McIntosh Unit 4B Topped PCFB Demonstration Project

Protect Terminated

Participant

City of Lakeland, Lakeland Electric

Additional Team Members

Foster Wheeler Corporation—supplier of carbonizer; engineer

Siemens Westinghouse Power Corporation—supplier of topping combustor and high-temperature filter

Location

Lakeland, Polk County, FL (Lakeland Electric's McIntosh Power Station, Unit No. 4)

Technology

Fully integrated second-generation PCFB technology with the addition of a carbonizer island that includes Siemens Westinghouse's multi-annular swirl burner (MASB) topping combustor

Plant Capacity/Production

103-MWe (net) addition to the 137-MWe (net) McIntosh 4A project

Coal

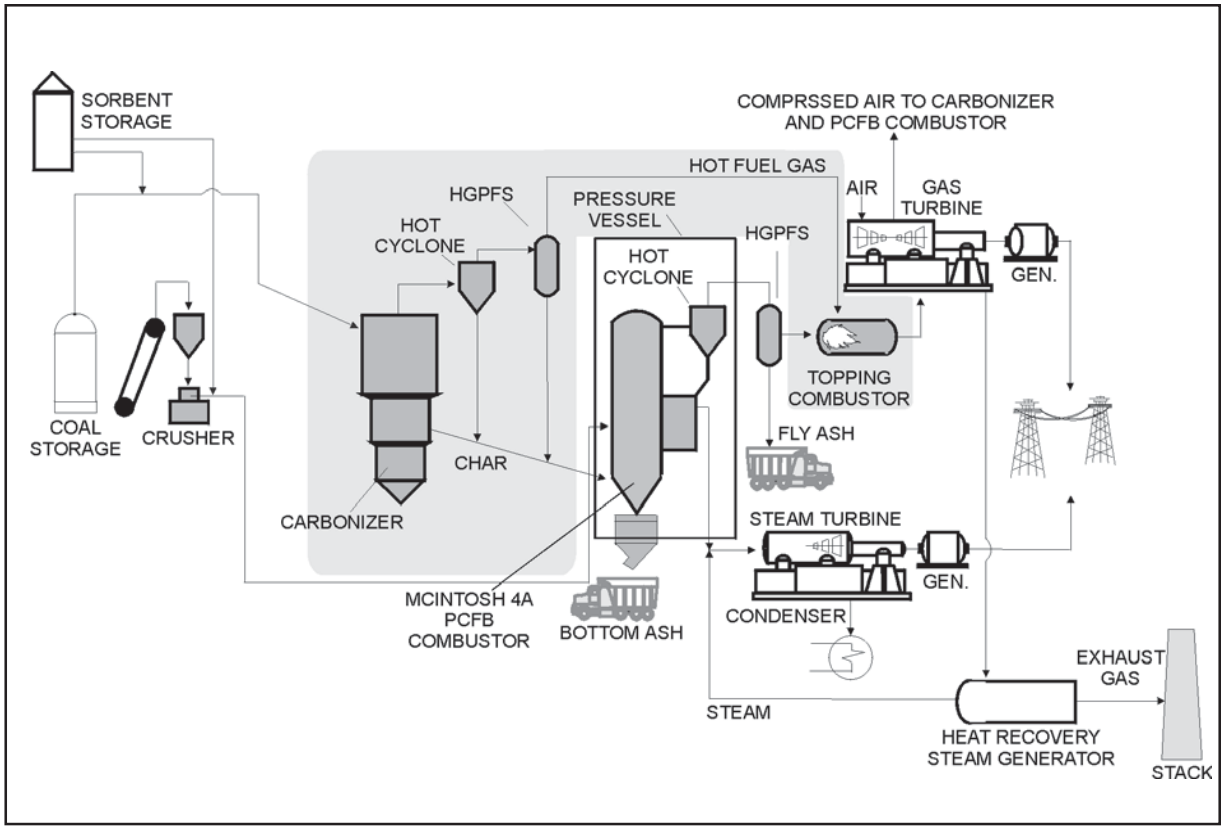
Eastern Kentucky and high-ash, high-sulfur bituminous coals

