



## Project Summary

# Proceedings: Seventh Symposium on the Transfer and Utilization of Particulate Control Technology

Susan R. Fields, Compiler

The proceedings of the Seventh Symposium on the Transfer and Utilization of Particulate Control Technology are contained in two volumes. Volume 1 consists of: a summary of a panel discussion (Plenary Session), Dust Properties, Power Supplies and Controls for Electrostatic Precipitators (ESPs), Advanced SO<sub>2</sub>/Particulate Control Studies I, ESP Performance Evaluation and Upgrading I and II, and ESP Modeling I and II. Volume 2 consists of: Particulate Control for Incinerators, Full-Scale Fabric Filter (FF) Studies I and II, Advanced SO<sub>2</sub>/Particulate Control Studies II, and FF Pilot-Scale Studies I and II. The Symposium, held in Nashville, TN, March 22-25, 1988, was co-sponsored by the Environmental Protection Agency and the Electric Power Research Institute.

*This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in two volumes of the same title (see Project Report ordering information at back).*

### Introduction

The papers in these two volumes provided an opportunity for the transfer of information on particulate control technology between manufacturers, users, regulators, and educators. The purpose of the symposium was to advance new ideas and innovative ap-

proaches and to share experiences with on-going technologies. The main interests of participants in past such symposia have been in ESPs and FFs. These interests were reflected in the papers presented at this meeting. The topics of this symposium were ESPs, FFs, flue gas desulfurization (FGD), and municipal waste incineration particulate control. The symposium was conducted in parallel sessions, each containing from two to six related papers. The sessions presented ESP-related papers in one session while FF-related papers were presented in the other.

### Volume 1—Papers

Volume 1 describes various aspects of ESP control. The panel discussion which comprised the plenary session addressed developments and issues that will have an influence on particulate control technology in the future and what these effects may be. Also addressed in the panel discussion were effects that PM<sub>10</sub> and other new environmental regulations will have on particulate control at utility plants. Volume 1 also describes various aspects of ESP performance enhancement. Methods were discussed to improve ESP performance such as flue gas temperature mixing, improve ESP performance such as flue gas temperature mixing, increased plate spacing, pulsed energization, back corona suppression, multistage ESPs with cooled-pipe pre-charging, and chemical conditioning. Papers also described new computer control for ESPs and the effects of

resistivity of flyash/sorbent mixtures on ESPs. Papers were also presented that described ESP performance modeling which included the effects of turbulence and secondary flow and electrohydrodynamics.

### Plenary Session

Panel Discussion: Particulate Control Issues

### Session 1A: Dust Properties

Resistivity of Fly Ash/Sorbent Mixtures  
R. P. Young, J. L. DuBard, Southern Research Institute; and L. S. Hovis, USEPA/AEERL

On-Line, In-Situ Particle Measurements in Large-Scale Combustion Systems  
P. L. Meyer, D. J. Holve, INSITEC; and L. J. Muzio and G. H. Shiimoto, Fossil Energy Research Corporation

### Session 2A: Power Supplies and Controls for ESPs Automatic ESP Control: Start-Up to Shutdown

P. G. Abbott, T. C. Schafebook, GE Environmental Systems; and J. A. Brummer, Metropolitan Edison Company

Comparison Between Traditional and Modern Automatic Controllers on Full-Scale Precipitators

V. Reyes, The F.L. Smith Group  
A Supervisory Computer Control for Smaller Industrial Electrostatic Precipitators

J. D. Riley, Lurgi Corporation; and F. Neulinger, Lurgi GmbH

A Total Energy Management System for Electrostatic Precipitators

S. F. Weinmann and A. Russell-Jones, Lodge-Cottrell

Expert Systems--Operator Advisors for Particulate Control Equipment

J. G. Musgrove and P. N. DiDomenico, Bechtel Western Power Company

ESP Intermittent Energization Trials at Niles Generating Station

J. W. Hilborn, Ohio Edison Company; and R. Crynack, Wheelabrator Air Pollution Control

### Session 3A: Advanced SO<sub>2</sub>/Particulate Control Studies I

Field Evaluation of Humidification for Precipitator Performance Enhancement  
G. C. England, B. A. Folsom, R. Payne, T.M. Sommer, Energy and Environmental Research Corporation; P. J. Chappell, USEPA/AEERL; M. W. McElroy, Electric Power Research Institute; and

I. A. Huffman, Richmond Power and Light

Preliminary Test Results for ESP Performance with Furnace Sorbent Injection and Flue Gas Conditioning on a 300-MW Boiler

