82660

PASSAIC RIVER STUDY AREA

RI/FS WORK PLANS

Site Management Plan

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Remedial Investigation Work Plan

Site Management Plan

for the

Passaic River Study Area

January 1995

23508-22089/R13.TS 01-04-95(2:56pm)/RPT/8

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1.0
SCOPE OF PLAN

This Site Management Plan (SMP) for Passaic River Study Area Activities has been prepared pursuant to Section B.3 of Appendix I of the Administrative Order on Consent (AOC) Index No. II - CERCLA-0117 in the matter of the Diamond Alkali Superfund Site (Passaic River Study Area).

The SMP identifies major contractors and their subcontractors to Maxus performing on behalf of Occidental Chemical Corporation (OCC), for remedial investigation, human and ecological risk assessment, and feasibility study activities on the Passaic River Study Area. The SMP also identifies key employees expected to participate in the work and describes their respective responsibilities. The Quality Assurance Project Plan (QAPP) Section 2 provides a description on the project organization, project position titles, and responsibilities. The Health and Safety Contingency Plan (HASCP) provides the Health and Safety organizational and structure and description of position requirements.

Remedial Investigation activities, as described in Sections 34 through 38 of the AOC, include the following:

1. Submission of a detailed Remedial Investigation Work Plan (RIWP) for the performance of a Remedial Investigation (RI) for the Site. The RIWP shall include a reasonable schedule for the performance of the tasks comprising the RI. The RIWP shall include the following:

    - a Site Management Plan (SMP);
    - an Investigation Work Plan (IWP);
    - a Field Sampling Plan (FSP);

- a Quality Assurance Project Plan (QAPP); and
- a Health & Safety/Contingency Plan (HASCP).

2. Performance of the RI.

3. Submission of an RI Report detailing the results of the RI.

Human and ecological risk assessment activities, as described in Section 39 of the AOC will include the following:

1. Completion of the screening level (first three parts) Human and Ecological Risk Assessment (HERA).

2. If EPA determines that field sampling is not needed, submission of the HERA Report.

3. If EPA determines that insufficient information is available to complete the HERA, field sampling will be performed. An Ecological Sampling Plan (ESP) will be submitted.

Feasibility study (FS) activities, as described in Sections 40 through 44, will include the following:

1. Submission of the Feasibility Study Work Plan (FSWP).

2. Performance of the FS.

3. Submission of a FS Report.

Procedures for updating/revising the SMP for the addition of or change in contractors or key employees involved in the administration, remedial investigation and feasibility study (RI/FS) activities are discussed in Section 3.0 of this document. A description of how public health will be protected and how public and private property impacts will be minimized during implementation of the RI/FS work is provided in the HASCP. Procedures for maintaining records of persons authorized to work on the Passaic River Study Area and maintenance of a daily log of the names of project related visitors entering the Passaic River Study Area is given in HASCP Section 7.10. Procedures for storing equipment at the end of the workday to prevent unauthorized removal or vandalism are provided in FSP, Section 2.2. Requirements for establishing work zones both on the water craft and on the shore are provided in HASCP Section 8.4.

2.0
CONTRACTOR AND SUBCONTRACTOR IDENTIFICATION

Pursuant to the terms of the April 20, 1994 AOC, OCC is responsible for the performance of RI, HERA and FS activities for the Passaic River Study Area of the Diamond Alkali Superfund Site in New Jersey. Maxus is implementing the AOC on OCC's behalf and Mr. Richard McNutt of Maxus is the Facility Coordinator responsible for the activities of all contractors and their subcontractors working on the project. Mr. Scott Burton of Maxus is the Alternate Facility Coordinator. The project Quality Assurance Officer (QAO) is yet to be identified. The identity and qualifications of the QAO will be provided to the EPA and the state.

The project organization for the Passaic River Study Area activities is shown on Figure 2-1 of the QAPP. Major contractors and subcontractors to be utilized on the project are:

- Sediment Characterization: EA Engineering, Science and Technology, Inc. (EA)
- Human and Ecological Risk Assessment: ChemRisk, Division of McLaren Hart
- Sediment Mobility Modeling: EA
- Feasibility Study: EA
- Sediment Mobility Subcontractor: Simons & Associates, Inc.

- Vibracoring Subcontractor: (to be identified)
- Piezocone Subcontractor: (to be identified)
- Marine Services Subcontractor: (to be identified)
- Marine Surveying/Hydrography Subcontractor: (to be identified)
- Analytical Chemistry Laboratories:
  - Coast to Coast Analytical Services, Inc.
  - Alta Analytical Laboratory
  - S-Cubed
  - Lancaster Laboratories
- Radiochemical Laboratory
  - Teledyne Isotopes

2.1 SEDIMENT CHARACTERIZATION, SEDIMENT MOBILITY MODELING, AND FEASIBILITY STUDY - ENGINEERING, SCIENCE AND TECHNOLOGY, INC. (EA)

Sediment Characterization, Sediment Mobility Modeling and the Feasibility Study (FS) will be performed by EA Engineering, Science and Technology, Inc. (EA) as a contractor to Maxus. EA will also provide validation of data obtained by other contractors and reporting of progress to the Agency. A description of the qualifications of EA is presented in Appendix A-1. The key personnel on the project will include James Zarzycki - Project Director; Richard K. Peddicord - Project Manager; and Robert Cypher - Project Quality Assurance/Quality Control Officer.

Mr. James Zarzycki will be the EA Project Director. He is responsible for overall direction of the project including conformance to the contractual scope of work, review of project work and deliverables, and maintenance of communications with Maxus and appropriate governmental agencies.

Dr. Richard K. Peddicord will be the EA Project Manager. He is responsible for coordination between the various tasks, maintenance of communication channels between Maxus, governmental agencies, subcontractors and EA technical personnel, conformance to project schedules, and issuance of the plans and reports required by the Statement of Work (Appendix I of the AOC).

Mr. Robert Cypher will be the Project Quality Assurance/Quality Control Officer for EA's activities. His responsibilities will include implementing the project quality assurance program, auditing of the project and taking corrective action as necessary.

Resumes of all key responsible EA personnel identified above are included in Appendix A-2 to this Plan.

2.2 HUMAN AND ECOLOGICAL RISK ASSESSMENT - CHEMRISK

Human and Ecological Risk Assessment will be performed by ChemRisk of Portland, Maine as a contractor to Maxus. A description of the firm's capabilities is provided in Appendix B-1 to this plan.

Key personnel for ChemRisk on this project will be Timothy J. Iannuzzi, Dr. Brent L. Finley, and Dr. Dennis J. Paustenbach. Resumes for these personnel are included in Appendix B-2 of this plan.

2.3 SEDIMENT MOBILITY - SIMONS & ASSOCIATES, INC.

Sediment mobility activities associated with the Sediment Mobility Modeling Task will be performed by Simons & Associates, Inc. of Fort Collins, Colorado under the technical direction of EA. A description of the firm's capabilities is provided in Appendix C-1 to this Plan.

Key personnel for Simons & Associates, Inc. on this project will be Dr. Daryl B. Simons and Dr. Robert K. Simons. Resumes for these personnel are included in Appendix C-2 of this Plan.

2.4 VIBRACORING - (to be identified)

Vibracoring will be performed by contractors under the technical direction of EA. Prior to implementation of vibracoring activities, the vibracoring contractor(s) will be identified and a description of the firm's capabilities, identification of key personnel and their respective responsibilities, and resumes of key personnel will be provided to the EPA and the State.

2.5 PIEZOCONE - (to be identified)

Piezocone testing will be performed by contractors under the technical direction of EA. Prior to piezocone testing, the piezocone testing contractor(s) will be identified and a description of the firm's capabilities, identification of key personnel and their respective responsibilities, and resumes of key personnel will be provided to the EPA and the State.

2.6 MARINE SERVICES - (to be identified)

Marine services, such as the use of watercraft, will be performed by a contractor under the technical direction of task contractors. Prior to activities requiring marine services, the marine services contractor(s) will be identified and a description of the firm's capabilities, identification of key personnel and their respective responsibilities, and resumes of key personnel will be provided to the EPA and the State.

2.7 MARINE SURVEYING/HYDROGRAPHY - (to be identified)

Surveying/hydrography services will be performed by a contractor under the technical direction of task contractors. Prior to activities requiring marine surveying/hydrography, the surveying/hydrography contractor(s) will be identified and a description of the firm's capabilities, identification of key personnel and their respective responsibilities, and resumes of key personnel will be provided to the EPA and the State.

2.8 ANALYTICAL CHEMISTRY LABORATORIES

Analytical laboratories will be utilized for chemical analyses and studies required during remedial investigation, human and ecological risk assessment, and feasibility study activities. Depending upon the analyses required, the following laboratories may be utilized:

a. Polychlorinated dibenzo-p-dioxins (PCDD)/polychlorinated dibenzofurans (PCDF) Analysis Laboratories

   1. Coast to Coast Analytical Services, Inc.; - Indianapolis, Indiana
   2. Alta Analytical Laboratory - El Dorado Hills, California

b. Laboratories For Other Chemical Analysis

1. S-Cubed - San Diego, California
2. Lancaster Laboratories - Lancaster, Pennsylvania

Brief descriptions of the capabilities of the laboratories and resumes of key personnel are included in Appendixes D through G of this Plan.

2.9 RADIOCHEMISTRY LABORATORY

Teledyne Isotopes will be utilized for radiochemistry analyses and studies during sediment characterization activities. A brief description of the capabilities of the laboratory and resumes of key personnel are included in Appendix H of this Plan.

3.0
PLAN UPDATES

It is a requirement of this Plan that the EPA and the State be notified within 28 calendar days of any changes in the identification and/or responsibilities of key personnel or subcontractors identified in this Plan.

Notification shall be directed to the addresses and individuals listed below:

1) EPA (2 copies)

Chief, New Jersey Superfund Branch - 2
Emergency and Remedial Response Division
United States Environmental Protection Agency
Region II
26 Federal Plaza
New York, New York 10278

Attention: Diamond Alkali Project Manager
Passaic River Study Area

2) State and/or NJDEP (2 copies)

Diamond Alkali Project Manager - Passaic River Study Area
New Jersey Department of Environmental Protection
Division of Hazardous Waste Management
401 East State Street, 5th Floor
CN-028
Trenton, New Jersey 08625-0028

Attention: Mr. Nicholas Marton

3) Diamond Alkali Site Attorney (1 copy)

Chief, New Jersey Superfund Branch
Office of Regional Counsel
United States Environmental Protection Agency
26 Federal Plaza
New York New York 10278

Attention: Diamond Alkali Site Attorney
Passaic River Study Area

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Site Management Plan
Revision No. 1.0
January 1995

APPENDIX A

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

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APPENDIX A-1
DESCRIPTION OF QUALIFICATIONS

EA Overview

- Environmental assessments and management
- Investigation and characterization of contaminated sites
- Remedial design
- Pollution prevention plans
- Remedial action and restoration
- Compliance programs
- Waste management and waste minimization programs
- Human health and ecological risk assessment and risk management
- Energy and water resource planning
- Analytical and toxicological laboratory services
- Regulatory liaison, community relations, expert testimony

EA provides planning, scientific, engineering, remediation, and analytical services to characterize and resolve environmental problems. Our two decades of success have been built upon our excellence, responsiveness, and ability to solve problems.

EA investigations are planned to yield results which not only characterize the nature and extent of environmental problems, but which also provide a firm basis for focused remedial design and successful remedial action. We have a track record of successfully integrating the results of multidisciplinary studies to yield solutions which are technically sound and economical. Our capabilities in the area of human and ecological risk assessment provide a unique dimension which allows us to prioritize problems in a logical fashion...producing significant cost savings at both the investigation and remedial action phase. We have the staff and resources needed to conduct field studies and analyses that address regulatory and business requirements and to support permitting in air, water, siting, and waste management.

Supporting our project teams are: EA Laboratories' sophisticated analytical/environmental chemistry, biology, and aquatic toxicology services; field and engineering test equipment; and the construction experience of EA Remediation Technologies.

Our staff employs the most advanced, proven, and cost-effective technologies available in conducting studies and implementing solutions. Our experience includes hazardous waste sites, petroleum storage and production facilities, industrial waste and cooling water effluents, water diversions, natural resources, solid waste facilities, alternative energy sources and technology, energy conservation, and air emissions.

- Risk management studies
- Ecological and human health risk assessment
- Community relations/ risk communications
- Product licensing and approval submissions
- Comprehensive environmental programs
- NPDES and related water permit applications
- Air compliance and regulatory submittals
- Natural Resource Damage Assessments
- Water quality and sediment assessment and permitting
- Review critique, and comment of proposed regulations

EA Risk Assessment and Management

EA assists clients in evaluating environmental action alternatives for areas of suspected contamination, planned development and redevelopment, and process changes.

Our nationally recognized professional toxicologists, ecologists, and health professionals assess environmental, ecological, and human health risks, identify hazardous waste issues that affect environmental decisionmaking, such as selecting remedial alternatives, and develop the underpinnings for environmental permitting and reducing risks and the concomitant liability issues.

Our scientists and engineers have the experience needed to negotiate and secure air and water permits as well as the issues associated with contaminated sediment management.

- Clean Water Act
- Safe Drinking Water Act
- RCRA
- Clean Air Act
- CERCLA
- Underground storage tank projects

EA Laboratories

EA has recently completed construction of a 17,000 ft^2 analytical chemistry laboratory that specializes in the highly structured and rigorous testing of environmental samples. EA Laboratories has the capacity to process concurrent samples from several complex sites.

EA Laboratories maintains a comprehensive set of certifications from State and Federal government agencies. Quarterly monitoring programs, specific investigations, and analyses that require expert interpretations are integral parts of day-to-day operations. All environmental regulatory programs are supported. EA Laboratories specializes in providing customized analyses that meet the challenges and unique needs of sites with environmental problems or permitting requirements.

Our staff of trained technicians and professional chemists is committed to the highest quality performance on each and every task. This commitment is reinforced by a team approach that is based on effective communication between clients and EA project managers.

- CERCLA, RCRA, and SARA services
- Hazardous waste remedial design and construction-phase services
- Contaminated sludge
- Manufactured gas site studies/remediation
- Solid waste management
- Waste minimization
- OSHA compliance
- Asbestos surveys, remediation oversight
- Real property transfer assessments
- Wastewater process engineering

EA Waste Management Services

Generating waste leads to the need for environmental management: of the waste stream itself, of the processes used to manage it, of the sites where disposal and treatment take place. EA's waste management professionals plan and design the management of solid and hazardous wastes, evaluate sites suspected to have contamination, and design facilities for managing and treating wastes and remediating sites found to have contamination.

EA's remedial investigation/feasibility studies experience includes sites identified under CERCLA and RCRA programs. Our engineers, physical scientists, and chemists work closely with risk assessment professionals to develop designs that manage risks, tying engineering decisionmaking to scientific information to focus action and obtain results.

- NEPA documentation
- Licensing and permitting
- Water rights and instream flow
- Comprehensive resource management and planning
- Mitigation planning and implementation
- Monitoring and sampling programs
- Public participation and public relations
- Regulatory assistance and compliance audits
- Consultation, negotiation, and dispute resolution

EA Environmental Assessment and Management

Effective management of natural resources, and the human demands placed upon those resources, requires a sound understanding of the physical, biological, and social processes that form the system and a recognition of the interrelationships that drive those processes. EA helps its clients make informed resource management decisions based on science and systems analysis as an approach to problem solving.

EA develops innovative management solutions which improve the quality of our lives by protecting and enhancing the quality of our natural environment.

EA designs and conducts interdisciplinary studies and supports client needs related to impact assessment, resource management, ecological evaluations, regulatory compliance, and facility siting and licensing. EA's technical and regulatory expertise is supported by extensive experience with agency consultation, public participation, and other forms of communication and documentation frequently needed to facilitate implementation of clients' projects.

EA Strategic Energy and Environmental Consulting

EA develops strategies and provides support for the integration of environmental and energy considerations into business planning. We specialize in environmentally sensitive management of facilities, vehicle fleets, and water resources. We provide litigation support for a wide range of environmental issues.

Pollution prevention services aid clients in reducing use of hazardous materials and generation of hazardous wastes through cost-effective engineering and managerial initiatives.

Energy services focus on fuel selection, transportation planning, and industrial use/generation alternatives.

Compliance services aid corporate and industrial managers in assuring environmental compliance of their facilities, in estimating costs of future compliance, and in program planning to support improved environmental management.

Computer services feature database management and geographical information systems (GIS). Computer models of physical processes and of ecological and economic systems are used to minimize cost of compliance and thoroughly explore compliance options.

Water resources engineering and management professionals provide a wide spectrum of technical and permitting services.

- **Pollution prevention plans**
- **Industrial process selection**
- **Alternative fuels implementation planning and implementation**
- **Transportation options and fleet planning**
- **Industrial energy use and generation options**
- **Cogeneration and power production**
- **Compliance audits**
- **Compliance plans, manuals, and training**
- **Database and GIS development**
- **Stormwater management and permitting**
- **Water quality, hydrodynamics and dispersion modeling**
- **Effluent dilution studies**
- **Bridge/culvert hydrologic and hydraulic evaluation**

EA Petroleum Environmental Services

EA applies technology and experience to client needs in meeting the federal, state, and local regulations pertaining to petroleum contamination related to under- and aboveground storage tanks.

For the owners and operators of tank facilities ranging in size from corner retail stations to complex fuel handling facilities and storage terminals, EA has programs for management of fuel environmental audits, compliance, site assessments, feasibility studies, remedial design, remedial action plans, and remedial design. In addition, we provide design and oversight of tank removal/replacement programs.

- **Compliance audits/inspections**
- **Compliance management programs**
- **Site assessments**
- **Underground and surface investigations**
- **Hydrocarbon fate and transport analysis**
- **Feasibility studies/remedial action plans**
- **Treatability and pilot studies**
- **Design and permitting of remedial systems**
- **Oversight of tank removals and closures**

EA Remediation Technologies, Inc.

EA has a proven record in successfully implementing site cleanup throughout the United States. A major advantage in our approach is the close partnership which has been built among our remediation, laboratory, engineering, and science staffs. This partnership ensures sound planning and executing remedial activities with the ability to quickly resolve any regulatory or engineering issues that might surface in the field.

Our nationwide base and strong project management capability along with our comprehensive training and the depth of our staff (presently EA RTI field personnel have an average of 17 years of construction experience) provide the client with the confidence that we will get the job done, and done right.

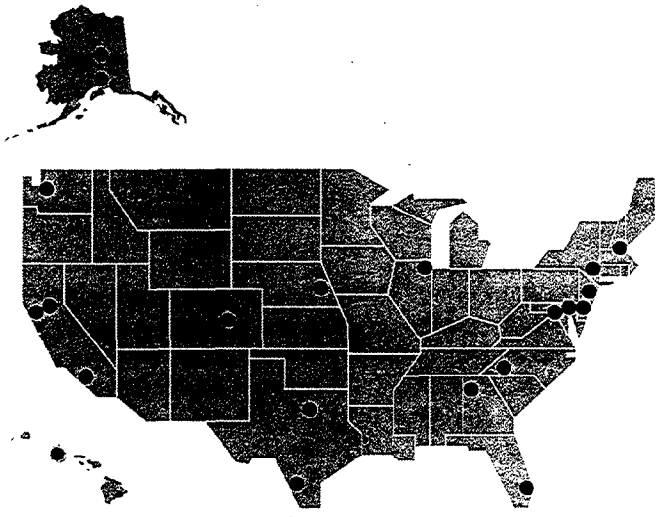
EA RTI offers convenience and cost savings—and real internal synergies to create a successful project.

- **Waste site remediation/restoration**
- **Biological remediation**
- **Facilities decontamination/demolition**
- **Storage tank removal, replacement, upgrade, and closure**
- **Recovery treatment systems for ground water and soils**
- **Onsite incineration**

EA Overview

EA Offers

- Environmental management
- Environmental conditions surveys
- Environmental impact statements
- Ecological and human health risk assessments
- Facilities compliance & permitting
- Recreational studies
- Wetlands delineation
- Natural resource damage assessments
- Pollution prevention
- Hazardous and toxic materials management
- Solid waste management & design
- Storage tank assessments & remediation
- Air quality management
- Water quality management
- Biomonitoring
- Water resources management
- Water and Wastewater engineering
- Fuel applications/ alternative fuels
- Renewable energy systems
- Onsite power generation/ cogeneration
- Industrial hygiene
- Health & safety programs
- Analytical chemistry
- Aquatic toxicology
- Regulatory liaison
- Permitting assistance
- Modeling/GIS



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EA Risk Assessment and Management

EA Strategic Energy and Environmental Consulting

EA Petroleum Environmental Services

EA Waste Management Services

EA Remediation Technologies, Inc.

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APPENDIX A-2
RESUMES OF KEY PERSONNEL

J.H. (Jim) Zarzycki, P.E.
Vice President and
Director of Waste Management Services

Mr. Zarzycki, an engineer with 22 years of experience, has specialized in environmental engineering management, hazardous waste contamination investigations and remediations, and the specifications of materials and equipment to protect personnel in toxic environments. He has managed numerous hazardous waste projects at sites throughout the country which have dealt with environmental contamination problems due to solvents, pesticides, heavy metals, explosives, and low level radiological materials. He has directed feasibility studies, design activities, and remediation to address surface water and groundwater contamination, the control and treatment of contamination sources, and the decontamination of structures and equipment. He has nationwide responsibility for EA's Waste Management Services Business.

Education:

M.P.A.; Harvard University; Administration; 1986
M.E.; Texas A & M University; Industrial Engineering; 1970
B.S. ChE; New Jersey Institute of Technology; Chemical Engineering; 1969

Training:

OSHA 40-Hour Hazardous Waste Operations Safety Training Course
EA Expert Witness Training
Design Professional's Liability Course; 1990
Defense Management College; 1977

Registration:

Professional Engineer (P.E.)—Maryland; 1988 (17626)
Professional Engineer (P.E.)—New Jersey; 1978 (21367)

Experience:

Engineering Management—Manages a wide range of environmental engineering activities using teams of civil, chemical, and environmental engineers, construction inspectors, geologists, and environmental scientists. Design engineering projects have included sanitary landfills, the remediation of hazardous waste sites, industrial wastewater treatment, and contaminated groundwater treatment.

Hazardous Waste Management—Is currently managing an ecological risk based RI/FS at a Superfund site in the Southeast U.S. which is contaminated with pesticides and heavy metals. This project has included development of a site specific model which assures ecological risk and was used in the Feasibility Study to define the extent of remedial activity required. Responsibilities have included negotiating on behalf of the PRP's with EPA, the State and the national resource trustees. Managing an RI/FS in Syracuse, New York at a former chemical manufacturing plant. Areas of concern include a landfill and the former processing area. The project has included development of a conceptual flow model to help evaluate contaminant transport in the overburden and limestone bedrock aquifer.

Directed the Remedial Investigation/Feasibility Study at the Lake City Ammunition Plant National Priorities List site. This project addressed approximately 75 source areas of contamination organized into several operable units. The contaminants of concern included solvents, explosives, and heavy metals.

Directed the baseline environmental investigation conducted at a series of oil terminals along the Hudson River. Prepared corrective action plans for these facilities which included the evaluation of technologies to address contaminated soil and groundwater including non-aqueous phase liquids. Participated in the negotiations associated with the sale of these properties.

Was formerly Chief of the Restoration Branch of USATHAMA where he executed the Army's Superfund Program. In this capacity, he conducted site assessments and sampling and analysis efforts at more than 20 Army installations and developed several remediation plans. Directed hazardous waste cleanup operations at Anniston Army Depot.

Managed the Rocky Mountain Arsenal environmental cleanup project where he was responsible for the design and execution of a detailed groundwater sampling and analysis program and where he designed a groundwater dewatering/treatment/recharge system. The Rocky Mountain Arsenal project also required the development of various engineering alternatives for the closure of a 93-acre hazardous waste surface impoundment.

Early in his career, was a member of a team formed to develop a concept plan for the Army's Installation Restoration Program. This team was charged with detailing an approach for defining and addressing the contamination which resulted from former operations at Army facilities. This plan was a forerunner to the EPA CERCLA Superfund program. The methodology included the means to prioritize the examination of the more than 1,000 Army properties. The concept called for a phased approach with a series of decision points at the completion of each phase and involved search of records, site reconnaissance with limited sampling and analysis, preliminary site investigations followed by more detailed investigations, if warranted, and finally, the implementation of the design and remedial actions. The concept plan was published in 1978.

Environmental Protection—Directed the environmental studies associated with the base closure of Fort Meade, Maryland. This included evaluation of sanitary landfill and other potential sources of contamination that would result in potential liability with the property transfer. Was project manager for the Weldon Spring Chemical Plant assessment and as such designed and executed the low level radiological survey of the 220-acre site. This included the development of a health physics program and ultimately the preparation of a decontamination and decommissioning plan. While with the Army, piloted a technology to incinerate explosively contaminated sediments for use at Army depots that had conducted explosives washout operations. In order to ensure compliance with environmental regulations, implemented for the Army's Chemical Research Development and Engineering Center a comprehensive RCRA program which addressed the proper training of workers who dealt with hazardous materials and the proper procedures for disposal of waste materials.

Professional Affiliations:

American Institute of Chemical Engineers
Society of American Military Engineers
Hazardous Materials Control Research Institute

Robert L. Cypher
Director, Quality Assurance

Mr. Cypher has over 17 years of experience in developing, managing, and operating quality assurance programs for major companies. In addition, he has over 12 years of experience in toxicology, working with known and unknown carcinogenic, biological, toxic, and hazardous agents and/or chemicals. Mr. Cypher is the Corporate Director of Quality Assurance for EA Engineering, Science, and Technology, reporting to the Executive Vice President of Business Services. His primary objective is to: ensure, assess, and document the required quality of divisional, regional, and project management, field and laboratory data, and support systems in accordance with EA policies and procedures and external client requirements and governing regulations. Mr. Cypher provides technical guidance to the scientific and engineering staff on quality assurance/quality control as it relates to departmental or project-specific studies, and reviews and approves QA/QC plans for environmental studies. He assists project managers and department directors in implementing corrective actions based on audit findings. He provides department and project-specific QA reviews of procedures to assure the technical quality of project deliverables.

Education:

M.S.; Frostburg State University; Management; 1975
B.S.; Georgetown College; Biology; 1965

Experience:

Quality Assurance—Has established several quality assurance programs in staffing, training, writing of procedures, implementing auditing systems to monitor a variety of company activities and reporting mechanisms to assure management that the company is in compliance with various federal, state and local regulations. Has developed QA/QC systems for: monitoring critical phases in project life cycles; training programs; maintenance and distribution systems for standard operating procedures; QC manuals and archives; scheduling audits; audit follow-ups and reporting of findings.

Designated as project QA officer on many projects. Reviews and/or approves work, sampling, QA project and quality management plans for environmental studies. Responsible for maintaining, revising and distributing EA's corporate QA manual and program. Designated a key player for implementing TQM activities and the ISO 9000 standards to EA. Participates in client audits of EA's analytical, biological, and toxicological laboratories. Experienced reviewer of federal QA program plans for USAEC, USACE, NEESA, USAF, EPA, and state programs for NJDEP, NYDOH, and FDEP.

DOD Experience—Final review/approval of DOD Quality Assurance Project/Sampling/Design/ Chemical Management Plans in support of the Installation Restoration Programs (IRP) and/or DERP(DERA) programs for: the U.S. Army Environmental Center (formerly USATHAMA); the U.S. Air Force (Air Force Center for Environmental Excellence and Armstrong Laboratory); the U.S. Navy - Naval Energy and Environmental Support Activity (NEESA) and the U.S. Army Corps of Engineers, Missouri River Division (MRD), Tulsa and Baltimore Districts. Directed the validation/certification inspections of EA Laboratories by the above DOD Agencies. Designated as the Contractor QAC for USAEC Program and QA Officer on various other DOD Programs. Conducted data audits and onsite audits of sampling activities of various projects in support of the

IRP studies for the U.S. Navy, Northern Division Naval Facilities Engineering Command, U.S. Army Corps of Engineers, etc.

Laboratory Certification—Responsible for achieving certification of EA Laboratories in the states of Arkansas, Georgia, Kentucky, North Dakota, Tennessee, and Virginia. Directed the annual or biannual onsite laboratory inspections by the states of California, Florida, New York, Maryland, New Jersey, and the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) of EA Laboratories.

Laboratory/Project Management—Responsible for designing and managing a large bioassay facility at the Frederick Cancer Research Center and supervising a technical staff of 30 laboratory personnel. Managed budgets, maintained equipment inventories, written progress/final reports, standard operating procedures, protocols, study designs, and costed proposals. Managed a chemical carcinogenesis program under contract to the National Cancer Institute to determine the potential carcinogenic effect of 25 industrial compounds.

Regulatory Compliance—Has participated in over 200 regulatory compliance inspections by federal and state agencies (FDA, EPA, DOD, OSHA, NIOSH, GAO, NTP, and USDA). Provided input into companies' viewpoints regarding various government-proposed rules and regulations. Participated in Institutional Review Boards (IRBs) for review and approval of drug or device products going into clinical investigations.

Nuclear Power Facilities—Has conducted QA audits in accordance with NRC-prescribed QA Program Requirements for Nuclear Facilities of the Aquatic Ecology Monitoring and Radiological Environmental Monitoring Programs under contract to a Nuclear Power Facility.

Consulting—Served as a consultant to biotechnology companies for developing procedures, training personnel, facility layout and design, and documentation control procedures. Has performed regulatory inspections of laboratories in accordance with Good Laboratory Practices and/or Good Manufacturing Practices regulations.

Research and Development—Has participated in various government or company funded R&D programs for newborn carcinogenesis, combination toxicity, initiator/promotor assays, skin painting, and animal/chemical fate analysis.

Toxicology—Has managed, conducted, and performed acute, subchronic, chronic, teratology, and reproduction toxicological evaluations on a variety of animal species. Majority of toxicological work was done in support of drug or chemical submissions to federal agencies by cosmetic, food, drug, or chemical companies for approval to market their products.

Professional Affiliations:

Society of Quality Assurance
Mid-Atlantic Region Society of Quality Assurance
American Society for Quality Control
Regulatory Affairs Professionals Society

Richard K. Peddicord, Ph.D.
Director of Sediment Management

Dr. Peddicord has experience in all aspects of sediment management for a variety of clients. His responsibilities include technical and administrative oversight of projects, client support, regulatory interaction, and business development. Dr. Peddicord's technical activities include evaluation and remediation of contaminated sediments, assessment of potential impacts of dredging and disposal, regulatory review and negotiation, expert testimony, and participation in public meetings and hearings.

Education:

Ph.D.; Virginia Institute of Marine Science - University of Virginia; Marine Science; 1973
B.S.; Morehead State University; Biology; 1968

Training:

EA Litigation Support Training, 1991
EA Project Manager Training, 1991
EA Federal Contracts Management, 1991

Experience:

Project Management—Managed several comprehensive environmental evaluation and remediation studies conducted under federal or state compliance orders for major industrial clients. These projects involved fisheries, benthic, and avian ecologists, environmental chemists, hydrodynamicists, regulatory analysts, toxicologists, and civil and environmental engineers in problem identification and assessment, ecological and human health risk assessments, evaluation of remediation alternatives, recommendation of solutions, and securing concurrence on the recommendation from state regulatory officials. Led the revision and updating of the EPA/CE ocean dumping implementation manual, devised to provide technical guidance for testing and evaluation of all dredged material proposed for disposal in the United States under Section 103 of the Marine Protection, Research, and Sanctuaries Act. During his 10 years at the U.S. Army Engineer Waterways Experiment Station, was a key individual in conceptualizing, developing, and conducting both the 5-year $8.7 million joint EPA/Corps Field Verification Program and the Long-term Effects of Dredging Operations Program, the U.S. Army Corps of Engineers (USACE) major ongoing research effort on environmental impacts of contaminated sediments, dredging, and disposal under various conditions. Played a major role in the Dredging Operation Technical Support Program, designed to assist regulatory authorities in applying the findings of scientific research.

Regulatory Activities—Developed technical comments for major trade groups on EPA's proposed sediment quality criteria and Contaminated Sediment Management Strategy. Is Technical Advisor to the International Association of Ports and Harbors at the London Convention, the primary international treaty regulating placement of dredged material in the oceans. With the USACE, served as a technical consultant to the Office of the Chief of Engineers on national and international regulation of the disposal of dredged material. Was a major contributor to technical aspects of the dredged material regulations implementing Section 103 of the Marine Protection Research and Sanctuaries Act, and to the testing requirements for implementing Section 404 of the

Clean Water Act. Dr. Peddicord was Technical Editor of the EPA/CE testing manual for environmental requirements of Section 103 of the Marine Protection, Research, and Sanctuaries Act. Served for 10 years on the EPA/CE Technical Committee on Criteria for Discharge of Dredged and Fill Material.

Expert Testimony—Has appeared as an expert witness on environmental impacts of contaminant discharges before the House Committee on Merchant Marine and Fisheries three times, the House Committee on Science and Technology, and the House Committee on Public Works. Prepared affidavits based on his scientific expertise for three major national litigations concerning environmental issues. Provided expert testimony concerning environmental management of dredged material in New Zealand court proceedings.

Public Involvement—Appointed to the National Academy of Sciences' National Research Council Marine Board Committee on Contaminated Marine Sediments. Participated in many negotiations on environmental issues with State and Federal regulators. Has made presentations to the USACE Environmental Advisory Board, EPA's Science Advisory Board, the Marine Board of the National Academy of Sciences, and the Congressional Office of Technology Assessment. Chaired four workshops on sediment bioassay implementation and evaluation for the Corps of Engineers. Dr. Peddicord was a U.S. delegate to the 8th and 13th U.S./Japan Experts Meeting on Management of Bottom Sediments Containing Toxic Substances. He was also a delegate to the U.S./Netherlands Memorandum of Understanding on Dredging and Related Technology.

Selected Publications and Presentations:

Suedel, B., R.K. Peddicord, et.al. 1994. Trophic transfer and biomagnification potential of contaminants in aquatic ecosystems. Rev. Env. Contam. Toxicol. 136:21-89.

Peddicord, R.K. 1993. Managing ecological risks of contaminated sediments, *in Environmental Toxicology and Risk Assessment, ASTM 1179* (W. Landis J. Hughes and M. Lewis, eds.) American Society for Testing and Materials, Philadelphia.

Peddicord, R.K. (technical editor). 1991. Evaluation of dredged material proposed for ocean disposal. EPA-503/8-91/001. U.S. Environmental Protection Agency/U.S. Army Corps of Engineers, EPA Office of Water, Washington, D.C.

Lee, C.R., and R.K. Peddicord. 1988. Decision-making framework for management of dredged material disposal, *in Environmental Management of Solid Waste: Dredged Material and Mine Tailings* (W. Salomons and V. Forstner, eds.). Springer-Verlag, Berlin, FRG.

Palermo, M.R., N.R. Francingues, C.R. Lee, and R.K. Peddicord. 1986. Evaluation of dredged material disposal alternatives: Test protocols and contaminant control measures, *in* Proceedings of WODCON XI, the Eleventh World Dredging Conference, Brighton, United Kingdom.

Francingues, N.R., M.R. Palermo, C.R. Lee, and R.K. Peddicord. 1985. Management strategy for disposal of dredged material: Test protocols and contaminant control measures. Technical Report D-85-1, U.S. Army Engineer Waterways Experiment Station, USACE, Vicksburg, Mississippi.

Peddicord, R.K. 1980. Direct effects of suspended sediments on aquatic organisms, *in Contaminants and Sediments*, (R.A. Baker, ed.), Vol. 1. Ann Arbor Science, Ann Arbor, Michigan.

Site Management Plan
Revision No. 1.0
January 1995

APPENDIX B
CHEMRISK

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APPENDIX B-1
DESCRIPTION OF QUALIFICATIONS

ChemRisk®
A Division of McLaren/Hart Environmental Engineering

McLaren/Hart/ChemRisk® is a full-service environmental science and engineering firm with nearly 700 professionals in 12 offices nationwide. The company's fundamental business is the risk-based investigation, characterization, and cleanup of toxic and hazardous waste sites backed by a comprehensive list of engineering, scientific, and management services.

The ChemRisk® Division of McLaren/Hart Environmental Engineering has one of the largest technical staffs in the country dedicated solely to the practice of solving environmental problems based on a risk assessment and applied toxicology approach. The ChemRisk team of over 80 health professionals spans a full range of disciplines including toxicologists and scientists with Ph.D. and Master's degrees, certified industrial hygienists, aquatic toxicologists, wildlife biologists, pharmacologists, health physicists, regulatory specialists, computer programmers, statisticians, and air and groundwater modeling experts. The Portland, Maine, office is comprised of a staff of 35 individuals with hundreds of years of combined experience in conducting human health and ecological risk assessments. ChemRisk developed the concept of health-based, risk-driven, remedial investigations and feasibility studies and have contributed more peer-reviewed publications to the field of health risk assessment than any other consulting group.

APPENDIX B-2
RESUMES OF KEY PERSONNEL

TIMOTHY J. IANNUZZI
Senior Environmental Scientist

Education

M.A.	Biology, State University of New York, Oneonta, New York, 1990
B.S.	Biology, State University of New York, Oneonta, New York, 1987 Aquatic Ecology Specialty
A.A.S.	Natural Resource Conservation, State University of New York, Morrisville, New York, 1984, Fisheries and Wildlife Ecology/Management Specialty

Capabilities

- Ecological Risk Assessment
- Fisheries and Aquatic Ecology (Marine, Estuarine and Freshwater)
- Probabilistic Food Chain Modeling/Bioaccumulation Analyses
- Sediment and Water Quality Assessments
- Multimedia Bioassays
- Remedial Investigation/Feasibility Studies (RI/FS)
- NEPA Environmental Impact Statements (EIS)/Assessments
- USEPA 316 (a) and (b) Analyses
- Wetlands Delineations/Functional Assessments

Experience Summary

Mr. Iannuzzi has over seven years experience in aquatic ecological and ecotoxicological research and consulting, including considerable experience in project management and senior technical review. His particular areas of interest are fisheries and invertebrate ecology, modeling/assessing the trophic transfer of chemicals through aquatic food chains, developing site-specific sediment quality criteria, and designing statistically defensible field and laboratory risk investigations. Mr. Iannuzzi has managed a number of ecological risk assessment projects. His broad-based background in biology, ecology, and chemistry has enabled him to conduct assessments in estuarine, freshwater, wetland, and terrestrial ecosystems.

Prior to joining ChemRisk, Mr. Iannuzzi was the Supervisor of the Aquatic Ecology/Ecological Risk Assessment Group for Ebasco Environmental. He was responsible for the development of ecological risk assessment capabilities within the company to support numerous projects for the USEPA (CERCLA; REM III/ARCS II), DOE, DOD, and private sector clients. Throughout his career, he has gained extensive experience in regulatory compliance (federal and state), including NEPA, CERCLA, RCRA, and the CWA.

Key Projects

Selected project experience for Mr. Iannuzzi includes:

ChemRisk Division, McLaren/Hart, July 1993 - Present

- Manager of environmental risk assessment projects for multiple clients. Responsibilities include government negotiations, designing statements of work, and technical oversight activities.

Ebasco Environmental, Lyndhurst, NJ, 1989 - 1993

- Manager for an RI/FS ecological risk assessment for the NASA Langley Research Center in Hampton VA. Conducted quantitative ecological surveys, multimedia exposure analyses, sediment bioassays, bioaccumulation analyses, and probabilistic food chain modeling to calculate site-specific cleanup goals for PCBs/PCTs in sediments in Tabbs Creek, a polyhaline tidal tributary to the Back River in the lower Chesapeake Bay.

- Technical Reviewer for the Rocky Mountain Arsenal ecological risk characterization report/model.

- Manager for an RI/FS ecological risk assessment for the U.S. Navy Radio Transmitting Facility in Driver, VA. Utilized exposure/ecotoxicity parameters and site-specific bioaccumulation analyses to assess potential adverse impacts to fish and shellfish resulting from a point-source PCB spill. Assessed the impacts of potential remedial alternatives to sensitive estuarine habitats in the lower Chesapeake Bay, with respect to potential ecological risks from sediment-bound PCBs.

- Project Manager for the Davids Island Development Project in western Long Island Sound. Evaluated the impacts of dredging and construction of an 800 slip marina and associated breakwater on benthic primary and secondary production in intertidal and subtidal habitats. Determined existing depth-specific macro- and microalgal production on hard and unconsolidated substrates as well as floating docks in a nearby marina. Modeled post-construction production in the marina using substrate and depth-specific productivity rates. Performed numerical classification statistical analyses on benthic invertebrate data to predict changes in community structure following dredging. Prepared two manuscripts for work efforts which are state-of -the art marina impact assessments.

- Project Manager of the Pfizer NPDES Compliance Project, Groton, CT. Responsible for multi-task effort to provide client with environmental and engineering services for regulatory compliance at their Groton pharmaceutical plant. Tasks included biofouling control strategies, coliform monitoring, and related chlorination control studies.

- Manager for ecological risk assessment activities/technical oversight at the DOE Savannah River Site (SRS) in Aiken, South Carolina for Westinghouse Savannah River Company. Responsibilities included development and review of technical work plans to conduct ecological risk assessments at over 150 sites on the SRS, conducting assessments at assigned sites, and training WSRC personnel in ecological assessment methodologies. Designed and presented a workshop on regulatory framework and methodologies for conducting ecological risk assessments.

- Task Manager of an RI/FS ecological risk assessment for a site on the tidal freshwater portion of the Delaware River estuary. Utilized exposure and ecotoxicity data to assess potential impacts

to aquatic receptors from site-specific contaminants with respect to background concentrations in the industrialized portion of the river. Designed a follow-up focused ecological and sediment investigation to calculate sediment cleanup goals for isolated portions of the river.

- Task manager for conducting an ecological risk assessment for a former pesticide manufacturing facility in New Jersey. Conducted a preliminary probabilistic risk characterization for songbirds utilizing a bioaccumulation model and Monte Carlo simulations. Designed an extensive field investigations program to conduct a comprehensive quantitative risk assessment for terrestrial, wetlands, and aquatic habitats on and adjacent to the site.

- Conducted extensive literature reviews for a cogeneration project on the upper Hudson River, NY, concerning projected stack emissions and acid deposition effects from coal burning on aquatic receptors, particularly on sensitive waterbodies in the eastern Adirondack mountains. Participated in the preparation of expert testimony for an Article VIII application before the New York State Board on Electric Siting and the Environment.

- Conducted an ecological risk assessment for the Pennsylvania DER in French Creek, PA. Conducted quantitative benthic invertebrate, ichthyoplankton, and fish surveys at locations upstream, adjacent to, and downstream of a state designated hazardous waste site. Compared faunal diversity and abundance indices, and weight:length regressions for dominant fish species between sample locations, to assess potential adverse impacts from the site.

- Performed aquatic ecological surveys and habitat mapping in the Hub River estuary and adjacent portion of the Arabian Sea near Karachi, Pakistan, to assess the potential impacts of a 1200 MW oil-fired electric generating plant with once-through cooling. Prepared relevant portions of an interpretive environmental assessment report for the World Bank Organization. Discovered 16 new species of benthic invertebrates. Preparing relevant manuscripts on benthic ecology, fisheries and sediment chemistry.

- Project Manager responsible for preparation of a 316(b) demonstration for a 360 MW coal-fired electric generating facility with a recirculating cooling system on a tributary of the Delaware River estuary. Designed and conducted studies examining the distribution and abundance of ichthyoplankton, and juvenile and adult fish populations. Assessed the potential impingement/entrainment impacts to critical aquatic organisms.

- Task Manager for the City of New York Arverne Urban Redevelopment Project. Responsible for designing and conducting field investigations to determine the water quality of estuarine embayments in Jamaica Bay, New York. Prepared relevant portions of a NEPA environmental assessment report evaluating the effects of proposed urban stormwater discharges on water and sediment quality and physical effects on salt marshes.

- Ecological risk assessment lead for numerous USEPA CERCLA RI/FS projects. Conducted ecological inventories of aquatic, wetland, and terrestrial habitats, including endangered species surveys, on and adjacent to the sites. Assessed the impacts of contaminants on ecosystems using a variety of ecological risk assessment methodologies. Evaluated the potential impacts of

proposed remedial alternatives on ecological habitats. Prepared ecological risk assessment portions of RI/FS reports.

State University of New York Biological Research Station, Oneonta, New York, 1986 - 1988

- Graduate student and research assistant responsible for conducting a limnological water quality investigation on Otsego Lake in central New York State to provide baseline data for use in land use planning efforts for the surrounding watershed. Studies included spatial nutrient, chemical and bacteriological analyses to locate potential point sources of pollution, as well as monitoring of physical parameters to determine the effects of increased nutrient loading on coldwater fish habitats.

Publications

Iannuzzi, T.J. In preparation. Ecological risk assessment of sediment PCB/PCT contamination in Tabbs Creek (Langley, Virginia): The use of bioenergetics-based modeling and latin hypercube simulations to calculate probabilistic cleanup goals. To be submitted to: Environ. Toxicol. Chem., 1994.

Iannuzzi, T.J., M.P. Weinstein, K.G. Sellner and J.C.Barrett. In press. Habitat disturbance and marina development: An assessment of ecological effects. I. Changes in primary production due to dredging and marina construction. Estuaries, 1994.

Barrett, J.C., M.P.Weinstein, and T.J. Iannuzzi. In press. Habitat disturbance and marina development: An assessment of ecological effects. II. Changes in benthic communities along a natural shorefront due to dredging and marina construction. Estuaries, 1994.

Iannuzzi, T.J. 1990. The chemical limnology and water quality of Otsego Lake, New York. M.S. Thesis, S.U.N.Y. Oneonta, Oneonta, New York.

Presentations

Iannuzzi, T.J., 1993. Ecological risk assessments of tidal creeks in the lower Chesapeake Bay: Approaches and Methods. Presented at the spring meeting of the Atlantic Estuarine Research Society, March 19, 1993.

Iannuzzi, T.J., and L.M. Schmeising. 1993. Ecological risk assessments of a tidal creek in the lower Chesapeake Bay: Approaches and Methods. Presented at the 14th annual meeting of the Society of Environmental Toxicology and Chemistry, November 14 -18, 1993.

Iannuzzi, T.J., M.D. Moese and J.D. Schaffer. 1992. Ecological Risk Assessment Workshop. Presented to Westinghouse Savannah River Company, April 14 - 17, 1992, Ebasco Environmental, Augusta, GA.

Cuschnir, A.A., T.J. Iannuzzi and M.D. Moese. The fish component of the lower Hub River (Pakistan), an altered estuarine system. Presented at the 12th biennial meeting of the Estuarine Research Federation, November 14 - 18, 1993.

Iannuzzi, T.J., A.A. Cuschnir, M.D. Moese and N. Mountford. The benthic invertebrates of the lower Hub River (Pakistan), an altered estuarine system. Presented at the 12th biennial meeting of the Estuarine Research Federation, November 14 - 18, 1993.

Professional Affiliations

Society of Environmental Toxicology and Chemistry
ASTM E-47 Committee
Estuarine Research Federation
Atlantic Estuarine Research Society
Estuarine Coastal Sciences Association
American Fisheries Society

BRENT L. FINLEY, Ph.D., DABT
Principal Health Scientist

Education

Ph.D., Toxicology/Pharmacology, Washington State University, 1986
B.S., Biochemistry, Cornell University, 1982

Capabilities

Health Risk Assessments
Risk-Based Sampling Design
Regulatory Negotiations

Experience Summary

Dr. Finley is a Principal Health Scientist with McLaren/Hart's ChemRisk® Division. He has over 10 years of experience in conducting and managing technical studies involving chemicals and health. He is currently serving as Principal-in-Charge for several human and environmental health risk assessments at major sites throughout the United States. Dr. Finley's areas of expertise include dioxin, chromium, pesticides, and petroleum wastes.

Key Projects

- Recently prepared a multi-pathway exposure and risk assessment for a State Superfund site in the Midwest. The assessment demonstrated that particulate emissions from a client's pesticide-formulating facility did not pose a significant health risk to the surrounding community. Accordingly, the EPA issued a no-action alternative for the site, and no remediation was required.

- Demonstrated that post-remedial levels of mercury in soil at an industrial site in Puerto Rico did not pose a significant health risk to individuals working on the property. As a result, the site was formally closed in 1992 with no further remediation.

- Prepared and submitted comments to the USEPA's proposed "reference concentrations" for chromium. As a result of the submitted comments, Dr. Finley has been invited to serve on a USEPA work group to evaluate better methods for setting these criteria.

- Prepared an extensive critique of the State of New Jersey's proposed 1991 Regulation for Cleanup Standards. The critique included detailed comments regarding appropriate methods for assessing contaminant uptake and developing health-protective levels for chemicals and metals in soils, groundwater, and building interior surfaces. The revised version of the Proposed Standards incorporated many of Dr. Finley's suggested refinements.

- Prepared and submitted detailed comments to the Agency for Toxic Substances Disease

Registry (ATSDR) draft Toxicological Profile for chromium. The evaluation included a critique of the manner in which cited exposure studies were interpreted and offered a point-by-point re-interpretation of many of the key studies.

- Currently managing a complex assessment of the health risks associated with chromium-contaminated soil at over 30 sites in New Jersey. This assessment has entailed the development of new sampling and analytical techniques for ambient chromium concentrations, coordination and oversight of a $2 million human patch-testing study, and extensive regulatory negotiation with the USEPA and New Jersey Department of Environmental Protection.

- Prepared a multi-pathway assessment of the health risks associated with emissions of dioxin particulates and vapors from a combustion source. The State of California had previously determined that the dioxin risks were significant and that the client would have to warn the surrounding residential community. Dr. Finley used refined risk assessment techniques to demonstrate that the potential health risks were insignificant. Exposure pathways considered included ingestion of mother's milk, vegetable crops, and local meat and dairy products.

- Used "fingerprinting" techniques to demonstrate that dioxin contamination of river sediments was due to sources other than the client's.

- Employed risk assessment principles to design and guide remedial investigation activities at a State Superfund site. EPA approval of the sampling designs, which greatly minimized the number of environmental samples collected (residential soil, groundwater, garden vegetables, and ambient air), saved the client $2 million in originally estimated sampling and analytical costs.

- Prepared human health risk assessments for several abandoned refinery sites in Wyoming.

- Prepared an avian health risk assessment at a State Superfund site. The assessment, which involved collecting and analyzing live and dead birds, determined that a client's chemical facility was not responsible for avian deaths noted in the area of concern.

Academic Honors and Awards

1991: Diplomate of the American Board of Toxicologists (DABT)

1987: National Institute of Environmental Health Sciences *National Research Service Award,* offered May 22, 1987. Title of research proposal: Role of Epoxide Hydrolase Levels in Biomechanisms. Fellowship # 1 F32 ES05436-01 BI-2.

1986: Society of Toxicology's *Graduate Student Mechanisms of Toxicity Award.* Cash award based on manuscript developed from a submitted abstract.

1984: *Pharmaceutical Manufacturer's Association Advanced Predoctoral Scholarship.* Award covered tuition, fees, and stipend for the final two years of dissertation research.

Publications

Paustenbach, D.J., T.T. Sarlos, V. Lau, B.L Finley, D.A. Jeffrey, and M.J. Ungs. 1991. "The Potential Inhalation Hazard Posed by Dioxin Contaminated Soil." *J. Air Waste Manage. Assoc.* 41:1334-1340.

Paustenbach, D.J., J.D. Jernigan, B.L. Finley, S.R. Ripple, and R.E. Keenan. 1990. "The Current Practice of Health Risk Assessment: Potential Impact on Standards for Toxic Air Contaminants." *Journal of Air and Waste Management Assn.* 40, 1620.

Finley, B.L., and D.J. Paustenbach. January 1990. "Using Risk Assessment to Design Cost-Effective Remedial Investigations: A Case Study." *ECON.*

Finley, B.L., and B.D. Hammock. 1988. "Increased Activity of Cholesterol Epoxide Hydrolase Subsequent to Clofibrate Treatment." *Bioch. Pharmacol. 38, 24210.*

Finley, B.L., P.J. Ashley, A.G. Neptune, and G.S. Yost. 1986. "Substrate-Selective Induction of Rabbit Hepatic UDP-Glucuronyltransferases by Ethanol and Other Xenobiotics." *Bioch. Pharmacol.* 35, 2875.

Yost, G.S., and B.L. Finley. 1985. "Stereoselective Glucuronidation as a Probe of Induced Forms of UDP-Glucuronyltransferases. *Drug Metab. Dispos.* 13, 5.

Yost, G.S., and B.L. Finley. 1983. "Ethanol as an Inducer of UDP-Glucuronyl-transferases". *Bioch. Biophys. Res. Commun.* 111, 219.

Abstracts

Wenning, R.J., M. Harris, M.J. Ungs, B.L. Finley, and D.J. Paustenbach. 1991. Abstract #446 (SETAC, 1991 Seattle, WA). "PCDD and PCDF fingerprint patterns in surficial sediments from the lower Passaic River and Newark Bay using multivariate statistics."

Finley, B.L., M. Harris, and D.J. Paustenbach. 1991. "Recent Changes in Regulatory Toxicity Rankings for Wood-Treating Chemicals and Their Impact on Risk Assessment and Remediation at Wood-Treating Sites." (1991 Amer. Wood Preservers Institute: Scottsdale, Arizona).

Harris, M., B.L. Finley, R. Wenning, and D.J. Paustenbach. 1991. Abstract #729 (30th Annual Meeting of the Society of Toxicology, Dallas, TX). "Evaluation of Potential Sources of 1,2,8,9-TCDD in Aquatic Biota from Newark Bay."

Paustenbach, D.J., B.L. Finley, R. Kalmes, and B. Fishman. 1990. Session #8-2 pgs. 133-136 (1990 Environmental Conference, Seattle, WA). "Methodology for Setting Airborne Emissions Limits for Chloroform, Chlorine Dioxide, and Chlorine from Paper and Pulp Mills."

Finley, B.L., and D.J. Paustenbach. 1990. "Assessment of Pesticide-Related Hazards to Birds in a Residential Community." HazMat Central Proceedings.

Finley, B.L., 1989. "Using Risk Assessment Requirements to Design Cost-Effective Remedial Investigations." HazMat West Proceedings.

Finley, B.L., and B.D. Hammock. 1987. "Induction of Microsomal Cholesterol Epoxide Hydrolase by Clofibrate." *Toxicologist.* 7, 22.

Finley, B.L., and G.S. Yost. 1986. "Isolation and Partial Characterization of Ethanol-Induced UDP-Glucuronyltransferase from Rabbit Hepatic Microsomes." *Toxicologist.* 6, 12.

Finley, B.L., and G.S. Yost. "Stereoselective Glucuronidation in Rabbit Hepatic Microsomes". *Toxicologist.* 5, 36.

DENNIS J. PAUSTENBACH, Ph.D., C.I.H., DABT

Vice President, McLaren/Hart
Chief Technical Officer, McLaren/Hart/ChemRisk®
Chief Toxicologist

Education

Ph.D., Environmental Toxicology, Purdue University, 1982.
M.S., Industrial Hygiene, University of Michigan, 1977.
M.S., Counseling Psychology, Indiana State University, (at night), 1978.
BSChE, Chemical Engineering, Rose-Hulman Institute of Technology, 1974.

* Post-Doctoral Research, Pharmacokinetics, Wright-Patterson Air Force Base, 1985-1987.

Professional Experience

Vice President, McLaren/Hart Environmental Engineering Corp.
Chief Technical Officer, McLaren/Hart/ChemRisk®
October, 1991 to Present

- Responsible for directing the technical/scientific efforts of the company and for providing leadership to the five professional disciplines within all fifteen offices. Responsible for coordinating corporate efforts involving projects larger than $3-million.

- Responsible for managing the National Business Programs in a) Remediation, Regulatory Compliance Management (RCM), c) Risk Assessment, d) Department of Defense Contracts, e) Environmental Chemistry, f) Sales/Business Development, and g) Marketing.

- Contributes to the overall management of McLaren/Hart Engineering.

- Coordinates scientific and business aspects of international activities.

- Gives scientific and managerial guidance to McLaren/Hart offices in: Alameda, CA; Burbank, CA; Irvine, CA; Rancho Cordova, CA; Chicago, IL; Portland, ME; Southfield, MI; Springfield, MO; St. Louis, MO; Warren, NJ; Albany, NY; Cleveland, OH; Philadelphia, PA; Pittsburgh, PA; and Houston, TX.

- Has more than 17 years of experience in the fields of environmental engineering and toxicology.

- Has directed over forty million dollars in risk assessment work between 1985-1992. These addressed the potential hazards posed by sites requiring a total of twelve billion dollars of remediation.
- Has supervised/managed more than $20M in environmental remediation work.

- Has published nearly 100 peer-reviewed, publications and 35 conference abstracts in the fields of risk assessment, chemical engineering, industrial hygiene, toxicology, and safety. Has presented more than 100 papers at scientific meetings and has written

about 10 book chapters. Was the editor of the first comprehensive book on environmental and human health risk assessment.

Vice President, McLaren/Hart Environmental Engineering Corp.
National Director, ChemRisk Division
November, 1987 to October, 1991

- Founder of the ChemRisk® Division of McLaren/Hart Environmental Engineering.
- Directed consultation activities in the areas of risk assessment, environmental and occupational toxicology, and the scientific aspects of toxic tort cases. Provided scientific advice on air toxics and industrial hygiene issues, as well as, the design of remediation investigations and feasibility studies (RI/FS).
- Provided expertise in the areas of industrial and environmental toxicology, pharmacokinetics, environmental fate and transport, air pollution, odor abatement, environmental modelling, and ventilation engineering.
- Routinely involved in the evaluation of health hazards posed by hazardous waste sites, landfills, contaminated soil, gaseous emissions, water, the workplace, and incinerators, as well as the control of in-plant gaseous releases, local exhaust ventilation, treatment of point-source gaseous emissions, contaminated soil and run-off, pesticides, and manufacturing processes.
- Managed projects involving the assessment of the health risks and significance of chemical contaminants present in water, ambient air, food, soil, occupational environment, and consumer products.
- Frequently interacted with local, regional, state and federal regulatory agencies. Participated in negotiations to resolve issues involving clean-up standards for air, water, soil and reusable items, e.g., contaminated vehicles and equipment.
- Risk communication experience included: (a) coordination of the scientific and medical aspects of complex toxic tort cases, (b) representation of clients at public hearings, (c) presentation of scientific data in professional and public forums, and (d) development of opinion letters for use in litigation.
- Participated in the scientific debate regarding acceptable levels of emissions of TCDD in water from pulp and paper mills (Georgia and North Carolina, 1990); as well as, identifying acceptable levels of TCDD, benzene, formaldehyde and chromium in air and soil.

Manager, Industrial and Environmental Toxicology
Syntex Corporation; Palo Alto, CA
August, 1984 to November, 1987

- Managed the group of Ph.D. toxicologists responsible for evaluating the corporation's occupational and environmental health hazards (world-wide). They also served as a scientific resource for the industrial hygiene and environmental engineering departments at both the corporate headquarters and at remote manufacturing facilities.

- Conducted complex risk assessments of three Superfund waste sites including Times Beach, Missouri. Other activities in which his group was involved included the assessment of health risks of hazardous waste sites, the coordination of toxicity testing of all manufactured intermediates, the establishment of guidelines for laboratory use and manufacture of super-potent pharmaceuticals, setting of corporate occupational exposure limits, and directing of applied toxicology research programs.

- Participated in face-to-face negotiations with federal and state regulatory agencies with regard to: the evaluation, remediation, and closure of hazardous waste sites; reaching agreements on joint research efforts (e.g., EPA's mobile incinerator); and defining compliance with air and water pollution regulations.

- Wrote six, 200 page evaluations of proposed governmental standards which were submitted to EPA. Was influential in the development of the EPA and CDC positions on the health hazards posed by dioxin in soil, air, fly ash, water, and other materials.

Major Contributions

- Directed the efforts to participate in the EPA's scientific re-evaluation of the health hazards posed by low level exposure to dioxin.

- Developed and directed the scientific and medical aspects of the litigation associated with the remediation of Times Beach, Missouri and, peripherally, the other 43 dioxin contaminated sites.

- Conducted a risk assessment of an EPA superfund site outside Boulder, Colorado and the Lowry Landfill in Denver.

Risk Assessment Scientist
Stauffer Chemical Company; Westport, CT
February, 1982 to August, 1984

- Toxicologist responsible for the scientific aspects of environmental regulatory affairs. Primary responsibility was to evaluate the safety of company products through health studies.

- Involved with obtaining and maintaining the registration of agricultural and specialty chemicals. Developed scientific response for company products alleged to present environmental or human health hazards. Responsible for developing and awarding contract research involving radionuclides, as well as, environmental fate and toxicology of pesticides, and non-target wildlife.

- Responsible for assessing the potential hazards posed by municipal waste sites, groundwater contamination, water pollutants, new product uses, indoor and ambient air pollutants; and the manufacture and use of new products. Responsible for the development of the firm's occupational exposure limits. Provided toxicology support for developing PMNs.

- Interacted with environmental groups such as the Sierra Club, Environmental Defense Fund, etc. Interacted with both state and federal regulatory agencies including OSHA, EPA and CPSC as well as California Department of Health Services, Louisiana Department of Health, and Texas Department of Agriculture.

- Represented the regulated community (AIHC and CICC) at three public hearings regarding the proposed California Cancer Policy (1983).

Major Contributions

- Responsible for developing the research programs and risk assessment needed to obtain an EPA registration for the first "Biorational" pesticide to be marketed. Pro-Drone, a pesticide for fire ants, was an insect juvenile hormone mimic.

- Prepared risk assessments which were instrumental in registering three agricultural chemicals that produced annual sales of $80,000,000.

- Studied regulatory restrictions on sale of major pesticides by demonstrating their safety through risk assessments.

- Participated in EPA Science Advisory Board hearings on Radionuclide Emissions from phosphorous processing facilities (Section 112 of Clean Air Act). Participated in development of the risk assessment used in developing the proposed rule.

Visiting Professor/Graduate Instructor
Purdue University; West Lafayette, Indiana
September, 1978 to February, 1982

- Prior to and during the pursuit of a doctoral degree, held an appointment in the School of Health Sciences and in the Department of Industrial Engineering.

- Set up and developed the undergraduate, graduate program and curriculum in industrial hygiene in the School of Health Sciences. Over four years, the Purdue undergraduate Industrial Hygiene program became the largest in the Nation.

- Developed and taught the graduate level courses in environmental and occupational health which included: (a) Industrial Toxicology and Hygiene, (b) Industrial Hygiene Engineering, (c) Occupational Health Law, and (d) Occupational Safety and Health Engineering.

- Under a research grant from NIOSH, wrote a comprehensive (500-page) detailed outline for a textbook(s) and graduate course in Occupational Health Engineering. This textbook is currently used by engineering schools to incorporate an awareness of safety and health principles into their design courses.

- Taught a 15-week graduate engineering course (Ind. Eng. 550) on closed network live TV in which 150 students (90 on campus) and 10 companies from 2 states were enrolled.

Industrial Hygiene Engineer
Eli Lilly and Company, Lafayette, Indiana
July, 1977 to February, 1980

- Participated in a wide variety of corporate projects involving environmental and occupational health at the firm's three major production facilities in Lafayette, Clinton and Indianapolis, Indiana. Established the company's industrial hygiene program,

including employee training and a trace analytical chemistry lab at these plants. Worked on numerous corporate projects in occupational health in the U.S., Canada and elsewhere. Responsible for establishing programs to ensure the safe laboratory use and manufacture of toxic chemicals and sensitizing agents.

Major Contributions

- Involved in the design of new production facilities ($200,000,000 program) with the goal of insuring that good environmental and occupational health engineering practices were implemented.
- Participated in developing the original EPA protocol to assess the potential human hazards associated with the field application of herbicides and pesticides.
- Played a significant role in obtaining a favorable closure of an EPA RPAR of this firm's major product (Treflan) which has been found to contain nitrosamines.
- Primary contact with NIOSH on health hazard evaluation studies of workplaces which handled or manufactured DES, pesticides, nitroglycerin and products containing nitrosamines.

Process Engineer/Chemist
Eli Lilly and Company, Clinton, Indiana
May, 1974 to September, 1976

- Served as a chemical engineer, chemist and industrial hygienist. Duties included improvement of production yields and installing process equipment in the facilities which manufactured antibiotics and fermentation products (Biochemical Division). Designed and installed several million dollars in process equipment.
- Played a significant role in several research and development projects which brought about dramatic improvements in profitability.
- Was member of primary engineering team responsible for "start-up" of new automated broth processing unit for world's largest fermentation operation. Member of technical service group responsible for daily operation of two large solvent recovery units.
- Involved in establishing procedures for complying with FDA, OSHA and EPA regulations. Established this facility's industrial hygiene program.

Honors and Professional Contributions

- One of the invited representatives of U.S. EPA to the International Conference on Ecotoxicology, Melbourne, Australia (October 6-8, 1993).
- Invited peer-reviewer of the risk assessment report on the Great Lakes Initiatives (July 1993).
- Served as a consulting member of the USEPA Science Advisory Board (SAB), Environmental Health Committee (December, 1991 to December, 1994).

- Charter member of Scientific Committee 87-2 (Risk-Based Waste Classification) of the National Council on Radiation Protection (NCRP) (1993-1995).
- Invited peer reviewer of the National Academy of Science (NAS) document regarding their evaluation of the "Role of the National Health Effects Research Institute" (Jan 2, 1993; Washington).

- Invited peer reviewer of Congress' Office of Technology Assessment (OTA) document "Risk Assessment Research Needs in the 1990's." (December 28, 1992; Washington, D.C.).

- Invited participant at a meeting of experts who discussed How to Prioritize the National Environmental Agenda Using Risk Assessment. (November 10 & 11, 1992; Resources for the Future; Annapolis, MD).

- Member of Editorial Review Board of the Journal of Toxicology and Environmental Health (1989 - present), and Regulatory Toxicology and Pharmacology (1988 - Present), and Risk Analysis (1990-present), and Soils (1991-present).

- Member of EPA Publicly Attended Expert Panel on the document Exposure Assessment of Dioxin-like Compounds (September 14, 1992; Washington, D.C.).

- Recipient of the Kusnetz Award of the American Industrial Hygiene Association (1992). A National annual award given to a person under 40 years of age who has made significant contributions to the field of industrial hygiene and who shows good potential for continued leadership in the field.

- Chairman of Industrial Health Foundation's Expert Panel which was charged with recommending a TLV for formaldehyde (June-December, 1991).

- Served as invited participant at U.S. Office of Technology Assessment (OTA) Workshop entitled "Dioxin Treatment Technologies" (May 29, 1991; Washington, D.C.). Proceedings were published as OTA-BP-0-93 and ISBN 0-16-036007-2.

- Invited participant in the USEPA 1992 Workshop on Environmental Exposure Assessment (January 21-23; Virginia Beach, Virginia).

- Selected as a charter member of the Council for the Health and Environmental Safety of Soils (CHESS) which operates under the auspices of the International Society for Regulatory Pharmacology and Toxicology (September 1987 - present). Objective of this group is to set national clean-up levels for chemically contaminated soils. From 1989-1992, served as the Co-chairman of the Health Effects Group.

- Invited speaker and participant at the 1992 National Academy of Science Symposia on "State of the Art Approaches to Exposure Assessment." Symposia was held as part of the EPA's Committee on Risk Assessment Methods (February 10 and 11; Washington, D.C.).

- Invited participant in the 1991 National Academy of Science Workshop on developing Ecological Risk Assessment Guidelines (February 26-28; Fairfax, Virginia).

- Served on the United States Environmental Protection Agency (EPA) Ad-Hoc Science Advisory Board (SAB) Dioxin Subcommittee (1988-1989).

- Served on the Scientific Review Board of the Chemical Industry Institute of Toxicology [CIIT] on Ethylene Oxide (November 8, 1990; Chapel Hill, NC).

- Appointed to one of Governor Deukmejian's technical advisory committees of the task force on toxics, waste and technology. The group assessed the effectiveness of California sponsored programs for Remediating Hazardous Waste Sites (October - December, 1985). Task force was reconvened in November 1987.

- Invited peer reviewer of U.S. EPA's proposed Risk Specific Dose (RSD) for dioxin (December, 1987).

- Member of American Industrial Health Council's (AIHC) Scientific Committee and the Quantitative Risk Assessment Sub-Committee (1982-1984).

- Served as a member of National Nutrition Foundation Expert Panel which evaluated the 1984 proposed Congressional Office of Science and Technology Policy (OSTP) Risk Assessment Guidelines for Carcinogens.

- A principal industry reviewer of the 1983 DOHS California Cancer Policy. Represented Chemical Industry Council of California (CICC) in public hearing dealing with the proposed Cancer Policy.

- Selected as a member of the steering committee for the ACGIH Community Air Guidelines Committee (1987). The objective of the group was to set community air standards for airborne toxics [dissolved in 1988].

- Appointed to California Hazard Evaluation System and Information Services (HESIS) Advisory Committee (1985-87).

- President of Indiana Section-American Industrial Hygiene Association (1981).

Specialized Training and Certifications

- Certified Industrial Hygienist (#1815) (CIH) - Recertified 1987 and 1993.
- Certified Safety Professional (#5954) (CSP) - Recertified in 1987
- Registered Professional Engineer-in-Training (EIT) - 1974
- Diplomat of the American Board of Toxicology (DABT) - Recertified in 1990
- Certified Environmental Assessor (State of California) - REA-01264.
- Diplomat of the American College of Toxicology (DABT) - 1993.

Professional Honors

- Chemical Engineering Honorary [Omega Chi Epsilon] (1974)
- Health Sciences Honorary [Alpha Chi Omega] (1980)
- Full member of Sigma Xi, Science Honorary (1981)
- Full member of the Society of Toxicology (SOT) (1988)
- Selected for Who's Who in the West (1987) and Who's Who in America (1992)
- Full member of the New York Academy of Science (1988)

- Kusnetz Award Winner [National Industrial Hygiene Award] (1992)
- Admitted to the Academy of Toxicologal Sciences (1993).

Security Clearance

Q-Level Security Clearance was issued for 1991-1995. Renewable in 1995.

Presentations

1977 - Presented a short course on "The Problems of Accurate Air Sampling at the Part Per Billion Level" at the Midwest Safety Conference (December; Indianapolis, IN).

1978 - Presented a paper at the Midwest Management Conference "Nitrosamines: One Corporation's Experience with a Suspect Carcinogen" (April; Traverse City, MI).

1979 - Addressed New York State Section of the AIHA on "Engineering Control Techniques in the Chemical Industry" (October; Rochester, NY).

1979 - Presented a paper entitled "Reviewing New Manufacturing Facility Designs in Order to Minimize Future Environmental Health Problems" at Midwest Management Conference (April; Traverse City, MI).

1979 - Presented a paper at the Annual Meeting of the AIHA titled "The Toxicology and Pharmacokinetics of Inhaled Carbon Tetrachloride During 8 and 12 Hour Exposure Periods" (May; Portland, OR).

1981 - Invited participant in the 2nd NIOSH Symposium on "The Need for Industrial Hygiene Engineering in Engineering Education" (July 25; Texas A&M University, College Station, TX).

1981 - Presented invited paper at the Annual Meeting of the American Institute of Chemical Engineers, titled "The Need to Educate Engineers in Occupational Safety and Health and A Proposal for Schools of Engineering" (November 11; New Orleans, LA).

1982 - Invited lecture at the University of Michigan, School of Public Health, titled "Criteria for Setting Occupational Exposure Limits for Unusual Work Schedules" (January; Ann Arbor, MI).

1982 - Invited lecture at the Rocky Mountain Center for Occupational Health entitled "The Effect of a 12 Hour Exposure Regimen on the Distribution, Pharmacokinetics and Toxicology of Carbon Tetrachloride in the Rat" (February; Salt Lake City, UT).

1982 - Presented a paper at the annual meeting of the Society of Toxicology titled, "The Fate of Carbon Tetrachloride in the Rat Following Exposure During the 8 and 12 Hour Workshift" (April; Boston, MA).

1982 - Co-authored a paper at the annual meeting of the Health Physics Society titled, "Health Physics and Industrial Hygiene Education and Training at Purdue University" (July; Honolulu, HI).

1982 - Co-authored a paper presented at the 90th annual conference of the American Society for Engineering Education, titled "A New Technique for Educating Engineering in Occupation Safety and Health" (July; Texas A&M University, College Station, TX).

1982 - Chaired a one-half day symposia at the annual meeting of the AIHA on "The Non-Traditional Workshift and Human Health" (June 9; Cincinnati, OH). Editor of the symposia manuscript.

1982 - Presented two papers at the annual meeting of the American Industrial Hygiene Association (June 10; Cincinnati, OH):

- "The Effect of the Unusual Workshift on the Toxicology, Disposition, and Pharmacokinetics of Carbon Tetrachloride in the Rat."
- "Industrial Hygiene and Health Physics Education at Purdue University" (co-authored with Dr. Neil Zimmerman).

1982 - Presented an invited lecture at the University of Texas School of Public Health titled "Toxicological Implications of the 12 Hour Workshift and Various Models for Adjusting Occupational Exposure Limits" (June; Houston, TX).

1983 - Presented a 2-hour, state-of-the-art, short course at the Midwest Occupational Health Conference: "Quantitative Risk Assessment and Occupational Health" (October; St. Louis, MO).

1983 - Presented an invited lecture on the "Pharmacokinetics Aspects of 12 Hour Per Day Exposure Schedules" at the Exxon Environmental Health Center (February; East Millstone, NJ).

1983 - Organized and chaired a two-day symposium on "Approaches to Establishing Occupational Exposure Limits" at the annual meeting of the AIHA (May 24; Philadelphia, PA).

1983 - Presented an invited lecture at the Connecticut Chapter of Sigma XI: "The Regulatory and Societal Aspects of Using Pesticides for Fire Ant Control." (November; Southbury, CT).

1983 - Presented a one half-day, short course on "Inhalation Toxicology Methods and Data Interpretation" at the Southern States Occupational Health Conference (November 30; New Orleans, LA).

1983 - Presented a paper at the annual meeting of Society of Environmental Toxicology and Chemistry (SETAC) titled, "An Environmental Risk Assessment of Pro-Drone: Insect Growth Regulator for the Control of the Imported Red Fire Ant" (November 5; Washington, D.C.).

1983 - Presented an invited paper at the 3rd Northeastern Occupational Health Conference titled, "The Successful Interaction of the Toxicologist and the Industrial Hygienist." (December 2; East Brunswick, NJ).

1984 - Presented a paper at the annual Fire Ant Symposium, "The Toxicology, Environmental Fate and Ecological Impact of Pro-Drone as a Fire Ant Pesticide." (March 26 & 27; Gainesville, FL).

1984 - Primary instructor at a 3-day NIOSH sponsored course for engineering professors titled, "Principles of Occupational Health Engineering" (April 2-4, Purdue University).

1984 - Instructor for a one-day AIHA and National Safety Council professional development seminar titled "Methods for Setting Occupational Exposure Limits and Conducting Risk Assessments." (March 5; Las Vegas, NV).

1984 - Invited speaker at symposium on Risk Assessment at the New EPA sponsored by the Center for Environmental and Energy Management (CEEM). Talk was titled, "The Problem With Most Risk Assessments." (April 8th; Washington, D.C.).

1984 - Invited speaker at annual meeting of the Accreditation Board for Engineering and Technology (ABET), "What Does Industry Expect Engineering Graduates to Know about Environmental Safety and Health?" (October 23; Knoxville, TN).

1985 - Gave an invited lecture to scientists at Monsanto Corporation headquarters titled, "The Shortcomings of Most Environmental Risk Assessments." (February 14; St. Louis, MO).

1985 - Gave a one-day lecture at the AIHA and NSC Professional Development short course conference titled "Methods for Setting Exposure Limits" (March 11; Salt Lake City, UT).

1985 - Presented a platform paper at the annual meeting of the Society of Toxicology titled "A Physiologically-Based Pharmacokinetics (PB-PK) Model for Carbon Tetrachloride" (March 15; San Diego, CA).

1985 - Gave an invited paper titled "Setting Occupational Exposure Limits in High Tech Industries" at the Northern California AIHA Symposium on Industrial Hygiene Aspects of Emerging Technologies (April 17; Oakland, CA).

1985 - Presented a paper at the annual meeting of the American Industrial Hygiene Association, "Shortcomings in Risk Assessment Approaches Used in Occupational Health" (May 25; Las Vegas, NV)

1985 - Presented a paper at the 5th International Symposium on Chlorinated Dioxins and Related Compounds titled, "A Critical Review of Assessments of the Health Risk Associated with TCDD in Soil" (September 16-19; Bayreuth, Germany).

1986 - Presented a poster at 25th annual meeting of Society of Toxicology titled, "An Examination of Critical Assumptions in Health Risk Assessments of 2,3,7,8-TCDD Contaminated Soil" (March 6; New Orleans, LA).

1986 - Presented a paper at 196th Annual Meeting of the American Chemical Society titled, "Critical Assumptions in Risk Assessment of Soil Contaminated with 2,3,7,8-TCDD" (April 13; New York, NY).

1986 - Presented an invited paper titled "Conducting an Environmental Risk Assessment of Contaminated Soil" at EPA Region I, II and III Workshop on the Assessment of Health Hazards of Contaminated Soil (May 8; Andover, MA).

1986 - Co-authored a paper at the 3rd International meeting on Regulatory Toxicology and Pharmacology titled "A Critical Examination of Assumptions Used in Risk Assessments of Dioxin Contaminated Soil" (September 27; Washington, D.C.).

1986 - Invited paper (poster and discussion) at the National Academy of Science's Workshop on "The Use of Pharmacokinetics in Risk Assessment" (October 16; Washington D.C.).

1986 - Invited paper at a toxicology symposium on Dioxins: From Soil to Receptor, at the Medical College of Virginia. Talk was entitled "The Process of Evaluating Environmental Health Risks" (November 21; Richmond, VA).

1987 - Invited lecture at a symposium sponsored by the Silicon Valley Clean Water Alliance entitled, "The Fundamentals of Toxicology and Risk Assessment" (August 10; San Jose, CA).

1987 - Invited lecture on "Improved Risk Assessment Approaches for Carcinogens and Developmental Toxins" at the annual meeting of the California Manufacturers Association (September 14; Santa Barbara, CA).

1987 - Participated in an EPA experts workshop on Risk Assessment Methods for Developmental and Reproductive Toxicants (September 18-19; Little Rock, AR).

1987 - Presented a paper at the 2nd conference on Petroleum Contaminated Soil entitled "Evaluating the Public Health Hazards of Contaminated Soil" (September 28-29; Amherst, MA).

1987 - Co-authored four papers at the 7th International Symposium on Dioxins and Related Compounds (October 4-9; Las Vegas, NV).

- A physiologically-based pharmacokinetics model for 2,3,7,8-TCDD.
- Documentation of an occupational exposure limit for 2,3,7,8-TCDD.
- Evaluation of factors used to assess incinerator emissions as a potential source of TCDD in foods of animal origin.
- Oral bioavailability in the rat of soil-bound TCDD.

1987 - Co-authored a paper with Dr. George Fries at the annual meeting of the Society of Risk Analysis titled "A Risk Assessment of Incinerator Emissions as a

Potential Source in Foods of Animal Origin," WAM-C4 (November 1-4; Houston, TX).

1987 - Co-authored a paper at the annual meeting of the Society of Environmental Toxicology and Chemistry entitled, "A Methodology for Calculating the Level of Dioxin Contamination Due to Particulate Emissions From Incinerators." (November 22; Pensacola, FL).

1987 - Presented an invited lecture at the Annual meeting of the occupational and environmental health groups at Hewlett-Packard Corporation entitled, "Risk Assessment Approaches for Developmental and Reproductive Toxicants" (November 11; Palo Alto, CA)

1987 - Presented a paper at the 1987 Hazardous Materials Conference titled, "Complying with Prop 65 Using Risk Assessment Approaches" (December 3; San Diego, CA).

1987 - Gave a one-hour lecture on "Assessing the Risks of Your Operations Under Proposition 65" at the California Manufacturers Association (CMA) short course on Prop. 65. (December 9-10; Oakland and Anaheim, CA).

1988 - Gave an invited lecture to The New York City Bar Association (Environmental Law Section) entitled, "Shortcomings in Traditional Approaches to Risk Assessment" (February 4; New York, NY).

1988 - Presented a 30-minute invited paper on "Assessing the Environmental and Human Health Hazards of Contaminated Soil" at the 27th Annual Meeting of the Society of Toxicology (February 15-19; Dallas, TX).

1988 - Co-authored paper entitled, "A Physiologically Pharmacokinetics Description of the Tissue Distribution and Enzyme Induction of 2,3 7,8-Tetrachlorodibenzo-p-dioxin in the Rat" at the 27th Annual Meeting of the Society of Toxicology (February 15-19; Dallas, TX).

1988 - Dinner Lecture to the Southern California Chapter of the American Industrial Hygiene Association entitled "Risk Assessment and Prop. 65: A Challenge for Industrial Hygienists" (March 10; Los Angeles, CA).

1988 - Invited lecture at the 1st Conference on Municipal Solid Waste Disposal (Landfilling, incineration, resource recovery, recycling, and composition) entitled, "A Comparative Health Risk Assessment of Landfilling versus Incineration" (April 13; Amherst, MA).

1988 - One-hour invited lecture at the annual meeting of The American Occupational Medical Association, entitled, "Risk Assessment Approaches for Developmental Toxicants and Other Non-Carcinogenic Chemicals" (April 27; New Orleans, LA).

1988 - Invited paper entitled "Risk Assessment and Prop 65" At the Annual meeting of Food Processors and Engineers (February 28; Santa Barbara, CA).

1988 - Invited paper entitled "Justification for EPA's New Position on Dioxin" at the joint meeting of the USEPA Science Advisory Panel and Society of Toxicology entitled "Assessing the Risks From Toxics In Northern California; What Science Can Tell Us" (April 8; San Francisco, CA).

1988 - Invited paper on "Why the EPA Risk Assessment Guidelines Need to be Updated" at the Joint meeting of the Northern California Society of Toxicology and Society of Risk Analysis (May 3; Letterman Toxicology Institute, San Francisco, CA.).

1988 - Invited one hour lecture at workshop on "CAPCOA Air Toxics Risk Assessment" sponsored by Santa Clara County Manufacturing Group. (July 22; Santa Clara, CA).

1988 - Invited paper entitled "How Health Standards for Groundwater Contaminants are Established" at a workshop on "Solving Groundwater Problems" sponsored by the American Groundwater Trust (July 28; City of Industry, CA).

1988 - Invited lecture on "The EPA's Proposed Position on the Health Hazards Posed by Dioxin" sponsored by the Center for Environment and Energy Management. (September 18, Washington, DC).

1988 - Invited Lecture on "New Approaches to Assessing the Risks Posed by Dioxin" sponsored by The Society of Toxicology (November 18; Cadbury, NJ).

1988 - Invited lecture entitled, "Use of Risk Assessment Methods in Negotiating Clean-up Standards" at Peninsula Industrial and Business Association (PIBA) (December 8; San Mateo, CA).

1989 - Keynote speaker at Western States HAZMAT Meeting entitled, "Setting Clean-up Levels; Site, by Site, by Site" (February 14; Seattle, WA).

1989 - Invited speaker at California Manufacturers Association (CMA) Conference on "Case Studies of Less Than Perfect Risk Assessments" (May 25; Los Angeles, CA).

1989 - Chairman of a four-hour professional development course on The Risk Assessment of Environmental and Human Health Hazards. Held at the annual meeting of the Society of Toxicology and attended by 450 of its members (February 27; Atlanta, GA).

1989 - Presented four, 45-minute short courses on "Risk Assessment Approaches for Complying with California's Toxic Hot Spots - AB 2588 Law" Sponsored by Latham and Watkins (April and May; Held in San Francisco, Los Angeles, Burbank and San Diego, CA).

1989 - Invited lecture entitled "Risk Based Clean-up" at the conference on California Environmental Compliance Management. Sponsored by California Business Law Institute. (June 7-8; Los Angeles, CA)

1989 - Invited paper #24 entitled "Evolving Science and Risk Assessment Methods." Fifth Annual San Diego Conference on Environmental Compliance. (August 24; San Diego)..

1989 - Presented a two-hour short coverage entitled "Risk Assessment Methods for Petroleum Contaminated Sites" (September 25; 4th Annual Petroleum Contaminated Soils Conference; Amherst, MA).

1989 - Co-Authored a paper presented at the annual meeting of the Society of Environmental Toxicology and Chemistry entitled "Assessment of Pesticide Related Hazards to Birds in Residential Setting" (September; Toronto, Canada)

1989 - Invited paper entitled "Setting a Clean-up Level for Dioxin Contaminated Soil Based on Indirect Routes of Exposure" at a Symposium sponsored by Resources for the Future entitled " A Re-evaluation of the 1 ppb Standard for Dioxin in Soil" (November 2; Washington, D.C.).

1989 - Co-authored a paper at the annual meeting of the Society of Risk Analysis entitled "Conservation in Practice of Health Risk Assessment Suggestions for Avoiding Mistakes."

1989 - Invited paper and short course entitled "The Role of Risk Assessment in Dioxin Litigation" at the conference on Dioxin Claims and Litigation. Sponsored by Executive Enterprises, Inc. (November 29-30; Washington, D.C.).

1989 - Presented an opinion paper entitled "Assessing the Risks of Environmental Tobacco Smoke" at the International Symposia on Environmental Tobacco Smoke (November 3-4; Montreal, Canada).

1990 - Conducted a two hour short-course on "Risk Assessment Approaches for Petroleum Contaminated Soils" at the Annual West Coast Meeting on Petroleum Contaminated Soils (February 19; Anaheim, CA).

1990 - Presented an invited paper entitled "Fundamentals in Risk Assessment for Safety Engineers" at the annual meeting of the American Society of Safety Engineers (California Section) (April 11, Long Beach, CA).

1990 - Team taught an 8 hour short course entitled "Current Procedures in the Practice of Health Risk Assessment" at the 12th Annual Hazmacon meeting (April 18; Anaheim, CA).

1990 - Presented a lecture entitled "Risk Assessments Methods and Compliance with AB-2588" to the Santa Clara Manufacturers Association (April 12; San Jose, CA).

1990 - Presented paper entitled "Criteria for Using Substitution as a Control Measure" at the 10th Annual meeting of the Semiconductor Safety Association (April 10; Phoenix, Arizona).

1990 - Presented paper entitled "The Practice of Health Risk Assessment in the 1990's" at the 4th Conference on Toxic Substances sponsored by the Canadian Air and Waste Management Association (April 5; Montreal, Canada).

1990 - Co-authored a paper entitled "Methodology for Setting Airborne Emissions Limits for Chloroform, Chlorine Dioxide, and Chlorine from Paper and Pulp Mills" at the annual meeting of the Technical Association of the Paper and Pulp Industries (TAPPI) (April 9-11; Seattle, Washington).

1990 - Co-authored a paper entitled "Setting Rational Health-Based Water Quality Standards for Dioxin: Risk Assessment for the Columbia River" at the annual meeting of the Technical Association of the Paper and Pulp Industries (TAPPI). (April 9-11; Seattle, Washington).

1990 - Co-authored a paper presented at the annual meeting of the Air Pollution and Waste Management Association entitled, "Development and Field Validation of a Sampling and Analytical Method for Airborne Hexavalent Chromium" (May 2; Raleigh, N.C.).

1990 - Co-authored a paper presented at the annual meeting of the Air Pollution and Waste Management Association entitled "The Assessment of Health Risks Associated with Indoor Benzene Vapor Emitted from Building Foundation Soil: A Case Study" (May 2; Raleigh, N.C.).

1990 - Invited speaker at conference on Management of Hazardous Waste Issues. Presentation was entitled "Using Health Risk Assessment to Set Clean-up Levels," sponsored by Executive Enterprises (June 1-2; San Francisco, CA).

1990 - Co-authored a paper presented at the 10th International Dioxin Meeting entitled, "A Re-evaluation of the Tumor Histopathology of Kociba et al, (1978) using 1990 Criteria: Implications for the Risk Assessment of 2,3,7,8-TCDD using the Linearized Multistage Model," (September 12; Bayreuth, Germany).

1990 - Co-authored a paper presented at the 10th International Dioxin Meeting entitled, "Risk Assessment of 2,3,7,8-TCDD using a Biologically-based Cancer Model: A Re-evaluation of the Kociba et al (1978) Bioassay," (September 12; Bayreuth, Germany).

1990 - Co-authored a paper presented at the 10th International Dioxin Meeting entitled, "An Evaluation of the Inhalation Hazard Posed by Dioxin-contaminated Soil," (September 11; Bayreuth, Germany).

1990 - Co-authored a paper presented at the 10th International Dioxin Meeting entitled, "Dioxin risk assessment of the Columbia River," (September 12; Bayreuth, Germany).

1990 - Co-authored a paper presented at the 10th International Dioxin Meeting Entitled, "PCDDs and PCDFs in surficial sediments form the lower Passaic River and Newark Bay," (September 12; Bayreuth, Germany).

1990 - Presented a 45-minute paper entitled "What does the Risk Assessment Process Tell us about the TLVs?" at the 20th Professional Industrial Hygiene Conference (October 24; Vancouver, B.C., Canada).

1990 - Presented a one-hour talk on the "Practice of Health Risk Assessment and its Impact on the Economy" at the Annual Meeting of American Institute of Chemical Engineers (AIChE) of New York State (Nov. 14; Albany, NY).

1990 - Presented a one-hour lecture on "The Proper Use of Risk Assessment to Solve Environmental Problems" to the Northern Ohio Manufacturers Association. Sponsored by the Law firm of Squire, Sanders and Dempsey (December 14; Cleveland, OH).

1991 - Presented a 45 minute lecture on "The use of Risk Assessment to Optimize the Remedial Investigation Process" at a conference entitled "Environment Remediation - From Cradle to Grave." Sponsored by Armstrong, Teasdale, Schlafly, Davis and Dicus (January 25; St. Louis, MO).

1991 - Presented a one-day seminar on "Future Trends in Health Risk Assessment" to the Biomedical Research Laboratories of Exxon (February 11; Millstone, NJ).

1991 - Presented a one-hour seminar on "Risk-Based Remedial Investigations" to Phillips Petroleum Environmental Engineering Staff (February 6; Bartlesville, OK).

1991 - Presented guest lecture at University of Michigan School of Public Health entitled "Future Likely Changes in the TLV's" (February 8; Ann Arbor, MI).

1991 - Presented guest lecture to the Exxon Biomedical Research Group entitled "The Practice of Risk Assessment Over the Next 10 Years; Impact on the Petroleum Industry" (February 11; East Millstone, NJ).

1991 - Presented paper entitled "A comprehensive approach to setting soil standards" to the 3rd Western States Contaminated Soil and Groundwater Conference (March 6; Newport Beach).

1991 - Invited speaker/lecturer at the First International Conference on the Health Hazards of Gasoline. Lecture was entitled "A State-of-the-Art Review of the Human Health Hazards Posed by Benzene" (November 7; Miami).

1991 - Invited speaker at conference on Problems Posed by Transferring Contaminated Properties entitled "The Role of Risk Assessment," sponsored by Diepenback and Associates (November 13; Sacramento).

1991 - Co-authored a paper entitled "Recent Changes in Regulatory Toxicity Rankings for Wood-Treating Chemicals and Their Impact on Risk Assessment and Remediation at Wood-Treating Site." Finley, B., M. Harris, and D.J. Paustenbach. Presented at the Amer. Wood Preservers Institute (Scottsdale, Arizona).

1991 - Co-authored a paper at the Western States meeting of the Air and Waste Management Association entitled "A Quantitative Uncertainty Analysis of the CAPCOA approach to risk assessment" (November 1; Seattle).

1992 - Invited speaker at the symposia on State-of-the-art approaches to exposure assessment sponsored by the National Academy of Sciences, CRAM Committee. The title was "Improving risk assessment through the use of Monte-Carlo Analyses" (February 10; Washington, D.C.).

1992 - Invited speaker of the 1992 Northern California American Industrial Hygiene Association Annual Meeting. The paper was entitled "Use of Risk Assessment in Setting TLV's" (March 16; San Francisco, CA).

1992 - Co-authored a paper presented at the Fourth Annual Petroleum Contaminated Soils Conference entitled "Regulatory Actions with TCDD: What Will Happen in the 1990s?" (March 15; Newport Beach, CA).

1992 - Co-authored an invited paper for the 1992 Gulf Coast Hazardous Substance Research Center's Fourth Annual Symposium. Paper was entitled "State-of-the-Art Approaches for Assessing the Risks of Contaminated Groundwater." (April 2-3; Lamar Univ., Beaumont, TX).

1992 - Presented an invited paper at the Annual American Industrial Hygiene Conference (AIHC) entitled "The Rationale For the Proposed TLV for Formaldehyde." (June 2; Boston, MA).

1992 - Co-authored and presented three papers at the 12th International Dioxin Meeting in Tampere, Finland (August 26-28).

- Chemometric Comparisons of PCDD and PCDF Fingerprint Patterns in Environmental Sources and Marine and Freshwater Sediments. (Abstract #ANA-9) R.J. Wenning and D.J. Paustenbach.

- Chemometric Analysis of Potential Sources of PCDD/PCDD in surficial sediments from Newark Bay. (Abstract #13520) R.J. Wenning and D.J. Paustenbach.

- A Monte Carlo Analysis of Exposures and Cancer Risks from 2,3,7,8-TCDD in Soil at Residential and Industrial sites. (Abstract #RSK-29) D.J. Paustenbach, R. Wenning and V. Lau.

1992 - Presented a dinner lecture on "How to set a TLV for an Irritant" at the quarterly meeting of the Northeast section of the AIHA (October 13; Hartford, CT).

1992 - Presented an invited lecture entitled "The U.S. Should Adopt a Risk-Based Environmental Agenda" at the President's Forum at the Annual Meeting of the American Paper and Pulp Institute at Syracuse University (October 14; Syracuse, NY).

1992 - Presented a paper at the Annual Meeting of the Society of Risk Analysis entitled "Comparing the Results of a Monte Carlo Analysis with EPA's Reasonable

Maximum Exposed Individual (RMEI): A Case Study of a Former Wood Treatment Site." T.L. Copeland, D.J. Paustenbach, M.A. Harris, and V. Lau. (December 7-9; San Diego).

1992 - Presented a paper at the Annual Meeting of the Society of Risk Analysis entitled "Historical Reconstruction of Benzene Exposure for an Occupational Cohort of Rubber Workers." D.J. Paustenbach and P.S. Price. (December 7-9; San Diego).

1993 - Presented a one-hour paper at the SETAC Symposium on The hazard posed by Dioxin in the Passaic River. Paper was entitled "Understanding the hazard posed by xenobiotics in Passaic River sediments." (February 26; Rutgers University; Piscataway, NJ).

1993 - Presented a one-hour invited lecture at UCLA, School of Public and Engineering, entitled "Health Risk Assessment and the Practice of Engineering" (February 12; Los Angeles, CA).

1993 - Co-authored a paper presented at the Dermatology Conference entitled, "Using Human Patch-Test Data to Establish Health-Protective Concentrations of Allergens in Soils. (February 27; Hawaii).

1993 - Presented two, one-hour professional development courses on "Recent Improvements in Exposure Assessment" at the annual meeting of the Society of Toxicology (March 14; New Orleans).

1993 - Presented a paper at the Annual meeting of the Society of Toxicology entitled "Approaches to Assessing Human Exposure to Soil Contaminants at Wood Preserving Facilities." Gargas, M.L., P.K. Scott, B.L. Finley, and D.J. Paustenbach (March 17; New Orleans).

1993 - Presented a paper at the Annual meeting of the Society of Toxicology entitled, "An Alternative to the USEPA's Proposed Inhalation Reference Concentrations for Hexavalent Chromium." B.L. Finley, D.M. Proctor, and D.J. Paustenbach (March 18; New Orleans).

Published Abstracts

1980 - Abstract #302 (American Ind. Hygiene. Conf.; Houston, TX). "A Unit Operations Approach to Engineering Control of Health Hazards."

1981 - Abstract #120 (Amer. Ind. Hygiene Conf.; Portland, OR). "A Comparative Study of the Pharmacokinetics and Toxic Effects of Exposing Rats to CCl_4 During a Standard and Normal Workweek."

1981 - Abstract #124 (Amer. Inst. Chemical Eng; New Orleans, LA). "The Need to Educate Undergraduate Engineers in Occupational Health and Safety."

1982 - Abstract #188 (Society of Environmental Toxicology and Chemistry; Boston, MA). "Effects of exposure duration on the severity of toxic response."

1983 - Abstract #224 (Society of Environmental Toxicology and Chemistry). "An Environmental Risk Assessment of an Insect Growth Regulator for Control of Fire Ants."

1984 - Abstract #112 (Amer. Ind. Hyg. Conf.; Detroit, MI). "Unusual Work Schedules: An Overview."

1985 - Abstract #135 (5th Inter. Dioxin symposium; Bayreuth, Germany). "A Critical Examination of Assessments of the Health Risks Associated with 2,3,7,8-TCDD in Soil." Paustenbach, D.J. and Murray, F.J.

1985 - Abstract #219 (Amer. Ind. Hyg. Conf.; Las Vegas, NV). "A Critical Review of Cancer Risk Assessment Methodologies." Paustenbach, D.J. and Dufour, J.T.

1985 - Abstract #288 (Society of Toxicology; San Diego, CA). "A Physiologically-Based Pharmacokinetics Model (PB-PK) for Inhaled CCl_4 in the Rat." Paustenbach, D.J. et al.

1986 - Abstract #30 (191st National Meeting, Amer. Chemical Society; New York, NY). "Critical Assumptions in the Risk Assessment of TCDD in Contaminated Soil."

1986 - Abstract #1132 (Society of Toxicology; New Orleans, LA). "Alternate Approaches to Mathematically Analyzing the Bioassay Data for 2,3,7,8-TCDD." Sielken, R.L., Carlborg, F.W., Paustenbach, D.J., Murray, F.J. and Shu, H.S.

1986 - Abstract #1133 (Society of Toxicology; New Orleans, LA). "An Examination of Critical Assumptions in Health Risk Assessments of 2,3,7,8-TCDD in Contaminated Soil."

1987 - Abstract (#279) (8th Annual meeting of the Society for Env. Toxicology and Chemistry; Pensacola, FL). "Evaluation of Factors Used to Assess Incinerator Emissions as a Potential Source of TCDD in Foods of Animal Origin." Fries, G.F.,and Paustenbach, D.J.

1987 - Abstract MA-02 (7th Inter. Dioxin Symposium: Las Vegas, NV). "A Physiologically-Based Pharmacokinetics Model for 2,3,7,8-TCDD." Leung, H.W., Anderson, M.E., Ku, R.H. and Paustenbach, D.J.

1987 - Abstract #2D (3rd Hazmat West Conference; Long Beach, CA) "Determining Significant Risk Under Proposition 65." Paustenbach, D.J.

1987 - Abstract WAM-C4 (6th Annual meeting of the Society of Risk Analysis; Houston, TX). "A Risk Assessment of Incinerator Emissions as a Potential Source of TCDD in Foods of Animal Origin." Paustenbach, D.J. and Fries, G.F.

1987 - Abstract RC-04 (7th Inter. Dioxin Symposium; Las Vegas, NV). "Documentation for an Occupational Exposure Limit for 2,3,7,8-TCDD." Leung, H.W. and Paustenbach, D.J.

1987 - Abstract RC-05 (7th Inter. Dioxin symposium; Las Vegas, NV). "A Critical Evaluation of the Factors Used in Assessing Incinerator Emissions as a Potential Source of TCDD in Foods of Animal Origin." Fries, G.F. and Paustenbach, D.J.

1987 - Abstract 12 (2nd Conference on the Environmental and Public Health Effects of Petroleum Contaminated Soils; Amherst, MA). "Environmental and Public Health Hazards of Contaminated Soil." Paustenbach, D.J.

1987 - Abstract PS-40 (7th Inter. Dioxin Symposium; Las Vegas, NV). "Oral Bioavailability in the Rat of Soil-Bound TCDD." Shu, H., Paustenbach, D.J., Murray, J., Marple, L., Brunck, P., and DeiRossi, D.

1988 - Abstract #618 (Annual meeting of the Society of Toxicology; Dallas, TX) "A Physiological Pharmacokinetics Description of the Tissue Distribution and Enzyme Induction of 2,3,7,8-TCDD in the Rat." Leung, H.W., Andersen, M.E., Ku, R.H. and Paustenbach, D.J.

1989 - Abstract (5th Annual HazTech meeting; San Francisco, CA). Improvements in Health Risk Assessment 1990's. D.J. Paustenbach

1989 - Abstract #3. (Annual meeting of the American Bar Association; Honolulu, HI) "Applications of Risk Assessment to Toxic Tort Litigation." Paustenbach, D.J. and Ripple, S.

1989 - Abstract #MPM-F4. (Annual Meeting of the Society of Risk Analysis; San Francisco, CA). "Conservatism in Health Risk Assessment: Suggestions for Avoiding Past Mistakes." Paustenbach, D.J.

1989 - Abstract #8A. (6th International Meeting on Dioxins and Related Chemicals; Toronto, Canada) "Dioxin Emissions from Incinerators." Paustenbach, D.J. and Kasunic, C.K.

1989 - Abstract #101. (4th Annual Hazmat West Conference; San Jose, CA) "Risk Assessment in the 1990's." Paustenbach, D.J.

1989 - Abstract #P111. (Annual Meeting of The Society of Environmental Toxicology and Chemistry; Toronto, CA). "Evaluation of Emission Rate and Health Risks of Volatile Gasoline Components of Soil." Sarlos, T., Fishman, B., and Paustenbach, D.J. Toronto, Canada.

