



## Acknowledgements

ASHRAE and Elsevier would like to recognize the generous support of the SDL Sub Committee, Educational and Examining Board Members. Their time, efforts, technical expertise and professionalism have significantly added to the exceptional quality of this eLearning program.

### Subject Matter Experts and Reviewers

In addition, ASHRAE and Elsevier would like to recognize the following Subject Matter Experts (SMEs) and the reviewers for their many hours of work in the review and development of this eLearning program.

Your dedication to ASHRAE and to the development of superior training for the HVACR industry is greatly appreciated!

### Courses: Fundamentals of HVAC Systems and Fundamentals of HVAC Control Systems

*Subject Matter Expert and Author: Robert McDowall, PEng*



Robert McDowall is a professional engineer registered in Manitoba. His recent activities have focused on HVAC energy conservation, writing, and teaching courses across western Canada.

His recent publications include the Fundamentals of HVAC Systems, IP (inch/Pound) and SI (metric) editions, as well as the Fundamentals for HVAC Control Systems IP and SI. These publications act as the course readers for the corresponding ASHRAE/Elsevier eLearning courses, for which he is the subject matter expert and author. Before undertaking these publications, Robert worked as an engineering consultant for a variety of clients in the area of energy conservation. While working at the University of Manitoba he organized a successful \$14 million, off-balance sheet, energy performance contract.

The reading text for this course was originally written by Ross Montgomery, PE and edited by Robert McDowall, PEng. The online course content was authored by Robert McDowall, PEng, based on the book by Ross Montgomery, PE.

### *Reviewers:*

Kenneth Fulk, Reed Wells, Benson & Co, TX – Fundamentals of HVAC Systems

Tino Mendez, OK, – Fundamentals of HVAC Control Systems

### Courses: Fundamentals of ANSI/ASHRAE/IESNA Standard 90.1

*Subject Matter Expert: Carol Marriott P.Eng (90.1.)*



Carol Marriott is the Director for Environmental Strategy at McQuay International, a manufacturer of HVAC equipment. Carol is a professional engineer with a Bachelor of Engineering Science and Bachelor of Arts in Economics degree, both from the University of Western Ontario. Carol is an ASHRAE Member and currently serves on the Standards Committee. Other previous positions at ASHRAE have included Chair of TC 5.5 Air-to-Air Energy Recovery, Mechanical subcommittee chair and vice chair of SSPC 90.1.

**Reviewer:**

Rose-Marie Bartlett, PNNL, WA

**Courses: Fundamentals of ANSI/ASHRAE/IESNA Standard 90.1 for Architects**

*Subject Matter Expert: Leonard Sciarra (90.1 for Architects)*



Mr. Sciarra is a project architect in the mission critical facilities area, with Gensler, a global architecture, design, and planning firm. With a strong background in sustainable and environmental design, Mr. Sciarra has served as the Co-Chair of the AIA Committee on the Environment and is acting as the AIA Committee on the Environment Midwest regional team liaison. He is currently a member of the ASHRAE/IESNA Standard 90.1 Energy Standard for Buildings Except Low Rise Residential, and trains others in the application of the standard and other “green” building practices. He has assisted the State of Illinois in writing the guidelines for a statewide energy code, is a member of the Evanston Environmental Board and works as a liaison to the Evanston Energy Commission.

**Course: Fundamentals of ASHRAE Standard 62.1**

*Subject Matter Expert: Hoy Bohanon, PE*



Hoy Bohanon, PE, is owner and manager of Bohanon Engineering, PLLC, a company that focuses on sustainable improvement of the indoor environment in existing buildings. During his 33-year engineering career, Mr. Bohanon worked at manufacturing corporations as a product design engineer, project engineer, facilities engineer, facilities manager, indoor air quality researcher, and environmental engineer. He has a Masters degree in Engineering from North Carolina State University, and a Bachelors degree in Mechanical Engineering from Georgia Tech.