J. A. Arnott, Ontario Hydro; and H. V. Krigmont and E. L. Coe, Jr., Wahlco, Inc.

Rapping Properties of Precipitated Ash/Sorbent Mixtures

M. G. Faulkner, J. P. Gooch, R. Beittel, and J. L. DuBard, Southern Research Institute

Precipitator Performance on a 130-MW Coal-Fired Atmospheric Fluidized-Bed Boiler Retrofit

T. Willkomm, J. Larva, Northern States Power Company; and T. Lugar, General Electric Environmental Services, Inc.

Full-Scale Demonstration of Flue Gas Desulfurization by the Injection of Dry Sodium Reagents into an Electrostatic Precipitator

R. G. Hooper, CRSS, Inc.

### Session 4A: ESP Performance Evaluation and Upgrading I

An Unexpected Case of Back Corona

A. J. Ahern, American Electric Power Service Corporation

Overview of Keystone Station's Opacity Degradation and Subsequent Improvements

D. L. Strein, D. W. Read, Pennsylvania Electric Company; and A. Zarechnak, MPR Associates

Flue Gas Temperature Mixing to Improve Electrostatic Precipitator Performance at Keystone Generating Station

J. Dudeck, Pennsylvania Electric Company; and E. B. Bird, MPR Associates, Inc.

Performance of the Dale Station Precipitators with Increased Plate Spacing

E. C. Landham, Southern Research Institute; J. M. Shipp, J. K. Neathery, East Kentucky Power Cooperative, Inc.; and R. F. Altman, Electric Power Research Institute

Experience with Pulsed Energization and Back Corona Suppression of Electrostatic Precipitators

K. Porle, Flakt Industri AB; and K. Bradburn, Flakt, Inc.

### Session 5A: ESP Performance Evaluation and Upgrading II

Proof-of-Concept Testing of ESP Retrofit Technologies for Low and High Resistivity Fly Ash

G. A. Rinard, University of Denver; Marlin Anderson, Consultant; and R. F. Altman, Electric Power Research Institute

Experimental Study of Ash Layer Detachment and Reentrainment Under Normal and Shear Rapping of Electrostatic Precipitator Collector Plates

D. H. Choi, S. A. Self, M. Mitchner, and R. Leach, Stanford University  
Analysis of the Performance of Multi-Stage Electrostatic Precipitators with Cooled-Pipe Precharger

L. E. Sparks, USEPA/AEERL  
Acoustic Sootblower Applications in Electrostatic Precipitators  
J. L. Shelton, The Drayton Corporation

A New Chemical Conditioner Together with a Special Feed System Keeps Plants on Emission Compliance at Low Treatment Costs

R. K. Sinha, Calgon Corporation

### Session 6A: ESP Modeling I Effects of Turbulence in Wire-Plate Precipitators

S. A. Self, M. Mitchner, and K. D. Kim, Stanford University

A New Concept in Electrostatic Precipitator Gas Distribution

A. G. Hein, Hipp Engineering Ltd.  
Structural Repair of Large Hot-Side Electrostatic Precipitators--An Update  
C. A. Altin, R. A. Schmidt, and K. K. Fatehpuria, Ebasco Services Incorporated

A Self-Consistent Deutschian ESP Model

M. G. Faulkner, J. L. Dubard, Southern Research Institute; and L. S. Hovis, USEPA/AEERL

A Pilot Plant Study of Wide Plate Spacing for Precipitators

J. K. Horrocks, R. G. Corbin, and D. E. Towell, Central Electricity Research Laboratories

Particle Charging and Collection Efficiency in a Laboratory Scale Electron Beam Precipitator

W. C. Finney, J. S. Clements, and R. H. Davis, Florida State University

### Session 7A: ESP Modeling II

Calculation of Electric Field and Current Distributions Along Profiled Collecting Electrodes in a Wire-Plate Electrostatic Precipitator

C. E. Akerlund, Flakt Industri AB  
Three-Dimensional Secondary Flow and Electrohydrodynamics for Various Electrostatic Precipitator Configurations  
T. Yamamoto, P. A. Lawless,

Research Triangle Institute; and N. Plaks and L. E. Sparks, USEPA/AEERL

An Interactive Model for Analysis of Electric Conditions in Electrostatic Precipitators

