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HTRI®

Heat Transfer Research, Inc.

training

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training from HTRI

Heat Transfer Research, Inc. (HTRI) is the global leader in process heat transfer and heat exchanger technology. Founded in 1962, our industrial research and development consortium serves the engineering needs of over 1000 corporate member sites.

WHY ATTEND OUR TRAINING?

We make it easier for you to achieve maximum benefit from HTRI software and to better understand how our research findings impact your heat exchanger designs.

HTRI continues to conduct research and to apply our findings in the latest software versions. Our training gives you the opportunity to update your knowledge of heat exchanger technology and the latest software features and to solve industrial design cases under guidance of HTRI staff.

Our instructors include the same engineers who conduct our research and develop our software—they know our products and, better yet, the heat transfer industry.

All courses include comprehensive manuals and case studies that you can review after the training session ends.

WANT CUSTOMIZED OR ONSITE TRAINING?

We can customize our courses to fit your needs, help your staff immediately apply their new skills, and bring the training to you, saving staff time and travel costs. If you provide cases that you encounter in your workplace, we will develop content to address your specific issues. Contact us for details or to request a quote.

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HTRI® short courses

Designing Exchangers for Fouling Service

Don't get your exchangers all fouled up. Review traditional methods to apply margins in heat exchanger design for fouling service.

Industry experience indicates that these traditional methods may result in excessive heat transfer area in some applications and promote fouling in others. Use of fouling models may provide an improved approach in selected applications where fouling data is available. In most cases, experience and judgment are used to set realistic design margins.

KEY TOPICS

TEMA fouling factors • "Clean" applications • Types of fouling • Fouling measurements • Fouling models (crude oil and water) • Thermal and pressure drop margins • Fouling characteristics of exchanger geometry • Case studies

SUGGESTED PARTICIPANTS

Engineers who specify, rate, and/or analyze heat exchangers in fouling service

Fundamentals of Heat Exchanger Technology

Focusing on the principles of heat exchanger technology provides a framework for practicing engineers to gain information and understand the latest methods of heat exchanger operations. By combining state-of-the-art heat exchanger design technology with practical plant applications, this course gives novice and occasional designers guidelines to evaluate heat exchanger operation and performance.

KEY TOPICS

Basic heat transfer principles • Heat exchanger geometries • Design methods • Overview of maintenance, repair, and troubleshooting • Two-phase pressure drop calculations • Rules-of-thumb • Standards and specifications

SUGGESTED PARTICIPANTS

Novice heat exchanger designers and engineers who are occasionally responsible for reviewing heat exchanger design and performance

Heat Exchanger Technology

A strong foundation of heat exchanger technology is needed to design and troubleshoot units efficiently. This course presents and then builds upon fundamental principles, as well as reviews the limitations of their application to industrial heat transfer equipment.

Case studies are based on discussions of engineering standards, specifications, and software that is available to evaluate heat exchanger operation. Participants analyze operational problems involving fouling, vibration, and temperature pinch.

KEY TOPICS

Basic heat transfer principles • Heat exchanger geometries • Design methods • Single-phase and two-phase pressure drop • Standards and specifications • Maintenance and repair • Case studies of operational problems, including fouling, vibration, leakage, and maldistribution

SUGGESTED PARTICIPANTS

Heat exchanger designers and engineers who are responsible for heat exchanger design and troubleshooting

Kettle Reboilers

Thermal design methods for kettle reboilers have evolved over the years and old rules-of-thumb no longer apply. New research results, software advances, and feedback from industry all contribute to improved design practices. The course presents the most up-to-date research in kettle reboilers, provides our current recommendation to use ***X****ist* to model kettles accurately, and discusses future research and software development to improve predictions. Many example problems illustrate recommended good practices for using ***X****ist*, interpreting warning messages, improving designs, and troubleshooting cases.

KEY TOPICS

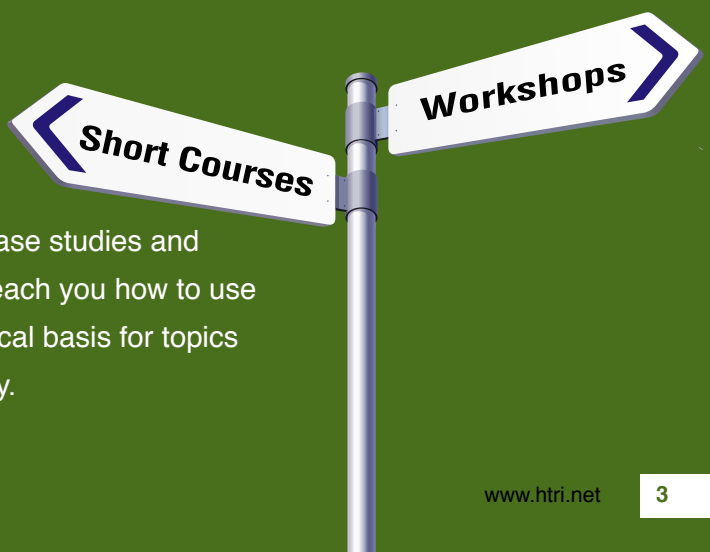
Shellside boiling methods • Recirculation • Liquid level and bundle dryout • Differences between bundle composition and feed composition • Kettle sizing • Entrainment • Vibration • Fouling

SUGGESTED PARTICIPANTS

Thermal design engineers and heat exchanger experts

? Short Courses versus Workshops

Are you trying to decide whether to attend a short course or a workshop? If you need assistance with ***X****changer Suite* modules, then a workshop is the right choice for you. While our short courses include case studies and references to ***X****changer Suite*, they are not meant to teach you how to use the software. Instead, short courses provide a theoretical basis for topics related to heat transfer and heat exchanger technology.



