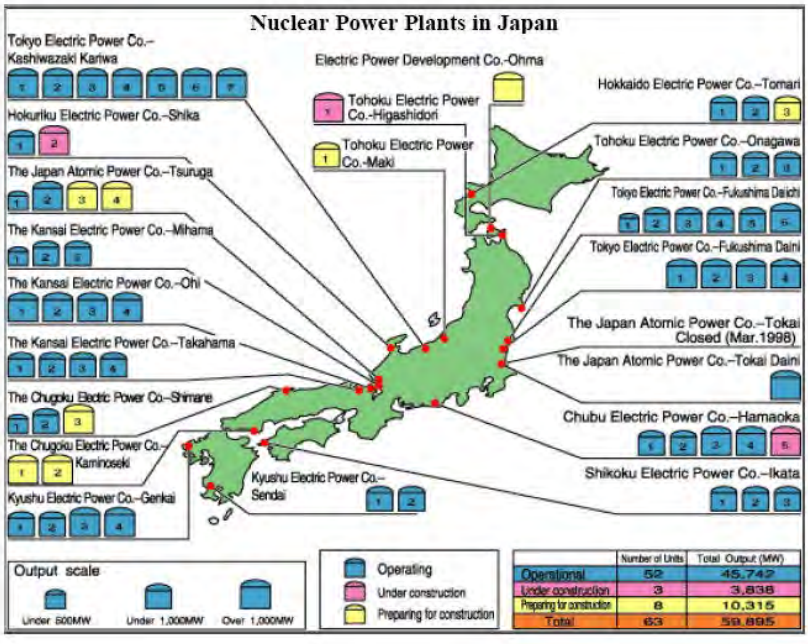
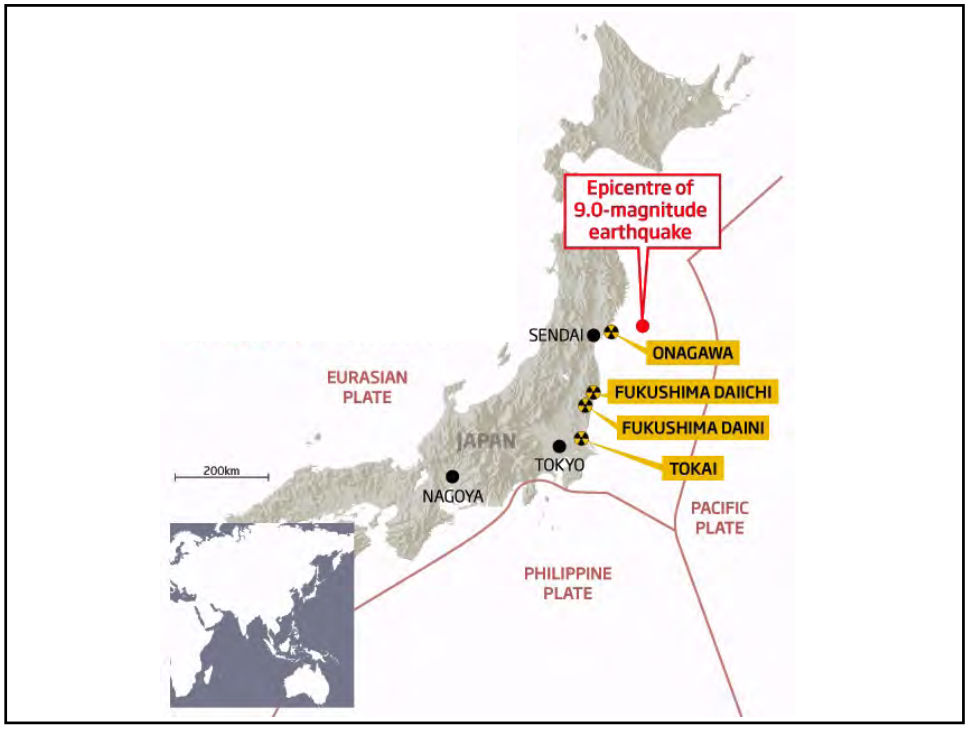
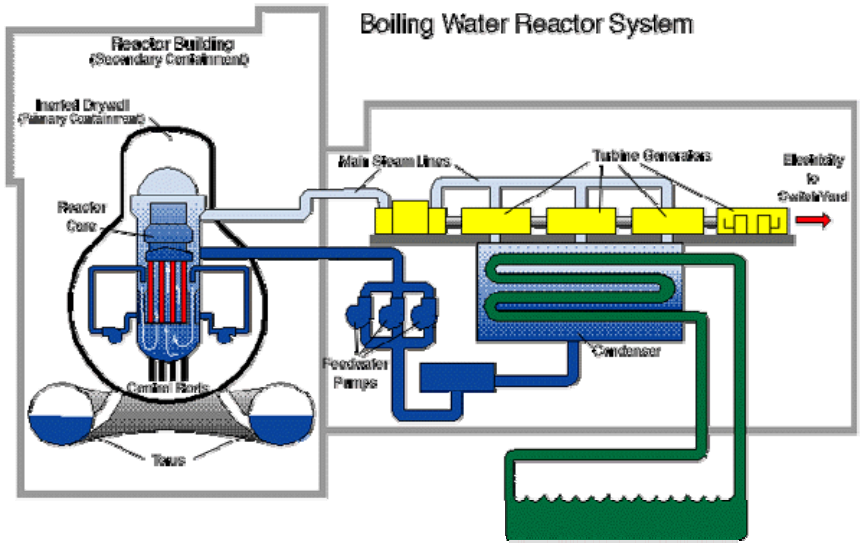
# The Fukushima Daiichi

