



Project Summary

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

Franklin A. Ayer

The proceedings of the Fifth Symposium on the Transfer and Utilization of Particulate Control Technology consists of four volumes: Volume 1, Plenary, Advanced Energy Applications, Economics, and Novel Concepts; Volume 2, Electrostatic Precipitators; Volume 3, Fabric Filters; and Volume 4, Fugitive Emissions, Dry SO₂, and Operation and Maintenance. EPA and EPRI cosponsored the symposium, held in Kansas City, MO, August 27-30, 1984.

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

Introduction

The papers in these four volumes of the proceedings were presented at the symposium and provided the forum for researchers, manufacturers, users, government agencies, educators, and students to discuss new particulate control technologies and to share experiences of using existing technologies.

The major particulate control technologies—electrostatic precipitators (ESPs) and fabric filters (FFs) — were the primary concern of the symposium. These technologies were discussed from perspectives of economics, new technical advancements in science and engineering, fundamentals, applications, and operation and main-

tenance. Additional topic areas dealt with dry SO₂ removal, fugitive emissions, and novel concepts.

The symposium was conducted as a series of parallel sessions, each containing four to six related papers. The sessions were scheduled, however, to avoid any conflict that might be caused by simultaneous sessions dealing with the same topic. The papers, therefore, have been divided into four volumes. Each volume contains a set of related session topics so as to provide reasonably ready access to a unified technology area.

Volume 1 Papers

Volume 1 describes various aspects of particulate control. The plenary session was devoted to the regulatory framework for future technology needs and the impact of particulate control requirements on utilities, the iron and steel industry, and large and small manufacturers. Economic comparisons of the costs of the particulate control devices, computerized process control of ESPs, leveled annual revenue requirements for electric utilities and microcomputer models, and the impact of proposed acid rain legislation on control equipment were presented and discussed. Novel particulate control technologies covered particle charging with an electron beam precharger and by evaporating charged water droplets as well as the roles of electrostatic forces in high velocity particle collection devices, hot gas fabric filtration, and the prediction of plume opacity from stationary sources.

Session 1: Plenary Session

The Regulatory Framework for Future Particulate Technology Needs

Sheldon Meyers, U.S. EPA

The Impact of Coming Particulate Control Requirements on the Utility Industry

George T. Preston, EPRI

The Impact of Coming Particulate Control Requirements on the Iron and Steel Industry

Earle F. Young, Jr., American Iron and Steel Institute

The Impact of Particulate Control Requirements: Large Manufacturer's Viewpoint

Herbert H. Braden, Research-Cottrell, Inc.

Future Particulate Regulations: The View of the Small Manufacturer

Sidney R. Orem, Industrial Gas Cleaning Institute

Session 2: Advanced Energy Applications

High-Temperature, High-Pressure Electrostatic Precipitation, Current Status

P. L. Feldman and K. S. Kumar, Research-Cottrell, Inc.

Test Results of a Precipitator Operating at High-Temperature and High-Pressure Conditions

Donald E. Rugg, George Rinard, Michael Durham, and James Armstrong, Denver Research Institute

Evaluation and Development of Candidate High Temperature Filter Devices for Pressurized Fluidized Bed Combustion

T. E. Lippert and D. F. Ciliberti, Westinghouse Electric Corporation; and S. G. Drenker and O. J. Tassicker, EPRI

High Temperature Gas Filtration with Ceramic Filter Media: Problems and Solutions

Ramsay Chang, Acurex Corporation

The Development and High Temperature Application of a Novel Method for Measuring Ash Deposits and Cake Removal on Filter Bags

David F. Ciliberti and Thomas E. Lippert, Westinghouse Electric Corporation; and Owen J. Tassicker and Steven Drenker, EPRI

Session 3: Economics

Economics of Electrostatic Precipitators and Fabric Filters

Victor H. Belba and Fay A. Horney, Stearns Catalytic Corporation; and Robert C. Carr and Walter Piulle, EPRI

Estimating the Benefits of SO₃ Gas Conditioning on the Performance of Utility Precipitators When Burning U.S. Coal

Peter Gelfand, P. Gelfand Associates

Microcomputer Models for Particulate Control

A. S. Viner and D. S. Ensor, Research Triangle Institute; and L. E. Sparks, U.S. EPA

The Impact of Proposed Acid Rain Legislation on Power Plant Particulate Control Equipment

William H. Cole, Gibbs & Hill, Inc.

