

**GEORGE C. HOWROYD, Ph.D., P.E.**  
**CH2M HILL**  
**Vice President and CH2M HILL Technology Fellow**

**Education**

Ph.D., Mechanical Engineering, University of Waterloo, Canada (1979)  
M.S., Mechanical Engineering, University of Waterloo, Canada (1975)  
B.S., Mechanical Engineering, University of Waterloo, Canada (1973)

**Professional Registrations**

Professional Engineer: Georgia, Mississippi, Ontario  
Certified Consulting Meteorologist (CCM), American Meteorological Society  
Qualified Environmental Professional (QEP), Air & Waste Management Association

**Countries Worked In**

United States, Canada, Mexico, Venezuela, Argentina, Brazil, Chile, Colombia, England, Holland, Belgium, Germany, France, Spain, India, Thailand, Malaysia, Singapore, Indonesia, Australia, Philippines, China, Equatorial Guinea

**Relevant Experience**

Over thirty years experience conducting Environmental Assessments, Environmental Permitting, Domestic and International Environmental Audits and Compliance Assessments; Emission Inventory Development; Toxic Air Pollutant Evaluations and Assessments; Dispersion Modeling; Control Technology Assessments and Evaluations; Regulatory Analysis and Interpretation; Air Quality and Meteorological Monitoring; Noise Evaluations and Assessments, and Expert Testimony. He has assisted domestic and worldwide international clients in the general manufacturing, pulp and paper, automotive, petrochemical, petroleum, steel, utility, and food products sectors.

## *Environmental Compliance and Due Diligence Assessments*

- Senior Consultant on a limited scope environmental due diligence assessment of the facilities and holdings associated with the \$2.65 billion sale of the majority of Potomac Electric Power Company's (PEPCO) electric generating assets to Southern Energy, Inc (SEI) (now Mirant Corp.). CH2M HILL was an integral part of SEI's due diligence assessment team which was tasked with evaluating the viability of assets and their associated potential liabilities associated with all aspects of the current and future operation of the identified facilities. CH2M HILL identified potentially significant environmental issues of concern to SEI, and provided budgetary estimates of the costs associated with rectifying or remediating said issues. The facilities of concern included four coal and oil fired generating plants with a total capacity of over 5,000 MW. CH2M HILL provided strategic input to SEI on environmental matters during the formulation of the financial aspects of the purchase and advised the company on key issues of concern that could have a significant impact on shareholder value.
- Project Director for an environmental due diligence assessment of the facilities and holdings associated with the \$850 million sale of Pacific Gas & Electric's Bay Area generation facilities to Southern Energy, Inc (SEI) (now Mirant Corp.) SEI, a subsidiary of The Southern Company, contracted with CH2M HILL to assist with the environmental due diligence with the proposed transaction, including preliminary cost assessments designed to facilitate SEI's bid on the assets being offered by PG&E. CH2M HILL also provided follow-up support to ensure timely and reliable permit transfers as well as consultation on permitting procedures associated with the potential future re-powering of the facilities. The purpose of the assessment was to identify potentially significant environmental issues of concern to SEI, and to provide budgetary estimates of the costs associated with rectifying or remediating said issues. The facilities of concern included five natural gas and oil-fired power generation facilities with a capacity in excess of 4,000 MW. CH2M HILL provided strategic input to SEI on environmental matters during the formulation of the financial aspects of the merger and advised the company on key issues of concern that could have a significant impact on shareholder value
- Project Director for an environmental due diligence assessment of the facilities and holdings associated with the refinancing of a 1000 MW combined cycle generating facility owned by Mississippi Power Corporation at its Plant Daniel facility in southeast Mississippi. Mississippi Power, an operating entity of The Southern Company, contracted with CH2M HILL to assist with the environmental due diligence for the proposed transaction, including preliminary cost assessments designed to quantify potential environmental liabilities and to assess the probability of future expenditures.

- Tenneco Inc./Kern River Pipeline - Project Director for an environmental and compliance assessment of a 900-mile natural gas pipeline owned by Kern River Corporation, a Tenneco subsidiary. The 36-inch pipeline runs from southwest Wyoming to southern California and traverses sensitive government and privately owned lands, Indian owned lands, and areas where protected species and habitat are of special concern. The associated pipeline operations include 5 compressor stations, numerous gas metering stations, warehouses, and corporate facility offices in Wyoming, Utah, Nevada, and California. The purpose of the assessment was to provide environmental support for the \$800 million sale of the company. Activities included a review of corporate and facility files, an inspection of the facilities from both the ground and the air (helicopter), interviews with state and federal agency personnel, and estimates of outstanding environmental liabilities (\$) associated with the operations.
- Albright & Wilson, Ltd – Third party environmental due diligence and environmental compliance assessment of Albright & Wilson’s phosphorous mining and processing operations in Newfoundland, Quebec, and South Carolina. The investigations included on-site investigations of air quality, waste management, water quality, and potential subsurface water and soil contamination.
- Project Director for a third party environmental due diligence assessment of the worldwide operations of Albright & Wilson, Ltd., a manufacturer of surfactants and specialty chemicals. Over 40 major chemical manufacturing facilities were included in the assessment, which were located in over 16 countries in the United States, Canada, South America, Mexico, England, Europe, India, Southeast Asia, Australia, the Philippines, and China. The project was conducted to support a \$750 Million initial public offering of the company on the U.K. stock market and included the participation of over 75 personnel for the on-site investigation of air quality, waste management, water quality, storage tanks, soils, SPCC plans, aerial photograph review, and agency file review.
- Voisey’s Bay Nickel Company Ltd. (International Nickel Company of Canada Subsidiary) – Environmental Due Diligence Assessment of an existing brownfield site for use as a nickel processing and refining facility in Argentia Newfoundland. The project involved comprehensive due diligence studies of the mine site(s), the proposed nickel processing site, and evaluating the impacts associated with the ultimate buildout scenario.

