YOUR GUIDE TO THE

ASHRAE WINTER CONFERENCE

JANUARY 23–27, 2016 • **ORLANDO**

Included Inside: • Complete technical program
• Social events schedule • All education courses
• Maps of meeting areas

Your Guide to the ASHRAE Winter Conference

January 23–27, 2016

ASHRAE EVENTS APP

Update your ASHRAE App for the Winter Conference to access the full meeting agenda with venue floor plans, social events, and tips for your time in Orlando. The app also features exclusive features like the ability to view Virtual Conference presentations from your mobile device, a customizable personal schedule, digital speaker evaluations, and live in-session audience polling. The app is made possible through support from the following sponsors:

Get the free mobile app at: www.ashrae.org/app

PERSONAL PROGRAM—PLAN YOUR OWN MEETING SCHEDULE!

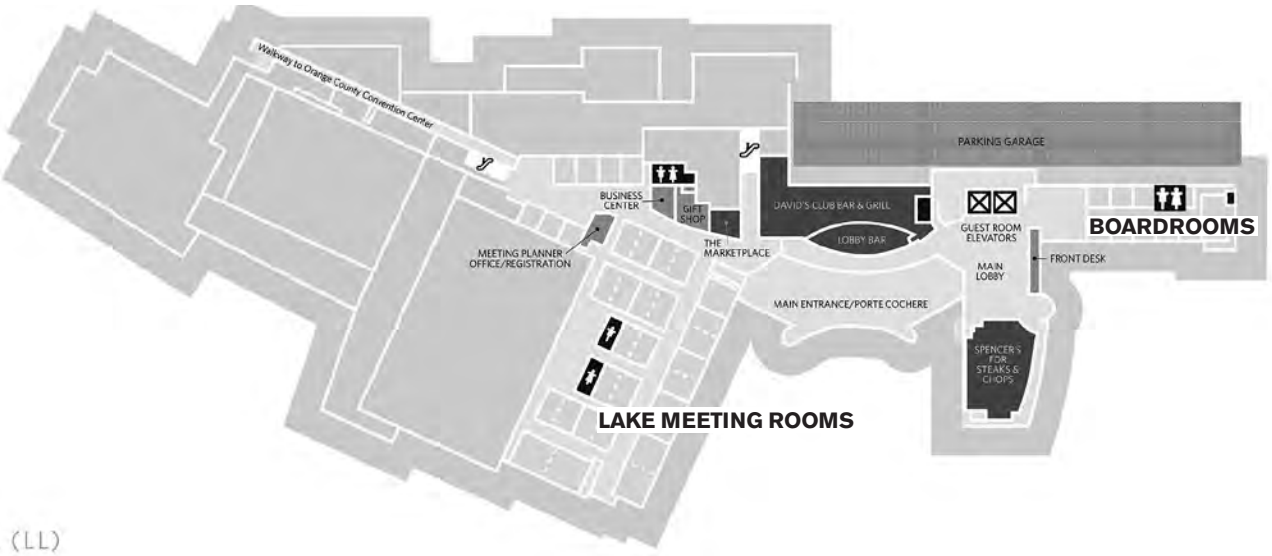
FRIDAY, JANUARY 22	SATURDAY, JANUARY 23	SUNDAY, JANUARY 24
8:00 am–12:00 noon	8:00 am–12:00 noon	8:00 am–9:30 am
1:00 pm–5:00 pm	8:00 am–3:00 pm	8:30 am–12:00 noon
5:00 pm–10:00 pm	1:00 pm–3:00 pm	9:45 am–10:45 am
	3:15 pm–5:00 pm	11:00 am–12:30 pm
		1:30 pm–3:00 pm
	6:30 pm–8:30 pm **Welcome Party** Sea World	3:00 pm–7:00 pm

NOTES:

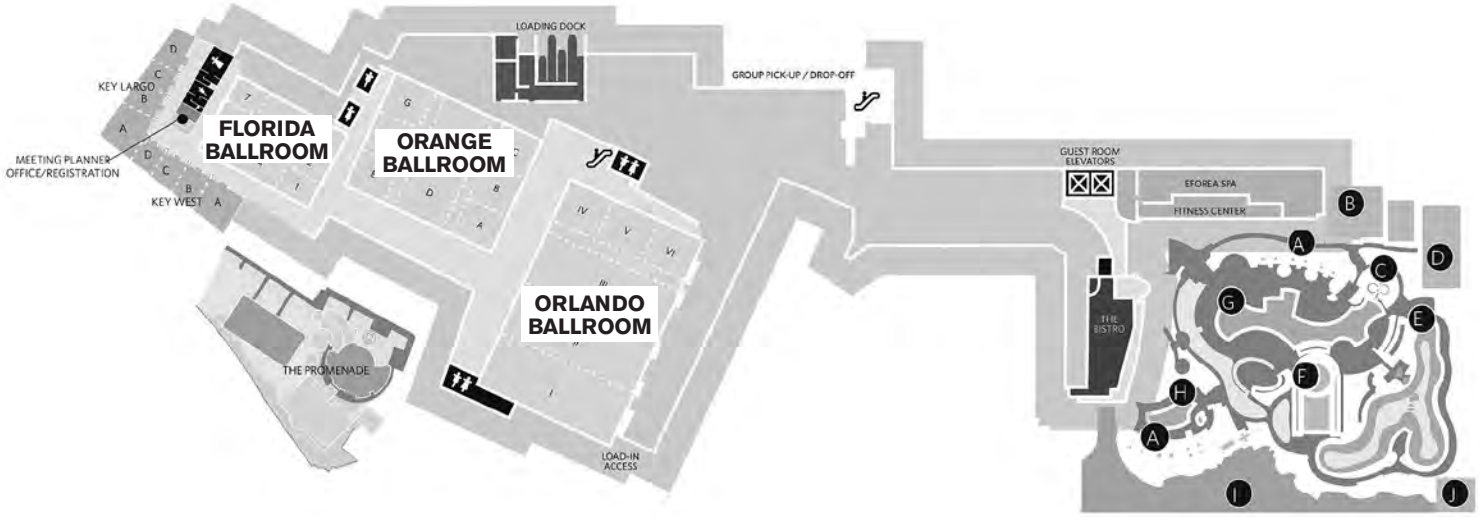
PLAN YOUR OWN MEETING SCHEDULE!—PERSONAL PROGRAM

MONDAY, JANUARY 25	TUESDAY, JANUARY 26	WEDNESDAY, JANUARY 27
8:00 am–9:30 am	**8:00 am–9:00 am**	**8:00 am–9:30 am**
9:45 am–10:45 am	**9:45 am–10:45 am**	**9:45 am–10:45 am**
11:00 am–12:00 noon	**11:00 pm–12:30 pm**	**11:00 am–12:30 pm**
12:15 pm–2:00 pm **President's Lunch** Orlando Ballroom I/II, Lower Level	**1:00 pm–3:30 pm**	**1:00 pm–5:00 pm**
2:15 pm–4:15 pm	**3:30 pm–6:00 pm**	
4:15 pm–6:30 pm	**6:15 pm–10:30 pm** **Members' Night Out** Orlando Ballroom I/II, Lower Level	

HILTON ORLANDO – LOBBY AND LOWER LEVEL

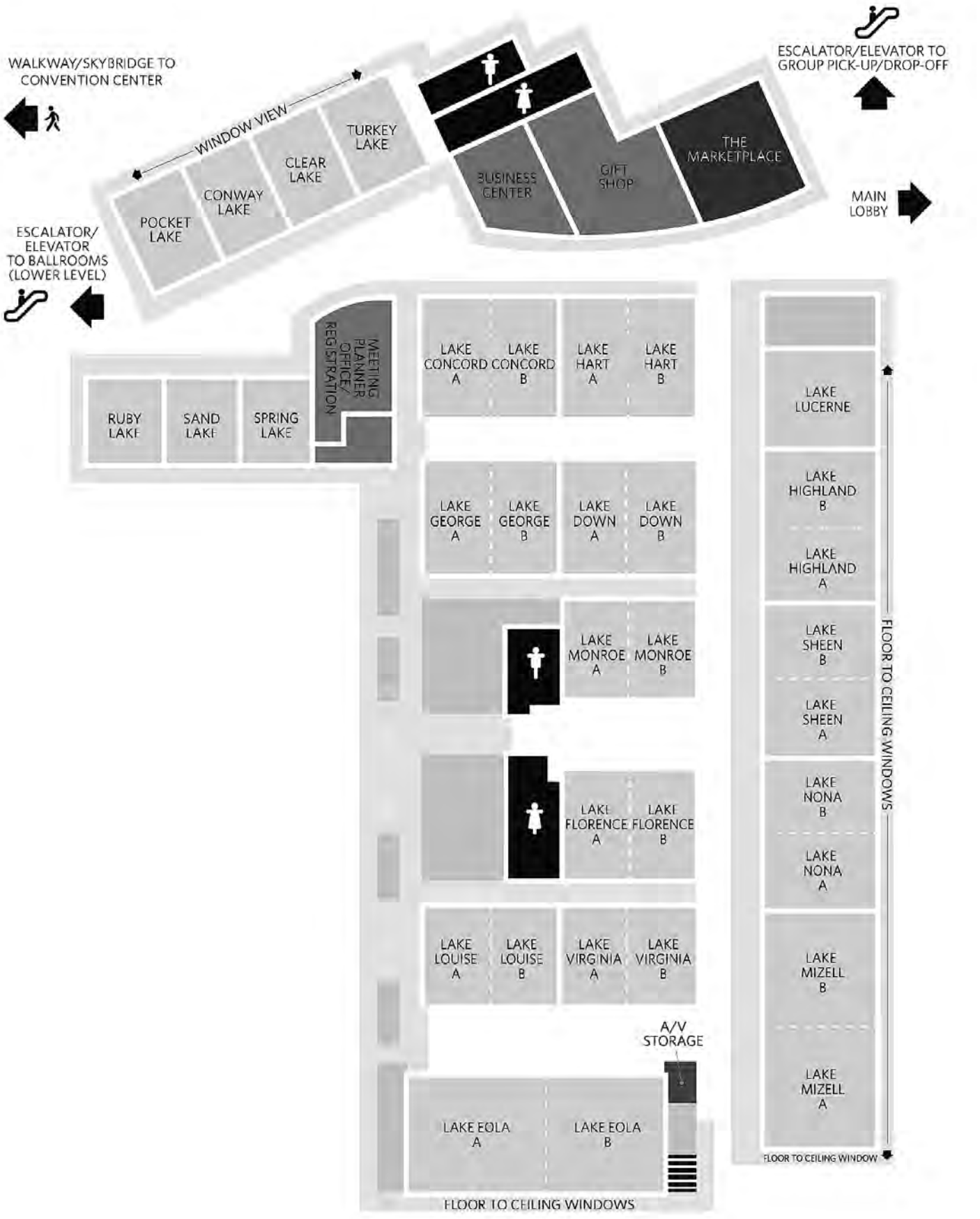


LOWER LEVEL (LL)



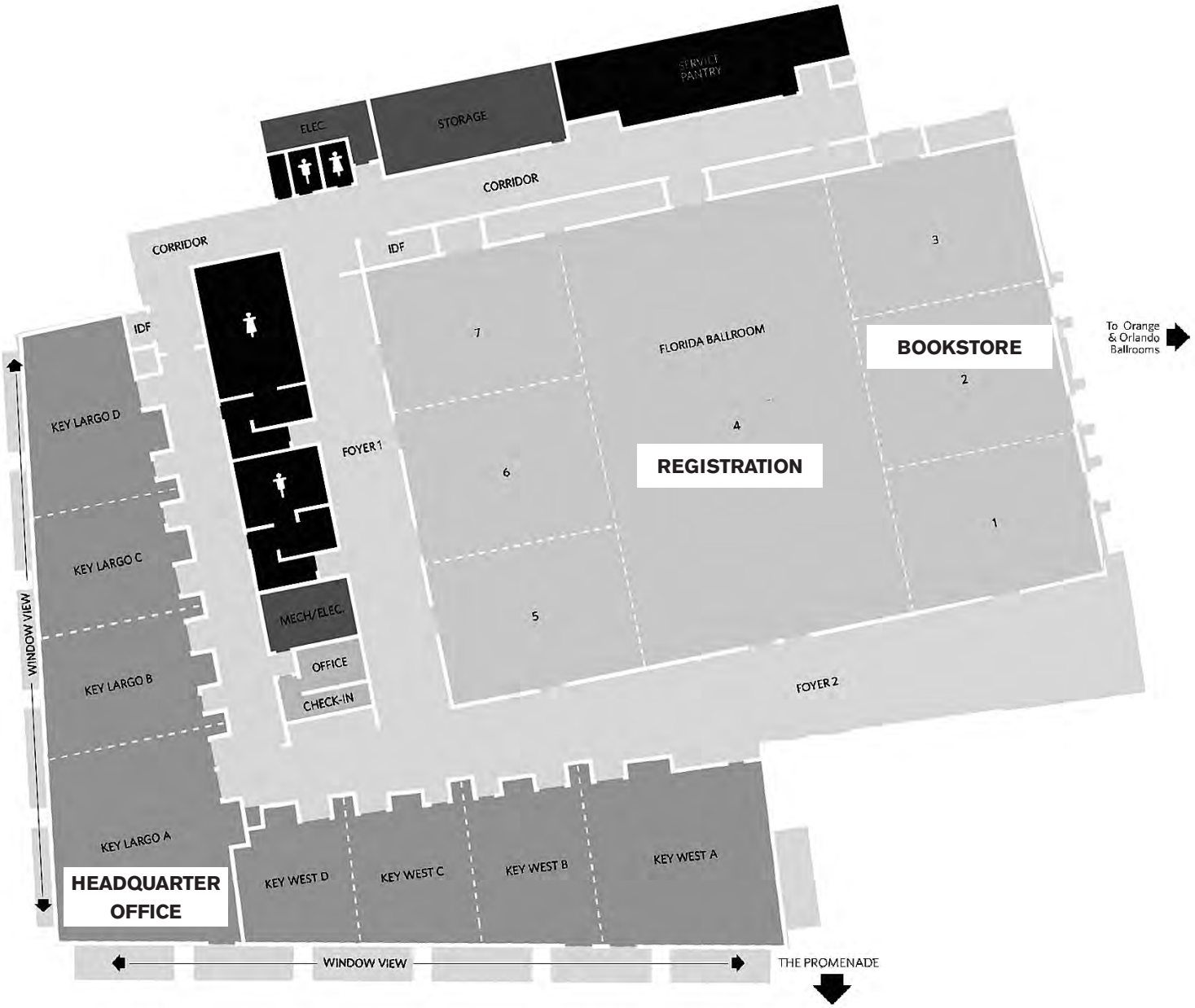
HILTON ORLANDO – LAKE MEETING ROOMS

Lobby Level (L)



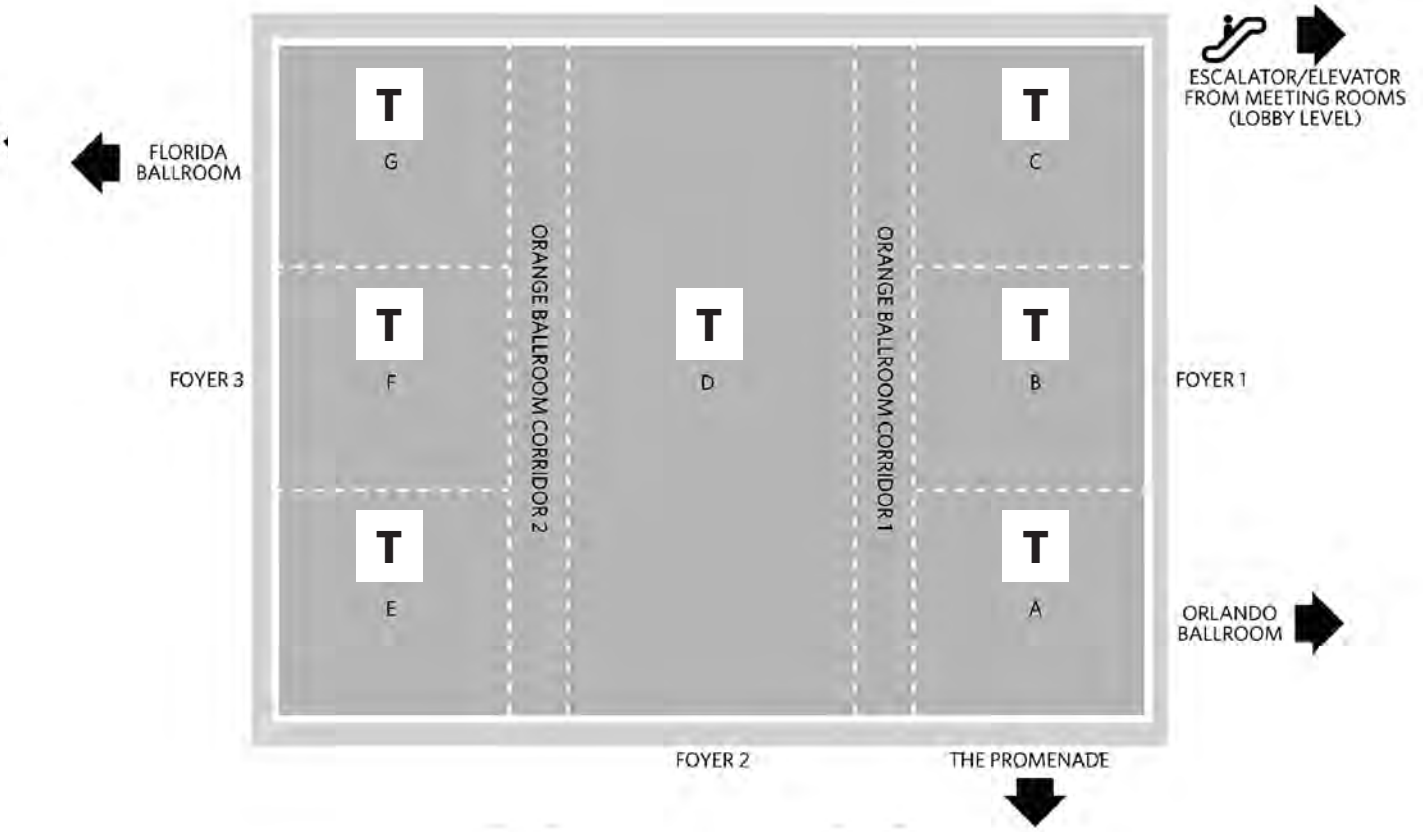
HILTON ORLANDO – FLORIDA BALLROOM

Lower Level (LL)



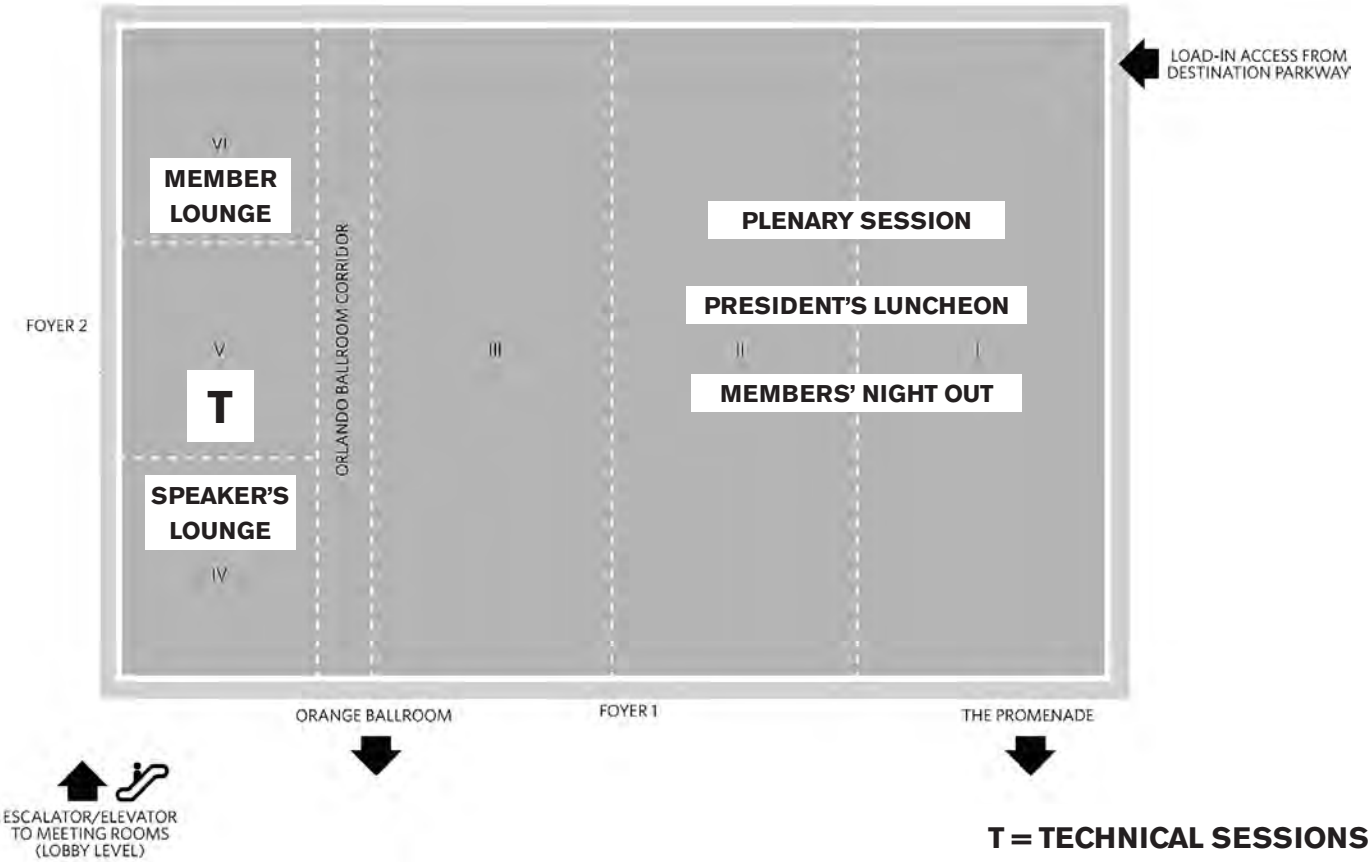
HILTON ORLANDO – ORANGE BALLROOM

Lower Level (LL)



HILTON ORLANDO – ORLANDO BALLROOM

Lower Level (LL)



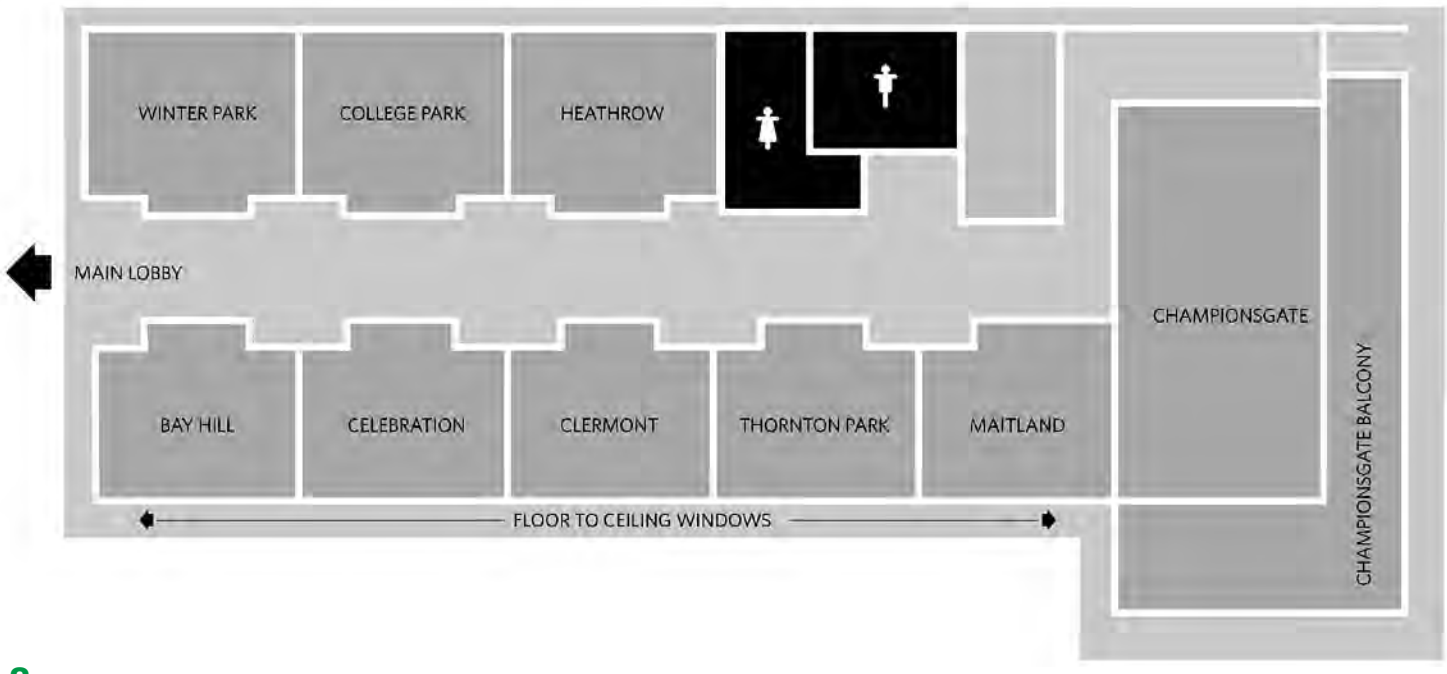
T = TECHNICAL SESSIONS

HILTON ORLANDO – KEY WEST & KEY LARGO MEETING ROOMS

Lower Level (LL)

HILTON ORLANDO – BOARDROOMS

Lobby Level (L)



CONFERENCE SPONSORS

ASHRAE thanks the following sponsors for their support of the 2016 Orlando Conference

Sponsor of the Keynote Speaker

Sponsor of the ASHRAE Bookstore

Sponsor of the YEA

Sponsor of the Women in ASHRAE Breakfast

Sponsor of Conference Note Pads

CHAPTER AND SOCIETY OFFICIALS

A special thanks to all the members in the Central Florida Chapter who helped make the 2016 Winter Conference a success!

CENTRAL FLORIDA CHAPTER OFFICERS

Burns Bradford, President
John Davant, President-Elect
Paul Albers, Vice-President
Mitesh Smart, Treasurer
Kyle Inge, Secretary

ORLANDO HOST COMMITTEE

General Chair, Wade Conlan
Vice Chair, Kyle Inge
Tours, Jason Alfonso and Todd Moore
Entertainment, Mike Dillard and Amy Weaver
Sessions, Paul Albers and Michael Murphy
Hospitality, Firouz Keikavousi and Christian Robledo
Publicity and Information, Jacob Moberg and Ian LaHiff
Sustainability Project, Nate Boyd and Mitesh Smart

ASHRAE OFFICERS

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Timothy G. Wentz, President-Elect
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Dennis Alejandro
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Thomas H. Kuehn
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Kevin L. Marple
Corey B. Metzger
Cynthia Moreno
Robert A. Neely
Ann J. Peratt
Rachael Romero
Frank Schambach
Leon Shapiro
Jeffrey D. Spitler
Samir R. Traboulsi
Wade H. Conlan, Consultant

GENERAL INFORMATION

BADGES MUST BE WORN FOR ADMISSION TO SESSIONS

Your ASHRAE Conference badge is required for admission to the technical program. Room monitors will be scanning badges at the rooms. The scanning process will provide you with a summary of all sessions attended at the conclusion of the conference and will be sent directly to you by email. The room monitors will distribute evaluation forms for each session. Please complete the form and return it to the monitor when you leave the session. Room monitors will also distribute and collect comment cards on which attendees are encouraged to submit written questions regarding papers presented at Technical Paper Sessions. Questions are given to the authors for reply and published in ASHRAE Transactions.

HOTEL ADDRESS, TELEPHONE

Orlando Hilton
6001 Destination Parkway
Telephone: 407-313-4300

ON LINE REGISTRATION

Need to register or buy a ticket for social events, tours, or Learning Institute courses? You can register online throughout the conference. You can also register during registration hours in the Florida Ballroom 4, lower level of the Orlando Hilton. Just come to registration to pick up your tickets or badge.

INTERNET ACCESS

Internet access for e-mail is available in the Cyber Café located in the registration area during operating hours. Please be considerate to others and limit your usage to five minutes.

Wireless internet will be available in all meeting rooms. ASHRAE will be working with the internet provider to manage the bandwidth so that member expectations of accessibility and speed are fulfilled. We have developed some history on how much bandwidth has been used during certain times but we would like to continue to request that everyone limit their usage to functions that do not use excessive bandwidth such as Facebook, YouTube, streaming video, etc. Access code for the wifi: ASHRAE2016 is the network, Password is orlando16 and the code is case sensitive.

ASHRAE APP

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To download the app, visit www.ashrae.org/app.

NOTICE

ASHRAE regards the materials presented at these sessions to be the unique work of ASHRAE and exercises control over the dissemination and/or use of such products in the future. Accordingly, videotaping and recording of this program are not allowed without ASHRAE's prior written consent.

CELL PHONES/PAGERS

Please be considerate and turn off your phones in committee meetings and during technical presentations.

COMPANY-SPONSORED HOSPITALITY SUITE POLICY

Hospitality suite hours must not conflict with ASHRAE meetings or social functions. Product displays, literature handouts, posting of signs in hotel lobbies or hallways, and commercial advertising or recruiting are not allowed in the Orlando Hilton, ASHRAE's headquarters hotel.

SALE OF MERCHANDISE

Sale of merchandise, or the solicitation to sell merchandise, of any type at the Annual and Winter Conferences will only be permitted by prior approval of the Conferences and Expositions Committee and any surplus will go to the Society.

SIGNS/DISPLAY OF AFFILIATE MEETING INFORMATION

Signs and information concerning affiliate or related organizations must be approved by the Society prior to display. No signs are to be attached to walls, and all signs must be professionally printed.

PHOTO RELEASE

Photographs will be taken at the ASHRAE Winter Conference. By registering for this conference, you agree to allow ASHRAE to use your photo in any ASHRAE-related publications or Web site.

WHAT TO WEAR

Normal business attire is appropriate for meetings and social events; however, the Welcome Party and Members' Night Out will be business casual.

LOST AND FOUND

Items found during the conference should be turned into the staff in the ASHRAE headquarters room, Key Largo A or ASHRAE registration. If you have misplaced something during the conference please check these two locations as well as security with the hotel and convention center.

ORLANDO SUSTAINABILITY PROJECT

The sustainability footprint program was launched by the Salt Lake City Host Committee at the 2008 Annual Conference. Those wishing to donate to the Orlando sustainability project can do so via online conference registration. Take a moment to stop by and thank the committee for their efforts. A complete description of the project is located in this program.

TECHNICAL PROGRAM PDHs

All of the sessions presented in the technical program are approved for professional development hours (PDHs), including State of Florida PDHs. In addition, some sessions are approved for the State of New York PDHs and AIA Learning Units. Those programs are indicated with a NY PDH symbol. Others are approved for LEED AP credits and are indicated with a G symbol. Certain sessions may be acceptable for ASHRAE certification renewal. Send questions to certification@ashrae.org. In order to report your attendance at the session, use the PDH and AIA sign-in sheets in the session room.

Sessions are approved for 1, 1.5 or 2 PDHs depending on the length of the session.

SCANNING

Your badge will be scanned as you enter the session and a summary of sessions attended will be emailed to you upon conclusion of the conference. The scanning process may take a little longer to get into the room so have patience. Please keep track of the sessions that you attend at the conference. If you do not desire to have a summary of the sessions you do not need to be scanned.

MEETING PAPERS

During the conference, papers presented at the technical paper and conference paper sessions can be purchased in the ASHRAE Bookstore. After the conference, papers will be posted in the online ASHRAE Bookstore. Papers are not available for seminars or forums. Technical paper session papers will be published with discussion in ASHRAE Transactions. Other meeting papers can be purchased in the online Bookstore at www.ASHRAE.org or searched online in Abstract Center. The Abstract Center is a searchable database of abstracts on everything ASHRAE has published since 1980. This service is free to ASHRAE members, but a subscription fee will be charged to nonmembers. For ordering information, contact ASHRAE Customer Service at 1-800-527-4723.

VIRTUAL CONFERENCE

Free for Paid Conference Registrants

ASHRAE is offering a virtual conference option so you won't miss the state-of-the-art concepts and latest design techniques presented in the Society's technical program. The Orlando Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board. All conference attendees paying the full registration fee will receive an email notification when sessions are available for viewing. The email will include a link to the Orlando Virtual Conference. If you do not have your password, go to www.ashrae.org/Orlandoonline and click on the link to access the Virtual Conference and put in your email address to request your password.

