

Patrick J. Rafferty, MSPH, CIH

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### *Summary*

- Over 35 years consulting experience in occupational health and safety.
- Over 29 years professional practice as a Certified Industrial Hygienist (CIH), addressing potential exposures to asbestos, lead, benzene, solvents and other hazardous materials.
- Recognized expertise and professional leadership in indoor environmental quality issues, including microbiological investigation, chemical decontamination and asbestos management.
- Designated expert witness in industrial hygiene, indoor air quality and public health.

### *Certification*

Certified Industrial Hygienist (Comprehensive Practice), American Board of Industrial Hygiene, No. 3187 (1986-Present).

### *Education*

M.S.P.H., Environmental Chemistry and Biology, 1978  
University of North Carolina, Chapel Hill, NC

B.S., Chemistry, 1975  
University of Delaware, Newark, DE

Continuing education in occupational health & safety, industrial hygiene, environmental chemistry, public health, risk assessment, indoor air quality, microbiology, building sciences, and related fields.

### *Affiliations*

American Academy of Industrial Hygiene, Diplomate, 1986-Present

American Industrial Hygiene Association, 1985-Present

- Task Force on Microbiological Remediation, 1999 to 2001
- Product Safety and Health Committee, 1995 to 2003
  - Secretary, 1998 to 2002
- Indoor Environmental Quality Committee, 1988 to 1994, 1997 to present
  - Chair, 1991 to 1992
  - Vice-Chair, 1990 to 1991
- Philadelphia Local Section, Director, 2011-2013

Immaculata University President's Council, 1997-2004

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## *Employment History*

### Rafferty & James, Devon, PA

- President 2001 to Present

### Clayton Environmental Consultants, Inc., Downingtown, PA

- Manager, Occupational Safety and Health 1996 to 1999
- Director, Indoor Air Quality 2000 to 2001

### Roy F. Weston, Inc., West Chester, PA

- Project Director 1994 to 1996
- Technical Director 1990 to 1994
- Senior Industrial Hygienist 1986 to 1990

### JACA Corporation, Fort Washington, PA

- Industrial Hygienist 1980 to 1986

### University of North Carolina, Chapel Hill, NC

- Research Assistant 1976 to 1978

### Ingersoll-Rand Research, Inc., Princeton, NJ

- Research Assistant 1975

## *Experience*

### *Mold investigations*

Directed an investigation to assess widespread mold damage to a 15-story luxury apartment building on Miami Beach. Provided executive-level consultation to ownership regarding options for remediating the building and its contents. Trained industrial hygienists and mechanical engineers to conduct assessments, prepare remediation scopes of work, and inspect the remediation process.

Provided indoor air quality and mold consultation regarding several high-rise apartment buildings in New York City. Conducted detailed inspections, collected digital photographic and video documentation, reviewed consulting reports and advised on causation and extent of mold damage and remediation options.

Investigated reports of water infiltration and fungal growth in a luxury garden apartment community on Long Island. When the initial findings revealed substantial hidden mold growth in wall cavities, worked with owner to develop a community-wide investigation and remediation program. Prepared specifications for mold removal, developed a scope of work for each apartment, collected evidentiary samples and photographs, and conducted quality assurance of remediation.

Inspected fire stations in Georgia regarding claimed injuries as a result of mold exposure. Conducted destructive inspections of five fire stations, collected photographic documentation, reviewed consulting reports and laboratory analyses.

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Investigated water infiltration and mold growth caused by multiple building envelope failures at a securities brokerage office. Worked with brokerage firm in negotiations with owner in correcting the water infiltration and mold damage.

Conducted investigations of mold growth caused by water infiltration for numerous homeowners. Identified areas of mold damage, prepared remediation workplans, verified the adequacy of mold remediation and, in some cases, collected evidentiary samples and specimens.

Directed a mold evaluation of a critical care wing of a metropolitan hospital in Georgia to determine the source of *Aspergillus* causing an outbreak of nosocomial Aspergillosis. Identified likely sources and reservoirs, and assisted the hospital in developing a remediation plan.

