# Feds say design flaw led to Calif. nuke plant woes

MICHAEL R. BLOOD - Associated Press - Associated Press

SAN JUAN CAPISTRANO, Calif. (AP) — Federal regulators said Monday that a botched computer analysis resulted in design flaws that are largely to blame for unprecedented wear in steam tubes at the San Onofre nuclear power plant, but it isn't clear how the problems can be fixed.

The preliminary findings by a team of Nuclear Regulatory Commission investigators were disclosed nearly five months after the seaside plant was shut down following a break in a tube that carries radioactive water. There is no date to restart either of its two reactors.

The problems center on excessive tube wear in steam generators that were installed at San Onofre during a $670 million overhaul in 2009 and 2010. Tests found some tubes were so badly corroded that they could fail and possibly release radiation, a stunning finding inside the virtually new equipment.

Long unknown was what was causing tubes to vibrate and rub against each other inside the massive machines, manufactured by Mitsubishi Heavy Industries.

Greg Werner, who headed the federal team, said a Mitsubishi computer analysis vastly misjudged how water and steam would flow in the reactors. Also, changes intended to improve manufacturing were never thoroughly reviewed in the context of the generator design, resulting in weaker support around bundles of tubes that contributed to vibration, he said.

The plant's operator, Southern California Edison, could face penalties, while problems at the plant have raised fears of a nuclear accident in Southern California and cut off one of the region's important sources of power.

"The ultimate responsibly resides with them ... because they are responsible for safety," said Regional Administrator Elmo Collins, the agency's top official in the western U.S.

When the generators were designed, the crucial tool Mitsubishi used, a computer model, failed to predict conditions inside the machines and resulted in the tube shaking, Collins said.

Edison agreed with the findings.

In an interview with The Associated Press on Sunday, Collins said missteps in fabrication or installation were considered as possible sources of the rapid tube decay but "it looks primarily we are pointed toward the design" of the generators.

Collins didn't rule out that one or more of the generators might have to be replaced.

"We think it's too early to tell," he told reporters.

The findings were released during a three-hour meeting Monday in which officials also faced sometimes-testy questions from local citizens concerned about safety.

Outside the hearing, protesters from Friends of the Earth and other groups critical of the nuclear industry displayed signs that said "Not another Fukushima" and "Shut unsafe San Onofre."

The group on Monday filed a petition asking the NRC to keep the plant offline until the company amends its license to reflect design changes in the generators.

"This is a safety problem," said Friends of the Earth consultant Arnie Gundersen, a former nuclear industry executive and licensed reactor operator who has written several reports on the San Onofre generators. "These changes put the public at risk."

So far, a fix has remained elusive.

"It's not too hard to frame up the problem," Collins told AP. "The answers are very difficult, or they already would have emerged."

The disclosure will rivet new attention on a series of alterations to the equipment design, including the decision to add 400 tubes to each generator and installing V-shaped supports that were intended to minimize tube wear and vibration. According to company documents, each of the replacement generators weighed nearly 24 tons more than the original generators.

The generators were designed to meet a federal test to qualify as "in-kind," or essentially identical, replacements for the original generators, which would allow them to be installed without prior approval from federal regulators.

The agency is reviewing how that was handled.

Inside the guts of the machinery, the original steam generators and the replacements "look substantially different," Collins said.

Company officials and Collins said safety would remain the first consideration at San Onofre. About 7.4 million Californians live within 50 miles of San Onofre, which can power 1.4 million homes.

"These are significant technical issues. They are not resolved yet," Collins said.

The company said in a statement that the Unit 2 reactor likely would remain offline at least through August, pending NRC approval for a restart. It did not project a restart date for Unit 3, where tube damage has been more severe. The company is expected to submit a plan to the NRC later this summer to restart one, or both, reactors, which would have to outline how the company can control the tube damage.

"We know that the outage and the tube wear issue have generated concern in our community," Edison President Ron Litzinger said.

Cracked and corroded generator tubing has vexed the nation's nuclear industry for years.

Decaying generator tubes helped push San Onofre's Unit 1 reactor into retirement in 1992, even though it was designed to run until 2004. The following year, the Trojan nuclear plant, near Portland, Ore., was shuttered because of microscopic cracks in steam generator tubes, cutting years off its expected lifespan.

Westinghouse Electric Corp. weathered a legal battle with five utilities in the 1990s that wanted the company to replace steam generators it manufactured for the Beaver Valley nuclear power plant in Pennsylvania after tubing corroded.

But the troubled San Onofre generators, manufactured by Mitsubishi Heavy Industries, might be a unique case because of the extensive modifications. Only one other U.S. nuclear plant uses Mitsubishi generators, the Fort Calhoun Nuclear Station, about 20 miles north of Omaha, Neb., but its generators are smaller than those at San Onofre and have not displayed excessive tube decay, federal officials say.

The cause of the unusual wear has been eagerly anticipated, as Edison prepares to submit a proposal to the NRC to restart one or both of the reactors. The company has suggested the reactors would run for a test period under reduced power to reduce vibration.

"The phenomenon that we think causes this tube-to-tube interaction is definitely proportional to the power," Collins said. "At least in some theoretical sense, that might be part of the answer."

The company has announced that 510 tubes have been plugged, or retired from use, in the Unit 2 reactor, and 807 tubes in its sister, Unit 3. Each of the generators has nearly 10,000 tubes, and the number retired is well within the limit allowed to continue operation.

The steam generators — two in each reactor — function something like a car radiator, which controls heat in the vehicle's engine. The generator tubes circulate hot, radioactive water from the reactors, which then heats non-radioactive water surrounding them. That makes steam, which is used to turn turbines to make electricity.

The tubes have to be thin enough to transfer heat, but thick enough to hold up under heavy pressure. They represent a critical safety barrier — if a tube breaks, there is the potential that radioactivity can escape into the atmosphere. Also, serious leaks can drain protective cooling water from a reactor.

The trouble began to unfold in January, when the Unit 3 reactor was shut down as a

precaution after a tube break. Traces of radiation escaped at the time, but officials said there was no danger to workers or neighbors. Unit 2 had been taken offline earlier that month for maintenance, but investigators later found unexpected wear in tubes in both units.

Edison has been facing pressure from some nearby communities and anti-nuclear activists that have raised safety concerns, while the company looks for a solution to the tube problem and a path to restarting the plant. The design of the generators is also under congressional scrutiny.

The plant is owned by SCE, San Diego Gas & Electric and the city of Riverside. The Unit 1 reactor operated from 1968 to 1992, when it was shut down and dismantled.

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