Contaminated water leaking from Japanese nuclear plant

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Further evidence emerged yesterday that the Fukushima Daiichi nuclear complex was leaking significant quantities of highly radioactive water into areas outside the reactor containment buildings. The water was seriously impeding efforts to bring the situation at the plant under control and threatening to further contaminate the surrounding environment.

Japan's Nuclear and Industrial Safety Agency (NISA) explained that contaminated water emitting radiation at 1,000 millisieverts per hour was found in an overflow tunnel outside the plant's Unit 2 reactor. The maximum annual radiation dose for workers at the plant has recently been raised from 100 to 250 millisieverts.

NISA deputy director-general Hidehiko Nishiyama told the media that the tunnel led from the reactor's turbine building, where radioactive water was discovered on Saturday. Nishiyama said the agency was unsure whether water had already overflowed out of the tunnel into the sea. Contaminated water, at lower levels of radiation, has also been found in tunnels leading from the Unit 1 and Unit 3 reactors. No explanation has been given for the leaking water.

Four of the six reactors at the Fukushima plant have been damaged as a result of the earthquake and tsunami that struck the area on March 11. The loss of emergency electricity supplies meant water pumps vital for cooling the reactor cores were inoperable, threatening a possible meltdown. Frantic efforts were made to supply water to the reactors and adjacent spent fuel rod ponds, which were also heating up. While that now appears to have been achieved, the extent of damage to the reactors and spent fuel rods, and thus potential dangers, is not known.

Speaking yesterday at the daily press conference of the US-based Union of Concerned Scientists (UCS), Dr David Lochbaum explained that fresh water, rather than corrosive sea water, was now being injected into the damaged reactor cores, and that water was being supplied to all the fuel rod ponds. "Things could get worse," he warned. "They could have some more equipment failures that lead to more damage of the fuel, but it seems like the fuel damage to date has already been done."

Lochbaum added: "The bad news is that there's a lot of fuel damage that has occurred that's caused the release of a lot of radioactivity into some damaged structures, and that radioactivity has gotten to places that it shouldn't be, like turbine buildings." That posed a challenge, he said, to make sure that as little as possible of that large amount of radioactivity got released into the environment.

The very methods that are being used to cool the reactor cores and spent fuel rods may be compounding the problem. In a properly functioning boiling water nuclear reactor, the water that is turned into steam to generate electricity is recycled back into the reactor, thus containing radioactivity. At present, however, it is not clear that the water being injected into the reactor is being recycled. The excess water tanks may already be full and are a possible source of the leakage of contaminated water.

Speaking yesterday, UCS scientist Dr Ed Lyman warned: "[T]hey don't have provisions right away for being able to deal with that water, but they may have

no choice but to continue dumping large quantities of radioactive water into the environment." According to the Japanese press, the Fukushima plant's operator, the Tokyo Electric Power Company (TEPCO) yesterday reduced the amount of water being pumped into the Unit 2 reactor from nine to seven tonnes, but that move could increase the danger of the reactor overheating.

Other scientists are concerned that the leakage of contaminated water might indicate a breach of the primary containment vessel of one or more reactors and serious damage to the reactor cores. Arnie Gundersen, a nuclear consultant at Fairewinds Associates, told the *Washington Post* that it was possible that the seals around control rods inserted into the reactor core from the reactor's base could have been damaged by high temperatures or high radiation. If that were the case, highly radioactive water could be leaking from the reactor itself.

On Sunday, a TEPCO spokesman said he did not know how or if the radioactive water was leaking from the reactor cores.

Yesterday, TEPCO reported finding traces of plutonium in soil samples taken from the Fukushima plant. The highest of the readings is more than three times the average level found in Japanese soil. Plutonium was deposited in trace amounts around the world as fallout from atmospheric nuclear tests that halted in 1980. While the plutonium at the Japanese plant might be from that source, it could also indicate significant damage to the reactor cores or spent fuel rods. The discovery of the radioactive isotope, cerium 144, in the area last weekend points to the same conclusion.

Uncertainty about the extent of the damage and dangers at the Fukushima plant is compounded lack of adequate information from TEPCO, which remains in charge of the efforts to contain the disaster despite a long history of cover-ups and safety breaches. TEPCO's priorities from the outset have been to limit both the physical damage to its investment and the political damage to an already tarnished reputation whatever the cost to its workforce and the broader population.

Speaking at yesterday's UCS press conference, Dr Lyman was scathing in his assessment of TEPCO's procedures. "It is clear that the radiation protection measures that are being taken on-site are haphazard at best," he said. "There are anecdotal reports of workers not being given dosimeters (radioactivity measuring devices); ignoring alarms because of the assumption that they're wrong; and the incident over the weekend when TEPCO revised its estimate of the dose rate in a Unit 2 turbine building a hundred times downward."

Three workers who were hospitalised last week after walking into highly radioactive water in the turbine room of Unit 2 reactor were released yesterday. They had not been provided with adequate protective clothing and safety gear, and suffered radiation burns as a result. Doctors said on Monday that the men had no internal injuries or skin abnormalities.

While these workers appear to have recovered, others may not be so fortunate. In generally cautious comments to the *New York Times* on Saturday, Dr David Brenner, a specialist on the impact of radiation on health, said that he expected cases of radiation sickness among workers at the Japanese plant. "I fear there will be fatalities," he said. Between 500 and 1,000 workers are engaged in operations at the plant each day, including TEPCO employees, subcontractors, defence personnel and fire fighters.

The broader dangers facing people in Japan and internationally will not be known until the leakage of radiation from the Fukushima plant is finally brought under control. Water sampled in the sea around the area on Sunday was found to have levels of iodine-131 at 1,150 times greater than the official government safety level. Traces of iodine-131 thought to come from the Fukushima disaster have been found on the west coast of Canada and the US and as far away as Massachusetts.