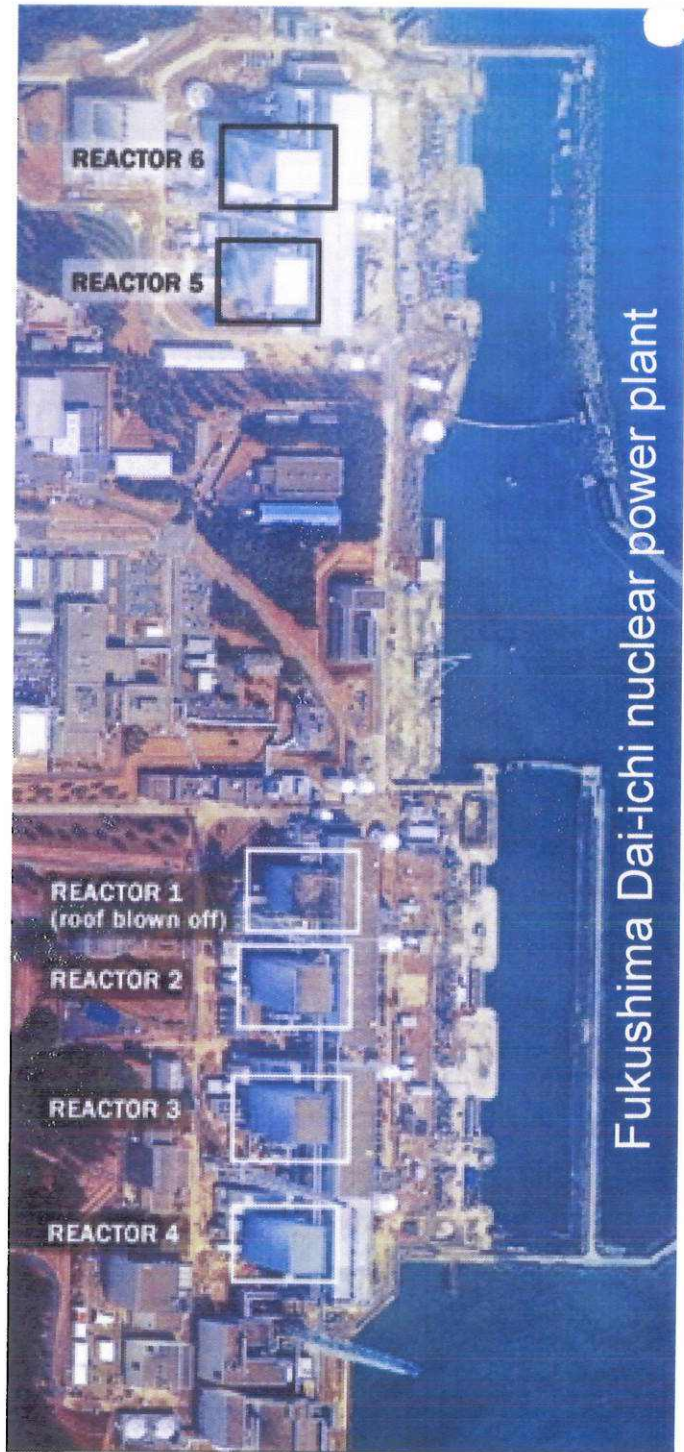


(2) Melting and migration of fuel cladding



(3) Melting and migration of fuel pellets

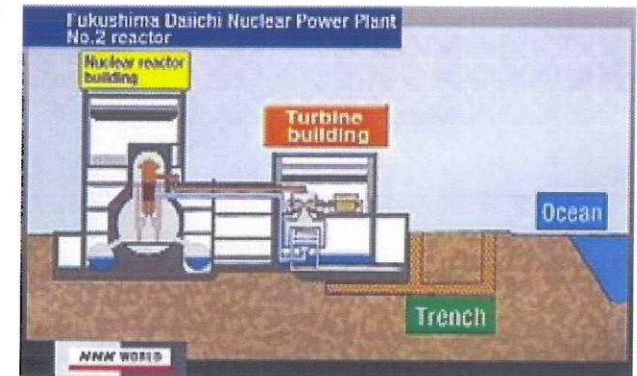




Unit 2 Event timeline

Unit 2 – 784MW (292 fuel assemblies in the core, 40 of which are fresh. The spent fuel pond contains 50 tons of fuel)

- 11th March Automatic shutdown
 - 14th March Seawater injected into reactor
 - 15th March Explosion in reactor building
 - 26th March Power Restored
 - 27th March Water found in basement of reactor
 - 28th March Fresh water injected into reactor
 - 2nd April Water leaked from trench into ocean
-
- Water injection continues
 - Reactor parameters steady





Unit 3 Event timeline

Unit 3 – 784MW (514 fuel assemblies in the core, 52 of which are fresh. The spent fuel pond contains 88 tons of fuel)

- 11th March Automatic shutdown
- 13th March Seawater injected into reactor
- 14th March Explosion in reactor building
- 24th March Power Restored
- 24th March Water found in basement of reactor
- 25th March Fresh water injected into reactor

- Water injection continues
- Reactor parameters steady

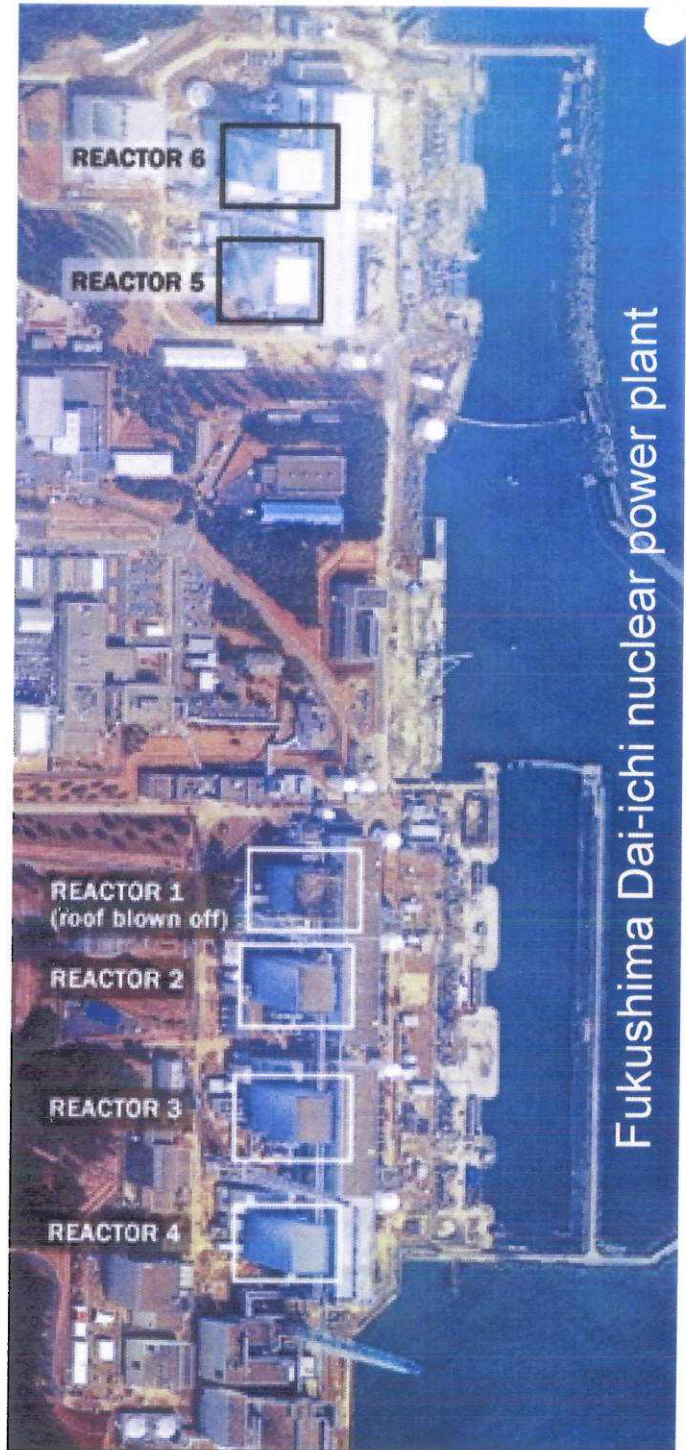


Unit 4 Event timeline

Unit 4 – 784MW (0 fuel assemblies in the core, 0 of which are fresh. The spent fuel pond contains 100 tons of fuel)

- Shut down for routine maintenance
- 15th March Seawater pumped into spent fuel pond
- 15th March Explosion in reactor building
- 29th March Power Restored
- 30th March Fresh water pumped into spent fuel pond

- Reactor parameters steady



Unit 5 & 6 Event timeline

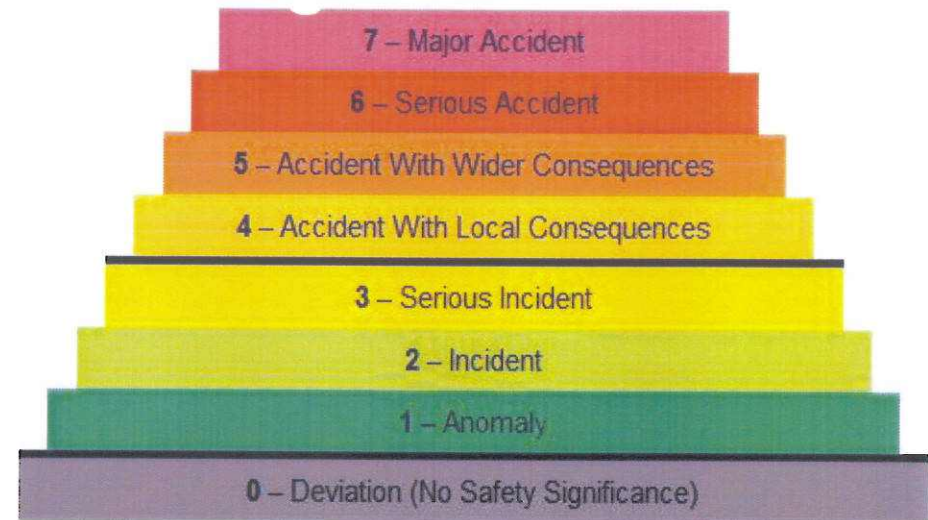
Unit 5 – 784 MW (548 fuel cores)

Unit 6 – 1100 MW (764 fuel cores)

Shut down for routine maintenance

- March 11 - Reactors not damaged
- March 12 – Vent opened to reduce risk of hydrogen explosion in Units 5 and 6.
- March 19 – Heat removal pumps started
- March 20 – Units placed in cold shutdown

INES Rating



Preliminary INES Level (April 12)