HTRI® workshops

Advanced *Xace*

Improve your understanding of the methods in ***X****ace* and develop new skills to model difficult cases. This workshop focuses on troubleshooting cases, interpreting results, improving thermal predictions, and developing workarounds. Even the most experienced thermal designers will gain new insight into how to improve thermal analyses using ***X****ace*.

KEY TOPICS

Natural draft air-coolers • Fin efficiency • A-frame condensers • Continuous tube-in-plate fins • Modeling bundle bypass

SUGGESTED PARTICIPANTS

Experienced ***X****ace* users who design and troubleshoot crossflow bundles

Advanced *Xist*

Have you been using ***X****ist* successfully but need to know more about analyzing complex cases? This workshop is for experienced users with a good working knowledge of heat exchanger design and operation.

This class addresses the latest HTRI guidelines for difficult cases. New research developments and software options are discussed and applied to a set of troubleshooting exercises.

KEY TOPICS

Shells in series • Shellside condensation • Design mode • Flooded evaporators • Falling film evaporators • Modeling glycol injection • Continuous fins

SUGGESTED PARTICIPANTS

Experienced ***X***ist users who troubleshoot cases and evaluate shell-and-tube exchanger performance

Condensers

Learn the fundamentals of condensation mechanisms and how they apply to condenser designs! Apply guidelines to develop ***X****changer Suite* cases for accurate assessment of performance. This course provides a foundation for understanding the basis for thermal design of typical industrial heat exchangers.

KEY TOPICS

Film condensation in vertical surfaces • Condensation in horizontal tube bundles • Interfacial vapor shear effects on condensation heat transfer • Condensation inside horizontal tubes • Desuperheating and subcooling • Condensation with mixtures • Condensation with enhanced heat transfer surfaces • Two-phase pressure drop • Venting inerts • Drainage

SUGGESTED PARTICIPANTS

Engineers who design and evaluate condenser equipment

Enhanced Heat Transfer in *Xist*

If you have cases that are heat transfer or pressure drop limited, this is the workshop for you. Learn how to use ***X****ist* to enhance the performance of shell-and-tube exchangers. Case studies of suitable applications for enhanced geometry and features in ***X****ist* will be discussed.

KEY TOPICS

Finned tubes • Tube inserts • Specifying vendor tubes • Helical baffles • EMbaffles® • Rod-type baffles • Square-One™ baffles

SUGGESTED PARTICIPANTS

Engineers responsible for specifying or improving shell-and-tube exchanger performance

Heat Exchanger Troubleshooting

Design decisions can have a costly impact on heat exchanger operation. Learn by reviewing several real cases in which unit designs had critical commercial consequences for operators/owners. In some cases, the units did not work in service; in others, the designs were revamped before the units began operation.

Each case study is introduced as a problem; participants work individually or in groups to determine the cause and develop solutions. Prior to each case, the instructor reviews related HTRI methods.

KEY TOPICS

Shellside boiling methods • Recirculation • Liquid level and bundle dryout • Differences between bundle composition and feed composition • Kettle sizing • Entrainment • Vibration • Fouling

SUGGESTED PARTICIPANTS

Thermal design engineers and heat exchanger experts

HTRI Technology

This workshop guides participants in the effective application of HTRI ***X**changer Suite* to rate, design, simulate, and troubleshoot process heat exchangers. The workshop provides a survey of heat exchanger geometry supported by ***X**changer Suite*, discusses performance fundamentals based on HTRI research, and provides input guidelines for specifying accurate thermal models, interpreting results, and troubleshooting cases. Students apply methods by working example problems.

KEY TOPICS

Heat exchangers modeled in ***X**changer Suite* • Process specifications for thermal ratings • Guidelines for fluid property and heat release input • TEMA shell-and-tube technology • Air-cooler technology • Vibration analysis including screening analysis in ***X**ist* plus an introduction to detailed analysis with ***X**vib* • Condensers • Reboilers

SUGGESTED PARTICIPANTS

Engineers who design, maintain, or troubleshoot heat exchangers

HTRI ***X**changer Suite* Essentials

Do you need a review of modeling techniques and HTRI methods in ***X**changer Suite*? After a brief introduction to the component software, you receive debugging tips and a checklist for data needed to set up a case.

Using hands-on examples, learn about HTRI's latest guidelines to specify fluid properties, boiling and condensing method options, and general recommendations for reviewing results.

