FETC SUCCESS
U.S. Department of Energy
Federal Energy Technology Center

CLEAN AFFORDABLE POWER

- [x] fossil energy
- [ ] environmental
- [ ] energy efficiency
- [ ] other

M99000297 P6.5

United Technologies Research Center Developing High Performance Power Systems (HIPPS) for the 21st Century

States Impacted:
Massachusetts, Michigan, New Jersey, New York, Ohio, South Carolina, Tennessee, Virginia, North Dakota, Utah

Benefit Areas:
Environment, Energy Security, Technology Leadership, Lower Cost of Electricity

Participants:
United Technologies Research Center, ABB Combustion Engineering, Bechtel, Fluor Daniel, Kraftwork Systems, Pratt & Whitney, PSI Technology, Reaction Engineering International, Energy and Environmental Research Center, University of North Dakota

FETC Contact:

Arun C. Bose*

Office: (412) 386-4467
E-Mail:bose@fetc.doe.gov

MAIL ADDRESS:

* U.S. Department of Energy
P.O. Box 10940
626 Cochrans Mill Road
Pittsburgh, PA 15236-0940

**U.S. Department of Energy
P.O. Box 880
3610 Collins Ferry Road
Morgantown, WV 26507-0880

WEBSITE:
www.fetc.doe.gov

Description

Partnering with United Technologies Research Center (UTRC), the Department is developing a beyond state-of-the-art High Performance Power Systems (HIPPS) for the 21st century, which generates inherently low carbon dioxide (CO_2) emissions. The UTRC concept is based on thermodynamically optimized indirectly fired cycles -- a new way of burning coal. A baseline efficiency of 47% is achievable with optimized efficiencies approaching 55% using the advanced cycles. The major component development need for the HIPPS technology is the High Temperature Advanced Furnace (HITAF).

This UTRC concept uses a topping Brayton (gas) cycle and a bottoming Rankine (steam) cycle, and clean air is the working fluid. In the indirectly fired combined cycle (IFCC), air compressed to the turbine inlet pressure is heated in the coal-fired HITAF, and then expanded in the turbine to produce more than half of the cycle's power output. Heat recovered from the turbine exhaust air and from the furnace flue is used to raise steam for the steam turbine. The HITAF extracts heat from coal combustion with a radiative air heater and a convective air heater connected in series. For ash handling considerations, the radiative air heater operates in slagging mode. The working fluid does not come in contact with the corrosive coal combustion environment.

Successful testing of the HITAF has demonstrated the ability to heat the working fluid to 2000 °F, which surpasses design expectations and validates the novel IFCC configuration. This test further demonstrates that an overall thermal efficiency nearing 55% is achievable when HIPPS is ready for commercial deployment.

Goals

The goals of the UTRC project are to develop HIPPS technology that allows dramatic improvements in environmental performance, while lowering the cost of new power production. The design has the highest CO_2 mitigation potential of any coal-burning option, estimated to be 28-40% lower compared to conventional pulverized coal boilers. In addition, NO_x, SO_2, and particulate emissions from HIPPS plants would be less than one-tenth of current New Source Performance Standards. Successful HIPPS technology would allow the Department to achieve its pertinent Vision 21 goals.

Tangible Benefits

National: Development of the High Performance Power System provides the U.S. with advanced, highly efficient, and clean power generation for the 21st century.

Regional: Clean, efficient energy in regional power grids.

Local: Lower energy costs to consumers and a cleaner environment.

March 1999