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Fukushima nuclear power plant accident was preventable

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On 11 March 2011, the fourth largest earthquake in recorded history triggered a large tsunami, which will probably be remembered from the dramatic live pictures in a country, which is possibly the most tsunami-prepared in the world. The earthquake and tsunami caused a major nuclear power plant (NPP) accident at the Fukushima Dai-ichi, owned by Tokyo Electric Power Company (TEPCO). The accident was likely more severe than the 1979 Three Mile Island and less severe than the Chernobyl 1986 accidents. Yet, after the 26 December 2004 Indian Ocean tsunami had hit the Madras Atomic Power Station there had been renewed interest in the resilience of NPPs to tsunamis.

The 11 March 2011 tsunami hit the Onagawa, Fukushima Dai-ichi, Fukushima Dai-ni, and Tokai Dai-ni NPPs, all located approximately in a $230km$ stretch along the east coast of Honshu. The Onagawa NPP was the closest to the source and was hit by an approximately height of $13m$ tsunami, of the same height as the one that hit the Fukushima Dai-ichi. Even though the Onagawa site also subsided by $1m$, the tsunami did not reach to the main critical facilities. As the International Atomic Energy Agency put it, the Onagawa NPP survived the event "remarkably undamaged." At Fukushima Dai-ichi, the three reactors in operation were shut down due to strong ground shaking. The earthquake damaged all offsite electric transmission facilities. Emergency diesel generators (EDGs) provided back up power and started cooling down the reactors. However, the tsunami flooded the facilities damaging 12 of its 13 EDGs and caused a blackout. Among the consequences were hydrogen explosions that released radioactive material in the environment.

It is unfortunately clear that TEPCO and Japan's principal regulator Nuclear and Industrial Safety Agency (NISA) had failed in providing a professional hazard analysis for the plant, even though their last assessment had taken place only months before the accident. The main reasons are the following. One, insufficient attention was paid to evidence of large tsunamis inundating the region, i.e., AD 869 Jogan and 1677 Empo Boso-oki tsunamis, and the 1896 Sanriku tsunami maximum height in eastern Japan whose maximum runup was $38m$. Two, the design safety conditions were different in Onagawa, Fukushima and Tokai NPPs. It is inconceivable to have had different earthquake scenarios for the NPPs at such close distance from each other. Three, studying the sub-standard TEPCO analysis performed only months before the accident shows that it is not the accuracy of numerical computations or the veracity of the computational model that doomed the NPP, but the lack of familiarity with the context of numerical predictions. Inundation projections, even if correct for one particular scenario, need to always be put in context of similar studies and events elsewhere. To put it in colloquial terms, following a recipe from a great cookbook and having great cookware does not always result in great food, if the cook is an amateur.

The Fukushima accident was preventable. Had the plant's owner TEPCO and NISA followed international best practices and standards, they would had predicted the possibility of the plant being struck by the size of tsunami that materialized in 2011. If the EDGs had been relocated inland or higher, there would have been no loss of power. A clear chance to have reduced the impact of the tsunami at Fukushima was lost after the 2010 Chilean tsunami. Standards are not only needed for evaluating the vulnerability of NPPs against tsunami attack, but also for evaluating the competence of modelers and evaluators.

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