## Nuclear Power Plant and Loss-of-Coolant Accident

C.F.Lee
March 19, 2011




Epicentre of 9.0-magnitude earthquake
SENDAI
ONAGAWA
FUKUSHIMA DAIICHI
FUKUSHIMA DAINI
TOKAI
EURASIAN PLATE
JAPAN
TOKYO
NAGOYA
200km
PACIFIC PLATE
PHILIPPINE PLATE


Boiling Water Reactor System
Reactor Building
(Secondary Containment)
Inerted Drywell
(Primary Containment)
Reactor
Core
Main Steam Lines
Turbine Generator
Electricity
to
Switchyard
Condenser
Feedwater
Pumps
Torus

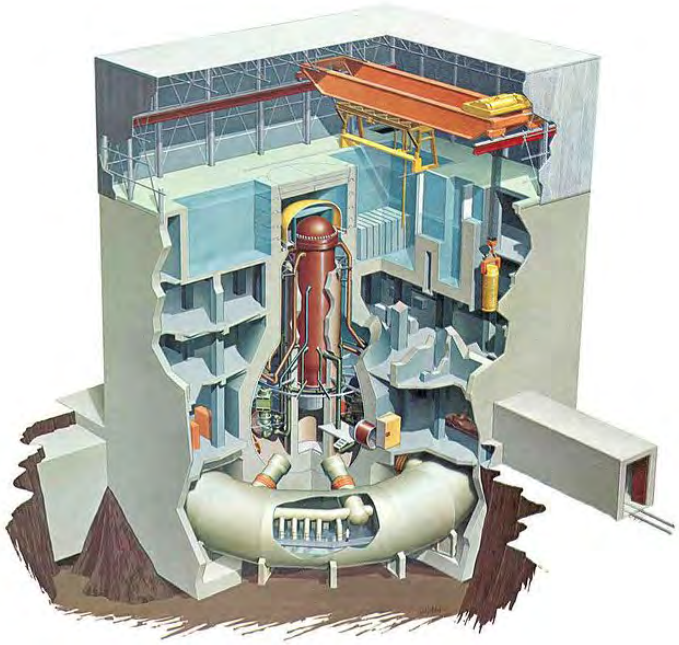



Image: Reuters/DigitalGlobe

## Blast at Fukushima Daiichi NNP

## Storage pool for irradiated fuel assemblies

## Fuel assemblies

## Fukushima Daiichi NPP- IAEA Alert Log (1)

(as of 12:00 UTC, 15 March 2011)

- Japanese authorities have informed the IAEA that teams of experts from Toyko Electric Power Company, the plant's operator, are working to restore cooling in the reactor unit 4 and bring it to cold shutdown.
- Japanese authorities yesterday reported to the IAEA at 21:05 CET that the reactors units 1, 2 and 3 of the Fukushima Daiichi NPP are in cold shutdown status. This means that the pressure of the water coolant is at around atmospheric level and the temperature below 100 degrees Celsius. Under these conditions, **the reactors are considered to be safely under control**.

## Fukushima Daiichi NPP- IAEA Alert Log (2)

(as of 11:25 UTC, 15 March 2011)

- The Japanese authorities have informed the IAEA that the following radiation dose rates have been observed on site at the main gate of the Fukushima Daiichi NNP. At 00:00 UTC on 15 March a dose rate of 11.9 millisieverts (mSv) per hour was observed. Six hours later, at 06:00 UTC at 15 March a dose rate of 0.6 millisieverts (mSv) per hour was observed. **These observations indicate that the level of radioactivity has been decreasing at the site**.

## Fukushima Daiichi NPP- IAEA Alert Log (3)

(as of 14:10 UTC, 15 March 2011)

- The IAEA Incident and Emergency Centre continues to monitor the status of the nuclear power plants in Japan that were affected by the devastating earthquake and consequent tsunami.
- **All units at the Fukushima Daini, Onagawa, and Tokai NNP are in safe and stable condition (i.e. cold shutdown)**.
- The IAEA remains concerned over the status of the Fukushima Daiichi NPP, where sea water injections to cool the reactors in units 1, 2 and 3 are continuing. Attempts to return power to the entire Daiichi site are also continuing.
- After explosions at both **units 1 and 3, the primary containment vessels of both units are reported to be intact**. However, the explosion that occurred at 04:25 UTC on 14 March at the Fukushima Daiichi **unit 2 may have affected the integrity of its primary containment vessel. All three explosions were due to an accumulation of hydrogen gas.**

