9:00 on April 4, 2011

The Possible Influence of the Fukushima Daiichi NPP Accident Caused by the Eastern Japan Earthquake Disaster

The Federation of Electric Power Companies

We offer our sincerest condolences to the casualties of the Eastern Japan Earthquake Disaster on March 11.

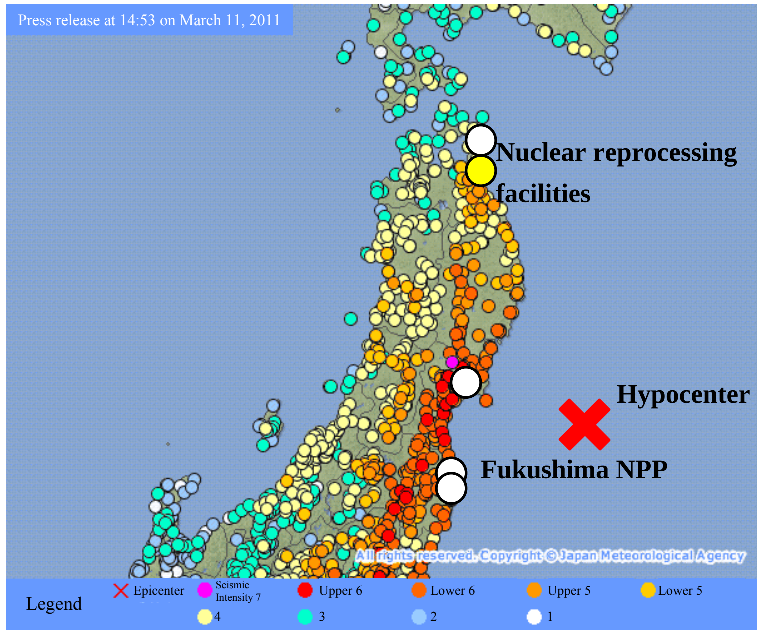
We are extremely aware of the serious concerns and difficulties caused by the accident at TEPCO's Fukushima Daiichi Nuclear Power Plant and the consequent release of radioactive material, both for those living nearby and the wider public, and we most deeply apologize for this situation.

Working with the support of the Japanese Government and related agencies, TEPCO is making the utmost effort to prevent the situation from deteriorating, and the electricity industry as a whole is committing all its resources, including vehicles, equipment and manpower, toward saving the situation.

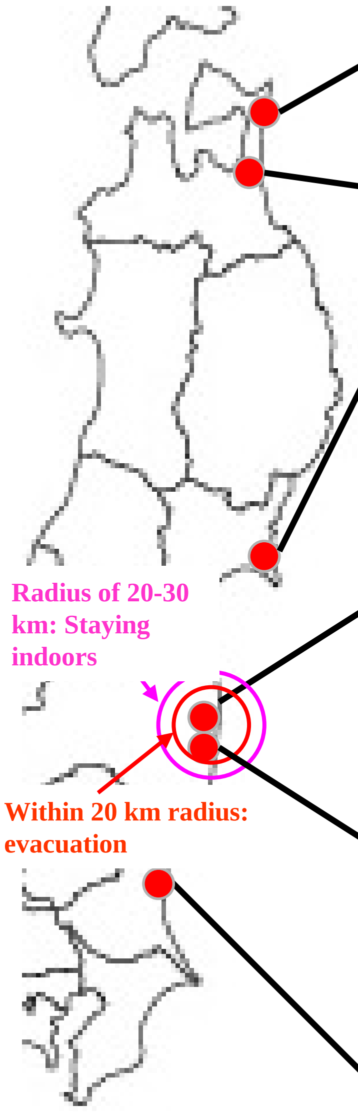
Outline of the Tohoku-Pacific Ocean Earthquake

- ➢ Date of occurrence: 14:46 on Friday, March 11, 2011
- ➢ Epicenter: Offshore Sanriku (38ºN, 142.9ºE), Depth of hypocenter: 24 km (tentative value), Magnitude: 9.0
- ➢ Seismic intensity 7: Kurihara city, Miyagi prefecture
- □ Upper 6: Hitachi city, Ibaraki prefecture, Naraha-cho, Tomioka-cho, Okuma-machi, Futaba-cho, Fukushima prefecture, Natori city, Miyagi prefecture, etc.
- □ Lower 6: Ofunato city, Ishinomaki city, Onagawa-cho, Miyagi prefecture, Tokai village, Ibaraki prefecture, etc.
- □ Upper 5: Miyako city, Iwate prefecture, Fukushima city, Fukushima prefecture, Taihaku ward, Sendai city, Miyagi prefecture
- □ Lower 5: Kuji city, Iwate prefecture, Kariiwa village, Niigata prefecture
- □ 4: Rokkasho village and Higashidori village, Aomori prefecture, Kashiwazaki city, Niigata prefecture, Tadami-cho, Fukushima prefecture

Hypocenter and seismic intensity



Current Status of NPPs Affected by the Earthquake



Tohoku Electric Higashidori NPP
Unit 1
□

JNFL reprocessing plant: no significant event

◎ Cold shutdown (with cooling water below 100ºC)
▲ Hot shutdown
□ Reactor shutdown for outage
Numbers in parentheses show the time of cold shutdown.

Tohoku Electric Onagawa NPP		
Unit 1	Unit 2	Unit 3
◎(**0:58 on Mar. 12)**	◎**(*)**	◎ **(1:17 on Mar. 12)**

*Cooling water temperature was 100ºC because the units had just been started up.

Tokyo Electric Fukushima Daiichi NPP					
Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
▲	▲	▲	□	◎ **(14:35 on Mar. 20)**	◎ **(19:27 on Mar. 20)**

Tokyo Electric Fukushima Daini NPP			
Unit 1	Unit 2	Unit 3	Unit 4
◎ **(17:00 on Mar. 14)**	◎ **(18:00 on Mar. 14)**	◎ **(12:15 on Mar. 12)**	◎ **(7:15 on Mar. 15)**

JAPC Tokai II NPP
◎ **(0:40 on Mar. 15)**

Current Status of Fukushima Daiichi NPP

- Control rods were inserted to shut the reactor down following signals received from seismometers. The operating plant automatically shutdown, which means the shutdown function worked.
- The loss of cooling function at units 1, 2 and 3 caused the temperature and pressure inside the reactor pressure vessel to rise, leading to a release of radioactive materials from the reactor.

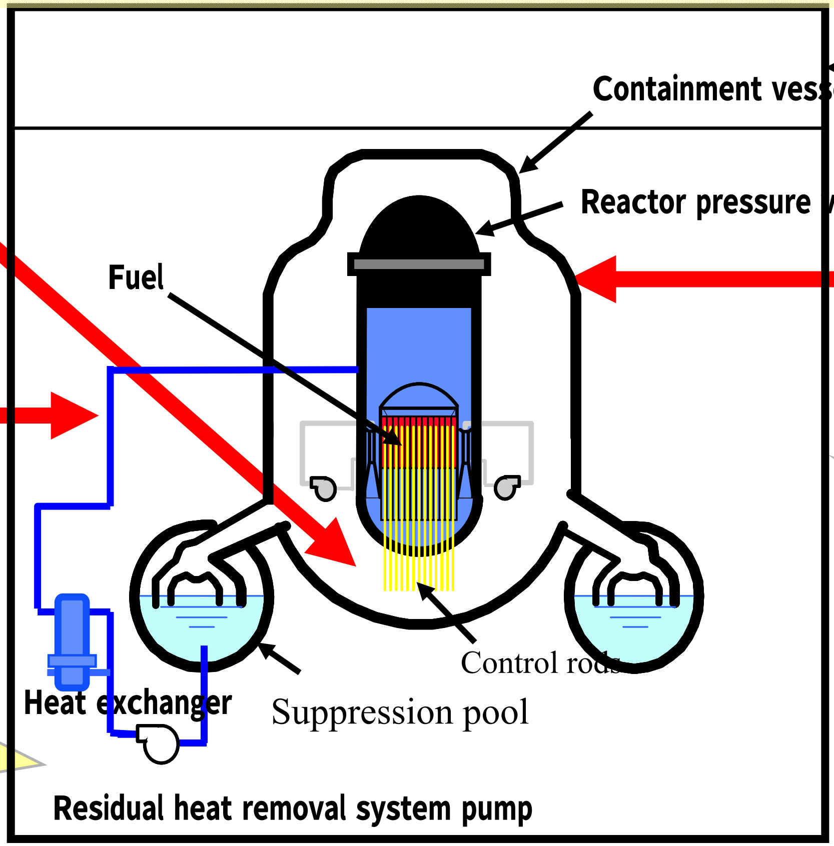
Shutdown

Shut down the reactor by inserting all control rods to prevent neutrons from causing nuclear fission.

Cool down

Cool the reactor water to maintain the temperature from 30 °C to 40°C.

Loss of power to the pumps used to circulate water to cool the reactor coolant resulted in the loss of the cooling function.



Containment

Prevent radioactive materials from being released outside the reactor building by five-layer wall.

A hydrogen explosion blew off upside of the reactor building resulting loss of the containment function.

Current Status of Fukushima Daiichi NPP

Before the quake →

After the quake ↓

Tsunami possibly flooded up to this line?