Fukushima Dai-Ichi: INES 7

Earlier INES Level for Fukushima Dai-Ichi and Dai-Ni

Fukushima Dai-Ichi

Unit 1: INES 5
Unit 2: INES 5
Unit 3: INES 5
Unit 4: INES 3

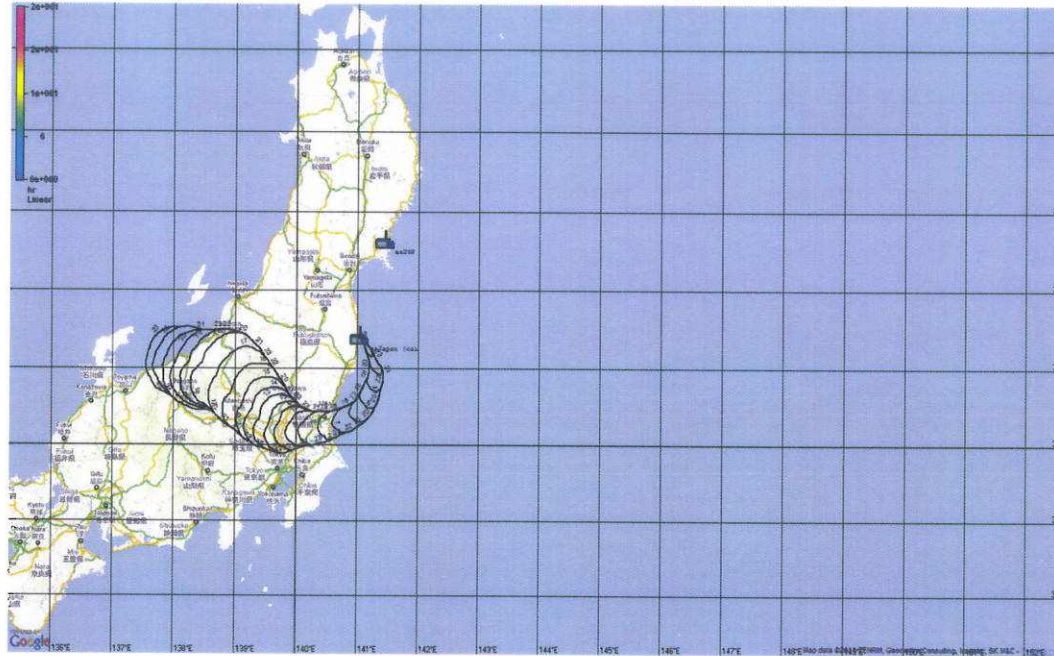
Dai-Ni

Unit 1: INES 3
Unit 2: INES 3
Unit 3: Not Assessed
Unit 4: INES 3

Initial INES Level for Fukushima Dai-Ichi and Dai-Ni

Fukushima Dai-Ichi - INES 4 (IAEA and Japan), INES 6 (France)

Atmospheric Modelling

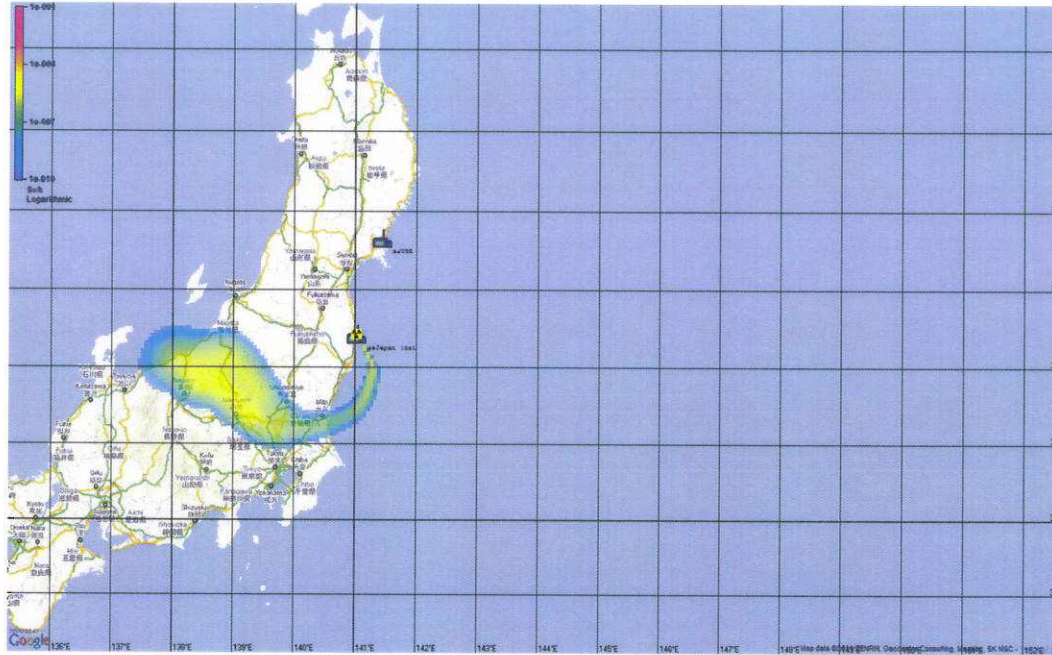


Time of Arrival: 19-03-2011 1800 UTC (20-03-2011 0500 AEDST)

| Radionuclide | Percent of Inventory Released 1% Core Release |
|-------------------|---|
| Noble gases | 10% |
| Iodine | 0.5% |
| Cesium | 0.3% |
| Tellurium | 0.15% |
| Barium, Strontium | 0.05% |

Based on 72 hour Australian Bureau of Meteorology predictive weather data.

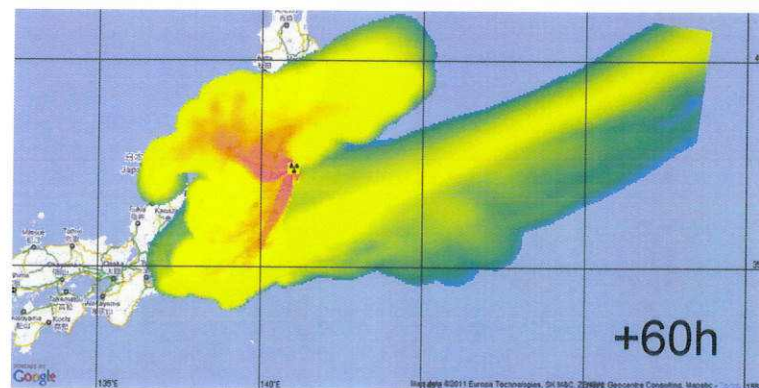
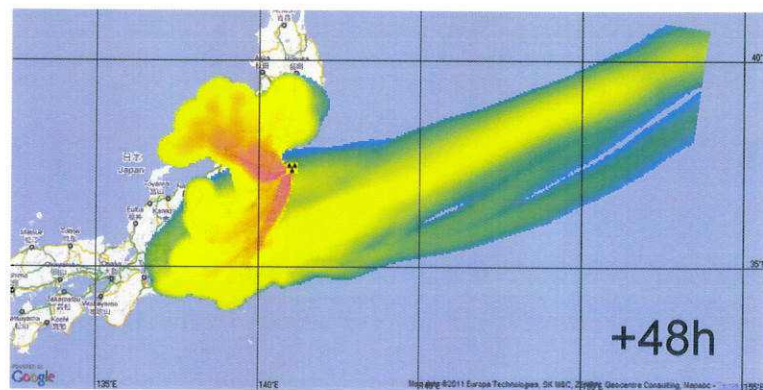
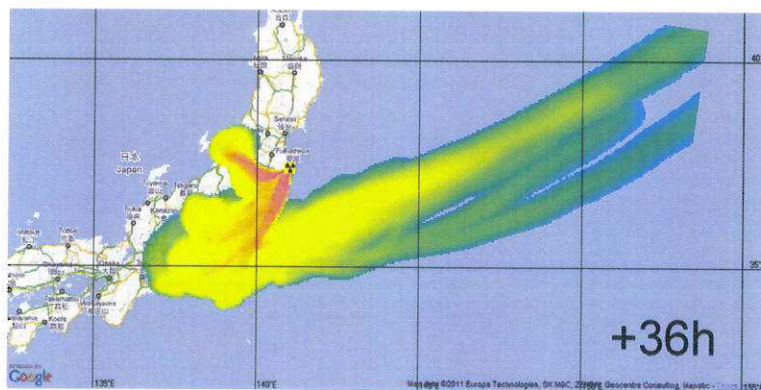
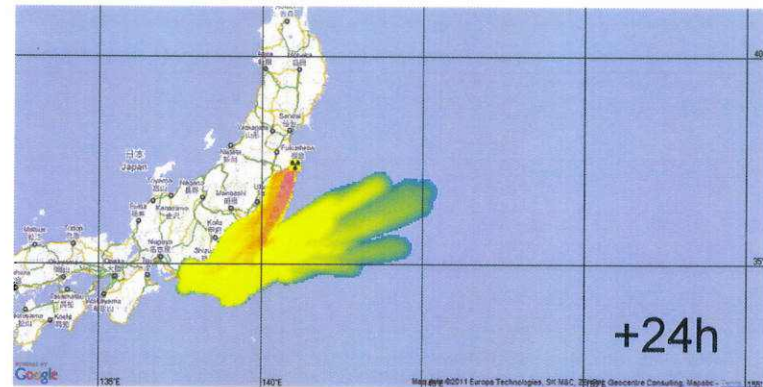
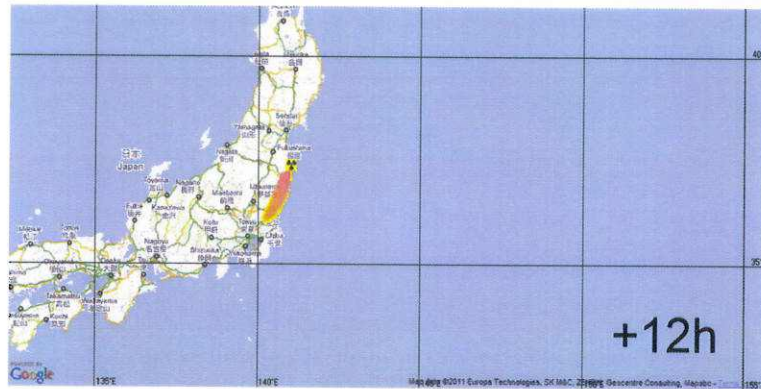
Atmospheric Modelling



