Fukushima N-crisis: how it happened

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NUCLEAR CRISIS: HOW IT HAPPENED: Kan's visit 'wasted time'

Nearly three months have passed since the Great East Japan Earthquake triggered a nuclear crisis that shows little sign of ending any time soon.

This is the first installment in a series that looks into what has given rise to the unprecedented crisis, dealing a fatal blow to the myth of safety at nuclear power plants in this country.

Shortly after 1 a.m. on March 12—about 10 hours after the massive earthquake and tsunami struck—Prime Minister Naoto Kan was becoming increasingly exasperated.

Kan, 64, told his aides at the Prime Minister's Office that he wanted to go and visit the Fukushima No. 1 nuclear power plant to grasp the situation in person. But Chief Cabinet Secretary Yukio Edano, 47, tried to dissuade him from doing so, saying, "If you leave the Prime Minister's Office at this moment, you'll come under fierce criticism."Kan shouted in anger."You idiot! Which is more important, ending this situation or thinking about the risk of drawing fire?"

Pressure in the No. 1 reactor's containment vessel shot up to a level nearly double its designed strength. Given the situation, plant operator Tokyo Electric Power Co. came to the conclusion that venting radioactive steam from the reactor was needed to prevent an explosion. Such a measure had never before been taken in this country.

TEPCO workers called a situation that required venting the worst-case scenario. And the company was hit by more unexpected trouble—loss of all power. That hampered preparations for the venting.

At 6:14 a.m. Kan headed for the plant in a Self-Defense Forces helicopter and arrived there at 7:11 a.m.

"Has the venting been done yet?" he shouted in a meeting room in a strongly earthquake-resistant building used as a base for the restoration work.

At that moment, more than five hours had passed since the government had told TEPCO to vent steam from the reactor.

Kan regained his composure as Masao Yoshida, 56, head of the plant, told him, "We'll form a suicide squad to do it."

As soon as Kan left the crippled power plant after 8 a.m., Yoshida

immediately instructed his men to carry out the venting. It was as if he had been waiting until the prime minister's departure to do so.

Work to prepare for the venting at the No. 1 reactor started at 9:15 a.m.

Workers headed for the reactor building, carrying nitrogen cylinders and batteries over their shoulders. They called the mission their "last service."

In a severe working environment where they were exposed at one point to more than 106 millisieverts of radiation, a level that exceeded the limit permitted for workers at nuclear power plants, three teams of two people took turns venting steam from the reactor. At about 2 p.m., the venting was deemed a success.

However about 1-1/2 hours later, there was a hydrogen explosion at the reactor.

TEPCO has cited slowness in the evacuation of residents in neighboring areas as a reason for its delay in carrying out the venting. But the government-ordered evacuation of people living within three kilometers of the plant was completed by 12:30 a.m. on March 12.

It remains unknown why Yoshida waited for hours to order workers to conduct the venting.

A photograph provided by TEPCO showed that updates of the situation on the site were given on a whiteboard in the No. 1 reactor's central control room. But from 6:29 a.m., shortly after Kan departed the Prime Minister's Office, to 9:04 a.m., an hour after he left the plant, there was nothing written on the board. Speculation has arisen that work to fight the crisis was stalled during the missing 2-1/2 hours.

"The director had to accompany the prime minister. I'm not sure if the hydrogen explosion could have been prevented, but I'm sure [Kan's visit] wasted our time," a senior TEPCO official said.

Meanwhile, Kan has apparently viewed TEPCO's handling of the crisis as problematic, saying they failed to respond promptly to the government's instruction to carry out the venting.

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* http://www.yomiuri.co.jp/dy/national/T110608005066.htm

NUCLEAR CRISIS: HOW IT HAPPENED: Hydrogen blasts at plant surprised experts

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“An explosion was heard at the Fukushima No. 1 nuclear power plant.”

At 3:36 p.m. March 12, this information was conveyed from the Fukushima prefectural police via the National Police Agency to the government’s crisis management center, located in the basement of the Prime Minister’s Office.

But officials of the Nuclear and Industrial Safety Agency and Tokyo Electric Power Co. who were at the Prime Minister’s Office at the time refused to accept the information, some of them repeatedly saying, “That’s not possible.”

It was not until five hours later that the government acknowledged that a hydrogen explosion had occurred at reactor No. 1. Such an explosion had not been factored into their scenarios, and it took some time for officials to analyze the situation.

At 8:40 p.m., Chief Cabinet Secretary Yukio Edano held a press conference. "The explosion destroyed the reactor building, but the containment vessel [housing the reactor] has not been damaged," he said, stressing that the reactor was safe.

Meanwhile, TEPCO, the plant operator, had only made an announcement that it was analyzing the incident.

"No expert had predicted that a hydrogen explosion would occur at the reactor building," said Goshi Hosono, special adviser to Prime Minister Naoto Kan.

Haruki Madarame, chairman of the Nuclear Safety Commission, had said, "The containment vessel has been refilled with nitrogen, so a hydrogen explosion won’t happen." Kan accepted the explanation.

Nuclear experts, including Madarame, overlooked the risk of a hydrogen explosion because they were shackled with what was considered common sense among many nuclear experts. Instead it turned out to be more like excessive self-confidence.