Circulating water pump

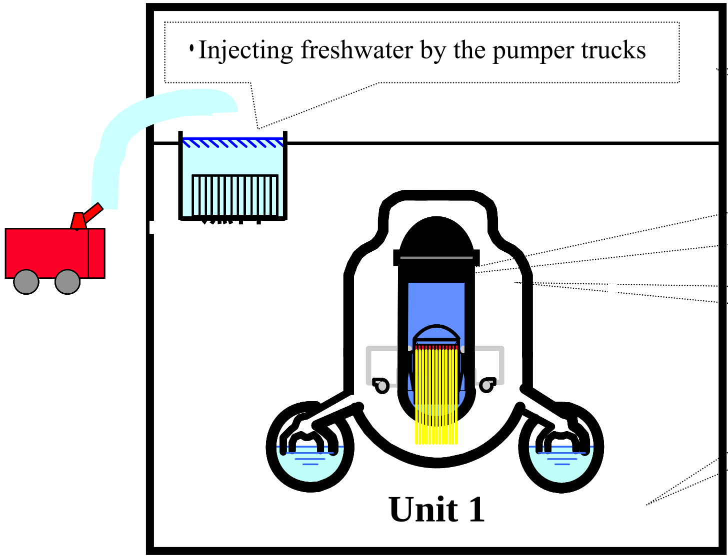
Seawater pump

Seawater Intake

Heavy oil tank

Photos: http://www.digitalglobe.com/

Current Status of Fukushima Daiichi NPP (Unit 1 & 2)



・A hydrogen explosion blew off upside of the reactor building

・The Reactor condition is stable
・Continuing freshwater injection by a temporary electric-driven pump

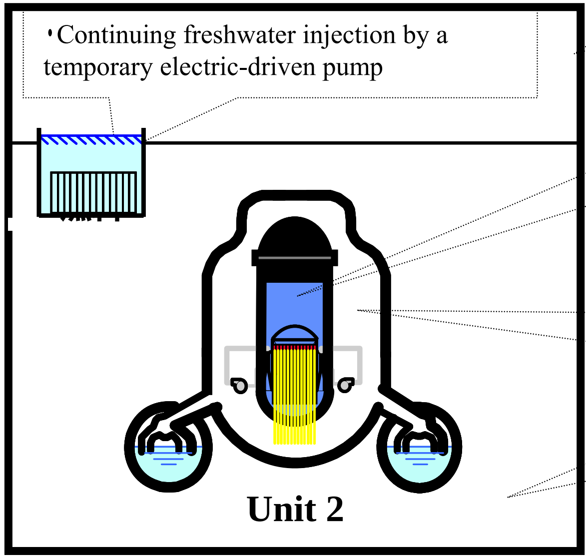
・The Containment Vessel is not damaged. *

・External power was restored. (Checking integrity of machinery)

Mar.11 14:46 Scram
15:42 All power sources failed
16:36 ECCS stopped (batteries exhausted)
Mar. 12 1:20 CV pressure rose abnormally.
10:17 Start venting
15:36 A hydrogen explosion
20:20 Start injection of seawater and boric acid into the reactor
Mar. 24 Lighting restored in the control room
Mar. 25 Start injection of freshwater instead of seawater

Leaked water is being transferred from the turbine building and the trench.

＊Highly contaminated water was detected in the turbine.



・The reactor building remains sound

・The Reactor condition is stable
・Continuing freshwater injection by a temporary electric-driven pump

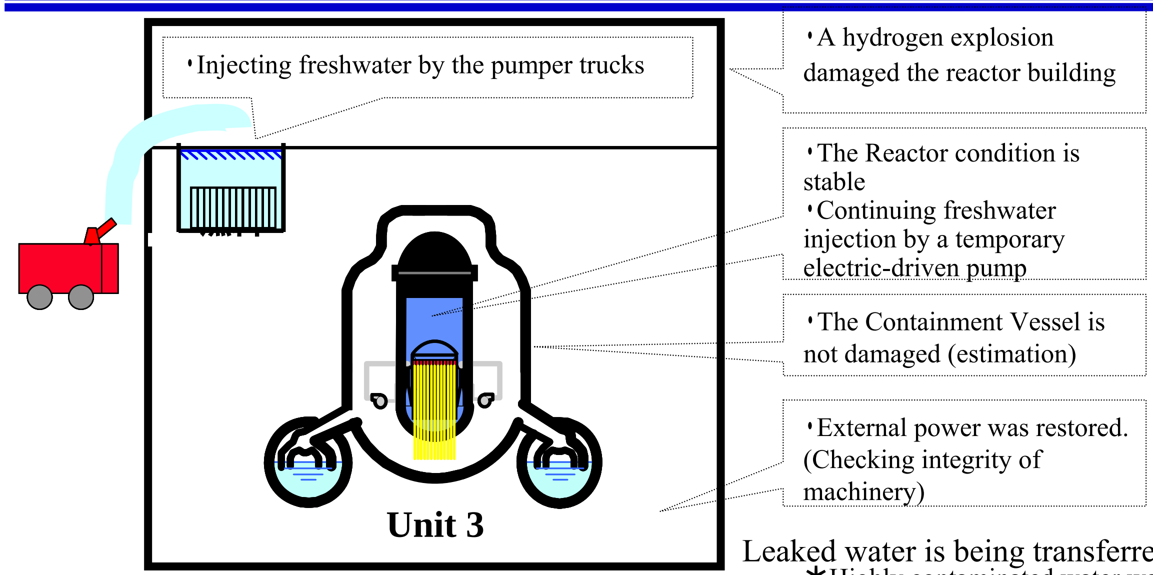
・An explosion sound observed (the suppression chamber damage suspected).

・External power was restored. (Checking integrity of machinery)

Mar.11 14:46 Scram
15:42 All power sources failed
16:36 ECCS stopped (batteries exhausted)
Mar. 13 11:00 Start venting
Mar. 14 16:34 Start injection of seawater
22:50 CV pressure rose abnormally.
Mar. 15 0:02 Start venting
6:10 An explosion sound observed (the suppression chamber damage suspected).
Mar. 26 Start injection of freshwater instead of seawater
Mar. 26 Lighting restored in the control room

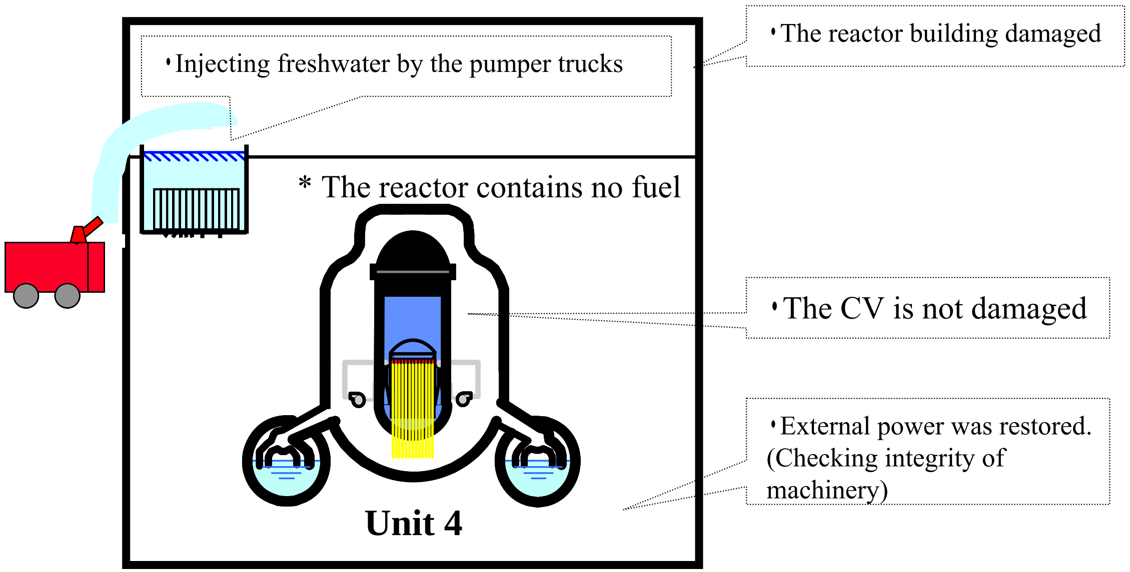
Leaked water is being transferred from the turbine building and the trench.

Current Status of Fukushima Daiichi NPP (Unit 3 & 4)



Mar.11 14:46 Scram
15:42 All power sources failed
Mar. 12 20:41 Start venting
Mar. 13 5:10 ECCS stopped (batteries exhausted)
8:41 Start venting
13:12 Start injection of seawater and boric acid into the reactor
Mar. 14 5:20 Start venting.
7:44 CV pressure rose abnormally
11:01 A hydrogen explosion
Mar. 22 Lighting restored in the control room
Mar. 25 Start injection of freshwater instead of seawater

Leaked water is being transferred from the turbine building and the trench.
∗Highly contaminated water was detected in the turbine.

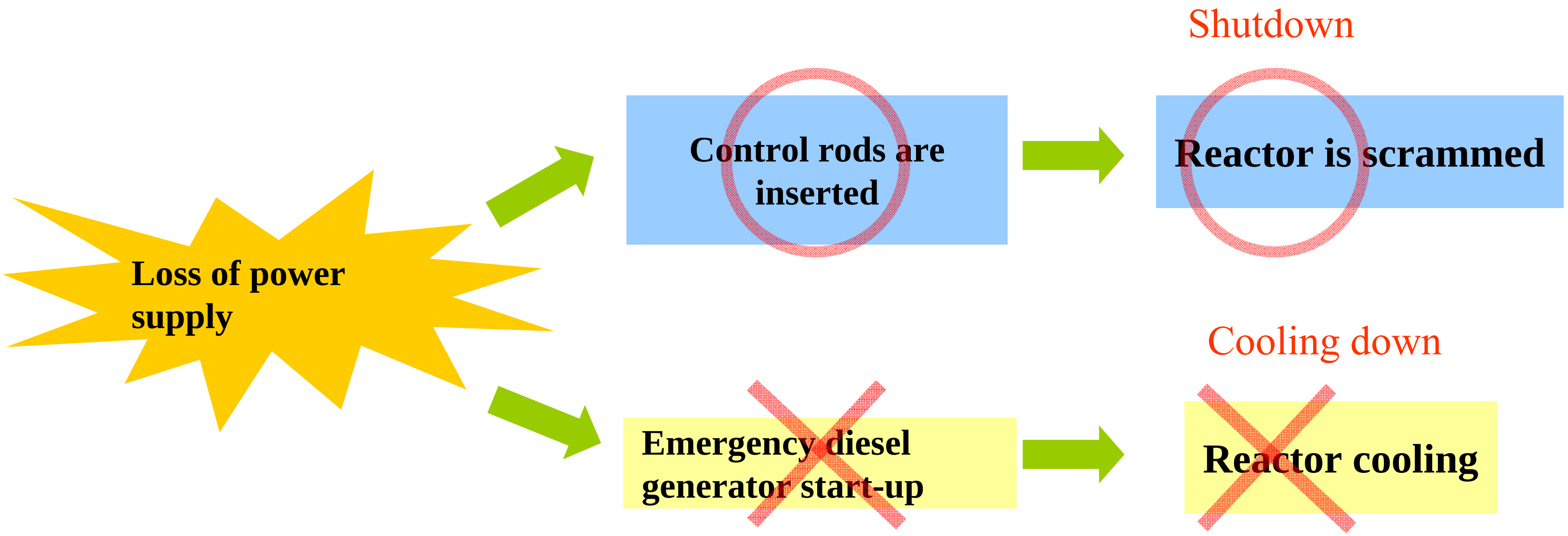


Mar. 15 The reactor building wall partially damaged
A fire on 3rd floor of the reactor building
Mar.16 A fire was observed again.

