

Threat from Japanese nuclear emergency widens

Chris Talbot, Patrick O'Connor
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Japan's nuclear safety agency yesterday raised its assessment of the crisis at the Fukushima nuclear facility from 4 to 5 on the 7-point scale, marking official recognition that the situation has changed from an incident with local consequences to one with a potentially wider impact. The Japanese classification remains lower than the category 6 issued by France's nuclear authority, which has placed the disaster just one notch lower than the 1986 Chernobyl meltdown, indicating the escalating danger at the more than 40-year-old plant.

Radiation from Fukushima has now been detected as far away as California, on the North American west coast, though reportedly far below the level that would pose a threat to human health. US air force detectors in the city of Sacramento, designed to detect clandestine nuclear tests during the Cold War, found trace levels of iodine 131 and cesium 137, carcinogenic by-products of nuclear reactor operations. Radiation levels in the US and around the world are expected to increase. The contaminants now being detected were released from Fukushima up to a week ago; the more recent leaked radiation spikes would not have had time to cross the Pacific Ocean.

Los Angeles is 5,400 miles (8,800 km) from Fukushima, and passengers arriving on aircraft from Japan are now being routinely screened for radiation. The World Health Organisation has said that it sees no reason to ban flights to Japan, declaring that while radiation levels in Tokyo are elevated they do not pose a health threat. The US Nuclear Regulatory Commission (NRC) has stressed that levels of radiation reaching the US are not expected to be harmful.

"All the available information continues to indicate Hawaii, Alaska, the US Territories and the US West Coast are not expected to experience any harmful levels of radioactivity," an NRC spokesman said.

In Britain, the Meteorological Office has plotted the expected movement of the radioactive plume for the government's emergency COBRA committee, but it has not been publicly released.

There is a certain mismatch between the reassuring public statements and the preparations now being made. A major operation is underway to monitor the global spread of radiation from Fukushima and it seems likely that unpublished risk analyses have assessed the danger could become greater and more widespread than is currently being admitted.

The US Environmental Protection Agency has set up additional radiation detectors around the country. A team of scientists at the Lawrence Livermore National Laboratory near San Francisco is tracking the results and preparing models based on radiation and meteorological data.

"The models show what happens if the situation gets worse, if the winds change, or if it rains, to predict what could happen." Damien LaVera, a National Nuclear Security Administration spokesman said.

The NRC has declared a 50-mile (80-kilometre) exclusion zone around the Japanese nuclear plant at Fukushima, and both the US and the British governments have advised their citizens to evacuate this zone. It is four times the size of the area evacuated by the Japanese government, which has ordered residents within 12 miles (20 kilometres) of the plant to evacuate and those within 18 miles (30 kilometres) to remain indoors.

While hazardous levels of radiation are currently limited to the site itself, there is no guarantee that this will remain the case. Improvised and desperate efforts to cool the reactors and spent fuel rods continued yesterday, with Japanese Self-Defence Force units spraying water at reactor 3 for about 40 minutes. The defence ministry reported that six specially equipped fire engines rotated one by one to minimise radiation exposure while carrying out the operation. An estimated 50 tonnes of water was discharged—according to some experts, the amount of liquid needed every day for each reactor to prevent overheating.

The US has stepped up its surveillance over Fukushima, with drones and U-2 spy planes reportedly being diverted from the Korean peninsula to fly over the affected area. An unnamed Obama administration official told the *Wall Street Journal* the move was a response to mounting dissatisfaction with the official announcements from Tokyo. "There is a simmering amount of frustration about the speed and accuracy of information flowing from the Japanese government," he said.

Yukiya Amano, head of the UN's International Atomic Energy Agency (IAEA), met with Japanese Prime Minister Naoto Kan yesterday and reportedly urged him to "provide more detailed information". Amano is scheduled to brief the IAEA board on the situation in Vienna on Monday.

Gregory Jaczko, chairman of the NRC, told a Washington news conference on Friday that he expected the struggle to bring down the temperatures at the Fukushima to be a long one. "This is something that will take some time to work through, possibly weeks, as you eventually remove the majority of the heat from the reactors and then the spent fuel pools," he said. When asked whether the Japanese authorities could avoid a "worst case scenario" he refused to offer an opinion. "I really don't want to speculate on where this could go," he said.

Gunther Oettinger, the European Union energy head, said, "We are somewhere between a disaster and a major disaster. There could be further catastrophic events, which could pose a threat to the lives of people on the island."

It was wrong, Oettinger said to “exclude the worst.” He continued “There is talk of an apocalypse, and I think the word is particularly well chosen.”

John Large, who has carried out risk analyses in both military and civil nuclear situations, said that the response to the Fukushima crisis had been “shambolic”. The nuclear industry, he said, did not plan for the one in a million accident. “They are taking a chance, a risk with the helicopters and water,” he added.