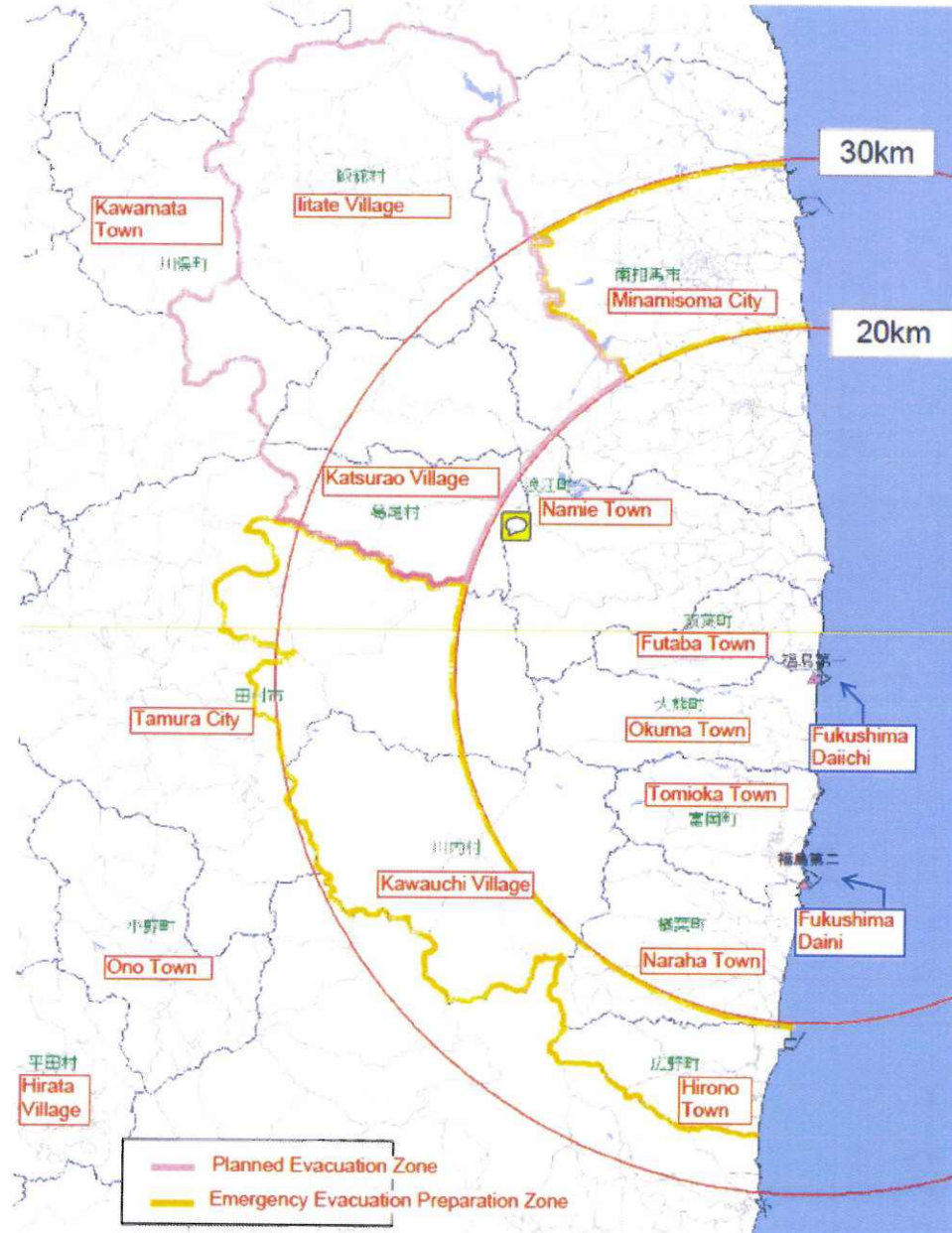
Total Dose: 19-03-2011 1800 UTC (20-03-2011 0500 AEDST)

| | Units | 1 % Core Pulse Release |
|--|--------------|-------------------------------|
| Fukushima Dai-ichi | | |
| Max Child Dose at 20 km Evac. Boundary | (mSv) | 67 |
| Max Adult Dose at 20 km Evac. Boundary | (mSv) | 53 |
| Child Thyroid Boundary (30 mGy) | (km) | 55 |
| | | |
| TOKYO | | |
| Time of Arrival | (hours) | 12 |
| Total Eff. Dose for Child | (uSv) | 400 |
| Total Eff. Dose for Adult | (uSv) | 240 |
| Max Gamma Dose Rate | (uSv/h) | 5 |
| Date & Time Max Gamma Dose Rate | (UTC) | 20-3-2011 1000UTC |

Deposition starting 1200utc 20-3-11



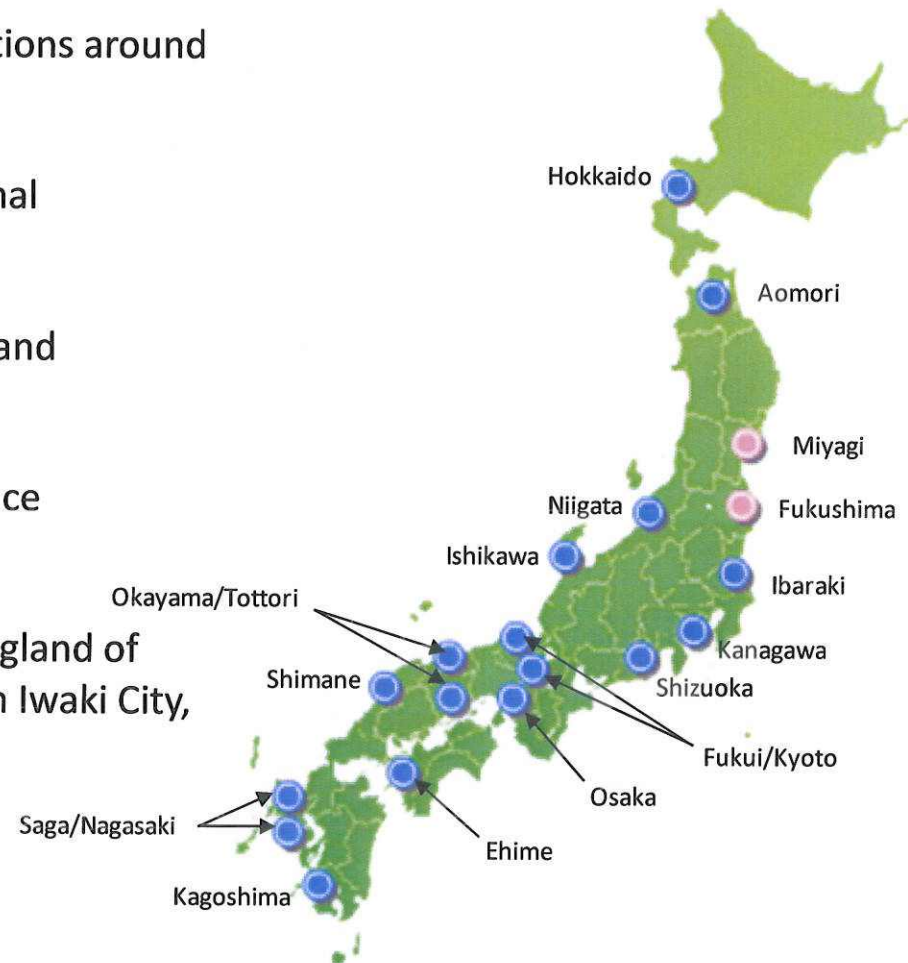
Current Evacuation Zones



SPEEDI network

System for Prediction of Environment Emergency Dose Information (SPEEDI)
Ministry of Education, Culture, Sports, Science and Technology (MEXT)

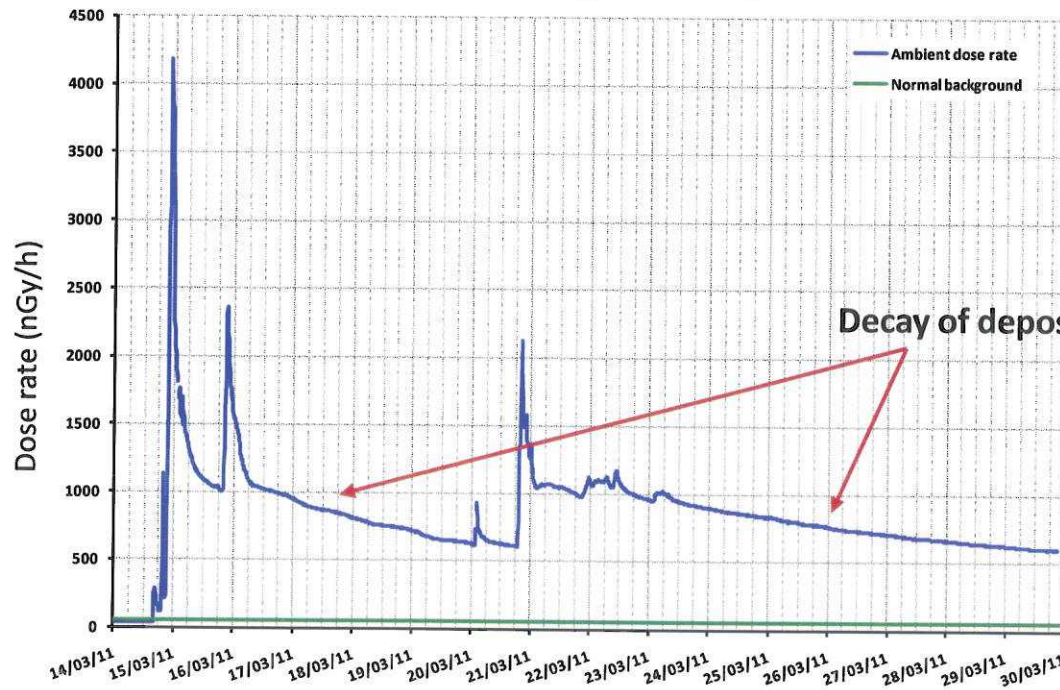
- Near real-time data from monitoring stations around major nuclear facilities
- No substantial deviation away from normal background at most sites
- Elevated dose rates measured at Ibaraki and Kanagawa (Tokyo area) prefectures
- Fukushima and Miyagi stations offline since earthquake and tsunami
- More than 1000 examinations of thyroid gland of children age 1-15 years was carried out in Iwaki City, no problems reported (March 30).