1989 - Abstract #P118. (Annual Meeting of The Society of Environmental Toxicology and Chemistry; Toronto, Canada). "Assessment of Pesticide-Related Hazards to Birds in a Residential Community." Finley, B., and Paustenbach, D.J..

1989 - Abstract #946. (28th Annual Meeting of the Society of Toxicology; Atlanta, GA) "Dose-dependent Pharmacokinetics of [^{125}I]-2-IODO- 3,7,8-Trichlorodibenzo-p-dioxin (I-TCDD) in Mice." Leung, H.W., Poland, A.P., Murray, F.J., Paustenbach, D.J. and Andersen, M.E.

1990 - Abstract # (10th International Dioxin Meeting; Bayreuth, Germany). "Risk Assessment of 2,3,7,8-TCDD using a biologically-based cancer model: A reevaluation of the Kociba et al. (1978) bioassay." Vol. 1, p. 561-566. Layard, M., Paustenbach, D.J., Wenning, R.J., and Keenan, R.E.

1990 - Abstract # (10th International Dioxin meeting; Bayreuth, Germany). "Dioxin risk assessment of the Columbia River." Vol. 1, p. 541-546. Keenan, R.E., Parsons, A.H., Wenning, R.J., Ebert, E.J., and Paustenbach, D.J.

1990 - Abstract # (10th International Dioxin Meeting; Bayreuth, Germany). "A Reevaluation of the Tumor Histopathology of Kociba et al (1978): Using 1990 Criteria: Implications for the Risk Assessment of 2,7,8-TCDD using the Linearized Multistage Model." Vol. 1, p. 549-554. Keenan, R.E., Wenning, R.J., Parsons, A.H., and Paustenbach, D.J.

1990 - Abstract #, Session #8-2 (1990 TAPPI Environmental Conference; Seattle, WA). Methodology for Setting Airborne Emissions Limits for Chloroform, Chlorine Dioxide, and Chlorine from Paper and Pulp Mills. Pgs. 133-136. Paustenbach, D.J., Finley, B., Kalmes, R., and Fishman, B. Book 1.

1990 - Abstract # (10th International Dioxin Meeting; Bayreuth, Germany). "PCDDs and PCDFs in surficial sediments from the lower Passaic River and Newark Bay." Organohalogen Compounds. Vol. 1, p. 409-414. Finley, B.L., Wenning, R.J., Ungs, M.J., Huntley, S., and Paustenbach, D.J.

1990 - Abstract #, Session #38-2 (1990 TAPPI Environmental Conference; Seattle, WA). Setting Rational Health Based Standards for Dioxin--Risk Assessment for the Columbia River. Pgs. 801-811. Keenan, R.E., Parsons, A.H., Wenning, R.J., Ebert, E.S., and Paustenbach, D.J. Book 2.

1990 - Abstract # (10th International Dioxin Meeting; Bayreuth, Germany). "An Evaluation of the Inhalation Hazard Posed by Dioxin-contaminated Soil." Vol. 3, p. 335-338. Paustenbach, D.J., Finley, B.L., and Sarlos, T.T.

1990 - Abstract # (5th annual meeting of the Semiconductor Safety Association; Phoenix, AZ). "Criteria for using Substitution as a Control Measure." Paustenbach, D.J..

1990 - Abstract # (Air Pollution and Waste Management Association Annual Meeting; Raleigh, NC). "Development and Field Validation of a Sampling and Analytical Method for Airborne Hexavalent Chromium." Paustenbach, D.J. and Sheehan, P.

1990 - Abstract #8-2. (TAPPI Annual Meeting; Seattle, WA). "Methodology for Setting Airborne Emissions Limits for Chloroform, Chlorine Dioxide, and Chlorine from Paper and Pulp Mills." Paustenbach, D.J., Fishman, B., Kalmes, R., and Ripple S..

1990 - Abstract #38-2. (TAPPI Annual Meeting; Seattle, WA). "Setting Rational, Health-Based Water Quality Standards for Dioxin-Risk Assessment for the Columbia River."

1991 - Abstract #16. [Annual Meeting of the Amer. Wood Preservers Institute; Scottsdale, Arizona (October 30).] Recent Changes in Regulatory Toxicity Rankings for Wood-Treating Chemicals and Their Impact on Risk Assessment and Remediation at Wood-Treating Site. Finley, B., M. Harris, and D.J. Paustenbach.

1991 - Abstract #42 [Technical Association of the Paper and Pulp Industry (TAPPI)]. "A New Look at the Dioxin RSD Using a Biologically-Based Model." Paustenbach, D.J, Keenan, R., and Layard, M.

1991 - Session P125 (11th International Symposium on Chlorinated Dioxins and Related Compounds; Research Triangle Park, NC). Comparisons of PCDD and PCDF Fingerprint Patterns in Lower Passaic River and Newark Bay Sediments and Known Environmental Sources Using Multivariate Statistics. Harris, M.A., Wenning, R.J., Ungs, M.J., and Paustenbach, D.J.

1991 - Session P129 (11th International Symposium on Chlorinated Dioxins and Related Compounds; Research Triangle Park, NC). PCDD and PCDF Fingerprint Patterns in Sediments from Newark Bay and Other Industrialized Waterways Using Principal Components and Cluster Analyses. Wenning, R.J., Ungs, M.J., and Paustenbach, D.J.

1991 - Session P154 (11th International Symposium on Chlorinated Dioxins and Related Compounds; Research Triangle Park, NC). Recent Developments on the Hazards Posed by 2,3,7,8-Tetrachlorodibenzo-p-dioxin in Soil: Implications for Setting Risk-Based Clean-up Levels at Residential and Industrial Sites. Paustenbach, D.J., Wenning, R.J., Lau, V., Harrington, N.W., Rennix, D.K., and Parsons, A.H.

1991 - Session #33-4. (1991 Environmental Conference; San Antonio, TX). Risk Estimates for 2,3,7,8-TCDD 1978 and 1990 Histopathology Interpretations of the Kociba et al. Bioassay Using a Biologically-Based Cancer Model. Paustenbach, D.J., Wenning, R.J., Keenan, R.E., and Layard, M.W.

1991 - Session #36-3 (1991 Environmental Conference; San Antonio, TX). Scientific Evaluation of Natural Resource Damage Claims Associated with PCDD and PCDF Contamination in the Aquatic Environment. Huntley, S.L., Wenning, R.J., Bonnevie, N.L., Keenan, R.E., and Paustenbach, D.J.

1991 - Abstract #446 (SETAC; Seattle, WA). PCDD and PCDF fingerprint patterns in surficial sediments from the lower Passaic River and Newark Bay using multivariate statistics. Wenning, R.J., Harris, M., Ungs, M.J., Finley, B.L., and Paustenbach, D.J.

1991 - Abstract #447 (Annual Meeting of the Society of Toxicology and Environmental Chemistry [SETAC]) Seattle, WA. Comparisons of PCDD and PCDF Fingerprint Patterns in Lower Passaic River and Newark Bay Sediments and Known Environmental Sources Using Multivariate Statistics. Harris, M.A., Wenning, R.J., Ungs, M.J., and Paustenbach, D.J.

1991 - Abstract #447 (SETAC; Seattle, WA). Comparisons of PCDD and PCDF Fingerprint Patterns in Lower Passaic and Newark Bay Sediments and Known Environmental Sources Using Multivariate Statistics. Harris, M.A., Wenning, R.J., Ungs, M.J., and Paustenbach, D.J.

1991 - Abstract #448 (SETAC; Seattle, WA). Comparisons of PCDD and PCDF fingerprint patterns in sediments from Newark Bay and other industrialized waterways using principal components and cluster analyses. Wenning, R.J., Ungs, M.J., and Paustenbach, D.J.

1991 - Abstract #729 (30th Annual Meeting of the Society of Toxicology; Dallas, TX). Evaluation of Potential Sources of 1,2,8,9-TCDD in Aquatic Biota from Newark Bay. Harris, M., Finley, B., Wenning, R., and Paustenbach, D.J.

1992 - Abstract # (Annual Meeting of the Society of Environmental Toxicology and Chemistry [SETAC]). "Potential Sources of PCDDs and PCDFs in Newark Bay Sediments Using Principal Components Analysis." Wenning, R.J., Paustenbach, D.J., Harris, M.A., and Bedbury, H.

1992 - Abstract #ANA-9 (12th International Symposium on Chlorinated Dioxins and Related Compounds; Tampere, Finland). Chemometric of Potential Sources of PCDD/PCDD in surficial sediments from Newark Bay. R.J. Wenning and D.J. Paustenbach.

1992 - Abstract #RSK-29 (12th International Symposium on Chlorinated Dioxins and Related Compounds; Tampere, Finland). A Monte Carlo Analysis of Exposures and Cancer Risks from 2,3,7,8-TCDD in Soil at Residential and Industrial sites. D.J. Paustenbach, R. Wenning, and V. Lau.

1992 - Abstract #4I-1 (Annual Meeting of the Society of Risk Analysis [SRA]; San Diego, CA). Historical Reconstruction of Benzene Exposure for an Occupational Cohort of Rubber Workers. D.J. Paustenbach and P.S. Price.

1992 - Abstract #4PS-8 (Annual Meeting of the Society of Risk Analysis [SRA]; San Diego, CA). Comparing the results of a Monte Carlo analysis with EPA's Reasonable Maximum Exposed Individual (RMEI): A Case Study of a Former Wood Treatment Site. Copeland, T, D.J. Paustenbach, M.A. Harris, and V. Lau.

1992 - Abstract #686 (Annual Meeting of the Society of Toxicology (SOT); Seattle, Washington). "Development of a risk based re-entry levels for PCB's, dioxins and furans following a PCB fire." Jayne Michaud and Dennis Paustenbach.

1992 - Abstract #1170 (Annual Meeting of the Society of Toxicology (SOT); Seattle, Washington). "Quantitative Uncertainty Analysis of AB-2588 Default Exposure Parameters." K.M. Connor, T.L. Copeland, A.M. Holbrow and D.J. Paustenbach.

1992 - Abstract #13520 (SETAC 13th Annual Meeting; Cincinnati, OH, November 8-12). "Sources of PCDD/Fs in Newark Bay Sediments." Wenning, R.J. and D.J. Paustenbach.

1993 - Abstract #1045 (Annual meeting of the Society of Toxicology; New Orleans). "Approaches to Assessing Human Exposure to Soil Contaminants at Wood Preserving Facilities." Gargas, M.L., P.K. Scott, B.L. Finley, and D.J. Paustenbach.

1993 - Abstract #1643 (Annual meeting of the Society of Toxicology; New Orleans). "An Alternative to the USEPA's Proposed Inhalation Reference Concentrations for Hexavalent Chromium." B.L. Finley, D.M. Proctor, and D.J. Paustenbach.

Expert Testimony in Public Hearings

1983 - Expert witness at four public hearings which addressed the environmental safety of an aerially applied pesticide used to control Fire Ants (January, March, September; Kerrville, Bourne, and San Antonio, TX).

1984 - Represented Stauffer Chemical Company and the American Industrial Health Council at several public hearings regarding the proposed California Cancer Policy (February; Berkeley, CA).

1987 - Discussed the human health hazards posed by toxic and odorous emissions from pharmaceutical and power generation facilities (October 17; Freeport, Bahamas).

1988 - Reviewed the potential human health hazards posed by an accidental release of Selexol (Hydrogen Sulfide Scrubber Solution) (November 9; Calumet City, Indiana).

1988 - Presented a talk on the human and environmental health hazards posed by implementation of a Remedial Action Plan (RAP) for a dioxin contaminated Superfund site (March 28; Verona, MO).

1989 - Presented the health risk assessment for a proposed Hazardous Waste Incinerator to the town council and Local Assessment Committee (LAC) (Tanner Process) at a public meeting (April 12; Martinez, CA).

1989 - Presented the health risk assessment for an Illinois State Superfund site at a Town Meeting (May 9; Atlanta, IL).

1989 - Presented the health risk assessment for a California Superfund site (Barron Park) at a town meeting (June 27; Palo Alto, CA).

1989 - Presented testimony to the Prop 65 Science Advisory Board on "A PB-PK Model for Estimating the Risk Specific Dose for 1,4 Dioxane" on behalf of the Halogenated Solvents Industry Alliance (HSIA). (October 20; Davis, CA).

1990 - Presented testimony before the Michigan Air Pollution Control Commission on "Risk Assessment of Dioxin emissions from a Municipal Waste Combustor." (May 2; Detroit, MI).

1990 - Presented testimony before the Oregon Environmental Health Commission on "Risks Posed by Paper Mill Effluents containing Dioxin." (June 12; Portland, OR).

1990 - Participated in Public Hearing involving Rocky Flats. (September 27; Denver, CO).

1991 - Presented testimony to the ACGIH TLV committee on Benzene (March 26; Cincinnati, OH).

1991 - Participated on the Panel at South Coast Air Quality Management District Exposure Assessment Workshop on AB-2588 on behalf of the Western States Petroleum Association (April 8; Los Angeles, California).

1992 - Presented testimony to the ACGIH TLV Committee on benzene and formaldehyde (February 23; Seattle, Washington).

1992 - Presented chromium research activities to Commissioner Weiner, New Jersey Department of Environmental Protection [NJDEP]. (April 15, May 20, and June 16; Trenton, New Jersey).

1992 - Participated in a series of four semi-public Inter-agency meetings with NJDEP on chromium toxicology and risk assessment (Trenton; New Jersey).

1993 - Participated in meeting with Newark/New York Port Authority regarding dioxin contamination of the Passaic River and Newark Bay (February 16; New York City).

Depositions and Court Testimony

1990 - Served as a fact witness in Myers vs. Exxon. Case was settled out of court.

1992 - Gave two depositions as an expert witness in the case of White vs. Tanglewood. Attorneys were from Brown, Maroney, Oaks, and Hartline of Austin, Texas and Royston-Razor of Houston, Texas (April and May; Houston, Texas). Case was settled out of court.

1992 - Presented testimony to an administrative law judge on the health hazards of trace levels of vinyl chloride in natural gas on behalf of GSF energy and Air Products Inc. (October 16; San Francisco, CA).

1993 - Gave several days of depositions as an expert witness in the case of Cutshaw vs. Weyerhaeuser. Law firm was Hillis, Clark, Martin, and Peterson of Seattle (Depositions: January 11-13, January 26 and February 4).

Peer Reviewed Publications

1976 - Published three Hygienic Guides on the toxicology and analytical chemistry hygiene guides (SO_2, SO_3 and Sulfuric Acid). Published by the American Industrial Hygiene Association (AIHA), Akron, OH.

1983 - Co-authored and presented with Dr. Tanner Stewart three case studies at the Darden Graduate School of Business, University of Virginia. The cases addressed the ethical and societal difficulties faced by executives who must deal

with issues surrounding environmental and occupational safety and health. The cases were then used at several prominent business schools.

1983 - Paustenbach, D.J., Carlson, G.P., Christian, J.F., Born and, G.S. and Rausch, J.E.; "A Dynamic Closed-Loop Recirculating Inhalation Chamber for Conducting Pharmacokinetics and Short Term Toxicity Studies." Fund. and Appl. Tox. 3:528-532.

1983 - Paustenbach, D.J. "The Professional Engineers Responsibility for Occupational Disease Prevention." In: Industrial Hygiene Aspects of Plant Operations. Cralley and Cralley (eds.), Vol. II, p. 5-24, MacMillan Pub., NY, NY.

1984 - Paustenbach, D.J.; "The Need to Educate Engineers in Occupational Safety and Health: A Proposal for Schools of Engineering." Professional Safety. 100:15-23 (December).

1984 - Paustenbach, D.J.; "Risk Assessment and Engineering in the 80's." Mechanical Engineering. 106:54-59 (November).

1984 - Paustenbach, D.J.; "Occupational Safety- Are You Professional." Mechanical Engineering. 106:76-82 (March).

1984 - Paustenbach, D.J.; "The Toxicology, Environmental Fate and Ecological Impact of Pro-Drone As A Fire Ant Pesticide." In: Proceedings of the Sixth Annual Imported Fire Ant Conference. Dr. Michael Mispagel (ed.),University of Georgia Press, p. 55-56.

1984 - Paustenbach, D.J. and Dufour, J.T.; "The Engineer's Role in Protecting Human Health-Legal Aspects." Mechanical Engineering. 106:62-69 (August).

1984 - Stewart, W.T. and Paustenbach, D.J.; "Ethical Decision Making for Engineers and Production Managers." Industrial Engineering. 16:68-76 (April).

1985 - Authored two chapters in: Patty's Industrial Hygiene and Toxicology, 2nd Edition, Cralley and Cralley (eds.); John Wiley and Sons, New York.

- Volume IIIa: Chapter 6: Occupational Exposure Limits, Pharmacokinetics, and Unusual Work Schedules. (p. 111-277).
- Volume IIIb: Chapter 5: Biological Rhythms, Shiftwork and Occupational Health (with Drs. Smolensky and Scheving). (p. 175-312).

1986 - Paustenbach, D.J. and Langner, R.R.; "Corporate Occupational Exposure Limits: The Current State of Affairs." Amer. Ind. Hyg. Assoc. Journal. 47:809-818.

1986 - Paustenbach, D.J., Shu, H.P., and Murray, F.J.; "A Critical Examination of Assumptions Used in Risk Assessments of Dioxin Contaminated Soil." Reg. Toxicol. Pharm. 6:284-307.

1986 - Paustenbach, D.J. and Murray, F.J.; "A Critical Examination of Assessments of Health Risks Associated with 2,3,7,8-TCDD (Dioxin) in Soil." Chemosphere 15:1867-1874.

1986 - Paustenbach, D.J., Christian, J.E., Carlson, G.P., Born, G.S.; "The Effect of an 11.5 Hr./Day Exposure Schedule on the Toxicity and Distribution of Inhaled Carbon Tetrachloride in The Rat." Fund. Appl. Toxicol. 6:472-483.

1986 - Paustenbach, D.J., Carlson, G.P., Christian, J.E., and Born, G.S.; "A Comparative Study of the Pharmacokinetics of Carbon Tetrachloride in the Rat Following Repeated Inhalation Exposures of 8 and 11.5 Hr/Day." Fund. Appl. Toxicol. 6:484-497.

1987 - Andersen, M.E., MacNaughton, M.G., Clewell, H.J. III, and Paustenbach, D.J.; "Adjusting Exposure Limits for Long and Short Exposure Periods Using a Physiological Pharmacokinetics Model," Amer. Ind. Hyg. Assn. Journal. 48:335-343.

1987 - Leung, H.W., Hallesey, D.W., Shotwell, L.D., Murray, F.J., and Paustenbach, D.J.; "Toxicological Evaluation of Substituted Dicylopentadienyliron (Ferrocene) Compounds." Toxicol. Letters. 38:103-108.

1987 - Parades, C., Kessler, W.V., Landolt, R.R., Ziemer, P.L. and Paustenbach, D.J.: "Radionuclide Content of, and 222 Remanation from Construction Materials Made from Phosphate Industry Waste Products and Radiological Considerations." Health Physics. 53:23-29.

1987 - Paustenbach, D.J.; "Assessing the Potential Environmental and Human Health Risks of Contaminated Soil." Comments On Toxicology. 1:185-220.

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1987 - Paustenbach, D.J. "Bhopal, Asbestos, and Love Canal... How They Should Affect Engineering Education" IEEE Tech. and Society Mag. (March) 6,1:9-15.

1987 - Paustenbach, D.J. Shu, H.P., and Murray, F.J.; "Assessing the Potential Human Health Hazards of Dioxin-Contaminated Soil" Chapter 14 in: Solving Hazardous Waste Problems, J. Exner (ed.), American Chemical Society, Washington, D.C., p. 178-213.

1987 - Shu, H.P., Paustenbach, D.J., and Murray, F.J.; "A Critical Evaluation of the Use of Mutagenesis, Carcinogenesis and Tumor Promotion Data in a Cancer Risk Assessment of 2,3,7,8-TCDD." Regul. Toxicol. Pharm. 7:57-88.

1987 - Veng-Pedersen, P., Paustenbach, D.J., Carlson, G.P., and Suarez, L. "A Linear Systems Approach to Analyzing the Pharmacokinetics of Carbon Tetrachloride in the Rat Following Exposure to an 8 Hour Day and 12 Hour/Day Schedules." Arch Toxicol. 60:355-364.

1988 - Leung, H.W. and Paustenbach, D.J.; "Application of Pharmacokinetics to Derive Biological Exposure Indexes from Threshold Limit Values." American Industrial Hygiene Association Journal. 49:445-450.

1988 - Leung, H.W., Murray, F.J., and Paustenbach, D.J.; "A Proposed Occupational Exposure Limit for 2,3,7,8-TCDD." Amer Ind. Hyg. Assn. Journal. 49:466-474.

1988 - Leung, H.W., Ku, R.H., Paustenbach, D.J. and Andersen, M.E.; "Physiologically-Based Pharmacokinetics Model of 2,3,7,8-TCDD in C57BL/2J and DBA/2J Mice." Toxicology Letters. 42:15-28.

1988 - Leung, H.W. and Paustenbach, D.J.; "Setting Occupational Exposure Limits for Irritant Organic Acids and Bases Based on Their Equilibrium Dissociation Constants." Applied Ind. Hygiene. 3:115-118.

1988 - Paustenbach, D.J.; "Response to Comments on Paper on Engineering Education" J. Prof. Issues in Engineering.

1988 - Paustenbach, D.J.; "A Methodology for Evaluating the Environmental and Public Health Risks of Contaminated Soil" Chapter 20 in: Petroleum Contaminated Soil, (Volume 1), pages 225-262. (E. Calabrese and P. Kostecki, eds.) Lewis Pub., Ann Arbor, MI.

1988 - Paustenbach, D.J.: "Assessment of the Developmental Risks Resulting from Occupational Exposure to Select Glycol Ethers within the Semi-conductor Industry." J. Toxicol. Env. Health. 23:53-96.

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1988 - Shu, H., Teitelbaum, P. Webb, A.S., Marple, L., Brunck, B., Dei Rossi, D., Murray, J., and Paustenbach, D.J. "Bioavailability of Soil-Bound TCDD: Dermal Bioavailability in the Rat" Fund. Appl. Toxicol. 10:335-343.

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1989 - Paustenbach, D.J., editor; The Risk Assessment of Environmental And Human Health Hazards: A Textbook of Case Studies. 34 chapters by 51 contributors. John Wiley and Sons, New York, N.Y. 1157 pages.

1989 - Paustenbach, D.J. (Summary of Oral Paper). "Toxic Chemicals and Health Risk Assessments in Regulation and Litigation." The Record of the Association of the Bar of The City of New York. 44:406-409.

1989 - Paustenbach, D.J. ; "Shortcomings in the Traditional Practice of Health Risk Assessments." Columbia J. Environmental Law. 14: 411-427.

1989 - Paustenbach, D.J.; "The Engineer's Responsibility for Controlling Occupational Disease and Preventing Accidents," Chapter 28 in Volume II of: In-Plant Practices for Job Related Health Hazards Control: Engineering Aspects. (Cralley, L. and Cralley, L. eds.), p. 541-569. John Wiley and Sons. New York, N.Y.

1989 - Paustenbach, D.J.; "A Survey of Health Risk Assessment," Chapter 1 in The Risk Assessment of Environmental and Human Health Hazards: A Textbook of Case Studies, p. 27-124. John Wiley and Sons, New York, NY.

1990 - Finley, B., R.J. Wenning, M.J. Ungs, S. Huntley, and D.J. Paustenbach. PCDDs and PCDFs in surficial sediments from the lower Passaic River and Newark Bay. Proceedings of Tenth International Symposium on Chlorinated Dioxin and Related Compounds. pp. 409-414. Bayreuth, Germany.

1990 - Finley, B. and Paustenbach, D.J.; "Using Risk Assessment to Design Cost Effective Remedial Investigations: A Case Study." Econ 5,1:57-59.

1990 - Fries, G.F. and Paustenbach, D.J.; "Evaluation of Potential Transmission of 2,3,7,8-tetrachlorodibenzo-p-dioxin-contaminated incinerator emissions to humans via foods." Toxicol. Environ. Health. 29:1-43.

1990 - Keenan, R.E., R.J. Wenning, A.H. Parsons, and D.J. Paustenbach. A re-evaluation of the tumor histopathology of Kociba et al. (1978) using 1990 criteria: Implications for the risk assessment of 2,3,7,8-TCDD using the linearized multistage model. Proceedings of Tenth International Symposium on Chlorinated Dioxin and Related Compounds. pp. 549-554. Bayreuth, Germany.

1990 - Keenan, R.E., A.H. Parsons, E.S. Ebert, R.J. Wenning, and D.J. Paustenbach. Setting rational health-based water quality standards for dioxin-Risk assessment for the Columbia River. Proceedings of Technical Association of the Pulp and Paper Industry (TAPPI). pp. 801-812. Bayreuth, Germany.

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1990 - Layard, M., D.J. Paustenbach, R.J. Wenning, and R.E. Keenan. Risk assessment of 2,3,7,8-TCDD using a biologically-based cancer model: A re-evaluation of the Kociba et al. (1978) bioassay. Proceedings of the Tenth International Symposium on Chlorinated Dioxin and Related Compounds pp. 561-566. Bayreuth, Germany.

1990 - Leung, H.W. and Paustenbach, D.J.; "Organic Acids and Bases: Review of Toxicological Studies." Amer. J. Ind. Med. 18:717-735.

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Professional and Society Memberships

- American Industrial Hygiene Association (AIHA)
- American Conference of Governmental Industrial Hygienists (ACGIH)
- Society of Environmental Toxicology and Chemistry (SETAC)
- Society for Exposure Assessment (SEA)
- American Institute of Chemical Engineers (AIChE)
- Society for Risk Analysis (SRA)
- Inter. Soc. of Regulatory Toxicology and Pharmacology (ISRTP)
- Society of Toxicology (SOT)
- American Board of Toxicology (ABT)
- Academy of Toxicology (ACT)
- Air and Waste Management Association (AWMA)
- New York Academy of Science (NYAS)
- Sigma Xi (Stanford Chapter)
- Board of Certified Safety Professionals (CSP)
- American Board of Industrial Hygiene (ABIH)

Professional Activities

- Member of the Council for the Health and Environmental Safety of Soils (CHESS) (1985-present). A group established to set consensus clean-up levels for soils.
- Member of the National Council on Radiological Protection (NCRP), Committee on Hazardous Waste (1993).

- Adjunct Professor, University of California, Irvine, School of Medicine (1993-1995).
- Adjunct Professor, University od Massachusetts (1993-1995)
- Liaison Member Between AIHA and Society of Risk Analysis (1990-1991)
- Member, USEPA Science Advisory Board on Dioxin (1988-1989)
- Adjunct Professor, Univ. of Texas, School of Public Health (1985-1989)
- Instructor in Ind. Hyg. for the National Safety Council, Chicago, IL (1981-1985)
- Member of AIHA Committee on Unusual Workshifts (1981-1984)
- Member of AIHA Workplace Exposure Limits Committee (1982-1984)
- Member of AIHA Toxicology Committee (1982-1984)
- Adjunct Professor, Purdue Univ., Dept. of Toxicology/Pharmacology. (1983-1984)
- Visiting Professor, Univ. of Bridgeport, Dept. of Mechanical Eng. (1983)
- Instructor for NIOSH in the area of Occupational Health (1980-1982)
- Member of AIHA Hygiene Guides Committee (1976)
- Textbook reviewer for Wiley Interscience (Jim Smith, Senior Editor)
- Chairman of Human Health Effects Group of CHESS.
- Textbook reviewer for MacMillan Publishing Company (G. Papke, Editor)

Peer-Reviewer for the following Journals

Science, Toxicology and Applied Pharmacology, American Industrial Hygiene Association Journal, Journal of Chemical Engineering Education, Risk Analysis, Fundamental and Applied Toxicology, Journal of Professional Issues in Engineering, Mechanical Engineering, J. Toxicol. Environ. Health., Regulatory Toxicology and Pharmacology, Toxicology and Industrial Health.

Research and Professional Interests

Quantitative Risk Assessment, Industrial Toxicology, Pharmacokinetics, Radon, Environmental Toxicology, Industrial Hygiene Engineering, Setting Occupational and Environmental Exposure Limits, Engineering and Business Ethics, Indoor Air Pollution and Industrial Ventilation, Occupational Health, Unusual Workshifts.

APPENDIX C

SIMONS & ASSOCIATES, INC.

826600110

APPENDIX C-1
DESCRIPTION OF QUALIFICATIONS

2601 South Lemay Avenue, Suite 39
Fort Collins, Colorado 80525
Telephone: (303) 223-9957
FAX: (303) 223-9958

Simons & Associates, Inc.

Simons & Associates, Inc. (SA) is an engineering consulting firm specializing in civil engineering, environmental engineering, and water resources projects. The engineers of SA have participated nationally and internationally in a myriad of projects and are recognized for their leadership and expertise in the following areas:

- 1-, 2- and 3-Dimensional Mathematical Modeling
- Channel Stability
- Climatology
- Environmental/Habitat Analysis
- Erosion and Sedimentation
- Expert Systems
- Fate and Impact of Contaminants
- Geomorphology
- Groundwater
- Hydraulic Structures
- Hydraulics
- Hydrology
- Litigation Support
- Mine Site Reclamation
- River Mechanics
- Seepage Control
- Video Development
- Water Quality
- Water Resources Development

Simons & Associates utilizes state-of-the-art, as well as more traditional methodologies, to obtain solutions for engineering and environmental problems. The level of analysis and types of methodologies utilized are based upon the complexity of the local environment and each client's individual needs. The physical processes governing the movement of water, sediment, and contaminants are considered where applicable to analysis and design. Simons & Associates offers realistic and practical services which integrate technical, scientific and environmental approaches augmented by a thorough understanding of the physical processes related to each problem. The SA engineers have numerous years of in-depth experience on hundreds of projects utilizing the following procedures:

- **Geomorphic Analysis**
- **Engineering Analysis and Design**
- **Groundwater Analysis and Development**
- **Ecological Habitat Evaluation**
- **Analysis of the Fate and Impact of Contaminants**
- **Mathematical Modeling of Complex Systems**
- **Development and Utilization of Expert Systems**
- **Physical Modeling**

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Geomorphic Analysis

Geomorphic analysis is an important component of any engineering design dealing with dynamic systems. Virtually every water resources development project requires a detailed geomorphic analysis that must be dove-tailed into engineering design, interdisciplinary constraints, public constraints and environmental and legal issues. Simons & Associates has worked on geomorphic problems pertaining to hydropower development, hydropower relicensing, mining and agriculture. Also, their analysis considers the short-, intermediate- and long-term responses of river systems which may be subjected to changing climatic conditions, changing hydrologic regimes, and/or changing conditions imposed by water resources development occurring within the system. The geomorphic analysis is intimately linked to the more detailed engineering analysis and design. The analysis and design is supplemented by the development and use of mathematical models, the development and use of expert systems, and the use of physical models, as required, to determine and finalize the best design among alternatives.

Engineering Analysis and Design

Simons & Associates engineers' have acquired extensive experience in dealing with problems related to all aspects of civil engineering including water resources development which includes hydropower, irrigation systems, water supply systems, mining, navigation, and flood control. Such experience has been achieved through the successful completion of hundreds of projects both nationally and internationally. Successful engineering design must incorporate various levels of analysis, depending upon the complexity of the project. The initial phases of design take advantage of experience and knowledge regarding geomorphic processes. The middle phases expand upon this knowledge by utilizing engineering concepts, principles and experience. The final phases refine the design by utilizing mathematical models and/or physical models as required to achieve identification of the best and most economical methods of achieving analysis and design objectives.

Groundwater Analysis and Design

Simons & Associates has developed and utilized techniques requiring the use, development, and refinement of sophisticated groundwater models which include analysis of linkages between ponds, reservoirs and the natural drainage system. Simons & Associates has worked extensively with problems of seepage from canals, reservoirs, and sewage lagoons. Most recently, S&A has conducted studies for Syar Industries in California involving seepage, the impacts of impermeable boundaries on seepage, and the linkages between ponds, aquifers and river systems. This project area is located on the Russian River and adjacent terrace lands near Healdsburg, California.

Ecological Habitat Evaluation

Simons & Associates has conducted a number of analyses related to fisheries issues including habitat, passage, and spawning. This type of analysis generally uses principles developed in the Instream Flow Incremental Methodology (IFIM) applying a combination of hydraulic modeling and habitat suitability criteria. The habitat suitability criteria principally includes depth, velocity, and substrate for various species and life stages of fish. In addition, SA has collected data and developed flow/habitat models specifically for threatened and endangered birds who use riverine areas for roosting and nesting.

Analysis of the Fate and Impact of Contaminants

Simons & Associates has conducted numerous analyses of concentrations of contaminants for both static and dynamic conditions. These analyses have included the determination of concentration, half-life, mobility, and fate of contaminants with regard to development and environmental impacts.

Mathematical Modeling of Complex Systems

To facilitate SA engineers' expertise in answering complex water resources problems, a number of models applicable to rivers and watersheds have been developed. These are 1-, 2- and 3-dimensional models which have been applied to a wide range of water resources and environmental analysis-related projects. In addition, SA has developed and utilized state-of-the-art water-sediment routing models and pollutant transport models for analysis of watersheds, rivers (including scour problems), aggradation, degradation, bridge hydraulics, channel stability analysis, and the response of watersheds and river systems to all types of development. Simons & Associates has an extensive engineering library of software with emphasis on water resources which is continuously reviewed and updated in order to maintain leadership in this field. A fundamental truth that SA recognizes and applies in engineering design is that it is essential to understand the system within which the design must function. For example, when dealing with river response it is necessary to identify the supply of sediment, the characteristics of the sediment and the linkage between the sediment and the hydrology to achieve a successful analysis and design. Many water resources systems experience delivery of sediment to a site based upon supply of sediment not sediment transport capacity. In some cases, there can be orders of magnitude difference between supply of sediment to a site versus transport capacity as dictated by theory.

Development and Utilization of Expert Systems

Simons & Associates is experienced with the use of Artificial Intelligence concepts. Clients have discovered that use of Expert Systems specifically designed to comply with their individual requirements is an efficient way to transfer information, teach physical principles, identify best alternatives, cope with environmental requirements, and avoid the loss of valuable knowledge. Simons & Associates is a leader in the field of computation water resources methodologies.

Physical Modeling

Because of the complexity of physical systems, it is often expedient to build scale models and utilize them to test geomorphic and engineering design concepts. The utilization of such models greatly enhances the understanding of the physical system and can be an extremely useful component of analysis and design, for refining designs, and for communicating with the client. Large physical model facilities are available locally for use by SA as are other laboratory facilities.

Examples of Typical Projects that have been Completed by SA Engineers

- *Analysis of sediment transport in rivers*
- *Analysis of the effect of sand and gravel extraction from rivers*
- *Analysis of the fate and impacts of pollutants*
- *Analysis of water quality*
- *Bank erosion protection evaluation and design*
- *Design of hydraulic structures*

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Examples of Typical Projects, Continued

- *Environmental impact assessment*
- *Geomorphic and engineering analysis of channel stability*
- *Groundwater analysis and development*
- *Hydrologic and hydraulic modeling and analysis*
- *Instream Flow Incremental Methodology (IFIM) studies*
- *Monitoring of complex watersheds*
- *Point and nonpoint sourcce pollution analysis*
- *Prediction of aggradation and degradation*
- *River sedimentation and watershed sediment yield for hydropower and other types of reservoirs*
- *Sediment exclusion and ejection*
- *Seepage control*
- *Water resources projects and mine permit analysis*
- *Wetlands assessment*

Additional Services Offered by Simons & Associates

Simons & Associates has provided a wide variety of support services in civil, water resources and environmental engineering to utilities; public utility commissions; consumer advocacy groups; local, state and federal governments; power producers; other industrial clients and law firms. These services include:

- providing technology transfer,
- development of videos, and
- assisting in hearings, depositions, and litigation as expert witnesses

Technology Transfer

Simons & Associates have actively participated in technology transfer for numerous years. This technology transfer has been accomplished through teaching short courses, preparation of training and design manuals, and publication and presentation of technical papers. Additionally, SA has published several reference books and textbooks.

Video Development

Simons & Associates has developed and participated in numerous films and videos for presentation which identified and supported application of concepts related to problem analysis and decision making and assisted in the determination of sensitivity to imposed conditions. The development of state-of-the-art videos using physical processes combined with computer simulation models of technical issues to visually depict the problem at hand has been successfully used in hearings, depositions, and litigation.

Hearings/Litigation Support

Simons & Associates prides itself in serving to solve complex problems. This is accomplished by providing services in the areas of public hearings and participation within the negotiation processes. However, if necessary, they also have the experience to represent clients by preparing reports, critical literature and data reviews and by providing expert testimony.

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APPENDIX C-2
RESUMES OF KEY PERSONNEL

ROBERT K. SIMONS

2601 South Lemay Avenue, Suite 39
Fort Collins, Colorado 80525
Phone: (303)223-9957
FAX: (303)223-9958

EDUCATION

Ph.D. (Civil Engineering, Hydraulics) Colorado State University, 1986
M.S. (Civil Engineering, Hydraulics) Colorado State University, 1977
B.S. (Civil Engineering) Colorado State University, 1973

REGISTRATION

Registered Professional Engineer in Colorado

EXPERIENCE SUMMARY

Dr. R.K. Simons' principal fields of interest and expertise are hydraulics, river mechanics, erosion and sedimentation, sediment transport, hydraulic structures, mathematical modeling, hydrology, riverine habitat modeling, riparian vegetation modeling, and analysis related to various aspects of fisheries. He serves as project manager and engineer on many of the Simons & Associates' projects by conducting engineering analysis as well as managing other engineers and staff members.

Dr. Simons has extensive experience on over 150 projects covering various aspects of civil engineering including evaluation of channelization and levee designs, reservoir optimization for flood mitigation, prediction of river response to various management alternatives, bank stabilization, reservoir sedimentation, storm water management, and flood warning. Dr. Simons developed design methodologies for channel bank protection using gabions based on hydraulic principles, risk analysis, and probability of motion. He has developed and applied a number of computer models predicting sediment transport, erosion, sedimentation, riparian vegetation dynamics, and flow/habitat relationships.

In addition to engineering analysis and computer modeling, Dr. Simons has experience in hydrologic data collection including stream gaging, suspended sediment sampling, bed material sampling, bed-load transport, surveying, and various types of meteorological data collection. He has collected data in many areas of the United States, including Alaska, and in a number of international locations.

Dr. Simons has served as an expert witness on a number of occasions. He has applied engineering principals to analyze legal issues in such cases as a dam break, a boundary dispute due to shifting river channels, flood mitigation based on reservoir operation, effects of gravel mining on channel stability, effects of changing water rights on channel maintenance and morphology, effects of proposed water projects on water availability to the projects as well as water availability to provide instream flows, and the effect of instream flows in providing riverine habitat for various species.

Some specific examples of Dr. Simons' project involvement include:

- Analysis of channel stability and dynamics of 67 mountain channel reaches for the Denver Water Department as part of the Systemwide/Site Specific Environmental Impact Statement. This work was designed to analyze the impacts of proposed future water supply projects on channel morphology. Specifically, the work included analysis of hydraulics, sediment supply, sediment transport capacity, aggradation/degradation, lateral migration, bank stability, and vegetative encroachment. It addressed issues raised by the Forest Service and their concerns to provide favorable conditions of water flow in the National Forests. In addition, the analysis also included prediction of spawning gravel changes on many streams and analysis of flushing flows for spawning gravels for squawfish on the Colorado River.

- Analysis of channel dynamics issues in the dispute over Federal Reserved Water Rights in the National Forests in the State of Colorado.

- Hydrologic analysis of a complex water resources system dealing with channel morphology, environmental impacts, and habitat on the North Platte, South Platte, and Platte Rivers. This work involved extensive hydrologic modeling of a large basin, hydraulic modeling, data collection, sediment transport and geomorphic analysis as well as analysis and modeling of habitat for various species. Models were developed to analyze riparian woodland expansion (vegetative encroachment) and channel narrowing, and habitat/flow relationships for whooping cranes and sandhill cranes. Analysis was also conducted on the relationship between flow and ice with respect to bald eagle foraging. Additionally, data was collected and analyzed for flow/habitat relationships for interior least terns and piping plovers, and analysis of substrate for fisheries was also conducted. Through this and other projects, Dr. Simons has used and is familiar with the Instream Flow Incremental Methodology (IFIM) and has developed other models that relate flow to habitat.

- Analysis of issues related to resuspension of sediment due to towboat traffic on the Mississippi River for the Mississippi River Lock and Dam 26 replacement EIS.

- Analysis of potential channel changes and fisheries habitat changes resulting from a municipal water supply project which would divert water from the Delaware River via the Point Pleasant Diversion to a small stream in Pennsylvania.

- A gravel enhancement project on the White Salmon River in Washington to determine the feasibility of placing gravel to enhance spawning habitat from a physical process perspective.

- Extension of the work of riparian vegetation dynamics/channel width modeling developed on the Platte River to the Snake River in Idaho to predict changes in riparian vegetation resulting from potential future modification of streamflow.

- Modeling of reclaimed coal mine areas in Wyoming to predict potential erosion over a future period of 1,000 years.

- Hydrologic modeling of four future proposed projects on the Platte River to determine the availability of water as well as interproject water effects. The analysis utilized minimum instream flow criteria for wildlife habitat purposes as a constraint on diversions and reservoir operation.

- Analysis of gravel mining on channel morphology as it affected a bridge and several major pipeline crossings.

- Computer modeling of a series of drop structures for a channel stabilization design on Sand Creek and Cherry Creek in Denver.

- The analysis and design of sedimentation reservoirs to eliminate excess sediment inflow from side drainages to a large irrigation canal system (the design included recreational features such as tennis and basketball courts and softball and soccer fields.

- Channel stabilization analysis and design recommendations for a development in California.

Dr. Simons' experience also includes international work on several projects in South America, the Caribbean, Indonesia, and Asia. These projects included:

- Irian Jaya, Indonesia: Hydrologic and other data collection as part of a long-term environmental monitoring program and modeling of sediment transport and riverine channel morphology.

- Venezuela: Several months during 1972 were spent working on the VIMHEX II project (Venezuelan International Meteorologic and Hydrologic Experiment) collecting and analyzing rainfall, runoff, and channel geomorphology data.

- Argentina: Analysis of major bank failures along the Rio Parana de las Palmas. Bank failures due to flood conditions were threatening the large Exxon refinery near Campana. Prediction of future erosion was made and bank protection methods were proposed.

- Peru, Columbia and Ecuador: Analysis of several hydropower projects. These analyses dealt mainly with sediment transport, reservoir sedimentation, and damage to various hydropower generating components due to sediment. For example, Amaluza Reservoir in Ecuador which produces large quantities of energy from its high head (1,800 feet) turbines, reservoir sedimentation was modeled and mitigation measures were analyzed to help select a feasible method of reducing sediment damage to the turbines.

- Nepal: Analysis of sediment sluicing and ejection from the headworks of a major diversion dam on the Arun River in Nepal to make design and operation recommendations.

- Dominican Republic: Analysis of sedimentation issues for an existing diversion project. Recommendations were made to reduce the potential for sedimentation of the diversion and canals.

Dr. Simons has published over 25 papers in his field and a listing is available upon request.

DARYL B. SIMONS

2601 South Lemay Avenue, Suite 39
Fort Collins, Colorado 80525
Phone: (303)223-9957
FAX: (303)223-9958

EDUCATION

Ph.D. (Irrigation, Hydraulics, River Mechanics) Colorado State University, 1957
M.S. (Hydraulics, Structures) Utah State University, 1948
B.S. (Civil Engineering) Utah State University, 1947

REGISTRATION

Registered Professional Engineer in Colorado, Wyoming, Arizona, New Mexico and Nebraska.

EXPERIENCE SUMMARY

Dr. Simons is widely recognized for his research and experience in the fields of hydraulics, hydrology, geomorphology, river mechanics, sediment transport, hydraulic modeling and hydraulic structure design. He has supervised hundreds of water-related projects which include hydrology, hydraulics, flood control, river geomorphology, sediment transport, channel relocation, water and sediment routing, data collection, data storage and retrieval systems, physical and mathematical modeling, navigation, water resources planning and development, gravel mining permit applications and physical impact analysis, expert witness, and hydraulic and erosion analysis of bridges and other hydraulic structures.

Prior to forming Simons & Associates, Inc., Dr. Simons was the President of Simons, Li & Associates, Inc. His other professional duties have included serving as a professor at the University of Wyoming; Project Chief for the U.S. Geological Survey to conduct research in fluvial hydrology and hydraulics; and Associate Dean for Research, Director of Engineering Research and Professor of Civil Engineering at Colorado State University from 1963 to 1983. He has served as a hydraulic consultant on numerous engineering projects for the United Nations and federal government agencies dealing with watersheds, channel stability, river mechanics, flood control, hydraulic structures, navigation problems, geomorphic response, river forecasting, dams, hydropower, and water resources development. He has also served on national and international panels delegated to outline research needs in hydraulics, irrigation and drainage, and water resources development.

PROFESSIONAL CAREER (Detailed Assignments)

Oct 1984 to present:

Principal Engineer, Simons & Associates, Inc.
2601 South Lemay Avenue, Suite 39
Fort Collins, Colorado 80525

Professional Career, Cont'd

1983 to present:

Continue to conduct research at Colorado State University in Civil Engineering as Professor of Civil Engineering on a transitional basis

Jan 1981 to Oct 1984:

President and Principal Engineer, Simons, Li & Associates, Inc.,
3555 Stanford Road, Fort Collins, Colorado 80525

July 1965 to May 1983:

Associate Dean, Engineering Research/College of Engineering
Director of the Engineering Research Center and Professor of Civil Engineering,
Colorado State University, Fort Collins, Colorado 80523

July 1963 to July 1965:

Section Chief of Civil Engineering Research and Professor of Civil Engineering,
Colorado State University, Fort Collins, Colorado 80523

June 1957 to July 1963:

Research Chief and Hydraulic Engineer, U.S. Geological Survey,
Colorado State University, Fort Collins, Colorado 80523

Sept 1948 to June 1957:

Professor of Civil Engineering, University of Wyoming, Laramie, Wyoming

April 1943 to Sept 1946:

U.S. Army, Captain/Unit Commander

CONSULTANTSHIPS (Major Activities)

World Bank

Consultant on Panel of Experts for Kukule Ganga hydropower project in Sri Lanka.

World Bank

Consultant on design of sewer and storm water systems for China. (Anticipated cost of pipelines, pumping plants, detention system and outfall will be on the order of 2 billion dollars.)

Consultantships, Cont'd

World Bank

Consultant on Panel of Experts for three hydropower projects (Arun-I and Arun-III and Kali Gandaki "A") in Nepal.

Inter-American Development Bank

Redesigning of outlet works and sediment management for major dam on Paute River, Ecuador, South America.

Inter-American Development Bank

Consultant on Panel of Experts for Alfalfal Hydroelectric Project in Chile.

International Boundary and Water Commission

Water resources development, channel stabilization, hydraulic structures, irrigation, hydrologic and hydraulic data collection, analyses and physical modeling.

IECO/World Bank

Served with a Blue Ribbon Panel of Consultants through IECO of San Francisco for World Bank to evaluate the response of the Ganges River Consultantships, development on the lower river system, particularly during dry periods and droughts. Study was the basis for negotiating a division of flow on the Ganges River between Bangladesh and India. Two, five-year agreements were negotiated. Also, analyzed hydrologic and hydraulic impacts on construction of a transmission tower for a crossing of the Brahmaputra River at its confluence with the Ganges.

Egypt, Nile River (United Nations, Environmental Protection Agency, Egyptian and Canadian Governments)

Channel stabilization, flood control, channel degradation, water quality and related problems on the Nile River. Completed study in 1965 regarding the response of the Nile River downstream of the high dam, Simons (1965) . Intermittently involved in associated Nile River problems since 1965. Presently working with environmental Protection Agency (EPA) to undertake a study of the short- and long-term response of the river to the development and utilization of the high dam.

West Pakistan

Design of the Link Canals (canals with discharge capacities ranging from 8,000-26,500 cfs), analysis of sediment supply in the Indus Basin.

Consultantships, Cont'd

Spain

Consulting firms: river systems, hydraulic structures, river crossings, erosion and sedimentation.

Department of Defense

Climatological, meteorological, hydraulic and hydrology problems in South America.

Corps of Engineers, Vicksburg, Mississippi

Mississippi River - river response, channel stabilization, mathematical modeling of Yazoo River basin, development of data storage and retrieval systems for interactive computing.

USAID/Vicksburg COE

An 18-month geomorphic analysis of the Niger River Basin. Other related facets include the collection of existing climatological, hydrologic and sediment data for incorporation into a data storage and retrieval system. The study precedes future work that will be advertised related to improving the existing data base and applying water sediment routing models to identify and evaluate short- and long-term basin development.

Corps of Engineers, Ohio River Division

Hydraulic response of the Ohio River to development, expert witness on bank erosion litigation.

Corps of Engineers, St. Paul District

Mathematical modeling of the Upper Mississippi River and its major tributaries, channel stabilization, dredging, environmental impacts of river development.

Engineering Consultants, Inc. (ECI), Denver, Colorado

Bangladesh Rivers - irrigation, drainage, sediment problems, river response to development, etc.

James Bay Hydropower, Canada

Response of river systems to increased discharge.

Associated Consulting Engineers (ACE), Pakistan

Design and modeling of Kalabagh Dam (proposed 11,000,000 AF dam on Indus River).

Consultantships, Cont'd

U.S. Forest Service and Army Corps of Engineers

Physical and mathematical modeling of debris basins and development of new designs.

HIDROSERVICE (Brazil and Ecuador)

Prefeasibility and feasibility studies of major hydropower and irrigation projects, emphasis on reservoir sedimentation problems, mathematical modeling, aggradation and degradation problems.

South America Projects

Numerous consultantships in 5 South American countries on projects involving watershed management, hydropower development, reservoir management, irrigation, etc. during the past 20 years.

HONORS

1991 Hunter Rouse Award, American Society of Civil Engineers (ASCE)
1991 Keynote Speaker, Fifth Federal Interagency Sedimentation Conf., Las Vegas, NV
1988 Address the National Environmental Advisory Board, Corps of Engineers, Chief of Civil Works, General Hatch and General Kelly, Denver, Colorado
1986 Distinguished Service Award, Colorado State University Engineering Deans Council
1985 Outstanding Engineer Award, Utah State University
1979 Karl Emil Hilgard Hydraulic Prize, ASCE
1973 Outstanding Professional Engineer for Colorado
1964 Croes Award, ASCE
1960 J.C. Stevens Award, ASCE

NATIONAL COMMITTEES

American Association for the Advancement of Science, AAAS, member
Executive Committee, U.S. Committee on Irrigation, Drainage and Flood Control, member 1976 to present.
Remote Sensing Committee, ASCE, corresponding member
Underground Construction Research Council, ASCE, contact member
Pipeline Research Council, ASCE, contact member
Technical Council on Research, ASCE, member 1975 to present
ASCE Work Group VI of ISO/TC of the American National Standards Institute (ANSI), representative 1976 to present
Technical Council on Aerospace, ASCE, member 1975
Technical Activities Committee, United States Committee on Irrigation, Drainage and Flood Control, member 1974 to present
Highway Research Board National Research Council, institutional representative
Panel on Methodology for Delineating Mudslide Hazard Areas with National Research Council, member 1973

National Committees, Cont'd

Committee on Research, ASCE Technical Council on Aerospace, chairman 1973
National Subcommittee for the Study of Types of Revetments of the Permanent International Association of Navigation Congresses, member 1973
International Affairs Committee of National Association of State Universities and Land-Grant Colleges, member 1973
IAHR Task Committee on Navigation, member 1972 to 1977
IAHR Committee on Fluvial Hydraulics, member 1969 to 1975
ICID Committee on Collection and Publication of Data Relating to Design of Channels (in regime as well as non-regime), chairman 1969 to present
ASCE Task Committee on Channel Stabilization Works, chairman 1972 to present
ASCE Committee on Sediment, Hydraulics Division, chairman 1972 to 1974
UCOWR Committee on Education and Research in Water Resources Engineering, chairman 1970 to 1971
ASCE Committee on Sediment, Hydraulics Division, member 1970 to 1972
ASCE Committee on Regulation and Stabilization of Rivers, chairman 1968 to 1970

REPRESENTATIVE RESEARCH PROJECTS

Physical Modeling of Water Intake Structure for Nuclear Power Plant, Duke Power Company, Charlotte, North Carolina.
Physical Modeling of Waste Water Outfall Involving Sediment, Air Entrainment and Design Improvement, CH2MHill, San Francisco, California.
Development of a System of Analysis for the Yazoo Basin of the Mississippi which involved Flood Control, Dredging, Land Use Changes (encompasses about one-fourth of the State of Mississippi and includes some 30 rivers and four major reservoirs), Corps of Engineers, Vicksburg, Mississippi.
Development and Application of Mathematical Models for Routing Water, Sediments and Pollutants, EPA, Athens, Georgia.
Analysis of Use of Buffer Strips to Control Sediment from Roads, EPA, Athens, Georgia.
Detailed Analysis of Water and Sediment Routing from Watersheds, the Coupling of Subsurface Flows, Analysis of Mass Wasting Activities, Design of Debris Basins, etc., U.S. Forest Service, Flagstaff, Arizona.
Mathematical Modeling of the Upper Mississippi River and its Major Tributaries, U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Twin Cities, Minnesota.
Sediment Yields from Roads in Forests, Rocky Mountain Forest and Range Experiment Station, Flagstaff, Arizona.

PROFESSIONAL AND HONORARY SOCIETIES

American Society of Civil Engineers, Fellow
(President of Wyoming Section in 1956)
American Geophysical Union
International Association for Hydraulic Research - IAHR
International Commission on Irrigation and Drainage - ICID
Sigma Xi

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Professional and Honorary Societies, Cont'd

Phi Kappa Phi
Sigma Tau
Sigma Pi Sigma

TEACHING

Erosion and Sedimentation (Graduate Level)
Transport Mechanisms and Transport of Sediment in Relation to Hydraulics, Water Resources and Environment (published new text for general use entitled Sediment Transport Technology.
River Mechanics (Graduate Level)
Characteristics of Rivers, Mechanics of Sediment and Water Discharge emphasizing Alluvial Systems, Channel Stabilization, Control, Response.
Hydraulic Structures (Graduate Level)
Soil Mechanics (Undergraduate and Graduate Level)
Fluid Mechanics (Undergraduate Level) Water Supply and Sewage Treatment (Undergraduate Level)

PUBLICATIONS

Over 400 technical publications (list available upon request)

Texts Published:

Fluid Mechanics for Engineers, by Maurice L. Albertson, James R. Barton and Daryl B. Simons, 1960. (Revised edition to be published in 1993.)
Sediment Transport Technology, by Daryl B. Simons and Fuat Sentürk, 1977 (2nd ed. Water and Sediment Dynamics published in January, 1992).
Solutions Manual for Sediment Transport Technology, by Daryl B. Simons and Fuat Sentürk, January, 1992.
Engineering Analysis of Fluvial Systems, by Simons, Li & Associates, 1982.
Highways in the River Environment, Hydraulic and Environmental Design Considerations, Daryl B. Simons and others, 1975 (2nd ed., 1988, 3rd ed., 1990).

FILMS AND VIDEO CONTRIBUTIONS

Has developed and participated in numerous films and videos pertaining to hydraulic structures, reservoir operation, flooding, and flows in alluvial channels from 1962 to 1991.

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APPENDIX D

COAST TO COAST ANALYTICAL SERVICES, INC.

826600127

CARBAMATE PESTICIDES

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1. Description of Analytical Procedures:

EPA Method 531.1	Measurement of N-Methylcarbamolyoximes and N-Methylcarbamates in Water By Direct Aqueous Injection HPLC With Post Column Derivitization

2. Instrumentation Description:

Hewlett-Packard 1050 High Pressure Liquid Chromatograph with UV and 1046A Programmable Fluorescence Detectors, Pickering PCX5000 Post Column Reaction Module and Hewlett-Packard 3365 Chemstation software.

3. Detection Limits:

Water:	2 ppb for all analytes

Detection limits are highly dependent upon the sample matrix and must be calculated for each analysis. The limits listed are for normal type samples that are relatively clean and do not require extensive cleanup. If samples contain a large amount of an analyte, detection limits for all other compounds may be affected.

4. Sample Capacity:

The laboratory is currently capable of processing approximately 100 sample per week for any of the methodologies listed.

5. Turn-around Times:

Turn-around times from receipt of sample is two weeks. Faster turn-around is available with special arrangement. Turn-around time guarantees the completion of one attempt by standard EPA methodology on or before the due date. In most cases any sample requiring reanalysis and /or extra cleanup procedures due to matrix or contamination level will also be completed before the due date. If samples can not be

analyzed due to instrument problems and not sample interferences within the established holding time, the client will be notified and options for analysis will be discussed at that time.

6. QA/QC Procedures:

CCAS-Indianapolis follows the plan summarized below which meets and exceeds all EPA QA/QC requirements for the methods utilized.

Reagent blanks, instrument blanks, matrix blanks, matrix spikes and spike duplicates, sample duplicates, daily calibration and QC check standards are analyzed daily with every batch of samples. The frequency of these QC samples shall not exceed 20 sample intervals.

QC data is verified and documented by the analyst. This data is generally not given to the client unless a special report format is requested at an additional premium. Matrix spikes and spike duplicates and sample duplicates are done arbitrarily. If these QC samples must be performed on a particular sample, they will qualify as billable samples.

7. Sampling Procedures:

Samples may be submitted in any of the recommended standard EPA packaging. Water samples are to be in 1 litre bottles with teflon lined septa. Soils and solid waste may be collected in any convenient sized glass bottle with a teflon lined lid. The bottles may be amber or clear but must be protected from light. All bottles should be acetone rinsed and dried. Samples must be kept at 4 C from time of collection until time of receipt in laboratory. Water samples should be submitted in duplicate in the event that the sample must be reextracted.

Samples will be held for a minimum of thirty days after analysis and will then be disposed of by CCAS-Indianapolis. The sample extracts will be held for a period of sixty days after analysis and then disposed of by CCAS-Indianapolis.

8. Quantitation Range:

The quantitation range is set to give maximum accuracy at or near the method detection limits. The range is set to include all levels between 0.01 ppb and 1 ppm. Any analyte at a level more than 1 ppm would be diluted and reanalyzed. This would bring in a percentage error.

9. Transmission of Results:

Hardcopy of the final analytical report showing identification and results will be sent within two weeks. Upon request, results can first be transmitted by telephone, Fax, or directly to the client's computer.

EXCELLENCE
IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

STATEMENT OF QUALIFICATIONS

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SECTION I - CARBAMATE PESTICIDES

Facilities Description:

Coast-To-Coast Analytical Services, Inc., Indianapolis Division, formerly TMS Analytical Services, occupies a 17,000 square foot facility located in Indianapolis, Indiana, approximately 20 minutes from the airport. The facility contains separate dedicated laboratory preparation rooms with state of the art air handling and exhaust systems, three dedicated mass spectrometry laboratories, an organic and inorganic laboratory, dedicated glassware cleaning area, and document control areas.

CCAS-Indianapolis has the capability to perform standard GC, GC/MS, GC/HRMS, GC/HPLC, ICP, and AA methods as well as a variety of specialized MS/MS methods. The laboratory staff includes low resolution, high resolution, and tandem mass spectrometer operators, GC and HPLC operators, ICP and AA operators, along with staff who are experienced in organic and inorganic chemistry procedures and sample preparation.

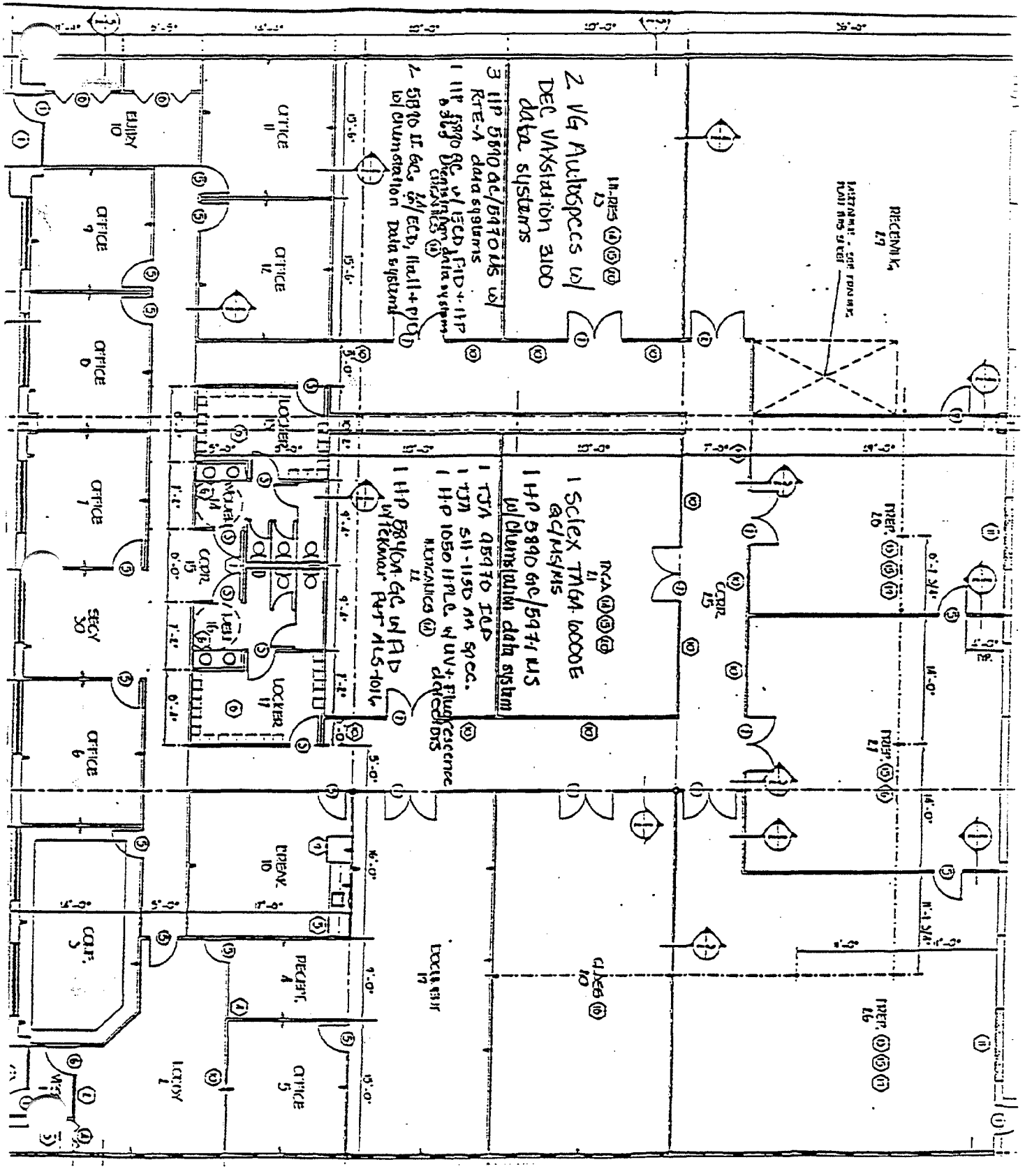
Laboratory equipment available includes gas chromatographs, liquid chromatographs, assorted spectrophotometers, ICP, AA, and support equipment. The principle laboratory instrumentation includes a sophisticated tandem quadrapole mass spectrometer, an EBE geometry computer controlled double focusing high resolution mass spectrometer, and several conventional Hewlett-Packard GC/MS systems.

The tandem quadrapole mass spectrometer is a state-of-the-art SCIEX TAGA 6000E. The instrument is equipped with extended mass range to 1500 amu, and all available interfaces including GC, APCI, LPCI, LC, probes, and gas sampling. The instrument is computer controlled and is capable of all forms of MS/MS operation, including SIM, parent/daughter SIM, parent scans, daughter scans, and neutral loss scans. The instrument is cryopumped and capable of handling continuous gas loads directly into the source as high as 40 ml/minute. The low pressure CI source is a bright townsend discharge that generates an extremely high ion density.

The high resolution mass spectrometer is a VG AutoSpec hybridized magnetic sector with OPUS data analysis and chemical information system. The present configuration includes, EI, CI, and probe sources.

The conventional Hewlett-Packard GC/MS systems are capillary gas chromatographs coupled with mass selective detectors. The data system supporting the three GC/MSD units is an HP

1000 A-Series computer, Real-Time Executive (RTE-A) operating system, HP mass spectrometer application/data reduction software and HP peripheral hardware (scanning interface, disc drives, terminals, printers, etc.). It controls or assists in instrument tuning, data acquisition, data reduction, report production and automation.


2 VG Autospecs w/
DEC VAXstation 3100
data systems
3 HP 5890 GC/5970 MS w/
RTE-A data systems
1 HP 5890 GC w/ ECD, FID + HP
5969 Chemstation data system
2 5890 II GCs w/ ECD, Hall + PID
w/ Chemstation Data systems
1 Sciex TAGA 6000E
GC/MS/MS
1 HP 5890 GC/5971 MS
w/ Chemstation data system
1 TJA 95970 ICP
1 TJA SH-1150 AA spec.
1 HP 1050 HPLC w/ UV + Fluorescence detectors
1 HP 5890A GC w/ FID
w/ Tekmar PAT ALS-1016
RECEIVING
OFFICE 11
OFFICE 12
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OFFICE 7
OFFICE 6
OFFICE 5
LOCKER 17
LOCKER 14
LOCKER 16
CORR. 15
CORR. 25
SECY 30
COUR. 3
RECEPT. 4
LOBBY 2
LOBBY 10
CLOSET 10
PREP. 26
PREP. 27

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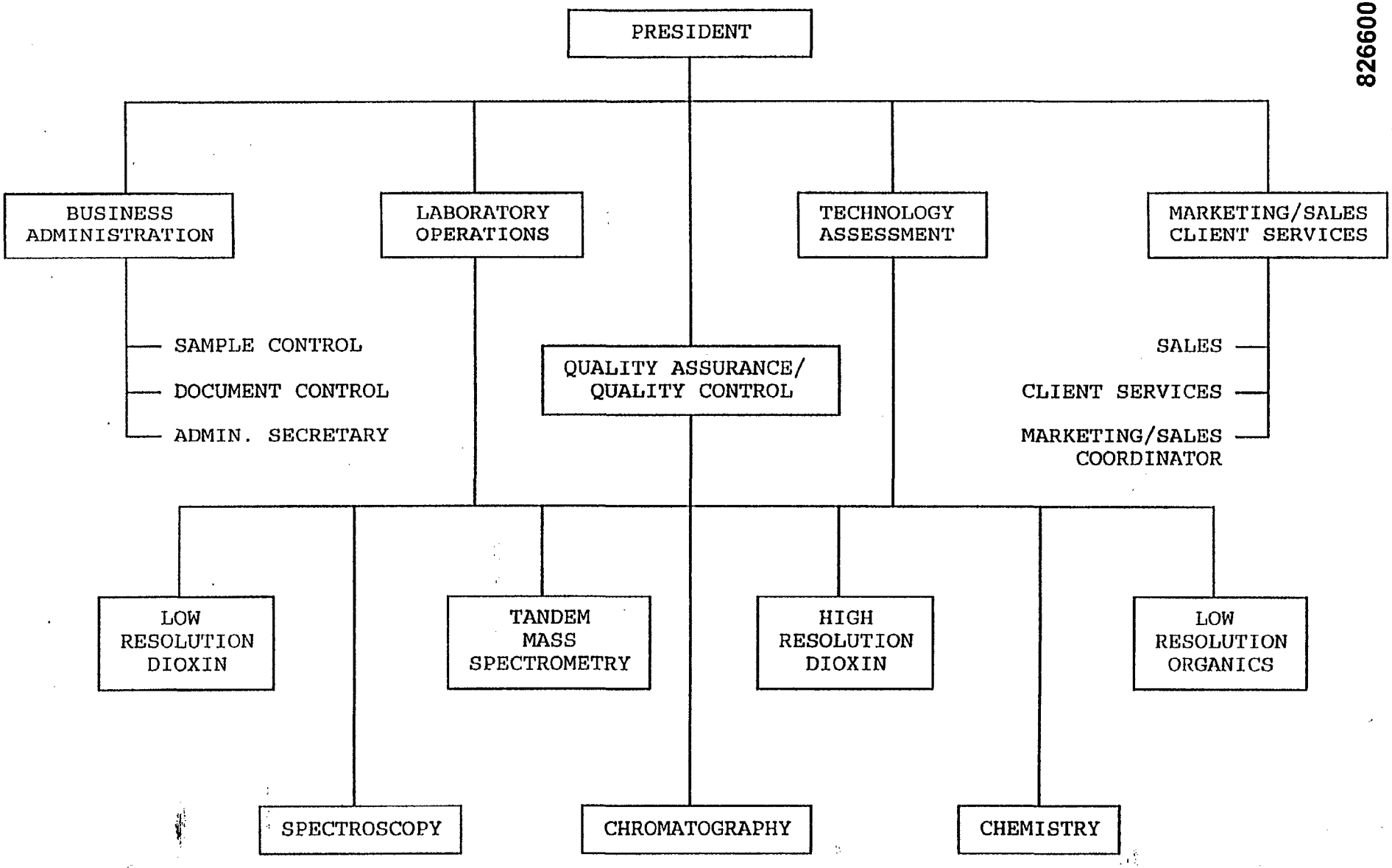
PRESIDENT
BUSINESS ADMINISTRATION
LABORATORY OPERATIONS
TECHNOLOGY ASSESSMENT
MARKETING/SALES CLIENT SERVICES
SAMPLE CONTROL
DOCUMENT CONTROL
ADMIN. SECRETARY
QUALITY ASSURANCE/ QUALITY CONTROL
SALES
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MARKETING/SALES COORDINATOR
LOW RESOLUTION DIOXIN
TANDEM MASS SPECTROMETRY
HIGH RESOLUTION DIOXIN
LOW RESOLUTION ORGANICS
SPECTROSCOPY
CHROMATOGRAPHY
CHEMISTRY

Past performance:

CCAS-Indianapolis, formerly TMS Analytical Services, has been providing comprehensive Dioxin and Furan testing to various government agencies as well as the private sector for ten (10) years. While the laboratory's experience has been primarily with Dioxins and Furans, our history as a participant in the Contract Laboratory Program has provided us with a vast array of information. This information provides CCAS-Indianapolis the ability to meet or exceed requirements as set forth in various protocols as published by the U.S. EPA.

The following is a partial listing of past contracts with the U.S. EPA and various private clients. Due to client confidentiality, actual clients may not be identified; however, the type of analysis is indicated along with methodology. This listing includes analysis of solids, liquids, sludges and air.

Case/Contract #	Agency	Type of Contract	Type of Work and Method
5878HQ	EPA	QTM Study	VOA - 624
			PCB/Pest - 608
6181G	EPA	SAS	VOA - 624
6173A	EPA	SAS	VOA - 524
5974C	EPA	SAS	VOA - 502
2142G	VIAR/EPA	SAS	Rapid Turn Dioxin
4948C	VIAR/EPA	SAS	PCDD/PCDF - 8280
2212G	VIAR/EPA	SAS	Rapid Turn Dioxin
2204G	VIAR/EPA	SAS	Rapid Turn Dioxin
4761B	VIAR/EPA	SAS	PCDD/PCDF - 8280
2205G	VIAR/EPA	SAS	Rapid Turn Dioxin
2691X	VIAR/EPA	SAS	Rapid Turn Dioxin
4761B	VIAR/EPA	SAS	PCDD/PCDF - 8280
2843G	VIAR/EPA	SAS	Rapid Turn Dioxin
4246A	VIAR/EPA	SAS	PCDD/PCDF - 8280
4470C	VIAR/EPA	SAS	PCDD/PCDF - 8280
4430G	VIAR/EPA	SAS	Met. Dev. Dioxin
68-01-7390	VIAR/EPA	CLP	Rapid & RAS Dioxin
5615G	VIAR/EPA	SAS	PCDD/PCDF - 8290
0222B	Pvt. Clt.		VOA - 624
0409A	Pvt. Clt.		VOA - 8240
			SVOA - 8270
			PCB/Pest - 8080

Case/Contract #	Agency	Type of Contract	Type of Work and Method
0425B	Pvt. Clt.		SVOA - 625
0502C	Pvt. Clt.		PCB - 8080
0419B	Pvt. Clt.		PCB - 8080
0408B	Pvt. Clt.		PCB/Pest - 8080
0320A	Pvt. Clt.		Met. 6010/200.7
1211C	Pvt. Clt.		PCB/Pest - 8080

If additional information or references are required, they will be furnished upon request.

DIOXIN

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1. Description of analytical procedures:

EPA Protocol specified in 11/92 Statement of Work (SOW) for Dioxin analysis; Multi-Media, Multi-Concentration.

EPA Method 8280, latest revision by EPA HQ Staff.

EPA Method 8290, latest revision by EPA HQ Staff.

EPA Method 1613, latest revision by EPA HQ Staff.

NOTE: All procedures are performed to EPA laboratory standards wherever applicable. All sample extraction procedures, sample cleanup procedures, computational procedures, and report formats are in accordance with methods cited above. Clients may specify specific sample cleanup procedures from the literature if desired. If it is necessary to use a procedure from another source, such as a literature reference or a procedure desired by EPA, these requirements are applied to that procedure to the extent that they are applicable.

2. Instrumentation description:

VG AutoSpec; High Resolution Magnetic Sector Mass Spectrometer

Sciex TAGA 6000E Tandem Mass Spectrometer

Hewlett-Packard 5970 Mass Spectrometer (two instruments)

Hewlett-Packard 5971 Mass Spectrometer

3. Detection limits:

Method	Instrument	Typical Limits	
1613/8290	HRGC/HRMS	Water:	10 ppq
		Soil:	1 ppt
EPA 11/92 SOW	GC/MS/MS	Water:	1 ppt
		Soil:	300 ppt
8280	GC/MS	Water:	1-10 ppt
		Soil:	1-10 ppb

Detection limits are highly dependent upon the sample matrix and must be calculated for each analysis. In general, if the samples are normal type samples that are relatively clean, these detection limits can be routinely met. If, however, soil samples come from chemical waste disposal sites, or include asphalt, oils, tar, etc. then detection limits can rise sharply. The instrumental sensitivity is rarely the limiting factor. Both the HRMS and GC/MS/MS techniques offer more certainty for achieving the desired detection limits because of their selectivity, but only the tandem option is suitable for rapid sample screening at low cost.

4. Quantitation range:

The quantitation range is generally set to give maximum accuracy close to the action levels for dioxins and furans, i.e. close to 1 ppb for solids and 1 ppt for water. Values above 20 times this level are outside the calibration range, but are reported as extrapolated values. If a sample is known to be heavily contaminated and an accurate number at that high level is needed, the analysis can be adjusted accordingly with advance notice.

5. Sample capacity:

The laboratory is currently capable of processing approximately 50 samples per week for total PCDD's and PCDF's by Method 8290/1613; approximately 50 samples per week for total PCDD's and PCDF's by Method 8280, depending on the sample matrix. An additional 200-250 samples per week can be processed for GC/MS/MS analysis of 2,3,7,8-TCDD.

6. Sample turn-around:

Sample turn-around ranges from 48 hours to 30 days from date of receipt. Other turn-around times are available with special arrangements.

Results are transmitted first either by telephone, by FAX, or directly to the client's computer. This initial notification of results is then followed by hardcopy of the final analytical report showing identification and results.

1. DESCRIPTION OF EQUIPMENT

CCAS-Indianapolis uses a Sciex TAGA 6000E GC/Tandem Mass Spectrometer for the rapid determination of 2,3,7,8-TCDD in environmental media. The instrument is equipped with an extended mass range to 1500 amu, and the system is controlled by a PDP 11/23 mini-computer which runs a multi-user, multi-task operating system. This instrument is particularly suited for rapid turn-around analysis because of its high sensitivity and specificity. Samples may be analyzed that have undergone considerably less clean-up than is required for the usual GC/MS technique.

2. METHODS

Samples are received and handled, extracted, cleaned up using column chromatography, and analyzed using GC/MS/MS according to the USEPA statement of work titled, "Selected Ion Monitoring (SIM) GC/MS Analysis for 2,3,7,8-TCDD". This statement of work is dated November, 1992 (11/92). The statement of work provides analytical methods, QA/QC criteria, and reporting requirements for the following sample matrices:

Solids (soil/sediment, dust, wood, fiber, vegetation, insulation)

Liquids (water, rinsate)

Airs (Polyurethane foam plug in a glass cartridge)

In addition, we handle wipe samples. The USEPA Region VII's method titled, "Rapid Determination of TCDD in Wipe Samples using Gas Chromatography and Tandem Mass Spectrometry" dated February 1986 provides the analytical method, QA/QC criteria, and reporting requirements for samples designated "wipes". This matrix is defined as an absorbent pad (cotton gauze or filter paper).

CCAS-Indianapolis has developed a method for the clean-up of samples containing asphaltic material. Samples are of the solid matrix, and a different extraction procedure and column clean-up are used. The sample extracts are analyzed and results are reported accoring to the November, 1992 Statement of Work.

CCAS-Indianapolis occasionally analyzes ash samples. The extraction and clean-up procedures for this matrix differ from the other solid matrix procedures. Extracts are analyzed and reported according to the November, 1992 Statement of Work.

3. METHOD SUMMARY

A tracking sheet is created for every batch of samples that enters the laboratory. Important information such as sample numbers, weights, volumes, matrices, etc... is recorded here. The analyst preparing the samples must place his/her initials and date of preparation here also. This sheet follows the samples through preparation and analysis to the final hardcopy report.

After a sample has been weighed out and spiked with internal standard, the appropriate extraction fluid is added. The sample is allowed to extract for a specified period of time. Following extraction, the fluid is separated out and carried forward through column chromatography. During column clean-up, oil and other visible contamination are removed from the sample. Analysis can normally take place after column chromatography, but occasionally some samples need further clean-up. If so, a carbon column is used to remove more oil and dirt. After carbon column clean-up, all samples are analyzed by GC/MS/MS.

TAGA analysis will confirm the presence or absence of 2,3,7,8-TCDD, and selected ion monitoring information is then entered into a Dbase program. A report is generated listing all required data following the completion of GC/MS/MS analysis. The results can be transmitted by fax or by computer to the client to speed turn-around time. Upon the completion of the quality assurance review process, the final hardcopy report is compiled and sent to the client.

Routine turnaround time for this analysis is one week from the time samples are received at our laboratory. Upon request, analytical results can be reported to the client within 48 hours, unless a samples is of an atypical matrix which requires more extensive clean-up.

4. DETECTION LIMITS

The detection limits for each matrix are set by the USEPA. They are the limits at which a result equal to or above is considered a "positive" or "detect", and a result below is considered a "non-detect". They are as follows:

Solid	0.3 ng/gm	(ppb)
Liquid	1.0 ng/l	(ppt)
Air	1.0 pg/m3	
Wipe	0.4 pg/cm2	
Asphalt	0.7 ng/gm	(ppb)
Ash (also a solid)	0.3 ng/gm	(ppt)

5. QA/QC

Each batch of samples received for rapid TCDD determination must meet certain criteria to be acceptable by EPA. A batch is defined as a set of 24 or fewer samples of related matrices. The laboratory automatically adds a method blank and a method spike sample to each batch. The blank is an amount of substance (usually sodium sulfate) that is known to contain no native TCDD. Internal standard is added, and the blank undergoes the same preparation procedures that the rest of the samples undergo. The spike sample is just like the blank but with a known amount of native TCDD added. The result obtained from the spike must be +/- 10% of the theoretical value or known amount. The purpose in preparing these QA/QC samples is to show recovery of the internal standard that was added prior to extraction and clean-up. This validates the method and demonstrates that dioxin is not destroyed or lost in the preparation of the samples.

In addition to the blank and spike, PE (performance evaluation) samples will be prepared on request or as provided by the client. These are <u>not</u> automatically included, the client must specify PE analysis and/or provide the laboratory with PE samples. Usually, one PE per batch will be acceptable. The results from all QA/QC samples (method blanks, method spikes, PE's) will be reported along with sample results.

Before the actual analysis of samples can be performed, a daily calibration check of the instrument must be run. This is simply the analysis of an aliquot of EPA Calibration Solution I. The values obtained for the native TCDD ratio

(257/259) and the native relative response factor (RRFn) must be within +/- 10% of the mean values set by the initial calibration. The initial calibration is a 9-point calibration consisting of three analyses each of EPA aliquots of Calibration Solutions I,II, and III. After an acceptable daily calibration check has been run, samples can then be analyzed. The daily calibration is good for 12 hours or for as many samples that need to be run, whichever comes first. Should sample analysis run past 12 hours, another daily calibration check needs to be run before the first one expires. All daily calibrations and the initial calibration are included in the reported results.

It has been found that the internal standard gives responses for the 257 and 259 ions (the native ions). Therefore, there is also a blank calibration for rapid turn-around TCDD analysis. It is a 20-point calibration consisting of the analyses of 20 aliquots of the internal standard, USEPA Spiking Solution II. This calibration provides a mean value of that internal standard contribution to native responses and gives us a correction factor - a percentage of the response - to be subtracted out from each samples result. The computer automatically calculates and subtracts the correction from each sample result. The blank calibration and correction factor are included in reported results.

Participation in analysis of performance evaluation samples for an EPA invitation for bid on rapid turn-around dioxin analysis resulted in a perfect score. A copy of the scoring shows the 400 out of 400 possible points included: TCDD identification and quantitation in soil, water, wipe, and air matrices; quality control; and reporting deliverables.

EXCELLENCE
IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

INDIANAPOLIS LABORATORY

Located at: 7726 Moller Road
Indianapolis, Indiana 46268

Phone numbers: 317-875-5894
800-875-8674

Fax number: 317-872-6189

Primary Contact: Jody Walker, Client Services

Secondary Contacts: Dale Pershing, Project Manager
Trent Temperly, Account Executive

Thank you for the opportunity to submit our Statement of Qualifications. We look forward to working with you and discussing your project needs.

COAST-TO-COAST ANALYTICAL SERVICES, INC.
MIDWEST REGION: Indianapolis & Valparaiso, Indiana; Livonia, Michigan
EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC

INDIANAPOLIS DIVISION

STATEMENT OF QUALIFICATIONS

7726 Moller Road • Indianapolis, IN 46268 • 317-875-5894 • 800-875-8674 • 317-872-6189 FAX

VOLATILE ORGANICS

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1. Description of analytical procedures:

CLP Method for GC/MS analysis of volatiles
EPA Method 624
EPA Method 524.2, Revision 3.0
EPA SW-846 Method 8240 and Method 5030

2. Instrumentation description:

Hewlett-Packard 5970 MSD with RTE-A Computer Data System
Tekmar Purge and Trap System LSC2000/2016
Tekmar Capillary Interface

3. Quantitation Limits for Methods 624, 8240, and CLP:

Water:	3 ppb	for every compound
	10 ppb	for acetone, 2-butanone
Soil/Sediment:	5 ppb	for every compound
	10 ppb	for ketone

Method Detection Limits for Method 524.2:

Water: 0.1 ppb approximately

4. Sample Capacity:

The laboratory is currently capable of processing approximately 20 samples per week for GC/MS volatile organic compound analysis.

5. Sample turn-around:

Sample turn-around time is normally ten working days from date of receipt. Other turn-around times are available with special arrangement.

6. QA/QC procedures:

The laboratory follows EPA methodology for quality control to assure the quality of the data generated. The standard data

package includes daily calibration checks and matrix spike/matrix spike duplicate per twenty samples per run for QC purpose.

7. Sampling procedures:

The specific sampling procedures and transportation requirements will be provided to customers upon request. Sampling containers are provided at no additional charge.

8. Transmission of results:

Hardcopy of the final analytical report showing sample identification and results will be sent within ten working days. Upon request, results can first be transmitted by telephone, Fax, or directly to the client's computer.

SEMIVOLATILE ORGANICS

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1. Description of analytical procedures:

CLP Method for GC/MS analysis of semivolatiles
EPA Method 625
EPA Method 525, Revision 2.1
EPA SW-846 Method 8270

2. Instrumentation description:

Hewlett-Packard 5970 MSD with RTE-A Computer Data System

3. Quantitation Limits for Methods 625, 8270, and CLP:

Water:	10 ppb for every compound 50 ppb for nitrophenols and nitroaniline
Soil/Sediment:	660 ppb for every compound 3300 ppb for nitrophenols and nitroaniline

Method Detection Limits for Method 525:

Water:	between 0.1-0.8 ppb

4. Sample Capacity:

The laboratory is currently capable of processing approximately 10 samples per week for GC/MS semivolatile organic compound analysis.

5. Sample turn-around:

Sample turn-around time is normally ten working days form date of receipt. Other turn-around times are available with special arrangements.

6. QA/QC procedures:

The laboratory follows EPA methodology for quality control to assure the quality of the data generated. The standard data package includes daily calibration checks

and matrix spike/matrix spike duplicate per twenty samples per run for QC purpose.

7. Sampling procedures:

The specific sampling procedures and transportation requirements will be provided to customers upon request along with sampling containers.

8. Transmission of results:

Hardcopy of the final analytical report showing sample identification and results will be sent within ten working days. Upon request, results can first be transmitted by telephone, Fax, or directly to the client's computer.

PESTICIDES AND PCB'S

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1. Description of Analytical Procedures:

EPA Method 608	Organochlorine Pesticides and PCB's
EPA Method 508	Determination of Chlorinated Pesticides in Water by Gas Chromatography with an Electron Capture Detector
EPA Method 8080	Organochlorine Pesticides and PCB's

2. Instrumentation Description:

Two Hewlett-Packard 5890 Series II Gas Chromatograph with Electron Capture Detectors, 7673 Autosamplers and Hewlett-Packard 3365 Chemstation software.

3. Detection Limits:

Soil/Sediment:	1 ppb for all Pesticides and 100 ppb for all PCB's
Water:	0.01 ppb for all Pesticides and 1 ppb for PCB's
Oil:	0.01 ppb for all Pesticides and 0.5 ppb for PCB's

Detection limits are highly dependent upon the sample matrix and must be calculated for each analysis. The limits listed are for normal type samples that are relatively clean and do not require extensive cleanup. If samples contain a large amount of an analyte, detection limits for all other compounds may be affected. The cleanup procedures may raise the detection limits for dirty samples.

4. Sample Capacity:

The laboratory is currently capable of processing approximately 25 sample per week for any of the methodologies listed.

5. QA/QC Procedures:

CCAS-Indianapolis follows the plan summarized below which meets or exceeds all EPA QA/QC requirements for the methods utilized.

Reagent blanks, instrument blanks, matrix blanks, matrix spikes and spike duplicates, sample duplicates, daily calibration and QC check standards are analyzed daily with every batch of samples. The frequency of these QC samples shall not exceed 20 sample intervals.

QC data is verified and documented by the analyst. This data is generally not given to the client unless a special report format is requested at an additional premium. Matrix spikes and spike duplicates and sample duplicates are done arbitrarily. If these QC samples must be performed on a particular sample, they will qualify as billable samples.

6. Sampling Procedures:

Samples may be submitted in any of the recommended standard EPA packaging. Water samples are to be in 1 litre bottles with teflon lined septa. Soils and solid waste may be collected in any convenient sized glass bottle with a teflon lined lid. The bottles may be amber or clear but must be protected from light. All bottles should be D.I. rinsed. Samples must be kept at 4 C from time of collection until time of receipt in laboratory. Water samples should be submitted in duplicate in the event that the sample must be reextracted.

Samples will be held for a minimum of thirty days after analysis and will then be disposed of by CCAS-Indianapolis. The sample extracts will be held for a period of sixty days after analysis and then disposed of by CCAS-Indianapolis.

7. Turn-around Times:

Turn-around times from receipt of sample is two weeks. Faster turn-around is available with special arrangement. Turn-around time guarantees the completion of one attempt by standard EPA methodology on or before the due date. In most cases any sample requiring reanalysis and /or extra cleanup procedures due to matrix or contamination level will also be

completed before the due date. If samples can not be analyzed due to instrument problems and not sample interferences within the established holding time, the client will be notified and options for analysis will be discussed at that time.

8. Limits of Detection:

Limits of detection are established for each instrument according to the EPA approved method. Detection limits may be higher if the sample is highly contaminated.

9. Quantitation Range:

The quantitation range is set to give maximum accuracy at or near the method detection limits. The range is set to include all levels between 0.01 ppb and 10 ppm. Any analyte at a level more than 10 ppm would be diluted and reanalyzed. This would bring in a percentage error.

10. Transmission of Results:

Hard copy of the final analytical report showing identification and results will be sent within two weeks. Upon request, results can first be transmitted by telephone, Fax, or directly to the client's computer.

METALS

1. Description of analytical procedures:

		EPA Method No.
TCLP Metals	Hg by cold vapor	245.1
	As,Se by GFAA	206.1,270.2
	Ag,Cd,Ba,Cr,Pb by ICP	200.7
Priority Pollutants	As,Se by GFAA	206.1,270.2
	Hg by cold vapor	245.1
	Ag,Be,Cd,Cr,Cu	200.7
	Ni,Pb,Sb,Tl,Zn	
	200.7	
Hazardous Metals	Al,Sb,As,Ba,Be,Cd,Ca	200.7
	Cr,Co,Cu,Fe,Pb,Mg	200.7
	Mn,Ni,K,Se,Ag,Na	200.7
	Tl,V,Zn	
	200.7	
	Cyanide	335.1
	Phenols	420.1
	Mercury by cold vapor	245.1

2. Instrumentation description:

Thermo Jarrel Ash - ICAP-61 with Thermospec data analysis.
Thermo Jarrel Ash - AA S-11 equipped with CTF 188 Furnace Atomizer and Atomic Vapor Accessory 440 with Thermospec data analysis.

3. Detection limits:

For GFAA analysis:	7 ppb
For Direct Aspiration (Flame):	.1 ppm
For Hg by cold vapor analysis:	.2 ppb
For ICP:	will vary according to element

4. Sample turn-around:

Sample turn-around is normally two weeks from date of receipt. Faster turn-around is available upon request.

5. Sampling and data reporting information for ICP - 200.7 EPA method:

A. QA/QC procedures:

Standardize Instrument by Analyzing Quality Control, check Standards as follows:

1. Analyze instrument check standard containing elements of interest at a frequency of 10%. This is used to determine instrument drift. If results are not +/-5% of expected values or within established control limits, whichever is lower, analysis is out of control. The analysis is terminated, and instrument restandardized.

   Instrument check standard is prepared by combining compatible elements at a concentration equivalent to the midpoint of their respective calibration curves.

2. Analyze calibration blank at a frequency of 10%. The results should be within established control limits of two standard deviations of the mean value. If not, repeat analysis 2 more times and average the 3 results. If average is not within the control limit, terminate analysis and restandardized instrument.

3. To verify interelement and background correction factors, analyze the interference check sample at the beginning, end and at periodic intervals throughout the sample run. Results should be within established control limits of 1.5 times standard deviation of mean value. If not, terminate analysis and restandardize instrument.

6. Sampling and data reporting information for AA:

A. QA/QC procedures:

A calibration curve must be prepared each day with a minimum of a reagent blank and three standards,

verified by use of at least a reagent blank and one standard at or near the mid-range. Checks throughout the day must be within 20% of original curve.

If 20 or more samples per day are analyzed, the working standard curve must be verified by running an additional standard at or near the mid-range every 10 samples. Checks must be within +/- 20% of true value.

At least one duplicate and one spike sample should be run every 20 samples, or with each matrix type to verify precision of the method.

B. Sampling procedures:

Before collection of a sample, the type of data (i.e. dissolved, suspended, total or total recoverable) must be determined. For dissolved and suspended, the sample should be filtered site and acidified to pH < 2.

A polyethylene bottle with a polypropylene cap (no liner) is preferred. A minimum of 100 ml is required, however, 500 ml is recommended to allow for any necessary reanalysis. For solid samples a minimum of 10g is required for single attempt. 50g is recommended to allow for reanalysis.

For total and total recoverable, the sample should be acidified to pH < 2.

POLYNUCLEAR AROMATIC HYDROCARBONS

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1. Description of Analytical Procedures:

EPA Method 8310	Polynuclear Aromatic Hydrocarbons

2. Instrumentation Description:

Hewlett-Packard 1050 High Pressure Liquid Chromatograph with UV and 1046A Programmable Fluorescence Detectors, Pickering PCX5000 Post Column Reaction Module and Hewlett-Packard 3365 Chemstation software.

3. Detection Limits:

Soil/Sediment:	10 ppb for all analytes
Water:	.010 ppb for all analytes except Napthalene, Acenaphthylene, and Acenapthene for which the detection limit is .02 ppb.

Detection limits are highly dependent upon the sample matrix and must be calculated for each analysis. The limits listed are for normal type samples that are relatively clean and do not require extensive cleanup. If samples contain a large amount of an analyte, detection limits for all other compounds may be affected.

4. Sample Capacity:

The laboratory is currently capable of processing approximately 25 samples per week for any of the methodologies listed.

5. Sample Turn-Around:

Turn-around times from receipt of sample is two weeks. Faster turn-around is available with special arrangement. Turn-around time guarantees the completion of one attempt by standard EPA methodology on or before the due date. In most

cases any sample requiring reanalysis and /or extra cleanup procedures due to matrix or contamination level will also be completed before the due date. If samples can not be analyzed due to instrument problems and not sample interferences within the established holding time, the client will be notified and options for analysis will be discussed at that time.

6. QA/QC Procedures:

CCAS-Indianapolis follows the plan summarized below which meets or exceeds all EPA QA/QC requirements for the methods utilized.

Reagent blanks, instrument blanks, matrix blanks, matrix spikes and spike duplicates, sample duplicates, daily calibration and QC check standards are analyzed daily with every batch of samples. The frequency of these QC samples shall not exceed 20 sample intervals.

QC data is verified and documented by the analyst. This data is generally not given to the client unless a special report format is requested at an additional premium. Matrix spikes and spike duplicates and sample duplicates are done arbitrarily. If these QC samples must be performed on a particular sample, they will qualify as billable samples.

7. Sampling Procedures:

Samples may be submitted in any of the recommended standard EPA packaging. Water samples are to be in 1 litre amber bottles with teflon lined septa. Soils and solid waste may be collected in any convenient sized glass bottle with a teflon lined lid. All bottles should be acetone rinsed and dried prior to use. Samples must be kept at 4 C from time of collection until time of receipt in laboratory. Water samples should be submitted in duplicate in the event that the sample must be reextracted.

Samples will be held for a minimum of thirty days after analysis and will then be disposed of by CCAS-Indianapolis. The sample extracts will be held for a period of sixty days after analysis and then disposed of by CCAS-Indianapolis.

APPENDIX E
ALTA ANALYTICAL LABORATORY

826600158

ALTA

STATEMENT OF QUALIFICATIONS

Alta Analytical Laboratory Inc.
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
FAX (916) 933-0940
(916) 933-1640

826600159

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SECTION I.
Introduction

INTRODUCTION

Alta Analytical Laboratory (ALTA) was formed in 1990 and is a privately held California corporation employing a staff of over 20 scientists. ALTA's primary mission is to provide state-of-the-art mass spectrometry services to various industrial, consulting and governmental clients. ALTA operates with the intent of providing data of highest quality, responsive service and short turnaround time.

ALTA has within three years grown to a company with an expanding national and international client base of over 400. This tremendous growth is attributable to the reputation ALTA has gained in performing difficult trace level analyses reliably for the pulp and paper, air toxics consulting and the agrichemical industries. ALTA's expertise lies in the analysis of semivolatile organic compounds such as Dioxin/Furans (PCDD/Fs), Polynuclear Aromatic Hydrocarbons (PAHs), Poly Chlorinated Biphenyls (PCBs), Chlorobenzenes, Chlorophenols, other semivolatile compounds (8270 list) and select pesticides and herbicides.

ALTA's founders and technical staff represent a unique and highly experienced group of mass spectrometry specialists. This strength in experience has enabled ALTA to provide project/client specific method development and technical consulting unsurpassed in the industry. ALTA staff have provided guidance to the government agencies responsible in the development of USEPA Methods 8290, 1613A and California Air Resources Board (CARB) Methods 428 and 429.

ALTA has actively participated in interlaboratory round robin studies and certification programs such as the USEPA (ITD) study of PCDD/PCDFs in effluents; Radian Corporation study of PCDD/PCDFs in soils; Environment Canada studies on Dioxin precursors DBD & DBF, PCDD/PCDFs in air, PCDD/PCDFs in pulp and paper; Cambridge Isotopes Lab (CIL) study on Coplanar PCBs and PCDD/PCDFs in fish; the National Council for Air and Stream Improvement (NCASI) lab certification program study and the NCASI\USEPA variability study on PCDD/PCDFs in pulp and paper.

ALTA participates in the USEPA Special Analytical Services Program (SAS) on a regular basis primarily in the area of PCDD/PCDFs analysis in difficult matrices. ALTA currently holds two CARB contracts for the analysis of PCDD/PCDFs, PAHs, PCBs and other semivolatile compounds in air samples.

ALTA is also committed to internally funded research and new method development. ALTA has recently developed and presented papers on Solid Phase Extraction and Supercritical Fluid Extraction of Dioxins in effluents.

Quality is of paramount concern in the analytical industry today. In light of this, ALTA has implemented three company standards:

1 - ALTA will maintain a laboratory Quality Assurance Program compliant with USEPA Good Laboratory Practice Standards (40 CFR sec. 160)

2 - Laboratory Quality Control samples will be analyzed at a frequency in excess of 15%. Internal standard and laboratory control spike recoveries will meet or exceed method recovery criteria or sample batches will be rerun at no additional charge to our clients.

3 - The routine turnaround time from sample delivery to generation of a final written report will be 21 days.

In order to give an overview of Alta Analytical Laboratory, this Statement of Qualifications is organized into sections on Analytical Services, Facility, Equipment, Quality Assurance and Project Experience. Resumes for key technical staff can be found in the Appendix.

SECTION II.
Analytical Services

ANALYTICAL SERVICES

ALTA analytical services can be divided into two groups - *HRMS/LRMS and LCMS/MS.*

HRMS/LRMS SERVICES —

The trend in environmental legislation and regulation over the last decade has been increasingly driven by attempts to measure the impact of any exposure to the population via risk assessments. For these studies to have meaning, it has been necessary in many cases to be able to detect hazardous compounds at significantly lower levels. In the area of Dioxins/Furans, Coplanar PCB's and Polynuclear Aromatics, the necessary detection levels have resulted in the need for superior instrumentation. High Resolution Mass Spectrometry has become the most suitable analytical technique to fill this need.

ALTA's HRMS/LRMS group uses 3 magnetic sector double focusing VG High Resolution Mass Spectrometers. The two model VG70SE's and the more recently acquired VG Autospec typically enable ALTA to provide the lowest detection limits in the industry. ALTA has experience in analyzing a wide variety sample types and matrices for Dioxins/Furans, PAH's, PCB's, Coplanar PCB's, and selected other semivolatile organic compounds. Some typical sample sources and types analyzed at ALTA are listed below:

- Biological samples (fish, tissue, birds, clams, mussels, crayfish)
- Environmental samples such as waters, soils
- Foodstuffs and food packaging
- Fuel oils
- Human blood and tissue
- Industrial waste samples (sludges, effluents, fly ash, still bottom)
- Pulp and paper industry products, byproducts and wastes

- Stack source emmisions (MM5 train) from the following sources:
  - cement kilns
  - diesel fired boilers
  - hazardous waste incinerators
  - medical waste incinerators
  - municipal waste incinerators
  - oil fired boilers
  - waste to energy plants
  - wood fired boilers

- Ambient air studies (PUF, PUF/XAD_2 sandwich)
  - investigations
  - remediation sites

ALTA has the capability to perform all existing USEPA, CARB and NCASI methods for the determination of dioxins/furans, PCB's, PAH's, chlorobenzenes and chlorophenols and other selected organic contaminants by High or Low Resolution Mass Spectrometry. ALTA also specializes in the development of new sample preparation techniques which enable ultra-low level detection of semivolatile organics in complex sample matrices. The following tables list methods performed routinely by the ALTA HRMS/LRMS group.