Session 4: Novel Concepts

Particle Charging with an Electron Beam Precharger

J. S. Clements, A. Mizuno, and R. H. Davis, The Florida State University

Charging of Particulates by Evaporating Charged Water Droplets

G. S. P. Castle and I. I. Inculet, The University of Western Ontario; and R. Littlewood, Stelco, Inc.

Role of Electrostatic Forces in High Velocity Particle Collection Devices

H. C. Wang, J. J. Stukel, K. H. Leong, and P. K. Hopke, University of Illinois at Urbana-Champaign

Hot-Gas Fabric Filtration 500°F — 1500°F, No Utopia but Reality

Lutz Bergmann, Filter Media Consulting, Inc.

The Prediction of Plume Opacity from Stationary Sources

David S. Ensor, Ashok S. Damle, and Philip A. Lawless, Research Triangle Institute; and Leslie E. Sparks, U.S. EPA

Volume 2 Papers

Volume 2 describes various aspects of electrostatic precipitation. Papers were presented that described performance estimating (modeling), microcomputer program simulations, the analysis of propagation of error in computer programs, the use of mobile ESPs for pilot studies, the prediction of voltage-current curves for electrodes of different geometrical shapes, and the calculation of electrical conditions inside ESPs. Papers outlining improvements and experience in ESP performance using a conditioning system of NH₃ — SO₃, one using SO₃ and evaporating cooling, and one using a pilot-scale study with (NH₄)₂SO₄ are presented. Various aspects of plume opacity control, retrofitting applications, pulse energization and rigid electrodes were discussed. Advanced technology covering multistage ESPs, precharging applications, corona discharge, and large diameter electrodes are discussed. Theoretical and experimental presentations were made covering dust layer breakdown, bipolar current probes, sodium depletion, use of air heaters, space charge effects, turbulence, static field strength in wireplated ESPs, and fluid dynamics and the effects of electrode geometry.

Session 5: ESP: Performance Estimating (Modeling)

Microcomputer Programs for Precipitator Performance Estimates

M. G. Faulkner, J. L. DuBard, and R. S. Dahlin, Southern Research Institute; and Leslie E. Sparks, U. S. EPA

Analysis of Error in Precipitator Performance Estimates

J. L. DuBard, Southern Research Institute; and R. F. Altman, EPRI

Use of a Mobile Electrostatic Precipitator for Pilot Studies

Robert R. Crynack and John D. Sherow, Wheelabrator Air Pollution Control

Prediction of Voltage-Current Curves for Novel Electrodes-Arbitrary Wire Electrodes on Axis

Phil A. Lawless, Research Triangle Institute; and L. E. Sparks, U.S. EPA

Numerical Computation of the Electrical Conditions in a Wire-Plate Electrostatic Precipitator Using the Finite Element Technique

Gregory A. Kallio and David E. Stock, Washington State University

Session 6: ESP: Performance Enhancement I

A Field Study of a Combined $\text{NH}_3\text{-SO}_3$ Conditioning System on a Cold-Side Fly Ash Precipitator at a Coal-Fire Power Plant

Robert S. Dahlin, John P. Gooch, and Guillaume H. Marchant, Jr., Southern Research Institute; Roy E. Bickelhaupt, Bickelhaupt Associates, Inc.; D. Richard Sears, University of North Dakota; and Ralph F. Altman, EPRI

Conditioning of Power Station Flue Gases to Improve Electrostatic Precipitator Efficiency
Gernot Mayer-Schwinning, Lurgi GmbH; and J. D. Riley, Lurgi Corporation

Pilot-Scale Study of a New Method of Flue-Gas Conditioning with Ammonium Sulfate
Edward B. Dismukes, E. C. Landham, Jr., John P. Gooch, Southern Research Institute; and Ralph F. Altman, EPRI

Power Plant Plume Opacity Control

J. Martin Hughes and Kai-Tien Lee, Virginia Polytechnic Institute and State University

Pulse Energization System of Electrostatic Precipitator for Retrofitting Application

Senichi Masuda and Shunsuke Hosokawa, University of Tokyo

Session 7: ESP: Performance Enhancement II

Practical Implications of Pulse Energization of Electrostatic Precipitators

H. Milde, J. Ottesen, and C. Salisbury, Ion Physics Company

Laboratory and Full-Scale Characteristics of Electrostatic Precipitators with Rigid Mast Electrodes

H. Krigmont, R. Allan, R. Triscori, and H. W. Spencer, III, Joy Industrial Equipment Company

Full Scale Experience with Pulsed Energization of Electrostatic Precipitators

K. Porle, Flakt Industri AB; and K. Bradburn, Flakt, Inc.
New Life for Old Weighted Wire Precipitators: Rebuilding with Rigid Electrodes

Peter J. Aa and Gary R. Gawreluk, Research-Cottrell, Inc.