- DuPont Specialty Chemicals - Conducted an environmental due diligence assessment of the worldwide manufacturing operations of Protein Technologies International in support of the \$1.5 billion purchase of the company by DuPont. CH2M HILL conducted an intensive environmental assessment of six major manufacturing facilities in the U.S. and Europe that included strategic environmental planning, onsite regulatory compliance evaluations, Phase I due diligence, Phase II subsurface investigations, cost estimates for recommended remedial actions (for cost recovery purposes), and remedial action design. The project was completed in late 1997.
- Quaker State Corporation – Conducted strategic environmental due diligence in association with a proposed \$2.5 billion merger of Quaker State Corporation, with selected assets and facilities of the Pennzoil Corporation. Provided confidential assistance to Quaker State management and its Board of Directors in estimating potential additional shareholder liability for the merged company, primarily to facilitate structuring the environmental liability terms of the merger. Estimates were based on a review of corporate environmental files, interviews with corporate environmental management, and selected confidential site visits.
- Project Director for a \$250 million acquisition of a phosphate fertilizer manufacturing facility in Coatzacoalcos, Veracruz, Mexico. The facility was formerly owned by Fertilizantes de Mexico (Fertimex), prior to its privatization and eventual resale to a U.S. based Fortune 100 corporation. The due diligence assessment focused on regulatory compliance and general environmental impairment associated with air quality, solid and hazardous waste management, water quality, wastewater, storage tanks, soils, groundwater, and SPCC plans.
- Project Director for the strategic planning and environmental due diligence conducted for Tenneco Packaging's \$1.2 billion acquisition of the plastic packaging division of Mobil Plastics. CH2M HILL conducted an intensive environmental assessment of nine major manufacturing facilities in the U.S. and Canada that included strategic environmental planning during purchase negotiations, onsite regulatory compliance evaluations, Phase I due diligence, Phase II subsurface investigations, cost estimates for recommended remedial actions (for cost recovery purposes), and remedial action design. The project was completed in early 1997.
- Petroquímica de Venezuela, S.A. (PEQUIVEN) - Project Director for an environmental compliance and due diligence audit of the largest petrochemical refinery complex in Venezuela. The audit was performed for Petroleos de Venezuela (PDVSA) as part of an initiative to determine future environmental compliance and remediation costs at the company's Maracaibo (Zulia) complex. The facility operated production facilities for electricity, ammonia, urea, propylene, MVC/PVC, styrene, chlorine, olefins, LPG, latex, styrene monomer, and polyethylene resin.

- Albright & Wilson (U.S. and Canada) - Directed Phase I and Phase II environmental investigations of the pulp and paper chemicals division of Albright & Wilson Americas in the U.S. and Canada. Albright & Wilson is a major producer of sodium chlorate and sodium chlorite in North America. The project was conducted to support the \$400 million sale of the company to Sterling Chemical. Specialist teams were used for the on-site reconnaissance and investigation of air quality, waste management, water quality, underground storage tanks, soils, SPCC plans, aerial photograph review, and agency file review. The project involved extensive subsurface investigations of soil and water quality.
- Case Corporation (U.S., Canada, U.K., Europe, South America)-Directed a company-wide environmental assessment of over 30 major construction and agricultural equipment manufacturing facilities operated by Case Corporation. Specialist teams from various international office locations were used for on-site reconnaissance and investigation of air quality, waste management, water quality, underground storage tanks, soils, SPCC plans, aerial photograph review, and agency file review. Facilities were located in 8 U.S. states, Canada, England, France, Germany, Spain, Argentina and Brazil. The purpose of the assessment was to support a \$4 billion public sale of the company.
- Sperry Marine (U.S., U.K., Europe) - Directed company-wide environmental assessment of the marine navigation electronic equipment manufacturing facilities operated by Sperry Marine, Inc. Specialist teams from various international office locations were used for on-site reconnaissance and investigation of air quality, waste management, water quality, underground storage tanks, soils, SPCC plans, aerial photograph review, and agency file review. Facilities were located in 5 U.S. states, England, Holland and France.
- Packaging Corporation of America (Multiple U.S. Sites) - Directed air quality and regulatory compliance audits for 21 pulp and paper production facilities including two major pulp mills in Wisconsin and Georgia. Tasks included on-site reconnaissance and investigation of air quality, waste management, water quality, underground storage tanks, soils, SPCC plans, aerial photograph review, and agency file review. The project involved extensive Phase II subsurface investigations of soil and water quality. The purpose of the assessment was to support Packaging Corporation's \$750 million acquisition of the facilities from Georgia-Pacific Corporation.
- Packaging Corporation of America (Mississippi, Alabama, and Tennessee) - Directed an environmental assessment of over 175,000 acres of timberlands. Project involved aerial photograph review, chain of custody review, an in-field investigations of individual land tracts by a number of specialist teams. The purpose of the assessment was to identify potential environmental liabilities and associated costs of remediation in support of Packaging Corporation's financing of the property.

