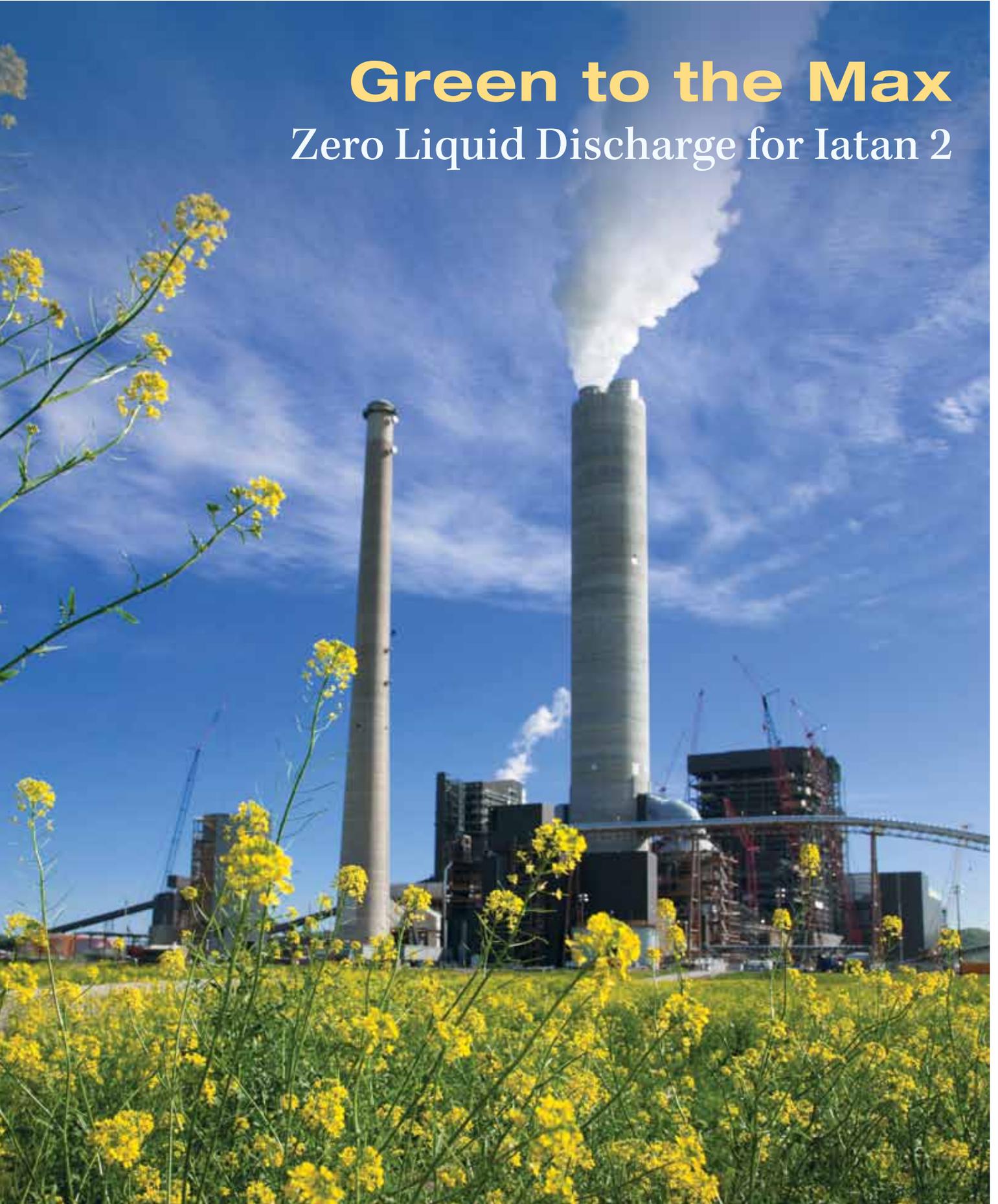


Green to the Max

Zero Liquid Discharge for Iatan 2



Iatan 2, Kansas City Power & Light's 850-megawatt (MW) generating station near Weston, Mo., is one of the cleanest coal-fired power plants in the United States. With high fuel efficiency and low air emissions, it's also the first coal-fired unit in the world to achieve zero liquid discharge (ZLD).

