Clean Coal Diesel Demonstration Project

Participant
TIAX, LLC (acquired the research contracts of Arthur D. Little, Inc.)

Additional Team Members
University of Alaska at Fairbanks (UAF)—host and cofunder

Fairbanks Morse Engine—diesel engine technology vendor

Gatliff Coal Company—coal supplier

Usibelli Coal Mine, Inc.—coal supplier

Location
Fairbanks, AK (University of Alaska facility)

Technology
Fairbanks Morse coal-fueled diesel engine

Plant Capacity/Production
6.4 MWe (net)

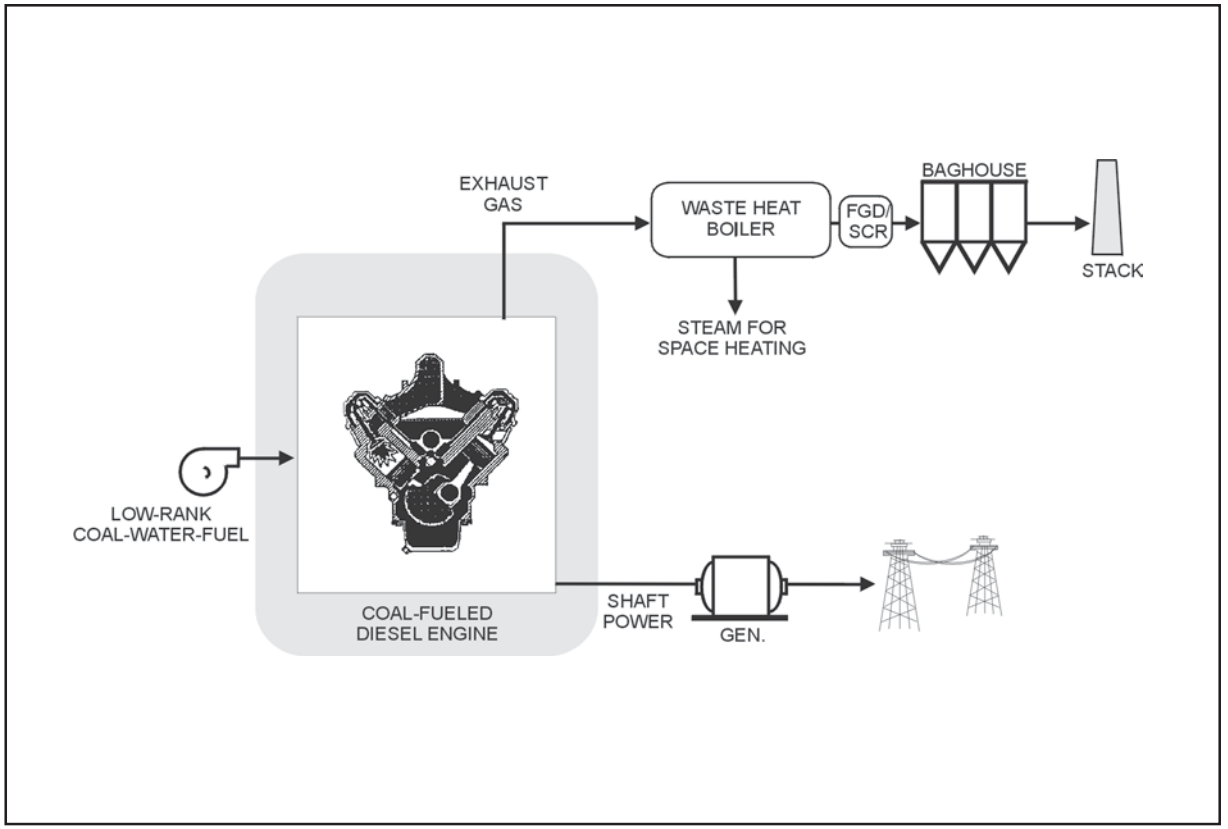
Coal
Kentucky bituminous and Alaskan subbituminous