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations from all technical paper sessions, conference paper sessions, seminars and workshops.
- Ability to post comments and rate presentations.
- Print presentation slides in notes format.
- Ability to post questions or answers for selected sessions through Wednesday, February 10. Presentations available online for 18 months.
- A full slate of technical programs will be posted beginning Monday, January 25, of the sessions that were presented the previous day, with additional content posted through Thursday, January 28.

Access to the Orlando Virtual Conference is free with your paid conference registration. To register only for the Virtual Conference, go to ASHRAE Registration in the Florida Ballroom 4. $249 ASHRAE member; $445 non member or register online.

Over 2,000 Exhibits AHR Expo®, Orange County Convention Center 9800 International Blvd.

(Connected by a covered foot bridge to Orlando Hilton, a 3 minute walk)

Hours:

Monday, January 25	10:00 a.m.–6:00 p.m.
Tuesday, January 26	10:00 a.m.–6:00 p.m.
Wednesday, January 27	10:00 a.m.–4:00 p.m.

If you have registered for the ASHRAE Conference, your conference badge is your admission into the exposition.

If you are attending the exposition only and you did not register in advance, the fee for admission is $30.00 and can be paid at the Orange County Convention Center. Registration for the AHR Expo® will be open from Noon to 4:00 p.m. on Sunday, January 24. Starting Monday, you can register one hour before the doors open.

You must be 18 years or older to be admitted to the show floor. Ages 16 and 17 will be admitted only if accompanied by an adult.

SOME COMMON SENSE SAFETY TIPS

Street Safety. The streets of any city at any time can be unsafe. When you leave your hotel to go out during the day or the evening, make sure you take off your badge. Wearing a badge is an advertisement that you are a visitor to the city and that you are probably unfamiliar with your location. Walk "smart" when you leave the convention site —know your destination and the best way to reach it. Walk along lighted sidewalks at night and don't walk alone. Trust your instincts—if you're uncomfortable with a situation, get out of it.

Hotel Safety. Some general guest safety tips include:

Don't answer the door in a hotel room without verifying who it is. If a person claims to be an employee, call the front desk and ask if a staff person is supposed to have access to your room and for what purpose.

Use the hotel safe-deposit box.

When you're in your hotel room, use all of the locking devices provided.

Don't reveal your room number or discuss plans for leaving the hotel within earshot of strangers.

EMERGENCY SITUATIONS

Hotel emergencies should be directed to the hotel operator; for police and fire department emergencies dial 911. Hotel security is trained in emergency response and can get to the scene of an emergency quickly if medical assistance is needed. The closest hospital is Orlando Regional Medical Center, 52 W. Underwood Street. (321) 841-5111.

Fire Emergency... Preparedness in Hotels

The hotel's PA system will advise you of the need to evacuate in the event of a fire. The PA system is used on all sleeping and meeting room floors. Plan ahead—when you check into your room, check the location of exits. Walk to the nearest exit; learn

General Information continued on next page

General Information continued from page 11

the route, obstacles, etc. Keep your room key on the night stand when you are in your room. Examine your room. Check the windows to see if they open and how. Examine the area outside your window.

CHARGING STATION

A kiosk to charge your cell phone and other devices has been provided by the Chapter Technology Transfer Committee's Annual Webcast. The charging station is located in the foyer outside of the Orange Ballroom.

SPOUSE/GUEST GUIDE

The ASHRAE Lounge is open daily for all individuals who are registered for the meeting. Refreshments are available from 7:30 to 9:30 a.m. each day and beverages are available all afternoon. Members of the Orlando Host Committee will be present to answer questions about local activities. Detailed information on the city including brochures and maps can be found at the Host Committee Desk located in the ASHRAE Registration area in the Orlando Hilton Florida Ballroom 4.

Location: Orlando Hilton, Orlando Ballroom VI, Lower Level

Hours

Saturday, January 23 . . . . . 7:30 a.m.-3:00 p.m.
Sunday, January 24 . . . . . 7:30 a.m.-4:00 p.m.
Monday, January 25. . . . . 7:30 a.m.-4:00 p.m.
Tuesday, January 26 . . . . . 7:30 a.m.-4:00 p.m.
Wednesday, January 27 . . . . 7:30 a.m.-1:00 p.m.

SPOUSE MEET AND GREET

Orlando Hilton, Florida Ballroom 5-7, Lower Level
Monday, Jan. 25
9:30-11 a.m.

The Meet and Greet, open to all registered spouses, gives spouses an opportunity to meet with old friends and greet new friends.

The program is a bead making class where participants will create a lanyard. A variety of Swarovski crystal pearls and Swarovski crystal beads are available to make personal lanyards. Instructors are on hand to assist.

The process of making the lanyard is similar to making a piece of jewelry. After participants complete their work, instructors will finish the piece and leave lanyards in the ASHRAE registration area. Final details are to be provided during the session.

Light refreshments will be served.

WELCOME PARTY

Saturday, January 23
6:30–8:30 p.m.

SeaWorld

The Welcome Party will be held in Ports of Call at SeaWorld. It features large windows overlooking a covered patio area and a lushly landscaped garden. Visitors to the Welcome Party will include a variety of tropical birds and exotic mammals. Specially trained educators will be available to provide information about all of these fascinating animals and everyone will be given a chance to have their photo made with the animal of choice.

Menu:

Floribbean Panzanella Salad
Fresh greens, feta cheese, Kalamata olives, red onions, tomatoes, avocados, celery, orange segments and pepperoncini served with sourdough croutons, Key lime vinaigrette dressing

Gourmet Burger Slider Station
Grilled Mahi-Mahi, Portabella Mushrooms and Kobe

Beef Miniature Sliders

Blackened Fish Tocos

Vietnamese Spring Rolls

Home-style Cheddar Mac & Cheese

Dessert Selections
Coconut, Carrot and Chocolate Chip Cakes, Brownies

Shuttle service will begin at 6:10 from the Group Transportation area on the lower level of the Hilton Orlando. Access via escalators between David's Club and Marketplace.

A ticket is required to attend.

Ticket cost is $60 and includes two drink tickets.

WOMEN IN ASHRAE CONTINENTAL BREAKFAST

Monday, January 25, 7:00 – 8:30 a.m.
Orlando Hilton, Florida Ballroom 5-7
Lower Level

The purpose of this event is to encourage women to be active ASHRAE participants at the chapter, region, and/or society level and to give them ideas and information about how to do so. Current ASHRAE members will be on hand to provide insight and to share their experiences. A light breakfast and coffee will be served. This event required reservations.

PLENARY SESSION KEYNOTE SPEAKER – LAURA SCHWARTZ

Saturday, January 23

Empowerment Through Service

Laura Schwartz, the White House director of events for the Clinton Administration is the keynote speaker at the opening Plenary Session, Jan. 23.

In her keynote address, Schwartz shows how giving back today can make a difference in your world and in your organization. Regardless of your role in an organization, Schwartz will empower you to strengthen your commitment, whether that means working harder, becoming more involved or giving greater. As Schwartz explains, volunteer associations and service organizations are instrumental in our society because they can often do things more effectively than our own government. She communicates the power of service using colorful examples and entertaining anecdotes from her work in the White House.

Laura appears regularly as an international television commentator speaking about leadership, networking, domestic and foreign affairs, pop culture and special events. She covered the 2008 presidential campaign for the CBS Early Show, was the on-air political contributor for the Fox News Channel from 2004 to 2007, and was the special correspondent to Larry King Live and CNN for the 2008 presidential primaries. Laura is also seen internationally on the BBC World News and Sir David Frost's Frost Over the World. Laura's non-partisan commentary is well respected both domestically and internationally.

Laura is the annual emcee for several prominent charitable events, including the American Heart Association's Heart Walk in Chicago's Grant Park and the United Way's Community Celebration, which recognizes the top corporate executives, volunteers and government officials throughout the country. Laura is a member of the National Speakers Association and serves on the boards of the American Heart Association, the Clean the World Foundation and Event Solutions Magazine. She received the Steve Kemble leadership Foundation Award for Excellence and Advocacy and was named one of the "100 Most Influential Women in Chicago" by Today's Chicago Woman Magazine and one of Chicago's "Most Bold and Beautiful" by Chicago Magazine. In 2007 American University in Washington, D.C., awarded Laura its "Leadership in Education" award and in 2009 the prestigious Oxford Union in England invited Laura to speak on the Foreign Policy Legacy of the United States and the role of Women in the World.

***Eat, Drink & Succeed* – The Book – Available in the ASHRAE Bookstore**

Laura travels the globe teaching successful people how to get even bigger results. Her step-by-step formula for greatness is outlined in her first book, *Eat, Drink & Succeed.* Laura shows how the same secrets that fueled her success have worked for business powerhouses like Steven Spielberg and Oprah Winfrey, as well as CEOs, entrepreneurs, non-profit leaders and even stay-at-home parents. Most importantly, she shows how they can work for you!

PRESIDENT'S LUNCHEON

Orlando Hilton
Orlando Ballroom I/II, Lower Level
Monday, Jan. 25
12:15 p.m.–2 p.m.
(Doors open at 12 Noon)

2015–16 ASHRAE President David Underwood provides an update on his presidential theme, Making Connections. Major contributors to ASHRAE RP Campaign are recognized.

A ticket is required to attend.

Ticket cost is **$50**

MEMBERS' NIGHT OUT

Orlando Hilton
Orlando Ballroom I/II, Lower Level
Tuesday, Jan. 26
6:15 p.m.–7:00 p.m.
Reception, cash bar in Orlando Ballroom Foyer

Dinner and Entertainment

7:00 p.m. - 10:30 p.m.

End the Conference by spending a fun yet relaxing evening with friends. Jeff & Rhiannon Dueling Pianos is the featured entertainment so come prepared to enjoy the night with all-request music that will make you want to clap-a-long, sing-a-long and dance-a-long during this interactive piano show. They can play it all so come ready to request your favorite song.

Ticket cost is **$60**

HOW TO GET THE MOST OUT OF THE ASHRAE CONFERENCE AND MEETING

How many times have you been to a conference only to find later that you missed a speaker you would like to have heard or you missed your chance to sound off in a forum?

ASHRAE conferences provide numerous opportunities for you to hear about the latest technology in the HVAC&R industry, to express your opinion about controversial issues, to explore new applications for fundamental ideas, to meet the people behind those ideas and to help shape the Society that serves your profession.

Whether you are attending your first conference or your tenth, chances are that you will have questions about what is available, which events you want to attend, how to hear one speaker without missing another or where to go to give input regarding a standard or research project. From registration to committee meetings, the following summary should answer some of your questions and aid you in getting the most out of an ASHRAE conference and meeting.

Registration

ASHRAE offers conference attendees a variety of options for registration, the most convenient and least costly being pre-registration. By pre-registering at least 30 days prior to the conference, you can save 25 percent. You may purchase the conference registration which includes admittance to the technical program, the AHR Exposition (Winter Conference only), and you can add on social events like the Welcome Party (opening reception with food), President's Luncheon (current President speaks) and Member's Night Out (closing dinner). Tickets for social events, spouse and technical tours may be purchased separately. You must be registered to attend the technical program.

Sharing Technology:
The ASHRAE Conference Technical Program

The technical program for the ASHRAE Conference includes technical and conference paper sessions, seminars, workshops and forums. Once you receive your badge you have access to all of these sessions. Check the program to see what you want to attend or check the speaker list to see if someone you know is presenting. You can jump between sessions if you want to hear one specific presentation in each session. The order of presentations in this program is usually adhered to. Our host committee volunteers will be at the door checking and scanning badges.

Five types of sessions are presented:

Technical Paper Sessions. These sessions present papers on current applications or procedures, as well as papers resulting from research on fundamental concepts and basic theory. Papers presented in these sessions have successfully completed a rigorous peer review. You are invited to comment on these papers. Forms for written comment are available at each session, and if received by February 8, 2016, comments will be sent to respective authors for reply and publication in ASHRAE *Transactions*. PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Preprints of papers and an online papers collection are available for purchase in the ASHRAE Bookstore.

Conference Paper Sessions. These sessions present papers on current applications or procedures, as well as papers reporting on research in process. These papers differ from technical papers in that they are shorter in length and undergo a much less stringent peer review. PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Preprints of conference papers and an online papers collection are available for purchase in the ASHRAE Bookstore.

Seminars. Seminars feature presentations on subjects of current interest. Papers are not available from the Society; however, seminar PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Access is free for attendees who purchase a conference registration. Additional Virtual Conference registrations can be purchased in the ASHRAE Registration. For a permanent record of the seminar presentations, the Seminar DVD will be available. Orders can be taken in the ASHRAE Bookstore.

Forums. Forums are "off-the-record" discussions held to promote a free exchange of ideas. Reporting of forums is limited to allow individuals to speak confidentially without concern of criticism. There are no papers attached to these forums.

Workshops. Workshops enable technical committees and other ASHRAE committees to provide a series of short presentations on a topic requiring specific expertise. These short presentations are provided with an increased emphasis on audience participation and training in a specific set of skills. PowerPoint presentations with audio descriptions are posted online in the Virtual Conference.

Each hour attended in a session equals one PDH. For forums and other one-hour sessions, you must be present for the entire 50-minute program to earn a PDH. Sign-in sheets will be available in all session rooms for attendees to complete. State PDHs, AIA LUs and LEED AP credits are awarded for select sessions. Also, certain sessions may be acceptable for ASHRAE certification renewal. Send questions to certification@ashrae.org. Your badge will be scanned as you enter the session and a summary of sessions attended will be emailed to you upon conclusion of the conference.

Does your experience and background have something to offer to conference attendees? If so, explore how to participate in a future conference as a speaker by visiting the Speaker's Lounge and talking to a Conferences and Expositions Committee member.

Advancing the Industry: Society Meetings

The technical expertise of ASHRAE is concentrated in its technical committees, task groups and technical resource groups, which are responsible for preparing the ASHRAE Handbook volumes, initiating and supervising Society research projects, presenting programs at ASHRAE Conferences, reviewing technical papers and evaluating the need for standards.

To be a member of a technical committee (TC), you must be active in the field addressed by the committee. You do not have to be an ASHRAE member to participate in a technical committee, nor do you have to be a member of a technical committee to attend committee meetings.

Standards project committees (SPCs) are appointed specifically by the Standards Committee to develop and revise standards to reflect technical advances in the areas that they cover. To qualify for membership in a committee, you must be knowledgeable in the discipline of the proposed standard.

Technical and standards project committees meet in conjunction with the Conference. Membership in these committees allows you to exchange ideas, help shape the activities of the Society and contribute to the advancement of your profession. Your input can have a direct impact on the future of ASHRAE research projects, technical programs and standards as well as the industry.

A schedule of all meetings is included in the conference program. Attendance at TC and SPC meetings is open. Please consult your schedule and plan to attend the committee meetings that interest you.

Something for Everyone: Guest Program

Not everyone attending the Conference or a meeting is there to catch up on the latest in transient response to heat pumps or the thermodynamics of cogeneration. As an alternative, ASHRAE offers a guest program that includes tours of the host city, special interest seminars and social events. A complete program of events is included in this final program.

Support Services

The ASHRAE Bookstore and membership booth are set up on site to offer conference participants the latest information about the industry and to answer questions concerning ASHRAE membership.

ASHRAE publications, including technical and conference papers, are available for sale in the ASHRAE Bookstore. Located in the registration area of the headquarters hotel and in the EXPO during the Winter Conference only, the bookstore features a display of books devoted entirely to the HVAC&R industry. Publications from ASHRAE's publications catalog, as well as a variety of new publications and books from such organizations as the National Environmental Balancing Bureau, National Conference of States on Building Codes and Standards, Inc., and Sheet Metal & Air Conditioning Contractors' National Association are on display. ASHRAE publications may be purchased individually on site, or you may wish to order several books and have them shipped to you at a later date or use the online bookstore at www.ashrae.org/bookstore.

The membership booth is located in the registration area of the headquarters hotel. Membership applications are available, as well as brochures about the HVAC&R industry, information on student membership and information about the ASHRAE group insurance plan. Registrants paying the non member registration fee receive their first year of membership free. To obtain membership an application form must be submitted with the meeting registration form or within 60 days following the meeting. A staff member will be present during registration hours to assist you.

Networking: Getting Involved

ASHRAE conferences and meetings provide an international setting for attendees to gather and exchange ideas, to explore possibilities in the industry and to examine its problems. Opportunities to get involved range from presenting a technical paper to participating in a seminar or attending committee meetings. By reviewing your program and planning ahead, you can ensure that the conference will be a success instead of a series of missed opportunities. Start your day in the Member Lounge with a cup of coffee and the opportunity to meet up with old friends or make new ones.

UPCOMING CONFERENCES

6th International Conference on Energy Research and Development
March 14–16, 2016 • Kuwait

ASHRAE and IPBSA-USA SimBuild 2016: Building Performance Modeling Conference
August 10–12, 2016 • Salt Lake City, Utah

ASHRAE IAQ Conference: Defining Indoor Air Quality – Policy, Standards and Best Practices
September 12–14, 2016 • Alexandria, VA

2nd International Conference on Efficient Building Design: Materials and HVAC Equipment
September 22–23, 2016 • Beirut, Lebanon

LIFE MEMBERS' LUNCHEON

Orlando Hilton, Lake Eola B, Lobby Level
Tuesday, Jan. 26
11:30 a.m.-1 p.m.

Enjoy lunch, share ideas about the future of technology and swap memories of the Society while dining with Life Members. This member grade is for members who have completed 30 years of continuous membership and are at least 65 years of age.

Ticket required

Ticket cost is **$35**

AWARDS PRESENTATION

Saturday, January 23, 3:15–5:30 p.m.
Plenary Session, Orlando Hilton
Orlando Ballroom I/II, Lower Level

ASHRAE PIONEERS OF INDUSTRY AWARD

"Given to recognize deceased individuals who have made milestone contributions to the growth of air conditioning, heating, refrigeration and ventilation"

Daniel Livingston Holden

Benjamin Franklin Sturtevant

ASHRAE HONORARY MEMBER

"Given to recognize notable persons of preeminent professional distinction"

P. A. Hancock, Ph.D., Orlando, FL

Terry M. Manon, Danville, KY

STUDENT DESIGN PROJECT COMPETITION

"Given in recognition of outstanding student research and design projects"

HVAC System Selection
First Place: **Brianna Brass, Matthew Easlon, Mary Kleinsasser, Ben MacKenzie, Rachel Obenland** University of Nebraska (Faculty Advisor: David P. Yuill, Ph.D., P.E.)

HVAC Design Calculations
First Place: **Kristin Hanna, Garrett Johnson, Mark Wilder** University of Nebraska (Faculty Advisor: David P. Yuill, Ph.D., P.E.)

Integrated Sustainable Building Design
First Place: **Krestina Aziz, Adam Buchholz, Nicole Dunbar, Lee H. Han, Joel Joiner, Osman Sarper Kucuk, Blake Reynolds, Natalie Sherwood, Huy Tran, Alex Wilson** Portland State University (Faculty Advisor: Huafen Hu, Ph.D.)

Applied Engineering Challenge
First Place: **Miren Aizpitarte, Cinthya Mendez, Julia Stone, Willis Tang** California Polytechnic State University, San Luis Obispo (Faculty Advisor: Jesse Maddren, Ph.D., P.E.)

TECHNOLOGY AWARDS

"Given in recognition of innovative designs that comply with ASHRAE standards for indoor air quality and energy efficiency"

First Place
"Recognizing the first place ASHRAE Technology Award project which demonstrates the most outstanding achievement in the design and operation of energy efficient buildings"

Category I – Commercial Buildings – New
Benjamin A. Skelton, P.E., BEMP, for Walgreens Net Zero Store (Store # 15364)
Owner Representative, Jason Robbins, P.E., Walgreen Co.

Category I – Commercial Buildings - Existing
Dylan T. Connelly for DPR Construction's San Francisco Net Positive Energy Office
Owner Representative, Mike Messick, DPR Construction

Category II – Educational Facilities – New
Nicolas Lemire, Ing., HFDP, for Anne-Marie Edward Science Building – John Abbott College
Owner Representative, Michael H. Johnston, Cégep John Abbott College

Category IV – Industrial Facilities or Processes – New
Ken Warren, P.E., for Sea-Tac Airport Pre-Conditioned Air
Owner Representative, Mike Smith, Port of Seattle

Category VI – Residential
Jonathan M. Heller, P.E., for Stack House Apartments
Owner Representative, Brooke Kathrein, Stack House Acquisition LLC

ASHRAE DISTINGUISHED PUBLIC SERVICE AWARD

"Given in recognition of distinguished public service"

Erich Binder
Calgary, Alberta, Canada

E.K. CAMPBELL AWARD OF MERIT

presented by the Life Members' Club

"Given in recognition of outstanding service and achievement in teaching"

Michael M. Ohadi, Ph.D., Fellow ASHRAE
College Park, MD

JOHN F. JAMES INTERNATIONAL AWARD

"Given to an ASHRAE member who has done the most to enhance the Society's International activities"

Florentino Rosón Rodríguez, Ing., Buenos Aires, Argentina

ASHRAE FELLOWS

"Given in recognition of distinction in the arts and sciences of heating, refrigeration, air conditioning and ventilation"

Peter R. Armstrong, Ph.D., P.E., Abu Dhabi, UAE

Clive Broadbent, C.P.Eng.,
Campbell Australia Capitol, Australia

Wan Ki Chow, Ph.D., C.Eng., R.P.E,
Hung Hom, Kowloon, Hong Kong

Suhas D. Deshpande, Pune, Maharashtra, India

William D. Gerstler, Ph.D., Niskayuna, NY

Kristin Heinemeier, Ph.D., P.E., Davis, CA

Marisa Jimenez de Segovia, Monterrey, Mexico

Kishor Khankari, Ph.D., Ann Arbor, MI

Kwang Woo Kim, Ph.D., P.E., Seoul, South Korea

Dennis R. Landsberg, Ph.D., P.E., BEAP, Clifton Park, NY

Patrick C. Marks, P.E., York, PA

John A. Murphy, La Crosse, WI

Riyaz A. Papar, P.E., The Woodlands, TX

Andy Pearson, Ph.D., C.Eng., Glasgow, United Kingdom

Mukund Sudhakar Ranade, Pune, Maharashtra, India

Mick Schwedler, P.E., La Crosse, WI

Om Taneja, Ph.D., P.E., Kendall Park, NJ

ASHRAE HALL OF FAME AWARD

"Given to honor deceased members who have made milestone contributions to the growth of ASHRAE-related technology"

Calvin D. MacCracken

John Edwin Starr

F. PAUL ANDERSON AWARD

"Given in recognition of notable achievement, outstanding work, or service in any field of the Society"

Thomas E. Watson, Presidential Member, P.E., Fellow ASHRAE, Life Member, Staunton, VA

HOW AND WHY TO JOIN AN ASHRAE PROJECT COMMITTEE

WHAT IS A PROJECT COMMITTEE?

ASHRAE Project Committees (PCs) develop ASHRAE standards and guidelines. ASHRAE PCs consist of people who have a recognized expertise in a specific field of interest. Standards produced by ASHRAE are used as authoritative documents throughout our industry and are used either in total or in part as guides for state and municipal codes, for United States and Canadian government specifications, and as source documents for foreign countries. ASHRAE voluntary standards, like ASHRAE Handbooks, are a source of recommended practices that are accepted by a consensus of affected parties working in the areas covered by the standards. Consensus standards are developed and published to define minimum values or acceptable performance, whereas other documents, such as design guides, may be developed and published to encourage enhanced performance.

APPLYING FOR MEMBERSHIP ON A PROJECT COMMITTEE

ASHRAE welcomes new members to its project committees. With the exception of PC Chairs and Vice Chairs, it is not necessary to be a member of ASHRAE to participate on any of ASHRAE's Standard Project Committees (SPC), Guideline Project Committees (GPC), or Standing Standard/Guideline Project Committees (SSPC, SGPC). However, ASHRAE has strict requirements for the submission of the required paperwork for a person to be considered for PC membership. Unlike ASHRAE Technical Committees, ASHRAE PCs do not have corresponding members. However, some PCs may have non-voting members or consultants.

To be considered for project committee membership, you must:

- Submit a PC Application for Membership to ASHRAE staff at Standards.Section@ashrae.org
- Submit a Bias/Conflict of Interest Statement to ASHRAE staff.
- Update or complete an ASHRAE Bio online

After you correctly submit all necessary paperwork

- ASHRAE staff processes the application and provides the membership package to the PC chair
- The PC Chair reviews the membership package and accepts or declines each applicant
- ASHRAE's Standards Project Liaison Subcommittee approves new members

More details on applying for PC membership including forms and details are available online at https://www.ashrae.org/standards-research--technology/standards-forms--procedures

ATTENDING PROJECT COMMITTEE MEETINGS

A PC member is expected to attend meetings and pay attention to correspondence. All members are expected to bring to the standard relevant facts and to compromise at times in order for the PC to reach consensus on the requirements in the standard. The PC Chair may recommend removal of a PC member for lack of participation such as failing to attend at least half of the scheduled PC meetings in a year.

The ASHRAE Project Committees meet at each Society Winter and Annual Conference. Attendance at these meetings is open to everyone. Some PCs schedule meetings (in-person or conference call) between Society Conferences – those meetings will be announced in the ASHRAE Standards Actions (available at https://www.ashrae.org/standards-research--technology/standards-actions). You are encouraged to attend any of these meetings in which you have a technical interest. PC chairs are reminded prior to each meeting to make a special effort to welcome visitors (potential members) to PC meetings – A PC can never have too many willing and able volunteers.

notes

ROOMS/HOURS

FINDING THE ASSIGNED MEETING ROOM

To assist you in finding your meeting room at the Winter Conference, please refer to the floor plans located in the front of this program. Meetings are scheduled in the Orlando Hilton and the Orange County Convention Center.

CONFERENCE REGISTRATION

Hilton, Florida Ballroom 4, Lower Level

Registration is required for all conference participants. Official badges must be worn at all functions and for admission into the AHR Expo and ASHRAE technical sessions. ASHRAE conference registration will be open during the following hours:

Friday, January 22 . . . . . 1:00 p.m.–5:00 p.m.
Saturday, January 23 . . . . . 7:15 a.m.–6:00 p.m.
Sunday, January 24 . . . . . 7:00 a.m.–5:00 p.m.
Monday, January 25. . . . . 7:00 a.m.–5:00 p.m.
Tuesday, January 26. . . . . 7:30 a.m.–4:30 p.m.
Wednesday, January 27 . . . . 7:30 a.m.–11:00 a.m.

Computers with internet access will be available for E-mail and online registration.

Online registration is available 24/7. If you register on line just come to ASHRAE registration to pick up your badge or tickets.

ASHRAE BOOKSTORE

Hilton, Florida Ballroom 1-3, Lower Level

More than 300 books, conference papers, and other recent publications will be available for purchase in the ASHRAE Bookstore. The bookstore provides HVAC&R technical literature from ASHRAE and other publishers. The ASHRAE Bookstore will be open during the following hours:

Friday, January 22 . . . . . 1:00 p.m.–5:00 p.m.
Saturday, January 23 . . . . . 7:15 a.m.–6:00 p.m.
Sunday, January 24 . . . . . 7:00 a.m.–5:00 p.m.
Monday, January 25. . . . . 7:00 a.m.–5:00 p.m.
Tuesday, January 26. . . . . 7:30 a.m.–4:30 p.m.
Wednesday, January 27 . . . . 7:30 a.m.–1:00 p.m.

There will be a Demo Center near the Bookstore where visitors can preview ASHRAE CD-ROMs and other electronic products.

ASHRAE's eLearning system, from the ASHRAE Learning Institute, will also be demonstrated at the bookstore. Find out how you can participate in a hands-on demonstration and learn about new ways to earn CEUs on demand online.

OVER 2,000 EXHIBITS – AHR EXPO®, ORANGE COUNTY CONVENTION CENTER, 9800 INTERNATIONAL BLVD.

(connected by foot bridge to Orlando Hilton – a 3 minute walk)

Hours:

Monday, January 25. . . . . 10:00 a.m.–6:00 p.m.
Tuesday, January 26. . . . . 10:00 a.m.–6:00 p.m.
Wednesday, January 27 . . . . 10:00 a.m.–4:00 p.m.

If you have registered for the ASHRAE Conference, your conference badge is your admission into the exposition.

If you are attending the exposition only and you did not register in advance, the fee for admission is $30.00 and can be paid at the Orange County Convention Center. Registration for the AHR Expo® will be open from Noon to 4:00 p.m. on Sunday, January 24. Starting Monday, you can register one hour before the doors open.

You must be 18 years or older to be admitted to the show floor. Ages 16 and 17 will be admitted only if accompanied by an adult.

AHR BAR CODES

Exhibitors will scan your badge if you have interest in receiving product information from them. Contact information provided on the bar code only includes name and mailing address. No emails are captured.

ALI COURSES

Registration for the ASHRAE Learning Institute courses being held at the Orange County Convention Center is available at either the ASHRAE registration at the Orlando Hilton or at Orange County Convention Center Registration Lobby on Level 2 – same level as entrance from Hilton sky bridge. Registration will be open at the Convention Center on Sunday from 9:00 a.m.–3:00 p.m., Monday from 8:00 a.m.–6:00 p.m. and Tuesday from 8:00 a.m. –6:00 p.m. Online registration will close at midnight on the evening prior to the course.

ASHRAE MEMBER LOUNGE

Hilton, Orlando VI, Lower Level

The ASHRAE Lounge is open to all individuals who are registered for the conference. Admission to the lounge is by badge only. Orlando Host Committee members will be available to answer questions.

This room will be open during the following hours:

Saturday, January 23 . . . . . 7:30 a.m.–3:00 p.m.
Sunday, January 24 . . . . . 7:30 a.m.–4:00 p.m.
Monday, January 25. . . . . 7:30 a.m.–4:00 p.m.
Tuesday, January 26. . . . . 7:30 a.m.–4:00 p.m.
Wednesday, January 27 . . . . 7:30 a.m.–1:00 p.m.

Coffee and pastries will be served from 7:30 a.m. to 9:30 a.m. each morning.

TOURS

For information on the tours offered during the Winter Conference, see general tour information in the Tours section of this program.

SPEAKERS' LOUNGE

Orlando Ballroom IV, Lower Level

The Speakers' Lounge will be open during the following hours:

Saturday, January 23 . . . . . 1:00 p.m.–3:00 p.m.
Sunday, January 24 . . . . . 7:00 a.m.–5:00 p.m.
Monday, January 25. . . . . 7:00 a.m.–12:15 p.m.
. . . . . and 1:30 p.m.–4:30 p.m.
Tuesday, January 26. . . . . 7:00 a.m.–5:00 p.m.
Wednesday, January 27 . . . . 7:00 a.m.–1:00 p.m.

ASHRAE PRESS ROOM

Hilton, Florida Ballroom 4

The Press Room will be open during the following hours:

Saturday, January 23 . . . . . 8:00 a.m.–3:00 p.m.
Sunday, January 24 . . . . . 8:00 a.m.–3:00 p.m.
Monday, January 25. . . . . 9:00 a.m.–5:00 p.m.
Tuesday, January 26. . . . . 9:00 a.m.–3:00 p.m.

HEADQUARTER OFFICE

Hilton, Key Largo A, Lower Level

The ASHRAE Headquarter Office offers members complimentary copying, services of a typist, and access to printers for laptop computers. The Headquarter Office will be open during the following hours:

Friday, January 22 . . . . . Noon–5:00 p.m.
Saturday, January 23 . . . . . 8:00 a.m.–5:00 p.m.
Sunday, January 24 . . . . . 8:00 a.m.–5:00 p.m.
Monday, January 25. . . . . 8:00 a.m.–5:00 p.m.
Tuesday, January 26. . . . . 8:00 a.m.–5:00 p.m.
Wednesday, January 27 . . . . 8:00 a.m.–1:00 p.m.

MEMBERSHIP INFORMATION DESK

Hilton, Florida Ballroom 4, Lower Level

A Membership Information Desk is available for paying dues, applying for membership, updating membership information, and purchasing ASHRAE logo items. This desk is open during the same hours as registration, so feel free to stop by if you have any questions concerning your ASHRAE membership.

YOUNG ENGINEERS IN ASHRAE (YEA) HOSPITALITY

Hilton, Florida Ballroom 5-7, Lower Level

Attention members age 35 and younger! You are invited to visit the Young Engineers in ASHRAE (YEA) Hospitality Suite to be held on Sunday, January 24, from 4:00 p.m.–6:00 p.m. The hospitality offers social and networking opportunities and light refreshments will be available.

A YEA/student mixer will be held Saturday, January 23, from 5:00 p.m.–6:30 p.m. in the Orlando Ballroom III of the Hilton on the lower lobby. Come join us to meet other young ASHRAE members!

