
S. Dyer Harris, Ph.D., P.E., CFEI

Engineer: Mechanical, Industrial Processes & HVAC Systems

Industrial Processes

HVAC Systems

Thermal Sciences

Heat Transfer

Fluid Dynamics

Machinery & Equipment Design

Products Liability

Training

EDUCATION

- 1968** **Doctor of Philosophy in Mechanical Engineering**
Vanderbilt University, Nashville, Tennessee
- 1966** **Master of Science in Mechanical Engineering**
Vanderbilt University, Nashville, Tennessee
- 1964** **Bachelor of Science in Mechanical Engineering (Magna Cum Laude) with
Minor in Electrical Engineering**
Vanderbilt University, Nashville, Tennessee
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EXPERIENCE

January 2007 **The Warren Group, Inc., Wilmington, Delaware**
to Present

Branch Manager and Senior Consulting Engineer performing specialized consulting related to property loss analysis and the analysis of designs with regard to safety in the areas of mechanical and electrical systems.

Property Loss Analysis

Determine the cause of the loss involving:

- **Commercial and residential HVAC systems** including schools, government, private offices and homes involving design, construction, and maintenance problems or failures.
- **Computational analysis of stresses** in machinery and equipment.
- **Root cause analysis of industrial and commercial processes** involving process facilities and power plants, boilers, pressure vessels and process piping ruptures and explosions.
- **Fire and Explosion cause determination** involving analysis of heat transfer and thermo-fluid dynamics of single and multi-phase flow systems. Analyses may include estimating the pressure drop of flashing mixtures, two-phase venting via entrapment in liquid filled storage vessels exposed to fire, and flow through emergency relief devices and reaction forces, two phase flow discharge in nozzles and pipes, size of relief systems for two-phase flow, compressible flow in pipes, the discharge of gases from a reservoir through a pipe, pressure drop calculations, friction factors in turbulent pipe flow. Applications of multi-phase flow systems occur in the following industries:

EXPERIENCE, Continued

**January 2007
to Present
(Continued)**

- **Power Systems:**
Boiling water and pressurized water nuclear reactors, conventional power plants with boilers and reactors, geothermal energy plants, internal combustion engines
- **Heat Transfer Systems:**
Heat exchangers, evaporators, condensers, spray cooling towers, dryers, refrigerators and electronic cooling systems, heat pipes, direct contact heat exchangers
- **Process Systems:**
Extraction and distillation units, electroplating, fluidized beds, chemical reactors, phase separators, atomizers, scrubbers, absorbers, stirred reactors, porous media
- **Transport Systems:**
Air-lift pump, ejectors, pipeline transport of gas and oil mixtures, of slurries, of pulverized solid particles, pumps with cavitation; pneumatic conveyors
- **Lubrication Systems:**
Two-phase flow lubrication, bearing cooling, gas lubrication

Safety Design Analysis (both personal injury and property damage)

Industrial accident reconstruction, machine controls, machine safeguarding, OSHA compliance, standards and codes compliance, manufacturing systems, maintenance, fire and explosion analysis, products liability, consumer products, and failure analysis.

**August 1997
to Present**

President, Equipment Engineering Services, P.A. (EES)

Founder and principal partner. Consulting engineer and machinery and equipment designer performing engineering consulting, product design, prototype and product development.

Projects for clients have included:

- Evaluation of medical device susceptibility and patient safety to Y2K rollover.
- Identification of cause of early life lubrication failure in refrigerant compressors used by automotive and field HVAC technicians.
- Direction of development for commercializing patented software to minimize film consumption for multiple-image CAT scan and MRI studies, including obtaining FDA Class II certificate for client.

EXPERIENCE, Continued

August 1997
to Present
(Continued)