What Happened Following the Loss of the Off-site Power Supply

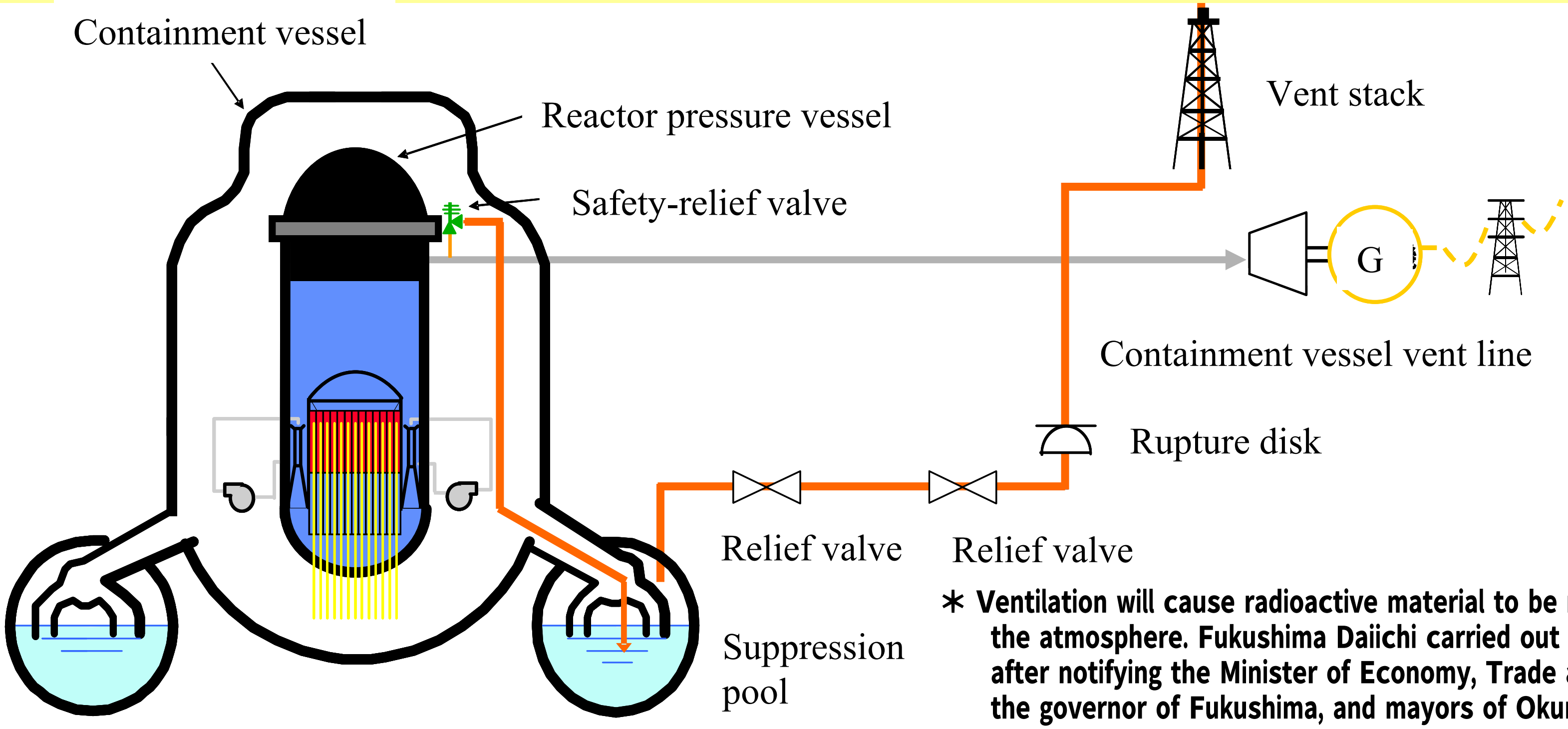
- The plant was designed so that:
- ➢ In case of loss of external power supply, the control rods that suppress nuclear fissions are automatically inserted into the reactor by water pressure to scram the reactor immediately (shutdown).
- ➢ At the same time, emergency diesel generators are automatically started up to supply the necessary electricity.

Following this earthquake, the reactor shutdown function worked properly, but the emergency diesel generators failed after starting up, causing loss of the function to cool the reactor.



How Containment Pressure is Reduced at Fukushima Daiichi NPP

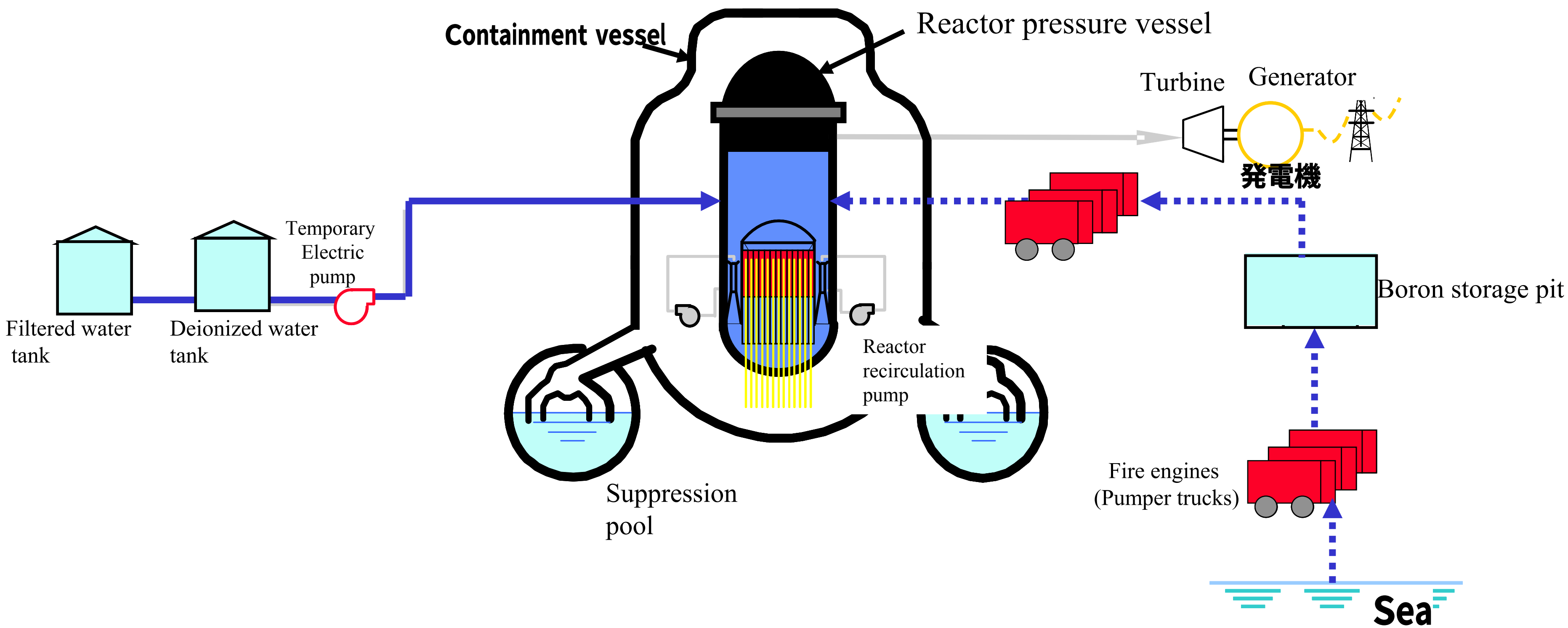
•The action to gradually reduce pressure inside the containment vessel to prevent damage to the containment vessel is called ventilation (venting). The relief valves are opened to release gas from the containment vessel and then the gas is discharged from the vent stack after iodine and other radionuclides have been absorbed to some extent by the water in the pressure suppression pool. This action maintains the integrity and containment function of the containment vessel.



＊ Ventilation will cause radioactive material to be released into the atmosphere. Fukushima Daiichi carried out ventilation after notifying the Minister of Economy, Trade and Industry, the governor of Fukushima, and mayors of Okuma and Futaba, and after issuing a press release, and it was confirmed that local residents had been evacuated.

How the Reactor is Being Cooled at Fukushima Daiichi NPP

- To submerge the fuel in water to maintain reactor safety:
  - Water is continuously being injected into the pressure vessel.
- The water source was primarily the filtered water and the fire-fighting water. After they were exhausted, seawater had been injected. At the present, fresh water is injected to diminish damages which seawater may pose on the facilities.



Differences between Exposure and Contamination

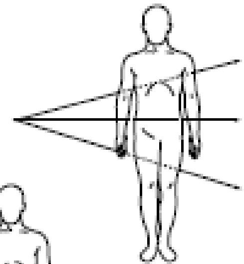
- According to the press release, the measured radioactive contamination of an evacuee was 40,000 cpm, which means a radiation exposure of approximately 0.18 mSv per hour in terms of the effect on the human body.

*Calculated values may differ if different types of instruments are used.

Radiation exposure: A person is exposed to radiation.

External exposure

External exposure occurs when the radiation source (radioactive material, etc.), such as roentgen, is outside the human body.
Measured values are represented as radiation dose per hour (in sieverts/hour, millisieverts per hour, or microsieverts per hour).