Conducted mold investigations related to water damage in owner-occupied homes, including physical inspection of the homes, preparation of remediation specifications, and quality assurance oversight of remediation.

Provided on-call mold and water damage investigations for leading national apartment owner/operators. Worked with property managers to identify and oversee corrective measures.

Conducted investigation of mold growth caused by defects in EIFS, stucco and other building envelope systems in townhouse communities. Identified locations of mold growth and water impact areas, and worked with architects and engineers to identify appropriate corrective actions.

Conducted mold investigation of pharmaceutical company headquarters following a high-pressure pipe burst and insufficient cleanup of water-damaged materials. Developed a plan for the removal of water- and mold-damaged materials.

#### *Disaster response*

Prepared and administered a site health and safety plan for the stabilization and investigation of a 40-story office building damaged in the World Trade Center attacks. Evaluated physical, chemical and biological hazards to personnel in a large-scale structural, architectural, and environmental investigation. Designed operating procedures for safely completing the required work under potentially dangerous conditions including fall hazards, structural instability and contamination.

Following an explosion and fire at a gasoline pipeline pumping station, conducted a hazard assessment and collected environmental samples for benzene and other contaminants to identify personal protection requirements based on analytical results.

Directed an investigation and cleanup of mold damage in a 22-story office building damaged by water used to fight a fire. Inspected the building, conducted interviews with eye witnesses and measured moisture content of building materials to assess paths of water movement through the building. Identified locations of mold growth on water-impacted building materials, and worked with an interdisciplinary team to develop specifications for remediation of the building.

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Following the rupture of a high-pressure hydronic line in a historic restoration project, conducted a water impact analysis for the developer. Produced graphic representation of water impact and remediation requirements and oversaw the remediation program.

Following a lightning strike and fire in a garden apartment building, conducted a water and mold investigation and provided consultation to the owner regarding water damage to the remaining structure. Catalogued the nature and extent of mold growth and insect infestation, provided cleanup objectives, and testified during arbitration hearing.

Completed a water impact assessment of an office building whose glass atrium was destroyed by a tornado. Identified materials requiring drying and dismantlement and/or removal.

Directed the emergency response to a 500-gallon PCB spill at a VA hospital. Directed emergency response operations, contamination assessment, and air monitoring near the adjacent occupied hospital, collected clearance samples to determine project completion, and prepared documentation for submittal to regulatory agencies, all with no interruption to hospital operations.

#### *Facility contamination assessments*

Directed a chemical contamination assessment as part of the decommissioning of a nuclear weapons systems manufacturing plant. Designed and managed a program to identify hazards posed by hazardous process residues. Developed contaminant-specific clearance criteria, remediation specifications, and sampling protocols to demonstrate the achievement of project objectives.

Investigated the misapplication of pesticides in a directory assistance center that had been evacuated because of acute illness among employees. Directed a contamination assessment to evaluate concentrations of pesticide ingredients on surfaces, prepared decontamination protocols, and collected samples to verify achievement of cleanup objectives.

Assessed the impact of a gasoline spill adjacent to offices of the United Mine Workers of America on the indoor air quality in the building. Collected air samples for benzene and other aromatic hydrocarbons, interpreted analytical results, and assisted in the design of engineering controls to mitigate the effects of vapors from the subsurface contamination.

Investigated the application of a pesticide that resulted in the evacuation of a suburban home. Collected samples for the pesticide and degradation products. Worked with toxicologist to develop field data in a manner that was useful to modeling of occupant exposures.

Responded to the release of lead-paint dust into a pre-school by a painting contractor. Worked with school administrators to communicate the process, as well as the associated risks involved in exposure, to parents. Identified the extent of contamination and appropriate procedures for decontamination, oversaw remediation, and collected samples to verify the success of the cleanup.

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Directed a contamination assessment of a gallium arsenide wafer manufacturing plant during the decommissioning of the plant. Developed a multi-tiered sampling and analytical strategy to assess the attainment of project-specific numerical cleanup objectives.