- Adaptation of direct digital radiography system to veterinary use by hardware and software modification and improvement.
- Evaluation of safety and stability of mobile electronic signage structure during road transport and susceptibility to high winds when in place.
- Evaluation of the electrical safety of a device for *in vivo* blood processing in development and specification of procedure for electrical safety testing conforming to IEC 601.
- Development of heat transfer models for major client with line of heat exchangers built of PTFE (e.g., Teflon[®] and related acid resistant materials, used typically in electroplating and chemical process industries. Translated 25-year-old FORTRAN listings to PC-utilizable coding; simplified and/or upgraded algorithms. EES also upgraded design prints, converting to CAD.
- Fluid dynamic analysis of blood flow fluid dynamics for *in vivo* blood processing device in development.
- Analysis of beam strength and structural requirements for a 30-meter overhead beam to support rail car wash crew with fall protection gear.
- Analysis of impact force of loaded forklifts on manhole cover regarding the potential of the forklift to shear off cover hold down screws and exposing pit.
- Laboratory evaluation of methods for detecting rotational position of polarizing optical fibers, using optical bench and instruments. Derivation of an analytical procedure to imbed in hardware to calculate angular movement of fiber to orient polarization axes correctly for bonding. Design of micro clamp to hold fiber and lenses (included in claims in Pat. 6,984,077).
- Direction of project to implement client's patent for onboard hydraulic system to move rear axle set on 18-wheel trucks to adjust wheel loading.
- Analysis of microwave drying of humid air being sampled for detection of airborne toxins. Provided computer program to client to calculate time to dry as a function of field strength, humidity, and airflow. Part of a larger EES program to demonstrate feasibility of system for field adaptation.

EXPERIENCE, Continued

**August 1997
to Present
(Continued)**

- Development of a device structure and prototype manufacturing methodology for a hygiene swab specific for cleaning and sterilizing ear piercings for jewelry. Guided client in patent application and analysis of FDA approval requirements.
- Analysis for major drinking water fountain manufacturer on means and methods to passivate copper tubing used in manufacture in order to meet new, more stringent EPA standards for copper in drinking water.
- Analysis, invention, and development of means to rapidly manufacture a product that required heating to a required component reaction temperature followed by rapid cooling. Method devised is described in Patent 7,022,274. Designed, directed fabrication and startup of manufacturing process implementing method.
- Development of mathematical model to predict the time required to heat a bag of a powdered product to sterilization temperatures, with the bags being stacked on a pallet and placed in a large industrial oven. Recommended means and methods to minimize the time while achieving required sterilization.

**April 1996 to
July 1997**

**Vice President, Imaging Equipment Research & Development,
Sterling Diagnostic Imaging, Inc.**

Responsible for Research & Development for medical electronic imaging products, advising the business on new technology, acquisitions and licensing of technology, directing product development teams and laboratory operations.

**Sept 1987 to
March 1996**

Director, Research and Engineering, DuPont Imaging Systems

Directed research and development for mechanical and digital electronic equipment products for DuPont's X-ray and publishing films businesses. Products ranged from precision film processors to electronic cameras (laser write engines) to software for image processing and manipulation.

Major contribution beyond operational direction was identifying major business opportunities from nascent technologies, championing and protecting them long before the business recognized the value. The Linx Networking System (now a product of Agfa) and Direct Radiography (flat plate receptor technology) (now a product of Hologics, Inc.) are two significant examples.

EXPERIENCE, Continued

**May 1985 to
October 1987****Principal Consultant, R&D Corporate Planning, DuPont**

Planned and coordinated DuPont Corporate R&D programs in support of corporate business objectives. Required close association and familiarity with a wide range of technologies being investigated in DuPont laboratories. Managed a company wide study of the environment for innovation, using a nationally known consultant. Created the DuPont \$EED program, that invited and granted seed funds to employees at all levels with a new idea for a company product, an improved manufacturing process, or a new marketing plan.

**January 1984
to May 1985****Program Manager, Fuel Assembly and Hydrogen Isotope Plants, DuPont-Savannah River Plant (SRL)**

Managed two manufacturing operations fabricating nuclear fuel assemblies and processing hydrogen gas isotopes at the Department of Energy's Savannah River Plant, then operated by DuPont. Approximately 800 employees; three shift, seven day operations. Required close interaction with Federal agencies associated with strategic nuclear materials. Q-WD clearance.

1981 to 1983**Section Director, Separations Development – DuPont SRL**

Director of all divisions related to isotope separation and processing, including both light (hydrogen) and heavy (uranium and transuranium) isotopes. Responsibilities included safety of laboratory operations, coordination of lab projects and plant needs, interaction with other Department of Energy laboratories to share technology, interaction with DOE offices for program proposals and budgeting, and personnel development and administration.

1980 to 1981**Research Manager, Isotope Separations Division – DuPont SRL**

Manager of new division to investigate alternative methods for heavy element isotope separation in place of chemical separation methods. Worked closely with related technical divisions at Livermore National Laboratories and Los Alamos National Laboratories. Stationed technical people at both sites for varying periods of time to observe and learn more about the technologies. Most of the work was classified for nuclear proliferation reasons.