LEADERSHIP U

At each ASHRAE conference, the Leadership U program gives four future ASHRAE leaders the opportunity to shadow an ASHRAE Board member, providing a high level conference experience and unique networking opportunity. This program is operated by the Young Engineers in ASHRAE (YEA) Committee and more information can be found at www.ashrae.org/yea. The Leadership U participants for the 2016 ASHRAE Winter Conference are:

Chonghui Liu, Central New York Chapter, Region I
Jessica Errett, Nebraska Chapter, Region IX
Manalee Nabar, New York Chapter, Region I
Cris Washburn, Mississippi Valley Chapter, Region VI

STUDENT ACTIVITIES

Hilton, Orlando Ballroom III, Lower Level

Plan to join the Student Welcome and Orientation on Saturday, January 23 from 1:30 p.m. to 3:00 p.m. in Orlando Ballroom III.

The Student Program will also be held in the Orlando III Ballroom on Sunday, January 24 from 9:00 a.m.–2:00 p.m. Take advantage of this opportunity to learn more about ASHRAE while becoming acquainted with your fellow students and ASHRAE members. There will be a speaker, design competition and grant award presentations, and a career panel. Don't miss the free student items and the raffle for your chance to win cool prizes! Activities for students are a unique feature of the ASHRAE Winter Conference—a foundation on which to build your network of resources for your future in the HVAC&R industry.

The Student Tour to Orange County Convention Center will begin with a seminar being presented in Orlando Ballroom III and departing from the Hilton to walk to the convention center.

2:00 Seminar at Hilton
2:30–4:30 Tour

Tickets are $10 and may be purchased at the ASHRAE registration in the Florida Ballroom 4.

WOMEN IN ASHRAE CONTINENTAL BREAKFAST

Monday, January 25, 7:00 – 8:30 a.m.
Hilton Florida Ballroom 5-7, Lower Level

The purpose of this event is to encourage women to be active ASHRAE participants at the chapter, region, and/or society level and to give them ideas and information about how to do so. Current ASHRAE members will be on hand to provide insight and to share their experiences. A light breakfast and coffee will be served. The breakfast requires a reservation.

ORLANDO HOST COMMITTEE INFORMATION DESK

Hilton, Florida Ballroom 4, Lower Level

The Host Committee will have an information desk located at the ASHRAE registration area. General information about the sights of the city will be available, and a host committee member will be present to answer questions about Orlando. Information Desk hours will be Saturday and Sunday from 8:00 a.m.–2:00 p.m. and Monday from 8:00 a.m.–Noon. Please take a few minutes to stop by and discover some of the activities available to you in the area.

ST. LOUIS CONFERENCE INFORMATION

Hilton, Florida Ballroom 4, Lower Level

Information on the upcoming Annual Conference June 25–June 29, 2016, in St. Louis, MO will be available in the registration area. Also, information will be online at www.ashrae.org/stlouis.

notes

SCHEDULE

LOCATION OF MEETINGS

To assist you in finding your meeting room at the Winter Conference, please refer to the floor plans located in the front of this program. Meetings are scheduled in the Orlando Hilton and the Orange County Convention Center (OCCC). All meetings in the OCCC are in the South Building which is the one closest to the Hilton.

The number in parenthesis indicates the floor location. The conference app also has floor plans. (L) is lobby level and (LL) is lower level. All of the Lake and Boardroom meeting rooms are located on the lobby level. Boardrooms are to the right as you enter the Hilton Lobby and Lake rooms are to the left.

All Ballrooms, Key West and Key Largo rooms are on the lower level. The walkway to the Orange County Convention Center is on the lobby level before the escalators down to the lower level.

Meeting Schedule

FRIDAY, JANUARY 22

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 57-72.

1:00–5:00 pm **Registration**, Orlando Hilton, Florida Ballroom 4 (LL)

ASHRAE Bookstore, Orlando Hilton, Florida Ballroom 1-3 (LL)

SATURDAY, JANUARY 23

7:30 am–3:00 pm **ASHRAE Lounge,** Orlando Hilton, Orlando Ballroom VI (LL)

7:15 am–6:00 pm **Registration,** Orlando Hilton, Florida Ballroom 4 (LL)

ASHRAE Bookstore, Orlando Hilton, Florida Ballroom 1-3 (LL)

8:00 am–3:00 pm **Press Room,** Orlando Hilton, Florida Ballroom 4 (LL)

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 57-72.

1:00 pm–3:00 pm **Speakers' Lounge,** Orlando Hilton, Orlando Ballroom IV (LL)

1:30 pm–3:00 pm **Student Orientation,** Orlando Hilton, Orlando Ballroom III (LL)

Special Event

3:15 pm–5:00 pm **Meeting of the Members**

Plenary Session,
Orlando Ballroom I/II (LL)

Opening and Welcoming Remarks by ASHRAE President **T. David Underwood**

Welcome by Director and Chair, Region XII, **Jennifer A. Isenbeck**

Secretary's Report by Executive Vice President **Jeff H. Littleton**

Awards Presentation
See page 16 for details.

Keynote Address: **Laura Schwartz**
See page 13 for details.
Plenary Session is open, no badge nor registration is required to attend.

5:00 pm–6:30 pm **YEA/Student Mixer**, Orlando Hilton, Orlando Ballroom III (LL)

Special Event

6:30 pm–8:30 pm **Welcome Party,** SeaWorld Orlando
See page 12 for details.

***Note:** \$60 ticket per person required. Tickets may be purchased online 24/7 or at the ASHRAE Registration Desk; Pick up your ticket at ASHRAE Registration. Advance-purchase tickets may be picked up at SeaWorld if after registration hours. Shuttle buses to SeaWorld will depart from the Group Pick-Up area on the Lower Level as indicated on the map in this program.*

SUNDAY, January 24

7:00 am–5:00 pm **Speakers' Lounge,** Orlando Hilton, Orlando Ballroom IV (LL)

7:00 am–5:00 pm **Registration,** Orlando Hilton, Florida Ballroom 4 (LL)

ASHRAE Bookstore, Orlando Hilton, Florida Ballroom 1-3 (LL)

7:30 am–4:00 pm **ASHRAE Lounge,** Orlando Hilton, Orlando Ballroom VI (LL)

8:00 am–4:45 pm **Technical Sessions**
See Technical Program on pages 31-56.

8:00 am–3:00 pm **ASHRAE Press Room,** Orlando Hilton, Florida Ballroom 4 (LL)

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 57-72.

8:30 am–4:30pm **General Tour**: Kennedy Space Center

9:00 am–9:30 am **Networking Coffee Break will feature a Curling match**
Promenade (LL) *(weather permitting)*
See description on page 61.

9:00 am–2:00 pm **Student Program,** Orlando Hilton, Orlando Ballroom III (LL)
See description on page 19.

2:30 pm–4:30 pm **Student Technical Tour:** Orange County Convention Center

3:15 pm–6:15 pm **Technical Tour:** SeaWorld Antarctica – Empire of the Penguin
See descriptions on page 23.

4:00 pm–6:00 pm **Young Engineers in ASHRAE (YEA)**
Hospitality Suite, Orlando Hilton, Florida Ballroom 5-7 (LL)

Attention members age 35 and younger—you are invited to visit the YEA Hospitality Suite, offering social and networking opportunities Light refreshments will be available.

MONDAY, January 25

7:00 am–8:30 am **Women in ASHRAE** Continental Breakfast, Orlando Hilton, Florida Ballroom 5-7 (LL)

7:00 am–12:15 pm **Speakers' Lounge,** Orlando Hilton, Orlando Ballroom IV (LL)

7:00 am–5:00 pm **Registration,** Orlando Hilton, Florida Ballroom 4 (LL)

ASHRAE Bookstore, Orlando Hilton, Florida Ballroom 1-3 (LL)

7:30 am–4:00 pm **ASHRAE Lounge,** Orlando Hilton, Orlando Ballroom VI (LL)

8:00 am–12:00 pm **Technical Sessions**
See Technical Program on pages 31-56.

9:00 am–5:00 pm **ASHRAE Press Room,** Orlando Hilton, Florida Ballroom 4 (LL)

9:30 am–11:30 am **ASHRAE Meet and Greet,** Orlando Hilton, Florida Ballroom 5-7 (LL)

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 57-72.

10:00 am–6:00 pm **AHR Expo®,** Orange County Convention Center, 9800 International Blvd.

If you are registered for the ASHRAE Conference, your conference badge is admission into the exposition; if attending exposition only and not registered in advance, admission is $30.00 at the exposition. ***Note:*** *You must be 16 years or older to be admitted to the show floor. Ages 16 and 17 will be admitted only if accompanied by an adult.*

The Orlando Hilton is connected by covered foot bridge to the Orange County Convention Center and is a 3 minute walk. The walkway is on the Lobby Level past the Business Center.

10:15 am–11:45 am **Student Congress,** Lake Down B (Lobby Level)

Special Event

12:15 pm–2:00 pm **President's Luncheon**
(doors open at 12 Noon)
Orlando Hilton, Orlando I/II (LL)

President T. David Underwood will speak on the State of the Society and the Golden Circle Awards will be presented "in honor of contributors who have consistently and significantly supported ASHRAE research." Spouses and guests are cordially invited to attend. ***Note:*** *Ticket required. Cost:* ***$50***

1:30 pm–4:30 pm **Speakers' Lounge,** Orlando Hilton, Orlando Ballroom IV (LL)

2:15 pm–5:00 pm **Technical Sessions**
See Technical Program on pages 31-56.

2:30 pm–6:00 pm **Technical Tour:** Harvest Power's Energy Garden

Technical Tour: UCF Power Plant

2:15 pm–6:15 pm **General Tour:** Alligator and Airboat Adventure
See descriptions on pages 22-23.

After 5:00 pm **Regional Dinners**
Sign up in ASHRAE registration area.

TUESDAY, January 26

7:00 am–5:00 pm **Speakers' Lounge,** Orlando Hilton, Orlando Ballroom IV (LL)

7:30 am–4:00 pm **ASHRAE Lounge,** Orlando Hilton, Orlando Ballroom VI (LL)

7:30 am–4:30 pm **Registration,** Orlando Hilton, Florida Ballroom 4 (LL)

ASHRAE Bookstore, Orlando Hilton, Florida Ballroom 1-3 (LL)

8:00 am–4:45 pm **Technical Sessions**
See Technical Program on pages 31-56.

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 57-72.

9:00 am–3:00 pm **Press Room,** Orlando Hilton, Florida Ballroom 4 (LL)

9:45 am–1:00 pm **General Tour**: I-Drive 360 – The Eye & Madame Tussauds

10:00 am–1:00 pm **General Tour:** Farris and Foster's Famous Chocolate Factory Party
See descriptions on pages 22-23.

10:00 am–6:00 pm **AHR Expo®,** Orange County Convention Center, 9800 International Blvd.

Noon–1:30 pm **Life Members' Lunch,** Lake Eola B (Lobby Level)

Note: *Ticket required.* Cost: **$35**

1:30 pm–5:30 pm **Technical Tour:** Florida Solar Energy Center
See description on page 24.

Special Event

6:15 pm–7:15 pm **Reception,** Orlando Hilton, Orlando Ballroom Foyer (LL)

7:30 pm–10:30 pm **Members' Night Out,** Orlando Hilton, Orlando Ballroom I/II (LL)
See page 13 for details.

Note: *Ticket required.* Cost: **$60**

WEDNESDAY, January 27

7:00 am–1:00 pm **Speakers' Lounge,** Orlando Hilton, Orlando Ballroom IV (LL)

7:30 am–11:00 am **Registration,** Orlando Hilton, Florida Ballroom 4 (LL)

7:30 am–1:00 pm **ASHRAE Bookstore,** Orlando Hilton, Florida Ballroom 1-3 (LL)

7:30 am–1:00 pm **ASHRAE Lounge,** Orlando Hilton, Orlando Ballroom VI (LL)

8:00 am–12:30 pm **Technical Sessions**
See Technical Program on pages 31-56.

8:00 am-5:00 pm **Committee Meetings**
See listing on pages 57-72.

10:00 am–4:00 pm **AHR Expo®,** Orange County Convention Center, 9800 International Blvd.

ORLANDO GENERAL TOURS

Stand-by tour tickets will be distributed at ASHRAE registration after a tour sells out. Stand-by tickets are provided to ensure that a tour is filled in the event of no-shows or last minute cancellations. If you have a stand-by ticket, please be prepared to pay by credit card or exact cash at the bus. Tour tickets may be purchased at the ASHRAE registration desk, Florida Ballroom 4 on the Lower Level.

All tours depart from the Group Transportation area (lower level) accessible from the escalators on the lobby level between David's Club and Marketplace.

Kennedy Space Center

Sunday, January 24
8:30 a.m.-4:30 p.m.

Experience your very own space adventure by exploring the exciting past, present and future of America's space program at Kennedy Space Center Visitor Complex. Built in 1967 as a means for NASA Astronauts' and employees' families to view space center operations, today the Visitor Complex is one of Central Florida's most popular destination.

The first stop on this go-at-your-own pace tour is the four story LC-39 Observation Gantry, where guests enjoy a panoramic view of Kennedy Space Center and the Space Shuttle launch pads, as well as the rocket launch pads a Cape Canaveral Air Force Station. A short film and interactive displays demonstrate how the launch pads are constructed and how a Shuttle is launched.

The motor coaches then drive by the monstrous Vehicle Assembly Building (VAB) where the Space Shuttle is stacked for launch, and where the Apollo/Saturn V rockets were once assembled, as well as the Orbiter Processing Facility (OPF) where the Orbiter is examined and maintained after each mission.

The second stop is the Apollo/Saturn V Center, where dramatic multi-media shows and numerous hands-on displays provide visitors with an inspirational and exhilarating look in America's quest for the moon. Guests relive the historic launch of Apollo at the Firing Room Theater, then marvel at a monstrous 363-foot Saturn V moon rocket, the most powerful rocket ever built, and one of only three Saturn V rockets in existence.

Finally, the Lunar Theater provides a rare look at the harrowing final moments before man landed on the moon. The Apollo/Saturn V Center is also home to the Moon Rock Café, the only place in the where guest can dine next to a genuine moon rock.

Cost: $94

Alligator and Airboat Adventure

Monday, January 25
2:15 – 6:15 p.m.

Deep in the middle of nowhere, a 100-year-old pioneer fish camp awaits you, looking like something straight out of Patrick Smith's bestselling novel, A Land Remembered. Here, you'll enjoy a refreshing soft drink and sample delicious cooked-to-order gator tail before boarding a 15-passenger airboat for a breathtaking 30-minute expedition down the St. Johns River and into the Central Florida Everglades, accompanied by your expert eco-guide's spellbinding live narration. With a U.S. Coast Guard-licensed swamp boat captain at the helm, you'll explore the freshwater habitat of the Florida alligator as your airboat skims the shallow waters of this legendary "River of Grass" at speeds up to 45-mph, slowing to an idle at times to let you take advantage of the incredible photo opportunities.

Following your airboat excursion, you'll gather with your fellow explorers to begin a 30-minute guided nature walk through the Tosohatchee Wildlife Refuge along the legendary Florida Trail. The hiking is easy, but the sights are unforgettable as your expert eco-guide leads you through this pristine natural habitat—home to both resident and migratory birds, white-tailed deer, bobcat, fox squirrel, alligators, cows and otters.

Cost: $100

I-Drive 360 - The Eye & Madam Tussauds

Tuesday, January 26
9:45 a.m.-1:00 p.m.

Take a moment to escape, and discover the magic and natural wonder Orlando has to offer from above. Be effortlessly lifted away in a capsule of calm and serenity to see Orlando in a way you've never seen it before. The iconic 400-foot tall observation wheel provides breathtaking views of Central Florida in all directions, with sights of downtown Orlando's skyline, theme parks, lakes and lush landscape, and on a clear day, views of Cape Canaveral on the east coast.

At Madame Tussuads you will see A-list celebrities, major sports figures, world leaders and world leaders in the arts and sciences. Take a journey 200 years back in time when Marie Tussaud first opened the doors to her Baker Street bazaar where an interactive story tells the dramatic and sometimes dark story of Madame Tussauds life and the legacy she left behind, accompanied by authentic props from the Madame Tussauds archive. You'll also learn what it takes to create a celebrity wax figure. Every step of the process is explained, from how the measurements are taken, the detailed sculpting involved, the intricate molding procedure and the painstaking finishing touches required to complete a figure. Feel actual celebrity hand casts and then test everything that you have learned in our fun touch screen quiz.

This will not be a guided tour but a tour staff member will be on-site. You will be able to explore this new $200 million entertainment area featuring attractions, restaurants and shops.

Cost: $71

Note: *Riding the Orlando Eye is subject to availability. Due to the nature of the experience the attraction may close to the public at any time without advance notice.*

Farris and Foster's Famous Chocolate Factory Party

Tuesday, January 26
10:00 a.m.-1:00 p.m.

Enter a glorious world of chocolate that would make Willy Wonka green with envy. However, you don't need a golden ticket to visit Farris and Foster's Famous Chocolate Factory. If you ever dreamed of chocolate rivers, waterfalls and bubbling vats of creamy, rich, dark and milk chocolate, this is a dream come true.

At Farris and Foster's there are multiple ways to express your love for chocolate. Choose from hundreds of molds to make your own chocolate confections, decorate pre-molded chocolate creations, cover your favorite fruit in chocolate or fill chocolate cups. If you are a chocoholic, this tour is for you.

Note: *This tour is not advisable for those with allergies to nuts or milk. Hairnets or hats will be provided.*

Cost: $75

ASHRAE TECHNICAL TOURS

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All tours depart from the Group Transportation area (lower level) accessible from the escalators on the lobby level between David's Club and Marketplace.

Student Tour: Orange County Convention Center

Sunday, January 24
2:00 Seminar at Hilton
2:30-4:30 Tour

Join us for a mini-seminar and facility tour which gives participants a quick look at the massive scale of equipment required to run the Orange County Convention Center, the largest LEED Gold Certified convention center in the world. With over 7.1 million square feet of building space, it takes a lot to keep 1.4 million visitors comfortable during the 200 client events hosted here each year. Join us to see how we make it all work. As a sustainability leader, OCCC has learned much over the past decade

The tour will be broken into three groups of 30 to 40.

Cost: $10

SeaWorld Antarctica: Empire of the Penguin

Sunday, January 24
3:15-6:15 p.m.

Get transported into the rarely seen and icy world of Antarctica. You'll feel the majestic grandeur of the South Pole and see it through the eyes of a penguin named Puck on an exhilarating, first-of-its-kind family adventure ride. You'll be able to choose a "mild" or "wild" version of this trackless, motion-based simulator experience.

After you step off the ride, you'll explore the penguins' colony in an expanse that envelopes you in cool extremes: bringing you above and below their icy world. Our special access will include a behind the scenes look at what it takes to keep the penguins at Antarctic conditions in Orlando!

Cost: $30

Harvest Power's Energy Garden

Monday, January 25
2:30-6:00 p.m.

The Central Florida Energy Garden is an organics management and renewable energy facility that is the first of its kind in the U.S., converting organic waste into renewable biogas and natural fertilizers. The anaerobic digester combines a unique set of proven technologies and will divert hundreds of thousands of tons of waste from Central Florida landfills.

The Energy Garden uses anaerobic digestion – a biological process that relies on trillions of naturally occurring bacteria – to produce renewable biogas. When operating at full capacity, the facility will process more than 120,000 tons of organic materials annually while producing 5.4 megawatts of combined heat and power.

Harvest Power's Energy Garden helps businesses and communities across Central Florida reduce and reuse organic material, increase renewable energy production and revitalize soil to boost local agriculture. Restaurants, hotels and food processors throughout the region are now able to send food scraps to the Energy Garden. Walt Disney World Resort is the facility's first customer with additional businesses in surrounding communities signing up every day

Cost: $30

UCF Power Plant

Monday, January 25
2:30-6:00 p.m.

UCF is the largest university in Florida and the second largest in the United States with approximately 60,000 students. This massive campus located in Orlando, FL has a 17,000 ton cooling district served by four central plants located around the campus. The plants are connected to a 3 mile long distribution loop that serves most buildings on the campus. The tour will visit some highlights of mechanical systems on the campus including a large 3M gallon thermal storage tank and a Combined Heat and

Power plant (CHP). The CHP generates 5.5 Mega Watts while simultaneously producing 5.6MM ton-hours of cooling utilizing the waste heat from the plant. Utilizing this plant allows for CO2 reductions approaching 10,000 metric tons per year.

Cost: $30

Florida Solar Energy Center

Tuesday, January 26
1:30 – 5:30 p.m.

Tour the Florida Solar Energy Center (FSEC) to discover how HVAC&R, window technology, natural lighting, controls and other building technologies were integrated to produce one of the most energy efficient buildings for hot, humid climates. Also find out what's new in alternative energy sources and energy saving technologies. FSEC is the largest and most active state-supported renewable energy and energy efficiency research, training, testing and certification institute in the United States.

FSEC's mission is to research and develop energy technologies that enhance Florida's and the nation's economy and environment and to educate the public, students and practitioners on the results of the research. Research at FSEC is based on field monitoring, computer simulations and controlled experiments in highly-instrumented laboratories. These research efforts are developed in partnership with industry, nonprofit organizations, private sponsors and national laboratories. FSEC's 20-acre research complex on Florida's Space Coast is adjacent to UCF's Cocoa Campus. This state-of-the-art research campus is composed of a number of buildings that provide office, laboratory and test facilities. This tour involves walking. Participants should wear comfortable shoes and dress for the weather.

Cost: $30

notes

FUTURE ASHRAE MEETINGS

Annual	Winter	Date
Orlando January 23–27	2016	St. Louis June 25–29
Las Vegas January 28–February 1	2017	Long Beach June 24–28
Chicago January 20-24	2018	Houston June 23-27

PAST ASHRAE MEETINGS

Los Angeles	1980	Denver
Chicago	1981	Cincinnati
Houston	1982	Toronto
Atlantic City	1983	Washington
Atlanta	1984	Kansas City
Chicago	1985	Honolulu
San Francisco	1986	Portland
New York	1987	Nashville
Dallas	1988	Ottawa
Chicago	1989	Vancouver
Atlanta	1990	St. Louis
New York	1991	Indianapolis
Anaheim	1992	Baltimore
Chicago	1993	Denver
New Orleans	1994	Orlando
Chicago	1995	San Diego
Atlanta	1996	San Antonio
Philadelphia	1997	Boston
San Francisco	1998	Toronto
Chicago	1999	Seattle
Dallas	2000	Minneapolis
Atlanta	2001	Cincinnati
Atlantic City	2002	Honolulu
Chicago	2003	Kansas City
Anaheim	2004	Nashville
Orlando	2005	Denver
Chicago	2006	Quebec City
Dallas	2007	Long Beach
New York	2008	Salt Lake City
Chicago	2009	Louisville
Orlando	2010	Albuquerque
Las Vegas	2011	Montreal
Chicago	2012	San Antonio
Dallas	2013	Denver
New York	2014	Seattle
Chicago	2015	Atlanta

ORLANDO SUSTAINABILITY PROJECT

The ASHRAE Central Florida Chapter and USGBC Central Florida Chapter identified an organization that is deeply in need of our services and support. We were approached by the Coalition for the Homeless to help them renovate the Women's Residential Counseling Center (WRCC), located in downtown Orlando. The WRCC is a 126-person transitional living program for single women and women with children, with an additional 12 beds for emergency situations. In addition to receiving shelter and nutritious meals, homeless women who turn to the Coalition for assistance work with a case manager at the WRCC to build a budget and savings account, and to develop a plan for self-sufficiency. The Coalition's goal is to help their residents move into stable, affordable housing. To know more about the scope of services that the Coalition provides at the WRCC, we encourage you to read more at http://www.centralfloridahomeless.org/help/women- food.cfm

The WRCC campus itself is comprised of 3 separate buildings surrounding a playground and courtyard. The conditions of the facilities and their infrastructure can best be described as in desperate need of our professional attention. We visited the campus to perform an initial walk-through and audit of the buildings and systems, and conversed with the staff at the WRCC to learn about the history of this campus. The buildings are multi-story, CMU construction with operable windows. The buildings are structurally sound with relatively new roofs, however the exterior walls are rife with various small penetrations, and the HVAC systems are woefully inadequate and very much in need of replacement. Each of the 3 buildings have completely different HVAC system types installed, and proper service of this equipment is outside of their current capabilities. Two of the buildings are served by chilled water systems; piping is PVC and what little insulation exists is saturated with condensation. One of the chillers is an antiquated air-cooled unit and the other is a unique water-cooled unit that appears to be a homemade design. There is no condenser water treatment and the condenser cooling tower is actually an aerator designed for well water use. That system is unsafe. The buildings are in need of make-up air ventilation to eliminate the negatively pressurized space with respect to outdoors. Degradation of water-sensitive components and surfaces within the buildings are widely evident. We have identified a sequence of measures that need to be undertaken at this site, and broken them up by order of importance and funding potential. Preliminary energy models have also been developed to determine rough order of magnitude equipment and ventilation needs.

1. Seal up the buildings – there are too many holes in the building from abandoned exhaust fans, tv and phone cabling, etc. that are allowing uncontrolled heat and moisture into the building. Sealing these up will improve the success of the HVAC upgrades. We need volunteers or donors to seal this place up. This can be accomplished by an organized grassroots movement of student members and volunteer professionals at little cost outside of the raw materials needed for the job.

2. Take the mechanical design from concept level up to construction documents – the mechanical design was taken to a construction document level and is in construction. Volunteers took on the design to a construction document level, including as-builts of the kitchen HVAC, finalizing load and ventilation calculations, surveying electrical and designing power for the HVAC systems.

3. Install DX Dedicated Outside Air Systems (DOAS) to introduce mechanical ventilation to the building to offset the negative pressure and its resulting uncontrolled heat and moisture migration into the building. These systems would improve the amount of fresh air in the building and reduce the indoor humidity levels. Interior surfaces (lighting, flooring, walls, etc…) will not be upgraded until after these units are operating properly. As of today, Sayre Hall is being fitted with this equipment which is approximately $34k in equipment only costs (ROM $68k installed). Thanks to generous donations in the form of price reductions (below cost) received by the equipment vendor and low install costs by the contractors this step is underway.

4. Install Split DX Variable Refrigerant Volume (VRV) Systems – This system would have a central condensing unit to replace the central chillers, but would operate using less energy. Each room would receive a new indoor A/C unit that would be piped to the central condenser. Approximately $200K in ROM cost for equipment and installation has been budgeted and due to generous and thoughtful equipment manufacturers and the installing contractors this phase is underway. The WRCC was in the process of replacing fan coil units in the other 2 buildings with the help of a Coalition grant. The hope is that funds will be raised for a new DX VRV system to cut their energy costs.

There are also some high level goals from an ASHRAE perspective that are worth mentioning:

The HVAC work at the WRCC should provide fresh air into the building, thus increase building pressure and stopping infiltration of untreated outdoor air. This will not only help in the overall indoor air quality of the building, but also reduce energy costs by unnecessarily running building HVAC systems to handle the infiltration.

The HVAC systems should reduce their water consumption (by eliminating the cooling tower).

The HVAC systems should reduce maintenance issues (chilled water leaks, condensation, failed fan coils). We need to improve the Indoor Air Quality.

The design meets or exceeds all of the latest applicable ASHRAE standards.

The initial Life Cycle Cost Analysis evaluated 6 different system options for the WRCC, including:

A. DOAS with VRV – preferred solution.

B. Replace in kind – we did not want to pursue this option because it will not improve the IAQ issues associated with ventilation and pressurization.

Article continues on page 56

ASHRAE 2016 WINTER CONFERENCE TRAINING

Full-Day Seminars & Half-Day Courses for In-Depth Instruction

ASHRAE Learning Institute (ALI) full-day seminars and half-day courses will be held at either the Hilton Orlando or the Orange County Convention Center. Each seminar and course carries Continuing Education Units (CEUs), Professional Development Hours (PDHs), and/or American Institute of Architects Learning Units (AIA LUs) which can be applied toward maintaining your P.E. licensure.

Registration for the ASHRAE Learning Institute seminars/courses being held at the Orange County Convention Center can be done at either the ASHRAE registration at the Hilton Orlando or at ASHRAE course booth at the Orange County Convention Center, South Concourse, Level II, across from Room S220. Registration will open at the Orange County Convention Center on Sunday from 9:00 a.m.-3:00 p.m., Monday from 7:30 a.m.-6:00 p.m. and Tuesday from 8:00 a.m. -6:00 p.m. Online registration will close at midnight on the evening prior to the course.

The Orange County Convention Center is accessible via a covered walkway from the Hilton.

Please refer to the map in this program to assist in finding the rooms for the ALI courses. All courses are in the South building.