Pulsing on a Cold-Side Precipitator, Florida Power Corporation, Crystal River, Unit 1

Joseph W. Niemeyer and Robert A. Wright, Lucidyne, Inc.; and Wayne Love, Florida Power Corporation

Session 8: ESP: Advanced Technology I

Field Study of Multi-Stage Electrostatic Precipitators

Michael Durham, George Rinard, Donald Rugg, Theodore Carney, and James Armstrong, Denver Research Institute; and Leslie E. Sparks, U.S. EPA

Optimizing the Collector Sections of Multi-Stage Electrostatic Precipitators

George Rinard, Michael Durham, and Donald Rugg, Denver Research Institute, and Leslie Sparks, U.S. EPA

Ceramic-Made Boxer-Charger for Precharging Applications

Senichi Masuda, Shunsuke Hosokawa, and Shuzo Kaneko, University of Tokyo

Precipitator Performance Enhancement with Pulsed Energization

E. C. Landham, Jr. and James L. DuBard, Southern Research Institute; Walter R. Piulle, EPRI; and Leslie Sparks, U.S. EPA

Aerosol Particle Charging in a Pulsed Corona Discharge

James L. DuBard, Southern Research Institute; and Walter R. Piulle, EPRI

Session 9: ESP: Advanced Technology II

Performance of Large-Diameter Wires as Discharge Electrodes in Electrostatic Precipitators

P. Vann Bush and Duane H. Pontius, Southern Research Institute; and Leslie E. Sparks, U.S. EPA

Technical Evaluation of Plate Spacing Effects on Fly Ash Collection in Precipitators

Ralph F. Altman, EPRI; Gerald W. Driggers and Ronald W. Gray, Combustion Engineering; and James L. DuBard and E. C. Landham, Jr., Southern Research Institute

Electrical Characteristics of Large-Diameter Discharge Electrodes in Electrostatic Precipitators

Kenneth J. McLean, University of Wollongong

Laboratory Analysis of Corona Discharge Electrodes and Back Corona Phenomena

P. Vann Bush and Todd R. Snyder, Southern Research Institute

Session 10: ESP: Fundamentals I

The Onset of Electrical Breakdown in Dust Layers

Ronald P. Young and James L. DuBard, Southern Research Institute; and Leslie E. Sparks, U.S. EPA

Bipolar Current Probe for Diagnosing Full-Scale Precipitators

Senichi Masuda and Toshifumi Itagaki, University of Tokyo; Shigeyuki Nohso and Osamu Tanaka, Sumitomo Heavy Industries, Ltd.; and Katsuji Hironaga and Nobuhiko Fukushima, Nihon Kagaku Koguo Co., Ltd.

A Method for Predicting the Effective Volume Resistivity of a Sodium Depleted Fly Ash Layer

Roy E. Bickelhaupt, Bickelhaupt Associates, Inc.; and Ralph F. Altman, EPRI

Analysis of Air Heater-Fly Ash-Sulfuric Acid Vapor Interactions

Norman W. Frisch, N. W. Frisch Associates, Inc.

Session 11: ESP: Fundamentals II

Experimental Studies of Space Charge Effects in an ESP

D. H. Pontius and P. V. Bush, Southern Research Institute

An Electrostatic Precipitator Facility for Turbulence Research

J. H. Davidson, University of Delaware; and E. J. Shaughnessy, Duke University

On the Static Field Strength in Wire-Plate Electrostatic Precipitators with Profiled Collecting Electrodes by an Experimental Method

C. E. Akerlund, Flakt AB

The Fluid Dynamics of Electrostatic Precipitators: Effects of Electrode Geometry

E. J. Shaughnessy, J. H. Davidson, and J. C. Hay, Duke University

Volume 3 Papers

Volume 3 describes various aspects of fabric filtration. Practical considerations of fabric filtration were covered in a session that dealt with fabric screening, tensioning of filter bags, use of sonic horns in saving energy, and solving the pressure drop problem. Full-scale studies were presented in other sessions on the performance and operating experiences of baghouse installations controlling 100 MW or larger coal-fired boilers, use of sonic energy, reverse gas methods, and shake/deflate methods. In addition, papers were presented and discussed in sessions on fundamentals/measurement techniques, advanced concepts, and pilot-scale studies that included presentations on the influence of coal-specific fly ash properties on baghouse performance, the development of woven electrode fabrics, and electrostatic fabric filtration experiments.