TABLE 1. — Methods Performed by ALTA HRMS/LRMS Group

Method	Sample Matrix	Dioxins/ Furans	PAH'S	PCB'S	Specialty Compounds
USEPA 1613A	S,E,Sl,T,W	X			
USEPA 8290	P,Sl,E,S,T,W,Fo,Sb	X			
USEPA 8280	S,W,Fa,Fo,Sb	X			
USEPA 613	W	X			
USEPA 513	W	X			
NCASI 551	P,Sl,E,S,W,Fa	X			
NCASI PCDD	P,Sl,E,S,W,Fa	X			
WHO	P,Sl,E,S,W,Fa	X			
USEPA 23	MM5	X			
USEPA TO9	PUF	X			
USEPA TO13	PUF or MM5		X		
CARB 428	MM5	X		X	
CARB 429	MM5		X		
ALTA Custom Methods	All	X	X	X	X

Sample Matrix key:

E = Effluent
Fa = Fly Ash
Fo = Fuel Oils
P = Pulp/paper
MM5 = MM5 Train air sample
S = Soil
Sb = Still Bottom
Sl = Sludge
T = Tissue
PUF = Polyurethane foam plug air sample

TABLE 2. — Typical Dioxin/Furan Detection Limits using HRMS and LRMS

Method	PCDD/F Technique	Sample Type	Cl_4	Cl_5-Cl_7	Cl_8
EPA Method 23	HRMS	MM5	1-5 pg/smpl	2-20 pg/smpl	50 pg/smpl
CARB Method 428	HRMS	MM5	1-5 pg/smpl	2-20 pg/smpl	50 pg/smpl
CARB Method 428	LRMS	MM5	100 pg/smpl	500 pg/smpl	1000 pg/smpl
EPA Method TO-9	HRMS	PUF	1-5 pg/smpl	2-20 pg/smpl	50 pg/smpl
EPA Method 8290	HRMS	SOLIDS	0.2-0.5 PPT	1-5 PPT	10 PPT
EPA Method 1613A	HRMS	EFFLUENTS / WATERS	5 PPQ	25 PPQ	50 PPQ
EPA Method 1613A	HRMS	PULP	0.5 PPT	2.5 PPT	5 PPT

TABLE 3. — Typical Reporting Limits for PAHs and PCBs

Method	Technique	Sample Type	Reporting Limits (ng/sample)
EPA Method TO-13 (for PAHs)	HRMS	MM5 or PUF	5-10
EPA Method TO-13 (for PAHs)	LRMS	MM5 or PUF	100-200
CARB Method 429 (for PAHs)	HRMS	MM5	5-10
CARB Method 429 (for PAHs)	LRMS	MM5	100-200
CARB Method 428 (for PCBs)	HRMS	MM5	1-5

LCMS & LCMS/MS SERVICES —

ALTA offers both routine analyses and method development services for pesticide residue and pharmaceutical studies utilizing Liquid Chromatography Mass Spectrometry (LCMS) with Thermospray (TSP), Electrospray (ESI) and Atmospheric Chemical Ionization (APCI) interfaces. ALTA also offers *Tandem* Mass Spectrometry in conjunction with liquid chromatography (LC/MS/MS) using TPS, ESI, and APCI.

The development of new LCMS instrumentation has moved this technique from the research environment into field monitoring programs. In addition to the advantages of LCMS when analyzing non-volatile or thermally labile compounds, the increased sensitivity and selectivity derived from LCMS is useful when low detection limits are required and sample amounts are limited.

The application of MS/MS to the soft ionization characteristics of any of these liquid chromatography interfaces results in a powerful analytical tool. LC/MS/MS techniques provide the pesticide residue chemist with streamlined sample preparation, structural confirmation and excellent detection limits.

The sensitivity and selectivity of LC/MS/MS methods produce sample preparation procedures requiring limited clean-up. Costs for multi-analyte screens using LC/MS/MS are similar to those involving conventional LC or GC methods due to the resulting high sample throughput. This is particularly true if the equivalent conventional method requires more than one instrument type or involves lengthy clean-up procedures.

SECTION III.
Facility

FACILITY

ALTA's operations are housed in an 11,000 square foot custom designed laboratory located in El Dorado Hills California, 25 miles east of downtown Sacramento. ALTA's laboratory was initially completed in December 1990 and a 2,500 sq. ft. expansion completed in April 1993.

The facility features:

- Large sample log-in and sample storage areas including a walk-in freezer and walk-in refrigerator. Sample Control freezers and refrigerators are continuously monitored for temperature by an Omega 5000 data logger. The data logger has a local alarm and is remotely monitored during non business hours ensuring that laboratory personnel will be notified in the event of a refrigerator or freezer failure.

- 5 separate sample preparation laboratories are designed to maximize throughput and minimize sample cross contamination. Each lab is windowed and spacious to provide chemists with a safe and high capacity work environment. Sample preparation capabilities include sample grinding and drying, MM5 air train preparation, supercritical fluid extraction, biological tissue processing and soil core subsampling.

- An open floor plan, 2,000 square foot instrument operations room. Accommodating 3 magnetic sector instruments and 3 triple stage quadrupole instruments, this design facilitates communication between instrument analysts. Instrument coolers are remotely located and pump emissions are evacuated to minimize noise and maintain safe working conditions.

- Separate Data Review carols and offices. Areas adjacent or proximal to the instrument operations room allow analysts to access and review instrument generated data in quiet, spacious conditions.

- Separate Quality Assurance data review office and separate Data Archive Room designed to meet USEPA Good Laboratory Practices standards regarding data security.

In August 1992 ALTA opened an East Coast satellite office in Newburyport, MA. Its function is to provide ALTA a regional presence to better develop ties and improve service to existing and potential Eastern U.S clients.

SECTION IV.
Equipment

EQUIPMENT

ALTA utilizes state-of the-art magnetic sector or triple stage quadrupole mass spectrometers. Each instrument is fully automated for 24 hour operations. Data can be off-loaded to stand-alone computers for data processing and review or directly uploaded into the laboratory information management system (LIMS).

Sample preparation capacity is large with over 60 soxhlet extractor positions and 15 rotary evaporators. 17 fume hoods each surrounded by open bench space are positioned throughout the preparatory labs.

Below is listed a description of the laboratory equipment:

HRMS Analytical Instrumentation —

CTC Autosampler Model A200S (3)
DEC Vaxstation 3100 w/Opus Data System (3)
DEC Vaxstation 4000 w/ Opus Data System (2)
Neslab HX200 Water Cooler (2)
Neslab HX500 Water Cooler (1)
VG 70SE High Resolution Double Focusing Mass Spectrometer (2)
VG Autospec High Resolution Mass Spectrometer (1)

LRMS Analytical Instrumentation —

CTC Autosampler Model A200S (2)
DEC Vaxstation 2100 w/ Utrix-32 Operating System (2)
DEC Vaxstation 5000 (1)
Finnigan MAT APCI/ESI Electrospray LCMS interface (1)
Finnigan MAT TSP-2 Thermospray LCMS interface (2)
Finnigan MAT TSQ-700 (3)
Waters Model 510 HPLC Pump (1)
Waters Model 590 MS Liquid Chromatograph (1)
Waters Model 600 MS Liquid Chromatograph (3)

Sample Preparation Equipment —

4 ft. fume hoods (1)
6 ft. fume hoods (3)
8 ft. fume hoods (13)
Berkel Scharfen Food Slicer (1)
Buchler Rotary Evaporator (15)
Electrothermal Electromantle 6 sample capacity (10)
Electrothermal Electromantle 3000 mL capacity (6)
Fischer Scientific Model A-160 Analytical Balance (1)
Fischer Scientific Model XL-3000 Top Loader Balance (1)
IEC Centra - 8 Centrifuge (1)
Lab Line Model 3590 Orbit Shaker (1)
Neslab Coolflow CFT-33 Cooler (5)
Organomation 24 Station N-EVAPorators (4)
Supercritical Fluid Extractor - Isco-2300 (1)
Thomas Grinder (1)
Thermolyne 1400 Furnace Kiln
VWR 1320 Oven (3)
Zymark Turbo Evaporator (1)

Data Management and Report Production Equipment —

ALTA uses Netware 386 and a Paradox based PC LIMS system
Canon Fax-L770 Facsimile
Concentrator (1)
HP Laser Jet II Printer (1)
HP Laser Jet IID Printer (1)
HP Laser Jet IIIP Printer (1)
HP Laser Jet IV Printer (2)
Kodak Ektaprint 90E Photocopier
Modem Server (1)
Network Server (1)
Personal Computer 386/16 (2)
Personal Computer 386/20 (3)
Personal Computer 386/33 (2)
Personal Computer 486/33 (7)

Sample Storage Equipment —

Freezer 2-door 50 cu. ft. capacity (1)
Freezer 3-door 68 cu. ft. capacity (1)
Freezer Walk-in 1150 cu. ft. capacity (1)
Omega 5000 Temperature Logger (1)
Refrigerator 1-door 20 cu. ft. capacity (3)
Refrigerator 2-door 50 cu. ft. capacity (3)
Refrigerator Walk-in 430 cu. ft. capacity (1)

SECTION V.
Quality Assurance

QUALITY ASSURANCE

The ALTA Quality Assurance Program has been designed to ensure that our laboratory reports meet or exceed the minimum data quality objectives stipulated in our client's project plans or the applicable method.

Basic laboratory systems, including personnel training, analytical standards management, and equipment operation are documented by Standard Operating Procedures (SOP's) in strict accordance with USEPA Good Laboratory Practices. Additional project or study specific QC options are available upon request. Based on the three tier approach described below, ALTA conducts a comprehensive QA Program that goes well beyond that typically available from other commercial laboratories.

TIER 1.— USEPA Good Laboratory Practices Standards

ALTA's standard operating procedures cover all operations and were written in accordance to USEPA GLP Standards required under 40 CFR Part 58 and Part 160. In particular, ALTA has taken the approach to adhere to GLP standards throughout the laboratory whenever possible including work not conducted in support of FIFRA/FDA registration requirements (e.g., NPDES, RCRA and SARA). This approach, although more stringent, ensures maximum uniformity in laboratory operations, particularly data collection and record keeping.

TIER 2.— Method Performance Evaluation

ALTA routinely analyzes the following QC samples to monitor HRMS/LRMS method performance:

- one method blank per set (batch) of samples extracted,
- a pair of laboratory control samples (LCS1/LCS2) for every 20 or less samples of similar matrix and analysis, or every 2 weeks whichever is less,
- periodically, a pair of matrix spikes (MS/MSD).

TIER 3.— Study/Project Specific QC Options

ALTA offers study/project specific quality control options on an as-needed basis including:

- Matrix Spike, Duplicate Spike samples,
- Duplicate samples
- Resin, Filter QC's,
- Raw data package (chromatograms, data sum sheets, calibrations)
- USEPA Method Detection Limit (MDL) Studies,
- Method Development and Validation Studies,
- Storage Stability Studies,
- Multiple column or MS/MS Confirmations.

Project Management

As a client of ALTA, your analytical work will be overseen by an experienced environmental chemist with "hands-on" involvement in your project. Studies are assigned by matching expertise with analytical program requirements. This ensures that clients receive expert consultation beginning with project definition and ending with the discussion of the final report. The resumes of key technical personnel are provided in the Appendix.

Sample Tracking

Clients conducting long term field studies or other monitoring studies often require that sample batches be analyzed according to a study or project specific analytical program. In order to provide this level of tracking and routine handling, ALTA assigns a Study ID and a sample Batch ID to all sample batches as they are logged into the ALTA Laboratory Information Management System (LIMS). This enables the Sample Control personnel to use a study template which reduces errors during log-in, and facilitates the assignment of appropriate analytical tests.

Study Audits

ALTA's QA Program has been designed to comply with USEPA Good Laboratory Practice. As part of GLP compliance, those studies conducted under a formal protocol will be routinely audited during the critical phases of sample preparation and analysis. In addition, study protocols specify unique ongoing QC requirements, including study specific precision and accuracy control limits.

Cost Accounting

ALTA's in-house accounting program routinely tracks invoices by Study ID (as well as Client ID). Upon request, project reports can be generated monthly, quarterly or year-to-date to document laboratory costs associated with a particular study or project. This service is valuable for project managers working under a fixed budget, or those that have multiple projects running concurrently with ALTA. In addition, it allows ALTA to verify the volume of revenue generated by an account and award volume discounts (if applicable) on a real time basis.

SECTION VI.
Selected Project Experience

SELECTED PROJECT EXPERIENCE

Air Toxics Monitoring Projects:

1. Performed PCDD/PCDF, PAH and semi-volatile analyses for the WTI Hazardous Waste Incinerator Trial Burn on over 50 samples (1992).

2. Stack emission monitoring of a hazardous waste incinerator test burn for PAH's and PCDD/PCDF using California Air Resources Board (CARB) Methods 428 and 429 (LRMS & HRMS).

3. Stack emission tests of hospital infectious waste incinerators for PCDD/PCDF and PAH's by CARB Methods 428 and 429 (LRMS & HRMS).

4. Sugar plant stack emission test and process water analysis for PCDD/PCDF by CARB Method 428 and EPA Method 1613A (HRMS).

5. Refinery stack emission monitoring of PAH's by CARB Method 429 (HRMS).

6. Diesel/natural gas boiler stack testing for PAH's by CARB Method 429 (LRMS & HRMS).

7. Ambient Air Analysis by Modified EPA Method TO-9 for PCDD/PCDF's (USEPA SAS #5710-D-01).

8. PCDD/PCDF Ambient Air Round Robin Study conducted for Environment Ontario [Contact: R.E. Clement (Environment Ontario), 416-235-5906].

9. Ambient Air Analysis by Modified EPA Method TO-9 for PCDD/PCDF, PAH, and Coplanar PCB's (USEPA SAS #1226).

10. ALTA holds 1-year contracts for California Air Resources Board for CARB 428 and 429 for 1993.

Pulp and Paper Industrial Monitoring Projects:

1. USEPA Industrial Technology Division Method 1613A interlaboratory method performance evaluation study involving pulp mill effluent analysis for PCDD/PCDF [Contact: William Telliard (USEPA-ITD), 202-383-7120].

2. NCASI Certification performance check sample analysis of standard reference pulps, sludges and effluents for TCDD/TCDF using NCASI Method 551 [Contact: Larry LaFleur (NCASI), 503-752-8801].

Pulp and Paper Industrial Monitoring Projects (continued):

3. NPDES compliance permit monitoring of PCDD/PCDF in fish by the Stalling's Method.

4. Determination of TCDD/TCDF in finished paper products by NCASI Method 551.

5. Interlaboratory study (DF-1) for the determination of dibenzo-p-dioxin and dibenzofuran in defoamers for Environment Canada.

6. NPDES compliance permit monitoring of PCDD/PCDF in pulp and paper industry effluents using EPA Method 1613A and NCASI Method 551.

7. NCASI/USEPA joint variability study involving analysis of pulp, sludge & pulp mill effluent for PCDD/PCDF. [Contact: Larry LaFleur]

Municipal and Industrial Monitoring Projects:

1. Determination of PCDD/PCDF in soil samples by EPA Method 8290 (SAS #5674-S-01).

2. Measurement of of PCDD/PCDF in power plant ash samples by EPA Method 8290.

3. Analysis of still bottom waste for PCDD/PCDF by EPA Method 8280.

4. NPDES compliance monitoring of POTW effluent by EPA Method 1613A.

5. Determination of PCDD/PCDF in refinery waste effluent by EPA Methods 8280 and 1613A.

6. Analysis of Drinking Water for 2,3,7,8-TCDD using EPA Method 1613A.

7. Fish Round Robin Study. [CIL Contact: Joel Bradley]

8. Soil Round Robin Study. [Radian Contact: Larry Keith]

Agrochemical Studies:

1. Development of TSP-LCMS methods for the determination of hydroxy triazines in soil and water.

2. Broad scale terrestrial field soil dissipation study involving the measurement of a dihydroxy triazine by TSP-LCMS.

3. Development of several TSP-MS/MS methods for the determination of a sulfonyl urea and its degredates in soil.

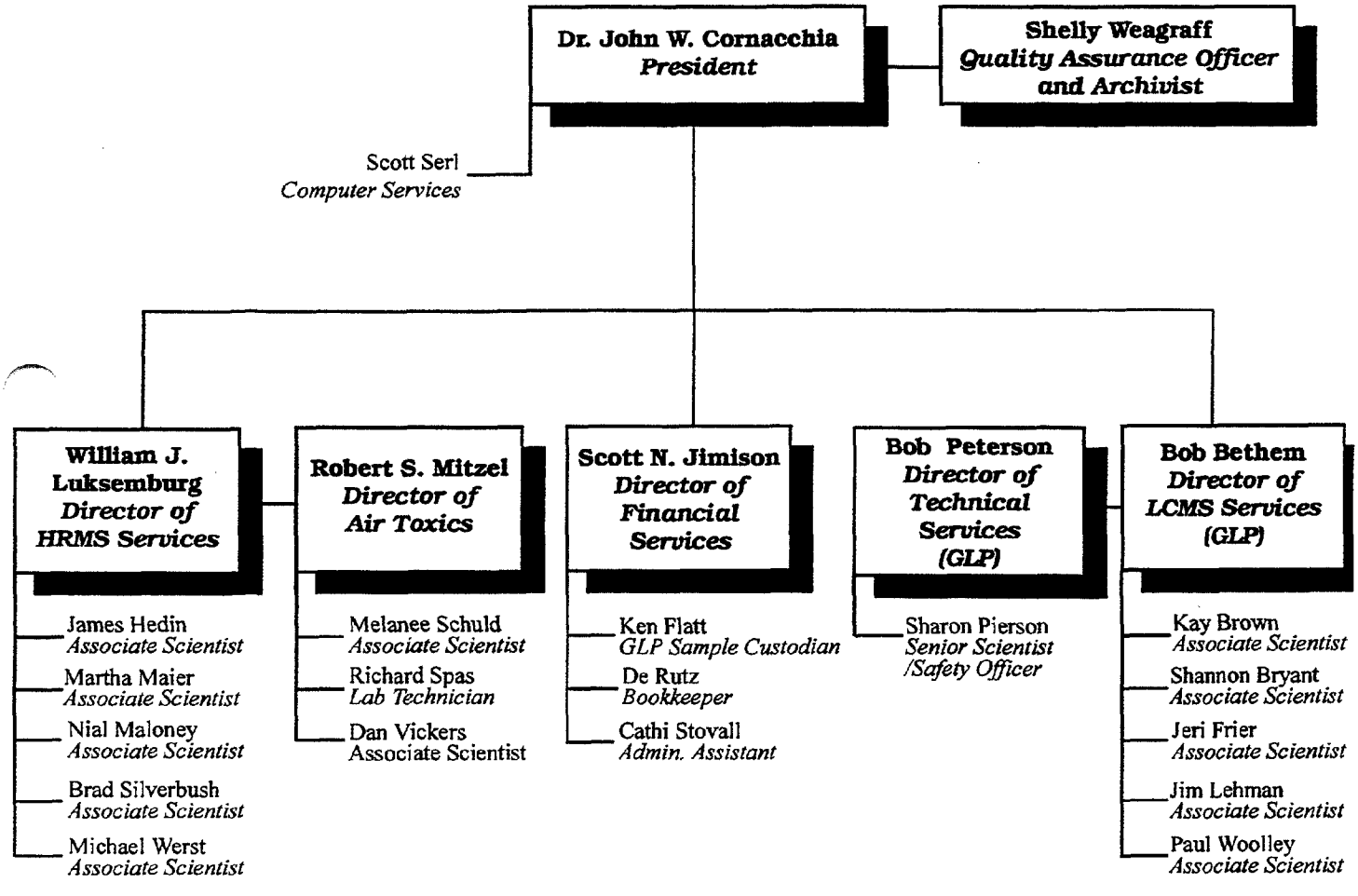
SECTION VII.
Appendix

APPENDIX

- ALTA Organizational Flowchart
- Key Technical Staff Resumes
- Certifications

ALTA Organizational Flowchart

ALTA ANALYTICAL LABORATORY



Version: *March 29, 1994*

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Key Technical Staff Resumes

John W. Cornacchia, Ph.D.

President

EDUCATION

Ph.D.	Ecology, University of California, Davis, CA (1982)
B.S.	Animal Science, University of California, Davis, CA (1975)

EXPERIENCE

Present

President, ALTA Analytical Laboratory
Dr. Cornacchia is co-founder, CEO, and a member of the Board of Directors of ALTA. He is responsible for the management of business planning including venture funding, sales and marketing and the review of laboratory operations. He participates in the planning of agrochemical studies, particularly field dissipation studies and groundwater monitoring projects.

1989 - 1990

Senior Program Administrator, Enseco-Cal Lab
Responsible for managing USEPA-FIFRA Environmental Fate Studies conducted for Fortune 500 chemical companies and government agencies. Also was responsible for all sales and marketing of LCMS and LCMS/MS services for the USEPA-FIFRA pesticide residue testing market.

1987 - 1989

Director of Production Planning & Control/Director of Information Services, Enseco-Cal Lab
Coordinated the scheduling and planning of laboratory production capacity and managed the Information Services Group (ISG) for the largest commercial laboratory in California. His ISG functions included the operation of the Sample Control Department, Data Control Group and the Computer Group. In addition, he managed analytical services programs supporting large-scale terrestrial field dissipation studies, groundwater monitoring investigations, and surface water surveys.

1986 - 1987

Technical Manager, Enseco-Cal Lab
Provided consultative services to agrochemical clients responding to the California Groundwater Contamination Prevention Act (AB2021) including the preparation of terrestrial field dissipation study reports. Managed analytical programs in support of aquatic field dissipation studies.

1981 - 1986 **Senior/Associate Environmental Specialist, Division of Water Quality, California Water Resources Control Board.**
As a member of the Pollutant Investigations Branch Special Studies Unit, Dr. Cornacchia designed, implemented and managed large-scale pesticide and water quality monitoring projects and aquatic bioassay studies. As part of the Pesticide Registration and Evaluation Unit/Priority Chemicals Unit, he performed statewide chemical risk assessments of agrochemicals including malathion, molinate, and thiobencarb.

QUALIFICATIONS

Dr. Cornacchia has over twelve years of experience in environmental research examining the fate and effects of agrochemicals in aquatic and terrestrial systems. He spent the first five years as a regulator performing aquatic risk assessments regarding pesticide usage in California, and the last four years developing analytical programs in support USEPA FIFRA Environmental Fate Studies and governmental water quality assessments. Many of the special projects he directed led to the development of new agrochemical screening techniques including solid phase extractions, GCMS-SIM methods, and most recently, LCMS and LCMS/MS procedures. Dr. Cornacchia has in-depth experience regarding USEPA-GLP Standards and the management of field and laboratory personnel.

SELECTED PUBLICATIONS & PRESENTATIONS

"Quantitative Analysis of Pesticides by Thermospray LCMS and MS/MS," Bethem, R.A., Cornacchia, J.W., presented at the 38th ASMS Conference on Mass Spectrometry and Allied Topics, June 5-10, 1990, Tucson, AZ.

"Determination of Triazine Pesticides and Degradation Products in Groundwater by Thermospray Liquid Chromatography Mass Spectrometry," Bethem, R.A., Cornacchia, J.W., presented at 10th Annual SETAC Meeting, Toronto, Canada (1989).

"Method Validation for Pesticide Determination in Water and Soil Using Quantitative Thermospray Liquid Chromatography/Mass Spectrometry," Bethem, R.A., Cornacchia, J.W., Kornfeld, R., Matusak, K., presented at the Pittsburgh Conference, New York, New York (1990).

"Rice Herbicides: Molinate (Ordram) and Thiobencarb (Bolero), A Water Quality Assessment," Cornacchia, J.W., Cohen, D.B, Bowes, G.W., Schnagl, R.J. and Montoya, B.L. Special Projects Report No. 84-4sp, California Water Resources Control Board.

"Recent Developments in Liquid Chromatography Mass Spectrometry (LCMS) for the Analysis of Pesticides in Soil and Water," Bethem, R.A., Cornacchia, J.W., Serl S., Balu, K., and Smith, J., presented at the American Chemical Society Spring Meeting, Denver, CO. (1993).

"Determination of Hydroxysimazine and Hydroxyatrazine in Well Water by High Performance Liquid Chromatography Thermospray Tandem Mass Spectrometry (TSP-LC/MS/MS)," Cornacchia, J.W., Bethem, R.A., Frier, J. and Balu, K., presented at the First Society of Environmental Toxicology and Chemistry World Congress, Libson, Portugal, (1993).

"Environmental Monitoring, Toxicity and Control of Rice Pesticide Emissions in the Sacramento Valley (CA) 1981-1991," Finlayson, B.J., Lee, J.M. and Cornacchia, J.W., presented at the First Society of Environmental Toxicology and Chemistry World Congress, Libson, Portugal, (1993).

"Rapid Low Level Detection of Organophosphorus Pesticides in Groundwater by High Performance Liquid Chromatography Thermospray Tandem Mass Spectrometry (TSP-LC/MS/MS)," Bethem, R.A., Cornacchia, J.W., Peterson, R.G., presentation accepted for the 6th Annual California Pesticide Residue Workshop.

PROFESSIONAL AFFILIATIONS

American Chemical Society
American Society of Mass Spectrometry
Society of Environmental Toxicology and Chemistry

Robert A. Bethem

Director of LCMS Services

EDUCATION

B.S. Chemistry, Antioch College, Yellow Springs, OH (1978)

EXPERIENCE

Present **Director of LCMS Services, ALTA Analytical Laboratory**
Mr. Bethem is a co-founder and member of the Board of Directors of ALTA. He initiates and manages all method development and routine work by Liquid Chromatography Mass Spectrometry (LC/MS), and tandem mass spectrometry, (MS/MS). He is responsible for the development of novel methods for the trace analysis of pesticides in water and soil by LCMS. In addition to his role in LCMS analysis, he is responsible for the application of GC/MS/MS techniques for the trace analysis of organic compounds in complex matrices.

1987 - 1990 **Principal Scientist/LCMS Manager, Enseco-Cal Lab**
Created and managed the LCMS Services Department and provided pesticide analysis services for industry and government. Developed and marketed several trace methods by GC/MS/MS. Supervised extraction and instrument personnel and was responsible for the final review and processing of all data. Coordinated and maintained two Finnigan MAT TSQ-70's and developed software for automated analysis.

1984 - 1987 **International Field Engineer, Finnigan MAT**
Performed mass spectrometer applications and engineering support for the Pacific Operations Centers in China and South America. Provided applications and technical support to several large USEPA contract laboratories.

1982 - 1984 **Manager of Mass Spectrometry, Cambridge Analytical Assoc.**
Organized and maintained the GC and GCMS laboratories for EPA and NIOSH protocol analysis. Supervised GC and GCMS personnel and was responsible for final data review and report generation.

1978 - 1982 **Research Assistant, Massachusetts Institute of Technology**
Provided low and high resolution analyses on several instruments using a variety of ionization techniques at the N.I.H. facility for Mass Spectrometry.

QUALIFICATIONS

Mr. Bethem has accumulated over 12 years of experience in mass spectrometry at a variety of research and production environments. He has recently pioneered the application of Thermospray LCMS to the quantitative analysis of pesticides and has demonstrated its ability to produce superior data quality in actual field studies. Recent work and publications have established him as one of the leaders in this field. He is a current member of the Joint Task Group of "Standard Methods for the Examination of Water and Wastewater" for the development of new LCMS methods. Mr. Bethem has an extensive background in biological and environmental analysis. As a result of his work with an instrument manufacturer, he has also developed a high degree of proficiency with software, electronic, and electro-mechanical devices.

PUBLICATIONS

"Thermospray MS and MS/MS of Polar, Urinary Metabolites and Metabolic Conjugates," Draper, W.M., Brown, F.R., Bethem, R.A., Miille, M.J., Biomed Environ. Mass Spectrom. 1989, 18, 767.

"Anion Exchange Thermospray Tandem Mass Spectrometry of Polar Urinary Metabolites and Metabolic Conjugates," Draper, W.M., Brown, F.R., Bethem, R.A., Miille, M.J., Liquid Chromatog./Mass Spectrom.: Applications in Agricult., Pharm., and Environ. Chem., Mark A. Brown, Editor, 1990.

"The Application of Tandem Mass Spectrometry to Environmental Measurements," Finnigan, R., Poppeti, J., and Bethem, R. (In Press).

"Quantitative Analysis of Pesticides by Thermospray LCMS and MS/MS," Bethem, R.A., Cornacchia, J.W. Presented at the 38th. ASMS Conference on Mass Spectrometry and Allied Topics, June 5-10, 1990, Tucson, AZ.

"Determination of Triazine Pesticides and Degradation Products in Groundwater by Thermospray Liquid Chromatography Mass Spectrometry," Bethem, R.A., Cornacchia, J.W., presented at 10th Annual SETAC Meeting, Toronto, Canada (1989).

"Method Validation for Pesticide Determination in Water and Soil Using Quantitative Thermospray Liquid Chromatography/Mass Spectrometry," Bethem, R.A., Cornacchia, J.W., Kornfeld, R., Matusak, K., presented at the Pittsburgh Conference, New York, New York (1990).

"Recent Developments in Liquid Chromatography Mass Spectrometry (LCMS) for the Analysis of Pesticides in Soil and Water," Bethem, R.A., Cornacchia, J.W., Serl S., Balu, K., and Smith, J., presented at the American Chemical Society Spring Meeting, Denver, CO. (1993).

"Determination of Hydroxysimazine and Hydroxyatrazine in Well Water by High Performance Liquid Chromatography Thermospray Tandem Mass Spectrometry (TSP-LC/MS/MS)," Cornacchia, J.W., Bethem, R.A., Frier, J. and Balu, K., presented at the First Society of Environmental Toxicology and Chemistry World Congress, Libson, Portugal, (1993).

"Rapid Low Level Detection of Organophosphorus Pesticides in Groundwater by High Performance Liquid Chromatography Thermospray Tandem Mass Spectrometry (TSP-LC/MS/MS)," Bethem, R.A., Cornacchia, J.W., Peterson, R.G., presentation accepted for the 6th Annual California Pesticide Residue Workshop.

PROFESSIONAL AFFILIATIONS

American Chemical Society
American Society for Mass Spectrometry
Joint Task Group - "Standard Methods for the Examination of Water and Wastewater"

William J. Luksemburg

Director of HRMS Services

EDUCATION

B.S. Chemistry, California State University, Fresno, CA (1974)

EXPERIENCE

Present **Director of HRMS Services, ALTA Analytical Laboratory**
Mr. Luksemburg, a co-founder, directs the routine analysis and method development work in the High Resolution Mass Spectrometry department. He is responsible for marketing HRMS dioxin services to environmental engineering firms, the pulp and paper industry, government agencies and other industrial clients. Mr. Luksemburg is also responsible for the development of new markets using HRMS instrumentation. In addition Mr. Luksemburg directs routine and special projects, review and interpret data, and interface with clients.

1986 - 1990 **Principal Scientist/HRMS Manager, Enseco-Cal Lab**
As Principal Scientist in the Special Services department at Enseco-Cal Lab Mr. Luksemburg coordinated the operation and maintenance of five high resolution magnetic sector instruments. He was responsible for developing a business that now is one of the major suppliers of HRMS PCDD/PCDF analysis to the pulp and paper industry in the U.S. Mr. Luksemburg also coordinated the training and development of the staff in the operation and maintenance of HRMS instruments.

1979 - 1986 **Senior Chemist, Radian Corporation**
In Radian's Sacramento laboratory, Mr. Luksemburg was GC/MS supervisor for ABN and VOA analysis. He coordinated the activities of five chemists in the operation and maintenance of four quadrupole mass spectrometers.

1974 - 1979 **Chemist, Carnation Company**
As a staff chemist, Mr. Luksemburg was involved in the analysis of products and ingredients used in Carnation's animal feed division.

QUALIFICATIONS

Mr. Luksemburg has over 17 years experience in production analytical laboratories including 13 years experience in the field of environmental mass spectrometry. Much of this experience has involved PCDD/PCDF analysis of environmental samples and for the last seven years has concentrated on High Resolution Mass Spectrometry analysis of PCDD's/PCDF's in a variety of matrices. Mr. Luksemburg is recognized through-out the pulp and paper industry for his research and production work on dioxins and furans. He recently was recognized on the international level when his chapter on dioxin analysis of pulp and paper (Rappe, 1991), was published by the World Health Organization. He is one of the few individuals in the world to successfully adapt the high resolution magnetic sector instruments to "production" analysis of environmental samples at the picogram and femtogram levels.

RECENT PRESENTATIONS

"Determination of Method Detection Limits in Pulp and Pulp Mill Effluents," in Rotorua, New Zealand, at the ISWPC Post Symposium Workshop, May 1991.

"Comparison of NCASI Method 551, EPA Method 1613A, and the Proposed FDA Method for the Analysis of 2,3,7,8-TCDD and 2,3,7,8-TCDF in Food Packaging Material," in Boston, MA, at the 1993 TAPPI Environmental Conference, March 1993.

PUBLICATIONS

NCASI Technical Bulletin No. 551, "NCASI Procedures for the Preparation and Isomer Specific Analysis of Pulp and Paper Industry Samples for 2,3,7,8,-TCDD and 2,3,7,8-TCDF," LaFleur, L., Ramage, K., Bousquet, T., Brunck, R., Luksemburg, W., Miille, M., Peterson, R., and Valmores, S., (1989).

"Optimization of Extraction Procedures for the Analysis of TCDD/TCDF in Pulp, Paper Base Stocks, and Pulp Industry Solid Wastes," Lafleur, L., Ramage, K., Gillespie, W., Luksemburg, L., Miille, M., and Valmores, S., Chemosphere, Vol. 19, pp 643-648, 1989.

"Analytical Procedures for the Analysis of TCDD and TCDF in Food Sources," LaFleur, L., Bousquet, T., Ramage, K., Davis, T., Luksemburg, W., and Peterson, R., Presented by L. Lafleur at Dioxin '89, Toronto, Canada. Waiting publication in Chemosphere.

"Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans in Pulp and Paper Industry Wastewaters, Solid Wastes, Ashes and Bleached Pulps," Luksemburg, W., Environmental Carcinogens-Methods of Analysis and Exposure Measurement-Volume 11, World Health Organization, Christopher Rappe, Editor, 1991.

PROFESSIONAL AFFILIATIONS

American Society for Mass Spectrometry
American Chemical Society
Technical Association of the Pulp and Paper Industry

Robert S. Mitzel

Director of Air Toxics

EDUCATION

B.A.	Chemistry, Chico State University, Chico, CA (1982)
B.A.	Biology, Chico State University, Chico, CA (1982)

EXPERIENCE

Present — **Director of Air Toxics, ALTA Analytical Laboratory**
Mr. Mitzel, a co-founder, manages production scheduling and client management for the Air Toxics group. He is also responsible for the final review and interpretation of analytical data and final reports. In addition, he serves as a marketing agent for Air Toxic service and development of new Air Toxic markets.

1989 - 1990 — **Director of Mass Spectrometry, Enseco-Cal Lab**
Directed five supervisors and 42 chemists in the GC/MS group. He was responsible for extractions, analyses, final review and processing of all data generated by the group. Served as project manager for selected accounts focusing on priority pollutants and dioxin/furans. His accomplishments included generating and managing a $7 million dollar production group in 1989. Mr. Mitzel served as the focal person for the Air Toxic program at Enseco-Cal Labs for mass spectrometry methods on Modified Method 5 (MM5) sampling trains.

1988 - 1989 — **Mass Spectrometry Lab Manager, Enseco-Cal Lab**
Managed the mass spectrometry group through four supervisors and assisted daily operations for the VOA, BNA, Dioxin, and extraction groups. He also assisted development efforts for new GC/MS methods including isotope dilution techniques for the analysis of polynuclear aromatic hydrocarbons from the Exxon-Valdez oil spill.

1986 - 1988 — **GC/MS Dioxin Lab Manager, Enseco-Cal Lab**
Initiated and managed the method development and routine analysis of dioxin/furan samples. Collaborated with the USEPA for the development of EPA Method 8280, and developed isotope dilution methods for polychlorinated biphenyls, polynuclear aromatic hydrocarbons, chlorobenzenes, and chlorophenols. He collaborated with the California Air Resource Board with the development of Method 428 and 429, which are now part of AB 2588 (Air Toxics "Hot Spots" Information Assessment Act of 1987).

1985 - 1986 **GC/MS Supervisor, Enseco-Cal Lab**
Managed the production night shift for the VOA, BNA, and Dioxin GCMS groups.

1983 - 1985 **Staff Chemist, California Analytical Laboratory**
Conducted specialized and routine analyses for volatiles, semi-volatiles, and dioxins. He operated several Finnigan MAT mass spectrometers including the: OWA, 1020, 5100, 3200, 4500, TSQ-4500, TSQ-4600, and Incos 50.

1982 - 1983 **Staff Chemist, California Analytical Laboratory**
Mr. Mitzel conducted specialized and routine extraction and clean-up methods for volatiles, semi-volatiles, and dioxins.

QUALIFICATIONS

Mr. Mitzel has over 11 years of experience in the environmental services business. He participated in the early development of novel techniques for the extraction and analysis of 2,3,7,8-TCDD and was instrumental in developing a multi-million dollar dioxin program for Enseco, Cal Labs. He has since expanded the use of isotope dilution techniques for several other compounds in a variety of complex environmental matrices. Mr. Mitzel has extensive experience managing large production groups in an environmental laboratory.

PUBLICATIONS

"Photolysis of Octachlorodibenzo-P-Dioxins on Soils: Production of 2,3,7,8-TCDD," Miller, G., Herbert, V.R., Miille, M.J., Mitzel, R., Zepp, R.G., Chemosphere, 18, 1265-1274, 1989.

AWARDS

Graduated Cum Laude with honors in Biological Sciences
Botanical Society Award

PROFESSIONAL AFFILIATIONS

American Chemical Society

Robert G. Peterson

Director of Technical Services

EDUCATION

M.S.	Chemistry, California State University, Sacramento, CA (1982)
B.S.	Chemistry, California State University, Sacramento, CA (1975)

EXPERIENCE

Present

Director of Technical Services, ALTA Analytical Laboratory
Is responsible for assisting in the resolution of technical problems and development of solutions to new sample preparation obstacles. Focuses on existing and future analytical methods. Additionally, he will function as a focal point for R & D efforts whether they are client or scientifically oriented.

1988 - 1990

Principal Scientist, Manager, Dioxins/Furans, Enseco-Cal Lab
As a Principal Scientist, Mr. Peterson was involved in developing new methods, refining and troubleshooting existing methods, and aiding in problem solving within the Special Services Group (Dioxins and Furans analysis). Because of his unique cross-disciplined experience and education, Mr. Peterson was frequently called upon as a primary scientific resource for other organic and inorganic projects. He also served as Client Manager for selected major accounts.

As a Manager, Mr. Peterson was responsible for the staff, production, and resource allocations for the two Dioxin Preparations Laboratories. One lab was devoted to prep for High Resolution dioxin/furan analyses and the other was devoted to Low Resolution dioxin/furan analyses. His staff consisted of 2 supervisors and 15 chemists/analysts.

1987 - 1988

Director of Inorganic Services, Enseco-Cal Lab
Directed all aspects of the Inorganics Department, including guiding the Department to meet existing and projected business and technical goals. He also served as Client Manager for selected major accounts.

1982 - 1987

Organics Preparation Manager, Enseco-Cal Lab
Mr. Peterson not only managed the Organic Preparation Group, he was directly involved in the creation and subsequent management of the Dioxin Preparation Lab and the Standards Preparation Group, which resulted in upgraded laboratory QA/QC traceability and verification of standards. In this capacity, he was responsible for the mobilization of resources to meet test requests and time constraints, and was the liaison between the groups and Client Managers for efficient coordination of work flow. He also served as Client Manager to clients with organic analysis requests.

1980 - 1982 **Senior Staff Chemist, California Analytical Laboratory**
Performed extractions, concentrations and clean-ups on environmental samples of a diverse nature for organic analytes.

1979 - 1980 **Chemist, Sacramento County Water Quality Control Laboratory**
Conducted inorganic and organic analysis of waters, sludges and sediments pertinent to wastewater treatment.

1976 - 1979 **Chemist, Morse Laboratories**
Mr. Peterson conducted inorganic analysis of waters, sediments and crop samples. He also served as Organics Lab Supervisor of satellite extractions and clean-up laboratory.

QUALIFICATIONS

Mr. Peterson has a wide range of technical and management experience. His knowledge of analytical chemistry covers a spectrum of cross-disciplines and he can provide expert assistance in special organic and inorganic projects. He is also an experienced teacher and trainer. He presently coordinates and conducts an ongoing class, which is part of the Hazardous Materials Certification Program at the University of California Extension, Davis campus.

RECENT PRESENTATIONS

(1) "Quantitative Analysis and Practical Laboratory Techniques," University of California Extension, Davis (1983 to present). Currently being taught Spring, Summer, Fall & Winter quarters.

(2) Hazardous Waste Analysis Seminar for J.H. Kleinfelder (1986).

(3) Hazardous Waste Analysis Seminar for Dames & Moore (1987).

(4) "Training Program on Pesticide Residue Analysis" in Bangkok, Thailand for The World Bank/UNIDO/UNDP/DOA, November 1987.

(5) "Overview of Analytical Techniques for Pesticide Studies" as part of "Pesticides in Soil and Groundwater," University of California Extension, Davis (1988).

(6) "Analytical Techniques" as part of "Principles of Hazardous Materials Management," University of California Extension, Davis (1989, 1990, 1991, 1992.)

(7) "The Environment: Air and Water Quality, Land, Safety, Health and Proposition 65" as part of "Advanced Executive Program," University of California Extension, Davis (1990).

PUBLICATIONS

"Cl_5-Cl_8 Isomers Synthesized from [^{13}C]-2,3,7,8-Tetrachlorodibenzofuran via Surface Chlorination," Bulletin of Environmental Contamination and Toxicology (1987).

NCASI Technical Bulletin No. 551, "NCASI Procedures for the Preparation and Isomer Specific Analysis of Pulp and Paper Industry Samples for 2,3,7,8-TCDD and 2,3,7,8-TCDF," LaFleur, L., Ramage, K., Bousquet, T., Brunck, R., Miille, M., Luksemburg, W., Peterson, R., Valmores, S. (1989).

"Analytical Procedures for the Analysis of TCDD and TCDF in Food Sources," LaFleur, L., Bousquet, T., Ramage, K., Davis, T., Luksemburg, W., and Peterson, R.. Presented by L. Lafleur at Dioxin '89, Toronto, Canada. Waiting publication in Chemosphere.

"Supercritical Fluid Extraction and Solid Phase Extraction Techniques Applied to the Analysis of Pulp and Paper Mill Effluents for 2,3,7,8-Tetrachlorodibenzo-p-dioxin and 1,2,7,8/2,3,7,8-Tetrachlorodibenzofuran," Peterson, R.G., Luksemburg, W.J., Hedin, J., Silverbush, B., Werst, M., Maloney, N. Presented at the Research and Technology Transfer Conference, Toronto, Ontario (1992).

PROFESSIONAL AFFILIATIONS

American Chemical Society
American Society for Mass Spectrometry
Society of Quality Assurance

AWARDS

"Excellence in Teaching and Outstanding Service Award," University of California, Davis (1989).

James M. Hedin

Associate Scientist

EDUCATION

B.S. Chemistry, University of Minnesota, Duluth, MN (1986)

EXPERIENCE

Present **Associate Scientist, ALTA Analytical Laboratory**
Mr. Hedin performs routine analysis and method development work in the High Resolution Mass Spectrometry department. He is responsible for routine maintenance of HR/MS instruments. Mr. Hedin also aides in the training of new staff, reviews and interprets data, and interfaces with clients.

1988 - 1990 **GC/MS Chemist, Enseco-Cal Lab**
As GC/MS Chemist at Enseco-Cal Lab Mr. Hedin was responsible for the operation and maintenance of quadrapole GC/MS instruments. His duties entailed sample analysis by EPA methods for volatiles and semi-volatiles. Mr. Hedin also aided in the training of the staff in the department.

1987 - 1988 **Extraction Chemist, Enseco-Cal Lab**
Mr. Hedin's duties entailed sample extraction for Dioxin/Furan Analysis by High Resolution Mass Spectrometry. He assisted in the training of new staff, and the developement of new extraction techniques.

QUALIFICATIONS

Mr. Hedin has over 6 years experience in production analytical laboratories including 5 years experience in the field of environmental mass spectrometry. Much of this experience has involved PCDD/PCDF analysis of environmental samples and for the last three years has concentrated on High Resolution Mass Spectrometry analysis of PCDD's/PCDF's in a variety of matrices.

PROFESSIONAL AFFILIATIONS

American Society for Mass Spectrometry

Martha M. Maier

Associate Scientist

EDUCATION

B.S. Chemistry, University of Wisconsin, Madison, WI (1983)
B.S. Philosophy, University of Wisconsin, Madison, WI (1983)

EXPERIENCE

Present **Associate Scientist, ALTA Analytical Laboratory**
Ms. Maier coordinates analytical work from ALTA's East Coast office. Assists customers in setting up projects and coordinates sample shipping, analysis and reporting. Also responsible for marketing in the eastern United States and attends technical meetings and presents papers.

1990 - 1992 **Technical Sales, Enseco-Cal Lab**
She coordinated the dioxin/furan marketing program. Responsibilities included preparing bids, organizing exhibits, and overseeing the production of marketing materials. Acted as a liaison between the salespeople and the dioxin/furan laboratory.

1988-1990 **HR GC/MS Operator, Enseco-Cal Lab**
Dioxin/furan analysis of pulp, food, and low level environmental samples using high resolution GC/MS. Promoted to scientist position in December 1989. Involved in data review and project management.

1987-1988 **GC/MS Operator, Enseco-Cal Lab**
Dioxin/furan analysis using low resolution GC/MS systems. Promoted to lead person in May 1988.

1986-1987 **GC/MS Semivolatile Operations Supervisor, Radian Corporation**
Responsible for the scheduling and completion of all semivolatile analyses. Trained other operators in Semivolatile and routine instrument maintenance.

1984-1986 **GC/MS Operator, Radian Corporation**
Analyzed environmental samples for volatile and semivolatile organic pollutants using EPA methods 624, 625, SW-8240, SW-8270, and by EPA Contract Lab Protocol. Performed routine maintenance on all systems. Responsible for interfacing the GC/MS Lab with the laboratory database management system.

1984-1984 **Analytical Chemist, Wisconsin Dept. of Agriculture, Madison, WI**
Assayed pesticide formulations using HPLC, GC, and TLC; researched, developed and modified methods.

PROFESSIONAL AFFILIATIONS

Air & Waste Management Association
Technical Association of the Pulp and Paper Industry

PRESENTATIONS

"Analysis of Coplanar PCBs using High Resolution Mass Spectrometry," in Long Beach, CA, at the HazMat Conference, November 1992.

QUALIFICATIONS

Ms. Maier has over 9 years experience in environmental analytical laboratories, including 8 years in the field of GC/MS. Her extensive background in the analysis of PCDD/PCDF in environmental samples is valuable in her present role as project manager.

Shelly A. Weagraff

Quality Assurance Officer (QAO)

EDUCATION

B.A. Biological Sciences, California State University, Sacramento (1986)

EXPERIENCE

Present **Quality Assurance Officer, ALTA Analytical Laboratory**
As Quality Assurance Officer (QAO) oversees the laboratory's compliance with ALTA's Quality Assurance Program Plan (QAPP), Standard Operating Procedures (SOPs), USEPA Good Laboratory Practices (GLP) and any client specific QA programs. Interacts with Sponsor QA team or regulatory agencies during on-site visits as well as written correspondence.

1993 - 1994 **Quality Assurance Associate, ALTA Analytical Laboratory**
Assisted the Quality Assurance Officer with overseeing the laboratory's compliance with ALTA's Standard Operating Procedures (SOPs), Quality Assurance Program Plan (QAPP), and USEPA Good Laboratory Practice Standards. Responsible for maintaining the data archive.

1990 - 1992 **Technical Representative, Appligene Inc.**
Provided technical customer support for the laboratory's custom DNA synthesis. Coordinated sales and marketing of a complete line of molecular biology instruments, reagents and enzymes. Arranged demonstrations and presentations for our outside sales representatives. Also responsible for the general management of office duties; such as, accounts payable, accounts receivable, inventory management, purchasing, and business status updates.

1988 - 1990 **Lead Analyst, Baxter Healthcare Corp., Hyland Biotech Division (Formerly Bio-response, Inc.)**
Supervised a team of assay analysts conducting analysis of monoclonal antibodies for a contract manufacturing laboratory. Responsible for overseeing the departments compliance with Standard Operating Procedures (SOPs) and USFDA Good Manufacturing Practice Standards. Scheduled the weekly activities of the analysts, reviewed and approved all assay data, developed new assays, and released final product data. Developed a computer sample tracking system designed specifically for easy analysis selection for the various departments as well as retrieval of released results.

1987 - 1988 **Assay Analyst, Bio-Response Inc.**
Performed routine monoclonal antibody assays for the various phases of mammalian cell line production which included cell culture, mass antibody culture, purification, and final product release. Types of assays performed included Enzyme Linked Immunosorbent Assay (ELISA), antibody resin functionality tests, Bradford protein, tPA fluorescence, Hoeschst DNA, tritium assay for growth factors, clotting assay, and High Performance Liquid Chromatography (HPLC).

QUALIFICATIONS

Ms. Weagraff has over six years of experience in the pharmaceutical laboratory and a year in the environmental laboratory. Her biotechnology background gives her a strong working knowledge for analyzing laboratory procedures and reviewing data. As a technical representative, Ms. Weagraff has experience in sales and marketing in which effective communication between the client and the laboratory was essential in the efficient coordination of production. This coupled with her technical background provides skills to successfully enhance the completion of a contract laboratory's goals and objectives. Management skills include the development of a fiscal budget for the assay department of a GMP contract laboratory, instrumentation evaluation and purchase, and staff review and hires.

PROFESSIONAL AFFILIATIONS

Pacific Regional Chapter of the Society of Quality Assurance

Bradley B. Silverbush

Associate Scientist

EDUCATION

B.S. Biochemistry, University of California, Davis, CA (1988)

EXPERIENCE

Present **Associate Scientist, ALTA Analytical Laboratory**
Mr. Silverbush performs routine analysis and method development work in the High Resolution Mass Spectrometry department. He is responsible for routine maintenance of HR/MS instruments and for the preparation, QC, etc. of all Standards. In addition, Mr. Silverbush assists in the training of new staff, reviews and interprets data, and interfaces with clients.

1990 - 1991 **GC/MS Chemist, Enseco-Cal Lab**
As GC/MS Chemist at Enseco-Cal Lab Mr. Silverbush was responsible for the operation and maintenance of quadrapole GC/MS instruments. His duties entailed sample analysis by EPA methods for volatiles. He was also responsible for the training of the staff in the department.

1988 - 1990 **Extraction Chemist, Enseco-Cal Lab**
Duties entailed sample extraction for Dioxin/Furan Analysis by High Resolution Mass Spectrometry. Involved with the training of new staff, and the development of new extraction techniques.

QUALIFICATIONS

Mr. Silverbush has over 6 years experience in production analytical laboratories including 5 years experience in the field of environmental mass spectrometry. Much of this experience has involved PCDD/PCDF analysis of environmental samples and for the last two years has concentrated on High Resolution Mass Spectrometry analysis of PCDD's/PCDF's in a variety of matrices.

PROFESSIONAL AFFILIATIONS

American Society for Mass Spectrometry

CURRENT CERTIFICATIONS

Arizona Department of Health Services — (Certificate No.: AZ0058)
Tetra-Octa dioxins and furans in wastewater and drinking water by EPA Method 1613A
Dioxins and furans in hazardous waste by EPA Method 8290
Exp:10/28/94

Arkansas Department of Health - (Approval granted through CA certification)
Dioxin in drinking water by EPA Method 1613A
Exp:10/31/95

Commonwealth of Kentucky — (Certificate No.: 90063)
Dioxin in drinking water by EPA Method 1613A
Exp:12/31/94

New York State Department of Health — (Certificate No.: 11411)
2,3,7,8-TCDD in potable water by EPA Method 1613A
Tetra-Octa dioxins in non-potable water by EPA Method 613
Exp:6/30/94

North Dakota State Department of Health - (Certificate No.: R-078)
Dioxin in drinking water by EPA Methods 513 and 1613A
Exp:10/31/95

State of California — (Certificate No.: 1640)
Dioxins in drinking water by EPA Methods 513 and 1613A
Hazardous waste by EPA Methods 8280 and 8290
Wastewater by EPA Method 1613A & 613
Exp:10/31/95

State of Tennessee — (Certificate No.: 02996)
Dioxins in drinking water by EPA Method 1613A
Exp:4/29/96

State of Utah — (Certificate No.: E-201)
Dioxins in drinking water by EPA Method 1613A
Exp:5/31/95

State of Wisconsin — (Certificate No.: 998036160)
Dioxins in drinking water by EPA Method 1613A
Exp:6/30/94

State of Wyoming - (Reciprocal Certification)
2,3,7,8-TCDD in drinking water by EPA Method 1613A
Exp:11/15/94

CURRENT CERTIFICATIONS

U. S. Army Corps of Engineers —
Dioxins and furans for the Fort Wainwright, Alaska project
Exp:3/12/95

U. S. EPA Region 5 -
2,3,7,8-TCDD in drinking water by EPA Method 1613A for Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.
Exp:12/29/96

Washington Department of Ecology — (Certification No.: C091)
Dioxins in wastewater by EPA Method 1613A
Exp:3/26/95

CERTIFICATIONS IN PROGRESS

State of Florida
Dioxins in drinking water by EPA Method 613 & 1613A

State of Nevada
Dioxins in drinking water by EPA Method 1613A

State of North Carolina
Dioxins in drinking water by EPA Method 1613A

State of Pennsylvania
Dioxins in drinking water by EPA Method 1613A

State of Connecticut
Dioxins in drinking water by EPA Method 1613A

APPENDIX F
S-CUBED

826600210

S-CUBED Capabilities for Analysis of Environmental and Mixed Waste Samples

1994

Prepared by:

MAXWELL
S-CUBED Division

8808 Balboa Avenue
San Diego, California 92123
619•637•7400
619•637•7401 (Fax)

826600211

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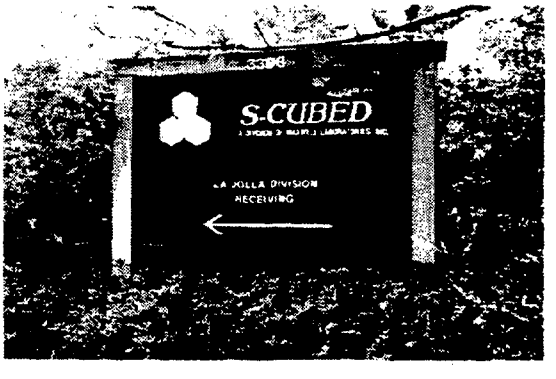
1 INTRODUCTION

In late 1977, an Environmental Chemistry and Chemical Engineering Program was established within S-Cubed to augment and complement its strong physical science, theoretical, and experimental capabilities. The intent of this technology growth was to permit expansion and implementation of Chemistry activities directly related to existing S-Cubed energy conversion and flue-gas clean-up projects. Another goal was to support the research, development, and regulatory programs of the Environmental Protection Agency. Since then, S-Cubed has seen considerable growth in its environmental activities and has become a national leader in environmental chemistry. S-Cubed is committed to developing and staffing an organization which is second to none in environmental analytical chemistry as evidenced by our recent $2.5M investment in new laboratory facilities.

We are proud of our new laboratory, conveniently located in the Kearny Mesa industrial park of San Diego. The facility consists of one building that houses all of the full service preparation and analysis laboratories. The single location for all of our laboratories, offices, and sample management functions makes it simple and cost effective to provide our clients with data of the highest quality, delivered in a timely manner. Our laboratory operates under a single QA program, which affords a consistency of performance which cannot be achieved with multiple laboratory locations. We provide one contact person for each of our contracts, which is a distinct advantage to our clients. Unlike many laboratories that have a number of locations, we are a laboratory that meets all of the needs of our clients from one location.

The S-Cubed Environmental Chemistry Sector is currently staffed with over 60 professional employees who have over 600 years of combined experience in analytical chemistry, instrumental analysis, and environmental engineering. The Environmental Chemistry Sector has experience and expertise related to many state and federal requirements for environmental management including applications related to RCRA, CERCLA/SARA, CWA, SDWA, TSCA, and the CAA.



In addition to developing and validating several methods for the EPA, S-Cubed has applied them on many high volume analytical projects.

S-Cubed has been performing environmental support work under contract to the U.S. Environmental Protection Agency (EPA) for 17 years and with the EPA Contract Laboratory Program (CLP) of the Superfund Office since its inception in 1982. This relationship has resulted in a unique understanding of

both the analytical requirements and the regulations which drive environmental monitoring and remediation projects.

In addition to the EPA, S-Cubed has provided analytical services to a broad range of Federal Programs including environmental analytical support to the Navy CLEAN Program for the past 3 years under contract to Jacobs Engineering Group Inc. and PRC Environmental Management Services. During this time, we have performed environmental chemistry services for the Navy at a level of over $8M, providing quality data in a timely and cost effective manner. In addition, we have established an excellent relationship with the Navy Southwest Division as well as the Western Division as a laboratory capable of delivering defensible data on time. S-Cubed is currently under contract to the Army Corps of Engineers, New England Division to provide split sample (QC) analysis in support of their Quality Assurance Program.

The experienced S-Cubed analytical staff, our state-of-the-art instrumentation, and effective QA program ensures on-time delivery of quality data.

During the 17 years S-Cubed has been providing Environmental Chemistry services, we have gained a national reputation for the production of quality analytical data. This reputation has been achieved through participation in numerous EPA analytical programs. As an example, we have performed on 6 multi-year methods development contracts for the EPA. Much of this work was in support of the Office of Solid Waste which resulted in the development and validation of more than 20 methods currently in SW-846 and the development and validation of the pesticide method currently used by the CLP. Because of our involvement in methods development, we have acquired a thorough understanding of the application of most EPA methods to routine and unusual matrices.

As part of our methods development activities we have acquired significant experience with the Toxicity Characteristic Leaching Procedure (TCLP) SW-846 Method 1311. This experience began with an initial validation and ruggedness study followed by the conducting of a 40 laboratory round-robin testing of the procedure. The round-robin test included a 3-day training course conducted by S-Cubed. We have also performed tasks for the OSW Methods Section involving Validation of Zero Headspace Extraction (ZHE), the Effects of Particle Size Reduction Before TCLP Leaching, the Cage Modification to the TCLP, and QC Procedures for Control of ZHE Analyses.

In addition to our methods development support to the EPA, we have also been a major quality assurance (QA) contractor. During the 17 years of our relationship with the EPA, S-Cubed has performed 10 multi-year QA support contracts for various EPA offices. Our initial contract resulted in development of the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80*, which is still the primary EPA document for QA Project Plan preparation. Since that time, we have continuously been under contract to the EPA to provide support in the areas of QA Project Plan reviews, contractor laboratory audits, final report reviews, and preparation of QA guidance documentation.

Our association with the EPA has expanded over the years, and we have also enlarged our support to other Government agencies, including portions of DoD and DOE. We are currently an approved HAZWRAP laboratory and have obtained NEESA approval to support the Navy CLEAN Program. Recently, S-Cubed has received U.S. Army Corps of Engineers (USACE) certification for the full range of

analytical support, including radiochemistry and explosives, and is supporting the USACE in several remedial investigations. We are certified to perform environmental analysis in a number of states, including Washington, Virginia, and Arizona, as well as California and the many states which have laboratory certification reciprocity with California.

A mixed waste analysis program, with appropriate licensing, is currently in place at S-Cubed. The primary focus of this capability is to support DOE environmental monitoring and remediation projects, including LANL, ORNL, INEL, and Hanford. A full radionuclide analysis capability has also been established at S-Cubed to support mixed waste as well as other environmental investigations. Radiochemistry instrumentation currently in place includes a liquid scintillation counter, two gas flow proportional counters, eight alpha spectrometers, and two gamma spectrometers.

We hope that after reviewing this proposal, you will feel, as we do, that S-Cubed has an exceptional capability in analytical chemistry, a highly experienced staff, and an excellent quality assurance program.

2 CORPORATE STRUCTURE

S-Cubed has been providing environmental analytical services to the EPA and other government clients for 17 years.

The S-Cubed Division of Maxwell Laboratories, Inc., is an interdisciplinary, high technology research and development organization which was founded in 1967 under the name of Systems, Science and Software. On January 29, 1984 S-Cubed became a separate operating Division of Maxwell Laboratories, Inc., a nationally known, pulsed-power technology systems and manufacturing firm. Initially devoted to work in energy and defense-related areas, S-Cubed has evolved into a nationally known center of expertise in the broad range of scientific and engineering disciplines listed below.

- Analytical Chemistry
- Chemical Engineering
- Mechanical Engineering
- Organic and Inorganic Chemistry
- Atomic and Plasma Physics
- Physical Chemistry
- Computer Science
- Environmental Engineering
- Geological and Structural Mechanics
- Geophysics
- Hydrodynamics and Fluid Mechanics
- Hydrogeology
- Instrument Design and Fabrication
- Process Measurements
- Heat Transfer and Radiation Transport
- Fluidized Bed and High Temperature Modeling
- Combustion Chemistry
- Chemical Kinetics
- Toxicology

2.1 CORPORATE STATUS

Maxwell Laboratories, headquartered in San Diego, California, specializes in developing comprehensive technical solutions to the pulsed-power and analytical research and testing needs of the U.S. government, private industry, education, and international customers.

S-Cubed has a fully licensed, staffed, and equipped Mixed Waste Laboratory.

These customers are served through various divisions and a subsidiary.

- The S-Cubed Division uses advanced techniques such as superior capabilities in chemistry, physics, and geology, mathematical procedures, and high-speed computers to provide state-of-the-art analytical services.

- The Balboa Division offers the world's most extensive capabilities in pulsed-power technologies, which has been developed over the company's 27 year history. This division designs and manufactures specialized systems and components that create and control high-voltage bursts of electrical energy.

- The I-Bus Division adapts PC technology to commercial and industrial environments and process control.

- Foodco Corporation, a subsidiary formed in 1988, is a partnership with three large, international food and food packaging companies whose purpose is to exploit proprietary Maxwell technologies in the food industry.

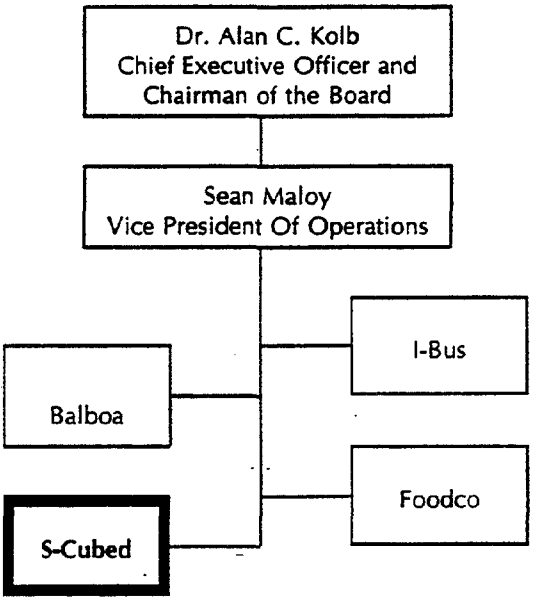


Figure 2-1. Organization chart.

2.2 DIVISIONAL STATUS

In 1984, S-Cubed was merged with Maxwell Laboratories as an operating Division under substantially the same administrative and financial arrangements it had employed for over 17 years as an independent company. Figure 2-1 shows the location of the S-Cubed Division within the Maxwell Laboratories, Inc. organization.

S-Cubed maintains principal offices and facilities in San Diego, California. Other divisional offices are located in Reston and Alexandria, Virginia; Albuquerque, New Mexico; Huntsville, Alabama; and Oakland, California. Present Division revenues approach $40.0 million per year. S-Cubed has a strong financial position with working capital and credit to support continued growth and expansion. Over 290 employees comprise the Division's management, scientific, engineering, and administrative staff. Table 2-1 shows a summary of the Corporate and S-Cubed Division size and sales for FY93.

TABLE 2-1. CORPORATE SUMMARY

Maxwell Laboratories	
Operating Divisions and Subsidiaries (S-Cubed, Balboa, I-Bus, Foodco)	
▸ Number of Employees	685
▸ Annual Sales (1993)	$90.2 M
S-Cubed Division	
▸ Number of Employees	290
▸ Annual Sales (1993)	$39 M

Figure 2-2 shows the organizational structure of the division which is led by Dr. Eduardo Waisman, the Division President. S-Cubed is organized along functional lines to provide strong technical, cost, and administrative control of its contracted projects. Under this organizational structure, S-Cubed has provided support for more than 1,500 contracts to over 300 clients in federal, state, and local govern-

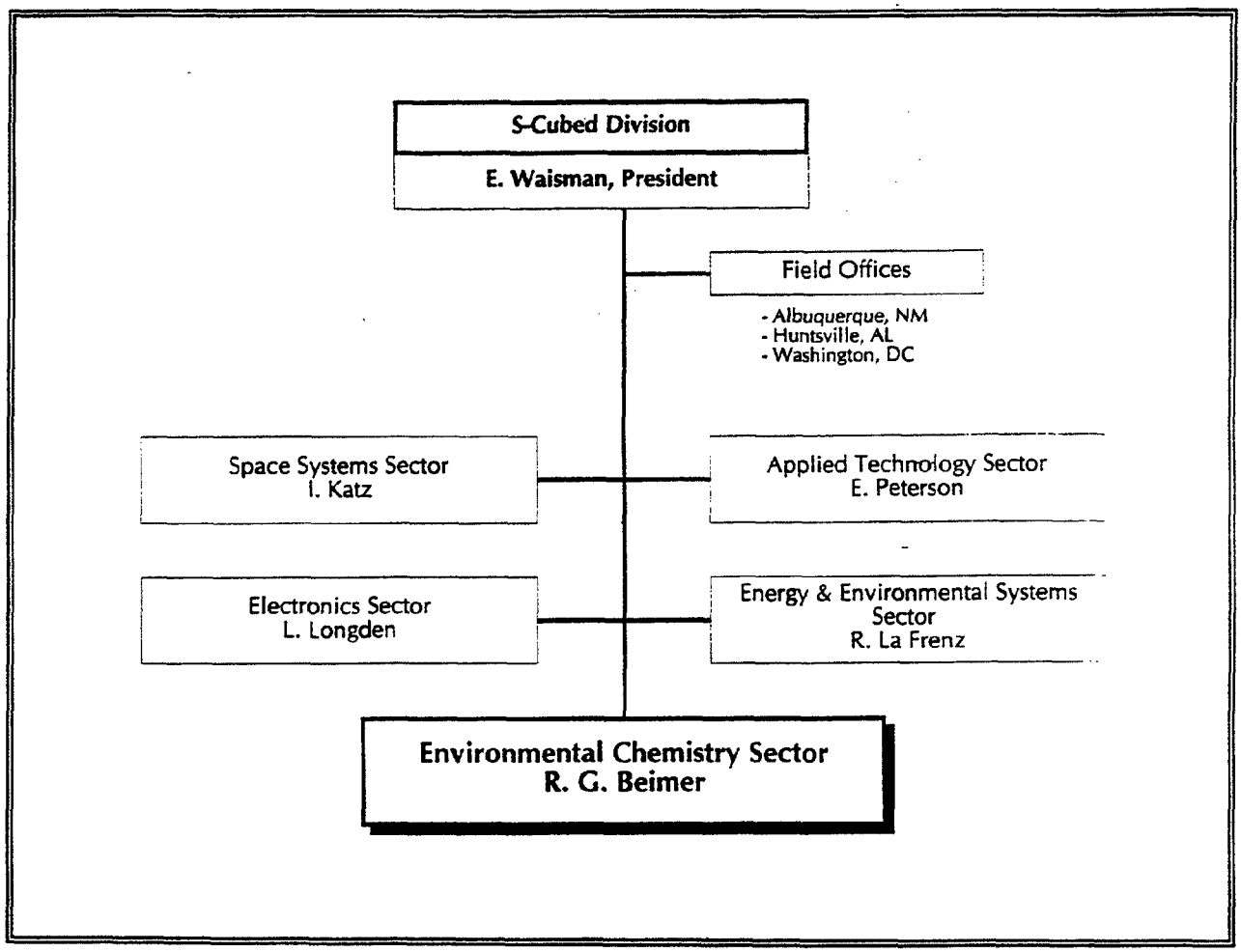


Figure 2-2. Organizational status of the S-Cubed Division.

2.3 ENVIRONMENTAL CHEMISTRY SECTOR

In late 1977, an experimental Chemistry program was established within S-Cubed to augment and complement its strong physical science, theoretical, and experimental capabilities. The intent of this technology growth was to permit expansion and implementation of Chemistry activities directly related to existing S-Cubed energy conversion and flue-gas clean-up projects. Another goal was to support the research, development, and regulatory programs of the EPA. Since then, S-Cubed has seen considerable growth in its environmental activities and has become a national leader in environmental chemistry. Figure 2-3 depicts the administrative organization and staffing of the Environmental Chemistry Sector (ECS).

The S-Cubed ECS is currently staffed with over 60 professional employees who have over 600 years of combined experience in analytical chemistry, instrumental analysis, and environmental regulations.

The ECS has experience and expertise related to many state and federal requirements for environmental management, including applications related to

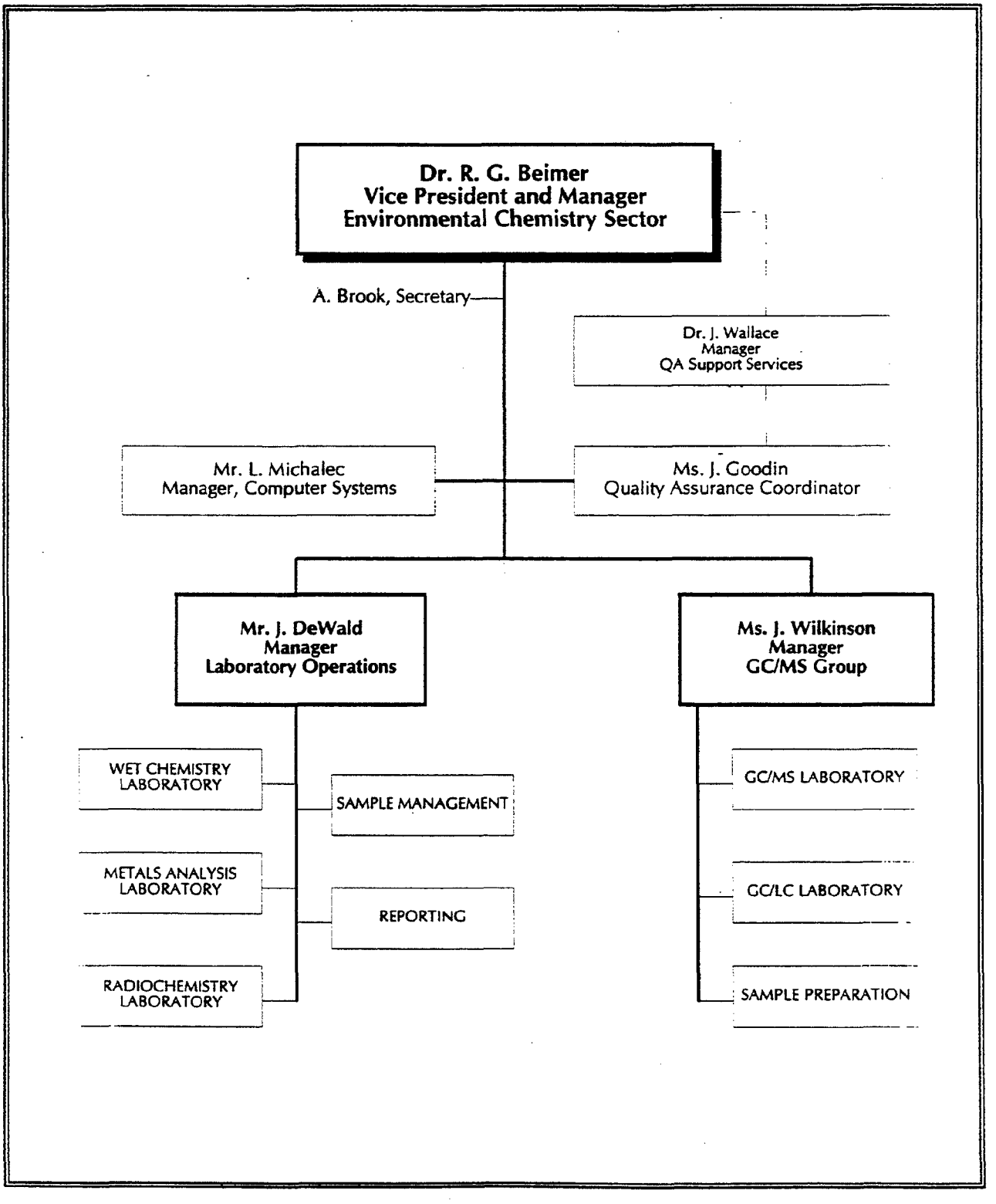


Figure 2-3. S-Cubed ECS administrative organization.

RCRA, CERCLA/ SARA, CWA, SDWA, TSCA, CAA, etc. Specific areas of expertise include:

- Analytical laboratory services (organic, inorganic, mixed waste, explosives, radiochemistry, and physical and leachability tests).
- QA/QC oversight and management of environmental data collection projects and control technology evaluations.
- Analytical methods development and validation.
- Multimedia sampling and monitoring programs.
- Environmental engineering.
- Control technology research and development.

The ECS activities have included quality assurance support, methods development, research, and routine analytical services for the EPA and federal, state, and local agencies, and various commercial clients. Highlights of this work include implementation of the agency-wide Quality Assurance program for the EPA, development or validation of many methods in SW-846 including 8080, 8140, 8270, 1311, 3540, and 3550, development of several Contract Laboratory Program (CLP) protocols, and development of isotope dilution GC/MS Methods (1624 and 1625) for the EPA Office of Water. S-Cubed has been an active participant in the EPA CLP since its inception and has provided analytical services to other EPA organizations, including the Office of Water Regulations and Standards, the Office of Emergency and Remedial Response, and the Office of Solid Waste.

2.4 PROJECT MANAGEMENT

S-Cubed employs a matrix organization to support project related work. This organization is designed to provide a focal point at the Project Manager position so that project efforts and communication are efficiently and effectively coordinated. Personnel are assigned to functional areas within the project structure based on their specific areas of expertise.

Project Management Plan Objectives

S-Cubed has adopted the following key objectives to be achieved by our project management plan.

- Flexibility to respond to a wide variety of analytical project needs with technically competent personnel.
- Delivery of a product that is responsive and addresses the technical, quality, and documentation needs of the project and client.
- Maintenance of a high level of technical quality in the data produced.
- Timely completion of analytical tasks for routine projects and for accelerated projects for which the client is facing critical deadlines.
- Control of project budgets and schedules.
- Effective communication between all entities involved in a project.

When adequate personnel and facilities are available, effective project management can make the difference between project success and failure.

At S-Cubed, we have developed our management approach for the accomplishment of these objectives based on our experience in successfully performing on a large number of quick response, level of effort, and general analytical support contracts.

Table 2-2 summaries someof the key elements of the management plan that are directed to achieving these goals.

TABLE 2-2. KEY ELEMENTS OF THE PROJECT MANAGEMENT PLAN

Goals	Resources
Flexibility to handle varied project needs	Range of disciplines available from S-Cubed under matrix management system. Use of a dedicated project organization. Availability of key subcontractor technical expertise (when required). Modular design of task and SOP elements.
Delivery of a responsive product	Use of experienced management and technical personnel. Careful development and review of project plans. Detailed review cycles for data. Broad base of analytical skills and experience applied to project through matrix organization. Routine progress reporting.
Maintenance of high level of quality	Use of a senior QA Manager as part of the permanent organization. Established internal QC procedures. Detailed QA plans and reviews. Assignment of QA/QC responsibilities throughout organizational structure. History of EPA QA contract work.
Timely delivery of data	Establishment of a permanent organizational structure. Use of experienced management staff. Depth of technical staff available to ensure response. Defined response procedures. Close coordination of projects. Redundancy in instrumentation. State-of-the-art LIMS developed by S-Cubed.
Control of project budgets and schedules	Direct responsibility of the project manager. Formal and informal staff organization. Dedicated budget tracking systems. Careful development of project plans. Established SOPs and reporting requirements.
Effective communication	Project Manager as the focal point. Regular staff meetings, briefings, and debriefings. Secondary contacts for backup communication. Feedback system for client. Effective written communication system.

Project Planning and Control

S-Cubed recognizes that the success of any project depends heavily on staff capabilities, effective project management, and project control. During the past 17 years, our related experience in performing RCRA and CLP analyses has clearly demonstrated that S-Cubed can provide quality data in a timely manner.

Given that the necessary technical talent and physical resources are committed to the project, management becomes the single most important aspect of project

success. The Project Manager is selected on the basis of the work content of the project and is generally the line manager of the area where the majority of the project work will be conducted. Because of the level of authority of the Project Manager, resources in terms of people and equipment will be accessed easily. The project will be further staffed with the support personnel with the expertise to assure that project work is completed in a timely manner.

The Project Manager's responsibilities include:

- Implementation and coordination of project direction from the client Technical Project Officer.
- Establishment of milestones and supervision of progress to assure that all project objectives are met.
- Detailed planning of all work and maintenance of such planning in a current status throughout the project.
- Staffing the project with qualified and experienced personnel who are familiar with the major elements of the project and have an understanding of the technology required for meeting project goals.
- Assuring that all key personnel are available as planned to provide project continuity.
- Generating clear-cut assignments of authority and responsibility while maintaining the flexibility required for a fluctuating sample load.
- Thorough reporting of all observations, analyses, recommendations, findings, decisions, and conclusions.
- Establishing and reviewing budgets.

It is expected that discussions of analytical requirements will occur between the S-Cubed Project Manager and the client Technical Project Officer prior to receipt of samples. This early contact allows preliminary planning and coordination to occur and minimizes the time required to respond to project assignments. In addition, S-Cubed may be able to provide technical and quality assurance advice to assist in planning and specifying sampling and analytical protocols, quality control requirements, etc., prior to the completion of a final project plan.

The matrix management system used at S-Cubed allows the most qualified personnel to be assigned to a given project.

Ms. J. Goodin, the Quality Assurance Coodinator (QAC), monitors all project activities to assure that quality control/quality assurance procedures are followed. Available as a consultant to the QAC and to the Project Manager is Dr. John Wallace, S-Cubed's QA Support Manager.

Dr. Wallace has considerable experience in quality assurance management and is currently Project Manager for an S-Cubed quality assurance support project for the EPA Risk Reduction and Engineering Laboratory (RREL-Ci). As such, he has had direct experience in the evaluation of adequacy to meet

environmental project objectives, identification of problem areas, and corrective actions.

Communication

The Project Manager serves as the focal point for communication within the laboratory and with the client Technical Project Officer. Tools used for internal communication include weekly staff meetings, project briefings and debriefings, internal memoranda, project planning forms, and established standard operating procedures. Table 2-3 provides contacts and phone numbers to assist our clients in communication with S-Cubed. We can provide emergency (after hours) contacts at both the Alexandria and San Diego facilities, as required.

TABLE 2-3. S-CUBED CONTACTS

	Direct Dial Area Code 619
► S-Cubed Chemistry Switchboard, 8:00 am to 5:00 pm PT	637-7400
► Fax (Primary)	637-7401
► Fax (Secondary)	637-7403
► Sector Manager, Robert Beimer	637-7410
► Laboratory Operations, John DeWald	637-7412
► Organic Section Manager, JoAnn Wilkinson	637-7413
► Inorganic Section Supervisor, Rick Phillips	637-7424
► Quality Assurance, Jane Goodin	637-7417
► Project Administration, Julie Alberti	637-7414
► Reporting Group, Loan Nguyen	637-7437
► Programming/Data Systems, Larry Michalec	637-7415
► Program Secretary, Alice Brook	637-7411
► Sample Custodian, Elaine Walters	637-7418
Shipping and Mailing Address	
Maxwell Laboratories, S-Cubed Division 8808 Balboa Avenue San Diego, CA 92123-1506 Attention: J. DeWald	

3 CAPABILITIES AND EXPERIENCE

S-Cubed has the experience and capability to provide complete in-house analytical services to meet the requirements of even the most complex of environmental projects.

S-Cubed has provided analytical services and support to government and industry for over 16 years with more than 4,000 contracts for over 300 customers. This work has included EPA quality assurance support, method development, research and analytical services for the EPA, Federal, state, and local agencies, and various commercial clients. Highlights of this work include implementation of the agency-wide Quality Assurance program for the EPA, support for the development and validation of many methods in SW-846 including 8080, 8140, 8270, 1311, 3540, and 3550, development of several Contract Laboratory Program (CLP) protocols and development of the isotope dilution Methods (1624 and 1625) for the EPA Office of Water. S-Cubed has been an active participant in the EPA CLP since its inception and has provided analytical services to many EPA organizations, including the Office of Water Regulations and Standards, the Office of Emergency and Remedial Response, and the Office of Solid Waste.

3.1 ANALYTICAL SERVICES

Our wide range of analytical instruments gives S-Cubed the capability to perform all of the analysis required by the EPA for regulatory monitoring programs and site investigations. Possessing the instrumentation is only the beginning, since it is actually our analytical methods experience which allows us to support complex monitoring projects. All of this support is provided from one large laboratory so that consistant performance is achieved and a uniform QA/QC program is applied. The full range of analytical services which we provide includes methods described in a number of compendiums published by the EPA and others, including those listed in Table 3-1.

Regulatory Support

Specific areas where S-Cubed has analytical methods experience includes: RCRA (SW-846), Superfund (CLP SOWs), the Safe Drinking Water Act (SDWA), and the Clean Water Act (CWA). These areas are discussed below.

Analytical Support for RCRA Requirements

The analytical requirements for the Resource Conservation and Recovery Act (RCRA) consist of a complex set of methods for measuring organic, inorganic, physical, waste characteristic, and radiochemical parameters. The methods are applied to a wide variety of matrices (i.e., groundwater, soil, sludge, and waste) and often require very low detection limits. Not all of the methods specified in SW-846 have been validated for all of the matrices specified. This limitation, which occurs all too frequently with the EPA, means that the laboratory performing SW-846 methods must be familiar with their application rather than just possessing a copy of the latest edition. S-Cubed is fully capable and experienced in performing analyses in support of the RCRA requirements presented in Table 3-2.

TABLE 3-1. METHOD COMPENDIUMS

Methods	Title
100 to 400 Series	▸ Methods of Chemical Analysis of Water and Wastes, Revised 1983, EPA 600/4-79-020.
500 Series	▸ Methods for the Determination of Organic Compounds in finished Drinking Water and Raw Source Water, EPA EMSL-Ci, December 1988 and updates.
600 Series	▸ Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, 40 CFR Part 136, October 26, 1984.
1000 to 9000 Series	▸ Test Methods for Evaluating Solid Waste - Physical/Chemical Parameters, 3rd Edition, EPA OSW SW-846, 1986 and 3rd Edition, Revision I, 1987.
Standard	▸ Standard Methods for the Examination of Water and Wastewater, 16th Edition, 1985 and 17th Edition, 1989 and 18th Edition, 1992.
CA DOHS	▸ Leaking Underground Fuel Tank Manual (LUFT), State of California Department of Health Services/Water Resources Control Board, May 1988.
Radiochemistry	▸ Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA 600/4-89-032, August 1980.
	▸ Health and Environmental Chemistry Analytical Technology, Data Management and Quality Assurance, Los Alamos, LA-10300-M, Revised September, 1987.
	▸ Procedures for Radiochemical Analysis of Nuclear Reactor Aqueous Solutions, EPA-R4-73-014.
DOE	▸ DOE Methods for Evaluating Environmental and Waste Management Samples (Draft), June 1992, USDOE.
1600 Series	▸ Analytical Methods for the National Sewage Sludge Survey, March 1988.
HASL 300	▸ EML Procedure Manual, 1982, DE83010805.
EERF	▸ Radiochemistry Procedures Manual, EPA 520/5-84-006.

TABLE 3-2. ANALYTICAL SUPPORT FOR RCRA REQUIREMENTS

RCRA Section	Analytical Requirements
40 CFR 261 Identification of Hazardous Wastes	▸ Hazardous Waste Characteristics - Corrosivity Method 9040, 9045, 1110 - Ignitability Method 1010 - Reactivity Section 7.3 - EP Toxicity Method 1310 - TCLP Method 1311 ▸ Appendix VIII
40 CFR 264 Land Disposal	▸ Appendix VIII ▸ Skinner List
40 CFR 268 Land Ban/Land Disposal Restrictions	▸ TCLP (CCWE and CCW) ▸ Listed Wastes ▸ California List (Appendix III) ▸ 1st, 2nd, and 3rd Third Treatment Standards
40 CRF 264 Groundwater Monitoring	▸ Suitability Parameters ▸ Water Quality Parameters ▸ Contamination Parameters ▸ Appendix IX
40 CFR 270 Hazardous Waste Permit Programs	▸ Appendix IX

The two main analytical requirements of RCRA are (1) identification and classification of hazardous wastes and (2) the monitoring of waste sites for environmental releases. A specific list of the analytical methods used in support of the various RCRA requirements is provided in Table 3-3. In addition to our experience in applying RCRA analytical procedures, S-Cubed assisted in the development and/or validation of 20 of the more popular SW-846 methods.

For 10 years, S-Cubed has been an active participant in good standing of the EPA Contract Laboratory Program.

Analytical Support for Superfund Requirements

S-Cubed has been providing analytical support for Superfund investigations for over 12 years through the EPA CLP and SITE programs. As a result, we are very familiar with the CLP Statements of Work (SOW) including those of most recent interest listed below:

- Low/Medium Organics (OLM01.8, OLM02.0)
- High Concentration Organics (10/88)
- Low Detection Limit Organics (OLC01.0, 10/92)
- Low/Medium Inorganics (2/87, 2/89, ILM03.0)
- Low Detection Inorganics (ILC01.0, 10/91)
- High Concentration Inorganics (IHC01.2)

Because of our long involvement with the CLP, we have developed an efficient system to provide the extensive reporting package and quality assurance requirements on a routine basis. In addition to providing Regular Analytical Services (RAS), S-Cubed has performed hundreds of Special Analytical Services (SAS) projects for the CLP. These projects have resulted in a valuable experience base for the application of the CLP procedures to a variety of matrices.

Analytical Support for SDWA Requirements

The analytical requirements of the Safe Drinking Water Act are continually changing as EPA establishes new testing procedures, lowers detection limits and adds new analytes to the regulated list. S-Cubed remains current with these changes by following the most recent developments in instrumentation and procedures which are applicable to drinking water analysis. We routinely provide analysis for the regulated parameters (Table 3-4) and can add additional parameters if they should become of interest.

Analytical Support for CWA Requirements

S-Cubed can provide all of the analytical services required under the Clean Water Act (CWA) (Table 3-5). This includes support for priority pollutant analyses, as well as NPDES monitoring. S-Cubed is also capable of providing other inorganic and physical property testing procedures, as well as specialty pesticide and semivolatile analyses for specific CWA requirements.

TABLE 3-3. METHODS REQUIRED FOR VARIOUS RCRA LISTS

Regulation	Parameter	Method
Appendix III, VIII, IX, Skinner List	Volatiles	8240, 8260
	Semivolatiles	8270
	Pesticides/PCBs	8080, 8081, 8270
	Organophosphorous Pesticides	8140, 8141, 8270
	Herbicides	8150
	Dioxins and Furans	8280
	Miscellaneous Volatiles	8015
	Metals	6010, 7000s
	Cyanide	9010
	Fluoride	300.0, 340.2
	Sulfide	9030
	Other Compounds	Special, HPLC
CA List	Paint Filter Test	9095
	Cyanide	9010
	Metals	6010, 7000s
	pH	9040, 9045
	PCBs	8080
TCLP, Treatment Standards	TCLP Leaching	1311
	TCLP - ZHE	1311
	Volatiles	8240
	Semivolatiles	8270
	Pesticides	8080, 8081
	Dioxins and Furans	8280
	Herbicides	8150
	Metals	6010, 7000s
	Cyanide	9010
Suitability, Quality, and Contamination Parameters	Metals	6010, 7000s
	Fluoride	300.0, 340.2
	Nitrate	9200, 300.0
	Pesticides	8080, 8081
	Herbicides	8150
	Sulfate	9038, 300.0
	Chloride	9252
	Phenols	9065
	pH	9040, 9045
	Conductance	9050
	TOC	9060
	TOX	9020

TABLE 3-4. ANALYTICAL SUPPORT FOR SDWA REQUIREMENTS

Regulation	Parameter	Method
40 CFR 141 Primary Drinking Water Regulations	Metals (As, Ba, Cd, Pb, Hg, Se, Ag)	EPA 200 Series
	Fluoride, Nitrate	EPA 300.0, 340.2, 352.1
	Volatile Organics	EPA 502.2, 524.1, 524.2
	Pesticide Organics	EPA 508, 505
	Herbicide Organics	EPA 515
	THMs	EPA 501, 502.2, 524.2
	Radioactivity (α, β, Radium 226, 228)	EPA 600/4-80-032
40 CFR 143 Secondary Drinking Water Regulations	Metals (Cu, Fe, Mn, Zn)	EPA 200 Series
	Chloride, Sulfate	EPA 300.0, 325.3, 375.4
	Color	EPA 110.3
	Odor	EPA 140.1
	TDS	EPA 160.2
	Surfactants (MBAS)	EPA 425.1
	Turbidity	EPA 180.1
	Conductance	EPA 120.1
Additional Organics	Organophosphorus Pesticides	EPA 507
	EDB, DBCP	EPA 504
	Specific Pesticides and Other Organics of Concern	EPA 500 Series

TABLE 3-5. ANALYTICAL SUPPORT FOR CWA REQUIREMENTS

Regulation	Parameter	Method
40 CFR 122 National Pollution Discharge Elimination System Conventional Pollutants	BOD	EPA 405.1
	pH	EPA 150.1
	Ammonia	EPA 350.3
	COD	EPA 410.4
	TSS	EPA 160.1
	TOC	EPA 415.2
	Boron	EPA 212.3
	Color	EPA 110.3
	Organic Nitrogen	EPA 350.3 and 351.4
	Oil and Grease	EPA 413
	Phosphorus	EPA 365
	Sulfide	EPA 376
	Sulfite	EPA 377
	Surfactants (MBAS)	EPA 425.1
	Metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)	EPA 200 Series
	Anions (Fl, Br, NO_3, NO_2, SO_4)	EPA 300 Series, 300.0
	Radioactivity (α, β, Radium 226, 228)	EPA 600/4-80-032
40 CFR 122 Priority Pollutants	Metals	EPA 200 Series
	Cyanide	EPA 335.2
	Total Phenols	EPA 420.1
	Volatile Organics	EPA 601, 602, 624
	Semivolatile Organics	EPA 625
	Organochlorine Pesticides/PCBs	EPA 608

Analytical support for other regulatory actions available from S-Cubed include Underground Storage Tank (UST) testing which may require Total Petroleum Hydrocarbon (Method 8015 or 418.1) and BETX analyses (Methods 602 or 8020) and air monitoring methods such as the EPA TO Series, VOST, modified Method 5, and NIOSH/OSHA procedures.

Other Analytical Services

Specialty analysis such as nitroaromatics and other explosives using USATHAMA procedures; analysis for specific radionuclides using α/β-counting, α-spec-troscopy, γ-spectroscopy, liquid scintillation or ICP/ MS; isotope dilution GC/MS analyses (Methods 1624 and 1625); PCB congener determination (Method 680); specialty pesticides analysis (Methods 1618, 632, 619, 617, 630, etc.); trace metals determination by ICP/MS; (Methods 6020 and 200.8) or ICP Method 1620 and specialty liquid and ion chromatography analyses are all available from S-Cubed to satisfy specific needs.

S-Cubed has been performing high volume analytical support work for the EPA for 17 years. This work includes support to Superfund (CLP) and RCRA (OSW).

In addition to the EPA, S-Cubed has provided analytical services to a broad range of Federal Programs including environmental analytical support to the Navy CLEAN Program for the past 3 years under contract to Jacobs Engineering Group Inc. and PRC Environmental Management Services. During this time, we have performed analytical services at a level of over $8M, providing quality data in a timely and cost effective manner. In addition, we have established an excellent relationship with the Navy Southwest Division as a laboratory capable of delivering defensible data on time.

Special Services

In many environmental investigations, the need arises for the development, modification, or validation of analytical methods to meet specific program or project needs. The design, execution, and documentation of this work must be performed adequately so that the resulting data will pass scientific and regulatory scrutiny. In most cases, a small investment in method development for program or project specific needs will result in a more effective and efficient environmental monitoring program.

S-Cubed can provide a wide range of method development support including assistance in the following areas.

- Evaluation, validation and ruggedness testing of methods.
- Application of methods to unusual or difficult matrices.
- New method research.
- Methods for site specific indicator compounds.
- Modification of methods to meet project specific performance criteria.

S-Cubed has a 13-year record of method development support to the EPA, DoD, and commercial clients. Included in this work is the successful completion of 6 major multi-year method support contracts for the EPA. During this time, S-Cubed has contributed to the development or validation of over 30 EPA methods, including methods for SW-846, the Office of Water Regulations and Standards, and OERR (the Contract Laboratory Program). Some of these methods are:

- CLP Pesticide SOW.

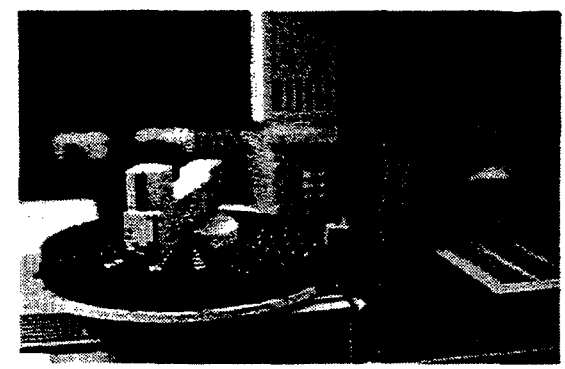
- CLP High-Concentration Organics SOW.
- CLP Low-Concentration Organics SOW.
- Method 8081 Organochlorine Pesticides.
- Method 8140 Organophosphate Pesticides.
- Method 8141 Organophosphate Pesticides.
- Method 1311 TCLP.
- Method 3640 GPC Cleanup for Appendix VIII Compounds.
- Method 8270 GC/MS Analysis for Appendix IX Compounds.
- Method 3540 Soxhlet Extraction.
- Method 3550 Sonication Extraction.
- Method 1624 Isotope Dilution GC/MS for Volatiles.
- Method 1625 Isotope Dilution GC/MS for Semivolatiles.
- Method 1618 Consolidated Pesticide Method.

S-Cubed also has experience in project specific method development through special analytical services contracts to the EPA and through projects for other agencies and consulting firms.

Mixed Waste Capabilities

S-Cubed has recently expanded its capabilities and capacity for handling mixed waste samples. This expansion was part of the opening of our new facility described in Section 5.0 which includes an extensive radioisotope laboratory, additional monitoring equipment, and amendments to our radioactive materials license to expand licensed activities and increase total radioactive materials inventory ceilings. Appendix B contains a copy of the license.

S-Cubed has a number of personnel available to assist in the safe handling of radioactive materials. The primary responsibility for ensuring that all activities are performed safely rests with the Maxwell, S-Cubed division, Radiation Safety Officer (RSO), Mr. Richard Sobilo. As the Health Physicist/RSO, Mr. Sobilo is responsible for ensuring that adequate training, procedures, management, and monitoring are in place and functioning to provide safety for personnel handling mixed waste samples and to ensure that the radioactive materials are properly managed and documented.



Automation in analytical instrumentation is necessary so that people's time is spent ensuring that the generated data is of acceptable and defensible quality.

Table 3-6 provides summaries of the procedures which are used when handling mixed waste samples. The goals of these procedures are to:

- Limit Personnel Exposure
  - Short term extremity contact doses.
  - Accumulated whole body radiation doses.
  - Respiratory doses.
  - Tritium exposure.
- Provide Materials Containment
  - Limit releases to laboratory.
  - Contain any releases to laboratory.
  - Adequate waste disposal procedures.
  - Area monitoring.
  - Area cleaning and decontamination.
- Provide Adequate Documentation
  - Radiation materials inventory and tracking.
  - Area monitoring records.
  - Personnel monitoring records.
  - Material shipment records.
  - Sample and extract inventory and tracking.
  - Radiation laboratory use records.

TABLE 3-6. PROCEDURES FOR HANDLING MIXED WASTE

Sample Management	▸ Field screening information requirements. ▸ Sample container screening. ▸ Sample screening for gross α and β (and tritium). ▸ Isolated radioactive sample storage areas. ▸ Extract screening. ▸ Low and medium level designations. ▸ Materials inventory documentation.
Personnel Monitoring and Protection	▸ Ring badges. ▸ Dosimeter program. ▸ Air monitoring program. ▸ Medical screening program. ▸ Personnel activity records. ▸ Personnel safety equipment requirements.
Area Monitoring	▸ Monthly monitoring program. ▸ Weekly monitoring program. ▸ Daily monitoring program. ▸ Stack effluent monitoring. ▸ Storage area monitoring. ▸ Documentation.
Sample Handling	▸ Facilities requirements. ▸ Training programs. ▸ Shielding requirements. ▸ Waste management. ▸ Spill response and decontamination procedures. ▸ RSO oversight and monitoring of programs. ▸ Specific protocols for low and medium samples.

Receipt, handling, and disposal of mixed waste samples will follow the procedures outlined in Section 7.2. Samples will be received, screened, and opened in Type B radioisotope laboratories. All activities involving handling of samples outside of sealed containers will also be performed in Type B laboratories. Table 3-7 describes the limitations and information requirements for mixed waste samples to be analyzed at S-Cubed. In some cases, more or less stringent requirements may be instituted by the S-Cubed RSO in order to maintain safety, meet radioactive materials licensing requirements, and to accommodate client needs. In such cases, the S-Cubed RSO will provide written notice of these requirements.

All radioactive samples will be returned to the client for proper storage or disposal once analyses are complete unless other arrangements are made. The client will be notified in advance of shipments of samples and related materials of what is being returned. All materials will be shipped according to appropriate DOT requirements. Samples will be returned at least 60 days after release of the analytical report.

Capacity

S-Cubed can meet the capacity requirements of most clients with our one central facility, assuring a consistency of performance under one manager and one quality assurance program. The S-Cubed environ-

TABLE 3-7. LIMITATIONS AND INFORMATION REQUIREMENTS FOR RECEIPT OF MIXED WASTE SAMPLES

Maximum allowable sample container surface contact dose reading that can be accepted for regular mixed waste samples.	10 mrem/hr (10 to 200 mrem/hr can be accepted as medium sample).*
Maximum allowable α and β contamination that a sample can contain.	100 μCi total α and β activity per sample (100 to 1,000 μCi samples can be accepted as medium samples)*.
Maximum allowable amount of uranium, plutonium, and other transuranics that a sample can contain.	10 μCi total transuranics per sample.
Minimum radiological characterization data necessary for receipt of samples at S-Cubed.	▸ Gross α and β activities for each sample. ▸ Expected or known isotopes present and maximum activity expected to be present in a sample batch. ▸ Estimated tritium level in samples expected to have high tritium activities. This is necessary to monitor license possession limits.

*Medium samples may require special handling and analytical procedures to limit analyst exposure. Projects with medium level samples will require prior approval and may require a surcharge to the regular mixed waste prices.

mental laboratories are designed to meet the needs of high volume sample preparation and analysis while providing the necessary flexibility for changing customer requirements. Table 3-8 presents our current maximum obligated capacity and remaining unobligated capacity by specific analysis area. Obligated capacity is the maximum level of sample throughput which S-Cubed is obligated to provide through current contracts. This obligated capacity is not always fully utilized and therefore, to maintain cost effective operations, we use excess capacity on short term analytical projects. As more of our total capacity is obligated and utilized, fewer short term projects are performed until additional capacity is acquired through capital equipment acquisition, personnel actions, and internal operational improvements. The goal of our laboratory management plan is to maintain a 20% excess capacity in order to handle peak work loads, to provide a buffer for additional growth and to protect our customers against delays due to instrument downtime.

As can be seen in Table 3-8, S-Cubed is capable of handling at least 100 samples per week in most of the analytical areas. However, we soon plan to signifi-cantly increase our analytical capacity in all areas.

Because of our size, S-Cubed has the significant advantage of providing clients with all of the normally required analytical services at one facility. This avoids the problem of coordinating sample shipments to multiple facilities and ensures consistency in data quality. A single facility for the full range of analytical support is important in maintaining data defensibility because of chain of custody requirements and the need for implementation of consistent quality assurance.

Analytical capacity consists of more than quantities of instruments and people. In order for a laboratory to maintain a high sample volume for extended periods, careful consideration must be given to sample scheduling, the planning of instrument use, the training of personnel, the implementation of analytical proce-

TABLE 3-8. CAPACITY ESTIMATES (SAMPLES/WEEK)

Analysis Area	Analysis Type	Capacity (Samples/Week)		
		Maximum	Obligated	Excess
Organic Analysis	GC/MS (VOA)	300	150	150
	GC/MS (BNA)	220	100	120
	GC/ECD (Pesticide)	220	100	120
	Other GC	150	100	50
Inorganic Analysis	Trace Metals ICP	275	100	175
	Trace Metals AA	225	100	125
	Wet Chemistry	125	20	105
Explosives	HPLC	90	10	80
Radiochemistry	Counting α/β	100	20	80
	α-Spectroscopy	100	20	80
	γ-Spectroscopy	100	10	90
Sample Preparation	Soils - Organic Preparation	600	100	500
	Waters - Organic Preparation	450	100	350
	Soils/Waters - Trace Metals Preparation	250	100	150
	TCLP - Semivolatiles/Metals	100	20	80
	Volatiles (ZHE)	50	20	30

dures, and the coordination of analytical activities. Attention must also be paid to developing the supporting activities so that they match analytical instrument capacity. For example, if the capacity in sample preparation or data validation does not meet or exceed instrument capacity, maximum instrument utilization can never be achieved.

S-Cubed has determined the capacities listed in Table 3-8 through careful evaluation of maximum instrument throughput for each of the analytical areas. The capacities have been verified through our experience with the CLP and other large analytical support projects. To consistently achieve the maximum capacity necessary for cost effective analytical work, a significant level of automation and redundancy is necessary. S-Cubed achieves this level of automation through the use of sophisticated autosampler systems on all of our major equipment, and electronic data processing using software enhancements developed in-house.

