Large aftershock hits northern Japan

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A major aftershock on Thursday night hit north-eastern Japan, the region already struck by the March 11 earthquake and tsunami. Three people died in the latest quake, which left more than four million households without power, and disrupted gas and water supplies in the city of Sendai and other urban areas.

The aftershock highlighted the vulnerability of Japan's nuclear plants to further tremors. While Tokyo Electric Power Company (TEPCO) reported no change in the state of its crippled reactors at the Fukushima Daiichi plant, other nuclear facilities in northern Japan suffered power losses and were compelled to rely on emergency diesel generators.

The quake, which measured 7.1 on the Richter scale, struck at around 11.30 p.m. on Thursday, creating fresh panic throughout areas that are struggling to recover from the March 11 disaster. The epicentre was located off the east coast, 66 kilometres from Sendai, a major regional city north of Tokyo with a population of more than one million. A tsunami alert was issued but quickly lifted.

Yesterday evening more than 450,000 households were still without power. The region's nuclear plants were already offline, and the available electricity supply fell further after five conventional power plants automatically shut down when the aftershock occurred. The outages were compounded by damage to the power grid. Fires and gas leaks were reported in Sendai and other areas of Miyagi and Iwate prefectures.

A 63-year-old woman died in Yamagata prefecture after her respirator stopped working due to a power outage. An 85-year-old man collapsed and died trying to get to a shelter and a 79-year-old man was reported dead on arrival at a hospital in the city of Ishinomaki. Another 130 people were injured, 17 of them seriously.

Amid widespread concern over the nuclear disaster at the Fukushima Daiichi plant, a TEPCO spokesman issued a bland statement on Friday declaring that there was "no information immediately indicating any abnormality." The comments are a further example of the attempts by TEPCO and Japan's Nuclear and Industrial Safety Agency (NISA) to play down the ongoing critical situation at the facility.

TEPCO's statement simply means that it has observed no change to what the International Atomic Energy Agency (IAEA) continues to describe as a "very serious" situation. The TEPCO comment is doubly deceptive because the means for observing changes—the instrumentation that normally monitors the reactors—has been compromised by the impact of the March 11 earthquake and tsunami.

Conditions at the Fukushima plant are anything but normal. The conventional cooling systems of three of the six nuclear reactors—units 1, 2 and 3—were put out of action on March 11, resulting in the heating up of the reactor cores. A meltdown was only prevented by continuously pumping salt water, subsequently replaced by fresh water, into the reactors. Hydrogen explosions have badly damaged the reactor buildings of units 1 and 3 as well as unit 4, where the reactor core had been placed in the spent fuel rod pool to allow for reactor maintenance.

At this stage, the extent of the damage to the reactor cores can only be estimated, as no direct observation is possible. Nor is the state of the reactor cooling systems known, as deposits of salt are likely to be impeding water circulation. The danger of further hydrogen explosions was underscored by TEPCO's decision this

week to start pumping inert nitrogen into unit 2 to flush out hydrogen and oxygen from the primary containment vessel.

The US Nuclear Regulatory Commission (NRC) issued a statement on Wednesday indicating that part of the reactor core of unit 2 was probably out of the reactor pressure vessel and in the bottom of the drywell. The reactor pressure vessel is a steel structure that contains the core at the centre of the reactor. It is surrounded by a thick concrete primary containment vessel that includes the drywell.

The danger is that if the core material in the drywell is molten it could, in time, burn through the concrete containment vessel and lead to a major escape of highly radioactive material. Already, radioactive water has been leaking through a tunnel associated with unit 2. While the immediate leak was plugged on Wednesday, the source of the toxic water has not been found.

A confidential NRC assessment of the Fukushima power plant also warned that the large amount of water being pumped inside the reactor could compromise the ability of the primary containment vessels to withstand aftershocks.

Thursday's tremor and associated power blackouts impacted on three other nuclear facilities in northern Japan. A fuel reprocessing plant at Rokkasho and a power plant at Higashidori, both in the Aomori Prefecture, were temporarily cut off from the electricity grid and had to rely on backup emergency diesel generators.

While no major problems were reported, the procedure was not without incident. At the Higashidori power plant, the reactor itself was shut down but an emergency diesel generator was needed to cool the spent fuel rod pool. The generator was left running even after grid power was reconnected, but failed on Friday due to an oil leak. Two other backup generators were undergoing maintenance and thus unavailable.

The Onagawa Nuclear Power Station lost two of its three external power lines and used the remaining one to keep the plant going. The quake nevertheless triggered a temporary shutdown of power to the cooling systems of a spent fuel pool and jolted the pool itself, causing a small spillage of radioactive water.

The aftershock is unlikely to be the last major one. Some 400 tremors have hit the region since the March 11 quake. Brian Baptie, a seismologist with the British Geological Survey, told the *Financial Times*: "We would expect many large aftershocks after such a large earthquake... it is part of the stabilisation process. Many can be very large—the largest [so far] was 7.9 [on the Richter scale]."