Session 12: FF: Practical Considerations

Fabric Screening Studies for Utility Baghouse Applications

Larry G. Felix and Randy L. Merritt, Southern Research Institute

Tensioning of Filter Bags in Reverse Air Fabric Filters

Robert W. Tisone, Environmental Elements Corporation; and Gregory I. Lear, Pennsylvania Power and Light

Sound of Energy Savings

N. D. Phillips and J. A. Barabas, Fuller Company

Solving the Pressure Drop Problem in Fabric Filter Bag Houses

Carl V. Leunig, Albany International Corporation

Session 13: FF: Full-Scale Studies (Coal-Fired Boilers)

Emission Reduction Performance and Operating Characteristics of a Baghouse Installed on a Coal-Fired Power Plant

David S. Beachler, John W. Richardson, John D. McKenna, and John C. Mycock, ETS, Inc.; and Dale Harmon, U.S. EPA

Evaluation of Sonic-Assisted, Reverse-Gas Cleaning at Utility Baghouses

Kenneth M. Cushing, Larry G. Felix, and Anthony M. LaChance, Southern Research Institute; and Stephen J. Christian, Montana Power Company

Sonic Horn Application in a Dry FGD System Baghouse

Yang-Jen Chen, Minh T. Quach, and H. W. Spencer III, Joy Manufacturing Company

Full Scale Operation and Performance of Two New Baghouse Installations

C. B. Barranger, Flakt, Inc.

Session 14: FF: Full-Scale Studies II (Coal-Fired Boilers)

Performance of Baghouses in the Electric Generating Industry

Wallace B. Smith, Southern Research Institute; and Robert C. Carr, EPRI

Flue Gas Filtration:
Southwestern Public Service
Company's Experience in
Design, Construction, and
Operation

John Perry, Southwestern
Public Service Company

Start-Up and Operation of a
Reverse-Air Fabric Filter on a
550 MW Boiler

R. A. Winch, Houston
Lighting and Power Co., Inc.;
and L. J. Pflug, Jr., Research-
Cottrell, Inc.

Update on Australian Experience
with Fabric Filters on Power
Boilers

F. H. Walker, Electricity Com-
mission of New South Wales

**Session 15: FF:
Fundamentals/Measurement
Techniques**

Modeling Baghouse Performance
David S. Ensor, Douglas W.
VanOsdell, Andrew S. Viner,
and Robert P. Donovan,
Research Triangle Institute;
and Louis S. Hovis, U.S. EPA

Measurement of the Spatial
Distribution of Mass on a Filter
Andrew S. Viner, Research
Triangle Institute; R. P. Gard-
ner, North Carolina State
University; and L. S. Hovis,
U.S. EPA

Laboratory Studies of the
Effects of Sonic Energy on
Removal of a Dust Cake from
Fabrics

B. E. Pyle, S. Berg, and D. H.
Pontius, Southern Research
Institute

Cleaning Fabric Filters
G. E. R. Lamb, Textile
Research Institute

**Session 16: FF: Advanced
Concepts**

Modeling Studies of Pressure
Drop Reduction in Electrically

Stimulated Fabric Filtration
Barry A. Morris, George E. R.
Lamb, and Dudley A. Saville,
Textile Research Institute

Flow Resistance Reduction
Mechanisms for Electrostatically
Augmented Filtration

D. W. VanOsdell and R. P.
Donovan, Research Triangle
Institute; and Louis S. Hovis,
U.S. EPA

Laboratory Studies of Electrically
Enhanced Fabric Filtration

Louis S. Hovis and Bobby E.
Daniel, U.S. EPA; Yang-Jen
Chen, Joy Industrial Equip-
ment Co.; and R. P. Donovan,
Research Triangle Institute

Pressure Drop for a Filter Bag
Operating with a Lightning-Rod
Precharger

George E. R. Lamb and
Richard I. Jones, Textile
Research Institute

New High Performance Fabric
for Hot Gas Filtration

J. N. Shah, E. I du Pont de
Nemours & Co., Inc.

**Session 17: FF: Pilot-Scale
Studies (Coal-Fired Boilers)**

The Influence of Coal-Specific
Fly Ash Properties Upon
Baghouse Performance: A Com-
parison of Two Extreme
Examples