Project Funding

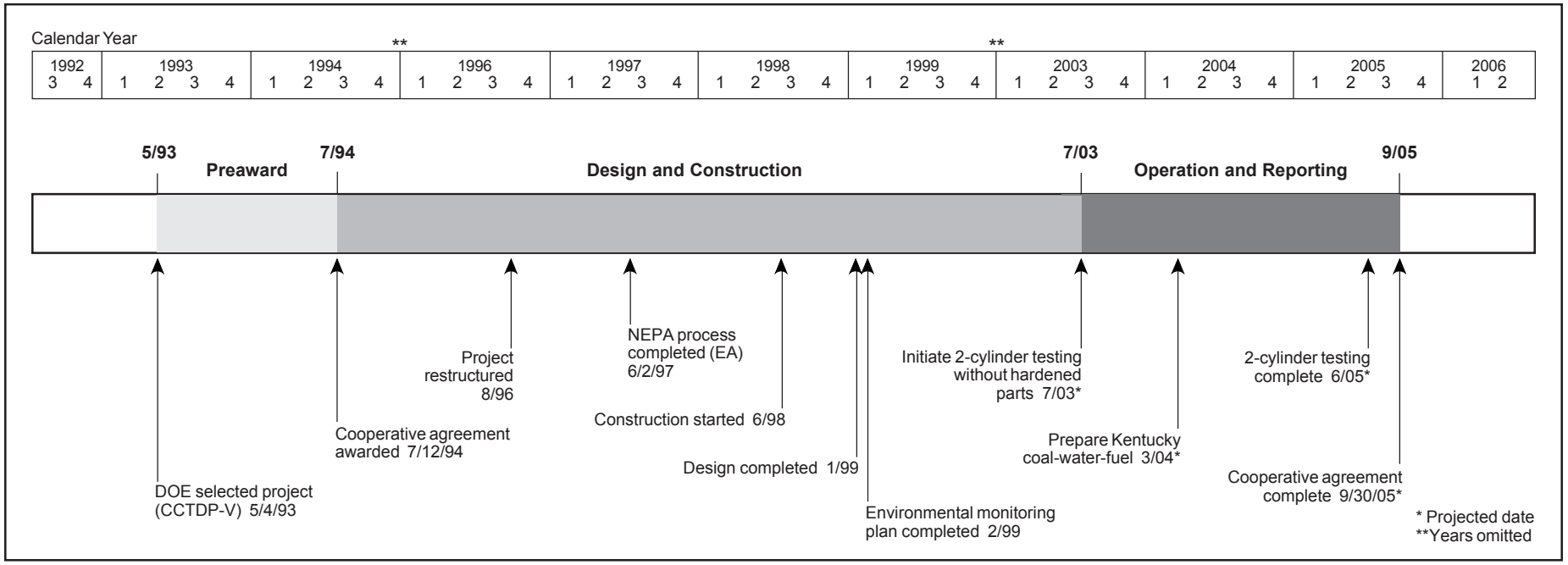
Total	$47,636,000	100%
DOE	23,818,000	50
Participant	23,818,000	50

Project Objective
To prove the design, operability, durability of a coal diesel engine during 1,000 hours of operation on coal water fuel.

Technology/Project Description
The Clean Coal Diesel Demonstration Project, as originally conceived, was to use a coal-water-fuel (CWF) slurry to operate an 18-cylinder diesel engine at the University of Alaska Fairbanks (UAF). Primarily because no coal slurry processor could be identified in Alaska to provide the necessary fuel to operate the UAF 18-cylinder engine, the scope of the project was modified. The new project scope includes 1,000 hours of testing on a two-cylinder engine in Wisconsin using a Kentucky coal source for slurry fuel. The two-cylinder engine in Wisconsin is identical to the 18-cylinder engine in Alaska in nearly every respect except for the number of cylinders. The two engines have identical horsepower per cylinder, emissions per cylinder, fueling rate per cylinder, wear rates, exhaust flow per cylinder, *etc*.



Initial tests will be conducted primarily on Kentucky bituminous CWF from the Gatliff Coal Company and on Alaskan subbituminous CWF from Usibelli Coal Mine, Inc. The clean coal diesel technology is expected to have very low NO_x and SO_2 emission levels. The 2-cylinder engine will first operate without hardened parts as an acceptance test for the CWF formulation and special fuel injectors. This initial operation will serve to define engine operation parameters, such as air preheat, number and size of injector tip holes, timing of start of injection, amount of diesel fuel pilot, and timing of diesel fuel pilot. After initial testing, the 2-cylinder engine will be modified to add hardened parts and operated on Kentucky bituminous CWF for 12 hours per day for a total of 1000 hours. The testing will be conducted in a series of four 250-hour tests, between which Fairbanks Morse Engine will inspect engine parts. Simultaneously, UAF will prepare the 18-cylinder diesel engine for future CWF operation by modifying the cooling system, modifying the injectors, adding selective catalytic reduction (SCR), and installing hardened parts. The 18-cylinder diesel engine testing will establish a baseline for NO_x and particulate emissions on diesel fuel and provide additional data for operation with hardened parts.



Project Status/Accomplishments

Overall project system design was completed in early 1999. The 18-cylinder diesel engine arrived on site at UAF in January 1999 and was mounted in the engine house in late February. In October 1999, the engine, after being connected to the generator, was operated on diesel fuel to ensure it would function coupled with the generator. In May 2000, total system startup was attempted on diesel fuel. The SCR system for the diesel was tested in August 2000 and achieved 90% reduction in NO_x emissions, which was within contract specifications. Since August 15, 2000, the diesel has been supplying all of the university's power requirements on fuel oil.

Testing was temporarily halted because the Goodrich Corp. division that operates the test facility, Engineered Industrial Products (which included Fairbanks Morse Engine), was spun off as a separate business now owned by EnPro Industries. As a result, the scope of the project was revised and the focus shifted to the 2-cylinder diesel engine as the optimal way to meet the demonstration project's objectives.

Commercial Applications

The U.S. diesel market is projected to exceed 60,000 MWe (over 7,000 engines) through 2020. The worldwide market is 70 times the U.S. market. The technology is particularly applicable to distributed power generation in the 5- to 20-MWe range, using indigenous coal in developing countries.

The net effective heat rate for the mature diesel system is expected to be 6,830 Btu/kWh (48% efficiency), which makes it very competitive with similarly sized coal- and fuel oil-fired installations. Environmental emissions from commercial diesel systems should be reduced to levels between 50% and 70% below NSPS. The estimated installation cost of a mature commercial unit is approximately $1,300/kW.