



NUCLEAR INFORMATION AND RESOURCE SERVICE

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FACT SHEET ON FUKUSHIMA NUCLEAR POWER PLANT

UPDATE 2:30 pm, Sunday, March 13, 2011. Tokyo Electric Power is reporting that some six feet of the core of Unit-3 remains uncovered and has been for some time despite efforts to pump water into the core. Tepco speculates there may be leaking pipes and water is not remaining in the core. A translation of part of the statement from our Japanese colleagues: "The fuel's integrity has been considerably compromised. We are assessing a considerably serious situation."

UPDATE, 1 pm, Sunday, March 13, 2011. The International Atomic Energy Agency reports that a first-level (lowest-level) emergency has been declared at the three-unit Onagawa nuclear station north of Fukushima. Immediately after Friday's earthquake a fire broke out at this facility, but it was said to have been extinguished fairly quickly. However, on Saturday, elevated radiation levels were measured at the Onagawa site (about 10 microSievert/hour or about 1 millirem/hour) for a few hours. The emergency was declared due to these elevated levels, but utility officials say the reactors there are under control.

Venting of the Fukushima Daiichi Unit-3 containment took place on Sunday morning, according to the IAEA, to relieve pressure building up inside the containment. Venting of a containment releases radiation into the air. According to an IAEA statement, "Subsequently, following the failure of the high pressure injection system and other attempts of cooling the plant, injection of water first and sea water afterwards started. The authorities have informed the IAEA that accumulation of hydrogen is possible." IAEA statement at:

<http://www.iaea.org/newscenter/news/tsunamiupdate01.html>.

An accumulation of hydrogen is believed to be the cause of Saturday's explosion at Fukushima Daiichi Unit 1. As noted below, Fukushima Daiichi Unit-3, unlike every other reactor at the site, uses plutonium-based MOX fuel.

UPDATE, 5:30 pm, Saturday, March 12, 2011. Reuters is reporting that Fukushima Daiichi Unit 3 has lost cooling capability: <http://www.reuters.com/article/2011/03/12/us-japan-quake-nuclear-cooling-idUSTRE72B3GI20110312> This is of particular concern since, unlike all of the other reactors in trouble, Unit 3 has been using plutonium-based MOX (mixed oxide) fuel since September 10, 2010. Consequences of an accident at a MOX-powered reactor would be even more severe than at a more typical uranium-powered reactor.

UPDATE, 3:25 pm, Saturday, March 12, 2011. The International Atomic Energy Agency reports that a total of 140,000 people have now been evacuated from zones 20 kilometers around Fukushima Daiichi and 10 kilometers around Fukushima Daini. The IAEA says that evacuation has not been completed.

At a Washington DC press event this afternoon, former NRC Commissioner Peter Bradford pointed out that no government would evacuate so many people in the midst of an ongoing natural disaster unless the situation were extremely serious.

UPDATE, 1:45 pm, Saturday, March 12, 2011. It is being reported that Japanese authorities are preparing to distribute potassium iodide to the public in the most affected zones. This helps protect against thyroid cancer caused by exposure to radioactive Iodine-131. The release of Iodine-131 to the environment indicates melting of reactor fuel.

UPDATE, 1 pm, Saturday, March 12, 2011. World Nuclear News is reporting that a worker who was apparently trapped in the exhaust stack of Unit 1 at Fukushima Daiichi has died.

Tokyo Electric Power Co. (Tepco) has announced that it will begin venting the containments of three of the four reactors at the Fukushima Daini site in an effort to reduce pressure inside those containments. This will cause additional radiation releases to the air. Evacuation of a three-kilometer zone around the Daini site has begun; people from 3 to 10 kilometers from the site are being told to take shelter indoors and have been notified that they may be asked to evacuate.

UPDATE 12:30 pm, Saturday, March 12, 2011. Japanese government officials state that radiation levels at the Fukushima Daiichi site have decreased from 1015 micro/Sieverts per hour to about 70 microSieverts/hour. There is no independent confirmation of these levels. Officials state that the primary containment remains intact.

However, there are indications that there has been some fuel melting, and there are reports that some radioactive cesium has been detected. Utility officials are reportedly now planning to pump in seawater directly, perhaps with boron added, in an effort to cool the reactor and avert further fuel melt. This may, if it works, also permanently disable the reactor (although at this point we believe this reactor could never operate again in any case).