Investigated the contamination of a home following the misapplication of fungicides during a mold remediation project that left the home evacuated. Reviewed consulting reports, documents and statements to determine the nature of the contamination and provided input to an indoor exposure model, which was used to estimate past, present and future exposures.

#### *Other indoor air quality assessments*

Conducted an investigation to identify causes of air quality complaints at the headquarters of a leading consumer products company. Identified the airborne presence of a degradation product of a biocide used in the HVAC system, which corresponded to patterns of employee discomfort.

Completed an IAQ (Indoor Air Quality) investigation of US EPA laboratories in Chicago. Conducted interviews with building management, designed sampling and analytical strategies to identify the source of airborne particulate matter. Identified and provided recommendations for controlling the source of the particulate, and presented findings to EPA personnel and managers.

Conducted investigation of indoor environmental conditions in a Philadelphia row home in response to allegations of sewer gas odors following the installation of a satellite dish on the home's sewer vent stack. Identified several other conditions more likely to cause the reported odors.

Conducted pro-active indoor air quality assessments for educational services firm. Designed and implemented inspection and testing protocols to identify anomalies in air quality parameters as an early indication of potential problems. Collected samples for a wide variety of indoor air contaminants, including carbon monoxide, ozone, nitrous oxides and formaldehyde. Worked with facility managers to further investigate and correct air quality concerns at their source.

#### *Occupational exposure assessments*

In response to elevated incidence of leukemia and leucopenia in South America's largest petrochemical facility, designed and implemented a multi-year evaluation of employee exposure to benzene and other chemical stressors for the refinery owner. Identified homogeneous exposure groups, directed personal exposure sampling, conducted statistical analysis of results, and provided recommendations for reducing employee exposures. Directed the establishment of the first Brazilian laboratory to be designated proficient in the AIHA Proficiency Analytical Testing Program.

Conducted an exposure evaluation of organic compounds in a new pipeline maintenance product for a regional utility. Designed and managed a program to evaluate exposures by field crews repairing leaking natural gas lines. Conducted a document review and designed a test program to narrow the chemicals of interest to those exhibiting the greatest toxicity and potential for exposure. Conducted simulations and field-testing to benchmark employee exposures and ensure the adequacy of engineering controls and protective equipment.

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Characterized occupational exposures of workers in municipal recycling facilities for an industry trade group. Conducted literature review, designed sampling protocol, inspected facilities, and monitored employee exposures for chemical and physical hazards.

Conducted historical exposure estimation of asbestos exposure of workers in shipyards, refineries, power plants and other locations. Reviewed qualitative descriptions of the activities performed, estimates of the duration of exposure, and descriptions of the workplace to develop estimates of worker exposure to airborne asbestos fibers. Compared these estimates to estimates of background asbestos exposures in the general environment.

Served as health and safety manager for hazardous waste cleanup sites. Prepared site health and safety plans that specified engineering and administrative controls, personal protective equipment, air monitoring, and action levels for a wide variety of sites involving organic and inorganic chemical wastes and contaminated soils and structures.

Conducted risk/benefit analyses of proposed OSHA regulations for OSHA's Office of Regulatory Analysis. Estimated anticipated illness and injuries averted and costs incurred under current and proposed standards, including hazard communication, cranes, lead, cadmium, and butadiene.

Designed and completed a product evaluation of high-efficiency particulate-air filtration systems for automotive repair. Designed a test protocol for simulated and actual use of vacuum cleaners and brake repair glove boxes to determine their efficacy in capturing airborne asbestos fibers.

#### *Occupational health and safety audits*

Conducted OSHA audits of oil extraction on Alaska's North Slope for a major oil company. Conducted management systems assessments comparing the roles, responsibilities, resources, and communications of field operations against regulations and corporate policies and procedures.

Conducted OSHA audits for a wide range of chemical and manufacturing companies. Evaluated OSHA compliance and related liability issues at refining, formulating, manufacturing and service operations, and developed and assisted in the implementation of compliance programs.

Directed an OSHA compliance audit of Freshkills Landfill, the world's largest municipal landfill. Audited compliance with construction and general industry regulations, and recommended improvements in engineering controls, personal protection, and operating procedures.