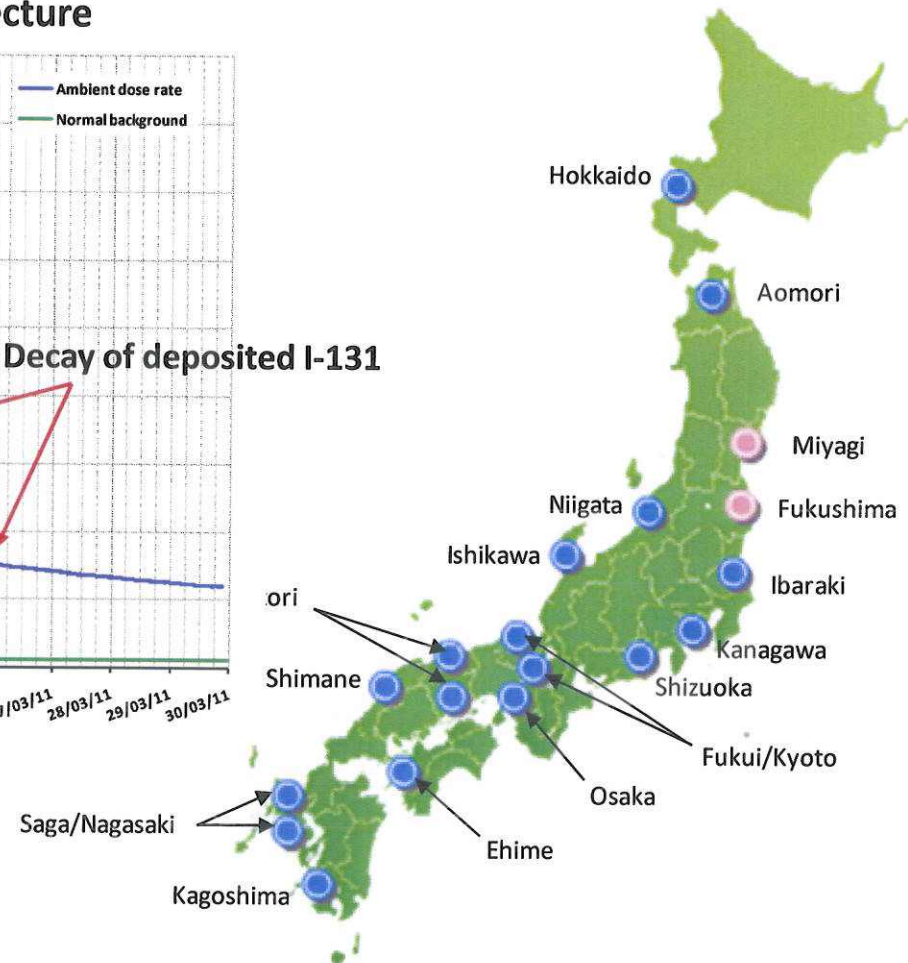
SPEEDI network

System for Prediction of Environment Emergency Dose Information (SPEEDI)
Ministry of Education, Culture, Sports, Science and Technology (MEXT)

Hitachinaka City, Ibaraki prefecture



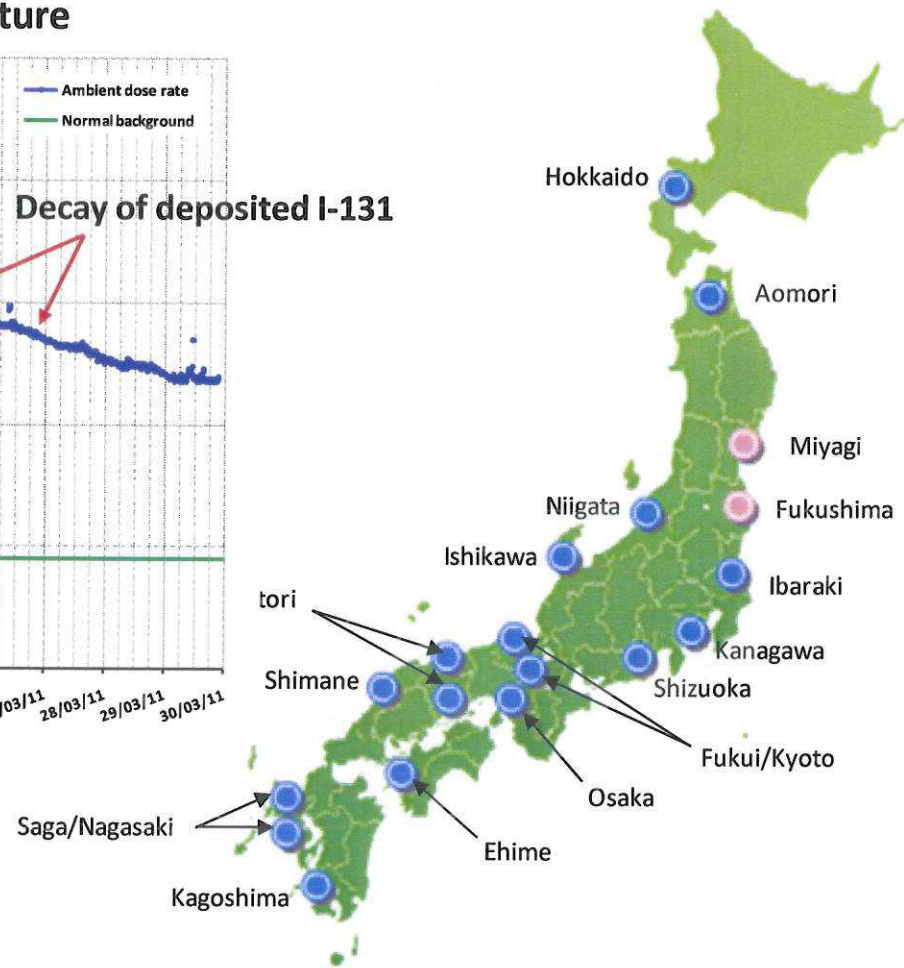
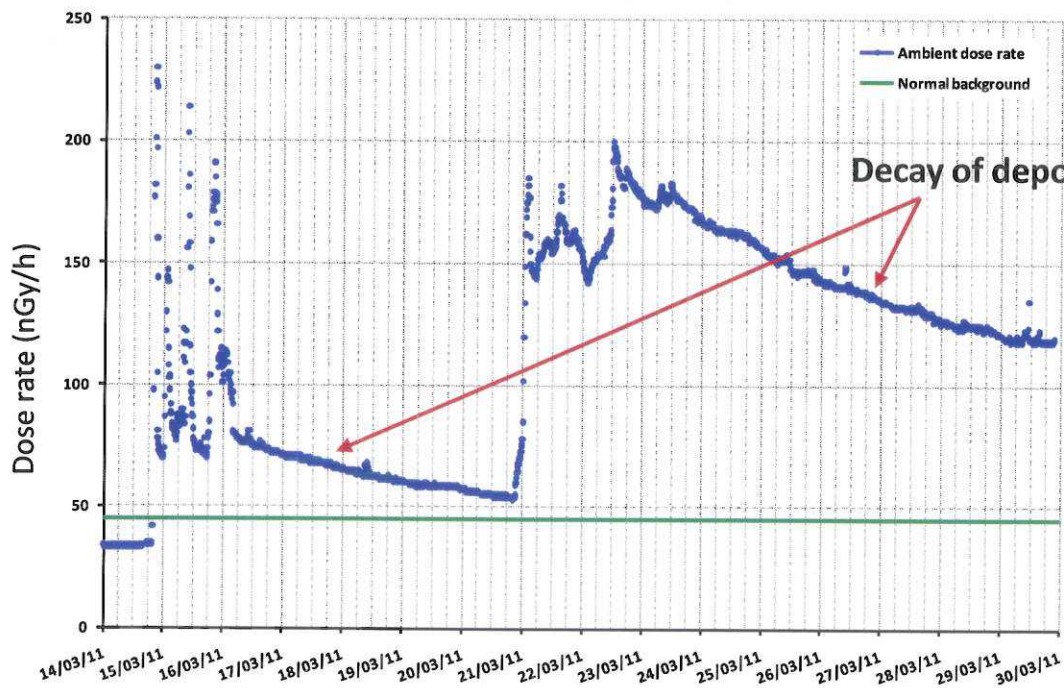
Decay of deposited I-131



SPEEDI network

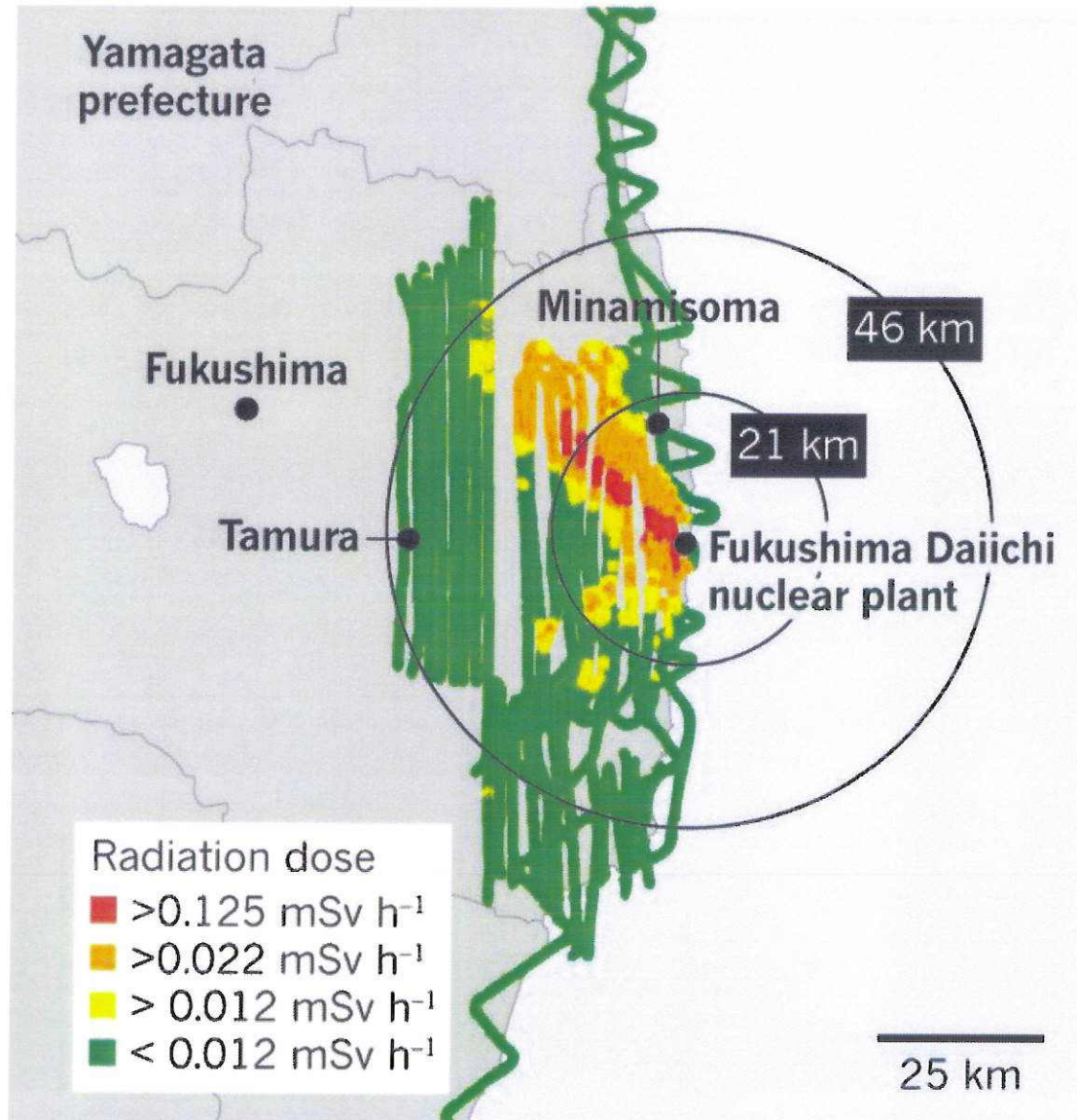
System for Prediction of Environment Emergency Dose Information (SPEEDI)
Ministry of Education, Culture, Sports, Science and Technology (MEXT)