UPDATE, 11:30 am, Saturday, March 12, 2011. Official reports are that radiation levels have decreased from those reported below; however radiation monitoring systems are either still down or not available to the public.

Some experts say the containment building at Unit 1 may not be completely destroyed; that the portion enclosing the steel liner (the primary containment) may still be intact. Available photos and videos are inconclusive. Clearly at least the top third of the building has been destroyed. In this reactor design, the irradiated fuel (sometimes incorrectly called “spent” fuel) pool sits inside containment above the reactor core. It is not clear from the photographic evidence whether a roof remains over the fuel pool.

UPDATE, 9:30 am, Saturday, March 12, 2011. An explosion has occurred at Fukushima Daiichi Unit 1. Video of the aftermath of the explosion shows that the containment building has been destroyed. In a General Electric Mark I reactor, the containment building is fairly weak and is considered the secondary containment. The primary containment is a steel liner that surrounds the reactor core. So far, video and photos have not been clear enough for us to determine whether this steel liner is intact.

Radiation levels at the site are reported to be 1,015 micro/Sieverts per hour. This is roughly equivalent to 100 millirems/hour. The allowable annual dose for members of the public from nuclear facilities in the U.S. is 100 millirems/year. The allowable annual dose for nuclear workers is 5,000 millirems/year. The average annual background dose from all radiation sources in the U.S. is about 360 millirems/year.

The explosion in Unit 1 was almost surely a hydrogen explosion. Pressure has been building up in the containment since offsite power was lost to the reactor because of the earthquake/tsunami. The GE Mark I reactor design is called a "pressure suppression" design. Rather than be built to withstand large pressure increases, General Electric sought with this design to attempt to reduce such increases in an accident scenario. The design has been criticized by independent nuclear experts and even Nuclear Regulatory Commission staff for many years (see: <http://www.nirs.org/factsheets/bwrfact.htm>). In this case, the design clearly did not work. 24 U.S. reactors use the GE Mark I design.

The evacuation zone around the site has been expanded to 20 kilometers (about 12 miles).

Another reactor at Fukushima Daiichi, Unit 2, is reported to be without cooling capability at this time. Three reactors at the nearby Fukushima Daini site are reported to be without cooling capability. These are GE Mark II designs, which are considered a mild improvement over the Mark I design. Both sites are on the Pacific Ocean, about six miles apart.

Video of the site after the explosion from NHK TV in Japan:
<http://www.youtube.com/watch?v=ELR3hdlce2g>

Video of the explosion itself, from Japanese TV: http://www.youtube.com/watch?v=jMEV-X5b_8

UPDATE, 8 pm, Friday, March 11, 2011. Venting of the containment began at Fukushima Daiichi Unit 1 around 9:00 am Tokyo time. This will release some radiation into the air. Because radiation monitors at the site are inoperable (see below), it will be impossible to know how much radiation is being released.

UPDATE, 7:45 pm, Friday, March 11, 2011. An evacuation of a three kilometer zone has been ordered at a second reactor site in the Fukushima area. Apparently there are also problems cooling three of the four reactors at the Fukushima Daini site. All of these reactors are later model General Electric Boiling Water Reactors.

UPDATE, 7:30 pm, Friday, March 11, 2011: Units 1, 2 and 3 at the Fukushima Daiichi site have lost offsite power. Pressure is building up inside Unit 1 (a General Electric Mark I reactor, see below). The normal procedure to release the pressure is to vent the containment (a procedure that releases radiation into the air), but the utility has been unable to do so because of the lack of power. Plant workers may need to enter the containment to do so manually.

UPDATE, 6: 45 pm, Friday March 11, 2011: Numerous sources are reporting radiation levels at Fukushima to be 1,000 times higher than normal inside Unit-2 (though some sources have also reported high radiation levels inside Unit 1) and at least eight times higher than normal at the plant gates outside. The evacuation zone has been expanded to 10 kilometers (about 6 miles) from the Fukushima reactor site.

UPDATE, 4:45 pm, Friday March 11, 2011: NHK News in Japan is reporting that some mobile “electric power source units” have arrived at the Fukushima reactor site and been connected, and that at least some power is being provided to the Unit-1 and Unit-2 reactors. We don’t yet know the nature or capability of these units.

UPDATE, 3:30 pm, Friday, March 11, 2011: A Japanese Cabinet Office report released at 12:30 am Saturday, March 12, 2011 (Japanese time) predicts that fuel damage will occur at the Fukushima Daiichi Unit-2 reactor late Saturday night (Japan time, early Saturday morning US time) if cooling is not restored before then.