EXPERIENCE, Continued

1979 to 1980 Research Manager, Actinide Technology Division – DuPont SRL

Manager of technical division with engineers, chemists, and technicians, responsible for research and technical support of plant isotope chemical separations operations. Projects included development of new methods for effective chemical separation that minimized radwaste, operational safety improvements, and daily support of technical issues in plant operations.

1978 to 1979 Group Supervisor, High Level Waste Technology – Dupont SRL

Supervised engineers responsible for design and testing of components for proposed Defense Waste Processing Facility (DWPF).

Alternative designs studied for depositing waste into molten glass and solidifying for long term safe disposal. Developed process flow sheet for moving radwaste from tank to melter safely. Coordinated specifications and design with Dupont Engineering Department and Bechtel. Observed testing of similar operations at other U.S. sites. Specified and built two melter concepts and facility for full scale testing. (The DWPF facility was later built and is currently operating at the Savannah River Site).

1976 to 1978 Group Supervisor, Engineering Design and Analysis – Dupont SRL

Supervised engineers, technicians, and draftsmen responsible for design and testing of new reactor components and related equipment. Projects included new irradiation components for producing high molecular weight isotopes; modification to fuel assemblies for improved cooling flow monitoring; concepts for using sintered metal technology for component manufacturing; shipping cask design, both on plant and off plant; contributions to nascent NRC standards relating to shipping casks, including cask design for breeder reactor fuels; onsite test series for cask integrity and spent fuel protection while on railroad transfer cars; analysis of integrity of reactor components and structures during hypothesized tornados and earthquakes. Initiated work on design development of a low level radwaste incinerator.

**1971 to 1980
(Part-time) President, Harris & Ridenhour, Inc.**

Founder and partner of South Carolina engineering firm providing architectural engineering involving heating, air conditioning and electrical distribution systems for hospitals, clinics and commercial buildings.

EXPERIENCE, Continued

1970 to 1975 Staff Engineer, Reactor Heat Transfer and Hydraulics Group – Dupont SRL

Performed calculations and experiments to establish thermal limit (component failure) of reactor fuel assemblies. Managed test project at Columbia University's Heat Transfer Laboratory with full scale mockups. Data verified improved safety margins with aluminum cladding and heavy water coolant versus steel and light water. Information affected plant operating safety set points.

Project manager for design and construction of the SRL Heat Transfer Laboratory. Simulated nuclear components using up to 3 MW DC power. Observed thermal/hydraulic response to simulated accident conditions such as loss of cooling pump, or control rod drive out. Information affected plant operating safety set points.

Ran extensive number of experiments in the Heat Transfer Laboratory facilities to answer plant questions including cooling of spent fuel, heat up of hypothetically dropped fuel during discharge, cavitation in cooling supply line, and flow instrumentation response to nucleate boiling. Information affected plant operating safety set points.

1969 to 1970 Research Engineer, Engineering Design and Analysis – Dupont SRL
Engineering Design Development of Reactor Fuel Assemblies and components. Focus on cooling flow distribution and monitoring.

Identified source of cooling flow fluctuations as vortex shedding in plenum tube. Information affected plant operating safety set points.

Identified through scale modeling, then full reactor testing that flow separation (stall) in plenum supply nozzles caused maldistribution of cooling flow to fuel assemblies. Information affected plant operating safety set points.

1964 Engineer, Dupont Old Hickory Plant, Nashville, TN

Textile Fibers R&D Lab. Member of team working on early spunbonded textile development (products later known as Typar[®], Reemay[®], Tyvek[®]). Studied fiber jet lay down methods for sheet uniformity.

PROFESSIONAL ORGANIZATIONS

American Society of Mechanical Engineers (ASME)

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

National Safety Council (Company Membership)

NATIONAL COMMITTEE/GROUP AFFILIATION

American Society of Mechanical Engineers (ASME), Delaware Section Chair (1999-2002)

American Society of Mechanical Engineers (ASME), Vice President, Region III (2003-2004)

American Society of Mechanical Engineers (ASME), National Vice President, Affinity Communities (2004-2007)

National Association of Fire Investigators

PATENTS

US Patent #6,984,077: System for joining polarization-maintaining optical fiber waveguides

US Patent #7,022,274: Gas Sintered carbon block and method

REGISTRATIONS

Professional Engineer in Delaware (#9707)

Professional Engineer in South Carolina (#4389)

Certified Fire & Explosion Investigator (#12781-6693)