The procedures that S-Cubed uses to train technical personnel are designed to achieve maximum capability in both capacity and flexibility. Training is provided by our core group of experienced scientists and technicians. It is our policy to cross train as many of our people as time permits, making it easy to move staff to analytical areas impacted by heavy sample loading. S-Cubed has also developed good working relationships with local universities and employment agencies which can quickly provide additional chemists and technicians when the need arises. The combination of an experienced core group, supporting technicians, and the availability of additional qualified staffing allows S-Cubed to adapt to very large projects easily, even when the work load on those projects fluctuates.

In addition to developing our management plan and procedures to handle high volume work, we continue to develop and refine our analytical procedures to achieve maximum efficiency. These refinements are designed to improve the effectiveness of an instrument or technician at specific bottlenecks in the analytical process. Attention is also paid to sample scheduling which includes optimizing sample batch sizes to reduce instrument idle time.

Analytical Services Experience

S-Cubed has experience in providing RCRA materials characterization and CERCLA analysis on a wide variety of matrices including soils, sludges, oils, waters, and industrial waste streams. This experience has included analyses of such difficult matrices as still bottoms from chemical manufacturing processes and drum samples with multiple phases.

Ten fully automated and computerized GC/MS systems are in place and operational to support environmental projects.

Section 3.4 provides a summary of some of the projects S-Cubed has performed which demonstrate our ability to implement EPA methods. We are in the unique position of having developed or validated many of these procedures under contract to the EPA, as well as having utilized them on high volume analytical services projects. S-Cubed has been providing analytical support to consulting engineers, industrial clients, and governmental agencies for 17 years. During this time, we have performed over 500,000 analysis in support of RCRA and CERCLA projects. Highlights of this work include:

- Participation in the EPA Contract Laboratory Program since its inception.
- EPA/OSW Relisting Program contractor.
- EPA Office of Water Regulations and Standards analytical contractor since 1978.
- State of California Superfund contractor for analytical services.
- Analytical Services contractor on over 15 major HAZWRAP, Navy CLEAN, and ACE projects.
- DOE support for ORNL, LANL, INEL, and Westinghouse Hanford.

S-Cubed has been a participant in the EPA Contract Laboratory Program (CLP) since its inception. We have actively participated in the CLP with an excellent record of on-time and accurate data delivery.

In addition to CLP Regular Analytical Services (RAS), S-Cubed has participated extensively in the CLP Special Analytical Services (SAS) program, providing analysis for unusual methods or matrices or special QC and reporting requirements. Through this broad experience, S-Cubed has developed an in depth knowledge of the application of analytical methods to real world environmental measurement projects. This knowledge includes an understanding of the details that must be considered in order for an analytical plan to be successfully implemented.

3.2 QUALITY ASSURANCE SUPPORT

S-Cubed is a nationally recognized Quality Assurance contractor and has been involved in the mandatory EPA quality assurance program since its inception. Our professional quality assurance support staff maintains the high level of technical expertise and quality assurance awareness that is needed to provide guidance for hazardous waste site investigations, monitoring programs, environmental technology testing and evaluation programs, and other planning activities incorporating environmental data collection or measurements.

Support Services

S-Cubed can assist in the successful implementation of QA on environmental monitoring projects through our Quality Assurance Support Services. These efforts will ensure that the project QA meets EPA regulatory requirements. Such services include:

- Quality assurance program plan preparation and implementation.

- Quality assurance project plan development.
- Quality assurance project plan review.
- Field and laboratory audits.
- Data quality audits.
- Data validation.

Quality Assurance Experience

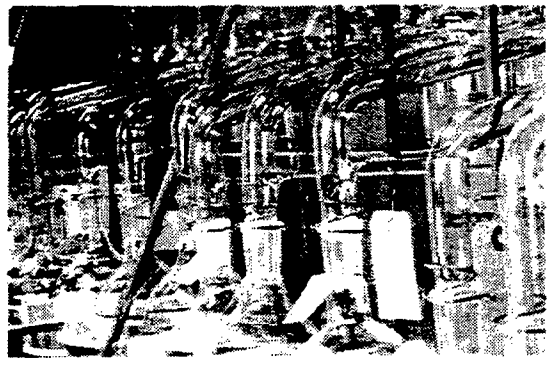
S-Cubed's experience in quality assurance/ quality control support services began in 1980 with support to the EPA Quality Assurance Management Staff for the initial implementation of the Agency-wide quality assurance program. This work included authoring *Interim Guidelines and Specifications for Preparation of Quality Assurance Plans* (QAMS005/80), which is used throughout the EPA as guidance for the preparation and review of quality assurance project plans. Since that time, we have expanded our quality assurance/quality control support experience through the completion of 10 multi-year EPA and DoD support contracts.

Over the past 14 years, this technical experience base has included quality assurance support contracts for various EPA/ORD laboratories, including RREL, AEERL, EMSL-LV, EMSL-CI, and MERL. Further, S-Cubed has provided support to commercial clients who require assurance that their environmental data are legally or scientifically defensible. Additionally, since 1985 we have provided quality assurance support to several EPA project offices including OSW and OERR, under various broad-based technical services support contracts.

Under ongoing quality assurance program contracts, S-Cubed is assisting the various EPA program offices and ORD laboratories in:

- Review and assessment of quality assurance project plans.
- Field sampling and laboratory analysis audits,
- Reviews of final reports, and
- Quality assurance training programs and information transfer efforts.

Over 450 quality assurance project plans prepared by the EPA and its contractors, primarily relating to hazardous waste treatment and remediation technology evaluation, have been comprehensively reviewed, over 250 on-site technical systems audits of field sampling and laboratory analysis activities have been conducted, and over 80 comprehensive final project report reviews have been completed under these contracts.



The S-Cubed Sample Preparation Laboratory is equipped and staffed to handle a high volume of diverse environmental samples.

3.3 REGULATORY EXPERIENCE

Because of our work in support of EPA/OSW (RCRA) and the Superfund Office, S-Cubed is in a unique position to provide input on analytical methods selection to satisfy regulatory requirements. S-Cubed has supported the U.S. Environmental Protection Agency (USEPA) on more than a dozen multi-year technical support contracts in the area of RCRA and CERCLA (Superfund) regulatory assessments. Additionally, S-Cubed has managed a number of projects for commercial clients involving site assessments and cleanups, compliance monitoring, permitting assistance, environmental audits, and related regulatory/technical assessments. A listing of selected projects that have incorporated interactions with environmental regulatory agencies, both in support of the regulatory agencies and in support of the regulated community is provided in Table 3-9.

TABLE 3-9. S-CUBED EXPERIENCE IN INTERACTING WITH REGULATORY AGENCIES

Project Description and Location	Description of Specific Activities Conducted by S-Cubed
Site Investigation and Remedial Assessment at the St. Vincent de Paul Center; San Diego, CA	Interfaced extensively with the responsible local regulatory agency on site contamination issues throughout a 4-year process that involved assessing the source and extent of soil and groundwater contamination, obtained appropriate permits and regulatory approval for the disposal of petroleum-contaminated soil, monitored contaminated groundwater discharges from site dewatering wells to ensure compliance with a clean-up and abatement order.
Hazardous Waste Variance Support, EPA/OSW (Various Locations: Nationwide)	Review and evaluation of delisting petitions and no-migration variances to the RCRA hazardous waste regulation for EPA. Assessed adequacy of the reported data and conducted technical analyses to support approval/denial of variance petitions.
Site Investigation and Remedial Assessment for a Pesticide Land Disposal Site; U.S. Army, Yuma Proving Ground; Yuma, AZ	Interfaced extensively with the USEPA, Region IX, in the conduct of this remedial site investigation and planning project. Specific interface activities included planning for the integration of site assessment documents, including the site sampling plan, QA/QC plan, site safety plan, air emissions control and monitoring plan, and excavation and materials handling plan; identifying applicable, relevant and appropriate regulatory standards (ARAR's); assessing the applicability of CERCLA (Superfund) regulatory standards to federal facilities at the time of the assessment project; and disposing of contaminated soils at a permitted hazardous waste landfill.
EPA Hazardous Waste Research, Development and Demonstration (RD&D) permit reviews; EPA/ORD; Cincinnati, OH	Although the reauthorization statutory interpretation (RSI) for RD&D permits provided general policy guidance for processing RD&D permit applications, the USEPA was concerned with assessing the validity of trial burns and other test data to be submitted with these permit applications. S-Cubed developed QA and related guidance for the development and review of RD&D permit applications.
Review and Assessment of the San Diego Regional Water Quality Control Board's Order Relating to NPDES Permitting; San Diego, CA	S-Cubed reviewed and assessed an order setting strict discharge limitations on wastewater and related discharges to a water quality limited bay. We assessed federal CWA and NPDES permitting regulations, state and local interpretation and implementation, and provided technical responses for use by the client.

These examples are representative and reflect only a fraction of the total project experience at S-Cubed incorporating interfaces with environmental regulatory agencies.

This experience with both sides of environmental regulations has given the S-Cubed staff a unique understanding of the regulatory process and an insight as to how the regulations drive analytical programs which support environmental monitoring and site remediation projects. This experience also allows S-Cubed to provide review comments on sampling and analysis plans and analytical methods selection for clients having to meet RCRA and CERCLA/SARA guidelines.

3.4 PROJECT SUMMARIES

Table 3-10 provides highlights of S-Cubed's recent analytical services contracts. The table includes a brief description of the various projects. Please note the number of follow-on contracts for individual clients. When a customer is satisfied with the services performed by a contractor, the customer will often return to the contractor when he requires additional work.

3.5 CERTIFICATIONS AND LICENSES

S-Cubed is approved through the Environmental Protection Agency to perform trace organic compound analyses in water, wastewater, and sludge collected from hazardous waste sites by the Office of Emergency and Remedial Response through the CLP Program. We participate in EPA's NPDES Performance Audit and the EMSL-Cincinnati Water Supply and Water Pollution Performance Audits. In addition, through the Special Analytical Services Program of the Office of Emergency and Remedial Response, S-Cubed has been approved to perform analyses of the 114 organic priority pollutants; and the Appendix VIII Hazardous Substance List, 40 CFR261, on samples collected by all of the EPA regions from water, wastewater, air, soil, sediment, sludges, and biological media. S-Cubed is certified to perform metal and organic pollutant analyses for the EPA National Urban Runoff Program for implementation of Section 208 of the Clean Water Act. S-Cubed is approved to support the HAZWRAP Program Site Investigations, and is certified by the State of California Department Health Services, Sanitation and Radiation Laboratory, as an approved laboratory for analyzing organic and inorganic compounds in water and waste. Copies of these certifications are available on request.

California is an agreement state, and as such, our state license for Radiation Handling is accepted by the NRC. California laboratory certification is also accepted through reciprocity by several other states.

S-Cubed has received NEESA certification as part of the Navy CLEAN Program, and Army Corps of Engineers certification. We are certified by the Commonwealth of Virginia, State of Washington, and the State of Arizona for drinking water analysis. We have also received plant protection and quarantine permits from the USDA to import soil samples from outside the US and from restricted domestic areas.

TABLE 3-10. S-CUBED HIGHLIGHTS OF PAST PERFORMANCE

Project Identification			Contract Amount ($K)		Period of Performance		Type of Contract
Title, Client, Address,	Brief Description of Project	Contract Number	Original	Final	Mo/Yr	Mo/Yr	
Uncontrolled Waste Site Priority Pollutant Analyses Support; Contract Laboratory Program (CLP) EPA-OSWER Washington, DC	Uncontrolled hazardous waste site priority pollutant analyses performed using the EPA CLP protocol. QA activities are designed to provide qualitative verification and quantitation of identified compounds. These data are used to support regulatory decisions under the CERCLA-Superfund program. GC (pesticides) and GC/MS (volatiles and semivolatiles) techniques are used for analysis.	EPA 68-01-6868 EPA 68-02-7021 EPA 68-01-7261 EPA 68-D9-0027	1,034 2,350 5,522 5,278	1,034 2,043 5,045 4,682	08/83 03/84 08/86 02/89	02/86 09/86 02/89 08/91	FFP
Quality Assurance Technical Services for RREL EPA-RREL Cincinnati, OH	S-Cubed has been providing QA Technical Services to the EPA-CI RREL since 1980 under five separate 3-year contracts. These task-order contracts have covered the entire spectrum of EPA mission responsibilities as they varied during the period. General work areas were (1) QA Project Plan preparation and evaluation, (2) special field studies and analytical services, (3) field audits, (4) report review and evaluation, and (5) preparation of training materials.	EPA 68-03-3181 EPA 68-03-4001 EPA 68-C9-0051 EPA 68-D0-0017 EPA 68-C3-0301	456 892 1,241 1,225 3,400	361 892 1,241 1,225 -*	09/83 09/86 09/89 12/89 02/93	10/86 10/89 10/92 01/93 09/97	CPFF
Method Standardization and Evaluation of Test Procedures for Analysis of Environmental Samples EPA-EMSL Cincinnati, OH	As a part of this 3-year task order project, S-Cubed developed analytical methodology for the EPA EMSL-CI. The primary focus was in the analysis of organic and inorganic constituents in water. Specific tasks included (1) evaluation of Method 3640 (GPC cleanup) for hazardous waste extracts; the focus was on recovery of Appendix XI analytes as determined by GC/MS, GC or HPLC, (2) validation of Method 8270 (GC/MS analysis of semivolatile organic compounds) for Appendix IX compounds, (3) optimization of the Extraction Procedures for SW-846 (Method 3540 Soxhlet and Method 3550 sonication) for the recovery of Appendix IX	EPA 68-03-3375	491	491	9/86	10/89	CPFF

*On-going

TABLE 3-10. S-CUBED HIGHLIGHTS OF PAST PERFORMANCE

Project Identification		Contract Number	Contract Amount ($K)		Period of Performance		Type of Contract
Title, Client, Address,	Brief Description of Project		Original	Final	Mo/Yr	Mo/Yr	
(Continued)	analytes from solid matrices, (4) Development and validation of a method for determining organic contaminants in drinking water for the Analytical Operations Branch of the Superfund office, and (5) development of a usable method for preparation and determination of organic analytes in POTW sludge.						
Organic Analysis by Isotope Dilution GC/MS EPA-OWRS Washington, DC	GC/MS analyses of water, wastewater and hazardous waste samples were performed to determine organic priority pollutants. Samples were analyzed by Methods 1624 and 1625 using fused silica column capillary GC/MS. The 114 organic priority pollutants, plus the Appendix VIII organic compounds, were determined. Inorganic analyses are performed using Method 1620.	EPA 68-01-7097 EPA 68-03-3545 EPA 68-C1-0038 EPA 68-C1-0049	1,665 1,540 4,600 750	1,665 1,116 * *	9/84 09/87 03/92 03/92	10/87 10/90 03/96 03/96	FFP
Technical Support for Quality Assurance Program Plans EPA Washington, DC	S-Cubed conducted this 2-year project to provide support to the QA Management Staff (QAMS) in review of Agency QA Program Plans. The objective of the project was to: (1) assure that the Agency's 44 reporting organizations were covered by a complete QA Program Plan, and (2) to provide an inventory of action items to assist QAMS in conducting Management Systems Audits of EPA's regions, project offices, research, engineering and monitoring laboratories.	EPA 68-02-4445	85	85	04/86	05/88	CPFF
Technical Support Services for EMSL-LV EPA-EMSL Las Vegas, NV	This project was a 3-year task order project to provide technical support services to the EPA EMSL-LV. Methods developed under this contract were used by the EMSL/LV laboratory to support the efforts of the EPA Office of Emergency and Remedial Response in executing the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA-Superfund).	EPA 68-03-1958	1,420	1,420	09/84	10/87	CPFF

*On-going

TABLE 3-10. S-CUBED HIGHLIGHTS OF PAST PERFORMANCE

Project Identification		Contract Number	Contract Amount ($K)		Period of Performance		Type of Contract
Title, Client, Address,	Brief Description of Project		Original	Final	Mo/Yr	Mo/Yr	
(Continued)	This project also supported the EPA Office of Solid Waste in the development and validation of methods for use under the Resource Conservation and Recovery Act (RCRA) and the EPA Office of Toxic Substances under the Toxic Substances Control Act (TSCA).						
Restrictions Rule Support EPA/OSW Washington, DC	The objective of this 3.5-year task order contract was to support EPA/OSW in the development of testing procedures and technical information related to the ban on land disposal of selected hazardous waste. S-Cubed conducted extensive sampling of industrial waste streams and tested newly established procedures which were designed to model the behavior of toxic constituents in a land disposal site.	Dynamac S-002-1148 EPA 68-01-7266	1,055	1,055	09/86	04/90	CPFF
Technical Support for Treatment, Storage, and Disposal Regulations EPA/OSW Washington, DC	The objective of this task-order contract was to support EPA/OSW in implementation of treatment, storage, and disposal regulations. Specific activities for which S-Cubed provided support included: (1) atmospheric emissions studies from solid and hazardous waste management facilities, (2) waste analyses, air emissions testing, soil sampling, and ground-water and surface-water monitoring, (3) technical assessment of treatment and management technologies as alternatives to land disposal of solid and hazardous waste.	NUS subcontract to EPA 68-03-1958 *Lack of funds limited scope.	806	120*	08/86	09/89	CPFF
SAIC - Keyport HAZWRAP Analytical Services San Diego, CA	This project involves the analysis of volatiles, semivolatiles, pesticides, and metals in environmental samples (using CLP procedures) taken from the Keyport Site in support of a HAZWRAP project. Specialized diskette reporting is required together with standard CLP (validatable) data packages.	14-920076-71 Prime: N62474-89-R-9295	490	450	05/91	11/92	FFP

*On-going

TABLE 3-10. S-CUBED HIGHLIGHTS OF PAST PERFORMANCE

Project Identification		Contract Number	Contract Amount ($K)		Period of Performance		Type of Contract
Title, Client, Address,	Brief Description of Project		Original	Final	Mo/Yr	Mo/Yr	
EPA/CLP/SAS (Viar/ Radian) - Sample Analysis Support Alexandria, VA Subcontract to CLP Superfund Office (SAS)	This task order, fixed price per analysis contract is used in support of the EPA Superfund CLP to obtain data on samples which do not fall under the standard contract protocols. The requested analyses involve the full range of EPA methods including both organic and inorganic procedures as applied to a wide variety of environmental matrices. Qualification for this program requires EPA/CLP contract participation and successful completion of CLP PE samples on a quarterly basis.	S3-0135 Prime: 68-D9-0135	1,200	*	02/91	04/95	FFP
Westinghouse Hanford Company Richland, WA	This project calls for the analysis of both organic and inorganic pollutants in a variety of environmental samples taken from the Hanford Site. Analysis protocols focus on CLP but involve other EPA procedures to a lesser extent. Rigorous attention to QA is required on this project due to the ultimate use of the data in enforcement actions.	MBH-SVV-230656 Prime: DEAC06-87RL-10930	1,200	1,200	05/91	03/94	FFP
PRC - Navy CLEAN Analytical Services San Francisco, CA	This multi-million dollar, 5-year project is providing analytical support to PRC for their Regional Navy CLEAN contract. site evaluations and remediation are being conducted at numerous Navy facilities on the west coast. Analyses performed by S-Cubed cover the full range of procedures but focus on CLP and SW-846 methods of analysis for organic and inorganic materials. Specialized reporting (electronic deliverables) was implemented by S-Cubed, using our newly developed LIMS system to meet special contract requirements.	5086-9-BOA-068 Prime: N62474-88-D-5086	8,500	*	05/91	06/96	FPP

*On-going

TABLE 3-10. S-CUBED HIGHLIGHTS OF PAST PERFORMANCE

Project Identification		Contract Number	Contract Amount ($K)		Period of Performance		Type of Contract
Title, Client, Address,	Brief Description of Project		Original	Final	Mo/Yr	Mo/Yr	
Navy CLEAN Analytical Services Jacobs Engineering Group Pasadena, CA	Various projects under a Basic Ordering Agreement form of contract with S-Cubed have been performed in support of the Jacobs/CH2M Hill/IT Navy CLEAN contract. Certification by NEESA and HAZWRAP were required prior to award of this project. Specific sites supported included the Naval ship yards at Long Beach, California and the El Toro Marine Base at El Toro, California. The methods used include both CLP and SW-846 and are applied to ground and surface water, wastewater, waste, soil, and biota.	01-F000-S-93-0016 N68711-89-D-9296	5,000	*	02/91	03/94	FFP
Los Alamos National Laboratory Analytical Support Project Los Alamos, NM	Organic, inorganic, and radiochemical analysis of potentially elevated activity samples for the full range of regulated parameters using EPA/CLP, SW-846, and DOE methods as necessary. The samples may be soil, water, sludge, biota, and hazardous waste.	7793L0014-95	15,000	-*	01/94	01/97	
QA Sample Analysis for the ACE New England Division Hubbardston, MA	S-Cubed is performing split sample analysis of mixed waste samples for the Army Corps of Engineers as their QA laboratory. Sample Analysis may include organic/inorganic and radiochemical analysis of samples taken and analyzed by ACE contractors in the northeast.	DACW 3394A0018			11/93	11/94	
Organic, Inorganic, and Radiochemical Analysis of Potentially Radioactive Samples SAIC Oak Ridge, TN	These three contracts with SAIC (Oak Ridge) are to provide analytical support in the areas of organic/inorganic/radiochemical analysis of potentially radioactive samples. The samples will be taken from the Oak Ridge National Laboratory (ORNL) site as part of the IR/WM program.	51-940057-42 51-940056-42 51-940109042	7,865	*	08/93	09/98	

*On-going

4 TECHNICAL PERSONNEL

Competent and experienced personnel are critical to the successful completion of environmental projects. S-Cubed's Environmental Chemistry Sector staff has a combined experience of over 600 years.

The most important aspect of S-CUBED's analytical capabilities is the knowledge and experience of our professional staff. S-Cubed employs over 250 scientists, technicians, and support personnel, of which over two-thirds are degreed professionals.

The Environmental Chemistry Sector (ECS) has over 60 professionals with Chemistry, Biology, Engineering, and Environmental Sciences backgrounds and a combined experience of over 600 years. Many of these individuals have over 10 years of experience, including participation in the EPA CLP program, development of analytical methods, and quality assurance support to the EPA and other clients. S-Cubed is proud of the professional stature that many of its scientists have achieved within the environmental community.

Figures 4-1 and 4-2 summarize the education and experience levels of the ECS staff and Table 4-1 provides a summary of the technical staff available for environmental projects.

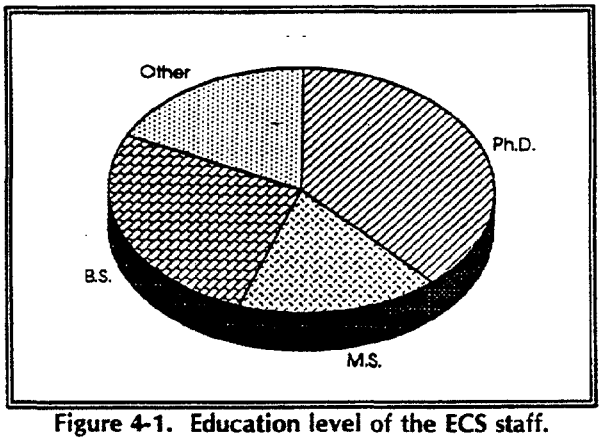


Figure 4-1. Education level of the ECS staff.

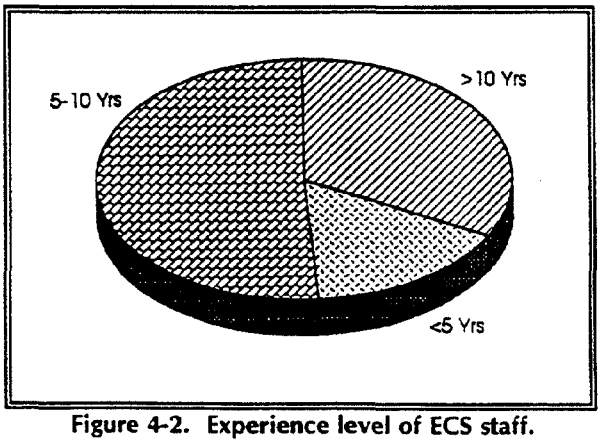


Figure 4-2. Experience level of ECS staff.

4.1 LABORATORY MANAGEMENT AND SUPPORT PERSONNEL

The management and supervisory staff of the Environmental Chemistry Sector have a combined experience of over 200 years in chemistry and related environmental fields. The spectrum of project management experience ranges from multimillion dollar support contracts to small sampling projects for consulting firms. The range of projects supported includes analytical services, method development and research, quality assurance support, and multi

TABLE 4-1. EDUCATIONAL AND EXPERIENCE HIGHLIGHTS OF THE ECS PROFESSIONAL STAFF

Individual	School	Field	Years of Experience
S. Adkins	University of California, San Diego	Psychology	3
A.L. Agustin	Adamson University	Chemical Engineering	10
J.L. Alberti	University of Las Vegas	Biology	5
E.G. Aranda	Far Eastern University	Zoology	14
R.G. Beimer	University of Arizona	Analytical Chemistry	28
C. Booth	Ottawa University	Biology	5
L.A. Bosch	University of California, San Diego	Biology	16
R.L. Calentine	University of Wisconsin	Biology	9
J.T. DeWald	Purdue	Chemistry	10
E.L. Eclar	Far Eastern University	Zoology	3
A.L. Flordeliza	Centro Escolar University	Biology	13
C.L. Fox	University of California, San Diego	Physics/Earth Science	2
J.M. Garrido	San Diego State University	Chemistry	4
J.E. Goodin	University of Kentucky	Organic Chemistry	18
M.D. Hatcher	San Diego State University	Chemistry	13
K.L. Hewa	Indiana Tech	Biology	4
D.M. Hickey	University of California, San Diego	Chemistry	8
C.A. Hook	University of California, Los Angeles	Geography	6
A. Lukiini-Johnson	San Diego State University	Chemistry	13
M.A. Martinez	Technical Institute Tijuana	Biochemistry Engineering	10
A. Mayahi	Southern University	Civil Engineering	14
M. Mayahi	East Central State	Chemistry	13
L.E. Michalec	University of California, Davis	Computer Science	22
R.G. Mullins	East Washington State	Chemistry	17
L.T. Nguyen	San Diego State University	Biology	4
T.M. Nguyen	Palomar College	Chemical Engineering	22
A.A. Perez	Technical Institute Tijuana	Chemical Engineering	6
R.B. Phillips	San Diego State University	Chemistry	10
E.F. Polk	University Massachusetts	Chemistry	9
A.B. Shurtleff	San Diego State University	Chemistry	11
S.A. Simons	University of California, San Diego	Biology	9
C. Stewart	Christian Heritage College	Biology	7
M. Tan	University of California, San Diego	Chemistry	3
D. Tellez	Technical Institute Tijuana	Biochemistry	6
J.R. Wallace	University of California, Berkeley	Chemistry	24
E.I. Walters	Palomar College	Chemistry	12
H.V. Weiss	University of Cincinnati	Chemistry	51
J.E. Wilkinson	American University	Chemistry	17

media sampling projects. The management staff is experienced in coordinating the technical, fiscal, scheduling, and communication aspects of complicated environmental data gathering projects.

S-Cubed is staffed with experienced professionals who possess the skills required to perform reliable organic, inorganic, TCLP, explosive, mixed waste, and radionuclide analyses for a variety of clients. The responsibilities and experience of the supervisory laboratory personnel are presented in Table 4-2.

The Laboratory Manager, Dr. Robert Beimer, has over 25 years of experience in mass spectrometry applications and analytical laboratory supervision, including over 15 years experience with EPA project management while at S-Cubed and TRW. Dr. Beimer has specific experience in the management of large, quick response analytical services projects including several involving the analysis of samples using SW-846 Methods. Among the projects he has

TABLE 4-2. LABORATORY SUPERVISORY PERSONNEL

Name	Position	Degree	Years Experience in Position	Years Experience Total
R.G. Beimer	Laboratory Manager	Ph.D.	14	28
J.T. DeWald	Laboratory Operations Manager	B.S.	7	10
J.E. Wilkinson	GC/MS Laboratory Manager	B.S.	6	17
R.B. Phillips	Inorganic Laboratory Supervisor	M.S.	2	10
M. Mayahi	Preparation Laboratory Supervisor	B.S.	3	13
J.E. Goodin	Quality Assurance Coodinator	M.S.	5	18
J.R. Wallace	Quality Assurance Manager	Ph.D.	5	24
L.E. Michalec	Systems Manager	B.S.	6	22
R. Sobilo	Radiation Safety Officer	M.S.	4	10
R.L. Calentine	GC/LC Laboratory Supervisor	B.S.	1	9
L.T. Nguyen	Reporting Group Supervisor	B.S.	2	4
M.D. Hatcher	Hewlett Packard Laboratory Supervisor	B.S.	4	13

managed are two work assignment, LOE contracts with the EPA involving methods development and validation (EPA 68-02-2689, EMSL-LV and 68-02-2812, EMSL-Ci), and an Army project (DAAK 1183-C-0095) to design, construct, and test an ultra high sensitivity atmospheric pressure ionization mass spectrometer to be used as an air monitoring system.

As part of the methods development projects with EMSL-LV and EMSL-Ci, Dr. Beimer supervised the development and validation of several EPA methods including the Toxicity Characteristic Leaching Procedure (TCLP Method 1311) and the CLP pesticide procedure.

Ms. JoAnn Wilkinson, the S-Cubed GC/MS Laboratory Manager, is one of the individuals who developed EPA Methods 1624 and 1625 for the isotope dilution determination of volatile and extractable analytes by GC/MS. She received her Bachelor's degree in Chemistry from the American University in Washington, DC and has 17 years of experience with the operation of GC/MS hardware and its application to environmental samples. She has been the GC/MS Laboratory Manager at S-Cubed for the past 6 years and provides a resource for the interpretation of GC/MS data when situations arise that cannot be resolved by the individual operators. She also provides technical support for the troubleshooting of

instrument and method problems, and performs a final review of reports that are subsequently submitted to the client. Her experience with the analysis of organic compounds by GC/MS covers a wide range of media and analysis techniques. She has been responsible for a number of S-Cubed projects in which methods development and/or validation has been performed for the EPA's Office of Water, the Contract Laboratory Program, and the Office of Solid Waste. Because she was involved with the initial development of the organic analytical portion (8240 and 8270) of the TCLP, there is no one who has more experience with the application of these methods. She provides the kind of supervision and training necessary to produce skilled GC/MS operators in support of environmental projects.

Our 12 GC/MS operators have a total of 90 years of experience in environmental analytical chemistry and 50 years of experience in the operation and maintenance of GC/MS equipment. As an example of their backgrounds, Mr. Art Shurtleff, who operates one of our GC/MS instruments for extractable organic analytes, was previously responsible for a task to evaluate the cage modification of the TCLP. The cage modification was implemented specifically to reduce the particle size of solid matrices such as cement products used to solidify hazardous waste.

Our Mass Spectral Interpretation Specialists are also highly experienced. Mr. Mark Hatcher, for example, has been performing this function for 9 years at S-Cubed and has also been a GC/MS operator at S-Cubed for 13 years. His skills in mass spectral interpretation have been gained by hands-on experience in performing environmental analyses and methods development. He also trains new GC/MS operators and provides them with the skills to judge the quality of MS data.

Mr. John DeWald manages several of our larger analytical projects. Mr. DeWald has a Bachelor's degree in Chemistry from Purdue University and 10 years of experience in supervising personnel in the analysis of trace environmental pollutants. During his 7 years at S-Cubed, Mr. DeWald has been involved with all aspects of environmental analysis and has been responsible for several methods development projects, including the evaluation of isotope dilution for the determination of constituents in POTW sludge. He is an expert in the application of the TCLP and was responsible for the TCLP round-robin testing which was conducted by S-Cubed for EPA/OSW. His skills in management and the training of personnel are reflected in the high quality of the data generated by our analytical and radiochemistry laboratories.

The GC/MS laboratory is equipped with the latest in hardware and computerization to minimize human interaction with data transfer.

The S-Cubed Inorganic Laboratory is headed by Mr. Rick Phillips. Mr. Phillips holds a M.S. from San Diego State University in Analytical Chemistry and during his tenure at S-Cubed spent 1 year at Los Alamos National Laboratory learning environmental anlaytical operations in a DOE Laboratory. The Support Personnel in the inorganic laboratory are also experienced in the operation of their specific instrumentation. Mr. Larry Bosch, one of our AAS operators, is also experienced in the operation of ICP/MS, which he has applied to the determination of uranium isotopes on a project in which minor changes in enrichment were to be determined.

The personnel in the GC laboratory are experienced in the determination of organochlorine pesticide, organophosphorus insecticide, and phenoxyacid herbicide residues in environmental matrices. Mr. Randy Calentine, supervisor of the GC/LC laboratory, was involved with the development of the procedure

currently used in the CLP for the determination of organochlorine pesticides and participated in the development of an SW-846 method for the determination of organophosphates. His experience, together with that of the other people responsible for GC operation and pesticide/herbicide analysis, ensures that only qualified personnel are utilized on environmental analysis projects.

S-Cubed has been providing high volume routine analysis to EPA/CLP since the program was begun and RCRA analysis to OSWand the EPA Officeof Waterfor 10 years.

Mr. Mostafa Mayahi, supervisor of the Sample Preparation Laboratory, has been with S-Cubed for 5 years. Mr. Mayahi's particular expertise and training is in the area of sample preparation and cleanup using TCLP, GPC, and other environmental sample preparation techniques. He is supported by 10 technicians in the operation of the sample preparation laboratory. These technicians provide the redundancy necessary to handle a high volume of samples and to ensure that extracts and digests are delivered in a timely manner to the instrument laboratories. Mr. Mayahi has a Bachelor's degree in chemistry from Central State University and 13 years of experience as an environmental analytical chemist.

Mr. Larry Michalec, the S-Cubed Computer Systems Manager, has over 20 years of experience using computers of all sizes and types. He has been the Systems Manager for the S-Cubed GC/MS, GC, and inorganic laboratory data systems for 6 years. During this time, he has written several programs for MS-DOS computers that gather the data files from analytical instruments and prepare magnetic media deliverables and hard copy reports. These programs have removed human data entry from the reporting process to the greatest extent possible, thus decreasing the opportunity for transcription error. His work has helped S-Cubed generate data deliverables both accurately and on time. He is currently responsible for an internal S-Cubed software system that prepares the CLP diskette deliverable and can implement almost any magnetic deliverable format required for a specific project.

One of the assets of S-Cubed in analytical support projects is our dedication to quality assurance. We are and have been a QA support contractor to several EPA programs (e.g., EMSL-Ci, EMSL-LV, AEERL, QAMS, and RREL-SITE) for the past 10 years. This experience has resulted in a stringent internal program to assure the generation and reporting of reliable and defensible data. Our staff is well trained in QA procedures and often participate in project plan reviews and audits of other laboratories for the EPA. This exposure to QA at other facilities results in careful adherence to method QC at our own laboratories.

Ms. Jane Goodin, the Quality Assurance Coordinator for S-Cubed, has 19 years of experience in analytical chemistry and quality assurance. In this position, she routinely submits performance evaluation samples to all portions of the laboratory in order to identify potential problems under routine conditions. She has also implemented the routine analysis of internal quality control check samples to assist in promptly identifying quality control problems. Ms. Goodin performs technical systems audits to determine compliance with contractual and S-Cubed quality assurance requirements and inspects data packages with respect to data quality. She develops in-house documentation, recommends quality control procedures to the laboratory personnel, and provides a source of quality assurance information to assist the various project managers in achieving their quality needs.

A summary of the responsibilities of our key personnel is provided in Table 4-3.

4.2 TRAINING

S-Cubed maintains a comprehensive training and development program to keep our personnel up to date on current and emerging techniques, instrumentation, and issues in environmental chemistry. Staff members participate in technical conferences and caucuses, and on-site and off-site instrument training and seminars. Staff members are also encouraged by our tuition reimbursement program to further their formal education through classes at one of the many local universities.

Technical Training

Technical training is conducted almost exclusively in-house by the managerial and more experienced staff members. As an example, GC and GC/MS operator training lasts for 1 year. During this period, the trainee operator is taught the procedures for analysis, typically starting with the CLP. The trainee performs the analysis in concert with a skilled operator, and during this year develops the skills necessary to perform GC and/or GC/MS analysis as well as diagnostic and maintenance skills on the analytical instrument he is using. At the present time, we have nine senior GC/MS operators, each with over 5 years of experience in performing a wide variety of analysis

TABLE 4-3. PROJECT RESPONSIBILITIES OF KEY PERSONNEL

Position	Responsibilities	Assignment
Laboratory Manager Line Managers	Laboratory Director. Technical and administrative performance of project. Coordination of project communications. Coordination of laboratory work. Final review and sign-off for reports. Final resolution of corrective actions. Project planning/progress monitoring. Adherence to QA project plans. Timely completion of project tasks. Assignment of task management responsibilities. Reports to Sector Manager.	B. Beimer J. DeWald J. Wilkinson W. Nisamaneepong
QA Manager	Ensure adherence to QAPP. Review project plans. Independent audits of performance. Oversight of QC procedures, and corrective action. QA advice and guidance. Reports to Senior Vice President.	J. Wallace J. Goodin
Functional Area Supervisors	Manage day-to-day analytical functions. Ensure adherence to project plans. Review data and reports from area. Ensure completion of corrective action in area. Communicate area progress and problems. Schedule work. Reports to Project Manager and Laboratory Manager.	M. Mayahi R. Calentine M. Hatcher R. Phillips L. Nguyen
Radiation Safety Officer	Facility monitoring. Adherence to mixed waste procedures. Oversight of radiation materials control. Personnel monitoring. Licensing requirements.	R. Sobilo

in support of various EPA, DOE, and DoD projects. We have three other GC/MS operators with less than 5 years of experience. In the GC laboratory we have six operators, four of which have more than 5 years of experience. This type of training program has resulted in the development of skilled instrument operators and a consistency of performance. The training program in the inorganic laboratory, i.e., operation of the ICP, ICP/MS, and AAS, is quite similar. We have three senior instrument operators and four operators in training at the present time.

Effective management and personnel training are the most important elements to ensure project success.

When a new project is introduced at S-Cubed, a kick-off meeting is held with those people responsible for performing the analytical work. At this kick-off meeting, the Project Manager distributes copies of the methods which will be utilized, a listing of the quality control requirements, and flowcharts briefly describing the sequence of sample preparation and analysis. This meeting provides all of the involved personnel with an understanding of the project objectives, such that the sample preparation technicians will understand the needs of the instrument operators, and the instrument operators will understand the complexity of sample preparation. This type of up-front exposure to all of the project objectives allows for quick diagnosis of problems when they are encountered during the performance of analysis. As a result, corrective actions can be taken in a timely manner rather than being discovered only at the time of final data review. Not only does this approach to the training of personnel reduce the overall cost of analysis, it instills a spirit of cooperation among the various segments of the laboratory.

Radiation Safety Training

Radiation safety training and instruction is provided by our Radiation Safety Officer/Health Phycist, Mr. Richard Sobilo. The general program for radiation safety training is specified in an S-Cubed SOP. In addition to an intensive course (approximately 20 hours) for new hires, a short (8 hours) refresher course is given annually to all employees who are potentially exposed to radiation. A general information (2 hours) lecture on radiation is provided annually to all employees, and a radiation laboratory procedures and monitoring requirements program is presented semiannually.

When new projects or procedures are introduced, the staff involved is briefed on both the technical and safety aspects, including radiation.

Safety Training

Another significant training activity is safety, especially as it relates to the handling of hazardous chemicals. All of our new employees are required to read the S-Cubed Safety Manual and are given a 4-hr course on chemical handling. In addition, all personnel are given a right-to-know lecture on an annual basis, and are provided with access and instructions for the use of material safety data sheets. We have special training programs in the areas of fire safety, CPR, and the use of respirators. Many of these programs involve video tape presentations, but are always supplemented with a lecture by one of our senior staff chemists. Attendance at these presentations is mandatory and attendance records are kept to assure that personnel are being provided with training at a frequency consistent with State of California requirements.

4.3 ADDITIONAL STAFFING

If necessary, S-Cubed has a number of excellent sources available to provide qualified scientists and technicians to support increased workloads and short-term project staffing needs on short notice. These sources include temporary agencies specializing in providing laboratory personnel, and local universities, including UCSD and SDSU. S-Cubed has a good working relationship with these organizations and has had experience utilizing personnel from these sources.

As project needs have grown, S-Cubed has been able to add and train staff quickly. We have a local reputation for excellence in analytical chemistry and, as a result, find it rather easy to attract highly qualified individuals. Our staff retention at the instrument operator level and above has been excellent, and our growth has enabled us to advance employees from incoming positions and provide them with sufficient training to step into higher levels of responsibility. The sample preparation laboratory is the main area where work load fluctuations affect our staffing ability. Fortunately, our work load tends to increase in the summer months, which allows us to offer summer jobs to local university chemistry students who are anxious to gain practical knowledge and experience in an analytical laboratory. After graduation, some of these former summer hires apply and are accepted for employment on a permanent basis.

Except during the summer months, we rely on temporary help to cover unexpected peak work loads. There are three agencies in the San Diego area which supply temporary laboratory support personnel. When required, we can have an experienced individual working within three days of a request. As a result of this cooperation, we have been able to handle radical fluctuations in sample load which have occurred in the past, and will be able to handle any fluctuation which may occur in the future. These circumstances do not occur very frequently, but when they do, it is good to have a demonstrated workable plan for effective response.

When our work load increases on a longer term basis, the full time staff is increased through recruiting locally and nationally, as required.

5 FACILITIES AND EQUIPMENT

S-Cubed's facilities, equipment, and sample handling procedures are designed to provide high sample capacity in a safe, efficient, and controlled environment.

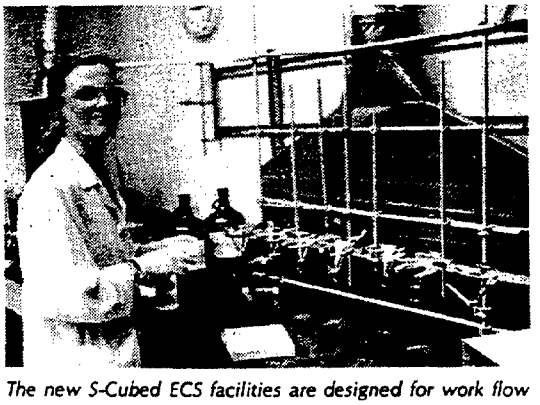
S-Cubed's facilities are located in over 125,000 ft^2 of office and laboratory space in the Sorrento Valley and Kearny Mesa industrial areas of San Diego in close proximity to the University of California at San Diego. The facilities include a 35,000 ft^2 analytical laboratory (Figure 5-1) located at 8808 Balboa Avenue. S-Cubed's equipment inventory consists of an extensive array of analytical instruments to provide the full range of analytical services required for today's complex environmental projects.

5.1 FACILITIES

The S-Cubed facility incudes extensive sample preparation laboratories; isolated volatile and semivolatile organic analysis laboratories; metals laboratories; radiochemistry laboratories; containment and mixed waste laboratories; over 4,000 ft^3 of refrigerated storage; report preparation areas; document control and archive areas; printing facilities, a library and computer center; bulk chemical storage and hazardous waste handling facilities; and technical support offices. Nearby buildings house additional printing facilities, a large technical library, a computer center, administrative support offices, and an electronics work shop/machine shop/instrument fabrication facility.

Sample Handling Facilities and Instrumentation Laboratories

The S-Cubed laboratories are designed to meet the needs of high volume sample preparation and analysis for a wide variety of matrices while providing flexibility for changing project requirements. The design of the laboratory is such that the expansion of any laboratory area can be accomplished in an adjacent location, eliminating fragmentation of functional areas. The laboratories are designed to make optimal use of the most advanced operations management techniques such as just-in-time (JIT), flexible manufacturing, and work cells. The design also provides a clear work flow from one laboratory function to the next and encourages maximum intercommunication between laboratory areas.



The new S-Cubed ECS facilities are designed for work flow and contamination elimination.

In addition to the production laboratory facilities, separate dedicated laboratory space is available for non-routine operations. For small, short-term projects isolated laboratories are located within each functional area as indicated on Figure 5-1. For long-term projects, areas are available which can be quickly configured to meet any laboratory need. These

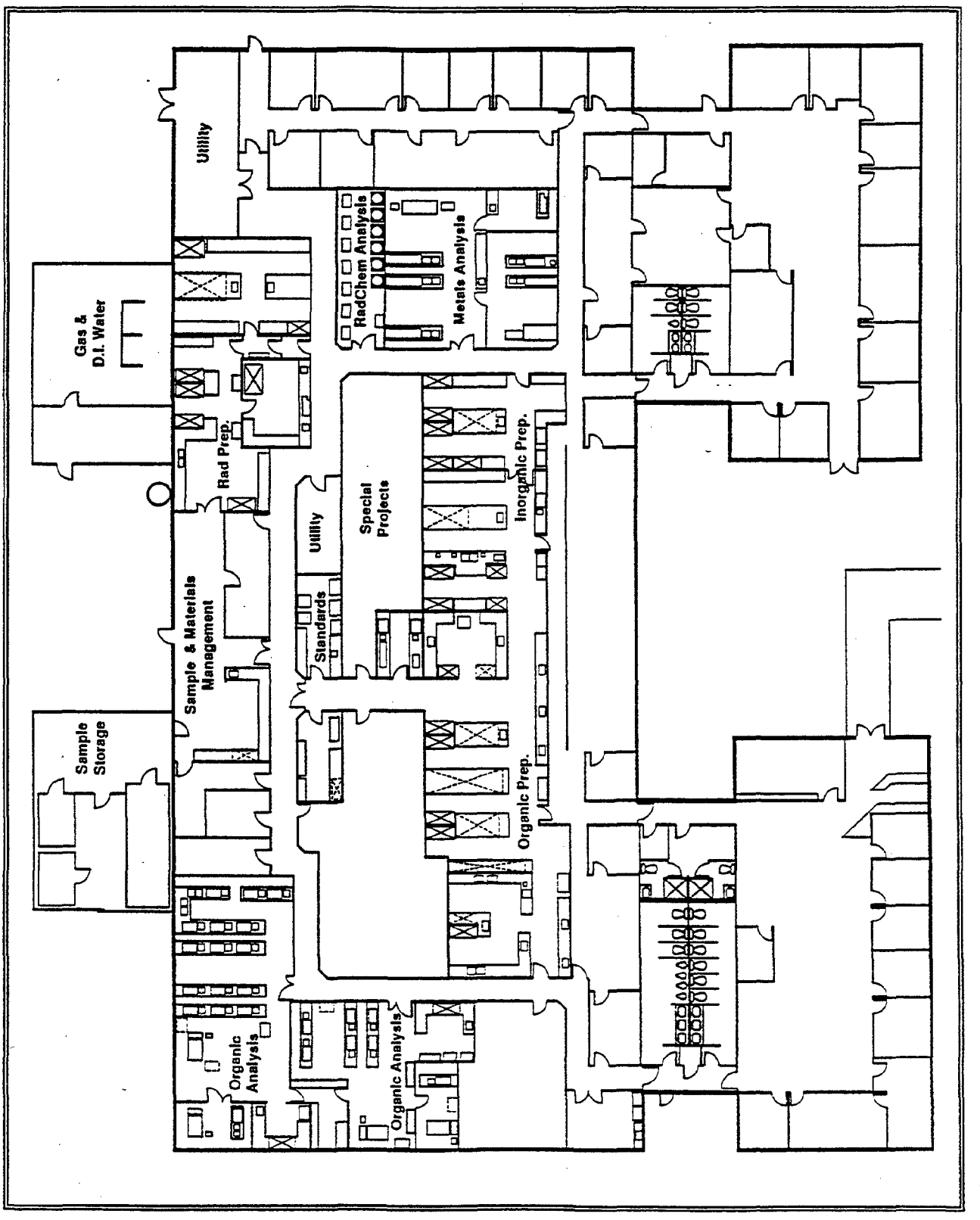


Figure 5-1. S-Cubed's New 35,000 ft^2 Analytical Laboratory Facility.

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areas, which already contain power and other utilities, are designed for easy laboratory expansion.

The sample preparation laboratories are well equipped to handle a large volume of organic and inorganic samples with over 80 liquid-liquid extractors, 35 Soxhlet extractors, 6 sonication extractors, 3 GPC units, 2 microwave digestion units, and over 100 hot plate digestion stations. The preparation laboratories have over 400 linear feet of bench space, including 175 linear feet of hooded bench space. The sample preparation laboratories are strategically located near the sample storage and materials management areas, with the organic and metals instrumentation laboratories located on each side. The preparation laboratory area contains special rooms for TCLP leaching operations and miscellaneous instrumentation such as IR, TOX, and TOC. A standards storage and preparation laboratory is centrally located in the preparation/extraction laboratory, which also contains a sophisticated glassware cleaning facility.

S-Cubed is currently a CLP/SAS contractor and has been since the inception of the program in 1982.

The organic analysis laboratory contains facilities for GC, HPLC, and GC/MS instrumentation. It is divided into separate extractable and volatile laboratory areas, which provide complete isolation of all GC and GC/MS volatile operations from potential contaminants. Each area is equipped with a small wet laboratory with countertops, sinks, and hoods for standards preparation and share a common spare parts storage area and computer room. The laboratories are designed with excess utilities and bench space so that additional leased or purchased instruments can be installed easily. Currently, the facility can house up to 18 GC and 15 GC/MS instruments with an expansion capacity of up to 25 GC and 22 GC/MS instruments. The volatiles laboratory also contains a volatile sample storage area so that volatile sample aliquots are isolated from all other laboratory activities. Containment laboratories to isolate controlled instruments used on special projects, radioactive samples, or dioxin samples are located in each laboratory area.

The metals analysis laboratory has facilities for ICP/AES, GFAA, Cold Vapor AA, Flame AA, and ICP/MS instrumentation. The laboratory has a containment area to isolate controlled instruments and a separate Cold Vapor AA mercury analysis laboratory. The metals analysis laboratory has extra filters on the inlet air to maintain low dust levels and eliminate airborne contaminants. The laboratory is designed to accommodate additional GFAA and ICP instrumentation as needed for future growth.

The radiochemistry analysis facilities contain laboratories for gamma spectrometers, alpha spectrometers, gas flow proportional counters, liquid scintillation counters, and radon flask counters. The counting laboratories can be arranged to separate low and medium level counting areas and are completely isolated from the sample preparation areas, eliminating potential background problems.

The mixed waste containment facility houses radioactive sample receipt and screening areas, organic and inorganic preparation laboratories for mixed waste and radioactive samples, isolated low level radiochemistry and medium level radiochemistry preparation laboratories and changing rooms. This area is designed to provide maximum safety and containment of radioactive materials and is operated as a Type B radioisotope laboratory. The facility is operated under negative pressure with all air exhausting through HEPA filters and is subject to regular monitoring for radioactive contamination. All waste efflu-

ents are collected and screened before release or disposal and all exit/entry points are restricted and have portal monitoring.

The sample and materials management facilities include bulk chemical storage for flammable and other solvents; a consumables store room; sample receiving facilities including benches and hoods; shipping and receiving areas; and sample, extract, and digest storage areas with over 4,000 ft^3 of refrigerated storage, including 800 ft^3 of refrigerated storage for radioactive and high hazard samples. A hazardous waste satellite collection area is also provided as part of this facility.

The data management facilities include work areas for report preparation; data control rooms; document and data archive rooms with fire rated storage capability; a computer center for network servers and data communication equipment; software programming offices; and a reproduction center capable of processing over 100,000 pages per day.

The technical support and management areas include conference rooms, a library, project administration offices, the QA staff offices, and laboratory managers' offices.

Technical Library

To meet the need for current technical information, S-Cubed maintains a technical library staffed with a full time librarian. The library collection includes over 5,000 volumes, 15,000 microfiche documents, and 150 journal subscriptions covering mathematics, computer science, physics, chemistry, and engineering, and includes specialized collections in environmental chemistry and environmental engineering. The library has extensive in-house computer data retrieval systems through which DIALOG, MELVYL, and other data banks can be accessed. Through these systems, S-Cubed has access to the University of California Libraries, the Stanford Library, the British Lending Library, DTIC, NRA, OSTI, NASA, NTIS, and many other libraries and databases. The Environmental Chemistry Sector also maintains an extensive analytical method library which includes EPA, NIOSH, OSHA, ASTM, AOAC, DOE, and FDA methods. In addition, S-Cubed has full access to the UCSD library/databases.

Computer Center Operation

S-Cubed's computer resources include a network of over 80 UNIX workstations and mini-computers used primarily for geophysical and a scientific visualization; a network of over 50 Macintosh computers for technical publication; and a Novell network of PCs for analytical chemistry data collection and sample tracking. The S-Cubed system is one of the largest non-government computer systems in San Diego.

S-Cubed's computing environment is characterized by its diversity of equipment and its computational capability. The UNIX workstation includes systems from 8 vendors running 11 variants of the UNIX operating system, all of which are integrated using the TCP/IP network protocol. The selection of systems is dictated by the need for high speed numerical computation. S-Cubed has capitalized on the competition of computer vendors by purchasing the fastest systems available. As a result of this approach, S-Cubed now boasts an aggregate computing capability well in excess of the capability of 10 Cray XMP supercomputers.

The UNIX environment includes 18 Silicon Graphics Indego workstations with advanced graphics and numerical functionality, over 20 SPARC class Sun workstations, 20 Sun 3 class workstations, and an assortment of other systems from HP, IBM, DEC, Ridge, Celerity, and Stardent. The systems are distributed between S-Cubed's San Diego facility and 4 remote offices outside of California. A system of area networking and modems allows each of these facilities to communicate.

S-Cubed also maintains high speed wide area network access to Supercomputer Centers at UC San Diego and the Los Alamos National Laboratories. These facilities allow S-Cubed's researchers to take advantage of some of the world's fastest

supercomputers, including 8 CPU Cray YMPs and a 1024 CPU Connection Machine for parallel supercomputing.

The Environmental Chemistry Sector specifically maintains over 50 personal computers for document preparation, data reduction, reporting, and management. These computers are connected to S-Cubed's Laboratory Information Management System. Many of these computers are capable of accessing S-Cubed's central computer system, various on-line information systems, EPA databases, and EPA program office data systems. These systems have a wide variety of software, graphics, and modem capabilities. A complete spectrum of data storage capabilities and printing systems are available for specific project needs. In addition to the PCs, the Sector also maintains 5 DEC PDP 11/73 computers, and 5 Hewlett Packard 1000 RTE computers for data generation and management. These systems are linked to the PCs for data transfer and reporting.

Safety

S-Cubed's facilities are designed to provide a safe working environment for operations involving hazardous materials. Specific features include extensive hood and ventilation systems, and numerous eyewashes and safety showers. Separate facilities are used for hazardous waste and chemical storage, including a flammable materials storage area equipped with special ventilation and fire suppression systems.

The safety program at S-Cubed includes extensive safety training which is required of all individuals whose activities may include working with hazardous materials, and includes a medical monitoring program designed to detect signs of chemical exposure. The divisional safety staff monitors the facility, equipment, and programs to ensure that safe working conditions are maintained.

The primary responsibility for ensuring that all mixed waste and radioactive materials handling activities are performed safely rests with the Maxwell S-Cubed Division, Radiation Safety Officer (RSO), Mr. Richard Sobilo. As a Health Physicist/RSO, Mr. Sobilo is responsible for ensuring that adequate training procedures, management, and monitoring are in place and properly used to provide adequate safety for personnel handling mixed waste samples, and to ensure that radioactive materials are properly managed and documented. In addition to the regular staff, S-Cubed also retains a number of consultants with experience in the radiation and health physics disciplines.

S-Cubed has two classifications for mixed waste samples, as described in Table 5-1.

TABLE 5-1. LOW AND MEDIUM-LEVEL MIXED WASTE DESIGNATIONS

Low
< 10 MREM contact
< 100 μCi alpha and beta
< 10 μCi transuranics
Medium
10 to 200 MREM contact
100 to 1,000 μCi alpha and beta

Low level samples will follow standard laboratory preparation and analysis procedures, with supplemental procedures for radiation safety and containment. However, medium level samples may require special handling such as method modifications, shielding, and sample size adjustments.

5.2 INSTRUMENTATION

S-Cubed's laboratory capital equipment inventory is valued in excess of $6 M and includes both state-of-the-art and newly emerging instrument technologies. All of the major instrumentation required to support a wide variety of projects is in place at S-Cubed. Table 5-2 provides a summary of our major equipment inventory.

TABLE 5-2. MAJOR INSTRUMENTATION SUMMARY

Instrumentation	Quantity
GC/MS	10
GC	12
HPLC	1
IC	1
ICP/AES	2
ICP/MS	1
AAS	4
Proportional Counters	2
Liquid Scintillation Counter	1
α-Spectroscopy Detectors	8
γ-Spectroscopy Detectors	2

With 10 GC/MS instruments, the S-Cubed San Diego facility is one of the largest environmental laboratories on the west coast. Our instrument redundancy provides substantial sample capacity and eliminates delays due to instrument downtime. In addition, S-Cubed maintains a large spare parts inventory, an electronics workshop, an instrument manufacturing facility, and trained and experienced technicians so that most instrument repair and maintenance are conducted in-house.

Where possible, all of these instruments have sophisticated autosampler systems and most are equipped with computers for data acquisition, reduction, and reporting. The Chemistry Sector's computing capabilities include 12 minicomputers and over 50 PCs, most of which are interconnected via the LIMS network. The network is also connected to the S-Cubed computer center which provides even greater capacity and flexibility.

A detailed listing of S-Cubed's analytical instrumentation is presented in Table 5-3.

In order to effectively maintain this level of instrumentation, S-Cubed has developed a number of internal capabilities and procedures for equipment repair and maintenance. An extensive in-house spare parts inventory is in place so that commonly needed parts are available immediately. Duplication in the models purchased by S-Cubed also help to make this parts inventory more efficient. For example, S-Cubed has 22 Hewlett Packard 7673 GC autosamplers, 17 Hewlett Packard 5890 gas chromatographs, 6 Hewlett Packard mass spectrometers, and 4 VG Mass Spectrometers.

To support the sample capacity provided by our instrument inventory, S-Cubed has developed well equipped and efficient sample preparation laboratories. Our current preparation equipment inventory includes 80 liquid-liquid extractors, 35 Soxhlet extractors, 6 sonication extractors, 3 GPC units, 3 24-place nitrogen blowdown units, 4 multi-position TCLP rotators, and two microwave digestion units. This equipment allows the laboratory to handle a wide variety of analytical methods and sample matrices while maintaining high sample throughput.

In addition to maintaining an extensive inventory of state-of-the-art instrumentation, S-Cubed is constantly testing and evaluating newly emerging instrument techniques in order to remain at the forefront of analytical development. As an example of this emphasis, S-Cubed acquired a VG PQ2+, ICP/MS instrument over 4 years ago when this technique was just beginning to realize environmental applications. As a result, we are now experienced with EPA Methods 200.8 and 6020 as applied to a wide variety of matrices. In addition, we have applied ICP/MS to radionuclide analysis in the determination of natural uranium and uranium isotopes.

The Hewlett Packard Microwave Induced Plasma Atomic Emission Detector was another developing technique which S-Cubed helped to evaluate. As a beta test site for this instrument, we studied its application to pesticide analysis in difficult matrices. Current technology evaluations include testing of new split/splitless GC injector designs, CLP reporting software and the beta testing of a PC based data system and the Hewlett Packard 5971 GC/MS.

TABLE 5-3. DETAILED LABORATORY EQUIPMENT LIST

Instrument	Units	Age (Yrs)
ORGANIC ANALYSIS		
GC		
Hewlett Packard Model 5890 Gas Chromatographs with dual ECD	4	3
Hewlett Packard Model 5890 Gas Chromatograph with Hall detector, PID, and FID	1	3
Hewlett Packard Model 5890 Gas Chromatograph with FID and ECD	1	3
Hewlett Packard Model 5880 Gas Chromatograph with FID and NPD	1	8
Hewlett Packard Model 5890 II Gas Chromatograph with dual FPD	1	2
Hewlett Packard Model 5890 II Gas Chromatograph with dual FID	1	0
Hewlett Packard Model 5880 Gas Chromatograph with dual ECD	1	8
Varian Model 3700 Gas Chromatograph with ECD and FID	1	9
Gow Mac Series 550P Gas Chromatograph with TCD	1	7
PE Nelson Access Chrom GC/LC Data System with a DEC Microvax II Computer	1	3
Varian Model 3500 Gas Chromatograph with FID	1	7
GC/MS		
Hewlett Packard 5970 Mass Selective Detectors coupled to Hewlett Packard 5890 Gas Chromatograph and Hewlett Packard 1000 RTE Data Systems	5	3
VG Model 12-250 GC/MS/DS equipped with DEC PDP11/73 Data Systems	2	7
VG Model TRIO2 GC/MS/DS equipped with DEC PDP11/73 Data Systems	2	6
Hewlett Packard 5972 Mass Selective Detector coupled to Hewlett Packard 5890 Series II Gas Chromatograph and PC Data System	1	0
EXPLOSIVE ANALYSIS		
Spectraphysics SP-8800 Ternary HPLC System with Autosampler, Hewlett Packard Diode Array Detector, Fluorescence Detector, and Fixed Wavelength UV Detector	1	5
INORGANIC ANALYSIS		
Perkin Elmer Model Z5100 Atomic Absorption Spectrophotometer with Flame, Furnace, and Hydride Capabilities, Autosampler, 8 Lamp Turret and Epson Equity 3 Plus Data Station	3	2
Instrumentation Laboratories Model 257 Atomic Absorption Spectrophotometer	1	11
Thermo Jarrell Ash, Enviro-II ICP Spectrometer with dual Simultaneous/Sequential Capability, Automatic Background Correction, Autosampler and Data System	1	1
Leeman Labs PS-3000 ICP with Simultaneous and Sequential Capability, Autosampler and Data System	1	3
VG Elemental Plasma Quad PQ2-Plus Inductively Coupled Plasma/Mass Spectrometer with Compaq 386 Desktop Data System and Gilson Autosampler	1	4
Perkin Elmer FIAS Automated Cold Vapor Mercury Analyzer with Autosampler	1	2
S-Cubed Custom Built Mercury Cold Vapor Analyzer	1	6
Spectro Products HG-4 Dedicated Mercury Analyzer	1	2
Instrumentation Laboratory Model 555B Graphite Furnace	1	7
Dionex Model 4000 Ion Chromatograph	1	4
Hach Model DR-3000 UV/Visible Spectrophotometer	1	4
Baush and Lomb Spectronic 20 Spectrophotometer	1	5
Dohrman TOC with Solids Introduction System	1	1
Dohrman TOX with Solids Introduction System	1	1
Perkin Elmer 1310 IR Spectrophotometer	1	4

(Continued)

TABLE 5-3. (CONTINUED)

Instrument	Units	Age (Yrs)
RADIOISOTOPE ANALYSIS		
Beckman LS9800 Liquid Scintillation Counter	1	8
Gamma Products G5000 Alpha, Beta, Gamma Low Level Counting System Gas Flow Proportional Counter with Autochanger	1	3
Ludlum 2200 Scaler with ZnS Alpha Counter	1	5
HP-210 Beta Counter	1	5
Nucleus Quantum 8 Multi-channel Analyzer with Well Counter	1	4
Ortec HPGC Gamma Spectrometer (35% P-Type)	1	3
Ortec HPGC Gamma Spectrometer (35% N-Type)	1	3
Ortec Model N5576A-450RV Alpha Spectrometer Systems	8	3
Berthold LB770 10 Channel Low Level Alpha/Beta Counting System	1	3
Ludium Radon Flask Counters with Scalers	2	3
PORTABLE RADIATION DETECTION EQUIPMENT		
TBM-3 GM Detectors	3	3
R-2 Portable Dose Rate Meter	1	3
Model 490 Survey Meter	2	3
Model 489-60 ZnS Alpha Probes	2	3
Model 489-110C Beta-Gamma Pancake Probes	2	3
Model 489-55 Gamma NaI Scintillation Probe	2	3
Victoreen 450 Portable Dose Rate Meter	2	3
Alpha Cum Model 758 Continuous Air Monitor	2	3
SAMPLE PREPARATION		
Continuous Liquid-Liquid Extractors	80	-
Soxhlet Extractors	35	-
ABC Gel Permeation Chromatograph Systems	3	3
Heat Systems Ultra Sonication Systems	6	2
Multi-Station TCLP Rotators	4	3
Multi-Station EP Toxicity Rotator	1	5
TCLP - Zero Headspace Extractors	6	4
MDS 81 Microwave Digestion Apparatus	2	2
Distillation Apparatus	15	-
Automated Purge and Trap Concentrators	8	3
Automated Headspace Autosampler	1	6
SAMPLE & EXTRACT STORAGE		
14' x 8' Walk-in Refrigerator	1	3
12' x 8' Walk-in Refrigerator	1	5
9' x 36' Walk-in Refrigerator	1	0
70 cu ft Refrigerator	1	3
15 cu ft Refrigerators	9	5
1.5 cu ft Refrigerators	7	2
20 cu ft Freezers	3	2
50 cu ft Refrigerators	2	4
LABORATORY COMPUTERS		
Hewlett Packard 1000	5	3
Dec Micro VAX	5	3
IBM Compatible PCs	57	2

6 QUALITY ASSURANCE

Over the past 10 years S-Cubed has performed 11 multi-year quality assurance support projects, assisting the EPA and other government agencies in the areas of quality assurance management, on-site audits, the review of quality assurance project plans, and the development of quality assurance educational materials.

S-Cubed's management is committed to the implementation of an effective quality assurance program, as delineated in the S-Cubed Quality Assurance Program Plan and related documents. This management commitment is exemplified by the policy statement (Figure 6-1) signed by the President, S-Cubed Division. The statement shows the commitment of our corporate management to the S-Cubed Quality Assurance Program.

The objective of the Quality Assurance (QA) Program at S-Cubed is to assure that the overall Quality Control (QC) effort is being performed effectively and is achieving the desired results. The QC effort is directed at obtaining sufficient information on measurement accuracy and precision to confirm that results meet user needs.

6.1 QUALITY ASSURANCE DOCUMENTATION

Documentation for the QA Program at S-Cubed occurs at three major levels of generality. The most general document is the Quality Assurance Program Plan, included as Appendix C. The QA Program Plan describes the QA organization and responsibilities, as well as general instructions that are applicable to all projects carried out within the Environmental Chemistry Sector (ECS) at S-Cubed. For specific projects, a QA Project Plan (QAPP) is prepared which identifies client requirements. The QAPP is a major tool for communicating the client's specific QC requirements to the laboratory management, analysts, and technicians. All aspects of sample receiving, analysis, QC procedures, data reporting, and data archiving must be carried out as described in this document. The QAPP is tailored to a given project and incorporates feedback from the client. It is the primary means of communicating project specific requirements to the laboratory. All QAPPs prepared by S-Cubed follow the requirements of QAMS 005/80, as supplemented by the EPA's "Preparation Aids" series of October, 1989, both of which were prepared for the EPA by S-Cubed, and the recently published EPA/530-SW-90-021, relating to RCRA. Additionally, they follow the guidelines set forth in DOE Order 5700,6C and NQA-1.

To supplement the QAPP, a number of Standard Operating Procedures (SOPs) have been developed to describe step-by-step procedures for carrying out routine operations within the laboratory and are used at the bench chemist level. In addition to these specific instructional and communication materials, various forms are used throughout the laboratory to maintain continuity and traceability of data. An example of the forms that maintain traceability of data is the Internal Traffic Log (ITL), which accompanies each sample lot throughout the laboratory. The ITL identifies the project, the sample numbers, each analysis that is to be performed, and special analytical requirements. This form also documents the chain-of-custody of the sample. Analysts are

QUALITY ASSURANCE POLICY
FOR THE ENVIRONMENTAL CHEMISTRY SECTOR

PURPOSE

The purpose of the Environmental Chemistry Sector (ECS) Quality Assurance Program is to assure the acquisition of data that are traceable, statistically valid, and of known and adequate quality. In general terms, the QA activities within the ECS will meet the standards specified by the EPA Quality Assurance Management Staff, as spelled out in QAMS 005/80 and related documents, unless otherwise required for specified clients. Goods and services will also conform to the applicable requirements of the Maxwell Laboratory Product Assurance Manual. The Quality Assurance Program within the ECS is designed to ensure that specific QC procedures are planned and implemented as required.

APPROACH

To give effect to this end, the following principles apply:

- An S-Cubed Divisional Quality Assurance Officer (QAO) shall be appointed to act as a Maxwell Laboratories Quality Representative. The QAO shall be available to ECS personnel performing quality functions for assistance with quality program implementation. Officer responsibilities shall include, but are not limited to, quality program planning; auditing to assess the adequacy of facilities, equipment, documentation, and statistical design; generation and revision of required quality documentation; corrective action implementation; apprising the ECS Manager of program status.

- The Quality Assurance Coordinator (QAC) shall be appointed for the purpose of assisting, implementing, and reviewing all aspects of the Quality Assurance Program within the ECS. The QAC and the QA staff is authorized to review all aspects of the laboratory operations, including planning, specific QC procedures, and documentation. The QAC will be responsible for assessing the adequacy of facilities, equipment, procedures, statistical design, and documentation, with the assistance of the QA Support Manager.

- The QAC will be independent of project management and will report to the S-Cubed Senior Vice President and Manager, ECS. The QA program within the ECS will be reviewed periodically by a corporate QA representative.

- All data producing activities within the ECS will be carried out pursuant to the ECS Quality Assurance Program Plan and in conformance to the Maxwell Laboratories Product Assurance Manual. The Quality Assurance Program Plan will provide guidelines for QA management, personnel qualifications, facilities and hardware, data generation, data management, measurement of data quality, and corrective action.

- The individual project managers are encouraged to request assistance as needed from the QAC and the QA Support Manager; however, the primary responsibility for product quality resides with the project manager.

APPROVAL

Eduardo Waisman
President, S-Cubed Division

Figure 6-1. Sample and extract flow for extractable organics.

also provided with Statements of Work and approved protocols to specifically describe the analytical and QC requirements of each project. Table 6-1 is provided as an aid in relating basic QA requirements to the various subsections of this Capability Statement.

6.2 QUALITY ASSURANCE ORGANIZATION AND RESPONSIBILITIES

The ECS Quality Assurance Coordinator (QAC) is responsible for organizing and coordinating all QA activities within the ECS. The QAC is organizationally independent of the functional groups that generate measurement data within S-Cubed. The specific activities routinely performed by the QAC, assisted by the QA staff, include:

- Technical Systems Reviews of all QA operations within the ECS.
- Submittal and evaluation of performance evaluation samples.
- Audits of data reports with respect to completeness and contract compliance.
- QA indoctrination of technical personnel.
- Review and approval of field, laboratory, and chain-of-custody procedures.
- Reviews of sample and data traceability.
- Monitoring of corrective action.
- Reporting on QA status within the ECS.
- Consulting with laboratory managers on QA matters.

As a part of our normal routine and in addition to formal contractual QC requirements, S-Cubed analyzes a series of laboratory control samples (LCS) with each sample case for the purpose of isolating and correcting potential problems. These data are forwarded to the QAC for evaluation and monitoring.

TABLE 6-1. LOCATION OF SELECTED QA INFORMATION

QA Element	Location in this Capability Statement			
	Capability Statement	QA Program Plan (Appendix C)	QA Project Plan (Appendix D)	Standard Operating Procedures
Policy and Objectives	6.0	1.0	1.0, 3.0	Not applicable
Management	2.0	2.0, 3.0	2.0	Not applicable
Facilities, Equipment, and Preventative Maintenance	5.0	4.0	4.0, 9.0	Various, frequently included with analytical methods
Document Control	6.0	5.0, 6.0	5.0, 8.0	20-008, 81-002 through 83-002
Analytical Methods	3.0	9.0	6.0	41-001 through 71-003
Data Generation	3.0, 7.0	5.0	6.0, 8.0	91-001 through 91-002
Quality Assurance	6.0	Entire Document	7.0, 9.0, 10.0, 11.0	20-000 through 21-001
Personnel Training	4.0	3.0	2.0	86-001

The QAC at S-Cubed also routinely monitors the submittal fo blind performance evaluation samples, which are included with routine analytical runs, to further chart laboratory performance.

The identification of appropriate QA/QC procedures, the documentation of these procedures, and the implementation of appropriate QC activities is ultimately the responsibility of the Project Manager. The Project Manager may receive substantial consultation and feedback from the QAC in the performance of this responsibility and will seek to act in a collaborative role with the QAC to ensure that appropriate QA/QC procedures associated with all project activities are properly defined and implemented. The QAC also monitors projects in order to reinforce conformance with QA goals and with all contract and user requirements.

The QA Support Manager, Dr. John Wallace, is available for QA/QC consultation at any time. Dr. Wallace's experience with QA includes the management of a contract to provide QA support to the USEPA Risk Reduction Engineering Laboratory. He is responsible for the development of QA/QC procedures, the critical review of QA Project Plans, the performance of audits, and the review of final reports. The QAC and the Project Managers frequently make us of his expertise in QA/QC.

For large, multimedia sampling and analysis efforts, the delegation of QA/QC responsibilities to levels below the Project Manager is required to assure full implementation and adequate attention. QC responsibilities are specifically assigned to field sampling personnel, laboratory analysts, and data reduction personnel, as appropriate. Additionally, direct responsibility for implementation of the specific QA/QC activities associated with a given task is typically delegated to the task manager to facilitate the essential involvement of immediate technical management personnel in the QA/QC effort. Detailed elements of QA/QC delegation and responsibilities are provided in the QAPP for specific work assignments or tasks as appropriate.

S-Cubed routinely performs scheduled QC procedures for each lot of samples. These procedures are the minimum performed; if there are others specified in a particular QAPP, the specified procedures will be performed in addition to the internal procedures discussed below.

As a result of our experience in implementing EPA QA programs with other contractors, we take our own internal QC on environmental projects very seriously.

Method and Reagent Blanks

Method blanks are performed during each day of sample preparation and for each set of up 20 samples. This analysis is used to determine background levels of analytes contributed by the preparation and analysis process and to detect any gross contamination problems. Blank contamination beyond limits specified in each protocol may require reextraction and reanalysis of the entire sample batch. Reagent blanks are used to detect contamination of instrumentation and are run in analytical sequences as specified in the particular protocol. A method blank is analyzed with each batch, the size of which is determined by the number of samples of similar matrix which can be processed simultaneously through the entire process, or 1 for each day or for every 20 samples, whichever is most frequent.

Replicates

Replicate analyses are performed by preparing and analyzing a second aliquot from a well mixed sample.

This analysis can provide an estimate of the precision of the data.

Matrix Spikes and Matrix Spike Duplicates

Matrix spike and matrix spike duplicates are prepared by spiking aliquots, from a well mixed sample, with analytes of concern as specified in the protocol. This data can provide an indication of the accuracy of the analysis. Matrix spike duplicates are used to provide estimates of precision when analytes of interest are not expected to be found in the sample.

Laboratory Control Samples (LCS)

Laboratory control samples (LCS) are prepared by spiking deionized water or clean sand (silica) with appropriate matrix spike compounds. These samples then undergo the entire analytical process with regular samples. The results of the analysis of these samples are used to develop control charts to monitor the analytical system performance for each analytical method. These samples are prepared and analyzed for each batch of 20 samples or less. For GC and GC/MS analyses the matrix spike compounds are used, for ICP and AA analysis all metals are used, and for wet chemical analyses all analytes are used in the spike. For other analyses, LCS compounds are specified in the Analytical Work Plan or in S-Cubed Method SOPs. Control charts are developed for each analysis and matrix spike.

Reference Standards and Samples

Reference standards and samples are analyzed when available and appropriate.

Control Charts

The S-Cubed Chemistry Group has utilized control charts for the past 3 years. The surrogate recoveries in blanks (organic analysis) and laboratory control sample recoveries (organic, inorganic, and radiochemistry analysis) are plotted. The criteria used for detecting an out-of-control situation are: a value outside of the control limits; a series of 6 or more points on one side of the control line; and a series of 5 successive points going in the same direction.

Audits

On-site technical audits of S-Cubed are performed regularly by a number of outside groups, including offices of the EPA, the State of California, the HAZWRAP QA staff, NEESA, DOE laboratories, and various commercial clients. It is S-Cubed's policy to prepare for these audits carefully, and to take the suggestions offered during the audit debriefings as constructive issues for the improvement of the laboratory.

Data are reviewed at several levels before the report is released to the client.

In addition to these technical systems audits (TSAs) of S-Cubed by outside groups, there are a number of performance evaluation (PE) samples analyzed by S-Cubed each year. Table 6-2 provides a list of these PE samples. In addition to the outside audits, the S-Cubed QA staff performs regular internal laboratory audits to ensure compliance with our QAP.

The QA staff performs the following types of independent QA audits. Technical Systems Audits (TSAs) are performed by examining the laboratory procedures, documentation, and QC procedures that are currently in use. The objective of each TSA is to determine whether the required analytical and QC procedures are being correctly and consistently carried out. Performance Evaluation Audits (PEAs) consist of submitting blind samples to the laboratory

TABLE 6-2. CURRENT SCHEDULE OF EXTERNAL PE SAMPLES

Program	Type	Frequency	Tentative Schedule
WP EPA Cincinnati	Wastewater	Semiannually	April, October
WS EPA Cincinnati	Drinking Water	Seminannually	May, November
Radiochemistry EPA Las Vegas	Radiochemistry	Quarterly to Annually (varies with parameters)	No set schedule
Radiochemistry DOE	Radiochemistry	Quarterly to Annually (varies with parameters)	No set schedule
HAZWRAP Martin Marietta Energy Systems, Inc.	RCRA and Superfund	Annually	No set schedule
NEESA	RCRA and Superfund	No set frequency	No set schedule
CA DOHS ELAP	State Certification	No set frequency	No set schedule

and judging the accuracy of the results. Audits of data quality (ADQs) consist of retrospective examinations of completed data sets. As part of our QA program, S-Cubed performs extensive review and validation of data before it is released to clients. Data packages may be reviewed at 4 or more levels. In addition, to this multi-tier review, the QA staff randomly reviews data packages for adherence to methods, project plans, and the S-Cubed QA Program Plan. Typically, a fraction of the reported analysis are recalculated from the raw data.

The TSAs performed by the QA staff are of 3 types. The QAC performs TSAs of the log-in, analytical, and documentation procedures of the laboratory on a semiannual basis, using a check list that is constantly evolving. The QA Support Manager performs oversight audits on an as-needed basis, when a new method is being used, or in response to the findings of a pervious audit. Lastly, a member of the staff of S-Cubed's QA Group in Alexandria, VA visits the Chemistry Group approximately once per year and performs a TSA. Formal reports of all audits are prepared, discussed with laboratory staff, and submitted to the laboratory management.

Corrective Action

The corrective action cycle is designed to identify QC problems or potential problems, supplement corrective actions, and promote follow-through and documentation.

All corrective actions undertaken by the laboratory are recorded on Corrective Action Forms (CAFs), which indicate the initial problem, the required corrective action, the date of the corrective action, and sample identification information. Upon completion of the required corrective action, this form becomes a permanent part of the case file.

Areas most commonly requiring corrective action include the following:

- Sample Check-in

  Problems encountered during sample check-in (i.e., broken sample containers or incomplete or incorrect documentation, etc.) are documented and reported immediately to the appropriate personnel.

- Sample Analysis

  Difficulties encountered during preparation and analysis are recorded on the CAF. The form is distributed for appropriate review and action.

The review includes the technical supervisor, the project manager, and the QA coordinator. The specific corrective action may include reanalysis, reextraction, use of alternate procedures, or simply a notation of the difficulty depending on the severity of the problem and its affect on the quality of the data.

- Data Review

  Problems encountered during data review may be corrected by the following actions: request of reanalysis, re-review of raw data, flagging sample results, or inclusion of comments in the report narrative.

Other problems which may arise in the course of method evaluation, optimization and ruggedness testing are also handled in this manner. Corrective actions are also initiated by the Task Manager as a result of other QA activities, including performance evaluation audits and technical systems audits.

6.3 S-CUBED EXPERTISE IN QUALITY ASSURANCE

S-Cubed's experience in quality assurance/ quality control support services began in 1980 with support to the EPA Quality Assurance Management Staff in its initial implementation of the Agency-wide quality assurance program. This work included authoring "Guidelines and Specifications for Preparation of Quality Assurance Plans" (QAMS 005/80), which is used throughout the EPA as guidance for the preparation and review of quality assurance project plans. Since that time, S-Cubed has expanded its quality assurance/quality control support experience through the performance of 11 major, multi-year EPA and DoD support contracts.

Over the past 10 years this technical experience base has included quality assurance support contracts for various EPA/ORD laboratories, including RREL, AEERL, EMSL-LV, EMSL-Ci, and MERL. Further, S-Cubed has provided support to commercial clients who require assurance that their data are legally or scientifically defensible. Additionally, since 1985 we have provided quality assurance support to several EPA project offices, including OSW and OERR, under various broad-based technical services support contracts.

As part of ongoing quality assurance contracts, S-Cubed is assisting the various EPA program offices and ORD laboratories in:

- Review and assessment of quality assurance project plans.
- Field sampling and laboratory analysis audits.
- Reviews of final reports.
- Quality assurance training programs and information transfer efforts.
- Data validation.
- Development of written instructional material, such as guidelines for the preparation of QA Project Plans.

S-Cubed is currently under contract to provide $2.4 million in QA services to the U.S. EPA in the above-mentioned general areas.

As part of this effort, S-Cubed has reviewed over 350 quality assurance project plans prepared by the EPA and its contractors, has performed over 200 on-site technical systems audits of field sampling and laboratory activities, and conducted over 60 comprehensive project final report reviews. S-Cubed has also prepared several QA instructional manuals at the request of the EPA.

Based on outstanding accomplishments in these areas, S-Cubed has several commendations from the EPA, three recent examples of which are presented in Figures 6-2, 6-3, and 6-4 recognizing our effective assistance in developing and implementing QA activities. It should be noted that the persons cited are currently on staff and are available to provide QA support to interested customers.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
RISK REDUCTION ENGINEERING LABORATORY
CINCINNATI, OHIO 45268

May 9, 1990

Dr. Kerry Dance
Division Vice President
S-CUBED
(Division of Maxwell Lab, Inc.)
3398 Carmel Mountain Road
San Diego, California 92121

Dear Dr. Dance:

On September 19, 1989, S-CUBED was awarded a contract (68-C9-0051) with the Environmental Protection Agency to support to Quality Assurance (QA) Program of the Risk Reduction Engineering Laboratory (RREL). It was anticipated that by September 30, 1989, the RREL would have two additional support QA contracts. This, however, did not happen, and as a consequence, S-CUBED was called upon to perform in a capacity equivalent to three times the norm.

To address this critical situation, S-CUBED planned and implemented an action process that met the challenge by setting alternative solutions in motion. It is quite apparent that S-CUBED's QA support group is characterized by an organization of quality trained, motivated employees working in an atmosphere, established by management, that encourages initiative and trust, and where each individual's contributions are sought to upgrade quality.

Quality is a never-ending value and never truly attained. Once begun, it requires relentless discipline for continued improvement. S-CUBED has provided relentless QA discipline through the efforts of the following people:

Evelyn Bentley
Burt Blackburn
Ann Miller
Seth Schulberg
Greg Swanson
Tracey Vandermark
John Wallace

Recognition of noteworthy achievements in quality assurance is one of my most welcome responsibilities as an EPA QA manager. In this case, I am especially happy to applaud S-CUBED's vital support to the RREL QA Program. I would appreciate you personally acknowledging the meritorious contributions of these outstanding individuals.

Sincerely yours,

Guy F Simes

Guy F. Simes
Quality Assurance Manager

cc: Dr. Tony Burns, S-CUBED
Dr. Robert Beimer, S-CUBED

Figure 6-2. EPA Letter of Commendation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
RISK REDUCTION ENGINEERING LABORATORY
CINCINNATI, OHIO 45268

E. A. Burns, Ph.D
S-Cubed
Division of Maxwell Laboratories, Inc.
3398 Carmel Mountain Road
San Diego, California 92121-1095

September 4, 1990

Reference: Recognition of W. Burton Blackurn's Excellent Performance

Dear Tony:

I want to tell you how pleased I am with Burt's commendable leadership and performance in his QA/QC work on my EPA-RREL and Office of Pesticide Programs (OPP) DINOSEB incineration projects.

Over the past two or three years, his service on various pesticide incineration tests has consistently maintained a steady, high quality. But as I look back over the past year in particular, it is clear that his contributions went well beyond high-normal.

Examples I'd like to cite are Burt's expert problem identification, handling, and solving of the many severe deficiencies EPA was faced with during the QAPP, sampling and analytical procedures, and what I'll politely term "basic human engineering" issues in our demonstration burns at three or more major commercial incinerator facilities and their associated S&A contractors. In "face-to-(angry)-face" meetings, I was always glad Burt was there to firmly yet cordially get our points across. To put it simply, "Every time things got tough, Burt led us out of the woods to success."

Not to detract one iota from the above, but I would be remiss if I didn't also note the companion efforts of S-Cubed's John Wallace and Seth Schulberg who also played major roles in our DINOSEB and other pesticide incineration work. As I recall, they quickly turned around some really sticky and would-be show-stopping tasks like the search for the illusive properties and sources of unheard of surrogate dinoseb compounds and sorting out grizzly NOx CFR methodology, plumbing, and calibration issues for us so that they made sense in the end.

All I have left to say is "THANK YOU" for the good work!

Sincerely yours,

Donald A. Oberacker
Senior Mechanical Engineer
Thermal Destruction Branch
Waste Minimization, Destruction and
Disposal Research Division

cc: Clyde Dempsey
Don Eckerman
Guy Simes

Figure 6-3. EPA Letter of Commendation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
RISK REDUCTION ENGINEERING LABORATORY
CINCINNATI, OHIO 45268

December 30, 1991

Dr. Kerry Dance
Division President
S-CUBED (Division of Maxwell Lab, Inc.)
3398 Carmel Mountain Road
San Diego, CA 92121

Dear Dr. Dance:

On behalf of the outstanding quality assurance (QA) support provided by Mr. Burt Blackburn, Dr. John Wallace and their QA staff under contracts 68-C0-0017 and 68-C9-0051, a plaque is being presented to S-CUBED. Independent thinking, creativity in problem solving, perseverance in overcoming obstacles, and realization of goals provide the foundation upon which their accomplishments are based.

Mr. Blackburn's and Dr. Wallace's skillful and longstanding managerial leadership in promoting and shaping a QA responsive community has been absolutely critical to the evolution of quality assurance from a subsidiary technical function to the fundamental component it now represents. They indisputably exemplify the QA epigram "do the right thing right, the first time".

It has been said that "If there's a way to do it better...find it". S-CUBED has truly demonstrated their ability to find new, innovative answers to the wide range of situations encountered in the world of QA. I would like to commend them for their ceaseless efforts toward the promotion of quality and toward a cleaner environment. In like manner, I invite you to join RREL in recognizing the meritorious contributions of Mr. Burt Blackburn, Dr. John Wallace and their QA support staff.

Sincerely yours,

Guy Simes

Guy F. Simes
Quality Assurance Manager

cc: Dr. Tony Burns, S-CUBED

Figure 6-4. EPA Letter of Commendation.

Following are examples of significant QA projects that have been conducted by S-Cubed:

Quality Assurance Technical Services for EPA/ RREL

S-Cubed has been providing Quality Assurance Technical Services to the EPA-Cincinnati Engineering Research Laboratory since 1980 under six separate 3-year contracts. These task-order contracts have covered the entire spectrum of EPA mission responsibilities as they varied during period.

General work areas are (1) QA Project Plan preparation and evaluation, (2) Special field studies and analytical services, (3) Field Audits, (4) Report review and evaluation, and (5) Preparation of training materials.

EPA/68-C3-301 1993-1997
EPA/68-C0-0017 1990-1993
EPA/68-C9-0051 1989-1992

- Current project tasks include (1) Quality Assurance Project Plan reviews, (2) QA audits, (3) Final Report review and evaluation, (4) Experimental design, review and development, (5) QA tracking, (6) QA/QC information development, and (7) Revision of the RREL QA Program Plan.

EPA/68-03-4001 1986-1989

- Project tasks included (1) Quality Assurance Project Plan review, (2) Final Report review and evaluation, (3) QA audits, (4) Experimental design, review and development, (5) QA tracking, (6) QA/QC information development, and (7) Revision of the RREL QA Program Plan.

EPA/68-03-3181 1983-1986

- Project tasks included (1) Quality Assurance Project Plan reviews, (2) QA audits, (3) QA/QC review of final reports, and (4) Development of a QA tracking system (QTRAK) specifically for HWERL.

EPA 68-03-2920 1980-1983

- Work included investigation and verification of sampling methods, analytical chemistry techniques, survey and design studies, and data handling and analysis.
- Project Activities included (1) Quality assurance review and planning services in support of hazardous waste incineration programs, (2) Evaluation of practices for sampling and analysis of mining industry wastes, (3) Optimization of procedures for isolating and quantifying organic compounds from industrial solid wastes, (4) Assessment of sampling and analysis methodologies for synthetic fuel technologies, and (5) Several hazardous waste incineration project field system and performance audits.

Quality Assurance Plan–CRDEC (Army)
Contract USA DAAA15-86-C-0093 1986-1989

The objective of this project was to prepare an integrated Quality Assurance Plan for use by the U.S. Army AMCCOM.

The plan was to be applicable to all of the six mission directorates; research, munitions, detection, physical protection, environmental technology, and research and development.

- In the initial phase of the activity, S-Cubed reviewed existing quality control procedures and practices within CRDEC, assessed their general applicability, conducted a detailed systems audits with key personnel, identified quality assurance needs, and recommended approach for detailed assessment.
- In Phase 2, a comprehensive assessment of the prioritized CRDEC quality assurance needs was accomplished. A compendium of updated analysis methods used by CRDEC was prepared.
- In Phase 3, the information gained in the first two phases was reviewed and an overall QA Program Plan was prepared.

Technical Support for QA Program Plans
EPA/68-02-4445 1986-1988

S-Cubed conducted this 2-year project to provide support to the Quality Assurance Management Staff (AMS) in review of Agency QA Program Plans. The objective of the project was to:

- Assure that the Agency's 44 reporting organizations are covered by a complete QA Program Plan,
- Provide inventory of action items to assist QAMS in conducting Management Systems Audits of EPA's Regions, Project Offices, Research, Engineering and Monitoring Laboratories.

Quality Assurance Technical Support Services for EMSL/LV
EPA/68-03-1958 1984-1987

This project was a 3-year task-order to provide quality assurance technical support services to the EPA Environmental Monitoring Systems Laboratory in Las Vegas, Nevada (EMSL/LV).

- Technical service areas were (1) Measurement methods evaluation and standardization, (2) Quality assurance guideline development, (3) Quality assurance plan review and program development consultation, (4) External audits of environmental pollutant sampling and analysis, and (5) Equivalent and reference methods review and testing.
- Environmental pollutant media included: air, sediment, sludge, hazardous wastes, radionuclides, water,

biological tissue, pure and manufactured raw materials and products.

- Methods developed under this contract were used by the EMSL/LV laboratory to support the efforts of the EPA Office of Emergency and Remedial Response in executing the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA-Superfund).
- This project also supported the EPA Office of Solid Waste in the development and validation of methods for use under the Resource Conservation and Recovery Act (RCRA) and the EPA Office of Toxic Substances under the Toxic Substances Control Act (TSCA).

Quality Assurance Program Support for IERL/ RTP (Now AEERL)
EPA/68-02-3972 1984-1987

- This project was a 3.5-year, task order effort to provide services to support the EPA Quality Assurance/Quality Control Program of the Industrial Environmental Research Laboratory in Research Triangle Park, NC (IERL/RTP). This organization is now called the Air and Energy Environmental Research Laboratory.
- General work areas were (1) Technical review of Quality Assurance Project Plans, (2) Quality assurance audits, (3) Technical assistance with quality assurance, (4) Quality assurance methods development, and (5) Quality assurance management support.
- Work assignments included (1) QA review assistance, (2) Continued QA/QC tracking development, (3) Design and feasibility demonstration of a Regional QA Tracking System, (4) Development of standard operating procedures for data quality analysis methods, and (5) Review of QA Program Plans for the Quality Assurance Management Staff.

Sampling and Analysis Technical Services
EPA/68-02-3629 1980-1984

Several Work Assignments on Quality Assurance were conducted during the 3-year, 30,000-hour task order contract to provide sampling and analysis technical support to EPA-IERL/RTP.

- Specific QA-related tasks included (1) Design, development and implementation of an automated tracking system for IERL/RTP's QA/QC activities, (2) Conduct of systems and performance audits, review of Quality Assurance Project Plans and development of SOP's to support the IERL/RTP QA Program, and (3) Review and update of SOP's for data quality analysis methods.

Quality Assurance Technical Services for MERL
EPA/68-03-3105 1981-1983

This project was a 2-year task order effort to support the quality assurance program of EPA's Municipal Environmental Research Laboratory, Cincinnati.

- Work included (1) Quality assurance method evaluation and development, (2) Special field studies and services/analytical service/data analysis/verification, (3) Project plans and guidance: support in preparation and review, field audits, system performance, inspection verification, and review, and (4) Evaluation of reports, technical outputs, preparation of necessary training materials.

Implementation of Agency-Wide Quality Assurance Program
EPA/68-02-3656 1980-1983

Technical services were provided to EPA's Quality Assurance Management Staff to ensure that the Agency's quality assurance policy was implemented in each Program Office, Regional Office, National Laboratory and State or other organizations.

- This project consisted of (1) Review and assessment of Quality Assurance Program Plans, (2) Survey of current status of quality assurance implementation within EPA, (3) Development of procedures for measuring cost of quality, (4) Development of procedures to assess failure costs, (5) Technical reviews of major EPA monitoring and measurement regulations, (6) Evaluation of QA reporting needs, (7) Development of QA training programs, (8) Development of the system for conducting on-site audits of QA program implementation, and (9) Conducting QA program audits.
- The objective was to assure that all EPA-acquired environmental data were complete, representative, comparable, valid and of known and adequate precision and accuracy.

7 SAMPLE AND DATA MANAGEMENT

The S-Cubed sample management and document control program ensure that all client needs for safety, custody, and documentation are met.

The S-Cubed procedures and specifications for sample and data management are designed to meet CLP, DOE, and DoD requirements. This is a result of our 10 years of participation in the EPA Contract Laboratory Program (CLP) as well as performance on many DOE and DoD contracts.

7.1 SAMPLE MANAGEMENT AND CHAIN OF CUSTODY

The sample management and analytical documentation procedures used at S-Cubed are designed to meet EPA CLP, DOE and DoD requirements as well as satisfy most other client needs. All samples are received under a strict chain-of-custody and are analyzed by procedures that follow good laboratory practices. The samples and extracts are tracked and accounted for at all points in the laboratory. The original sample analysis data are captured in a permanent form along with the appropriate documentation to support their quality. A sufficient level of redundancy exists so that all information can be verified from one or more sources.

Samples are received for S-Cubed Chemistry by the sample custodian in the Chemistry receiving area. The samples are assigned unique S-Cubed lot and sample numbers and are logged into the S-Cubed LIMS by Sample Delivery Group (SDG). Login documentation and internal tracking documents are then prepared automatically by the LIMS. The documentation is distributed to the analysts and departments requiring it, and the samples are stored in the appropriate locked walk-in refrigerators, VOA refrigerators, or other secure storage areas. Access to the samples is obtained through the sample custodian. The S-Cubed LIMS tracks sample progress throughout the laboratory capturing key dates and times such as sample receipt, sample extraction, and sample analysis. This data is used to monitor laboratory performance and throughput as well as to track and monitor holding time performance.

Hard copy Internal Traffic Logs are also used to document and track the progress of samples, extracts, and digests through each step of preparation and analysis for each matrix and method required. Extraction and instrument logs, sample tags, and analyst's notebooks are also kept and provide redundancy in sample tracking, preparation, and analysis documentation. Sample tags are prepared for each extract and digest and remain with them until their ultimate disposal. After all work has been completed, copies of the data, result summaries, sample documentation, logbooks, and other information are collected together in a Sample Delivery Group (SDG) file and are given to the reporting group for review and report preparation. After appropriate review and project manager approval, the report is released and the SDG file of original documents is given to the document control officer for archiving. The samples and extracts are also archived for retrieval, reanalysis, and eventual disposal as necessary. These actions are recorded on the appropriate internal traffic logs and in the LIMS. Figure 7-1 provides an illustration of the sample management process specifically for extractable organic analysis.

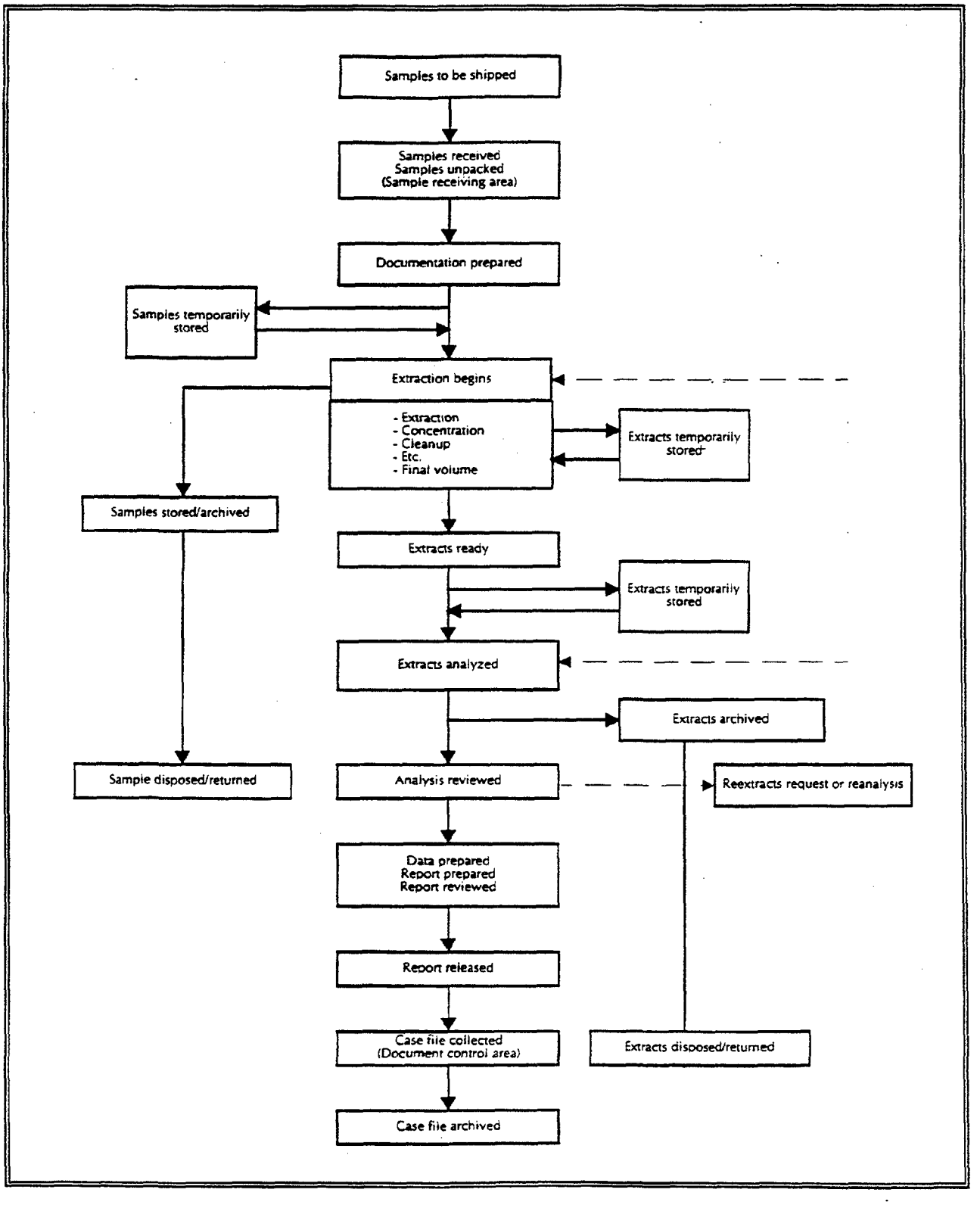


Figure 7-1. Sample and extract flow for extractable organics.

7.2 MIXED WASTE SAMPLE MANAGEMENT

Because of the safety and material control requirements for mixed waste samples, special precautions are taken in receiving and handling. These precautions are documented in SOPs and training programs and are described briefly below.

Mixed waste samples are handled using the same procedures as regular samples with regard to custody and documentation. However, a number of additional procedures are required to ensure safe handling and materials management. Mixed waste samples received by S-Cubed must be accompanied by preliminary screening information regarding radioisotope contamination. Upon receipt at the laboratory, the outside of the shipping container, as well as the sample containers, are surveyed to ensure safe handling. Each sample is further screened for gross alpha and beta activity and, in some cases, tritium levels to determine proper handling procedures. Samples which have activities exceeding S-Cubed's handling limits are returned to the client.

Samples determined to have radioisotope contamination are entered into a radiation materials data base and all aliquots of the samples are tracked. Only limited quantities of sample are distributed to the laboratories for analysis and these aliquots are returned to the controlled sample storage area following analysis. All transfers are documented in the radioactive materials data base. All mixed waste samples are returned to the customer site after 60 to 90 days. These mixed waste handling procedures are summarized in Figure 7-2.

Sample storage and handling areas are monitored by daily, weekly, and monthly surveys and all laboratory activities involving radioactive samples are monitored as necessary. A radioactive materials inventory is maintained to ensure that total sample activities do not exceed our licensing limits,and to track and document radioactive materials throughout our facility. The S-Cubed Radiation Safety Officer provides oversight for all of these activities.