External exposure

1 sievert = 1,000 millisieverts (mSv) = 1,000,000 microsieverts (μSv)

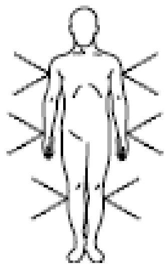
Internal exposure

Internal exposure occurs when radioactive material is taken into the human body by people swallowing radioactive materials or breathing contaminated air.
It is measured in radiation counts per minute (cpm).

Internal exposure

Contamination: Radioactive contamination occurs when radioactive material is deposited on the surface of skin or clothes.

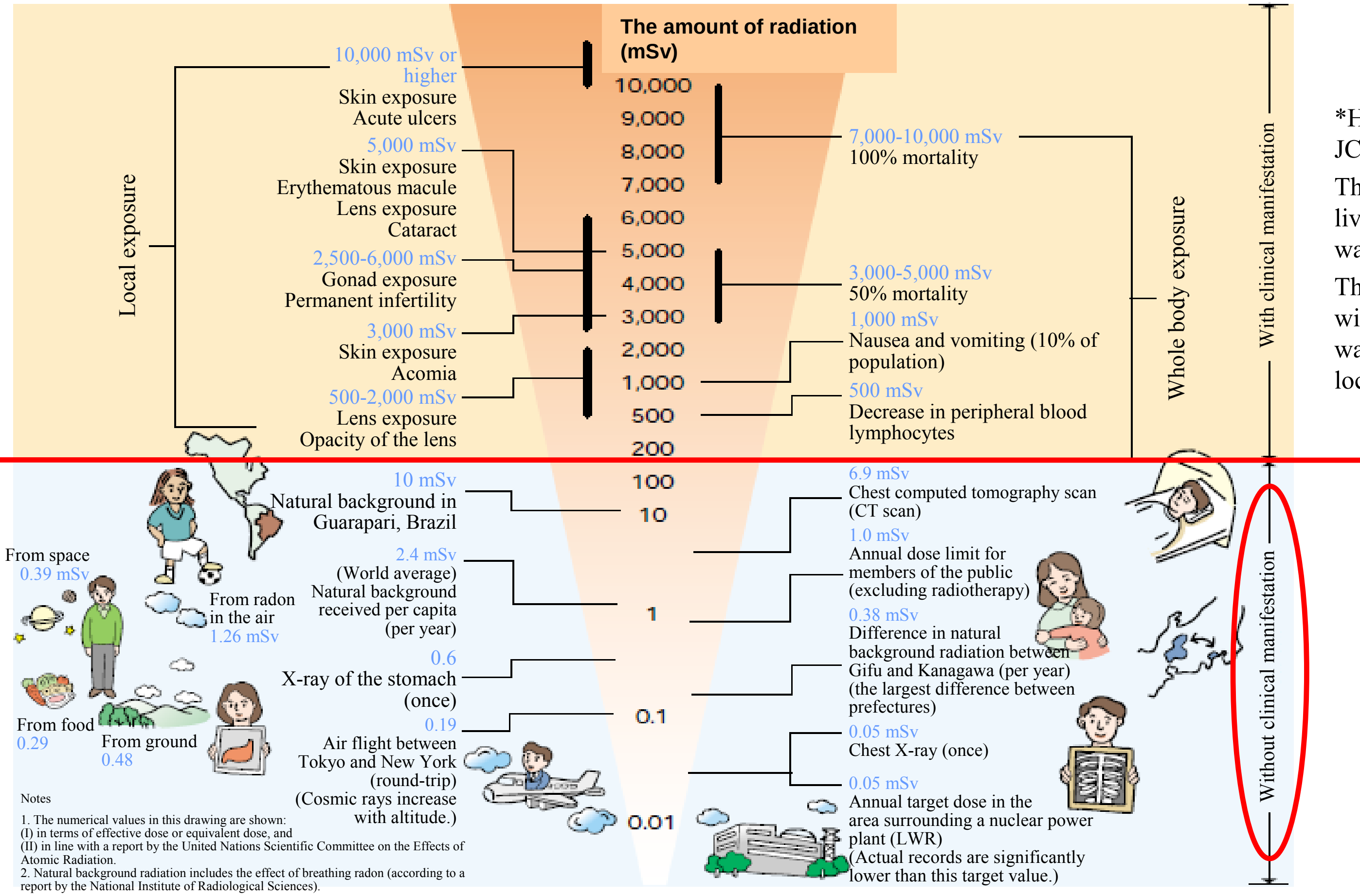
A contaminated person will be continuously exposed to radiation until the radiation source (radioactive material) is removed.
It is measured in radiation counts per minute (cpm).



Contamination

Possible Health Effects of Radiation on Local Residents

- The exposure dose received by local residents following the accident is unclear so far (to be surveyed).
- The average person receives roughly 2.4 millisieverts (mSv) of radiation exposure, both internal and external, a year due to exposure to natural sources in daily life (as global average).
- No health effects have been observed from radiation exposure below 100 mSv.



*Health effects of radiation released by the JCO criticality accident

The exposure dose received by local residents living on the west boundary of the JCO site was 16 millisieverts at the highest.

The level of detected radioactive material within a 10-kilometer radius from the facility was low enough not to affect the health of local residents or the environment.

Possible Health Effects of Radiation on Workers?

- Twenty one site workers including eighteen TEPCO employees have received a dose of more than 100 millisieverts, but less than the revised limit, of radiation so far.
- It was inferred that three workers from cooperating companies were exposed to radiation of 2000-3000 mSv on the feet and received internal exposure of 200 mSv or less. They received medical treatment at the National Institute of Radiological Sciences in Chiba City.

	Radiation Exposure Limits
General public	A whole body dose of no more than 1 mSv per year (beginning on April 1)
Occupational exposure	A whole body dose of no more than 100 mSv in five years (beginning on April 1) and no more than 50 mSv in any one year (beginning on April 1)
	No more than 100 mSv during emergency work

Personal dosimeter with alarm function

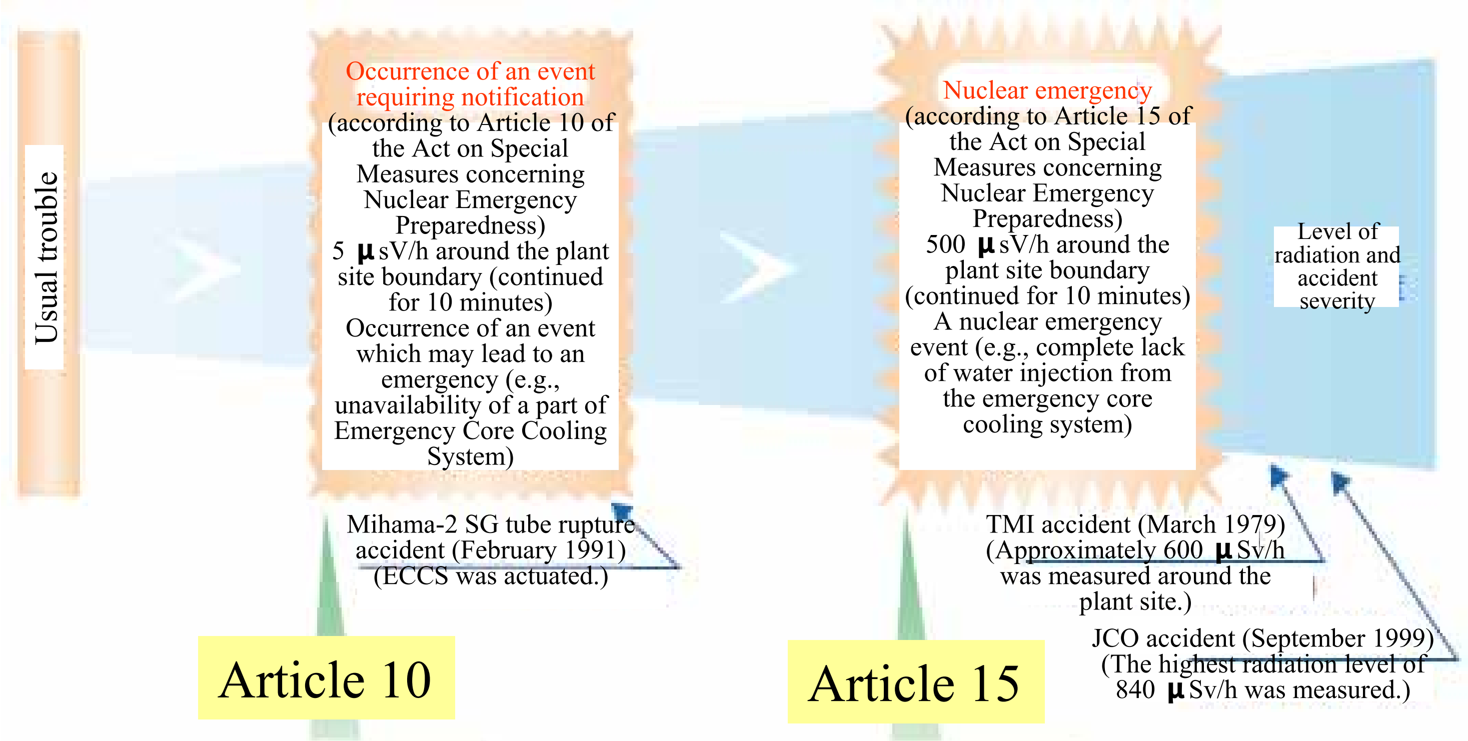
A personal dosimeter is always worn by workers during work to measure radiation exposure. The digital display shows the exposed dose directly. An alarm and sound are issued if the exposed dose exceeds the preset value.

The radiation exposure limit was raised to 250 mSv during emergency work.

Due to the current circumstances, the Ministry of Health, Labour and Welfare (MHLW) raised the annual radiation exposure limit only for workers involved in emergency work at nuclear power plants to 250 millisieverts from the existing standard of 100 millisieverts.
One reason for raising the limit is that the International Commission on Radiological Protection (ICRP) recommends that "the annual radiation exposure limit should not exceed 500 millisieverts (during a severe accident)".
Consequently, according to an officer from the MHLW, the radiation exposure limit was revised, but is still lower than the level recommended by the ICRP.