Mr. Bohanon has written technical papers and articles on indoor air quality, operations, and maintenance and is a frequent presenter at technical society meetings. He is a member of the ASHRAE Standard

62.1 Committee, Ventilation for Acceptable Indoor Air Quality and serves as program chair for SSPC62.1 and TC5.5, Air-to-Air Energy Recovery. He is chair of the US Technical Advisory Group panel 1 (general principles) and panel 4 (indoor air quality) for ISO TC205 Building Environment

Design. He is on the project committee writing the Advanced Indoor Air Quality Guide for EPA/ASHRAE/AIA/BOMA/SMACNA/USGBC.

**Reviewer:**

Keith Ohiggins, Metro Design Associates, IL

**Courses: Fundamentals of Refrigeration and Refrigeration Equipment**

*Subject Matter Experts: Bryan R. Becker, PhD, PE and Brian A. Fricke, PhD*



Bryan Becker, PhD, PE, is a professor of mechanical engineering at the University of Missouri-Kansas City. During his more than 21 years at the University of Missouri, Dr. Becker has conducted, as principal investigator or co-investigator, 45 research projects and has authored 192 journal articles, chapters in books, presentations, and research reports. He has directed the graduate research of 30 Master of Science students and six doctoral students. He is a fellow of ASHRAE and the American Society of Mechanical Engineers (ASME). Previously, Dr. Becker served as chair of mechanical engineering and then civil and mechanical engineering for seven years.

Dr. Becker's research and scholarly activity has centered around heat transfer, fluid flow and bioengineering.



Brian Fricke, PhD is an assistant professor in mechanical engineering at the University of Missouri-Kansas City, and he has been principal investigator or co-investigator on eight research projects and has authored 126 journal articles, books, chapters in books, presentations, and research reports. Due to his international reputation as a researcher in the area of food cooling and freezing as well as food thermophysical properties, Dr. Fricke was awarded the International Institute of Refrigeration (IIR) Clarence Birdseye Young Researchers Award in 2003.

***Reviewers:***

Donald L. Fenton, Kansas State University

Duane P. Rothstein, McQuay International

**Course: Air-Conditioning System Design**

*Subject Matter Expert: Walter Grondzik, PE, LEED-AP*



Walter Grondzik, an ASHRAE and ASES Fellow, is an architectural engineer and professor in the Department of Architecture at Ball State University, Muncie, IN. Professor Grondzik's teaching and research interests involve building environmental control systems, building performance, and energy/resource efficiency. Grondzik is Past-President of the Architectural Research Centers Consortium and of the Society of Building Science Educators and a current member of several ASHRAE technical and guideline committees. Grondzik has a Bachelor of Architectural Engineering degree from Penn State University and a Master of Science degree from Washington University in St. Louis. He was actively involved with the Vital Signs and Agents of Change building evaluation projects over a 10 year period and is co-author of Mechanical and Electrical Equipment for Buildings (10th ed) and The Green Studio Handbook. Grondzik is editor of the 2nd edition of ASHRAE's Air-Conditioning System Design Manual.

***Reviewer:***

David B. Meredith, Penn State University-Fayette, PA

**Course: Advanced Energy Design for Small Office Buildings**

*Subject Matter Expert: Joseph J. Deringer, AIA, LEED*



Joseph Deringer is an energy consultant and software developer, who has worked on projects throughout the US and in over 15 countries worldwide to improve building sustainability and energy efficiency as well as to reduce greenhouse gases. He has served on ASHRAE's energy efficiency standard 90.1 committee for 15 years, has chaired the 90.1 envelope subcommittee twice for a total of 10 years.

He has managed international consultant teams that have assisted nine developing and newly industrialized countries to develop first generation energy codes, has assisted several of these countries to implement those energy codes, and has authored two compliance guidelines for such codes. He has a B.A in History (Honors) from the University of Pittsburgh, PA, a B. Architecture from Carnegie-Mellon University, Pittsburgh, PA, and an M.S. in Operations Research from Case Western Reserve University, Cleveland, Ohio.

***Reviewer:***

Merle F. McBride, Owens Corning Science & Tech Center, OH

**Course: Advanced Energy Design for Small Retail Buildings**

*Subject Matter Expert: Charles H. Culp PE, PhD, FASHRAE, LEED-AP*



Charles Culp has over 25 years of experience of engineering, research, teaching, and management with expertise in high performance buildings, HVAC systems, measurement and verification, expert systems, system design, energy efficiency, and utility power distribution. He currently leads research in energy efficiency and building energy codes at College of Architecture at Texas A&M University where he is Associate Professor in the Department of Architecture. He was elected to ASHRAE Fellow in 2005 and was a member of the ASHRAE committee that developed Guideline 14 on M&V.