- Big River Industries, Inc. (Alabama)-Performed an air quality compliance audit for a lightweight aggregate clay products facility. Project included the preparation of a comprehensive emission inventory and the development of a plan to reduce point and fugitive emissions at various locations at the facility in order to ensure compliance with present permit limits.
- Southwire Company (South Carolina)-Performed an air quality compliance audit for the acquisition of an AT&T wire reclamation facility (secondary metal recovery) in Gaston, South Carolina. Included inspection of facilities, identification of emission sources, review of permit files and development of conclusions and recommendations.
- Beaird Industries (Louisiana)-Performed an air quality compliance audit for a heavy equipment manufacturing facility in Shreveport, Louisiana. The project included a comprehensive inspection of the facility to identify emission sources, review of files, development of conclusions and recommendations, and the preparation of a revised air emission permit application.

## *Greenhouse Gas Emission Reduction Quantification*

- CMS Energy (For Environmental Resources Trust, Inc.) – Developed a comprehensive Greenhouse Gas Emission Reporting Guideline and Monitoring and Verification Protocol (MVP) for a newly constructed methanol production facility on Bioko Island in Equatorial Guinea, West Africa. The purpose of the project was to quantify the reductions in greenhouse gas emissions associated with the beneficial use of natural gas (for methanol production) that was previously flared at CMS Energy’s gas processing facility. The project included an inspection of the facilities, a review of facility records, data acquisition and archiving methods, and the development of a detailed reporting guideline and MVP for use over the 30-year life of the facility. The project is expected to reduce greenhouse gas emissions by approximately 70 million tons/year over the life of the project. Future participation in the project will include an annual audit of the greenhouse gas reduction estimates.
- Capex, S.A. (For Environmental Resources Trust, Inc.) – Performed third party verification of CO<sub>2</sub> emission reductions for a simple to combined cycle conversion project in Argentina prior to the registration of the credits in the ERT Registry. The project included an inspection of the facilities during the physical conversion to combined cycle, the development of in-depth recommendations for a Greenhouse Gas reporting strategy, and the assessment and verification of the utility’s final procedure (and results) for determining and documenting CO<sub>2</sub> emission reduction credits attributable to the first year of operation of the project.  
A key element of the project was a review of the dispatch criteria utilized by the Argentine entity responsible for power dispatch, since emission reductions from the project are realized through the displacement of less efficient generation within the Argentine grid.
- Environmental Resources Trust – Performed third party verifications of CO<sub>2</sub> emission reductions attributable to the implementation of various coal, gas, and oil-fired projects by several U.S.-based. These verifications have included the review and assessment of emission reporting guidelines prepared by utilities, assessment of emission factors used in the quantification of emission reductions, assessment of DOE Form 1605 submittals, and the evaluation of reports documenting emission reductions for various projects.

## *Air Quality Permitting*

- Yellow Pine Energy (Georgia) - Project Manager for the environmental permitting of a 110 MW biomass fueled power generating facility in southwest Georgia. The project involved the acquisition of all environmental permits, including Prevention of Significant Deterioration, water/wastewater, wetlands, and negotiations with the permitting authority.
- Amarillo Power (Texas) - Combined Operating License Application. Responsible for the preliminary design, configuration, and siting of a 200 ft. meteorological monitoring tower for use in supporting NRC's licensing requirements. The preliminary assessments also included the meteorological and climatological suitability of the site at the development stage of the project
- GNEP (Kentucky) - Responsible for developing and evaluating weather and climate related site parameters for use in supporting a siting study for the Consolidated Fuel Treatment Center (a SNF reprocessing facility) and an Advanced Burner Reactor. The siting study included the development of a detailed site report describing the proposed site setting, and the character of the site and the environment that could be affected by the proposed facilities
- Progress Energy (North Carolina) – Preparation of Combined Operating License (COL) Application. Responsible for managing the development of the Final Safety Analysis Report (FSAR), Chapter 2 Environmental Impacts of Construction and Operation in support of Progress Energy's COL Application for two new nuclear generating units in North Carolina. Also responsible for performing all meteorological and air quality analyses, nonattainment/maintenance area air quality conformity analyses for CO, and cooling tower impact analyses using dispersion models associated with the development and operation of the proposed reactors in accordance with NRC's requirements
- Progress Energy (Florida) – Preparation of Combined Operating License (COL) Application. Responsible for managing the development of the Final Safety Analysis Report (FSAR), Chapter 2 Environmental Impacts of Construction and Operation in support of Progress Energy's COL Application for two new nuclear generating units in Florida. Also responsible for performing all meteorological and air quality analyses, air quality permitting (PSD) for cooling tower emissions, and cooling tower impact analyses using dispersion models associated with the development and operation of the proposed reactors in accordance with NRC's requirements. Responsibilities also included overseeing the design, specification, and installation of a 200 ft. meteorological tower for use in supporting NRC's licensing requirements.

