

Fukushima: what have caused a hydrogen explosion at the No. 1 reactor?

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Contents

- [TEPCO eyes design flaw in \(...\)](#)
- [TEPCO says venting failure \(...\)](#)

TEPCO eyes design flaw in hydrogen explosion

A design flaw in the exhaust system within the reactors at the Fukushima No. 1 nuclear power plant may have caused a hydrogen explosion at the No. 1 reactor March 12 that blew the top off the structure.

The same type of exhaust and venting system is installed at other nuclear plants in Japan, meaning a major review will likely be required at those plants.

TEPCO officials now believe that venting the containment vessel at the No. 1 reactor to reduce pressure within the vessel and prevent damage may have led to hydrogen gas flowing back into the reactor building, rather than outside as originally designed.

A valve in a separate exhaust system that is supposed to stop a reverse flow of hydrogen gas back into the building failed because all power to the reactor was lost in the hours after the March 11 Great East Japan Earthquake and tsunami.

TEPCO executives admitted flaws in the design for the exhaust system could have been a factor leading to the hydrogen explosion.

According to internal TEPCO documents, the No. 1 reactor has two emergency exhaust systems. One is the standby gas treatment system (SGTS), which releases gas from the reactor building through a filter to the outer atmosphere.

The other system is a pressure-resistant vent pipe, which releases gas from within the containment vessel to the outer atmosphere.

The two separate systems eventually join into a single pipe which is connected to the exhaust cylinder that releases all gas into the atmosphere.

When venting the containment vessel at the No. 1 reactor, the valve for the SGTS stuck in the open position after the reactor was automatically stopped following the quake. The subsequent loss of power source led to an inability to close the valve.

TEPCO officials believe hydrogen gas that should have been released from the vent pipe flowed back into the reactor building through the open SGTS valve after reaching the point where the two

exhaust systems converge.

The hydrogen gas that flowed back into the reactor building is believed to have accumulated and led to the hydrogen explosion.

The No. 1 reactor also did not have a valve designed specifically to prevent the reverse flow of gas back into the reactor building.

The No. 2 and No. 3 reactor buildings have such a special valve. While a hydrogen explosion also occurred in the No. 3 reactor building, the amount of hydrogen gas that flowed back into that building was likely limited by the valve, which can operate even if power sources are lost.

In the TEPCO manual for venting, workers are instructed to confirm the valve for the exhaust system to release gas from the reactor building is shut before starting the venting. However, because of the high levels of radiation within the reactor building, TEPCO workers were likely unable to check on the condition of the valve.

When the No. 1 reactor began operations in 1971, it had an exhaust system to release gas from the reactor building. After the 1986 nuclear accident at Chernobyl, the exhaust system for the containment vessel was installed in 1999 as a measure to prevent a severe accident.

TEPCO officials had until now given the explanation that the hydrogen explosion in the No. 1 reactor building was caused by hydrogen leaking from cracks in the pipes connecting the containment vessel to the outside.

A TEPCO executive defended the decision to conduct the venting because it was necessary to protect the containment vessel.

However, the executive also said, "We did not sufficiently consider the possibility that hydrogen gas might flow back into the reactor building when power sources were lost. We have to admit to design problems in the exhaust mechanism."

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<http://www.asahi.com/english/TKY201106040165.html>

TEPCO says venting failure caused hydrogen explosion at No. 1 reactor

Tokyo Electric Power Co. (TEPCO) has announced that an explosion at the No. 1 reactor of its crippled Fukushima No. 1 Nuclear Power Plant in March was possibly triggered by a failure to vent hydrogen gas out of the reactor building.

TEPCO disclosed on June 4 that hydrogen gas which was supposed to be vented out of the building containing the No. 1 reactor to lower pressure inside the container vessel had actually leaked inside the building.

The explosion took place at 3:36 p.m. on March 12 — a day after the magnitude-9.0 earthquake and

ensuing tsunami hit northeast Japan — blowing apart the upper part of the building containing the No. 1 reactor.

The hydrogen gas is believed to have been generated after heated zirconium — a material covering nuclear fuel rods — reacted with water. The No. 1 reactor building contains pipes that are intended to release gas outside the reactor building as well as pipes meant to release gas from the containment vessel. The two types of pipes converge and are connected to an exhaust stack outside the building.

Workers started venting hydrogen gas from the No. 1 reactor shortly after 10 a.m. on March 12, after pressure inside the reactor's containment vessel mounted, threatening to damage the vessel.

However, it is likely that workers were unable to close a pipe valve that was designed to prevent the backflow of gas into the reactor building following the loss of power in the wake of the tsunami. It is also possible that hydrogen gas leaked in the reactor building from the joints of pipes.

TEPCO is set to further investigate the cause of the explosion.

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<http://mdn.mainichi.jp/mdnnews/news/20110604p2a00m0na011000c.html>
