CASE STUDY

FUKUSHIMA TRANSBOUNDARY POLLUTION EVENT

The Fukushima Daiichi nuclear plant, 240 kilometres northeast of Tokyo, is one of the 15 largest nuclear power stations in the world. Following the magnitude 8.9 earthquake strike and subsequent tsunami that affected this part of Japan in 2011, a partial nuclear meltdown and several explosions took place at Fukushima. The meltdown was rated at Level 7 on the International Nuclear Event Scale, placing it in the same category as the Chernobyl disaster of 1986, described as a 'major release of radioactive material with widespread health and environmental effects requiring implementation of planned and extended countermeasures'.

The earthquake caused the Fukushima reactors to shut down automatically when their motion sensors felt tremors. However, the cooling system required to remove residual heat from the core failed and the tsunami knocked out the backup generators designed as a last measure to keep cool water pumping. As a result, the uranium heat elements overheated, causing water to evaporate from the system and generating explosive hydrogen, with disastrous effects. This resulted in a pattern of extensive transboundary air, ground and water pollution (Table 6.8). Fukushima radioactive pollution has since spread globally, at extremely low concentrations but traceable using ultra-sensitive instruments.

Table 6.8 Transboundary air, ground and water pollution resulting from the Fukushima disaster

Air and ground pollution	• Radiation escaped immediately into the atmosphere when hydrogen explosions occurred in two reactors and steam vented from the reactor buildings. Increased radiation levels close to the plant reached 400 Millisieverts (mSv) an hour (a chest X-ray involves exposure of 0.02 mSv). A 20 km exclusion zone was imposed, resulting in the forced migration of 70,000 people (to reduce the risk of thyroid cancer). As it fell to ground in Japan, radioactive dust caused local food sources, including milk and spinach, to show radiation levels seven times higher than the legal limit. • Prevailing winds blowing from the southwest carried the greatest radioactive releases northwards and eastwards of the site. The jet stream moved some emissions across the Pacific Ocean towards the USA. Low-level fallout was detected there just five days after the event: monitoring stations along the US west coast detected a spike in concentrations of radioactive iodine, caesium and tellurium, though not at dangerous levels.
Water pollution	• A large amount of radioactive water percolated from the site into groundwater and local coastal waters, threatening fisheries. In the years since the disaster, Pacific Ocean currents have carried caesium isotopes slowly to the west coast of North America. Pollution was detected offshore from British Columbia, Canada in 2013 and off Vancouver Island in 2015. • The highest detected level to date comes from a sample collected west of San Francisco in 2015. However, the level of radioactive caesium isotopes in the sample (11 Becquerels per cubic metre of seawater) was well below levels thought to pose environmental or public health threats.

The response

Around the world, many countries have rethought their nuclear policy as a result of Fukushima:

- Japan itself has begun to overhaul its nuclear power industry and to reappraise the tectonic risk. After the disaster, reactors were left idle but this resulted in a 30 per cent gap in the country's electricity supply that needed to be replaced by fossil fuels. Debate continues in Japan about the role nuclear power should play.
- In Germany, the government responded by accelerating an existing plan to phase out nuclear power, which used to produce almost one quarter of national electricity, by 2020.
- Switzerland has announced it will decommission its five nuclear power plants by 2034. They generate 40 per cent of its energy. The plan is to introduce greater efficiency and more renewables.

The disaster also revived one of the longest-running debates: how safe is it to build nuclear reactors in areas that are seismically active? Around 90 nuclear reactors out of the global figure of approximately 400 are located in areas of significant seismic activity (Figure 6.15). How many of these do you think are potential sites for transboundary pollution?

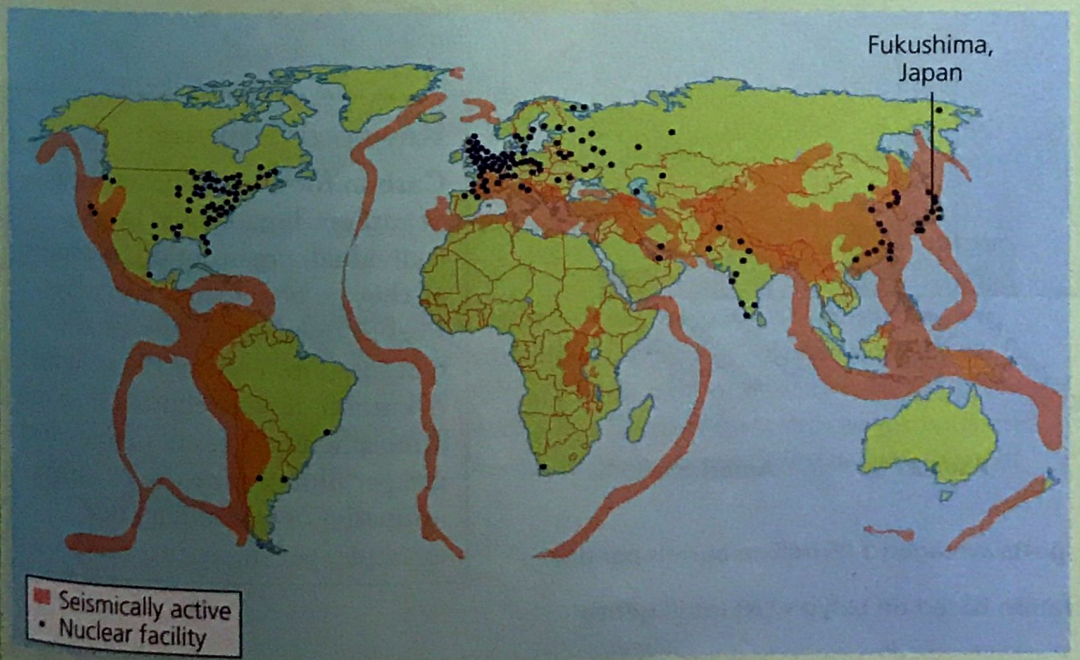

Figure 6.15 Nuclear power stations and seismic activity around the world