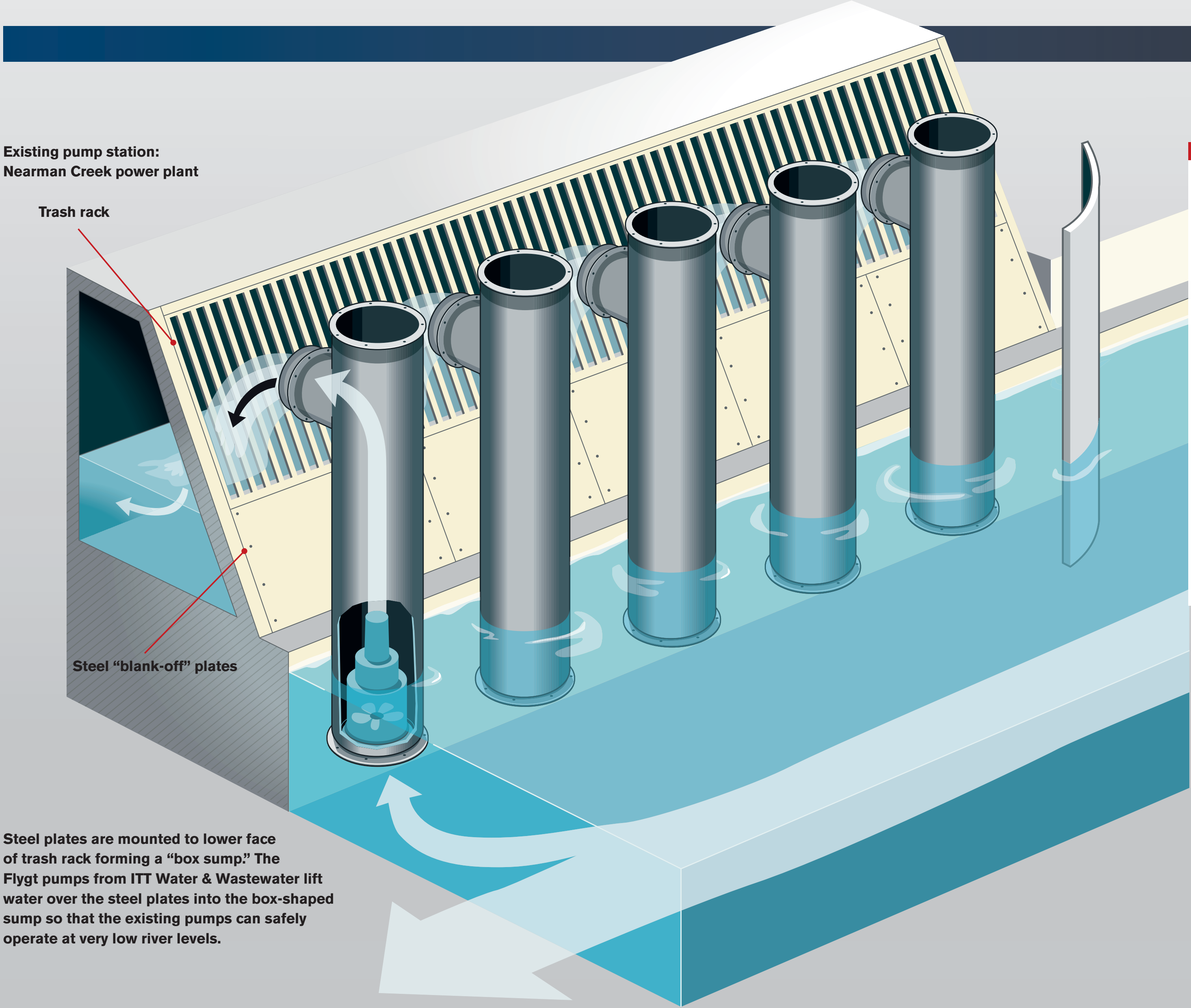

Steel plates are mounted to lower face of trash rack forming a “box sump.” The Flygt pumps from ITT Water & Wastewater lift water over the steel plates into the box-shaped sump so that the existing pumps can safely operate at very low river levels.

Pumps keep power plants online

text Katherine Schmidt, Steve London, Associated Press *illustration* Kjell Eriksson, Bob Domkowski

When water levels fell too low at the electric power plants along the Missouri River, in the United States, the solutions were found by using Flygt pumps from ITT Water & Wastewater. In Kansas the answer to the problems was a supplemental pumping system and a box sump to help the turbine pumps. These are new solutions to an old problem: insufficient raw water intake.

DEEP IN THE HEART of a Kansas winter, in mid-December, the Nearman Creek power generating station in Kansas City, Kansas had to shut down. The formation of ice jams upriver, following a drought the previous summer, led to a record low water level that left the power plant’s intake pumps, used for supplying cooling water, high and dry. The

Shut-downs due to ice a thing of the past

Engineers from ITT Water & Wastewater and the Kansas City (KS) Board of Public Utilities devised a multi-step plan to secure sufficient water from the Missouri River for the cooling intake at the Nearman Creek power plant. First they set up an ice-free lagoon in front of the intake screens, using barges and pilings. Then they had steel plates temporarily welded across the pump station intake trash rack, blanking out the screen to a point 9.02 feet (2.75 metres) above the invert of the intake pump station forebay, creating a box sump from which the turbine pumps could draw water. Finally, the engineers set up steel supports, linked by a network of steel cables, to anchor four Flygt CS-3530.820 - 169 hp (126kW) pumps from ITT Water & Wastewater in the newly created lagoon.