- Emirates Nuclear Energy Corporation (ENEC) – Senior technical review of meteorological monitoring program for the siting and licensing of multiple nuclear generating stations in Abu Dhabi. Consultation and analysis included meteorological and climatological characterization of the region as well as individual sites selected for reactor site licensing. Also included was an assessment of the design, installation, and operation of on-site meteorological monitoring programs for two sites. All work was performed under a CH2M HILL contract with ENEC as the Program Manager and Managing Agent for the United Arab Emirates (UAE) Civil Nuclear Power Program being developed in the country.
- Confidential Nuclear Client (Eastern Europe) – Siting studies for a proposed 2000 MW nuclear power plant. Task manager responsible for identifying and evaluating air quality, meteorology, and environmental criteria for over ten candidate sites. Evaluations were performed using European and U.S. Nuclear Regulatory Commission regulations.
- Singapore Energy Market Authority (Singapore) - Siting and licensing studies for a proposed nuclear power plant to be located in Singapore, including the mainland and owned islands. Task manager responsible for identifying and evaluating air quality, meteorology, and various environmental criteria for approximately ten candidate sites. Evaluations were performed using U.S. Nuclear Regulatory Commission regulations.
- Unistar Nuclear Energy (Joint Venture between Constellation Energy and Areva, Inc.). Task Manager responsible for establishing meteorological and climatological site selection criteria for potential new nuclear generating facility sites in the northeast United States.
- Exelon Generating Company (Illinois) - Siting Study and Early Site Permit (ESP) Application. Performed meteorological and air quality analysis in accordance with the regulatory requirements applicable to the development of an ESP application for a proposed new nuclear reactor in Illinois. The analysis focused on impacts associated with project alternatives and a demonstration of compliance with NRC regulations.
- NRG Energy (formerly LS Power, Mississippi) - Development of a PSD permit application for a 1000 MW combined cycle power generating facility in Batesville, Mississippi. The facility was initially developed as part of an expansion of the generating base for the Tennessee Valley Authority and included the preparation of a complete Draft and Final Environmental Impact Statement and participation in the NEPA process. The project involved the acquisition of all environmental permits including PSD (BACT, modeling, toxic pollutants), NPDES stormwater and discharge permits, water/wastewater engineering, noise assessments, wetlands permitting, and negotiations with the permitting authority.

- Mid-Georgia Cogeneration, LP (Georgia) - Development of a PSD permit application for a 300 MW combined cycle power generating facility developed as an independent power production (IPP) facility in mid-Georgia. The project involved all air permitting issues, documentation of best available control technology, dispersion modeling of criteria and toxic air pollutants, and negotiations with the permitting authority.
- Calpine Corporation – Project Director for the environmental permitting of a 1000 MW combined cycle power generating facility in South Carolina. The project involved the acquisition of all environmental permits (PSD, NPDES, wetlands, noise, etc.).
- El Paso Energy (formerly GPU International) (Mississippi) – Development of air permit applications for a 750 MW combined cycle power generating facility in north-central Mississippi. The project involved the acquisition of all environmental permits including PSD (best available control technology, dispersion modeling of criteria and toxic air pollutants), NPDES stormwater and discharge permits, wetlands permits, and negotiations with the permitting authority.
- Duke Energy Fort Pierce, LLC (Florida) – Development of air permit applications and Site Certification for a 640 MW simple cycle power generating facility in south Florida. The project involved all air permitting issues, documentation of best available control technology, dispersion modeling of criteria and toxic air pollutants, Class I area impact analyses using the CALPUFF model and negotiations with the permitting authority.
- Duke Energy Alexander City, LLC (Alabama) – Development of air permit applications and for a 1250 MW combined cycle and simple cycle power generating facility in Alabama. The project involved all air permitting issues, documentation of best available control technology, dispersion modeling of criteria and toxic air pollutants, and negotiations with the permitting authority.
- GenPower Anderson, LLC (South Carolina) – Project Manager for the permitting of a 650 Mw combined cycle power generating facility South Carolina. The project involved the acquisition of all environmental permits (PSD, NPDES, wetlands, noise, etc.), site infrastructure design and co-ordination of subconsultants.
- Peace Valley Generation, LLC (Georgia) – Project Manager for the environmental permitting of a 1250 MW combined cycle and simple cycle power generating facility in Georgia. The project involved the acquisition of all environmental permits, including PSD, water/wastewater, noise, wetlands, and negotiations with the permitting authority.

- Augusta Energy, LLC (formerly SkyGen and Calpine Corp., Georgia) – Environmental permitting of a 800 MW co-generation facility in Georgia. The project involved the acquisition of all environmental permits including PSD, water/wastewater, noise, wetlands, and negotiations with the permitting authority.
- New Orleans Sewer & Water Board of New Orleans – Development of a PSD permit application for a 100 Mw simple cycle power generating facility in the city of New Orleans. The facility is being developed as part of a program to improve the reliability of pumping systems during high water episodes in the city.
- Honda of America Manufacturing (Alabama) – Preparation of environmental permit application (PSD) for a new automobile assembly plant and engine manufacturing facility in Lincoln, AL. The work included comprehensive dispersion modeling of criteria and toxic air pollutants, review of BACT and MACT demonstrations prepared by Honda, assistance with negotiations with the State Agency prior to issuance of the permit, and multiple permit revisions to account for various design changes prior to the completion of construction of the facility.
- Ford Motor Company (Michigan). Air permit modifications for proposed changes to assembly plant paint shop facilities. Work included emission estimates, criteria and toxic air pollutant dispersion modeling, and permit application preparation.
- General Motors (Alabama). PSD permit application preparation for proposed modifications to the manufacturing facilities at GM's Saginaw steering gear manufacturing facility.
- General Motors (Louisiana). Preparation of SARA Title III Section 313 reports for automotive assembly facility.
- General Motors (Kentucky). Preparation of SARA Title III Section 313 reports for automotive assembly facility.
- Case International (nationwide). Environmental auditing, permit reviews, and air emission permit application preparation for agricultural tractor and construction equipment manufacturing facilities in 8 states. Air emission permitting included PSD as well as air toxics demonstrations in accordance with state air toxics policies and guidelines.