KEY TOPICS

Overview of ***X**changer Suite* components and data entry • Geometry input for shell-and-tube, air-cooled, and plate-and-frame exchangers • Process specifications for rating, simulation, and design • Guidelines for specifying fluid properties • Introduction to HTRI analysis methods

SUGGESTED PARTICIPANTS

Novice users of ***X**changer Suite* and engineers who need an update on the latest HTRI recommendations for exchanger performance

Reboilers

Learn the fundamentals of boiling mechanisms and how they apply to reboiler designs! Work with ***X**ist* to model boilers and thermosiphon reboilers accurately. This course provides a foundation for understanding the basis for thermal design of typical industrial heat exchangers.

KEY TOPICS

Pool boiling mechanisms including nucleate boiling, departure from nucleate boiling, and film boiling • Intube flow boiling mechanisms for horizontal and vertical configurations • Desuperheating and subcooling • Boiling with mixtures • Boiling with enhanced heat transfer surfaces • Two-phase pressure drop

SUGGESTED PARTICIPANTS

Engineers who design and evaluate reboilers

Vibration Analysis

A must for anyone who evaluates the vibration potential of shell-and-tube heat exchangers! In this course, you learn about vibration mechanisms in shell-and-tube heat exchangers and ***X**ist* methods to analyze vibration severity. Most importantly, you discover corrective measures to mitigate damage.

KEY TOPICS

Introduction to vibration phenomena • Flow-induced vibration (fluidelastic instability, vortex shedding, turbulent buffeting, acoustic vibration) • Design options to mitigate vibration • Field fixes • ***X**ist* Vibration Report • Example application and case studies

SUGGESTED PARTICIPANTS

Design and plant engineers responsible for the mechanical condition of shell-and-tube heat exchangers

Xace

Do you design only air-cooled heat exchangers? Evaluate their performance? Then this workshop is for you. Unlike the ***X**changer Suite* workshops, this course focuses on air-cooler geometry.

Learn how to use ***X**ace* effectively to rate and design air-cooled heat exchangers, economizers, and air preheaters. All example problems and practice exercises relate to real-world applications.

KEY TOPICS

Overview of ***X**ace* capabilities and applications • Geometry inputs for air coolers and economizers • Process specifications for rating, simulation, and design • Guidelines for specifying fluid properties • Introduction to HTRI analysis methods

SUGGESTED PARTICIPANTS

Designers of air-cooled heat exchangers and process engineers who evaluate their performance

Xfh

Learn how to simulate the performance of fired heaters. With ***X**fh*, engineers can predict the performance for a fired heater using HTRI's radiant- and process-side methods for pressure drop and heat transfer.

***X**fh* can help you troubleshoot fired heater problems, evaluate competing designs, or evaluate the effects of proposed changes in plant operating conditions and/or existing fired heater designs.

KEY TOPICS

General fired heater principles • ***X**fh* combustion model • ***X**fh* radiant-side models • Convection section simulation • Cylindrical heater simulation • Box heater simulation

SUGGESTED PARTICIPANTS

Designers of fired heaters and process engineers who evaluate fired heater performance

Xist

Even if your work is limited to shell-and-tube heat exchangers, there's much to be learned! This workshop is devoted to the geometries handled only by ***Xist***.

The day focuses on the extensive options available in ***Xist*** and how you can use these methods effectively to solve several example problems. You'll leave the class knowing how to take full advantage of the features this robust tool offers.

KEY TOPICS

Overview of ***Xist*** capabilities and applications • Geometry input for shell-and-tube heat exchangers • Process specifications for rating, simulation, and design • Guidelines for specifying fluid properties • Introduction to HTRI analysis methods

SUGGESTED PARTICIPANTS

Designers of shell-and-tube heat exchangers and process engineers who evaluate their performance

Xphe

Discover how to use HTRI's graphical tool for designing, rating, and simulating plate-and-frame heat exchangers. If you work only with plate-and-frame geometries, ***Xphe*** is the software for you.

In this workshop you learn how ***Xphe*** handles single-phase and two-phase heat transfer and pressure drop for many common plates and configurations. You'll also leave with a better understanding of the analytical methods used in ***Xphe***.

KEY TOPICS

Overview of ***Xphe*** capabilities and applications (single-plate types, multiple-plate types, frames in series, maldistribution) • Geometry input for plate-and-frame heat exchangers • Process specifications for rating, simulation, and design • Guidelines for specifying fluid properties • Introduction to HTRI analysis methods

SUGGESTED PARTICIPANTS

Designers of plate-and-frame heat exchangers and process engineers who evaluate their performance

Xvib

Because vibration can cause critical operating problems in heat exchangers, it is important to analyze the potential for flow-induced vibration.

This workshop teaches you how to develop an input file, interpret results, and obtain accurate prediction of the vibration potential for installed units. Using ***Xvib*** you'll practice determining if a heat exchanger is susceptible to vibration damage.