Each pump was fitted with a 500-millimetre gooseneck steel discharge pipe long enough to shoot water up over the top of the temporary blank-off plates into the sump in front of the intake. The pumps delivered more than 20,000 gpm (1,260 l/s) each into the cooling water pump sump. The intake pumps needed only 75,000 gpm, and the excess water thus supplied simply spilled back over the top of the screen blank-off plates and back into the river.

Kansas City Board of Public Utilities, owner of the plant, had to buy power on the wholesale market for between five and nearly 12 times its usual production cost. This affected nearly 70,000 customers in surrounding Wyandotte County.

Engineers at the plant called in Lee Mathews Equipment Inc., a local supplier of Flygt pumps from ITT Water & Wastewater, and quickly worked out a novel solution. First, they installed a temporary ice shear. Barges and pilings that extended out 100 feet (30.5 metres) from the shore deflected ice floes from the cooling water intake screens, creating a lagoon in front of them. This enabled the plant to run at 25 percent nominal capacity by using temporary pumps.

But to return to full capacity the main intake turbine-type pumps needed at least a 1.83 metres (6 feet) water elevation above the pump impeller to avoid damaging cavitation. The record low river level – 4.9 feet (1.5 metres) above sea level, compared to a winter norm of 8 to 9 feet (2.44 to 2.74 metres) – provided less than 3ft (0.92 m) of water in the intake structure. ITT Water & Wastewater system engineers helped their BPU colleagues devise a plan to install pumps from the ITT Water & Wastewater USA Flygt Large Pump Rental Bank to move river water up to the newly created water-pump box sump.

The engineers used steel supports and cables to secure four Flygt CS-3530.820 – 169hp/126kW pumps in the still area of the river protected by the ice shear barges. Less than two weeks after Nearman Creek had shut down, the 20-inch (50.8 centimetre) CS-3530s were each supplying 20,000 gallons (91,000 litres) per minute of river water to the intake structure, and the plant was back up to full operating capacity.

At BPU, assistant general manager Bernie Cevera was more than satisfied.

"We have never had news this good," he told reporters, adding that if there were any increases at all to customers' electricity bills, these would be "far smaller than anticipated."

Supplemental pumping

BY THE TIME the Missouri River reaches the bend south of Sioux City, Iowa, where MidAmerican Energy's Neal North power plant is located, it has passed through the three largest reservoirs run by the US Army Corps of Engineers, plus a series of dikes and revetments built to ensure flood control and optimal conditions for barge traffic.

However, these mitigation measures have led to a decrease in silt deposited along the river and a lowering of the riverbed, which in turn have caused a decrease in water levels over time. In periods of drought or when ice floes tie up river water, the river level can sink so low that the intake pumps for cooling water at Neal North may not be able to deliver enough water to ensure continuous operation of the plant. The #3 unit is the largest, and the most vulnerable to low water conditions. "We've experienced flows low enough to have forced it off-line in the past," says Kevin Calloway, a former plant engineer who worked to solve the problem with MidAmerican's consultant engineers at Burns & McDonnell. "That's a big financial hit to the utility, especially when we're forced to buy replacement power on the open market."

Plant engineers started working on the low-flow problem in 1982, when they installed a vacuum lift system. This system helped to supply sufficient cooling water even with ice jams in the river, but worked only down to a river level of 1,052 feet (320.6 metres) above sea level, at which point air was sucked under the vacuum lift wall. A prolonged drought in the 1990s increased concerns at the utility, and Calloway looked for another solution. His team considered various devices such as suction scoops, modifying the vacuum lift system, and conversion of the plant cooling system to a closed-loop design and felt the best long-term solution was to build a new consolidated intake for Neal's units 1 through 3. But given the high cost and uncertainty regarding new environmental regulations, the team opted for a supplemental pumping system that would ensure reliability of the #3 unit's intake during low river conditions in the winter. To protect the pumps, the engineers had eight armour-plated construction barges set up to form an ice shear in front of the intake. Six Flygt model PL-7101 axial flow submersible pumps from ITT Water & Wastewater were mounted in tubes on a removable framework attached to the intake. These can now provide water to the intake down to a river elevation level of 1,049 feet (319 metres). If needed, future extension of the pump tubes could overcome further degradation of the riverbed. Each year the system is installed in October and removed in late March for the beginning of the barge navigation season.

The Flygt pumps from ITT Water & Wastewater have proved to be easy to maintain and reliable. "The operations manager said the system kept us online a couple of times... when we would have been forced off," says Calloway. "We now feel we have some breathing room during low river stages." ◆

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