Project Funding

Total	$219,635,546	100%
DOE	109,608,507	50
Participant	110,027,039	50

Project Objective

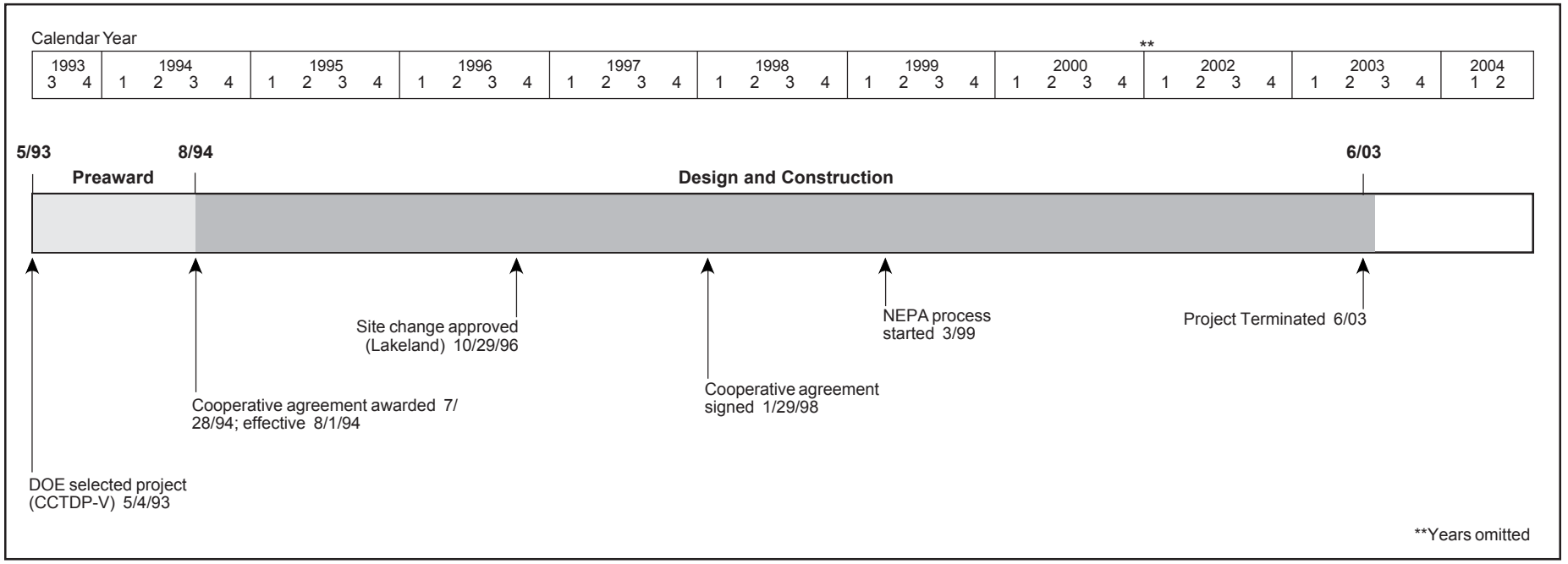
To demonstrate topped PCFB technology in a fully commercial power generation setting, thereby advancing the technology for future plants that will operate at higher gas turbine inlet temperatures and will be expected to achieve cycle efficiencies in excess of 45%.



Technology/Project Description

The project involved the addition of a carbonizer island to the PCFB demonstrated in the McIntosh 4A project. Dried coal and limestone are fed via a lock hopper system to the carbonizer with part of the gas turbine discharge air. The coal is partially gasified at about 1,750–1,800 ºF to produce syngas and char solids streams. The limestone is used to absorb sulfur compounds generated during the mild gasification process. After cooling the syngas to about 1,200 ºF, the char and limestone entrained with the syngas are removed by a hot gas particulate filter system (HGPFS). The char and limestone are then transferred to the PCFB combustor for complete carbon combustion and limestone utilization. The hot, cleaned, filtered syngas is then fired in the MASB topping combustor to raise the turbine inlet temperature to approximately 2,350 °F. The gas is expanded through the turbine, cooled in a heat recovery steam generator, and exhausted to the stack. The net impact of the addition of the topping cycle is an increase in both power output and efficiency. The coal and limestone used in McIntosh 4B are the same as those used in McIntosh 4A.

The 240-MWe (net) plant was expected to have a heat rate of 8,406 Btu/kWh (40.6% efficiency, HHV). The design SO_2 capture efficiency rate was 95%. Particulate and NO_x emissions were expected to be 0.02 lb/10^6 Btu and 0.17 lb/10^6 Btu, respectively. In the final configuration, the gas turbine would have produced 58 MWe and the steam turbine would have produced 207 MWe, while plant auxiliaries would have consumed about 25 MWe.



Project Status/Accomplishments

The project resulted from a restructuring of the Four Rivers Energy Modernization Project awarded under the fifth CCTDP solicitation. The Four Rivers project was to demonstrate the integration of a carbonizer (gasifier) and topping combustor (topping cycle) with the PCFB technology. By using a phased approach, Lakeland Electric would be able to demonstrate both PCFB (McIntosh 4A) and topped PCFB (McIntosh 4B) technologies at one plant site.

On January 29, 1998, a Cooperative Agreement modification was signed implementing the project restructuring from Four Rivers Energy Partners to the City of Lakeland. The Lakeland City Council gave approval in April 1998 for the 10-year plan of Lakeland Electric (formerly Department of Electric & Water Utilities), which included this project. However, the project was on hold while technical and economic issues were resolved. The issues could not be resolved and this project was terminated.

Commercial Applications

The commercial version of the topped PCFB technology would have a greenfield net plant efficiency of 45% (which equates to a heat rate approaching 7,500 Btu/kWh, HHV). In addition to higher plant efficiencies, the plant would (1) have a cost of electricity that was projected to be 20% lower than that of a conventional pulverized coal-fired plant with flue gas desulfurization, (2) meet emission limits allowed by the New Source Performance Standard (NSPS), (3) operate economically on a wide range of coals, and (4) be amenable to shop fabrication. The benefits of improved efficiency included reduced cost for fuels and a reduction in CO_2 emissions.

The commercial version of the topped PCFB technology has other environmental attributes, which include *in-situ* sulfur retention that can meet 95% removal requirements, NO_x emissions that will meet or exceed NSPS, and particulate matter discharge of approximately 0.03 lb/10^6 Btu. Although the system will generate a slight increase in solid waste compared to conventional systems, the material is a dry, readily disposable, and potentially usable material.