Kawasaki ward, Kanagawa prefecture



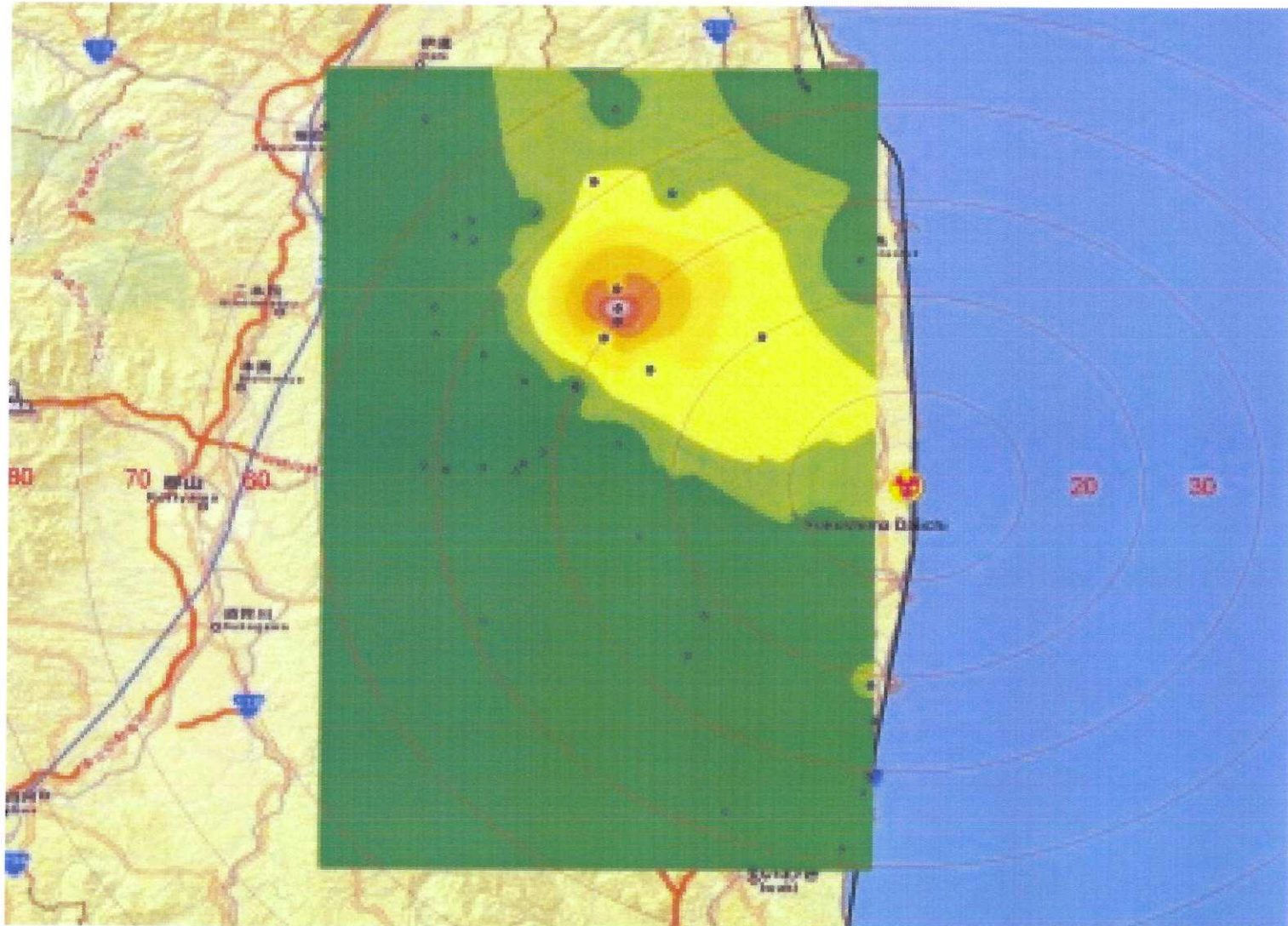
FUKUSHIMA'S FALLOUT

Data from air and ground monitoring show that highly radioactive fallout is largely localized within a narrow band northwest of the stricken plant.



US DOE
results

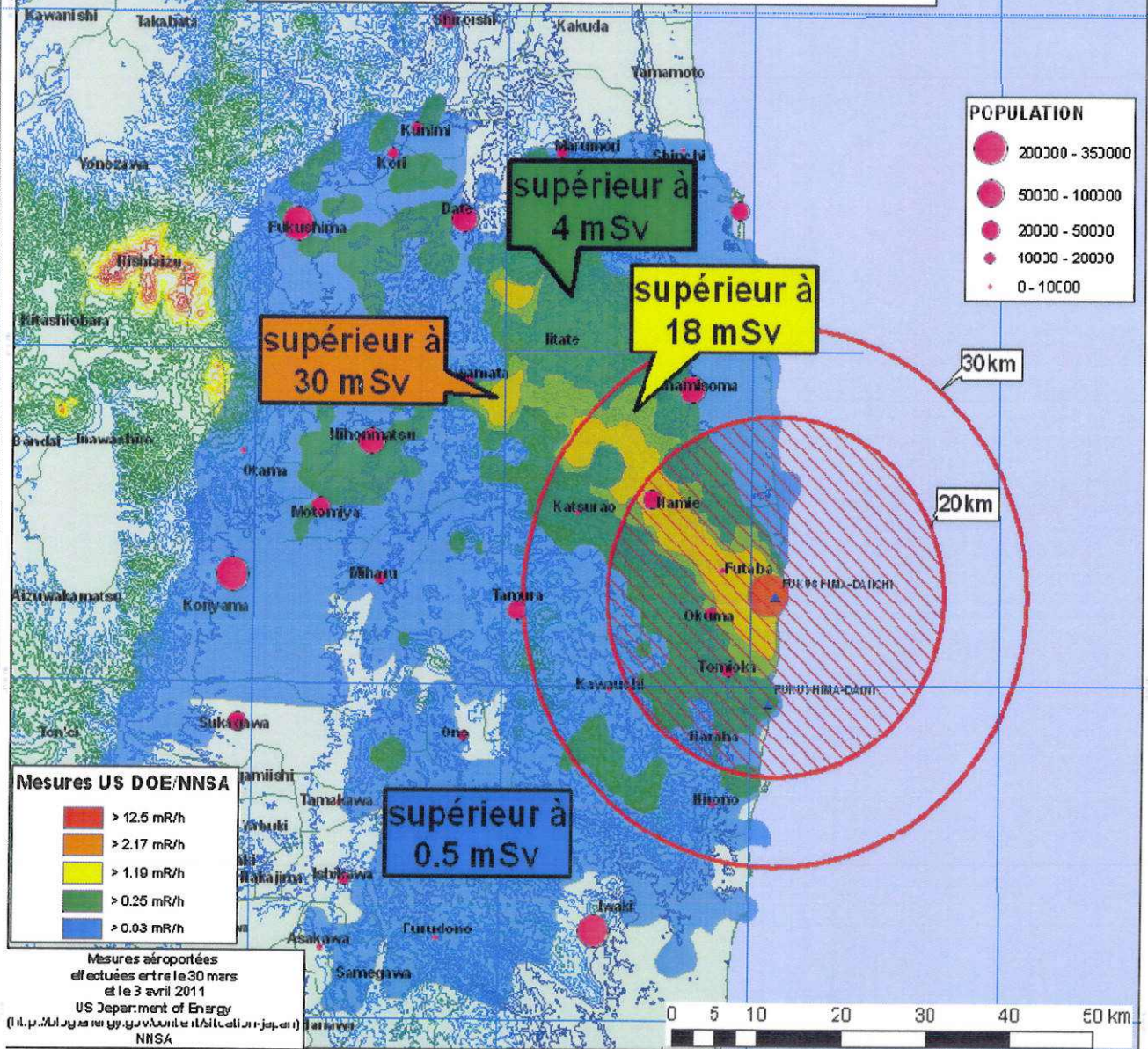
Fallout Field: IAEA



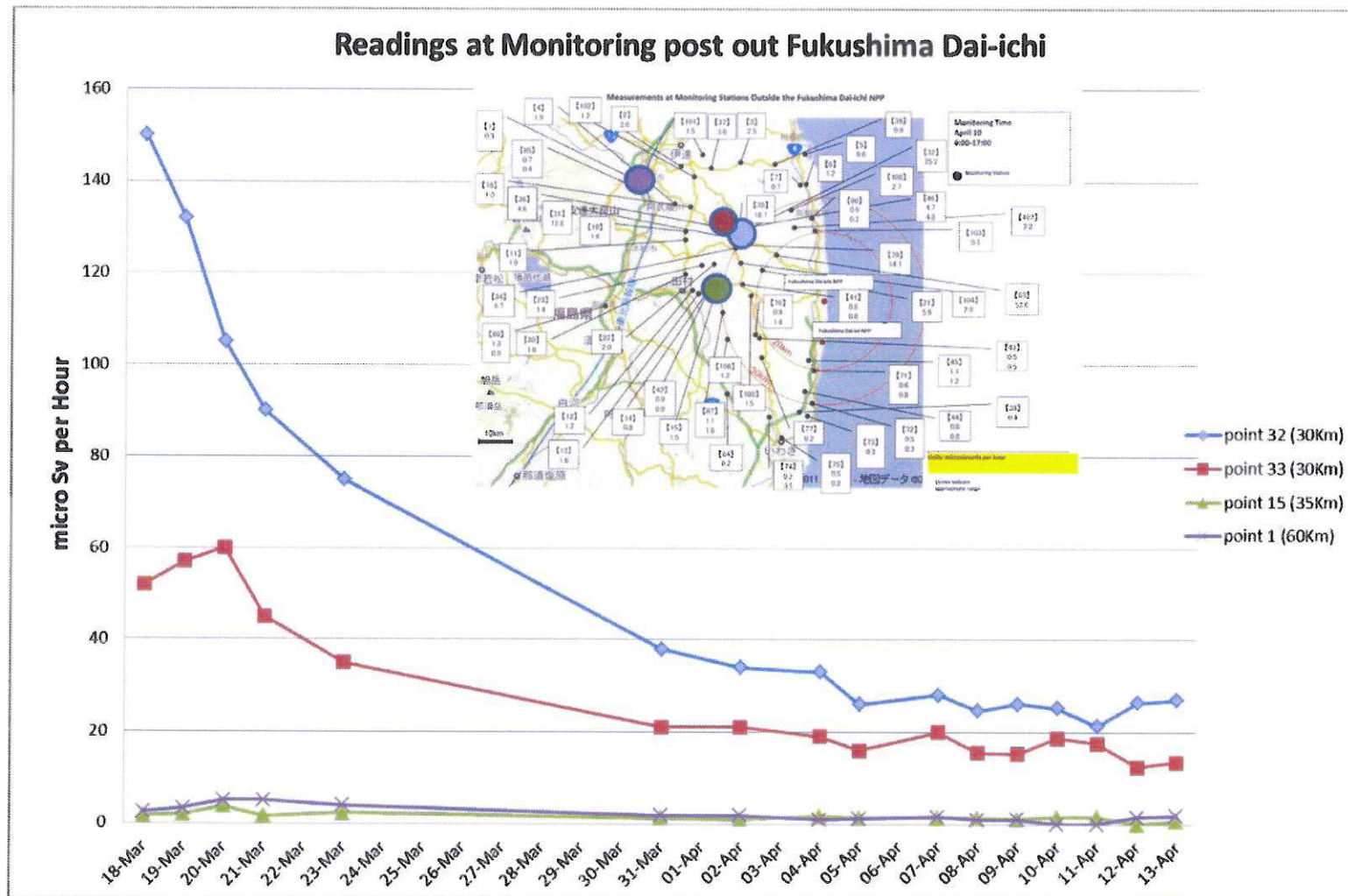
IRSN

INSTITUT
DE RADIATION
ET DE SURETÉ NUCLEAIRE

Estimation des doses reçues par irradiation externe la première année à partir des mesures US DOE/NNSA