- Arnold Engineering Development Center, Arnold Air Force Base, Tennessee – Development of a PSD Permit Application for an expansion of the allowable operating hours of the Large Engine Environmental Test Facility. The project involved all air permitting issues, documentation of best available control technology, dispersion modeling of criteria and toxic air pollutants, and negotiations with the Tennessee permitting authority. The project was completed under budget and within the schedule requirements of AEDC.
- Confidential Pulp and Paper Client (Alabama) – Retroactive PSD assessment to determine if sequential mill modifications made to a major pulp mill would have triggered or circumvented the need for PSD new source review. The project involved the historical review (since original construction) of all mill construction records, capital expenditure requests, fuel purchase and use records, steam and power generation records, pulp production, and emission test results. The work resulted in an estimated savings in fines and penalties of up to \$10 million.
- Confidential Client (Louisiana) - Preparation of a PSD permit application for the expansion of a manufacturing facility in Shreveport, Louisiana. The project involved the preparation of a comprehensive emission inventory, a BACT review and assessment, Dispersion modeling, preparation of permit documentation for both PSD and Title V permit applications, and meetings with DEQ staff.
- Georgia-Pacific Corporation (Mississippi)-Development of a PSD permit application for a new oxygen delignification system to be installed at an 1800 ton/day bleached kraft pulp mill.
- Weyerhaeuser Paper Company (Mississippi)-Project Director for the development of a Title V permit application for a kraft and thermomechanical pulp and paper production facility.
- Weyerhaeuser Paper Company (Mississippi)-Preparation of a Prevention of Significant Deterioration permit application (including dispersion modeling and Best Available Control Technology evaluation) for a kraft mill modification.
- Steelcase, Inc. (North Carolina)-Directed the preparation of a Title V emissions inventory for a furniture manufacturing and coating facility.
- Akzo Nobel Coatings (North Carolina)-Directed a PSD applicability review for a paint manufacturing facility. Evaluation of past and present operating configurations of the facility to ensure that existing permits were in conformance with the regulations. The scope included the development of a spreadsheet based emissions model for each of the processes at the plant and the preparation of a facility-wide emissions inventory.

- Georgia-Pacific Corp. (Mississippi)-Complete air emission permit application support for a grass roots 1800 ton/day bleached kraft pulp mill operated by Leaf River Forest Products (now Georgia-Pacific) in New Augusta, Mississippi. Projects included all air permit-related work since the facility's inception in 1979, including PSD permitting for numerous modifications, air toxics evaluations, BACT and dispersion modeling.
- Mead Corp. (Alabama)-PSD permitting for a facility modification at a corrugated medium manufacturing facility in Stevenson, Alabama. Project involved extensive dispersion modeling in very complex terrain.
- Great Southern Paper Co. (Georgia)-Preparation of a PSD permit application package for a 3,000 ton/day container board facility operated by Great Southern Paper Company (now Georgia-Pacific) in Cedar Springs, Georgia. The project involved the replacement of two 600 ton/day recovery boilers with two 800 ton/day units.
- A.E. Staley Manufacturing (Tennessee)-Complete air emissions permitting for a \$500 million grass roots corn milling facility. Project included all air permitting since the facility's inception in 1981, as well as ongoing permitting for facility modifications through 1994.
- Exxon (Alabama)-Preparation of a complete PSD permit application for an 1800 MMSCF/D sour gas treating facility near Mobile, Alabama.
- Getty Oil (Alabama)-Preparation of a PSD permit application for a gas compression/reinjection facility for Getty Oil Company's Hatter's Pond Gas Processing Plant near Mobile, Alabama.
- Texaco (Alabama)-Preparation of a PSD permit application for an oil and gas production and processing facility approximately 80 miles northeast of Mobile, Alabama.
- Chevron U.S.A. (Mississippi)-Complete PSD permitting support for a major expansion of a heavy crude oil refinery in Pascagoula, Mississippi. Project involved extensive emission inventory development, dispersion modeling analyses, BACT assessments, and consideration of Class I area impacts.
- Alabama Department of Environmental Management (Alabama)-Comprehensive air quality dispersion modeling analyses used to support an SIP revision for Jefferson County, Alabama. Work was performed under contract to EPA Region IV.

