Fukushima nuclear crisis

February 2012

On 11 March 2011 a magnitude 9.0 earthquake struck off the coast of Japan, followed by a tsunami that slammed the country's eastern coast, destroying communities and taking the lives of tens of thousands of people.

The event led to the biggest nuclear disaster since Chernobyl in 1986. It also exposed serious failures in the Japanese system for ensuring the safety of nuclear reactors.

Nuclear meltdown

The earthquake caused the loss of external power at the Fukushima Daiichi nuclear power plant, a site with six reactors. The subsequent tsunami flooded the plant's back-up diesel generators, causing complete loss of power and leading to a failure of the cooling systems. Due to the lack of cooling, the nuclear fuel was damaged and melted in reactors #1, #2 and #3. The build-up of hydrogen gas due to the damaged fuel resulted in hydrogen explosions in these three units and damaged the containment structure in reactor #4.

The nuclear disaster was rated Level 7 on the International Nuclear Event Scale (INES), the highest rating. Japan's Nuclear and Industrial Safety Agency (NISA) estimated that the amount of radioactive caesium sent into the atmosphere by the explosions was equivalent to 168 Hiroshima bombs.[1]

The possibility of a meltdown as a result of a tsunami had been predicted in documents made public since 2008 by the Japan Nuclear Energy Safety Organisation. Tokyo Electric Power Company (TEPCO), the plant owner, was aware of the possibility of a tsunami exceeding the design limits of the Fukushima nuclear plant, but never attempted to upgrade or fortify its facilities. Instead, regulators and TEPCO ignored the danger. This failure of human institutions to invest in safety measures led to the Fukushima disaster.

Evacuation

More than 150,000 people fled the contaminated areas up to 50km around the Fukushima plant. The 20km evacuation zone is still off limits; experts expect it will be uninhabitable for decades. Most of those who evacuated from other areas have thus far chosen not to return, due to concerns about radiation, unemployment and fears of living in a 'ghost town'.

Contamination

A study conducted by scientists from the Woods Hole Oceanographic Society called the Fukushima disaster 'the largest accidental release of radiation to the ocean in history'. In April 2011, oceanic levels of caesium-137 measured off the coast of the Fukushima Daiichi plant were 50 million times higher than before the disaster.[2]

Concerned researchers warn that the full effects of radiation on the ecosystem will not be known for decades. Testing of oceanic samples gathered by Greenpeace showed excessive levels of radioactive caesium in seaweed and fish. An analysis by Asahi News, using data from TEPCO, showed that 462 TBq (terabecquerel = trillion becquerel) of radioactive strontium have been released into the Pacific Ocean.[3] If it enters the food chain, radioactive strontium accumulates in bones and can cause leukaemia and bone cancer.

In Japan, contaminated rice, beef, fruits, vegetables, milk and baby formula were found, causing distress among residents and taking a huge toll on the Japanese economy. In January 2012, the Ministry of Economy, Trade and Industry (METI) admitted that radioactive gravel had been used

1 The Telegraph (2011). Fukushima caesium leaks 'equal 168 Hiroshimas': Japan's government estimates the amount of radioactive caesium-137 released by the Fukushima nuclear disaster so far is equal to that of 168 Hiroshima bombs. 25 August 2011. Available at: http://www.telegraph.co.uk/news/worldnews/asia/japan/8722400/Fukushima-caesium-leaks-equal-168-Hiroshimas.html

2 National Science Foundation (2011). Scientists assess radioactivity in the ocean from Japan nuclear power facility. 9 December 2011. Available at: http://www.nsf.gov/news/news_summ.jsp?cntn_id=122542

3 Naoya Kon (2011). Hundreds of trillions of becquerels of radioactive strontium leaked into sea. The Asahi Shimbun, 19 December 2011. Available at: http://ajw.asahi.com/article/0311disaster/fukushima/AJ201112190001b

to construct new homes and condominiums, and to repair roads and other infrastructure damaged in the earthquake. No regulations had been established to monitor radiation in stone and gravel.

Homes, schools and municipal areas need to undergo extensive decontamination, including soil removal. About 29m cubic metres of radioactive soil will need to be removed from Fukushima Prefecture alone. Removal is extremely difficult, and the government is still trying to determine where that radioactive soil will be stored. Waste disposal is an ongoing and growing concern.

State of the Fukushima reactors

In December 2011, the government and TEPCO declared the reactors had achieved a cold-shutdown-like status, even though they still can't determine the exact location or temperature of the melted fuel. The nuclear fuel is believed to have burned through the substantial steel floor of the reactor's pressure vessel and possibly even through the thick concrete base of the containment vessel below.

The government declared cold-shutdown for political reasons, to fulfil an earlier promise to achieve cold-shutdown before the end of 2011. The reality is that the four nuclear reactors at Fukushima Daiichi are not in a stable state, and the release of radioactive materials continues to contaminate the ocean as well as pollute ground water. Radiation levels remain too high for workers to enter the reactors, and efforts to view the interior using an endoscope have failed. Workers continue to inject nitrogen into the reactors to prevent another hydrogen explosion.

Efforts to decontaminate highly radioactive water used to cool the reactors have been fraught with difficulty; currently, over 100,000 tonnes of contaminated water is being stored at the plant. Cooling operations are makeshift. The damaged reactors continue to contaminate the environment and remain vulnerable to damage from Japan's frequent earthquakes.

Current estimates indicate decommissioning of the Fukushima Daiichi reactors will take 40 years.

Costs

The Japan Centre for Economic Research has estimated the entire cost of compensation and decommissioning of the six Fukushima reactors at between $520bn and $650bn US dollars[4]. TEPCO's liabilities will soon outweigh its assets. As a result, the Japanese government has already agreed to provide TEPCO $11.6bn and the company has asked for an additional $9bn. These amounts do not include government funds used to underwrite compensation costs for the victims of the disaster.

Compensation process

Only a small fraction of the people evacuated has received compensation. TEPCO's compensation procedures have been complicated and restrictive, slowing down applications. Initially, TEPCO required applicants to fill in a 58-page form, accompanied by a 158-page manual. In contrast, one TEPCO nuclear accident manual was just three pages long, and another only six pages long. Victims complained about the form and the company has simplified it.

Political and social effects

Outside Japan, the effects of the disaster were felt around the world. Many nations re-evaluated the ability of their own nuclear reactors to withstand natural disasters. Germany has shut down some of its reactors and has vowed to abandon nuclear energy entirely.

The Fukushima disaster raised serious questions about the myth of nuclear safety. In Japan, it revealed considerable corruption in the nuclear power sector, including efforts to mislead the public, as well as repeated examples of cronyism between power companies and the government agencies that regulate them.

Public support for nuclear power in Japan has largely eroded. Currently, over 90% of Japan's 54 reactors are offline. All could by offline by May 2012, if none is restarted. Many local government officials have said they will not grant approval for restarting reactors. Contrary to the cries of the nuclear industry, there have been no significant problems with the electricity supply, and Japan has shown that it can survive without nuclear power.

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[4] Japan Centre for Economic Research (2011). Abstract *The 38th Middle-Term Forecast,* 2 December 2011, p.3. http://www.jcer.or.jp/eng/pdf/m38_abstract.pdf.