Background

Burns & McDonnell provided permitting, design, procurement, construction management and startup services for Iatan 2, which began operation in the summer of 2010, and for air-quality control upgrades to KCP&L's existing Iatan 1 unit. Air-quality controls for the plants include wet flue gas desulfurization (FGD) systems that remove sulfur dioxide (SO₂), known for its role in creating acid rain.

Before entering the wet FGD system, combustion gases from the coal-fired boiler enter a bag house and are pushed through a fabric filter to remove fly ash, which is temporarily stored in a silo. The gas is then piped to a wet FGD unit, or scrubber, where sulfur in the gas stream reacts with limestone, precipitating out calcium sulfate, or gypsum, which can be used in sheetrock and other products.

The scrubbing process also produces blowdown, a liquid waste stream laden with calcium and magnesium chloride salts. Burns & McDonnell was charged with finding a way to dispose of that liquid waste stream without releasing it to the environment.

Challenges

"The client required a zero liquid discharge system," says Don Schilling, Burns & McDonnell chemical engineer. "That prompted a series of discussions on how we were going to achieve that."

One of the options discussed was distillation and crystallization. The technology existed — it's commonly used in some manufacturing processes. Burns & McDonnell had previously designed such a system for a power plant, but it was never installed, partially because the crystallization process is energy- and maintenance-intensive. During one brainstorming session, the project team had a flash of inspiration.

Someone asked, "Can we just use (the waste stream) to wet down the fly ash?" recalls Patricia Scroggin, another Burns & McDonnell chemical engineer who worked on the ZLD portion of the Iatan project. The team pondered the new idea. Although it would involve challenges, they decided it would be well worth it to avoid the larger problems associated with crystallization.

Solution

The idea was elegant in its simplicity. Although some of the fly ash would be sold for use in construction products, the balance would be disposed of in an on-site landfill. Fly ash has to be wetted before transfer anyway. Using the concentrated blowdown stream to wet down the fly ash would take care of both waste products, eliminating the need for the costly crystallization process. But there were still challenges in technology and material selection for distillation of the blowdown stream.

Based on experience with distillation in other industries, the team decided to adapt a falling-film evaporator that contained a vertical heat exchanger with a large recirculation flow rate. As the blowdown stream circulates through the evaporator tubes, it's reduced to concentrated brine. For every 100 gallons of the blowdown stream, approximately 75-90 gallons of water are recovered through the distillation process and piped back for reuse. Because the high concentration of calcium chloride makes the remaining brine extremely corrosive, specifications for the ZLD system

had to include high-grade, corrosion-resistant alloys, including titanium for some of the evaporator vessels.

As the final step in the ZLD process, the brine is combined with fly ash in a giant mixer. The mixer blends 120-140 gallons of brine into each 4-5 ton batch of fly ash. The mixture can then be transported to the on-site landfill.

Outcome

The environmental benefits of the system are twofold. "The first is the fact that you're not discharging the wastewater," Scroggin says. "The second aspect is that you use a lot less water in the FGD process." Since the FGD process normally discharges around 50 gallons of water per minute, reclaiming 75 percent to 90 percent for reuse represents substantial water savings. And even though Iatan's power output has increased by more than 800 MW with the addition of the new unit, the combined SO₂ emissions from the two units are 74 percent lower than the levels emitted from Iatan Unit 1 alone before the scrubbers were installed.

"The ZLD system designed by Burns & McDonnell is unique and innovative," said Brent Davis, Iatan 2 project director for KCP&L. Just one more example of the Burns & McDonnell mission — making our clients successful.

For more information, contact Patricia Scroggin, 816-822-3097.

Iatan Facts

- Iatan 2 is the world's first coal-fired plant featuring a wet FGD system with zero liquid discharge.
- Completed in 2010, the Iatan project was the largest construction project in the state of Missouri at the time.
- Iatan 2 supplies an additional 850 MW of reliable power.
- Designed with a supercritical steam boiler to produce maximum electrical power from each unit of coal burned, Iatan 2 emits 1.3

- million tons less carbon dioxide per year than the average for U.S. coal plants.
- FGD is one of several technologies installed to reduce emissions at Iatan 1 and Iatan 2. Other technologies include pulse-jet fabric filters to remove particulates and selective catalytic reduction units that remove nitrogen oxide, a greenhouse gas.
- Burns & McDonnell provided permitting, design, procurement, construction and startup management for Iatan 2 and for air-quality control upgrades to Iatan 1.