Notification according to Act on Special Measures concerning Nuclear Emergency Preparedness Articles 10 &15

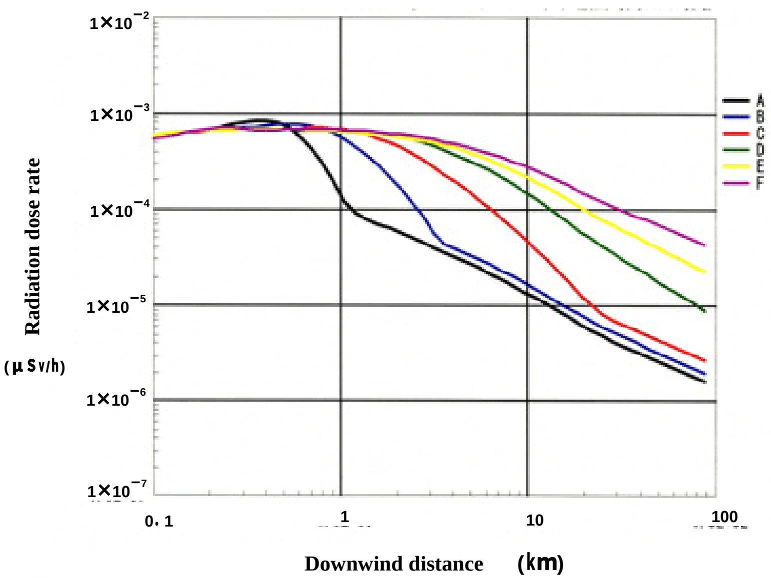
- Following the release of radioactive material from Fukushima Daiichi NPP, local residents living in a 20-km radius were ordered to evacuate and those living in a 20- to 30-km radius to stay indoors according to the Act on Special Measures concerning Nuclear Emergency Preparedness, Articles 10 and 15 respectively.
- This Act was enacted in June 2000 to improve disaster prevention measures, including the initial response in case of an accident, as well as cooperation between the national government and prefectures/municipalities based on the lessons learned from the JCO criticality accident in September 1999.



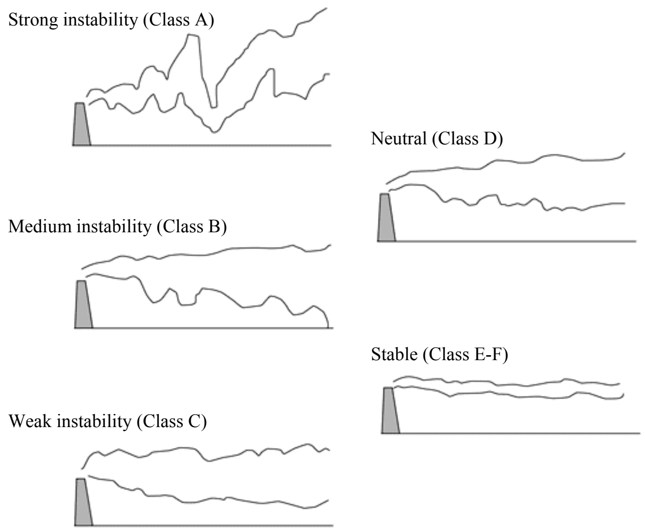
Appropriateness of a 20-km Radius Evacuation Area

- Radioactive material released into the air is carried downwind and dispersed depending on the wind velocity and atmospheric stability.
- The radiation dose rate on the ground surface, which is relatively high at the point of release, decreases further downwind as radioactivity is weakened by diffusion.
- Therefore, the central government of Japan designates an evacuation area to minimize the health effects of radiation.

Distribution of ground spatial radiation dose rate on the downwind axis depending on atmospheric stability



Atmospheric stability

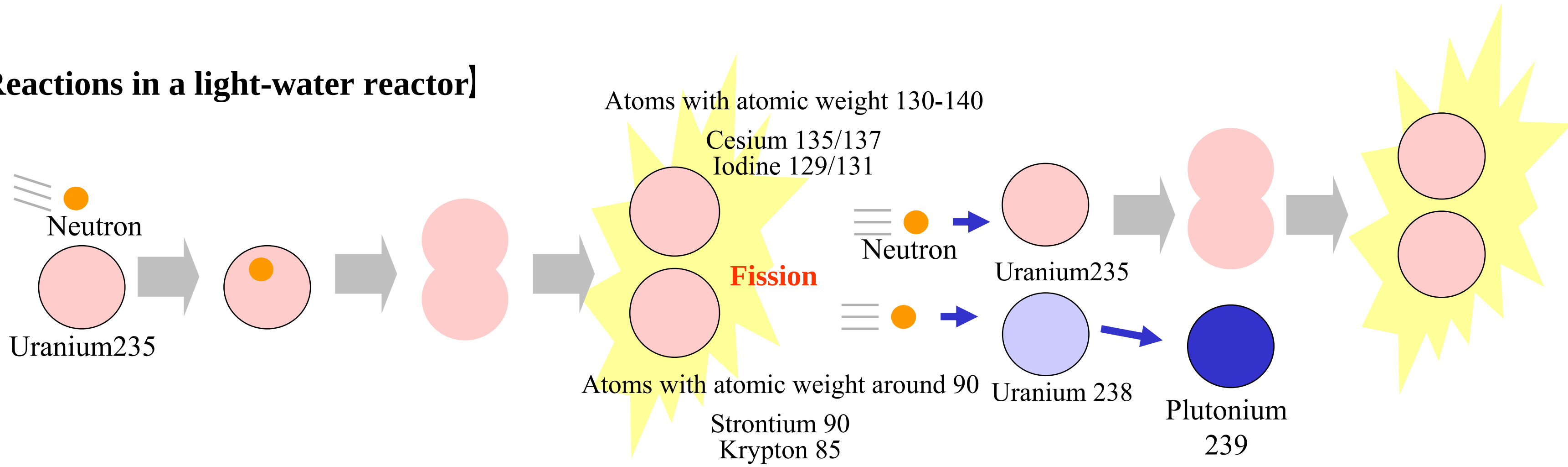


Atmospheric stability: An indicator of the degree of air movement and diffusion in the vertical direction. It depends on the intensity of solar radiation and wind, and is used to predict the diffusion of atmospheric material.
As instability increases, atmospheric material is more easily diffused; as stability increases, atmospheric material becomes harder to diffuse. It ranges from A (very unstable) to F (stable), with intermediate stability from B to E.

What Does the Detection of Cesium, Iodine and Plutonium Mean?

➢Cesium and iodine, which are radioactive materials, do not exist in nature, but are fission products produced from the fission of uranium and plutonium.
➢Plutonium, which is a radioactive material produced from uranium in reactors, do not exist in nature.
* Cesium, iodine and plutonium produced by foregone nuclear tests and the Chernobyl accident exist in Japan.
➢It is suspected that fission products, which should be contained in fuel pellets and fuel cladding, have been released with gases and steam due to continued abnormal conditions.

【Reactions in a light-water reactor】

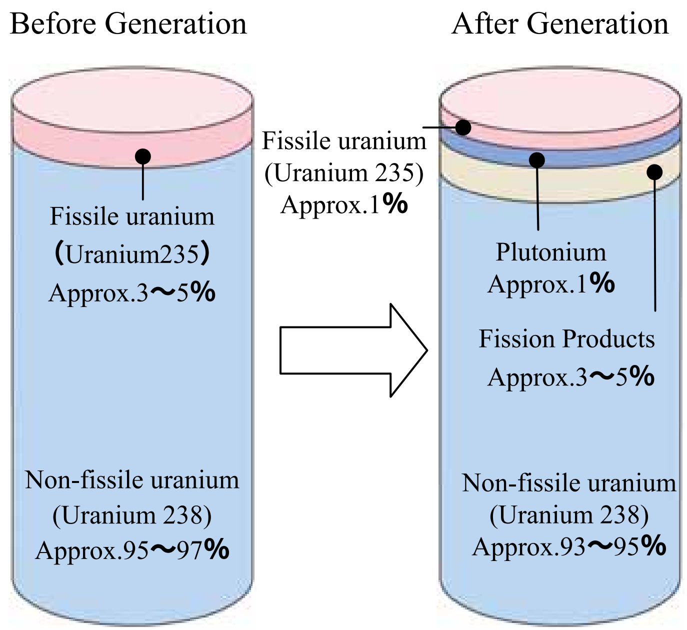


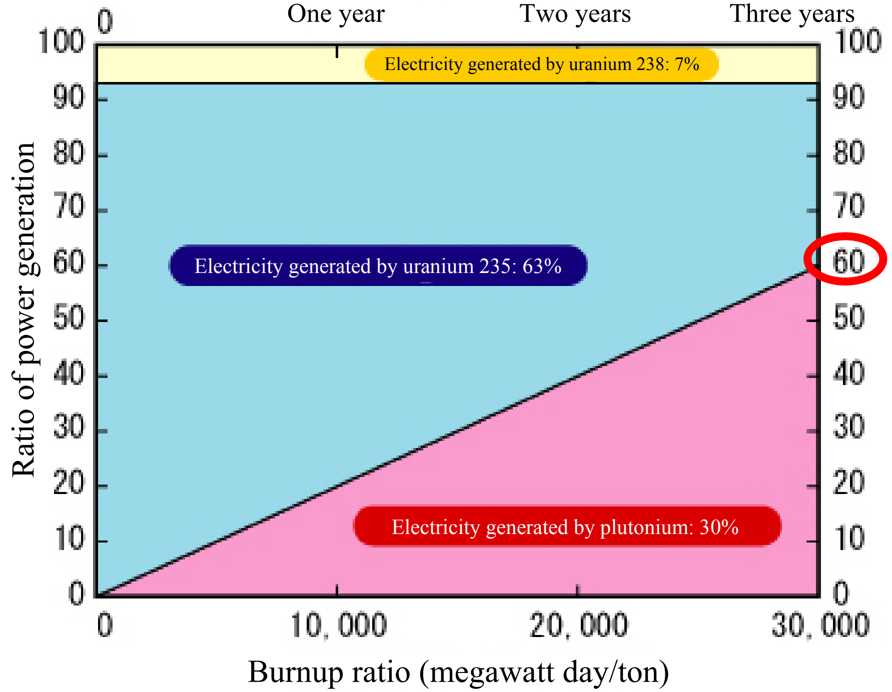
Effects of radiation to human bodies depend on nuclides and routes of exposure (internal or external)
Iodine 131 (Half-life 8 days): Accumulate in the thyroid gland. Volatile (apt to be released with gasses).
Cesium 135 (Half-life 30 years) : Accumulate in the muscular tissue. Buoyant (apt to be released with gasses).
Plutonium 239 (Half-life 24,000 years): Radiates alpha rays (A sheet of paper or air a few centimeter-thick can shield the rays. Thus, external exposure is unlikely. Heavy and difficult to diffuse widely.

