PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Environmental and Water Resources

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HEALTH EFFECTS OF SUB-CHRONIC INHALATION OF SIMULATED DOWNWIND COAL COMBUSTION EMISSIONS

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Background

Emissions from coal-fired power plants and their associated atmospheric reaction products contribute to environmental air pollution and are often cited as a critical cause of pollution-related health risks. However, there have been few toxicological evaluations of the heath hazards resulting from the inhalation of coal combustion emissions or of the influences of coal type, plant operating variables, emission control equipment, and atmospheric reactions. Virtually no toxicological research has been done to place "downwind" (rather than "top of the stack") emissions into context regarding pollution health risks.

Primary Project Goal

The goal of this project is to conduct a laboratory study evaluating selected respiratory and cardiac health hazards from repeated inhalation exposure to simulated downwind coal combustion emissions.

Objectives

Lovelace Respiratory Research Institute (LRRI) is conducting an integrated toxicological evaluation of the existence and dose-response relationships of cardio-respiratory effects of repeatedly inhaling a mixture of particulate matter and gases simulating the principal downwind components of air pollution from coal-fired power plants. Project objectives include: 1) establishing a laboratory-generated exposure atmosphere containing key particulate and gaseous species in ratios considered appropriate by atmospheric and combustion scientists; 2) conducting sub-chronic (daily up to six months) repeated inhalation exposures of rodents to four graded dilutions of the atmosphere, producing dose-response data down to environmentally relevant concentrations; 3) measuring a spectrum of health outcomes and mechanisms in the respiratory and cardiovascular systems that span multiple key public health concerns; 4) evaluating and publishing results demonstrating the presence or absence of health hazards and the nature of the dose-response curve, including evidence of thresholds; and 5) comparing the biological effects of coal combustion emissions to effects of other source emissions measured using the identical experimental protocol.

PARTNER

Lovelace Respiratory Research Institute
Albuquerque, NM

PERIOD OF PERFORMANCE

February 2005 to January 2008

COST

Total Project Value
$3,269,342

DOE/Non-DOE Share
$960,036 / $2,309,306

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Accomplishments

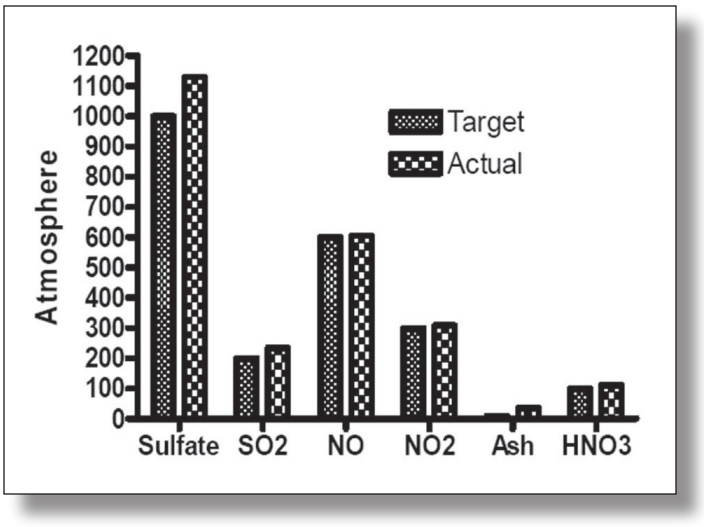
The project has developed and successfully evaluated the generation-exposure system, including setting up a drop-tube furnace, developing the emissions modification system, establishing operating conditions necessary to achieve a representative exposure atmosphere, and comparing results from two coal types – Powder River Basin low sulfur sub-bituminous coal (PRB) and Central Appalachian low sulfur bituminous coal (CALS). The key accomplishment to date was confirmation that the sub-chronic exposure atmosphere could be plausibly generated using either PRB or CALS coal. Although either coal type would have been acceptable, the PRB coal was selected for use in the toxicological study based on review of the target exposure atmosphere, results of an ancillary toxicity study, and operational considerations.

Benefits

This project is being performed as an integral part of a joint government-industry program by the National Environmental Respiratory Center (NERC, www.nercenter.org), which is aimed at disentangling the roles of different air pollutants and their sources in the health effects statistically associated with air pollution. The coal emission exposure data from this study will be compared with diesel and gasoline emissions, hardwood smoke, and street dust exposure data already generated by NERC using the identical experimental protocol. This data will be beneficial to policymakers in determining which components of particulate matter emissions should be regulated and why.

Planned Activities

Future project activities involve conducting the toxicological study using PRB coal, including exposures to four dilutions of the atmosphere for times ranging from a few days to six months (depending on the health endpoint); conducting health assays according to the protocol used successfully in studies of diesel emissions, hardwood smoke, gasoline emissions, and street dust by the NERC program at LRRI; analyzing exposure concentration-response relationships; comparing the results to those from studies of other source emissions; and publishing the results and analyses.



Approximation of Target Exposure Atmosphere Using PRB Coal