FULL-DAY PROFESSIONAL DEVELOPMENT SEMINARS

Registration fees: $485 per course; $395 for ASHRAE members
Completion of each seminar earns 6 PDHs/AIA LUs or .6 CEUs *(check with your state for their continuing education credit requirements)*

SATURDAY, JANUARY 23, 2016

Commercial Building Energy Audits (code 60)

8:00 am – 3:00 pm, Hilton Orlando, Orange Ballroom A
This seminar discusses how to perform commercial building energy audits. Best practices and other information relevant for building owners, managers and government entitles are covered. The seminar includes a summary of materials essential for performing ASHRAE Level 1, 2 and 3 audits, time-saving tips for every auditor, how to hire an auditor, what to ask for in a comprehensive audit report, and how to build a successful energy efficiency retrofit team.
Instructor: Jim Kelsey, P.E., Member ASHRAE, BEAP, LEED® AP

The Commissioning Process in New and Existing Buildings (code 61)

8:00 am – 3:00 pm, Hilton Orlando, Orange Ballroom B
The fundamentals of the commissioning process through each step of a new construction project from pre-design to occupancy and operations are presented in this seminar. The seminar discusses commissioning documentation, including an overview of commissioning specifications for new construction.
Instructor: Rick Casault, P.E., Member ASHRAE

Designing HVAC Systems to Control Noise & Vibration (code 62)

8:00 am – 3:00 pm, Hilton Orlando, Orange Ballroom C
This seminar emphasizes the important design information in ASHRAE's *Practical Guide to Noise and Vibration Control for HVAC Systems.* Beginning with a fundamental discussion of acoustics, the seminar focuses on the proper design and selection of HVAC equipment. Special attention is given to fans and air distribution systems. Also discussed are noise/vibration problems associated with central plant equipment, piping systems, and outdoor equipment.
Instructor: Curtis Eichelberger, P.E., Member ASHRAE

TUESDAY, JANUARY 26, 2016

Energy Modeling Best Practices and Applications (code 75) *(Co-sponsored by IBPSA-USA)*

9:00 am – 4:00 pm, Orange County Convention Center, Room: S330C
This seminar focuses on topics critical to the effective delivery of energy modeling services, including modeling fundamentals, modeling best practices and quality control, modeling to inform design, measurement and verification. This seminar presents case studies and discusses modeling tools for streamlining quality control procedures and the development of input data for building characterization.
Instructors: Drury Crawley, Ph.D., AIA, Member ASHRAE, BEMP and James Dirkes, P.E., Member ASHRAE, BEMP

Operations & Maintenance of High-Performance Buildings (code 76)

9:00 am – 4:00 pm, Orange County Convention Center, Room: S330D
This seminar provides practical insights about operations and maintenance practices for both typical and high-performance buildings. The seminar includes an interactive group project to reinforce concepts such as how to identify and define energy and maintenance management metrics, and how to make the business case for changes to existing buildings.
Instructor: Laurie Gilmer, P.E., Member ASHRAE, LEED® AP

HALF-DAY SHORT COURSES

Registration fees: $159 per course; $119 for ASHRAE members
Completion of each course earns 3 PDHs/AIA LUs or .3 CEUs *(check with your state for their continuing education credit requirements)*

SUNDAY, JANUARY 24, 2016

Laboratory Design: The Basics and Beyond (code 63)

3:30 pm – 6:30 pm, Orange County Convention Center, Room S330A
A comprehensive overview of HVAC design for laboratories is examined in this course. The course focuses on the essential elements of the design process that are unique to laboratory

HVAC systems. Topics include: planning steps; determining exhaust/supply requirements; load calculation; pressure mapping; evaluating system options; layout of ducts and rooms; sizing primary air systems; designing exhaust stacks; sustainability in laboratories and control strategies. Example problems and case studies will also be presented.
Instructor: John Varley, P.E., Member ASHRAE, HBDP, LEED® AP

Troubleshooting Humidity Control Problems (code 64)

3:30 pm – 6:30 pm, Orange County Convention Center, Room S330B
This course puts attendees on the fast track to understanding the effects of successful humidity control. It includes an in-depth discussion of moisture load calculations and how humidity control can be added to HVAC designs for seven different types of commercial buildings. The course also covers the effects of different humidity levels on thermal comfort, corrosion, mold growth and airborne microorganisms – information that helps the owner and designer define the optimal humidity control level for each application.
Instructor: Lew Harriman, Fellow ASHRAE

Understanding & Designing Dedicated Outdoor Air Systems (code 65)

3:30 pm – 6:30 pm, Orange County Convention Center, Room S330C
This course describes the advantages of separate dedicated outdoor air systems (DOAS) and the disadvantages of delivering the ventilation via single all-air variable air volume (VAV) systems. The course discusses the consequent issue of the thermodynamic state of delivered ventilation air that arises from the design paradigm of a separate DOAS.
Instructor: Stanley Mumma, PhD., P.E., Fellow/Life Member ASHRAE

Variable Refrigerant Flow System Design & Applications (code 66)

3:30 pm – 6:30 pm, Orange County Convention Center, Room S330D
Variable Refrigerant Flow (VRF) systems are now being applied in many building types across North America. This course provides non-manufacturer specific concepts of how to apply VRF systems to buildings. The course supplements the fundamental technology presented in the 2012 ASHRAE *HVAC Systems and Equipment Handbook* offering consulting engineers who already have a basic knowledge of VRF technology a comprehensive system design and application guidance using building specific scenarios.
Instructor: Dermot McMorrow, P.Eng., Member ASHRAE

MONDAY, JANUARY 25, 2016

Air-to-Air Energy Recovery Applications: Best Practices (code 67)

8:30 am – 11:30 am, Orange County Convention Center, Room S330A
Air-to-air energy recovery provides one of the most cost-effective and efficient ways to recycle waste energy and create superior indoor environments. This course reviews real-world examples of where and how air-to-air energy recovery technologies are integrated into some of the most commonly used commercially available systems. Particular configurations that are often used in high-performance buildings and how they can best be used to meet strict goals for IEQ, energy efficiency and thermal comfort will be examined with respect to established performance metrics, peak performance results and annual energy savings.
Instructor: Paul Pieper, P.Eng., Member ASHRAE

Application of Standard 62.1-2013: Multiple Spaces Equations and Spreadsheets (code 68)

8:30 am – 11:30 am, Orange County Convention Center, Room S330B
Applying Standard 62.1-2013 to multiple spaces can be challenging even for advanced HVAC practitioners. This course covers the new Appendix A method and focuses on using the spreadsheet from the *User's Manual*. The subject material includes both constant volume and VAV applications, and certain cases are examined where secondary recirculation applies. The course intent is to develop proficiency in using the spreadsheet tool for improving design solutions that will comply with the 2013 Standard. A copy of the spreadsheet will be provided and attendees are strongly encouraged to bring their laptops to learn the spreadsheet's power and the effect on total outdoor air required when changing different design parameters. In-class exercises will also be conducted.
Instructor: Hoy Bohanon, P.E., Member ASHRAE, BEAP, LEED® AP

Building Demand Response and the Coming Smart Grid (code 69)

8:30 am – 11:30 am, Orange County Convention Center, Room S330C
This course presents applications of new technologies and design concepts that are leading the way to how buildings and their systems will interact with a coming smart electrical grid. The course focuses on demand response measures and programs, although smart buildings and their new system concepts are also included. Finally, the course summarizes the future driving trends toward high-performance buildings across the globe.
Instructor: Tom Lawrence, Ph.D., P.E., Member ASHRAE, LEED® AP

Energy Management Best Practices (code 70)

8:30 am – 11:30 am, Orange County Convention Center, Room S330D
Buildings use 41% of US energy, of which one-third can be practically saved. This course discusses the principles of energy management, and also includes example problems, which are solved collaboratively by the class. This reinforces key points in the presentation, and results in a more in-depth learning experience. Students will learn emissions factors in different geographic regions, and how to develop the carbon footprint of a building. At the completion of the course, students are prepared to evaluate a reduced emissions program and the cost effectiveness produced by key energy management practices.
Instructor: Richard Pearson, P.E., Fellow/Life Member ASHRAE

Avoiding IAQ Problems (code 71)

2:45 pm – 5:45 pm, Orange County Convention Center, Room S330B

This course provides a systematic overview of the key objectives that must be met to achieve good indoor air quality. A review of the most common causes of IAQ problems in buildings, as well as the process management strategies that owners and design teams can use during design, construction and turnover to help avoid IAQ problems are discussed. The course discusses state-of-the-art strategies to prevent IAQ problems related to moisture and mold in building assemblies, outdoor contaminants, moisture and dirt in air handling systems, material emissions, outdoor air monitoring and control and more.

Instructor: Hoy Bohanon, P.E., Member ASHRAE, BEAP, LEED® AP

Commissioning Process & Standard 202 (code 72)

2:45 pm – 5:45 pm, Orange County Convention Center, Room S330A

Much confusion and misinterpretation exists today about the commissioning process. To alleviate this situation, this introductory-level course describes the fundamentals of the code-language process of the new *Standard 202-2013, Commissioning Process for Buildings and Systems.* The course focuses on the ASHRAE commissioning process intent, deliverables and activities. Standard 202 was written as a code-intended document that presents minimum acceptable characteristics for the practice of commissioning. This course complements ASHRAE's *Guideline 0-2013* course, which describes the characteristics and expectations of an ideal commissioning process.

Instructors: Walter Grondzik, P.E., Fellow ASHRAE

Complying with Standard 90.1-2013: HVAC/ Mechanical (code 73)

2:45 pm – 5:45 pm, Orange County Convention Center, Room S330C

In 2007, ASHRAE determined that the 2010 version of Standard 90.1 would show a 30% reduction in energy use when compared to the 2004 edition. In 2013, ASHRAE asked for an additional 20% reduction, setting a target for a Standard 50% below that required for a 2004-compliant building. Design professionals, code officials and building owners must keep up with the new, more stringent requirements to comply with this quickly evolving Standard. This course describes the new and updated Mandatory and Prescriptive requirements, along with insights on how to comply during building design and construction.

Instructors: McHenry Wallace, P.E., Member ASHRAE, LEED® AP; and Joseph Deringer, AIA, Member ASHRAE, LEED® AP

ASHRAE Standard 188-2015 – Successfully Managing the Risk of Legionellosis (code 74)

2:45 pm – 5:45 pm, Orange County Convention Center, Room S330D

This course describes the environmental conditions that promote the growth of Legionella in water systems and the locations where Legionella control measures can be applied in new and existing buildings. A comparison between general compliance and compliance for certain health care facilities will be provided. The course focuses on compliance with Standard 188-2015 to provide a safer and healthier building environment.

Instructors: William Pearson, Member ASHRAE; and Michael Patton, Member ASHRAE

TUESDAY, JANUARY 26, 2016

Exceeding Standard 90.1-2013 to Meet LEED® Requirements (code 77)

9:00 am – 12:00 pm, Orange County Convention Center, Room S330A

This course explores ways to obtain significant energy savings and LEED credits by following the new, more stringent requirements of Standard 90.1-2013, and by using Appendix G rules and procedures. Appendix G is especially applicable to LEED credits and to US energy tax credits. Standards 90.1-2010 and 90.1-2013 together produce almost 50% energy savings from the 2004 version. So, by substantially surpassing Standard 2013 requirements, buildings should achieve well over 50% energy savings. This course uses eQUEST examples, including live demos, to present an overview of applying key 90.1-2013 requirements and Appendix G rules.

Instructors: McHenry Wallace, P.E., Member ASHRAE, LEED® AP; and Joseph Deringer, AIA, Member ASHRAE, LEED® AP

IT Equipment Design Evolution & Data Center Operation Optimization (code 78)

9:00 am – 12:00 pm, Orange County Convention Center, Room S330B

Many opportunities exist to save energy in data centers, which are using an increasing amount of the total energy consumed by commercial facilities. The downside of this increased energy consumption is the resulting significant increases in the power required and the heat dissipated by the computing equipment. This course examines the best practices for data center energy efficiency. It focuses on the highlights from ASHRAE's Datacom Series of publications and whitepapers. The course provides a detailed discussion of the many variables, drivers, methods and processes that facilitate energy efficient data center design and operations, as well as how to plan for future data center needs.

Instructors: Don Beaty, P.E., Member ASHRAE; and Roger Schmidt, Ph.D., P.E., Member ASHRAE

Designing High-Performance Healthcare HVAC Systems (code 79)

1:00 pm – 4:00 pm, Orange County Convention Center, Room S330A

This advanced course discusses the nuances of HVAC system design for healthcare facilities. The course details the relationship of infection control and HVAC design including application of *ANSI/ASHRAE/ASHE Standard 170-2013, Ventilation of Health Care Facilities.* The course covers the interactions of the key elements of high performance in healthcare, infection control, comfort, reliability, safety, maintenance, energy and sustainability. Numerous energy conservation strategies are discussed in the context of achieving all the goals of a high performing hospital.

Instructor: Daniel Koenigshofer, P.E., Member ASHRAE, HFDP

WHAT IS A TECHNICAL COMMITTEE?

The technical expertise of ASHRAE is concentrated in its **Technical Committees (TCs), Task Groups (TGs), Technical Resource Groups (TRGs) and Multidisciplinary Task Group (MTGs)**. These groups are responsible in various degrees for:

- preparing the text of ASHRAE Handbook chapters
- originating, coordinating, and supervising Society-sponsored research projects
- presenting programs at ASHRAE meetings
- reviewing technical papers
- evaluating the need for standards
- and advising the Society on all aspects of the technology it embraces

ASHRAE TCs consist of people who have a recognized proficiency in a specific field of interest. TGs, similar to TCs, are formed when a subject of current interest is not covered in the scope of an existing TC or when the subject encompasses the scope of more than one TC. A TG is usually the first step towards becoming a TC when the TG's scope is not covered under a TC. TRGs are similar to TCs except that their responsibilities are limited to preparing, reviewing, or revising technical material. They do not have responsibility for programs, research, or standards. MTGs are different from TCs, TGs, and TRGs. A MTG is formed when the Society has determined a need for limited activity in a broad field of interest that encompasses the expertise of TCs from two or more sections and/or from non-TC groups such as Standing Standard Project Committees (SSPCs) or outside organizations. The functions of a MTG may include Handbook, Program, Publications, Research and Standards to various degrees, but the customary function of the MTG will be to coordinate those activities within the TCs and other groups, and organizations represented on the MTG.

APPLYING FOR MEMBERSHIP ON A TECHNICAL COMMITTEE

ASHRAE welcomes new members to its technical committees.

To be considered for technical committee membership, you must:

- Notify ASHRAE staff at TCStaff@ashrae.net of your interest in a particular TC, TG, TRG, or MTG.
- "Manage Your Membership" link from the ASHRAE Web site

Please note:
If you do not have an ASHRAE ID, are or not applying for ASHRAE membership, and are applying for a position that requires an ASHRAE bio to be on file, please go to www.ashrae.org and click on the Log In tab at the top of the page. Next click on need a login? to request an ID and PIN. You may also use that link if you already have an ASHRAE ID as a non-member, but you do not have a record of what that number is.

You will immediately be assigned as a Provisional Corresponding Member. The acceptance of provisional corresponding membership implies participation in committee activities through correspondence or in-person involvement. Provisional corresponding members serve 2 year terms. Although provisional corresponding members are not voting members, at the end of your term and based on participation in the committee, you may be considered for future voting membership.

Notification of acceptance to a TC is emailed upon your appointment.

ATTENDING TECHNICAL COMMITTEE MEETINGS

During the Annual and Winter Conference

The ASHRAE Technical Committees, Task Groups and Technical Resource Groups meet at each Society Winter and Annual Conference. Attendance at these meetings is open to all society members, to all registered guests at scheduled Society Conferences, and to those invited by the chair at the request of a member. You are encouraged to attend any of these meetings in which you have a technical interest. TC chairs are reminded prior to each meeting to make a special effort to welcome visitors (potential members), particularly international members, to TC meetings – A TC can never have too many willing and able volunteers.

ASHRAE WINTER CONFERENCE TECHNICAL PROGRAM

Orlando – January 2016

Earn Professional Development Hour (PDH) credits by attending sessions listed in the Technical Program. Each hour attended in a session equals one PDH. For forums and other one-hour sessions, you must be present for the entire 50-minute program to earn a PDH. Sign-in sheets will be available in all session rooms for attendees to complete. State PDHs, AIA LUs and LEED AP credits are awarded for select sessions. Also, certain sessions may be acceptable for ASHRAE certification renewal. Send questions to certification@ashrae.org. Your badge will be scanned as you enter the session and a summary of sessions attended will be emailed to you upon conclusion of the conference.

Technical sessions are in the Orlando Hilton.

All sessions listed as starting at the same time are concurrent.

ASHRAE'S CONFERENCES AND EXPOSITIONS COMMITTEE WELCOMES YOU TO THE 2016 WINTER CONFERENCE

Five types of sessions are presented:

Technical Paper Sessions. These sessions present papers on current applications or procedures, as well as papers resulting from research on fundamental concepts and basic theory. Papers presented in these sessions have successfully completed a rigorous peer review. You are invited to comment on these papers. Forms for written comment are available at each session, and if received by February 8, 2016, comments will be sent to respective authors for reply and publication in ASHRAE Transactions. PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Preprints of papers and an online papers collection are available for purchase in the ASHRAE Bookstore.

Conference Paper Sessions. These sessions present papers on current applications or procedures, as well as papers reporting on research in process. These papers differ from technical papers in that they are shorter in length and undergo a much less stringent peer review. PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Preprints of conference papers and an online papers collection are available for purchase in the ASHRAE Bookstore.

Seminars. Seminars feature presentations on subjects of current interest. Papers are not available from the Society; however, seminar PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Access is free for attendees who purchase a conference registration. Additional Virtual Conference registrations can be purchased in the ASHRAE Registration. For a permanent record of the seminar presentations, the Seminar DVD will be available. Orders can be taken in the ASHRAE Bookstore.

Forums. Forums are "off-the-record" discussions held to promote a free exchange of ideas. Reporting of forums is limited to allow individuals to speak confidentially without concern of criticism. There are no papers attached to these forums.

Workshops. Workshops enable technical committees and other ASHRAE committees to provide a series of short presentations on a topic requiring specific expertise. These short presentations are provided with an increased emphasis on audience participation and training in a specific set of skills. PowerPoint presentations with audio descriptions are posted online in the Virtual Conference.

VIRTUAL CONFERENCE

Free for Paid Conference Registrants

ASHRAE is offering a virtual conference option so you won't miss the state-of-the-art concepts and latest design techniques presented in the Society's technical program. The Orlando Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board. All conference attendees paying the full registration fee should have received via email their password and link prior to arriving in Orlando. If you do not have your password and link Go to www.ashrae.org/orlandoonline and click on the link to access the Virtual Conference and put in your email address to request your password.

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations
- Access to all seminar, technical paper and conference paper presentations
- Ability to post questions or answers for selected sessions through Wednesday, Feb. 10. Presentations available online for 18 months.
- A full slate of technical programs will be posted beginning Monday, Jan. 25, of the sessions that were presented the previous day, with additional content posted through Wednesday, Jan. 27.

On-site registration is available for those who would like to purchase the Virtual Conference. To purchase you can do so online or go to ASHRAE Registration, Hilton, Florida Ballroom 4 Lower Level, $249 ASHRAE member; $445 non member. If you register on site, your password will be emailed to you within 24 hours of your registration.

2016 ASHRAE Winter Conference—Papers (online)

Technical Paper and Conference Paper Session papers as presented at this Conference

$79 (includes five FREE hard copies of preprint papers)

Available at the Conference Bookstore

Conference Seminars DVD

69 Seminars (PowerPoint files synced with speakers' audio)

$119 (ships April 2016)

Conference Preprints (individual papers, in print)

Technical Paper and Conference Paper Session papers as presented at this Conference

$6 each

Available at the Conference Bookstore

ASHRAE Transactions (Print Volume)

Technical Paper Session papers with discussion questions and answers for papers in bound, library-quality form.

$79 (ships May 2016)

Approved for New York State Professional Development Hours (PDHs) and American Institute of Architects Learning Units (LUs)

GBCI LEED AP CE Credits

Packages

1. 2016 ASHRAE Winter Conference – Papers (online) and Seminars DVD

Get five FREE hard copies of preprint papers when you purchase this package.

$149 – *Purchase in the Conference Bookstore*

2. 2016 ASHRAE Winter Conference – Papers (online) and *ASHRAE Transactions*

(See description at left.)

Get five FREE hard copies of preprint papers when you purchase this package.

$124 – *Purchase in the Conference Bookstore*

3. Complete Winter Conference Content Package (2016 ASHRAE Winter Conference – Papers (online), Seminars DVD, and *ASHRAE Transactions*)

$174 – *Purchase in the Conference Bookstore*

All prices are special conference-only prices.

Sunday, January 24

8:00 AM-9:00 AM

SEMINAR 1 (INTERMEDIATE)

An Assessment of Unconventional Heat Pump Sizing with Variable Capacity Technology

Track: Modern Residential Systems
Room: Orange Ballroom A
Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps
Chair: Walter E. Hunt, Associate Member, Electric Power Research Institute, Knoxville, TN

Traditional methods for residential heat pump sizing allow for sufficient unit performance and comfortable indoor conditions. Variable capacity heat pumps have the ability to provide a range of sensible cooling, latent cooling and heating output, and therefore have flexibility in how they are sized for a specific application. Unconventional sizing of a variable capacity heat pump may offer energy savings and power demand reduction, while maintaining indoor comfort. This seminar examines two unique perspectives of unconventional heat pump sizing with variable capacity technology.

1. A Potential Solution for a Real-World Utility Issue: Oversized Variable Capacity Heat Pumps
George Gurlaskie, *Duke Energy, Orlando, FL*

2. A Study on Variable Capacity Heat Pump Sizing in Mixed-Humid and Cold Climates
Jeffrey Munk, Member, *Oak Ridge National Laboratory, Oak Ridge, TN*

8:00 AM-9:00 AM

SEMINAR 2 (INTERMEDIATE)

Centralized vs. Distributed Geothermal Heat Pump Applications

Track: The Great Debate
Room: Orange Ballroom G
Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications
Chair: Mike Filler, P.E., HBDP, Member, Trane Company, Pueblo, CO

Closed-loop geothermal heat pump (GHP) systems offer a variety of possibilities that can be optimized to the needs of the building type and owner's resources. This session offers recommendations for identifying characteristics and design approaches important to good matches of buildings and ground loops. The advantages and disadvantages of centralized GHP systems utilizing chiller(s) are examined and compared to distributed geothermal-source water-to-air heat pump systems.

1. Happy GHP Marriages: Building Types and GHP Loop Options
Steve Kavanaugh, Ph.D., Fellow ASHRAE, *University of Alabama, Tuscaloosa, AL*

2. When Should Centralized GHP Systems Be Considered?
Stephen Hamstra, P.E., HBDP, Member, *Greensleeves LLC, Zeeland, MI*

8:00 AM-9:00 AM

SEMINAR 3 (INTERMEDIATE)

Control Valves in Hydronics: A Painted Picture

Track: The Great Debate
Room: Orange Ballroom C
Sponsor: 06.01 Hydronic and Steam Equipment and Systems
Chair: Robert C. Walker, Member, Belimo Aircontrols Usa, Danbury, CT

This seminar proposes to compare design and benefits of pressure independent control valves versus standard control valves. It covers system background, valve design evolution as a result of system requirements and ultimately the benefits provided by the control valves. The presentation ethos/pathos/logos aims to paint a detailed and complete picture of the possibilities of solutions at the disposal of design engineers, contractors and facility technicians.

1. Hydronic Design with Standard Two-Way Control Valves
Larry Konopacz, Member, *Xylem Bell & Gossett, Morton Grove, IL*

2. Hydronic Design with Pressure Independent Control Valves
Hooman Daneshmand, P.E., Member, *Tour & Andersson, Dallas, TX*

8:00 AM-9:00 AM

SEMINAR 4 (INTERMEDIATE)

Is Recovery Possible? Controls Challenges with Medical Codes and Standards

NY PDH DVD G

Track: Standards, Guidelines and Codes
Room: Orange Ballroom E
Sponsor: 01.04 Control Theory and Application
Chair: Chariti Young, Member, Automated Logic Corp., Kennesaw, GA

Codes and standards establish minimum levels of compliance. Medical facilities have minimum levels understandably higher than many other fields. However, as the world of controls technologies and sequences of operation have advanced, medical construction codes and standards have not kept pace. In many cases, this limits the ability of owners and operators to use newer technologies and controls capabilities to save energy while keeping medical facility occupants safe and comfortable. Speakers present case studies where some of these challenges have been successfully overcome, as well as approaches that can prove new technologies for inclusion in medical codes and standards.

1. Mandatory Energy Waste? This Owner Says NO!
Travis R English, P.E., Member, *Kaiser Permanente, Anaheim, CA*

2. What's in the Way of Better Codes and Standards?
David Castillo, P.E., Member, *Office of Statewide Health Planning and Development, Sacramento, CA*

8:00 AM-9:00 AM

SEMINAR 5 (INTERMEDIATE)

Commissioning: Closing the Loop

NY PDH DVD G

Track: International Design
Room: Orange Ballroom F
Sponsor: 02.08 Building Environmental Impacts and Sustainability, TC 1.7, 07.02 HVAC&R Contractors and Design Build Firms
Chair: E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

It is common knowledge in the industry that buildings and systems have become both more complicated and more complex. This complexity often manifests itself in the interplay and display between various systems. Concomitant with this complexity has been the growth in the art and practice of commissioning. This program looks at commissioning from an international perspective. Experienced practitioners from far and not so far afield tell us how they get it done.

1. The Merge in the Middle: Commissioning in Pakistan
Abbas Sajid, Member, *Engineering Services, Karachi, Pakistan*

2. Running like New Under the Sun: Commissioning in the Middle East
Mohamed Yassein, *Khatib & Alami Consulting Engineers, Riyadh, Saudi Arabia*

8:00 AM-9:00 AM

SEMINAR 6 (INTERMEDIATE)

Presenting ASHRAE's New CHP Design Guide and eTool

NY PDH DVD G

Track: Systems and Equipment
Room: Orange Ballroom D
Sponsor: 01.10 Cogeneration Systems, TC 8.3, 06.02 District Energy
Chair: James Freihaut, Ph.D., Member, Pennsylvania State University, University Park, PA

Historically, combined heat and power (CHP) design guides have focused on design and development features of major system components. Although these elements are critical to develop high-performing and reliable components, they are not of particular interest to an engineering practitioner seeking to understand and apply a CHP system to a specific application. This new ASHRAE design guide, developed by ASHRAE research (RP-1592), provides application and operational information about prime movers, heat recovery devices and thermally activated technologies; technical and economic guidance regarding CHP systems design, site screening and assessment guidance and tools; and installation, operation and maintenance advice.

1. ASHRAE's CHP Design Guide Overview: A Walk on the Thermal Side
Richard Sweetser, Life Member, *Exergy Partners Corp., Herndon, VA*

2. ASHRAE's CHP Design Guide Review: CHP Assessment eTool
Gearoid Foley, Member, *Integrated CHP Systems Corp., Princeton Junction, NJ*

8:00 AM-9:00 AM

WORKSHOP 1 (INTERMEDIATE)

Case Studies in Engineering Ethics

NY PDH G

Track: Fundamentals and Applications
Room: Orlando Ballroom V
Sponsor: 01.07 Business, Management & General Legal Education
Chair: Mike Bilderbeck, P.E., Fellow ASHRAE, Pickering, Inc., Memphis, TN

ASHRAE members are often confronted with ethical issues (whether they realize it or not). This session is part of a continuing program under which ASHRAE members engage in an interactive session where participants are presented with three NPSE ethics cases, discuss the cases in small groups and then reveal their decisions. The actual NSPE decisions are then provided. Test your "Ethics IQ" against real cases and receive CE credit in the process.

1. Case Studies Parts 1 and 2
Mike Bilderbeck, P.E., Fellow ASHRAE, *Pickering, Inc., Memphis, TN*

2. Case Studies Parts 3 and 4
Kristin Schaefer, P.E., Member, *Schaefer Engineering, Katy, TX*

3. Case Studies Parts 5 and 6
Jennifer E. Leach, P.E., Member, *Cummins-Wagner Co, Inc., Annapolis Junction, RI*

8:00 AM-9:00 AM

WORKSHOP 2 (BASIC)

ASHRAE Standard 205P: Better Data, Better Models, Better Results

NY PDH G

Track: Standards, Guidelines and Codes
Room: Orange Ballroom B
Sponsor: 04.07 Energy Calculations, SPC 205
Chair: Timothy McDowell, Thermal Energy System Specialists, LLC, Madison, WI

ASHRAE Standard 205, Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment, is working with equipment manufacturers and software developers to create standard formats for the performance data provided. The intent is to make it easier to integrate this performance data into simulation programs so users of the programs can have access to the performance data of any piece of equipment that they are wishing to simulate. This session introduces some of the first categories of equipment that have been represented and provides a chance for the users to provide their input to the committee.

1. Performance Data Representation of Unitary Equipment
Neal Kruis, Ph.D., Student Member, *Big Ladder Software, Denver, CO*

2. An Overview of SPC 205's Annex for Water-Cooled Chillers: What It Is and How It Could be Used
Mark Hydeman, P.E., Fellow ASHRAE, *Continual Energy Inc, San Francisco, CA*

9:00 AM-9:30 AM

NETWORKING COFFEE BREAK AND CURLING MATCH (8:30 AM-9:30 AM)

Promenade (weather permitting), Lower Level

Grab some coffee and network with your fellow ASHRAE conference attendees after the opening sessions. This is a great chance to discuss the program and form connections to make the most of your time in Orlando. The coffee break includes a curling bonspiel, "Team Canada vs. Team World," from 8:30 am to 9:30 am. Please come and join us, throw a few rocks, learn some strategy and see what gives curling its nickname of "chess on ice."

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 1 (ADVANCED)

Simulating Noise Attenuation in Ducts

Track: Systems and Equipment
Room: Orange Ballroom G
Chair: Thomas H. Kuehn, PhD, Fellow ASHRAE, University of Minnesota, Minneapolis, MN

Ducts transmit much of the noise heard in office environments. This session uses finite element simulation to determine the attenuation that can be expected from insertion losses, transmission losses, elbows, side branches and breakout transmission loss in lined and unlined ducts for a much wider range of conditions than those provided in the Handbook tables. The results have demonstrated good agreement with available measured data.

1. A Simulation Approach to Determine the Insertion and Transmission Loss of Unlined and Lined Ducts (RP-1529) (OR-16-001)
David W. Herrin, Ph.D., P.E., Member *and Kangping Ruan, Ph.D., Student Member, University of Kentucky, Lexington, KY*

2. Simulation of Attenuation due to Elbows and Side Branches and Breakout Transmission Loss (RP-1529) (OR-16-002)
David W. Herrin, Ph.D., P.E., Member *and Kangping Ruan, Ph.D., Student Member, University of Kentucky, Lexington, KY*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 1 (INTERMEDIATE)

Indoor Air Quality and Energy Efficiency: Measurement and Analysis of Multiple Approaches

Track: Fundamentals and Applications
Room: Orange Ballroom B
Chair: Jaideep S. Karnik, Member, HCYU Building Engineered Solutions, Richmond, VA

This session presents results from measurements of the effectiveness of demand controlled ventilation in variable air volume (VAV) systems, CO2 concentrations in offices with displacement ventilation and testing of the effectiveness of a plant-assisted air filter in reducing outside air ventilation requirements. In each case, the measurements are combined with substantial analysis to point toward ways to more effectively use each technology and to aid in generalizing results of the measurements reported.

1. Demand Controlled Ventilation in Practice: Best Practices Learned from Six VAV Systems (OR-16-C001)
Scott Hackel, P.E., Member[1] *and Saranya Gunasingh*[2]*, (1)Energy Center of Wisconsin, Madison, WI, (2)Energy Center of Wisconsin, Chicago, IL*

2. Biowall for Improved IAQ in Residences (OR-16-C002)
William Hutzel, P.E., Member[1]***,*** *Reinhard Mietusch*[2]*, Osama Alradaddi, Student Member*[1] *and Bhargav Rajkhowa*[1]*, (1)Purdue University, West Lafayette, IN, (2)University of Dresden, Dresden, Germany*

3. Optimization of Carbon Dioxide Removal Efficiency in a Displacement Ventilation System (OR-16-C003)
Reza Ghias, Ph.D., Member[1]***,*** *Mike Koupriyanov, P.E., Member*[2] *and Ramin Rezaei*[1]*, (1)Southland Industries, Dulles, VA, (2)Price Industries Limited, Winnipeg, MB, Canada*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 2 (INTERMEDIATE)

Residential Energy Savings from Fuel Switching, Hot-Gas Bypass and Conditional Demand Analysis

Track: Modern Residential Systems
Room: Orange Ballroom A
Chair: Gary C. Debes, Member, BHH Engineers, a Division of Blackney Hayes Architects, Philadelphia, PA

This session explores the use of three very different approaches to reduce residential energy use. It presents evidence that switching from electric cooking and heating to LPG in Saudi Arabia can result in appreciable primary energy savings and emissions of greenhouse gases. Experimental work is presented showing both energy savings and improved heating system characteristics for a residential heat pump using hot gas bypass instead of conventional cycle reversal for defrost. Another author suggests that disaggregating residential end uses in Korea using conditional demand analysis may lead to improved residential energy efficiency.

1. Potential Energy Savings By Switching Residential Cooking and Water Heating Appliances from Electric to LPG in Saudi Arabia (OR-16-C004)
Faisal Al Musa *and Ayman Youssef, P.E., Member, Saudi Aramco, Dhahran, Saudi Arabia*

2. Single-Circuit Hot Gas Bypass Defrosting Strategy for Residential Heat Pump (OR-16-C005)
Cara Martin, BEMP, Associate Member[1]*, Dennis M. Nasuta, Associate Member*[1]*, Song Li, Associate Member*[1]*, William Hoffman*[1]*, John Bush*[2] *and Ron Domitrovic, Ph.D., Member*[2]*, (1)Optimized Thermal Systems, Inc., Beltsville, MD, (2)Electric Power Research Institute, Knoxville, TN*

3. Conditional Demand Analysis for Estimating the Electric Energy Consumption by Household Facilities in Apartment Buildings (OR-16-C006)
Hye-sun Jin, Member, *Bo-Hye Choi, Member, Sung-Im Kim, Student Member, Jin-Gyeong Kang, Jae-han Lim, Ph.D., Member and Seung-Yeong Song, Ph.D., Member, Ewha Womans University, Seoul, South Korea*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 3 (INTERMEDIATE)

Do Tall, Super Tall and Mega Tall Buildings Consume More Energy Than Conventional Buildings or Do They Conserve More Energy?

Track: International Design
Room: Orange Ballroom F
Sponsor: 09.12 Tall Buildings
Chair: Peter Simmonds, Ph.D., Fellow ASHRAE, Building and Systems Analytics LLC, Marina Del Rey, CA

Nearly all new tall, super tall and mega tall buildings are required to comply with Energy Codes and therefore the energy performance calculations become critical. This seminar looks at specifics associated with modeling of tall buildings and compliance with various energy codes. It also provides information on the Energy Use Index (EUI) of tall buildings and what the expectancies are when designing and modeling such intricate buildings and systems.

1. Benchmarking Energy Performance of Tall Buildings (OR-16-C007)
Mehdi Jalayerian, P.E., Member *and Edna Lorenz, Member, ESD, Chicago, IL*

2. Do Taller Buildings Require More Energy? (OR-16-C008)
Stephen Ray, Ph.D., Associate Member *and Luke Leung, P.E., Skidmore, Owings & Merrill LLP, Chicago, IL*

9:45 AM-10:45 AM

SEMINAR 7 (BASIC)

Energy Submetering Fundamentals: Benchmarking, Baselining and Beyond!

Track: Fundamentals and Applications
Room: Orange Ballroom E
Sponsor: 01.04 Control Theory and Application, 07.05 Smart Building Systems
Chair: Joseph Kilcoyne, P.E., Member, SC Engineers, Inc., San Diego, CA

Everyone is talking about improving energy consumption. However, if you can't measure it, you can't improve it. In a college setting where an entire campus may be fed from a single electrical or natural gas meter, individual building submetering is essential to identifying big ticket energy waste. This session highlights two different approaches to submetering: one campus which utilized their building automation system and the other which built a network of web-enabled sub meters tied into an energy dashboard. See how each campus is making their metering investment pay back through targeted benchmarking and monitoring-based commissioning.