P. A. Lawless, Research Triangle Institute; and N. Plaks and L. E. Sparks, USEPA/AEERL

Improving ESP Performance By Reducing Losses

P. A. Lawless, T. Yamamoto, Research Triangle Institute; and L. E. Sparks, USEPA/AEERL

## Volume 2—Papers

Volume 2 describes various aspects of FF, municipal waste incinerators, and FGD. Papers are presented dealing with emissions from sewage sludge incinerators which include dry particulates, organic sludge incinerators which include dry particulates, organic condensates, mercury, NO<sub>x</sub>, and SO<sub>x</sub>. An alternative to dry scrubbing, a rotary atomizing scrubber, is presented. The design, start-up, and operation of several full scale fabric filtration units were covered in two sessions, including units in Australia and West Germany. A paper was presented which included a data base of 40 operating FFs which indicated a wide variation of emissions. One paper discussed the Individual Bag Flow Monitor and the Bag Performance Monitor as a means of baghouse troubleshooting and evaluation of alternative fabrics. Operation of fabric filters and ESPs in FGD was presented in two sessions. The parameters studied with dry FGD with baghouse control were corrosion, bag life, pressure drop, cleaning cycle, and emission rates. Gas conditioning for ESP control was presented. Particulate and SO<sub>2</sub> control with the E-SO<sub>x</sub> process was also presented. In addition to full scale FFs, pilot plant studies were also presented, including advanced ESFF, flue gas conditioning, high temperature filter media, and the FF gas flow model.

### Session 1B: Particulate Control for Incinerators

Characterization of Stack Emissions from Sewage Sludge Incinerators

R. M. Leuser and L. A. Velazquez, Western Services, Inc.

Total Scrubbing of Incineration Air Pollutants--The EMCOTEK Approach

H. L. Marschall, H. H. Elliot, and D. G. Jones, EMCOTEK Corporation

### Session 2B: Full-Scale FF Studies I

The Design, Start-up and Operation of

the Intermountain Power Project, Unit 2 Fabric Filter System

R. L. Miller, General Electric Environmental Systems; J. J. Carnevale, T. L. Conkin, Los Angeles Department of Water and Power; and D. O. Swenson, Black and Veatch, Engineers-Architects

Monitoring of Startup and Operation of Intermountain Power Project Unit 1 Fabric Filter

P. V. Bush, Southern Research Institute; W. V. Piulle, Electric Power Research Institute; and J. J. Carnevale and T. L. Conkin, Los Angeles Department of Water and Power

Fabric Filter Emissions, Study of Their Variability

W. R. Lane, Bechtel Eastern Power Corporation

Fabric Filtration - Still A Black Art

R. M. Jensen, Consultant  
Flue Gas Dust Extraction for the Stagtap Pulverized Coal Firing at Brunswick Central Therman Power Station, Using the "Superjet" Tubular Filter

W. Flatt, Buhler Brothers, Ltd.

### Session 3B: Full-Scale FF Studies II Optimizing and Controlling Baghouse Operations at BG&E C.P. Crane Station

J. E. Sturtevant, Baltimore Gas and Electric Company; and G. P. Greiner, ETS, Inc.

Predicting Relative Drag For

Baghouses from Coal Chemistry  
P. V. Bush, T. R. Snyder, W. B. Smith, Southern Research Institute; and R. L. Chang, Electric Power Research Institute

Lifetime Baghouse Costs

P. E. Frankenburg, E.I. DuPont de Nemours, Inc.

Recommendations for a Baghouse Design Change and for Some New Test Procedures

R. M. Jensen, Consultant  
Australian Experience with Fabric Filters on Power Boilers -An Update for 1987

A. T. M. Vanderwalle, Howden Environmental Systems, U.S.A.; and H. F. Johnson, James Howden Australia Pty. Limited

### Session 4B: Advanced SO<sub>2</sub>/Particulate Control Studies II EPRI High-Sulfur Spray Dryer/Fabric Filter Pilot Results

G. Blythe, L. Lepovitz, Radian Corporation; R. Rhudy, Electric Power Research Institute; and

K. Cushing, Southern Research Institute

Particulate Control for a Combined Lime/Ammonia Spray Dryer for SO<sub>2</sub> Removal

W. T. Davis, A. Pakrasi, G. D. Reed, University of Tennessee; and T. C. Keener and J. T. Lee, University of Cincinnati

Operating Results of Several Baghouses in Dry FGD Service

M. Fiedler and C. Barranger, Flakt, Inc.

Dust Collector Design Considerations for MSW Acid Gas Cleaning Systems

B. Brown, J. R. Donnelly, T. D. Tarnok, R. J. Triscori, Joy Technologies, Inc.

A Study of a Reverse-Gas Fabric Filter Controlling Particulate Emissions from a 50 MW Atmospheric Fluid Bed Combuster