CONTINUING EDUCATION

April 21, 2010

Right from the Start- Commissioning for High Performing Buildings, online course presented by American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

June 24 - 25, 2009

Property Loss Research Bureau, 2009 Eastern Regional Conference, Providence, Rhode Island

- Estimating HVAC Claims
- Products Liability Claims in Property Damage Losses
- Emerging Issues in Construction Defect Cases
- Origin and Cause: Recent Trends in Successful Investigations

CONTINUING EDUCATION, Continued

March 17 -20, 2008

National Fire, Arson and Explosion Investigation Training Program, National Seminar on Fire Analysis Litigation, Certified Fire Investigation Instructor Seminar, Denver, Colorado

June 14, 2007

Commercial and Industrial Insulation, ASME sponsored course presented by the National Insulation Association, Wilmington, Delaware

April 20, 2007

Fires, Explosions and Electricity: Intensive Instruction in Irmo, Inner Circle of Investigators, 2007 Annual Conference, Irmo, South Carolina

November 2006

Tell Me True Workshop, ASME Leadership Training, Dr. Elaine Seat, 1-day, San Francisco, California

April 2002

Computational Fluid Dynamics, ASME Continuing Education Institute, Houston, Texas (3 days)

March 2000

Introduction to Solid Works, Prism Engineering, Horsham, Pennsylvania (4 days)

June 1997

C++ Programming with Intro to Java, University of Delaware, Newark, Delaware (5 days)

May 1997

Introduction to C Programming, University of Delaware, Newark, Delaware

August 1997

Executive Negotiation Workshop, The Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania (5 days)

June 1997

Commercial Energy Code Workshop, State of Delaware (1 day)

March 1997

Symposium on Quality, American Society for Quality Control

October 1996

Managing the Consultant-Client Relationship, Penn State University, University Park, Pennsylvania

CONTINUING EDUCATION, Continued

March 1996

Multi-Cultural Awareness Workshop, Janice Eddy Consultants (3 days)

January 1995

Justifying Technology's Value to the Bottom Line, Conference Board, New York

October 1995

Marketing Fundamentals, University of Delaware, Newark, Delaware (2 days)

January 1995

Face-To-Face Selling Skills Workshop, The Forum Corporation (2 days)

November 1994

Visionary Leadership Workshop, University of Delaware, Newark, Delaware (1 day)

May 1991

Product Quality Management Leadership Development, Dupont, Wilmington, Delaware

October 1987

Decision and Risk Analysis, Strategic Decision Group, Inc., New York

1985

AMA Management Courses, New York (4 weeks over 1 year)

November 1985

Marketing Management Program, Dupont, Wilmington, Delaware (5 days)

April 1982

Nuclear Orientation Advanced Course, USAF, 4-day, Albuquerque, New Mexico

November 1975

Solar Heating and Cooling of Buildings, University of South Carolina, Columbia, South Carolina

July 1973

Two-Phase Heat Transfer, ASME Short Course (Dr. Peter Griffith, MIT)

COURSES, SEMINARS AND LECTURES PRESENTED

Spring 2010

Adjunct Faculty, Department of Mechanical Engineering, University of Delaware, "MEEG 640 Intermediate Heat Transfer."

"Heat Exchangers and the Consequences of Breakdown" presented at the Large Loss and Complex Claims Investigations Seminar, The Warren Group, Irmo, South Carolina

- May 20, 2010
- March 18, 2010
- August 27, 2009

"Thermal Imaging Camera as a Tool in Investigating Hidden Defects" presented at the Large Loss and Complex Claims Investigations Seminar, The Warren Group, Irmo, South Carolina

- May 20, 2010

September 15-17, 2009

ER21/Liquid Engine Systems Staff at NASA Marshall Space Flight Center, Huntsville, Alabama, "Two-Phase Flow and Heat Transfer."

Spring 2009

Adjunct Faculty, Department of Mechanical Engineering, Villanova University, "ME 3950 Heat Transfer I."

2003 to Present

ASME Continuing Education Instructor and Course Writer: created course and currently conducts six week sessions in the ASME Online Study Series, "Two-Phase Flow and Heat Transfer."

2002

Taught P.E. Exam Preparation Course, Penn State University, Great Valley, Pennsylvania.

June 2000

EntreMed, Inc. R&D Staff, Rockville, MD: "Fluid Dynamics of the Flow Electroporation Device." Taught seminar on fluid flow fundamentals as applied to a blood treatment product under development.