1. From Submeters to Savings: How the San Diego Community College District Used a Submetering Project to Kickstart an Energy Savings Campaign
Chris Manis, *San Diego Community College District, San Diego, CA*

2. Leveraging Building Automation Systems to Perform Metering and M&V
Melissa Plaskonos, *University of San Diego, San Diego, CA*

9:45 AM-10:45 AM

WORKSHOP 3 (BASIC)

ASHRAE Standard 188-2015, Legionellosis: Risk Management for Building Water Systems: What's Your Responsibility?

Track: Standards, Guidelines and Codes
Room: Orange Ballroom D
Sponsor: 03.06 Water Treatment, SPC 188, 08.06 Cooling Towers and Evaporative Condensers
Chair: Jon Cohen, Member, ChemTreat, Richmond, VA

ASHRAE's new Standard 188 provides minimum Legionellosis risk management requirements for building water systems in managing risk due to Legionella bacteria. Use will impact building owners and designers, operators, practitioners and contractors. This workshop outlines the framework used in the standard, information on applying the standard to both utility water systems and potable water systems and aspects not currently in the standard, but are important considerations. The expert panel answers questions regarding the standard's implications, use and direction under continual maintenance and allows a forum for ASHRAE members to provide feedback to the committee and discuss its impact.

1. What's in the New ANSI/ASHRAE Standard 188-2015: Legionellosis: Risk Management for Building Water Systems
Bill Pearson II, Associate Member, *Southeastern Laboratories, Raleigh, NC*

2. ASHRAE's New Standard 188-2015, Legionellosis: Risk Management for Building Water Systems: What's Missing?
Janet Stout, Ph.D., Member, *Special Pathogens Lab, Pittsburgh, PA*

9:45 AM-10:45 AM

WORKSHOP 4 (INTERMEDIATE)

Compliance and Enforcement of Energy Performance Legislations: Status on the Ground and Possibilities for Improvement

Track: Standards, Guidelines and Codes
Room: Orange Ballroom C
Sponsor: INIVE EEIG
Chair: Peter J. Wouters, Dr.Ing., Member, INIVE EEIG, Brussels, Belgium

All European countries have energy requirements for new buildings, whereby requirements after 2020 must result in nearly zero energy buildings. Is it evident to assume that the energy declarations are reliable and correspond with the reality? If not, what possibilities exist to increase the reliability? What about the quality of the works? If frequent problems, what are the possibilities for a substantial improvement of the quality of the works? Most of the information provided during this presentation is related to activities carried out in the context of the Air Infiltration and Ventilation Centre (AIVC) and the EU QUALICHeCK project.

1. The European QUALICHeCK Project: Toward Better Compliance and Quality of the Works
Peter J. Wouters, Dr.Ing., Member, *INIVE EEIG, Brussels, Belgium*

2. Status on the Ground Regarding Compliance with Energy Performance Legislation
Jaap Hogeling, Dr.Ing., Fellow ASHRAE, *ISSO, Lienden, Netherlands*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 4 (INTERMEDIATE)

High Performance Heating, Cooling and Deep Retrofits

Track: Fundamentals and Applications
Room: Orange Ballroom G
Chair: Stephanie Kunkel, JMT, Sparks, MD

This session examines several high performance systems. These include direct fired heating technology for high bay buildings and radiant cooling coupled with dedicated outside air systems. Deep retrofits can provide dramatic efficiency improvements, but often face challenges as described in a case study. The final paper examines design changes needed to achieve maximum system efficiency with condensing boilers.

1. The Secret to High Performance Space Heating in High-Bay Buildings (OR-16-C009)
Marc Braun, Member *and Jim Young, Member, Navigant Consulting, Chicago, IL*

2. A Detail Case Study for Energy Performance Assessment of Radiant Cooling System through Modeling and Calibration at Component Level (OR-16-C010)
Jyotirmay Mathur, Dr.Ing., Member[1], *Yasin Khan, P.E., BEMP[1], Mahabir Bhandari, Ph.D., Member[2] and Guruprakash Sastry[3], (1) Malaviya National Institute of Technology, Jaipur, India, (2)Oak Ridge National Laboratory, Oak Ridge, TN, (3)Green Initiatives at Infosys Limited, Bangalore, India*

3. Design-Build Successes and Challenges for the Byron G. Rogers Federal Office Building (OR-16-C011)
Michelle Swanson, P.E., Member, *RMH Group, Lakewood, CO*

4. A Deeper Look at Modern Heating System Design (OR-16-C012)
Omar Hawit, P.E., Member, *Chris Wilson, P.E., Member and Trevor Jaffe, P.E., Member, Westlake Reed Leskosky, Washington, DC*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 5 (INTERMEDIATE)

Refrigerant Advances

Track: Systems and Equipment
Room: Orlando Ballroom V
Chair: Edward A. Vineyard, Fellow ASHRAE, Oak Ridge National Laboratory, Oak Ridge, TN

Attendees will learn about some of the latest research regarding refrigerants. The presentations will highlight studies done on alternative refrigerants, lubricant retention, optimizing low Global-Warming-Potential refrigerants and chiller performance with replacement refrigerants.

1. Evaluation of Alternative Refrigerants for High Ambient Applications (OR-16-C013)
Omar Abdelaziz, Ph.D., Member, *Jeffrey Munk, Member, Som Shrestha, Ph.D., BEMP, Member, Xiaobing Liu, Ph.D., Member and Bo Shen, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN*

2. Lubricant Retention in a R410A Microchannel Evaporator and Its Effects on Heat Transfer and Pressure Drop (OR-16-C014)
Sarath Mulugurthi, Student Member, *Ardiyansyah Yatim, Associate Member and Lorenzo Cremaschi, Ph.D., Member, Oklahoma State University, Stillwater, OK*

3. Optimizing the Flammability and Performance of Next Generation Low-GWP R-410A Replacements (OR-16-C015)
Stephen Kujak, Member *and Kenneth Schultz, Ph.D., Member, Trane, Ingersoll Rand, La Crosse, WI*

4. Comprehensive Assessment of Centrifugal Chillers Using Next Generation Refrigerant R-1233zd(E) (OR-16-C016)
Stephen Kujak, Member, *Kenneth Schultz, Ph.D., Member and Julie Majurin, Associate Member, Trane, Ingersoll Rand, La Crosse, WI*

5. Refrigerant R513A as a Replacement for R134a in Chillers (OR-16-C017)
Kenneth Schultz, Ph.D., Member, *Stephen Kujak, Member and Julie Majurin, Associate Member, Trane, Ingersoll Rand, La Crosse, WI*

11:00 AM-12:30 PM

SEMINAR 8 (INTERMEDIATE)

BIM Strategies for Energy Modeling and MEP Design Consulting

Track: Fundamentals and Applications
Room: Orange Ballroom C
Sponsor: 07.01 Integrated Building Design, BIM MTG, 01.05 Computer Applications
Chair: Krishnan Gowri, Ph.D., Member, Autodesk, San Rafael, CA

BIM is promoted and marketed by all factions of the design and construction industry as being THE critical component to successful project delivery with promises of streamlined cost and schedule metrics and efficiencies galore. More projects and owners require BIM now than ever before. This session brings together three industry experts to provide ASHRAE members with practical guidance on strategies to successfully implement BIM-based workflow for MEP design and building energy modeling.

1. BIM: An Incomplete MEP Design Solution and How to Complete It
Don Beaty, P.E., Fellow ASHRAE *and Neil Chauhan, DLB Associates, Eatontown, NJ*

2. Effective BIM to BEM through Project Team Collaboration
Christian Cianfrone, P.Eng., BEMP, Member, *Morrison Hershfield Corporation, Vancouver, BC, Canada*

3. BIM to BEM: Early Design Process Collaboration and Application
Eddy Santosa, *Callison, Seattle, WA*

11:00 AM-12:30 PM

SEMINAR 9 (ADVANCED)

Evaluating Low-GWP Refrigerants for the Air-Conditioning Industry in High Ambient Temperature Countries

Track: International Design
Room: Orange Ballroom F
Sponsor: UNEP, UNIDO
Chair: Walid M. Chakroun, Ph.D., Fellow ASHRAE, Kuwait University, Kuwait, Kuwait

This session addresses the challenges of high ambient countries in finding alternatives for the widely used HCFC-22 in residential air-conditioning applications. A project was launched to test locally built prototypes running with different low-GWP alternatives. The session discusses the outcome of these tests and a comparison of the results, which by no means endorse any of the tested refrigerants, but shed light on possibly workable refrigerant alternatives for high ambient operation. Other aspects of the project dealing with economics, technology transfer and the challenges of implementation are introduced, including recommendations of further required investigation.

1. Challenges in Promoting Low-GWP Refrigerants in High-Ambient Countries
Ayman Eltalouny, Member, *UNEP, Bahrain, Bahrain*

2. PRAHA Methodology: Building and Testing Prototypes and Related Research
Walid M. Chakroun, Ph.D., Fellow ASHRAE, *Kuwait University, Kuwait, Kuwait*

3. PRAHA Beyond Testing: Other Work and Key Findings
Bassam Elassaad, P.Eng., *Consultant, Toronto, ON, Canada*

4. Concluding Messages: Potentials and Remaining Work
Ole Nielsen, *United Nations Industrial Development Organization, Copenhagen, Denmark*

11:00 AM-12:30 PM

SEMINAR 10 (BASIC)

Legionella Codes, Standards and Guidelines

Track: Standards, Guidelines and Codes
Room: Orange Ballroom E
Sponsor: Environmental Health Committee, SSPC188, 09.06 Healthcare Facilities
Chair: Erica Stewart, Member, Kaiser Permanente National EH&S, Pasadena, CA

This seminar covers international and domestic codes, standards and guidelines for the management of Legionella in building water systems. The Health Safety Executive of the UK and Public Works and Government Services Canada have issued regulations for managing Legionella; in June 2015 ASHRAE published a standard for risk management of Legionella at the same time the American Industrial Hygiene Association released a guidance document for the recognition, evaluation and control of Legionella.

1. Latest Developments in the Control of Legionella in the UK
Frank Mills, Member, *Low Carbon Design Consultants, Liverpool, England*

2. Public Works and Government Services Canada MD15161: Control of Legionella in Mechanical Systems
Lan Chi Nguyen Weekes, P.Eng., *InAIR Environmental Ltd, Ottawa, ON, Canada*

3. ASHRAE Standard 188-2015 Legionellosis: Risk Management of Legionella for Building Water Systems: Common Mistakes in Addressing Legionella Risk
Janet Stout, Ph.D., Member, *Special Pathogens Lab, Pittsburgh, PA*

4. AIHA Guidelines for Recognition, Evaluation and Control of Legionella in Building Water Systems
David Krause, PhD, MSPH, CIH, *Geosyntec Consultants, Tallahassee, FL*

11:00 AM-12:30 PM

SEMINAR 11 (INTERMEDIATE)

New CFD Techniques for Design of Air Distribution Systems

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Sponsor: 04.10 Indoor Environmental Modeling
Chair: Atila Novoselac, Ph.D., Member, University of Texas at Austin, Austin, TX

Computational fluid dynamics (CFD) is a powerful modeling tool, widely applied in HVAC design. However, it could be computationally expensive and complex, and new techniques and models are needed for application in standard design practice. The building modeling community has been developing methods that are fast and accurate enough to be used in early stage of the design or even in real time control systems. This seminar presents application of coarse grid CFD, fast fluid dynamics (FFD) and reduced order modeling (ROM) on real problems, such as air distribution in buildings and data centers. It considers speed improvement and accuracy.

1. Coarse Grid CFD for Fast Modeling of Indoor Environments: Why NOT?
John Zhai, Ph.D., Member, *University of Colorado, Boulder, CO*

2. Reduced Order Modeling of Airflow and Thermal Fields in a Data Center
Cheng-Xian Lin, Ph.D., Member, *Florida International University, Miami, FL*

3. Faster and Simpler CFD for Data Center Applications
James VanGilder, P.E., Member, *Schneider Electric, Billerica, MA*

4. A Fast Coupled Simulation of 3D Indoor Airflow Motion and HVAC System for Ventilation Control of Complex Environment
Wangda Zuo, Ph.D., Member, University of Miami, Coral Gables, FL

11:00 AM-12:30 PM

SEMINAR 12 (INTERMEDIATE)

Operations and Maintenance for Optimal Performance of Efficient HVAC&R

Track: Cutting-Edge Technologies
Room: Orange Ballroom A
Sponsor: 07.03 Operation and Maintenance Management
Chair: Mina Agarabi, P.E., CPMP, Member, Agarabi Engineering PLLC, New York, NY

Energy efficiency measures (EEMs) have been shown to reduce energy costs significantly, but the impact of operations and maintenance (O&M) on EEM energy savings is not well understood. An investment in advanced technology that ignores O&M and staff training can end up as a costly mistake and cause new problems. This seminar's purpose is to present O&M methods for optimal performance of advanced technologies in HVAC&R. Case studies are presented of successful and unsuccessful O&M for efficient HVAC&R.

1. Operating Practices to Maximize the Energy Savings Potential of VFDs
Tristan Schwartzman, *Goldman Copeland Associates, New York City, NY*

2. Advanced Technologies Alone Are Insufficient to Deliver Energy Savings
Tom Sahagian, *Enterprise Community Partners, New York, NY*

3. Case Study: Lessons Learned after Advanced Technology Project Implementation
Mina Agarabi, P.E., CPMP, Member, *Agarabi Engineering PLLC, New York, NY*

11:00 AM-12:30 PM

SEMINAR 13 (INTERMEDIATE)

Updates and Perspectives on the New Version of ICC 700, The Residential Green Building Standard

Track: Standards, Guidelines and Codes
Room: Orange Ballroom D
Sponsor: 02.08 Building Environmental Impacts and Sustainability, Residential Buildings Committee
Chair: Jeff Inks, Window and Door Manufacturers Association, Washington, DC

ASHRAE has entered a partnership with NAHB and ICC to revise the 2012 version of ICC 700. The revised version of the standard includes some significant changes intended to increase its adoption and use. This seminar discusses key changes to the new version of the standard. ASHRAE involvement and feedback on the partnership with NAHB and ICC is also provided. Application of the standard from a user's perspective is discussed.

1. The National Green Building Standard ICC-700: A Residential Building Game Changer
Michelle Desiderio, *Home Innovations Research Labs, Upper Marlboro, DC*

2. ASHRAE's Partnership and Involvement with the National Green Building Standard
R. Christopher Mathis, Member, *MC2 Mathis Consulting Company, Asheville, NC*

3. Pre-Qualification of Products and Systems with the National Green Building Standard
Theresa A. Weston, Ph.D., Member*, DuPont Building Innovations, Richmond, VA*

1:30 PM-3:00 PM

TECHNICAL PAPER SESSION 2 (INTERMEDIATE)

IEA Annex 61 Deep Energy Retrofit, Part 1: International Energy Efficiency

Track: International Design
Room: Orange Ballroom F
Chair: Honorable Katherine G. Hammack, Member, U.S. Army, Washington, DC

This session covers studies that investigate energy retrofits from around the globe. International Energy Agency's Energy Conservation in Buildings and Communities Program's (IEC ECBC's) Annex 61 hopes to reduce energy consumption in these renovations by 50%. Learn how engineers are accomplishing this aggressive reduction.

1. Core Bundles of Technologies to Achieve Deep Energy Retrofit with Major Building Renovation Projects in Europe, the United States and China (OR-16-003)
Alexander M. Zhivov, Ph.D., Member[1], *Richard Liesen, Ph.D.[2], Rüdiger Lohse, Ph.D.[3] and Ove C. Moerck, Ph.D.[4], (1)US Army Corps of Engineers, Champaign, IL, (2)Engineer Research & Development Center, Champaign, IL, (3)Leiter Contracting, Baden-Württemberg, Germany, (4)Cenergia Energy Consultants, Copenhagen, Denmark*

2. A Parametric Study of Energy Efficiency Measures Used in Deep Energy Retrofits for Two Building Types and U.S. Climate Zones (OR-16-004)
Michael Case, Ph.D., Associate Member[1], *Richard Liesen, Ph.D.[2], Alexander M. Zhivov, Ph.D., Member[1] and Michael Zhivov[3], (1)US Army Corps of Engineers, Champaign, IL, (2)US Army Corps of Engineers, Newark, OH, (3)University of Illinois at Urbana-Champaign, Champaign, IL*

3. The Economic Challenges of Deep Energy Renovation: Differences, Similarities and Possible Solutions in Northern Europe—Estonia and Denmark (OR-16-005)
Jorgen Rose[1], *Kalle Kuusk[2], Kirsten Engelund Thomsen, CEng[3], Targo Kalamees, Ph.D.[2] and Ove Mørck[4], (1)Danish Building Research Institute, Copenhagen, Denmark, (2)Tallinn University of Technology, Tallinn, Estonia, (3)Danish Building Research Institute, AAU, Copenhagen, Denmark, (4)Cenergia Energy Consultants, Herlev, Denmark*

4. The Economic Challenges of Deep Energy Renovation: Differences, Similarities and Possible Solutions in Central Europe—Austria and Germany (OR-16-006)
Ruediger Lohse[1], *Heimo Staller[2] and Martina Riel[1], (1)KEA – Energy Services, Karlsruhe, Germany, (2)AEE INTEC, Gleisdorf, Austria*

1:30 PM-3:00 PM

CONFERENCE PAPER SESSION 6 (INTERMEDIATE)

Cooling Tower Filtration and Water Treatment

Track: The Great Debate
Room: Orange Ballroom G
Chair: Jon Cohen, Member, ChemTreat, Richmond, VA

Water treatment approaches differ for each building owner based on his or her facility staff, incoming water quality, filtration system and outdoor environment. Do you choose to use chemicals or do you choose the non-chemical route? This session covers the different types of water treatment and their impact on the system operation and maintenance so that engineers can select the best approach for their designs.

1. Demonstration of Chemical and Non-Chemical Cooling Water Treatment Principles and Performance (OR-16-C018)
Henry A. Becker, Member[1], *Jon J. Cohen[1] and Sean Parmelee[2], (1) H-O-H Water Technology, Inc., Palatine, IL, (2)University of Illinois Chicago, H-O-H Water Technology, Inc., Palatine, IL*

2. Filtration Selection for Cooling Tower Water (OR-16-C019)
Allyn Troisi, Member, *Tom Warnert and Prashant Joshi, Claude Laval Corporation – Lakos, Fresno, CA*

3. The Debate Is Over: Physical Water Treatment Meets the Demands of Modern Water Treatment Deliverables (OR-16-C020)
Michael P. Patton, Member, *Griswold Water Systems, New Smyrna Beach, FL*

4. The Great Debate between Non-Chemical Devices and Chemicals: What Program Can Meet Water Treatment Performance Standards? Chemical Treatment, Of Course! (OR-16-C021)
Helen R. Cerra, Member, *ChemTreat, Inc., Glen Allen, VA*

1:30 PM-3:00 PM

SEMINAR 14 (BASIC)

First Time at an ASHRAE Conference and Meeting

DVD

Track: Fundamentals and Applications
Room: Orlando Ballroom V
Sponsor: Conferences and Expositions Committee
Chair: Jon Cohen, Member, ChemTreat, Richmond, VA

First time at an ASHRAE Conference? Been coming for years, but still confused? What is a TC? What is a Standing Committee? Who can attend what? What is the AHR Expo? And why is all this happening at once? This crash course provides you with an introduction to the ASHRAE Conference activities and allows you to have your questions answered.

1. The Ins and Outs of ASHRAE
Chris Gray, Ph.D., P.E., Member, Southern Company, Birmingham, AL

2. Make the Most of Your Conference Experience
Frank Rivera, P.E., Mechanical Heating Supply, Bronx, NY

1:30 PM-3:00 PM

SEMINAR 15 (INTERMEDIATE)

Acoustics in Multi-Family Residential Environments

NY PDH DVD G

Track: Modern Residential Systems
Room: Orange Ballroom A
Sponsor: 02.06 Sound and Vibration Control
Chair: Chris Papadimos, Member, Papadimos Group, San Francisco, CA

Proper acoustics for multifamily residential projects are important to address and typically required for compliance with building codes. Achieving a suitable acoustic environment requires an integrated approach and encompasses various aspects of the design and construction process. This seminar covers the key focus areas, such as sound isolation from exterior to interior and between units, noise control for mechanical and plumbing systems, and includes case studies with lessons learned and the latest industry trends.

1. Plumbing Noise Control Essentials for Multi-Family Residences
Roman Wowk, Associate Member, *Papadimos Group, San Rafael, CA*

2. Sound Isolation Between Multi-Family Units
Matthew T. Murello, P.E., Member, *Lewis S. Goodfriend & Associates, Whippany, NJ*

3. Using and Understanding AHRI 275: Application of Outdoor Equipment Sound Ratings
Erik Miller-Klein, P.E., Member, *SSA Acoustics, LLP, Seattle, WA*

4. Ensuring Mechanical Ventilation with Heat Recovery Systems Are Quiet
Jason Swan, Member, *Sandy Brown Associates, LLP, London, United Kingdom*

1:30 PM-3:00 PM

SEMINAR 16 (ADVANCED)

Making the Commercialization of Low-GWP Refrigerants a Reality

NY PDH DVD G

Track: Fundamentals and Applications
Room: Orange Ballroom C
Sponsor: 03.04 Lubrication, TC 3.3, MTG.LOW GWP, 03.02 Refrigerant System Chemistry
Chair: Edward Hessell, Ph.D., Member, Chemtura Corporation, Middlebury, CT

The transition to lower global warming potential refrigerants such as HFOs, carbon dioxide and propane creates a number of design and operational challenges to compressor and system builders. Lubrication is one of the fundamental issues that must be addressed for any refrigerant change. This seminar presents examples of the lubrication challenges faced by the industry from three different perspectives; the compressor/system builder, the refrigerant manufacturer and the lubricant manufacturer. Examples are presented of strategies used to ensure that the transition to low GWP refrigerants results in refrigeration systems with the best possible properties of energy efficiency and long term reliability.

1. Energy Efficiency Performance of New Low-GWP Replacements for R-404A as a Function of Lubricant Structure and Refrigerant/Lubricant Properties in a Commercial Refrigeration Unit
Laurent Abbas, Ph.D., Member, *Arkema, Inc., King of Prussia, PA*

2. Lubricants for Low GWP Refrigerants: Still Slippery on Both Sides
Joseph A. Karnaz, Member, *CPI Engineering/Lubrizol, Midland, MI*

3. Challenges for Equipment Manufacturers in Adopting Low-GWP Refrigerants
Stephen Kujak, Member, *Trane, Ingersoll Rand, La Crosse, WI*

1:30 PM-3:00 PM

SEMINAR 17 (INTERMEDIATE)

Integrating ASHRAE Standard 189.1 and IgCC Compliance Requirements: Options and Issues

NY PDH DVD G

Track: Standards, Guidelines and Codes
Room: Orange Ballroom D
Sponsor: 02.08 Building Environmental Impacts and Sustainability
Chair: Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL

By agreement with ICC, ASHRAE Standard 189.1 provides the technical content of the next version of the International Green Construction Code. IgCC and Standard 189.1 have many similar provisions but also have major differences in some of the compliance requirements and calculation methodologies. This seminar provides an overview of the agreement between ICC and ASHRAE and its implications for future revisions to Standard 189.1. Key differences in the energy performance requirements between IgCC and Standard 189.1 are reviewed, along with options for updates to energy performance provisions within Standard 189.1.

1. Overview of the 189.1/IgCC Alignment: Who's Doing What
Andrew Persily, Ph.D., Member, *National Institute of Standards and Technology, Gaithersburg, MD*

2. ASHRAE Standard 189.1-2014 Energy Cost and Greenhouse Gas Emission Performance Requirements and Rationale
Molly McGuire, P.E., Associate Member, *Gas Technology Institute, Des Plaines, IL*

3. IgCC Source Energy and GHG Emissions Performance Requirements and Rationale
Richard Morgan*, South-central Partnership for Energy Efficiency as a Resource, Austin, IL*

1:30 PM-3:00 PM

SEMINAR 18 (INTERMEDIATE)

Integrating Cutting-Edge Technology: Renewable Energy and Thermal Energy Storage

NY PDH DVD G

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Sponsor: 06.09 Thermal Storage
Chair: Geoffrey C. Bares, Associate Member, CB&I, Plainfield, IL

Renewable energy sources such as wind and solar continue to increase their share of the national electrical power supply. The variable nature of energy production from renewables has made electrical grid stability a critical issue, with energy storage identified as a key part of the solution. Find out how mature and reliable thermal energy storage technologies can facilitate the fast-evolving integration of renewables into our energy supply, to the benefit of both building owners and power suppliers.

1. Distributed Energy Storage: How It Increases the Value of Renewables
Mark MacCracken, P.E., *Member, CALMAC Manufacturing Corp, Fair Lawn, NJ*

2. The Challenge of Intermittent Renewable Energy: Comparing Energy Storage Options and Exploring TES Solutions
John S. Andrepont, Life Member, *The Cool Solutions Company, Lisle, IL*

3. Impacts of Increasing Penetration of Renewable Energy Generation and Opportunity for Increased Use of TES
Douglas Reindl, Ph.D., P.E., Member, *University of Wisconsin-Madison, Madison, WI*

4. Grid-Interactive Electric Thermal Storage: Linking Thermal Energy Storage to Real-Time Grid Needs
Paul Steffes, P.E., *Steffes Corporation, Dickinson, ND*

1:30 PM-3:00 PM

SEMINAR 19 (INTERMEDIATE)

Standards Application: Legionella in Building Water Systems

Track: Standards, Guidelines and Codes
Room: Orange Ballroom E
Sponsor: Environmental Health Committee, SSPC188, 09.06 Healthcare Facilities
Chair: Erica Stewart, Member, Kaiser Permanente National EH&S, Pasadena, CA

This seminar presents three aspects of implementing a water management plan in health-care operations, from the facility manager and infection preventionist's point of view. In healthcare organizations the water management team is a multidisciplinary group whose differing roles and responsibilities are critical to successful implementation of a plan. A roundtable discussion of the challenges and successes of implementing a plan that follows ASHRAE Standard 188P follows a brief introduction of each area of expertise.

1. The Facility Manager Perspective
John D'Angelo, P.E., Member, *Northwestern University, Evanston, IL*

2. The Infection Preventionist Perspective
Linda Dickey, *University of California at Irvine, Irvine, CA*

3. The Industrial Hygienist Perspective
Megan Canright, Affiliate, *Forensic Analytical Consulting Services, San Diego, CA*

3:15 PM-4:45 PM

SEMINAR 20 (INTERMEDIATE)

Highlights from the 24th IIR International Congress of Refrigeration

Track: Cutting-Edge Technologies
Room: Orange Ballroom D
Sponsor: U. S. National Committee for the IIR (USNC/IIR)
Co-Sponsoring Committees: Refrigeration Committee; 3.1; 8.11; 10.7, 02.05 Global Climate Change
Chair: Van D. Baxter, P.E., Fellow ASHRAE, Oak Ridge National Laboratory, Oak Ridge, TN

The seminar's goal is to bring to ASHRAE members the technical highlights of the 24th IIR International Congress of Refrigeration held August 16-22, 2015 in Yokohama, Japan. The seminar starts with an overview of the Congress program. This is followed by three keynotes from the Congress dealing with latest issues/developments related to low-GWP refrigerants, microchannel heat exchangers and heat pumps in smart energy systems.

1. Overview of the 24th IIR Congress
Piotr Domanski, Ph.D., Fellow ASHRAE, *National Institute of Standards and Technology, Gaithersburg, MD*

2. Hitting the Bounds of Chemistry: Limits and Tradeoff for Low-GWP Refrigerants
Mark O. McLinden, Ph.D., Member, *National Institute of Standards and Technology, Boulder, CO*

3. New Developments in Microchannel Heat Exchangers
Predrag Hrnjak, Ph.D., Fellow ASHRAE, *University of Illinois, Urbana, IL*

4. The Role of Heat Pumps in Smart Energy Systems
Per Lundqvist, Ph.D., *KTH, The Royal Institute of Technology, Stockholm, Sweden*

Monday, January 25

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 7 (INTERMEDIATE)

Fine and Ultrafine Particle Filtration

Track: Systems and Equipment
Room: Orange Ballroom C
Chair: Calina Ferraro, P.E., Associate Member, Randall Lamb Associates, Inc., La Mesa, CA

Many people spend a significant amount of time indoors, either at home or in an office environment. The filters in the HVAC systems may not capture the finer particles, which could lead to increased levels of respiratory and cardiovascular distress. The papers in this session look at different methods of filtration and controls in office buildings located in the United States and China.

1. Experimental Study on Influencing Factors of Indoor Fine Particle Concentration and Control Strategies for Commercial Offices in Six Chinese Cities (OR-16-C022)
Jianlin Ren Sr., Ph.D., HBDP, Student Member, *Tianjin University, Tianjin, China*

2. Evaluating Economizer Use in Particulate Air Pollution in Office Buildings in Multi-Million Cities (OR-16-C023)
Shiyu Rao, Student Member *and Donghyun Rim, Ph.D., Pennsylvania State University, University Park, PA*

3. Modeling the Impact of Residential HVAC Filtration on Indoor Particles of Outdoor Origin (OR-16-C024)
Parham Azimi, Student Member, *Dan Zhao and Brent Stephens, Illinois Institute of Technology, Chicago, IL*

4. Characterizing the in-Situ Size-Resolved Removal Efficiency of Residential and Light-Commercial HVAC Filters for Particle Sizes Between 0.01 and 10 µm (OR-16-C025)
Torkan Fazli, Student Member *and Brent Stephens, Illinois Institute of Technology, Chicago, IL*

5. Fouling of Membrane-Based Energy Recovery Ventilators by Aerosols (OR-16-C026)
Amin Engarnevis, Student Member[1], *Ryan Huizing[2], Ali Vaseghi, Student Member[3], Sheldon Green, Ph.D., P.E.[1] and Steven Rogak, Ph.D., P.E.[1], (1)University of British Columbia, Vancouver, BC, Canada, (2) dPoint Technologies, Vancouver, BC, Canada, (3)British Columbia Institute of Technology, Burnaby, BC, Canada*

8:00 AM-9:30 AM

SEMINAR 21 (INTERMEDIATE)

Demand Response Using Variable Refrigerant Flow Systems

Track: Systems and Equipment
Room: Orlando Ballroom V
Sponsor: 08.07 Variable Refrigerant Flow
Chair: Harshal Upadhye, Electric Power Research Institute, Knoxville, TN

Demand response (DR) is defined as changes in electric usage from their normal patterns for the benefit of electrical grid in lieu of financial incentives by utility companies. Traditional DR mostly turns off the HVAC system completely or changes thermostats settings. Variable Refrigerant Flow (VRF) systems with their superior controls on compressors, fans and expansion valves can provide the kW reduction with minimal impact on customer comfort. This seminar provides an overview of DR capabilities of VRF systems and the benefits of providing DR with such systems.

1. How VRF Systems Can Help the Integrated Grid
Ron Domitrovic, Ph.D., Member, *Electric Power Research Institute, Knoxville, TN*

2. Potential for Demand Response Using VRF Systems
Bach Tsan, P.E., *Southern California Edison, Rosemead, CA*

3. For Demand Response, VRF Is More Than On or Off
Paul Doppel, *Mitsubishi Electric, Suwanee, GA*

4. VRF Demand Response: Review of Global Case Studies and Results and Future Opportunities
Chris Bellshaw, Member, *Daikin, Carrollton, TX*

8:00 AM-9:30 AM

SEMINAR 22 (INTERMEDIATE)

Innovative Design, Materials and Manufacturing Techniques for Heat/Mass Exchangers

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Sponsor: 01.03 Heat Transfer and Fluid Flow, 08.04 Air-to-Refrigerant Heat Transfer Equipment
Chair: Omar Abdelaziz, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Recent innovations in heat and mass transfer equipment result in continued improvement in the tradeoff between pumping power and heat transfer augmentation. However, such designs require advanced manufacturing techniques, such as additive manufacturing. The major limiting factors of the additive manufacturing are the low thermal conductivity of the metal used, feature size resolution of 150 micron or more, and build time. In this seminar, internationally renowned experts present their activities through CFD modeling, shape optimization, additive manufacturing of surfaces with disruptively high airside heat transfer coefficients with low pumping power penalties, and additively manufactured heat pipes.

1. Numerical Study on Air-Side Performance for Round, Oval and Flat Tube Heat Exchangers with a Different Configuration of Fins
Man-Hoe Kim, Ph.D., *Member, Kyungpook National University, Buk-gu, Daegu, South Korea*

2. Tube Shape Optimization for Air-to-Refrigerant Heat Exchangers
Vikrant Aute, Ph.D., Member, *University of Maryland, College Park, MD*

3. Impact of Additive Manufacturing on Next Generation Thermal Management Systems
Michael M. Ohadi, Ph.D., Fellow ASHRAE, *University of Maryland, College Park, MD*

4. Additively Manufactured Heat Pipes
Patrick Geoghegan, Ph.D., *Oak Ridge National Laboratory, Oak Ridge, TN*

8:00 AM-9:30 AM

SEMINAR 23 (INTERMEDIATE)

Metrics Matter: How Should We Judge Energy Performance?