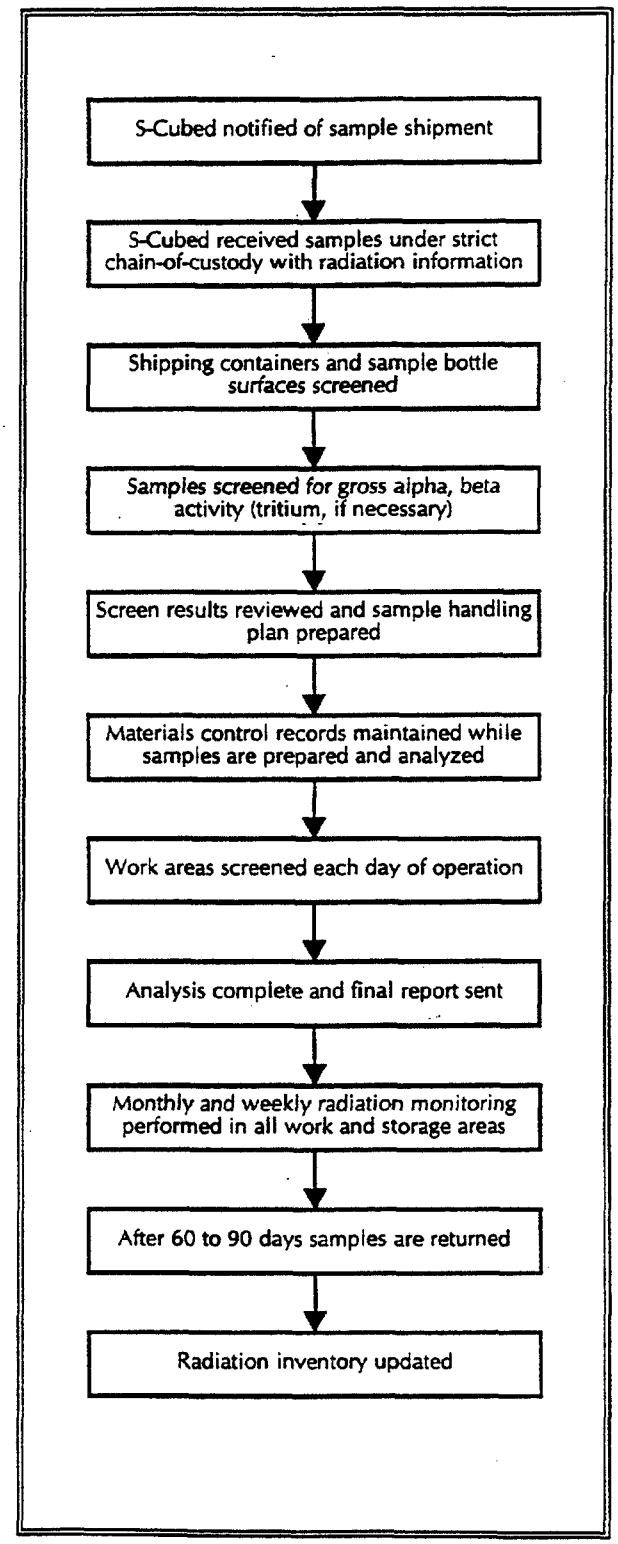


Figure 7-2. Mixed waste sample handling operations.

After analysis, radioactive samples are returned to the client for proper storage or disposal. The client is notified in advance of shipments of samples and related materials and is provided with a complete inventory of the materials being returned. All materials are shipped according to appropriate DOT requirements.

S-Cubed's facilities are designed for high sample throughput with documented quality.

7.3 S-CUBED LIMS

The S-Cubed Laboratory Information Management System (LIMS) was designed and constructed by the S-Cubed full-time programming staff. The LIMS is continually evolving to serve our needs, and those of our clients. It is a state-of-the-art tool that tracks samples, prepares hard copy and diskette deliverables, and provides management and accounting information. It is a Novell Network 3.1, MS-DOS PC based system with a 386 computer as the network server. The network employs mirrored 650 MB hard disks, a 1.2 GB tape backup system, and an uninterruptable power supply to ensure data integrity. There are currently over 35 PCs connected to the system directly, with an additional 15 PCs and 11 minicomputers connected indirectly to the system.

The network server provides:

- Central data storage for analytical data and software.
- A common secretarial data storage area.
- Print services for laboratory reports and proposals.

The network software is Novell Netware 3.11, which receives excellent support in the PC environment. Server connections use 16 bit ethernet cards connected by a thin coaxial cable. External computers are connected to the network via 9600 baud modems. Printing services are provided by 3 HP Laser Jet IIISI printers, two HP Laser Jet III printers, one NEC LC-890 postscript printer, and numerous dot matrix printers.

Data is stored in the LIMS using the Paradox data base system. The user interface is based on Microsoft Windows and conforms to the System Application Architecture (SAA) standard that exists for graphical applications. Paradox is a fully relational data base that is capable of any data storage and inquiry operation that may be required. The data base is actually several data bases arranged in a hierarchal structure, as shown in Figure 7-3.

The LIMS is written in the C++ programming language. The object-oriented programming model that this language provides has given the LIMS the flexibility to meet a wide variety of client needs. The data base structure is designed to hold all information that is currently needed, and is able to accept new data requirements easily. It is a flexible system that evolves over time to meet new customer and managerial requirements. The system is capable of accepting new data items in the data base structure at any time without affecting any of the items already in place. The data base system is designed to provide real-time information on any sample in the laboratory through the use of customer and analysis codes. All data is backed up on digital tape for archival storage.

The S-Cubed LIMS is designed to provide the following services:

- Data collection.
- Data reporting (hard copy and electronic deliverables).

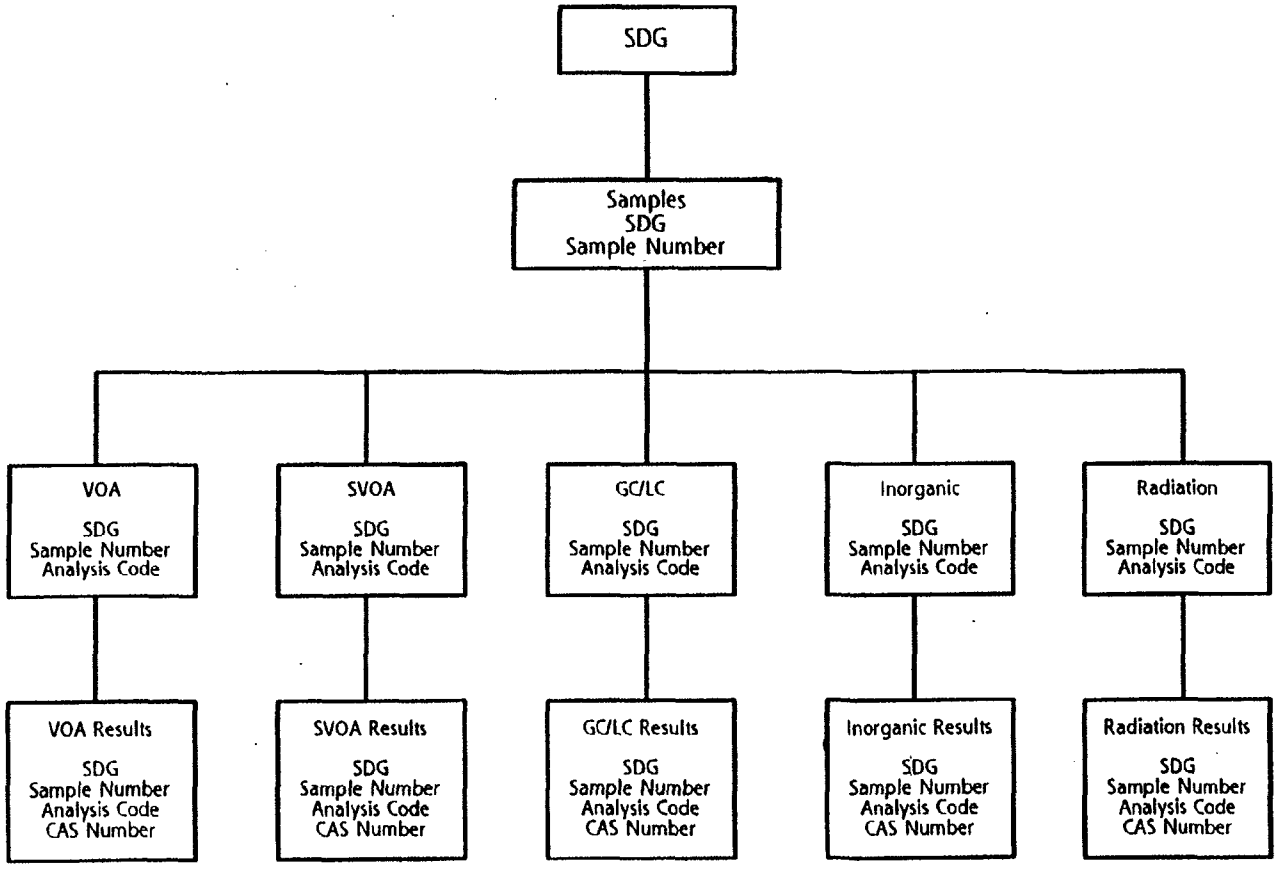


Figure 7-3. S-Cubed LIMS data base structure.

- Sample management.
- Laboratory performance monitoring.
- Quality assurance support and statistical process control.
- Administrative and accounting management.

The design of the LIMS is based on the reporting module in order to provide the most flexible reporting capabilities.

The LIMS is used to prepare all of our hard copy and disk deliverables. This system is capable of preparing forms for organic, inorganic, and radio-chemistry data in a CLP-like format for fully validatable data packages. S-Cubed can provide electronic deliverables in most commercially available software formats, including Lotus 123, dBase III, WordPerfect, and numerous ASCII file formats, both delimited and column specified. The LIMS is also capable of the electronic transmission of data and reports. Table 7-1 summarizes our electronic transmission capabilities.

All of S-Cubed's automated instrumentation is connected to the LIMS so that the analytical results from each the instruments are automatically read into the system. Thus, analytical results are not subject to human error in the transfer from the instrument to the LIMS. This results in increased data quality and reliability. In addition, many of the data transfer programs have quality control checking functions to provide additional data review.

The S-Cubed LIMS has significant capability in automating data review and reporting, which greatly increases report preparation capacity as well as improving report quality.

7.4 DATA MANAGEMENT AND DOCUMENT CONTROL

Data management and reporting are critical aspects of any analytical project. S-Cubed maintains state-of-the-art capabilities in data capture, data transmittal and reporting functions utilizing our extensive computer facilities. Hardcopy data and reports are maintained in a central document control area while

TABLE 7-1. S-CUBED ELECTRONIC DATA TRANSFER CAPABILITIES

Data can be Transferred by:	
Modem	▸ All baud rates from 300 to 14,400. ▸ All file transfer protocols with both hardware and software error correction.
Floppy Disk	▸ All MS/DOS formats. ▸ All Macintosh formats.
Magnetic Tape	▸ Streamer tape. ▸ 9-Track. ▸ Other popular formats as required.
10 Mega Bernoulli Box	
MCI Mail	
EPA E-Mail	
CompuServe	
Fax	S-Cubed Chemistry has two in-house fax machines. ▸ (619) 637-7401 ▸ (619) 637-7403

magnetic data archives are maintained in separate storage areas. The document control officer maintains these data archives, which include on-site short-term storge and off-site long-term storage.

S-Cubed has the capability to provide data security under Confidential Business Information procedures, including locked storage and limited access.

7.5 DATA REPORTING CAPABILITIES

S-Cubed is fully capable of preparing reports and special documents dealing with any of the elements of a multi-faceted project. S-Cubed personnel have prepared many types of written and verbal communications dealing with a wide variety of technical and research subject areas. The types of reports prepared in the past include detailed progress reports, technical manuals, procedure manuals, measurement activities summaries, guideline documents, summaries of technical meetings, and specific topic symposia reports.

S-Cubed staffs a central Reporting Group which specializes in preparing and reviewing analytical data reports for environmental activities. The staff specializes in the review and validation of analytical chemistry data as well as the operation of the reporting modules of the S-Cubed LIMS. All reports are processed through this group, which also coordinates activities dealing with the client's data validators. In addition to this staff, S-Cubed maintains a central publications center where the reports are reproduced.

S-Cubed can provide a wide range of analytical data reporting formats from simple summary reports to fully validatable report packages, such as those required by the CLP. Figures 7-4 through 7-8 provide outlines for reporting formats and for the narratives which are provided with all reports.

In addition to hardcopy data reporting, S-Cubed is capable of electronic transmission of data and reports. Data can be provided in most commercially available software formats, including Lotus 123, dBase III, and WordPerfect. S-Cubed also has in-house programming capabilities to develop custom software capable of meeting almost any electronic deliverable need.

MAXWELL
S-CUBED Division

Data Package Check List

Final Report Sequence

- Cover Letter ☐
- Sample Summary ☐
- Chain-of-Custody Documentation ☐

- Analysis Narrative ☐
- Sample Batch Results Summary ☐

- VOA GC/MS Data ☐
- BNA GC/MS Data ☐
- VOA GC Data ☐
- OC Pesticide GC Data ☐
- OP Pesticide GC Data ☐
- Herbicide GC Data ☐
- Other GC Analysis Data ☐
- _____ ☐

- Trace Metals Data ☐
  - ICP Data ☐
  - GFAA Data ☐
  - FAA Data ☐
  - CVAA Data ☐
  - Cyanide Data ☐

- Inorganics Data ☐
  - _____ ☐
  - _____ ☐
  - _____ ☐
  - _____ ☐
  - _____ ☐
  - _____ ☐
  - _____ ☐
  - _____ ☐
  - _____ ☐

Figure 7-4. Final report sequence data package check list.

MAXWELL S-CUBED Division

Data Package Check List

Method _____ **ORGANICS**

Analysis Narrative	☐
ITL	☐
Run Log Copy	☐
Extraction Log Copy	☐
Cleanup Log	☐

DATA PACKAGE

QC Summary

Surrogate Recovery Summary	☐	Form 2	Version:
MS/MSD Summary	☐	Form 3	
Blank Summary	☐	Form 4	
Tuning Summary	☐	Form 5	
Internal Sandard Summary	☐	Form 8	
Lab Control Sample Summary	☐	Form 10	

Sample Data

Sample Results Summary	☐	Form 1_	Version:
TIC Summary	☐	Form 1_	
Raw Data			
Chromatograms, Quant Reports	☐		
Spectra	☐		
Calculations (Sample)	☐		

Calibration Data

Initial Calibration (GC/MS, GC)	☐	Form 6	Version:
Continuing Calibration (GC/MS, GC)	☐	Form 7	
CLP Pesticide Run Sequence	☐	Form 8D	
CLP Pesticide Standards Summary	☐	Form 9	
CLP Pesticide Identification	☐	Form 10	
Calibration Raw Data	☐		

QC Data

Tun Raw Data	☐	
Blanks		
Summary	☐	Form 1
Raw Data	☐	
MS/MSD/Replicate		
Summary	☐	Form 1
Raw Data	☐	
LCS		
Summary	☐	Form 1
Raw Data	☐	

Supplemental Information	
MDL Studies	☐
Precision and Accuracy Studies	☐
Cleanup Check Samples	☐

Figure 7-5. Organic data package check list.

MAXWELL S-CUBED Division

Data Package Check List

Method _____ **TRACE METALS**

Analysis Narrative	❒
ITL	❒
Run Log Copy	❒
Digestion Log Copy	❒
Distillation Log	❒

Analysis Summary

Cover Page	❒	
Sample Results	❒	Form 1
Initial & Cont. Calibration	❒	Form 2A
CRDL Standard	❒	Form 2B
Blank Results	❒	Form 3
ICP Interference Check	❒	Form 4
Spike Sample Recovery	❒	Form 5A
Post Digest Spike Recovery	❒	Form 5B
MS/MSD Summary	❒	Form 5C
Duplicate Summary	❒	Form 6
Lab Control Sample	❒	Form 7
Standard Addition Results	❒	Form 8
ICP Serial Dilution	❒	Form 9
Holding Times	❒	Form 10
Instr. Detection Limits (Qtrly)	❒	Form 11
ICP Interelement Correction (Qtrly)	❒	Form 12A
ICP Interelement Correction (Qtrly)	❒	Form 12B
ICP Linear Ranges (Qtrly)	❒	Form 13
Analysis Run Log	❒	Form 14
ICP/MS Tuning	❒	From 14

Raw Data

ICP Run Printouts (Copies)	❒
GFAA Run Printouts (Copies)	❒
CVAA Bench Sheets and Printouts (Copies)	❒
CN Bench Sheets	❒

Supplemental Information

MDL Studies Raw Data	❒
Linear Range Studies (ICP)	❒
Precision & Accuracy Studies	❒

Figure 7-6. Trace metals data package check list.

MAXWELL
S-CUBED Division

Data Package Check List

Method _____ INORGANICS

Analysis Narrative	❒
ITL	❒
Run Log/Bench Sheet Copy	❒
Preparation/Distillation Log Copy	❒

Analysis Summary

Sample Results	❒	Form 1
Initial & Continuing Calibration	❒	From 2A
CRDL Standard	❒	From 2B
Blank Results	❒	Form 3
Spike Sample/MS/MSD Results	❒	Form 5
Duplicate Summary	❒	Form 6
Lab Control Sample	❒	Form 7
Standard Addition Results	❒	Form 8
Serial Dilution	❒	Form 9
Holding Times	❒	Form 10
Inst. Detection Limits	❒	Form 11

Supplemental Information

MDL Studies Raw Data	❒
Linear Range Studies Raw Data	❒
Precision & Accuracy Studies	❒
Other _____	❒

Figure 7-7. Inorganic data package check list.

MAXWELL S-CUBED Division

Narrative Outline

NARRATIVE

Project
Reference No.
Analysis

1. Methods Notes: Brief description of method and any alternatives or modifications, including reference, i.e., Method 8260 SW-846 3rd Edition, Revised 1988, and S-CUBED SOP number. May include instrument parameters.

2. Sample Results Notes: Brief summary of what was or was not found in samples. Summary of samples requiring reanalysis or dilution.

3. QC Results: Brief summary of QC results that did not meet specification and any comments on suggested causes and on corrective actions taken. Notes on effect of QC failure on data. QC to consider includes: holding time, calibration, blanks, surrogates, MS/MSD/replicate, LCS.

4. Notes on other Difficulties: Problems with interferences, sample size, problems in extraction, i.e., not enough sample, etc.

5. Summary: Brief overview that may include comparisons to results from other analyses, comments on general acceptability of data.

Approved by:

_____
Project Manager

Figure 7-8. Example of narrative.

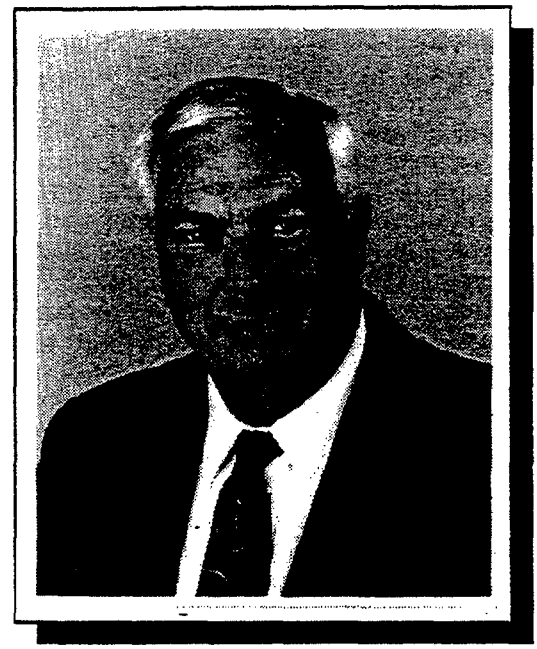
A

APPENDIX A
RESUMES

R.G.	Beimer	Sr. Vice President and Environmental Chemistry Sector Manager
R.L.	Calentine	GC/LC Laboratory Supervisor
J.T.	DeWald	Laboratory Operations Manager
J.E.	Goodin	Quality Assurance Coordinator
M.D.	Hatcher	GC/MS Laboratory Supervisor
M.	Mayahi	Preparation Laboratory Supervisor
L.E.	Michalec	Systems Manager
L.T.	Nguyen	Reporting Group Supervisor
R.B.	Phillips	Metals Laboratory Supervisor
R.	Sobilo	Radiation Safety Officer
J.R.	Wallace	Quality Assurance Support Manager
H.V.	Weiss	Consultant - Radiochemistry Laboratory
J.E.	Wilkinson	Manager, GC/MS Group

ROBERT G. BEIMER

Manager, Environmental Chemistry Sector



SUMMARY OF QUALIFICATIONS

- Ph.D. Analytical Chemist with over 25 years of experience in mass spectrometry and in supervision and management of analytical chemistry services.
- Sixteen years of experience in the management of Environmental projects involving the characterization of organic and inorganic toxic materials from multimedia sources.
- Experience in the design and development of analytical instrumentation.
- Contributed to the development of USEPA Procedures 1624 and 1625 involving the use of stable labeled isotopes to facilitate quantitation and recovery of analytes in the determination of priority pollutants.
- Contributed to the USEPA Effluent Guidelines Division work in characterizing pollutants in both energy and mining industry wastes which resulted in a Certificate of Appreciation Award from the USEPA in June, 1980 for *Important Contributions to Methods Development for Priority Pollutant Analysis.*

EDUCATION

Ph.D. in Analytical Chemistry, University of Arizona, 1969
B.S. in Chemistry, Iowa State University, 1965.

EXPERIENCE

S-Cubed (1985 - Present): Sr. Vice President and Manager, Environmental Chemistry Sector.

As Vice President and Manager of the Environmental Chemistry Sector, Dr. Beimer is in charge of 45 professionals who successfully complete about $5 M/year in contracted analytical services. He oversees all of the processes of an environmental chemistry laboratory. This includes the processing of samples of all types of matrices, and familiarity and specific experience with the basic analytical methods.

Two of Dr. Beimer's more notable projects with S-Cubed were multi-year methods development efforts for the USEPA (EMSL-LV and EMSL-Ci). As a part of these projects, the S-Cubed staff developed and validated 20 methods currently used in SW-846 and the CLP. Some of the more significant methods include:

- The current CLP pesticide procedure.
- The high concentration protocol (CLP).
- The low detection limit protocol (CLP).
- Validation of 8270 for Appendix IX analytes.
- Validation and training on the TCLP (Method 1311).

In addition to these methods, he has also developed, validated, and continues to implement EPA Methods 1624 and 1625. Dr. Beimer used these methods to perform the organic analysis portion of the USEPA National Sewage Sludge Survey. He recently presented five workshops across the country on the application of Methods 1624 and 1625 for the USEPA Office of Water.

Dr. Beimer managed and served as principal investigator for an Army project to design and construct an ultra high sensitivity atmospheric pressure ionization mass spectrometer capable of

detecting part-per-trillion levels of chemical agents in the atmosphere around incinerator facilities.

Hewlett Packard chose S-Cubed to serve as a beta test site for their new GC microwave induced plasma (MIP) atomic emission detector (AED). Dr. Beimer served as principal investigator for that study. The instrument was critically evaluated over a period of 8 months to determine its usefulness for the analysis of environmental samples. As a result of the study, four invited lectures were presented at technical meetings. The 50+ technical papers he has published or presented on GC/MS and related environmental topics symbolize his commitment to analytical chemistry.

Dr. Beimer conducted on-site audits of two Directorates of the Chemical Research, Development, and Engineering Center (CRDEC) as part of a larger effort to prepare an overall QA program plan for the U.S. Army.

TRW (1977 - 1985): Manager, Chemistry Department.

During his 8 years at TRW, Dr. Beimer managed USEPA projects on (1) Characterization of Multimedia Industrial Process Streams and Environmental Samples, (2) GC/MS Analysis Methods Development, and (3) The Development of Improved Environmental Assessment Protocols Relating to Health Effects and Decision Criteria. Perhaps his most sensitive responsibility was that of project manager for sampling and analysis in support of the Love Canal Contamination Study. Isotope dilution priority pollutant analysis of energy and mining wastes is one of the numerous analytical methods he helped the USEPA develop. His work on this project earned him a USEPA Certificate of Appreciation Award.

DuPont (1973 - 1977): Supervisor, Mass Spectrometry Applications Laboratory, Instrument Products Division.

Dr. Beimer's principal methods development responsibilities while at DuPont were trace level analysis of toxic substances using high sensitivity GC/MS, chemical ionization techniques, and capillary GC/MS. In addition to supervising the applications laboratory, he assisted in the design, development, and application of a new GC/MS/DS.

Celanese Research Company (1969 - 1973): Research Chemist, Mass Spectrometry Section.

At Celanese Research, Dr. Beimer performed methods development and chemical analysis using GC/MS, TGA/MS, and HRMS. One of his projects was the determination of mechanisms of flammability and flame retardant properties of polymers used in the manufacture of children's sleepware.

University of Arizona (1965 - 1969): Graduate Research Associate, Department of Chemistry.

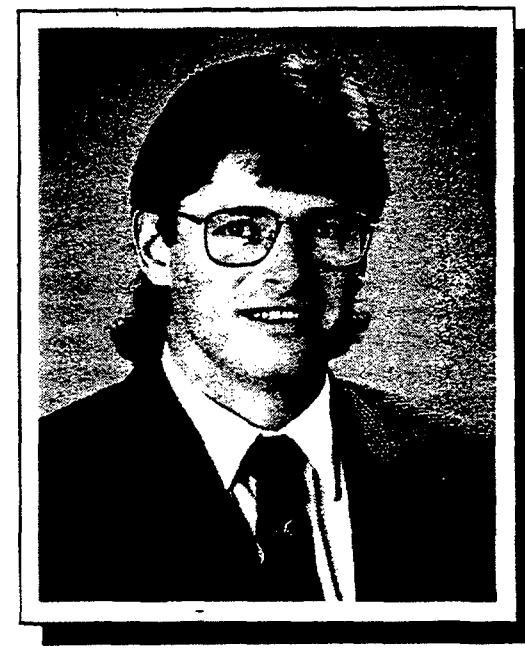
Dr. Beimer's graduate research was in the area of mass spectrometric determination of organometallic stability prediction based on molecular theory and fragmentation pathways.

AFFILIATIONS

American Chemical Society
American Society of Mass Spectrometry

RANDAL L. CALENTINE

GC/LC Laboratory Supervisor



SUMMARY OF QUALIFICATIONS

- Supervisor of the gas chromatography/high performance liquid chromatography sector.
- Chemist with 8 years of experience in laboratory analysis.
- Seven years of experience in pesticide analysis using gas chromatography and high performance liquid chromatography.
- Considerable expertise in instrument maintenance, operations, and troubleshooting.

EDUCATION

B.S. in Biology, minor in Chemistry, University of Wisconsin - River Falls, 1985.

EXPERIENCE

S-Cubed (1992 - Present): GC/LC Laboratory Supervisor.

Mr. Calentine is responsible for the supervision of the GC/LC analytical group. He provides technical assistance as well as assistance with instrumentation. He is an accomplished analyst of organochlorine and organophosphorous pesticides/PCBs and herbicides by gas chromatography according to EPA methods. Specific responsibilities include the operation and maintenance of gas chromatographs including autosamplers, capillary columns, and electron capture detectors. He is an expert in the analysis of explosives by HPLC using SW-846 Method 8330. He has experience with SW-846 Methods 8020, 8310, and 8015M. Further responsibilities include electronic data acquisition, reduction, and reporting utilizing a DEC Micro Vax II computer running a VMS operating systems and PE Nelson Access Chrom chromatographic software.

Additionally, Mr. Calentine is responsible for the review of each GC/LC data package. He also is responsible for troubleshooting, scheduling, customer interface, and methods development. Under his supervision, the GC/LC laboratory has increased the number of routinely performed analyses by 40% during 1993.

Twin Cities Testing Corp. (1990-1992): Scientist II.

At Twin Cities Testing, Mr. Calentine was responsible for the analysis of pesticides, herbicides, and PCBs in numerous matrices by gas chromatography. He gained experience with EPA Methods 515, 608, 8080, 8141, and 8150. He served as a project manager and methods development supervisor. He also provided GC technical assistance to the Good Laboratory Practices studies team. He collected and reduced chromatographic data using Multichrom Chromatography data software on a DEC VAX mainframe computer.

Hazelton Wisconsin, Inc. (1988-1990): Research Assistant/Study Coordinator.

Mr. Calentine was the study coordinator of the studies regulated by the Good Laboratory Practices guidelines. He was responsible for the extraction, purification, and GC analysis of pesticides in wide variety of matrices. As a part of this position, he gained experience with high performance liquid chromatography instrumentation as well as GC/ECD and GC/NPD. He performed data collection and reduction on an HP 1000 mainframe computer running L-Plot chromatography software.

Department of Veterinary Science, University of Wisconsin (1985-1987): Research Specialist

Mr. Calentine participated in a large predator-prey fish study of the Great Lakes region. This involved the collection, dissection, and inspection of the anatomy of over 200 species of fresh water fish.

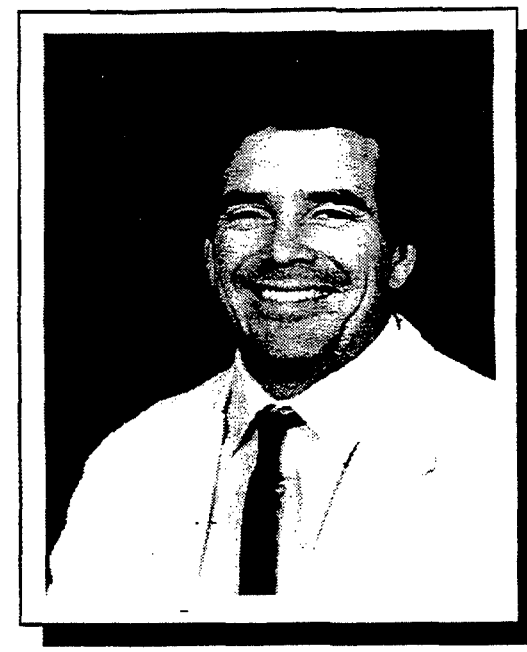
His work involved the preparation of bacteriology and virology media, the organization of field kits for fish health certifications, and participation in disease inspections. Mr. Calentine utilized numerous laboratory techniques, including the maintenance and isolation of bacteria cultures, and the operation of a Minitek Bacteria Differential System.

He also performed bacteria sensitivity tests and fluorescent antibody techniques. Additionally, he set up a database for fish health inspection reports and was responsible for laboratory maintenance and the ordering of supplies.

Wisconsin Department of Natural Resources (1987-1988): Research Specialist

Mr. Calentine was involved with certification of numerous federal fish hatcheries. His duties included the sampling and analysis of water, fish, and other biota to determine compliance with federal regulations.

JOHN T. DEWALD
Laboratory Operations Manager



SUMMARY OF QUALIFICATIONS

- Sixteen years of continuous experience in providing laboratory analysis services, including 10 years as a laboratory supervisor and manager.
- Broad familiarity and direct experience with all basic analytical methodologies, including volumetric, gravimetric, colorimetric, ion electrode, and wet chemistry techniques, as well as advanced instrumentation, including gas and liquid chromatography, mass spectrometry, atomic absorption spectrophotometry, inductively coupled plasma spectroscopy, gamma-spectrometry, and proportional and scintillation counting.
- Experience in the processing of all types of sample matrices, including air, water, and solids; detailed experience with complex, high-level hazardous waste, contaminated soil, and groundwater matrices.

EDUCATION

B.A. (eq.) in Chemistry, Purdue University, 1984.

EXPERIENCE

S-Cubed (1986 - Present): Manager, Laboratory Operations.

Mr. DeWald's current responsibilities include managing analytical services in support of commercial clients, S-Cubed engineering assessment and site investigation projects, and government subcontracts. In this capacity he coordinates sample shipment to the S-Cubed laboratories, selection of sample preparation and analytical methods, laboratory scheduling, data reduction and reporting. He also coordinates analytical services for non-routine analyses, including radiological, bacteriological, and geotechnical parameter analyses, and provides troubleshooting expertise when necessary.

Mr. DeWald was instrumental in the establishment of S-Cubed's radiochemistry laboratory. He purchased the instrumentation currently in use and performed some of the initial analyses. He is currently the manager of the radiochemistry laboratory.

He has been intimately involved with the development of S-Cubed's LIMS. Utilizing his knowledge of software and working closely with the programming staff, he has assisted in formulating S-Cubed's reports for inorganic parameters.

One of his previous responsibilities was that of the day to day operation of the Inorganic Analysis Laboratory at S-Cubed. The duties included management of personnel, scheduling for CLP and commercial projects, preparation of reports, and technical guidance.

He was also the supervisor of the sample preparation section of the analytical chemistry laboratories; responsible for managing sample receipt, timely preparation of samples for analysis, including EP/TCLP extractions, coordinating and scheduling subsequent analytical requirements, consolidation and review of all sample data, and customer liaison. He also monitored laboratory support functions, including consumables procurement, sample tracking and management, and SOP development/revision.

Mr. DeWald has performed a wide range of technical and managerial tasks at S-Cubed including developing and expanding analytical capabilities

and capacity, methods development and research project support, quality assurance support and project management.

Specific examples of capabilities development projects include: designing and implementing improvements to the facilities and procedures for organic sample preparation to increase the quality, capacity and efficiency of CLP and RCRA sample preparation. He has also increased the capabilities and capacity of wet chemistry and trace metals analysis including developing CLP inorganic analysis capabilities. The installation and development of ICP/MS was another of his efforts. Expansion of CLP capabilities using Hewlett Packard 5970 MSD instrumentation to increase production efficiency and capacity required him to develop software to automate much of the analysis and data reduction. The software developed under this task is currently part of the standard Hewlett Packard GC/MS data processing package.

Mr. DeWald has extensive experience in methods development. His work includes a broad range of efforts. One specific project addressed TCLP methods development. Some of the tasks for this effort included evaluating the TCLP cage modification, developing solutions to oily waste TCLP performance problems and using the ZHE apparatus for leaching cyanide. He managed and prepared the final report for the validation of EPA SW-846 methods 8081, 8141, and 8270 for the BDAT compounds. Other methods development projects include a colorimetric method for determining formaldehyde in groundwater, developing methods for the analysis of organochlorine, organophosphorus, and carbamate pesticides residues in avian brain tissue and evaluating the performance of semivolatile organic extraction procedures.

The most significant of his research projects at S-Cubed determined the partitioning behavior of toxic organic compounds in lagooned sewage sludge as part of the EPA National Sewage Sludge Survey.

As part of his management responsibilities Mr. DeWald has helped design and develop many laboratory operating procedures. These include the sample management and documentation procedures and many of the general laboratory SOP's. He has also developed and written many of the inorganic wet chemistry, trace metals, and leaching procedures.

Quality Assurance Laboratory (1984 - 1986): Laboratory Supervisor.

Mr. DeWald's functions included both performing and supervising analyses of water, wastewater, hazardous waste, industrial quality control, agricultural pesticide, and asbestos projects. His duties included marketing, pricing, client relations, instrument procurement and laboratory set up, sample management, quality control, safety SOP development, methods development, sampling and sample analysis. The specific instrumentation he used included AA, ICP, emission spectroscopy, GC, GC/MS, purge and trap, headspace, ion chromatography, TOC/TOX, wet chemistry and bacteriology.

Purdue University (1978 - 1984): Laboratory Supervisor, Professorial Assistant, Research Assistant, Laboratory Technician.

As a graduate student Mr. DeWald participated in various research projects that included work in enzymology, molecular biology, genetics, parasitology, and ecology. He supervised an electrophoresis laboratory and managed an animal facility housing human parasites.

JANE E. GOODIN
QA Coordinator

SUMMARY OF QUALIFICATIONS

- M.S. Chemist with over 10 years of experience as a laboratory scientist and specialist in quality assurance.
- Performed methods validation for EPA on the effects of preanalytical holding times on toxic waste samples while at Oak Ridge National Laboratory.
- Prepared quality assurance plans for the Department of Defense (U.S. Army).
- Has a thorough knowledge of general analytical chemistry as applied to environmental problems.
- Certified Quality Engineer by the American Society for Quality Control.

EDUCATION

M.S. in Organic Chemistry, University of Kentucky, 1979.
B.A. in Chemistry, Smith College, 1975.

EXPERIENCE

S-Cubed (1988 - Present): QA Coordinator.

As the quality assurance coordinator for the S-Cubed chemistry group, Ms. Goodin is responsible for the daily quality assurance/quality control functions. She assists the QA Manager in preparing and evaluating internal quality control samples and in reviewing data for adherence to contract and S-Cubed requirements. In addition, she maintains control charts for critical parameters to demonstrate that the quality of the data is being held within acceptable limits of variation. She also performs internal laboratory audits in order to ascertain that all methods are being followed. Ms. Goodin reviews laboratory standard operating procedures. She maintains correspondence related to quality assurance and accreditations, as well as the comprehensive QA files for the department.

Ms. Goodin reviews data on numerous samples from soil, water, air, and biological media for routine and non-routine analyses, as performed by ICP, AA, IC, and by wet chemical methods. She reviews the data produced to ensure that all quality assurance/quality control requirements are met. Additionally, she assists with client interface.

Previously at S-Cubed, Ms. Goodin supported the EPA RREL QA support project by performing project plan reviews and provided support to the S-Cubed quality assurance project with CRDEC (U.S. Army) by preparing a standardized methods manual and the CRDEC quality assurance project plan for surety materials.

Oak Ridge National Laboratory (1986 - 1988): Research Associate.

While at ORNL, Ms. Goodin conducted experimental studies on the effects of holding times on analytical results for volatile organic hazardous waste and explosive samples. Additionally, she was responsible for drafting a comprehensive quality assurance plan for chemical weapon demilitarization facilities.

IMED Corporation (1982 - 1986): Quality Control Chemist.

At IMED Ms. Goodin was responsible for the operation of the quality control chemistry laboratory in support of a medical device production line. Testing involved the measurement of the quality of plastic raw materials, solvents, and miscellaneous production components. As a part of this position, she developed and refined test methods to increase laboratory productivity.

Bio-Research Inc. (1979 - 1982): Junior Research Chemist.

At Bio-Research Ms. Goodin performed organic synthesis of materials, including peptides and polymers, and used analytical instrumentation to determine their structure and purity.

AFFILIATIONS

American Society for Quality Control
American Chemical Society
Society of Sigma Xi

MARK D. HATCHER

GC/MS Laboratory Supervisor

SUMMARY OF QUALIFICATIONS

- Chemist of distinguished educational background with 14 years of experience in GC/MS analysis of environmental samples; in-depth working knowledge of USEPA SW-846 Methods 8240 and 8270 as well as isotope dilution Methods 1624 and 1625.
- Project Manager for the independent testing of the Master Analytical Scheme (MAS) and Task Manager for Special Analytical Services (SAS) and Contract Laboratory Program (CLP) case reports. Responsible for experimental design, GC/MS analysis, data review and interpretation.
- Detailed experience in the analysis of high-level hazardous waste samples by GC/MS techniques.
- Performs Technical Systems Reviews in support of Quality Assurance Services contract to USEPA RREL.
- Developed a GC/MS method for the analysis of organophosphates for addition to EPA SW-846 Method 8270. Authored two reference analytical methods for EPA.

EDUCATION

B.S. in Chemistry, San Diego State University, 1980. (Magna Cum Laude, Distinction in Chemistry, Phi Beta Kappa.).

EXPERIENCE

S-Cubed (1980 - Present): GC/MS Laboratory Supervisor.

Mr. Hatcher's responsibilities include supervising laboratory staff, the project management of methods development projects, software applications programming to improve the efficiency of GC/MS data reduction and review, QC audits, and troubleshooting hardware and software problems. He is responsible for mass spectral interpretation as well as technical review of GC/MS data prior to report preparation. Mr. Hatcher also manages the S-Cubed beta testing of prototype Hewlett-Packard instrumentation, including the pressure programmable 5890 gas chromatography inlet system with septumless nuts and an on-column autosampler, and the HP 5971 GC/MS.

Mr. Hatcher was the Project Manager for the independent testing of the Master Analytical Scheme (MAS), involving the fabrication of a special cryofocussing purge and trap apparatus and customized capillary injector capable of GC/MS analysis of 10 different types of VOA and BNA samples. He is the Task Manager for GC/MS methods development projects, such as the GC/MS module of Method 8270 for the analysis of organophosphates.

Mr. Hatcher also managers Hewlett Packard Beta Test site activities at S-Cubed including Electronic Pressure Control the HP5890GC, HP5971 GC/MS, and the 7673A modified injection tower with cold on-column injection capabilities. Mark was task manager for the generation of performance data for the 6 semivolatile internal standards currently used for CLP. Mr. Hatcher was task manager for the generation and evaluation of performance data of the A/N extraction of semivolatiles which is currently in use in the CLP SOW. Mr. Hatcher was

task manager of the SAS for the evaluation of the effect of DFTPP tuning on Target Analyte Response Factors (1987) which supported widening of criteria windows in the 3/90 CLP SOW for DFTPP.

He is also Task Manager for the GC/MS analysis of complex, multi-media hazardous waste samples from the Organic Chemicals Manufacturing Industry in support of the EPA/OSW Industry Studies and Hazardous Waste Listing Programs.

Mr. Hatcher has performed approximately 8 Technical Systems Reviews and several Data Quality Audits in support of our Quality Assurance Services contract for the U.S. EPA Risk Reduction Engineering Laboratory in Cincinnati.

SELECTED PUBLICATIONS

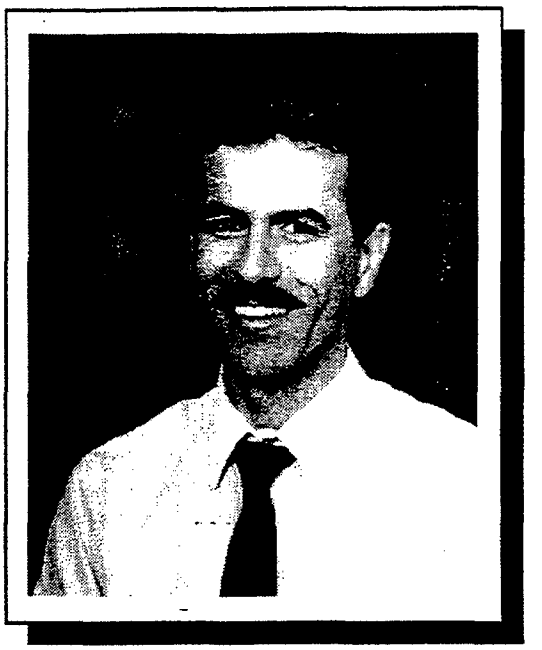
Hatcher, M.D., D.M. Hickey, and P.J. Marsden, "Development of a GC/MS Module for RCRA Method 8140," Final Report, EPA Contract No. 68-03-1958, November, 1988.

Hatcher, M.D., P.J. Marsden, and V. Taylor, Analysis of Organophosphorus Pesticides by Capillary GC/FPD and GC/MS, Proceedings of the United Sates Environmental Protection Agency Symposium on Waste Testing and Quality Assurance, Washington, D.C., July 11-15, 1988.

Hatcher, M.D., "Independent Testing and Application of the EPA Master Analytical Scheme for Analysis of Volatile Organic Compounds in Water," Final Report, EPA Contract No. 68-03-3204, October 30, 1985.

MOSTAFA MAYAHI

Preparation Laboratory Supervisor



SUMMARY OF QUALIFICATIONS

- Fourteen years of laboratory experience including sample extraction, sample concentration, sample cleanup, standards preparation, equipment calibration and maintenance, and EPA reporting.
- Experience in water chemistry, including power plant boiler water analysis and treatment, power plant water chemistry, and wastewater treatment.
- Supervisor of Preparation Laboratory.
- Experience with CLP and SW-846 sample preparation procedures, including EP and TCLP.

EDUCATION

B.S. in Chemistry, East Central State University, Ada, OK, 1980.

EXPERIENCE

S-Cubed (1989 - Present): Supervisor, Preparation Laboratory.

As supervisor of the S-Cubed Preparation Laboratory, Mr. Mayahi is responsible for all organic sample preparation including liquid-liquid, Soxhlet, sonication, and separatory funnel extraction, TCLP leaching, and the concentration of samples. His group also performs sample cleanup by gel permeation chromatography and other column cleanup techniques. Additionally, Mr. Mayahi is responsible for the group performing sample digestions for trace metals analysis and wet chemistry analyses.

As part of sample preparation Mr. Mayahi supervises and performs gas chromatographic screening of samples before they are sent to the analytical laboratories. He also prepares and supervises the preparation of standards for the analytical laboratories. He is responsible for the preparation of both internally and externally requested QC samples. Mr. Mayahi ensures that the sample documentation is properly completed. Mr. Mayahi is an expert in the preparation of samples for CLP and RCRA (SW-846), analysis including the TCLP and the preparation and extraction of air puff samples by Method T04.

Mr. Mayahi supervises and performs the analyses for total organic carbon, total organic halides, and total recoverable petroleum hydrocarbons. He is responsible for the maintenance of all of the instrumentation utilized in the preparation laboratory. Additionally, Mr. Mayahi has written numerous SOPs that apply to sample preparation.

In the area of methods development, Mr. Mayahi was responsible for an S-Cubed IR&D project to identify the effects of common laboratory sample preparation errors on analytical results. As an example, semivolatile surrogate recovery was measured by GC/MS on samples that were not acidified after the base/neutral fraction was removed. The compilation of these results is used by the S-Cubed data reviewing staff to quickly identify laboratory errors, and is also being used by the EPA for the indoctrination of new laboratories into the CLP. Mr. Mayahi also worked on an S-Cubed project to develop polymers and additives to withstand the high energy demands of special purpose capacitors.

As a part of an S-Cubed project to validate SW-846 Methods 3540 (Soxhlet extractions), 3550 (sonication extractions), 8270 (semivolatile analysis by GC/MS), 8081 (organochlorine pesticides by GC/ECD), and 8140 (organophosphate insecticides by GC/FPD) for BDAT listed compounds, Mr. Mayahi supervised all of the sample spiking and

preparation activities and wrote a significant portion of the final EPA report.

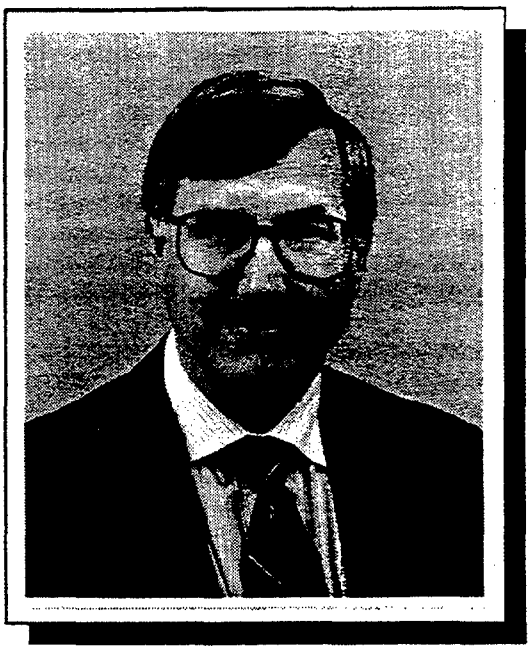
Mr. Mayahi has also worked on the validation of Method TO_4, the analysis of EDB and DBCP by GC/ECD and the validation of Methods 8090 and 8330, the analysis of nitroaromatics by GC and HPLC, respectively.

Mr. Mayahi was a principal investigator on a study to optimize the efficiency of continuous liquid-liquid extractors. Optimization of continuous liquid-liquid extractors is important since they are required as part of the procedure for water extraction in the new CLP statement of work and are currently required by the EPA Office of Water for Methods 1625 and 1618. Several controllable variables, such as reflux rate, agitation, and extraction time, were varied in a ruggedness test to determine their effect on analyte recovery. Mr. Mayahi was a coauthor of a paper presented at the EPA OSW conference in July, 1990 presenting the results of this work.

Oklahoma Gas & Electric Co., Oklahoma City, Oklahoma (1981 - 1988): Plant Chemist.

Mr. Mayahi worked in the Water Chemistry Department monitoring boiler water at the Oklahoma Gas & Electric Co. Accurate analyses were critical, since improperly treated water could result in damage to the generators. He was also in charge of wastewater analysis and treatment operations. The wastewater streams were analyzed for sulfate, chloride, total suspended solids, and other analytes. As part of keeping the water system functioning he was responsible for the maintenance and regeneration of demineralization baths. Interpretation of data from, and maintenance of, automatic analyzers in steam lines were also his responsibilities. He wrote boiler water activity reports, usage reports for water and chemicals, and monthly reports on overall boiler and water treatment system conformance.

LARRY E. MICHALEC
Systems Manager



SUMMARY OF QUALIFICATIONS

- Primary author of S-Cubed's LIMS.
- Seven years as the S-Cubed Chemistry Sector Computer Systems Manager. Expert in programming, networking, and data deliverable issues.
- Nineteen years as a Senior Chemical Engineer and Project Manager, specializing in computer applications for air pollution control and hazardous waste studies.
- Detailed Experience in the field acquisition of industrial process and waste data and in the development and implementation of sampling and analysis plans.
- Thoroughly familiar with computer-linked data-base management, statistical analysis, and low-end expert systems.

EDUCATION

Graduate Studies in Civil Engineering, University of Arizona, 1972 to 1974.
B.S. in Chemical Engineering, University of California, Davis, 1971.

EXPERIENCE

S-Cubed (1981 - Present): Systems Manager.

As Computer Systems Manager for the S-Cubed Environmental Chemistry Sector, Mr. Michalec is the primary author of the Laboratory Information Management System (LIMS). He and his programming staff, utilizing their expertise in MS windows and the C++ programming language, have programmed a system that is capable of transporting data electronically from all of the laboratory instrumentation and producing sample tracking information, data reporting forms, and accounting information. Mr. Michalec has also developed diskette deliverable software for the CLP and other projects. S-Cubed can now produce disk deliverables in any of several formats. He previously wrote a code to download GC and GC/MS data to PCs for report generation, significantly reducing the transcription error rate.

Some of Mr. Michalec's numerous responsibilities at S-Cubed have included project management of a variety of environmental studies, engineering assessment projects, and computer applications projects. He also managed a project to develop and demonstrate an automated prototype monitoring instrument for identifying and quantifying volatile organic compounds (VOC) in groundwater at the part-per-billion level for the USAF.

QTRAK is an EPA Quality Assurance Tracking System for Agency QA Programs. Mr. Michalec designed, wrote, and installed QTRAK on the agency mainframe, as well as on personal computers. As part of the QTRAK installation, he conducted training sessions and provided user support. He also managed the initial EPA project to develop a computerized and automated tracking system for EPA's QA activities on an Agency- wide basis.

As the field team leader on the EPA/OSW Hazardous Waste Survey project for the Petroleum Refining Industry, he was responsible for the field acquisition of industrial process and waste data and for the development and implementation of sampling and analysis plans.

Mr. Michalec was project manager of a study to measure the fugitive emission potential of the

specialty organic chemicals industry. The study involved comprehensive engineering analyses on ten synthetic organic chemical manufacturing industry plants to identify potential emission routes for volatile organic compounds. The study required Mr. Michalec to conduct site visits, write sampling and quality assurance plans, supervise the sampling effort, and to write the data reduction and reporting software and the final technical report.

Under the many S-Cubed QA support contracts to EPA's research laboratories, he has been responsible for a number of QA Project Plan reviews and technical systems audits.

Naval Oceans Systems Center, (1974-1981): Section Head, Air Program.

As Section Head of the Air Group, Mr. Michalec had technical responsibility for all aircraft related air pollution problems world-wide within the Navy. The group's mission was to develop standard gaseous and particulate emission measurement techniques and procedures and then use them to catalog emissions from Naval aircraft operations.

Mr. Michalec was the technical project officer and principal user of the automatic isokinetic turbine engine particulate sampler, a prototype device designed to accurately measure mass loading and size distribution of particulate matter at the exit plane of an operating turbine engine. In 1978, he became a member of the Society of Automotive Engineers E-31 committee, which has responsibility for developing industry-wide aircraft gas turbine emission measurement techniques, and was Chairman of the Smoke Measurement Subcommittee.

Also, in 1978, he became a member of the Air Pollution Control Association TS-1.2 committee, which has responsibilities similar to the E-31 committee.

From 1977 to 1981, he was the Navy's technical liaison with the legal defense team required to litigate the status of California-based turbine engine test cells. Mr. Michalec dealt with both Naval and State of California legal counsel and gave expert testimony regarding Naval air pollution emissions. He also represented the Navy in technical discussions with various regulatory agencies and briefed many high ranking civilians and Naval officers, up to flag rank, on the technical aspects and implications of the lawsuit. Once the lawsuit was adjudicated, he organized and implemented compliance source testing for Naval turbine engine test cell air pollution emissions.

University of Arizona, (1972-1974): Graduate Associate, Civil Engineering Department.

Taught and assisted in various air and water pollution control classes.

SPECIALIZED TRAINING/SKILLS

Mr. Michalec is proficient in the use of the following computer systems and programs: Machines: MS-DOS Personal Computers, Univac 1100/80, Assorted VAX, Sun and Celerity mini- computers. Languages: "C", DBASE (III+ and Clipper dialects), Fortran, Assembler (8088), BASIC. Operating Systems: MS-DOS, UNIX, VMS. Programs: DBASEIII+, Lotus 1-2-3, WordPerfect, Brief, Periscope, MS-Windows, Excel, Paradox.

AFFILIATIONS

American Institute of Chemical Engineers
Association of Computing Machinery

LOAN T. NGUYEN
Reporting Group Supervisor

SUMMARY OF QUALIFICATIONS

- Scientist with 3 years of experience in environmental laboratories.
- Experienced in project management of commercial projects.
- Experienced in inorganic analysis and data review.
- Expert with computer word processing and data entry programs.

EDUCATION

B.S. in Biology, San Diego State University, 1990.

EXPERIENCE

S-Cubed (1991 - Present): Supervisor, Data Reporting Group

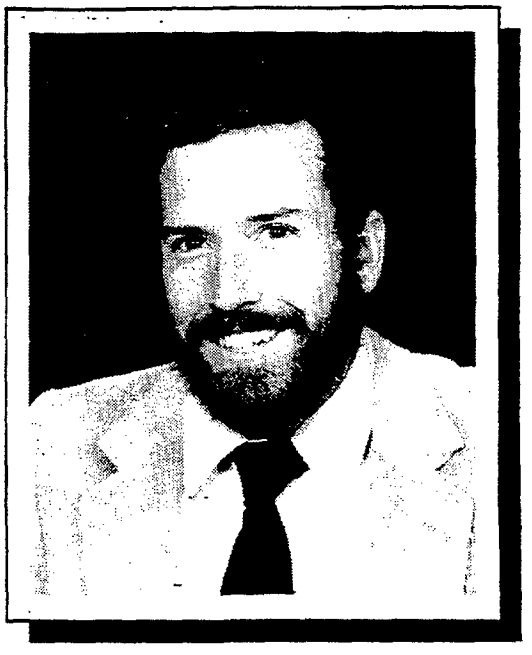
As the supervisor of the data reporting group, Ms. Nguyen has been responsible for the implementation of the data reporting software and the training of clerks and laboratory personnel in its use. She is also responsible for interfacing with project managers on specific client requirements, due dates, and quality assurance/quality control needs. As part of her responsibilities, she supervises the data review of organic and inorganic data packages for requirements specified by the client. In addition, Ms. Nguyen has participated in the development of standard operating procedures for data flow through the laboratories and to final report preparation. She has written SOPs for the reporting of non-computerized analyses. She is involved in the development of diskette deliverables for individual clients and performs quality control on a every diskette deliverable. She trains data reviewers and other personnel in data deliverable preparation. She provides the final quality assurance/quality control review for the laboratories, and initiates corrective actions for problems encountered in the reported data. Additionally, she responds to questions from data validators regarding data deliverables from S-Cubed.

Previously at S-Cubed, Ms. Nguyen performed sample preparation for metals analysis, including the digestion of samples for ICP and GFAA analysis using CLP and SW-846 methods. Additionally, she analyzed samples by ICP and GFAA according to CLP and SW-846 methods. She performed wet chemistry methods of analysis such as analysis for cyanide, fluoride by the ion specific electrode method, alkalinity by the titrimetric method, and nitrate/nitrite by the spectrophotometric method. She also reviewed inorganic data packages for release to the reporting group and for release to clients. Prior to her assignment with the inorganic laboratory, Ms. Nguyen was a technician in the organic preparation laboratory, where she performed extractions by the continuous liquid-liquid, Soxhlet, sonication, and separatory funnel methods.

San Diego State University (1988): Laboratory Assistant

Ms. Nguyen monitored and organized chemicals used by the students, supervised the collection and distribution of laboratory testing equipment, and maintained records for the ordering of suppliers and equipment.

RICHARD B. PHILLIPS
Metals Laboratory Supervisor



SUMMARY OF QUALIFICATIONS

- Supervisor responsible for the day-to-day running of the trace metals analysis laboratory.
- Analytical Chemist with M.S. degree and 9 years of experience in the application of gas chromatography/ mass spectrometry (GC/MS) analysis to detect trace levels of organic compounds.
- Task Manager for projects to develop and modify the TCLP to improve analyte detection.
- Experience includes routine analysis of soil and water samples for toxic components, as well as task management of projects to develop or modify protocols for the analysis of organic pollutants.
- Experienced in neutron activation analysis.

EDUCATION

M.S. in Analytical Chemistry, San Diego State University, 1985.
B.S. in Oceanography, Humboldt State University, 1982.

EXPERIENCE

S-CUBED (1986 to Present): Inorganic Supervisor.

Mr. Phillips' responsibilities include sample scheduling, troubleshooting, data review, customer interface, and methods development as related to trace metals analysis.

He is also involved in designing, documenting, and implementing a training program, standard operating procedures, and quality assurance for the trace metals laboratory. His hardware expertise has resulted in maximum productivity of the instrumentation associated with trace metals analysis.

Formerly at S-Cubed, Mr. Phillips was a GC/MS Laboratory Supervsior responsible for the analysis of water, soil, and air hazardous waste samples for extractable and purgable organic compounds. In this capacity, he was experienced with numerous analytical protocols including EPA Methods 624, 625, 1624, 1625, 524.1, 524.2 8270 and T01.

Mr. Phillips' project management experience includes the Toxicity Characteristic Leaching Procedure (TCLP) methods development project. This project focussed on how to analyze leachable components of a stabilized waste without compromising the integrity of those stablizers which truly immobilize contaminants. By incorporating a stainless steel cage into the TCLP jar (a novel, inexpensive, on-line addition) the method can now simulate a solidified sample's ruggedness to a series of wet/dry and freeze/thaw cycles. The results of this project are detailed in Publications 1 and 2.

One of his most significant applied research projects investigated the fate of semivolatile compounds contained within the sludges generated by municipal wastewater treatment plants. The project verified that selected compound partition coefficients (between sludge solids and their separated liquids) reflect the general trends found in the true values for octanol and water partition coefficients. The results were detailed in *Determination of the Fate of Toxic Organic Materials in Surface Sludge Impoundments*, J. DeWald, R. Phillips, Report No. SSS-DFR-90-10930.

His expertise also proved valuable on a project that optimized the soxhlet and sonication procedures for the extraction of Appendix IX analytes. The project tested the ruggedness of the two extraction methods and validated the two SW-846 methods using selected contaminated soils provided by EMSL-Ci and the CLP program of the EPA. Details of the project are presented in *Evaluation of Methods 3540 (Soxhlet) and 3550 (Sonication) for Extraction of Appendix IX Analytes from Solid Samples*, C. Hein, P. Marsden, A. Shurtleff, and R. Phillips, Report No. SSS-R-88-9436.

Naval Ocean Systems Center (1983 - 1984): Analytical Chemist.

While at NOSC Mr. Phillips made extensive use of neutron activation analysis coupled with wet chemistry to develop a method for detecting iridium in sea water. He also evaluated a procedure to measure aluminum in sea water by co-precipitation with ferric hydroxide. The study is documented in Publication 3. In addition he developed a simple method for shipboard detection of boron trifluoride.

SELECTED PUBLICATIONS

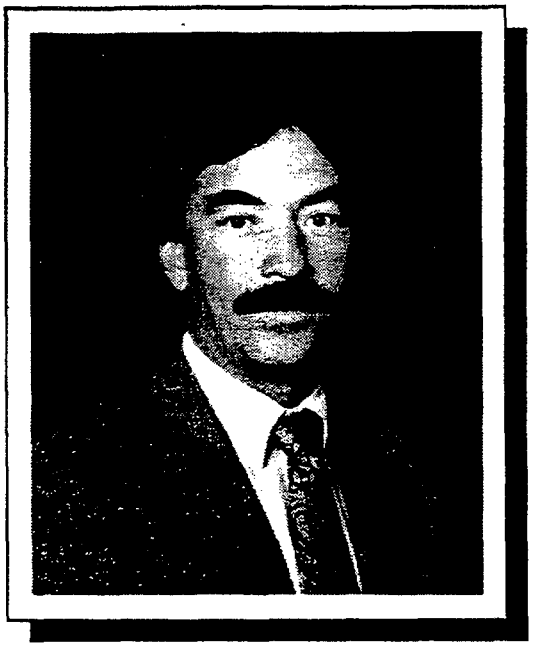
(1) Marsden, P.J., R.B. Phillips, L.R. Williams, and G. Hansen, *Performance of a TCLP Cage Modification to Prepare Solidified Wastes*, USEPA, Proceedings of the Waste Testing and Quality Assurance Symposium, 1988.

(2) Phillips, R.B. and P.J. Marsden, *Modification of the TCLP to Accommodate Solidified Waste*, Final Report, S-Cubed No. SSS-R-88-8974 on USEPA Contract 68-03-1958 1987.

(3) Fresco, J., Weiss, H.V., Phillips, R.B. and Askeland, R.A., Talanta 32, 830, 1985.

RICHARD SOBILO

Radiation Safety Officer/Health Physicist



SUMMARY OF QUALIFICATIONS

- Experienced in managing and monitoring radiation safety programs.
- Health physicist and S-Cubed Radiation Safety Officer.
- Eleven years experience with radiation safety at nuclear power plants.
- Accomplished teacher, capable of making radiation safety rules and procedures understandable.

EDUCATION

M.S. in Health Physics, San Diego State University (Pending).
B.S. in Earth Science, University of Pittsburgh, 1974.

EXPERIENCE

S-Cubed (1989 to Present): Radiation Safety Officer.

Mr. Sobilo has developed and continues to maintain the S-Cubed radiation safety program. As a part of this maintenance, he provides 20 hours of training and an annual refresher course for all personnel involved in the use of radioactive materials. Some of his other duties include conducting semi-annual audits of all on-going projects that use radioactive materials and monthly surveys of potentially contaminated work areas. He formulates policies and procedures for the control of radiation, and receives, reviews, and approves all protocols for the use of radioactive materials. He is responsible for any necessary license revisions and amendments as well as for any radioactive material that enters or leaves the site. Included in this responsibility, is authorizing the procurement, receipt, and distribution of all radioisotopes, and the distribution, receipt, and processing of personnel monitoring devices, including the maintenance of records. He maintains an active inventory of all radioactive materials, and coordinates, and supervises radioactive material waste disposal. He also provides supervision and assistance for the management of emergency, accident, spill, or exposure situations.

RAD Services Inc., (1985-1989):

At the San Onofre Nuclear Generating Stations II and III, San Onofre, CA, Mr. Sobilo was responsible for health physics support in refueling outage and Reactor Coolant Pump (RCP) seal replacement, work crew monitoring, alpha, beta, and gamma surveys, and air sampling. He participated in the search and secure team for failed fuel particles contamination. He also secured and monitored hazardous liquids.

Nuclear Hazards Control, Inc. (1983-1985):

At Rockwell Int., Energy Systems Group, Canoga Park, CA, Mr. Sobilo performed alpha and beta radiation and contamination surveys for the piece by piece dismantling and decontaminating of the nuclear fuel fabricating plant. He also performed counting room instrument checks.

Combustion Engineering (1981 - 1983):

At the San Onofre Nuclear Generating Stations II and III, San Onofre, CA, Mr. Sobilo performed health physics start-up support, including radiation monitor calibration, counting room duties, surveys and map preparation, fuel loading coverage, air sampling, and Ge-Li detector operations.

Bartlett Nuclear Inc. (1981):

At the Nine Mile Point Nuclear Station, Scriba, NY Mr. Sobilo performed radiation and contamination surveys, health physics job coverage for control rod drive removal, component shielding, torus repair, primary systems checks, and in core instrumentation adjustment.

RAD Services (1979 - 1980):

Mr. Sobilo responsibilities at the Davis-Besse Nuclear Power Station, Toledo, OH included counting room duties, surveys, decontamination crew supervision, control point monitoring, air sampling, and coverage for pipe hanger modifications.

At the Salem Nuclear Generating Station Unit II, Hancock Bridge, NJ his duties included control point command, radioactive waste shipment, dosimetry records, surveys, health physics coverage of the eddy current of stream generators, and reactor coolant pump removal.

At the Rancho Seco Nuclear Power Station, Clay, CA he provided continuous health physics coverage of pressurizer heater bundle welding, and control of dosimetry records.

At Three Mile Island Unit II, Middletown, PA, he was a member of the initial recovery team, responsible for control point command, auxiliary building air filter changes, reactor coolant sample coverage, air sampling, and surveys.

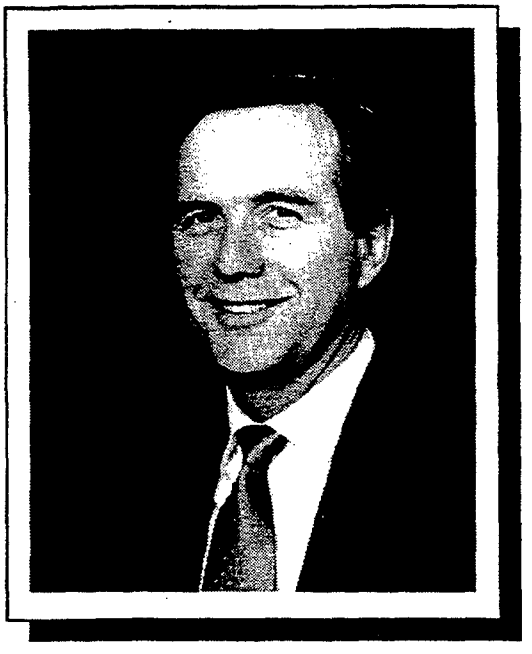
Duquesne Light Company, (1974 - 1979):

At the Beaver Valley Atomic Power Station, Shippingport, PA his responsibilities included map design and makeup surveys, fuel receipt and inspection, fire school, plant start-up (including fuel loading and initial criticality survey), radioactive waste inspection, power entries, counting instrument use and calibration, air sampling, dosimetry records, and Thermo Luminescent Device (TLD) system operations. He attended in-house training in plant system design and operation. He provided training of plant personnel in self contained breathing apparatus, dosimeters, radiation protection and neutron monitoring.

At the Shippingport Atomic Power Station, Shippingport, PA he attended, completed, and passed the Radiation Technician Training Program, the final written exam, the final oral exam, obtained a satisfactory performance evaluation, and obtained a qualification certification.

JOHN R. WALLACE

Quality Assurance Support Manager



SUMMARY OF QUALIFICATIONS

- Ph.D. Chemist and Quality Assurance Specialist with distinguished education in chemistry and over 20 years experience in all areas of chemical analysis, especially chromatographic methods.
- Practical knowledge of chemical analysis and sample collection carried out under field conditions.
- Hands-on experience with the development of methods and instruments for chemical analysis, especially for use by the nonchemist.
- Detailed experience in project and laboratory management, including proposal and report preparation, sales, client communications, and cost control.
- Specific background in detection of reduced sulfur compounds at trace levels, detection of chemical agents, and general characterization of synfuel wastes and airborne particulate matter.
- Experienced in quality assurance. Manages a contract to provide quality assurance support to the USEPA Risk Reduction Engineering Laboratory in Cincinnati, OH.
- Responsible for the development of QA/QC procedures, for critical review of Quality Assurance Project Plans, for conducting Technical Systems Audits of Superfund Innovate Technology Evaluation (SITE) projects, and for review of project final reports.

EDUCATION

Ph.D. in Analytical Chemistry, University of Illinois, 1974.
B.S. in Chemistry (Honors), University of California, Berkeley, 1969.

EXPERIENCE

S-Cubed (1987 to Present): QA Manager.

After successfully managing an $800K contract (1987-1989) to provide Quality Assurance Technical Services to the EPA/ORD Risk Reduction Engineering Laboratory (RREL) in Cincinnati, Dr. Wallace is currently managing the $1,200 K follow-on contract to support the RREL QA program through 1994. As part of these projects he will continue to conduct QA Project Plan reviews, provide QA program guidance, and coordinate other review and audit activities. Among these are Technical Systems Reviews of Superfund Innovative Technology Evaluation (SITE) projects and the review of project final reports.

Dr. Wallace has authored a large number of documents for RREL, among which were the Preparation Aids for Preparing Quality Assurance Projects Plans (1991). For his work during 1987-1990 he received two EPA letters of commendation in 1989 and 1990 for "blue ribbon" contributions to the RREL QA Program. He was also the Principal Investigator of an S-Cubed contract to provide quality assurance (QA) support to the Chemical Research, Development and Engineering Center (CRDEC) of the U.S. Army.

Demonstrating his ability to impart chemistry to the non-chemist, he has developed analytical procedures

and instrumentation that are suitable for field use by para-professional personnel.

Wallace Instruments (1986 - 1987): President.

Dr. Wallace started his own company to develop miniature, optical wave guide sensors for H_2S monitoring, and microlithographic sensors for a proprietary product.

Denver Research Institute, University of Denver (1978 - 1986): Principal Investigator.

As a principal investigator Dr. Wallace was responsible for the overall direction of applied research projects, including client relations, preparation of proposals, technical direction, cost control, and report preparation. The major projects he completed during this tenure include: (1) development of a portable monitor for sulfur-containing odorants in natural gas; (2) conceptual design and literature study on portable monitors for chemical agents; (3) development and application of analytical methods for synfuel wastewaters and product gases. The analytical methods developed during this time are currently being applied in support of various pollution control tests. Much of this effort required the development of new or modified chromatographic methods, although spectroscopic and wet chemical methods were also developed.

CDM/Acculabs (1976 - 1978): Technical Director.

While at CDM Dr. Wallace was the technical director of an analytical laboratory providing services in the area of inorganic mass spectrometer, radiochemistry, water quality, and coal evaluation. His accomplishments during this period include (1) implementation of a formal quality assurance program; (2) development of computer programs to monitor data flow and prepare client reports; (3) technical direction of a field program to characterize an air quality visibility problem; and (4) increasing laboratory billings and volume by approximately 80 percent.

Lawrence Berkeley Laboratory (1974 - 1976): Post Doctoral Associate.

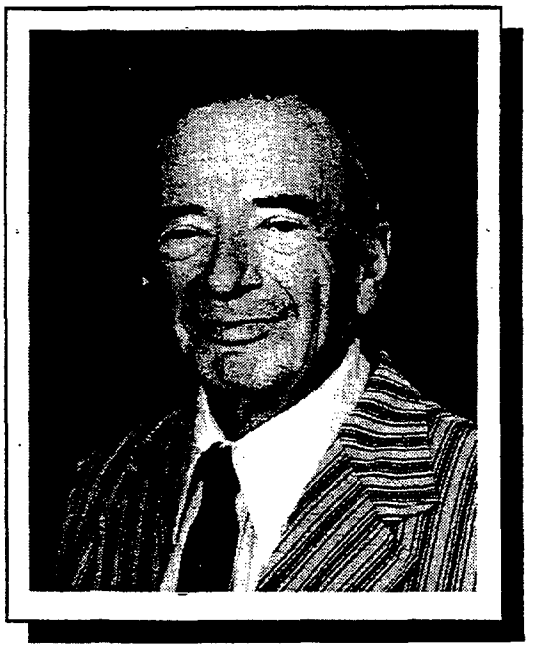
Air pollution measurement is another of Dr. Wallace's fields of expertise. During his post-doctoral work he developed and applied methods for collection and analysis of airborne particulate matter. He also participated in tests characterizing automobile exhaust under field conditions.

AFFILIATIONS

Air and Waste Management Association (Air Pollution Control Association)
American Chemical Society, Environmental and Analytical Divisions

HERBERT V. WEISS

Consultant - Radiochemistry Laboratory



SUMMARY OF QUALIFICATIONS

- Over 40 years of experience with the determination of radionuclides.
- Over 50 literature publications in the field of radiochemistry.
- Nationally renowned radiochemist with specific experience on DOE projects.

EDUCATION

Postdoctoral Fellow, University of Rochester, 1952-53.
Ph.D. in Chemistry, University of Cincinnati, 1952.
M.A. in Chemistry, New York University, 1949.
B.A. in Chemistry, New York University, 1942.

EXPERIENCE

S-Cubed (1990 - Present): Consultant, Radiochemistry Laboratory.

While at S-Cubed, Dr. Weiss has been involved in implementing published methodology for the determination of radionuclides. His involvement has been continuous since the initial installation of the S-Cubed radiochemistry laboratory. He supported the installation, check out, and calibration of our radiochemistry equipment and is currently working on implementing alpha-spectroscopy techniques for the determination of actinides in environmental samples. The separation chemistry involved in the preparation of samples for analysis by alpha spectroscopy is particularly time consuming, and Dr. Weiss' broad experience has expedited our application of methodologies and has provided us with greater efficiency.

Currently, Dr. Weiss is investigating the determination of radium in soil. The new method of measurement simplifies chemical operations while obviating the 20 to 30 day time delay attendant to the growth of radon and radon daughter products.

San Diego State University (1988 - Present): Adjunct Professor.

In his position as adjunct professor at San Diego State University, Dr. Weiss is managing a program sponsored by the Department of Energy to establish the effect of an accidental entry into marine waters of components of radioisotopic thermoelectric generators used as power sources in the space program.

Naval Oceans Systems Center (1969 - 1988): Scientist.

Dr. Weiss' work at the Naval Oceans Systems Center established that an iridium-encapsulated plutonium oxide heat source, when buried in coastal sediment, developed a concretion as a result of thermally driven reactions. The properties of the concretion were such that complete protection against the corrosive action of the surrounding waters was afforded. The geochemical processes involved were studied and the chemistry of the concretion was defined. The information obtained as a part of this study was used in the DOE Final Safety Analysis Report to support the Ulysses and Galileo space missions.

US Radiological Defense Laboratory, (1956 - 1969): Radiochemist.

During his time with the US Naval Radiological Laboratory, Dr. Weiss managed a program to establish the levels of radioactive contamination from fallout in a variety of environmental materials recovered from the Marshall Islands following a nuclear detonation. As an outgrowth of this work, he established that some radionuclides are accumulated in living organisms out of proportion to their concentration in the environment. This phenomenon was verified in a laboratory study which followed the initial

observation. Another project with which he was involved was the development of a co-crystallization procedure for the determination of uranium in seawater. The development resulted in a rapid separation method using organic chelating agents and the procedure is still in laboratory use today.

Dr. Weiss has developed procedures for the measurement of radium and plutonium in urine. He developed rapid radiochemical procedures that permitted separation of elements within a second of the fissioning process. With this technique he found isotopes of cadmium, silver, and palladium (Cd^{121}, $Ag^{117, 118}$, Pd^{116}) not previously identified. He worked on methods for the determination of multiple elements in seawater using neutron activation.

He is the holder of two patents, one dealing with the concretization reaction and its application to the disposal of radioactive waste in the oceans, and the other dealing with the trace quantification of elements from seawater using co-crystallization. Dr. Weiss has received several awards from the US Navy for his work in radiochemistry.

JOANN E. WILKINSON
Manager, GC/MS Group

SUMMARY OF QUALIFICATIONS

- Seventeen years of hands-on experience in the GC/MS analysis of environmental samples and management of major laboratory analysis contracts with the government and the EPA.
- Fourteen years of experience in the supervision of GC/MS laboratory operations.
- In-depth experience in the development, refinement, and use of new sample preparation techniques for characterization of priority pollutants in a variety of matrices, including industrial sludges and process residues, soils, and other hazardous wastes.
- Detailed experience in utilization of capillary column GC and GC/MS methods.

EDUCATION

B.S. in Chemistry (Magna Cum Laude), American University, Washington, D.C., 1976.

EXPERIENCE

S-Cubed (1979 to Present): Manager, GC/MS Laboratory.

As the manager of S-Cubed's GC/MS Laboratory, Ms. Wilkinson is involved with daily personnel management, scheduling, analysis, and data review. She is the project manager for several government contracts under the Naval Energy and Environmental Support Activity (NEESA). These contracts involve the analysis of large numbers of soil and water samples for volatile, base/neutral, and acidic priority pollutants and selected pesticides, herbicides, volatile and extractable total petroleum hydrocarbons and total recoverable petroleum hydrocarbons, metals, and wet chemistry parameters.

Ms. Wilkinson has also been intimately involved with the development of S-Cubed's LIMS. Utilizing her knowledge of software and working closely with the programming staff, she has assisted in formulating S-Cubed's reports for all organic parameters.

She was the project manager for the S-Cubed Superfund Contract Laboratory Program. Additionally, she manages the Special Analytical Services for the EPA Contract Laboratory Program. These projects involve the non-routine analysis of samples from diverse media including fish, wildlife, sediments, and air. Major long term Special Analytical Service projects include the analysis of high concentration soil, sediment, and drum samples and the analysis of residential well water samples for trace contaminants. Other significant projects in this program include comparison of field versus laboratory analyses for PCB congeners and PAHs, developing a data base for the EPA on the effect of GC/MS tuning requirements on library searchable mass spectra, air monitoring for PCBs during dredging of the New Bedford Harbor, and comparison of different standard methods for determination of the leachability of both inorganic and organic compounds in soil samples.

Methods Development projects are one of S-Cubed's strengths and Ms Wilkinson contributes her expertise to these efforts as they relate to GC/MS analyses. Her method development project experience includes the validation of the current TCLP procedures for both volatile and semivolatile compounds, comparison of different extraction procedures for organic compounds in both soils and waters, determination of the feasibility of GC/MS analysis of Appendix IX compounds in soil and sludge samples, and the develop-

B

APPENDIX B RADIOACTIVE MATERIALS LICENSE

ment of analytical protocols for the analysis of publicly owned treatment plant sewage sludge samples.

Ms. Wilkinson provides expertise to S-Cubed's Environmental Engineering Group in the development of analytical protocols for the analysis of samples of industrial waste streams and Superfund Innovative Technology Evaluation (SITE) contract support.

Ms. Wilkinson was the project manager for an EPA effort to expand the NIH/NBS Mass Spectral Data Base by over 3,000 entries. All of the spectra she submitted to the project met the strict data quality requirements in terms of documented purity and mass spectral quality.

Ms. Wilkinson also supports the S-Cubed QA support contracts. This work includes performing systems audits at both EPA and contractor laboratories. She also helped to define QA/QC terminology and develop laboratory audit checklists.

Battelle Columbus Laboratory, (1976-1979): Analytical & Environmental Research Chemist.

While at Battelle, Ms. Wilkinson worked on several methods development projects. She helped to develop and validate sampling and analysis protocols for polynuclear aromatic hydrocarbons in industrial stack effluents and other sources of airborne pollutants. She was also involved in the development of class specific characterization protocols using both spectroscopic and spectrometric methods. One of her more exotic and timely projects investigated methods for the safe destruction of chemical warfare agents.

AFFILIATIONS

American Chemical Society
American Society of Mass Spectrometry
Association of Women in Science
Phi Kappa Phi Honor Society

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

Pursuant to the California Administrative Code, Title 17, Chapter 5, Subchapter 4, Group 2, Licensing of Radioactive Material, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, use, possess, transfer, or dispose of radioactive material listed below; and to use such radioactive material for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations, and orders of the Department of Health Services now or hereafter in effect and to any conditions specified in this license.

1. Licensee	Maxwell Laboratories, Inc	3. License No.	5322-80 Amendment No. 8
2. Address	3020 Callan Road San Diego, CA 92121	4. Expiration date	December 5, 1996
Attention:	Richard Sobilo Radiation Safety Officer	5. Inspection agency	San Diego County Department Of Health Services

License Number 5322-80 is hereby amended as follows:

6. Nuclide	7. Form	8. Possession Limit
A. Hydrogen 3	A. Any	A. Not to exceed 100 millicuries total.
B. Any nuclides listed in Section 30356 Appendix B with atomic number 3-83 inclusive except radioiodine	B. Any	B. Not to exceed 100 times Appendix B for any one nuclide; Total not to exceed 100 millicuries.
C. Any nuclides with atomic number 3-83 inclusive.	C. Sealed sources manufactured in accordance with license issued by the NRC or Agreement State.	C. Not to exceed 1 curie total.
D. Any nuclides with atomic number 84-105 inclusive except source material and SNM	D. Any	D. Not to exceed 10 microcuries total.
E. Any nuclides with atomic number 84-105 inclusive except source material and SNM	E. Sealed sources manufactured in accordance with license issued by the NRC or Agreement State.	E. Not to exceed 1 curie total.

For the State Department of Health Services

Date December 4, 1991 by 3

Radiologic Health Section
744 P Street, Sacramento, CA 95814

RH 2550 (2/81)

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

License Number: 5322-80

Supplementary Sheet

Amendment Number: 8

F. Source material	F. Any	F. Not to exceed 15 pounds total.
G. Californium 252	G. Sealed sources (Savannah River Model SR-Cf-3000 Series)	G. 4 sources, not to exceed 30 curies each.
H. Cobalt 60	H. Sealed sources (Neutron Products, Model NPRD 91-10-F)	H. 2 sources not to exceed 3025 Curies each.
I. Cesium 137	I. Sealed source (Industrial Nucleonics custom source Model S-6)	I. 1 source not to exceed 14.5 curies.
J. Any nuclides except source material and SNM	J. Activated components	J. Not to exceed 100 millicuries total.
K. Cobalt 60	K. Sealed sources (AECL Model C-198)	K. Not to exceed 35,000 curies total.
L. Cesium 137	L. Sealed source (Amersham Model CDC.93)	L. 1 source not to exceed 3 curies.
M. Californium 252	M. Sealed sources (Isotope Products Model FF-252-1)	M. 2 sources not to exceed 6 microcuries each.
N. Americium 241	N. Plated source (NBS Model 4904-E)	N. 1 source not to exceed 10 microcuries
O. Isotopes of Uranium (Maximum 5% of U-235)	O. Uranium Oxide (DOE Standards)	O. Not to exceed 3 grams total.
P. Cobalt 60	P. Sealed sources (Neutron Products, Model NPRD 91-10-F)	P. 2 sources not to exceed 3025 Curies each.

For the State Department of Health Services

Date: December 4, 1991

By: 3

Radiologic Health Branch
P.O. Box 942732
Sacramento, CA 94234-7320

RH 2551 (int.) (1/91)

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

License Number: 5322-80

Supplementary Sheet

Amendment Number: 8

Q. Hydrogen 3	Q. Samples for analysis	Q. Not to exceed 100 millicuries per sample; total not to exceed 10 curies.
R. Any radionuclide with atomic number 3-83.	R. Samples for analysis	R. Not to exceed 1 millicurie per sample.*
S. Any radionuclide with atomic number 84-105.	S. Samples for analysis	S. Not to exceed 10 microcuries per sample.*
		* Total of Subitems R. and S. not to exceed 1 curie.

9. Authorized Use

A.-F. To be used in research and development as defined in Section 30100 (ad), radiation effects testing, and quality control and operational testing of radiation detection instruments (testing on animals or use of radioiodines is not authorized).

G. To be used for radiation measurements, neutron flux measurements, dosimetry, and irradiation of materials.

H. To be used for irradiation of materials.

I. To be used as components of Industrial Nucleonics Exposure Device for irradiation of materials.

J. To be used incidental to testing of neutron irradiated components.

K. To be used as components of AECL Gammacell 220 for irradiation of materials.

L. To be used as a component of J. L. Shepherd irradiator Model 28 series for irradiation of materials.

M.-N. To be used in research and development as defined in Section 30100 (ae).

O. To be used to calibrate instruments.

For the State Department of Health Services

Date: December 4, 1991

By: _____

Radiologic Health Branch
P.O. Box 942732
Sacramento, CA 94234-7320

RH 2551 (Int.) (1/91)

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

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Amendment Number: 8

P. To be used for storage in DOT approved shipping containers only.

Q.- S. and D. To be used incidental to analysis of environmental and mixed waste samples from DOE and other facilities.

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10. Radioactive material shall be used only at the following locations:

    (a) 3020 Callan Road, San Diego, CA (Subitems A-J., N, O and P)
    (b) 7696 Formula Place, San Diego, CA (Subitems J and K)
    (c) 9284 Balboa Avenue, San Diego, CA (Subitem M)
    (d) 11588 Sorrento Valley Road, San Diego, CA (Subitems O, Q, R and S)
    (e) 3398 Carmel Mountain Road, San Diego, CA (Subitems A-F, O, Q, R, and S)
    (f) 11545 Sorrento Valley Road, Suite 307, San Diego, CA (Subitems Q, R and S)

11. This license is subject to an annual fee for sources of radioactive material authorized to be possessed at any one time as specified in Item 8 of this license. The annual fee for this license is required by and computed in accordance with Sections 30230-30232 of the California Radiation Control Regulations and is also subject to an annual cost-of-living adjustment pursuant to Section 113 of the California Health and Safety Code.

12. (a) Radioactive materials described in Subitems A.- J., M., N. & P of this license shall be used by, or under the supervision of the following individuals:

    (1) Richard Sobilo
    (2) Thomas Bradley
    (3) Eric Duff
    (4) Ben Hawkinson
    (5) Lance Steere

For the State Department of Health Services

Date: December 4, 1991

By: 3

Radiologic Health Branch
P.O. Box 942732
Sacramento, CA 94234-7320

RH 2551 (Rev.) (1/91)

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

License Number: 5322-80

Supplementary Sheet

Amendment Number: 8

12. (continued)

(b) Radioactive materials described in Subitems J. and K. of this license shall be used by, or under the supervision of the following individuals:

(1) Richard Sobilo
(2) Peter Kwei
(3) George Jordan
(4) Bryan Green
(5) Charles Land
(6) Todd Gofoth
(7) Steve Schneider
(8) Ben Hawkinson
(9) Thomas Bradley
(10) Eric Duff

(c) Radioactive materials described in Subitem L of this license shall be used by, or under the supervision of, the following individuals:

(1) John Rauch
(2) Robert Schell

(d) Radioactive materials described in Subitem O of this license shall be used by, or under the supervision of, the following individuals:

(1) Robert Mullins
(2) Larry Bosch
(3) Lance Steere

(e) Radioactive materials described in Subitems Q, R and S of this license shall be used by, or under the supervision of, the following individuals:

(1) Robert G. Beimer, Ph.D.
(2) Elaine Walters
(3) Jo Ann Wilkinson
(4) Dennis D. Blevins
(5) Lance Steere

13. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 7, and 8 of this license in accordance with statements, representations, and procedures contained in the documents listed below. The Department's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

For the State Department of Health Services

Date: December 4, 1991

By: _____

Radiologic Health Branch
P.O. Box 942732
Sacramento, CA 94234-7320

RH 2551 (Int.) (1/91)

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

License Number: 5322-80

Supplementary Sheet

Amendment Number: 8

13. (continued)

(a) The application with attachments dated April 17, 1989 signed by D.R. Grine as modified by letters with attachments dated August 25, 1989 signed by D. R. Grine, dated October 9, 1989 and November 7, 1989 both signed by Kerry Dance, and letter received on November 21, 1989 signed by Richard Sabilo.
(b) The letter with attachments dated November 30, 1989 signed by Richard J. Sobilo.
(c) The letter with attachments dated January 22, 1990, signed by Richard J. Sobilo.
(d) The letter with attachments dated February 7, 1990, signed by Richard Sobilo.
(e) The letter with attachments dated February 9, 1990, signed by Richard Sobilo, regarding loading and testing Cobalt sources in the irradiator.
(f) The letter with attachments dated May 11, 1990, signed by Richard Sobilo regarding radiation measurements and safety precautions instituted for the use of 6000 Curies of Co-60 in The Neutron/Gamma Facility.
(g) The letter (regarding clarification of decontamination action levels) dated November 20, 1990, signed by Richard Sobilo.
(h) The letter dated May 30, 1990 (received July 20, 1990) with attached application, signed by Richard J. Sobilo, Radiation Safety Officer.
(i) The letter with attachment dated June 4, 1991, signed by Richard Sobilo, regarding the preparation of standards for mixed waste with atomic numbers 84 thru 105.
(j) The letters with attachments (regarding repair and modification of Neutron Gamma Facility), dated August 26, 1991 and October 15, 1991, both signed by Richard Sobilo.

14. (a) The radiation safety officer in this program shall be Richard Sobilo.

(b) The alternate radiation safety officer shall be John Rauch, Balboa Facility and Charles Land, Formula Place Facilities.

15. Sealed sources possessed under this license shall be tested for leakage and/or contamination as required by Section 30275(c) of the California Radiation Control Regulations.

16. Analytical tests for leakage and/or contamination of sealed sources shall be performed only by persons specifically authorized to perform that service.

17. The following individuals are authorized to collect wipe test samples of sealed sources possessed under this license using leak test kits acceptable to the California Department of Health Services:

(a) The Radiation Safety Officer.
(b) Qualified individuals designated by the radiation safety officer.

For the State Department of Health Services

Date: December 4, 1991

By: 3

Radiologic Health Branch
P.O. Box 942732
Sacramento, CA 94234-7320

RH 2551 (INT.) (7/91)

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

License Number: 5322-80

Supplementary Sheet

Amendment Number: 8

18. Records of leak test results shall be kept in units of microcuries and maintained for inspection. Records may be disposed of following Department inspection. Any leak test revealing the presence of 0.005 microcuries or more of removable radioactive material shall be reported to the Department of Health Services, Radiologic Health Branch, 744 P Street, P.O. Box 942732, Sacramento, CA 94234-7320, within five days of the test. This report shall include a description of the defective source or device, the results of the test, and the corrective action taken.

19. Each high radiation area in which there may exist radiation at such levels that an individual could receive in any one hour a dose to the whole body in excess of 500 rem from a source of radiation used to irradiate materials shall:

    (a) Have each entrance equipped with automatic control devices which shall:

        (1) Prevent inadvertent entry whenever a high radiation area exists.

        (2) Permit deliberate entry only after a control device is actuated which shall cause the radiation level to be reduced and prevent operation of the source of radiation to ensure that a high radiation area cannot be created.

    (b) Be equipped with additional control devices such that upon failure of the entry control devices to function as required by paragraph (a) of this condition:

        (1) The radiation level within the area shall be reduced such that a high radiation area does not exist; or

        (2) Inadvertent entry to the area is prevented; and

        (3) Visible and audible alarm signals shall be generated to make an individual attempting to enter the area aware of the hazard, and the user or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of such failure of the entry control devices.

    (c) Be equipped with control devices such that upon failure or removal of physical radiation barriers other than storage containers:

        (1) The radiation level from the source of radiation shall be reduced so that a high radiation area does not exist.

For the State Department of Health Services

Date: December 4, 1991

By: 3

Radiologic Health Branch
P.O. Box 942732
Sacramento, CA 94234-7320

RH 2551 (RH) (1/91)

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

License Number: 5322-80

Supplementary Sheet

Amendment Number: 8

19. (continued)

(2) Visible and audible alarm signals shall be generated to make potentially affected individuals aware of the hazard, and the user or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of the failure or removal of the physical barrier. When the shield is a liquid, means shall be provided to monitor the integrity of the shield and to signal automatically loss of adequate shielding. Physical radiation barriers that complete permanent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of this paragraph.

(d) Be equipped with devices that will automatically generate visible and audible alarm signals to alert personnel in the area before the source can be put into operation and in sufficient time for any individual in the area to operate a clearly identified control device which shall be installed in the area and which can prevent the source from being put into operation.

(e) Be controlled by such administrative procedure and such devices as are necessary to assure that the area is cleared of personnel prior to each use of the source of radiation.

(f) Be checked by physical radiation measurement to assure that prior to the first individual/s entry into the area after any use of the source of radiation, the radiation level is sufficiently reduced such that a high radiation area does not exist.

(g) Have the controls required by this condition established in such a way that no individual shall be prevented from leaving a high radiation area.

(h) Have entry control devices required by this section tested for proper functioning prior to initial operation with such source of radiation on any day that operations are not uninterruptedly continued from the previous day and before resuming operations after any unintended interruption. No operations other than those necessary to place the source of radiation in safe condition or to effect repairs on controls shall be conducted unless control devices are functioning properly. The user shall maintain records, showing dates, times and results of the tests of function of all such system tests available for inspection.

For the State Department of Health Services

Date: December 4, 1991

By: 3

Radiologic Health Branch
P.O. Box 942732
Sacramento, CA 94234-7320

RH 2551 (Int.) (1/91)

State of California—Health and Welfare Agency

Department of Health Services

RADIOACTIVE MATERIAL LICENSE

License Number: 5322-80

Supplementary Sheet

Amendment Number: 8

19. (continued)

(i) Have the entry and exit portals that are used in transporting materials to and from the irradiation areas, and that are not intended for use by individuals, controlled by such devices and administrative procedures as are necessary to physically protect and warn against inadvertent entry by an individual through such portals. Exit portals for processed materials shall be equipped to detect and signal the presence of any loose radiation sources that are carried toward such an exit and to automatically prevent such loose sources from being carried out of the area.

For the State Department of Health Services

Date: December 4, 1991

By: 3

Radiologic Health Branch
P.O. Box 942732
Sacramento, CA 94234-7320

RH 2551 (9M.) (1/91)

Site Management Plan
Revision No. 1.0
January 1995

APPENDIX G
LANCASTER LABORATORIES

826600327

Qualifications Manual

Lancaster Laboratories

826600328

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APPENDIX C - Resumes of Key Personnel

This manual provides a detailed picture of Lancaster Laboratories, Inc. with special emphasis on our personnel, physical facilities, instrumentation, and quality assurance programs. It allows the reader to appraise our ability to provide those technical services which we offer. The best way for a prospective client to judge our capabilities is by a personal visit. However, if limitations of time and geographical distance preclude such a visit, we hope this manual will prove an adequate substitute.

M Lewis Hess
Quality Assurance Director Signature

January 1994
Date

SECTION 1
INTRODUCTION

A. MISSION STATEMENT AND PRINCIPLES . . . A CREDO

We will provide quality independent laboratory services in the chemical and biological sciences by:

- Fully understanding and always meeting the requirements of those we serve
- Relating to our clients, coworkers, suppliers, and community in a fair and ethical manner
- Managing our growth and financial resources so we can serve our clients well, preserve our independence, and maintain our meaningful and enriching workplace

B. STATEMENT OF VALUES

Lancaster Laboratories' heritage has as its core the ethical treatment of everyone involved with our business. As a corporate community, we embrace our heritage of integrity and strive to live by the following principles:

- Fairness and honesty in all our relationships
- Mutual trust
- A respect for ourselves and others
- A sense of caring that leads us to act responsibly toward each other and society, now and in the future
- Loyalty to our clients and one another
- A spirit of open-mindedness as we deal with all
- Dedication to service
- Good stewardship of our resources
- A commitment to flexibility and continuous improvement

We each take personal responsibility to live these values in all our dealings, knowing full well our pledge may involve difficult choices, hard work, and courage.

C. DESCRIPTION OF COMPANY

Lancaster Laboratories, Inc. is an independent company offering high-quality technical services in the chemical and biological sciences with personal attention to client needs. These services include chemical analyses, microbiological testing, contract research and development, and consulting. Our firm is a privately-held corporation and is not a subsidiary of another company. We are, therefore, an independent, technical service company and do not manufacture or distribute goods. Our "product" is accurate and timely technical information. As a for-profit, taxpaying organization, our continued existence depends on the quality of the services we offer and the efficiency with which we deliver them. Our operations are organized into the separate specialty areas of Environmental Sciences, Food Sciences, and Pharmaceutical Sciences.

D. COMPANY HISTORY

Our firm was founded in 1961 by Dr. Earl H. Hess in response to a perceived need for high quality technical services by the agricultural and industrial community in Southeastern Pennsylvania. Initial staff consisted of Dr. Hess, one technician, and Mrs. Hess as a part-time secretary and bookkeeper. Our organization reached its present size of over 480 people through continual growth, which has required nine expansions of the physical plant.

E. GEOGRAPHICAL AREA SERVED

Our clientele ranges over the entire conterminous United States and beyond, into South and Central America and Europe. Although most of our clients are in the Middle Atlantic states, the advent of overnight deliveries allows us to offer prompt service to the entire country. Our clients include private individuals; private business enterprises of all sizes; trade associations; universities and colleges; and federal, state, and local government organizations.

F. OWNERSHIP

The company is incorporated under the laws of the Commonwealth of Pennsylvania and is operated as a closed corporation. Earl H. Hess, founder, is the largest stockholder; all other stock is held by family members and key employees.

Lancaster Laboratories, Inc. holds controlling equity interest in Mountain States Analytical, Inc. in Salt Lake City, UT.

1. Board of Directors

   The Board of Directors of the corporation consists of the following members:

   Earl H. Hess, Ph.D., Chairman of the Board, CEO
   J. Wilson Hershey, Ph.D., Executive Vice President, Laboratory Operations
   Kenneth E. Hess, B.S., Executive Vice President, Finance & Data Processing, Treasurer
   Carol D. Hess, M.B.A., Executive Vice President, Human Resources & Administration, Secretary
   Christoph J. Grundmann, Ph.D., Board Member Emeritus

2. Consultants

   The following are consultants retained by the corporation as Research Associates:

   Christoph J. Grundmann, Ph.D.
   Ray F. Dawson, Ph.D.

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SECTION 2
ORGANIZATIONAL STRUCTURE

The organizational structure of the company is shown on the charts on pages 13 to 18. We have three business units: Environmental Sciences, Food Sciences, and Pharmaceutical Sciences. In addition, a Support Services Group handles the nontechnical work of the corporation. Here is a listing of the employees clients are likely to have contact with. Staff members' names appear with their regular work groups, but many workers are cross-trained and can perform the analytical work of various groups. Resumes of key technical personnel can be found in Appendix C.