He is principal investigator, co-principal investigator on numerous projects at the Energy Systems Laboratory in his role as Associate Director. He is also the director of several research and engineering departments for

Emerson Electric and currently leading the Measurement and Verification (M&V) activity with an ESCO and a multi-campus Texas State Agency on the first major ESCO building energy efficiency program in Texas.

***Reviewer:***

Michael Lane, LC, Lighting Design Lab, WA

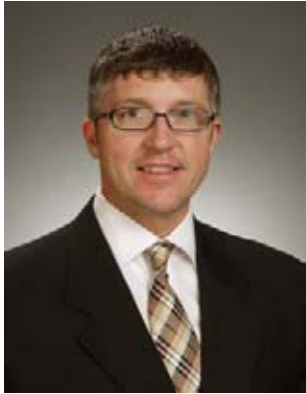
**Course: Fundamentals of Sustainable Buildings and High Performance Systems Design (GreenGuide)**

*Subject Matter Experts: Tom Lawrence, PhD, PE, LEED-AP and John Swift JR., PE, LEED, CEM*



Dr. Lawrence is a Public Service Associate with the University of Georgia, and has over 25 years of professional experience in engineering and environmentally related fields. Before going back for his PhD in Mechanical Engineering at Purdue, he spent approximately 20 of those years in progressively more responsible engineering and management positions in industry and consulting. Currently, he is vice-chair of ASHRAE TC 2.8, Building Environmental Impact and Sustainability, and is a member of the committee writing an ASHRAE standard on high-performance green buildings (Standard 189.1). Dr. Lawrence has presented papers on building energy usage and indoor air quality at conferences in the U.S. and Europe, and has published papers on sustainable design and energy usage in buildings in journals such as

ASHRAE Journal, Solar Today, and Buildings and Environment. As an ASHRAE Distinguished Lecturer, he has given presentations and workshops on green building design at venues around the world. At the University of Georgia, Dr. Lawrence teaches or has taught courses in Building Environmental Control, Green Building Design, Industrial Ventilation, Residential Building Design, Heat Transfer and Thermodynamics, and in these courses he works to bring in sustainable design concepts practices. As part of the Engineering Outreach program, he is helping to coordinate building energy reduction activities within the state university system. Dr. Lawrence is also a consultant to Commissioning and Green Building Solutions in the Atlanta, GA, area. He is an active volunteer with Habitat for Humanity, serving as Vice-President of the board of directors for the Athens, GA, chapter while working to introduce sustainable design practices in the houses built there.



John Swift is a Principal with Cannon Design and is a member of the Board of Directors of the Firm, and has over 20 years of experience in high performance building systems engineering design. In his role at Cannon Design, Swift has led sustainability efforts throughout the firm, and has facilitated the acceptance of the Architecture 2030 Challenge. Mr. Swift's total commitment to an integrated design process and sustainable strategies make him a national leader in the design of high performance environments. John is a member of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the Association of Energy Engineers (AEE), and the U.S. Green Building Council. He has extensive experience in the design and construction of numerous institutional building types that require optimization of occupant comfort while minimizing energy and water usage. Swift is a voting member and the Vice Chair of ASHRAE Technical Committee TC 2.8 Building Environmental Impacts and Sustainability, and is a Senior Editor of the ASHRAE GreenGuide. The GreenGuide is a best-selling publication and one of the more prominent green guides in the institutional and commercial building design industry. Swift is the chair of the proposed ASHRAE Standard for Water Efficiency (SPC 191), and is currently serving on the ASHRAE GSA ad hoc committee promoting energy efficiency in federal buildings. John recently served on Governor Patrick's MA Zero Net Energy Buildings Task Force, and was a member of the Leadership Council of the Boston Chapter the US Green Building Council. He is also on the Board of Directors for Roxbury Youthworks, Inc., a non-profit agency that works with inner-city families at-risk.