Track: The Great Debate
Room: Orange Ballroom G
Sponsor: 02.08 Building Environmental Impacts and Sustainability, Residential Buildings Committee, 01.10 Cogeneration Systems
Chair: Richard Sweetser, Life Member, Exergy Partners Corp., Herndon, VA

Determining a building's energy performance for benchmarking, code compliance and investment decisions is extremely complicated. The choice of metric, methodology and values all matter if the primary intent of the initiative is to be achieved equitably in a competitive marketplace. This seminar compares and contrasts different metrics and approaches used by ASHRAE and other organizations, including metrics based on end use loads, site energy, energy cost, primary energy and greenhouse gas emissions. Benefits and challenges with each metric are explored, and options for reconciling differences among the metrics are examined.

1. Site Energy-Based Metrics Are Useful and Easy to Use
Keith Dennis, P.E., *National Rural Electric Cooperative Association, Arlington, VA*

2. One Metric May Not Be Enough, but Some Are Better Than Others
David Goldstein, *Natural Resources Defense Council, San Francisco, CA*

3. Primary Energy, Energy Cost, and GHG Emissions All Make Sense
Neil P. Leslie, P.E., *Member, Gas Technology Institute, Des Plaines, IL*

8:00 AM-9:30 AM

SEMINAR 24 (BASIC)

Back to Basics: The Science, Application and Art of Load Calculations

Track: Fundamentals and Applications
Room: Orange Ballroom D
Sponsor: 04.01 Load Calculation Data and Procedures
Chair: Glenn Friedman, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

Science: New ASHRAE Load Calculations User's Manual and the current overview of load calculations. Application: Zoning and load calculation basics—what do you do early in design when you don't have all the answers? Art: Case studies, horror stories, what to watch for and odd-ball cases.

1. Science: New ASHRAE Load Calculations User's Manual and the Current Overview of Load Calculations
Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE, *Oklahoma State University, Stillwater, OK*

2. Application: Zoning and Load Calculation Basics: What Do You Do Early in Design When You Don't Have All the Answers
Larry Sun, P.E., Member, *tk1sc, Irvine, CA*

3. Art: Case Studies, Horror Stories, What to Watch for and Odd-Ball Cases
Steven F Bruning, P.E., Fellow ASHRAE, *Newcomb & Boyd, Atlanta, GA*

8:00 AM-9:30 AM

SEMINAR 25 (INTERMEDIATE)

High Performance Residential Building Applications and Issues

Track: Modern Residential Systems
Room: Orange Ballroom A
Sponsor: Residential Buildings Committee, 01.12 Moisture Management in Buildings
Chair: Lew Harriman, Fellow ASHRAE, Mason Grant, Portsmouth, NH

The energy efficiency levels of new homes built in the U.S. have improved significantly in the past decade with developments in building science and improved construction practices according to the United States Department of Energy (DOE). This seminar provides updated design guidance for energy-efficient homes from DOE's Building America program to achieve zero energy ready performance. It also explores issues with depressurization and humidity loads with tight, efficient envelopes, and the potential impact on gas appliances along with ventilation strategies for a healthy indoor environment.

1. Advanced Technologies from the Building America Program
Eric Werling, *U.S. Department of Energy, Washington, DC*

2. Natural Gas Appliances Operating Under Depressurized Conditions in High Performance Houses: Issues and Solutions
Larry Brand, Member, *Gas Technology Institute, Des Plaines, IL*

3. Ventilation Strategies for High Performance Homes
Iain Walker, Ph.D., Fellow ASHRAE, *Lawrence Berkeley National Laboratory, Berkeley, CA*

8:00 AM-9:30 AM

SEMINAR 26 (INTERMEDIATE)

Achieving Comfort and Energy Savings Using Desiccant Technologies

Track: Cutting-Edge Technologies
Room: Orange Ballroom F
Sponsor: 08.12 Desiccant Dehumidification Equipment and Components
Chair: Michael Sherber, P.Eng., HBDP, BEAP, Member, SavageALERT, Inc., Rocky Hill, CT

The purpose of this session is to inform practitioners about the latest developments in desiccant technologies.

1. Achieving Comfort and Energy Savings with Desiccant Technologies
Mark Piegay, Member, *Alfa Laval - Kathabar, Tonawanda, NY*

2. Modeling and Design of Liquid Desiccant Heat Exchangers
Jason Woods, *National Renewable Energy Laboratory, Golden, CO*

3. Designing Air Conditioners with Liquid Desiccant Heat Exchangers
Eric Kozubal, Member, *National Renewable Energy Laboratory, Golden, CO*

4. Electricity-Producing Air Conditioners
Daniel Betts, Ph.D., *Be Power Tech, LLC, Parkland, FL*

8:00 AM-9:30 AM

SEMINAR 27 (INTERMEDIATE)

The Drive to Regulate HFCs: A Patchwork of New Global HFC Rules

Track: Standards, Guidelines and Codes
Room: Orange Ballroom E
Sponsor: 02.05 Global Climate Change
Chair: Eric Sturm, Member, Trane, La Crosse, WI

Hydrofluorocarbons (HFCs) were introduced as replacements for ozone-depleting substances. The use of HFCs and their replacements are critical to ASHRAE members because they are used as refrigerants in air-conditioning and refrigeration systems. A global effort is underway to manage HFCs under the Montreal Protocol, but several regional programs have emerged that will affect the way consumers and firms select, purchase, use and service HFCs. This seminar provides an introduction to new HFC requirements in the U.S., Canada and Japan occurring in 2016. The framework and implementation of each program and its impacts to ASHRAE members are discussed.

1. The U.S. and Australia: A Comparison of Two Fluorocarbon Control Mechanisms
Julian de Bullet, *deBullet Consulting LLC, Front Royal, VA*

2. HFC Regulation North of the Pine Curtain: Understanding the Proposed Canadian HFC Regulation
William McQuade, Member, *Johnson Controls, Inc., York, PA*

3. Japan's Implementation of "the Act on Rational Use and Proper Management of Fluorocarbons"
Osami Kataoka, Member, *Daikin Industries, Ltd., Osaka, Japan*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 3 (INTERMEDIATE)

Data Center Energy Performance Metrics

Track: Fundamentals and Applications
Room: Orange Ballroom G
Chair: Chuck Curlin, P.E., Member, Shultz Engineering Group, Charlotte, NC

Data center design has become more and more energy conscious over the recent years. What has been the impact to the airflow within the raised floor with regard to system performance (space, rack, fans, coils and more)? CFD models and actual field data show the predictability of airflow performance. In addition, the business case for sustainable data centers and what should be in that life cycle assessment are presented.

1. Measurement of Perforated Tile Airflow in Data Centers (OR-16-007)
James VanGilder, P.E., Member[1], *Zachary Pardey[2] and Christopher M. Healey, Ph.D.[1], (1)Schneider Electric, Billerica, MA, (2)Northeastern University, Boston, MA*

2. The Business Case for Sustainability in Data Centers (OR-16-008)
Sophia Flucker, CEng *and Robert Tozer, Ph.D., P.E., Operational Intelligence Ltd., Kingston upon Thames, United Kingdom*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 8 (INTERMEDIATE)

Energy Efficiency Around the World

Track: International Design
Room: Orange Ballroom F
Chair: Sheila Hayter, Member, National Renewable Energy Laboratory, Golden, CO

There are many regions of the world where local building codes, climatic zone variations, cultural differences and energy costs (to name but a few factors) do not lend themselves to easy adoption of ASHRAE standards. This session highlights some of these issues and provides ideas on how to make ASHRAE standards more inclusive.

1. A Systematic Approach to Meet Corporate Energy Efficiency Targets: A Case Study for Lighting Replacement in Saudi Arabia (OR-16-C027)
Ayman Youssef, P.E., Member *and Faisal Al Musa, Saudi Aramco, Dhahran, Saudi Arabia*

2. Climate Zone Map Tool for Building Energy Code Compliance in Saudi Arabia (OR-16-C028)
Ayman Youssef, P.E., Member, *Saudi Aramco, Dhahran, Saudi Arabia*

3. Application of ASHRAE 90.1 Building Envelope Requirements for Middle East Regions (OR-16-C029)
Mir Gayas Ali, Member[1], *Walid M. Chakroun, Ph.D., Fellow ASHRAE[2] and Wayne Reedy, P.E., Member[1], (1)SSH International Consultants, Kuwait, Kuwait, (2)Kuwait University, Kuwait, Kuwait*

4. Energy Utilization Effectiveness (EUE): A New Metric for Commercial Building Energy Use Characterization (OR-16-C030)
Roger Chang, P.E., BEMP, Member, *Westlake Reed Leskosky, Washington, DC*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 9 (INTERMEDIATE)

Protecting Coils: UV, Odor and Frost

Track: Systems and Equipment
Room: Orlando Ballroom V
Chair: Dunstan Macauley, P.E., Member, WSP, Arlington, VA

Cooling coils are essential to the HVAC industry and should be protected to ensure optimal performance for air pressure drop, frost and defrost cycles, and avoiding odor generation. These papers discuss in detail the impact of the UV irradiation of the cooling coil in terms of energy use as well as odor and contaminant levels in the facility. In addition, the coil's design to improve frosting and defrosting performance is analyzed in hopes to improve heat conduction for the unit.

1. Field Study of Energy Use-Related Effects of Ultraviolet Germicidal Irradiation of a Cooling Coil (OR-16-C031)
Joseph Firrantello, P.E., Member[1], *William Bahnfleth, Ph.D., P.E., Fellow ASHRAE[2], Ross Montgomery, P.E., BEAP, BEMP, CPMP and HBDP, Fellow ASHRAE[3] and Paul Kremer[2], (1)Penn State University, State College, PA, (2)Pennsylvania State University, University Park, PA, (3)Quality Systems and Technology Inc., Parrish, FL*

2. Using Patterned Surface Wettability for Improved Frosting/Defrosting Performance (OR-16-C032)
Nicole Okamoto, Ph.D.[1], *Andrew Sommers, Ph.D.[2], Isaac Tineo[1], Christian Petty[2], Jonathan Carlson[1] and Dean DiBlasio[1], (1)San Jose State University, San Jose, CA, (2)Miami University, Oxford, OH*

3. Odor Due to UV Disinfection (OR-16-C033)
Normand Brais, Ph.D., P.E. *and Benoit Despatis, P.Eng., Member, Sanuvox Technologies, St-Laurent, QC, Canada*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 10 (INTERMEDIATE)

Strategies to Reduce Greenhouse Gas Emissions and Controlling Other Harmful Gases

Track: Fundamentals and Applications
Room: Orange Ballroom E
Chair: Jaideep S. Karnik, Member, HCYU Building Engineered Solutions, Richmond, VA

Controlling harmful gases (VOCs, ozone, etc.) within buildings and reducing greenhouse gas (GHG) emissions as a result of operating buildings are concerns for ASHRAE members. This session deals with strategies that can be utilized to provide better IAQ and reduce the levels of GHGs.

1. Is the Wheeler-Jonas Equation Applicable to Describe the Breakthrough Curve of the Oxidizing Gas: Ozone? (OR-16-C034)
Lumeng Liu, Ph.D., Student Member[1], *Junjie Liu, Ph.D.[2] and Jingjing Pei, Ph.D., Member[2], (1)School of Environment Science and Engineering, Tianjin University, Tianjin, China, (2)Tianjin University, Tianjin, China*

2. Reduction of Campus Greenhouse Gas Emissions through a Hybrid Centralized Energy Distribution System (OR-16-C035)
Chelsea Guenette, Student Member, *Joshua Talbert, P.E., Member and Kevin L. Amende, P.E., Associate Member, Montana State University, Bozeman, MT*

9:45 AM-10:45 AM

SEMINAR 28 (BASIC)

Introduction to Biomass Heating and Hydronics for Young Engineers

Track: Modern Residential Systems
Room: Orange Ballroom A
Sponsor: 06.01 Hydronic and Steam Equipment and Systems, 06.10 Fuels and Combustion
Chair: Benjamin Bell-Walker, Affiliate, Biomass Thermal Energy Council, Washington, DC

In recent years, the fastest-growing fuel source for residential heating has been biomass, especially wood systems. However, many system designers and specifiers are unfamiliar with biomass heating technologies and are often unable to provide guidance for someone pursuing biomass hydronic heating. This workshop is intended to introduce young engineers to specific challenges and design considerations in the use of biomass as heat source for hydronic systems. The first part of the workshop provides an overview of common biomass feedstocks. The second part discusses system design issues such as thermal storage, boiler sizing and fuel storage.

1. Biomass Feedstocks: Properties and Principles
Bede Wellford, Member, *Viessmann Manufacturing Company (U.S.), Inc., Warwick, RI*

2. Biomass Hydronic System Design Considerations
John Karakash, Member, *Resource Professionals Group, Harford, PA*

9:45 AM-10:45 AM

SEMINAR 29 (ADVANCED)

Modern Absorption Systems and Application for Both Cooling and Heating

Track: Systems and Equipment
Room: Orange Ballroom C
Sponsor: 08.03 Absorption and Heat Operated Machines
Chair: Ersin Gercek, P.E., CPMP, Associate Member, Real Engineering Services LLC, Totowa, NJ

This session on absorption systems explains the working principle and an overview of the cycle, classification and types of absorption chillers and heat pumps. It also provides an overview of what makes modern absorbers different from those of the past. A case study is added where an absorption chiller is coupled with a CHP plant at a large retail store to increase energy efficiency and resilience.

1. Modern Commercial/Industrial Absorption Capabilities as Showcased in a Big Box Retail Store Application
Douglas A. Davis, Associate Member, *Broad USA, Hackensack, NJ*

2. Lithiumbromide Water Absorption Heat Pumps for Heating Applications
Rajesh Dixit, Associate Member, *Johnson Controls, York, PA*

9:45 AM-10:45 AM

SEMINAR 30 (INTERMEDIATE)

New Bi-National GLHE/GSHP Standards and Translating GLHE Standards to Code: Good, Bad or Really Ugly?

Track: Standards, Guidelines and Codes
Room: Orange Ballroom D
Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications
Chair: Lisa Meline, P.E., Member, Meline Engineering Corporation, Sacramento, CA

Ground source heat pumps (GSHPs) and ground heat exchanger language is finally being included into national and international codes and standards. This is quite a coup for the GSHP industry. Eventually, these standards find their way into code formulated by independent code authorities. These codes are adopted by the regulatory authorities. We, as engineers, must design to both the standards and the code. What happens if standards and code conflict? What is the general impact of this conflict? How do we change or modify the code? Standard to disaster or standard to a well-designed system?

1. Ground Source Heat Pumps Get Bi-National Attention!
Lisa Meline, P.E., Member, *Meline Engineering Corporation, Sacramento, CA*

2. Conflicting Codes and Standards: What Happens Now?
Cary Smith, Member, *Sound Geothermal Corp., Sandy, UT*

9:45 AM-10:45 AM

SEMINAR 31 (INTERMEDIATE)

The Impacts of Operable Windows on Building Performance

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Sponsor: 07.05 Smart Building Systems
Chair: Liping Wang, Ph.D., P.E., Member, University of Wyoming, Laramie, WY

Operable windows provide occupants with the ability to control local environments and satisfy human expectation to access outdoor environments. Operation behaviors or strategies for operable windows have substantial impacts on the indoor environment and building energy consumption. Facility managers complain about operable windows left open in buildings with conventional HVAC systems. However, optimum control strategies of window operation reduce energy consumption for buildings via mixed-mode ventilation. This seminar presents recent research efforts on operation strategies for various types of building ventilation systems and thorough case studies on operable windows for LEED Platinum high performance buildings in Midwestern United States.

1. The Impact of Operable Windows on a High Performance Office Building in U.S. Midwest
Ran Liu, Ph.D., Associate Member, *Iowa Energy Center, Ankeny, IA*

2. Window Operation and Its Impact on Building Energy Consumption for a Medium-Size Office Building
Liping Wang, Ph.D., P.E., Member, *University of Wyoming, Laramie, WY*

10:00 AM-11:00 AM

TC SEMINAR (ADVANCED)

Study to Identify CFD Models for Use in Determining HVAC Duct Fitting Loss Coefficients

Track: Fundamentals and Applications
Room: Lake Nona A
Sponsor: 05.02 Duct Design

Chair: Stephen A. Idem, Ph.D., Member, Tennessee Tech University, Cookeville, TN, and Ahmad K. Sleiti, Ph.D., P.E., Member, Qatar University, Doha, Qatar

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. The presenters give a report the final results from RP-1682. From 10:00 – 10:30, Dr. Idem presents "Study to Identify CFD Models for Use in Determining HVAC Duct Fitting Loss Coefficients: Experimental Results." From 10:30 – 11:00, Dr. Sleiti presents "Study to Identify CFD Models for Use in Determining HVAC Duct Fitting Loss Coefficients: CFD Model Results."

11:00 AM-12:00 PM

TECHNICAL PAPER SESSION 4 (ADVANCED)

High Efficiency Heat Transfer Technology and High Efficiency Energy Conversion

Track: Systems and Equipment
Room: Orlando Ballroom V
Chair: Kaylee Haupt, BKMA, Baltimore, MD

Liquid-to-air membrane energy exchangers (LAMEEs) and Tesla turbines can, respectively, provide highly efficient heat transfer and energy conversion when properly designed and utilized. This session explores the creative use of each of these technologies.

1. A Monthly-Based Bore Field Sizing Methodology with Applications to Optimum Borehole Spacing (OR-16-009)
Patricia Monzó, P.Eng.[1], *Michel Bernier, Ph.D., P.E., Member[2], José Acuña, Ph.D., P.E.[1] and Palne Mogensen, P.E.[3], (1)Royal Institute of Technology, Stockholm, Sweden, (2)Ecole Polytechnique De Montreal, Montreal, QC, Canada, (3)PM AB, Stockholm, Sweden*

2. Improving Utilization of Energy at the Power Generation Plant by Recovering Heat Energy for the Production of Cooling Power: A Sustainable Design Approach (OR-16-010)
Ali M. Hasan, CEng, Member, *KEO International Consulting Engineers, Doha, Qatar*

3. Experimental Study of Effects of Phase Change Energy and Liquid Desiccant Flow Rate on Performances of 2 Fluid and 3 Fluid Liquid-to-Air Membrane Energy Exchangers (OR-16-011)
Mohamed R.H. Abdel-Salam, *Robert W. Besant, Fellow Life Member and Carey J. Simonson, Ph.D., P.E., Member, University of Saskatchewan, Saskatoon, SK, Canada*

4. Investigating the Possibility of Utilizing a Tesla Turbine as a Drive Unit for an Automotive Air-Condition Compressor Using CFD Modeling (OR-16-012)
Ali M. Hasan, CEng, Member, *KEO International Consulting Engineers, Doha, Qatar*

11:00 AM-12:00 PM

CONFERENCE PAPER SESSION 11 (INTERMEDIATE)

Achieving Net-Zero Energy Use in Data Centers

Track: Fundamentals and Applications
Room: Orange Ballroom C
Chair: Calina Ferraro, P.E., Associate Member, Randall Lamb Associates, Inc., La Mesa, CA

ASHRAE has a goal to achieve net zero energy use in data centers by 2030. This session explores competing design/operation strategies that can be utilized to help meet this target.

1. Data Center Water Energy Recovery (OR-16-C036)
John C. Peterson, P.E., Member[1], *Tahir Cader, Ph.D., Member[2] and Roy Dragseth, Ph.D.[3], (1)Hewlett Packard, Takoma Park, MD, (2) Hewlett-Packard Company, Spokane, WA, (3)University of Tromso, Tromso, Norway*

2. Data Center Great Debate: Competing Ideas for Maximizing Design Efficiencies (OR-16-C037)
Dan Comperchio, P.E., Member[1] *and Sameer Behere, P.E.[2], (1)Willdan Energy Solutions, Chicago, IL, (2)Syserco, Inc., Fremont, CA*

11:00 AM-12:00 PM

SEMINAR 32 (INTERMEDIATE)

Educational Facility Design From an International Perspective

Track: International Design
Room: Orange Ballroom F
Sponsor: 09.07 Educational Facilities
Chair: Dawen Lu, P.E., BEMP, BEAP, HBDP, HFDP, OPMP, Member, Lu + Smith ENGINEERS, PLLC, Richmond, VA

The UK and China both have a tremendous amount of existing school buildings stock and demands for new school buildings. While these buildings being upgraded and built, unique challenges and opportunities are presented. Some of them are very applicable to the school building construction in North America.

1. HVAC Design for Educational Buildings in the UK
Frank Mills, Member, *Low Carbon Design Consultants, Liverpool, United Kingdom*

2. Optimizing Central Energy Plant: A Case Study on a School Project in China
Zhenjie Hu, *Tianjin University Research Institute of Architectural Design, Tianjin, China*

11:00 AM-12:00 PM

SEMINAR 33 (ADVANCED)

Should You Use Your Building Automation System to Commission Your Building Systems?

Track: The Great Debate
Room: Orange Ballroom A
Sponsor: 01.04 Control Theory and Application
Chair: Chad Moore, P.E., Member, Engineering Resource Group, Jackson, MS

With the availability of large amounts of building automation system data and the advent of automated building system commissioning tools, will the need for laborious human-based commissioning be replaced with automated commissioning? This seminar debates the advantages and disadvantages of both traditional component/building system commissioning and autonomous, model-based commissioning.

1. No Amount of BAS Data or Digital Processing Will Replace Human Commissioning in the Field
Barry B. Bridges, P.E., CPMP, Life Member, *Sebesta, Saint Paul, MN*

2. Autonomous Model-Based Commissioning Pros and Cons
Allan Daly, P.E., Member, *Taylor Enginering, Alameda, CA*

11:00 AM-12:00 PM

SEMINAR 34 (INTERMEDIATE)

Hydronic Systems: Doing More with Less

Track: Fundamentals and Applications
Room: Orange Ballroom D
Sponsor: 06.01 Hydronic and Steam Equipment and Systems, Student Activities
Chair: Julia Keen, BEAP, HBDP, Kansas State University, Manhattan, KS

This session illustrates doing a better job serving the needs of most commercial buildings by utilizing "Low Flow/High Delta" water-based systems. Water has a high affinity for energy and should be used in a much wiser fashion. This presentation illustrates how to use water-based systems to transfer energy more efficiently, save operational expense, help control systems operate with greater ease and open other benefits to the overall building design and operation. Lessons learned are illustrated on the application of "Low Flow – High Delta" water-based systems.

1. The Fundamentals of Low Flow and High Delta
Douglas F. Zentz, Associate Member, *Ferris State University, Big Rapids, MI*

2. Lessons Learned in Low Flow Applications
Jason A. Atkisson, P.E., HBDP, Member, *Affiliated Engineers, Inc. , Madison, WI*

11:00 AM-12:00 PM

SEMINAR 35 (INTERMEDIATE)

The Internet of Everything: How Smart and Connected Sensors Will Transform the HVAC Service Industry

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Sponsor: 01.05 Computer Applications, 07.03 Operation and Maintenance Management
Chair: Stephen Roth, P.E., Member, Carmel Software Corp., San Rafael, CA

This seminar discusses how the Internet of Things (IoT), which has been popularized by consumer devices such as fitness trackers, can be applied to HVAC maintenance and operations. Specifically, this seminar focuses on how light-weight sensors can easily be installed inside HVAC rooftop units to measure a wide variety of conditions and how these sensors can better aid in fault detection and diagnose equipment issues. This seminar also focuses on how much of the data from these sensors is being collected by remote, "cloud-based" databases so it can be further analyzed by mobile-based applications.

1. Using Simple Internet-Connected Sensors to Monitor HVAC Equipment
Janet Peterson, Associate Member, *XCSpec, Larkspur, CA*

2. Using Mobile Apps to Conduct HVAC Maintenance and Operations
Stephen Roth, P.E., Member, *Carmel Software Corp., San Rafael, CA*

11:00 AM-12:00 PM

FORUM 1 (INTERMEDIATE)

Got Demand Response? How Should Buildings Be Designed to Connect to the Smart Grid?

Track: Standards, Guidelines and Codes
Room: Orange Ballroom E
Sponsor: 01.09 Electrical Systems, 07.05 Smart Building Systems
Chair: Randall Higa, P.E., Associate Member, Southern California Edison, Rosemead, CA

Demand response (DR) is the ability to effect a short-term change in a facility's electric demand due to actions on the building's energy consuming systems. DR can provide value by addressing grid reliability or variations in renewable energy output. California's Title 24 and IgCC Green Code require buildings to be capable of responding to DR events. There is interest in preparing a guideline for DR that could be incorporated into standards such as Standard 90.1 and 189.1. What should be the scope and structure of such a guideline? How should buildings be designed to connect to the smart grid?

11:00 AM-12:00 PM

FORUM 2 (INTERMEDIATE)

Air Change Rates: Friend or Foe?

Track: The Great Debate
Room: Orange Ballroom G
Sponsor: 09.11 Clean Spaces, TC 9.06, TC9.10
Chair: Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

Air change rates (ACR) or air changes per hour (ACH) are often specified in many standards, codes and design guidelines as supply airflow requirements for healthcare, cleanrooms, laboratories and other similar facilities. A group of people who support such philosophy think it has been working successfully from several decades in making these spaces safe, comfortable and healthy. Another group thinks this legacy practice has a little scientific basis and is a burden on energy efficiency and cost of operation of HVAC systems. This session has an open debate on this issue. Active participation is required from the attendees.

2:15 PM-3:45 PM

SEMINAR 36 (BASIC)

HVAC Pumps: New ECM Motor and Control Technologies

Track: Cutting-Edge Technologies
Room: Orange Ballroom D
Sponsor: 06.01 Hydronic and Steam Equipment and Systems
Chair: Jason A. Atkisson, P.E., HBDP, Member, Affiliated Engineers, Inc. , Madison, WI

Electronically commutated motor (ECM) technologies have been used for years in wet running heating circulator pumps, with noted energy savings. These technologies are now available on pumps for general HVAC applications. This seminar describes the energy saving potential of ECM technology when used on general HVAC pumps and how it is applied in heating and cooling applications.

1. Energy Saving Potentials By Using ECM Motor Technologies for HVAC Pumps
Niels Bidstrup, Ph.D., Member, *Grundfos Management A/S, Bjerringbro, Denmark, Bjerringbro, Denmark*

2. Combined Delta T and Pressure Controlled Secondary Pumps with ECM Motor in a Large Residential Heating System: A Case Study
Anders Nielsen, *Grundfos Holding A/S, Bjerringbro, Denmark*

3. Use of ECM-Driven Large Circulators in HVAC Cooling System Applications
Larry Konopacz, Member, *Xylem Bell & Gossett, Morton Grove, IL*

Tuesday, January 26

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 12 (INTERMEDIATE)

Heat Pumps and Unitary Equipment: Optimizing Efficiencies

Track: Systems and Equipment
Room: Orlando Ballroom V
Chair: Charles E. Henck, Whitman, Requardt & Associates LLP, Baltimore, MD

Heat pumps and unitary equipment efficiency can be impacted in many ways: through the operation of the system as well as through the assembly of the parts and pieces. These papers discuss the methods to optimize the system for different climate zones—whether it be from setpoint changes, using multiple compressors, multi-speed units or altered vapor injection. This session provides the insight to better select the heat pump or unitary equipment for your climate and application.

1. Unitary HVAC Equipment: Performance Optimization Strategy and Field Tests (OR-16-C038)
Michael K. West, Ph.D., P.E., Member, *Advantek Consulting Engineering, Melbourne, FL*

2. Cold Climate Heat Pumps Using Tandem Compressors (OR-16-C039)
Bo Shen, Ph.D., Member, *Omar Abdelaziz, Ph.D., Member, Rice Keith, Ph.D., Member and Van D. Baxter, P.E., Fellow ASHRAE, Oak Ridge National Laboratory, Oak Ridge, TN*

3. Annual Performance of a Two-Speed, Dedicated Dehumidification Heat Pump in the NIST Net Zero Energy Residential Test Facility (OR-16-C040)
W. Vance Payne, Ph.D., Member, *National Institute of Standards and Technology, Gaithersburg, MD*

4. A Non-Dimensional Mapping of a Dual-Port Vapor Injected Compressor (OR-16-C041)
Christian K. Bach, Ph.D., Associate Member[1], *Eckhard Groll, Dr.Ing., Fellow ASHRAE[2], James Braun, Ph.D., Fellow ASHRAE[2] and Travis Horton, Ph.D., Member[2], (1)Oklahoma State University, Stillwater, OK, (2)Purdue University, West Lafayette, IN*

5. Mapping of Vapor Injected Compressor with Consideration of Extrapolation Uncertainty (OR-16-C042)
Christian K. Bach, Ph.D., Associate Member[1] *and Howard Cheung, Ph.D., Member[2], (1)Oklahoma State University, Stillwater, OK, (2) Purdue University, West Lafayette, IN*

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 13 (INTERMEDIATE)

Improving the Design and Performance of Ground Source Heat Pump Systems

Track: Fundamentals and Applications
Room: Orange Ballroom F
Chair: Gary C. Debes, Member, BHH Engineers, a Division of Blackney Hayes Architects, Philadelphia, PA

Ground source heat pump (GSHP) systems have proven to be highly efficient and effective in many applications (especially residential and commercial). This session explores methods to improve design (based on climatic and/or geological variations), efficiency (based on hybrid systems), and modeling.

1. Deep Boreholes for Ground Source Heat Pump Systems: Scandinavian Experience and Future Prospects (OR-16-C043)
Signhild E. A. Gehlin, Ph.D., Member[1], *Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE[2] and Göran Hellström, Ph.D.[3], (1)Swedish Centre for Shallow Geothermal Energy, Lund, Sweden, (2)Oklahoma State University, Stillwater, OK, (3)Lund University of Technology, Lund, Sweden*

2. In Situ Testing of Shallow Depth Helical Heat Exchangers for Ground Source Heat Pump Systems (OR-16-C044)
F. Javier Alvarez-Revenga, Student Member[1], *Kevin L. Amende, P.E., Associate Member[1] and Angelo Zarrella[2], (1)Montana State University, Bozeman, MT, (2)University of Padova, Padova, Italy*

3. Energy Use of Ground-Source Heat Pumps for Various Load Temperatures (OR-16-C045)
Michel Bernier, Ph.D., P.E., Member[1], *Guillaume Soudan[2] and Nicolas Haché[3], (1)Ecole Polytechnique De Montreal, Montreal, QC, Canada, (2)Université de Mons, Mons, Belgium, (3)Ecole Polytechnique De Montreal, Monreal, QC, Canada*

4. Coupling PV/T Collectors with a Ground Source Heat Pump System (OR-16-C046)
Pauline Brischoux, Student Member *and Michel Bernier, Ph.D., P.E., Member, Ecole Polytechnique de Montreal, Montreal, QC, Canada*

5. Experimental Validation of a Thermal Resistance and Capacity Model for Geothermal Boreholes (OR-16-C047)
Corentin Lecomte[1], *Vivien Godefroy[1], Michel Bernier, Ph.D., P.E., Member[1] and Mark Douglas, P.Eng.[2], (1)Ecole Polytechnique De Montreal, Montreal, QC, Canada, (2)CanmetENERGY, Ottawa, ON, Canada*

8:00 AM-9:30 AM

SEMINAR 37 (INTERMEDIATE)

Best Practices in Manufacturing, Field Installation and Servicing Refrigeration and Air-Conditioning Systems

Track: Systems and Equipment
Room: Orange Ballroom C
Sponsor: Refrigeration Committee, TC3.3, 9.3, 10.3, 10.7, 08.11 Unitary and Room Air Conditioners and Heat Pumps
Chair: Georgi Kazachki, Ph.D., Fellow ASHRAE, Dayton Phoenix Group, Inc., Dayton, OH

The efficient, reliable and environmentally sound operation of refrigeration and air-conditioning systems depends to a large extent on the presence of moisture, non-condensables, contaminants and refrigerant leaks. Good practices have been established over the years, yet time and cost-reduction pressures often lead to questioning some of these practices, such as minimizing component exposure to ambient before assembly and installation, brazing with inert gas, leak elimination and deep evacuation before charging with the proper amount of fresh refrigerant. This seminar illustrates the best practices with respect to the system chemistry and material compatibility in refrigeration systems.

