the ENERGY lab

PROJECT FACTS

Gasification Technologies

Development of High-Pressure Dry Feed Pump for Gasification Systems

Background

Even though coal-based power generation via Integrated Gasification Combined Cycle (IGCC) is more efficient, cleaner, and uses less water than conventional pulverized coal burning systems, widespread IGCC deployment has not occurred because of its relatively high cost. The Pratt & Whitney Rocketdyne (PWR) high-pressure dry feed pump addresses IGCC cost disparity by enabling lower cost and more reliable coal feed into gasification processes. These improvements are expected to significantly decrease the cost of producing power using gasification. Increasing reliability, availability, and maintainability (RAM) of coal-based gasification systems has been identified as one of the major factors that will help overcome barriers to widespread commercial deployment. Replacing traditional feed system with a high-pressure dry feed pump will increase the RAM factors for IGCC plants, thus making the highly efficient and cleaner gasification technologies more commercially viable.

The high-pressure dry feed pump will also enable high pressure gasification of abundant low rank coal, which is typically considered to be too low in energy density to be cost effective in the currently used slurry feed systems.

The PWR dry feed pump operates at pressures currently used by the gasification industry (about 450 pounds per square inch (psi)), but may also operate at higher pressure, enabling dry-feed gasifiers to operate at up to 1,000 psi. The enabling of gasifiers to operate at higher pressures is another opportunity to make efficiency gains in the future.

Project Description

The project focuses on development of a high-pressure solids feed pump for use in high-pressure gasifiers and includes tests using various grades of coal, and a coal-biomass mixture. Prototype testing is being performed at pump rates up to 600-ton-per-day (tpd), and to discharge pressure up to 1,200 psi. The PWR feed pump is able to transport ambient pressure solid fuel into a high-pressure gasifier operating at 1,000 psi without the need to form a water slurry. This process improvement results in greater gasifier efficiency since excess water is not introduced into the process. The PWR feed pump is also being designed to operate across much greater pressure differentials, at a lower cost and higher predicted reliability, than a conventional lock hopper system. PWR has agreed to make their feed pump technology readily available to industry once it is ready for commercial use.

CONTACTS

Jenny Tennant
Technology Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880, MS B17
Morgantown, WV 26507-0880
304-285-4830
jenny.tennant@netl.doe.gov

K. David Lyons
Project Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4379
k.david.lyons@netl.doe.gov

Alan Darby
Principal Investigator
Pratt & Whitney Rocketdyne
6633 Canoga Ave
P.O. Box 7922
Canoga Park, CA 91309
818-586-0975
alan.darby@pwr.utc.com

PARTNERS

Energy and Environmental Research Center at the University of North Dakota

PROJECT DURATION

Active Budget Period Start Date
08/01/2008

Active Budget Period End Date
12/31/2012

COST

Active Budget Period Total Value
$29,922,537

DOE/Non-DOE Share
$15,738,219 / $14,184,318

NATIONAL ENERGY TECHNOLOGY LABORATORY

Albany, OR • Fairbanks, AK • Morgantown, WV • Pittsburgh, PA • Sugar Land, TX

Website: www.netl.doe.gov

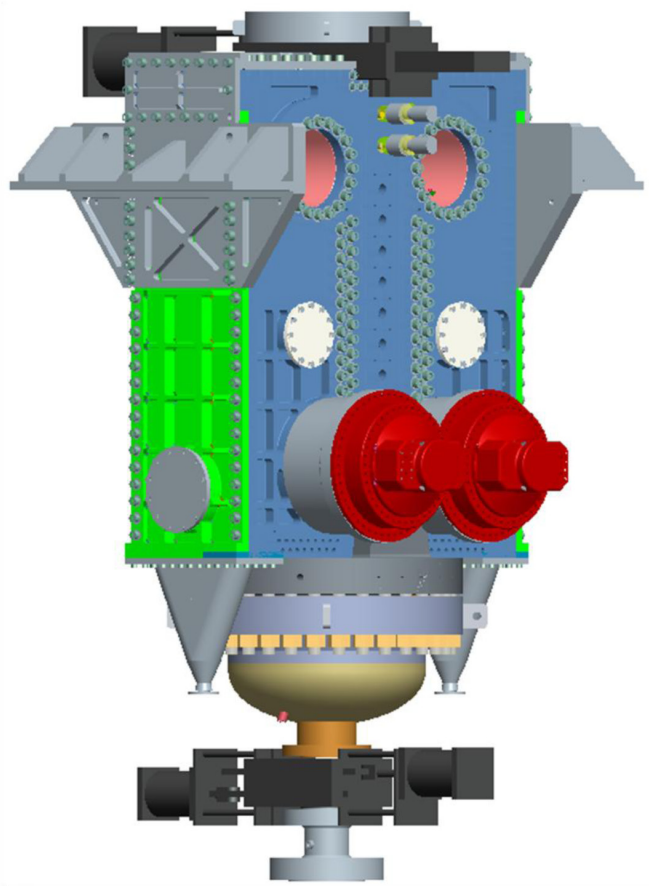
Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

