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Damage, design flaws in Oroville Dam spillway point to lengthy repairs, consultants say

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The main spillway at Oroville Dam is riddled with design flaws and so badly damaged that an independent panel of experts hired by the state has concluded it's probably impossible to repair the structure completely before the next rainy season begins in November.

The panel of four engineering consultants, in a recent memo to the state Department of Water Resources, said it believes the concrete spillway can be made functional enough to release water from Lake Oroville during the next rainy season. But the panel noted it's "questionable" whether the state has enough time to replace the badly damaged lower half of the 48-year-old spillway. The bottom of the structure is now split from the top by a gaping chasm that extends into the neighboring hillside.

Above the crater, consultants described design problems in the intact portion of the chute that are so "gross and obvious" they will have to take priority this year, said J. David Rogers, a dam expert from Missouri, who reviewed the report at The Sacramento Bee's request. Rogers said the problems the consultants described were so egregious he was surprised the spillway didn't fail decades ago.

"It calls into question the whole design of what's still there in the upper section," said Rogers, a professor at the Missouri University of Science and Technology.

The report contradicts DWR officials' assertions that the 3,000-foot-long spillway can be completely repaired in time for the next rainy season. DWR Acting Director Bill Croyle has said he expects to announce a repair plan by the end of March.

Asked about the panel's report, DWR spokeswoman Lauren Bisnett said the agency's objective "is to have a fully functional spillway before the start of the next storm season."

"We are expediting work that will continue nonstop through next fall," she added. "We are in the process of analyzing alternative approaches, both temporary and permanent, and we expect to detail that process and preferred alternatives within the next weeks."

The expert panel's conclusions, based on a review of reports and an on-site inspection earlier this month, provide a first-ever accounting of structural and design problems that might have caused the spillway to essentially split in half Feb. 7. The consultants described seeing troubling amounts of water flowing from underneath the structure,

concrete that was far too thin and dangerous gaps underneath the foundation on which the massive concrete chute sits.

The fracture prompted [the temporary evacuation](#) of 188,000 downstream residents as water levels in Lake Oroville rose to unprecedented heights. In the weeks since, DWR crews have been fortifying the top of the main spillway with quick-drying concrete and other measures while planning for permanent repairs. Following a three-week hiatus, DWR last week [resumed releasing water](#) over the spillway to reduce lake levels before the spring snowmelt season begins in earnest.

Two of the four consulting engineers on the panel couldn't be reached for comment, John Cassidy of Walnut Creek and Faiz Makdisi of Oakland. The other two, Kerry Cato of Temecula and Eric Kollgaard of Concord, referred a reporter to state officials for comment.

The state forwarded the panel's report to the Federal Energy Regulatory Commission, which ordered the state to convene the panel shortly after the crisis at Oroville began. FERC posted the report on its website last week.

In its report, the panel also addressed lingering problems with the [dam's emergency spillway](#), which nearly crumbled Feb. 12 after water started flowing over the structure for the first time in the dam's 48-year history. The near failure of the emergency spillway prompted the evacuations.

DWR crews have been shoring up the hillside below the emergency spillway in the weeks since the evacuations ended. Acting Director Croyle has said he would be willing to employ the structure again if necessary this spring.

The independent panel argued that use of the emergency spillway should be avoided.

"We will state what appeared clear to everyone ... that it is imperative that the Emergency Spillway not receive additional flows and that a long-term mitigation and re-design plan begin now," the panel wrote.

The panel's report makes clear that repairing the two spillways will be a long and complex process.

"You have to do some kind of quick fix that you can get through next year in case next year is as bad as this year," said Rogers, the expert from Missouri. "At the same time, you've got to really look at this whole thing and say, 'How can we build a better spillway chute that's more resilient?'"

The independent panel found a host of problems with the spillway, some of which date to its original design and construction.

Notably, the panel expressed concern that the concrete chute is only a foot thick, and less so in some places. DWR built the spillway on an uneven mountainside and in some spots used compacted clay to fill in the depressions in the rock foundation beneath the concrete. The consultants described finding evidence of "a number of repair instances"

in which portions of the chute were cut away in order to “fill voids beneath the concrete.”

“This calls into question whether the portions of the slab that appear undamaged by the failure should be replaced during the restoration,” the panel wrote.

Rogers said the structure probably needs to be rebuilt from the ground up.

“I was shocked to hear the slab is only 12 inches thick, and that there’s clay pockets underneath it,” he said. “That section is going to have to be ripped up and you’re going to have to start over again, most likely.” He added that “it’s remarkable it lasted as well as it did.” He said he’s surprised the structure didn’t fail after the winter of 1997, when officials cranked up releases to their highest-ever amounts.

Paul Tullis, a dam safety consultant from Utah who reviewed the panel’s report for The Bee, agreed that it found the original design and construction inadequate.

“They’re really not satisfied with 12 inches (of concrete) and clay underneath it,” Tullis said. “They’re talking about starting all over. ... That’s more than a year’s project.”

The panel report also said that while touring the spillway, consultants spotted “extraordinarily large” amounts of water gushing out of drains designed to move water out from beneath the intact portion of the chute. The water was flowing even though the spillway’s gates were closed and it wasn’t raining, the consultants wrote, adding that they believed further investigation is needed.

Bisnett, the DWR spokeswoman, said the agency plans over the long haul to “rebuild or replace” both spillways “with the latest design, technology and materials, with public safety as our top abiding concern.” She added that the main spillway “met the design and construction standards of its time half a century ago. Through the decades, the spillway has been inspected repeatedly and been found to be well maintained and satisfactory for continued use.”

Video links:

New look at Oroville Dam spillway after reopening 0:52. New video shows water coming down Oroville Dam's main spillway on March 21, 2017. The dam's main spillway fractured Feb. 7, 2017, prompting a temporary shutdown of the structure as a big storm rolled in. On Wednesday, more than a month after a near-catastrophe at Oroville Dam sparked mass evacuations, Butte County's sheriff Wednesday lifted an evacuation warning that had been in place for thousands of downstream residents. Department of Water Resources

<http://www.sacbee.com/news/state/california/water-and-drought/article140284228.html>

After being closed to allow for assessment, repairs and dredging o the Feather River below, the Oroville Dam main spillway again is funneling water from fast-filling Lake Oroville. Releases roared down the still-compromised concrete chute on Friday, March 17, 2017. This second video is available at the url for the article (url follows).

<http://www.sacbee.com/news/state/california/water-and-drought/article140390898.html>