### ***Toxic Air Pollutant Evaluations***

- Boise Cascade (Alabama) - Conducted a dispersion modeling based hazard assessment for potential accidental releases of chlorine and ammonia from a kraft pulp mill in southern Alabama. Work was performed in support of the requirements associated with the accidental release provisions of the Risk Management Program (RMP) rule of Section 112(r) of the Clean Air Act (40 CFR 68).
- Georgia-Pacific (Mississippi)-Performed an analysis of potential accidental releases of chlorine, ammonia, chlorine dioxide, and propane at a kraft pulp mill (formerly Great Northern Nekoosa). Particular emphasis was placed on the determination of evacuation zones for worst-case accident scenarios. Supporting documentation was prepared for use in the development of an emergency response manual for use by plant personnel.
- U.S. Army Corps of Engineers (West Virginia) - Directed a dispersion modeling based impact analysis of hazardous air pollutant emissions at a hazardous waste disposal site in Winfield, West Virginia. Modeling results were used as the basis for a human health risk assessment. Participated in the public hearing process.
- Petroquímica de Venezuela (Maracaibo, Venezuela) - Development of a comprehensive toxic air pollutant emission inventory and dispersion modeling analysis for the largest petrochemical complex in Venezuela. The project was undertaken to provide a basis for the design and installation of an ambient air quality monitoring network (primarily air toxics) in and around the facility.
- Cargill, Inc. (Florida) - Performed an analysis of potential accidental releases from an anhydrous ammonia storage facility at an ammonium phosphate fertilizer production facility (formerly Gardinier, Inc.). Particular emphasis was placed on the determination of evacuation zones for worst-case accident scenarios. Supporting documentation was prepared for use in the development of an emergency response manual for use by plant personnel.

### ***Air Quality Impact Studies***

- Ocean State Power Company (Rhode Island)-Preparation of an Environmental Impact Statement for a grass roots gas/oil fired power plant. Included all air and noise-related issues, review and evaluation of background air quality and noise measurements, and a projection of the corresponding impacts on the community for the as-built configuration of the plant. Project included full participation in the NEPA process, including initial scoping meetings and public hearings.

- U.S. Department of Energy (Northeast U.S.)-Preparation of Environmental Impact Statements for mandated conversions from oil to coal at major electric generating stations. Included in the supporting analyses were the development of comprehensive emission inventories (including air toxics) for both oil and coal combustion, as well as fugitive emissions from fuel storage and handling and fly ash storage/disposal. Dispersion modeling analyses were performed to estimate the off-site ambient impacts attributable to the fuel conversion.
- Siting studies for large industrial facilities and electric utilities. Alternative sites for selected facilities were evaluated for overall suitability on the basis of air quality constraints defined by state and federal agencies.
- U.S. Department of Energy-Evaluation of fugitive dust impacts at major coal-fired electric generating stations. Project resulted in the development of a published technical document entitled "A Technical Guide for Estimating Fugitive Dust Impacts From Coal Handling Operations". All aspects of the coal handling process were investigated from initial mining to disposal of the fly ash.
- South Carolina Electric & Gas (South Carolina)-Assessment of site-specific meteorological and dispersion characteristics at SCE&G's Virgil C. Summer Nuclear Station. The objective was to evaluate the potential effect of the adjacent heat dissipation reservoir (i.e., Monticello Reservoir) on transport and diffusion. A protocol was developed for incorporating those effects into an emergency response model developed for the facility.
- Pennsylvania Power & Light (Pennsylvania)-Evaluation of the potential for building wake and entrainment effects at PP&L's Susquehanna Steam Electric Station (SSES). The objective was to estimate the potential for entrainment of exhaust air into the fresh air intake vents at SSES.
- Design and development of computer models for predicting the ambient impacts of natural- and mechanical-draft cooling tower operation. The models were designed to utilize historical meteorological data records to predict the frequency of occurrence and size of visible plumes, the probability of icing and fogging conditions, and the amount of solid particle deposition as a function of distance from the cooling towers.
- Pennsylvania Power & Light (Pennsylvania)-Assessment of the performance of the drift deposition model used in the Environmental Report-Operating License (ER-OL) for PP&L's Susquehanna Steam Electric Station.
- Air quality dispersion modeling studies involving plume/complex terrain interaction for industrial facilities and electric utilities.

- Large-scale experimental diffusion studies documenting the behavior and dispersion characteristics of natural- and mechanical-draft cooling towers at large coal-fired power plants in Alabama and Georgia. The studies were performed using an aircraft-based instrumentation sampling platform for the Tennessee Valley Authority and the Southern Company.
- Experimental and theoretical investigations of the horizontal and vertical transport and dispersion characteristics of plumes emitted from very tall stacks (i.e., greater than 1,000 ft.). The primary objective of the project was to investigate the possibility of enhanced plume dispersion due to directional wind shear effects. The study was performed using an instrumented aircraft for the Southern Company (Southern Company Services).
- Investigation of particulate matter and carbon monoxide distributions adjacent to urban highways for the Ontario Ministry of the Environment.

### ***Ambient Air Quality and Meteorological Monitoring***

- A.E. Staley Manufacturing (Tennessee)-Directed one year of on-site ambient monitoring for SO<sub>2</sub>, NO<sub>x</sub>, PM, PM-10, and meteorological parameters at a corn products facility near Loudon, Tennessee. The program was initiated to support future PSD permitting requests.
- U.S. Army Corps of Engineers (West Virginia)-Directed two months of on-site monitoring for PM, PM-10, dioxins, PAHs, VOCs, heavy metals, asbestos, and meteorological parameters at a former hazardous waste disposal site. The program was conducted to provide support for a human health risk assessment of various alternatives identified for the closure or remediation of the site.
- Mead Coated Board, Inc. (Alabama)-Design and installation of an automated meteorological monitoring system at a coated paper products manufacturing facility.
- Petroquímica de Venezuela (Maracaibo, Venezuela)-Design and development of a comprehensive ambient air quality monitoring network in and around the largest petrochemical complex in Venezuela. The program was designed to monitor toxic and other pollutants at their point of maximum impact, as well as at several locations where public exposure could be a concern.
- Georgia Power Company (Georgia)-Directed three years of ongoing support for a meteorological monitoring program at Georgia Power's Plant Hatch. Project included semi-annual calibration and certification of the instrumentation on a 100-meter meteorological tower.