KEY TOPICS

Analysis methods for fluidelastic instability and vortex shedding • Velocity profile development • Vibration susceptibility

SUGGESTED PARTICIPANTS

Engineers responsible for the mechanical condition of shell-and-tube heat exchangers

HTRI® seminars

Using HTRI *Xchanger Suite* with Process Simulators

This half-day workshop discusses the techniques and benefits of using ***X**changer Suite* with process simulators. Through a series of demonstrations, hands-on exercises, and case studies, attendees learn how to specify physical properties using different methods, import a stream from a process simulator, and import an exchanger unit operation from a process simulator. The workshop also describes and demonstrates the inclusion of HTRI unit operations within different process simulators.

KEY TOPICS

Interfaces between ***X**changer Suite* and process simulators • Heat exchanger models • Process simulator environment

SUGGESTED PARTICIPANTS

Heat exchanger designers who want to use a process simulator to generate physical properties for exchanger designs or who want to embed rigorous heat exchanger ratings into a process simulator flowsheet

Designing for Success: Shell-and-Tube Heat Exchangers

In exchanger design, what you don't know can hurt you. Even after decades of advanced research in process heat transfer, a complete understanding of certain fundamental issues remains at the core of successful exchanger design. In this seminar, we discuss the design of shell-and-tube heat exchangers, including vacuum thermosiphons, vacuum condensers, kettle reboilers with wide boiling ranges, and other cases. Learn about recent research initiatives to address design uncertainty, understand the basis behind the latest HTRI guidelines, and identify alternative design strategies. Share your ideas with other heat exchanger specialists and get some new ideas for your own designs.

KEY TOPICS

Vacuum condensers • Kettle reboilers

SUGGESTED PARTICIPANTS

Experienced engineers familiar with HTRI technology

Lessons Learned in Engineering Services

Sometimes the best thermal performance prediction requires an adjustment to the standard ***X**changer Suite* results. Attend this seminar and learn how to improve the accuracy of the software predictions. This seminar will help you determine when and how to change the initial results. This session is for those who are familiar with ***X**changer Suite* but would like to know the latest advanced techniques for its use.

KEY TOPICS

Course content changes annually to address interesting cases from users.

SUGGESTED PARTICIPANTS

Experienced users of ***X**changer Suite*

HTRI® webinars

HTRI offers free hour-long webinars to its members. Live webinars include an opportunity for questions and answers at the end of each session. Recorded webinars are available on the HTRI website so that you can review the entirety of the presentation at any time. To view these recordings, you will need Adobe Flash Player and e-Library. If you have technical issues viewing the recordings, please contact HTRI Technical Support.

Beyond the Basics

Building Your First Case in *Xfh*

This webinar provides new ***X****fh* users with the information they need to build their first case. The webinar discusses the capabilities of ***X****fh*, including an overview of combustion, the radiant section, the convection section, the stack, and API 530 tube design. Next, we outline how to input values for the cylindrical heater multizone model by transferring input from specification sheets and drawings.

Debugging Fatal Errors in *Xist*

The error messages generated by ***X****ist* are helpful because they identify either the root cause or the symptoms of the problems with your case. This webinar discusses the types of errors, analyzes four examples of fatal errors, and provides guidelines for preventing and debugging fatal errors in ***X****ist*. Important concepts in this webinar include the types of data check and runtime messages (informative, warning, or fatal), the use of ***X****ist* resources (help files, FAQs, TechTips) to prevent fatal error messages, and the engineering expertise needed to determine root cause of problems that fatal error messages do not clearly identify.

Rating, Simulation, or Design? Understanding Case Modes in HTRI *Xchanger Suite*

Most ***X****changer Suite* modules allow you to run an exchanger in three different modes—rating, simulation, and design. This webinar discusses these types in terms of how they differ, how to specify each type, and why each type is useful.

Building Your First Case in *Xist*

Are you ready to build your first case in ***X****ist*? This webinar discusses the ***X****ist* interface, including how to navigate, how to use the options to model your exchanger, how to determine which version of ***X****ist* you are running, and how to get help. Using a TEMA datasheet with limited process information, the webinar demonstrates how to input, run, and troubleshoot a case in ***X****ist*.

Building Your First Case in *Xvib*

This webinar describes the capabilities of ***X****vib* and identifies reasons why you would want to use ***X****vib* to carry out a vibration analysis. Other topics included in this webinar are the ***X****vib* input panels and key features of the software, a demonstration on how to build an ***X****vib* case from an existing ***X****ist* case and a discussion of the differences between ***X****vib* and ***X****ist*.

Research Update

Crude Oil Fouling

We begin this webinar with a definition of crude oil fouling and the difference between crude oil fouling and other types of fouling mechanisms. Following this review, we discuss fouling research at HTRI by describing the High Temperature Fouling Unit (HTFU), the research testing that we conduct, and the prediction models in development.

Non-Newtonian Flows in Heat Exchangers

In order to discuss the plans for the non-Newtonian flows research program, this webinar reviews the definition of non-Newtonian fluids, the use of apparent viscosity (focusing on power law fluids), how non-Newtonian flows affect pressure drop and heat transfer in heat exchangers, and the capabilities of ***X****phe* with regard to non-Newtonian fluids. The webinar concludes by reviewing the future of this research program at HTRI.