Environmental activists in the area report that radiation monitoring stations in the Fukushima Daiichi area are not operating. Tepco's (Tokyo Electric Power Co.) monitoring website is at: <http://www.tepco.co.jp/nu/pamp/index-j.html>

At the top it says that "monitoring goes on around the clock year round". At the bottom it says in red: THIS SYSTEM IS CURRENTLY SHUTDOWN"

Activists believe this is indicative of an attempt to downplay potential radioactive releases, especially as Tepco says it plans to vent the containment to relieve pressure, which will cause release of radioactivity into the air.

There are six nuclear reactors at the Fukushima Daiichi nuclear power site, located near the town of Okama in the Fukushima Prefecture. Another site in the same Prefecture, Fukushima Daini, contains four nuclear reactors. The sites are on the eastern Japanese coast about 200 miles north of Tokyo. All of these reactors are owned and operated by Tokyo Electric Power Co. (Tepco).

The earthquake of March 11, 2011 appears to be causing the greatest problems for the Fukushima Daiichi reactors, although several reactors at both sites were affected by the earthquake. Specifically, Fukushima I-2 has lost backup power and necessary cooling capability. As of 11:30 am Eastern time March 11, cooling capability has not been restored.

About 3,000 people within three kilometers of the reactor site are being evacuated. People living three to ten kilometers from the site are being told to stay indoors.

At 2:20 am Tokyo time (12:20 pm eastern US time); it was reported that pressure is rising inside the Unit 2 reactor and that radiation may be vented to the atmosphere. At 1:45 eastern US time, the Associated Press reported that venting of the reactor containment to reduce pressure building up inside the containment is about to begin. This venting will release some radioactivity into the air. Elevated radiation levels were also reported inside the control room of the Unit 1 reactor.

These reactors are:

Fukushima Daiichi 1

Reactor	Design	Size	Date of Commercial operation
Fukushima I-1	General Electric Mark I BWR	439MW	March 1971
Fukushima I -2	General Electric Mark I BWR	760 MW	July 1974
Fukushima I - 3	General Electric Mark I BWR	760 MW	March 1976
Fukushima I - 4	General Electric Mark I BWR	760 MW	October 1978
Fukushima I - 5	General Electric Mark I BWR	760 MW	April 1978
Fukushima I - 6	General Electric Mark II BWR	1067 MW	October 1979

Fukushima Daini II

Fukushima II-1	General Electric Mark II BWR	1067 MW	April 1982
Fukushima II-2	General Electric Mark II BWR	1067 MW	February 1984
Fukushima II-3	General Electric Mark II BWR	1067 MW	June 1985
Fukushima II-4	General Electric Mark II BWR	1067 MW	August 1987

In 1986, Harold Denton, then the NRC's top safety official, told an industry trade group that the "Mark I containment, especially being smaller with lower design pressure, in spite of the suppression pool, if you look at the WASH 1400 safety study, you'll find something like a 90% probability of that containment failing."

Some modifications have been made to U.S. Mark I reactors since 1986, although the fundamental design deficiencies remain.

For more information about the GE Boiling Water Reactor designs and some of their drawbacks: <http://www.nirs.org/factsheets/bwrfact.htm>

Citizens' Nuclear Information Center, a Japanese environmental group, has documented previous safety problems and cover-ups by Tepco at the Fukushima reactor complex: <http://cnic.jp/english/newsletter/nit92/nit92articles/nit92coverupdata.html>



Wikipedia photo of the Fukushima Daiichi complex

On June 17, 2010, the same Fukushima I-2 reactor experienced a loss-of-power accident. According to Citizens' Nuclear Information Center, "On June 17, Tokyo Electric Power Company's Fukushima I-2 (BWR, 784MW) scrambled due to a problem with the generator. Power was lost for a time, because the switchover to the offsite power supply was unsuccessful. As a result, the feedwater pump stopped and the water level in the reactor core fell about 2 meters. The emergency diesel generator started up just in time, so the Emergency Core Cooling System was not activated. The water level was restored by an alternative pump in the core isolation cooling system."

At least one reactor at the complex, Fukushima I-3, began using MOX (mixed plutonium-uranium) fuel in September 2010.

This factsheet will be updated as new information becomes available. Michael Mariotte, March 11, 2011.