- Kemira, Inc. (Georgia)-Directed the installation and calibration of a meteorological monitoring system at a chemical products facility in Savannah, Georgia.

### *Air Pollution Control Technology Evaluations*

- Original design and analysis of particulate wet-scrubbing devices. Several pilot scale models of a low-energy once-through wet scrubbing device were designed, constructed, and tested for overall efficiency. Particulate matter removal efficiency was evaluated as a function of water droplet size distribution for various input loadings and size distributions of particulate matter
- Packaging Corporation of America (Tennessee) – Evaluation of wet scrubber performance on a coal- and oil-fired utility boiler. Project involved emissions testing to evaluate scrubber design and operational changes involving droplet size distributions, mesh design, and other parameters.
- Big River Industries, Inc. (Alabama) – Development and implementation of a plan to reduce point and fugitive particulate matter emissions at a lightweight aggregate clay products facility. The project focused on the design and implementation of open and enclosed wet scrubbing of particulate matter from a variety of emission sources.
- Confidential Client (Mississippi) – Evaluation and troubleshooting of an electrostatic precipitator installed on a coal-fired boiler. Project included emission testing program design, evaluation of results, and recommendations for operational changes to effect an increase in precipitator performance and overall reliability.
- Confidential Client (Tennessee) – Troubleshooting of baghouse performance problems at a food products manufacturing facility. The project included the measurement of emission control performance under a variety of operating conditions and configurations, and recommendations for physical and operational changes designed to enhance unit performance and reliability.

### *Air Quality Training and Seminars*

- Tenneco Packaging – Presented a comprehensive 2-day training seminar on PSD and new source review procedures. The seminar was presented to all of Tenneco Packaging’s corporate and facility environmental managers. Included in the seminar were topics such as applicable regulations, BACT requirements, dispersion modeling, Class I area considerations, and the permit review process.
- Georgia Power Company (Georgia) - Primary speaker at a series of ten half-day seminars sponsored by the Georgia Power Company on the Clean Air Act, Title V Operating Permits and Title III MACT regulations. Attendees were various large industrial customers of GPC.
- Industrial Technology Research Institute of Taiwan-Provided two weeks of classroom instruction to a group of visiting scientists on the Clean Air Act and its requirements and implications, the principles of dispersion modeling, and the hands-on use of dispersion models.
- Packaging Corporation of America - Presented a half-day seminar on the Clean Air Act Amendments of 1990 and their impacts on PCA facilities in the coming years. Attendees were the environmental managers of PCA at an annual environmental meeting of the company.
- Laporte, Inc.-Presented a half-day seminar on the Clean Air Act Amendments of 1990 and their impacts on Laporte's small chemical manufacturing facilities in the coming years. Attendees were the environmental managers of Laporte at an annual environmental meeting of the company.

### *Noise Assessments and Investigations*

- Exelon Energy – Comprehensive assessment of existing and projected noise levels associated with the construction and operation of a proposed new nuclear reactor at Exelon’s existing nuclear generating facility in Clinton, IL. The results of the analyses were compared with local noise ordinances and the results were described in an Early Site Permit (ESP) Application and National Environmental Policy Act (NEPA) documents, including an Environmental Impact Statement that was prepared for the project.

- Progress Energy - Comprehensive assessment of existing and projected noise levels associated with the construction and operation of two proposed nuclear reactors (2200 MW) at Progress Energy's existing nuclear plant near Raleigh, NC. The results of the analyses were compared with local noise ordinances and the results were described in a Combined Operating License (COL) Application and National Environmental Policy Act (NEPA) documents, including an Environmental Impact Statement that was prepared for the project.
- LS Power – Comprehensive assessment of noise related impacts of a proposed 1000 MW natural gas-fired combined cycle power generating facility in Batesville, Mississippi. The project included a baseline noise measurement program and noise modeling analyses designed to estimate projected noise levels during construction and operation of the facility. The results of the analyses were compared with local noise ordinances and the results were described in National Environmental Policy Act (NEPA) documents, including an Environmental Impact Statement that was prepared for the project.
- Calpine Energy - Assessment of noise related impacts of a proposed 1000 MW natural gas-fired combined cycle power generating facility in Rock Hill, South Carolina. The project included a baseline noise measurement program and noise modeling analyses designed to estimate projected noise levels during construction and operation of the facility. The results of the noise projection analyses were compared with local noise ordinances to demonstrate that the operation of the facility will comply with applicable noise requirements and that there would be no unacceptable or adverse impacts to the surrounding area.
- GenPower Anderson - Assessment of noise related impacts of a proposed 650 MW natural gas-fired combined cycle power generating facility in Anderson, South Carolina. The project included a baseline noise measurement program and noise modeling analyses designed to estimate projected noise levels during construction and operation of the facility. The results of the noise projection analyses were compared with local noise ordinances to demonstrate that the operation of the facility will comply with applicable noise requirements and that there would be no unacceptable or adverse impacts to the surrounding area.
- Peace Valley Generation, LLC - Assessment of noise related impacts of a proposed 1250 MW natural gas-fired combined cycle power generating facility in Columbus, Georgia. The project included a baseline noise measurement program and noise modeling analyses designed to estimate projected noise levels during construction and operation of the facility. The results of the noise projection analyses were compared with local noise ordinances to demonstrate that the operation of the facility will comply with applicable noise requirements and that there would be no unacceptable or adverse impacts to the surrounding area.

