FY98-XXX-84

LIGNITE TESTING IN THE HIGH-TEMPERATURE ADVANCED FURNACE

CONTRACTOR: Energy & Environmental Research Center

PRINCIPAL INVESTIGATOR:
Greg Weber
Phone: (701) 777-5159
Fax: (701) 777-5181
gweber@eerc.und.nodak.edu

PROJECT MANAGER:
John P. Hurley, Ph.D.
Phone: (701) 777-5159
Fax: (701) 777-5181
jhurley@eerc.und.nodak.edu

PARTICIPANTS

Sponsor		Cost Share
United Technologies Research Center (UTRC)		7,000,000
UTRC HIPPS Team		
AAB/Combustion Engineering		
Fluor Daniel		
Pratt and Whitney		
Physical Sciences Incorporated		
Reaction Engineering International		
Bechtel		
U.S. DOE Combustion 2000 HIPPS Program		28,000,000
Utility Advisory Committee		In-Kind
EERC,		
Northern States Power Company,		
Minnesota Power,		
Minnkota Power Cooperative UTRC team		
ND Industrial Commission	(returned unused commitment)	$262,502
Total Project Cost		$35,262,502

Project Schedule – 4 Months

Contract Date – 4/2/98
Start Date – 4/2/98
Completion Date – 7/31/98

Project Deliverables

Final Report: July 31, 1998 ✓

OBJECTIVE / STATEMENT OF WORK

The general objective of the Combustion 2000 Program is to develop an advanced power system at least 35% more efficient (relative) than current systems while emitting less SO_x, NO_x and particulate matter, and reducing the cost of electricity by 10%. The UTRC system is based on a high-temperature advanced furnace (HITAF) that uses heat exchangers to produce clean air to drive an advanced turbine. The system does incorporate a combined cycle and is suitable for retrofit application. The specific objective of the Industrial Commission funded activity is to evaluate lignite performance in a pilot-scale slagging combustor built to simulate a HITAF, and bench-scale tests to evaluate slagging and corrosion unique to the use of lignite in the UTRC system.

STATUS

DOE added an additional $175,057 to the project through the EERC jointly sponsored research cooperative agreement. The added money was used to perform trace element sampling and compare the emissions of trace elements from the EERC pilot-scale HITAF to those from existing power plants firing the same fuels, as well as to emissions from the EERC system when burning a bituminous coal. Because of the added work scope, the project end date was extended to April 1999.

- Two lignites were fired in the EERC slagging furnace system for approximately one week each in April and June 1998. The Coal Creek Station and Milton R. Young Station each provided lignite that was tested in this project.
- Furnace wall temperatures were maintained at approximately 2700F during each test. No problems related to slag flow were evident when firing the lignites. The slag from both lignites was very corrosive to new patches of the 99% alumina refractory lining the combustor at this high-wall temperature. However, older refractory coated with less corrosive slags from previous tests was much less affected indicating that it may be possible to employ coatings to significantly reduce refractory corrosion by lignite slags.
- As expected, the lignites produced lower flame temperatures than bituminous coals. The lower flame temperatures indicate that efficiency of the UTRC system when firing lignite would be approximately 45% (HHV) as compared to 47% when firing a bituminous coal.
- The radiant air heater that is integral to the UTRC design produced clean 100-psi air at temperatures of up to 1690F when firing the lignites in the pilot-scale system. This air would be used to turn an aeroderivative turbine in a commercial plant. No problems in operation of the radiant air heater were evident as a result of lignite firing.
- Performance of the convective air heater indicated that although fouling was more rapid with the lignites than with higher rank coals, the heat recovery rate was similar once deposits developed.
- Trace element emissions from the pilot-scale system were similar to those from utility boilers firing the same lignites on a coal-firing rate basis. However, with the higher efficiency of the UTRC design, emissions would be reduced along with the reduced coal-feed rate necessary to produce a given amount of power.
- Large fractions of arsenic, selenium, and nickel in the flue gas were collected in the baghouse. Only small amounts of flue-gas mercury were collected in the baghouse for any of the fuels.
- The lignites produced similar emission levels of mercury, arsenic, and nickel as an Illinois No. 6 fuel, but only 1/5 to 1/9 of the levels of selenium as the bituminous coal.
- Testing of the commercial applications of the ash and slag produced from the slagging furnace system indicate that they have similar value and properties to ash and slag produced at the power plants firing the lignites. However, the design of the UTRC system causes much more of the ash to end up in slag, rather than as fly ash.
- Overall, the pilot-scale tests indicate that the UTRC HITAF concept offers a high-efficiency option for lignite-fired power generation. In addition, the similar design of the UTRC system to that of conventional PC-fired systems makes it an ideal retrofit technology. However, DOE has recently cut funding for further development of the HITAF concept, so commercialization of the technology is currently on hold.