Stanley J. Miller and D.
Richard Sears, University of
North Dakota Energy
Research Center

Development of Woven
Electrode Fabric and Preliminary
Economics for Full-Scale
Operation of Electrostatic Fabric
Filtration

James J. Spivey, Research
Triangle Institute; Richard L.
Chambers, Southwestern
Public Service Company; and
Dale L. Harmon, U.S. EPA

ESFF Pilot Plant Operation at
Harrington Station

Richard L. Chambers,
Southwestern Public Service
Company; James J. Spivey,
Research Triangle Institute;
and Dale L. Harmon, U.S. EPA

Volume 4 Papers

Volume 4 describes various aspects of
particulate control. The sessions on
fugitive emissions covered evaluation of
hood capture systems, air curtain
technology, and emission control and
evaluation of roadway dust, street sweep-
ing, storage piles, chemical stabilizers, and
wind screens. Two sessions were devoted
to dry SO₂ removal that covered topics
on modeling, pilot- and full-scale results
of fabric filter operations, novel design
concepts, startup and operating experi-
ence of reverse air fabric filtration, dry
injection systems, and the impact of acid
rain on ESP performance. Additional ses-
sions provided insights into operation and
maintenance problems and methods used
to eliminate the problems.

Session 18: Fugitive Emissions I

Technical Manual on Hood
Capture Systems to Control
Process Fugitive Particulate
Emissions

E. R. Kashdan, J. J. Spivey,
and D. W. Coy, Research
Triangle Institute;
H. Goodfellow and T. Cesta,
Hatch Associates, Ltd; and D.
L. Harmon, U.S. EPA

Pilot Demonstration of
Air Curtain Control of Buoyant
Fugitive Emissions

Michael W. Duncan, Shui-
Chow Yung, and Ronald G.
Patterson, Air Pollution
Technology, Inc., and William
B. Kuykendal and Dale L.
Harmon, U.S. EPA

Characterization of Fugitive
Particulate Emissions from
Industrial Sites

K. S. Basden, University of
New South Wales

Evaluation of an Air Curtain
Secondary Hooding System

John O. Burckle, U.S. EPA

Session 19: Fugitive Emissions II

Technical Manual on the Identification, Assessment, and Control of Fugitive Emissions

Chatten Cowherd, Jr. and John S. Kinsey, Midwest Research Institute; and William B. Kuykendal, U.S. EPA

Quantification of Roadway Fugitive Dust at a Large Midwestern Steel Mill

Keith D. Rosbury and William Kemner, PEDCo Environmental, Inc.

Evaluation of Street Sweeping as a Means of Controlling Urban Particulate

T. R. Hewitt, CRS Serrine, Inc.

Windbreak Effectiveness for the Control of Fugitive-Dust Emissions from Storage Piles — A Wind Tunnel Study

Barbara J. Billman, North Carolina State University

Evaluation of Chemical Stabilizers and Windscreens for Wind Erosion Control of Uranium Mill Tailings

Monte R. Elmore and James N. Hartley, Pacific Northwest Laboratory

Session 20: Dry SO₂ Removal I

Modeling of SO₂ Removal in Spray-Dryer Flue-Gas Desulfurization System

Ashok S. Damle, Research Triangle Institute; and Leslie E. Sparks, U.S. EPA

Fabric Filter Operation Downstream of a Spray Dryer: Pilot and Full-Scale Results

Richard G. Rhudy, EPRI; and Gary M. Blythe, Radian Corporation

Novel Design Concepts for an 860 MW Fabric Filter Used

with a Dry Flue Gas Desulfurization System

Michael F. Skinner and Steven H. Wolf, Northern States Power Company; John M. Gustke and Donald O. Swenson, Black & Veatch, Engineers-Architects

Start-Up and Operating Experience with a Reverse Air Fabric Filter as Part of the University of Minnesota Dry FGD System

J. C. Buschmann and J. Mills, Flakt, Incorporated; and W. Soderberg, University of Minnesota

Spray Dryer/Baghouse Experiences on a 1000 ACFM Pilot Plant

Wayne T. Davis and Gregory D. Reed, The University of Tennessee; and Tom Lillestolen, Flakt, Inc.