***Reviewers:***

*Tim McGinn, COHOS EVAMY, AB*

*Paul McGregor, McGregor & Associates, NSW, Australia*

*Constantinos A. Balaras, PhD, PE Group Energy Conservation (GREC), Greece*

Acknowledgements also go to:

Justin Mole and Chris Ercoli at Cannon Design and Brittany Romig from University of Georgia

**Courses:**

**Data Centers: Equipment Load Trends and Planning for the Future**

**Data Centers: Thermal Guidelines for Data Processing Equipment: Environmental Specifications & Measurement and IT Equipment Thermal Reporting**

**Data Centers: Datacom Facility Basics (Datacom 101) – coming soon**

**Data Centers: Strategies and Infrastructure for Liquid Cooling of Equipment and Facilities**

*Subject Matter Experts: Bryan Becker, PhD, PE, Brian Fricke, PhD., and Don Beaty,*



Bryan Becker, PhD, PE, is a professor of mechanical engineering at the University of Missouri-Kansas City. During his more than 21 years at the University of Missouri, Dr. Becker has conducted, as principal investigator or co-investigator, 45 research projects and has authored 192 journal articles, chapters in books, presentations, and research reports. He has directed the graduate research of 30 Master of Science students and six doctoral students. He is a fellow of ASHRAE and the American Society of Mechanical Engineers (ASME). Previously, Dr. Becker served as chair of mechanical engineering and then civil and mechanical engineering for seven years. Dr. Becker's research and scholarly activity has centered around heat transfer, fluid flow and bioengineering.



Brian Fricke, PhD is an assistant professor in mechanical engineering at the University of Missouri-Kansas City, and he has been principal investigator or co-investigator on eight research projects and has authored 126 journal articles, books, chapters in books, presentations, and research reports. Due to his international reputation as a researcher in the area of food cooling and freezing as well as food thermophysical properties, Dr. Fricke was awarded the International Institute of Refrigeration (IIR) Clarence Birdseye Young Researchers Award in 2003.



Don Beaty started DLB associates over 20 years ago and continues to lead the firm through his vision and holistic approach to problem solving. A licensed engineer in over 40 states, Don has always sought to challenge convention and redefine the design and construction industry. Don was chair of ASHRAE TC 9.9, Mission Critical Facilities, Technology Spaces, & Electronic Equipment from its inception through June 2006. His exclusive interest is in exposing the industry to the work of TC 9.9. His interest in educating the industry about ASHRAE being the unbiased source of data center cooling material has resulted in Don publishing over 50 technical papers and articles.

He also is a frequent presenter on the subject including having presented in nine countries on the topic of data center cooling. Don is currently International Chair of TC 9.9 Committee-Liaisons, Alliances and International Activities. Since 1993, Don has served various roles on the ASHRAE TC 90.1, Energy Standards Committee.

***Reviewer:***

*Don Beaty, DLB Associates, Consulting Eng PC, NJ*

**Courses: Fundamentals of Electricity, Building Electrical System Design and Building Electrical Energy**

*Subject Matter Expert: Rich. Nowak, PE, and Rick Coughlin, PE*



Rich Nowak is the President & CEO of CÉVON Corp., a green energy services company (ESCO) based in the seacoast area of northern New England. Rich has compiled over 35 years of distinguished experience in an assortment of engineering, education, and management positions in the energy engineering field. Rich has a Bachelor of Science Degree in Engineering Science from R.P.I. in Troy, NY. He received his Master of Science Degree in Architectural Engineering from Penn State. He is a registered professional engineer in five states. Rich is the recipient of an ASHRAE "Best Technical Paper Award" for his research work in alternative refrigerants which are in common use today.



Rick Coughlin, PE, is co-author of the ASHRAE continuing education course titled The Fundamentals of Electrical Systems and Building Electrical Energy Use. He has a Master of Science degree in Architectural Engineering from Pennsylvania State University and a Master of Science degree in Mechanical Engineering from the University of New Hampshire.

He is a registered professional engineer located in Maine. He designed electrical and mechanical systems for buildings for 15 years and currently is a forensic investigative engineer.

***Reviewers:***

*Larry Markel: Fundamentals of Electricity*

*Robert Crosby and Marvin Thedford: Building Electrical System Design*

*Marvin Thedford and Leo Stambaugh: Building Electrical Energy Use*