#### *Asbestos management*

As the technical coordinator of the US EPA's Asbestos Action Resource Group, coordinated the development of technically feasible strategies for federal and state government implementation of the Asbestos Hazard Emergency Response Act of 1986 (AHERA), including identification of asbestos-containing materials, exposure assessment, and exposure control strategies.

Served as technical consultant in the drafting of Philadelphia's asbestos control regulations.

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Provided technical direction and oversight of comprehensive asbestos surveys of U.S. Army installations in the U.S. and Germany. Developed technical approach, trained survey teams, provided quality assurance, and directed the development of data management systems.

Conducted literature review and analysis for an industry coalition regarding an administrative stay of the 1994 OSHA Asbestos Standard. Evaluated the sufficiency of scientific evidence that OSHA had used to enact its ban on aerosol brake cleaning products as part of its 1994 revision of the General Industrial Asbestos Standard.

Managed and directed a multi-year on-call project to provide comprehensive asbestos management services to the Philadelphia Department of Public Property, which was responsible for more than 1,000 city-owned buildings. Provided rapid-response services in hazard assessment, abatement project monitoring and inspection, and specifications development, enabling city services to continue with a minimum of interruption during renovation and abatement activities.

Served as technical consultant to US EPA Superfund project in evaluating community exposure to asbestos from tailing piles in a downtown area. Designed a sampling strategy and analytical protocol to assess release rates of fibers from the piles and to develop exposure profiles in the community.

Provided quality assurance oversight of emergency asbestos inspections at over 30 New York City schools. Designed rubrics for inspector qualifications, inspection performance, chain of custody documentation and report preparation. Trained inspectors in conduct and documentation to ensure uniform and reliable inspections.

Conducted asbestos surveys of hundreds of industrial, commercial and residential buildings. Delineated the scope of work, identified and collected samples of potential asbestos-containing materials, prepared reports and recommended corrective actions.

Directed a team of industrial hygienists providing comprehensive asbestos management consulting services for a leading environmental consulting firm. Developed protocols for conducting asbestos inspections, preparing abatement specifications, conducting quality assurance oversight of abatement, collecting and interpreting clearance samples, and preparing asbestos management plans.

#### *Public health assessments*

Designed air monitoring programs for residences affected by underground gasoline pipeline leaks and subsequent groundwater contamination. Developed and oversaw quality assurance programs for sampling and analysis of benzene and other hydrocarbons. Provided consultation in the development of residential remediation strategies.

Provided public health consultation to address the potential for lead-containing dust during the demolition of over 1,000 row houses in Baltimore, MD. Developed demolition protocols and environmental monitoring strategies and criteria, and presented them in public meetings.

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Conducted ambient air quality monitoring pre- and post-construction for transportation hubs. Collected samples and provided real-time monitoring for a variety of air pollutants, including particulate matter, nitrous oxides, ozone, carbon monoxide and polynuclear aromatic hydrocarbons.

Provided health and safety oversight of corrective actions at a PCB-contaminated Superfund site. Developed a contractor health and safety plan to support the remediation of PCB-contaminated structures, equipment and soils. Developed protocols for background, personnel, and perimeter monitoring for a variety of contaminants.

Provided industrial hygiene support for the design of a submerged quench incinerator to treat hazardous wastes containing highly toxic herbicides and heavy metals. Provided technical support to architects and design engineers in contaminant control, decontamination protocols, levels of protection, and standard operating procedures.

#### *Water Quality*

Constructed and operated a pilot-scale sewage treatment plant to test a new technology for sludge separation based on micro-bubble aeration of the effluent stream. Collected water and waste samples and conducted wet-chemical tests for basic water quality parameters.

Designed, constructed and operated a bench-scale water treatment system to evaluate the effectiveness of a new treatment technology in reducing boiler scale. Collected and analyzed water samples for basic water quality parameter using wet chemical methods.

Conducted laboratory experiments to ascertain the impact of suspended soil particles in drinking water sources on the production of halomethanes in drinking water. Collected source water and drinking water samples and conducted gas chromatographic analysis of halomethanes.