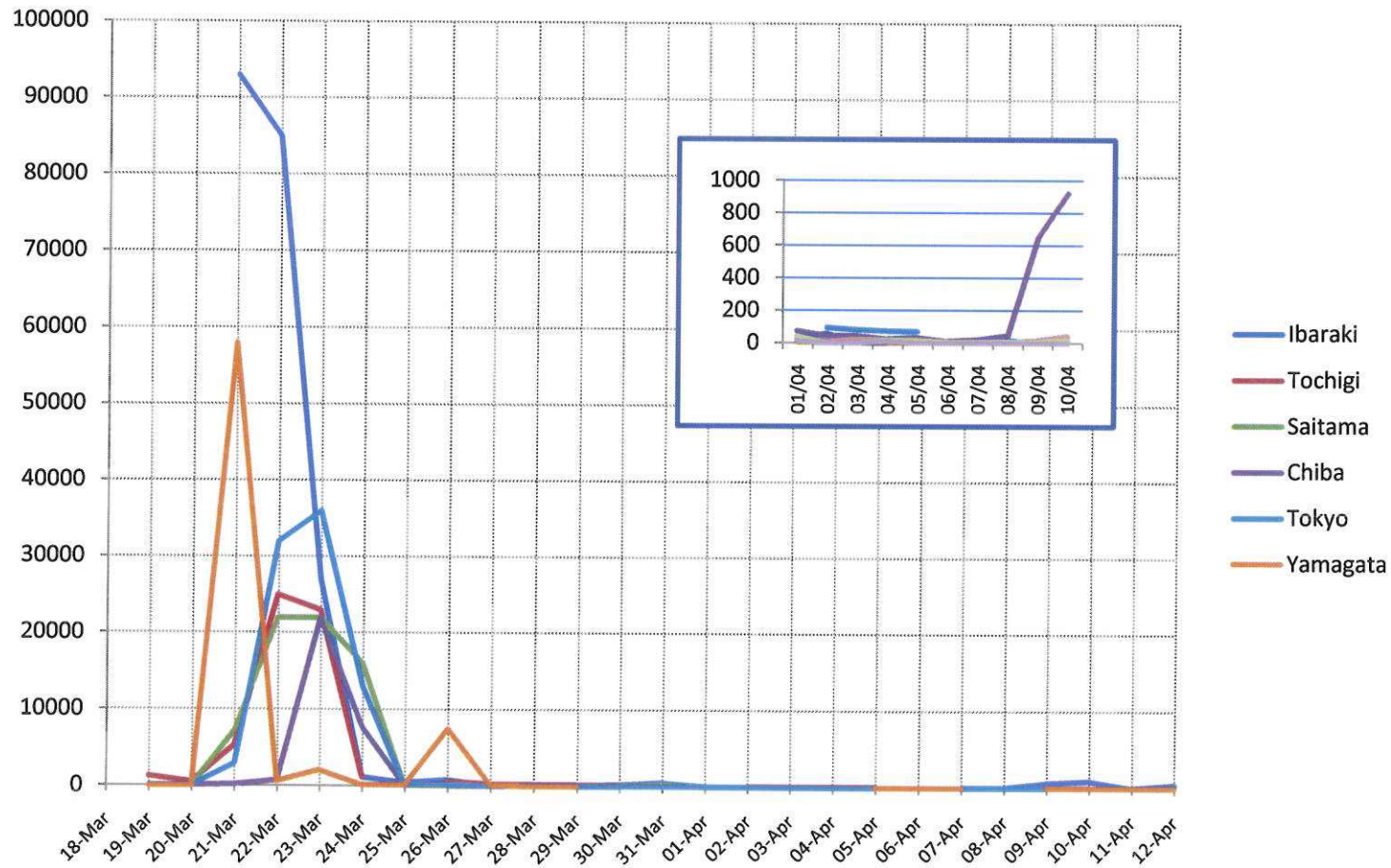
Dose rates beyond 20 km zone



Highest dose rates are to the northwest of Fukushima Dai-ichi NPP near the boundaries of the 20 and 30 km zones

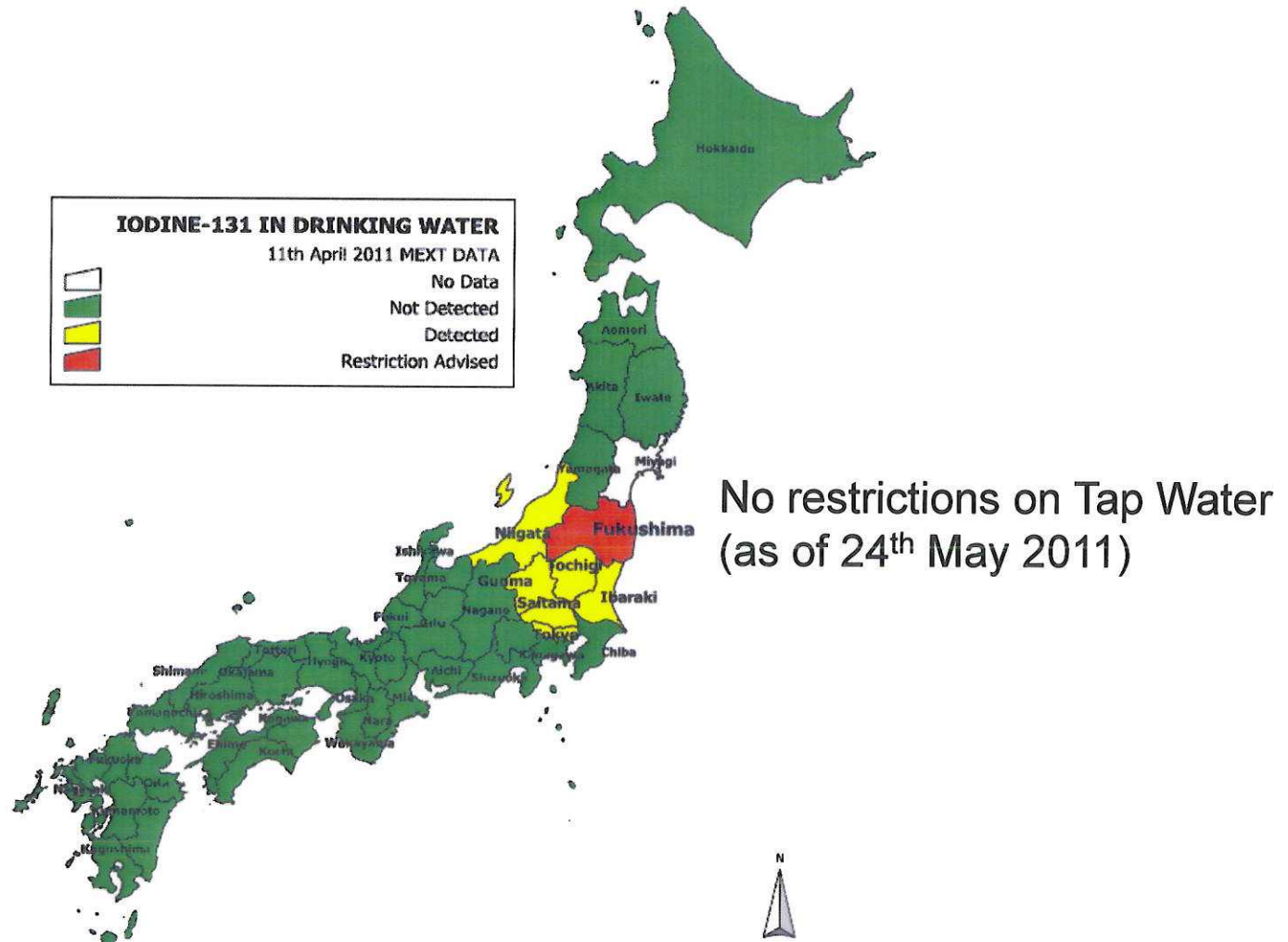
I-131 daily deposition

I-131 daily deposition (Bq/m²)

