PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

**Gasification Technologies**

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# ADVANCED HIGH TEMPERATURE, HIGH-PRESSURE TRANSPORT REACTOR

## CONTACTS


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## Description

Today, coal supplies over 55 percent of the electricity consumed in the United States and will continue to do so well into the next century. One of the technologies being developed for advanced electric power generation is an integrated gasification combined cycle (IGCC) system that converts coal to a combustible gas, cleans the gas of pollutants, and combusts the gas in a gas turbine to generate electricity. The hot exhaust from the gas turbine is used to produce steam to generate more electricity from a steam turbine cycle. The utilization of advanced hot-gas particulate and sulfur control technologies together with the combined power generation cycles make IGCC one of the cleanest and most efficient ways available to generate electric power from coal. One of the strategic objectives for U.S. Department of Energy (DOE) IGCC research and development program is to develop and demonstrate advanced gasifiers and second-generation IGCC systems. Another objective is to develop advanced hot-gas cleanup and trace contaminant control technologies. One of the more recent gasification concepts to be investigated is that of the transport reactor gasifier, which functions as a circulating fluid-bed gasifier while operating in the pneumatic transport regime of solid particle flow. The University of North Dakota Energy and Environmental Research Center will develop and study performance of the Transport Reactor Development Unit (TRDU) under a variety of operating conditions using a wide range of fuels while demonstrating acceptable performance of hot-gas filter elements on the hot, dust-laden fuel gas stream coming from the TRDU.

The pilot-scale TRDU has an exit gas temperature of up to 980 °C (1800 °F), a gas flow rate of 325 scfm (0.153$m^3$/s), and an operating pressure of 120 psig (9.3 bar). The TRDU system can be divided into three sections: the coal feed section, the TRDU, and the product recovery section. The TRDU proper, as shown in Figure 1, consists of a riser reactor with an expanded mixing zone at the bottom, a disengager, and a primary cyclone and standpipe. The standpipe is connected to the mixing section of the riser by an L-valve transfer line. All of the components in the system are refractory-lined and designed mechanically for 150 psig (11.4 bar) and an internal temperature of 1090 °C (2000 °F).

## Primary Project Goal

The objective of this work is to make modifications to the reactor riser for the design, setup, and testing of riser gas- and solid-sampling equipment and then to collect samples on several coals at several conditions. The data collected will be used to tune the MFIX CFD code which will then be used to predict the performance of commercial scale plants.

## PARTNERS

University of North Dakota, Energy and Environmental Research Center

Kellogg Brown and Root

Southern Company Services, Inc

## COST

**Total Project Value**
$1,691,894

**DOE/Non-DOE Share**
$1,353,514 / $338380

## CUSTOMER SERVICE

**1-800-553-7681**

## WEBSITE

**www.netl.doe.gov**

# Accomplishments

One 200-hour test on Mississippi lignite has been completed to date in the pilot-scale TRDU at the Energy and Environmental Research Center (EERC). Test data regarding both solids and gas compositions were taken at various levels within the riser.

# Benefits

This TRDU gasifier concept provides excellent solid/gas contacting of relatively small particles to promote high gasification rates and also provides the highest coal throughput per unit cross-sectional area of any other gasifier, thereby reducing capital cost of the gasification island. Another benefit of this system is the work on the advanced high temperature-gas cleanup and trace contaminant control technologies. Collectively, this system may increase overall plant efficiency.

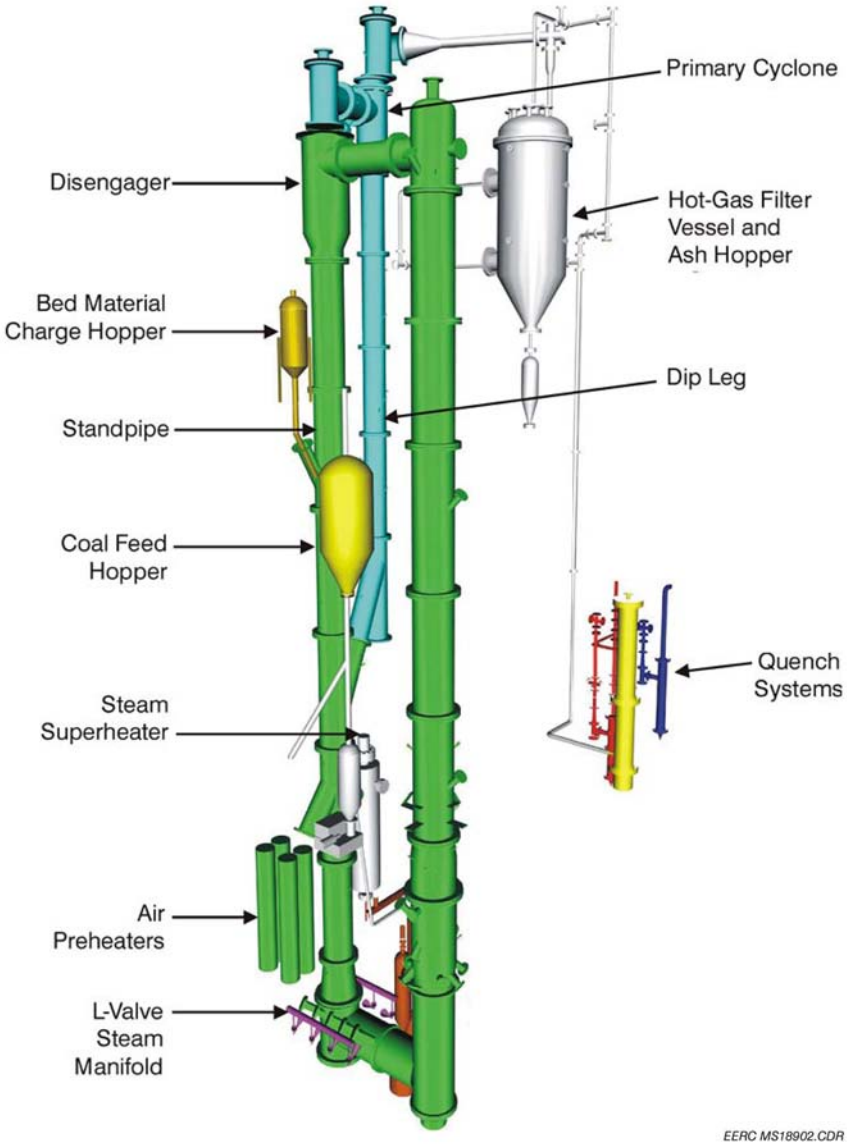


*Figure 1. TRDU and Hot-Gas Vessel in the EERC Gasification Tower*