

Case Study

Great Plains Synfuels Plant

A Successful Commercial-Scale Coal Gasification Plant

Basin Electric, through its for-profit subsidiary, Dakota Gasification Company, owns and operates the Great Plains Synfuels Plant. Located five miles northwest of Beulah, ND, the Synfuels Plant has been owned and operated by Dakota Gas since 1988.

This \$2.1-billion plant began operating in 1984. Using Lurgi gasifiers, the Synfuels Plant gasifies lignite coal to produce valuable gases and liquids. The average daily produc-

tion is about 153 million cubic feet of natural gas, the majority of which is piped to Ventura, IA, for distribution in the eastern United States.

The Synfuels Plant is Unique

It is the only commercial-scale coal gasification plant in the United States that manufactures natural gas. It supplies car-

bon dioxide to the world's largest carbon capture and storage project in the world in Saskatchewan. About 3 million tons of CO₂ from the Synfuels Plant are sequestered annually.

This process results in a CO₂ stream that is very dry and 96 percent pure, so it requires no further processing. This is in contrast to CO₂ from power plants, which is very wet and diluted with nitrogen and oxygen, and would require further processing.

The plant's CO₂ infrastructure will be used to transport the CO₂ captured from the neighboring Antelope Valley Station during a demonstration of Powerspan's CO₂ capture technology, which is scheduled to be operational in 2012.

It has been the focus of worldwide attention and has been visited by groups from Germany, China, Italy, Korea, England and Japan; by national media like 60 Minutes, The History Channel, Fox News; and international media from London, Tokyo and Montreal.

How It Works

It is the cleanest energy plant operating in the state of North Dakota, according to a comparison of emissions data available from the North Dakota Department of Health.

Dakota Gas shares natural gas sales revenue with the U.S. Department of Energy through an agreement established in 1988 when Dakota Gas purchased the plant from the DOE. To date, Dakota Gas has given more than \$379.8 million to the DOE.

Gasifying coal involves dismantling its molecular structure with heat and pressure and reassembling the resulting hydrogen and carbon as methane gas (methanation), which is sent to a pipeline.

- o The heart of the Synfuels Plant is its 14 gasifiers. These gasifiers are cylindrical pressure vessels, 40 feet high with an inside diameter of 13 feet.
- o Each day 16,000 tons of lignite coal is fed into the top of the gasifiers. Steam and oxygen are injected into the bottom of the coal beds causing intense combustion at 2,200 degrees F.



Pipes carry many fuels and liquids throughout the Great Plains Synfuels Plant in Beulah, ND.

Dakota Gas captures and sells CO₂ produced at the plant to two customers and transports it through a 205-mile pipeline to Saskatchewan, Canada, to be used for enhanced oil recovery (EOR) in the Weyburn and Midale fields.

The first CO₂ was sent to Canada in October 2000. Today, Dakota Gas exports about

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- o The hot gases break down the molecular bonds of coal and steam, releasing compounds of carbon, hydrogen, sulfur, nitrogen and other substances to form a raw gas that exits the gasifiers.
- o The raw gas is cooled. Tar, oils, phenols, ammonia and water by-products are condensed from the gas stream, purified, and sent on. The gas moves to a cleaning area where further impurities are removed.
- o Methanation occurs when the cleaned gas passes over a nickel catalyst causing carbon monoxide and remaining carbon dioxide to react with free hydrogen to form methane. Carbon monoxide is removed.
- o The gas is then cooled, dried and compressed. It enters the pipeline with a heating value of 975 Btu per cubic foot.

Dakota Gas captures and markets by-products and coproducts of coal gasification.

- o Ammonium sulfate is an agricultural fertilizer marketed under

the name, Dak Sul 45®. Approximately 110,000 tons are produced yearly by a flue gas desulfurization system.

- o Anhydrous ammonia is used as fertilizer for farming and as a feedstock for producing various chemicals. Dakota Gasification Company has the ability to produce about 400,000 tons per year and operates a railcar fleet of about 238 cars.
- o Carbon dioxide is used for enhanced oil recovery.
- o Dephenolized cresylic acid is used in the manufacture of pesticides and products such as wire enamel solvent, phenolic and epoxy resins, and antioxidants. About 33 million pounds are produced annually.
- o Krypton and xenon gases are used for specialty lighting, such as high-intensity lighting and lasers, and for thermopane window insulation. About 3.1 million liters of krypton-xenon are produced annually.



Dakota Gasification's chief operating officer, Gary Loop at the Great Plains Synfuels Plant in Beulah, ND.

- o Liquid nitrogen is used for food processing refrigeration, as an oil well additive, and in chemical processes. About 24 million gallons of liquid nitrogen are produced each year.
- o Naphtha contains products that can be used as a gasoline blend stock, in making solvents, and in benzene production. About 7 million gallons are produced annually.
- o Phenol is used for the production of resins in plywood manufacturing and in the casting industry. About 33 million pounds of phenol are produced annually.

Spring Conference continued

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There will also be presentations on topics that may not be new – like safety, outage planning and vegetation management – but the solutions are. The Bonneville Power Administration will share their experience executing a regulator directed Remedial Action Directive to patrol over 15,000 circuit miles of transmission lines and certify all spans free and clear of vegetation.

Clearly the focus of this conference is the operational issues engineers and opera-

tors encounter daily. But the need to attract and retain skilled workers in the electric power industry is also an important issue. Enrollment in electrical engineering programs has steadily declined for decades and many university programs have atrophied. To counteract this disquieting shortage of trained engineers and other technical personnel, utility and engineering companies are collaborating to create programs that will build a pipeline of young engineers able to handle the technical demands of our power system now, and in the future.

Golfers Take Note

You are invited to play golf for a good cause at the beautiful River Course at Key-

stone on Sunday, May 17. The format will be a four-person scramble and all proceeds will benefit the RMEL Foundation scholarship program.

Guests and Spouses are Welcome

We encourage you to bring your spouse or guest to the Spring Conference. They may register as a guest and participate in meals and functions. We also have a special guest activity planned for Monday, May 18 – a cooking class with Executive Chef Steven Nguyen! It's an entertaining cooking lesson that ends with a fabulous lunch.

For more information and to register for the *RMEL 2009 Spring Electric Energy Conference*, go to www.RMEL.org.