Is My Design OK?

Shell Selection
Inferior thermal design often results from an incorrect selection of shell type. This webinar reviews TEMA shell types, describes the factors that impact shell selection, and discusses the advantages/disadvantages of each type. Using ***X**ist*, we compare the results of shell selection on a single-phase liquid, low temperature approach, a once-through reboiler, and a vacuum mixture condenser.

Baffled by Heat Exchanger Design
Throughout the webinar, we examine standard TEMA and non-TEMA baffle types, ***X**ist* examples to illustrate how different baffles affect heat exchanger performance, and rules-of-thumb concerning proper design with respect to baffle cut, spacing, and orientation. Finally, we summarize the performance characteristics of the different baffle types needed to achieve effective shell-and-tube heat exchanger design.

Understanding Tube Layout
This webinar discusses the key issues you should address to achieve successful tube layout in a heat exchanger.

Shellside Condenser Design
A concise review of shellside condenser design, this webinar begins with a discussion of the fundamentals of shellside condensation, including film condensation and pressure drop. The webinar uses a vertical G-shell condenser model as a sample case to discuss the objectives of condenser design.

Thermosiphon Modeling in *Xist*
To help you better use ***X**ist* to model thermosiphon reboilers, this webinar begins with an overview of thermosiphon reboiler operations. Next, we discuss design rules-of-thumb and ***X**ist* input guidelines, including reboiler inputs and piping. The webinar concludes with helpful hints for interpreting results by focusing on troubleshooting error messages.

TechTip

Kettle Entrainment Prediction
(presented in Chinese)
After an overview of kettle reboilers and the fundamentals of entrainment, this webinar reviews ***X**ist* input and output as well as design considerations that affect kettle entrainment. By working through an example case, this webinar shows that accurate prediction of liquid entrainment is crucial for some applications, that liquid carryover depends on many parameters, and that ***X**ist* 6 calculates entrainment more accurately and provides more options than previous versions.

Modeling A-Frame Condensers
Using the workarounds outlined in this webinar, you can model A-frame condensers in ***X**ace* 6. After describing A-frame geometry and analysis methods, the webinar includes a demonstration of ***X**ace* input options and works through two sample cases—a rating without reflux and a simulation with reflux.

Improvements in Specifying EMbaffles®
HTRI continues to improve EMbaffle implementation in ***X**ist*. In this webinar specifically geared toward the use of EMbaffles in ***X**ist*, we describe the technology, discuss how to specify these baffle types, and explain the EMbaffle-related improvements in ***X**ist* 6 Service Pack 3. We conclude the webinar by demonstrating input options for E- and F-shells.

Impact of HTRI *Xchanger Suite* 6, Service Pack 3
Service Pack 3, released in January 2011, includes a number of improvements for ***X**changer Suite*. This webinar discusses a few of these improvements in detail, including the HTRI input translation tool, modifications to heat transfer coefficients, changes to reports, and updates for kettle reboilers, continuous fins, and EMbaffles®.

Using HTRI *Xchanger Suite* with UniSim Design
You can obtain properties from UniSim Design within any module in ***X**changer Suite* by embedding an ***X**ist* model into a UniSim Design simulation. This webinar demonstrates how to interface between ***X**changer Suite* and UniSim Design by installing and registering UniSim Design, calculating properties, importing streams, and embedding ***X**ist* cases. The methods demonstrated are also valid for other HYSYS®-based process simulators.

HTRI summary of fees

through December 31, 2011

Short Courses	Length	Fee (per person)
Designing Exchangers for Fouling Service	1 day	US$ 600
Fundamentals of Heat Exchanger Technology	1 day	US$ 600
Heat Exchanger Technology	2 days	US$1000
Kettle Reboilers	1 day	US$ 600
Workshops	**Length**	**Fee (per person)**
Advanced *Xace*	1 day	US$ 375
Advanced *Xist*	1 day	US$ 375
Condensers	1 day	US$ 375
Enhanced Heat Transfer in *Xist*	1 day	US$ 375
Heat Exchanger Troubleshooting	1 day	US$ 375
HTRI Technology	2 days	US$ 650
HTRI *Xchanger Suite* Essentials	1 day	US$ 375
Reboilers	1 day	US$ 375
Vibration Analysis	1 day	US$ 375
Xace	1 day	US$ 375
Xfh	2 days	US$ 650
Xist	1 day	US$ 375
Xphe	1 day	US$ 375
Xvib	1 day	US$ 375
Seminars	**Length**	**Fee (per person)**
Using HTRI *Xchanger Suite* with Process Simulators	½ day	US$ 200
Designing for Success: Shell-and-Tube Heat Exchangers	½ day	US$ 200
Lessons Learned in Engineering Services	½ day	US$ 200
All Webinars	**Length**	**Fee (per person)**
Webinars are for HTRI members only	1 hour	Free