## Fukushima Daiichi NPP- IAEA Alert Log (4)

(as of 18:00 UTC, 15 March 2011)

- Unit 4 was shut down for a routine, planned maintenance outage on 30 November 2010. After the outage, all fuel from the reactor was transferred to the spent fuel pool.
- Units 5 and 6 were shut down at the time of the earthquake. Unit 5 was shut down as of 3 January 2011. Unit 6 was shut down as of 14 August 2010. Both reactors are currently loaded with fuel.
- As of 00:16 UTC on 15 Mar, plant operators were considering the removal of panels from units 5 and 6 reactor buildings to prevent a possible build-up of hydrogen in the future. It was a **build-up of hydrogen at units 1, 2 and 3 that lead to explosions** at the Daiichi facilities in recent days.

## Fukushima Daiichi NPP- IAEA Alert Log (5)

(as of 14:30 UTC, 17 March 2011)

- The IAEA can confirm that fire trucks have sprayed water on the building of reactor unit 3 from 10:05 to 11:09 UTC of 17 March.
- Police trucks equipped with water cannons were also used in the operation.

## Fukushima Daiichi NPP- IAEA Alert Log (6)

(as of 16:55 UTC, 17 March 2011)

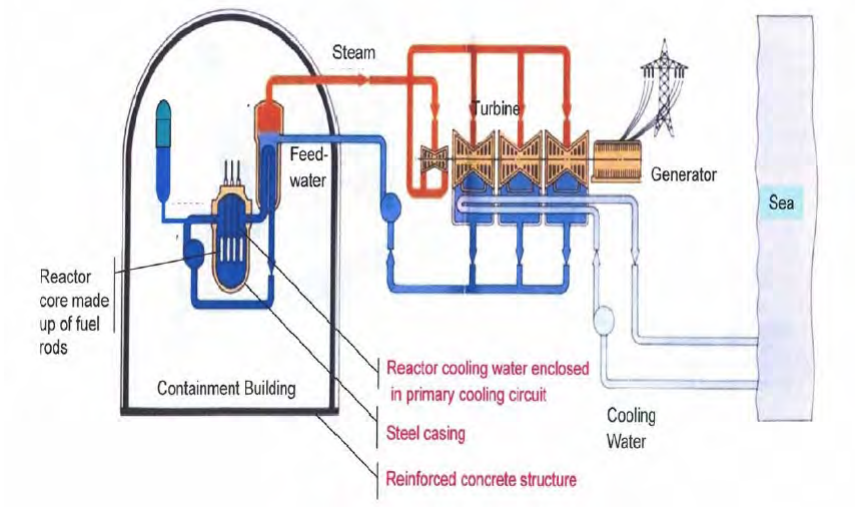
- Japanese authorities have informed the IAEA that engineers were able to lay an external grid power line cable to unit 2. The operation was completed at 08:30 UTC.
- They plan to reconnect power to unit 2 once the spraying of water on the unit 3 reactor building is completed.

## Fukushima Daiichi NPP- IAEA Alert Log (7)

(as of 10:15 UTC, 18 March 2011)

- Japanese authorities have informed the IAEA that new INES ratings have been issued for some of the events relating to the nuclear emergency at the Fukushima Daiichi and Daini nuclear power plants.
- Japanese authorities have assessed that **the core damage at the Fukushima Daiichi 2 and 3 reactor units caused by loss of all cooling function has been rated as 5 on the INES scale**.
- Japanese authorities have assessed that **the loss of cooling and water supplying functions in the spent fuel pool of the unit 4 reactor has been rated as 3**.
- Japanese authorities have assessed that the loss of cooling functions in the reactor units 1, 2 and 4 of the Fukushima Daini nuclear power plant has also been rated as 3. All reactor units at Fukushima Daini nuclear power plant are now in a cold shut down condition.

# Daya Bay Nuclear Power Station


A conceptual diagram of Daya Bay Nuclear Power Station

# Comparison on the Design of Daya Bay and Fukushima

| | Daya Bay | Fukushima |
|---|---|---|
| **Reactor Type** | Pressurized Water Reactor | Boiling Water Reactor |
| **Cooling System** | • Two cooling systems<br>• One cooling system using water under pressure to transfer reactor heat to an adjoining but separate secondary cooling system to raise steam for power generation | • Single cooling system<br>• A single cooling system to make use of reactor heat to raise steam directly for power generation |
| **Steam** | • Bears no radioactive materials | • Bears some radioactive materials ***(In case of venting, the steam vented may necessarily release radioactive products)*** |
| **Back-up for heat removal** | • Three sets of back-up feedwater pumps to support reactor residual heat removal, with 2 driven by electricity and the remaining one driven by the steam generated from the secondary cooling system. ***(In case of loss of electrical power, the steam-driven pump is still available to pump the cooling water for residual heat removal)*** | • No effective deployment of similar back-up equipment |

# The Circumpacific Seismic Belt