- Augusta Energy - Assessment of noise related impacts of a proposed 800 MW natural gas-fired combined cycle power generating facility near Augusta, Georgia. The project included a baseline noise measurement program and noise modeling analyses designed to estimate projected noise levels during construction and operation of the facility. The results of the noise projection analyses were compared with local noise ordinances to demonstrate that the operation of the facility will comply with applicable noise requirements and that there would be no unacceptable or adverse impacts to the surrounding area.
- Ocean State Power - Assessment of noise related impacts of an existing 560 MW natural gas and oil-fired combined cycle power generating facility in Burrillville, Rhode Island. The project included a baseline noise measurement program and noise modeling analyses designed to estimate projected noise levels during construction and operation of the facility. The results of the analyses were compared with local noise ordinances and the results were described in National Environmental Policy Act (NEPA) documents, including an Environmental Impact Statement that was prepared for the project.
- Comprehensive analyses of noise impacts from various gas and oil fired combustion turbine installations at natural gas pipeline compression facilities in New York, Massachusetts, and Rhode Island. Investigations were primarily focused on the assessments of compliance with ambient noise standards and guidelines.

### ***Expert Testimony and Public Hearing Support***

- South Carolina Public Service Commission – Provided expert testimony at public hearings held for the licensing of a 1000 MW combined cycle generating facility being developed by Calpine in York County, South Carolina. As Project Manager for the environmental permitting of the proposed facility, the testimony involved all environmental media.
- South Carolina Public Service Commission – Provided expert testimony at public hearings held for the licensing of a 650 MW combined cycle generating facility being developed by GenPower in Anderson County, South Carolina. As Project Manager for the environmental permitting of the proposed facility, the testimony involved all environmental media.
- U.S. Department of Energy - Provided expert testimony on air quality issues at public hearings associated with fuel switching projects at five major electric generating facilities in New Hampshire, Pennsylvania, Massachusetts, and Virginia.

- Various industrial facilities (confidential clients) - Provided expert testimony during depositions, preliminary hearings, and court proceedings for air quality issues associated with industrial accidents, proposed new construction of facilities, and citizen lawsuits for facilities located in Ohio, Mississippi, Virginia, Florida, and South Carolina.
- Ocean State Power - Expert witness for air quality permitting support during public hearings for a gas and oil fired power plant in Rhode Island. Participated in the public hearings that were required as part of the NEPA process.
- Various natural gas pipeline routings and modifications - Provided expert testimonial support on air quality issues for six different pipeline projects in the southeastern and northeastern U.S. Public hearings were required for these projects by FERC.

### ***Other Experience***

- Project Manager for the development of a facilities and infrastructure inventory for GlobalOne, a worldwide telecommunications firm. The project was conducted in 6 months and involved the on-site assessment of facilities and infrastructure at over 400 facilities in over 55 countries. The work was performed in support of GlobalOne's Year 2000 (Y2K) certification program.
- Comprehensive analyses of noise impacts from various gas and oil fired combustion turbine installations at power plants and gas pipeline compression facilities in New York, Massachusetts, and Rhode Island. Investigations were primarily focused on the assessments of compliance with ambient standards and guidelines.
- Development of a comprehensive industrial cogeneration feasibility assessment model for electric utilities. The model was developed as an analysis tool to aid utilities in the assessment of cogeneration potential among large customers of an electric utility by performing engineering and economic evaluations of several types of cogeneration systems which could be used to meet some or all of the thermal loads at a facility.
- Public Service Electric & Gas Company (New Jersey)-Assessment of industrial cogeneration potential for PSE&G's industrial customer base in New Jersey. The assessment utilized a specially developed feasibility assessment model designed expressly for this purpose. Over 200 of PSE&G's customers were assessed.

### ***Recent Publications***

*Technical Guide for Estimating Fugitive Dust Impacts from Coal Handling Operations – Available from National Technical Information Service, Document No. DOE/RG/10312-1 (Volumes 1 and 2). 155 pages.*

*Early Site Permit Applications for Nuclear Power Facilities – Meteorology and Climatology.* Presented at the 2002 Annual Meeting of the American Nuclear Society, Hollywood, Florida, June 12, 2002.

*Monitoring and Verification for a Greenhouse Gas Reduction Project in Equatorial Guinea, West Africa.* Presented at the 2003 Annual Meeting of the Air and Waste Management Association, San Diego, California, June 24, 2003.

*Meteorological Considerations for Nuclear Power Plant Siting and Licensing.* Presented at the 2008 Annual Meeting of the Air and Waste Management Association, Portland, Oregon, June 24, 2008.