“What this means is, accidents like we are seeing now where there are two breaches—one involving the reactors, and one involving fuel ponds outside the reactors—they don’t have any plans for it. They don’t have a procedure in a book to turn to—that’s why there is some turmoil. Taking a water cannon and spraying it in may not work. This shows the fundamental omission in nuclear safety culture. What this shows is the basic confidence of nuclear engineers and operators is flawed.”

The concern is that with the situation still unstable at Fukushima, one or more of the steel containment vessels could rupture or the spent-fuel rods may begin to melt down, producing an even more serious nuclear emergency. Some experts have suggested that the fuel rods stored in pool 4 may have already gone critical on Wednesday. That would mean that a nuclear reaction—nuclear fission—is taking place, without any of the usual means to control it.

The *New York Times* has cited an unnamed “senior Western nuclear industry executive” saying that Japanese engineers have concluded that there is a serious leak in the floor or sides of the spent fuel pool at reactor 4, making it extremely difficult to fill with water. According to the source, the leak has not yet been located, but “engineers had concluded that it must exist because water sprayed on the storage pool has been disappearing much more quickly than would be consistent with evaporation”.

The *Los Angeles Times* noted that a “breach in the pool would leave engineers with a problem that has no precedent or ready-made solution”. Edwin Lyman, a physicist with the Union of Concerned Scientists, said: “My intuition is that this is a terrible situation and it is only going to get worse. There may not be any way to deal with it.”

In a normally operating reactor, control rods are used to absorb the neutrons produced by the nuclear reaction, either partially or completely. When the control rods are fully inserted into the reactor, fission in the fuel rods ceases. But fission of the nuclear by-products continues to produce heat, which is why a reactor must continue to be cooled after it is shut down.

“A criticality event outside a containment vessel is very serious,” Large warned.

Enormous amounts of energy and neutrons are released in such a situation. Neutrons are relatively heavy elementary particles with no electric charge, allowing them to penetrate even heavy shielding structures. There is no danger of a nuclear bomb-type explosion, since that requires highly enriched uranium. But the situation is a very dangerous one in terms of continued long-term emission of radioactive materials. This is the “worst case scenario” for Fukushima. It would mean increasingly serious consequences for human health over a widening area, the longer the reaction continued unchecked.

TEPCO admitted that ultimately the Fukushima site will have to be buried in sand and concrete, as was done at Chernobyl. But even that

drastic measure is out of the question if a nuclear reaction is still running out of control. Any attempt to bury the site before the spent-fuel rods are cooled down could result in nuclear fuel melting or bursting through the sand and concrete.

Teams of engineers, working in rotation under conditions of high radiation, have succeeded in setting up a kilometre-long power cable to the plant. TEPCO has issued a statement claiming that electricity can now be supplied. This may be a significant development in the struggle to contain the disaster, potentially enabling pumps to be brought into operation so that the reactors can be kept cool and the spent-fuel rod pools refilled. However, there is no guarantee that the pumps and cooling systems will work. They have been doused in seawater. Someone will have to go into the control rooms to connect valves. Even then the water circuits may be blocked or damaged.

Moves to reconnect power have been carried out at what is already a high human cost. One worker was killed in the crane operating plant at nearby Fukushima Daini when the earthquake struck. Two workers are missing, presumed dead, after a fire in Fukushima Daiichi unit 4, and 21 other workers are reported to have been injured or taken to hospital since the emergency began.

At least one TEPCO worker has been hospitalised after he received a high dose of radiation while venting radioactive steam from Fukushima Daiichi 3. Nineteen people have been treated for radiation exposure on site. All the members of the emergency teams have received significant doses of radiation that will inevitably impact on their long term-health. With some justification, the workers struggling to bring this unfolding disaster under control have been called a suicide squad.

Richard Wakeford of the Dalton Nuclear Institute at the University of Manchester stressed the danger presented by the spent-fuel rod tanks as they run dry. “If the water goes, you’ve got no shielding, and it’s like having a great gamma-ray searchlight shining into the sky. That is presumably what the helicopters are seeing. That makes life extremely difficult for those trying to deal with this,” he said. “Even though they are in Chinooks, they haven’t got much in the way of shielding. They would need lead on the bottom to protect people who are operating them.”

Set against the rising death toll from the earthquake and tsunami—now 6,911, with another 10,692 people missing—the death toll from the nuclear emergency at Fukushima is still comparatively small. But the picture that is unfolding is of long-term health risks to the workers at the plant, and to the Japanese people, from the radioactive contamination that will remain on the site and that has already been dispersed in the vicinity of the plant. The longer the emergency continues, the greater the threat becomes to the wider population in Japan and beyond.

This is not a single incident, but a whole series of crises, each of which would be serious in its own right. The total radioactive emissions are building all the time. Some of the contaminants are relatively short-lived and some will be diffused over the Pacific. But others have long half-lives and will continue to present a threat to human health for centuries to come.



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