C. C. Barranger, Flakt, Inc., H. Isaka, Electric Power Development Company; and Y. Matsui, Gadelius KK

### Session 5B: Advanced SO<sub>2</sub>/Particulate Control Studies III

Analysis of the Performance of an ESP Operating Downstream of a Spray Dryer on High-Sulfur-coal Flue Gas

M. D. Durham, ADA Technologies, Inc.; C. Huang, J. DeGuzman, B. F. Kee, Tennessee Valley Authority; and R. G. Rhudy, Electric Power Research Institute

E-SO<sub>x</sub> System for Combined Particulate and SO<sub>2</sub> Control

L. S. Hovis, R. E. Valentine, USEPA/AEERL; J. L. DuBard, Southern Research Institute; and J. C. S. Chang, Acurex Corporation

Full Scale Precipitator Experience Following a Lime Slurry Flue Gas Desulphurization System

K. Bradburn, Flakt, Inc.; and C. Mauritzson, Flakt Industri AB

Video Based In-Situ Droplet Concentration and Size Analyzer

J. D. McCain, Southern Research Institute

### Session 6B: FF Pilot-Scale Studies I Fabrics Evaluation for Utility

Baghouses on Coal-Fired Boilers

D. V. Giovanni, Electric Power Technologies, Inc.; and L. G. Felix, C. J. Bustard, G. E. Kenniston, W. B. Smith, Southern Research Institute;

Parametric Testing of Filtration Fabrics for Low-Sulfur-Western Coal Fly Ash  
L. G. Felix, C. J. Bustard, G. E. Kenniston, Southern Research

Institute; D. V. Giovanni, Electric Power Technologies, Inc.; and R. L. Chang, Electric Power Research Institute

Pulse-Jet Fabric Filters for the U.S. Electric Utility Industry

R. C. Carr, Electric Power Technologies, Inc.; A. T. M. Vanderwalle, Howden Environmental Systems, Inc.; and W. B. Smith, Southern Research Institute

Mechanisms of Fabric Filter Performance Improvement with Flue Gas Conditioning

S. J. Miller, D. L. Laudal, University of North Dakota; and S. S. Kim, U.S. Department of Energy

Advances in Electrostatically Stimulated Fabric Filtration  
N. Plaks and B. E. Daniel, USEPA/AEERL

**Session 7B:** FF Pilot-Scale Studies II  
Using the Fabric Filter Gas Flow Model to Stimulate the Operation of a Pilot-Scale Baghouse

D. H. Pontius, C. J. Bustard, Southern Research Institute; and R. L. Chang, Electric Power Research Institute

Fabric Filter Options for Low-Sulfur Coal

K. M. Cushing, C. J. Bustard, W. B. Smith, Southern Research Institute;

W. V. Piulle, Electric Power Research Institute; and R. C. Carr, Electric Power Technologies, Inc. Fabric Filter Options for High-Sulfur Coal

R. F. Heaphy, R. R. Wilson, Jr., Southern Research Institute; R. P. Gehri, Southern Company Services; and R. F. Altman, Electric Power Research Institute Experience with High Temperature Filter Media in Envelope Type Filters in Flue Gas Cleaning

E. Vogel, DCE Benelux B.V.

*Susan R. Fields is with Radian Corp., Research Triangle Park, NC 27709*

*Geddes H. Ramsey is the EPA Project Officer (see below).*

*The complete report consists of two volumes, entitled "Proceedings: Seventh Symposium on the Transfer and Utilization of Particulate Control Technology:"*

*"Volume 1." (Order No. PB 89-194 039/AS; Cost: \$49.95)*

*"Volume 2." (Order No. PB 89-194 047/AS; Cost: \$49.95)*

*The above reports will be available only from: (Cost subject to change)*

*National Technical Information Service*

*5285 Port Royal Road*

*Springfield, VA 22161*

*Telephone: 703-487-4650*

98

*The EPA Project Officer can be contacted at:*

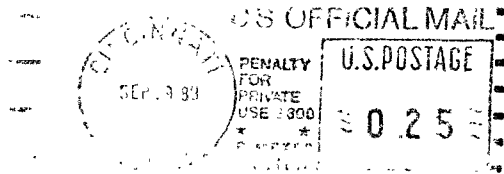
*Air and Energy Engineering Research Laboratory*

*U.S. Environmental Protection Agency*

*Research Triangle Park, NC 27711*

United States  
Environmental Protection  
Agency

Center for Environmental Research  
Information  
Cincinnati OH 45268



Official Business  
Penalty for Private Use \$300

EPA 600/S9-89/046

000085833 PS  
U S ENVIR PROTECTION AGENCY  
REGION 5 LIBRARY  
230 S DEARBORN STREET  
CHICAGO IL 60604