1. Using a Protective Atmosphere During Brazing of HVAC&R Copper Tubing and Its Effect on Braze Quality and System Contamination
Marc Scancarello, P.E., Member, *Emerson Climate Technologies, Inc., Sidney, OH*

2. Effects of Process Lubricants for Fin Stamping, Tube Bending and Construction of HVAC&R Systems
Robert Turner, *Metalloid Corporation, Sturgis, MI*

3. Impact of Refrigeration System Commissioning on Energy Usage and System Reliability
Michael Collins, *Carlyle Compressor Company, Syracuse, NY*

Practical Impact When Servicing Air Conditioners/Heat Pumps Using A2L Refrigerant HFC32
Hilde Dhont, *Daikin Europe, Oostende, Belgium*

8:00 AM-9:30 AM

SEMINAR 38 (INTERMEDIATE)

Cooling with the Sun: Solar PV Cooling

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Sponsor: 06.07 Solar Energy Utilization
Chair: Janice Means, P.E., Life Member, Lawrence Technological University, Southfield, MI

Solar photovoltaic (PV) applications for providing building comfort cooling have now become a viable economic alternative. The speakers address various opinions and techniques to best apply solar PV for handling cooling loads.

1. Introduction to Solar PV Cooling and Comparison with Alternatives
James A. Leidel, Member, *Oakland University, Rochester, MI*

2. Case Studies for PV Cooling
Svein Olav Morner, Ph.D., P.E., CPMP, Member, *Sustainable Engineering Group LLC, Middleton, WI*

3. Unitary Rooftop Air-Conditioning with Solar Photovoltaic Power Input
Dutch Uselton, P.E., Fellow ASHRAE, *Lennox Industries Inc., Carrollton, TX*

4. Double-Skin's Integrated PV for Buildings Cooling and Heating Deep Energy Refurbishment: Total Performance Prediction
Marija Todorovic, P.Eng., Fellow ASHRAE, *University of Belgrade, Belgrade, Serbia*

8:00 AM-9:30 AM

SEMINAR 39 (INTERMEDIATE)

Cutting-Edge Japanese Technologies (System and Equipment) SHASE AWARD for System and Equipment in 2015

Track: International Design
Room: Orange Ballroom D
Sponsor: SHASE
Chair: Shinsuke Kato, Dr.Ing., Fellow ASHRAE, University of Tokyo Institute of Industrial Science, Tokyo, Japan

If you have an old building, there are two possibilities to treat it. One is to demolish it and another is to retrofit it. This session introduces best practices in both cases. One is an environmentally friendly closed type demolishing method which was adapted for two skyscrapers in Tokyo. Another one is the retrofit project for large office complexes, whereby the water transport system for district heating and cooling was significantly improved. The third one is a medium-sized office building, in which an expanded BEMS, "Building Energy and Interactive Communication System (BEICS)," has been introduced.

1. Development and Application of an Enclosed Demolition Method with Environmental Consideration for High-Rise Buildings
Taiki Sato, *Taisei Corporation, Tokyo, Japan*

2. Energy-Saving Retrofit of Facilities in the Large Compound Building
Takashi Momose, *Shimizu Corporation, Tokyo, Japan*

3. Green Building Renovation of H Office Built 35 Years Ago in Osaka: Equipment System Considering Occupants' Behavior
Shunsuke Nakajima, *Osaka Gas Co., Ltd., Osaka, Japan*

8:00 AM-9:30 AM

SEMINAR 40 (BASIC)

Delivering Building Performance Through Collaboration and Integration

Track: The Great Debate
Room: Orange Ballroom G
Sponsor: CIBSE ASHRAE liaison committee, MTG.BIM Building Information Modeling
Chair: Tim Dwyer, Fellow ASHRAE, UCL Institute for Environmental Design and Engineering (IEDE), London, United Kingdom

With an ever-increasing demand for more stringent building environmental requirements, collaboration across the building 'team' is critical to deliver effective buildings that meet standards and performance metrics. Successful projects do not come from 'silo' working practices and increasingly the engineer will be the lead for interdisciplinary design solutions that benefit from the integrating tools and technologies as well as timely, and properly informed, client communication and interaction. Illustrated with real-world examples, this seminar explores how such enlightened thinking and collaborative methods can deliver truly high performing buildings.

2. Integrating Performance Goals into the Design Process
Trevor Butler, P.Eng., *Archineers Consulting Ltd, Kelowna, BC, Canada*

3. Communication, Communication, Communication: The Only Way of Achieving High Performance Building Projects
Sergio Sádaba, P.E., Member, *Skidmore, Owings, & Merrill Ltd, Chicago, IL*

4. Delivering Performance
Nick Mead, CEng, *Imtech, Ashford, United Kingdom*

8:00 AM-9:30 AM

SEMINAR 41 (INTERMEDIATE)

Residential Smart Appliances: Enabling Electric Grid Resilience and Demand Response

Track: Modern Residential Systems
Room: Orange Ballroom A
Sponsor: 07.05 Smart Building Systems
Chair: Kristen Cetin, Ph.D., P.E., Iowa State University, Ames, IA

In the face of challenges regarding the stability and reliability of the electric grid, and growing interest for energy-reducing solutions, significant advances in residential appliances are being made to meet these needs. Much of the 38% of total electricity use and up to 50% of peak electricity loads contributed by residential buildings in the United States are associated with residential appliances. This seminar covers recent efforts to develop, test and implement advanced residential grid-connected solutions. This diverse set of solutions includes kitchen appliances, as well as HVAC systems, water heaters, batteries, electric vehicle charging stations and photovoltaic systems.

1. Using Connected Devices in the Home to Provide Grid Services
Bethany Sparn, *National Renewable Energy Laboratory, Golden, CO*

2. Demand-Response Performance of GE Electric Resistance and Sanden Unitary/Split-System Heat Pump Water Heater
Joseph Petersen, *Pacific Northwest National Laboratory, Richland, WA*

3. Residential Grid-Connected Smart Appliances: Laboratory Vs. Field Performance
J. Carlos Haiad, P.E., Member, *Design & Engineering Services, Southern California Edison, Irwindale, CA*

8:00 AM-9:30 AM

SEMINAR 42 (INTERMEDIATE)

Trending Research and Advances in Simulation

Track: Systems and Equipment
Room: Orange Ballroom E
Sponsor: Publishing and Education Council
Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD

This session offers presentations based on a select group of recently published papers from the ASHRAE journal, "Science and Technology in the Built Environment," regarding new research in refrigerants with low global warming potential, response strategies for variable air volume (VAV) HVAC systems and fast fluid dynamics.

1. Dynamic Simulation and Analysis of Ancillary Service Demand Response Strategies for VAV HVAC Systems
David H. Blum, Student Member *and Leslie Norford, Ph.D., Member, Massachusetts Institute of Technology, Cambridge, MA*

2. Accelerating Fast Fluid Dynamics with a Coarse-Grid Projection Scheme
Qingyan Chen, Ph.D., Fellow ASHRAE, *Mingang Jin, Ph.D., Member and Wei Liu, Purdue University, West Lafayette, IN*

3. Performance Ranking of Refrigerants with Low Global Warming Potential
Mark Kedzierski, Ph.D., Member[1], *J. Steven Brown, Ph.D., P.E., Fellow ASHRAE[2] and Junemo Koo, Ph.D.[3], (1)National Institute of Standards and Technology, Gaithersburg, MD, (2)Catholic University of America, Washington, DC, (3)Kyung Hee University, Seoul, South Korea*

9:45 AM-11:00 AM

TECHNICAL PAPER SESSION 5 (INTERMEDIATE)

Building Modeling Simulation

Track: Fundamentals and Applications
Room: Orange Ballroom C
Chair: Sheila Hayter, Member, National Renewable Energy Laboratory, Golden, CO

The papers in this session delve into different aspects of building modeling. One paper focuses on the modeling of metal building insulation assemblies, while the second paper looks at the controls algorithms for the most efficient night setback parameters. The third paper tackles recent refinements to the radiant time series method (RTSM) as part of 1616-RP.

1. Improved Treatment of Weather Conditions in the Radiant Time Series Method (RP-1616) (OR-16-013)
Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE *and Laura E Southard, P.E., Member, Oklahoma State University, Stillwater, OK*

2. A General Approach for Predicting the Thermal Performance of Metal Building Fiberglass Insulation Assemblies (OR-16-014)
M. K. Choudhary, Ph.D., P.E., *Owens Corning Center of Science and Technology, Granville, OH*

3. Implementation of an Adaptive Occupancy and Building Learning Temperature Setback Algorithm (OR-16-015)
H. Burak Gunay, Student Member, *William O'Brien, Ph.D., Member, Ian Beausoleil-Morrison and Jayson Bursill, Carleton University, Ottawa, ON, Canada*

4. Investigating the Effects of Turbulence and Pre-mixed Air/Methane Fuel Combustion on the Performance of a Miniature Gas Turbine: Computer Numerical Simulation (OR-16-016)
Ali M. Hasan, CEng, Member, *KEO International Consulting Engineers, Doha, Qatar*

9:45 AM-11:00 AM

TECHNICAL PAPER SESSION 6 (ADVANCED)

Refrigerant and Refrigeration Systems

Track: Systems and Equipment
Room: Orange Ballroom A

The papers in this session are fairly diverse. The first paper focuses on the modeling of dispersing refrigerant. The second paper investigates liquid overfeed and DX refrigeration performance and the third paper looks at Einstein's refrigerator.

1. A Numerical Study of Refrigerant Dispersion in Single and Multiple Connected Spaces (OR-16-017)
Christopher R. Laughman, Ph.D.[1], *Saleh Nabi, Ph.D.[2] and Piyush Grover, Ph.D.[2], (1)Mitsubishi Electric Research Laboratories, Waltham, MA, (2)Mitsubishi Electric Research Laboratories, Cambridge, MA*

2. Investigation of Liquid Overfeed and DX Refrigeration Systems Performance (OR-16-018)
Syed Zahid Hussain Rizvi, Ph.D., Member, *Johnson Controls Inc – IR Industrial Refrigeration, Dubai, United Arab Emirates*

3. The Einstein-Szilard Refrigerator: An Experimental Exploration (OR-16-019)
Keng Wai Chan, Ph.D., P.E.[1] *and Malcolm McCulloch, Ph.D.*[2]*, (1) University Sains Malaysia, Nibong Tebal, Malaysia, (2)University of Oxford, Yarnton, United Kingdom*

9:45 AM-11:00 AM

CONFERENCE PAPER SESSION 14 (INTERMEDIATE)

Building Modeling and Optimization

Track: Fundamentals and Applications
Room: Orange Ballroom F
Chair: Daniel Pettway, Member, Hobbs & Associates, Norfolk, VA

How can we better model buildings and HVAC systems? The papers in this session focus on the early design stage of a sustainable project and how better communication and databases of design knowledge can assist the process. The session also includes information on how to model cooling towers more effectively.

1. Using the Poppe's Mathematical Method to Model the Thermodynamic Behavior of Evaporative Countercurrent Water Cooling Towers to Optimize Operation (OR-16-C048)
Marcio Nunes Sr., M.D., *IPT – Institute for Research and Technology, Sao Paulo, Brazil*

2. A Simplified and Scalable Heat Flow-Based Approach for Optimizing the Form, Massing and Orientation for High Performance Building Design (OR-16-C049)
Zhaozhou Meng, Student Member *and Jianshun Zhang, Ph.D., Fellow ASHRAE, Syracuse University, Syracuse, NY*

3. Mixed Methods Applied to the Building Energy Quotient (OR-16-C050)
Bryce Johnson, P.E., Member, *Davis Design, Inc, Lincoln, NE*

4. A Visual Analytics-Based Methodology for Multi-Criteria Evaluation of Building Energy Design Alternatives (OR-16-C051)
Ranojoy Dutta[1]***,*** *T. Agami Reddy, Ph.D., P.E., Member*[2] *and George Runger, Ph.D.*[3]*, (1)View Dynamic Glass, Milpitas, CA, (2)The Design School/The School of Sustainable Engineering and the Built Environment, Tempe, AZ, (3)Arizona State University, Tempe, AZ*

9:45 AM-11:00 AM

SEMINAR 43 (INTERMEDIATE)

Cutting-Edge Japanese Technologies (Cutting-Edge Technologies) SHASE AWARD for Non-Industrial Buildings in 2015

Track: International Design
Room: Orange Ballroom D
Sponsor: SHASE
Chair: Shin-ichi Tanabe, Ph.D., Fellow ASHRAE, Department of Architecture, Waseda University, Tokyo, Japan

This session introduces three newly constructed buildings. One is the headquarters building of a major construction company, introducing various technologies such as ceiling radiation panel cooling, desiccant air-conditioning system and so on. The second is a university campus where CO2 emissions were reduced by 40 percent over other similar campuses. Major measures included large-scale thermal storage tanks and low-temperature low-volume air distribution units. The third one is owned by a life insurance company, featuring the installation of a large-scale central VOID (40 x 40 meters) and an air-type panel cooling system as well as others.

1. Urban High-Rise Office Building That Contributes to a Sustainable Society
Mitsuhiro Takahashi, *Shimizu Corporation, Tokyo, Japan*

2. Energy Conservation Application on University Campus in Japan with TES
Hirokazu Nakamura, NIKKEN SEKKEI LTD, Tokyo, Japan

3. Office Building with a Large-Scale Void
Takayoshi Shibahara, Takenaka Corporation, Tokyo, Japan

9:45 AM-11:00 AM

SEMINAR 44 (INTERMEDIATE)

Energy Savings Technologies for Hospitals

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Sponsor: 09.06 Healthcare Facilities
Chair: Jeremy Fauber, P.E., Member, Heapy Engineering, Dayton, OH

New and existing hospitals regularly have an EUI above 200 kBTU/sq. ft. due to continuous operation and code requirements. The first step toward net zero energy usage for hospitals is a reduction in the quantity of energy required to operate the facility. This program reviews a new facility that achieved an Energy Star rating of 97 and strategies for reducing energy usage in existing buildings, including a waterside economizer system that utilizes energy recovery.

1. Design Highlights of an Energy Efficient Community Hospital in Clay County, Florida
Ben Roseborough, P.E., HFDP, *TLC Engineering for Architecture, Orlando, FL*

2. Improving Chilled Water Plant Operation
Brian Arbogast, P.E., *Associate Member, Heapy Engineering, Dayton, OH*

3. Reduction of Energy Usage through Controls Tune-Ups and Retro-Commissioning
Pavel Likhonin, P.E., Member, *Dewberry, Chapel Hill, NC*

9:45 AM-11:00 AM

SEMINAR 45 (INTERMEDIATE)

Indoor Environmental Quality

Track: Systems and Equipment
Room: Orlando Ballroom V
Sponsor: Publishing and Education Council
Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD

This session offers presentations based on a select group of recently published papers from the ASHRAE journal, "Science and Technology in the Built Environment," regarding new research in UV-photocatalytic oxidation, and emissions from ozone reactions with human-worn clothing.

1. Evaluation of UV-Photocatalytic Oxidation of Light Alcohols at Sub-PPM Concentrations
Chang-Seo Lee, Ph.D., Associate Member, *Fariborz Haghighat, Ph.D., P.E., Fellow ASHRAE, Alireza Aghighi, Student Member, and Lexuan Zhong, Ph.D., Member, Concordia University, Montreal, QC, Canada*

2. Numerical Modeling of VOC Emissions from Ozone Reactions with Human-Worn Clothing in an Aircraft Cabin
Qingyan Chen, Ph.D., Fellow ASHRAE[1]***,*** *Aakash Chand Rai, Ph.D., Student Member*[1] *and Chao-Hsin Lin, Ph.D., Fellow ASHRAE*[2]*, (1)Purdue University, West Lafayette, IN, (2)Boeing, Everett, WA*

9:45 AM-11:00 AM

SEMINAR 46 (BASIC)

Orlando's Energy Plan: Now and in the Future

Track: Standards, Guidelines and Codes
Room: Orange Ballroom E
Chair: John Constantinide, Alpha MRC Architects Engineers, Merritt Island, FL

In every major American city, buildings account for the majority of energy use and air pollution – even more than the transportation or industrial sectors. If cities want to be more competitive and more resilient against unexpected energy and economic challenges, they must find ways to boost the efficiency of their building stock. This presentation will unveil the investments that Orlando is making to optimize our use of natural resources, an overview of City Energy Project initiatives, and

share what the City of Orlando is working on to become a national leader in energy efficiency for new and existing buildings.

1. Orlando's Energy Plan: Now and in the Future
Ian L. LaHiff, P.E., City of Orlando, Orlando, FL

2. Orlando's Energy Plan: Now and in the Future (2)
Chris Castro, City of Orlando, Orlando, FL

9:45 AM-11:00 AM

SEMINAR 47 (ADVANCED)

The Campus Planning Question: To Centralize Energy or Decentralize?

Track: The Great Debate
Room: Orange Ballroom G
Sponsor: 06.02 District Energy
Chair: Tim M. Anderson, P.E., Member, Applied Engineering Services, Inc, Indianapolis, IN

This seminar focuses on campus energy planning to centralize or decentralize. A short introductory presentation is provided naming the key issues on the topic, such as energy efficiency, maintenance and operational cost. Two case studies follow to present a central campus plan and a decentralized campus plan. The case studies include the key decisions made at the beginning stages which swayed the owner's decision.

1. A Case Study in Central Plant Design
Blake Ellis, P.E., Member, *Burns & McDonnell, Kansas City, MO*

2. Two Case Studies in Centralized Vs. Decentralized Energy Approach
Jeff Urlaub, P.E., Member, *MEP Associates, Eau Claire, WI*

3. A 20-Year Decision: The Next Heating System for a Veteran's Home Campus
Tim M. Anderson, P.E., Member, *Applied Engineering Services, Inc, Indianapolis, IN*

11:15 AM-12:45 PM

CONFERENCE PAPER SESSION 15 (INTERMEDIATE)

Building Envelope Applications

Track: Fundamentals and Applications
Room: Orange Ballroom C
Chair: Ann Peratt, Associate Member, PKMR Engineers, Overland Park, KS

This session covers five papers that cover building envelope systems. Topics covered include insulation performance and installation, thermal resistance calculations, and drapery used for shading. The attendee will learn about insulation applications as well as some of the latest research regarding shading.

1. Thermal Insulation System for Energy Efficient and Green Buildings (OR-16-C052)
Krishna Kumar Mitra, Fellow ASHRAE[1], *and Ashish Rakheja, P.E., Member[2],(1)Lloyd Insulations (India) Limited, New Delhi, India, (2)AEON Integrated Building Design Consultants LLP, Noida, India*

2. In-Situ Measurement of Building Thermal Resistance with a Plane Heater (OR-16-C053)
Yue Zou, Ph.D., P.E., CPMP, Associate Member[1], *Haigang Yu[1] and Yun Liu, CPMP[2], (1)Donghua University, Shanghai, China, (2)Dianwei Ltd, Shanghai, China*

3. Thermal Insulation Performances of Various Opaque Building Envelopes Considering Thermal Bridges (OR-16-C054)
Jin-Hee Song[1], *Seung-Yeong Song, Ph.D., Member[1], Jae-han Lim, Ph.D., Member[1] and Min-Ju Park[2], (1)Ewha Womans University, Seoul, South Korea, (2)Civil & Building R&D group, R&D division, Hyundai engineering and construction co,. LTD, Yong-In, South Korea*

4. Off-Normal Solar-Optical Performance of Pleated Drapery: Simulation Versus Measurement (OR-16-C055)
Michael Collins, Ph.D., P.E., Member, *Ned Huang and John Wright, Ph.D., P.E., Member, University of Waterloo, Waterloo, ON, Canada*

5. An Examination of Keyes Fabric Properties Chart: Almost 50 Years Later (OR-16-C056)
Michael Collins, Ph.D., P.E., Member, *Ned Huang and John Wright, Ph.D., P.E., Member, University of Waterloo, Waterloo, ON, Canada*

11:15 AM-12:45 PM

CONFERENCE PAPER SESSION 16 (INTERMEDIATE)

Heat Pump Applications for Domestic Hot Water

Track: Modern Residential Systems
Room: Orange Ballroom A
Chair: Kimberly Pierson, Moser Mayer Phoenix Associates, Greensboro, NC

This session explores several issues related to use of heat pumps to provide domestic hot water, ranging from codes to the impact on space heating requirements, use as back-up for solar domestic hot water systems and gas-fired heat pumps. Authors end up recommending code changes to increase use of heat pump water heating in California and noted that while they saved energy compared to gas-fired or electric resistance water heating in a Canadian test, there were no overall energy cost savings compared with a gas-fired water heater. Other authors suggest that a heat pump may be more suitable for back-up of a solar water heater than resistance heating and that a gas-fired absorption heat pump not only reduces the amount of gas use, but has substantially smaller gas line requirements.

1. Getting Heat Pump Water Heaters into California (OR-16-C057)
James D. Lutz, P.E., Member, *Retired, Oakland, CA*

2. The Impact of a Heat Pump Water Heater on an R2000 Home (OR-16-C058)
Martin Thomas, P.Eng., Member, *CANMET Energy Technology Centre, Ottawa, ON, Canada*

3. The Performance of an Auxiliary Heat Pump Water Heater Installed in a Dual-Tank System in a Net Zero Energy Residence (OR-16-C059)
Tania Ullah, Associate Member *and William M. Healy, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD*

4. Field Testing of a Prototype Residential Gas-Fired Heat Pump Water Heater (OR-16-C060)
Neil P. Leslie, P.E., Member[1], *Paul Glanville, P.E., Associate Member[1], Hillary Vadnal, Associate Member[1], Michael Garrabrant[2] and Roger Stout[2], (1)Gas Technology Institute, Des Plaines, IL, (2)Stone Mountain Technologies, Inc., Erwin, TN*

11:15 AM-12:45 PM

CONFERENCE PAPER SESSION 17 (INTERMEDIATE)

Improvements in Building Systems

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Chair: Joy Altwies, University of Wisconsin-Madison, Madison, WI

In this session the attendee learns about advances in several building system technologies. The authors present their findings on VRF systems and air distribution. Some studies are done using a practical, case-study approach while others are using modeling to identify how to accomplish improvements in HVAC systems.

1. Analysis of Supply Airflow Rate on the Performance of Radiant Cooling Systems (OR-16-C061)
Kishor Khankari, Ph.D., Fellow ASHRAE, *AnSight LLC, Ann Arbor, MI*

2. Energy Saving Measures in a Classroom Using Low Pressure Drop Ceiling Supply Device: a Field Study (OR-16-C062)
Harald Andersson[1], *Mathias Cehlin, Ph.D.[1] and Bahram Moshfegh, Ph.D.[2], (1)University of Gävle, Gävle, Sweden, (2)Linkoping University, Linkoping, Sweden*

3. Development and Validation of a New VRF Model in EnergyPlus (OR-16-C063)
Kaiyu Sun[1], *Tianzhen Hong, Ph.D., Member[1], Rongpeng Zhang, Ph.D., Associate Member[1], Oren Schetrit[1], Ryohei Hinokuma[2], Shinichi Kasahara[3] and Yoshinori Yura[3], (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Daikin US Corporation, Irvine, CA, (3) Daikin Industries, Osaka, Japan*

4. Extremum Seeking Controls for Efficient Operation of Multi-Functional Variable Refrigerant Flow System (OR-16-C064)
Liujia Dong[1], *Yaoyu Li1, Timothy Salsbury, Ph.D.[2], John House, Ph.D., Member[2], Zhigang Wu, Ph.D.[3] and Lee Wang, Ph.D.[3], (1)University of Texas at Dallas, Richardson, TX, (2)Johnson Controls, Inc., Milwaukee, WI, (3)Johnson Controls, Inc., Asia Engineering Center, Wu-Xi, China*

5. An EnergyPlus/OpenStudio-Based Fault Simulator for Buildings (OR-16-C065)
Zheng O'Neill, Ph.D., P.E., Member *and Yanfei Li, Student Member, University of Alabama, Tuscaloosa, AL*

11:15 AM-12:45 PM

SEMINAR 48 (ADVANCED)

Advanced Non-Vapor Compression Cycles

Track: Fundamentals and Applications
Room: Orange Ballroom F
Sponsor: 01.01 Thermodynamics and Psychrometrics
Chair: Omar Abdelaziz, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Cooling technology requirements have moved beyond our basic needs for comfort and food safety, and their new development should meet extra requirements, such as compliance to new efficiency standards and legal codes on refrigerant. ASHRAE members have demonstrated a lot of development in these aspects for vapor compression technology, but what is happening to other alternatives? In this seminar, the new breakthroughs of three alternative cooling technologies—electrocaloric cooling, magnetocaloric refrigeration and elastocaloric cooling—are explored for their potentials to meet the new challenges. The presentations also cover their theories and experimental results, including potential commercial development.

1. Electrocaloric Cooling: Present Advances and Future Perspectives
Qiming Zhang, Ph.D., *Penn State University, University Park, PA*

2. Magnetocaloric Refrigeration, Potentials, State of the Art and Challenges
Ayyoub Mehdizadeh Momen, Ph.D., Member, *Oak Ridge National Laboratory, Oak Ridge, TN*

3. Testing Results of Compressive Elastocaloric Cooling Prototype
Yunho Hwang, Ph.D., Member, *University of Maryland, College Park, MD*

11:15 AM-12:45 PM

SEMINAR 49 (ADVANCED)

Cooling with the Sun: Solar Thermal Cooling

Track: Cutting-Edge Technologies
Room: Orange Ballroom E
Sponsor: 06.07 Solar Energy Utilization
Chair: Vinay Ananthachar, P.E., Member, Northeast Utilities, Stamford, CT

Peak cooling demand in summer is associated with high solar radiation availability. This offers excellent opportunity to exploit solar energy with thermal technologies to cool the building efficiently. The presenters discuss the basics of solar thermal cooling and case studies of actual solar thermal-assisted air-conditioning installations, PV/thermal desiccant dehumidification systems and solar-assisted absorption cooling. The learning outcomes are to identify the main components of a solar thermal air-conditioning system and understand the process flow of a thermally driven chiller.

1. Introduction to Solar Thermal Air-Conditioning
Khalid Nagidi, BEAP, Member, *Energy Management Consulting Group, Wantagh, NY*

2. Design and Actual Performance Benchmarks of Solar Thermal-Assisted Air-Conditioning Installations
Constantinos Balaras, Ph.D., Fellow ASHRAE, *Group Energy Conservation IERSD, Palea Penteli, Greece*

3. Solar-Assisted Absorption Cooling for Distributed Tri-Generation: A Case Study
Marija Todorovic, P.Eng., Fellow ASHRAE, *University of Belgrade, Belgrade, Serbia*

4. PV/Thermal Desiccant Dehumidification Demonstration at the Orange County Convention Center
Tim Merrigan, Member, *National Renewable Energy Laboratory, Golden, CO*

11:15 AM-12:45 PM

SEMINAR 50 (INTERMEDIATE)

Double Skin Facade Design and Application

Track: International Design
Room: Orange Ballroom D
Sponsor: 04.01 Load Calculation Data and Procedures, 06.07 Solar Energy Utilization
Chair: Steve Taylor, P.E., Fellow ASHRAE, Taylor Engineering, LLC, Alameda, CA

Large glazed façade results in high building heating and cooling loads, and thus significant financial and environmental burdens. Double skin façade (DSF) is one potential response to these problems. This seminar explores DSF dynamics, design, modeling, case studies, seasonal control strategies and energy efficiency. This session provides ASHRAE members with a fundamental understanding of DSF principles, challenges, key influential factors, evaluation criteria, and design and modeling approaches.

1. Thermal Performance of Double Skin Façade with Buoyancy-Driven Airflow
John Zhai, Ph.D., Member, *University of Colorado, Boulder, CO*

2. Experimental and Numerical Appraisal of the Application of a Double Skin Façade in Moderate Climate
Aleksandar Andjelkovic, Ph.D., Associate Member, *University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia*

3. Double Façade Influence on Heating and Cooling Load: Three Models for Calculation of Interspace Temperature
Tanja Cvjetkovic, P.Eng., *Delhaize Group, Belgrade, Serbia*

4. Assessment of Climatic Parameters Inside Experimental Room Equipped with Box Double-Skin Facade
Gabriel Nastase, Ph.D., Associate Member, *Transilvania University From Brasov, Brasov, Romania*

11:15 AM-12:45 PM

SEMINAR 51 (BASIC)

Electronic Cigarettes: An Emerging Issue for ASHRAE

Track: Fundamentals and Applications
Room: Orlando Ballroom V
Sponsor: Environmental Health Committee
Chair: Wane A. Baker, P.E., CIH, Member, Trane / Ingersoll Rand, La Crosse, WI

Over the past several years, use of electronic cigarettes has risen sharply. Debate continues regarding the efficacy of e-cigs as a smoking cessation technique, the health risks associated with "vaping" and the impact of secondary exposures indoors. This seminar provides an introduction to these electronic nicotine delivery systems, summarizes the related research conducted to date and offers insights on their relevance for ASHRAE members.

1. A Medical Toxicologist's Perspective: Miracle or Menace?
Jennifer Lowry, M.D., *Children's Mercy Hospital and Clinics, Kansas City, MO*

2. AIHA White Paper Findings: Emissions, Exposures and Health Risks
Cheri Marcham, PhD, CIH, *University of Oklahoma, Oklahoma City, OK*

3. Potential Impacts of Vaping on Occupants of the Indoor Environment
David Krause, PhD, MSPH, CIH, *Geosyntec Consultants, Tallahassee, FL*

4. How Do Current Standards Deal with Smoking?
Roger Hedrick, P.E., BEMP, Member, *NORESCO, Boulder, CO*

11:15 AM-12:45 PM

SEMINAR 52 (INTERMEDIATE)

Peak Envelope Cooling Loads: How Did We Get to Today? Is This Where We Want to Be?

Track: The Great Debate
Room: Orange Ballroom G
Sponsor: Historical Committee, 04.01 Load Calculation Data and Procedures
Chair: Jeff Haberl, Ph.D., BEMP, Fellow ASHRAE, Texas A&M University, College Station, TX

This seminar reviews the peak envelope cooling loads in the U.S. and Australia and relates the historical development of the methods to the methods that are being taught to today's engineers and architects, including: the Total Equivalent Temperature Difference/Time Average method (TETD/TA), Cooling Load Temperature Difference/Cooling Load Factor/Solar Cooling Load (CLTD/CLF/SCL) and Radiant Time Series (RTS) methods. The presentations include a brief history, as well as the advantages and disadvantages of each method.

1. History of Peak Envelope Cooling Load Methods in the U.S.
Jeff Haberl, Ph.D., BEMP, Fellow ASHRAE, *Texas A&M University, College Station, TX*

2. Overview of Peak Envelope Cooling Load Methods Using the RTS Method
Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE, *Oklahoma State University, Stillwater, OK*

3. An Architect's Perspective of U.S. Envelope Peak Cooling Load Methods
Walter T. Grondzik, P.E., Fellow Life Member, *Ball State University, Muncie, IN*

4. Overview of Australian Envelope Peak Cooling Load Methods
P.C. Thomas, Team Catalyst, *Sydney, Australia*

1:00 PM-1:30 PM

TC SEMINAR (BASIC)

The Latest Technologies and Solutions in Building Automation—An Open Session for YEA Members

Track: Cutting-Edge Technologies
Room: Orange Ballroom G
Sponsor: 01.04 Control Theory and Application
Chair: Frank Shadpour, P.E., HFDP, Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. This seminar focuses on the latest available technologies and solutions in building automation systems. It addresses topics such as wireless technology, dashboards and continuous commissioning, plus a number of other innovative solutions for today's green, sustainable buildings. This seminar is highly recommended for Young Engineers in ASHRAE (YEA). Ron Bernstein, Member, RBCG, LLC, Encinitas, CA, presents "What's on the Horizon for Building Automation Controls: Whole Building Integration, Cyber Security and Iot Cloud Apps." Chad Moore, P.E., Member, Engineering Resource Group, Jackson, MS, presents "Future Applications of Controls—Today."

1:00 PM-2:30 PM

TC SEMINAR (ADVANCED)

Building Integrated PV (BIPV) Standardization is an International and Global Need

Track: Standards, Guidelines and Codes
Room: Orange Ballroom F
Sponsor: 06.07 Solar Energy Utilization, 4.1 Load Calculation Data & Procedures, 1.9 Electrical Systems, 07.01 Integrated Building Design
Chair: Marija Todorovic, P.Eng., Fellow ASHRAE, University of Belgrade, Belgrade, Serbia

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. The objective of this forum is to discuss international BIPV as matured cutting-edge technology aimed at determining relevant tasks and a working plan for preparation of an International BIPV standard that is globally acceptable concerning BIPV technologies, technical requirements of both buildings construction industries and of the electronics industries, developed as a scientifically and technically sound hub. All relevant data and measuring-technical specifications enable globally correct national "top-down" insertions. ASHRAE TC's could have a crucial role in international BIPV standardization. Prof. Dr. Stephen Wittkopf, Lucerne University of Applied Sciences and Arts presents "Singapore and Swiss BIPV Case Studies and Visual Standards". Dr. Şiir & Prof. Birol Kilkis, Scientific and Technological Research Council of Turkey & Baskent University present "Comparative Evaluation of Energy and Exergy Efficiencies of BIPV Systems. Dr. D. Charlie Curcija, Lawrence Berkeley National Lab presents "FLEXLAB Testbed Measurement of the Energy and Daylighting Performance of Glazing-Integrated BIPV Façade." Dr. Francesco Fontini, University of Applied Sciences and Arts of Southern Switzerland presents "BIPV Technical Standards-Developments within the European Union/Switzerland."

