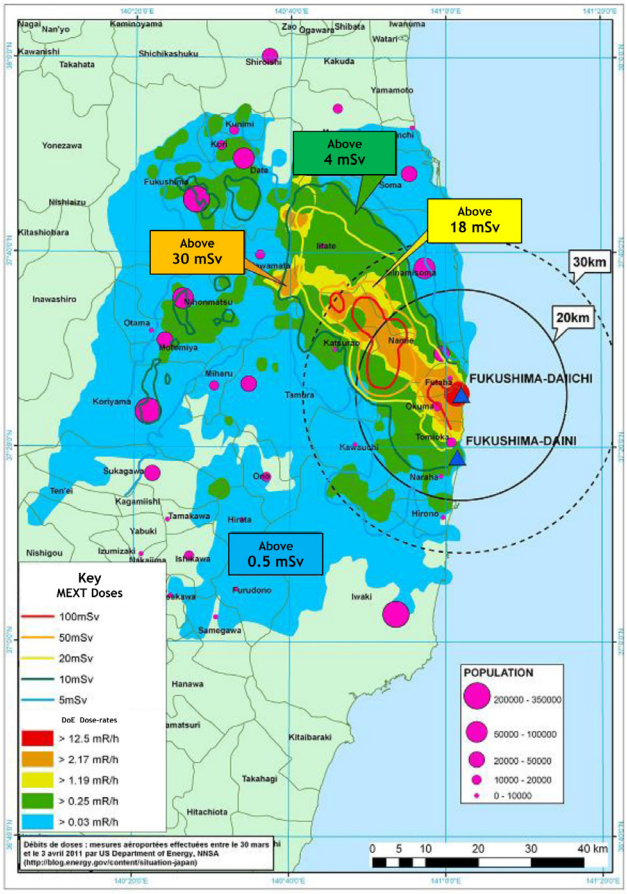
Fukushima-daiichi nuclear accident: Environmental contamination

The meltdown of nuclear fuel inside the Fukushima-daiichi nuclear power reactors began within hours of the plant's loss of power and cooling functions on March 11, 2011. It was at this time that the release of large amounts of radioactivity into the environment became inevitable. While radiation from the nuclear plant has spread around the world, the most serious impacts are on the environment of Japan and on the health of its people. By November 2011 it was announced by the government that as much as 8 percent of the landmass of Japan, or over 18,000 square miles, had been contaminated by radioactive fallout from the Fukushima accident.[1] The accident has had immediate impacts, with radioactive iodine measured in children's' thyroids and nearly half of elementary school children in one district testing positive for caesium contamination.[2] Only in decades to come will the full scale of the disaster be understood.

The largest releases of radioactivity took place in the first weeks after March 11, 2011, though radiation continues to be released one year after the accident. The radiation that spread beyond the plant perimeter was in the form of gases and fine particles, as well as highly contaminated water. Radioactive gases, including iodine and caesium, spewed out from the three damaged reactors, their dispersal dependant upon weather conditions, in particular wind direction and strength. As the accident took place in late winter, prevailing winds took the majority of radioactive gases eastwards over and into the North Pacific. However, wind patterns also blew radioactive clouds over Fukushima Prefecture, particularly to the north-west, as well as hundreds of miles to the south including over large populations centers including Tokyo. It is estimated that 80 percent of the radioactive gases released dispersed over the Pacific Ocean, with 20 percent dispersed over Japan.[3]



An assessment on the 66th day of projected external doses from the nuclear accident in Fukushima. Source: Institut de Radioprotection et de Surete Nucleaire http://www.irsn.fr/EN/news/Documents/IRSN-Fukushima-Report-DRPH-23052011.pdf .

The highly contaminated water that has accumulated on the Fukushima-daiichi site is a massive source of radioactive contamination to the Pacific Ocean.[4] Tokyo Electric, in an attempt to cool the reactors, pumped vast amounts of seawater onto the melted fuel cores and spent fuel pools. This led to the accumulation of over 120,000 tons of highly contaminated water held within the reactor basements, turbine buildings and trenches. Managing this large volume of water so that it did not enter the Pacific then became a crisis for the reactor operators. One year after the start of the accident, over 175,000 tons of contaminated water has been processed

1 See, http://ajw.asahi.com/article/0311disaster/fukushima/AJ201111210014
2 See, http://ajw.asahi.com/article/0311disaster/fukushima/AJ201110251571 3
3 See, http://www.atmos-chem-phys.net/12/2313/2012/acp-12-2313-2012.html
4 See, http://www.largeassociates.com/3196%20Fukushima%20GP%20de/R3196-A1%2010%20April%202011.pdf