A. CORPORATE SERVICES

Earl H. Hess, Ph.D., Chairman of the Board, President, and CEO

Gerry Hershey, Administrative Assistant/Specialist
Linda Weber, Corporate Services Administrative Assistant

1. Quality Assurance

M. Louise Hess, B.S., Director, Quality Assurance

Kathy DiNunzio, B.S., Quality Assurance Specialist
Kathleen Loewen, B.S., Data Package Quality Assurance Specialist/Coordinator
Kimberly Oliver, B.S., Quality Assurance Specialist
Linda Saad, B.S., Quality Assurance Specialist
Susan Shorter, B.S., Quality Assurance Specialist
Chris Wubbolt, B.S., Quality Assurance Specialist

B. BUSINESS UNITS

J. Wilson Hershey, Ph.D., Executive Vice President, Laboratory Operations

1. Environmental Sciences

a. Air Quality, ExpressLAB, Field Sampling, Instrumental Water Quality, and Water Quality

Arthur Pezzica, B.A., Manager

(1) Air Quality

Nadia Alfieri, IHIT, M.S., Air Quality Project Specialist
Brett Chronister, B.S., Industrial Hygienist
Greg Gusavage, B.A., Associate Industrial Hygienist
Mark Hoover, B.S., Associate Industrial Hygienist
Luke Lazar, B.S., Associate Industrial Hygienist
Patrick Weidinger, B.S., Industrial Hygienist/Coordinator

(2) ExpressLAB

Delwyn Schumacher, B.S., Group Leader

Matthew Barton, B.S., Chemist
Bob Brown, Chemist
Joseph Davis, B.S., Chemist/Coordinator
Melissa McDermott, B.A., Chemist/Data Package Specialist

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Timothy Pyle, Chemist
Terry Schuck, B.S., Chemist/Coordinator

Additional Support Personnel in this Group: 6

(3) Field Sampling

Jeffrey Allen, Administrator

Additional Support Personnel in this Group: 1

(4) Instrumental Water Quality

Sam Huber, B.S., Group Leader

Eric Eby, Associate Chemist
David Evans, B.S., Chemist/Coordinator
Frederick Freed, B.A., Associate Chemist
Daniel Lavrich, B.S., Associate Chemist
Livy Smith, B.S., Chemist

Additional Support Personnel in this Group: 11

(5) Water Quality

Bethany Ebling, B.S., Group Leader

Erik Frederiksen, B.A., Chemist/Coordinator
Tara Flick, B.S., Associate Chemist
Robert Heisey, B.A., Chemist/Coordinator
Sandra Miller, Associate Chemist
Elaine Stoltzfus, Associate Chemist

Additional Support Personnel in this Group: 15

b. Business Development and Client Services

Richard Burke, M.S., Director, Business Development/Client Services

(1) Business Development

Marianne Bragg, B.S., Business Development Specialist
Glenn Cahilly, Ph.D., Business Development Specialist
Patricia Downing, B.S., Business Development Specialist
Richard Entz, B.A., Senior Technical Specialist
Rick Griffith, Business Development Specialist
Robert Large, B.S., Business Development Specialist
Julie O'Donnell, B.A., Business Development Specialist
Donald Wyand, B.S., Business Development Specialist

Additional Support Personnel in this Group: 1

(2) Client Services

Susan Page, B.A., Group Leader

Brad Ayars, Client Services Specialist, Environmental Sciences
Nancy Bornholm, B.S., Client Services Specialist, Environmental Sciences
Stephanie Bozym, B.S., Client Services Specialist, Pharmaceutical Sciences

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De Brooks, Client Services Specialist, Environmental Sciences
Michelle Crawford, B.S., Client Services Specialist, Food Sciences
Kathy Hallquist, Client Services Specialist, Environmental Sciences
Lynn Hebner, B.S., Client Services Specialist, Environmental Sciences
Eileen Hostetler, B.S., Client Services Specialist, Environmental Sciences
Jeannie Jacobson, B.S., Client Services Specialist, Pharmaceutical Sciences
Katherine Klinefelter, M.S., Client Services Specialist, Environmental Sciences
Rachel Kreamer, B.S., Client Services Specialist, Environmental Sciences
John MacKay, B.S., Client Services Specialist, Food Sciences
Wendy Park, B.S., Client Services Specialist, Environmental Sciences
Patrick Parmer, Client Services Specialist, Air Quality
Kim Purdy, B.A., Client Services Specialist, Food Sciences
Jill Wolgemuth, B.S., Client Services Specialist/Coordinator, Environmental Sciences
Kimberly Zeeman, B.S., Client Services Specialist, Environmental Sciences

Additional Support Personnel in this Group: 1

c. Data Package

Mary Ann Brubaker, M.S., Group Leader

Debra Looper, Data Package Administrator
Sandra Patton, B.S., Data Package Specialist
David Weiser, B.S., Data Package Specialist/Coordinator

Additional Support Personnel in this Group: 6

d. Equipment Maintenance, GC/MS Group, Inorganic Analysis Group, and Organic Analysis Group

Timothy Oostdyk, Ph.D., Manager

(1) AAS Metals

Debora Gifford, B.S., Group Leader

Eugene Abel, B.S., Chemist/Coordinator
Brenda Buckwalter, B.A., Associate Chemist
Doug Graham, Chemist
Beatrice Joseph, B.S., Chemist
Nelli Markaryan, B.S., Associate Chemist
Betsy Menefee, B.S., Chemist/Coordinator
Rick Rodgers, B.S., Chemist
Julie Slaughenhoupt, B.S., Associate Chemist
Danny Taylor, Chemist
Matthew Thomas, B.S., Chemist
Elizabeth Tomlinson, B.S., Chemist
Timothy Trees, A.A.S., Chemist/Coordinator
Nancy Wagner, B.S., Associate Chemist

Additional Support Personnel in this Group: 12

(2) Equipment Maintenance

Tim Arms, Instrument Specialist
Fred Tolan, Instrument Specialist
Michael Tolan, B.S., Administrator

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(3) ICP Metals/Leachates

Ramona Layman. B.S., Group Leader

Eric Cuba, B.S., Chemist/Coordinator
Jane Follweiler, B.S., Chemist/Coordinator
Nina Haller, Technical Associate
Michael Hintenach, B.S., Computer Integration Specialist
David Ressler, Administrator
Donna Sackett, Associate Chemist
Lee Seats, M.B.A., Senior Chemist
Max Snavely, B.S., Chemist
Robert Strocko, B.S., Associate Chemist
Betty Umble, Administrator

Additional Support Personnel in this Group: 6

(4) GC/MS Semivolatiles

Jon Kauffman, Ph.D., Group Leader

Derek Berger, B.S., Chemist
Rachel Eng, B.A., Associate Chemist
Phillip Esbenshade, Ph.D., Chemist
Joseph Hill, B.S., Chemist/Coordinator
Catherine Holt, B.S., Computer Specialist
George Main, B.S., Chemist
Lietta Milton, Administrator/Data Package Coordinator
Christine Ratcliff, B.S., Chemist/Coordinator
Mark Ratcliff, B.A., Chemist
James Rittenhouse, Ph.D., Chemist
Brad Roadcap, B.S., Chemist
Rick Shober, B.S., Chemist
Tara Spaide, Technical Associate/Coordinator
Andrew Strebel, Technical Specialist
Shari Thomas, B.S., Associate Chemist
Lynn Wallace, B.A., Chemist/Coordinator
Thomas Willig, B.S., Chemist
Kendra Wiser, B.A., Associate Chemist

Additional Support Personnel in this Group: 6

(5) GC/MS Volatiles

Michele McClarin, B.A., Group Leader

Matthew Benton, B.S., Associate Chemist
Charles Bourque, B.A., Chemist
David Chandler, B.S., Associate Chemist
Paul Cormier, B.A., Chemist
Susan Croyle, B.S., Chemist
Kathy Fair, Data Package Administrator
Leah Ann Garibay, Associate Chemist
Kathy Holley, B.S., Chemist
David Hoppman, Technical Specialist
John Layman, B.A., Chemist
Thomas Lehman, Ph.D., Chemist
Duane Luckenbill, B.S., Chemist/Coordinator
Robert Mellinger, B.S., Chemist

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John Morton, M.S., Chemist
Tracey Neff, B.S., Associate Chemist
Melanie Rittenhouse, Ph.D., Chemist
Robin Runkle, B.S., Chemist
Trent Sprenkle, B.S., Associate Chemist
Lawrence Taylor, B.S., Chemist
Barbara B. Weaver, B.S., Chemist
Kevin Witman, B.S., Chemist

Additional Support Personnel in this Group: 2

(6) Organic Analysis by GC and Organic Analysis Group

Judy Colello, B.S., Group Leader

Karen Baney, B.S., Chemist
Stephanie Brodhecker, B.S., Associate Chemist
Barbara Frantz, B.S., Associate Chemist
Susan Kreider, Associate Chemist
Denise Null, B.S., Associate Chemist
Linda Pape, B.A., Technical Associate
Luke Peterschmidt, B.S., Chemist
Jeffrey Schlegelmilch, B.S., Chemist
Donald Shelly, B.S., Chemist
Robert Stauffer, B.S., Integration Systems Specialist
Christiane Sweigart, B.S., Chemist/Coordinator
Tina Thoman, B.S., Chemist
Dennis Urban, M.S., Chemist
Tan Vo, B.S., Associate Chemist
Melissa Yanchuck, B.S., Technical Specialist/Coordinator

Additional Support Personnel in this Group: 5

b. Pesticide Residue Analysis

Nelson Risser, B.A., Manager

Jenifer Hess, B.S., Group Leader

Greg France, B.A., Chemist
Joseph Friel, B.S., Chemist
Donna Lewis, B.S., Chemist/Coordinator
Dorothy Love, B.S., Data Review Specialist/Coordinator
Michele Mack, B.S., Chemist
Lori Martin, B.S., Data Package Administrator
Carmen Navarro, Data Package Administrator
Nancy Saunders, B.S., Chemist
Douglas Seitz, B.S., Associate Chemist
John Styles, B.S., Chemist
Troy Wingenroth, B.A., Computer Specialist

Additional Support Personnel in this Group: 12

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2. Food and Pharmaceutical Sciences

a. Food Sciences

Philip Oles, Ph.D., Manager

Gordon Beitzel, B.S., Systems Specialist
David Schumacher, B.S., Senior Systems Specialist
Bryan Winship, B.S., Chemist

(1) Food Chemistry

Sandy Bailey, B.S., Group Leader, Nutrition Labeling
Gloria Gates, B.S., Group Leader, Project Work

Jean Brown, Technical Specialist
Mark Clark, B.S., Chemist
Jack Follweiler, B.S., Chemist
Samir Gouda, B.S., Associate Chemist
Tammy Heinbaugh, B.S., Chemist
Mark Herrmann, B.S., Chemist
Carol Johnson, B.A., Chemist/Coordinator
James Kushubar, Chemist
Deb Marcuson, B.A., Chemist
Lisa Mease, Technical Associate
Victoria Pillion, B.S., Chemist
Valerie St. Clair, B.S., Chemist
Darla Schumacher, Technical Specialist/Coordinator
Jeanine Schreiber, Technical Specialist/Coordinator
Arlene Silcox, B.A., Chemist
Brenda Weaver, Technical Specialist
Jon Wenger, B.S., Chemist
Jon Wright, B.S., Chemist

Additional Support Personnel in this Group: 18

(2) Food Microbiology

Rose Sorgenfrei, M.B.A., Group Leader

Charles Ducker, B.S., Microbiologist
C. Robert Graham, B.S., Senior Microbiologist
Audrey McClune, Technical Associate/Coordinator
Christine Rank, B.A., Associate Microbiologist
Brian Sauders, B.S., Associate Microbiologist
Matthew Westerman, B.S., Associate Microbiologist

Additional Support Personnel in this Group: 6

(3) Applied Research & Development

Chuck Neslund, B.S., Chemist
Tamra Schumacher, B.S., Chemist
John Snyder, Ph.D., Senior Chemist

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b. Pharmaceutical Sciences

Wesley Neumann, M.S., Manager

(1) Pharmaceutical and Environmental Microbiology

Mark Kaiser, Group Leader

Sue Bocchicchio, B.A., Technical Associate
Craig Carlough, B.A., Microbiologist
Harolyn Clow, B.S., Microbiologist/Coordinator
Earl Custer, B.S., Microbiologist/Coordinator
Suzanne Gebhart, B.S., Microbiologist
Kendra Hartman, B.A., Associate Microbiologist/Coordinator
Ann Nuyen, B.S., Associate Microbiologist
Lisa Ulmer, B.S., Microbiologist/Coordinator
Michael Yunginger, B.S., Microbiologist/Coordinator

Additional Support Personnel in this Group: 7

(2) Pharmaceutical Chemistry

Robert Reagan, B.A., Group Leader

Anthony Andrews, B.S., Chemist
Brian Clow, B.S., Chemist/Coordinator
Travis Emig, B.S., Chemist
Myra Fink, Technical Associate
Kelly Gamble, B.S., Chemist
Mark Heinbaugh, B.A., Chemist/Coordinator
Timothy Klock, B.S., Chemist
Gregory Kupp, B.S., Chemist
Denise Legall, M.S., Chemist/Coordinator
Scott Montague, B.S., Associate Chemist
Jan Parker, B.A., Chemist
Stacia Pfautz, A.A.S., Technical Associate
Joan Rebert, B.S., Chemist
Tony San Martin, A.S., Chemist/Coordinator
Deborah Sharrow, Technical Associate
Laura Shepler-Moore, B.S., Associate Chemist
David Wright, B.S., Chemist

Additional Support Personnel in this Group: 8

3. Sample Administration and Sample Support

Nelson Risser, B.A., Manager

a. Sample Administration

Anneliese Hutchison, M.B.A., Group Leader

(1) Environmental Sciences

Deb Neslund, Specialist/Coordinator

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(2) Food and Pharmaceutical Sciences

Lynn Carruthers, B.S., Specialist/Coordinator

Additional Support Personnel in this Group: 13

b. Sample Support

Cynthia Ayars, B.S., Group Leader

Additional Support Personnel in this Group: 11

C. SUPPORT SERVICES

1. Administration

Carol Hess, M.B.A., Executive Vice President, Administration/Corporate Secretary

Bonnie Lee, M.S., Corporate Projects Specialist
Barbara J. Weaver, CIH, Corporate Technical Projects Specialist

a. Human Resources

Beth DiPaolo, Group Leader, Training and Recruiting
Margaret Stoltzfus, Group Leader, Benefits and Safety

Jeanette Beisel, Administrator
Laima Carlisle, Recruiting Specialist
Donna Kauffman, B.S., Computer Specialist
Janice Mehnert, B.A., Training and Development Specialist
Mary Munster, B.S., Safety/Chemical Hygiene Officer/Benefits Specialist
Robert Schindewolf, B.A., Recruiting Specialist
Cindy Weiser, Administrator

Additional Support Personnel in this Group: 2

b. Office Support

Lorraine Heagy, Group Leader

Nancy Crouse, Office Services Specialist/Coordinator
Janet Hess, Billing & Reporting Administrator/Coordinator
Denise Splain, Office Services Administrator
Sandra Weekes, B.S., Legal Specialist

Additional Support Personnel in this Group: 14

c. Physical Services

Jay Fitze, Group Leader

Jerry Clipper, Manager, Facilities and Physical Services
Barry Gehman, Coordinator
Melvin Martin, Coordinator
Harold Milton, Security Coordinator

Additional Support Personnel in this Group: 18

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d. Public Relations and Government Affairs

Anne Osborne, M.A., Manager

Lisa Bamford, B.S., Public Relations Specialist
Lisa Shields, A.A., Graphic Arts Specialist

3. Data Processing, Finance, Marketing, and Transportation

Kenneth Hess, B.S., Executive Vice President, Finance and Data Processing/Corporate Treasurer

a. Accounting, Purchasing, and Transportation

Thomas Wolgemuth, M.B.A., Manager

Steve Davies, B.S., Group Leader
Thomas Dull, A.A.S., Purchasing Administrator
Marjorie Hollinger, Accounting Specialist
Charles Kurtz, Purchasing Specialist Coordinator

Additional Support Personnel in this Group: 18

b. Computer Services

David Hooley, Ph.D., Group Leader

David Jacobson, B.S., Computer Specialist
David Leedom, B.S., Computer Specialist
G. Scott Martin, A.A.S., Computer Specialist
Scott Stauffer, B.S., Computer Specialist
Deborah Stoltzfus, A.A.S., Computer Specialist
Tom Wise, B.S., Computer Specialist
Ed Zeigler, A.S., Computer Specialist

Additional Support Personnel in this Group: 1

c. Corporate Marketing

George Mummert, M.Admin., Manager

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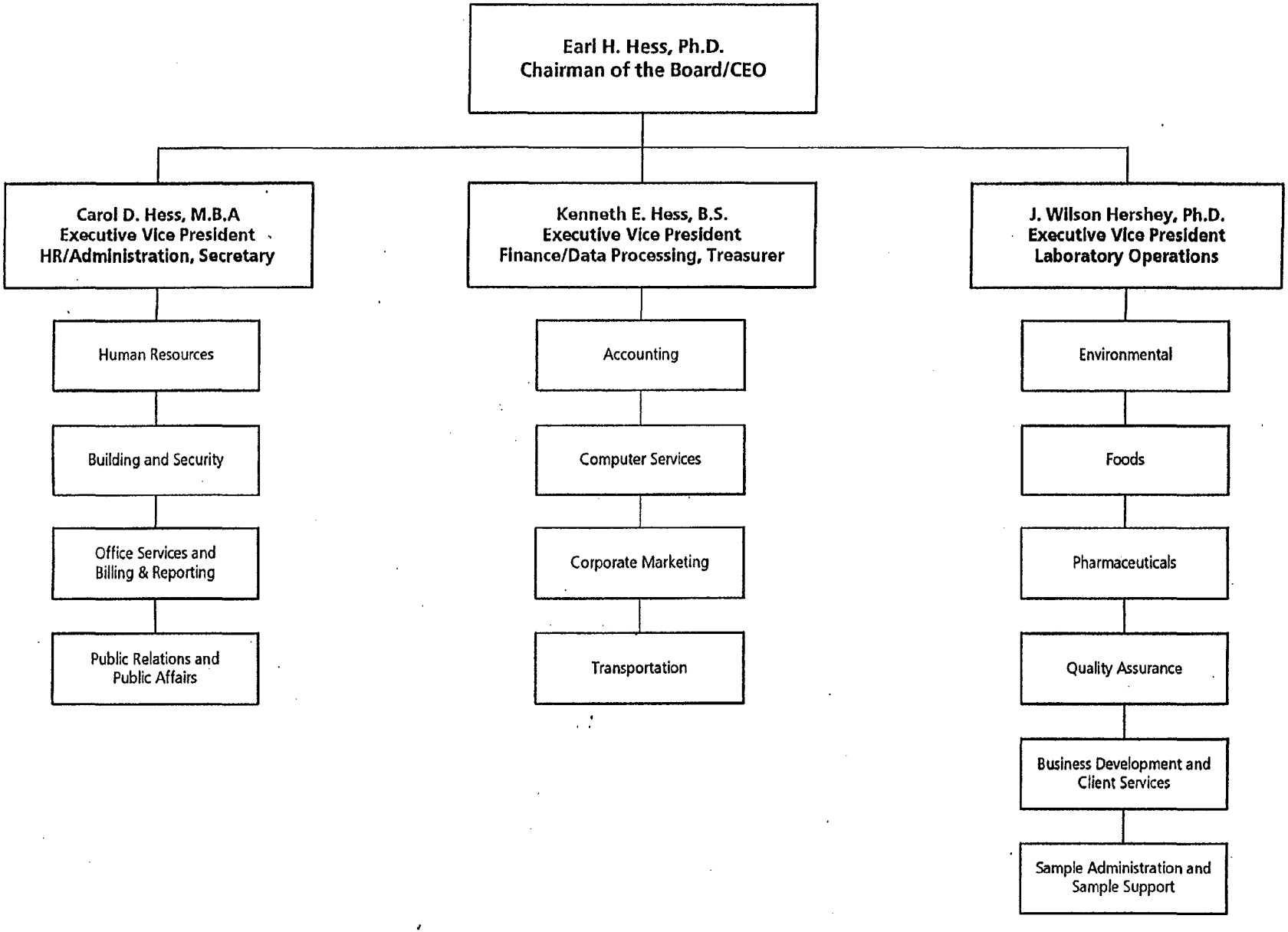

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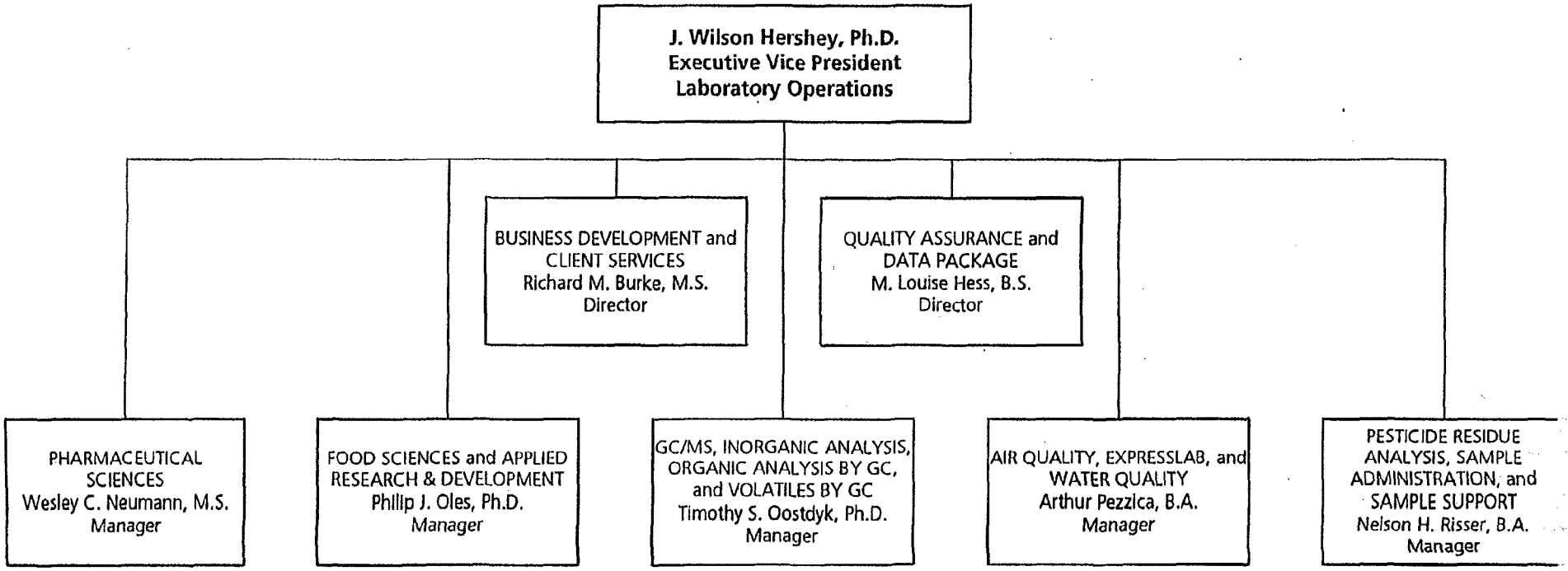
J. Wilson Hershey, Ph.D.
Executive Vice President
Laboratory Operations
BUSINESS DEVELOPMENT and CLIENT SERVICES
Richard M. Burke, M.S.
Director
QUALITY ASSURANCE and DATA PACKAGE
M. Louise Hess, B.S.
Director
PHARMACEUTICAL SCIENCES
Wesley C. Neumann, M.S.
Manager
FOOD SCIENCES and APPLIED RESEARCH & DEVELOPMENT
Philip J. Oles, Ph.D.
Manager
GC/MS, INORGANIC ANALYSIS, ORGANIC ANALYSIS BY GC, and VOLATILES BY GC
Timothy S. Oostdyk, Ph.D.
Manager
AIR QUALITY, EXPRESSLAB, and WATER QUALITY
Arthur Pezzica, B.A.
Manager
PESTICIDE RESIDUE ANALYSIS, SAMPLE ADMINISTRATION, and SAMPLE SUPPORT
Nelson H. Risser, B.A.
Manager

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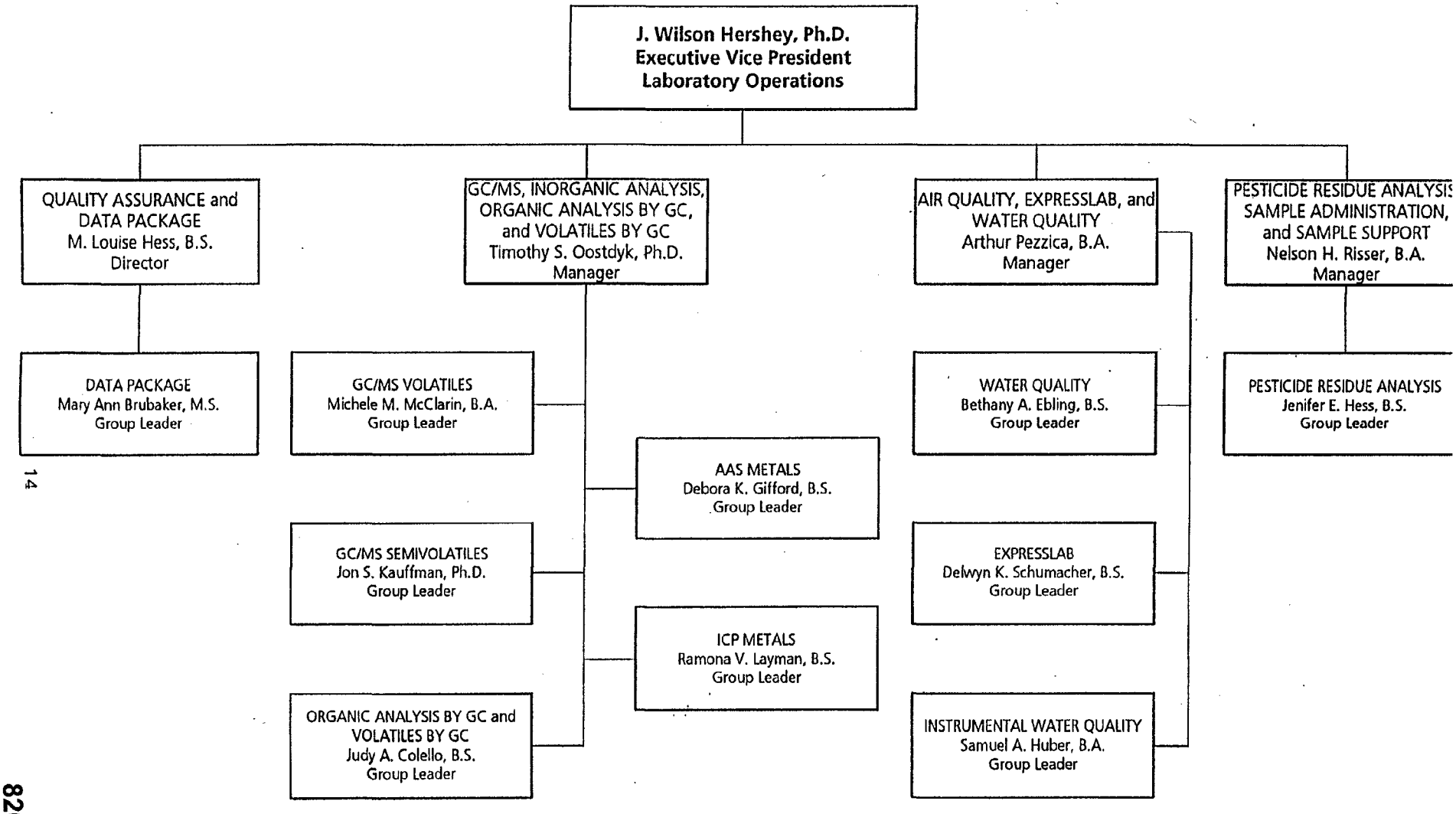

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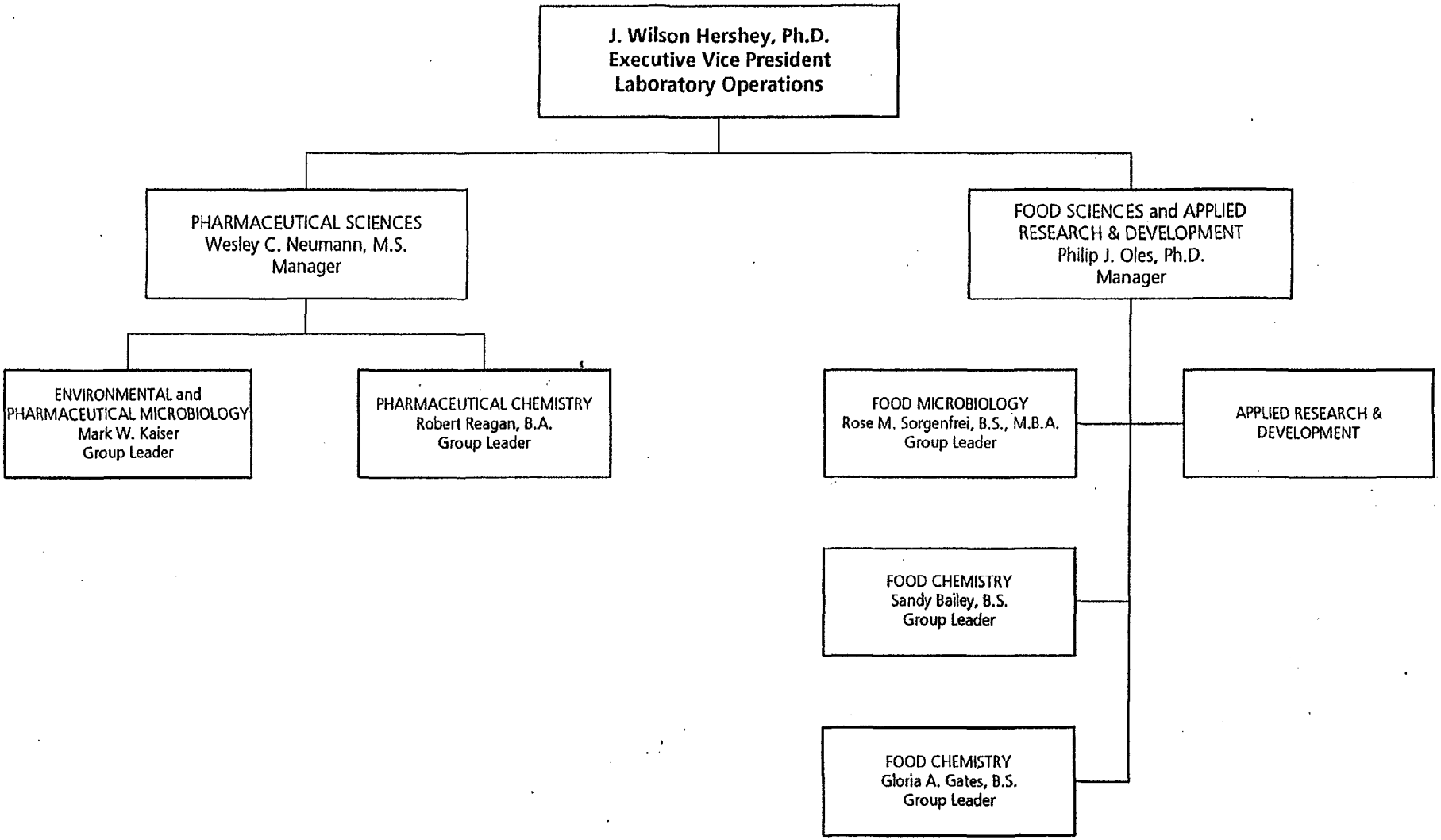

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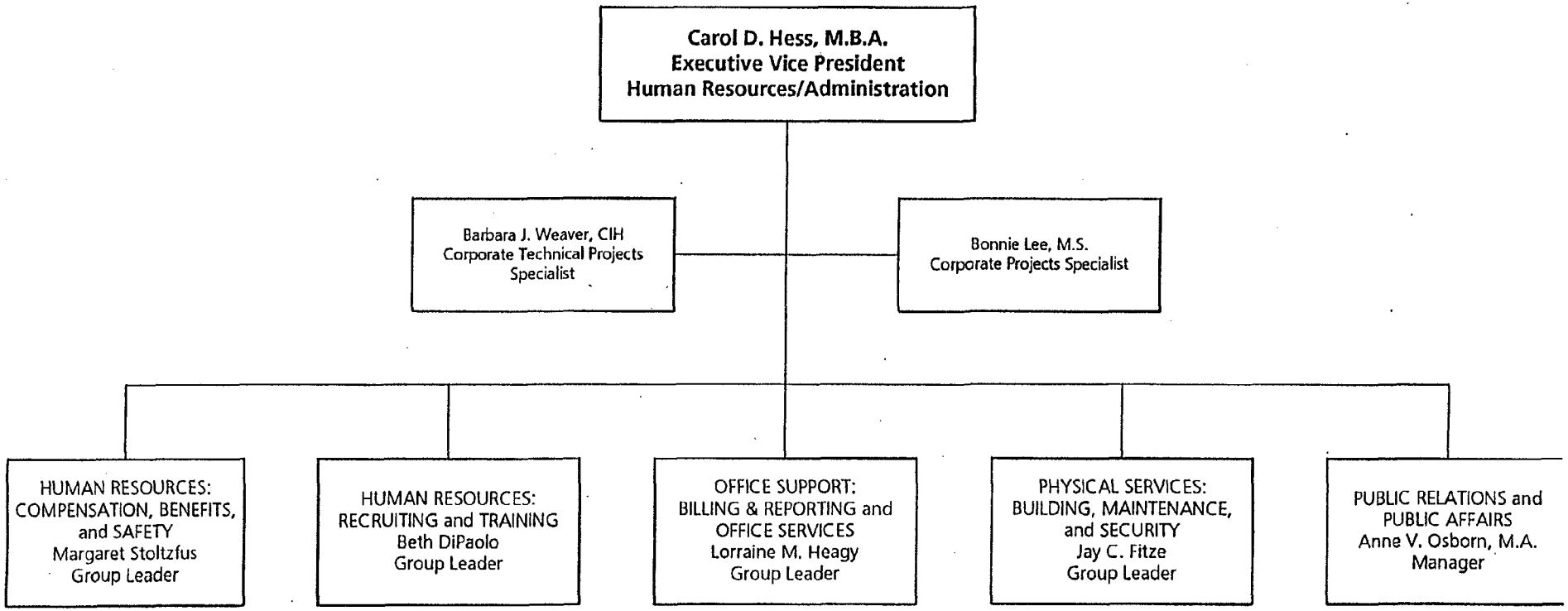

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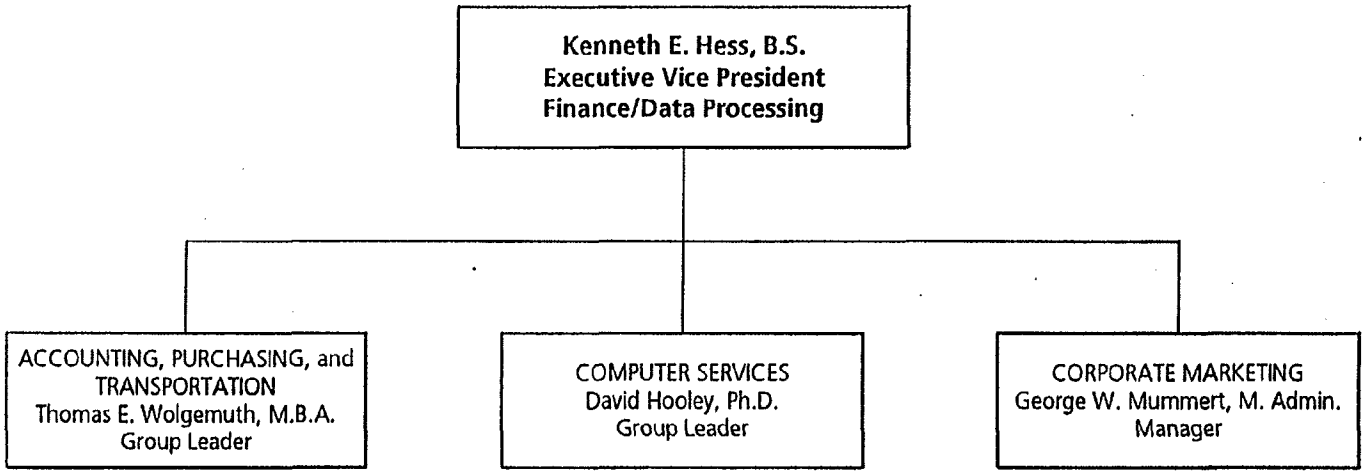
Kenneth E. Hess, B.S.
Executive Vice President
Finance/Data Processing
ACCOUNTING, PURCHASING, and TRANSPORTATION
Thomas E. Wolgemuth, M.B.A.
Group Leader
COMPUTER SERVICES
David Hooley, Ph.D.
Group Leader
CORPORATE MARKETING
George W. Mummert, M. Admin.
Manager

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SECTION 3
PHYSICAL FACILITIES AND INSTRUMENTATION

A. BUILDINGS

The physical facility is located on a four-acre lot on Pennsylvania Route 23 (2425 New Holland Pike) about five miles northeast of the City of Lancaster, PA. In addition to a major building complex, there are four auxiliary buildings housing a general maintenance shop, archives, stability storage, preparation area, auto maintenance, and storage areas; solvent storage sheds located at some distance from the other buildings; and waste storage facilities.

The main building complex has a total area of 100,000 square feet including laboratories, offices, refrigerated and room-temperature sample storage areas, library, data processing center, employees' lunch room, and conference rooms. A class 100 clean room with a class 1000 gowning suite was added in 1990. The facility has undergone nine expansions to accommodate our growing staff, and a tenth addition of 15,000 square feet will be completed in May of 1994.

The air-handling system for the main laboratory is specially designed to protect sensitive instruments from harmful vapors and to ensure that samples are not contaminated. In addition, sample preparations and instrumental analyses are performed in separate rooms.

The building is protected by a sophisticated security and fire alarm system. All outside doors, except the main entrance, are kept locked at all times to prevent unauthorized entry. Employees are issued cards which allow them to enter the building, and the main entrance is monitored by an attendant who registers visitors during normal business hours. During weekends and second and third shift operations, all doors are locked and personnel assigned to security are on duty to prevent unauthorized entry into the laboratory and to accept packages.

An automated storage and retrieval system is housed in the largest walk-in refrigerator. The system combines robotic cranes, carousels, computers, and bar codes to allow samples to be tracked, stored, and retrieved efficiently without entering the refrigerated area.

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B. INSTRUMENTATION

Instrument	# of Units	Manufacturer/Model #
Gas Chromatography:		
GC/MS (With: electron impact ionization and purge and trap concentrator)	1	Finnigan INCOS 50
GC/MS* (With: RTE-6VM or RTE-A operating system on HP-1000 computer, 9-track magnetic tape drive, and 7 with purge and trap concentrator)	16	Hewlett-Packard 5970
GC/MS* (With: electron impact and PC MS/DOS based data system)	2	Hewlett-Packard 5971
Gas Chromatograph* +	11	Varian 3700
Gas Chromatograph* +	2	Varian 6000
Gas Chromatograph* +	41	Hewlett-Packard 5890
Gas Chromatograph +	9	Tracor 540
Gas Chromatograph* +	1	Shimadzu 15A
Gas Chromatograph* +	7	Varian 3400
Gas Chromatograph* +	2	Varian 3600
Auxiliary Equipment for Gas Chromatographs:		
Automated Concentrator	2	Entech M 2000
Purge and Trap	22	Tekmar Various Models
Purge and Trap	3	O.I. Corp.
Headspace Sampler	1	Hewlett-Packard 19395A
Headspace Sampler	1	Dani 3950
Thermal Desorber for Adsorbant Tubes	2	ENTECH TD16A
Detectors available for GC: Electron Capture, Flame Ionization, Photoionization, Hall Electolytic Conductivity, Nitrogen/Phosphorus, Thermal Conductivity, and Flame Photometric All of the chromatographs are connected with electronic integration systems. One of the HP5890 units is equipped with MIDI Gas Chromatographic Microbial Identification System.		
High Performance Liquid Chromatography:		
High Performance Liquid Chromatograph* +	14	Shimadzu LC-6A or 6B
High Performance Liquid Chromatograph* +	1	Hewlett-Packard 1040
High Performance Liquid Chromatograph*	1	Shimadzu LC-600
High Performance Liquid Chromatograph* +	13	Hewlett-Packard 1050

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Instrument	# of Units	Manufacturer/Model #
High Performance Liquid Chromatograph	1	Spectra System AS 3000
High Performance Liquid Chromatograph	4	Hitachi AS-4000
Auxiliary Equipment for High Performance Liquid Chromatography:		
Post Column Derivitazation Unit	1	Kratos PCR 520 SF-980, SF-400
Post Column Reaction Unit	1	Pickering EC-500
SEC/GC Software	1	Justice Innovations
Detectors available for HPLC: Diode Array Spectrophotometer, Refractive Index, Ultraviolet, Fluorescence, and Evaporative Light Scattering Detector		
Gel Permeation Chromatography:		
Gel Permeation Chromatograph	1	Zymate System - ZB0012
Gel Permeation Chromatograph	1	Zymark B3
Gel Permeation Chromatograph	1	ABC Lab 601
Gel Permeation Chromatograph	1	ABC Lab 1002A
Gel Permeation Chromatograph	1	ABC Lab 1000
Ion Chromatography:		
Ion Chromatograph* +	1	Dionex 2010
Ion Chromatograph* +	1	Dionex DX-100
Ion Chromatograph* +	1	Dionex 1500
Atomic Absorption/Emission Spectrophotometry:		
Inductively Coupled Argon Plasma Spectrometer* +	1	Thermo Jarrell-Ash ICAP 61
Inductively Coupled Argon Plasma Spectrometer* +	1	Thermo Jarrell-Ash 1100
Atomic Absorption Spectrophtometer*	1	Perkin-Elmer 5000
Atomic Absorption Spectrophtometer	4	Varian 20
Atomic Absorption Spectrophtometer*	1	Varian SpectrAA 10
Atomic Absorption Spectrophtometer +	3	Varian SpectrAA 400 Zeeman
Atomic Absorption Spectrophtometer*	2	Perkin-Elmer 5100
Microwave Sample Preparation System	1	CEM MDS-2000
Graphite Furnace*	3	Varian GTA-96
Graphite Furnace*	1	Hitachi Z-9000

Instrument	# of Units	Manufacturer/Model #
Graphite Furnace*	2	Perkin-Elmer 5100ZL
Mercury Analyzer and Preparation System	1	Leeman Labs HG3079
Molecular Absorption/Emission Spectrophotometry:		
Fourier Transform Infrared Spectrophotometer	1	Perkin-Elmer 1610
Fourier Transform Infrared Spectrophotometer	1	Perkin-Elmer 1620
Fourier Transport Infrared Spectrophotometer	1	Perkin-Elmer 1600
Diode Array UV/VIS Spectrophotometer	1	HP 8452
Scanning UV/Visible Spectrophotometer	1	Perkin-Elmer Lambda 3B
Visible Spectrophotometer	1	Milton Roy Spectronic 21D
Scanning UV/Visible Spectrophotometer	1	Shimadzu UV160U
Visible Spectrophotometer	1	Hach DR2000
Scanning UV/Visible Spectrophotometer	1	Milton Roy 1201
Visible Spectrophotometer	1	Turner Instruments 330
Nephelometer	1	Monitek 21
Fluorometer	1	Turner Instruments 110
Spectrofluorophotometer* +	1	Shimadzu RF540
Microscopes:		
Petrographic Microscope with Phase Contrast, Polarized Light, and Photomicrographic Capability	1	Olympus BHTP BH2
Petrographic Microscope with Phase Contrast, Polarized Light, and Photomicrographic Capability	1	Olympus BHSP BH2
Phase Contrast Microscope	3	Olympus CH
Phase Contrast Microscope	1	Olympus BHTP BH2
Polarizing and Phase Contrast Microscope	1	American Optical 1135
Stereo Microscope	2	American Optical 570
Stereo Microscope with Fluorescent Antibody Attachment	1	American Optical 2071
Stereo Microscope	1	American Optical Spencer
Miscellaneous Instrumentation:		
Air Flow Calibration Device	1	Gilian Gillibrator

Instrument	# of Units	Manufacturer/Model #
Air Quality Monitor	1	Metrosonics AQ-501
Airborne Particulate Monitor	1	Met One, Inc. 206L
Antibiotic Zone Reader	2	Fisher Scientific 126
Auto Titrator	1	Orion 960
Autoanalyzer*	2	Technicon AA-2
Autoanalyzer* +	3	Scientific Instrument AP-100, AS-140, AC-100, AF-100
Automated Composite Water Sampler	4	ISCO 1580
Automated Composite Water Sampler	2	ISCO 2910
Automated Composite Water Sampler	1	SIGMA 1350
Automated Composite Water Sampler	1	ISCO 1680
Automated Composite Water Sampler	2	ISCO 2710
Automatic Titrator	1	Mettler DL25K
Biological Safety Cabinet	1	NuAire NU-425-600
Biological Safety Cabinet	1	NuAire NU-425-400
Bomb Calorimeter	1	Parr 1241
Centrifuge	1	Monsthion WM
Closed Cup Flashpoint Apparatus, Pensky-Martin	1	Fisher Scientific TA6
Digistrip	1	Kaye 3
Digital Viscometer	1	Brookfield LVDV II
Disintegration Apparatus	1	Van-Kel 1113
Dissolution System	3	Distek 2100A
Dissolution System (6 Spindle)	2	Van-Kel 600
Dissolution System (6 Spindle)	3	Hanson QC72RB
Fibertec	1	Tecator TC-1020
Fibertec E with Bath	1	Tecator 1023, 1024
Fibrous Aerosol Monitor	1	GCA FAM-1
Flashpoint Tester	1	Fisher
Flow Solution Autoanalyzer	2	ALP Kem
Freeze Dryer	1	Virtis B3
Fribilator/Counter	1	Van-Kel 10809
Gas Sorption Analyzer	1	Coulter 360CX

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Instrument	# of Units	Manufacturer/Model #
Hardness Test Apparatus	1	Vector 2E
High Purity Solvent Recycling System	2	B/R Instrument 8600
High Volume Air Sampling Pump	20	Micro Trap, Inc. Micro-max I
Hot Wire Anemometer	1	Datametrics 800VTP-2
Karl Fischer Titrator	2	Brinkman 701
Karl Fischer Titrator	1	Brinkman 684/3
Kjehldal Distillation Apparatus	1	Fisher
Laser Barcode Scanner	1	Intermec 12-M1620A
Melting Point Apparatus	1	Metler FP62
MicroTIP	1	Photovac MP-100
Microwave Digester	1	Prolabo 8300
Negative Air Filtration Unit	1	Industrial Products AT 1000
Nitrogen Determinator	1	Leco FP-248
Octagon Sieve Shaker	1	CSC Scientific 200
Oxygen and Combustible Gas Meter	1	Bacharach Sniffer 202
Oxygen Analyzer	1	Biomarine
Particle Counter	1	Coulter 320
Personal Sampling Pump	28	Various
Polarimeter	1	Perkin-Elmer 241
Refractometer	1	Bausch & Lomb
Refrigerated Centrifuge	1	Fisher GP8R
Slit to Agar Biological Sampler	1	New Brunswick Scientific STA-203
Sound Level Meter	1	DuPont SCM-1
Soxtec	1	Tecator 1043
Sterility Tester	1	Millipore Steri-test
Stomacher Lab Blender	1	Tekmar BAZO22
Submersible Pump (Upgraded for 300 foot depth)	1	Hajoca Corp. P050-2W
Supercritical Fluid Extractor	1	Suprex SFE/50
Thermometer Calibration System	1	Ertco TCS 100
Titrino Auto Titrator	1	Brinkman 716/C-20

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Instrument	# of Units	Manufacturer/Model #
Total Organic Carbon Analyzer*	3	O.I. Corp. 700
Total Organic Halogen Analyzer	2	Mitsubishi TOX-10
Ultrasonic Flowmeter	1	ISCO 3210
Velometer	1	Alnor Series 6000
Viscosimeter	2	Brookfield LVT
Viscosimeter	1	Brookfield DV-II
Water Activity System	1	Decagon Devices CX-2
Wellcutter for Antibiotic Assay	1	Purdue
Zero Headspace Extractor	49	Various Models

*Indicates autosampler capability
+Indicates peripheral data-handling equipment

Stability Chambers		
Brand	Model	Setpoint
Lab-Line	700SHR4	30°C/75% RH
HotPack	317522	40°C/75% RH
HotPack	682	25°C/60% RH
HotPack	CUC-1092	30°C
Lab-Line	1236	40°C
VWR	1915	50°C
VWR	1925	55°C
Lab-Line	703A-1SH	30°C/60% RH
Lab-Line	1236	4°C
Baxter	ILT-48-A	40°C
Lab-Line	3550DTFL	25°C
	Walk-in	25°C

The previous list shows our major instrumentation or instruments which demonstrate specific capabilities. In addition, we have numerous minor instruments (e.g., pH meters and analytical balances), and support equipment (e.g., ovens, centrifuges, incubators, autoclaves, muffle furnaces, etc.). We also have walk-in refrigerators for sample storage and a reverse osmosis, deionized water system, which is U.V. sterilized and continuously circulating to all laboratories. A 75 KVA electric generator is available on a standby basis to supply electrical power to selected areas of the laboratory in case of a power outage. To reduce spikes and spurious line voltage changes to instruments which can affect results or damage electronic equipment, "conditioned power" is fed to all sensitive instruments (e.g., GCs, HPLCs, GC/MSs). All essential computer hardware is on "uninterruptable power," a battery system, which provides continuous conditioned power in the event of a short power outage and is also backed up by an emergency generator.

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C. COMPUTER EQUIPMENT

Our laboratories make extensive use of computers for business applications, technical operations (e.g., our sample management system), and QA program (see section on Quality Assurance). The following is a list of the major components of our computer system.

WANG VS 7380 Super Mini Computer System:

- 40 MB Ram
- 160 Connected Terminals
- 12 GB On Line Disk
- 6250 Bit/Inch Tape Drive
- 5 GB DAT Tape Back Up
- 10 Printers including two 26-Pages/Minute Lasers

WANG VS 5000 Super Mini Computer System (for testing programs):

- 8 MB Ram
- 3.0 GB Disk

Networks/Telecommunication:

- WANGNET Broadband Local Area Network
- TCP/IP Protocols
- Ethernet 802.3 Network
- Lantastic PC
- Novell
- Northern Telecom SLI PBX
    - 16 Data ports in use

Personal Computers:

- 20 Network File Servers
- 100 486 Personal Computers
- 200 386 SX Personal Computers
- 100 286 Personal Computers

Power Systems:

- 10 KVA 3 Phase Uninterrupted Power System
    - Dedicated to Computer Systems only

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SECTION 4
QUALITY ASSURANCE PROGRAM

The major function of an independent laboratory in today's society is to generate technical information. In our case, the information consists of the results of chemical and microbiological analyses, along with whatever auxiliary information is necessary for proper interpretation, and research reports.

Our clients use this information for a variety of purposes. It may be used to demonstrate compliance with a government regulation; to evaluate a raw material for a manufacturer or food processor; to demonstrate value or quality of a finished product, as in nutritional analyses; to establish the basis for a patent; or to decide a legal dispute. This information has a high and intrinsic value over and above the cost of providing it to a client. Since this information is important to our clients, it is necessary to produce it under a program which will assure that it has the necessary "quality" (i.e., that it has a degree of accuracy that is commensurate with its intended use). This section of the manual will describe the Quality Assurance Program under which we operate. Details relating to specific types of technical operations will be found in the sections dealing with the various technical groups.

A. OBJECTIVES OF THE QUALITY ASSURANCE PROGRAM

The objectives of our Quality Assurance Program, as directed by Corporate Management are:

- To establish quality control procedures which will ensure that data generated in the laboratory is within acceptable limits of precision and accuracy.
- To establish procedures to document that these quality control measures are, in fact, being carried out.
- To establish procedures to ensure the "accountability" of the data (i.e., that the results reported do apply to the sample as submitted).
- To establish procedures to ensure that any result reported to a client is traceable to:
  - The date the analysis was run
  - The analyst who performed the test
  - The raw data generated during the performance of the test
  - The condition of any instrument or equipment at the time it was used in the test
  - The status of the quality control system at the time of the test
- To establish procedures which minimize the possibility of loss, damage, or tampering with the data.

The administration of our Quality Assurance Program is the responsibility of the Quality Assurance Director in cooperation with all levels of management. The Quality Assurance Director reports directly to the Vice President of Laboratory Operations, thus ensuring that corrective actions can be taken immediately for any quality problems. The Quality Assurance Director does not have any direct supervisory responsibility for the generation of technical data to avoid any "conflict of interest" which could interfere with the Quality Assurance Program.

The Quality Assurance Department is also responsible for preparing quality assurance project plans required by EPA and reviewing plans submitted to us by clients. Auditing of data packages is also performed by Quality Assurance personnel.

The formal structure of our Quality Assurance Program is described in a set of Standard Operating Procedures (SOPs). Copies of these SOPs are given to each technical Group Leader and they are available to all laboratory personnel. The following is a list of our current Quality Assurance (QA) SOPs, with a brief description of each:

QA-101 Sample Collection - In order for meaningful analytical data to be produced, the samples must be representative of the system from which they are drawn. Our samplers are trained and use written sampling procedures. Sample containers are chosen according to the analyses to be performed and are labeled to fully identify each sample. Where necessary, chemical preservatives and temperature-adjusted storage during transport to the laboratory are employed.

QA-102 Sample Log-in - To ensure accountability of results, each sample is assigned a unique sample identification number which is referenced in all pertinent laboratory documentation. Information corresponding to sample identity is logged with this sample number and included on the analysis report.

QA-103 Sample Storage and Disposal - Because sample integrity can be compromised by improper storage, samples are maintained in various locations to prevent deterioration. Locations are assigned in refrigerators, freezers, and at room temperature as needed to assure that the chemical, physical, and biological properties of samples do not change prior to analysis. Sample locations are tracked by computer to prevent loss. After results are reported to clients, samples may be held for a period of time in case additional testing is required. Samples are then disposed of or returned to the client.

QA-104 Chain-of-Custody Documentation - Samples being tested for litigation or regulatory purposes may require locked storage and documentation of the laboratory personnel who used the sample as well as the times during which the sample was removed from locked storage. Chain-of-custody documentation minimizes the possibility of tampering with the samples and is available upon request.

QA-105 Analytical Methods Manual - The method manuals, which are comprised of clear, complete written instructions for performing each standard test, are the basis for our analytical testing program. In addition to the actual procedure, each method includes safety and quality control information. Every standard method is assigned a unique identification number to ensure traceability. Copies of the methods are readily available to analysts in the lab.

QA-106 Validation and Authorization of Analytical Methods - Although our routine testing procedures are based on official or standard methods whenever possible, laboratory personnel must verify that acceptable precision and accuracy are obtainable before management will approve the use of any method. Validation studies may include the use of standard reference materials, fortified samples, or replicate analyses.

QA-107 Analytical Methods for Non-standard Analyses - Frequently, clients request analyses which are not regularly performed in our laboratory although we have the technical capabilities to do so. In these instances, methods may be supplied by the client, dictated by regulations, derived from scientific literature, or developed in the laboratory. In any case, special procedures must be followed to ensure that the method used is thoroughly documented. In addition, records of validation or quality control samples performed are maintained.

QA-108 Subcontracting - For the convenience of our clients, some analyses which we do not perform may be subcontracted to other laboratories. These laboratories must submit evidence of their qualifications to us. Wherever possible, laboratories certified by appropriate agencies will be used. Results produced by subcontracted laboratories will always be designated as such on our laboratory reports.

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QA-109 Laboratory Notebooks and Documentation - All data which is manually acquired in the laboratory is entered into bound notebooks. Distribution of notebooks to personnel is controlled, with a master file kept of the recipient of the notebook, date issued, date returned, and place of storage of completed notebooks. Personnel are instructed in the proper method of data entry. All entries are made in ink, dated, and signed. Blank pages or substantial portions of pages are canceled out. Periodic review and signing of notebooks by supervisors are also required. Requirements for documentation of computer-generated data are also listed in this SOP.

QA-110 Reagents - Chemical and reagent quality will have a significant impact on our analytical results. Procedures for receiving, preparing, documenting, and storing reagents have been set forth to ensure that only supplies of adequate quality are used in our testing. Each analytical method contains specifications for the required materials.

QA-111 Instrument and Equipment Calibration - All instruments and other equipment are calibrated on a regular basis in accordance with written procedures, with frequency of calibration dependent on the type of instrument and its frequency of use. Acceptable limits of accuracy are also described in the procedures.

QA-112 Instrument and Equipment Maintenance - All maintenance work done on instruments and equipment is recorded in bound notebooks, with separate notebooks kept for each instrument. Routine, preventive maintenance is performed according to written procedures.

QA-113 Data Entry and Verification - In order to minimize errors, data reduction and transcription is computerized wherever possible. Analysts responsible for the generation of data also have the responsibility to log their results into the computer for reporting to clients. Results are then reviewed by a supervisor or the supervisor's designee before reporting to clients.

QA-114 Data Storage and Security - The data generated in our laboratories is a valuable commodity, purchased by our clients. In order to provide traceability, data is stored in an orderly fashion under controlled access so that loss, deterioration, or tampering is prevented. Copies of reports and all supporting raw data will be maintained for ten years.

QA-115 Quality Control Records - The term "quality control" is used to denote those laboratory procedures whose purpose is to ensure that the analytical system is in control within established limits of accuracy and precision. Quality control procedures for each analysis are documented in the written method. Results of quality control analyses are subjected to statistical evaluation to detect trends and outliers. Documentation of quality control samples is maintained on our Sample Management System computer.

QA-116 Investigation and Corrective Action - One of the most effective means for maintaining the production of high quality data is to respond immediately to indications of suspicious data or equipment malfunctions. Whenever results from quality control samples fall outside of established limits, the cause of the irregularity is investigated and corrected as soon as possible. Documentation of these activities is then used to prevent future occurrences of the problem.

QA-117 Personnel Training Records - Supervisors are required to maintain personnel training records of all personnel under their supervision. Training records for technicians indicate the date on which they were considered to be proficient in various laboratory techniques or in various analytical methods. Training records for professionals indicate special training or education received over and above their educational qualifications.

QA-118 Quality Assurance Audits - To ensure that laboratory personnel are following the procedures set forth in our Quality Assurance Operations Manual, periodic checks of each group are made by the Quality Assurance Department. These audits may entail observation as procedures are carried out or a review of records to demonstrate traceability and compliance with all documented recordkeeping procedures. Reports of the findings of these audits are made to management, and a response detailing corrective action is provided by the supervisor.

QA-119 Proficiency Samples - The choice and frequency of quality control samples are specified in the analytical method and are often based upon the recommendations of regulatory agencies such as EPA. In addition, samples are obtained from various organizations that conduct collaborative studies or provide reference materials. Quality control samples are also submitted blind to analysts so that they may be analyzed without bias which may be introduced by known quality control samples.

QA-120 Documentation of Programming for the Sample Management System - The computerized Sample Management System is used to perform calculations which convert raw data to the final result reported to our clients. Thus the computer code is part of the chain of documentation relating to each sample and must be recorded. All new or modified programming on this system is tested prior to use in the laboratory and records of the tests are maintained.

QA-121 Computer Validation - The design and development of software systems used to acquire and process data in the laboratories is a responsibility that is distributed among various groups within our laboratory. To maintain consistency of documentation and to ensure that all programs function correctly, guidelines for development, validation, and maintenance of quality computer software are provided. These guidelines are consistent with GLP requirements.

B. ACCOUNTABILITY OF RESULTS

The term "accountability" as applied to testing results refers to the procedures followed to assure that the data reported refers to the sample submitted. In other words, there has been no sample mix-up and the sample has been properly handled in its transit through the laboratory to minimize changes in chemical composition or bacteriological quality.

At Lancaster Laboratories, Inc., we rely on our computerized Sample Management System to track and control movement of samples from the time of receipt until disposal. The system works as follows:

Samples are received at the laboratory in one of three ways: by personal delivery, by mail or common carrier, or by sample pickup by laboratory personnel. All samples are received by personnel of the Sample Administration Group, who are responsible for sample log-in and tracking. The first step, after sample receipt, is entry into our Sample Management System. All samples are logged into the computer along with pertinent information, e.g., the client's name, account number, client designation or description, and analyses requested. The computer assigns a unique number to the sample and requests information regarding necessary storage conditions, e.g., refrigeration, freezing, etc. The computer then assigns a storage location where the sample will be kept until analysis is begun and prints a label which is immediately attached to the sample container. The information contained on the label includes sample number, client designation, tests scheduled, and a bar code. The computer also assigns a storage time or disposal date which varies according to the nature of the sample or with specific instructions from the client. The database, which is thus automatically generated, is used in many ways. For example, each Group Leader receives a daily printout, which lists all samples and analyses waiting to be run in the laboratory. This is of inestimable value in planning and organizing the workload. The date of sample collection is also available through the computer to ensure that holding times are met, where applicable.

When a sample is to be analyzed, it is retrieved from the designated storage space by the analyst or by a member of the Sample Support Group if storage is in a controlled-access area. During analysis, raw data is recorded in ink in bound notebooks or on printouts from

instruments and then entered into the computer against sample number and analytical method number. Some instruments are connected directly to the Sample Management System, eliminating manual transcription. The computer performs many of the calculations to avoid a common source of error. When all analyses are completed and have been verified by a supervisor or designee, the computer generates a report. The client receives a copy of the face of the report containing the results of the analysis plus comments entered by the analyst where necessary. The back of the laboratory copy of the report contains the raw data plus the names of the analysts who made each entry. This copy is retained in our archives.

The following page is a copy of a simulated report. Note that opposite each reported result is a code number, which identifies the analytical method used. In addition, to avoid ambiguity in interpreting results, the reverse side of the client's copy of the report contains an explanation of all symbols and units used in reporting data. The report also contains the name of the person who reviewed the final report. In addition to the basic analysis reports, data is available in other formats which include various levels of raw data and quality control information. Results may also be supplied electronically on diskette.

In the case of samples which are likely to be involved in litigation or a legal dispute, more stringent sample handling procedures are available upon request. Strict chain-of-custody procedures are followed. The delivery of the sample is documented, the sample is kept under locked storage, and photographs or videotapes may be used to document the condition of the sample or visual aspects of the test. After analysis, samples will be returned to the client or disposed of at his/her written request.

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Lancaster Laboratories
Where quality is a science.

LLI Sample No. WW 1962163
Collected: 1/28/94 at 11:00 by MLH
Submitted: 1/28/94 Reported: 2/ 3/94
Discard: 2/11/94

Account No: 00649
Smith Engineering, Inc.
1000 Any Street
Lancaster, PA 17601-5994

Water Sample from Monitoring Well #5
Collected on 01/28/94 at 1547 by MLH

CAT NO.	ANALYSIS NAME	AS RECEIVED RESULTS	LIMIT OF QUANTITATION	UNITS
0303	Total Coliform	<2.2	2.2	/100ml
	This sample is SAFE for drinking or swimming according to bacteriological standards established by the U.S. Public Health Service and the Environmental Protection Agency (EPA).			
0255	Lead	0.30	0.10	mg/l
0178	Pesticides/PCB's			See Page 2
0418	Trichloroethene	12.	1.	ug/l
0219	Nitrite Nitrogen	0.05	0.02	mg/l
0220	Nitrate Nitrogen	11.	0.05	mg/l
0222	Ammonia Nitrogen	4.1	0.1	mg/l
0273	Total Organic Carbon	8.5	0.5	mg/l
	The Total Organic Carbon (TOC) result reported above was determined by measuring total carbon by a persulfate digestion/infrared detection method on an acidified sample which has been purged of inorganic carbon using nitrogen. It represents "non-purgeable TOC".			

1 COPY TO Smith Engineering, Inc. ATTN: John Smith

Questions? Contact your Client Services Representative
Earl R. Custer at (717) 656-2301

Respectfully Submitted
Bethany A. Ebling, B.S.
Group Leader, Water Quality

Lancaster Laboratories, Inc.
2425 New Holland Pike
Lancaster, PA 17601-5994
717-656-2301

See reverse side for explanation of symbols and abbreviations.

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	**BMQL**	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	**MPN**	Most Probable Number
IU	International Units	**CP Units**	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	**NTU**	nephelometric turbidity units
C	degrees Celsius	**F**	degrees Fahrenheit
Cal	(diet) calories	**lb.**	pound(s)
meq	milliequivalents	**kg**	kilogram(s)
g	gram(s)	**mg**	milligram(s)
ug	microgram(s)	**l**	liter(s)
ml	milliliter(s)	**ul**	microliter(s)
m3	cubic meter(s)	**fib > 5 um/ml**	fibers greater than 5 microns in length per ml

< less than - The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

> greater than

ppm parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

ppb parts per billion

Dry weight basis Results printed under this heading have been adjusted for moisture content. This increases the analyte concentration to approximate the value present in a similar sample without moisture.

U.S. EPA data qualifiers:

Organic Qualifiers

A	TIC is a possible aldol-condensation product
B	Analyte was also detected in the blank
C	Pesticide result confirmed by GC/MS
D	Compound quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
J	Estimated value
N	Presumptive evidence of a compound (TIC's only)
P	Concentration difference between primary and confirmation columns >25%
U	Compound was not detected
X,Y,Z	Defined in case narrative

Inorganic Qualifiers

B	Value is <CRDL, but ≥IDL
E	Estimated due to interference
M	Duplicate injection precision not met
N	Spike sample not within control limits
S	Method of standard additions (MSA) used for calculation
U	Compound was not detected
W	Post digestion spike out of control limits
*****	Duplicate analysis not within control limits
+	Correlation coefficient for MSA <0.995

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITATION OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. We disclaim any other warranties, express or implied, including a Warranty of Fitness for Particular Purpose and Warranty of Merchantability. We accept no responsibility for the purpose for which the client uses the test results. No purchase order or other order for work shall be accepted by the company with any conditions that vary from our Standard Terms and Conditions. If Lancaster Laboratories performs work requested by the client, conditions at variance to our Standard Terms and Conditions are not part of the contract.

C. QUALITY CONTROL

1. Analysis of Blank, Spiked, Duplicate, Reference, and Control Samples

Each specific analytical method includes the particular quality control requirements performed to ensure that the data produced is of known quality. In addition to the necessary calibration standards, these quality control checks may consist of one or several different types of checks. Blanks, spikes, duplicates, reference materials, and control samples are employed, as appropriate for the analysis. The general criteria for the use of each of these types are outlined below.

Blanks are analyzed with most types of analyses to prevent reporting of false positives caused by factors in the laboratory system. Blanks are prepared and analyzed using the same reagents and equipment as the samples in the batch the blank represents. Acceptance criteria for blanks are based on the laboratory quantitation limit.

Spiked samples are samples fortified with a known amount of target analyte and subjected to the entire analytical procedure. The recovery of the method is calculated and indicates the appropriateness of the method for the matrix. Many of the gas chromatographic analyses in Environmental Sciences employ the special category of quality control samples known as matrix spike duplicates. This is the analysis of a pair of fortified samples from the same source. The use of matrix spike duplicates yields precision information as well as recovery. The acceptance criteria for percent recovery on spiked samples is based on EPA or other agency recommendation or past information generated in our laboratories.

Duplicate sample analysis is the analysis of the same sample twice in order to determine the precision of the analysis. The relative percent difference (RPD) between the two determinations is calculated and compared to values prescribed by EPA or determined by statistical analysis of past information generated in our laboratories.

Reference materials are samples which contain a known amount of target analyte. These are routinely analyzed to ensure accuracy of the analytical procedure. The reference materials may be from NIST or EPA, or they may be prepared in our own laboratories. Accuracy information determined from reference materials is valuable because variables specific to sample matrix are eliminated. The acceptance criteria for this type of quality control is either dictated by the agency from whom the material is obtained or by statistical analysis of past information generated in our laboratories.

Control samples are similar to reference materials except that the true value of the target analyte is not known with specific degrees of confidence. Acceptance criteria is developed by applying statistical techniques to repetitive determinations.

In addition, many of our chromatographic analyses employ surrogate and internal standards to evaluate analytical efficiency. The acceptance criteria for the recovery of these compounds is the same as that listed above for spiked samples.

The results of all quality control samples are entered into the computer in the same way as the results of client samples. The computer is programmed to compare the individual values with the acceptance limits and inform the analyst if the results of the quality control tests are in or out of specification. If the results are not within the acceptance criteria, corrective action suitable to the situation must be taken. This may include, but is not limited to, checking calculations, examining other quality control analyzed with the same batch of samples, qualifying results with a comment stating the observed deviation, and reanalysis of the samples in the batch. Daily reports of quality control outliers are generated by the computerized system to keep management informed. The cause and solution to the problem are documented to prevent recurrence. In addition, computerized

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reports on the results for all quality control analyses including mean and standard deviation are generated monthly. These are used by the Quality Assurance Department to check for trends which may indicate method bias. Control charts are plotted via computer and may be accessed at any time by all analysts.

These programs have been found to be invaluable in monitoring our analytical procedures and detecting situations where a system was trending toward loss of control before the problem became serious enough to affect the integrity of the sample results.

2. Blind Samples

For many of the more common analyses performed in our laboratories, the Quality Assurance Department periodically submits blind samples to the laboratory using a pseudo-client name. These blind samples are similar to control samples, and results are reported directly to the Quality Assurance Department, for data evaluation. Summaries of the data are prepared periodically and reported to the Group Leaders and the Director of Laboratory Operations. The value of the blind sample system lies in the fact that the analysts are unaware that they are analyzing a quality control sample, thereby avoiding unconscious bias in performing the analysis.

3. Proficiency Sample Testing

Proficiency samples and check samples are samples submitted to the laboratory by an outside organization. The concentration of certain analytes is known to the outside organization but not to the laboratory. The laboratory is required to analyze the samples for the indicated analytes.

The proficiency sample testing programs are part of an accreditation process, and results of samples must be within limits defined as acceptable by the submitting organization, or the laboratory may lose its accreditation. In the case of check sample programs, participation is voluntary, and results are used to compare the laboratory's competence to other participating laboratories. The following is a list of proficiency testing and check sample programs in which Lancaster Laboratories, Inc. participates:

Organization	Sample Type	Analytes
U.S. Environmental Protection Agency	Potable Water	Organic and inorganic parameters require for Safe Drinking Water Act
U.S. Environmental Protection Agency	Wastewater	Various pollutants
National Institute for Standards & Technology (NVLAP)	Build building materials	Asbestos
American Industrial Hygiene Association	Filters and charcoal tubes	Metals, organics, and asbestos fibers
PA Department of Agriculture	Dairy products	Bacterial contamination
American Association of Feed Control Operations	Animal feeds	Moisture, protein, fat, fiber ash, phosphorus, calcium, and various additives (nutritional and veterinary drugs)
American Oil Chemists	Vegetable oils	Fatty acid profile
New York Department of Health	Potable/Non-potable water	Various organic and inorganic pollutants

Organization	Sample Type	Analytes
American Association of Cereal Chemists	Cereal	Vitamins, minerals and proximate, and micro-biological contamination
Summit Laboratories	Food	Salmonella and Listeria
Beta Matrix	Meat	Moisture, protein, fat, salt, calcium, sodium

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SECTION 5
TECHNICAL OPERATIONS

A. OPERATIONAL PROCEDURES

1. Standard Testing

This category of work includes microbiological tests and chemical analyses using well-established methods, or methods which have been validated for the matrix being analyzed. Whenever possible, "official" or "standard" methods are used. "Official" methods are those required for compliance to government regulations, e.g., the methods mandated by the Environmental Protection Agency (EPA) for drinking water, wastewater, or solid waste or methods developed by the National Institute of Occupational Safety and Health (NIOSH) for industrial hygiene work. "Standard" methods are those established by standard-setting organizations, e.g., the American Society for Testing and Materials (ASTM), the Association of Official Analytical Chemists (AOAC), the American Oil Chemists Society (AOCS), or the United States Pharmacopoeia (USP). These methods have been subjected to rigorous validation studies and interlaboratory collaborative testing and are considered very reliable. Analysis summary sheets which list basic principles and method references for each standard test are available upon request. An example is given in Appendix B.

Occasionally a client will request that we test samples by a method furnished by the client, which is neither official nor standard. We will comply with the client's request with the provision that we cannot guarantee accuracy or reproducibility of results unless a validation study is authorized. In other cases, we develop our own in-house methods of analysis. In these cases, a validation study is always required before a method is authorized for use in standard testing. We have a formal documented procedure by which approval is granted to our laboratory personnel to use a new or modified method in this type of testing.

a. Work-Flow Routing

The computerized "Sample Management System," described in Section 4B, has many benefits for our clients. Accuracy is improved since many of the calculations are done by the computer, eliminating transcription of data from one piece of paper to another. In addition, traceability of results is assured since each result indicates by code the analyst who entered the raw data and the method used. The Sample Management System has built-in levels of security to prevent unauthorized changes of data or verification status. Management receives a daily printout of the status of all samples in the lab, including a printout of those with priority status or those which have exceeded a preset turnaround time. This is an important aid to efficient work scheduling. In addition, a request for information on a client's samples can be immediately answered by instant referral to a computer terminal.

b. Reporting of Results

When all analyses are completed, the results are reviewed and approved by technical personnel prior to mailing. In addition to the hard copy of the analytical report, data is available on diskette in a variety of formats.

We recognize that one of the most important aspects of the services we offer is "turnaround time," i.e., the time which elapses between the receipt of a sample at the laboratory and the report of the final results. This is one reason we operate on a three-shift, around-the-clock basis. Our normal turnaround time is about 7 to 14 days, but it can vary considerably depending on the workload in the various groups analyzing the sample and the nature of the analysis.

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If faster turnaround time is required, clients should discuss their needs with a client service representative. Our ExpressLAB, dedicated to helping clients with tight schedules, has its own three-shift staff of chemists and technicians. The scope of their operations is described in the next section.

One way of shortening turnaround time is personal delivery of samples to the laboratory or pick-up of samples by our personnel. Another method is to request that results be reported by telephone or fax. Such requests will always be honored and will be confirmed subsequently by mailed reports. The fastest means of getting hard copy results for routine samples will be via our Data Access System.

c. Data Access System

Clients who have need of fast turnaround time and who submit samples on a regular basis should investigate our computerized Data Access System. Under this system, a client can access our computer system by telephone and receive a printout in his/her own office or laboratory of all analytical results on samples which are completed and verified. The equipment required at the client's location is a teleprinter (or a computer terminal which can simulate a teleprinter) and an inexpensive telephone modem. For security purposes, clients are given access codes which limit access to their samples only. The codes are easily changed in case of a potential breach of security (e.g., loss of client key personnel).

Clients interested in our Data Access System should contact David Hooley, Group Leader of Computer Services. There is no charge for this service.

d. Billing

Standard analyses are billed on a per sample, per analysis fee basis, as described in our Schedule of Services, a copy of which is available upon request. Discounts are available, as described in the Schedule of Services. A copy of our Standard Terms and Conditions may be found in Appendix A.

2. Specialized Testing

This type of work includes analyses for which standard methods are not available, or are available for substrates other than the samples being considered. This type of work is only attempted if we are convinced that our facilities and expertise are sufficient to assure a reasonable chance of success.

a. Work-Flow Routing

Management, in consultation with technical personnel, will make the decision whether or not to attempt the analyses. If the decision is made to proceed, the work flow will follow the general outline given under Standard Testing.

In cases involving litigation or the possibility of future litigation, special precautions are taken in sample handling and analysis, as described in Section 4.

b. Reporting

Results are reported in a manner similar to that described under Standard Testing. If the methods used are markedly different from those used in standard tests, a letter report disclosing the methods is prepared. Any difficulties and/or special techniques or precautions are also reported, as well as any interpretive information which may be necessary to understand the results.

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c. Billing

Billing for specialized testing is on a per sample, per analysis fee basis, in accordance with our best estimate of the cost of doing the tests. This fee may be subject to later revision, either upward or downward, as we gain experience with the test method. The client will be informed of the fee or any fee revision prior to our beginning work.

Any method development or evaluation work which the client has agreed to finance is billed according to time records describing the level of effort of actual persons working on the project. Time charges are calculated based on the time spent on the project, multiplied by the worker's hourly rate, multiplied by a factor which covers overhead costs and profit. We reserve the right to determine the level of technical expertise required to solve a particular problem.

3. Contract Research and Development

Contract research and development has been an on-going activity at Lancaster Laboratories, Inc. since its inception in 1961. We have performed this service for many manufacturing companies, both large and small, for engineering firms, for government agencies, and for trade and industrial associations. Typical examples include: product formulation and evaluation for patent and marketing purposes; analytical method development; waste and by-product utilization studies; waste treatment studies; competitive product evaluation and "deformulation;" shelf-life and other stability studies; identification of unknown materials; "off-taste" and "off-odor" identification; and many other investigations in the fields of chemistry and microbiology. Special expertise is also available in analytical support for toxicology and environmental fate studies conducted under Good Laboratory Practice Regulations (GLPs).

Such projects usually begin with a client conference with a member of our Research and Development Group at no obligation to the client. The objectives of the project and possible technical approaches to achieving the objectives are discussed and, if possible, a rough estimate of the cost is given. After this meeting, assuming the client agrees, further discussions with technical staff are undertaken to refine the concept of the proper technical approach. A brief literature survey may be made to clarify technical questions and the feasibility of performing the work in view of staff expertise, instrumental and equipment capabilities, and workload is evaluated. The client usually is not charged for this phase of the investigation unless a more extensive literature search is necessary, which the client is asked to authorize.

At this point, assuming mutual agreement with the client, we prepare a detailed project proposal, including a cost estimate. This is done by breaking down the work into a series of tasks and estimating the number of work hours and level of technical expertise (professional, technician, quality assurance, secretarial, etc.) needed for each task. From this we can estimate the cost of labor plus overhead to complete the project. Other related incidental expenses (e.g., the cost of special chemicals, travel costs, if necessary, and the like) are added to labor costs to arrive at a final project estimate.

The project cost quotation may contain a contingency factor, which represents our uncertainty in evaluating costs, or may be presented on a "not to exceed" basis, depending on the client's wishes. We require a written authorization from the client to proceed with the project prior to our beginning work.

Clients should realize that because of the exploratory nature of the work, it is frequently very difficult to arrive at highly accurate project costs. It is also impossible to guarantee success, i.e., results which are as expected beforehand by the client. We can guarantee that we will put forth our best technical effort in pursuing the work as agreed.

a. Reporting

Contract research and development projects will be reported to clients in the form of written reports. Reports are generated at the conclusion of the project or at intervals over the course of the project depending on the client's specifications. Reports include a description of the methods and materials used, experimental results, discussion of results, and conclusions based on the results. A Quality Assurance Statement as required by the GLPs will also be provided if the laboratory has been informed that those regulations apply to the project.

b. Billing

Contract research and development projects are billed at the conclusion of the project if completed within one month or on a monthly basis if not. When a client authorizes a project, a project number is assigned to that project, and employee time is logged against that number on a daily basis for all work done on the project. Project costs are calculated by multiplying the employee's time by his/her hourly rate and adding a factor to account for overhead and profit. Extraordinary costs not normally included as overhead are billed directly to the project as they are accrued. The monthly or final invoice sent to the client contains a list of itemized costs.

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SECTION 6
BUSINESS UNITS

Technical personnel and equipment are organized into three business units: Environmental Sciences, Food Sciences, and Pharmaceutical Sciences, which reflect both the type of client served and the nature of the work done. The units are further divided into Groups on the basis of the same criteria.

This section will describe these various Groups with emphasis on special expertise available in the Group, and the quality assurance programs specific to that Group. For a discussion of our overall Quality Assurance Program, see Section 4 of this manual.

For the names of key personnel in each Group see Section 2, and for instrumentation available see Section 3.

ENVIRONMENTAL SCIENCES

A. ORGANIC ANALYSIS

The determination of trace volatile organic compounds is the forte of this group. Environmental samples are analyzed for volatile organic contaminants at the parts per billion (ppb) level using purge and trap/gas chromatography. Waste solvents, air samples collected using charcoal tubes and organic vapor badges, and other environmental samples are analyzed for organic contaminants at the parts per million level (ppm) using gas chromatographs equipped with automatic sample injectors and FID or ECD detectors.

Special expertise is available in the following areas:

- Analysis of potable water for trihalomethanes and volatile organic compounds for compliance with the Safe Drinking Water Act.
- Analysis of groundwater, wastewater, and solids for organic pollutants.
- Identification of solvents in unknown industrial wastes by capillary GC.
- Analysis of air samples using approved NIOSH and OSHA methods.

<u>Quality Assurance</u>

1. Instrument Calibration:
   - Gas Chromatographs: Multiple levels of standard solutions are used to calibrate instruments each time a run is initiated. Instrument response is checked periodically to prevent detector drift. Where applicable, surrogate standards are used in samples. Quality control samples obtained from commercial sources are analyzed periodically.
2. Standards: For analysis of volatile organic compounds by purge and trap GC, purgeable gases (e.g., chloromethane, bromomethane, vinyl chloride, and chloromethane) are purchased in solution from chemical supply houses. Purgeable halocarbons and aromatics may be purchased in solution or neat and used for calibration and standardization.
3. Quality Control: Each batch of 20 samples analyzed by purge and trap techniques includes a blank, a matrix spike duplicate pair, a detection limit standard, and a calibration check sample.

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B. PESTICIDE RESIDUE ANALYSIS

This group is responsible for the analysis of pesticides, polychlorinated biphenyls, herbicides, and similar compounds. Using gas and liquid chromatography, a wide variety of samples including water, soil, and foods are checked for trace residues. Automatic sample injectors, a variety of detectors, including ECD, NPD, FID, FPD, UV, and fluorescence, and microprocessor instrument control make the efficient analysis of many samples possible. HPLC analysis for polynuclear aromatic hydrocarbons and formaldehyde is also available.

Special expertise includes:

- Analysis of potable water for pesticides and herbicides required for compliance with the Safe Drinking Water Act.
- Pesticide residue analyses on agricultural products, foods, animal feeds, soils, and water.
- PCB content of environmental samples, transformer oils, and other industrial fluids.
- Determination of pesticide contaminations according to Contract Laboratory Program (CLP) and Resource Conservation and Recovery Act (RCRA) methodology.
- Standard analyses following RCRA, FIFRA, and FDA GLP guidelines.

Quality Assurance

1. Instrument Calibration: Gas chromatograph standardization is accomplished as described under the Organic Analysis Group.
2. Standards: Purified pesticides and herbicides obtained from the Environmental Protection Agency or chemical supply houses which guarantee purity are used for preparing standard solutions for analysis of these compounds.
3. Quality Control: Is based on method requirements, but usually includes a blank, matrix spike/matrix spike duplicate, and laboratory control sample (LCS) to be analyzed with each batch of 20 samples analyzed for Pesticides/PCBs. Surrogate standards are added to each sample, where applicable.

C. INORGANIC ANALYSIS

This Group has responsibility for the determination of trace metal concentrations by atomic absorption spectrophotometry (AAS) and inductively coupled plasma spectroscopy (ICP). Flame, furnace, hydride generation, and cold vapor techniques are employed as appropriate to sample and analyte.

Special expertise is available in this Group for:

- Analysis of sludge, leachates, soils, and water for inorganic contaminants.
- Analysis of potable water for compliance with EPA regulations for trace inorganic elements.
- Determination of inorganic compounds using methods employed in the EPA CLP.

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Quality Assurance

1. Instrument Calibration: The AA spectrophotometers are calibrated with every run by analyzing three to five levels of standard solutions. The calibration curve is validated using a standard prepared from a source other than that used for preparation of the calibration standards. In addition, the calibration curve is verified throughout the run by periodic standard and blank check solutions. The ICAPs are calibrated according to the procedure prescribed by the EPA CLP.

2. Standards: Trace elements standards which have been checked against National Institute of Standards and Technology (NIST) Standard Reference Materials (SRM) are purchased from chemical supply houses for calibration of instruments. We maintain standards for each element for which we analyze. In addition, quality control samples obtained from commercial suppliers are analyzed periodically.

3. Quality Control: Minimally each batch of 20 samples includes a blank, a laboratory control, a spike, and a duplicate. Additional quality control samples are run if required by the method.

D. GAS CHROMATOGRAPHY/MASS SPECTROMETRY

The combination of gas chromatography and mass spectrometry detector is a powerful tool for analysis of complex mixtures of organic compounds. It is possible not only to separate these compounds by chromatography, but to obtain definitive confirmation of identity by the mass spectrometer. The technique is widely used in analysis of groundwater, wastewater, and soils for industrial pollutants, and in special problems where the identity of trace contaminants must be determined.

Special expertise is available for:

- Determination of organic contaminants according to EPA methodology.
- Priority pollutant determinations in waters and soils.
- Identification of unknown organic constituents.
- Determination of polynuclear aromatic hydrocarbons in air by TO-13.

Quality Assurance

1. Instrument Calibration: Calibration and tuning is performed according to EPA method requirements depending upon the analysis requested. Minimally, instruments are tuned and calibrated daily.

2. Standards: For GC/MS analysis of the volatile and semivolatile compounds neat compounds or standard mixes received from chemical supply houses are used to prepare standard solutions. Quality control samples obtained from commercial suppliers are analyzed periodically as an independent check on the accuracy of our standards.

3. Quality Control: A blank, a matrix spike, and a matrix spike duplicate are analyzed with each batch of 20 samples. When required by the method, a laboratory control sample is also analyzed. Surrogate and internal standards are added to each sample or extract.

E. WATER QUALITY

This Group is responsible for wet chemistry analysis of potable water, wastewater, and soil samples. Examples would be: cyanide, phenols, phosphates, ammonia, turbidity, chemical oxygen demand, etc.

Analysis of wastes for hazardous components is also a responsibility of this Group with RCRA compliance and Pennsylvania Department of Environmental Resources (PA DER) Module #1 specialties.

Major instrumentation for these analyses includes total organic carbon (TOC) analyzers, total organic halogen (TOX) analyzers, ion chromatographs, FT-IR Spectrophotometer, automatic analyzers, and a full complement of field sampling equipment.

Special expertise is available in this Group for:

- Wastewater Sampling and Flow Measurement: Equipment and personnel are available for field sampling of wastewater effluents, using either flow proportional or time proportional compositing techniques.
- Groundwater Test Well Sampling and Monitoring: Submersible pumps and Teflon bailers are available.
- Toxicity Characteristic Leaching Procedure (TCLP) and EPA Toxicity Testing: Equipment and expertise are available for the EPA-mandated leaching and toxicity testing for hazardous waste.
- Biochemical Oxygen Demand (BOD): BOD analyses are a specialty of this Group.
- Anion Analyses: Ion chromatography is used for analysis of a variety of ions, both inorganic and organic.

<u>Quality Assurance</u>

1. Instrument Calibration:

   - Total Organic Carbon (TOC) Analyzer: A calibration standard and five calibration check standards are run with each use of the instrument. An additional calibration check is run following every tenth injection.
   - Total Organic Halogen (TOX) Analyzer: A calibration standard and absorption efficiency sample are run daily, followed by four calibration check samples. Also, a calibration check sample is run after every eight samples.
   - Automatic Analyzers: Six different levels of standard solutions are run with each group of samples. A calibration check standard is run after every ten injections.
   - Ion Chromatograph: Standard solutions are run at five different concentrations with each batch of samples. A calibration check standard is run after every ten injections.
   - FT-IR Spectrophotometer: A six-point calibration curve is run each day of use. A calibration check standard is run after every ten samples.
   - Conductivity Meter: Cell constant is checked at each use with standard KCl solution.
   - Dissolved Oxygen Meter: The instrument is checked with each use against the Winkler iodometric titration procedure for dissolved oxygen.

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- BOD Incubators: The temperature is checked and recorded twice daily. The thermometer used is calibrated against a standard thermometer traceable to NIST.

- Flowmeters for Wastewater Monitoring: These instruments are calibrated immediately before use.

2. Standards: Chemically pure standards are purchased from supply houses for use as calibration standards. Standard solutions with components typical of those found in wastewater, supplied by commercial suppliers, are analyzed periodically for a wide variety of analytes, and results are compared to certified values.

3. Quality Control: Due to the wide variety of tests performed by this group, it is difficult to describe here the QC performed for each one. Generally, each batch of 20 samples includes a blank, a spike, a duplicate, and a reference material.

F. AIR QUALITY

The responsibility of this Group is the evaluation of health hazards resulting from indoor air pollution in workplaces, homes, and schools. Much of this Group's work is conducted on-site at client facilities, supplemented by laboratory analysis of samples collected and evaluated for health hazard potential. Our laboratory is certified by the American Industrial Hygiene Association, and a Certified Industrial Hygienist is on staff.

Special expertise which is available includes:

- On-site personal or area air sampling for identification and quantitation of airborne contaminants. This may be done for evaluation for Occupational Safety and Health Administration (OSHA) compliance, for industrial hygiene purposes, or for industrial process control. NIOSH, OSHA, or other protocols are used in collection of air samples, where applicable.

- Air sampling for analysis of asbestos fibers in schools, office buildings, and elsewhere. On-site microscopy service is available.

- Monitoring of building contractors' adherence to specifications for asbestos removal projects.

- Identification and quantitation of asbestos in bulk materials, e.g., building materials and insulation.

- Surveys, inspections, and management plans for buildings to comply with Asbestos Hazard Emergency Response Act (AHERA).

- Use of portable direct-reading sampling instruments to evaluate common indoor air pollutants, such as VOC, CO_2, and CO.

- Industrial hygiene surveys and consulting.

- Measurement of noise levels and noise exposure hazards.

- Evaluation of fume hoods and other protective ventilation devices.

- Evaluation of indoor air quality for hazardous substances, e.g., carbon monoxide, carbon dioxide, formaldehyde, bacteria, fungi, and VOC.

- Training courses are offered for EPA-AHERA and PA Act 194 certifications in asbestos-related occupations. Examples include worker and contractor/supervisor training and building inspection and management planner refresher training.

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Quality Assurance

1. Instrument Calibration:

   - Area Ambient Air Samplers: These devices are calibrated before and after use by flowmetering devices, e.g., rotameter, limited orifice, etc.

   - Personal Air Samplers: These are calibrated before and after sampling using a primary standard, the Gilian Gilibrator.

   - High Volume Area Air Samplers: These are calibrated before and after sampling using a primary standard, the Gilian Gilibrator.

   - AQ-501: Calibrated from standards purchased from commercial suppliers (CO and CO_2) before and after each use and calibrated from the factory (humidity and temperature) on an annual basis.

   - MicroTIP: Calibrated against standard gases purchased from commercial suppliers before and after each use.

   - Sound Level Meter: Calibrated to a standard sound level at a given frequency before and after each use.

2. Standards:

   - Standards are provided by NIST for evaluating personnel and methods for the quantitation of asbestos in bulk materials.

   - Samples from the NIOSH Proficiency Analytical Testing (PAT) program are used to determine proficiency in counting asbestos fibers for airborne asbestos analysis.

   - Chemically pure standards are purchased for use as calibration standards.

3. Quality Control:

   The quality control follows the OSHA/NIOSH methods and includes submission of at least one blank per analysis group.

Analysis of air sampling media carried out by the Inorganic and Organic Analysis Groups and are subject to the QA programs in those Groups.

G. EXPRESSLAB

This Group has a dedicated laboratory staffed for delivering rapid turnaround time results that meet the same high-quality standards of the other environmental groups. The analytical work is performed using gas chromatographs, purge and trap concentrators, atomic absorption spectrophotometers, and automated moisture analyzers. Some express analytical work is performed in the routine environmental laboratories, but the work is coordinated and reported through this Group's administrative functions.

Rapid turnaround-time service is focused in the following areas:

- Key analyses for monitoring petroleum contamination.

- Priority pollutant list parameters.

- TCLP extraction and analysis for TCLP list parameters.

- Metals analysis by flame, cold vapor, and hydride atomic absorption.

- Standard GC and GC/MS volatiles, semivolatiles, and pesticide analyses.

Special expertise is available for:

- Analysis of mercury in water samples in the parts per trillion range.
- Various petroleum hydrocarbon analyses in water, soils, and food products using gas chromatographic techniques.

Quality Assurance

Instrument Calibration, Standards, and Quality Control is parallel to these respective functions as performed in the routine departments.

FOOD SCIENCES

A. FOOD CHEMISTRY

This Group is responsible for chemical analyses of foods, animal feeds, and agricultural products, except for certain trace organic analyses which may be performed by the Organic Analysis Group in Environmental Sciences. In addition to standard tests, e.g., proximate analyses, special expertise is available in:

- Nutritional analysis, including sampling, labeling, and consultation on regulatory requirements.
- Vitamin analyses, including vitamins A, all B vitamins (B_1, B_2, B_3, B_4, B_5, B_{12}, and B complex), C, D, and E.
- Sugar analyses by High Performance Liquid Chromatography (HPLC) on foods and beverages, including screens for dextrose, fructose, maltose, lactose, and sucrose. For samples containing high levels of sodium, sugar analysis is performed by derivitization and gas chromatography.
- Atomic absorption analysis for inorganic constituents in foods and animal feeds.
- Fatty acid profile analysis by GC. This technique is to determine the amount of saturated fat and monosaturated fat for nutritional labeling.
- Analysis of laboratory animal feeds. Feeds used for laboratory animals in nutritional and toxicity testing must be carefully characterized for nutritional content and possible contamination.

Quality Assurance

1. Instrument Calibration:

   - HPLC: Standard solutions are run with each batch of samples and instrument response is monitored periodically throughout the run. Control or reference materials are run when available.
   - GC: Standards are run with each batch of samples and instrument response is monitored periodically throughout the run. Control or reference materials are run when available.
   - pH Meters: These instruments are calibrated with standard buffer solutions (pH 4.0, 7.0) each day used.

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- AA: Trace elements standards which are traceable to NBS are purchased from chemical supply houses for calibration.

- Analytical Balances: Calibration is checked daily with various weights, and a complete overhaul and calibration is performed annually by a certified service company.

- UV/Visible Spectrophotometer: A set of standard solutions is used for calibration of absorbance and wavelength readings.

- Spectrofluorophotometer: A standard solution is run with each batch of samples, and instrument response is checked.

2. Standards: A complete inventory of high purity samples is kept for all analyses for which standards are available. These are used for instrument and method calibration. In addition, control samples, such as dry cereal, pasta, NIST egg powder, and chocolate are used for Quality Control (QC) charting for our most frequently performed analyses (proximate analyses, vitamins, sugars, metals, and cholesterol).

B. FOOD MICROBIOLOGY

This Group is responsible for all microbiological testing of food, animal feeds, and industrial products. In addition to standard tests, e.g., plate counts and bacteriological identification, special expertise is available as follows:

- Extraneous Matter: Identification and quantitative estimation of the contamination of various foods and agricultural products by unwanted material, e.g., rodent hairs, insect fragments, synthetic fibers, and other materials.

- Analysis for selected pathogens such as Salmonella, Listeria, and E. coli 0157;H7.

- Sanitary Inspection: Our staff is experienced in inspection of food processing plants, equipment, and warehouses for sources of microbiological, rodent, and insect contamination and can make recommendations for elimination of unsanitary practices.

- Microbiological vitamin assays including B_6, B_{12}, biotin, folic, niacin, pantothenic, and total folates.

Quality Assurance

1. Instrument and Equipment Calibration:

   - A-O Microscope: Field diameter calibration is conducted every two years in conjunction with Milk Sanitation Certification by the Pennsylvania Department of Agriculture.

   - Incubators, Refrigerators, and Water Baths: Temperatures are read and recorded twice daily. Thermometers are immersed in liquid.

   - Autoclaves: Quarterly preventative maintenance is performed by a certified service company. Autoclave tape is used to indicate maximum temperatures in each run, and time and temperature are recorded continuously for each run.

   - pH Meters: pH meters are calibrated twice daily with commercial buffer solutions (pH 4.0, 7.0, and 10.0).

   - Thermometers (glass): Glass thermometers are checked annually against a standard thermometer traceable to the NIST.

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- Thermometers (dial type): These thermometers are checked semiannually against a standard thermometer traceable to the NIST.

- Automatic Pipettor: This is calibrated each day it is used.

- Analytical Balance: Accuracy is checked twice daily with various weights.

2. Standards: All chemicals and nutrients used in microbiological testing are purchased from supply houses which guarantee specifications to be equal or better than required by the Food and Drug Administration (FDA), United States Public Health Service (USPHS), etc. Stains used are "biological grade," i.e., certified by the Biological Stain Commission.

   Standard cultures of microorganisms are obtained from the American Type Culture Collection (ATCC), government agencies, medical schools, or industry.

3. Procedures: Microbiological testing is less amenable to statistical techniques of quality control than is analytical chemistry. Many microbiological tests are qualitative, involving identification of microorganisms; while in other tests, meaningful standards are not available and substrates are perishable. For these reasons, microbiological quality control must rely on strict control of materials, test parameters, e.g., time and temperature, and individual analyst technique and training. The following are illustrative of quality control procedures used in our laboratory.

   - Sterility checks are run on each batch of dilution water.

   - Sterility and pH checks are run on each batch of media used.

   - Airborne microbial density measurements are performed daily.

   - Records are kept of media batch sterilizations showing lot number, date, sterilization time, temperature, and initial and final pH.

   - Media are dated when received and opened, and discarded if caked.

   - Laboratory pure water is checked annually for bactericidal properties and for heavy metal contamination.

   - Laboratory pure water is checked monthly for pH, chlorine residual, standard plate count, and low level ammonia. Conductance of the water is continually monitored, and recorded twice daily.

   - All new plastic caps for dilution bottles or agar bottles are boiled three times in deionized water, and the final water wash is checked for inhibitory substances prior to use.

   - Records are maintained of bacteriological suitability of detergents and procedures for their use.

   - Coliform media in tubes is discarded after one week of room temperature storage or three weeks of refrigerated storage.

   - Bacteria spikes are initiated regularly for E. coli, Pseudomonas, Staphylococcus, Clostridia, and Shigella tests. All reagents and/or media used are recorded as well as corresponding preparation dates, expiration dates, and control numbers, as applicable.

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- A toxicity test is performed for each lot number of Brilliant Green Dye.

- Positive and negative controls are initiated for the following: phosphatase tests, Staphylococcus coagulase reactions, Listeria monocytogenes (USDA, FDA methods), Salmonella rapid method screening assay, and antibiotic tests.

PHARMACEUTICAL SCIENCES

A. PHARMACEUTICAL AND ENVIRONMENTAL MICROBIOLOGY

This Group has responsibility for microbiological analysis of finished pharmaceuticals, raw materials, and intermediates. This group is also responsible for potable water testing for coliforms. Special expertise is available in this group for:

- USP and CFR sterility testing using membrane filtration and direct inoculation procedures.

- Endotoxin testing of raw materials and finished products using the gel clot procedure. Testing is performed in compliance with the 1987 FDA Guideline on Validation of the Limulus Amebocyte Lysate Test.

- Antimicrobial preservative effectiveness testing using modified USP, BP, and client methods.

- Microbial limit testing of raw materials, intermediates, and finished products.

- Testing in support of process and new facility validation, including analyses for pharmaceutical water systems, environmental monitoring, biological indicator enumeration and incubation, and endotoxin indicator preparation and analysis.

- Organism identification.

- Particulate matter analysis of small- and large-volume parenterals.

Quality Assurance

1. Instrument and Equipment Calibration and Maintenance:

   - Autoclave: Temperature distribution studies are used to validate the autoclave. Sterilization cycles are validated for sterility testing media and apparatus. Preventative maintenance is performed and sterilizer controls are calibrated on a routine basis.

   - Incubators, Refrigerators, and Water Baths: The temperature is monitored using NIST traceable thermometers.

   - Oven: Sterilization and depyrogenation cycles are validated using biological indicators, endotoxin indicators, and heat distribution studies.

   - Clean Rooms and Biological Safety Cabinets: Each room and cabinet is certified every six months. Tests performed during certification include particle count, integrity testing of HEPA filters, and air velocity profile. Room pressurization is also measured for the clean rooms. Disinfection of critical and noncritical surfaces is performed routinely and includes rotation of disinfectants on a regular basis. Microbial monitoring of critical and noncritical surfaces is performed to evaluate the effectiveness of disinfection procedures. Organisms isolated from environmental monitoring are identified to genus and species when possible. Biological safety cabinets are certified to meet requirements in NSF Standard No. 49.

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- Airborne Particle Counter: Calibration is performed once a year by a certified service company.

- pH Meter: These instruments are calibrated with standard buffer solutions (pH 4.0, 7.0, and 10.0) each day used.

- Spectrophotometer: A set of standard solutions is used for monthly calibration of absorbance and wavelength.

- Balances: Calibration is checked daily with working class weights and monthly with Class S weights. Maintenance and calibration is performed annually by a service company.

- HIAC/Royco Particle Counter: Calibration and maintenance are performed yearly by the manufacturer. Volume, accuracy, and flow rate are checked monthly.

2. Standards:

   - Laboratory cultures are obtained from the American Type Culture Collection (ATCC). Cultures used in testing are no more than five transfers from ATCC Freeze Dried Cultures.

   - Control standard endotoxin and limulus amebocyte lysate (LAL) reagent are obtained from licensed manufacturers.

3. Media Preparation:

   - Batch records are kept of all media and reagent preparation which include sterilization records, pH checks, and sterility checks. Each batch of media is labeled with a unique control number, expiration date, and storage condition.

   - Growth promotion is performed on each batch of media, if applicable, using the procedures outlined in the USP XXII.

4. Sterility Testing:

   - Viable particulate monitoring is performed during sterility testing using a slit-to-agar sampler.

   - Nonviable particulate monitoring is performed during sterility testing using a MET-ONE particle counter.

   - Microbial monitoring of critical and noncritical surfaces is performed during sterility testing using contact plates and swabs and includes personal monitoring.

   - Alert and action limits are established for viable and nonviable particulate monitoring and surface monitoring. Organisms isolated during environmental monitoring are identified to genus and species whenever possible.

   - A manipulative control is performed with each sterility testing batch.

   - Bacteriostasis/Fungistasis testing is performed on new products submitted for sterility testing if required by the client.

   - Gowning training and qualification is performed for all analysts working in the sterility testing laboratory. Analysts are requalified annually.

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5. Endotoxin Testing:

- Lysate label claim verification is performed on all lots of lysate used for testing as outlined in the 1987 FDA Guideline on LAL testing.
- Each analyst is qualified using procedures outlined in the 1987 FDA Guideline on LAL testing. Analysts are requalified annually.
- A 2 λ positive product control and negative control are analyzed with each endotoxin test.
- Inhibition and enhancement testing is performed on new products submitted for endotoxin testing.

6. Microbial Limits Testing:

- Positive and negative manipulative controls are performed with each batch of samples analyzed.
- Product validation is performed on new products submitted for microbial limit testing if required by the client.

7. Particulate Matter Testing:

- Sensor is calibrated yearly by the manufacturer.
- A laboratory control standard and calibration verification standard is performed with each batch of samples analyzed. Glassware checks are performed as outlined in the USP.
- Sample volume accuracy and flowrate are checked monthly.
- Sensor resolution is determined quarterly.
- Particle counting accuracy is determined every six months using the USP Particle Count Reference Standard.

B. PHARMACEUTICAL CHEMISTRY

This Group provides stability analyses, quality control testing, process validation, cleaning validation, water system evaluation, raw material testing (USP, EP, BP, JP), analytical method development, and analytical method validation to support the pharmaceutical industry. Stability studies can be housed in our stability chambers or sent to Lancaster Laboratories, Inc. after removal from a client's chambers. A computer tracking system is used to ensure studies are tested at the required intervals and the stability chambers are monitored continuously for temperature and humidity (when applicable). Assistance with stability study design and analytical method validation protocol design are provided. Most chemical and physical testing requirements for our pharmaceutical clients can be met by this Group.

Quality Assurance

1. Instrument Calibration:

- Stability Chambers: Stability chambers are located in a limited access area and are monitored continuously for temperature and humidity (when applicable) by an automated monitoring system. Physical inspections of the stability chambers are performed four times daily every day of the year. All monitoring is documented. Temperature and humidity distribution studies are performed annually. Calibration for temperature and humidity is completed using equipment referenced to NIST.

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- HPLC and GC: Calibration of all chromatographic instrumentation is performed annually using equipment referenced to NIST and capable of calibrating temperatures (ovens, injectors, detectors, column heaters), flowrates, wavelengths, ramp times, detector output, analog to digital conversion, and injection volume.

- pH Meter: These instruments are calibrated with standard buffer solutions (pH 1.68, 4.0, 7.0, and 10.0) and are verified whenever instruments are used.

- Analytical Balances: Calibration is checked daily using NIST Class S weights or better, and a complete overhaul and calibration is performed annually by a certified service company.