For the US EPA Office of Drinking Water, analyzed the correlation between industrial contaminants in drinking water with the incidence of various types of cancer in the population served by the drinking water. Used novel methods to assess contamination status and regression analysis to evaluate the correlation between water contamination and cancer incidence.

Developed a guidance document on environmental regulations and technologies for the electroplating industry for the US EPA Office of Water. Researched and presented information for facility operators on new water and waste regulations and compliance strategies.

For the US EPA's Office of Water, prepared guidance documents for local water management officials on issues impacting freshwater lakes. Provided recommendations on water quality monitoring, nutrient control, restoration of eutrophic lakes and sustainable development.

As part of a pro-active indoor environmental quality management program, collected drinking water and air quality samples in leased office space. Inspected premises for indicators of degraded air and water quality and provided recommendations for any issues identified.

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Investigated the potential causes of employee illness in a 2,000-employee office building. Conducted interviews with affected employees and property management personnel, conducted physical inspections and chemical and microbiological testing for suspected contaminants, including *Legionella* in drinking water and cooling water. Worked with the occupational physician to evaluate possible links between air and water quality and manifestations of illness.

Investigated consumer health complaints lodged with a spa chemicals manufacturer using a new water treatment technology. Collected and analyzed samples, administered questionnaires, and worked with a physician and toxicologist to characterize the components of the treatment system with respect to their potential for adverse health impact on spa users.

Managed an emergency response to a suspected outbreak of Legionnaire's Disease in a government office building. Collected water samples from drinking water, cooling water and condensate water for identification and DNA characterization of *Legionella* bacteria. Prepared cleaning protocols and a long-term water quality management program.

### *Training*

Designed and delivered IAQ training for facility managers at a large urban energy utility. Presented courses in pro-active IAQ management, including topics such as ventilation assessment, combustion products, product emissions and microbiological growth.

Designed and delivered training in mold prevention and response to apartment management and maintenance staffs for a nationwide apartment owner/manager. Trained over 600 personnel in procedures for responding to reports of water damage and mold growth in buildings.

Delivered OSHA-required training in hazardous waste operations and emergency response, asbestos inspection and abatement oversight, and hazard communication to a wide variety of audiences.

### *Presentations*

P. . Rafferty, A. Prieto, P. Johnson, P. Harnett, "Ethics and the Industrial Hygienist." Professional Development Course Presented at the American Industrial Hygiene Association, Princeton, NJ, 2013.

P.J. Rafferty, G. McCluskey, B. Silverstein and C. Schneider, "Starting and Growing a Consulting Practice." Presented at the American Industrial Hygiene Association Professional Development Course, Villanova, PA, 2012.

P.J. Rafferty, "Introduction to Industrial Hygiene." Presented at Penn State University Brandywine Campus, 2012.

P.J. Rafferty, "The Science Behind Mold Investigation." Presented via an on-line webinar hosted by TASA Group, 2011.

P.J. Rafferty, "Occupational Health and Safety in the 21<sup>st</sup> Century." Presented at Villanova Law School, Villanova, PA, 2010.

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P.J Rafferty, "Health and Safety Implications of Remediation." Presented at Mealey's National Mold Litigation Conference, Los Angeles, CA, 2005.

P.J Rafferty, "Technical Analysis of IICRC S520." Presented at Mealey's National Mold Litigation Conference, Orlando, FL, 2004.

P.J. Rafferty, "Building Investigation and Remediation—the Industrial Hygienist's Perspective." Presented at the National Multi-Housing Council Mold Conference. Naples, FL, 2002.

P.J. Rafferty, "Assessing and Correcting Mold Contamination in Buildings." Presented at the Tampa Bay American Industrial Hygiene Association Local Section Meeting. Tampa, FL, 2001.

P.J. Rafferty, "Criteria for Completion of Fungal Remediation Projects." Presented at the American Industrial Hygiene Conference and Exposition. Toronto, ON, 1999.