Session 21: Dry SO₂ Removal II

Design and Operation of the Baghouse at Holcomb Station, Unit No. 1

B. R. McLaughlin, United Engineers & Constructors Inc.; and R. D. Emerson, Sunflower Electric Cooperative, Inc.

An Update of Dry-Sodium Injection in Fabric Filters

Richard G. Hooper and Robert C. Carr, EPRI; G. P. Green, Public Service Co. of Colorado; V. Bland and L. J. Muzio, KVB, Inc.; and R. Keeth, Stearns-Catalytic

Removal of Sulfur Dioxide and Particulate Using E-SOX

Leslie E. Sparks, Geddes H. Ramsey, Richard E. Valentine, and Cynthia Bullock, U.S. EPA

Comparison of Dry Injection Systems at Normal and High Flue Gas Temperatures

Robert M. Jensen, William

Dunlop, George C. Y. Lee, and Duane Folz, Bechtel Power Corporation

Acid Rain Control Options — Impact on Precipitator Performance

Victor H. Belba, Fay A. Horney, and Donald M. Shattuck, Stearns-Catalytic Corporation

Session 22: Operations and Maintenance I

Comparison of U.S. and Japanese Practices in the Specification and Operation and Maintenance of Electrostatic Precipitators

Michael F. Szabo, PEI Associates, Inc; Charles A. Altin, Ebasco Services, Inc., and William B. Kuykendal, U.S. EPA

Operation and Maintenance Manuals for Electrostatic Precipitators and Fabric Filters

Michael F. Szabo, Ronald D. Hawks, Fred D. Hall, and Gary L. Saunders, PEDCo Environmental, Inc.

An Update of the Performance of the Cromby Station Fabric Filter

M. Gervasi, Philadelphia Electric Company; and J. R. Darrow and J. E. Manogue, W. L. Gore & Associates, Inc.

Critical Electrostatic Precipitator Purchasing Concepts

Charles A. Altin, Ebasco Services Incorporated; and Ralph F. Altman, EPRI

Reducing Electrostatic Precipitator Power Consumption

Joseph P. Landwehr and George Burnett, Burns & McDonnell Engineering Company

Session 23: Operations and Maintenance II

Design Considerations to Avoid Common Fly Ash Conveying Problems

Gus Monahu, Ash Systems Engineering, Inc.; and Walter Piulle, EPRI

Feasibility of Using Parameter Monitoring as an Aid in Determining Continuing Compliance of Particulate Control Devices

Joseph Carvitti, Michael F. Szabo, and William Kemner, PEDCo Environmental, Inc.

Air Pollution Control: Maintenance Cost Savings from the Washing, Patching and Reuse of Bags Used in Fabric Filters

Frank L. Cross, Jr., Cross/Tessitore & Associates, P.A.

Optimizing the Performance of a Modern Electrostatic Precipitator by Design Refinements

Donald H. Rullman, Lurgi Corporation; and Franz Neulinger, Lurgi GmbH

Weighted Discharge Electrodes — A Solution to Mechanical Fatigue Problems

John A. Knapik, Neundorfer, Inc.

Paper Presented at the Fourth Symposium on the Transfer and Utilization of Particulate Control Technology but not Published in Proceedings

Measurement of the Electrokinetic Transport Properties of Particles in an Electrostatic Precipitator

Wallace T. Clark III, Robert L. Bond, and Malay K. Mazumder, University of Arkansas

Unpresented Paper

Electrostatic Precipitator Bus Section Failure: Operation and Maintenance

Louis Theodore, Joseph Reynolds, and Francis Taylor, Manhattan College; and Alan Filippi and Steve Errico, Consolidated Edison Company of New York

Franklin A. Ayer, the compiler, is with Research Triangle Institute, Research Triangle Park, NC 27709.

Dale L. Harmon is the EPA Project Officer (see below).

The complete report consists of four volumes, entitled "Proceedings: Fifth Symposium on the Transfer and Utilization of Particulate Control Technology: Volumes 1 thru 4," (Set Order No. PB 86-167 145/AS; Cost: \$114.00)

"Volume 1," (Order No. PB 86-167 152/AS; Cost: \$22.95)

"Volume 2," (Order No. PB 86-167 160/AS; Cost: \$40.95)

"Volume 3," (Order No. PB 86-167 178/AS; Cost: \$28.95)

"Volume 4," (Order No. PB 86-167 186/AS; Cost: \$40.95)

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

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/S9-86/008

RECEIVED
JUN 2 1986
ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

0000329 PS

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