- UV Spectrophotometer: Wavelength calibration and photometric calibration are performed semiannually with Standard Reference Materials 2034 Holmium Oxide and 930D Glass Filters, respectively.

- Dissolution Baths: Calibration is performed twice a year using salicylic acid and prednisone tablets as specified in the current USP.

- Muffle Furnace: Calibration is performed annually using a meter and probe and calibrator tablets referenced to NIST.

- Melting Point Apparatus: Calibration is performed at time of use with USP Melting Point Reference Standards.

- Viscometer: The Brookfield Viscometers are calibrated yearly using Brookfield standard solutions and according to Brookfield recommendations. Capillary viscometers are calibrated according to Standard Test ASTM D 445.

- Hardness Tester: Calibration is performed every six months using a NBS traceable Class F weight, and the unit is sent once every two years to a certified company for calibration.

- Refractometer: Calibrated per manufacturer recommendations annually using a prism reference to NIST.

- Polarimeter: Calibrated per manufacturer recommendations annually.

- Friabilator: Calibrated per manufacturer recommendations annually.

- Thermometers: Calibrated against NIST reference standard thermometer annually.

- Karl Fischer Titrators: Calibration of the dispensing unit is performed annually.

- Automatic Titrators: Calibration of the dispensing unit is performed annually.

- FTIR: This instrument is calibrated quarterly using a polystyrene film standard.

2. Standards: USP Reference Standards or client-supplied reference standards are typically used.

SECOND AND THIRD SHIFTS

Our second shift operates from approximately 4:30 p.m. to 1:00 a.m., Monday through Friday, while our third shift works from 10:00 p.m. to 7:00 a.m., Sunday through Thursday. In addition, some groups require technical staff on Saturday and Sunday to maintain the operations. The operating hours of personnel on various shifts overlap to ensure good communications and continuity of operations.

Personnel of these two shifts at our Lancaster location are responsible for a variety of duties. In addition to performing certain standard analytical tests, they are responsible for sample preparation steps such as sample digestion for trace element analyses. This shortens the time for turnaround on multiple, repetitive analyses, thus improving our efficiency. They are also responsible for glassware cleaning, glassware and instrument set-up for the day-shift personnel, autoclaving, media preparation, and certain building maintenance services. Clients with emergency problems occurring in off-hours can be accommodated with certain services, e.g., sample receipt or early alerting of Group Leaders to the need for RUSH analyses.

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SECTION 7
SUPPORT SERVICES

The following describes some of the Groups of personnel which supply support to our Business Units and whose operations are frequently vital to the efficient and reliable provision of the services we offer.

A. BUSINESS DEVELOPMENT

This Group is responsible for sales, market development, and client services. These functions include:

- Coordination and preparation of proposals, in consultation with technical staff.
- Coordination of exhibits at technical meetings and conferences.
- Design and production of company literature including a Schedule of Services and various technical bulletins on the services we offer. Please inquire if you would like to receive copies of this literature or to be placed on our mailing list.

B. CLIENT SERVICES

Personnel of this Group are often the first to have contact with a prospective client since their responsibilities include receipt of incoming calls regarding the services we offer. They also assist clients by providing the following services:

- Giving status reports, verbal results via telephone, and faxing reports before the analysis report is issued. Only results which have been verified by technical personnel are given by telephone or fax.
- Coordinating high-priority samples between the client and laboratory personnel.
- Answering common technical questions for clients.
- Coordination with technical staff regarding client inquiries such as status of sample analyses.

C. DATA PACKAGE

Members of this Group are responsible for the preparation of "data packages" for clients who request them. Our standard report format consists only of the final result generated in the laboratory. However, government regulations have made it necessary for many of our clients to retain copies of raw data as well as quality control information. The function of this Group is to collect and index methods, quality control, and raw data into a format that will be useful to our clients. The options and costs for this service are listed in our Schedule of Services.

This group is also responsible for producing diskette deliverables. This additional format for data transfer compiles analytical data onto diskettes in a variety of formats. Clients may then download this data into spreadsheets or databases, eliminating time-consuming data entry and transcription errors.

D. EQUIPMENT MAINTENANCE

Preventative maintenance, calibration, installation, and repair of analytical instrumentation is performed by this Group. Trained specialists use a variety of equipment including oscilloscopes, analog and digital multimeters, and waveform generators to maintain equipment in optimal condition.

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E. FINANCE/DATA PROCESSING

This Group is responsible for all financial transactions of the company and the establishment and maintenance of all data processing programs.

All financial transactions, including accounting, billing, accounts receivable, accounts payable, purchasing, and payroll, are monitored and recorded by personnel of this Group.

Data processing includes, in addition to our computerized accounting system, all computerized aspects of our technical operations, e.g., our computerized Sample Management System, computer aspects of our QA program, and our Data Access System. Continued research and development into new and improved hardware and software are ongoing activities of this Group.

F. HUMAN RESOURCES

Human resource management includes coordination of all hiring, employee orientation, safety monitoring, the employee evaluation program, and other personnel management functions. Secretarial services are also coordinated by this Group. Because of the technical nature of our business, a well-trained staff is critical to the production of quality data. Human Resources has oversight of the employee training program which includes on-site training in basic subjects and training courses offered by outside organizations.

G. MAINTENANCE & SECURITY

Major functions of this Group include buildings and grounds maintenance. This Group also has certain responsibilities which impact directly on the quality and reliability of our technical services:

- Responsible for maintenance of our deionized water system. Pure, sterilized water is a vital necessity for all of our laboratories. Continuous, in-line monitoring of conductivity is used to ensure that high quality water is produced.

- Responsible for maintenance of our Heating, Ventilating, and Air Conditioning (HVAC) and exhaust hood systems. This is particularly important in our instrumentation rooms and computer center where a controlled environment, positive-pressure system is maintained to prevent contamination by dust or solvent vapor.

- Maintenance of the equipment used to generate and maintain conditioned electrical power is performed by this group.

- This Group also utilizes its carpentry and mechanical skills to develop and fabricate special pieces of equipment for laboratory or field use by our scientific staff.

H. SAMPLE ADMINISTRATION

Sample Administration has overall responsibility for the receipt and log-in of all samples. Analyses requested, sample descriptions, analysis report recipients, invoicing information, and special laboratory instructions are included in the types of information entered into the sample management system by this group.

I. SAMPLE SUPPORT

Sample Support supplies environmental clients with sample bottles and mailing kits, performs preservation and homogenization on samples, maintains the central locked storage facility, and disposes of samples upon completion of the analytical work. The department maintains nearly 2500 square feet of refrigerated storage space.

J. TRANSPORTATION

The Transportation Group is responsible for pickup of samples from clients. We currently offer regularly scheduled pickups in Lancaster, Harrisburg, York, Philadelphia, Reading, and Allentown/Bethlehem/Easton, Pennsylvania; Baltimore, Maryland; Northern Delaware; and Central and Northern New Jersey. Special pickups in other areas can also be arranged. We maintain a fleet of vehicles for sample pick-up service, field operations in industrial hygiene and wastewater sampling, and general use by our professional staff. Drivers are trained in the technical aspects of sampling and sample handling and may also perform simple on-site tests, such as residual chlorine in swimming pools. Mobile phone communication with the laboratory is available in all vehicles.

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SECTION 8
ACCREDITATIONS, CERTIFICATIONS, REGISTRATIONS, AND CONTRACTS

Accreditation of a laboratory has been defined as "the verification by a competent, disinterested third party that a laboratory possesses the capability to provide accurate test data and that it can be relied upon in its day-to-day operations to maintain high standards of performance."* The terms "certification," "registration," and others have been used in the past and are currently being used by some organizations, as synonyms for accreditation, but in recent years a consensus has been reached to restrict the term accreditation to laboratories and other organizations and to reserve certification to individuals, e.g., Certified Industrial Hygienist, Certified Public Accountant, or to products which conform to certain standards or specifications.

Accreditation is thus the one generally accepted method by which a laboratory such as ours can demonstrate its capability of generating acceptable, professional, quality test results in those areas in which it claims competence. To this end, we have actively sought accreditation by organizations offering it in those areas relevant to our technical expertise.

Although organizations offering accreditation differ somewhat in the details of their programs, they generally evaluate laboratories in four basic areas: personnel (education, training, and experience), physical facilities, instrumentation/equipment, and quality assurance programs. The evaluation is performed by one or more of the following procedures: periodic on-site inspection of the laboratory by assessors experienced in technical operations and management, periodic testing of proficiency evaluation samples, and periodic updating of the laboratory's file to reflect changes in personnel, equipment, or services offered.

The following lists the accreditations, registrations, and contracts currently held by Lancaster Laboratories, Inc.:

- American Association for Laboratory Accreditation (A_2LA): A_2LA is a private-sector, non-profit organization whose sole mission is accrediting laboratories in 12 fields of testing. Lancaster Laboratories, Inc. is accredited in the environmental field of testing. Certificate #0001-01.

- American Industrial Hygiene Association (AIHA): AIHA accredits laboratories for their ability to analyze collection media used in air pollution sampling for a broad variety of industrial workplace contaminants. Accreditation #17601-001.

- Department of Defense (DOD): We have project-based approval experience in compliance with the requirements of the Naval Energy and Environmental Support Activity (NEESA), the Air Force Center for Environmental Excellence (AFCEE), and the Missouri River Division of the Army Corps of Engineers.

- EPA Contract Laboratory Program (CLP): This program is not truly an accreditation program, although many people consider it a de facto accreditation. In order to receive an EPA contract to perform laboratory work in support of Superfund investigations, a laboratory must successfully bid on a contract, obtain acceptable results on performance samples, and pass an on-site inspection by EPA officials. Lancaster Laboratories has participated as a Routine Analytical Services contract laboratory for Organics analysis and also performs Special Analytical Services (SAS) for the EPA-CLP.

- Food and Drug Administration (FDA): Because of our work for pharmaceutical companies, we are a registered FDA laboratory required to adhere to the Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP) regulations and subject to periodic, unannounced audits. This registration does not imply FDA approval. Registration #2513291.

*From paper presented to the Annual Meeting of the Texas Council of Engineering Laboratories, by Earl H. Hess, Ph.D. (January 28, 1984).

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- State Environmental Authorities: We are accredited in the following states, by the appropriate authorities, for the analysis of drinking water and, where applicable, for wastewater analyses:
  - Colorado Department of Health (drinking water).
  - Connecticut Department of Health Services (drinking and nonpotable water), Identification #PH-0746.
  - Delaware Health and Social Services (drinking water).
  - Indiana Department of Health (drinking water).
  - Kansas Department of Health and Environment (drinking water, nonpotable water, and hazardous/ solid waste), Certificate #E-151 (water), Certificate #E-1130 (solid or hazardous waste).
  - Maryland Department of Health & Mental Hygiene (drinking water), Lab ID #PA009.
  - Massachusetts Department of Environmental Protection (drinking and nonpotable water), Lab ID #PA009.
  - Michigan Department of Public Health (drinking water).
  - New Jersey Department of Environmental Protection (drinking and nonpotable water), Identification #77443.
  - New Hampshire Department of Environmental Services (drinking and nonpotable water).
  - New York Department of Health (drinking water, nonpotable water, hazardous waste, air, and emissions), Identification #10670.
  - North Dakota Department of Health (potable water), Identification #R-061.
  - Pennsylvania Department of Environmental Resources (drinking water), Identification #36-037.
  - Utah Department of Health (nonpotable water and solid waste), Certificate #E-88.
  - Virginia Department of General Services (drinking water), Identification #00187.
  - West Virginia Department of Health & Human Resources (drinking water), Certification #R-16.
  - West Virginia Division of Environmental Protection (wastewater), Certification #055.
- U.S. Public Health Service (USPHS): The Food Microbiology Group is an Approved Dairy Laboratory, subject to evaluation by USPHS through the Pennsylvania Department of Agriculture. FDA #42137.
- National Voluntary Laboratory Accreditation Program (NVLAP): NVLAP is an accreditation program administered by the National Institute of Standards and Technology. Our laboratory is accredited by them for the analysis of asbestos in building materials. Laboratory Code #1084.

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A. COMPANY MEMBERSHIPS

The following lists those business and technical organizations in which Lancaster Laboratories, Inc. holds membership:

- American Association for Laboratory Accreditation
- American Council of Independent Laboratories
- Association of Official Analytical Chemists
- Better Business Bureau of Eastern Pennsylvania
- Chambers of Commerce:
  - United States Chamber of Commerce
  - Maryland Chamber of Commerce
  - Pennsylvania Chamber of Commerce
  - Lancaster (PA) Chamber of Commerce and Industry
- National Food Processors Association
- Pennsylvania Manufacturing Confectioners Association (Associate Member)
- Pennsylvania Association of Approved Environmental Laboratories
- Refrigerated Foods Association

B. STAFF MEMBERSHIPS

The following organizations are some of those in which one or more members of our technical staff hold individual memberships:

- Air and Waste Management Association
- American Association for the Advancement of Science
- American Association of Candy Technologists
- American Association of Cereal Chemists
- American Association of Pharmaceutical Scientists
- American Board of Industrial Hygiene
- American Chemical Society
- American Industrial Hygiene Association
- American Marketing Association
- American Oil Chemists Society
- American Public Health Association (APHA)
- American Society for Microbiology

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- American Society of Safety Engineers
- American Society for Testing and Materials
- American Society for Training and Development
- American Society of Mass Spectrometry
- American Water Works Association
- Association of Official Analytical Chemists
- Chromatography Forum of Delaware Valley
- Institute of Food Technologists
- International Association of Milk, Food, and Environmental Sanitarians
- International Association of Official Analytical Chemists
- International Society for Pharmaceutical Engineering
- LAL User's Group
- Lancaster County Industrial Safety Council
- National Asbestos Council
- National Food Processor's Association
- National Registry of Microbiologists
- National Safety Council
- New York Academy of Science
- Parenteral Drug Association
- Pennsylvania Dairy Laboratory Directors Association
- Pennsylvania Manufacturing Confectioners Association
- Society of American Military Engineers
- Society for Applied Spectroscopy
- Society for Human Resource Management
- Society of Quality Assurance
- Water Environment Federation

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APPENDIX A
STANDARD TERMS AND CONDITIONS

Lancaster Laboratories
Where quality is a science.

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Standard Terms and Conditions

Unless otherwise agreed in a formal contract, services provided by Lancaster Laboratories, Inc., are expressly limited to the terms and conditions stated herein.

Confidentiality ... Strict confidentiality is maintained in all of our dealings with clients. Confidentiality agreements, therefore, are signed willingly. In any instance where information is subpoenaed by and must be released to a regulatory or legal body, the client is promptly notified. Likewise, the client agrees to respect all such relationships of trust. Client agrees it will not use Lancaster Laboratories' name and/or data in any manner which might cause harm to the company's reputation and/or business. Under no circumstances is the name of Lancaster Laboratories, Inc., (LLI) to be published -- either alone or in association with that of any other party -- without its approval in writing.

Payment Terms ... Payment in advance is required for all clients except those whose credit has been established with our company. For clients with LLI-approved credit, our standard terms are net 30 days, after which time a 1-1/2% per month late charge is added to all unpaid balances. Any deviation in payment terms must be agreed to in writing. LLI has the right to ask for payment in advance, if the established payment terms are not adhered to. In the event of default in payment for services rendered, the client is responsible for reasonable collection and/or legal fees.

Billing ... All fees are charged or billed directly to the client. The billing of a third party will not be accepted without a statement, **signed by the third party,** which acknowledges and accepts payment responsibility. (Note: We will not be responsible for the re-collecting of samples whose holding times have been exceeded due to late or unauthorized requests for third-party billing.) It is necessary for us to assume that the paperwork submitted with a sample describes the testing protocol desired. Any changes to this protocol must be submitted to LLI **in writing.** However, if changes are made after the originally requested testing is initiated or has been completed, the client must accept payment responsibility. We cannot be responsible for holding times that are exceeded due to such changes. Please send all requests for changes marked: "Client Services -- URGENT!" Our FAX number is (717) 656-2681.

Fee Discounts ... Economy-of-scale discounts are available for routine environmental and food work. Discounts are determined by the number of samples, the nature and spectrum of the requested analyses, and the composition and matrix of the samples. Quotations are provided free of charge. For established environmental and food clients, discount rates are reevaluated annually, and a new rate is applied to future invoices based upon the previous year's volume of work, type of analyses, ease of scheduling, and work continuity. For clients with intermittent analytical needs, discounts may be extended based upon the quantity of work submitted **at one time** ($1,000 - 4,999 = 5%, $5,000+ = 10%). All discounts are contingent upon meeting payment terms. LLI reserves the right to drop discounts on late payments. No discounts apply to services provided by hourly rate.

Minimum Billing ... Minimum fee for service is $10.

Rush Analyses ... A surcharge is usually added to the list fee if rapid reporting is requested; that is, if work must begin immediately upon receipt of the sample. The surcharge will be 50 to 200% of the list fee, depending upon the analysis to be performed. Rush analysis service is offered contingent upon prearrangement with our Client Services Group.

Hazardous Wastes ... Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work. These include samples known or suspected to contain hazardous materials as defined by state or federal regulatory agencies. The cost of returning the sample may be invoiced to the client. The sample and portions thereof remain the property of the client at all times.

Reports ... LLI prohibits use of its name in connection with any unauthorized condusions based on its reports without its prior written consent.

Special Reports ... Additional charges may be necessary for customized reports which differ significantly from the LLI format. Additional charges will apply for specific QA/QC report formats, such as data packages or data on diskette. Please ask for a quotation. (NOTE: No reports or copies thereof will be sent to anyone other than the client unless the client formally requests us to do so in writing.)

Litigation ... All costs associated with compliance to any subpoena or other official request for documents, for testimony in a court of law, or for any other purpose relating to work performed by LLI, in connection with work performed for that client, shall be paid by the client. Such costs shall include, but are not limited to, hourly charge for persons involved in responding to subpoenas, travel and accommodations, mileage, attorney's preparation of testifier and advice of counsel in connection with response to subpoenas, and all other expenses deemed reasonable and associated with said litigation.

Warranty and Limits of Liability ... In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. **The foregoing express warranty is exclusive and is given in lieu of all other warranties, expressed or implied. We disclaim any other warranties, expressed or implied, including a Warranty of Fitness for Particular Purpose and Warranty of Merchantability.** We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by the company which includes any conditions that vary from the above described Standard Terms and Conditions, and LLI hereby objects to any conflicting terms contained in any acceptance or order submitted by client.

Equal Opportunity/Affirmative Action Notice ... Lancaster Laboratories, Inc., is an equal opportunity/affirmative action employer and complies with all the regulations of executive order 11246 and the regulations promulgated thereunder.

Contracts ... All contracts are subject to review and approval by LLI's legal department and must be signed by a corporate officer.

Retention of Samples ... After the analytical results have been reported, samples are routinely retained in our storage facilities according to the following schedule. Prior arrangements must be made if samples are to be held for periods longer than those indicated. LLI may charge a monthly fee for long-term storage.

Sample Type	Retention Time
Wastewater, sludge	7 days
Foods, perishables	7 days
All other samples	14 days

(Water tested for potability is discarded immediately after the analysis.)

Retention of Reports ... After analytical results have been reported to client, LLI shall retain copies of such analytical reports for a period of ten years, after which such reports may be destroyed. If client requests additional copies of such analytical reports during the retention period, an additional charge will apply for the preparation and printing of such reports.

Terms 12/01/93

APPENDIX B
EXAMPLE OF ANALYSIS SUMMARY SHEET
(Available Upon Request for all Standard Analyses)

LLI Analysis Summary

Analysis	: 0203 Total Solids EPA 160.3
Quantitation limit	: 10 mg/l
Sample type	: waters
Minimum sample size to be submitted	: 250 ml
Container type	: glass/plastic
Preservative	: none
Department	: 29 WATER QUALITY
Holding time	: 7 days
Storage conditions	: cool, 4C

Special Instructions:

Basic Principles: A well-mixed sample is evaporated in a tared beaker and dried to a constant weight in an oven at 103° to 105°C. The increase in weight is the total solids.

Reference: USEPA 600/4-79-020, Methods for Chemical Analysis of Water and Wastes, Office of R&D, USEPA-EMSL, Cincinnati, Ohio (March 1983). Method 160.3.

Other Related Reference: Standard Methods for the Examination of Water and Wastewater, 18th ed., 1992. Method 2540B.

APPENDIX C
RESUMES OF KEY PERSONNEL

Earl H. Hess, Ph.D., Chairman of the Board, President, and CEO

Education:

B.S. Chemistry (cum laude) Franklin and Marshall College (1952)
Ph.D. Organic and Biochemistry, University of Illinois (1955)

Continuing Education:

Executive Quality College, Philip Crosby Associates (1989)
Quality Education System Instructor Training, Philip Crosby Associates (1989)
Ethical Fitness Seminar, Institute for Global Ethics (1992)
Ethical Fitness Instructor Training, Institute for Global Ethics (1993)

Post Doctoral Experience:

Chemistry Faculty, Franklin and Marshall College (1955 - 1957)
Research and Development Division, General Cigar Company (1957 - 1961)
Established Lancaster Laboratories, Inc. (1961)

Publications:

Various U.S. and foreign patents, scientific papers on basic and applied research (bibliography furnished on request)

Biographical Listings:

Who's Who in America
American Men and Women of Science
Men of Achievement
Who's Who in the East
Who's Who in Frontier Science and Technology
Who's Who in Technology Today

Awards, Citations, and Honorary Societies:

Honorary Societies - Phi Beta Kappa, Phi Lambda Upsilon, Sigma Xi
American Council of Independent Laboratories, Inc.,
  Special Service Award (1979)
  Roger W. Truesdail Award for Outstanding Service to Independent Laboratories (1983)
  Fellow Award (1992)
Distinguished Pennsylvanian (1982) (William Penn Committee)
Business Leader of the Year (1988) Pennsylvania Chamber of Business and Industry
Franklin & Marshall Alumni Citation (1988)
Lancaster Chamber of Commerce Exemplar Award (1988)
Sales and Marketing Executive of the Year Award (1989)
Small Business Award (Lancaster Chamber) (1989)

Professional, Trade, Civic, Memberships, and Offices:

American Council of Independent Laboratories (ACIL)
  President (1985 - 1986)
ACIL Education Institute, Chairman of the Board (1992 -)
Lancaster Chamber of Commerce and Industry
  Chairman of the Board (1985)
Pennsylvania Chamber of Commerce, Board of Directors (1980 -)
U.S. Chamber of Commerce, Board of Directors
  Vice Chairman, Eastern Region; Chairman, Environmental Committee; Chairman, Accrediting Board
Chairman, Pennsylvania Delegation to 1986 White House Conference on Small Business

Issues Commissioner, Pennsylvania Governor's Conference on Small Business (1988)
American Association for the Advancement of Science (AAAS)
American Association for Laboratory Accreditation (A2LA)
Chairman, Accreditation Council (1988 - 1991)
American Chemical Society (ACS)
American Public Health Association (APHA)
American Society for Testing and Materials (ASTM)
Business Executives for National Security (BENS)
City of Lancaster, Southeast Area Commercial and Industrial Revitalization Program Task Force, Co-chairman
Commonwealth Foundation, Board of Directors, Treasurer
New York Academy of Sciences

Other Affiliations:

Mountain States Analytical, Inc., Chairman of the Board

J. Wilson Hershey, Ph.D., Executive Vice President/Director, Laboratory Operations

Education:

B.A. Chemistry, Millersville State College (1972)
M.S. Chemistry, Villanova University (1983)
Ph.D. Analytical Chemistry, Villanova University (1985)
M.B.A., Villanova University (1991)

Continuing Education:

Attended numerous technical meetings and seminars including short courses in gas chromatography and atomic spectroscopy.
Quality Management College, Philip Crosby Associates (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1972
Executive Vice President (1991)

Publications:

Seven scientific publications on analytical chemistry

Memberships:

American Association for Laboratory Accreditation Environmental Advisory Committee
American Chemical Society
Chromatography Forum of Delaware Valley
American Water Works Association

Carol D. Hess, M.B.A., Executive Vice President, Human Resources and Administration

Education:

B.S. Applied Mathematics/Economics, Ursinus College (1982)
M.B.A. Administrative Management, Saint Joseph's University (1987)

Continuing Education:

Franklin and Marshall College, Interviewing and Selection Techniques (1983)
Franklin and Marshall College, Personnel Management (1983)
Managing Human Performance (1984)
Quality Management College, Philip Crosby Associates (1989)
Creation, Care, and Feeding our Corporate Culture (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1981
Executive Vice President (1991)

Publications:

Two publications on human resources

Memberships and Appointments:

Leadership Lancaster, 1984 Graduate
American Society for Training & Development (1985)
Junior Achievement, Board of Directors (1985 - 1986)
Multiple Sclerosis Society, Board of Directors (1985 - 1988)
Human Resources Committee of the Pennsylvania Chamber of Commerce
Chairperson, Employee Benefits Subcommittee
Health and Employee Benefits Committee of the U.S. Chamber of Commerce
Chairperson of the Human Resources Committee for the American Council of Independent Laboratories (ACIL)
Named Working Mother of the Year by Working Mother magazine (1990)
Lancaster Chamber of Commerce Board of Directors, Executive Committee
Lancaster General Hospital Board of Directors
Named to HR Executive Honor Roll (1992)

Kenneth Hess, B.S., Executive Vice President, Finance and Data Processing

Education:

B.S. Chemistry, Juniata College (1975)

Continuing Education:

Various courses in accounting and computers.
Quality Management College, Philip Crosby Associates (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1975
Executive Vice President (1991)

Memberships:

Juniata College Trustee

Eugene Abel, Jr., B.S., Chemist/Coordinator, AAS Metals, Environmental Sciences

Education:

B.S. Science, Pennsylvania State University (1965)

Continuing Education:

Atomic Absorption Spectroscopy, Instrumentation Laboratories, Inc. (1975)
Computer School for Spectroscopic Applications, Angstrom, Inc. (1983)

Professional Experience:

Horsehead Resources Development Co., Inc./Zinc Corporation of America,
Chemist/Lab Supervisor (1965 - 1989)
With Lancaster Laboratories, Inc. since 1989
Coordinator (1990)

Nadia Alfieri, IHIT, Air Quality Program Specialist, Air Quality, Environmental Sciences

Education:

B.S. Environmental Science, Rutgers University (1982)
M.S. Environmental Science, Rutgers University (1987)

Continuing Education:

Industrial Hygienist In Training (1990)
The Clean Air Act From A to Z, Executive Enterprises (1991)
Clean Air Operating Permits, Executive Enterprises (1992)
EPA AHERA Asbestos Inspector Refresher Course (1994)
EPA AHERA Asbestos Management Planner Refresher Course (1994)
Sampling and Analysis for Hazardous Air Pollutants, AWMA (1992)

Professional Experience:

Structure Probe, Inc., Research Chemist (1980 - 1984)
Johnson & Johnson Baby Products, Industrial Hygienist/Chemical Inventory Coordinator
(1984 - 1985)
Rutgers University, Assistant Instructor (1983 - 1985)
Princeton Testing Laboratory, Assistant Manager, Industrial Hygiene (1985 - 1987)
Forum for Scientific Excellence, Manager, Industrial Hygiene (1987 - 1989)
Alfieri Environmental, Inc., President (1989 - Present)
With Lancaster Laboratories, Inc. since 1991

Memberships:

Air & Waste Management Association
NJ & PA Sections of American Industrial Hygiene Association
PA Association of School Business Officials

Anthony Andrews, B.S., Chemist, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

Barber-Scotia College (1984)
U.S. Army Reserve (1984 - 1986)

Professional Experience:

With Lancaster Laboratories, Inc. since 1993

Honors, Awards, and Citations:

Alpha Phi Alpha
Army Achievement Medal (1988)
Good Conduct Medal (1989)
Letter of Commendation (1984)
Premedical Summer Institute, Fisk University (1982) and Atlanta University (1983)
Sylvia Bowles Scholarship (1982)
Two United Negro College Fund Scholarships

Memberships:

American Chemical Society

Brad Ayars, Client Services Specialist, Environmental Sciences

Continuing Education:

Environmental Law & Policy, F&M College (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Client Services Specialist (1992)

Cynthia Anne Ayars, B.S., Group Leader, Sample Support

Education:

B.S. Chemistry, Shippensburg University (1987)

Continuing Education:

Telecation Associates CLP Training Course (1989)
Hitachi Z-9000 Operator's Training Course (1989)
Currently enrolled in M.B.A. program at Pennsylvania State University

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Group Leader (1991)

Sandra Bailey, B.S., Group Leader, Nutrition Labeling, Food Sciences, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry (cum laude), University of Delaware (1987)

Continuing Education:

Scientific Instruments Auto Analyzer Training Course (1987)

Entry Level Management Development Program (1989)
Applied Statistics, Penn State Continuing Education (1991)
Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Group Leader (1991)

Memberships:

American Association of Cereal Chemists
Institute of Food Technology
National Food Processors Association

Karen Baney, B.S., Chemist, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Medical Technology, Millersville University (1986)

Professional Experience:

St. Joseph Hospital, Medical Technologist (1986 - 1988)
With Lancaster Laboratories, Inc. since 1988
Chemist (1991)

Matt Barton, B.S., Chemist, ExpressLAB, Environmental Sciences

Education:

B.A. Biochemistry, East Stroudsburg University (1991)

Continuing Education:

Basic Atomic Absorption Spectroscopy, Varian (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1991
Chemist (1993)

Biographical Listings:

Who's Who Among American College Students

Gordon Beitzel, B.S., Systems Specialist, Food & Pharmaceutical Sciences

Education:

B.S. Electrical Engineering, Pennsylvania State University (1987)

Continuing Education:

Microsoft Developer's Tools Forum (1991)
Structured LAN Wiring Systems, American Research Group (1993)

Relational Databases for Programmers, Technology Mentors, Inc. (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Systems Specialist (1990)

Derek Berger, B.S., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Shippensburg University (1989)

Continuing Education:

M.S. Chemistry Coursework, Shippensburg University
Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist (1991)

Nancy Bornholm, B.S., Client Services Specialist, Environmental Sciences

Education:

B.S. Chemistry (magna cum laude), Muhlenberg College (1981)

Continuing Education:

Instrumental Analysis of Paints and Polymers, FBI Academy (1984)
Analytical Chemistry of Contaminants in Surface and Groundwater, ACS Short Course (1986)

Professional Experience:

University of Connecticut Health Center, Laboratory Technician (1977 - 1980)
Institute for Cancer Research, Research Technician (1981)
Baltimore City Crime Laboratory, Mobile Crime Unit Trainee (1981 - 1982)
Maryland State Police Crime Laboratory, Forensic Chemist III (1982 - 1985)
With Lancaster Laboratories, Inc. since 1985
Client Services Specialist (1987)

Charles Bourque, B.A., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.A. Chemistry/Mathematics, University of Maine (1981)

Continuing Education:

Gas Chromatography Training Course, Perkin Elmer Corp. (1984)
Hewlett Packard GC/MS Training Course (1984)
Management Training Course (1988)
Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

Planning Research Corp., Chemist (1981 - 1982)
E.C. Jordan Consulting Engineers, Chemist (1983 - 1986)
With Lancaster Laboratories, Inc. since 1986

Stephanie Bozym, B.S., Client Services Specialist

Education:

B.S. Microbiology, Pennsylvania State University (1990)

Continuing Education:

Currently enrolled in M.B.A. program at Lebanon Valley College

Professional Experience:

ICI Pharmaceuticals, Pharmaceutical Sales Representative (1990 - 1991)
With Lancaster Laboratories, Inc. since 1991

Marianne Bragg, B.S., Business Development Specialist, Environmental Sciences

Education:

B.S. Biology, Millersville University (1987)

Professional Experience:

With Lancaster Laboratories, Inc. since 1985
Business Development Specialist (1994)

Bob Brown, Chemist, ExpressLAB, Environmental Sciences

Education:

Attended 2.5 years at Penn State University
Currently pursuing B.S. in Environmental Biology, Millersville University

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist (1993)

Jean Brown, Technical Specialist, Food Chemistry, Food & Pharmaceutical Sciences

Education:

Attended 2.5 years at College of Mt. St. Vincent and Penn State University

Continuing Education:

Gas Chromatography - Practical Theory and Application at LLI (1992)
HP5890 GC Troubleshooting Course (1993)
Restek Capillary Chromatography (1993)

Hitachi Maintenance (1993)

Professional Experience:

RCA Corp., Technician (1966 - 1969)
General Cigar Corp., Technician (1972 - 1984)
Helme Tobacco, Senior Technician (1984 - 1989)
With Lancaster Laboratories, Inc. since 1989
Technical Specialist (1992)

Publications:

AOAC poster presentation: Gas Chromatographic Analysis of Sugars in Foods as Trimethylsilyl Derivatives (1993)

Awards and Citations:

Scientific Achievement Award, Lancaster Laboratories, Inc. (1993)

Mary Ann Brubaker, M.S., Group Leader, Data Package, Environmental Sciences

Education:

B.S. Chemistry, Marywood College (1971)
M.S. Chemistry, Xavier University (1973)

Continuing Education:

8 Graduate Credits in Polymeric and Inorganic Chemistry, University of Delaware (1975)

Professional Experience:

Armstrong World Industries R&D Center, Scientist (1976 - 1991)
With Lancaster Laboratories, Inc. since 1991

Publications:

One publication on inorganic chemistry

Awards and Citations:

Granted U.S. Patent No. 4,595,626 "Conformable Tile" June 17, 1986

Richard Burke, M.S., Director, Business Development & Client Services

Education:

B.S. Chemistry, LeMoyne College (1969)
M.S. Chemistry, State University of New York - College of Environmental Science and Forestry (1978)

Continuing Education

Quality Management College, Philip Crosby Associates (1989)
Marketing Professional Analytical Services, ACIL (1990)
Client Satisfaction Measurement, American Management Associates (1993)

Professional Experience:

Donohue & Associates, Laboratory Project Manager (1978 - 1979)
Camp Dresser & McKee, Inc., Laboratory Services Manager (1979 - 1981)
Kemron Environmental Sciences, Field Services Manager (1981)
IT Corp., Laboratory Manager (1982 - 1987)
IT Corp., Regional Lab Director (1987 - 1988)
With Lancaster Laboratories, Inc. since 1988

Publications:

One publication on environmental chemistry

Memberships:

Air & Waste Management Association
American Chemical Society
American Society of Testing and Materials
PA Chamber of Commerce, Environmental Affairs Committee
Society of American Military Engineers
Water Environment Federation

Glenn Cahilly, Ph.D., Business Development Specialist, New York/New England Region

Education:

B.S., Rutgers University (1958)
M.S., Virginia Polytechnic Institute (1961)
Ph.D. Biochemistry and Nutrition, Virginia Polytechnic Institute (1964)

Continuing Education:

Bioengineering Protein Separating Techniques, Cornell University (1969)
Autoanalyzer Techniques, Technicon Corp. (1970)
Professional Selling Skills, Xerox Corp. (1978)
Marketing Management, R. B. Harris Corp. (1978)
Quality Management College, Philip Crosby Associates (1989)

Professional Experience:

U.S. Department H.E.W., British West Indies, Analytical Biochemist (1961)
Vineland Training School, Research Biochemist (1963 - 1964)
Worthington Biochemical Corp., Technical Director (1964 - 1965)
W. R. Grace & Co., Biochemistry Research Department, Manager (1966 - 1969)
Biozyme Medical Laboratories, Inc., Founder and President (1969 - 1979)
MDS Health Group, Ltd., Vice President (1977 - 1982)
Lancaster Laboratories, Inc., Vice President (1988 - 1989)
Lancaster Laboratories, Inc., Executive Vice President (1989 - 1991)
Atlantic Testing Laboratories, Ltd., Environmental Laboratory Division, Manager (1991 - 1992)
With Lancaster Laboratories, Inc. since 1993

Publications:

Various scientific papers covering topics in nutrition, biochemistry, and clinical medicine.
One U.S. patent.

Awards, Citations, and Honorary Societies:

Sigma Xi
Phi Lambda Upsilon
Phi Sigma
ACIL's President's Award (1990)

Memberships:

Agricultural Research Institute
Allegany County, New York, Cooperative Extension
Animal Nutrition Research Council
American Chemical Society
American Clinical Laboratory Association
American Council of Independent Laboratories
American Institute of Chemists
American Management Associates
Central Vermont Chamber of Commerce
League of Vermont Writers
New York Academy of Science
New York State Christmas Tree Grower's Association
Olean, New York, Chamber of Commerce
Our Earth Peace Assembly, Inc.
Pennsylvania Chapter of AMT and ASMT
Pennsylvania Institute of Chemists
Pennsylvanians for Effective Government
Parish Resource Center, Inc., Board
Peacework Alternatives, Inc.
Virginia Polytechnic Institute and Rutgers Alumni Associations

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Craig Carlough, B.A., Microbiologist, Pharmaceutical Sciences, Food & Pharmaceutical Sciences

Education:

A.A. Liberal Studies, Union County College (1988)
B.A. Biological Sciences, University of Delaware (1992)

Professional Experience:

Alloy Surfaces, Quality Control Technician (1990 - 1991)
University of Delaware, Laboratory Technician (1992)
Du Pont/Merck Pharmaceuticals Co., Microbiology Laboratory Technician and Associate Scientist (1992 - 1993)
With Lancaster Laboratories, Inc. since 1993

Memberships:

American Society for Microbiology

Brett Chronister, B.S., Industrial Hygienist, Air Quality

Education:

B.S. Occupational Safety and Industrial Hygiene Management, Millersville University of Pennsylvania (1991)

Continuing Education:

EPA-Certified AHERA Building Inspector, Center for Environmental and Occupational Training (1992)
EPA-Certified Asbestos Contractor/Supervisor, Lancaster Laboratories, Inc. (1992)
Assessing Bioaerosols in Indoor Environments (1992)
Process Safety Workshop, Millersville University (1993)
Indoor Air Quality (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1991
Industrial Hygienist (1992)

Memberships:

Central PA Chapter of the American Industrial Hygiene Association
Central PA Chapter of the American Society of Safety Engineers

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Mark Clark, B.S., Chemist, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Biochemistry, Millersville University of Pennsylvania (1986)

Continuing Education:

Gas Chromatography, Chromatography Forum of the Delaware Valley (1991)
HP5890 GC Troubleshooting Course, Hewlett-Packard (1993)
Hitachi HPLC Maintenance Course (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1985
Chemist (1990)

Brian R. Clow, B.S., Chemist/Coordinator, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry (ACS Accredited), Colorado State University (1988)

Continuing Education:

Chemistry of Hazardous Materials in Soils, Graduate Studies, University of Colorado (1990)
Advanced Organic Chemistry, Graduate Studies, University of Colorado (1990)
HP1050 Maintenance, Hewlett-Packard (1992)
Issues in HPLC Quantitation, Hewlett-Packard (1993)
Troubleshooting UV Detectors, Hewlett-Packard (1993
Advanced Relational Database Design, Technology Mentors, Inc. (1993)
Currently pursuing M.S. in Quality Assurance/Regulatory Affairs, Temple University

Professional Experience:

Colorado State University Department of Chemistry, Teaching Assistant (1988)
Cord Laboratories/Geneva Generics, Junior Chemist (1989)

Woodward-Clyde Federal Services, Staff Chemist (1989 - 1991)
With Lancaster Laboratories, Inc. since 1991
Coordinator (1993)

Memberships:

American Chemical Society

Harolyn Clow, B.S., Microbiologist/Coordinator, Pharmaceutical Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Microbiology, Colorado State University (1986)

Certifications:

Registered Microbiologist in Consumer Products and Quality Assurance Microbiology, National Registry of Microbiologists of the American Academy of Microbiology

Continuing Education:

Laboratory Identification of Gram Positive Bacteria, Colorado Association for Continuing Medical Laboratory Education (1989)
Enterobacteriaceae, Colorado Association for Continuing Medical Laboratory Education (1990)
Laboratory Management: Quality Assurance/Quality Control, Colorado Association for Continuing Medical Laboratory Education (1990)
Current Issues in the Pharmaceutical Microbiology Laboratory Seminar/Workshop, Applied Analytical Industries, Inc. (1992)
MIDI Microbial Identification System Training (1993)
HP5890 GC Troubleshooting and Maintenance, Hewlett-Packard (1993)
Introduction to Capillary GC, Hewlett-Packard (1993)
Currently enrolled in Master's program in Quality Assurance and Regulatory Affairs at Temple University

Professional Experience:

Benedict Nuclear Pharmaceuticals, Inc., Supervisor of Quality Control (1987 - 1990)
Cell Technology, Inc., Quality Assurance/Quality Control Analyst (1990 - 1991)
With Lancaster Laboratories, Inc. since 1991
Coordinator (1993)

Memberships:

American Society for Microbiology
National Registry of Microbiologists
Parenteral Drug Association, Training Committee

Judy Colello, B.S., Group Leader, Organic Analysis by GC & Organic Analysis Group, Environmental Sciences

Education:

A.S. Applied Science Medical Technology, Manor Junior College (1982)
B.S. Business Administration, Millersville University (1992)

Continuing Education:

Assertiveness Training, Lancaster YWCA (1987)
Managing Multiple Priorities, Dun and Bradstreet (1988)
Geraghty and Miller, Fundamentals of Groundwater Contamination (1990 - 1991)
Hazardous Materials & Environmental Management, Industrial Hygiene for the Non-Industrial Hygienist (1992)
Master of Management Degree Candidate, Penn State University, Graduating July 1994
Industrial Hygiene for the Non-Industrial Hygienist, HazMat (1993)

Professional Experience:

Lancaster Community Hospital, Laboratory Technician (1982 - 1984)
Struthers Medical Arts Clinic, Laboratory Supervisor (1984 - 1985)
With Lancaster Laboratories, Inc. since 1985
Group Leader (1990)

Presentations:

One paper in management

Biographical Listings:

Who's Who in American Junior Colleges

Memberships:

Chromatography Forum of Delaware Valley
Registered MLT with American Society of Clinical Pathologists

Awards and Citations:

Spirit of LLI Award (1991)
Magna cum laude, Millersville University (1992)

Paul Cormier, B.A., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Microbiology, Virginia Tech (1984)
B.A. Chemistry, Virginia Tech (1984)

Continuing Education:

Hewlett Packard GC/MS Advance Operations/System Manager Course (1990)
Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experiences:

Environmental Testing & Certification (1985 - 1989)
Analytikem, Inc. (1989 - 1990)
With Lancaster Laboratories, Inc. since 1990

Memberships:

American Chemical Society

Michelle Crawford, B.S., Client Services Specialist, Environmental Sciences

Education:

B.S. Food Science, Penn State University (1988)

Continuing Education:

M.B.A. coursework (36 credits), Penn State University

Professional Experience:

RJR-Nabisco, Corporate Quality Assurance Intern (1987)
Penn State University, Food Microbiology Laboratory Technician (1987 - 1988)
John Cope's Food Products, Quality Assurance Manager (1988 - 1993)
With Lancaster Laboratories, Inc. since 1993

Publications:

One article on Total Quality Management

Memberships:

American Society for Quality Control (ASQC)
Institute of Food Technologists

Susan Croyle, B.S., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Juniata College (1988)

Continuing Education:

Advanced Aquarius Report Training, Hewlett Packard (1989)
How to Handle People with Tact and Skill, Harrisburg Area Community College (1992)
Positive Attitude and Peak Performance, Harrisburg Area Community College (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist (1990)

Memberships:

American Chemical Society

Eric Cuba, B.S., Chemist/Coordinator, ICP Metals, Environmental Sciences

Education:

B.S. Chemistry, King's College (1985)

Continuing Education:

Inductively Coupled Plasma & Thermo Spec Software Training Course, Thermo Jarrell Ash (1991)

Ward Environmental Data Reporting (EDR) System Seminar, Ward Scientific, Ltd. (1991)
Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Chemist/Coordinator (1991)

Memberships:

Society for Applied Spectroscopy, Reading, PA, Chapter

Earl Custer, B.S., Microbiologist/Coordinator, Environmental Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Biology, University of Pittsburgh (1969)

Professional Experience:

With Lancaster Laboratories, Inc. since 1973
Microbiologist/Coordinator (1989)

Joseph Davis, B.S., Chemist/Coordinator, ExpressLAB, Environmental Sciences

Education:

B.S. Biology, Millersville University (1986)

Continuing Education:

Discrete Structures I (PASCAL), Millersville University (1992)
Introduction to Computing I (PASCAL), Millersville University (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Chemist/Coordinator (1992)

Kathy DiNunzio, B.S., Quality Assurance Specialist

Education:

B.S. Business Administration (minor in Chemistry), Elizabethtown College (1989)

Continuing Education:

Environmental Law and Policy (1991)
Applied Statistics, Penn State University (1991)
IAETL - Regulatory Process and Technical Aspects of the Environmental Laboratory (1991)
Gas Chromatography: Practical Theory and Applications for LLI (1992)
SQA Training Course for GLP Regulations and Compliance (1993)
Quality Assurance in Environmental Monitoring (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1990
Quality Assurance Specialist (1992)

Patricia Downing, B.S., Business Development, Environmental Sciences

Education:

B.S. Chemistry, Spring Garden College (1982)

Continuing Education:

Sales Consultants, Sales Training (1989)
PAR Associates, Sales Training (1989)
How to Market Professional Services, ACIL Educational Seminars (1990)

Professional Experience:

Rollins Environmental Services, Inc., Chemist (1982 - 1986)
Century Labs, Client Services (1986 - 1988)
York Laboratories, Account Executive (1988 - 1990)
With Lancaster Laboratories, Inc. since 1990
Business Development (1991)

Charles Ducker, B.S., Microbiologist, Food Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Biology (cum laude), Millersville University (1992)
B.A. Philosophy, Millersville University (1992)

Professional Experience:

Hershey Foods, Laboratory Technician (1986 - 1989)
Dr. Wilson Miller, D.V.M., Microbiologist (1989 - 1991)
With Lancaster Laboratories, Inc. since 1992

Publications:

One publication on cell biology

Awards, Citations, and Honorary Societies:

Neimyer-Hodgson Research Grant (1991)
Nooran Endowment Grant (1991)

Memberships:

American Society for Cell Biology

Bethany Ann Ebling, B.S., Group Leader, Water Quality, Environmental Sciences

Education:

B.S. International Agriculture, Purdue University (1981)

Continuing Education:

Chrompack Inc. Basic HPLC course (1987)
Fundamentals of Groundwater Contamination, Geraghty & Miller, Inc. (1990)
Applied Statistics, Penn State Continuing Education (1990)
Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

Purdue University, Laboratory Technician (1981 - 1982)
Princeton University, Laboratory Technician (1983 - 1985)
Carnegie Mellon University, Environmental Engineering Laboratory Manager (1986 - 1988)
Extrel Corporation, QA/QC Specialist (1988 - 1989)
With Lancaster Laboratories, Inc. since 1989
Group Leader (1990)

Memberships:

American Chemical Society
Association of Official Analytical Chemists

Travis Emig, B.S., Pharmaceutical Chemistry, Food & Pharmaceutical Chemistry

Education:

B.S. Chemistry, Lebanon Valley College (1992)

Continuing Education:

Introduction to Capillary GC, Hewlett-Packard (1992)
Gas Chromatography, Inlets and Injection Ports, Restek (1992)
HP5890 GC Maintenance and Troubleshooting, Hewlett-Packard (1993)
HP1050 Repair Course, Hewlett-Packard (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1992

Richard Entz, B.A., Senior Technical Specialist, Environmental Sciences

Education:

B.A. Chemistry, Wabash College (1972)

Continuing Education:

Graduate Work in Analytical Chemistry, Kansas State University (1972 - 1977)
Basic Gas Chromatography, American Chemical Society (1978)
Advanced Gas Chromatography, American Chemical Society (1979)
Basic Liquid Chromatography, American Chemical Society (1980)
Toxicology for Chemists, American Chemical Society (1983)
Rational Decision Making, Kepner-Tregoe (1984)
Managing Multiple Priorities, Dun & Bradstreet (1987)
Procedures for Sampling and Analysis of Air Toxics, American Chemical Society (1990)
Environmental Regulations, Executive Enterprises (1991)
Advanced Methods for Monitoring Air Toxics, EPA/Air and Waste Management Association (1992)

Professional Experience:

Teaching Assistant, Kansas State University (1972 - 1974)
U.S. Department of Agriculture, Research Assistant (1974 - 1977)
U.S. Food and Drug Administration, Division of Chemical Technology, Chemist (1977 - 1984)
With Lancaster Laboratories, Inc. since 1984
Senior Technical Specialist (1991)

Publications:

Four publications in areas of environmental analytical chemistry and volatile organic compounds.

Awards and Citations:

Undergraduate Chemistry Award, Wabash College (1972)
Phillips Petroleum Research Award (1976)
Phi Lambda Upsilon

Memberships:

Air and Waste Management Association
American Chemical Society

Phillip Esbenshade, Ph.D., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Biology, Pennsylvania State University (1978)
M.S. Plant Pathology, North Carolina State University (1980)
Ph.D. Plant Pathology, North Carolina State University (1986)

Professional Experience:

International Meloidogyne Project, Department of Plant Pathology, North Carolina State University, Research Assistant (1980 - 1984)
Department of Genetics, North Carolina State University, Research Assistant (1985 - 1989)
With Lancaster Laboratories, Inc. since 1989
Chemist (1991)

Publications:

9 scientific publications on plant pathology, genetics, and nematology

Awards and Citations:

Phi Kappa Phi
Gamma Sigma Delta
Best Student Paper, Society of Nematologists (1984)
Sigmi Xi

Memberships:

American Phytopathological Society, Committee on Nematology
Society of Nematologists

David Evans, B.S., Chemist/Coordinator, Instrumental Water Quality, Environmental Sciences

Education:

B.S. Chemistry, Millersville University (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist/Coordinator (1991)

Jack Follweiler, B.S., Chemist, Project Work, Food & Pharmaceutical Sciences

Education:

B.S. Analytical Chemistry, Juniata College (1982)

Continuing Education:

Industrial Hygiene Refresher Course (1985)
Asbestos in Buildings - A Symposium, U.S. EPA
Asbestos Hazards, Evaluation and Abatement, U.S. EPA (1986)
Advanced Asbestos Identification, McCrone Research Institute (1986)
Symposium on Indoor Air, U.S. EPA (1986)
AHERA Building Inspector, U.S. EPA (1987)
Quality Management College, Philip Crosby Associates (1989)
Project Design I, National Asbestos Council Professional Development Seminar (1990)
Environmental Assessments, National Asbestos Council Professional Development Seminar (1990)
Asbestos Contractor/Supervisor Annual Refresher, U.S. EPA (1987, 1988, 1989, 1990, 1991)
AHERA Building Inspector Annual Refresher, U.S. EPA (1988, 1989, 1990, 1991)
AHERA Management Planner, U.S. EPA (1991)
AHERA Project Designer, U.S. EPA (1991)
PA-DOLI Management Planner (1991, 1992, 1993)
PA-DOLI Project Designer (1991, 1992, 1993)
Project Management/Cost Estimating II, Pennsylvania State University (1991)
AHERA Project Designer Annual Refresher, U.S. EPA (1992, 1993)
A Practical Approach to Reverse-Phased HPLC Method Development, Macmod Analytical (1993)

Professional Experience:

ICI Americas, Inc., Analytical Chemist/Industrial Hygienist (1982 - 1985)
With Lancaster Laboratories, Inc. since 1985

Memberships and Appointments:

Central Pennsylvania Section - American Industrial Hygiene Association (CPS-AIHA), Co-Director, Professional Development (1987 - 1988)
EPA Technical Consultant for air sampling and analytical methodologies (EPA Region III)
PLM/PCM Subcommittee of the Sampling and Analytical Committee of the National Asbestos Council
Asbestos Subcommittee of the Environmental Section of the American Council of Independent Laboratories, Inc.
Pennsylvania Chapter of the National Asbestos Council (PAC-NAC)
National Asbestos Council (NAC)

National Institute of Building Science (NIBS) Asbestos O&M Work Practices Committee (1991 - 1993)
Lead-Based Paint Work Practices Committee (1993)
Pennsylvania Chamber of Business and Industry Asbestos Certification Work Group

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Jane Follweiler, B.S. Chemist/Coordinator, ICP Metals, Environmental Sciences

Education:

B.S. Biology, Juniata College (1982)

Continuing Education:

Society for Applied Spectroscopy Short Course: "Plasma Spectrochemical Analysis" (1990)
Inductively Coupled Plasma & Thermo Spec Software Training Course, Thermo Jarrell Ash (1991)
Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

John Hopkins University (1982 - 1983)
University of Medicine and Dentistry of New Jersey (1983 - 1985)
M. S. Hershey Medical Center of Penn State University (1985 - 1990)
With Lancaster Laboratories, Inc. since 1990
Coordinator (1991)

Publications:

Two publications on applied biology

Memberships:

Society for Applied Spectroscopy

Greg France, B.A., Chemist, Pesticide Residue Analysis, Environmental Sciences

Education:

B.A. Chemistry, Holy Cross College (1988)

Continuing Education:

The Practice of Modern HPLC (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist (1991)

Erik Frederiksen, B.A., Chemist/Coordinator, Water Quality, Environmental Sciences

Education:

B.A. Chemistry, University of Virginia (1990)

Continuing Education:

Infrared Spectral Interpretation (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1990
Chemist/Coordinator (1993)

Joseph Friel, B.S., Chemist, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, PMC, Widener University (1964)
20 graduate credits, Chemistry, State University of New York (1966 - 1971)

Professional Experience:

Ayerst Laboratories, ascending positions in all phases of quality control laboratory testing (1964 - 1982)
Ayerst Laboratories, Manager, Estrogen Labs (1982 - 1986)
Scott Paper Company, Chemical Services Technician (1986 - 1987)
With Lancaster Laboratories, Inc. since 1987

Memberships:

Chromatography Forum of Delaware Valley

Kelly Gamble, B.S., Chemist, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, Shepherd College (1987)

Continuing Education:

Three graduate courses, Salisbury State (1987 - 1988)
AA Course, Perkin Elmer (1989)
Basic Atomic Absorption Spectroscopy, Varian (1992)
Capillary Chromatography, Restek (1993)
Leaks and Clogs, Hewlett-Packard (1993)
Peak Purity on HPLC Diode Array, Hewlett-Packard (1993)
Identification and Quantitation in HPLC Diode Array, Hewlett-Packard (1993)

Professional Experience:

Gascoyne Laboratories (1988 - 1990)
With Lancaster Laboratories, Inc. since 1990
Chemist (1993)

Gloria Gates, B.S., Group Leader, Project Work, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, Bloomsburg State College (1983)

Continuing Education:

Maintaining and Troubleshooting Chromatographic Systems Workshop, ACS Short Course (1986)
Wide Bore GC Course, Chrompack Inc. (1988)
Capillary GC Course, J & W Scientific (1989)

Professional Experience:

Berkley Products, Analyst (1983)
Warner-Lambert, Parke Davis, Associate Chemist (1984 - 1985)
With Lancaster Laboratories, Inc. since 1985
Group Leader (1991)

Publications:

One publication on food chemistry

Memberships:

American Oil Chemists Society
Association of Official Analytical Chemists
Delaware Valley Chromatography Forum

Awards and Citations:

Spirit of LLI Award (1992)

Suzanne Gebhart, B.S., Microbiologist, Pharmaceutical Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Pennsylvania State University (1987)

Continuing Education:

Currently enrolled in Master's Program for Quality Assurance/Regulatory Affairs at Temple University
Testing Particulate Matter in Injections Using HIAC/Royco 8003 Equipment, HIAC/Royco (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Microbiologist (1993)

Memberships:

Parenteral Drug Association

Debora Gifford, B.S., Group Leader, AAS Metals, Environmental Sciences

Education:

B.S. Health and Physical Education, Ursinus College (1977)

Continuing Education:

General, Organic, and Analytical Chemistry Courses, Muhlenberg College (1979 - 1981)
Calculus I and II, Villanova University (1983)
Physics I and II, Ursinus College (1985)

Professional Experience:

Eastern PA Health Care Foundation, Special Projects Coordinator (1978 - 1981)
BCM Lab, Technical Supervisor (Instrumentation) (1981 - 1985)
With Lancaster Laboratories, Inc. since 1985
Group Leader (1989)

Memberships:

American Chemical Society
Society for Applied Spectroscopy

C. Robert Graham, B.S., Senior Microbiologist, Food Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Dairy Science, Pennsylvania State University (1963)

Professional Experience:

With Lancaster Laboratories, Inc. since 1964
Senior Microbiologist (1985)

Publications:

Two papers on microbiology

Memberships and Appointments:

American Association of Candy Technologists (Philadelphia Section, Chairman)
American Society for Testing and Materials
AOAC Committee on Microbiology and Extraneous Materials
Approved Dairy Inspector, Pennsylvania Department of Agriculture
Associate Referee of AOAC for Extraneous Filth in Chocolate & Chocolate Products
Pennsylvania Dairy Laboratory Directors Association
Pennsylvania Manufacturing Confectioners Association (Program Committee)
Pennsylvania Manufacturing Confectioners Association (Board of Directors)

Doug Graham, Chemist, AAS Metals, Environmental Sciences

Education:

Pursuing B.S. in chemistry, Millersville University

Professional Experience:

With Lancaster Laboratories, Inc. since 1985
Chemist (1993)

Memberships:

Society for Applied Spectroscopy

Rick Griffith, Business Development, Environmental Sciences

Education:

Assoc. Electronics, DeVry Technical Institute (1980)

Continuing Education:

Supervisory Management Certification, Franklin & Marshall College (1983)
How to Market Professional Services, ACIL (1990)

Professional Experience:

RCA, Production Supervisor (1980 - 1986)
B+B Communications, Sales Representative (1987 - 1988)
With Lancaster Laboratories, Inc. since 1988
Business Development (1991)

Memberships:

Society of American Military Engineers

Kathy Hallquist, Client Services Specialist, Environmental Sciences

Education:

Onondaga Community College
Community General Hospital Pharmacy Technician Certification Program (1976)

Continuing Education:

Pharmacology - Study of Drugs and Their Effects (1978)

Professional Experience:

Community General Hospital, Pharmacy Technician IV (1976 - 1980)
Evanston Hospital, Senior Technician IV (1980 - 1981)
Hazelton Environmental, Chemistry Lab Technician (1981)
Hazelton Laboratories of America, Sample Administrator of Radioimmunoassay Dept. (1981 - 1983)
St. Joseph's Hospital, Pharmacy Technician IV (1983 - 1985)
With Lancaster Laboratories, Inc. since 1985
Client Services Specialist (1989)

Lynn Hebner, B.S., Client Services Specialist, Environmental Sciences

Education:

B.S. Conservation and Resource Development, University of Maryland (1981)

Professional Experience:

University of Missouri, Senior Research Lab Technician (1982 - 1984)
GPU Nuclear Corporation, Data Analyst (1985 - 1989)
With Lancaster Laboratories, Inc. since 1989

Mark Heinbaugh, B.A., Chemist/Coordinator, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, Shippensburg State College (1979)

Professional Experience:

Warner Lambert Company, Senior Analyst/Laboratory Supervisor (1980 - 1989)
With Lancaster Laboratories, Inc. since 1989

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

Tammy Heinbaugh, B.S., Chemist, Project Work, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Albright College (1980)

Continuing Education:

Graduate Courses in Anatomy at Temple University (1981)
Basic HPLC Course, Chromatography Forum of Delaware Valley (1985)
Maintaining and Troubleshooting Chromatographic Systems - ACS Short Course (1986)
Advanced HPLC Course, Chrompack Inc. (1988)
Basic Capillary GC Course, Chrompack Inc. (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1984
Chemist (1986)

Robert Heisey, Jr., B.A., Chemist/Coordinator, Water Quality, Environmental Sciences

Education:

B.A. Chemistry, Millersville State College (1972)

Professional Experience:

RCA Corp., Engineering Technician (1972 - 1987)
With Lancaster Laboratories, Inc. since 1988
Chemist/Coordinator (1989)

Jenifer Hess, B.S., Group Leader, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, University of Delaware (1984)

Continuing Education:

Currently enrolled in M.B.A. program, University of Delaware (21 credits)

Professional Experience:

J. M. Huber Corporation, Research Chemist (1984 - 1985)
With Lancaster Laboratories, Inc. since 1985
Chemist/Coordinator (1990)
Group Leader (1992)

Memberships:

American Chemical Society

M. Louise Hess, B.S., Director, Quality Assurance

Education:

B.S. Chemistry (cum laude), Lebanon Valley College (1978)

Continuing Education:

Several short courses in atomic absorption and gas chromatography
Quality Assurance of Chemical Measurements, ACS (1985)
Quality Assurance in Microbiology, AOAC (1985)
Villanova University graduate work in analytical chemistry (1986)
Quality Management College, Philip Crosby Associates (1989)
Quality Education System Instructor Training, Philip Crosby Associates (1989)
Quality Work Group Instructor Training, Philip Crosby Associates (1989)
Society of Quality Assurance Conference (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1978
Director, Quality Assurance (1985)

Publications:

Two scientific papers on basic research in physical chemistry
One publication on computer validation
Two publications on laboratory quality

Memberships:

Lancaster Quality Council
Chair, Quality Awards Committee (1993)
Society of Quality Assurance

Joseph Hill, B.S., Chemist/Coordinator, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Biology (magna cum laude), Fairleigh Dickinson University (1982)

Continuing Education:

Superincos Operation, Finnigan MAT Institute (1987)
Mass Spectral Interpretation Course, ACS Course (1988)
Mass Spectral Interpretation, Finnegan MAT Institute (1991)

Professional Experience:

ICI Americas, Inc., Senior Research Technician (1982 - 1984)
National Foam Inc., Senior Research Technician (1985 - 1986)
Roy F. Weston, Inc., Associate Project Scientist (1986 - 1989)
With Lancaster Laboratories, Inc. since 1989
Chemist (1990)

Memberships:

American Chemical Society

Michael Hintenach, B.S., Computer Integration Specialist, ICP Metals, Environmental Sciences

Education:

B.S. Chemistry, Lebanon Valley College (1988)

Continuing Education:

Computer Organization & Design, Villanova (1989)
DECUS Symposium, RSX System Management (1989)
Object Oriented Technology & C++ (1991)
Object Oriented Software Engineering with C++, Lehigh University (1992)
Relational Databases for Programmers (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Computer Integration Specialist (1991)

Memberships:

DECUS

Kathleen Holley, B.S., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Biology/Chemistry, Beaver College (1987)

Continuing Education:

Mass Spectral Interpretation Course, Finnigan MAT Institute (1991)

Professional Experience:

E. I. Du Pont Experimental Station, Analytical Chemist (1987 - 1988)
Roy F. Weston, Inc., Assistant Project Scientist (1988 - 1989)
With Lancaster Laboratories, Inc. since 1989

Catherine Holt, B.S., Computer Specialist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.A. Mathematics, Franklin & Marshall College (1984)
B.S. Computer Science, Millersville University (1987)

Continuing Education:

Novell Network Seminar (1989)
Clarion Database Management Seminar (1991)

Professional Experience:

R.R. Donnelley & Sons Company (1985 - 1987)
Shared Medical Systems (1987 - 1989)
With Lancaster Laboratories, Inc. since 1989

David Hooley, Ph.D., Group Leader, Computer Services

Education:

B.A. Chemistry, Eastern Mennonite College (1973)
Ph.D. Chemistry, Virginia Polytechnic Institute (1981)

Continuing Education:

Effective Management of Chemical Analysis Laboratories (1984)
Masscomp MC5500 Hardware Maintenance (1986)
Attended numerous conferences on analytical chemistry, scientific computing and laboratory information management

Professional Experience:

WVPT-TV, Harrisonburg, VA, Operating Engineer (1972 - 1974)
Virginia Polytechnic Institute, Research Assistant (1974 - 1981)
Standard Oil Research & Development (1981 - 1987)
With Lancaster Laboratories, Inc. since 1987
Group Leader (1991)

Publications and Presentations:

Five scientific publications in computer applications in analytical chemistry
Two presentations in computer applications in analytical chemistry

Memberships:

American Chemical Society
Forth Interest Group
Phi Lambda Upsilon

David Hoppman, Technical Specialist, GC/MS Volatiles, Environmental Sciences

Professional Experience:

Textile Machine Works, Laboratory Technician (1960 - 1970)
Fuller Co., Laboratory Supervisor (1970 - 1973)
With Lancaster Laboratories, Inc. since 1980
Technical Specialist (1990)

Eileen Hostetler, B.S., Client Services Specialist, Environmental Sciences

Education:

B.S. Biology (magna cum laude), Millersville University (1987)

Professional Experience:

Lancaster Magnetic Imaging, MRI Technologist (1991 - 1992)
With Lancaster Laboratories, Inc. since 1992

Samuel Huber, B.S., Group Leader, Instrumental Water Quality, Environmental Sciences

Education:

B.S. Biology, Lebanon Valley College (1988)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist/Coordinator (1991)
Group Leader (1993)

Anneliese Hutchison, M.B.A., Group Leader, Sample Administration

Education:

B.S. Molecular and Cell Biology, Pennsylvania State University (1986)
M.B.A., Pennsylvania State University (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Group Leader (1992)

Jeannie Jacobson, B.S., Client Services Specialist, Pharmaceutical Sciences

Education:

B.S. Biology (cum laude), Lambuth College (1986)

Continuing Education:

Limulus Amebocyte Lysate Testing Workshop (1988)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Client Services Specialist (1990)

Biographical Listings:

Who's Who in American Colleges & Universities

Carol Johnson, B.A., Chemist/Coordinator, Foods Inorganic Analysis, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, Macalester College (1971)

Continuing Education:

Department of Community Affairs - NPDES Laboratory Procedures, Water Pollution Control Association of Central PA (1982)
Laboratory Safety Course, National Safety Council (1988)
Basic and Intermediate Courses, American Association of Feed Microscopy (1988 and 1990)
How to Comply with the OSHA Lab Standard, PA Chamber of Business & Industry (1990)
OSHA Lab Standard and Right-to-Know, Pathfinder Associates (1991)

Professional Experience:

Worcester Foundation for Experimental Biology (1971 - 1979)
Interlab New England (1979 - 1980)
William E. Sacra & Associates (1981 - 1982)
Pennfield Corp. (1982 - 1992)
With Lancaster Laboratories, Inc. since 1992
Coordinator (1993)

Beatrice Joseph, B.S., Chemist, AAS Metals, Environmental Sciences

Education:

B.S. Chemistry, College of Pharmacy and Chemistry, Iraq (1953)

Continuing Education:

Atomic Absorption Spectrometry

Professional Experience:

St. Joseph's Hospital, Research Institute, Laboratory Technician (1969 - 1976)

With Lancaster Laboratories, Inc. since 1976
Chemist (1977)

Mark Kaiser, Group Leader, Pharmaceutical and Environmental Microbiology, Food & Pharmaceutical Sciences

Education:

Elizabethtown College, Biology 120 credits (1983)

Continuing Education:

Fundamentals of D, Z, and F Valves, Parenteral Drug Association (1989)
Viable and Nonviable Environmental Monitoring, Parenteral Drug Association (1990)
Validation in the Pharmaceutical Microbiology Laboratory, Applied Analytical Laboratories (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1983
Group Leader (1986)

Memberships:

LAL User's Group
Parenteral Drug Association, Delaware Valley Chapter, Chair Operating Committee
Parenteral Drug Association, Microbiological Subcommittee

Jon Kauffman, Ph.D., Group Leader, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Millersville University (1985)
Ph.D. Chemistry, University of Delaware (1989)

Continuing Education:

Basic Mass Spectral Interpretation, Finnigan MAT Institute (1990)
Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

Chemistry Department, University of Delaware, Teaching Assistant Honors Chemistry (1985 - 1987)
Chemistry Department, University of Delaware, Nuclear Magnetic Resonance Graduate Assistant (1987 - 1988)
Center for Catalytic Science and Technology, University of Delaware, Research Assistant (1988 - 1989)
With Lancaster Laboratories, Inc. since 1989
Group Leader (1991)
Chemistry Department, Millersville University, Adjunct Professor since 1992

Publications:

Four publications on solid-state NMR spectroscopy

Katherine Klinefelter, M.S., Client Services Specialist, Environmental Sciences

Education:

B.S. Chemistry, Rutgers University (1983)
M.S. Physiology, Rutgers University (1985)

Continuing Education:

Additional graduate work in Physiology, Rutgers University (1985 - 1989)

Professional Experience:

Rutgers University, Research and Teaching Assistant (1984 - 1989)
M. S. Hershey Medical Center of Penn State University, Senior Research Technician (1990 - 1993)
With Lancaster Laboratories, Inc. since 1993

Publications:

Ten abstracts and three scientific papers on membrane transport physiology
Four presentations on membrane transport physiology

Awards, Citations, and Honorary Societies:

Dean's Graduate Student Dissertation Research Award, Rutgers University
Dean's Graduate Student Travel Award, Rutgers University
Steinetz Memorial Fund Award, Department of Biological Sciences, Rutgers University

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Timothy Klock, B.S., Chemist, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Medicinal Chemistry, State University of New York at Buffalo (1990)

Continuing Education:

A Practical Approach to Reverse-Phase HPLC Method Development, Macmod (1993)
USPOVI, Chromatography Forum of Delaware Valley (1993)
HP5890 Maintenance and Troubleshooting, Hewlett-Packard (1993)

Professional Experience:

Fujisawa USA, Associate Scientist, Quality Control Department (1990 - 1992)
With Lancaster Laboratories, Inc. since 1992
Chemist (1993)

Memberships:

American Chemical Society

Rachel Kreamer, B.S., Client Services Specialist, Environmental Sciences

Education:

B.S. Biology, Eastern Mennonite College (1980)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Client Services Specialist (1990)

Gregory D. Kupp, B.S., Chemist, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Minor Chemistry, College Misericordia (1989)

Continuing Education:

Developing LC Separations Short Course, Waters Associates (1990)
Introduction to Capillary GC, Hewlett Packard Short Course (1991)
Method Validation Utilizing a Diode Array, PittCon Short Course (1992)
GC Headspace Analysis, PittCon Short Course (1992)
Current Good Manufacturing Practices, Temple University (1993)
HP5890 GC Troubleshooting and Maintenance Course, Hewlett-Packard (1993)
HP1050 Repair Course, Hewlett-Packard (1993)

Professional Experience:

Hercon Laboratories, Inc., Research Associate, Analytical Chemistry Department (1990 - 1992)
With Lancaster Laboratories, Inc. since 1992

James Kushubar, Chemist, Food Chemistry, Food & Pharmaceutical Sciences

Education:

Chemistry Courses, Millersville University

Continuing Education:

Tutorial in Method Development and Analysis of Metals by Graphite Furnace, AAS, and ICP

Professional Experience:

Lancaster Laboratories, Inc. (1979 - 1985)
General Engineering Labs (1985 - 1986)
With Lancaster Laboratories since 1986
Chemist (1990)

Robert Large, B.S., Business Development, Environmental and Pharmaceutical Sciences

Education:

B.S. Zoology, Pennsylvania State University (1973)

Continuing Education:

Chromatography/Mass Spectral Interpretation, Finnigan MAT Institute (1981)
Foundations of Management, Gilbert Associates (1982)
M.B.A. Program, St. Joseph's University (1984 - 1987)
How to Market Professional Services, ACIL (1990)

Professional Experience:

Gilbert Associates, Inc., Program Manager (1977 - 1984)
Spotts, Stevens, & McCoy, Director of Client Services (1984 - 1990)
With Lancaster Laboratories, Inc. since 1990

John Layman, B.A., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.A. Chemistry, Millersville University (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1981
Chemist (1989)

Ramona Layman, B.S., Group Leader, ICP Metals/Leachates, Environmental Sciences

Education:

B.S. Chemistry, Grove City College (1984)

Continuing Education:

Basic Ion Chromatography, Dionex (1988)
Plasma Spectrochemical Analysis, Society for Applied Spectroscopy Short Course (1992)
Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1979
Group Leader (1989)

Denise Legall, M.S., Chemist/Coordinator, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, National Taiwan University (1955)
M.S. Chemistry, University of Houston (1959)

Professional Experience:

Schering Plough, Quality Control Manager (1963 - 1990)
With Lancaster Laboratories, Inc. since 1993

Thomas Lehman, Ph.D., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Biochemistry, Elizabethtown College (1985)
Ph.D. Chemistry, University of Delaware (1991)

Professional Experience:

Weis Center for Research, Geisinger Medical Center, Post Doctoral Scientist (1991 - 1992)
With Lancaster Laboratories, Inc. since 1992

Publications:

Three publications on biochemistry

Awards:

Joel L. Silver Memorial Symposium Award, University of Delaware (1990)

Memberships and Appointments:

American Association for the Advancement of Science
American Chemical Society
Secretary, Elizabethtown College (1983 - 1984)
Delaware Valley Enzymology Club
University of Delaware, Teaching and Fellowship Committee (1988 - 1989)

Donna Lewis, B.S., Chemist/Coordinator, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Zoology, University of Massachusetts-Amherst (1983)
B.S. Food Chemistry, Framingham State College (1984)

Continuing Education:

Basic GC Course, Chrompak (1989)

Professional Experience:

U.S. Army Natick R&D Center, Physical Engineer Technician (1977 - 1983)
Advanced Energy Dynamics, Analytical Technician (1983 - 1984)
Forsyth Dental Center, Research Assistant (1984 - 1986)
Bacon Industries, Chemist (1986 - 1988)
With Lancaster Laboratories, Inc. since 1989
Chemist (1992)
Coordinator (1993)

Publications:

One publication on medical biology

Memberships:

American Chemical Society

Kathleen Loewen, B.S., Data Package Quality Assurance Specialist/Coordinator

Education:

B.S. Biology, West Virginia Wesleyan College (1969)

Continuing Education:

Environmental Analytical Quality, Hewlett Packard (1988)
Environmental Analytical Laboratory Services, NUS (1989)
Symposium on Waste Testing and Quality Assurance, U.S. EPA (1990)
RCRA Quality Assurance Workshop, U.S. EPA (1990)
Symposium on Waste Testing and Quality Assurance, U.S. EPA (1991)
Quality Assurance Workshop, U.S. EPA (1991)
Environmental Seminar Series on SPE, GPC, and HPLC, Millipore (1992)
Symposium on Waste Testing and Quality Assurance, U.S. EPA (1992)
Conference on Quality Assurance in Environmental Monitoring (1993)
Symposium on Waste Testing and Quality Assurance, U.S. EPA (1993)

Professional Experience:

Microbiological Associates, Biological Laboratory Technician (1969 - 1970)
Schuyler Laboratories, Laboratory Technician (1970 - 1971)
Victor F. Weaver, Inc., Labeling-Specifications Supervisor/Liason with USDA (1985 - 1988)
With Lancaster Laboratories, Inc. since 1988
Coordinator (1991)

Dorothy Love, B.S., Data Review Specialist/Coordinator, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Environmental Health, Indiana University of Pennsylvania (1981)

Professional Experience:

Sun Transport, Inc., Safety Assistant (1980 - 1981)
Texas A & M University, Research Assistant (1982 - 1984)
Texas Water Commission, Chemist (1984 - 1986)
GHR Analytical, Chemist (1986 - 1987)
Clean Harbors, Inc., Senior Chemist (1987 - 1989)
With Lancaster Laboratories, Inc. since 1989

Duane Luckenbill, B.S., Chemist/Coordinator, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Chemistry, Clarion University of PA (1989)

Professional Experience:

ATEC Associates, Inc., GC/MS Analyst (1989)
With Lancaster Laboratories, Inc. since 1989
Chemist (1990)
Coordinator (1993)

Publications:

One publication on mass spectrometry

Awards:

Undergraduate Award in Analytical Chemistry, American Chemical Society (1988)
Department of Chemistry Competitive Award, Clarion University (1988 - 1989)
Outstanding Senior Chemistry Award, American Institute of Chemists Foundation (1989)
Senior College Award for Chemistry, Society for Analytical Chemists of Pittsburgh (1989)

Memberships:

American Chemical Society

Michele Mack, B.S., Chemist, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, Temple University (1990)

Continuing Education:

Gas Chromatography: Practical Theory and Applications for LLI (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1991
Chemist (1993)

John MacKay, B.S., Client Services Specialist, Food Sciences

Education:

B.S. Biochemistry, Pennsylvania State University (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1991

George Main, B.S., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S., University of Pittsburgh (1991)

Professional Experience:

Lancaster Laboratories, Inc. since 1991
Chemist (1993)

Deb Marcuson, B.A., Chemist, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Biology, Millersville University (1979)

Continuing Education:

HPLC Course, Chrompack (1990)
LECO Nitrogen Determination Training (1990)
Lipid Analysis Laboratory Course, AOCS (1993)
HP5890 GC Troubleshooting, Hewlett-Packard (1993)
Capillary Chromatography Training, Restek (1993)

Professional Experience:

Marine Science Consortium, Technician (1975 - 1976)
Ichthyological Associates, Technician (1977 - 1978)
Peace Corps, Fisheries Extension Agent (1979 - 1980)
Phillips Petroleum, Technician (1981 - 1982)
Biometrics, Technician (1983 - 1984)
With Lancaster Laboratories, Inc. since 1984
Chemist (1992)

Memberships:

American Oil Chemists Society

Michele McClarin, B.A., Group Leader, GC/MS Volatiles, Environmental Sciences

Education:

B.A. Chemistry, East Stroudsburg University (1987)

Continuing Education:

Interpretation of Mass Spectra, ASMS (1989)
Service Operations Process Optimization, Penn State University (1992)
Survey of Management, Penn State University (1992)
Organization, Design, and Development, Penn State University (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Group Leader (1991)

Awards:

American Institute of Chemists Award (1987)

Memberships:

American Chemical Society
National Association of Female Executives

Melissa McDermott, B.A., Chemist/Data Package Specialist, ExpressLAB, Environmental Sciences

Education:

B.A. Biology, Millersville University (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1992

Robert Mellinger, B.S., Chemist/Coordinator, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Chemical Engineering, Pennsylvania State University (1987)

Continuing Education:

Hewlett Packard Advanced RPN Programming course (1989)
Basic Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Chemist (1989)
Coordinator (1993)

Betsy Menefee, B.S., Chemist/Coordinator, AAS Metals, Environmental Sciences

Education:

B.S. Chemistry (cum laude), Salem College (Winston-Salem, NC) (1958)

Continuing Education:

Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

Duke University, Research Assistant (1958 - 1959)
With Lancaster Laboratories, Inc. since 1980
Chemist (1990)

Publications:

Two scientific publications in analytical chemistry

John Morton, M.S., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Biochemistry, California Polytechnic State University (1974)
M.S. Chemistry, University of Delaware (1977)

Continuing Education:

Introduction to Data Processing and Algorithm Design in BASIC, Gwynedd-Mercy College (1983)
The LC Short Course, Waters Associates (1983)
The Series 1020/OWA Operator Course, Finnigan MAT Institute (1985)
Operation of the Superincos Data System, Finnigan MAT Institute (1986)
MS/PC DOS: The Disk Operating System, West Chester University (1989)

Professional Experience:

BCM, Inc., Analytical Chemist (1978 - 1980)
Envirosafe Services, Inc., Q.C. Supervisor (1980 - 1981)
Copper Range Company, Chief Chemist (1982)
Q.C. Inc., Analytical Chemist (1983 - 1988)
With Lancaster Laboratories, Inc. since 1988

Publications:

Two publications in polymer chemistry and pharmaceutical chemistry

Memberships:

American Chemical Society

George Mummert, M.Admin., Manager, Corporate Marketing

Education:

B.A. Political Science, Allegheny College (1962)
M.Admin. Business Administration/Marketing, Pennsylvania State University (1974)

Professional Experience:

PACE Resources, Inc., Marketing Associate (1975 - 1978)
Friendly Ice Cream Corp., Division of Hershey Foods Corp., Manager Marketing Research and Planning (1978 - 1982)
Victor F. Weaver, Inc., Division of Holly Farms Corp., Marketing Manager (1982 - 1989)
With Lancaster Laboratories, Inc. since 1989

Memberships and Appointments:

American Marketing Association (Executive Member)

Mary Munster, B.S., Safety/Chemical Hygiene Officer/Benefits Specialist

Education:

B.S. Occupational Safety & Hygiene Management, Millersville University (1988)

Continuing Education:

Asbestos Abatement Workshop for the Worker/Supervisor, Temple University (1988) (Course recognized by the EPA)
A.H.E.R.A. Building Inspector Training Course, Temple University (1988) (Course recognized by the EPA)
Hazardous Materials Transportation Training Course, National Safety Council (1989)
OSHA Laboratory Standard Conference, PA Chamber of Business and Industry (1990)
Basics of Hazardous Materials Management, Padgett Thompson (1991)
Safe Transportation of Hazardous Materials, Millersville University (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Safety Specialist (1989)
Chemical Hygiene Officer (1990)

Benefits Specialist (1992)

Awards & Citations:

Scholarship presented by Central PA Chapter of the American Society of Safety Engineers (1987)

Memberships:

American Society of Safety Engineers
American Industrial Hygiene Association
Lancaster County Industrial Safety Council, Board of Directors (1991 - 1995)
National Safety Council

Charles Neslund, B.S., Chemist, Applied Research & Development, Environmental Sciences

Education:

B.S. Chemistry, University of Pittsburgh (1982)
Organic Chemistry (1983)

Professional Experience:

Magee Women's Hospital, Pittsburgh, Laboratory Technician (1981 - 1984)
With Lancaster Laboratories, Inc. since 1984
Chemist (1991)

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

Wesley Neumann, M.S., Manager, Pharmaceutical Sciences, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, Syracuse University (1968)
M.S. Chemistry, Northeastern University (1971)

Continuing Education:

Pharmaceutical Quality Assurance Certification, New Jersey Quality Control Association (1985)
Innovative Teamwork Program, Synetics, Inc. (1986)
Dr. W. Edwards Deming's Methods for Management Productivity and Quality, George Washington University (1987)
Statistical Process Control, Phillips Quality Consultants (1988)
Problem Solving and Decision Making, Kepner-Tregor (1988)
Quality Assurance for the Analytical Laboratory, Center for Professional Advancement (1989)

Professional Experience:

Warner Lambert Research Institute, Assistant Associate Chemist (1973 - 1977)
Pharmacia, Chemist (1977 - 1979)
Bristol-Myers Squibb, Group Leader/Manager (1979 - 1990)
With Lancaster Laboratories, Inc. since 1990

Memberships:

American Association of Pharmaceutical Scientists
American Chemical Society
International Society for Pharmaceutical Engineering

Julie O'Donnell, B.A., Business Development, Food Sciences

Education:

B.A. Chemistry, Franklin & Marshall College (1979)

Continuing Education:

Carlisle-Hart Management Development Program (1984)
Villanova University Graduate Courses in Biochemistry (1984) and Analytical Chemistry (1986)
Financial Accounting & Managerial Accounting, Franklin & Marshall College (1988)
Introduction to DOS, Johnson County Community College (1990)
How to Market Professional Services, ACIL (1990)
The New Food Label, Food & Drug Law Institute (1993)

Professional Experience:

Lancaster Laboratories, Inc., Food Chemistry Group Leader (1979 - 1989)
Kansas City Analytical Services, Quality Assurance Director (1989 - 1991)
With Lancaster Laboratories, Inc. since 1991

Publications:

One publication in analytical chemistry

Memberships:

Institute of Food Technologists

Philip Oles, Ph.D., Manager, Applied Research & Development and Foods Group, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, University of Connecticut (1968)
Ph.D. Analytical Chemistry, University of Massachusetts (1974)

Continuing Education:

Hewlett Packard GC/MS Training Course (1986)
Process Design Optimization, Polaroid (1988)
Quality Management College, Philip Crosby Associates (1989)
Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

Upjohn Company, (1974 - 1979)
Polaroid Corporation (1978 - 1989)
With Lancaster Laboratories, Inc. since 1989

Publications:

11 publications on analytical chemistry , food chemistry, and experimental design
Presentations in food chemistry, experimental design, and statistics

Memberships:

American Chemical Society
American Oil Chemists Society
Institute of Food Technologists
International Association of Official Analytical Chemists

Kimberly Oliver, B.S., Quality Assurance Specialist

Education:

B.S. Biology, Pennsylvania State University (1983)

Continuing Education:

Center for Professional Advancement, Good Laboratory Practices (1988)
Society of Quality Assurance Conference (1989)
Society of Quality Assurance Conference (1990)
Mid-Atlantic Region Society of Quality Assurance Meeting (May 1991, June 1992, September 1993, November 1993)

Professional Experience:

Biospherics, Inc., Laboratory Technician (1983 - 1984)
Eastern Laboratory Service Associates, Laboratory Technician (1984 - 1985)
With Lancaster Laboratories, Inc. since 1985
Quality Assurance Specialist (1990)

Memberships:

Mid-Atlantic Region Society of Quality Assurance
Society of Quality Assurance

Timothy Oostdyk, Ph.D., Manager, GC/MS Group, Environmental Sciences

Education:

B.A. Chemistry (cum laude), Franklin and Marshall College (1985)
Ph.D., Analytical Chemistry, Villanova University (1993)

Continuing Education:

ICP Seminar (1985)
ASMS Interpretation of Mass Spectra (1989)

Professional Experience:

Nabisco Brands Technology Center, Technician (Summer 1983)
With Lancaster Laboratories, Inc. since 1985
Manager (1990)

Publications:

Seven scientific publications in analytical chemistry

Awards and Citations:

Phi Beta Kappa, Franklin and Marshall College
Sigma Xi
Spirit of LLI Award (1989)

Susan Page, B.A., Group Leader, Client Services

Education:

B.A. Economics (magna cum laude), Millersville University (1974)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Group Leader (1990)

Wendy Park, B.S., Client Services Specialist, Environmental Sciences

Education:

B.S., Allegheny College (1991)

Professional Experience:

Roy F. Weston, Inc. (1992 - 1993)
With Lancaster Laboratories, Inc. since 1993

Jan Parker, B.A., Chemist, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, University of Evansville (1981)

Professional Experience:

Energy Supply, Inc., Chemist (1981 - 1984)
Central Pharmaceuticals, Inc., Chemist (1984 - 1987)
Roxane Laboratories, Inc., Supervisor Method Development (1987 - 1991)
With Lancaster Laboratories, Inc. since 1991

Patrick Parmer, Client Services Specialist, Air Quality

Education:

Professional Service Works, Harrisburg Area Community College (1991)

Professional Experience:

Lancaster Machinery Company, Customer Service (1985 - 1989)

With Lancaster Laboratories, Inc. since 1989
Client Services Specialist (1991)

Awards:

Spirit of LLI Award (1990)

Sandy Patton, B.S., Data Package Specialist, Data Package, Environmental Sciences

Education:

B.S. Medical Technology, Millersville University (1974 - 1979)
St. Joseph Hospital School of Medical Technology (1979)

Professional Experience:

Ephrata Community Hospital, Chemistry Department (1979 - 1981)
St. Joseph Hospital, Chemistry Department (1981 - 1988)
With Lancaster Laboratories, Inc. since 1988
Data Package Specialist (1991)

Memberships:

American Society of Clinical Pathologists

Luke Peterschmidt, B.A., Chemist, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Chemistry, Mary Washington College (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1991

Arthur Pezzica, B.A., Manager, ExpressLAB/Water Quality/Field Sampling/Air Quality, Environmental Sciences

Education:

B.A. Chemistry (cum laude), University of Maryland (1975)

Continuing Education:

Basic HPLC Short Course, Delaware Valley Chromatographic Forum (1981)
Practical Aspects of Liquid Chromatography, American Association of Clinical Chemists (1984)
2nd Annual International Symposium, Sample Preparation and Isolation using Bonded Silica's, Analytichem (1985)
Advanced Solid Phase Extraction Seminar, Method Development and Troubleshooting Techniques, Analytichem (1987)
Fundamentals of Groundwater Contamination, Geraghty & Miller (1990)
4th Annual Storage Tank Seminar, MD Chamber of Commerce (1991)
Pennsylvania Environmental Law, Federal Publications, Inc. (1993)

Professional Experience:

Office of the Chief Medical Examiners (1975 - 1980)
SmithKline Beecham Clinical Laboratories (1980 - 1989)
With Lancaster Laboratories, Inc. since 1990

Victoria Pillion, B.S., Chemist, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, Alvernia College (1983)

Continuing Education:

HPLC Course, The Chromatography Forum of Delaware Valley (1986)
Basic HPLC Course, Chrompack Inc. (1987)
Troubleshooting GC, Chrompack Inc. (1989)
A Short Course in Capillary Chromatography, Supelco, Inc. (1990)

Professional Experience:

Warner Lambert Co., Associate Analyst (1984 - 1987)
Royer Pharmaceutical Corp., Analytical Control Chemist (1987)
AMP Inc., Chemist II (1988)
With Lancaster Laboratories, Inc. since 1988

Kimberly Purdy, B.A., Client Services Specialist, Food Sciences

Education:

Smith College (1982 - 1984)
B.A. Biology, Bowdoin College (1986)

Continuing Education:

Working on M.B.A., Penn State University

Professional Experience:

Tilton School (1986 - 1987)
Carney, Sandoe, & Associates, Educational Consultants (1987 - 1989)
With Lancaster Laboratories, Inc. since 1989

Publications:

One publication on nutrition labeling regulations

Tim Pyle, Chemist, ExpressLAB, Environmental Sciences

Education:

93 semester hours towards B.S. Chemistry, Arizona State University

Continuing Education:

Interpretation of Mass Spectra, Hewlett-Packard

Professional Experience:

Sonora Laboratory Sciences (1983 - 1987)
Scottsdale Memorial Hospital (1987 - 1989)
Western Michigan Environmental Services (1991 - 1992)
With Lancaster Laboratories, Inc. since 1993

Awards, Citations, and Honorary Societies:

Mathematics Assocation of America National Merit Award Winner
Phi Lambda Upsilon National Chemical Honorary Society

Memberships:

American Chemical Society
Mathematics Association of America

Christine Ratcliff, B.S., Chemist/Coordinator, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Shippensburg University (1988)

Continuing Education:

Mass Spectral Interpretation, Finnigan MAT Institute (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist (1991)
Coordinator (1994)

Mark Ratcliff, B.A., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.A. Physics, Franklin & Marshall College (1988)

Continuing Education:

Finnegan Mass Spectral Interpretation Course (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist (1992)

Robert Reagan, B.A., Group Leader, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, Wake Forest University (1982)

Continuing Education:

Drug Regulation and the FDA: The Regulatory Process, Ciba-Geigy (1987)
Statistics for Experimenters, Ciba-Geigy (1987)

Professional Experience:

Ciba-Geigy Corporation, Research Scientist (1982 - 1988)
Hercon Laboratories Corporation, Manager of Analytical Chemistry (1988 - 1992)
With Lancaster Laboratories, Inc. since 1992

Memberships:

American Association of Pharmaceutical Scientists
American Chemical Society

Joan Rebert, B.S., Chemist, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, Juniata College (1990)

Continuing Education:

Troubleshooting UV Detectors, Hewlett-Packard (1993)
Issues in HPLC Quantitation, Hewlett-Packard (1993)
Automated Identification and Quantitation in HPLC using Diode-Array Detectors, Hewlett-Packard (1993)
A New Approach to Automated Peak Purity Profiling in HPLC Utilizing Diode Array Detection, Hewlett-Packard (1993)

Professional Experience:

Juniata College, Research Assistant (1989)
With Lancaster Laboratories, Inc. since 1990
Chemist (1992)

Nelson Risser, B.A., Manager, Pesticide Residue Analysis/Organic Analysis/Sample Support, Environmental Sciences

Education:

B.A. Chemistry, Shippensburg University (1977)

Continuing Education:

Chromatography Forum of Delaware Valley, Capillary GC (1981)
Dionex Ion Chromatography (1983)
Finnigan MAT 1020/OWA Operation (1983)
Finnigan MAT 1020/OWA Maintenance (1983)
Finnigan MAT Mass Spectra Interpretation and GC/MS (1984)

Finnigan MAT OWA/1050 Software (1986)
Hewlett Packard 5988/5966/5970 RTE Operator's Training Course (1987)
Quality Management College, Philip Crosby Associates (1989)
M.B.A. (33 credits) Coursework, Penn State

Professional Experience:

Frederick Cancer Center, Frederick MD, Analytical Chemist (1977 - 1979)
With Lancaster Laboratories, Inc. since 1979
Manager (1990)

Publications:

Four scientific papers on chemical analysis of carcinogens

Biographical Listings:

Who's Who in Environmental Science

Memberships:

American Chemical Society
American Society for Mass Spectrometry
Chromatography Forum of Delaware Valley

James Rittenhouse, Ph.D., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Albright College (1950)
M.S. Chemistry, University of Pennsylvania (1955)
Ph.D. Chemistry, University of Pennsylvania (1957)

Continuing Education:

Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

Reading Batteries, Superintendent of Manufacturing (1950 - 1953)
Armstrong World Industries, Senior Research Scientist (1957 - 1988)
With Lancaster Laboratories, Inc. since 1991

Memberships:

American Chemical Society
Sigma Xi

Melanie Rittenhouse, Ph.D., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.A. Chemistry, Immaculata College (1967)
M.S. Chemistry, Villanova University (1987)
Ph.D. Analytical Chemistry, Villanova University (1989)

Continuing Education:

Basic Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

Armstrong World Industries (1967 - 1977)
Warner-Lambert Co. (1980 - 1986)
With Lancaster Laboratories, Inc since 1990

Awards and Citations:

Phi Kappa Phi
Sigma Xi

Brad Roadcap, B.S., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Shippensburg University (1990)

Continuing Education:

Mass Spectral Interpretation Course, Finnigan MAT Institute (1991)
Symposium on Waste Testing and Quality Assurance, U.S. EPA (1992)
Working on Master's of Science degree in Chemistry at West Chester University

Professional Experience:

With Lancaster Laboratories, Inc. since 1990
Chemist (1992)

Memberships:

American Chemical Society

Richard Rodgers, B.S., Chemist, AAS Metals, Environmental Sciences

Education:

B.S. Chemistry, Millersville University (1975)

Continuing Education:

Perkin-Elmer Atomic Absorption Workshop (1977)
5985 Gas Chromatograph/Mass Spectrometer Users (1980)
Analytical Methods for Priority Pollutants (1981)
Symposium on Advances in Analytical Methods for Monitoring Organic Chemicals in the Environment - Water and Hazardous Wastes (1984)
GC/MS System Manager Training Course - User 1 (1986)
Interpretation of Mass Spectra - Short Course (1987)

Professional Experience:

Millersville State College, Department of Chemistry
Laboratory Assistant (1971 - 1972)
Chemistry Technician (1972 - 1975)

Ichthyological Associates, Inc., Analytical Chemist (1975 - 1977)
Radiation Management Corporation, GC/MS Operator, Manager (1978 - 1985)
With Lancaster Laboratories, Inc. since 1985

Publications:

One publication on prescreening analysis for GC/MS volatile organics

Memberships:

American Chemical Society
American Society for Mass Spectrometry
Chromatography Forum of Delaware Valley

Robin Runkle, B.S., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Chemistry, State University of New York (1988)

Continuing Education:

Introduction to Mass Spectral Intepretation, Finnigan Mat (1991)
Gas Chromatography: Practical Theory and Applications for LLI (1993)
HP5890 GC Troubleshooting and Maintenance, Hewlett-Packard (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist (1993)

Linda Saad, B.S., Quality Assurance Specialist

Education:

B.S. Forestry & Agriculture, University of New Hampshire (1985)

Continuing Education:

Salmonella Detection Methods, USDA (1990)
Immuno Assay Certificate, AOAC (1991)
Microorganism Identification, PA Dept. of Agriculture (1991)
Good Laboratory Practices Workshop, AOAC (1992)
Autoclave Validation Seminar (1992)
GLP Training, Society of Quality Assurance (1993)
Effective Auditing, Center for Professional Advancement (1993)

Professional Experience:

University of New Hampshire, Sr. Research Technician (1985 - 1988)
Science Education, Anne Arundel County, MD, Public Schools (1988 - 1989)
Wenger Feed Mills, Quality Assurance/Research & Development (1989 - 1992)
With Lancaster Laboratories, Inc. since 1992

Memberships:

Association of Official Analytical Chemists
Mid-Atlantic, Executive Committee

Valerie St. Clair, B.S., Chemist, Foods Inorganic Analysis, Food & Pharmaceutical Sciences

Education:

B.S. Biology, James Madison University (1977)

Continuing Education:

Carlisle-Hart Management Development Program (1984)
MIF/IAICM Listeria Workshop (1986)
AMI Listeria Workshop (1987)
Rapid Methods and Automation in Microbiology Workshop, Kansas State University (1987)
ASM Salmonella spp. and Campylobacter jajuni Workshop (1988)
Seafood Surveillance Program HACCP Workshop for Breaded Fish and Speciality Products (1988)
Applied Food Microbiology, graduate course at Pennsylvania State University (1988)
Food Microbiology for the '90's (1989)
Chilled Food Roundtable (1989)
ASM Quality Assurance and HACCP Workshop (1990)
Basic Atomic Absorption Course (1992)
Gas Chromatography: Practical Theory and Applications for LLI (1993)
GC Troubleshooting, Hewlett-Packard (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1977
Chemist (1991)

Publications:

One publication on food microbiology

Tony San Martin, Chemist/Coordinator, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

Chemistry Courses, New Jersey Institute of Technology

Continuing Education:

LC Resources Inc., Computer-Aided HPLC Method Development
Center for Professional Advancement, Laboratory Interfacing with IBM PC

Professional Experience:

Bristol Myers, Chemist/Supervisor (1963 - 1990)
With Lancaster Laboratories, Inc. since 1990
Coordinator (1992)

Nancy Saunders, B.S., Chemist, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, Syracuse University (1985)

Continuing Education:

Analytical Gas Chromatography, J&W Scientific (1988)
HPLC Troubleshooting, Chrompac (1990)

Professional Experience:

Cayuga County Laboratory, Auburn, NY, Senior Technician (1967 - 1985)
With Lancaster Laboratories, Inc. since 1986
Chemist (1990)

Memberships:

American Chemical Society

Jeffrey Schlegelmilch, B.S., Chemist, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Chemistry, Pennsylvania State University (1988)

Continuing Education:

Applied Statistics, Penn State Continuing Education (1990)
HP5890 Maintenance and Troubleshooting, Hewlett-Packard (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist (1990)

Awards:

Weidner Scholarship, Pennsylvania State University (1988)

Memberships:

American Chemical Society
Nittany Chemical Society
Phi Lambda Upsilon National Honorary Chemical Society

Jeanine Schreiber, Technical Specialist/Coordinator, Project Work, Food & Pharmaceutical Sciences

Education:

Three years of undergraduate work, Millersville University and Penn State University

Continuing Education:

Basic HPLC Course, Chrompack, Inc. (1987)
Basic GC Course, Chromatography Forum of Delaware Valley (1988)

Good Laboratory Practice Seminar, AOAC (1992)
PMCA Sugar and Fat Replacers Seminar
Troubleshooting UV Detectors and Issues in HPLC Quantitation, Hewlett-Packard (1993)
Automated Identification and Quantitation in HPLC using Diode-Array Detectors, Hewlett-Packard (1993)
Capillary Electrophoresis Development and Methods Applications, Chromatography Forum of Delaware Valley (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1982
Technical Specialist/Coordinator (1993)

Publications:

One poster presentation using gas chromatographic analysis of foods

Awards, Citations, Honorary Societies:

Scientific Achievement Award, Lancaster Laboratories, Inc. (1993)

Terry Schuck, B.S., Chemist/Coordinator, ExpressLAB, Environmental Sciences

Education:

B.S. Environmental Resource Management, Pennsylvania State University (1984)

Continuing Education:

Groundwater Monitoring Seminar, Institute for Environmental Education (1986)
Water Quality Management, Penn State University (1990)
Water Pollution Control, Penn State University (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1984
Chemist/Coordinator (1989)

Darla Schumacher, Technical Specialist/Coordinator, Foods Wet Chemistry, Food & Pharmaceutical Sciences

Continuing Education:

Service Operations Process Optimization, Penn State University (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1974
Technical Specialist (1992)

David Schumacher, B.S., Senior Systems Specialist, Food & Pharmaceutical Sciences

Education:

B.S. Biochemistry (cum laude), Pennsylvania State University (1972)

Continuing Education:

Immunochemical Techniques for Chemists, American Chemical Society (1988)
Microsoft Developer's Tools Forum (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1972
Senior Chemist (1985)
Senior Systems Specialist (1992)

Publications:

Five scientific publications in agricultural/environmental analytical chemistry

Memberships:

Association of Official Analytical Chemists
Chromatography Forum of Delaware Valley
Institute of Food Technologists

Delwyn Schumacher, B.S., Group Leader, ExpressLAB, Environmental Sciences

Education:

B.S. Chemistry, Pennsylvania State University (1977)

Continuing Education:

Rubber Technology, American Chemical Society (1979)
Capillary Chromatography, West Chester State University (1980)
Environmental Analytical Chemistry: Air Toxics, American Chemical Society (1989)

Professional Experience:

Pennsylvania Department of Environmental Resources, Field Technician (1977)
Armstrong World Industries, Inc., Chemist (1977 - 1979)
With Lancaster Laboratories, Inc. since 1979
Group Leader (1990)

Publications:

Cosigned two records of invention involving assembly line furniture finishing for Armstrong World Industries (1977)
Cosigned patent application for a polymerizing silicone masonry treatment for protection against weathering for Lancaster Laboratories' client (1984)

Memberships and Appointments:

Chromatography Forum of Delaware Valley

Tamra Schumacher, B.S., Chemist, Research & Development, Environmental Sciences

Education:

B.S. Chemistry (cum laude), Millersville University (1985)

Continuing Education:

1 Year Graduate Work in Chemistry, Villanova University (1987)

Professional Experience:

With Lancaster Laboratories, Inc. since 1985

Memberships:

Chromatography Forum of Delaware Valley

Lee Seats, M.B.A., Senior Chemist, ICP Metals, Environmental Sciences

Education:

B.S. Chemistry, Millersville University (1979)
M.B.A. General Administrative Management, St. Joseph's University (1991)

Continuing Education:

Inductively Coupled Plasma Spectroscopy, Instrumentation Laboratories (1983)

Professional Experience:

With Lancaster Laboratories, Inc. since 1980
Senior Chemist (1992)

Memberships:

Society for Applied Spectroscopy
Treasurer (1993)

Donald Shelly, B.S., Chemist, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Forestry and Wildlife Management, Virginia Polytechnic Institute (1989)

Professional Experience:

Chem Alysis, Inc., Technician Supervisor/Purchaser (1989 - 1990)
Chem Alysis, Inc., Gas Chromatography Analyst/Technician Supervisor (1990 - 1991)
Envirosystems, Inc., Gas Chromatography Chemist/Extraction Supervisor (1991 - 1993)
With Lancaster Laboratories, Inc. since 1993

Richard Shober, B.S., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Muhlenberg College (1984)

Continuing Education:

Inductively Coupled Plasma Spectroscopy, Allied Analytical (1985)
ACS Short Course, Analytical Chemistry of Contaminants in Surface and Groundwater (1986)

Professional Experience:

With Lancaster Laboratories, Inc. since 1984
Chemist (1985)

Publications:

Poster paper on computer applications for analytical chemistry

Biographical Listings:

Who's Who in Environmental Science

Memberships:

Reading Chapter Society for Applied Spectroscopy
Technical Program Committee (1992 - 1993)

Susan Shorter, B.S., Quality Assurance Specialist

Education:

B.S. Chemistry/Mathematics, Cedar Crest College (1986)

Continuing Education:

Short Course in Plasma Spectrochemical Analysis (1990)
Inductively Coupled Plasma, Thermo Jarrel-Ash (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Quality Assurance Specialist (1991)

Memberships:

Society for Applied Spectroscopy

Arlene Silcox, B.A., Chemist, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, West Virginia Wesleyan College (1981)

Continuing Education:

Statistical Quality Control, Penn State Capitol Campus (1983)
HPLC Course, Center for Professional Education (1987)
Capillary GC Course, J&W Scientific (1989)
Troubleshooting GC, Chrompack Inc. (1989)

Professional Experience:

Warner Lambert Co., Analyst, Assistant Microbiologist (1982 - 1988)
With Lancaster Laboratories, Inc. since 1989

Memberships:

Chromatography Forum of Delaware Valley

Livonia Smith, B.S., Chemist, Instrumental Water Quality, Environmental Sciences

Education:

B.S. Chemistry, University of Rochester (1956)

Continuing Education:

Gas Chromatography, Chromatography Forum of Delaware Valley (1991)

Professional Experience:

American Viscose Corp., Chemist (1956 - 1962)
With Lancaster Laboratories, Inc. since 1979
Chemist (1991)

Memberships:

Chromatography Forum of Delaware Valley

Max Snavely, B.S., Chemist, ICP Metals, Environmental Sciences

Education:

B.S. Chemistry, Lebanon Valley College (1977)

Continuing Education:

Inductively Coupled Plasma Spectroscopy, Thermo Jarrell Ash (1991)

Professional Experience:

Sterling Drug, Inc., Quality Control Chemist (1977 - 1980)
Andrew S. McCreath & Sons, Inc., Analytical Chemist (1980 - 1987)
With Lancaster Laboratories, Inc. since 1987
Chemist (1990)

John Snyder, Ph.D., Senior Chemist, Applied Research & Development, Environmental Sciences

Education:

B.A. Chemistry, Messiah College (1975)
Lancaster Theological Seminary (1979 - 1980)
M.S. Chemistry, Villanova University (1985)
Ph.D., Analytical Chemistry, Villanova University (1993)

Professional Experience:

Teacher, Zimbabwe & Zambia (1975 - 1978)
National Hydron (1978 - 1979)
Charles Snyder (1981 - 1982)

With Lancaster Laboratories, Inc. since 1982
Senior Chemist (1989)

Publications:

8 publications on analytical chemistry, supercritical fluid extraction, solid-phase extraction, gas chromatography, and atomic emission spectroscopy

Biographical Listings:

Who's Who in Environmental Science

Memberships:

American Chemical Society
American Society of Mass Spectroscopy (ASMS)
Chromatography Forum of Delaware Valley

Rose Sorgenfrei, M.B.A., Group Leader, Food Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Zoology, Penn State University (1967)
M.B.A., Villanova University (1988)

Certifications:

American Society of Clinical Pathologist Microbiologists (ASCPM) (1971)

Continuing Education:

Effective Speaking and Human Relations, Dale Carnegie, New York University (1992)
Quality Assurance for Microbiological Laboratories, AOAC International (1992)
Rapid Methods and Automation in Microbiology, Kansas State University (1993)

Professional Experience:

A&P Tea Company, Headquarters Laboratory, Analytical Food Chemist and Food Microbiologist (1967 - 1968)
St. Mary's Hospital, Clinical Microbiologist (1969)
Oakwood Hospital, Clinical Microbiologist (1970 - 1973)
Oakwood Hospital, American Society of Clinical Pathologist's, Microbiology Internship (1971)
Damon Clinical Laboratory, Microbiologist (1982 - 1984)
Paoli Memorial Hospital, Microbiologist (1985 - 1986)
Ore-Ida Foods, Plant Microbiologist (1989 - 1993)
With Lancaster Laboratories, Inc. since 1993

Publications:

One article on microbiological testing of beef products

Awards, Citations, and Honrary Societies:

Beta Gamma Sigma

Memberships and Appointments:

AOAC International

Institute of Food Technologists
International Association of Milk, Food, and Environmental Sanitarians

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Robert Stauffer, B.S., Integration Systems Specialist, Volatiles by GC, Environmental Sciences

Education:

B.S. Microbiology, Pennsylvania State University (1979)
B.S. Computer Science, Millersville University (1986)

Continuing Education:

Hewlett-Packard HP1000 System Manager Training (1988)
Hewlett-Packard HP1000 Laboratory Automation System Programming Training (1988)
Harrisburg Area Community College, Data Networks & Communications Course (1992)

Professional Experience:

Frederick Cancer Research Center, Microbiology Research Technician (1979 - 1981)
Victor F. Weaver, Inc., Quality Assurance Inspector (1982 - 1984)
Victor F. Weaver, Inc., Computer Programmer/Operator (1984 - 1987)
With Lancaster Laboratories, Inc. since 1988

Memberships:

INTEREX - International Association of Hewlett-Packard Computer Users

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Andrew Strebel, Technical Specialist, GC/MS Semivolatiles, Environmental Sciences

Education:

Advanced Aquarius Programmers Course, Hewlett Packard (1989)
Environmental Applications of GC/MS, Indiana University

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Technical Specialist (1991)

John Styles, B.S., Chemist, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, Bucknell University (1989)

Continuing Education:

The Practice of Modern HPLC (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist (1991)

Christiane Sweigart, B.S., Chemist/Coordinator, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Chemistry/Medical Technology, Elizabethtown College (1985)

Professional Experience:

With Lancaster Laboratories, Inc. since 1985
Chemist (1991)
Coordinator (1993)

Danny Taylor, A.A., Chemist, AAS Metals, Environmental Sciences

Education:

A.A. Pre-Engineering, Santa Fe Community College (1988)
Extensive coursework in Aerospace Engineering, University of Central Florida (1988 - 1991)

Continuing Education:

Varian Spring AA Workshops (1989, 1990, 1991, 1992)
Atomic Spectroscopy Sample Preparation, Florida Society of Environmental Analysts (1991)
Perkin Elmer AA Benchtop Software (1991, 1992)
Perkin Elmer Zeeman Furnace User's Group (1991, 1992)
ICP-Mass Spectrometry, FACSS XIX (1992)
Perkin Elmer Environmental Seminars (1992)
Varian FLAA and GFAA Seminar (1993)
Atomic Spectroscopy Workshop, 32nd Eastern Analytical Symposium (1993)

Professional Experience:

Environmental Science and Engineering, Technician's Aide (1987 - 1988)
PBS&J, Environmental Laboratory Division, Technician (1988 - 1990)
Bionomics Laboratory, Inc., Chemist (1990 - 1993)
With Lancaster Laboratories, Inc. since 1993

Publications:

One scientific paper on fast graphite furnace analysis in environmental samples

Memberships and Appointments:

Florida Society of Environmental Analysts
Perkin Elmer Zeeman Furnace User's Group
Society of Applied Spectroscopy

Lawrence Taylor, B.S., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Chemistry, Shippensburg University (1989)

Continuing Education:

QA Report Operator Training Course, Finnigan Mat Institute (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist (1992)

Tina Thoman, B.S., Chemist, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Biology/Medical Technology, Millersville University (1981)

Continuing Education:

Gas Chromatography, Chromatography Forum of Delaware Valley (1990)

Professional Experience:

Memorial Hospital, Medical Technician (1981 - 1986)
St. Joseph's Hospital, Medical Technician (1986 - 1988)
With Lancaster Laboratories, Inc. since 1988
Chemist (1992)

Memberships:

American Society of Clinical Pathologists

Matthew Thomas, B.S., Chemist, AAS Metals, Environmental Sciences

Education:

B.S. Chemistry and Mathematics, Davis & Elkins College (1991)

Continuing Education:

Varian FAA-GFAA Workshop

Professional Experience:

With Lancaster Laboratories, Inc. since 1991
Chemist (1993)

Elizabeth Tomlinson, B.S., Chemist, AAS Metals, Environmental Sciences

Education:

B.S. Biology, Shippensburg University (1989)

Continuing Education:

Varian AA Course (1992)
GMP Training (1993)

Professional Experience:

Eastern Laboratory, Microbiologist (1989 - 1990)
Wyeth Laboratory, Biological Manufacturing Technician (1990)

RMC Environmental Services, Laboratory Technician (1990 - 1992)
With Lancaster Laboratories, Inc. since 1992
Chemist (1993)

Timothy Trees, A.A.S., Chemist/Coordinator, AAS Metals, Environmental Sciences

Education:

Certificate, Water/Wastewater Treatment Operations, Columbia Green Community College (1985)
A.A.S. Environmental Control of Hazardous Waste/Water Quality, Ulster Community College (1987)

Professional Experience:

York Wastewater Management (1985 - 1986)
Rider Engineering (1986 - 1988)
With Lancaster Laboratories, Inc. since 1988
Coordinator (1991)

Lisa Ulmer, B.S., Microbiologist/Coordinator, Pharmaceutical Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Juniata College (1986)

Continuing Education:

LAL Testing: Drugs, Medical Devices, and Biotechnology, Center for Professional Advancement (1990)
Limulus Amebocyte Lysate Test Technology and LAL Workshop, Parenteral Drug Association (1991)
Microbiological QA for Pharmaceutical Products, Parenteral Drug Association (1992)
Managing Quality in a Regulated Industry, ASQC (1993)
HP5890 GC Troubleshooting and Maintenance, Hewlett-Packard (1993)
Introduction to Capillary GC, Hewlett-Packard (1993)
Microbial Identification System Training, MIDI (1993)

Professional Experience:

Lancaster Laboratories, Inc., Microbiologist/Coordinator (1986 - 1989)
SmithKline Beecham Clinical Laboratories, Medical Technologist (1989 - 1990)
SmithKline Beecham Pharmaceuticals, Inc., Associate Microbiologist (1990 - 1993)
With Lancaster Laboratories, Inc. since 1993

Memberships:

LAL User's Group

Dennis Urban, M.S., Chemist, Organic Analysis by GC, Environmental Sciences

Education:

B.A. Chemistry, Millersville State University (1972)
M.S. Chemistry, St. Joseph's College (1976)

Continuing Education:

Seminars for various methods of instrumental analysis in the areas of gas chromatography, high performance liquid chromatography and infrared spectrometry

Professional Experience:

RCA, Associate Engineering Technician (1972 - 1977)
Wyeth Laboratories (Marietta, PA), Control Analyst (1977 - 1979)
Wyeth Laboratories (West Chester, PA), Chemist II (1979 - 1980)
RCA, Senior Engineering Technician (1980 - 1982)
Member, Technical Staff (1982 - 1987)
With Lancaster Laboratories, Inc. since 1987

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

Irene Lynn Wallace, M.B.A., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.A. Chemistry, Washington & Jefferson College (1988)
M.B.A., Pennsylvania State University (1993)

Continuing Education:

Mass Spectral Interpretation Course (1991)
High Impact Communication Skills (1992)
GC Troubleshooting Course (1993)

Professional Experience:

Stauffer Chemical Company, Food Chemist (1987 - 1988)
With Lancaster Laboratories, Inc. since 1988
Chemist (1991)

Memberships and Appointments:

American Business Women's Association
American Chemical Society
National Society of Collegiate Journalists

Barbara B. Weaver, B.S., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Biology, Guilford College (1979)

Continuing Education:

Graduate coursework in Biology, University of North Carolina (1980 - 1982)

Professional Experience:

Roche Biomedical Laboratories, Medical Technologist (1983 - 1985)

Carolina Biological Supply Company, Medical Technologist (1985 - 1987)
Carolina Biological Supply Company, Department Head (1988)
E. I. Du Pont de Nemours & Co., Laboratory Technician (1989 - 1990)
With Lancaster Laboratories, Inc. since 1991
Chemist (1993)

Publications:

Three educational articles on biological subjects
One poster presentation on biological research

Awards, Citations, and Honorary Societies:

Sigma Xi, Grant-in-Aid of Research (1982)

Barbara J. Weaver, CIH, Corporate Technical Projects Specialist

Education:

B.S. Chemistry, Elizabethtown College (1971)

Certifications:

American Board of Industrial Hygiene - Certified in the comprehensive practice of industrial hygiene, Certification #2719

Continuing Education:

Business Law, Elizabethtown College (1979)
NIOSH Course #553 "Industrial Hygiene Sampling, Decision Making, Monitoring and Record Keeping, Sampling Strategies" (1979)
Industrial Toxicology, 5-Day Workshop, Thomas Jefferson University (1980)
Special Topics: Environmental Analytical Chemistry, Graduate Work, Villanova University (1981)
"Comprehensive Industrial Hygiene Review", University of Cincinnati, NIOSH Education Resource Center (1983)
Environmental Health, Graduate Work, West Chester University (1985)
Chemical Hygiene - The OSHA Laboratory Standard, NEAIHA PDC (1990)
Health and Safety Management for Hazardous Waste Professionals, AIHA PDC #11 (1990)
Financial Accounting, Undergraduate Course, Penn State (1990)
NIOSH Course #582 "Sample and Analysis of Airborne Asbestos Dust", NIOSH Education Resource Center, Cincinnati (1992)
Survey of Management, Undergraduate, Penn State University (1993)

Professional Experience:

Warner Lambert, Inc., Quality Control Chemist (1971 - 1973)
Hershey Medical Center, Junior Research Technician (1973 - 1974)
Elizabethtown College, Laboratory Instructor (1977 - 1978)
With Lancaster Laboratories, Inc. since 1978
Corporate Technical Projects Specialist (1991)

Publications:

One publication on microscopy
One publication on NMR and Copper-histidine

Biographical Listings:

Who's Who in the East, under Barbara J. Felty
Who's Who in the Safety Profession

Memberships and Appointments:

American Board of Industrial Hygiene
American Chemical Society
ACS, Chemical Health and Safety Section, Membership Committee (1992 - 1993)
American Industrial Hygiene Association and Central Pennsylvania Section - Offices at local section:
Treasurer (1981 - 1984), President-Elect (1985 - 1986), President (1986 - 1987), Membership Director (1988 - 1993)
Lancaster County Industrial Safety Council (Director 1988 - 1990)

Brenda Weaver, Technical Specialist, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Biology, Messiah College (1980)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Technical Specialist (1993)

Patrick Weidinger, B.S., Industrial Hygienist/Coordinator, Air Quality, Environmental Sciences

Education:

B.S. Occupational Safety and Hygiene Management, Millersville University (1986)

Continuing Education:

Asbestos-Hazard Evaluation and Abatement, Drexel University (1987) (Course recognized by the EPA)
Asbestos Abatement for Inspectors, Tufts University (1987) (Course recognized by the EPA)
Asbestos Abatement Conference for Management Planners, Temple University (1988) (Course recognized by the EPA)
Assessing Bioaerosols in Indoor Environments, University of Michigan (1988)
Industrial Ventilation Workshop, Millersville University (1990)
Fundamentals of 1990 Clean Air Act, Lancaster Laboratories, Inc. (1992)
Process Safety Workshop, Millersville University (1993)

Professional Experience:

High Industries, Inc., Safety and Health Intern (1986)
With Lancaster Laboratories, Inc. since 1986
Industrial Hygienist/Coordinator (1991)

Awards and Citations:

Scholarship presented by Central PA Chapter of the American Society Engineers Occupational Safety and Hygiene Management

Memberships:

American Industrial Hygiene Association (AIHA)
American Society of Safety Engineers (ASSE)

David Weiser, B.S., Data Package Specialist/Coordinator, Data Package, Environmental Sciences

Education:

B.S. Education, Biology, Millersville University (1987)

Continuing Education:

How to Supervise People & Building a Winning Team, Fred Pryor Seminars (1989)
How to be a Better Team Leader, Padgett Thompson Seminars (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Data Package Specialist/Coordinator (1991)

Jon Wenger, B.S., Chemist, Foods Inorganic Analysis, Food & Pharmaceutical Sciences

Education:

B.S. Biochemistry, minor in Biology, Elizabethtown College (1989)

Professional Experience:

Warner Lambert Co., QC Chemist (1986)
With Lancaster Laboratories, Inc. since 1989
Chemist (1992)

Memberships:

American Chemical Society

Tom Willig, B.S., Chemist, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Biology, Millersville University (1988)

Continuing Education:

Operation and Maintenance of GPC Systems, ABC Laboratories (1992)

Professional Experience:

Millersville University, Chemistry Department, Adjunct Instructor (1988 - 1991)
With Lancaster Laboratories, Inc. since 1990

Troy Wingenroth, B.A., Computer Specialist, Pesticide Residue Analysis, Environmental Sciences

Education:

B.A. Mathematics, Shippensburg University (1983)

Continuing Education:

Assembly Language I for the IBM Mainframe, Harrisburg Area Community College (1992)
Advanced Cobol, Harrisburg Area Community College (1992)
RPG III, Harrisburg Area Community College (1992)
Structural Query Language, Harrisburg Area Community College (1992)

Professional Experience:

CADO/CONTEL/VERSYSS, Programmer (1984 - 1991)
With Lancaster Laboratories, Inc. since 1992

Bryan Winship, B.S., Chemist, Food & Pharmaceutical Sciences

Education:

B.S. Analytical Chemistry, Juniata College (1981)

Continuing Education:

Liquid Chromatography Short Course, Chromatography Forum of Delaware Valley (1982)
Shimadzu HPLC and Operator Training Course (1986)
HP3350 LAS Operator Training Course, Hewlett-Packard (1986)
Robotic Automation Environmental Short Course, Zymark Corporation (1991)
Computer-Assisted GC and HPLC Methods Development, LC Resources (1991)
Fractional Factorial Design (1991)
Chemometric Techniques for Quantitative Analysis, EAS Symposium ACS Short Course (1992)
Service Operations Process Optimization, Penn State University (1992)
Hitachi HPLC Operator Training Course (1993)
Advanced Relational Database Design, Technology Mentors, Inc. (1993)

Professional Experience:

Department of Energy, Shale Research Project Assistant (1978 - 1980)
Juniata College, Laboratory Assistant (1980 - 1981)
With Lancaster Laboratories, Inc. since 1981

Publications:

Two poster papers on analytical chemistry

Memberships:

Association of Official Analytical Chemists
Chromatography Forum of Delaware Valley

Awards/Citations/Honorary Societies:

Dawson/Grundmann Innovation Award for Creative Problem Solving (1993)

Kevin Witman, B.S., Chemist, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Physics, Millersville University of Pennsylvania (1988)

Continuing Education:

Finnigan Mass Spectral Interpretation Course (1991)
GC Column Maintenance and Troubleshooting (1992)
Column Installation and Selection (1992)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist (1992)

Publications:

One poster presentation in stellar astronomy

Memberships:

Sigma Pi Sigma, Society for Physics Majors

Jill Wolgemuth, B.S., Client Services Specialist/Coordinator, Environmental Sciences

Education:

B.S. Biology, Dickinson College (1979)

Professional Experience:

With Lancaster Laboratories, Inc. since 1984
Client Services Specialist (1986)
Coordinator (1993)

David Wright, B.S., Chemist, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Millersville University (1987)

Continuing Education:

Theory of Gas Chromatography, Chromatography Forum of Delaware Valley (1990)
Automated Identification and Quantitation in HPLC Using Diode-Array Detectors, Hewlett-Packard (1993)
Issues in HPLC Quantitation and Troubleshooting UV Detectors, Hewlett-Packard (1993)
HP5890 GC Troubleshooting Course, Hewlett-Packard (1993)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist (1991)

Memberships:

American Chemical Society (1991 - 1992)

Jon Wright, B.S., Chemist, Project Work, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Albright College (1981)

Continuing Education:

Graduate-level toxicology courses, St. John's University (1985 - 1987)
Chrompack Course, "Troubleshooting GC" (1989)
Chrompack Course, "Capillary GC" (1990)

Professional Experience:

Bolar Pharmaceutical Co., Inc. (1984 - 1989)
With Lancaster Laboratories, Inc. since 1989

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

Christiaan Wubbolt, B.S., Quality Assurance Specialist

Education:

B.S. Physics/Computer Engineering, Millersville University (1988)

Continuing Education:

Formaster Training Course
Basic Mass Spectral Interpretation, Finnigan MAT Institute (1991)
Computer System Validation in a Regulatory Environment, Raskasky Group (1993)
Graduate coursework, Villanova University and Penn State University

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Quality Assurance Specialist (1992)

Memberships:

Association of Official Analytical Chemists
Mid-Atlantic Region Society of Quality Assurance

Donald Wyand, B.S., Business Development, Environmental Sciences

Education:

B.S. Chemistry, Lebanon Valley College (1989)

Continuing Education:

Pursing a Ph.D. in Chemistry, Villanova University

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Client Services Specialist (1990)
Business Development (1993)

Memberships:

Society of American Military Engineers
Society of Applied Spectroscopy

Melissa Yanchuck, B.S., Technical Specialist/Coordinator, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Biology, Millersville University (1984)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Technical Specialist/Coordinator (1991)

Michael Yunginger, B.S., Microbiologist/Coordinator, Pharmaceutical Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Millersville University (1985)

Continuing Education:

LAL Technology Workshop (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Microbiologist/Coordinator (1990)

Memberships:

LAL User's Group

Kimberly Zeeman, B.S., Client Services Specialist, Environmental Sciences

Education:

B.S. Biology, Shippensburg University (1991)

Professional Experience:

Polybac Corporation (1992)

Upper Saucon Township, Laboratory Technician (1992 - 1993)
With Lancaster Laboratories, Inc. since 1993

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APPENDIX H
TELEDYNE ISOTOPES

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TELEDYNE
BROWN ENGINEERING
Environmental Services

50 VAN BUREN AVENUE
P.O. BOX 1235
WESTWOOD, NEW JERSEY 07675-1235
(201) 664-7070 FAX (201) 664-5586

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Teledyne Brown Engineering Environmental Services is a nuclear analytical service laboratory which has been providing environmental radioactivity monitoring, nuclear fuel analysis, radiological health surveys, nuclear waste disposal, and personnel dosimetry services to nuclear industries for over 35 years. Other service areas include age determination using various isotopes, uranium and petroleum exploration using nuclear techniques, and the fabrication of thermoluminescent dosimeter instrumentation and sodium iodide crystals.

The company was originally founded as Isotopes Inc. by a group of scientists form the Lamont (now Lamont-Doherty) Geological Observatory of Columbia University, which specialized in geochemical analyses. This laboratory was called upon by the U.S. government to survey the entire biological environment -- man, plant and animal -- to determine how much strontium-90 was getting into the biosphere from atmospheric testing of nuclear weapons. When the work expanded beyond the scope of the academic institution, a new company was formed. Its purpose was to make the most sensitive and precise isotopic measurements possible.

Subsequently, as a result of the Limited Test Ban Treaty of 1963, work was begun on advanced atmospheric and soil gas sampling and analysis techniques. This effort was intended to develop methods for detecting low level radioisotopes that might leak to the surface after clandestine nuclear explosions. The company's research scientists made measurements at every U.S. underground nuclear test for a period of ten years to develop this technology. Later work was directed toward methods of identifying the type and character of the unknown weapon being tested, from the radioisotopes it produced.

From the background in government research, the company's talents were gradually turned to the expanding field of radiological monitoring of the environment. Testing of environmental samples taken regularly surrounding nuclear power plants became the most important segment of the company's business. This effort then became expanded to characterizing the environments of all kinds of nuclear production and processing industries. At this time, government research and production sites are important for remediation efforts. Also important is the use of natural and man-made isotopes for determining the chronology of sediments in natural bodies of water, providing calendar dates for the deposition of various toxic substances.

The company was acquired by Teledyne Inc. in 1967 and was renamed Teledyne Isotopes. Teledyne is a conglomerate of diversified advanced technology industries, based in California. In January of 1994, a consolidation of Teledyne companies took place which merged several units with Teledyne Brown Engineering in Huntsville, Alabama. The company's name was changed to its present form but its work and character remains the same. There are two locations, one in Westwood New Jersey with 100 employees, and another in Northbrook Illinois with 30 employees. The organization includes an Environmental Analysis Department, a Mass Spectrometry Department, a Radiological Services Department, a TLD Instruments Department, and a Crystals Manufacturing Department. The company employs professionals in geology, nuclear physics, chemistry, oceanography, and environmental sciences.

Services and Products from Teledyne Isotopes

Truth in RADIATION

A Matter of Accurate Measurement

- ▼ Radiochemistry
- ▼ TLD Badge Service
- ▼ Alpha Spectroscopy
- ▼ Gamma-ray Spectroscopy
- ▼ C-14 Age Determinations
- ▼ Radon Detection Services
- ▼ Radioactive Gas Analysis
- ▼ Nuclear Fuel Isotopic Analysis
- ▼ TLD Instrumentation & Phosphors
- ▼ Gamma-ray Detectors/NaI(Tl) Crystals
- ▼ Geochronometry/Age Determinations
- ▼ TeleTrace®- Petroleum Reservoir Tracing
- ▼ ProTrace - Chemical Process Tracing
- ▼ Health Physics Services
- ▼ Radioactive Waste Services

TELEDYNE ISOTOPES

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TELEDYNE ISOTOPES

RADIOACTIVE WASTE SERVICES

■ ON-SITE TRAINING ■ PACKAGING ASSISTANCE ■ COMPACTION
■ ULTRA-COMPACTION ■ SCINTILLATION VIAL PROCESSING
■ COMPUTERIZED TRACKING OF YOUR WASTE ■ COMPUTERIZED ANNUAL REPORTS
■ COMPLETE INVENTORY OF SUPPLIES ■ TRAINED TECHNICIANS ■ CUSTOMIZED SERVICES

HEALTH PHYSICS SERVICES

■ CONTAMINATION SURVEYS ■ X-RAY LEAKAGE SURVEYS ■ FINAL SITE SURVEYS
■ BIOASSAYS ■ DECONTAMINATION & DECOMMISSIONING ■ LICENSE REVIEWS
■ HEALTH PHYSICS CONSULTING ■ ENVIRONMENTAL RADIATION SURVEYS
■ INSTRUMENT CALIBRATIONS ■ SEALED SOURCE LEAK TESTS

COPY, COMPLETE & FAX TO: TELEDYNE ISOTOPES
FAX 201 664-5586

- ☐ I Have Immediate Need of Your Services:
- ☐ Contact Me Directly
- ☐ Add My Name to Your Mailing List

- ☐ Send Additional Information about:
- ☐ Radioactive Waste Disposal
- ☐ Health Physics Services
- ☐ TLD Badge Services
- ☐ TLD Phosphors
- ☐ TLD Equipment
- ☐ Isotope Geochemistry
- ☐ Scintillation Crystals & Detectors
- ☐ TeleTrace
- ☐ Radon Testing
- ☐ Radiological Services
- ☐ Nuclear Fuels Analysis

Institution_____
Name_____ Title_____
Address_____
City_____ State_____ Zip_____
Phone area code ( ) _____

TELEDYNE ISOTOPES

50 Van Buren Avenue, Westwood, NJ 07675
1-800-666-0222
FAX: 201/664-5586

ENVIRONMENTAL RADIOLOGICAL SERVICES from

TELEDYNE ISOTOPES

A LEADER IN THE INDUSTRY

Teledyne Isotopes has been providing high quality environmental radiological services to the nuclear industry for over 30 years. These services have diverse applications and are designed to meet the specific needs and stringent requirements of the individual customer.

Our experience includes: Analysis of samples collected near nuclear facilities to monitor for potential releases of radioactivity. Air, water, milk, food crops, vegetation, soil, sediment, animals and aquatic life are some of the environmental media tested.

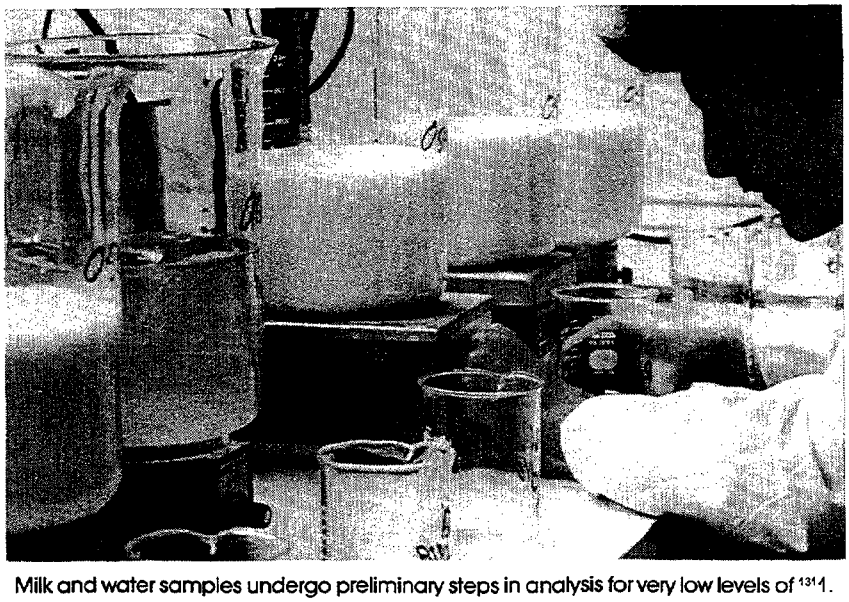
Analysis of soil and groundwater on and near low level radioactivity disposal sites, uranium mills, ore piles and tailings, and other known contaminated sites to detect any release of radioactivity to the public domain.

Evaluation of proposed construction sites for unsuspected, previously-disposed radioactive waste.

ANALYTICAL SERVICES.

A variety of analytical services is available at Teledyne Isotopes. These services, performed by qualified professionals using specialized instruments, have been developed over time to meet the emerging needs of our customers. Our capabilities include:

- Radiochemical analysis for gross alpha, gross beta, total radium, total uranium, ^{226}Ra, ^{228}Ra, ^{131}I, ^{89}Sr, ^{90}Sr, ^{55}Fe, ^{14}C, ^{99}Tc and ^{210}Pb among others.
- Gamma Ray spectroscopy for fission products, activation products, natural radioisotopes, and radioisotopes used in research and medical treatment including ^{40}K, ^{54}Mn, ^{58}Co, ^{59}Fe, ^{60}Co, ^{134}Cs and ^{137}Cs.
- Detection of tritium in surface and groundwater.
- Alpha spectroscopy for ^{234}U, ^{235}U, ^{238}U, ^{239}Pu, $^{239/240}Pu$, ^{241}Am, ^{242}Cm, $^{243/244}Cm$, ^{210}Po.
- Environmental monitoring of gamma-ray radiation in the field using thermoluminescent dosimetry (TLD).
- Radon in air and soil.



Milk and water samples undergo preliminary steps in analysis for very low levels of ^{131}I.

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TELEDYNE ISOTOPES

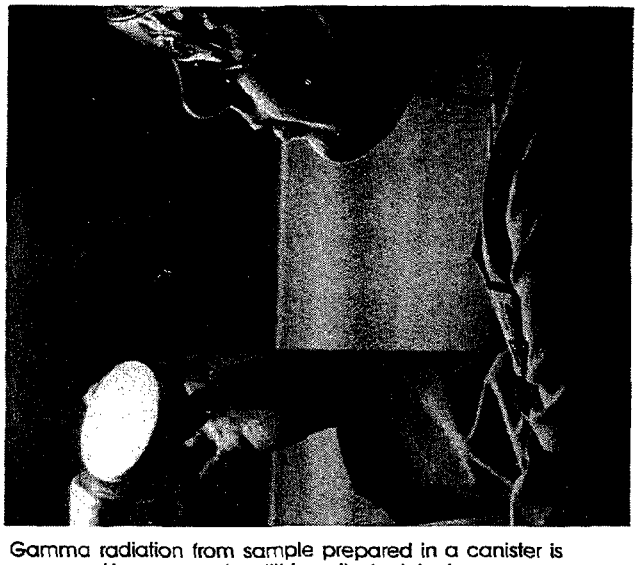
QUALITY ASSURANCE

Teledyne Isotopes' expertise and attention to detail continue throughout the program.

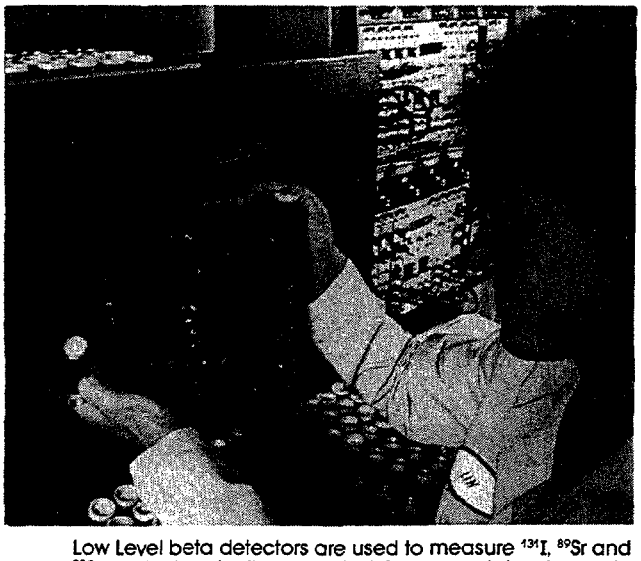
Quality Assurance/Quality Control is maintained in compliance with U.S. NRC Regulatory Guide 4.15 to assure accurate analyses. Teledyne Isotopes successfully participates in the U.S. EPA Interlaboratory Intercomparison Program, The U.S. EPA Radon Measurement Proficiency Program, and the International Intercomparision of Environmental Dosimeters Program. Teledyne Isotopes is certified by the State of New Jersey for certain radiometric parameters for the EPA drinking water standards.

REPORTING

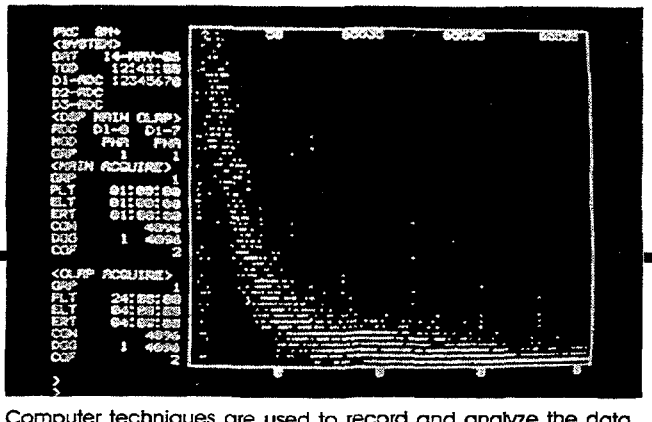
A comprehensive written report is prepared within 30 days, sooner if required. Quarterly and/or annual reports are also available.



Gamma radiation from sample prepared in a canister is measured in a germanium lithium diode detector.



Low Level beta detectors are used to measure ^{131}I, ^{89}Sr and ^{90}Sr radiochemically separated from a variety of sample types. The detectors are also used to determine the ^{210}Pb content of soil as part of the evaluation of proposed building sites.



Computer techniques are used to record and analyze the data from radiation monitoring devices. An evaluation report summarizing the findings of the test is printed out for each customer.

For more information about Environmental Radiological Services from Teledyne Isotopes and how we can meet your special needs, contact J. David Martin, Manager, Environmental Analysis Department.

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50 Van Buren Avenue
Westwood, NJ 07675
1-800-666-0222
FAX: 201 664-5586

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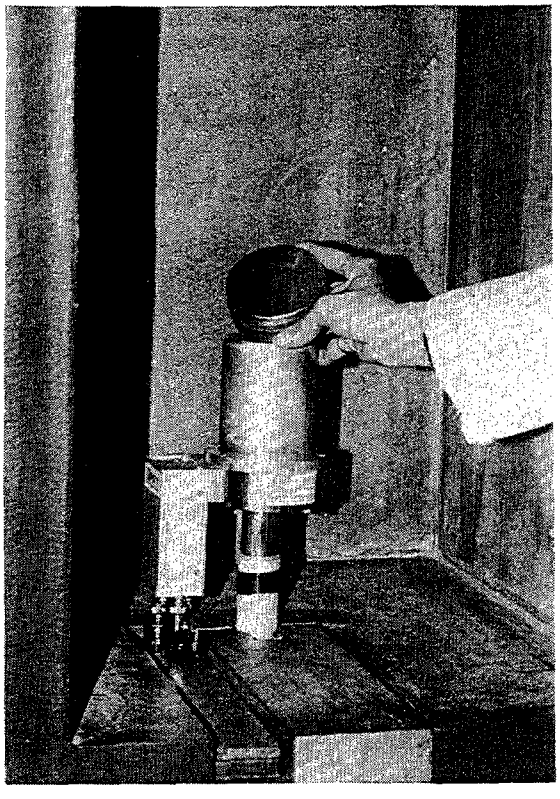
TELEDYNE ISOTOPES



RADON TESTING

Servicing Home Inspection, Realtors, Schools, Commercial Buildings, Municipalities, Homeowners

INDOOR AIR

Homes, Schools, Commercial Buildings, Municipal Buildings,

WATER

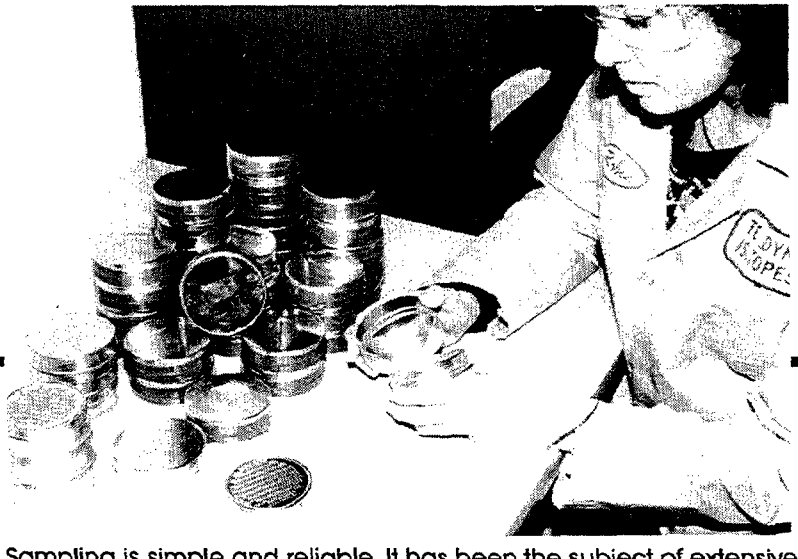
Well water for municipal water supplies and individual homeowner wells

SOIL

Building sites and existing home lots

QUALIFICATIONS

Teledyne Isotopes is one of the oldest and largest radon laboratories in the country. We have been in the radioactivity measurement business for over 30 years, and have successfully participated in every US EPA radon measurement proficiency program.



CANISTER-PAK

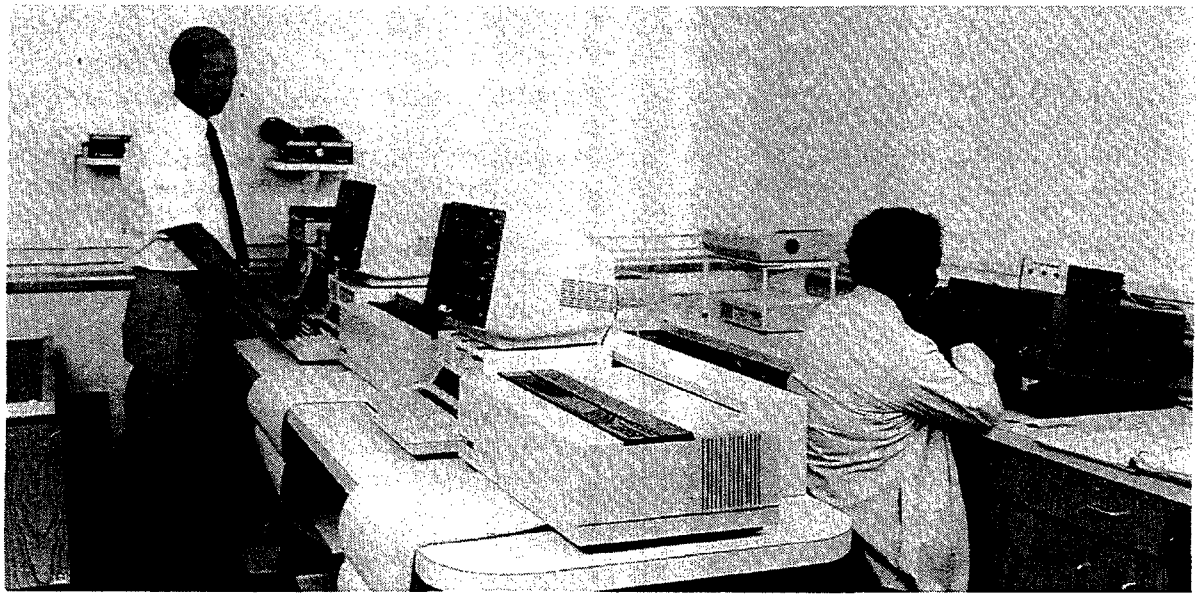
The canister contains activated charcoal which attracts and stores radon. The top is removed and the canister is placed in a position most representative of the air in the basement or living quarters.

After 4 days, the top is replaced and the canister is mailed to the laboratory for analysis.

Sampling is simple and reliable. It has been the subject of extensive calibration studies and surveys. It is most effective during the winter months when outside-to-inside air circulation is at a minimum. The canister is small and light-weight, and can be easily mailed.

Personnel monitoring for radiation demands pinpoint accuracy

Teledyne Isotopes TLD Badge Service



The importance of your employees' health is immeasurable. So the accurate monitoring and measurement of exposure from radioactive materials and medical x-rays are critical. That's why nuclear reactors, fuel fabricators and hospitals utilize Teledyne Isotopes TLD Badge Service.

Our experience in nuclear technology began in 1955 and, over the past 35 years, we have continued to develop advanced and highly refined readout technologies and methods to make the detection and measurement of radiation even more exacting.

In addition to accurate readout and interpretation capabilities, Teledyne Isotopes TLD Badge Service offers quick and comprehensive dose reports. Our highly-trained professional staff and computerized reporting systems enable you to receive up-to-the-minute dose reports on time, every time. The consistent accuracy and punctuality save you time and money in the management of monitoring personnel.

Accuracy in measurement, effectiveness in cost, timeliness in reporting — all combine to make Teledyne Isotopes TLD Badge Service your best choice for personnel monitoring.

826600479

and Teledyne Isotopes TLD Badge Service gives you that accuracy!

Only Teledyne Isotopes TLD Badge Service offers...

1. **Sensitivity.** Teledyne Isotopes Thermoluminescent Dosimeters (TLD, $CaSO_4$:Dy phosphor) are highly sensitive, 30 times more sensitive than LiF, with a minimum detectable level of 3mR at a 99% confidence level.
2. **Ruggedness.** Unlike film which can fog or fade under adverse conditions, the Teledyne dosimeter can be exposed to high temperatures (50°C for as long as one week), light, water, and many chemical fumes with a minimal effect. In fact, it can even withstand dry cleaning or being cycled through a washing machine!
3. **Low Fade Rate.** The TL dosimeter experiences less than 2% fade per month at 25° -35°C as compared to 15% per month for film.
4. **Excellent Beta Response.** The thin TL dosimeter with its thin covering assures a better beta response than film, which features a thick protective covering, or a thick LiF chip.
5. **Precise Monitoring.** Teledyne Isotopes dosimeters are re-usable and can be preselected to a dosimeter-to-dosimeter variation of less than 5% standard deviation. Because of the low batch-to-batch variation few pre-exposed calibration dosimeters are required for the readout process. The situation is reversed with film. Film can only be used once; it cannot be pre-exposed to minimize film-to-film variation. In addition, because of resulting batch-to-batch variations, many calibration dosimeters are necessary, ideally one with every developing tray.
6. **Readout Accuracy.** Errors in analysis of data are minimal due to the well-designed software programs and reliability of the TLD readers. Readout accuracy is also insured because standards are processed daily on each TLD reader.
7. **Reverification.** Each TLD card contains eight dosimeter elements, including a reserve area of four unread dosimeters. This reserve area insures that an independent assessment of exposure, using a different TLD reader, can be performed if reverification is required. This is not possible with film.
8. **Energy Information.** The approximate photon effective energy to which the dosimeter has been exposed can be determined, something virtually impossible with LiF.
9. **A Permanent Record.** The results of each TLD are stored as a permanent record, fulfilling the legal, administrative and technical requirements for personnel monitoring. All raw data and reports are microfilmed for long term storage.
10. **Timely Reporting.** All data are analyzed and reported within 20 days. One hour emergency reporting is available seven days a week.
11. **Cost Effectiveness.** On the surface more expensive than film, TLD is more cost effective in the long run.
12. **Overall Quality.** Teledyne Isotopes is a TLD system manufacturer with expertise developed over the past quarter century. Our dedicated technical staff, combined with sophisticated, up-to-date equipment, insure the highest quality products and service available.

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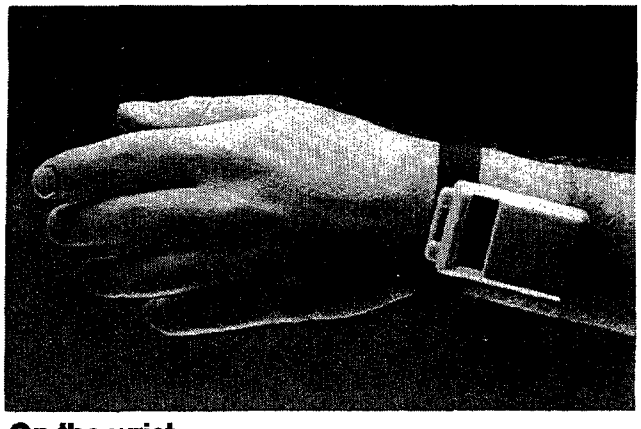
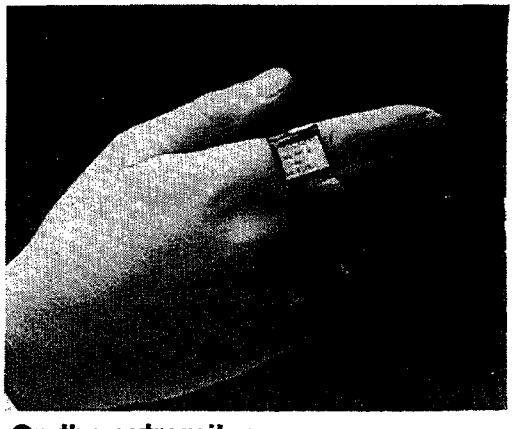
Badge Cases

The badge case is an integral part of the personnel monitoring system. It houses the TL dosimeter along with filter configurations needed for various dose interpretations. A variety of styles and colors are available.



On the wrist

Wrist badge, attached to a band similar to a "watch band", will provide deep and shallow dose.



On the extremites

The sachet is attached to the finger with a velcro fastener and can be immersed in water without damage.

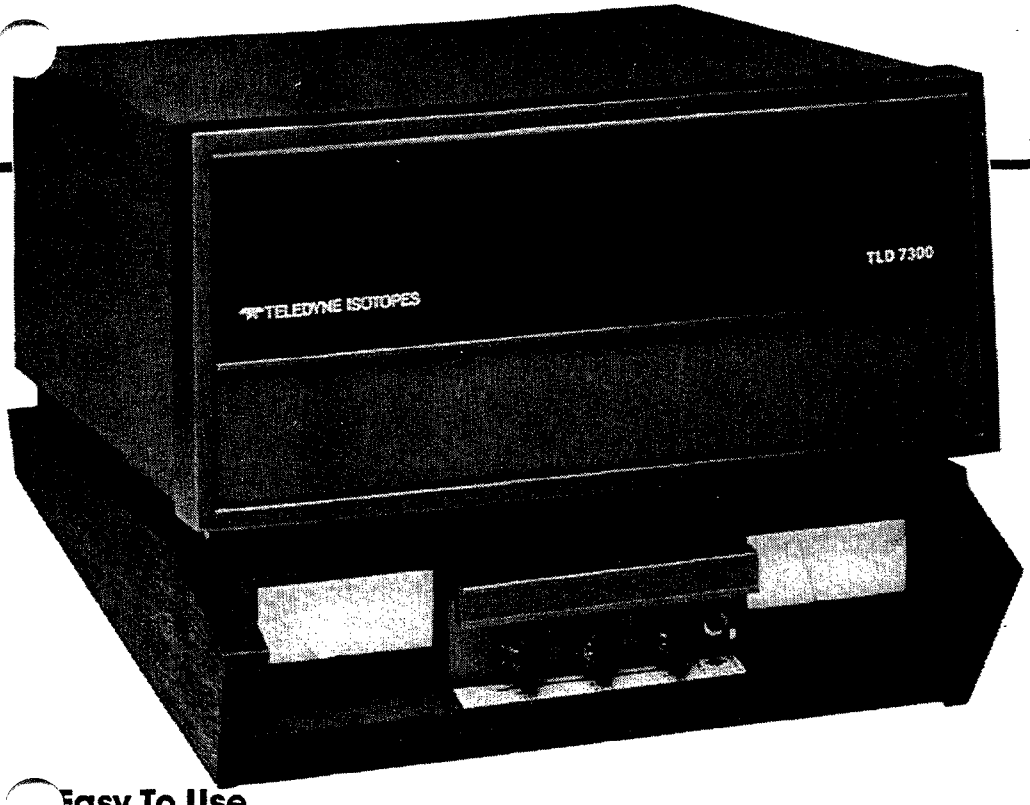
On the lapel

Whole-body badge case can be supplied in various colors, including blue, black, red, yellow and green.

On the hand

With the ring badge, the dosimeter is protected from dirt and water and is convenient to wear.

7300 TLD READER



A versatile, reliable TLD analyzer for demanding laboratory requirements

The Teledyne Isotopes 7300 TLD Reader has been engineered with an exceptional range of quality features. It combines programmed and research cycles to consistently deliver accurate and reliable Thermoluminescent Dosimeter readings in a variety of applications.

Easy To Use

The smart design of the Teledyne Isotopes 7300 TLD Reader goes beyond sophisticated applications engineering — it's convenient and easy to operate too.

Here's why the 7300 Reader is the smart choice:

- **Easy-to-reach controls.** All controls are front panel mounted except the on-off switch.
- **Easy-to-remove heating elements.** The entire element containing the dosimeter is removed after readout — even powders are processed easily.
- **Easy manual control.** The operator has the option of fully controlling sensitivity, pre-heat and readout temperature by setting the front control range switch at "Manual."
- **Easy built-in annealing.** Annealing in an oven is not required to reuse dosimeters, if the dosimeter has been exposed to less than 10R.

Versatile, Precise

The Teledyne Isotopes 7300 TLD Reader has the features you need for flexibility and accuracy in the laboratory.

Here are the reasons why you can depend on the 7300 Reader in demanding applications:

- **Built-in calibration** maintains a constant light source reading to give you high-precision measurement
- **Patented Inert gas flow** gives you stable, accurate readout low doses
- **Rapid, electronically-controlled readout** is available for a wide variety of dosimeters, even powders, Teflon discs and rods, hot pressed chips, extruded rods, and sintered chips
- **Thermocouple sensor and feedback control** give you accurate display and control of dosimeter temperature
- **Fast-response thermocouple control** gives you precise dosimeter heating
- **Programmed and research cycles** allow routine measurements or research and teaching applications

Designed For Your Application

Health Physics

Airborne radioactivity monitoring
Astronautical dosimetry
Critical dosimetry
Environmental monitoring
Extremity monitoring
Personnel monitoring
Shield studies

Medical Physics

Clinical radiology
Internal emitter dosimetry
In-vivo tissue and bone dose
Phantom dosimetry
Therapy monitoring

Experimental Physics

High-energy physics studies
Mixed-field dosimetry
Radiation damage studies
Source calibration

THE TLD SYSTEM 300

TELEDYNE ISOTOPES

The most accurate and reliable system for personnel and environmental monitoring!

The TLD system 300 incorporates a TLD reader, computer, software, TLD cards, badge cases, automatic irradiator and automatic issuing/packaging machine. Designed to meet the increasing need for improved TLD technology and to comply with current and proposed standards, the TLD System 300 is accurate, efficient, reliable, automatic, convenient and cost-saving.

Accurate. A highly sensitive phosphor, 30 times more sensitive than lithium fluoride or lithium borate, precisely measures exposures less than 100 mRem. The TLD card consists of 8 independent dosimeters, enabling a second analysis and additional energy information.

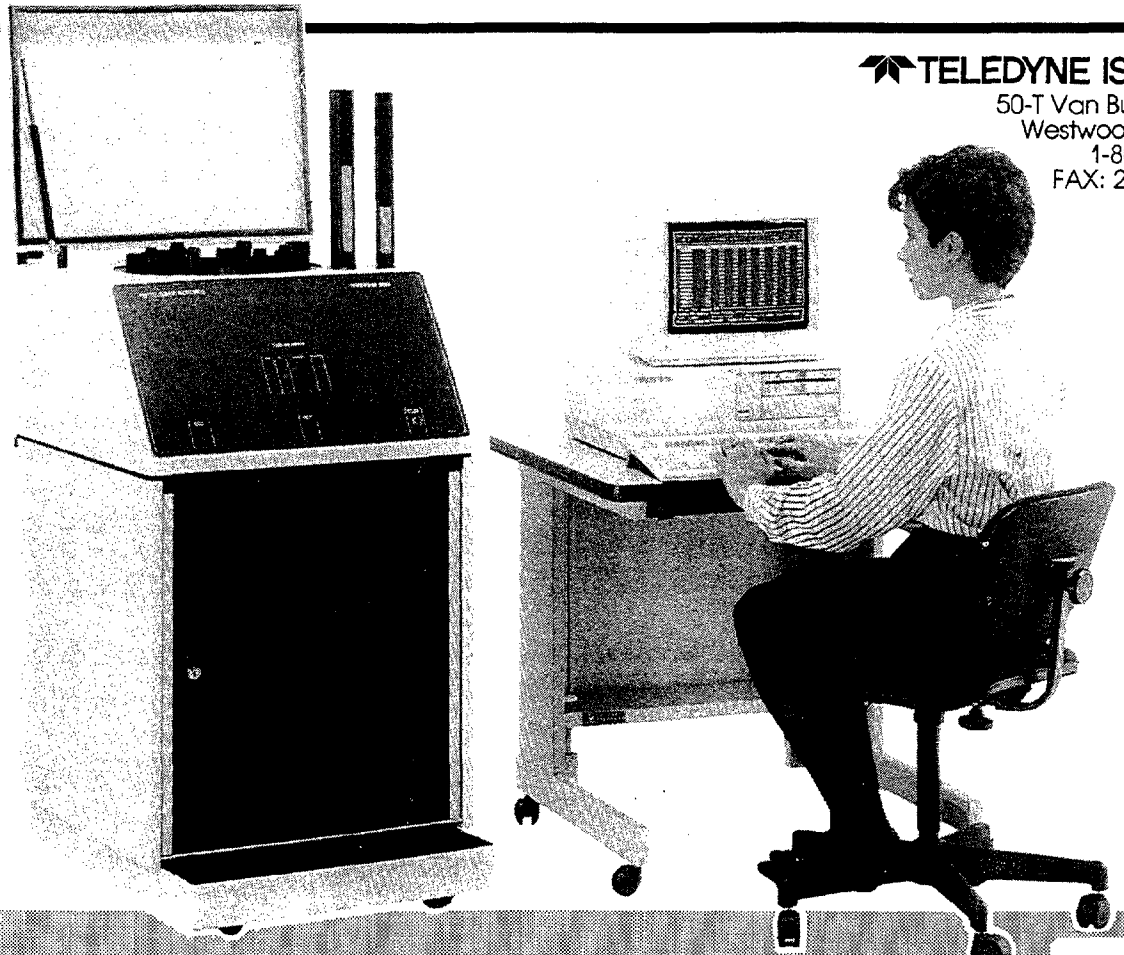
Efficient. A unique feature, "Standards on Demand", eliminates the need to manually intersperse calibration cards between samples. High speed and large capacity allow the cards to be processed quickly with minimal operator intervention.

Reliable. The dosimeters are securely held in an Teflon-coated aluminum substrate, guaranteed for 500 uses. Each dosimeter is a solid disc with the phosphor bound in a Teflon matrix, a proven technology developed over the last 25 years. This process avoids the problems associated with powder dispersed in other media. The phosphor is non-hygroscopic and exhibits a minimal amount of fade so it can be used at high temperatures and read out immediately after irradiation without averse affects.

Automatic. Automation is incorporated into every facet of System 300, including automatic calibration and daily check. The irradiator and issuing/ packaging machine eliminates hours of tedious, manual effort.

Convenient. Small, lightweight badge cases and cards are simple to handle, easy to wear. Cards are available in a variety of colors to distinguish types, and bar coding permits scanning for inventory control.

Cost-Saving. The use of advanced technology and high reliability makes System 300 economical to purchase and maintain. These cost savings make it easy for any laboratory to convert from film to TLD.



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ISOTOPE GEOCHEMISTRY

TELEDYNE ISOTOPES

A staff of geochemists, experienced and fully trained to give your sample the careful attention it requires.

- Consultation is available to help you determine the best techniques to use for sample collection, preparation, and analysis.
- Mineral separations will be performed for you, if required.
- After sample analysis, we can help you interpret the data as it applies to the solution of your particular problem.

Analytical Services for geochronology and isotope geochemistry

Since 1955, geologists, geochemists, geological engineers, archaeologists...a world-wide community of scientists...have utilized Teledyne Isotopes laboratories for their geochronological and isotope geochemical analyses.

Our laboratories are at your service, fully staffed and equipped to offer analyses and data interpretation for:

GEOCHRONOLOGY K-Ar Rb-Sr U-Pb Pb-Pb

ISOTOPE GEOCHEMISTRY Strontium Lead

RADIOISOTOPE ANALYSIS

- Performed on a wide range of naturally occurring isotopes such as ^{210}Pb, ^{226}Ra, ^{222}Rn, and Tritium.
- Performed on many artificial isotopes which can be introduced into natural systems as tracers for probing geological processes.

EXPLORATION PROGRAMS FOR MINING, OIL, GAS, AND GEOTHERMAL INDUSTRIES

Advanced analytical techniques are brought within the reach of geologists, archaeologists, anthropologists, petrologists, stratigraphers, volcanologists, hydrologists, and oceanographers throughout the world.

Meticulously maintained laboratories that are organized to provide individualized handling for your sample. From the day of its arrival at Teledyne Isotopes, your sample is processed by specialists using modern equipment under ultra-clean conditions.

Analytical equipment that is known by the geological community to be state-of-the-art. The three solid-source mass spectrometers are of NBS design. They are computer-controlled and provide on-line data reduction. The two gas mass spectrometers are AEI MS-10 static-vacuum models.

The procedures followed at Teledyne Isotopes incorporate the use of NBS standards and internationally recognized reference materials as a constant monitor of our precision and accuracy.

TELEDYNE ISOTOPES

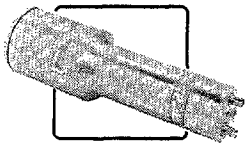
Scintillation Crystals

The fact that certain crystals emitted light when exposed to nuclear radiation was recognized by Roentgen in 1885. Although this scintillation effect was first observed in natural crystals, synthetic crystals produced in laboratories are more nearly perfect and consequently, give superior performance.

Today, scintillation crystals coupled with photomultiplier tubes have become the most common method for measuring the spectrum and intensity of radiation. The Teledyne Isotopes Crystals Division is a leader in their production.

Thallium activated sodium iodide crystals are produced in a wide variety of sizes and shapes for detecting and measuring high or low energy gamma radiation, high energy heavy particles, and medium or high energy beta rays.

Low-Background Assemblies



EXTERNAL SOURCES

Radioactivity arising from the environment outside the detector system: cosmic radiations, radiations from the material environment, and manmade contaminations.

By providing the proper shielding for NaI (Tl) Detectors, you can sustantially reduce the background arising from external sources. However, the shield itself can contribute to the total background of the detector system.

ELECTRONIC NOISE

Spurious signals that originate in the photomultiplier tube or in the electronic circuitry.

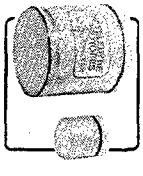
Teledyne Isotopes offers specially designed equipment to minimize electronic noise.

INTERNAL SOURCES

Radioactivity inherent in the detector materials.

The background from internal sources can be controlled, to a great extent, by the materials used to make the detector itself. Internal background can arise from the crystal material, the container or housing material, the optical window, and the photomultiplier tube material.

Standard NaI (Tl) Detectors

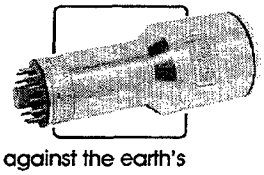


Teledyne Isotopes Standard Detector assemblies offer flexibility. You can couple the crystal to a photomultiplier tube of your own choice, or you may prefer using a series of different Standard Detectors with one or more basic photomultiplier tubes.

Our detectors feature thallium-activated sodium iodide crystals which have been grown from high purity material under rigidly controlled conditions. The smaller assemblies, listed below, are immediately available from stock. Custom sizes are available on order.

All crystals in this series are hermetically sealed in spun aluminum housings. Copper or stainless steel housings are available as extra-cost options when your needs require low-background assemblies.

Integral NaI (Tl) Detectors



The Integral Detector assemblies manufactured by Teledyne Isotopes are hermetically sealed units containing a NaI (Tl) crystal optically coupled to a photomultiplier tube.

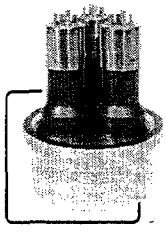
Integral assemblies are designed for crystals up to 3" in diameter. (Unitized Detector assemblies are designed to make optimum use of larger diameter crystals.)

An internal magnetic shield is built into each Integral Detector. This shield is sufficient protection against the earth's field, but an external magnetic shield may be ordered as an extra-cost option if required.

Other custom options include:

Copper or stainless steel housings, Voltage divider with or without preamplifier, Quartz light pipes and Focus and gain controls.

TELEDYNE ISOTOPES



Unitized NaI (Tl) Detectors

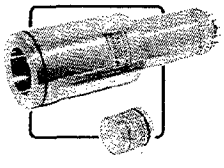
Unitized Detector assemblies assure optimum utilization of scintillation crystals that are 4" or more in diameter. These larger crystals offer significant advantages in the detection of low levels of high energy nuclides.

To achieve superior performance with larger crystals, Teledyne Isotopes has extended the unitized concept of detector assembly to include multiple photomultiplier tube configurations for use with crystals larger than 5" in diameter.

In each Unitized Detector assembly, an optically matched photomultiplier tube (or tubes) is bolted to a separately housed crystal. This arrangement has several advantages. Most important is the superior performance obtained by specifying and matching photomultiplier tubes. Optical coupling problems are minimized and enhanced resolution is achieved.

Another advantage is that photomultiplier tubes can be easily replaced without exposing the crystal. External and internal shields are standard unitized assemblies.

Extra-cost options include: Copper or stainless steel housings, Voltage divider with or without preamplifier and Focus and gain controls

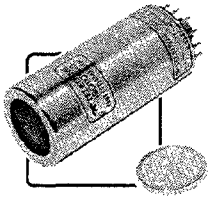


Well-Type NaI (Tl) Detectors

A well-type receptacle in a NaI (Tl) Detector provides maximum absorption of radiation from a sample by approximating 4π geometry.Teledyne Isotopes well-type assemblies satisfy those medical and industrial applications which require high efficiency in counting low levels of gamma activity.

Parts for well-type models of Standard and Integral Detectors are maintained in stock for fast delivery.

NaI (Tl) crystals can be custom cut to your specifications to provide the well dimension necessary for your particular application. If you require a well receptacle in a crystal more than 3" in diameter, the detector will be made according to our unitized assembly standards.

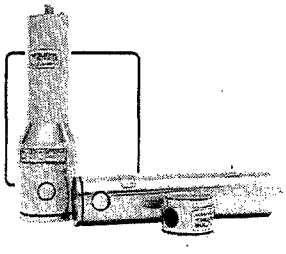


Thin Crystal Detectors

Hand cleaved NaI (Tl) crystals present a single face to minimize backscattering. Teledyne Isotopes produces a wide range of hand cleaved, thin crystal detectors especially suited to applications such as X-Ray studies and Mossbauer-effect experiments.

Only 1-6 mm thick and 2" or less in diameter, these thin crystals are available in Standard and Integral assemblies. Specially sized thin crystals are available on request.

Choose Aluminum or Beryllium for the radiation entrance window material. Standard thickness is .005 inches. Other thicknesses are available at extra cost.



Hole-Through NaI (Tl) Detectors

Hole-through detectors, by their design, approximate 4π geometry at close to 100% efficiency. The hole-through feature also permits analysis of a flowing medium.

Teledyne Isotopes offers hole-through crystals in both Standard and Integral Detector assemblies. All hole-through crystals are custom-made to meet your particular specifications.

Guarantee

All Teledyne Isotopes scintillation crystals are unconditionally guaranteed for one year against defects in materials and workmanship.

The photomultiplier tube manufacturer's warranty is extended from date of shipment from Teledyne Isotopes.

All guarantees are void if failure occurs due to modifications of crystal assembly, faulty installation, improper operating conditions, or damage caused by improper handling. No other warranty is implied.

SERVING YOUR NEEDS IN NUCLEAR FUELS ANALYSIS

TELEDYNE ISOTOPES

The mass spectrometry specialists at Teledyne Isotopes offer a complete range of analytical services to meet your needs, from fabrication to reprocessing of irradiated fuels.

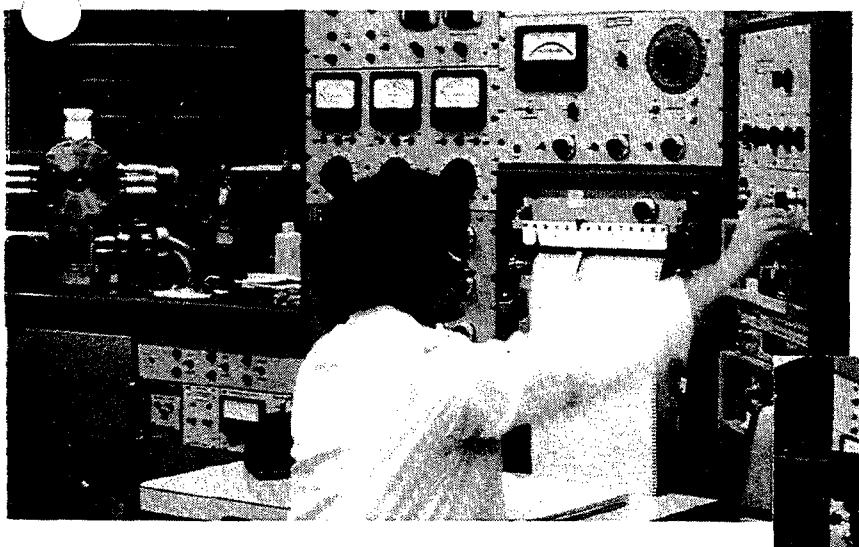
Applications

- Milling, refining and alloying
- Fuel procurement and preparation
- Fuel element fabrication and cladding
- Reprocessing and recovery of irradiated fuels
- Impurity specification analyses and quality control
- Research on reactor operations, special fuel types, and burn-up studies
- Referee Analysis for settling shipper-receiver differences

Teledyne Isotopes offers precision isotopic analyses for uranium, plutonium, boron, rare-earths, lithium, and hafnium. Trace analyses of uranium, plutonium, and boron in various matrices, utilizing the isotope dilution method, are also available.

Samples are accepted in various forms:

Scrap recovery samples	Irradiated solutions	UF_4 and UF_6	Sludges	Oxides
Acid salts and solutions	Organic Solutions	Ceramics	Alloys	Metals



Our laboratories include three N.B.S. designed Thermal Ionization Mass Spectrometers calibrated to National Bureau of Standards reference materials.

Call or write for further information.

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50 Van Buren Avenue
Westwood, NJ 07675
1-800-666-0222
FAX: 201 664-5586

RADIOISOTOPIC TRACING SERVICES

TELEDYNE ISOTOPES

PROTRACE - PROCESS TRACING SERVICES

USE SHORT-LIVED RADIOISOTOPES TO TRACE

- Flow Rates
- Residence Time Distribution
- Multiphase Differential Flow
- Density Distribution

Process tracing provides accurate data for analysis flow and residence times in refinery and chemical processing systems. Short-lived gaseous, liquid and solid state radioisotopes safely provide real time information on flow regimes under actual operating conditions without requiring sampling or off-site analysis.

Teledyne Isotopes specializes in high speed data acquisition with high resolution and high sensitivity detector systems. We have over nine years of international experience in tracing systems ranging from bench-scale research to full-scale refinery production facilities. Applications have included fluidized catalytic cracking units, oil shale retorts, coal liquefaction pilot plants and other research applications.

TELETRACE - RESERVOIR FLUID TRACING

Radioisotope tracers reveal fluid movement. ....and industry studies agree:

"...The radioactive tracer study is regarded as one of the most useful tools employed in describing the reservoir and, later, in controlling fluid flow within it.
....tracers are of greatest utility in revealing problems with which the reservoir engineers must cope."

*SPE 8432 (1980)

"...Tracers provide a means of determining the source of water breakthrough, so that injection rates can be adjusted to avoid trapping oil behind the advancing flood fronts."

*SPE 9476 (1981)

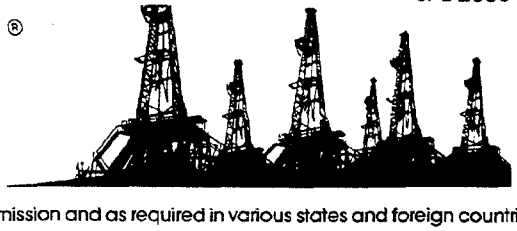
"..Radioactive tracer material introduced at the injection well and identified at the producing well provides the flow direction and rate of movement of injected fluids."

*SPE 8434 (1981)

"...The configuration of displacement fronts, variations in sweep patterns, and fluid movements in general, can be detected by radioactive tracer techniques. ...Multiple tracer injections at a single source can be used to measure the relative velocities of injected fluids behind the displacement fronts."

*SPE 2853 (1970)

ELE TRACE®



Licensed by the US Nuclear Regulatory Commission and as required in various states and foreign countries.

Typical Teletrace® Applications

- Water Floods
- Gas Floods
- Surfactant/Polymer Floods
- Miscible Displacement
- Pressure Maintenance
- Determination Of Water Or Oil Saturation In Cores
- Caustic Floods
- In-Situ Combustion
- Steam Drive
- Co_2 Or N_2 Injections
- Gas Storage Projects
- Geothermal Investigations & More Innovative Uses

Alabama	Louisiana	Ohio	Canada
Alaska	Michigan	Oklahoma	Colombia
Arkansas	Mississippi	Texas	Greece
California	Montana	Utah	Malaysia
Colorado	Nevada	West Virginia	North Sea
Florida	New Mexico	Wyoming	Saudi Arabia
Illinois	New York	Dubai, U.A.E.	Venezuela
Kentucky	North Dakota	Algeria	

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"Serving the Nuclear Industry for 35 Years"

Equipment Used In Instrumental Analysis And Quantitative Radiation Measurment

I Gamma Ray Spectroscopy Laboratory

Manufacturer	Item Description	Model No.	Quantity	Date Purchased
Nuclear Data	Gamma Spectroscopy System	ND-6620	1	Sep-79
Nuclear Data	Gamma Spectroscopy System	ND-6620	1	(acquired) Jun-83
Nuclear Data	Gamma Spectroscopy System	ND-6620	1	(acquired) Jun-83
Nuclear Data	Gamma Spectroscopy System	ND-6700	1	Jan-87

High Resolution Germanium Detectors used with above listed systems.

Manufacturer	Detector Type	Serial No.	Efficiency	Date Purchased
PGT	Ge(Li)	1451	17.63%	Feb-78
PGT	Ge(Li)	1653	16.00%	Jun-79
PGT	Ge(Li)	1732	20.80%	May-80
PGT	Ge(Li)	1602	17.00%	Oct-80
Canberra	Ge(Li)	1835	20.00%	Apr-83
Ortec	HPGe	23P064A	23.10%	Apr-83
Ortec	HPGe	2365	22.30%	May-83
PGT	Ge(Li)	1640	20.20%	(acquired) Jun-83
PGT	Ge(Li)	1496	19.41%	(acquired) Jun-83
PGT	Ge(Li)	1637	25.80%	(acquired) Jun-83
Canberra	HPGe	883883	19.20%	Aug-83
Canberra	HPGe	883874	19.20%	Aug-83
Canberra	HPGe	7841057	21.00%	Oct-84
Ortec	HPGe	26P57MB	27.10%	Dec-86

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Manufacturer	Detector Type	Serial No.	Efficiency	Date Purchased
Canberra	HPGe	12892256	30.20%	Dec-89
Tennelec	HPGe	6015	49.40%	Feb-90
Ortec	HPGe	30TP40151A	30.40%	Apr-90
Ortec	HPGe	30TP10635B	26.80%	Oct-90
Ortec	HPGe	30TP10630B	28.40%	Oct-90
Ortec	HPGe	30TP30563A	27.20%	Oct-90
Ortec	HPGe	31TP10712A	32.20%	Jul-91
Ortec	HPGe	31TP20610B	32.20%	Jul-91
Ortec	HPGe	31TP10727B	40.40%	Dec-91
Ortec	HPGe	31TP10768B	41.50%	Dec-91
Ortec	HPGe	31TP10760A	32.30%	Mar-92
Ortec	HPGe	31TP20651A	32.00%	Mar-92
Ortec	HPGe	31TP20654A	36.00%	Mar-92
Ortec	HPGe	31TP40312B	36.70%	Mar-92
Ortec	HPGe	33TP10933A	35.80%	May-93
Ortec	HPGe	33TP10937B	35.60%	May-93
Ortec	HPGe	33TP10938A	36.10%	May-93
Ortec	HPGe	33TP20784A	50.20%	May-93

Scintillation Detectors used on the ND6700 System

Manufacturer	Detector Type	Model No.	Quantity	Date Purchased
Teledyne Isotopes	NaI(Tl) 3x3	S-1212-I	16	Jun-87
Teledyne Isotopes	NaI(Tl) 3x1	S-1204-I	4	Jun-89
Teledyne Isotopes	NaI(Tl) 3x3/4	S-1203-I	4	Jun-89

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II Alpha Spectrometry

Manufacturer	Item Description	Model No.	Quantity	Date Purchased
Canberra	Multichannel Analyzer	S100	2	Aug-90
Canberra	Multichannel Analyzer	S100	1	Jun-92
Canberra	Multichannel Analyzer	S100	2	Oct-92
Canberra	Integrated ADC-Mixer/Router	1520	2	Aug-90
Canberra	Integrated ADC-Mixer/Router	1520	1	Jun-92
Canberra	Integrated ADC-Mixer/Router	1520	2	Oct-92
Canberra	Quad Alpha Spectrometer	7404VR	2	Dec-83
Canberra	Quad Alpha Spectrometer	7404VR	1	Feb-84
Canberra	Quad Alpha Spectrometer	7404	3	Jan-90
Canberra	Quad Alpha Spectrometer	7404	2	Aug-90
Canberra	Quad Alpha Spectrometer	7404	2	Dec-91
Canberra	Quad Alpha Spectrometer	7404	4	Jun-92
Canberra	Quad Alpha Spectrometer	7404	6	Oct-92
Canberra	Partially Depleted Silicon Surface Barrier Detectors	PD-300-24-100	4	Feb-84
Canberra	Passivated Implanted Planer Silicon (PIPS) Detectors	SPD-300-21-100	12	Jan-90
Canberra	Passivated Implanted Planer Silicon (PIPS) Detectors	SPD-300-19-100	8	Aug-90
Canberra	Passivated Implanted Planer Silicon (PIPS) Detectors	SPD-300-19-100	16	Dec-91
Canberra	Passivated Implanted Planer Silicon (PIPS) Detectors	SPD-300-19-100	16	Jun-92
Canberra	Passivated Implanted Planer Silicon (PIPS) Detectors	SPD-300-19-100	24	Oct-92

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III Radiochemistry

Manufacturer	Item Description	Model No.	Quantity	Date Purchased
Tennelec	Automatic Low Background Alpha/Beta Counting System	LB 5100-1	1	(acquired) Jun-83
Tennelec	Automatic Low Background Alpha/Beta Counting System	LB 5100-2	1	May-85
Tennelec	Automatic Low Background Alpha/Beta Counting System	LB 5100-3	1	Mar-90
Gamma Products	Automatic Low Background Alpha/Beta Counting System	G 5000/40	1	Mar-91
Gamma Products	Automatic Low Background Alpha/Beta Counting System	G 5000/100	1	Sep-91
Berthold	10 Channel Low Level Counter	LB 770-2	1	Aug-87
Berthold	10 Channel Low Level Counter	LB 770-2	1	Apr-89
Berthold	10 Channel Low Level Counter	LB 770-1	1	Jan-91
Berthold	10 Channel Low Level Counter	LB 770-1	1	May-92
Scintrex	Uranium Analyzer	UA-3	1	(acquired) Jun-83
Packard	Liquid Scintillation Spectrometer	2500 TR/AB	1	Sep-92
Canberra	Multichannel Analyzer	Series 35 Plus	1	
Teledyne Isotopes	Low Energy X-ray Spectrometer	none	1	Jun-84
Teledyne Isotopes	Low Energy X-ray Spectrometer	none	3	May-93
Hewlett Packard	Micro Computer	86B	1	Mar-84

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III Radiochemistry (con't)

Manufacturer	Item Description	Model No.	Quantity	Date Purchased
Hewlett Packard	Micro Computer	87XM	1	Jul-82
Hewlett Packard	Micro Computer	87XM	1	Jun-91
Mettler Instrument	Analytical Balance	Type B-5	1	
Mettler Instrument	Analytical Balance	AC100	1	(acquired) Jun-83
Orion Research	Digital Ionalyzer	501	1	Jun-85
Orion Research	Microprocesser Ionalyzer	901	1	(acquired) Jun-83
Corning	pH meter	10	1	
Teledyne Isotopes	Beta/Gamma Coincidence with Canberra Series 30 MCA	none	1	Jun-82

IV Tritium

Manufacturer	Item Description	Model No.	Quantity	Date Purchased
Tennelec	GM Tube Preamplifier	TC-149	4	Mar-76
Tennelec	Preamplifier	TC-175	4	Mar-76
Tennelec	Low/Wide Beta Amp/SCA	TC-165	4	Mar-76
Tennelec	Guard Gate Generator	TC-430	4	Mar-76
Tennelec	Multiscaler	TC-535P	4	Mar-76
None	One-liter Proportional Detector	None	4	
John Fluke	High Voltage Power Supply	410B	3	Jan-81
Power Designs	High Voltage Power Supply	1543C	1	Feb-88
Packard	Low Level Liquid Scintillation Counter	2250 CA	1	Dec-92
Packard	Low Level Liquid Scintillation Counter	2550 TR/LL	1	Nov-91

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V Radium 226

Manufacturer	Item Description	Model No.	Quantity	Date Purchased
Canberra	Amp/Discriminator	2012/2032	4	
Canberra	Preamp/Amp/Discriminator	814	6	Apr-86
Canberra	Dual Counter Timer	1790C	2	
Canberra	Dual Counter Timer	2071A	5	Apr-86
Canberra/Ortec	Bin/Power Supply	1400/2000/401A	3	Apr-86
Teledyne Isotopes	Alpha Counting Chamber	none	5	
Teledyne Isotopes	Alpha Counting Chamber	none	5	Jun-91
Power Des./Bertan	High Voltage Power Supplies		3	
Canberra	High Voltage Power Supplies	3002/3102/3005	3	

VI Krypton-85 -- Carbon-14 (Performed in Gas Analysis)

Manufacturer	Item Description	Model No.	Quantity	Date Purchased
Canberra	Universal Counter/Timer	1790	4	Feb-81
Canberra	Logic Shaper and Delay	2055-S8	1	Feb-81
Canberra	Spectroscopy Amplifier	2011	4	Feb-81
Canberra	Constant Fraction Timing SCA	2035A	4	Feb-81
Canberra	Discriminator	1432	1	
Canberra	Preamplifier	1406	4	
Reuter Stokes	100cc Proportional Counter	unknown	4	
Power Designs	High Voltage Power Supply	HV-1545	1	
Power Designs	High Voltage Power Supply	2K20	1	
Aerograph	Gas Chromatograph	A-90-P3	1	
Hewlett Packard	Gas Chromatograph	5720A	1	

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TELEDYNE
BROWN ENGINEERING
Environmental Services

CERTIFICATIONS

State of New Jersey - Department of Environmental Protection & Energy
Certified Water Laboratory

State of New Jersey - Department of Health
Clinical Laboratory License

U.S. Department Health & Human Services
Clinical Laboratory Improvement Act (CLIA) License

Army Corp of Engineers
Radiometric Analysis Certification

State of Delaware - Health and Social Services
Drinking Water Certification

State of California - Department of Health Services
Radon Certification

State of New Jersey - Department of Environmental Protection & Energy
Radon Certification

State of Tennessee - Department of Health
Radiometric Analysis Certification

State of West Virginia - Department of Health and Human Resources
Radiometric Analyses

RESUME

Hewitt W. Jeter, Ph.D., Senior Scientist

Employment Experience
1972 - Present

TELEDYNE BROWN ENGINEERING
Environmental Services
Manager of the Radiochemistry Laboratory. Responsibilities include supervision of the technicians who perform chemical separations of various nuclides on a variety of sample types. Subsequently, radioactive measurements are performed using nuclear instrumentation. Also responsible for developing new radiochemical procedures, maintaining quality control and instrument calibration and scheduling laboratory production.

Also participated in geophysical research projects for the U.S. Department of Energy while at Teledyne Isotopes. These projects involved the mathematical simulation of uranium ore deposits using finite-difference computer methods. Results were documented to the DOE in "A Modeling Study of Gaseous Rn-222, Xe-133 and He-4 for Uranium Exploration", 1980. He also worked on a mathematical simulation of dissolved species in rivers which was funded by the federal Environmental Protection Agency for predicting pollution levels.

1963 - 1967

United States Navy

Education:

Oregon State University, Corvallis, Oregon
Ph.D. Oceanography - 1972

Yale University, New Haven, Connecticut
B.E. Chemical Engineering - 1963

Special Honors:

Author of papers on oceanic measurement methods and is co-inventor of the "Expendable Bathyoxymeter" rapid survey device for dissolved oxygen structure studies at sea. He is currently listed in "American Men and Women of Science" and "Who's Who in Technology Today"

RESUME

John David Martin, Ph.D., Manager Environmental Analysis

Employment Experience 1974-Present

TELEDYNE BROWN ENGINEERING
Environmental Services
Manager of the Environmental Analysis Department: Dr. Martin is responsible for the overall management of the radiological environmental monitoring programs, reactor in-plant monitoring programs, and bioassay programs for nuclear power facilities. The Environmental Analysis Department is composed of five laboratories: Radiochemistry, Gamma-ray Spectroscopy, Tritium Analysis, Alpha Spectroscopy, and Gas Analysis. Dr. Martin's responsibilities also include the management of the Radiocarbon Laboratory, TeleTrace® operations, and Environmental TLD Badge Service. Dr. Martin joined Teledyne Isotopes in 1970.

Dr. Martin directed and participated in the research and development of various nuclear instrument counting systems under a U.S. Government contract at Teledyne Isotopes. Included was the development of a low background gas proportional spectrometry system for conducting measurements of gaseous radio nuclides produced by cosmic interactions in the troposphere.

1968-1970

McCLELLAN CENTRAL LABORATORY, McCLELLAN AIR FORCE BASE
Physicist - In his capacity as physicist Dr. Martin assisted in the development of new techniques for measuring the radioactivity of various elements. Emphasis was on the gaseous elements using liquid scintillation and solid state detection systems.

1966 (summer)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
Physicist - Engaged in an atmospheric light scattering experiment for the purpose of determining the molecular number density as a function of the height above the surface of the earth.

Education

University of Florida
Gainesville, Florida
Ph.D. Physics 1967

College of William and Mary
Williamsburg, Virginia
M.A. Physics 1963

Virginia Military Institute
Lexington, Virginia
B.S. Physics 1961

Professional Affiliations

American Physical Society
Sigma Pi Sigma

RESUME

Jeffrey M. Guenther, QA Manager

Employment Experience 1990-Present

TELEDYNE BROWN ENGINEERING
Environmental Services
Quality Assurance Manager - Responsible for performing the functions for attaining quality including assurance that an appropriate QA program is established and executed, performing internal audits, verifying that sufficient controls and calibrations are performed and assuring that all programs are documented and controlled. Additional duties include writing monthly reports to the president of Teledyne ~~Isotopes~~ regarding the status of the QA program and any problems encountered or corrective actions necessary, analyzing results of spiked, blank, replicate and EPA samples, assisting in audits by contractors, checking and approving procedures, writing and revising QA and QC manuals, approving acceptance criteria for laboratory equipment and practices, training personnel in QA functions and approving data before final reports are reduced and delivered to contractors.

1989-1990

CINTICHEM
Health Physicist - Responsible for the development, implementation, evaluation, investigation, follow-up and/or performance of site radiation and industrial safety programs/operations regarding ALARA principles, regulatory requirements, and health, safety and environmental considerations.

1983-1989

TELEDYNE ISOTOPES
Health Physicist - Responsibilities included supervision of staff technicians, commercial services, in-house health physics, licensing and duties of the Alternate Radiation Safety Officer. Commercial services include radiation safety surveys, air sampler installation, sealed source leak testing, x-ray surveys, facility decontaminations, review of survey reports and consulting. Maintain the radiation safety program for several broad scope by-product material licenses, a special nuclear material license, a source material license and New Jersey and Illinois State licenses.

Special assignments included providing technical support for radioactive tracer projects including design, licensing, reciprocity, safety and effluent analyses with dispersion modeling and performing the on-site health physics and training for the projects throughout the United States and internationally.

Education

Rutgers University
New Brunswick, New Jersey
MS Candidate in Radiation Science (August 1991)

Trenton State College
Trenton, New Jersey
BA Physics 1981

Other: Mr. Guenther attended a one week workshop titled "In-place Filter Testing" at Harvard School of Public Health - 6/87 and a one week course titled "Auditing Nuclear Quality Assurance Programs" given by STAT-A-MATRIX - 7/90.

Professional Affiliations

National Health Physics Society - member since 1983
New Jersey Chapter of the Health Physics Society - member since 1984
Northern NJ Section of the American Nuclear Society - member since 1990
American Nuclear Society - member since 1991.
American Society for Quality Control - member since 1991.

RESUME

JAMES D. BUCKLEY - SENIOR ASSOCIATE SCIENTIST

Employment Experience
1065 - Present

TELEDYNE BROWN ENGINEERING
Environmental Services
Chemist and geologist supervising the Radiocarbon Dating and Tritium Sections and the Alpha Spectroscopy sections of the Scientific Services Department. Responsibilities include management of the largest commercial radiocarbon dating laboratory in our country and supervision of the analytical work in the Tritium Section. Supervises the complete process, preparation and analyses of various materials for radiocarbon activity and low-level environmental tritium measurements.

Field sampling, separation and analysis of radionuclides in the atmosphere and in groundwater for the verification of nuclear weapons testing at the Nevada Testing Site. Also involved in the analyses of nuclear reactor core fuels, cladding materials, poisons, light isotope ratios and specific analyses required for various age determination techniques.

Also provides health physics and field services for radiometric tracer services to the gas and petroleum industry.

1963-1965

ESSO PRODUCTION RESEARCH LABORATORY
Research Technician. Specialist engaged in determining the basic physical chemistry properties of liquids used to develop biodegradable detergents.

Education

Upsala College
East Orange, NJ
Bachelor of Science Degree
Chemistry and Geology

Graduate Studies: University of Maine
Seton Hall University

Professional Affiliations

American Chemical Society
American Archaeological Society
Geologic Institute of America

Also, compiled several radiocarbon lists which have been published by the American Journal of Science. These lists are annual compilation's of carbon-14 ages determined for the worldwide community of scientists working with radiocarbon dating.

RESUME

Ann W. Alston, B.S., Assistant Scientist

Employment Experience 1967-Present

TELEDYNE BROWN ENGINEERING
Environmental Services
Mrs. Alston is Supervisor of the Radiochemistry Laboratory of the Environmental Analytical Department. Responsibilities are to plan, coordinate, and supervise the activities of the lab technicians and to train lab personnel in chemical procedures and techniques. Responsible for testing new chemical procedures and prepares quality control samples, blanks and standards.

Prior to her present position, Mrs. Alston had varied analytical experience in the separation and purification of compounds prior to analysis by Mass Spectrometry. This analytical experience has given her considerable competence in a wide range of environmental materials, nuclear fuels materials and bioassay analysis.

1961-1967

Continental Oil Company
Technician in their testing laboratory. She was assigned to a group making evaluations on the performance and reliability of detergents formulated and produced by the company.

1957-1961

Ledoux and Company
Junior Chemist in their analytical laboratories. She did testing and analysis of various organic and inorganic materials in the metallurgical field, using gravimetric, colormetric and titrimetric methods.

1953-1957

Columbia Mineral Beneficial Company
Junior Chemist, analyzing highly radioactive materials for an AEC-sponsored project. Qualitative and quantitative analyses were made on organic and inorganic samples supplied by the AEC, with uranium being the element of greatest interest.

Education

Bennett College
Greensboro, North Carolina
B.S. Degree in Environmental Science

Columbia University
New York, New York
Graduate work in the Biological Sciences

Special Recognition

Recipient of Teledyne Isotopes' Employee of the year Award for 1982, to honor her outstanding achievement in the area of her responsibilities.

RESUME

Lewis F. Casabona, Manger - Mass Spectrometry Services

Employment Experience 1965 - Present

TELEDYNE BROWN ENGINEERING
Environmental Services
Manager of the Mass Spectrometry Services Department which consists of Nuclear Fuels Analysis, Isotope Geochemistry and Precious Metal Processing. Responsibilities include the direction of isotopic and concentration measurements of nuclear materials and geological samples and the recovery and processing of precious metals for the U.S.D.O.E. Additional responsibilities include the technical supervision, customer relations and marketing of these services to the nuclear industry. Previous assignments include supervision of the radiochemistry laboratories for five years. Special Source Nuclear Materials accountability officer for Teledyne Isotopes since 1968 and a member of the Teledyne Isotopes Radiation Safety Committee since 1977.

1955-1965

LEDOUX & COMPANY
Laboratory Supervisor: In his capacity as supervisor he was responsible for performing quantitative analyses of ores, minerals and alloys utilizing such techniques as mass spectrometry, flame and emission spectroscopy, ion exchange chromatography, fluorimetry, gravimetric and columetric analyses.

Education

Fairleigh Dickinson University
Teaneck, New Jersey
B.S. Chemistry, 1967

Professional Affiliations

American Chemical Society - since 1980
Institute of Nuclear Materials Management - since 1968
Anerican Society for Mass Spectrometry - since 1974

Military 1957 - 1959

U.S. Army - assigned to a U.S. Army N.I.K.E. guided missle installation

RESUME

Alan W. Skaar, Systems Engineer

Employment Experience 1973 - Present

TELEDYNE BROWN ENGINEERING
Environmental Services

Mr. Skaar is presently responsible for the operation and maintenance of the complex counting systems employed by the Carbon-14, Tritium, Gas Analysis, Alpha/Beta, and Gamma-Ray Spectroscopy Laboratories at Teledyne Brown Engineering Environmental Services. He is also responsible for the development of necessary software for the operation of computerized systems.

1981-1982

During 1981-1982 he was responsible for the design, setup, and operation of the data acquisition and analysis system for the Exxon Coal Liquefaction Pilot Plant Tracer Project.

Earlier experience at Teledyne Isotopes involved supervising the Gamma-Ray Spectroscopy Laboratory. He was responsible for the operation and maintenance of the gamma-ray analysis systems and for coordination of sample counting and data reduction. The system is composed of lithium-drifted germanium detectors, multi-channel analyzers, minicomputers, and associated electronics.

Mr. Skaar has worked on a number of government-funded projects including Projects DOGS and NUPS, sponsored by the Advanced Research Projects Agency, during which time he gained much of his experience in high resolution gamma spectroscopy. Earlier assignments included Project ECHO, also sponsored by the Advanced Research Projects Agency, which was study of the propagation of long period acoustic gravity waves in the upper atmosphere. His responsibilities included operation and maintenance of a data acquisition system, covering a number of stations located within a 100 mile radius, and assisting in the data reduction analysis which was done on an IBM 360 Computer.

GLATT AIR TECHNIQUES

Additional expertise was gained at Glatt Air Techniques where Mr. Skaar was responsible for overseeing the installation, startup, and training of personnel in the use and servicing of Fluid Bed Granulating, Drying and Tablet Coating equipment in the United States and the Caribbean. This equipment was primarily used by the pharmaceutical and food industries and employs the use of complex pneumatic logic controlling systems.

Education & Training

Mr. Skaar is a graduate of RCA Institute where he completed Electronics Engineering Program (T-3)

Special Recognition

Recipient of the Teledyne Isotopes Employee of the Year Award in 1973.

RESUME

LINDA LEE TYNDALL - SUPERVISOR, Gamma Spectroscopy

Employment Experience
1980 - Present

TELEDYNE BROWN ENGINEERING
Environmental Services
Supervisor of the Gamma Spectroscopy Laboratory of the Environmental Analysis Department. Responsibilities include the scheduling of sample analyses for the gamma laboratory, preparation of samples, operation of the gamma ray systems and data computations. These systems are composed of lithium-drafted germanium detectors, multi-channel analyzers, mini-computers and associated electronics. Also performs calibration of the counting equipment and measurements of systems backgrounds. Supervision of the laboratory technicians working in the gamma spectroscopy laboratory.

Education

William Paterson College
300 Pompton Rd.
Wayne, New Jersey 07470
B.A. Degree
1970

Professional Affiliations

Health and Safety Committee since 1981.
American Association of Radon Scientists and Technologists.

RESUME

Al Hogan, Program Manager

Employment Experience 01/83-Present

TELEDYNE BROWN ENGINEERING
Environmental Services

Program Manager: In this capacity, Mr. Hogan has managed the Radiological Environmental Monitoring Programs (REMP contracts) for the Peach Bottom Atomic Power Station, Limerick Generating Station, Susquehanna Steam Electric Station, Nine Mile Point Nuclear Station, James A. Fitzpatrick Nuclear Power Plant, and the Salem Nuclear Generating Station for Teledyne Brown Engineering Environmental Services since 1983. This work requires interfacing with the utilities project engineers and the analytical laboratories at Teledyne Brown Engineering Environmental Services. Other aspects of REMP management include adherence to Quality Control and Quality Assurance requirements, report writing, technical audits based on Reg. Guide 4.15 and 10 CFR part 21, equipment calibrations and other qualifications.

Additional program management responsibilities include responding to requests for proposal, performing technical reviews and data validation for several large RCRA programs such as the U.S. Department of Energy (DOE) Paducah Gaseous Diffusion Program and the Rocky Flats Program.

Mr. Hogan's involvement in the radon department has been in the design and performance of numerous site qualifications for susceptibility to radon gas production using field surveys, geological studies, soil testing, radon gas collection, working level measurements and measurement and testing of existing structures. This concept, because it is an important tool for all developers, incorporates what is already known about the particular site (i.e.. geological, soil and uranium resource data) coupled with actual measurements collected on site.

Other work experience includes the performance of design and carrying out of land use surveys for the Calvert Cliffs Nuclear Plant. This involved a computer model for dose calculation based on information gathered during the land use survey. In addition to the land use surveys Al Hogan was responsible for performing numerous farm surveys for the Artificial Island Nuclear Plants. The information once again was used to calculate the maximum dose potential via computer model to the residents in the environs surrounding the nuclear facility.

Education

Mr. Hogan has completed three years toward a Bachelor's degree at St. Bonaventure University in Olean, New York.

Professional Affiliations

Health Physics Society, member since 1982.
American Chemical Society, member since 1983.
American Association of Radon Scientists and Technologists since 1987.

RESUME

Andrew J. Carmichael, Senior Associate Scientist

Employment Experience 1972 - Current

TELEDYNE BROWN ENGINEERING
Environmental Services
Supervisor of the Gas Analysis Laboratory of the Environmental Analysis Department and the TeleTrace® Project Coordinator. As Supervisor he is responsible for all phases of gas analyses on samples from commercial nuclear power facilities, U.S. Government sponsored contracts, site characterization studies, and TeleTrace® projects. His responsibilities include system design, testing, and maintenance as well as data calculation and reporting. Project work has involved the development of new techniques for measurement of ambient levels of atmospheric gaseous radioactivity including an integrating air sampling system for low level radioactive waste burial site characterization.

As TeleTrace® Project Coordinator he is responsible for coordination of all projects from their initial design stage to final data interpretation and reporting of the analytical results on collected samples to the client. He develops design specifications, orders radioisotopes, specifies procurement of the appropriate state licenses, coordinates shipment of all injection materials with the injection date. In addition, when required he participates in the field, on tracer injection projects where he has done all phases of onsite Health Physics supervision from initial radioisotope receipt to radioactive waste disposal and the final Health Physics survey of the site. He coordinates the analysis and data interpretation of samples collected from the production wells to establish flow patterns and breakthrough times. He has also performed the follow-up Health Physics surveys on previously injected projects.

Education & Training

Upsala College
East Orange, N.J.
Bachelor of Science Degree
Geology 1971

Other: Has completed a course in Radiation Protection at Harvard School of Public Health (1977), a graduate course at Fairleigh Dickinson University (1980) in Health Physics which covered health and safety in handling radioactive materials, the biological effects of ionizing radiation, and instrumentation. He has also completed three courses in gas chromatography given by Varian Corporation and a Hazardous Materials Shipping Regulation course given by Federal Express.

Professional Affiliations

Society of Petroleum Engineers - member since 1981

Special Recognition

Recipient of the Teledyne Isotopes Employee of the Year Award for 1981 for his outstanding performance in his areas of responsibility.

5/94

RESUME

Donald F. Schutz, Ph.D., General Manager

Employment Experience 1990 - Present	**TELEDYNE BROWN ENGINEERING** **Environmental Services** Group Executive for the Engineering Group.
1975 -1989	**President:** Overall responsibility for products, services and research in environmental radioactivity monitoring, thermoluminescent dosimetry, sodium iodide crystal manufacture, radiological waste disposal, nuclear fuel analysis, geochronometry and isotope geochemistry. He is the Chairman of the Radiation Safety Committee and is responsible for the Quality Assurance Program of the company.
1970 - 1975	**Vice President.**
1968-1970	**Manager, Nuclear Geochemistry Department.** Responsible for projects for the Defense Advanced Research Projects Agency (DARPA), the Arms Control and Disarmament Agency (ACDA), and the Atomic Energy Commission for the study of radioactive products of atmospheric and underground nuclear exlosions in the environment. Reponsibilites ranged from laboratory studies to engineering development of sampling and detection systems. He participated in, and directed numerous field operations at the Nevada Test Site and at various off-site nuclear test areas. Principal investigator on projects sponsored by the National Uranium Resource Evaluation Program (NURE) of the Department of Energy. The projects were concerned with exploration for uranium ore deposits by use of radon and other gases produced by Uranium decay. He also did computer modelling studies of river basin pollution for the U.S. Environmental Protection Agency and the Division of Water Resources, NJ Department of Environmental Protection.
1964-1968	**Project Manager** Directed field and laboratory operations pursuant to the development of on-site radiological inspection techniques in support of the VELA UNIFORM Program.
1963-1964	**YALE UNIVERSITY** **Dept. of Geology & Geophysics** Research Staff Geologist, Applied neutron activation and X-Ray fluorescence analysis to samples of sea water collected during the summer of 1962/63.
Education	Yale University B.S. (cum Laude) in Geology, 1956 Ph.D. Degree in Geology and Geochemistry, 1964 Rice University M.S. Geology, 19580.
Languages	Spanish, knowledge of Russian