HTRI®
about the instructors

Salem Bouhairie, *Engineer, Research*, earned his BEng, MEng, and PhD in Civil Engineering from McGill University, in Montreal, Quebec, Canada. While pursuing his graduate studies, he taught Water Resources and Hydraulic Engineering as an Adjunct Professor; Bouhairie also worked as a Laboratory Experimenter in open-channel hydraulics. Following his graduation, he became a Research Assistant at the university, gaining additional expertise with CFD in modeling fluid flows. He worked at Northwest Hydraulic Consultants, in Edmonton, Alberta, Canada, where he conducted physical hydraulic modeling investigations and river hydrology assessments. This experience gave him a broad-based knowledge of heat and mass transfer, thermal-hydraulic design, and computational methods. Bouhairie has delivered presentations on his work in Canada, the United States, England, and Brazil; his work has been published in the *Journal of Fluid Mechanics* and the *Journal of Hydro-environment Research.*

Rose C. Craft, *Engineer, Research,* received her BS and MS in Mechanical Engineering from Rensselaer Polytechnic Institute, Troy, New York, USA. As an undergraduate research assistant, she designed and built a test rig to study boiling heat transfer and pressure drop in micro-channels. She continued to focus on this topic in her graduate studies. Her thesis, *Condensation Heat Transfer in Micro-channels Using Thermoelectric Coolers*, dealt with two-phase flow in micro-channels and the development of a low temperature thermal management approach for distributed, large-scale, high-power electronic systems. Craft now works on projects across multiple research areas at HTRI.

J. Brandon Dooley, *Engineer, Research,* earned his BS, MS, and PhD in Mechanical Engineering from Texas A&M University, College Station, Texas, USA. His dissertation research focused on developing a set of quantitative microscopy and image processing techniques that were used to characterize the mechanisms responsible for ice propagation on droplet-laden heat exchanger surfaces. His primary research at HTRI is experimental and computational single-phase heat transfer. Prior to joining HTRI, Dooley was a lecturer in the Department of Mechanical Engineering at Texas A&M University and worked as a field engineer for the Energy Systems Laboratory at the Texas Engineering Experiment Station in College Station. He interned at Los Alamos National Laboratory in Los Alamos, New Mexico (NM), USA, while an undergraduate and then at Sandia National Laboratories in Albuquerque, NM, during his graduate studies. Dooley is a member of ASME, ASHRAE, and the APS.

David J. Evans, *Manager, Technical Support,* joined HTRI after working for ten years at AspenTech UK Ltd, first as Senior Technical Support Engineer and more recently as Customer Support Manager, UK. Prior to that, he worked as a Software Developer with AEA Technology Plc. for over ten years, and as a Project and Process Engineer with Steetley Engineering Ltd. A Chartered Engineer (CEng) and Chartered Information Technology Professional (CITP), Evans earned two BSc degrees, one in Chemical Engineering from University of Birmingham, Edgbaston, Birmingham, United Kingdom (UK), and the other in Computer Science from the Wolverhampton Polytechnic (now University of Wolverhampton), Wolverhampton, UK. Evans coordinates technical support and provides training worldwide, focusing on EMEA. His education, combined with over 30 years of experience in heat transfer and process simulation, gives him a broad-based skill set for his role at HTRI. He is actively involved in the UK Heat Transfer Society as a Trustee and Committee Member.

Kevin J. Farrell, *Director, Research,* graduated from Pennsylvania State University, State College, Pennsylvania, USA, with his BS, MS, and PhD in Mechanical Engineering. His areas of expertise include fluid dynamics, vibration, and thermal engineering. His responsibilities at HTRI focus on flow-induced vibration, computational fluid dynamics (CFD), visualization studies, and fired heaters. Prior to joining HTRI, he worked for 16 years as a researcher and deputy head of the Fluid Machinery Department of the Applied Research Laboratory (ARL) at Pennsylvania State University. A member of ASME and ISA, Farrell is a licensed Professional Engineer (PE) in Pennsylvania and Texas, USA.

Ian Gibbard holds a BSc in Chemical Engineering from Loughborough University of Technology. He began his career as a heat transfer engineer with John Brown Engineers and Constructors Ltd, involved in the design and procurement of all types of heat transfer equipment for process plant projects. In 1993 he joined Cal Gavin Limited, a company specializing in the development and application of heat transfer enhancement devices, becoming Managing Director in 1996. In 2002 he set up his own company, Progressive Thermal Engineering, providing consultancy and training services to a worldwide client base.

Joseph W. Holmes, *Principal, H² Integration,* holds BS and MS degrees in Chemical Engineering from Texas A&M University, College Station, Texas (TX), USA. Holmes brings to this position more than 30 years of software development experience. Prior to focusing on the integration of products obtained via our alliance with Honeywell, he served as the project manager for HTRI ***X****changer Suite* and its components. He has assisted in the development and updating of several HTRI workshops and is a knowledgeable, experienced HTRI workshop instructor, having conducted numerous courses for HTRI members. Before joining HTRI, Holmes worked for Bryan Research and Engineering, Bryan, TX, as a process research and development engineer. Holmes is a member of AIChE and a licensed Professional Engineer (PE) in Texas.

