

## Hamaoka reactor likely wrecked in seawater accident

November 21, 2012

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By JIN NISHIKAWA/ Staff Writer

A restart may be impossible at one of Japan's idled nuclear reactors without substantial repairs, after an accident during a shutdown procedure last year in which hundreds of tons of seawater flooded equipment including the central pressure vessel.

Unrefined seawater contaminated sensitive appliances and subsequent inspections have found rust on many key components of the affected unit, the No. 5 reactor at the Hamaoka nuclear power plant in Shizuoka Prefecture. Damaged devices include those that regulate the rate of nuclear fission.

The incident occurred while workers were shutting down the reactor on May 14, 2011. They were responding to a request, delivered eight days previously, by Prime Minister Naoto Kan for a shutdown of all reactors at Hamaoka on account of the plant's location--one of high seismic risk.

An alarm sign lit up at 4:30 p.m., while the workers were lowering the pressure inside the reactor. The alarm indicated high salinity in the condenser, a device that uses seawater to cool the pure water vapor that drives the turbines.

Later studies revealed a dislodged alloy cap that previously had been welded to the end of a pipe. A high-pressure jet of hot water had hit and broken 43 tubes that conduct seawater inside the condenser. As a result, about 400 tons of seawater flooded inside.

At the time, clean water heated to 240 degrees was circulating under high pressure between the nuclear reactor and the condenser.

An estimated 5 tons of seawater entered the reactor pressure vessel itself.

Once inside, the seawater corroded pumps and driving mechanisms, key components that insert and remove control rods as operators regulate the rate of nuclear fission. The water also corroded 40 holes in the bottom and walls of the condensate storage tank, which stores cooling water for reactor operations. Some of the holes penetrated the tank's metal lining.

Corrosion also deformed the tubes within the condenser itself.

Chubu Electric Power Co., the operator of the Hamaoka power plant, began work last year to desalinate the tank and other contaminated equipment. But it halted work this year when water leaked on Aug. 14 from the piping of a desalination device.

In response to the initial accident, the Nuclear and Industrial Safety Agency, the government's now-defunct nuclear industry watchdog, set up an expert panel in July 2012 and held four hearings. The panel's interim report endorsed Chubu Electric's own investigation as "appropriate."

But a number of problems remain unaddressed, including an assessment of the broader impact of the seawater contamination.

Chubu Electric has said it plans to inspect only certain contaminated elements, but members of the expert panel have called for more than that.

"Exhaustive checks and replacement of key components should be considered," one member said.

Another added: "How to verify conditions in some enclosed sections, where inspection is impossible, remains a challenge."

The panel also highlighted a need to search for other problems including possible corrosion-like damage from microorganisms in the seawater.

In September, Chubu Electric extracted all 872 fuel assemblies from the reactor and moved them into a spent fuel storage pool. It is unclear if they remain usable.

A similar accident occurred 40 years ago in the United States, but the Hamaoka case likely involved considerably more seawater, of much higher salinity.

The U.S. incident took place at the Unit 1 reactor of the Millstone nuclear power plant in Connecticut in September 1972, 18 months after the unit first went live. Seawater leaked from a corroded hole in the condenser's piping system while the reactor was being reactivated.

Post-accident inspections and safety checks took place and the reactor was restarted. It functioned normally until it was shut down in 1998 for management reasons.

The salinity of the leak at the Millstone reactor at most was about 3 percent of that at Hamaoka.

"The Millstone incident likely involved less seawater than at the Hamaoka No. 5 reactor," said an official at the Japan Nuclear Energy Safety Organization. "The reactor underwent a cleanup, including near-total replacement of water, within a month. That is not the case with the Hamaoka No. 5 reactor, where seawater has remained inside for a long time."

The No. 5 reactor first went online in 2005. It is the newest unit at the Hamaoka nuclear plant. Chubu Electric has been carrying out inspections in the hopes of restarting it one day.

But the Nuclear Regulation Authority, the NISA's successor, said it has yet to decide when and how it will screen equipment for safety and assess the overall suitability of a reactor restart.

"Reuse and restart cannot be contemplated without confirming the potential consequences of major disasters involving coolant loss, on a case-by-case basis," said Toyoshi Fuketa, a Nuclear Regulation Authority commissioner who served on the NISA expert panel.

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