Wilsonville Power Systems Development Facility

Description

The Power Systems Development Facility (PSDF) is a unique research and development center designed to test, evaluate and accelerate the deployment of advanced coal-based power system components and technologies. The facility is a highly flexible test center, where developers evaluate pre-commercial innovative system components in an integrated process at commercially relevant process conditions. The PSDF is large enough to produce commercially representative data while remaining sufficiently small for economic operation and has the following primary components: (1) a coal preparation facility, (2) a KBR Transport Reactor designed to operate as either a two ton-per-hour coal gasifier or combustor, in either air-blown or oxygen-blown operating modes at pressures of 150-230 psig and temperatures of 1500-1900°F; (3) several convective gas coolers; (4) a Siemens high temperature Particulate Control Device (PCD) to remove fine solids from the nominal 20,000 pounds-per-hour of fuel/flue gas at higher process temperatures; (5) a heat-recovery boiler; (6) a fifty pound-per-hour fuel/flue gas slipstream for evaluating processes for carbon capture, gas contaminant cleaning, fuel cells, gas separation technology, and/or instrumentation; (7) a four MW combustion turbine; and (8) a syngas combustor. The facility also houses a stand-alone cold-flow test unit, with sub-scale versions for additional study of the Transport Reactor, coal feeders, and PCD (filter element and fail-safe screening). Data from the PSDF can be used to identify and guide further R&D needed for the tested technologies, or to confirm the readiness of the technology for scale-up to commercial operations. The PSDF has an infrastructure (staff/utilities) to support a range of testing scales and conditions.

Primary Project Goals

The U.S. Department of Energy’s goal is to accelerate the development and deployment of advanced coal-based power systems components, technologies and processes. The Wilsonville PSDF will serve as the proving ground for performing integrated systems, process, and component testing at an industrially relevant scale of operation via a government/industry partnership.

Accomplishments

- In record time, the PSDF and DOE’s private/public collaboration efforts have resulted in the introduction to the commercial marketplace of the new TRIG gasification process -- one focused on low-rank coal. The data generated at the PSDF provided the information for scale-up for the first Transport Gasifiers to be demonstrated at commercial plants.
- A Transport Reactor that is suitable as both a coal combustor and a coal gasifier was fabricated, commissioned, and operated at the PSDF. Transport Reactor operations have become extremely reliable for the 250-750 hour planned durations for typical test campaigns.
- The PSDF supported the development of filter elements and fail-safe technology for hot gas cleanup, ash depressurization and removal systems, sensor development, and high pressure coal feed systems; all of which are being further developed and commercialized.
PARTNERS
- Southern Company Services
- Kellogg, Brown and Root
- Siemens-Westinghouse Power Corporation
- Southern Research Institute
- Rolls Royce-Allison Engine Company
- EPRI
- Peabody Coal Company
- BNSF
- Lignite Energy Council

COST
- Total Project Value
  $426,935,593

- DOE/Non-DOE Share
  $366,568,332 / $60,367,261

ADDRESS
- National Energy Technology Laboratory
  1450 Queen Avenue SW
  Albany, OR  97321-2198
  541-967-5892

  2175 University Avenue South
  Suite 201
  Fairbanks, AK  99709
  907-452-2559

  3610 Collins Ferry Road
  P.O. Box 880
  Morgantown, WV  26507-0880
  304-285-4764

  626 Cochran's Mill Road
  P.O. Box 10940
  Pittsburgh, PA  15236-0940
  412-386-4687

  One West Third Street,
  Suite 1400
  Tulsa, OK  74103-3519
  918-699-2000

CUSTOMER SERVICE
- 1-800-553-7681

WEBSITE
- www.netl.doe.gov

- Between 1999 and the 2007, the Transport Reactor was operated as a gasifier, generating syngas for a cumulative 10,500 hours. These operational hours were accumulated during twenty-two gasification test campaigns during which nine fuels (four bituminous, one sub-bituminous, and four lignite) and two in-bed sulfur sorbents (limestone and dolomite) were fed. After redesigning and reconfiguring a portion of the gasifier, carbon conversions of up to 99% have been realized.

- Between 1996 and 1999, the Transport Reactor was successfully operated as a combustor for a cumulative 4985 hours. These operational hours were accumulated during nine test campaigns during which five different fuels (three bituminous coals, one sub-bituminous coal, and petroleum coke) and four in-bed sulfur sorbents (three limestones and one dolomite) were fed.

- High Sodium Lignite, a difficult fuel to process, was successfully tested at PSDF on behalf of the Lignite Energy Council.

- The PSDF tested filter elements for 1000 hours to provide support data to Westinghouse for use on the city of Lakeland Clean Coal Technology project.

- The PSDF supported Stamet in testing their dry-feed coal pump for 500 hours, the longest testing yet achieved. Testing revealed the need for several design modifications for the pump to perform reliably at high pressure.

- Two test campaigns were successfully completed on 0.6 kW solid oxide fuel cells (SOFC) manufactured by Delphi, marking the first time an SOFC had been operated on coal-derived syngas.

- In testing a developer’s fuel cell under DOE sponsorship, PSDF identified certain design improvement needs.

- Construction and commissioning of a Fluidized Bed Combustor revealed problems of installing and operating alkali getters downstream of the Particulate Control Devices, a process that had been considered standard practice for many years.

- Design shortcomings of the Multi-Annular Swirl Burner (MASB) were identified at the PSDF.

- Two particulate removal devices and over thirty different filter element types (e.g., monolithic ceramic, ceramic composite, sintered metal powder, sintered metal fiber) have been tested at the PSDF.

- PSDF results showed the commercial impracticality of a Particulate Control Device (PCD) ceramic tube sheet design for certain applications.

Benefits
To meet the growing demand for electricity, coal will continue to supply at least half of the nation’s electricity needs. Yet, future coal systems must become increasingly clean and more efficient for the United States to fully realize the potential of its most abundant fossil fuel. The PSDF gives U.S. industry the world’s most cost-effective, flexible test center for evaluating the critical components of tomorrow’s coal-based power-generating systems. Capable of operating from pilot to near-demonstration scales, the facility is suitably flexible and adaptable to a variety of industry needs. When compared with the costs of building each of the technologies in use at the PSDF at stand-alone facilities, construction at one site saved more than $32 million. In addition, the transport gasifier technology developed at the PSDF has been selected for commercial-scale development under a Clean Coal Power Initiative Round 3 award.