**Japan’s nuclear crisis explained**

Answers to frequently asked questions about the situation in Japan [UPDATED]

by [Jason Kirby](http://www2.macleans.ca/author/jasonkirby/) on Wednesday, March 16, 2011 4:09 http://www2.macleans.ca/2011/03/16/japans-nuclear-crisis-explained/

[](http://macleans.files.wordpress.com/2011/03/explainer21.jpg)

Teams of government specialists at the emergency rescue headquarters frantically analyze data from the leaked radiation from the Fukushima nuclear facilities damaged by last week’s major earthquake and following tsunami, Wednesday, March 16, 2011, in Fukushima city, Fukushima prefecture, Japan. (AP Photo/Wally Santana)

**1. Have Japan’s Fukushima reactors melted down?**

In short, no, though it is believed several reactors have suffered partial meltdowns. There’s a vast difference between those two scenarios.

A partial meltdown occurs when the fuel rods that contain the uranium are damaged or partially break down. When nuclear fission occurs, it produces extreme energy and heat. For that reason the rods are kept submerged in water. When everything is working correctly, the rods heat the water, which produces steam that then powers turbines to create electricity. But in three of the reactors at the Fukushima Daiichi plant, water levels have fallen, exposing the fuel rods. If the heat rises to around 1,200 degrees Celsius, the material the rods are made of—zirconium—begins to break down, and some radiation is released. At several points during Japan’s nuclear crisis the rods have been fully exposed, despite the efforts by operators to pump in cold seawater. Given the high radiation levels around the reactors, it’s believed a partial meltdown has most certainly occurred, though it’s not known how badly damaged the rods are at this point. (Also note, as the zirconium degrades it releases hydrogen. It was the hydrogen that ignited and caused at least three explosions at the plant—and not, importantly, a full blown nuclear explosion.)

A full meltdown is far, far worse. For that to happen the rods would have to be exposed for several hours. The zirconium would then melt away and the uranium fuel pellets inside the rods would fall to the floor of the reactor. As the temperature rose higher, they’d then form a molten mass that could melt through the heavy steel and concrete containers surrounding the reactor. Once loose, they would unleash massive amounts of radiation into the environment.

**2. What are spent fuel pools, and why is everyone suddenly worried about them?**

The spent fuel pools are where fuel rods are stored after they’re removed from the reactors. As with the fuel rods in the reactor, the spent fuel needs to stay submerged in cold water or it will heat up. What’s happened is that, with nearby fires and the heat given off by the spent fuel rods, the water temperature has been rising. If the water boils off, and the rods are exposed, they could meltdown. Unlike the fuel rods in the reactors though, the spent fuel rods don’t have steel and concrete enclosures. If the heat damages the rod casings, they could catch fire and spew radiation into the atmosphere. Experts are warning that the spent fuel pools may pose the biggest radiation threat at Fukushima.

**3. What are the Japanese doing to deal with the crisis?**

Plant operators have tried several things to cool down the reactors. The first step was to pump fresh water into the reactors, since the cooling system was no longer functioning. Unfortunately there were valve malfunctions, so workers have since been pumping seawater and boric acid into the reactors. The boric acid helps slow nuclear fission.

Unfortunately high radiation levels have made it dangerous for workers to fight several fires that have broken out at the plant. The Japanese government considered using helicopters to fly above the fires to disperse water and boric acid over the plant, but that mission was aborted due to safety concerns. Ground crews now plan to use water canons to spray water onto the fires and reactors.

**4. How long could this go on?**

Days or even weeks. The good news is the reactors have been shut down. Immediately after the earthquake hit, control rods were automatically inserted into the reactor, which had the effect of disabling the fission process. But unlike a light bulb that gets switched off right away, the reactor core remains extremely hot. At the same time byproducts of the fission process continue to decay, giving off heat. If the normal cooling process had continued to function, within 24 hours the temperature of the core would have cooled dramatically and been well on the way to achieving the necessary “cold shutdown.” But the earthquake knocked out power to the cooling system, while the tsunami right afterwards destroyed the backup diesel generators. Now some experts believe it could take weeks for operators to fully gain control of the reactors.

**5. Weren’t the reactors built to withstand major earthquakes? How did this happen?**

Japan’s nuclear plants are built to withstand earthquakes of 7.5 magnitude, but the quake that hit last Friday ultimately measured 9.0. Given the quake was far stronger than what the plant was built for, it’s remarkable it held up as well as it did. But the designers had not accounted for a tsunami measuring nine meters high to hit the plant after a quake. As well prepared as Japan was for either a massive quake or massive tsunami, the nuclear plants were not designed to withstand both.

**6. How bad is the radiation?**

At this point the real danger is limited to the immediate vicinity of the reactors. Radiation levels at the plant hit between 600 and 1000 millisieverts (mSv) at different times before falling. Millisieverts measure the rate at which radiation is absorbed by the body. Anything over 100 mSv in a year can lead to elevated cancer risks, and being hit with 5,000 mSv over just a few hours is fatal.

But again, those readings relate to the area right by the reactors. The further away you are, the exposure levels begin to drop fast. The people most at risk at this point are the 50 workers who have stayed behind to try get the reactors back under control. Meanwhile in Tokyo radiation levels at their highest never reached above 1 microsievert per hour (1 mSv is 1,000 microsieverts), far less exposure than a person receives with a full body CT Scan or x-ray.

**7. Are people in North America, particularly along the west coast, at risk?**

No. Even if there were a massive burst of radiation from the plant, health experts say it would take roughly a week to cross the Pacific Ocean and by then the radioactive particles would be dispersed in the atmosphere. Despite that, pharmacies in B.C. have been cleaned out of potassium iodide tablets as people have begun stockpiling them. (Iodide pills blocks the body from absorbing radioactive iodine.) As such, Dr. Perry Kendall, B.C. provincial health officer, has recommended that “pharmacies do not dispense or stockpile potassium iodide tablets.”

**FOOD FOR THOUGHT:**

**This one will focus straight-up at the comprehension level of Bloom’s (you’ll be giving me your own version of the information you learned above). Tell me, in your own words, what the heck is happening at the Fukushima nuclear facility. In your explanation, include the lead-up to this crisis, what the crisis actually is, what steps have been taken to prevent and/or contain it, and the real threat that exists. Now that you’re more “in the know,” how scared do you think people should be?**