Has Dangerous Plutonium been Released from the MOX in Fukushima Daiichi Unit 3?

➢Plutonium detected in the soil of the Fukushima Daiichi site has not been determined to have come from unit 3 reactor.

➢There is no difference in released radioactive material between a uranium fuel reactor and MOX fuel reactor because plutonium is produced during power generation in a uranium fuel reactor.





•Uranium fuel (after generation) contains approx.1% of plutonium produced from uranium 238.

•Plutonium contained in each reactor of Fukushima Daiichi does not vary much because there are only 32 MOX fuel clusters among 548 fuel clusters in total in Fukushima Daiichi Unit 3 reactor.

•Uranium fuel remains in the reactor for 3 to 4 years to continuously generate power. After 3 to 4 years of use, about 60% of the electricity comes from plutonium.

Are Milk and Spinach Safe when Excess Radioactive Materials Are Detected?

➢The provisional limits set in line with the Food Sanitation Act are strict (with a wide safety margin) taking into consideration long term ingestion, and so ingesting milk and spinach at this level would not immediately affect human health.

Iodine-131 was detected in raw milk (sampled in Date-gun, Fukushima on March 17)

Detected value: 1,510 Bq/kg
Provisional regulatory limit: 300 Bq/kg

According to the government;

The cumulative radiation dose in one year if a person were to keep drinking milk with the detected level would be equivalent to 6.9 millisieverts (same as a CT scan).

Iodine-131 and cesium-137 were detected in spinach (sampled in Takahagi-city, Ibaraki on March 18)

Iodine-131 Detected value: 15,020 Bq/kg
Provisional regulatory limit: 2,000 Bq/kg

Cesium-137 Detected value: 524 Bq/kg
Provisional regulatory limit: 500 Bq/kg

According to the government;

The cumulative radiation dose in one year if a person were to keep eating spinach with the detected level would be equivalent to 1.4 millisieverts (one-fifth of a CT scan).

<Provisional regulatory limits>
Indices of allowable radiation exposure established by the Nuclear Safety Committee based on the recommended limits for protection against radiation exposure by the International Commission on Radiological Protection (ICRP).

In compliance with the provisional limits, the government ordered four prefectures to restrict shipping or ingesting such food products which excess the limit (Current status is as follows).
Shipping Restriction: Spinach and kakina produced in Fukushima, Ibaraki, Tochigi and Gunma pref.. Raw milk, broccoli, cauliflower etc. produced in Fukushima pref.. Raw milk and parsley produced in Ibaraki pref..
Ingestion Restriction: spinach, komatsuna, cabbage produced in Fukushima pref.

IsTap Water Safe when Excess Radioactive Materials Are Detected?

- "Indices relating to limits on food and drink ingestion" are set to protect human health even in the very unlikely scenario that drinking-water was contaminated and consumed for an entire year at this level. Therefore, a few-days dose would not immediately affect human health. And daily use of tap water at this level would not cause any problem to human health.

Iodine-131 was detected in clean water

Sampled at the waterworks facility in Iidate vil. (Fukushima) on Mar. 20

Detected value: 965 Bq/kg

Sampled at the Kanamachi waterworks facility (Tokyo) on Mar. 22

Detected value: 210 Bq/kg

" Indices relating to limits on food and drink ingestion "

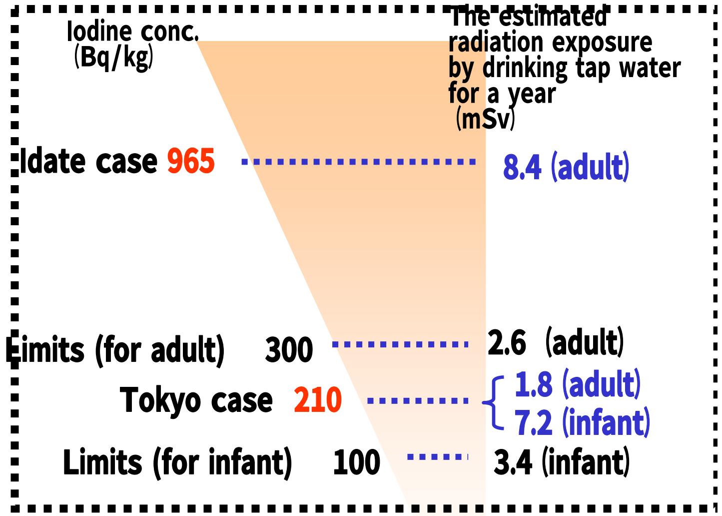
For Adult: 300 Bq/kg

For Infant: 100 Bq/kg

By drinking tap water in above cases for an entire year, the radiation exposure would amount

In the Iidate Case approx. 8.4 mSv (for an adult)

In the Tokyo Case approx. 1.8 mSv (for an adult)



[Indices relating to limits on food and drink ingestion]
Indices indicated by the Nuclear Safety Commission of Japan taking into consideration recommendation of the International Commission on Radiological Protection (ICRP) regarding standard for radiological protection.

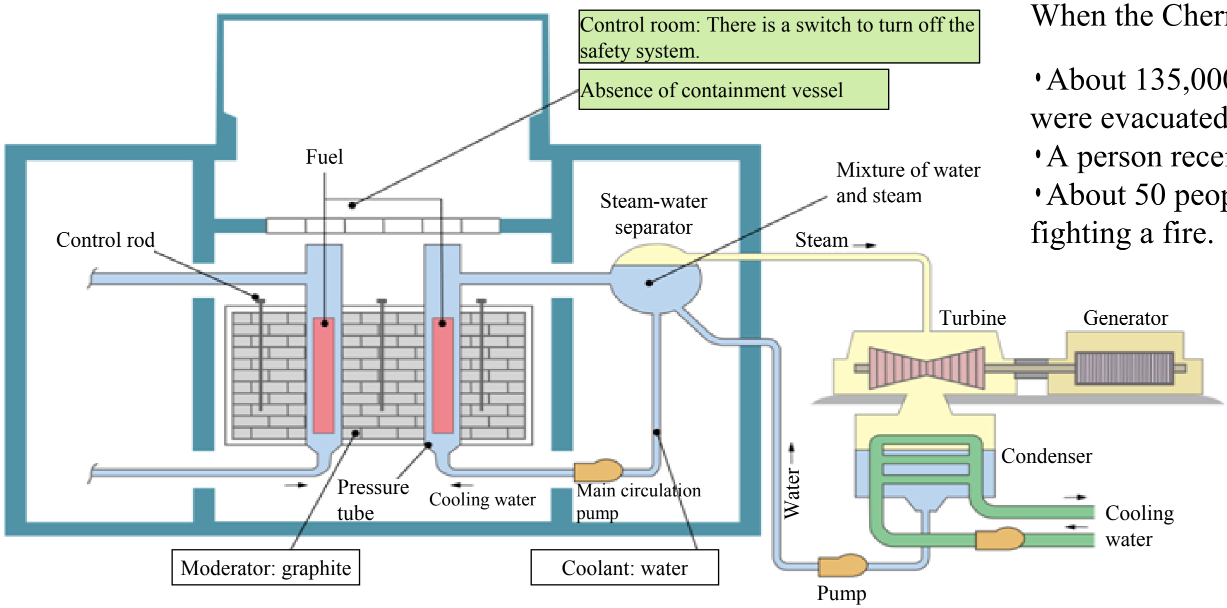
In compliance with the indices, the restriction of the ingestion of tap water for infants continues in Iitate Village, Date City, Minamisoma City and Iwaki City, Fukushima Prefecture. The restriction of ingestion of tap water, once promulgated in several parts of Fukushima, Ibaraki, Chiba, Tochigi Pref. and Tokyo, were withdrawn.

Outline of the Chernobyl Accident

•Outline of the accident at Chernobyl (former Soviet Union, 1986):

A rapid increase in power output occurred during low-power operation for an extended period of time, which was prohibited, damaging the core. As the type of the reactor was unique to the former Soviet Union and the reactor wasn't made of steel, moreover, there was no containment vessel, it was impossible to seal radioactive material. Both the reactor and building cracked, causing the release of a large amount of radioactive material.

Structure of Chernobyl power plant



When the Chernobyl accident occurred:

・About 135,000 people living within a 30-km radius were evacuated.
・A person received at average dose of 120 millisieverts.
・About 50 people were exposed to radiation during fighting a fire.