The 2002 report, compiled by TEPCO and five other power companies, on response measures to be taken in the event of core meltdowns and other severe nuclear accidents, stated, "There is no need to take a hydrogen explosion into consideration." This belief came from the common knowledge that such an explosion would not occur if the containment vessel was filled with nitrogen, which would keep the concentration level of hydrogen low.

The government’s safety screening was based on similar beliefs.

Tomoho Yamada, director of the NISA’s Nuclear Power Licensing Division,

said, "[The reactor] was designed to keep hydrogen from leaking out of the containment vessel into the reactor building.“”In the safety screening, we assumed that a hydrogen explosion would not occur in the reactor building," Yamada added, admitting that due to this assumption, measures to prevent a hydrogen explosion in the reactor building were not included in the list of safety measure evaluations.

But according to an analysis by TEPCO, after all of the nuclear fuel at the No. 1 reactor melted 16 hours after the massive earthquake and tsunami on March 11, the pressure and the containment vessels became damaged. Hydrogen, which was generated from the reaction between the zirconium cladding of the fuel rods and oxygen, leaked out and began accumulating in the reactor building.

A former TEPCO executive said: "I'd never have thought such a large amount of hydrogen would be generated after the nuclear fuel was exposed. We must accept that we were overly confident."

TEPCO attempted to ventilate other reactor buildings at the power plant, but workers struggled with high radiation levels, and failed to prevent a hydrogen explosion at the No. 3 reactor on March 14.

The hydrogen explosion at the No. 1 reactor was indeed a critical point leading to delays in responses to the nuclear accident.

When nuclear reactors are in operation, hydrogen tends to be generated by the radiolytic decomposition of water and other chemical reactions. But hydrogen generation was not the cause of most past explosions at nuclear plants, so close attention was not initially paid to the phenomenon during the Fukushima crisis.

In the 1979 accident in which a cooling malfunction crippled the Three Mile Island nuclear power station in the United States, a hydrogen explosion took place inside a containment vessel about 10 hours after the malfunction began. But the reactor building and containment vessel stood intact despite the blast. Several hours later, the cooling system was restored.

But it took four days until the threat of immediate catastrophe was declared to be over after hydrogen was eliminated.

An explosion that occurred at Chubu Electric Power Co.'s Hamaoka nuclear power plant in Shizuoka Prefecture in November 2001 was due to hydrogen combustion inside a pipe used for the emergency cooling of a reactor core.

Reactor design a factor

The Fukushima No. 1 plant suffered a series of explosions because the design of its reactors made it prone to hydrogen blasts, but this risk was overlooked, according to some experts.

At the plant, the Nos. 1-5 reactors are the Mark-1 model developed by General Electric Co. of the United States in the 1960s. The Mark-1 is

one of the oldest light-water reactor models. Construction of Fukushima's No. 1 reactor dates back to 44 years ago.

"[The Mark-1] containment vessels are relatively small and pressure fluctuates greatly, so its operation is difficult," said a former senior TEPCO official who worked at the Fukushima plant. "As hydrogen accumulates easily, I felt a potential risk."

In the United States, among 104 reactors in use at 65 nuclear power plants, the Mark-1 model accounts for 23 reactors at 16 plants, a major subject of criticism among antinuclear activists.

In the 1970s, U.S. nuclear regulators considered a ban on the use of the Mark-1 model out of concern that its containment vessels could be vulnerable to serious accidents. But as the model was already being widely used, authorities stopped short of forbidding its use.

However after the 1970s, experts pointed to the need for measures to prevent rapid hydrogen buildup. As a result, plant operators have since taken steps such as installing equipment that regenerates water from hydrogen in turbine buildings and injects nitrogen into containment vessels.

Such measures have also been taken at the Fukushima plant.

But in the 1980s, a senior official of the U.S. Nuclear Regulatory Commission named Harold Denton pressed the argument that Mark-1 reactors had a 90 percent probability of suffering an explosion if fuel rods overheated and melted in an accident.

In the late 1980s, GE attempted to help the model survive such criticism by equipping it with improved devices such as a venting system to reduce pressure in the containment vessel.

NRC Chairman Gregory Jaczko has said all existing reactors in the United States, including Mark-1 reactors, are operating safely.

But regarding the Mark-1 model and its 40-year history, a senior official of a nuclear reactor manufacturer said, "The biggest problem is we lacked knowledge of the workings of devices that were vulnerable to a loss of power."

Even the device to regenerate water from hydrogen cannot work if power is lost.

"Unexpectedly, nuclear engineers aren't so familiar with electric systems," a TEPCO official said.

TEPCO uses Mark-2 reactors at its Fukushima No. 2 nuclear power plant. Immediately after the March 11 disaster, the cooling system temporarily halted at the plant's three reactors, but a hydrogen blast did not occur there.

In Japan, the Mark-1 model also has been used at the Nos. 1 and 2

reactors at the Hamaoka plant. Nuclear plants in Onagawacho, Miyagi Prefecture; Matsue, Shimane Prefecture; and Tsuruga, Fukui Prefecture, each have one Mark-1 reactor.

In a report prepared for the International Atomic Energy Agency, the government has included the installation of equipment to eliminate hydrogen from reactor buildings as a measure to prevent hydrogen explosions.

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http://www.yomiuri.co.jp/dy/national/T110609005186.htm