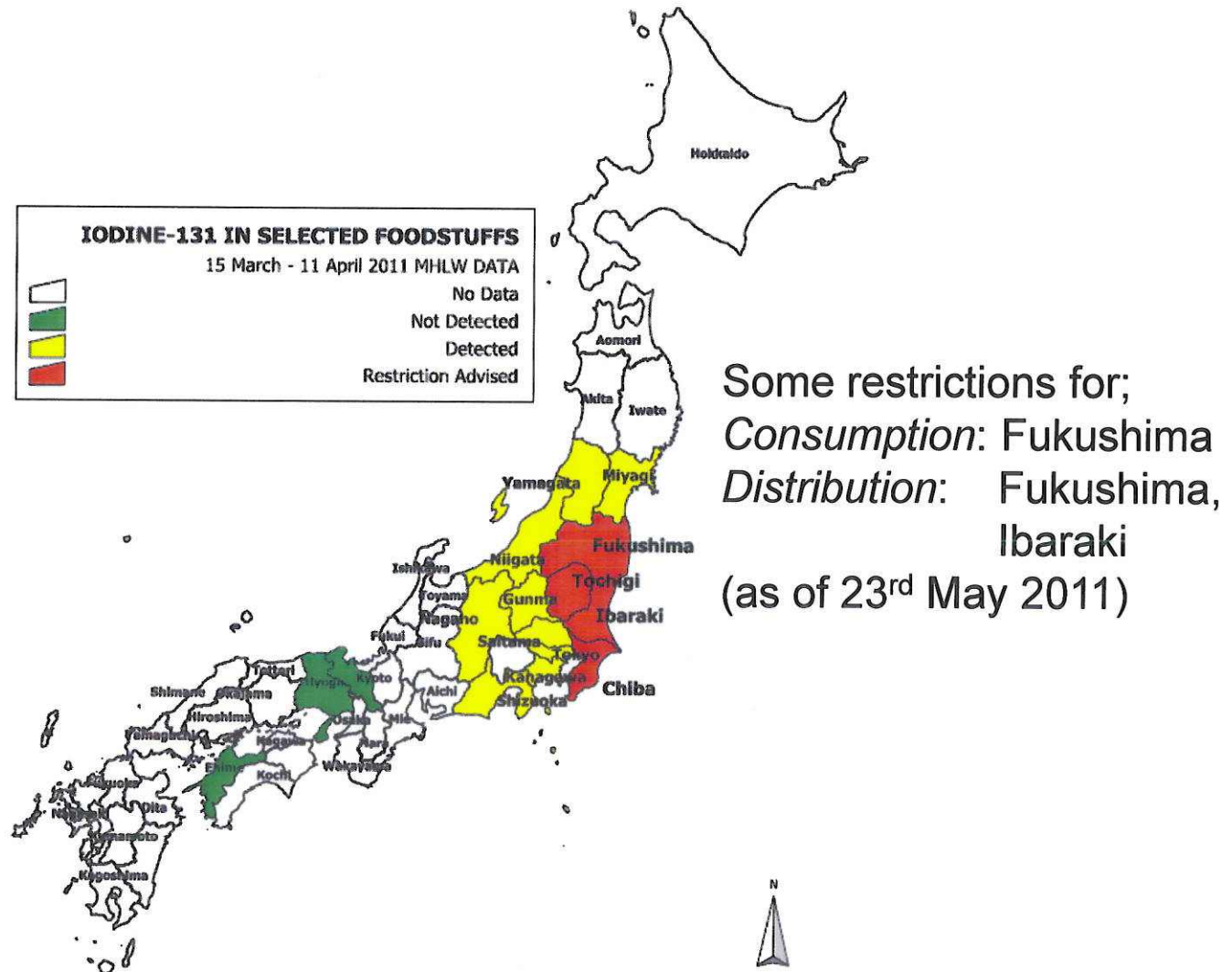


I-131 in drinking water

Ministry of Education, Culture, Sports, Science and Technology (MEXT) data



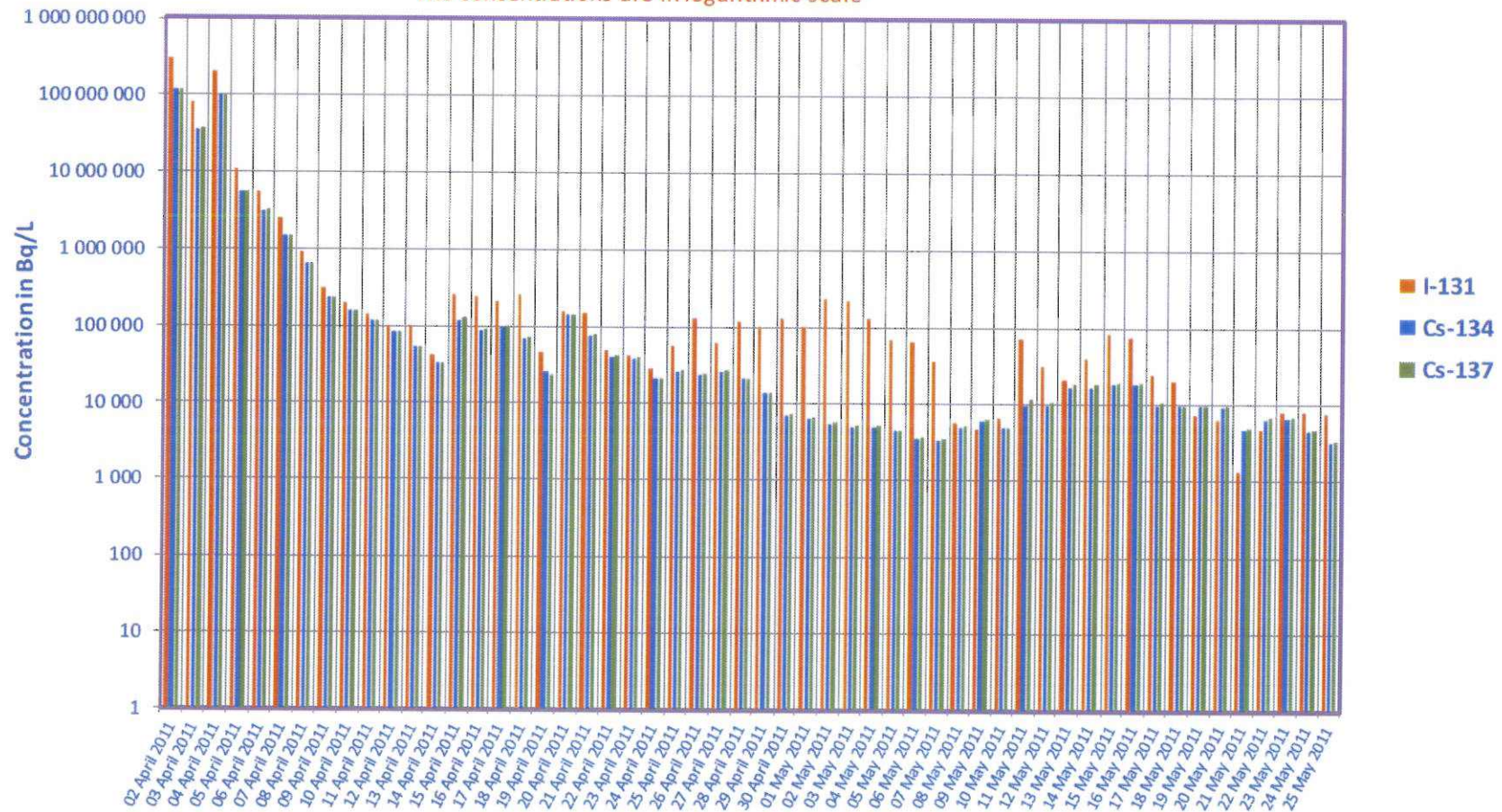
I-131 in foodstuffs



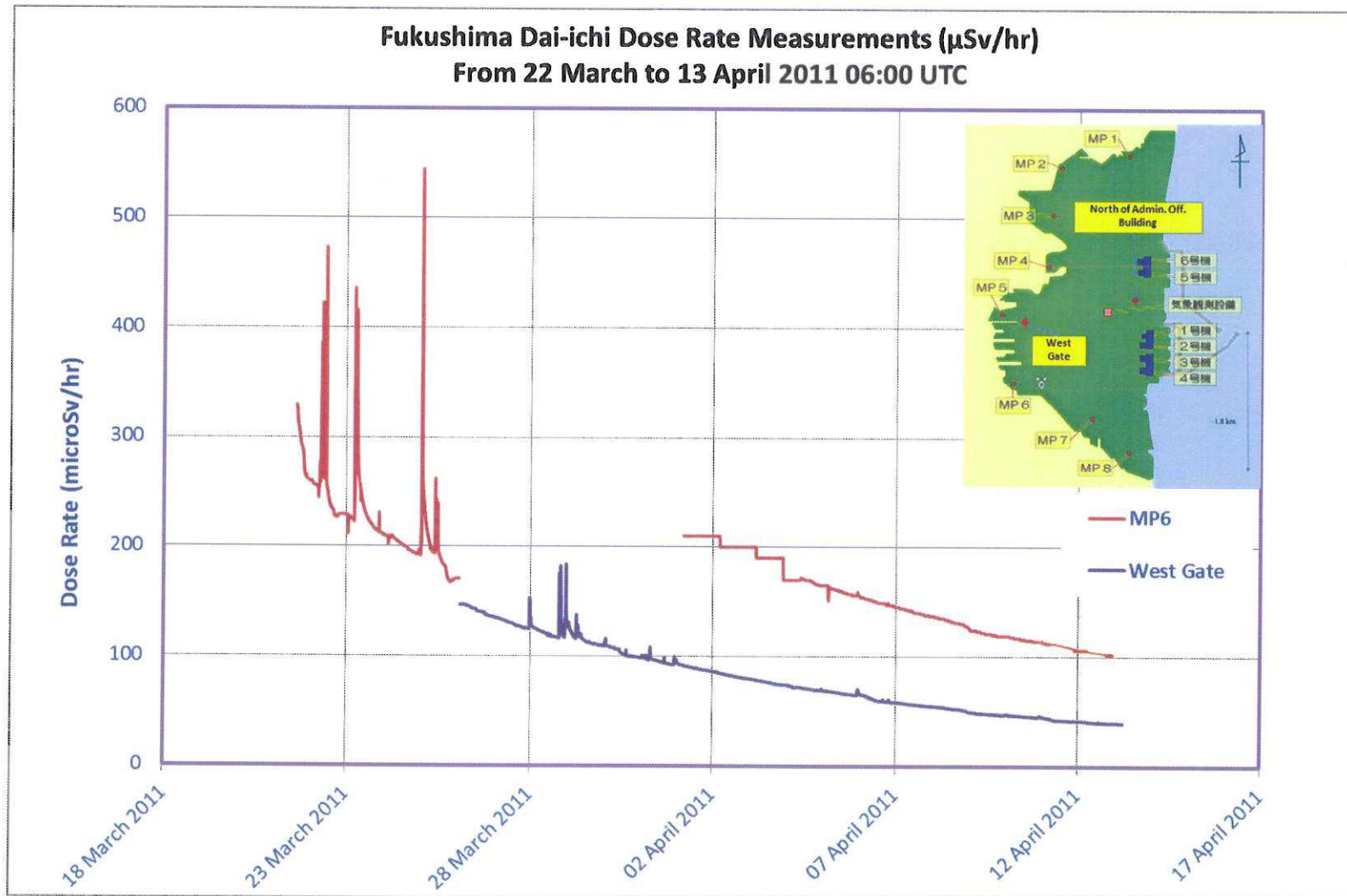
Radionuclides in Seawater

I-131, Cs-134 & Cs-137 (Becquerel/litre) concentration of seawater
at the screen of Unit 2 upper-layer water

