



## SCIENCE & ENVIRONMENT

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# Japan earthquake triggers nuclear shutdown

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**Japan's prime minister has declared a "nuclear emergency" after a number of reactors shut down after a massive earthquake hit the country.**

Eleven reactors at four nuclear power stations automatically shut down, but officials said one reactor's cooling system failed to operate correctly.

Under Japanese law, an emergency must be declared if a cooling system fails.

In total, the country has 55 reactors providing about one-third of the nation's electricity.

In a statement, the Japan Atomic Industrial Forum released a statement that said Prime Minister Naoto Kan had declared the emergency "in case prompt action" had to be taken, but added that "no release of radioactive material" had been detected.

It added: "Nuclear and Industrial Safety Agency (Nisa) of the [Ministry of Economy, Trade and Industry] set up an emergency preparedness headquarter... in an effort to collect information on any possible damage to the NPPs (nuclear power plants).

"Since emergency diesel generators at the Fukushima-1 and -2 NPPs are out of order, (energy company) TEPCO sent the emergency report to Nisa. There is no report that radiation was detected out of the site."

The reactor at the Fukushima Daiichi power station that triggered the emergency alert was the 40-year-old Reactor 1, one of six on the site.

Reactors 1, 2 and 3 automatically shut down when the Magnitude 8.9 quake shook the plant, while reactors 4, 5 and 6 were not in operation as they were undergoing scheduled inspections.

The reactors are Boiling Water Reactors (BWR), one of the most commonly-used designs, and widely used throughout Japan's fleet of nuclear power stations.

Heat is produced by a nuclear reaction in the core, causing the water to boil, producing steam. The steam is directly used to drive a turbine, after which it is cooled in a condenser and converted back to water. The water is then pumped back into reactor core, completing the loop.

A statement by the power station's operator, Tokyo Electric Power Company, pressure inside the reactor had risen after the cooling system had been damaged by the quake.

About 3,000 residents within a two-kilometre radius of the power station, located about 170 miles north-east of Tokyo, were told to leave their homes as part of the emergency procedure.

Even when the reactor is shut down and the nuclear fission is halted, an intense level of heat remains and needs to be dissipated, which is the role of the cooling mechanisms.

Dr Richard Phillips from the University of Leeds said that a reactor has to be rapidly cooled when it is automatically switched off.

"One power station failed to cool sufficiently but the stations are robust and there is no expectation that any leaks will occur," he explained.

"Once checks have been undertaken the stations should be back online in a few days."

It is understood that the earthquake cut electricity supplies to the power station, and the back-up generators did not come into operation when the outage occurred. As a result, not all of the cooling systems were available.

### **Local evacuation**

An estimated 2,800 residents within a two-kilometre radius of the Fukushima Daiichi power station, located about 170 miles north-east of Tokyo, have been told to leave their homes as part of the emergency procedure.

World Nuclear Association (WNA) spokesman Jeremy Gordon said the state of emergency was a legal requirement and did not mean that there was a genuine case for concern.

"It allows authorities to take additional measures," he told BBC News. "It empowers officials in the local region, such as the fire service, police etc to take the action they need to take, but at this stage it is purely precautionary."

Under Japanese law, a nuclear emergency must be declared if there is a release of radiation, if there is a dangerous level of water in the reactor, or if the cooling mechanisms fail.

"It is important to remember that for a large reactor like that, it would have a number of diesel generators that are supposed to start up automatically, when the plant is disconnected from the grid," Mr Gordon said.

"But it is not the case that you have just one generator - the nuclear business is not like that, you never rely on just one thing. You always back up your back-ups."

Mr Gordon added: "It is hard to find country more experienced in earthquakes than Japan, and they are also one of the most experienced in nuclear power."

He said that the country has been commercially operating nuclear power stations for 45 years, during which time there have been a number of major earthquakes.

"The most recent quake to affect a nuclear power station was in 2007, and it hit the seven-reactor Kashiwazaki-Kariwa plant very hard as I think the epicentre was very close by.

"It was shaken a lot harder than anyone ever thought it would be, so it was an example of how the over-engineering in nuclear power station design goes beyond the super-conservative regulatory requirements."

But Steve Thomas, professor of energy policy at Greenwich University, said the reactors were only now just beginning to come back into operation.

"There were things that should've held together but didn't, and it's taken them years to get [the reactors] back in service," he told BBC News.

"I think it was a shock to the Japanese that the plants didn't hold up as well as they should've done."

### **'Earthquake proof'**

Nuclear engineer and fellow of the UK's Royal Academy of Engineering Dame Sue Ion said Japan had extremely tight standards when it came to ensuring nuclear power plants were earthquake-resistant.

"Authorities, utilities and reactor vendors ensure that appropriate safety systems are incorporated at the design stage and implemented in construction and operation," she observed.

"Systems automatically shut down when trigger points are reached to allow for relevant safety inspections to take place before restart.

"Japan's nuclear power stations are being shown to be robust against the threat of earthquake: Safety systems have operated as they should."

The Japan Atomic Industrial Forum said that it would continue to post regular updates on its website to keep people informed about developments at Fukushima.

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