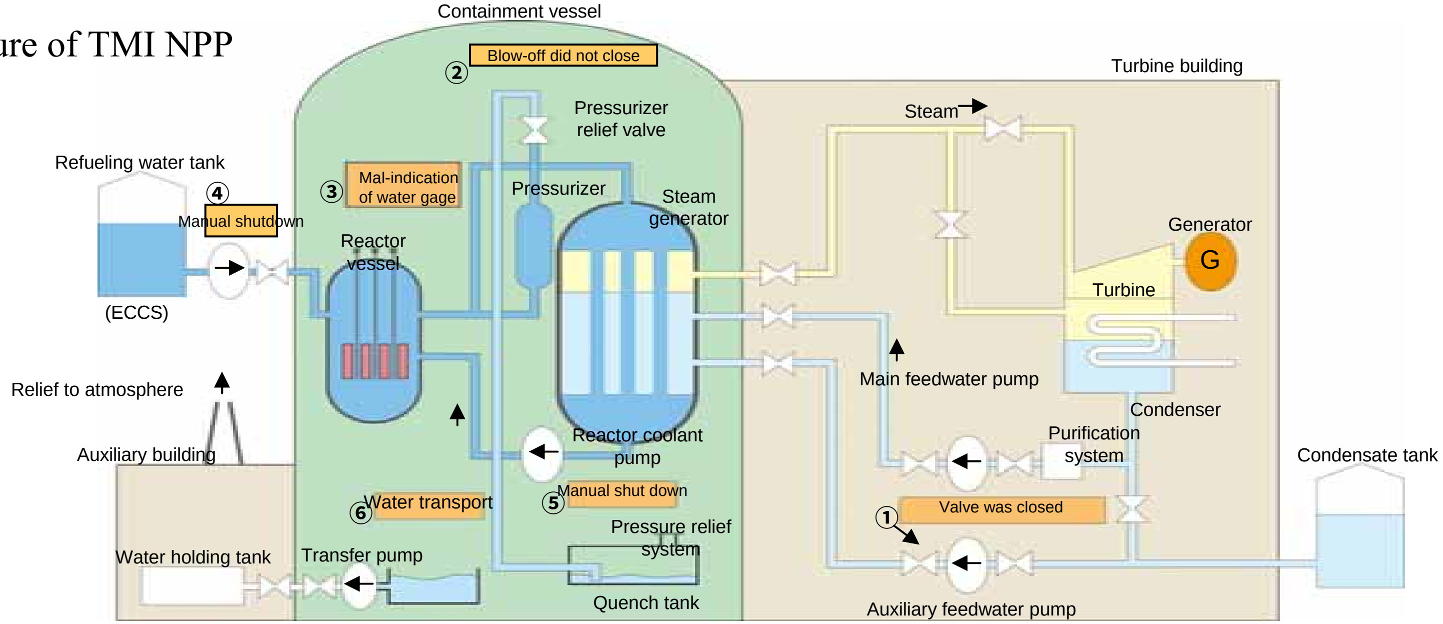
		Japanese reactor	Chernobyl reactor
Self-control ability		Yes	Possibility of loss
	Coolant	Water	Water
	Neutron moderator	Water	Graphite
Safety system		Preventing risky operation by interlock function	Easy to be removed
Rigid containment vessel enclosing the reactor		Yes	No

Outline of theThree Mile Island Accident

Outline of the TMI accident (U.S.A., 1979)

When the main feedwater pumps and valves malfunctioned, operators made multiple mistakes, including accidentally shutting down the emergency core cooling system, which caused a loss of inventory of reactor coolant and fuel damage. However, the containment of radioactive material remained intact, and thus only a small amount of radioactive material was released, causing no health effect.

Structure of TMI NPP



"China Syndrome" is a term coined in the U.S. for an exaggerated core meltdown accident, in which the core at a nuclear power plant in the U.S. melts down, penetrates the earth's crust, and reaches the opposite side of the earth (China). The phrase was used as the title of an American film about a nuclear power plant accident.

Level of Fukushima Daiichi NPP Accident

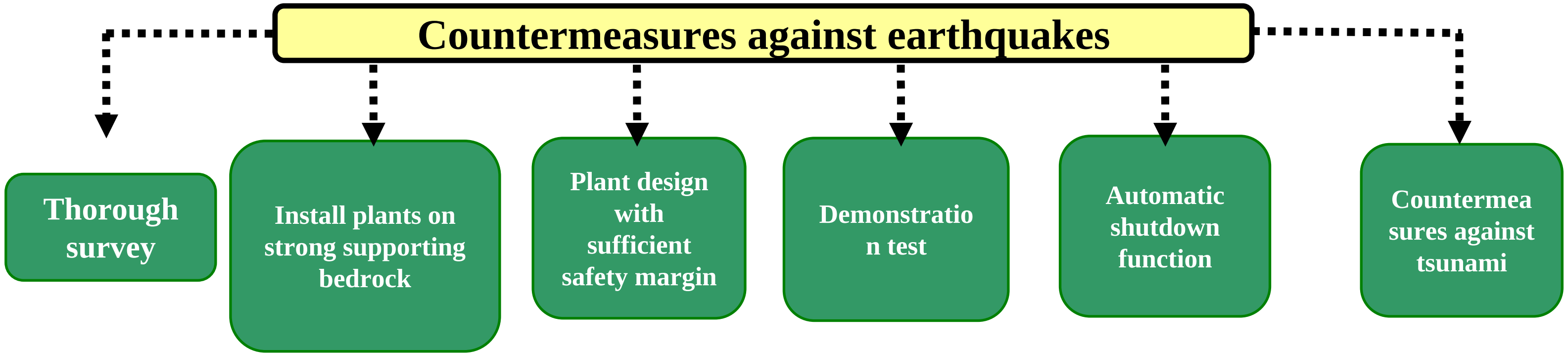
➢ The level of Fukushima Daiichi NPP accident was determined as ‘ Level 5 ’ based on the International Nuclear and Radiological Event Scale（INES）（provisional）.

[International Nuclear and Radiological Event Scale (INES)]

	INES Level	General description of INES levels: People and Environment	General description of INES levels: Radiological Barriers and Control	General description of INES levels: Defence-in-Depth	Examples of Events
Accident	Major Accident Level 7	■ Major release of radioactive material with widespread health and environmental effects requiring implementation of planned and extended countermeasures.			Chernobyl, 1986
Accident	Serious Accident Level 6	■ Significant release of radioactive material likely to require implementation of planned countermeasures.			
Accident	Accident with Wider Consequences Level 5	■ Limited release of radioactive material likely to require implementation of some planned countermeasures. ■ Several deaths from radiation.	■ Severe damage to reactor core. ■ Release of large quantities of radioactive material within an installation with a high probability of significant public exposure. This could arise from a major criticality accident or fire.		Three Mile Island, USA, 1979
Accident	Accident with Local Consequences Level 4	■ Minor release of radioactive material unlikely to result in implementation of planned countermeasures other than local food controls. ■ At least one death from radiation	■ Fuel melt or damage to fuel resulting in more than 0.1% release of core inventory. ■ Release of significant quantities of radioactive material within an installation with a high probability of significant public exposure.		Tokaimura (JCO), Japan, 1999
Incident	Serious Incident Level 3	■ Exposure in excess of ten times the statutory annual limit for workers. ■ Non-lethal deterministic health effect (e.g., burns) from radiation.	■ Exposure rates of more than 1 Sv/h in an operating area. ■ Severe contamination in an area not expected by design, with a low probability of significant public exposure.	■ Near accident at a nuclear power plant with no safety provisions remaining. ■ Lost or stolen highly radioactive sealed source. ■ Misdelivered highly radioactive sealed source without adequate procedures in place to handle it.	
Incident	Incident Level 2	■ Exposure of a member of the public in excess of 10 mSv. ■ Exposure of a worker in excess of the statutory annual limits.	■ Radiation levels in an operating area of more than 50 mSv/h. ■ Significant contamination within the facility into an area not expected by design.	■ Significant failures in safety provisions but with no actual consequences. ■ Found highly radioactive sealed orphan source, device or transport package with safety provisions intact. ■ Inadequate packaging of a highly radioactive sealed source.	
Incident	Anomaly Level 1			■ Overexposure of a member of the public in excess of statutory annual limits. ■ Minor problems with safety components with significant defence-in-depth remaining. ■ Low activity lost or stolen radioactive source, device or transport package.	Mihama, Japan, 2004
Below Scale	Deviation (Below Scale/ Level 0)			0+ 0-	
Out of Scale		Events of no safety relevance			

Seismic Safety of Nuclear Power Plants

- In Preparation for the seismic designing, investigations on geological structures and active faults both in land and marine area around the site should be conducted. Based on the investigation, the maximum levels of earthquakes should be formulated in order to evaluate consequent ground motions which may hit the power plant.
- Nuclear power plants should be built on stable rock ground and designed to withstand possible earthquake ground motions (the Design Bases Ground Motions (DBGM)).
- The validity of the seismic safety of a nuclear power plant is judged according to the " Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities " (revised in 2006) established by the Nuclear Safety Committee.



[Observed ground motions at Fukushima Daiichi NPP]

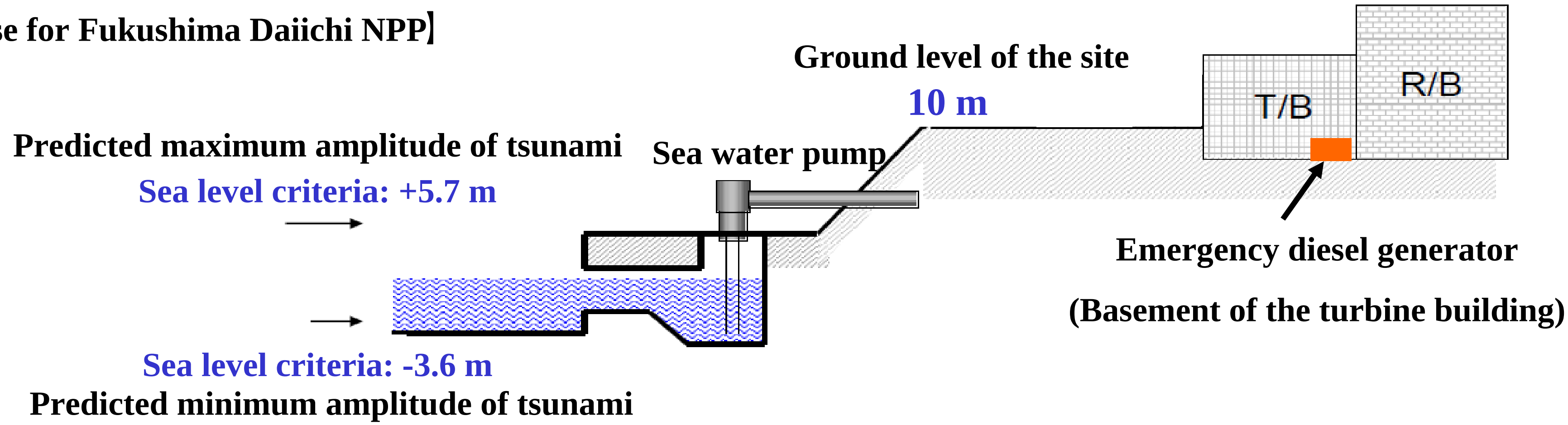
Unit: Gal

	Peak ground acceleration (actually recorded)			Peak ground acceleration corresponding to GBGM Ss		
Direction	N-S	E-W	Vertical	N-S	E-W	Vertical
Unit 1	460	447	258	487	489	412
Unit 2	348	550	302	441	438	420
Unit 3	322	507	231	449	441	429
Unit 4	281	319	200	447	445	422
Unit 5	311	548	256	452	452	427
Unit 6	298	444	244	445	448	415

Tsunami Countermeasures at Nuclear Power Plants

- Based on the " Safety Design Examination Guidelines " and the concept of " Tsunami Evaluation Technology (Japan Society of Civil Engineers), " water levels were determined for countermeasures to be taken by individual power plants by examining past tsunamis and evaluating the results of tsunami simulations for the largest tsunami predicted.
- At Fukushima Daiichi NPP, countermeasures for tsunami were established with a water level criteria of +5.7 m and as a margin, the site level of the plant was set as 10 m.