The concentrations are in logarithmic scale



Dose rates at Fukushima Dai-ichi

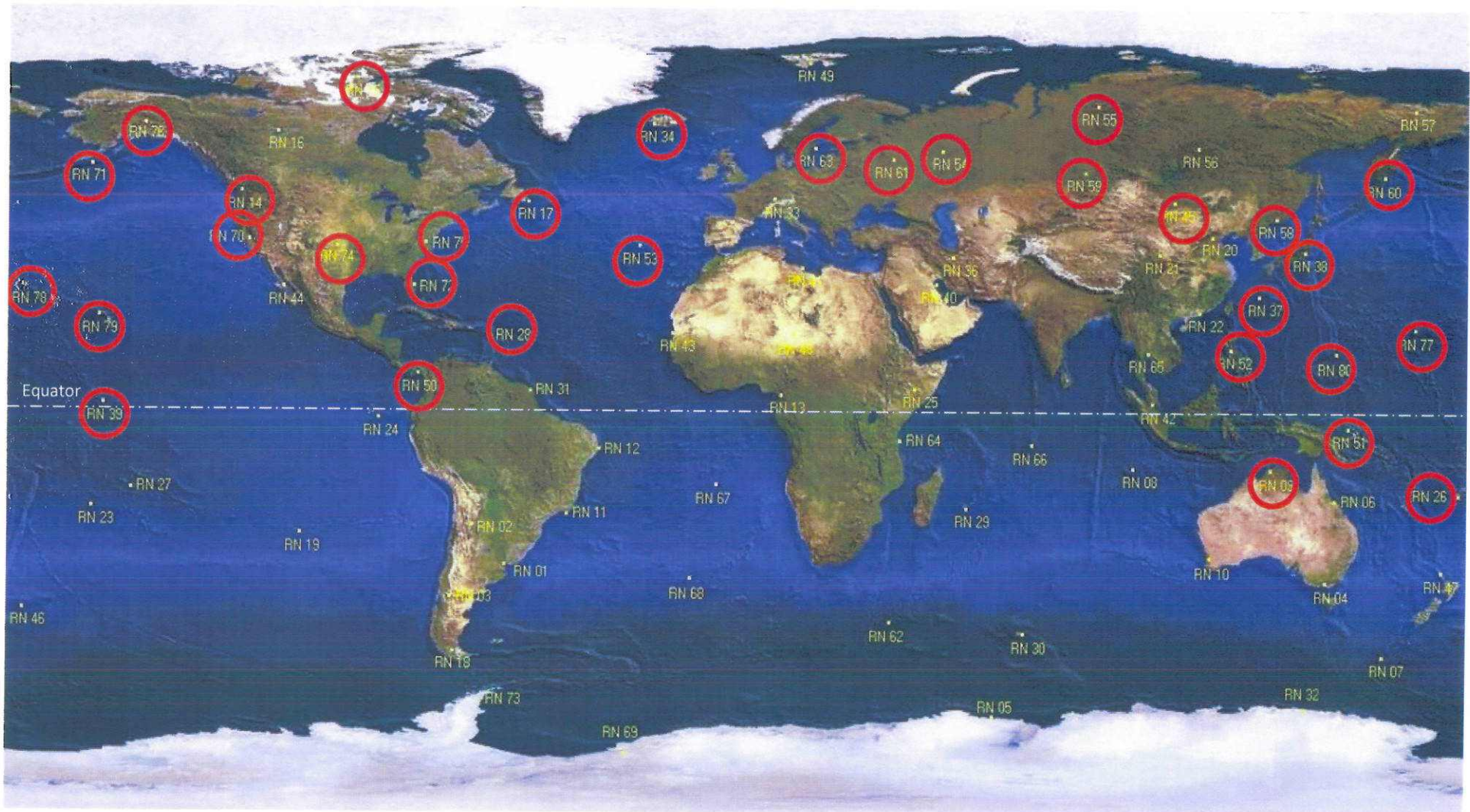


Dose rates to Fukushima Dai-ichi Workers

- 3 workers working in the basement of Unit 3 were exposed to between 170-180 mSv.
- Level of localised exposure workers legs estimated between 2-6 Sv.
- All 3 workers working in the basement of Unit 3 who were exposed to contaminated water (beta burns to feet) left hospital March 28th
- To date a total of 31 workers have been exposed to more than 100mSv but none exposed to more than 250 mSv. (IAEA 5th May)

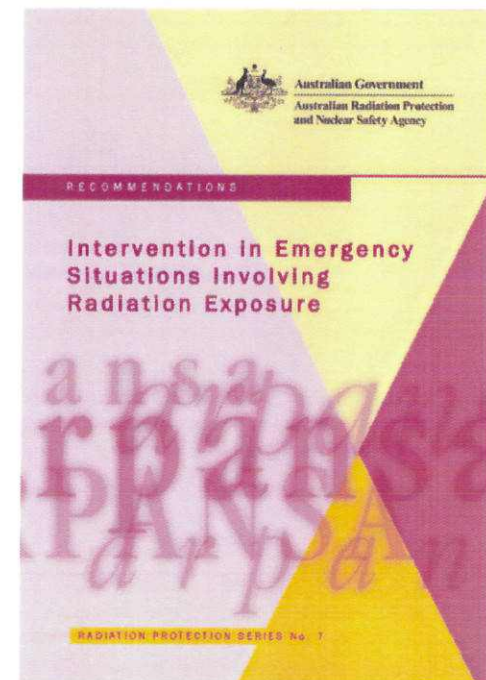


I-131 hits at CTBT IMS stations



Public Health Messages

- Advice for Australians remaining in Japan on food and water precautions, the availability and use of potassium iodide tablets and on appropriate sheltering from radiation if required have been provided with regular updates by Australia's Chief Medical Officer and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).
- The key message is that Australians remaining in Japan should follow any protective measures recommended by the Japanese Government. This may include evacuation or shelter in place orders.
- Japan protective measures are similar to RPS 7.



Operational Intervention Levels

Table 8

OPERATIONAL INTERVENTION LEVELS IN A REACTOR ACCIDENT

| Basis | OIL | Default value | | Protective measure |
|---|-------|--------------------------|-----------------------|--------------------------------------|
| Ambient dose rate in plume | OIL1 | 1 mSv/h ^(a) | | Evacuation |
| | OIL2 | 100 µSv/h ^(b) | | Sheltering |
| | OIL2 | 100 µSv/h | | Iodine Prophylaxis Adult |
| | OIL2c | 20 µSv/h | | Iodine Prophylaxis Child |
| Marker radionuclide concentration in plume: I-131 | | 50 kBq/m ^{3(c)} | | Iodine Prophylaxis Adult |
| | | 10 kBq/m ^{3(c)} | | Iodine Prophylaxis Child |
| Ambient dose rate from deposition | OIL3 | 1 mSv/h | | Evacuation or substantial sheltering |
| | OIL4 | 200 µSv/h | | Temporary relocation |
| | OIL5 | 1 µSv/h | | Restriction of foodstuffs |
| Marker radionuclide concentrations in ground deposition | | General food | Milk | |
| I-131 | OIL6 | 10 kBq/m ² | 2 kBq/m ² | Restriction of foodstuffs |
| Cs-137 | OIL7 | 2 kBq/m ² | 10 kBq/m ² | Restriction of foodstuffs |
| Marker radionuclide concentrations in food, milk, water | | General food | Milk and water | |
| I-131 | OIL8 | 1 kBq/kg | 0.1 kBq/kg | Restriction of foodstuffs |
| Cs-137 | OIL9 | 0.2 kBq/kg | 0.3 kBq/kg | Restriction of foodstuffs |

Public Health Message

| Dose, (mSv) | Level of concern | Justification |
|-------------|------------------|---|
| Less than 1 | Minimal | The annual dose to the average Australian is 3 – 3.5 mSv per annum from all sources, including the man-made ones. The dose is fluctuating widely between individuals and an individual that receives a whole-body CT scan for diagnostic purposes receives an extra 5-10 mSv from that procedure. Thus, a 1 mSv annual dose is entirely within the range of normal variation for any Australian citizen |
| 1 - 20 | Low | The annual dose limit for a worker in radiation practices is 20 mSv as an annual average (for a single year, 50 mSv is used). Doses should always be kept as low as reasonably achievable; however, there is international consensus that this level would afford workers adequate protection. |
| 20 - 100 | Significant | This dose range is abnormal and has been identified internationally as the dose range that should be applied in emergency situations. |
| Over 100 | Of Concern | International recommendations state that operations under such dose rates should only be carried out if they are urgent or life-saving. A few hundred mSv will lead to transient effects in the blood cells. Symptoms of early stages of acute radiation syndrome (ARS) may start to appear at 500 mSv and above. From ca 4 500 mSv we would expect fatalities among the exposed. |



News & Events

[Home](#) > [News & Events](#) > [Media Releases](#) >

[Introduction](#)

[What's New?](#)

[Events](#)

[Media Releases](#)

Media Releases

Date: 30 March 2011 Time: 1600

Department of Health and Ageing

and

Australian Radiation Protection and Nuclear Safety Agency

This Page:

- [Advice on exposure to radiation arising from nuclear incidents in Japan](#)
- [Advice for Australians remaining in Japan](#)
- [Shelter in place \(sheltering\)](#)
- [Potassium iodide tablets](#)
- [Advice for Australians returning home](#)
- [Consolidated Advice for Medical Practitioners including Frequently Asked Questions](#)
- [Frequently Asked Questions for Medical Practitioners](#)
- [Food and Water in Japan and Food Imported from Japan](#)
- [No Current Restriction on Flights and Shipping to Japan](#)
- [Processing imported goods and passengers arriving from Japan \(PDF 49kb\)](#)

CONTACT

For more information please get in touch with ARPANSA

-  [+61 3 9433 2211](tel:+61394332211)
-  [+61 3 9432 1835](tel:+61394321835)
-  [email ARPANSA](mailto:email@arpansa.gov.au)



News & Events

Home > News & Events > Media Releases > Japan Nuclear Accident

Introduction

What's New?

Events

Media Releases

Media Releases

Date: 26 May 2011 Time: 1600

Department of Health and Ageing and Australian Radiation Protection and Nuclear Safety Agency

Current Advisories:

- Exposure to radiation arising from the nuclear accident in Japan
- Australians remaining in Japan
- Shelter in place (sheltering)
- Potassium iodide tablets
- Australians returning home
- Consolidated Advice for Medical Practitioners including Frequently Asked Questions
- Restriction on Flights and Shipping to Japan

Links to Advice on Australian Government Sites:

Department of Foreign Affairs and Trade

- Travel advice for Japan - [Smarttraveller](#)

Australian Customs and Border Detection

- [Processing imported goods and passengers arriving from Japan \(PDF 49kb\)](#)
- [Processing maritime cargo vessels arriving from Japan \(PDF 43kb\)](#)

Food Safety Australia New Zealand (FSANZ)

- [Safety of food from Japan - a fact sheet from Food Standards Australia New Zealand \(FSANZ\)](#)

Australian Quarantine and Inspection Service (AQIS)

- [Imported Food Notices - DAFF](#)

Advice on exposure to radiation arising from the nuclear accident in Japan - 26 May 2011: TIME: 1600

Advice for Australians remaining in Japan on food and water precautions, the availability and use of potassium iodide tablets and on appropriate sheltering from radiation if required have been provided by Australia's Chief Medical Officer and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

Extensive advice on these new topics of concern, together with information for people returning from Japan and for use by GPs is contained on this website and is updated regularly.

CONTACT

For more information
please get in touch
with ARPANSA

+61 3 9433 2211
+61 3 9432 1835
[email ARPANSA](#)

Chernobyl Comparison (I)

UNSCEAR Report 2008 – Annex D

- Explosion of operating reactor
- 2 workers died in the explosions
- 134 cases of Acute Radiation Syndrome of whom 28 died of acute effects
- Uncontrolled releases for 10 days with strong thermal uplift from graphite fire contaminating large areas of Europe
- Release 5.2×10^{18} Bq I-131 (equiv.)

Chernobyl Comparison (II)

UNSCEAR Report 2008 – Annex D

- Recovery workers:
530,000 with average 120 mSv
- Evacuees: 115,000
- Exclusion zone: 30 km
- Collective exposure: 4×10^5 manSv
- 5000-7000 cases of thyroid cancer of which 15 had proven fatal by 2005

Disaster Aftermath

- 15,269 were confirmed dead.
- 8,526 missing and 5,363 injured.
- Damage estimate in excess of 25 trillion yen (\$300 billion)
- Displaced people peaked at 500,000.
- Electricity Shortages

