PROGRAM facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Combustion Technologies

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FLUIDIZED BED COMBUSTION PROGRAM

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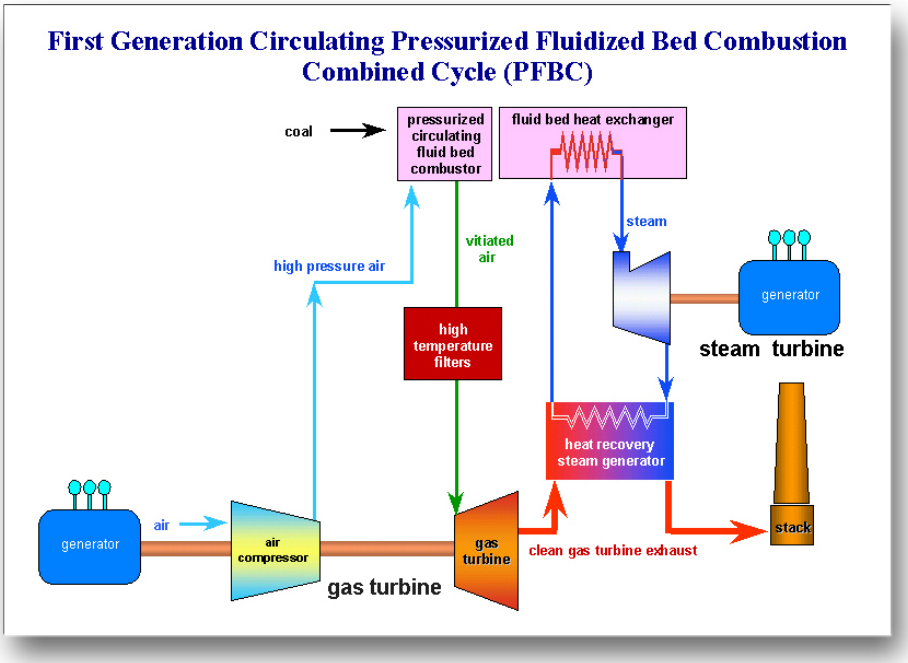
Description

Advanced fluidized-bed combustion technology offers a viable power generation option for the 2010 time frame. Commercial fluidized bed combustion units operate at competitive efficiencies, cost less than today's units, and have NOx and SO2 emissions below levels mandated by Federal standards. FBC systems fit into essentially two major groups: atmospheric systems (FBC) and pressurized systems (PFBC) and two minor subgroups: bubble or circulating fluidized bed.

Fluidized Bed Combustion Program

Coal is projected to remain a dominant source of fuel for electric power generation, both domestically and globally, well into the 21st century. Coal currently supplies more than 56% of U.S. electric-power needs. Part of DOE's mission is to foster the development and deployment of advanced, clean, affordable, fossil-based power systems that use coal to produce low-cost, reliable electricity.

In the early part of the next decade, U.S. power generators will select the next generation of baseload power plants. In an era of tight environmental standards, new plants will have to meet very stringent air-quality requirements. Coal is expected to remain a fuel of choice for many of these plants, and FBC technology could provide an important option for a power company that must meet these air-quality standards while producing the most affordable electricity possible for its consumers.



Fluidized Bed Combustion Program

Pressurized Fluidized Bed Combustion Program

PRESSURIZED FLUIDIZED BED PROGRAM GOALS

- To demonstrate the technical and commercial viability of First Generation PFBC technology in U.S. utility applications.
- To develop and demonstrate the necessary technology base for Second Generation PFBC systems.
- To achieve PFBC system performance targets.

FLUIDIZED BED COMBUSTOR PROGRAM BENEFITS

- Reduction in the cost of electricity while maintaining a high standard of living for the U.S.
- Reduction in the emission of air pollutants via the use of advanced FBC technology.
- Minimize the emissions of greenhouse gases like CO2 through the use of advanced PFBC technology.
- Reduction in US dependence upon imported fuels for economic security.
- Reduction in use of premium, high value, industrial fossil feedstock for the production of electricity.
- Export of FBC technology will create 826 thousand jobs through the 2030 timeframe. The $41.3 billion of U.S. sales of PFBC technology will result in an overall net benefit to the country of $45.7 billion due to new tax revenues and reduction in unemployment costs.

The first generation PFBC system uses a sorbent such as limestone or dolomite to capture sulfur released by the combustion of coal. Jets of air suspend the mixture of sorbent and burning coal during combustion, converting the mixture into a suspension of red-hot particles that flow like a fluid. Elevated pressures and temperatures produce a high-pressure gas stream that can drive a gas turbine, and steam generated from the heat in the fluidized bed is sent to a steam turbine, creating a highly efficient combined cycle system.

In more advanced second-generation PFBC systems a pressurized carbonizer is incorporated to process the feed coal into fuel gas and char. The PFBC burns the char to produce steam and to heat combustion air for the gas turbine. The fuel gas from the carbonizer burns in a topping combustor linked to a gas turbine, heating the gases to the combustion turbine's rated firing temperature. Heat is recovered from the gas turbine exhaust in order to produce steam, which is used to drive a conventional steam turbine, resulting in a higher overall efficiency for the combined cycle power output.

Research being conducted in several FBC subprograms is demonstrating advanced features of FBC and developing the technology base to lower capital and production costs. Thrusts include simplification of FBC systems and components, incorporation of alternative feed and withdrawal systems, and incorporation of advanced subsystems and steam cycles.

Results from system studies will guide future R&D determine optimum turbine-compressor configuration and lead to the demonstration of first-generation PFBC systems. Optimum configurations of second-generation PFBC for Vision 21 power plants with fuel cells and CO2 sequestration options are also being developed. Gas turbine studies will be performed on gas compositions and heat capacities specific to PFBC, which can lead to higher allowable turbine blade temperatures.

PFBC Power System	First Generation	Second Generation	
		Initial	Final
Net System Efficiency	40%	45+%	50+%
Target Date	by 2000	by 2010	by 2015
SO2 Emission Relative to NSPS	1/4th	1/5th	1/10th
NOx Emissions Relative to NSPS	1/3rd	1/5th	1/10th
Air Toxic Emissions Relative to 1990 CAAA	Meet	Meet	Meet
Capital Cost, $/kW	1300	1100	1000
Cost of Electricity vs. Conventional PC Coal Power Plant	90%	80%	75%

Note:
NSPS - New Source Performance Standards
CAAA - Clean Air Act Amendments