1973 – 1979

University of South Carolina-Aiken Adjunct professor: taught undergraduate courses in Engineering Mechanics, Engineering Dynamics, and Thermodynamics.

COURSES, SEMINARS AND LECTURES PRESENTED, Continued

1966-1967

University of Tennessee, Nashville, TN: taught Statics and Dynamics for Engineers Course.
Applications of Complexity Theory to Projects and Organizations: Taught course to:

- Dupont Medical Products Department Leadership, May 1993
- Dupont BioChemical Science and Engineering Leadership, June/October 1999
- Rio Grande Medical Technologies Leadership, Albuquerque, NM, December 1999
- Cargill Corporation, Minneapolis, MN, June 2001 (with S. Zeisler)
- National Marine Educators Association Annual Meeting, New London, CT, 2003

PUBLICATIONS

"Two-Phase Pressure Drop in Pipes," Myer Kutz (ed.), Chapter 24, Heat Transfer Calculations, McGraw-Hill, 2005

"Two-Phase Flow and Heat Transfer," Short course written for ASME Continuing Education Institute, 2003

"QuikCalcs, Back-of-the-envelope Calculations for Mechanical Engineers," EES, 2002

"Weak Signals: Detecting the Next Big Thing" (co-author with S. Zeisler), The Futurist, November/December 2002

"Order from Chaos" (co-author with S. Zeisler), Scenario and Strategy Planning, Part I, April/May 2000

"Order from Chaos" (co-author with S. Zeisler), Scenario and Strategy Planning, Part II, June/July 2000

"Order from Chaos" (co-author with S. Zeisler), Scenario and Strategy Planning, Part III, August/September 2000

"Experimental Determination of the Velocity Gradient in Two Dimensional Turbulent Flow" (co-author with J. Williamson), Journal of Hydraulic Research, 1980

"Response of a Double Tube Sheet Structure to Hydraulic Pressure Transients" (co-author with W. Yau), ASME Symposium on Vibration and Dynamics, June 1979

"Numerical Solution of Three-Dimensional Natural Convection by the Strongly Implicit Method" (co-author with D. Pepper), 78-WA/HT-10, ASME Winter Annual Meeting, December 1978

"Spray Cooling of Heated Cylinders," AIChE Symposium Series, Vol. 74, 1978

"Calculation of Two-Phase Transient Flow in Low Pressure Systems" (co-author with D. Muhlbaier), 9th IAHR Symposium (joint ASME/ASCE), 1978

PUBLICATIONS, Continued

"Numerical Simulation of Natural Convection in Closed Containers by a Fully Implicit Method" (co-author with D. Pepper), ASME Trans. J. of Fluid Dynamics, Vol. 99, December 1977

"Temperature Distribution in Spent Fuel Shipping Baskets" (co-author with W. Yau), 5th International Symposium on Transportation of Radioactive Materials, 1978

"Spray Cooling of Simulated Dropped Irradiated Slug Assemblies" (co-author with J. Taylor), NTIS/SRL Technical Document, 1977

"Flow of Slightly Subcooled Water at Low Pressure through Orifices," NTIS/SRL Technical Document, 1976

"Threshold of Cavitation in Orifices," DP-MS-75-15," ASME Winter Annual Meeting, 1975

"Measurement of Flow Decay and Recovery Times with a Simple Assembly Model" (co-author with B. Crain), NTIS/SRL Internal Technical Document, 1973

"Flow Monitor Transducer Response to Flow Instability Transients," NTIS/SRL Technical Document, 1973

"The Heat Transfer Laboratory of the Savannah River Laboratory" (co-author with D. Knoebel), DOE Report DP-1319, 1972

"Application of Potential Flow Theory to Reactor Coolant Circulation" (co-author with J. Reece), 8th Southeastern Seminar on Thermal Sciences, 1972

"Hydraulic Transient for Doubled-Ended Pipe Break," NTIS/SRL Technical Document, 1972

"Forced Convection Subcooled Critical Heat Flux Part I. Effect of Coolant: D₂O vs. H₂O" (co-author with B. Crain and D. Knoebel), 12th National Heat Transfer Conference, 1971

"Forced Convection Subcooled Critical Heat Flux Part II. Heater Material Effect: Aluminum versus Stainless Steel" (co-author with B. Crain and D. Knoebel), 12th National Heat Transfer Conference, 1971

"Subcooled Nucleate Boiling in SRP Fuel Assemblies," NTIS/SRL Technical Document, 1970.