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on the site, but volumes of highly contaminated water are still in excess of 100,000 tons.[5] Leaks of this water have occurred since the start of the accident. One early incident released 520 tons of water into the Pacific with a level 20,000 times above the site limit, and 10,000 times the amount of radioactivity released by the Three Mile Island accident. Iodine-131 levels measured by Tokyo Electric were 7.5 million times above the safety limit.[6]

As early as late March 2011, estimates of radiation releases indicated that the accident was a level 7 on the international nuclear event scale. The only previous accident of such a scale was at Chernobyl in the Ukraine in 1986.[7] The Japanese government did not confirm the scale of the accident until one month after it began.[8] Releases of radioactive Xenon gas were reported as the largest single release of its type in history and 2.5 times that released by Chernobyl. Caesium-137 releases were estimated to be 40 percent of the Chernobyl accident.[9]

The government in August 2011 announced a large scale program of decontamination for Fukushima, with the aim of reducing radiation levels by half within two years. This applies largely to the areas outside the 20km exclusion zone. The total area in need of cleanup has been estimated at 1,000-4,000 square km (386-1,544 square miles), about 0.3 to 1 percent of Japan's total land area, and cost several trillion yen to more than 10 trillion yen (US$130 billion).[10]

However, the Japanese central government's decontamination plan leaves clean-up of any sites emitting up to 20 millisieverts of radiation annually or less to municipal governments, while also calling on those same governments to create temporary storage areas for contaminated materials.

The Japanese Environment Ministry has stated that 28 million cubic metres of contaminated soil and vegetation from around Fukushima prefecture may need to be disposed of.[11]

Decontamination measures planned include:[12]

- Domestic houses are to have drainpipes cleaned, removal of plants and weeds;
- Houses in high radiation areas will have high pressure washing of roofs, and "elimination of surface soil in gardens;"
- Roads are to be rinsed, and mud in roadside ditches removed;
- Branches of trees on the street must be trimmed and dead leaves disposed of; and
- Removal of contaminated agricultural top soil.

Apart from the effectiveness of the decontamination program, there are enormous issues raised including:

- Impact on farm land topsoil and long term fertility;
- Storage and disposal of contamination soil — decontamination of soil around three houses in Fukushima led to the generation of 35 tons of soil in a test program;
- Impact on radionuclide dispersal — washing down contamination into watercourses, rivers, sewage systems; and
- Resuspension and human impacts.

5 See, http://www.tepco.co.jp/en/press/corp-com/release/betu11_e/images/111130e1.pdf and See, http://www.bloomberg.com/news/2011-08-17/tepco-may-not-clear-radioactive-water-in-2011.html
6 See, http://www.jaif.or.jp/english/news_images/pdf/ENGNEWS01_1303469228P.pdf
7 See, www.greenpeace.de/fileadmin/gpd/user_upload/themen/atomkraft/HH_INES_Rating_Fukushima_23_03_2011.pdf, and http://www.greenpeace.org/international/PageFiles/285388/greenpeace_hirsch_INES_report_25032011.pdf and http://www.irsn.fr/EN/news/Documents/IRSN-Fukushima-Report-DRPH-23052011.pdf
8 http://www.nisa.meti.go.jp/english/files/en20110412-4.pdf
9 See, http://www.atmos-chem-phys.net/12/2313/2012/acp-12-2313-2012.html
10 See, Japan aims to halve radiation in affected areas in 2 yrs, Aug 26, 2011, http://www.reuters.com/article/2011/08/26/japan-nuclear-idUSL4E-7JQ1D620110826
11 See, http://www.japantimes.co.jp/text/nn20110929a3.html
12 See, August 24th http://www.jaif.or.jp/english/news_images/pdf/ENGNEWS01_1314161627P.pdf

The scale of contamination and efforts to decontaminate, store and dispose of contaminated soil and materials from across Japan is beyond comprehension, and is likely to be impossible. The prospect of hundreds if not thousands of temporary waste disposal sites moved a step closer with plans announced by the Forestry Agency. In October 2011, it announced that it had decided to allow local governments to use plots of land in state-owned forests to temporarily store soil and rice straw contaminated with radioactive substances.[13] Local governments may ask to be allowed to store sludge from the water supply and sewage systems, as well as ash produced by incinerating these materials. In principle, the temporary storage sites will be built in forests within the jurisdictions of local governments that have collected contaminated soil. The sites will be located as little as hundreds, even tens of meters from residential areas. As decontamination efforts remain the central policy of government, matched by their determination to refuse further evacuation, radioactive material continues to flood down rivers and out of forests, contaminating anew areas all over again — areas that had theoretically been decontaminated.

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13 See, http://www.yomiuri.co.jp/dy/national/T111023003048.htm