Long duration testing (up to 1,000 hours) of the PWR pump is to be performed at the Environmental and Engineering Research Center (EERC) at the University of North Dakota. To generate data to predict the maximum safe pressure gradient across the pump, testing will be performed on grind sizes typical for most entrained gasifiers, on larger particle size coal grinds, and on various types of feed, including coal and a coal-biomass blend. This will confirm the pump's ability to be used for a wide range of feed types, and various gasifier manufacturer designs.

Goals and Objectives

The primary goal of the project is to provide reliable and consistent dry feed, using a wide range of feed characteristics across a 1,200 psi pressure gradient, to set the foundation for the next development phase for the fuel pump. The project's primary tasks involve conceptual design, sub-scale testing, engineering design, construction, and operation of a prototype pump. To achieve project objectives, the prototype pump is designed for 600-tpd operation capacity and to provide data needed to predict commercial-scale operation constraints. Testing is planned for performance tests at EERC on bituminous coal, Powder River Basin (PRB) coal, lignite and petcoke at up to 1,200 psi to demonstrate reliable pump operation across a high-pressure gradient, to define the commercial target for pump size, to assess adequate safety factor for the pump, to validate the pump models, and to provide data for a final benefits analysis.



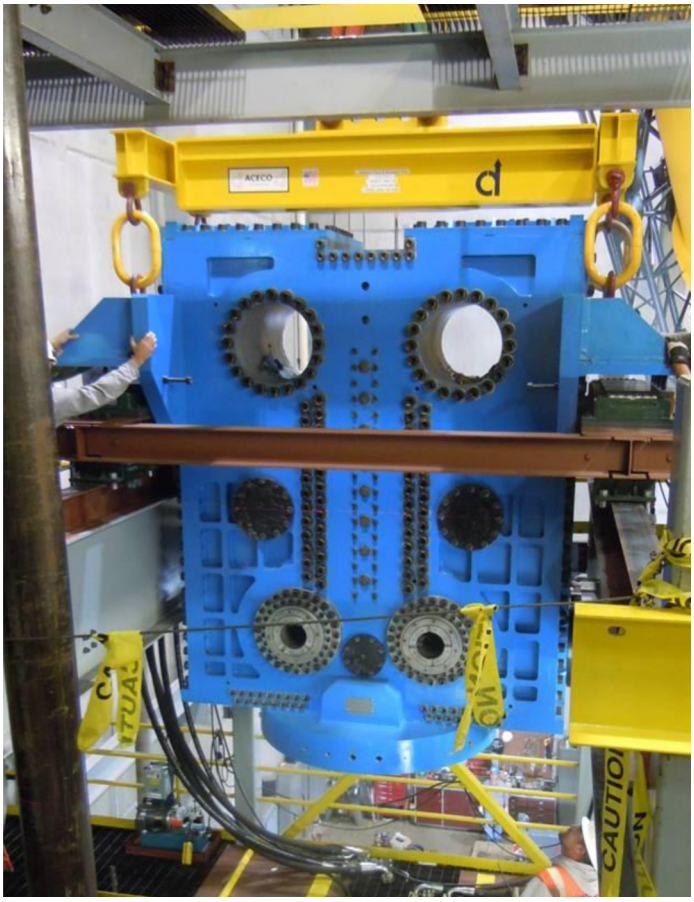
Rendering of the Dry Solids Pump

Accomplishments

- Completed feed characteristics analyses of 27 coal-biomass blends– bituminous, PRB, and lignite coals mixed with corn stover, switch grass, and sawdust at three different concentrations for each combination.
- Designed, constructed, and shipped the 600-tpd dry feed solids pump to EERC for testing.

Benefits

The PWR feed pump has the potential to significantly improve the efficiency of feeding coal, petcoke, and/or biomass into high-pressure gasifiers, thereby enabling higher efficiency of gasification plants, while simultaneously reducing feed system capital, maintenance and operating costs. Also, the ability to feed low rank coal into high-pressure gasifiers with neither the need to add water to form slurry, nor the use of lock hoppers, is expected to make these coals more commercially competitive. These technological gains, when realized, will not only contribute to the advancement of the environmentally friendly utilization of the Nation's abundant coal reserves, but will also enhance U.S. energy security.



Dry Solids Pump being installed in test stand at the Environmental and Engineering Research Center at the University of North Dakota.