LiDong Huang, *Manager, Research,* holds a BS from Shanghai Maritime University and an MS from University of Shanghai for Science and Technology, Shanghai, China. He received his PhD in Mechanical Engineering from the University of Houston, Houston, Texas, USA, where he studied and developed methods for predicting subcooled flow boiling, film boiling, and critical heat flux. Before joining HTRI, Huang worked as an instructor and thermal engineer in the Department of Marine Engineering at Shanghai Maritime University. Since joining HTRI, he has focused primarily on boiling and two-phase flow phenomena but also has done some experimental and analytical work on plate heat exchangers, organic fouling, and single-phase mixed convection. Huang has taught several courses at HTRI meetings and member company sites. He is a member of ASME and a licensed Professional Engineer (PE) in Texas.

Nathan W. Kidd, *Engineer, Engineering Applications,* graduated from Texas A&M University, College Station, Texas, USA, with a BS in Chemical Engineering. Kidd interned with HTRI for two terms, implementing rod-type baffles in ***X****ist* and modeling closed feedwater heaters. Since joining HTRI on a full-time basis, he has worked principally on the development of ***X****fh* and co-chaired the 2006 American Flame Research Committee (AFRC) International Symposium.

Christy M. Laird, *Engineer, Research,* earned her PhD in Chemical Engineering from Carnegie Mellon University, Pittsburgh, Pennsylvania, USA. During her graduate studies, she held a National Science Foundation Graduate Fellowship and served as a teaching assistant for undergraduate classes in Thermodynamics and Process Control. Her dissertation research focused on a model for production of solar-grade silicon in a fluidized bed reactor and provided experience for defining appropriate models for process equipment and using experimental data to fine-tune the model. Laird holds BS degrees in Chemical Engineering and in Mathematics from the University of Arkansas, Fayetteville, Arkansas, USA. At HTRI, her primary research responsibility is improving the kettle reboiler model and evaluating single-phase crossflow methods outside plain and finned tube bundles.

Thomas G. Lestina, *Vice President, Engineering Services,* has more than 25 years of engineering project management experience. He earned a BS in Mechanical Engineering from Union College, Schenectady, New York, USA, and an MS in Mechanical Engineering from Rensselaer Polytechnic Institute, Troy, NY. He is a member of ASME and serves as the chair of the technical committee for the ASME Performance Test Code 12.5, Single Phase Heat Exchangers. Prior to joining HTRI, he worked as a Lead Engineer for MPR Associates, Inc., Alexandria, Virginia, USA. Lestina manages our contract services, oversees our training program, and coordinates technical support activities. He also serves as principal subject matter expert on technical content for course and instructor materials, assists in developing and customizing training, and routinely teaches courses. Lestina is a licensed Professional Engineer (PE) in Texas.

Andrew C. Lintern, *Senior Project Engineer, Engineering Applications,* earned his PhD in Chemical Engineering from Imperial College, London, United Kingdom (UK) in May 2008. His PhD thesis research focused on two-phase flow and heat transfer in compact heat exchangers, with an emphasis on theoretical modeling of dephlegmators. He also received his Masters (MEng) in Chemical Engineering from Imperial College. Prior to joining HTRI, he worked in the UK as a software developer with AEA Technology Plc. and AspenTech Limited. His education, combined with nearly 15 years of experience, gives Lintern a broad-based knowledge of multiple types of heat exchangers, fired heaters, and CFD modeling. Lintern works on a variety of software development projects including ***X****fh* and enhancements to the HTRI ***X****changer Suite* calculation routines.

Lauren V. Moran, *Engineer, Engineering Services,* joined HTRI after having worked for five years with two National Aeronautics and Space Administration (NASA) contractors at the Johnson Space Center in the Houston, Texas (TX), USA: McDonald Detwiller and Associates Ltd. (MDA) and Science Applications International Corporation (SAIC). Her responsibilities as a Systems Engineer focused on projects related to the International Space Station. She was certified as a console extravehicular robotics engineer and safety engineer in the Mission Control Center and also served as technical liaison between Boeing and the Canadian Space Agency. Moran now provides technical support to HTRI members. She earned a BS in Engineering from LeTourneau University, Longview, TX.

Andrew J. Mountford provides technical support and training for HTRI. He earned a BSc and MSc in Chemistry and a PhD in Organometallic and Materials Chemistry from the University of East Anglia, Norwich, UK. During his tenure there, he conducted research at Wolfson Laboratory for Materials and Catalysis. He previously held the position of Thermal Design Supervisor at Tecnicas Reunidas in Madrid, Spain, gaining valuable experience using HTRI methods and software. Mountford oversaw the development of several high-profile PWR and BWR nuclear plant projects, as well as gained valuable experience in the thermohydraulic design of heat transfer equipment for the petrochemical and nitric acid/nitrates industries. His experience in using HTRI ***X****changer Suite* makes him uniquely qualified to bring an end user's perspective to the HTRI training program and to share techniques for effectively working with the software.

