Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion

Project Withdrawn

Participant

Sunflower Electric Power Corporation

Additional Team Members

Electric Power Research Institute — cofunder

GE Energy and Environmental Research Corp. — technology supplier

Location

Garden City, Finney County, KS (Sunflower Electric's Holcomb Station, Unit No. 1)

Technology

Modified low-NO_x burners (LNBs) with other combustion-staging controls

Plant Capacity/ Production

360 MW

Coal

Powder River Basin subbituminous

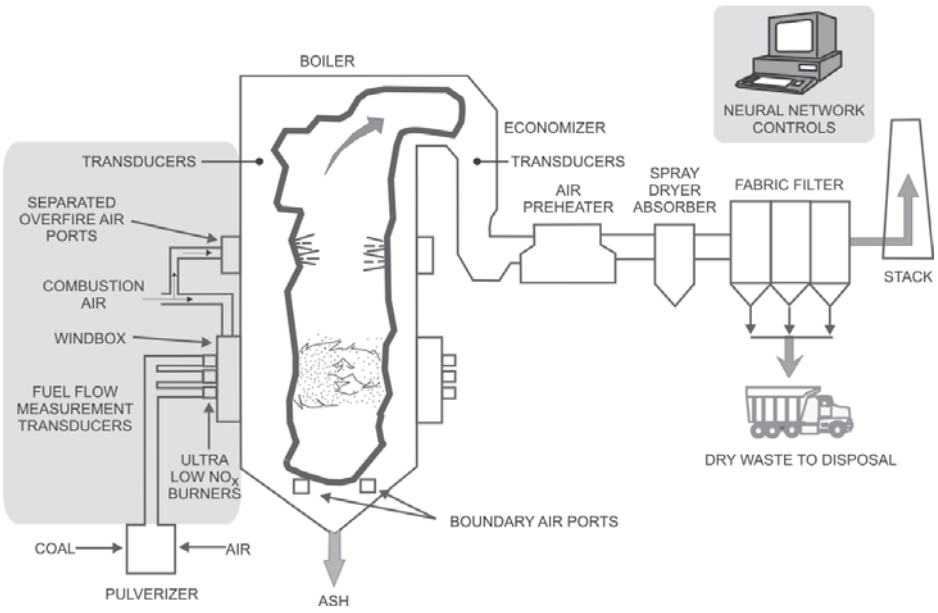
Project Funding

Total	$3,005,169	100%
DOE	1,387,530	48
Participant	1,617,639	52

PPII

Emissions Control

Mercury	☐	NO_x	■
SO_2	☐	$PM_{2.5}$	☐



Objectives

To demonstrate reduction of nitrogen oxide (NO_x) emissions to 0.15 lb/10^6 Btu by applying advanced low-NO_x burners (LNBs), coupled with separated overfire air (SOFA), sensors to measure key boiler parameters, and an artificial intelligence (AI) system to effectuate control; and to increase power output 7 MW by reducing the boiler heat rate.

Technology/Project Description

The project demonstrates modification of "first generation" LNBs and addition of SOFA and neural network controls to meet New Source Performance Standards (NSPS) for NO_x (0.15 lb/10^6 Btu), and improve heat rate on a 360-MW wall-fired boiler. This approach is being used in lieu of selective catalytic reduction (SCR) to reduce costs to ratepayers. Existing "first-generation" LNBs, which reduced NO_x emissions by 50 percent from uncontrolled emission rates, will be modified to optimize both the flame shape and the mixing of air and fuel. SOFA will be installed to allow the LNBs to operate under fuel-rich conditions, which reduces NO_x by providing air to complete combustion in a cooler zone above the LNBs. Staging the combustion and completing the combustion in a relatively cool zone of the boiler reduces NO_x emissions by avoiding hot spots and thermal NO_x emissions formation temperatures (2,800 ºF and above). Sensors and controls will be incorporated to measure and effectuate fuel flow and fuel/air balancing, and neural networks (AI systems) will allow integration of sensor input into optimization software to enhance boiler performance. With the high reactivity of the Powder River Basin coal being used, the LNB/SOFA system with neural network controls is expected to achieve an additional 40 percent reduction in NO_x emissions (beyond the original 50 percent reduction achieved). AI controls are expected to reduce boiler slagging and thereby improve heat rate. Incorporation of the combustion modification elements (LNB, SOFA, and AI sensors and controls) and modification of existing LNBs will be implemented sequentially to assess the benefits attributable to each action.

Project Duration 30 Months	Period of Operation *Project Withdrawn*	Status/Schedule *Estimated date

Benefits

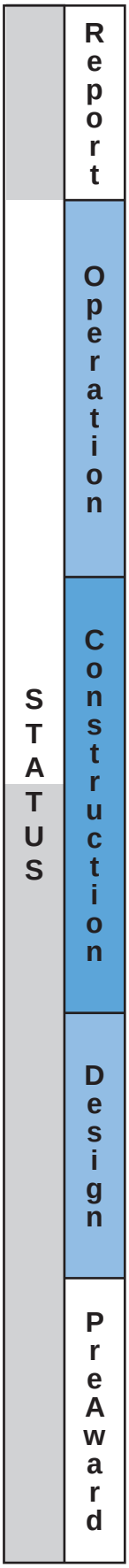
The combustion modification approach used in this project to meet NSPS NO_x emissions has distinct advantages over SCR, which is the conventional approach. While SCR can achieve low NO_x levels, it is 4 to 5 times more expensive than combustion modification; is difficult to retrofit; increases plant operating costs; reduces plant efficiency; and both uses and emits ammonia. The LNB/SOFA system in combination with AI sensors and controls offers a low-cost NO_x emissions compliance option that should enhance boiler efficiency and avoid escalation of annual operating costs. The outage time required for the combustion modification retrofit should be far less than that required for an SCR system. There are as many as 30 units throughout the United States for which this technology could be deployed to meet the current NSPS level (units that use high-reactivity coals, such as Powder River Basin coal). Additionally, there are about 60 units throughout the United States that will be able to achieve significant NO_x reductions, to levels of about 0.22 lb/10^6 Btu.

Status/Accomplishments

The project was selected for award on September 26, 2001. The cooperative agreement was awarded on December 17, 2002. To satisfy the National Environmental Policy Act (NEPA), DOE issued an Environmental Assessment (EA) in March 2003 and signed a Finding of No Significant Impact (FONSI) on March 11, 2003. Construction began immediately after signing of the FONSI.

A combustion optimization sensor package and coal flow monitoring system were installed. The existing LNBs were modified; however, problems caused delay of SOFA system installation. Sunflower decided to replace the existing LNBs and solicited bids for installation of new ultra low-NO_x burners and SOFA. Bids for the new low-NO_x burners came in higher than expected.

Due to significant cost increases associated with replacing the modified low-NO_x burners and other factors, Sunflower decided to withdraw their application to proceed with the second and final funding phase for the project. A Final Report of project activities was completed in June 2006.



Final Report Issued	*6/06*
Draft Report Issued	*9/05*
Operation Completed	*N/A*
Operation	*N/A*
Project Withdrawn	*6/05*
Construction	*3/03*
NEPA Completed (EA and FONSI)	*3/03*
Award	*12/02*
Selection	*9/01*

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