【Case for Fukushima Daiichi NPP】



【Countermeasure for Tsunamis】

	Level for authorized reactor installation	Predicted tsunami level (Japan Society of Civil Engineers))	Tsunami level of current Tohoku earthquake
Fukushima Daiichi	＋3.122m	＋5.4～＋5.7m	>14 m

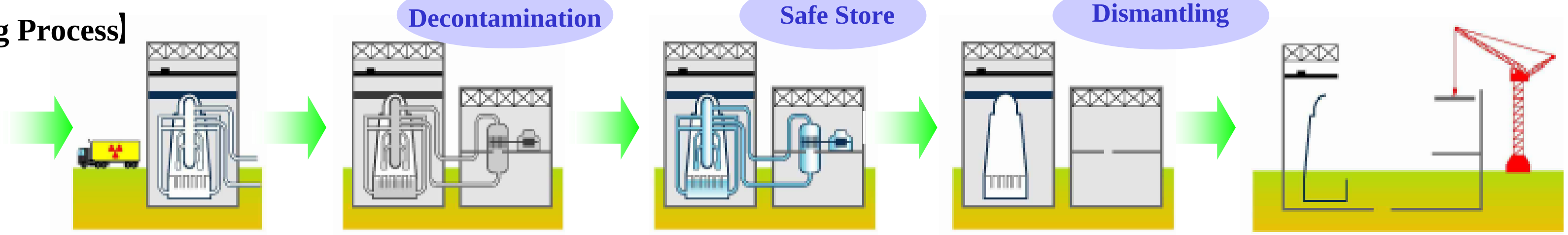
How a Reactor Decommissioning Should Proceed.

- A reactor decommissioning should proceed through three processes, which are Decontamination, Safe Store and Dismantling.
- In Japan、the Japan Power Demonstration Reactor had finished the decommissioning and dismantling and the Tokai NPP and the Advanced Thermal Reactor “Fugen” are proceeding the decommissioning programs.
- Decommissioning program for the Fukushima Daiichi NPP is to be discussed in the future.

【Decommissioning Process】

Decontamination　Safe Store　Dismantling

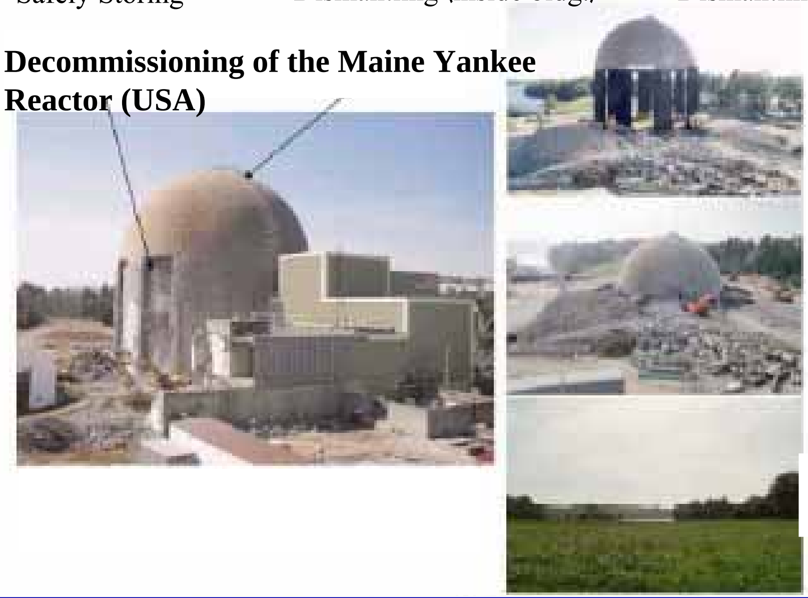
Stop Operation



Removal of Spent Fuels　Decontamination　Safely Storing　Dismantling (inside bldg.)　Dismantling (bldg.)

Decommissioning of the Japan Power Demonstration Reactor (of former Japan Atomic Energy Research Institute)

Decommissioning of the Maine Yankee Reactor (USA)



Past Experience with Rolling Blackouts

- **In Japan, power consumption was restricted due to insufficient electricity following the chaos after World War II (1946 to 1947) and at the beginning of the establishment of 9 electric power utilities.**

  * Kansai Electric Power Co.,Inc implemented rolling blackouts in 1952 due to an imbalance in demand and supply caused by a drought.

- **In California, excessive electricity deregulation caused an imbalance in demand and supply, resulting in rolling blackouts in 2001.**

  * Due to electricity deregulation implemented since 1998, utilities were unwilling to build new plants and the electricity supply did not sufficiently increase in California. Meanwhile, the concentration of IT firms in Silicon Valley led to a surge in electricity demand, exacerbating the electricity shortage, resulting in six rolling blackouts in January, March and May 2001. The blackouts caused factories to shut down, put automatic teller machines out of service, and stopped traffic lights, which caused traffic accidents.

- **During the oil crisis in Japan, electricity consumption was restricted due to the possible shortage of fuel for power generation according to the Electricity Business Act, Article 27. Large customers (highest contract electricity: 500 kW or more) were ordered to reduce their power consumption by 15%. The use of non-urgent electricity, such as for neon and advertising lights, was prohibited in principle.**

  * Electricity Utilities Industry Law, Article 27 (outline)

  The Minister of Economy, Trade and Industry has the authority to restrict power consumption and set an upper limit within a required range when a power shortage will adversely affect the economy, people's lives and the public interest.

  * The order to restrict electricity consumption was approved at a Cabinet meeting on January 11, 1974; it continued to the end of May 1974.

Possibility of Electric Power Exchange

➢**The exchange of electric power between western Japan (60 Hz) and eastern Japan (50 Hz) must go through frequency converters with a total installed capacity of 1,000 MW**

➢**There are three frequency converters between Tokyo Electric Power Co.,Inc(50 Hz) and Chubu Electric Power Co.,Inc(60 Hz):**

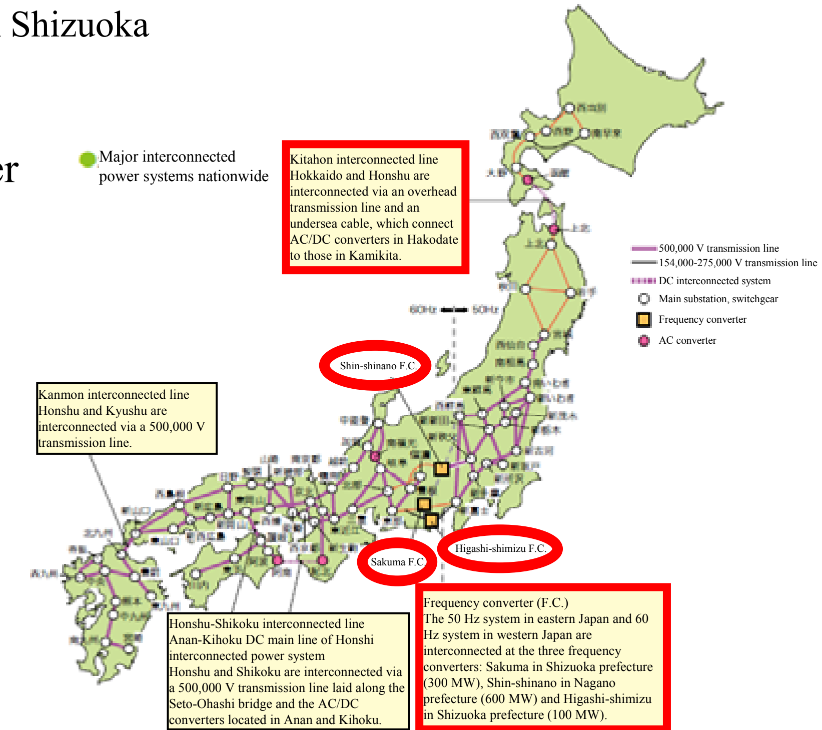
• Shin-shinano frequency converter (a 600-MW facility in Nagano prefecture owned by Tokyo Electric Power Co.,Inc.)

• Sakuma frequency converter (a 300-MW capacity facility in Shizuoka prefecture owned by Electric Power Development Co., Ltd.)

• Higashi-shimizu frequency converter (a 100-MW capacity facility in Shizuoka prefecture owned by Chubu Electric Power Co.,Inc)

• Frequency converter (Shin-shinano)

➢The electric power exchange from Hokkaido Electric Power Co.,Inc (50 Hz) is transmitted through the 600-MW Kitahon interconnected line with a capacity of 600-MW.



•Reference: What was the origin of the different frequencies between eastern and western Japan?

• ・In the Meiji and Taisho eras, the eastern region introduced 50 Hz generators from Europe, while the western region introduced 60 Hz generators from the U.S. The approximate boundary is the Fuji river (Shizuoka prefecture) and Itoi river (Niigata prefecture).

• ・Efforts to unify the frequency failed due to the huge cost and time required.