James T. Schaefer, Jr., *Project Engineer, Engineering Services,* joined HTRI after having worked for six years with Trane Residential Solutions, an Ingersoll Rand company, in Tyler, Texas (TX), USA. His principal areas of responsibility were data acquisition/control, diagnostics, and high efficiency systems in the R&D and Engineering Services divisions. He earned a BS and MS in Mechanical Engineering from Texas A&M University, College Station, TX. He is a member of ASHRAE and serves on several subcommittees of SSPC41 Standard Methods for Measurement. At HTRI, Schaefer focuses on contract services while helping with technical support.

Richard L. Shilling, *Senior Engineering Consultant,* joined the staff of HTRI after working for more than 25 years for Koch Heat Transfer Company, L.P. (formerly Brown Fin Tube Corporation) in Houston, Texas, USA. As Vice President of Engineering, he directed and managed their engineering research projects, as well as oversaw engineering software development. Shilling has also developed new heat exchanger enhancement devices and techniques for equipment designs. Having worked in a refinery, Shilling is also experienced in troubleshooting exchanger problems as a process heat transfer consultant. In his role at HTRI, he provides technical expertise and works with research and engineering services on various projects. Shilling graduated with a BS in Mathematics from Grove City College, Grove City, Pennsylvania, USA, and a BEng from Youngstown State University, Youngstown, Ohio, USA. Shilling co-chairs the HTRI Exchanger Design Margin Task Force (EDMTF). A member of ASME, he is a licensed Professional Engineer (PE) in Texas.

S. Greg Starks, *Regional Sales Manager, USA/Canada,* graduated with a BS in Mechanical Engineering from Texas A&M University, College Station, Texas, USA. While working at the Shuttle Support Thermal Control Systems Analysis Group of Rockwell International, Houston, Texas, he performed thermal analyses for the space shuttle and developed geometry models for the shuttle/space station. From 1994 – 1999, Starks was employed at HTRI, developing calculation engines for our software as well as a quality control database to track program changes. He then moved to Austin, Texas, to work as the Software Engineering Manager for Tanisys Technology, Inc., a supplier of automated test equipment for semiconductor memory technologies. When he rejoined HTRI, Starks was responsible for the ***X****tlo* calculation engine and enhancements to ***X****ist.* He now leads sales efforts in the United States and Canada.

Hirohisa Uozu, *Regional Manager, Asia-Pacific,* holds both a BS and an MS in Chemical Engineering from Nagoya University, Nagoya-City, Japan. Before joining HTRI in early 2001 as the manager of our newly established Asian office, Uozu had worked for Toyo Engineering Corporation, Chiba, Japan, and Japan Manned Space System Corporation, Tsukuba, Japan for a combination of over 25 years. His responsibilities in those positions included design and analysis of heat exchangers and thermal analysis of the space module. He also was involved in software development, including creation of the rigorous tubecount methods (a Toyo Engineering Corporation project) used in ***X****ist*. His career experiences and expertise enable him to provide high quality technical support and training throughout Asia. He is a member of JSME (The Japan Society of Mechanical Engineers) and HTSJ (The Heat Transfer Society of Japan).

Zhihua "Frank" Yang, *Manager, Research,* has a BS in Power and Mechanical Engineering from Xi'an Jiaotong University, China, and an MS and PhD in Mechanical Engineering from State University of New York at Stony Brook, New York (NY), USA. He has conducted research on multiphase flow and heat transfer for more than 25 years, focusing primarily on condensation. Yang has taught several courses at HTRI meetings and member company sites. Before joining HTRI, Yang worked briefly as a mechanical engineer with Analysis and Design Application Company (ADAPCO), New York, NY, and as a research engineer and lecturer with the State Key Laboratory of Multi-Phase Flow and Heat Transfer at Xi'an Jiaotong University, Xi'an, China. Yang, an ASME Fellow, is a licensed Professional Engineer (PE) in Texas.

Hans U. Zettler, *Director of Sales, EMEA,* joined HTRI while completing his PhD in Chemical Engineering at the University of Surrey, UK. His doctoral work focused on fouling and design of compact heat exchangers. He also possesses a mechanical engineering degree (Dipl.-Ing.) from the Technical University Karlsruhe, Germany. Zettler completed multiple internships in industry throughout Europe while pursuing his education. He is a member of the German Engineering Society (VDI), a member of the VDI-GVC Working Party on Heat and Mass Transfer, an associate member of the Institution of Chemical Engineers (IChemE), and a committee member of the Heat Transfer Society (HTS) in the UK.

Weiming Zhu, *Professorate Senior Engineer, China Huanqiu Engineering Corporation, Beijing, China,* has over 20 years of experience in heat exchanger design, operation of heat exchanger equipment, and heat transfer related areas in petrochemical, refinery, petroleum, fertilizer, and coal-based propylene industries. She graduated with a BS degree in power mechanical from University of Shanghai for Science and Technology, Shanghai, China. She served as Chair of HTRI's Communication Committee–China from 2008 to October 2010. She also currently serves as her company's HTRI Technical Advisory Committee Representative. She is a Registered Chemical Engineer in the People's Republic of China.

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