7.5.3 Fukushima

Figure 1: Tsunami striking the Fukushima Daiichi nuclear power plant on March 11, 2011. Reproduced with permission of Tokyo Electric Power Company (TEPCO 2011).

On March 11, 2011, three operating Mark 1 BWRs at a power station in Fukushima, Japan (three out of the six at the site - the other 3 were not operating), shut down automatically and successfully when they experienced a huge magnitude 9.0 earthquake. One hour later cooling, driven by the backup generators, was proceeding normally when the generators were swamped by a large tsunami (see figure 1), causing the generators to stop and the ECCS systems to fail. The cores heated up uncontrollably and partially melted before the situation was brought under control though not before several hydrogen explosions occurred. Despite this series of failures, the secondary containment was largely successful. There were no deaths though some workers received non-lethal radiation doses. Figure 2 shows the evacuation area and radiation levels after 7 months (WNA 2014) near the damaged Fukushima Daiichi nuclear power plant.

This accident did confirm the viability of the secondary containment system but showed that more attention needed to paid to the siting of nuclear power plants (see Okrent 1981) and to the emergency provision of power for the safety systems at nuclear power plants. Many plants are situated near large bodies of water so as to provide cooling water; therefore, they may be susceptible to floods, tides and tsunamis. Upgrading of the protection from such hazards has been occurring around the world, most notably in France. Moreover, in the aftermath of Fukushima, renewed attention has been given to (1) safety systems that are passive in the sense that they do not need emergency power and (2) improvements to the protection of the power supply for emergency systems.

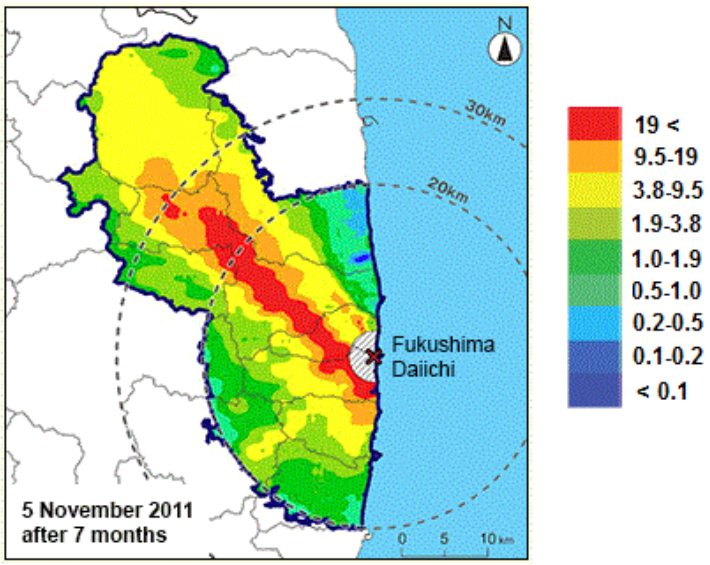

Figure 2: Fukushima Daiichi nuclear accident consequences: evacuation area (black outline) and radiation levels after 7 months measured 1 m above ground including background (in $\mu Sv/hr$). Adapted from WNA (2014).