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# Japanese Nuclear Reactor Faces Media Meltdown

The truth is told by an understanding of the structure and function of the Fukushima power plant and the damage it sustained both during and after the earthquake. A "layman's summary" by Dr. Josef Oehmen, PhD, of Boston's MIT, posted at BraveNewClimate, offers such insight.

Oehmen explains that the Fukushima plant is made up of boiling water reactors (BWR) built in the 1970s. The fuel that powers them is uranium oxide, which generates heat by a process called nuclear fission. Uranium atoms are split, propelling neutrons into other atoms, splitting them in turn. The process forms a chain reaction that makes nuclear a powerful energy source. Control rods made of boron, which absorbs neutrons, keep the chain reaction in check. But control rods are not the only safety features at Fukushima.

Uranium oxide is manufactured in pellets and then encased in tubes called fuel rods made of a zirconium alloy. Both the pellets and the rods provide barriers to release of radioactive by-products of nuclear fission. They make up a reactor core, which is placed in a steel pressure vessel that protects against high pressures resulting from accidents and acts as a third barrier to radioactive release. The pressure vessel is further housed in a containment structure made of steel and concrete, designed to contain a complete core meltdown. A secondary containment structure, also made of thick concrete, surrounds the primary structure, providing yet another layer of protection. A reactor building surrounds this nested complex and is the only part that does not serve to contain radiation. Its purpose is to keep the weather out, not the radiation in.

Within seconds of last Friday's earthquake, operators shut down all units, and the control rods brought their chain reactions to a halt. In such a situation, there is still residual heat from radioactive decay of fission products that requires cooling systems in the plant to maintain the integrity of the fuel rods. Otherwise, the rods will melt and allow radioactive release. Such release would, however, still be captured within the containment structures.

Even though the earthquake destroyed Fukushima's external power supply and the tsunami flooded the plant's backup diesel generators, operators used a battery backup system and mobile generators to continue cooling the core. However, the handicapped power supply compromised their water-based cooling system. Oehmen explains this is the likely cause of explosions that damaged some of the reactor buildings at Fukushima. As the water turned to steam, the generators could not maintain the water level above the top of the fuel rods. The rods melted, and the subsequent reaction between the zirconium alloy and water produced hydrogen, a highly combustible gas. It did not pose a danger in the

containment structure itself, because there is no air in the containment. But workers also had to release the tremendous pressure build-up in the containment structure to protect its integrity. They followed a regular venting schedule. Once enough hydrogen mixed with the vented gases, it caused explosions that damaged the outer buildings, which, as mentioned above, only serve to protect the reactors from Mother Nature, not to protect Mother Nature from the reactors.

The explosions caused mass evacuations despite the fact that radiation levels at the site remained well within levels of safe operation. Radiation is measured in units called sieverts, and Japanese law requires nuclear operators to file reports if levels at their reactors exceed 500 microsieverts. Following Monday's explosion at Fukushima's Unit 3 reactor, TEPCO reported radiation levels at 10.65 microsieverts, according to *The Huffington Post*. That level was due to a small amount of radioactive gas mixed with vented steam from the reactors. However, James Russell, P.E., retired nuclear engineer, told *The New American* that the radioactivity of the vented gas would amount to "a fraction" of the radiation a person absorbs during a cross-country flight from New York to L.A. "People are exposed to radiation every day," Russell explained. He listed sources such as uranium in the soil, the Sun's energy from nuclear fusion, and cosmic radiation.

Meanwhile, reactor workers began pumping in sea water to compensate for water losses at the plant. By Tuesday, TEPCO reported stable water levels and temperature at all Fukushima reactors and offsite power restored. *The Economist* noted the reactors "were designed to withstand tremors of magnitude 8.2. That they survived relatively unscathed through a magnitude 9.0 earthquake … seems remarkable."

What of the media reports that Fukushima could become another Chernobyl? "Completely incorrect," scoffed Russell. "What happened at Chernobyl could not happen in Japan because Chernobyl was a carbon block moderated reactor," not a BWR. The reactor itself burned in that situation, but at Fukushima, only the outer buildings suffered damage from the explosions. Also, Oehman points out that Chernobyl lacked Fukushima's containment structure built to withstand the excessive pressure buildup that ruptured the Russian plant.

Russell said that Fukushima could be more likely compared to Three Mile Island (TMI). Though the latter was a pressurized water reactor, its cores also partially melted "because they were uncovered for too long." Russell predicted another potential analogy between TMI and Fukushima: "TMI was used to stop expansion of the nuclear power industry in the U.S. The majority of people were scared by all the negative publicity, and the NRC [Nuclear Regulatory Commission] pandered to public opinion at that point. They've been very successful at shutting reactors down for several decades."

*Photo of Fukushima power plant: AP Images*