Clean Coal Diesel Demonstration Project

Project Withdrawn

CCTDP

Advanced Power Systems

IGCC	☐	CFB	☐
Hybrid	☐	Adv Comb	■

Participant

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

Additional Team Members

University of Alaska at Fairbanks (UAF) — host and co-funder

Fairbanks Morse Engine (FME) — host and diesel engine technology vendor

CQ, Inc. — coal-water fuel (CWF) formulation and production

Location

Fairbanks, AK (UAF facility)

Beloit, WI (FME facility)

Technology

Fairbanks Morse coal/water-fueled diesel engine

Plant Capacity/ Production

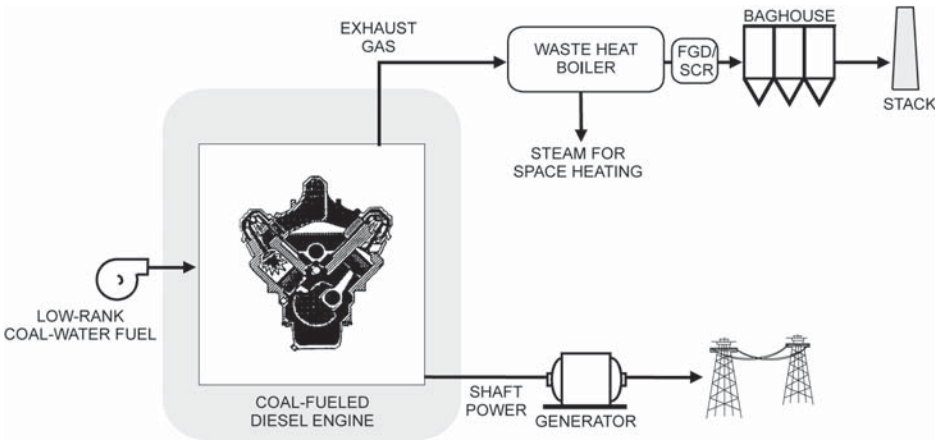
18-cylinder engine at UAF (6.4 MW) and 2-cylinder engine at FME

Coal

Kentucky bituminous and Alaskan subbituminous

Project Funding

Total	$41,611,958	100%
DOE	20,805,979	50
Participant	20,805,979	50



Objectives

To demonstrate that large-bore, heavy duty diesel engines can operate on relatively low-cost coal-water fuel (CWF) at acceptable performance levels and maintenance intervals with emissions at or below New Source Performance Standards.

Technology/Project Description

CWF testing is being conducted on a 2-cylinder engine in Beloit, Wisconsin, identical to the 6.4-MW equivalent 18-cylinder engine installed at the University of Alaska at Fairbanks (UAF) in terms of per cylinder horsepower, emissions, fuel rate, wear rate, and exhaust flow. The test plan for the 2-cylinder engine firing CWF specifies initial runs without the installation of hardened parts, such as special injectors and piston rings, to establish engine operating parameters (air pre-heat, number and size of injector tip holes, and timing and amount of diesel fuel for startup). Initial tests will be followed by the installation of hardened parts and four 250-hour tests (12 hours per day), between which Fairbanks Morse Engine inspects engine parts. Simultaneously, UAF is to integrate the 18-cylinder engine with balance of plant systems to enable commercial operation, including a generator, waste heat boiler, a selective catalytic reduction (SCR) system, and baghouse; and conduct baseline testing on diesel fuel. Subsequent to 2-cylinder testing, UAF is to incorporate hardened engine parts and provide performance data on CWF operation. CWFs to be tested include those derived from Alaskan subbituminous coals and from Kentucky bituminous coals.

Benefits

Diesel engines offer an attractive distributed generation option in the 5- to 20-MW range from the standpoint of efficiency, reliability, and established support infrastructure, but are hampered by high fuel costs in a world competing for oil. The U.S. market for diesels in the 5- to 20-MW range is projected to exceed 60,000 MW through 2020, and the worldwide market is estimated at 70 times the U.S. market. CWF-fueled diesel engines have particular overseas application in coal-rich developing Asia, where the bulk of energy expansion is occurring. Converging advancements in the fields of materials science and coal preparation make possible the use of coal to power diesel engines at acceptable performance and emission levels. Grinding coal to micron size allows release of most of the

Project Duration	Period of Operation	Status/Schedule
142 Months	*Project Withdrawn*	*Estimated date

ash and sulfur, and when mixed with water in high solids concentration slurries, provides a high-energy-density fuel. Abrasion-resistant materials emerging from materials research can be placed at high wear sites in diesel engines to sustain effective operation at the reduced lubricity levels associated with CWFs. Diesel engines emit far less nitrogen oxides (NO_x) when operated on CWF in lieu of diesel fuel, reducing the degree of control required. Efficiencies up to 48 percent are expected, with a projected heat rate of 6,830 Btu/kWh. Sulfur dioxide (SO_2) and particulate matter (PM) control requirements are minimal because most of the ash and sulfur are removed during CWF production.

Status/Accomplishments

The 18-cylinder engine at UAF began operation on diesel fuel in September 1999, started generating power in October 1999, demonstrated 90 percent NO_x reduction with the SCR in August 2000, and supplied all the UAF power requirements until a forced outage in August of 2004. Because the original planned source of CWF in Alaska was not viable, the unit continued to operate on diesel fuel. Eventually, CWF sources were located and a revision was made to the cooperative agreement to meet project objectives at reduced cost. In August 2003, DOE modified the cooperative agreement to execute the CWF test plan on a 2-cylinder engine at Fairbank Morse Engine facilities in Beloit, Wisconsin instead of the 18-cylinder engine installed at UAF.

In April 2004, the 2-cylinder engine was operated on Usibelli coal-derived CWF with a heating value of approximately 4,000 Btu/lb. The CWF-fired engine produced 270 horsepower and emitted 150 parts per million (ppm) of NO_x, which compared well with the 1,100 ppm NO_x emissions on diesel fuel. Preparations were under way for operation on bituminous coal-derived CWF, however, these tests were suspended due to test facility modifications and contractual matters.

The project has not been able to move forward due to legal proceedings on payment claims made by UAF for work performed on the project while Arthur D. Little, Inc. was the participant. TIAX requested termination of the project because they have been unable to continue work while waiting for the lawsuit to be settled. DOE concurred on the termination request in April 2006. TIAX is in the process of preparing a final report of project activities.

STATUS		
Report	*Final Report Issued*	*11/06**
	Draft Report Issued	*9/06**
Operation	*Operation Completed*	*NA*
	Project Withdrawn	*4/06*
	Operation on CWF	*4/04*
	Scope Modified	*8/03*
	Operation on Diesel	*9/99*
Construction	*Construction*	*6/98*
Design	*NEPA Completed*	*6/97*
	Project Restructured	*8/96*
	Award	*7/94*
PreAward	*Selection*	*5/93*

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