

Lignite Drying at Great River Energy's Coal Creek Station

Success Story



Demonstration of a prototype technology for drying lignite coal at Great River Energy's (GRE's) Coal Creek Station has the potential to increase plant performance and dramatically reduce air emissions of plants burning lignite. Use of the technology could also increase the net generating capacity of plants burning high-moisture coal, and increase the value of the nation's lignite reserves. EPR I assisted GRE in successfully proposing the project to the U.S. Department of Energy (DOE), which, with Great River Energy, is funding the demonstration. This work represents a potential landmark advance for fossil-steam plant performance improvement, emissions reduction, and plant availability.

The Challenge

Coal currently fuels more than half of the power plants in the United States. An estimated 45% of the world's coal reserves consist of lignite, a brown-to-black coal formed from peat. Lignite is cheap and low in sulfur, but it also has a moisture content of 25–40% and a low energy output relative to other coals.

Although current lignite-fueled power plants are designed to burn high-moisture coals, a reduction of 5–15% in the moisture content of lignite (about one-quarter of the moisture content in the coal) would result in significant improvements.

The Solution

A new process, called the Lignite Fuel Enhancement System (LFES), uses waste heat from the power plant condenser to drive a bubbling fluidized-bed coal dryer. The dryer removes nearly a quarter of the coal's moisture before the coal is fed into the power plant boiler.

The technology could also be used with sub-bituminous Powder River Basin (PRB) coal—another widely available, low-rank coal with a high moisture content.

Application

Performance of the LFES is being tested in a prototype dryer at GRE's Coal Creek Station, a two-unit, 1 200-MW plant about 50 miles north of Bismarck, North Dakota.

In the project's first phase, a prototype module will be designed to dry about one-sixth of the coal fed to a 546-MW unit at the Coal Creek Station. Following successful demonstration of the prototype, Great River Energy will design, construct, and perform full-scale, long-term operational testing on a complete set of dryer modules needed for full power operation of one of the 546-MW

units. The coal will be dried to several different moisture levels. The effects of coal drying on plant performance will be measured, and optimum operating conditions will be determined.

The \$25.6 million project will be administered by the DOE's Office of Fossil Energy, and managed by the National Energy Technology Laboratory. The DOE is expected to provide \$11 million for the project over its 45-month duration. In addition to the DOE, Great River Energy, and EPRI, project partners include Barr Engineering and Falkirk Mining.

The Great River Energy project is one of eight selected in the initial phase of the federal Clean Coal Power Initiative, a 10-year, \$2 billion commitment to clean coal technology. The program competitively seeks commercial-scale technology demonstrations to continue and expand the use of coal as a fuel source.

Benefits

The researchers will use North Dakota lignite, which typically contains about 40% moisture. By drying the lignite first, they expect to lower the coal's moisture content by at least 10%, resulting in an estimated 2.8–5% efficiency improvement in the plant. This improvement translates into 25% less emissions of sulfur dioxide (SO₂), and 7% less emissions of mercury, carbon dioxide, nitrogen oxides (NO_x), and particulates per unit of electricity output. In addition, auxiliary power consumption by pulverizers and fans will significantly decrease, resulting in greater plant efficiency.

Economically, deployment of the LFES at Coal Creek Station has the potential to offer substantial benefits, estimated at a total annual savings of \$0.92 per MWh.

Nationwide, successful commercial application of the technology could produce significant benefits. In the United States today, 35 power generation units with an installed capacity of 15 gigawatts (GW) burn lignite; 250 units, with an installed capacity of about 100 GW, burn PRB coal. Over the next two decades, the capacity of power plants burning high-moisture coals is projected to increase by another 100 GW.

If applied by power plants totaling just 10 GW, the technology would significantly reduce air emissions in the United States, estimated at 6,890 tons per year of NO_x, 18,360 tons per year of SO₂, more than 7 million tons per year of carbon dioxide, 9,340 tons per year of particulates, and almost 300 pounds per year of mercury.

Nationally, based on the estimated economic benefits at Coal Creek Station, the projected economic benefits are estimated at \$84 million for all U.S. lignite-fueled plants and \$840 million for all PRB-fueled plants.

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