P.J. Rafferty and R. Warwick. "Decommissioning of Industrial Buildings." Professional development course presented to the Environmental Information Association. Las Vegas, NV, 1996.

Rafferty, P.J., L. Smith, and R. Warwick. "Considerations for an Effective Building Decommissioning." Professional development course presented at the American Industrial Hygiene Conference. Washington, DC, 1996.

Rafferty, P.J. "How to Inspect HVAC Systems to Assure Air Quality." Presented at the American Society of Heating, Ventilation and Air-conditioning Engineers. Philadelphia, PA, 1993.

Rafferty, P.J. and E. Light. "IAQ Guidelines: Limitations and Alternatives." Presented at the American Society of Heating, Ventilation and Air-conditioning Engineers Annual Meeting. San Francisco, CA, 1992.

Bauckham, T. A., P. J. Rafferty, and M. Bradshaw. "Human Exposures to Physical, Chemical, and Biological Agents during Remedial Investigations at an Abandoned Army Chemical Agent Production Facility." Presented at the American Industrial Hygiene Conference, Boston, MA, 1992.

Rafferty, P.J. "Indoor Air Quality: Problems and Solutions." Presented to the Consumer Federation of America. Washington, DC, 1990.

Rafferty, P.J. "Protocol for Initial Investigations of Air Quality." Presented to the Air and Waste Management Association. Anaheim, CA, 1989.

Rafferty, P.J. and R. Ruch. "Indoor Air Quality Investigation: A Case Study." Presented to the Air and Waste Management Association, Anaheim, CA, 1989.

"Practitioner's Guide to Indoor Air Quality Investigations." Presented at the International Symposium on Indoor Air Quality. St. Louis, MO, 1989.

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*Publications*

E. C. Gunderson, Editor. "The IAQ Investigator's Guide, 3<sup>rd</sup> Edition." American Industrial Hygiene Association. Fairfax, VA, 2016. Contributor.

E. C. Gunderson, Editor. "The IAQ Investigator's Guide, 2<sup>nd</sup> Edition." American Industrial Hygiene Association. Fairfax, VA, 2006. Contributor.

L.L. Hung, J.D. Miller, and H.K. Dillon, Editors. "Field Guide for the Determination of Biological Contaminants in Environmental Samples" 2<sup>nd</sup> Edition. American Industrial Hygiene Association. Fairfax, VA, 2005. Chapter Author.

Rafferty, P.J., Editor. *Guide to Indoor Air Quality Investigations*. American Industrial Hygiene Association. Fairfax, VA, 1994.

Rafferty, P.J. "The Industrial Hygienist and Indoor Air Quality". *Indoor Air Review*, 1991, p.8.

Rafferty, P.J. "Indoor Air Quality: Managing the Liabilities". *The Legal Intelligencer*. February 7, 1991, p. 4.

Rafferty, P.J. "Cure for a Sick Building". *Asbestos Sourcebook*, 1990. p. 29-31.

Rafferty, P.J. "Practitioner's Guide to Indoor Air Quality Investigations". in "Proceedings of the International Symposium on Indoor Air Quality". American Industrial Hygiene Association. Akron, OH, 1989.

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Rafferty, P.J. and R. Ruch. "Indoor Air Quality Investigation: A Case Study". Conference Proceedings of the Air and Waste Management Association, 1989.

Rafferty, P.J. "Safety Incentives." *Harvard Business Review* 85(6), p. 226, 1985.

Rafferty, P.J. "Methylene Chloride." *American Industrial Hygiene Association Journal* 46 (9), p. B-24, 1985.

Rafferty, P.J. "Public Health Impact of the Chlorofluorocarbon Ban," in Ando, F. "The Economic Impact of Regulating Chlorofluorocarbon Emissions from Aerosol Products." US EPA Office of Pesticides and Toxic Substances, 1982.

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Taylor, M.R. and P.J. Rafferty, "Demolition Safety Manual." (Chicago: National Association of Demolition Contractors, 1981).

Rafferty, P.J., "Safe Use of Cutting Torches." Demolition Age, June 1981.