1:30 PM-3:00 PM

SEMINAR 53 (INTERMEDIATE)

Fellows Debate: Commissioning Is Not Part of the Construction Contractor's Turnover Package

Track: The Great Debate
Room: Orange Ballroom D
Sponsor: College of Fellows, 01.07 Business, Management & General Legal Education
Chair: Larry Spielvogel, P.E., Fellow Life Member, Consulting Engineer, Bala Cynwyd, PA

The design and construction marketplace has and will change. Clients want buildings that work. Commissioning is vital to prove that the building performs satisfactorily. Practice posits that commissioning takes place during the whole construction period and does not finish until at least one year after turnover to the owner. It is also argued that formal documentation and proof of performance is required as part of the turnover documentation. Alternatively this cannot happen in a organically growing building—things are always changing. Both sides of the argument must be understood to write good work scopes and contract documents.

Debaters: E. Mitchell Swann, P.E., Member, *MDC Systems, Paoli, PA;* ***Dennis Knight, P.E., BEMP, Fellow ASHRAE,*** *Whole Building Systems, LLC, Charleston, SC;* ***Nick Mead, CEng, FCIBSE, President CIBSE,*** *Imtech, Ashford, United Kingdom;* ***Robert Baker, P.E., Fellow ASHRAE,*** *BBJ Consulting Service, Apollo Beach, FL;* ***Richard Rooley, FREng, Presidential Fellow ASHRAE,*** *Rooley Consultants, Stoke Poges, United Kingdom; and* ***Don Beaty, P.E., Fellow ASHRAE****, DLB Associates, Eatontown, NJ.*

3:15 PM-4:45 PM

SEMINAR 54 (INTERMEDIATE)

Cold Climate Building Design Guide Best Practices

Track: International Design
Room: Orange Ballroom D
Sponsor: Cold Climate Design MTG
Chair: Frank Mills, Member, Low Carbon Design Consultants, Liverpool, United Kingdom

The ASHRAE Cold Climate Building Design Guide is being rolled out in Orlando and the speakers provide an overview of the guide, as well as best building practices. The guide was developed by an international group of ASHRAE members.

1. Best Practices of Utilities in Building Design for Cold Climate Applications
Erich Binder, Member, *Erich Binder Consulting Limited, Calgary, AB, Canada*

2. Best Practices HVAC Equipment Design Cold Climate Applications
David Lima, Member, *AquaAir, Calgary, AB, Canada*

3. Best Practices HVAC Controls for Cold Climate Applications
Cheryl McGinn, P.Eng., Member, *Convergint Technologies, Calgary, AB, Canada*

4. Best Practices HVAC Design for Cold Climates
Craig D. Fredeen, P.E., Member, *PDC Inc. Engineers, Anchorage, AK*

THE FOLLOWING FOUR DESIGN BUILD SESSIONS TAKE PLACE AT THE AHR EXPO AT THE ORANGE COUNTY CONVENTION CENTER:

11:00 AM-12:00 PM

SEMINAR 55 (INTERMEDIATE)

Don't Call it a Comeback! The New and Improved Design-Build Survival Guide

Track: Design Build
Room: S331BC
Sponsor: 01.07 Business, Management & General Legal Education, 07.02 HVAC&R Contractors and Design Build Firms
Chair: E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

Long ago in a land not too far away, TC 1.7 published the ASHRAE Survival Guide to Design-Build. Well, since that time, the design build (DB) delivery method has exploded. In Atlanta we listened to the members share their questions and sorrows with DB. In this seminar the speakers give the audience a first look at the new, improved and updated Design-Build Survival Guide.

1. The Design Build Survival Guide 2015
E. Mitchell Swann, P.E., Member, *MDC Systems, Paoli, PA*

2. The Design Build Survival Guide II: The Contractor's Story
James Fields, Member, *Superior Mechanical Services, Inc, Greensboro, NC*

1:00 PM-2:00 PM

SEMINAR 56 (BASIC)

Avoiding Pesky Pitfalls Integrating Seismic and Sound Control

Track: Design Build
Room: S331BC
Sponsor: 02.07 Seismic and Wind Restraint Design, 7.02 HVAC&R Contractors and Design Build Firms, 02.06 Sound and Vibration Control
Chair: Monte Troutman, P.E., Member, Mechanical Systems, Inc. & Mechanical Solutions LLC., Owensboro, KY

This session presents the advantage of integrating seismic compliance and sound control early in the design build process. Design of building systems for seismic, wind, sound and vibration control is generally delegated to some point later in the project. After all, it is not exactly essential to the design of the HVAC, controls, electrical or other systems. But what happens when this seemingly non-essential item is overlooked until late in the game? Now the cost to meet code compliance and/or owner demands becomes more than budgeted. The speakers discuss how to avoid these pitfalls.

1. Taking the Evil Out of Necessary Evil of Design for Seismic Compliance
Robert E. Simmons, P.E., Member, *Petra Seismic Design, LLC, Houston, TX*

2. Preventing Sound and Vibration Problems
Jerry Lilly, P.E., Member, *JGL Acoustics, Issaquah, WA*

2:30 PM-3:30 PM

WORKSHOP 5 (INTERMEDIATE)

Design-Build for DDC: Yes, It Works! No, It Doesn't! A Healthy Debate by Two Experts

Track: Design Build
Room: S331BC
Sponsor: 01.04 Control Theory and Application
Chair: Frank Shadpour, P.E., HFDP, Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

Those who recommend Design-Build for every situation need to be careful. When it comes to DDC, Design-Build may not be the best solution. Some general contractors claim that the controls subcontractor is no different than the drywall subcontractor, and if a Design Build delivery method works for one, it should work for all. Our speaker feels strongly that a Design-Build scenario is the best solution for today's DDC systems. "I beg to differ," says our other speaker. Categorizing drywall and DDC subcontractors under the same umbrella spells trouble. Join us for a healthy discussion.

1. Yes, It Works!
Brian Allen, Member, Engineering, ATS Automation, Renton, WA, U.S.

2. No, It Doesn't!
George Gemberling III, Member, County of Riverside, Riverside, CA

3:45 PM-5:15 PM

SEMINAR 57 (INTERMEDIATE)

How Does the Criterion Engineer's Role Affect the Design Build Contractor's and Design Build Engineer's Roles during All Phases of a Design Build Project?

Track: Design Build
Room: S331BC
Sponsor: 09.01 Large Building Air-Conditioning Systems
Chair: Alonzo Blalock, P.E., Member, Jacobs Engineering, Fort Worth, TX

Building owners will often retain a criterion engineer (CE) to establish the initial design criteria for a project. The CE will create documents that will be handed off to the design build contractor. After this, the role of the CE can vary. The direction of the project can be very dependent on the CE involvement after bridging documents are completed. This seminar discusses the issues that can arise as the owner and design build contractor interpret the bridging documents and how open or closed a line of communication is with the CE during all phases of a design build project.

1. Criterion Engineer's Role in a Design Build Project
Phillip M. Trafton, *Donald F. Dickerson Associates, Van Nuys, CA*

2. Who Holds the Risk: The Criterion Engineer, the Design Build Contractor or the Design Build Engineer?
John Kuempel, P.E., Member, *DeBra-Kuempel, Cincinnati, OH*

3. How Can the Design/Build Engineer Effectively Work with the Criterion Engineer on a Design/Build Project?
Jessica Mangler, P.E., Member, *Ross & Baruzzini, St. Louis, MO*

Wednesday, January 27

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 7 (INTERMEDIATE)

Advancements in Energy Modeling

Track: Fundamentals and Applications
Room: Orange Ballroom E
Chair: Scott A. Martin, P.E., Hill Engineers Architects Planners, Inc., Dalton, MA

Energy modeling is a quickly changing field of expertise. The papers in this session focus on software that streamlines the process of taking systems from a building information model (BIM) into a building energy simulation (BES), a study focusing on the development of control-oriented thermal models for an actively charged/discharged phase change material thermal energy storage (PCM TES) system intended for building integration, and a study of the dynamic response of low mass residential buildings and their respective space heating peak demands for different room temperature set point profiles.

1. Development of a Reference Building Information Model for Thermal Model Compliance Testing (RP-1468) Part 1: Guidelines for Generating Thermal Model Input Files (OR-16-020)
Mark Clayton, Ph.D., *Sandeep Kota, Francisco Farias, WoonSeong Jeong, Jong Bum Kim, Jose Luis Bermudez Alcocer, Wei Yan, Ph.D. and Jeff S. Haberl, Ph.D., P.E., BEMP, Fellow ASHRAE, Texas A&M University, College Station, TX*

2. Development of Reduced Order Thermal Models of Building Integrated Active PCM-TES (OR-16-021)
Vasken Dermardiros[1], *Yuxiang Chen, Ph.D.2, Ahmed Daoud, Ph.D.3 and Andreas Athienitis, Ph.D., P.E., Member1, (1)Concordia University, Montreal, QC, Canada, (2)University of Alberta, Edmonton, AB, Canada, (3)Hydro Quebec, Shawinigan, QC, Canada*

3. Impact of Thermal Model Resolution on Peak Heating Demand Calculation under Different Set Point Profiles (OR-16-022)
Jennifer A. Date[1], *Yuxiang Chen, Ph.D.2, Andreas K. Athienitis, Ph.D., P.E., Member1 and Michael Fournier3, (1)Concordia University, Montreal, QC, Canada, (2)University of Alberta, Edmonton, AB, Canada, (3)Hydro-Quebec LTE, Shawinigan, QC, Canada*

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 8 (ADVANCED)

IEA Annex 61 Deep Energy Retrofit, Part 2: The Path to Net Zero

Track: Fundamentals and Applications
Room: Orange Ballroom F
Chair: Alexander M. Zhivov, Ph.D., Member, US Army Corps of Engineers, Champaign, IL

Building energy use is tracked in many different forms—EUI, Co2, kwh and more—by facilities. This session provides insight into the techniques used in new and renovated buildings around the world to reduce their energy consumption on a path to net zero. The papers deal with HVAC, lighting, envelope, plug loads and other systems and their impact on the overall energy use. Multiple methods of validating the field information are discussed.

1. Evaluation of Building Retrofit Strategies in Different Climate Zones (OR-16-023)
Runming Yao, Ph.D., Member[1], *Mehdi Shahrestani, Ph.D., Student Member[1], Baizhan Li, Ph.D.[2], Xinyi Li2 and Shiyu Han[1], (1)School of Construction Management and Engineering, University of Reading, Reading, United Kingdom, (2)Chongqing University, Chongqing, China*

2. Thermal Bridge Mitigation in Army Buildings (OR-16-024)
A. Pagan-Vazquez, P.E.[1], *M. Lawton, P.Eng., Member[2], D. Chu, Member1, J. Yu[3], John Straube, Ph.D., Associate Member[4], Bob Ryan[5] and S. Lux[3], (1)US Army Corps of Engineers, Champaign, IL, (2) Morrison Hershfield, Vancouver, BC, Canada, (3)Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL), Champaign, IL, (4)University of Waterloo, Waterloo, ON, Canada, (5)Passive House Academy, Brooklyn, NY*

3. EU Project "School of the Future:" Refurbishment of School Buildings towards Zero Emission with High Performance Indoor Environment (OR-16-025)
Kirsten Engelund Thomsen, CEng[1], *Heike Erhorn-Kluttig[2], Hans Erhorn, Member[2], Stephan Kempe, Ph.D.[3], Christoph Hofle[3] and Jurgen Gorres, Ph.D.3, (1)Danish Building Research Institute, AAU, Copenhagen, Denmark, (2)Fraunhofer Institute for Building Physics, Stuttgart, Germany, (3)Office for Environmental Protection, Stuttgart, Germany*

4. Empirical Energy Performance Evaluation of a High Performance Office Building in U.S. Midwest (OR-16-026)
Xiaohui (Joe) Zhou, Ph.D., P.E., Member[1], *Ran Liu, Ph.D., Associate Member[2], Scott Lochhead, P.E.[2] and Nicholas J. Haberl[2], (1)Iowa Energy Center, Ames, IA, (2)Iowa Energy Center, Ankeny, IA*

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 18 (INTERMEDIATE)

New Methods for Airflow Determination and Building Pressurization

Track: Systems and Equipment
Room: Orange Ballroom C
Chair: Devin A. Abellon, P.E., Member, Uponor, Phoenix, AZ

This session addresses various aspects of airflow control within buildings. Fire and smoke damper code requirements are summarized and helpful tips provided. Trend data are used to estimate outdoor airflow using a virtual flow meter with results validated by a case study. A comparison of building pressurization using cascade controls and conventional controls is provided and airflow uniformity through air-handling units is predicted using computational fluid dynamics software. Wind-driven roof ventilators have been used with evaporative cooling and fabric ducts to provide ventilation and thermal comfort conditions in industrial settings in hot climates.

1. Understanding Fire and Smoke Damper Application Requirements (OR-16-C066)
Stephen W. Duda, P.E., BEAP, HBDP and HFDP, *Fellow ASHRAE, Ross & Baruzzini, Inc., St. Louis, MO*

2. Virtual Outdoor Airflow Meter for the Ongoing Commissioning of HVAC Systems: Lessons from a Case Study Building (OR-16-C067)
Nunzio Cotrufo[1], *Lorenzo Natale[2] and Radu Zmeureanu, Ph.D., P.E., Member[1], (1)Concordia University, Montreal, QC, Canada, (2)INSA-Strasbourg, Strasbourg, France*

3. Performance Comparison of Cascade Control with Conventional Controls in Air-Handling Units for Building Pressurization (OR-16-C068)
Kaustubh Phalak[1] *and Gang Wang, Ph.D., P.E.[2], (1)University of Miami, Coral Gables, FL, (2)University of Miami, Coral Gables, FL*

4. HVAC Solution with Evaporative Cooling System and Wind-Driven Roof Ventilator Systems (OR-16-C069)
Dinesh Jaikumar, J.D., *SunGreen Ventilation Systems P Ltd, Chennai, India*

5. Application of Computational Fluid Dynamics in the Optimization of Airflow through an Air-Handling Unit (OR-16-C070)
Andrew Byl, Student Member, *Kevin L. Amende, P.E., Associate Member and Erick L. Johnson, Ph.D., Montana State University, Bozeman, MT*

8:00 AM-9:30 AM

SEMINAR 58 (INTERMEDIATE)

Considering Occupancy Behavior in Design and Operation for Residential Buildings

Track: Modern Residential Systems
Room: Orange Ballroom A
Sponsor: 07.05 Smart Building Systems
Chair: Bing Dong, Associate Member, University of Texas at San Antonio, San Antonio, TX

Building energy consumption is a systematic procedure comprehensively influenced by not only engineering technologies, but also cultural concept, occupant behavior and social equity, etc. People spend more than 90% of time in buildings and as a result occupancy behavior becomes a leading factor that affects building energy consumption, particularly in residential buildings, but it is quite often oversimplified. Hence, having a better understanding, description and model of occupant behavior in residential buildings can improve the accuracy of building simulations and guide the design and operation of buildings. This forum is part of IEA EBC Annex 66 activities.

1. Logical, but Not Predictable: A Story of Three High-Rise Residential Building Occupant Studies
Liam O'Brien, Ph.D., Associate Member, *Carleton University, Ottawa, ON, Canada*

2. Occupant Control Behavior of Low-Temperature Air Source Heat Pump in Chinese Rural Housing: What Does It Mean to Thermal Comfort and Energy Consumption?
Xudong Yang, Ph.D., Fellow ASHRAE, *Tsinghua University, Beijing, China*

3. Beyond Technology: Improving Occupants' Energy Efficiency Behaviors through Social-Psychological Analysis
Chien-fei Chen, Ph.D., *University of Tennessee, Knoxville, TN*

4. Investigation of Occupancy Behavior in Residential Buildings
Bing Dong, Associate Member, *University of Texas at San Antonio, San Antonio, TX*

8:00 AM-9:30 AM

SEMINAR 59 (INTERMEDIATE)

Simulation Calibration Methods: Which Should I Choose?

Track: The Great Debate
Room: Orange Ballroom G
Sponsor: 04.07 Energy Calculations
Chair: Jaya Mukhopadhyay, Ph.D., Member, Texas A&M University, College Station, TX

This seminar presents the different techniques that are available for calibrating simulation models. The seminar also presents the ongoing research that has been conducted to develop methods to test calibration techniques.

1. Calibration of Building Energy Simplified Simulation Models: Approaches and Applications
Juan-Carlos Baltazar, Ph.D., P.E., BEMP, Member, *Texas A&M University, College Station, TX*

2. Bayesian Calibration: Calibrating Energy Models with Uncertainty
Ralph Muehleisen, Ph.D., P.E., Member, *Argonne National Laboratory, Lemont, IL*

3. Autotune Calibration and Trinity Test Evaluation
Joshua New, Ph.D., Member, *Oak Ridge National Laboratory, Oak Ridge, TN*

4. A Method of Test for Evaluating the Efficacy of Model Calibration Techniques
Ron Judkoff, Member[1], *Joel Neymark, P.E., Member[2] and Ben Polly[1], (1)National Renewable Energy Laboratory, Golden, CO, (2)J. Neymark & Associates, Golden, CO*

8:00 AM-9:30 AM

SEMINAR 60 (INTERMEDIATE)

Do You Know What You Are Breathing? Contaminants of Emerging Concern

Track: Fundamentals and Applications
Room: Orlando Ballroom V
Sponsor: 02.03 Gaseous Air Contaminants and Gas Contaminant Removal Equipment, SSPC 62.1, Environmental Health Committee
Chair: Kyung-Ju Choi, Clean & Science, Des Plaines, IL

Semi-volatile organic compounds (SVOCs), such as phthalates, organophosphates and siloxanes, are contaminants of emerging concern. Such chemicals are widely used as plasticizers, insecticides and flame retardants in building materials and consumer products used in households, such as antiperspirants, skin- and hair-care products, cosmetics and detergents. SVOCs are becoming more of a concern due to their widespread usage and potential health effects, such as endocrine disruption and cancer. The health effects of a specific SVOC depend on its chemical nature and the degree of exposure, which can occur through a combination of ingestion, respiration and skin absorption.

1. Emission and Transport of Phthalates in Indoor Environments
Ying Xu, Ph.D., Member, *The University of Texas at Austin, Austin, TX*

2. SVOC Transport in the Vicinity of Human Body
Donghyun Rim, Ph.D., *Pennsylvania State University, University Park, PA*

3. Contaminants of Emerging Concern: Siloxanes and Indoor Air Quality
Chang-Seo Lee, Ph.D., Associate Member, *Concordia University, Montreal, QC, Canada*

8:00 AM-9:30 AM

SEMINAR 61 (INTERMEDIATE)

Improving the Efficiency of Low-GWP Commercial Refrigeration Systems

Track: Systems and Equipment
Room: Orange Ballroom D
Sponsor: 10.07 Commercial Food and Beverage Cooling Display and Storage, MTG.LowGWP , 03.01 Refrigerants and Secondary Coolants
Chair: Shitong Zha, Ph.D., Member, HILLPHOENIX, Conyers, GA

Commercial refrigeration systems are searching for low-GWP refrigerant options due to the environmental responsibility and governmental regulations to limit the use of high-GWP refrigerants. Energy efficiency is very important in the refrigerant transition. The seminar covers commercial refrigeration systems using both natural refrigerant and low-GWP synthetics. How to increase R744 system efficiency when it operates at elevated ambient temperature? What is the R744 system with ejector technology? What is the Hybrid Geothermal R744 system? How to change the equipment design and control of low-GWP synthetics refrigeration to improve energy efficiency?

1. Commercial Refrigeration Applying R744 Refrigeration Technologies: A Global Perspective
Armin Hafner, Ph.D., *SINTEF, Trondheim, GA*

2. Energy Efficiency Improvements for Refrigeration Systems with Low-GWP Refrigerants
Michael Petersen, Associate Member, *and Gustavo Pottker, Member, Honeywell – Buffalo Research Laboratory, Buffalo, NY*

3. Hybrid Geothermal R744: An Alternative to Transcritical Booster Technology
Jason Robbins, P.E., Member, *Walgreens, Inc., Deerfield, IL*

4. Beverage Vending Machines: An Alternative Refrigerant to "Chill out" with
Sean Gouw, Associate Member, *Southern California Edison, Irwindale, CA*

8:00 AM-9:30 AM

SEMINAR 62 (INTERMEDIATE)

Variable Refrigerant Flow Systems: Best Practices for System Efficiency and Longevity

Track: Systems and Equipment
Room: Orange Ballroom B
Sponsor: 07.03 Operation and Maintenance Management
Chair: Mike Gallagher, P.E., Member, Western Allied Corp., Santa Fe Springs, CA

This seminar covers best practices in variable refrigerant flow (VRF) from the perspective of the manufacturer (OEM), facility manager and service contractor. Installation, operation and maintenance of VRF systems are discussed, including: skill requirements for VRF systems compared to conventional systems, installation best practices, manufacturer specific training, utilizing manufacturer service tools for ongoing maintenance and commissioning. A case study is presented from the owner's perspective at a hotel where VRF systems were recently installed to replace conventional systems.

1. VRF Training: Perspective from the Original Equipment Manufacturer
Bill Artis, *Daikin Applied, New York, NY*

2. VRF Maintenance: Perspective from the Original Equipment Manufacturer
Paul Doppel, *Mitsubishi Electric, Suwanee, GA*

3. VRF Operatiions and Maintenance: Perspective from the Facility Manager
John Caracciola, *Concorde Hotel, New York, NY*

4. VRF Maintenance: Perspective from the Service Contractor
Mike Gallagher, P.E., Member, *Western Allied Corp., Santa Fe Springs, CA*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 9 (INTERMEDIATE)

Air Side System Performance

Track: Systems and Equipment
Room: Orlando Ballroom V
Chair: Alamelu Brooks, BEAP, HBDP, ICF International, Columbia, MD

Analysis of data from a study of fan-powered terminal units indicated that leakage rates depend mainly on the downstream pressure and could be grouped into low, medium and high airflow rate values that can be included into building simulation tools. Two control methods were evaluated to

Tech Program

prevent reverse airflow through relief air dampers, return fan speed control and static pressure were two of the inputs required. Although mechanical ventilation systems are designed to provide adequate ventilation air to an occupant, recent measurements show that the convective boundary layer around a human body greatly influences the local transport of contaminants that may not be predicted by room airflow models.

1. Characterizing Air Leakage in Parallel Fan-Powered Terminal Unit (OR-16-027)
Dennis L. O'Neal, Ph.D., P.E., Fellow ASHRAE[1] *and Jacob L. Edmondson[2], (1)Baylor University, Waco, TX, (2)New York University Abu Dhabi, Abu Dhabi, United Arab Emirates*

2. Reverse Relief Airflow Prevention and Building Pressurization with a Decoupled Relief Air Damper in Air-Handling Units (OR-16-028)
Gang Wang, Ph.D., P.E. *and Kaustubh Phalak, University of Miami, Coral Gables, FL*

3. The Air Velocity, Temperature and Pollution Distribution around the Human Body (OR-16-029)
Dusan Licina[1], *Arsen Melikov, Ph.D., Fellow ASHRAE[2], Know Wai Tham, Ph.D.[3] and Chandra Sekhar, Ph.D., Fellow ASHRAE[3], (1) University of California Berkeley, Berkeley, CA, (2)Technical University of Denmark, Kongens Lyngby, Denmark, (3)National University of Singapore, Singapore, Singapore*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 10 (INTERMEDIATE)

Commercial Hot Water Use Research

Track: Fundamentals and Applications
Room: Orange Ballroom G
Sponsor: 06.06 Service Water Heating Systems
Chair: Wade Conlan, P.E., Member, Exp, Maitland, FL

The three papers in this session are the result of an ASHRAE research project that provided more recent information on hot water demand and usage patterns in two types of hotels, those with meeting rooms and a commercial food service kitchen and those without. The first paper provides an overview of the methodology used in the study. The second and third papers present the results of the data collected that resulted in a new hotel hot water system sizing procedure.

1. Hot Water Use in Hotels (Results of ASHRAE RP 1544) Part 1: Hotel Hot Water System Monitoring Techniques (OR-16-030)
Russell Johnson[1] *and Carl C. Hiller, Ph.D., P.E., Fellow ASHRAE[2], (1)Johnson Research LLC, Pueblo West, CO, (2)Applied Energy Technology, Davis, CA*

2. Hot Water Use in Hotels (Results of ASHRAE RP 1544) Part 2: Travel Hotel Hot Water System Monitoring Results (OR-16-031)
Carl C. Hiller, Ph.D., P.E., Fellow ASHRAE[1] *and Russell Johnson[2], (1)Applied Energy Technology, Davis, CA, (2)Johnson Research LLC, Pueblo West, CO*

3. Hot Water Use in Hotels (Results of ASHRAE RP 1544) Part 3: Business Hotel Hot Water System Monitoring Results (OR-16-032)
Carl C. Hiller, Ph.D., P.E., Fellow ASHRAE[1] *and Russell Johnson[2], (1)Applied Energy Technology, Davis, CA, (2)Johnson Research LLC, Pueblo West, CO*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 19 (INTERMEDIATE)

Challenges and Opportunities in Residential Construction

Track: International Design
Room: Orange Ballroom F
Chair: Jason Urso, P.E., Member, Tighe & Bond, Westfield, MA

The papers in this session describe issues with residential construction and energy use in three continents. A survey of residential energy use in Greece provides an existing database that can be used as the basis for additional EU requirements. A simulation approach was used to determine cost-effective means for further energy reduction in Toronto homes. The cold climate in Korea along with energy conservation measures have led to interior moisture condensation problems on windows. A new Korean design standard is discussed that addresses this issue.

1. Bottom-up Assessment of Hellenic Residential Building Stock Energy Performance (OR-16-C071)
Constantinos Balaras, Ph.D., Fellow ASHRAE[1], *Elena G. Dascalaki, Ph.D., Member[2], Kaliopi G. Droutsa[2] and Simon Kontoyiannidis[2], (1)Group Energy Conservation IERSD, Palea Penteli, Greece, (2)Institute for Environmental Research & Sustainable Development, NOA, Athens, Greece*

2. A Multi-Objective Optimization Environment for Analysis of Passive Energy Conservation Measures in a Toronto House (OR-16-C072)
Matthew Tokarik, Student Member, *Ryerson University, Toronto, ON, Canada*

3. Condensation Resistance Evaluation of a Double-Sliding Window System in Accordance with the Korean Design Standard for Preventing Condensation in Apartment Buildings (OR-16-C073)
Sihyun Park, Member, *Minhee Kim, Jae-Han Lim, Ph.D. and Seung-Yeong Song, Ph.D., Member, Ewha Womans University, Seoul, South Korea*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 20 (INTERMEDIATE)

Thermal Storage Applications

Track: Cutting-Edge Technologies
Room: Orange Ballroom B
Chair: Joy Altwies, University of Wisconsin-Madison, Madison, WI

This session addresses three applications of thermal storage to offset energy consumption and increase building efficiency. A ventilated concrete slab is evaluated as a thermal storage to preheat outdoor air introduced into an air source heat pump system and showed an increase in the coefficient of performance (COP) and a decrease in energy consumption in the evening. Secondly a design build project utilized computational fluid dynamics (CFD) modeling to determine the number of chilled water storage tanks required to supplement chillers in the event of a power outage. Lastly, 'pre-cooling' control strategies are modeled and tested to find the temperature change and energy saving when incorporated prior to a demand response event.

1. Using Building's Thermal Mass As Short-Term Integrated Energy Storage (OR-16-C074)
Navid Ekrami, Student Member *and Alan Fung, Ph.D., P.E., Member, Ryerson University, Toronto, ON, Canada*

2. CFD Design and Validation of a Thermal Storage Tank System and Its Impact in a Design-Build Project (OR-16-C075)
Michael Kilkeary, P.E., Member, *Reza Ghias, Ph.D., Member and Robert Huston, Southland Industries, Dulles, VA*

3. Utilizing Passive Thermal Storage for Improving Residential Air-Conditioning Demand Response (OR-16-C076)
Josh R. Wall, Ph.D., Member *and Jeremy Stoddard, CSIRO Energy, Newcastle, Australia*

9:45 AM-10:45 AM

SEMINAR 63 (BASIC)

Cybersecurity for HVAC Automation Systems

Track: Cutting-Edge Technologies
Room: Orange Ballroom E
Sponsor: 01.05 Computer Applications
Chair: Mike Galler, Member, National Institute of Science and Technology, Gaithersburg, MD

Cybersecurity of HVAC controllers and networks has become a topic of increased concern, especially in light of some recent highly publicized security-related incidents (i.e. Stuxnet and similar) in the industrial controls sector. This seminar provides a range of information related to HVAC cybersecurity.

1. IEC 62443: Industrial Network and System Security Applicability to the Built Environment
Bruce Billedeaux, P.E., Member, *Maverick Technologies, Benton Harbor, MI*

2. Let's Instrument Everything and Trust It
Stacy Prowell, Ph.D.*, Oak Ridge National Laboratory, Oak Ridge, TN*

9:45 AM-10:45 AM

SEMINAR 64 (INTERMEDIATE)

Pursuing Energy Efficiency May Put Your Data Center IT At Risk

Track: Fundamentals and Applications
Room: Orange Ballroom D
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Nick Gangemi, Member, Northern Air Systems, Rochester, NY

Reducing the environmental impact of data center cooling and the cost of operation is rightly high on the agenda. However, from a business perspective, it is important to recognize that actions to save energy may impact how much IT can be installed and whether it will be resilient when redundant cooling systems fail. Similarly, deployments of IT Equipment, and their in-cabinet configuration, may impact IT resilience, future install capacity and energy efficiency. This seminar addresses how IT and Facilities Management can work together to balance all 3 parameters and meet the business need.

1. A Holistic Approach to Characterizing Mission Critical Facility Cooling Performance
Husam Alissa, *State University of New York at Binghamton, Binghamton, NY*

2. Analysis of Cooling Performance of an Enclosed Hybrid-Cooled Server Cabinet
Kourosh Nemati, *State University of New York, Binghamton, Binghamton, NY*

3. Filling the Engineering Gap: Balancing Data Center Availability, Capacity and Efficiency
Mark Seymour, *Future Facilities Ltd, London, United Kingdom*

9:45 AM-10:45 AM

FORUM 3 (INTERMEDIATE)

How Can ASHRAE Help Provide Affordable High Performance Residential Buildings in Countries with Developing Economies?

Track: Modern Residential Systems
Room: Orange Ballroom A
Sponsor: Residential Buildings Committee
Chair: Ashish Rakheja, P.E., Member, AEON Integrated Building Design Consultants LLP, Noida, India

ASHRAE has a wealth of talent that can be applied to the unique and challenging issues and opportunities in developing economies. One of the major opportunities is to provide design guidance for affordable, workable residential building solutions for these economies. This forum discusses activities of the Developing Economies Ad Hoc Committee and seeks guidance from forum participants on ways ASHRAE leadership and members can encourage and improve interactions with engineering professionals in developing economies.

9:45 AM-10:45 AM

FORUM 4 (INTERMEDIATE)

What Can We Do to Manage CKV Odor and Keep our Favorite Restaurant from Becoming an Unwelcome Neighbor?

Track: Fundamentals and Applications
Room: Orange Ballroom C
Sponsor: 05.10 Kitchen Ventilation, 02.3, 04.03 Ventilation Requirements and Infiltration
Chair: Russell Robison, Member, Gaylord Industries, Tualatin, OR

With the increasing trend of mixed-use development allowing for greater housing variety and density, the collision of residential, commercial, cultural and institutional are starting to collide. This forum focuses on presenting the challenges in managing commercial kitchen exhaust odor in mixed-use developments.

11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 11 (INTERMEDIATE)

Strategies to Improve Building Models and Operation

Track: Fundamentals and Applications
Room: Orange Ballroom G
Chair: David S. Eldridge Jr., P.E., HBDP, BEMP, BEAP, Member, Grumman Butkus Associates, Evanston, IL

This session evaluates automated schedule and operation detection in commercial buildings to help lower energy costs and operating expenses and can be evaluated using linear regression and density-based clustering. Also, outdoor air percentage are varied to develop change-point regression modeling for heating and cooling in hot and humid climates. Energy models are obviously only as reliable as the information included in the model, and this session quantifies the economic risk of unknown assumptions and evaluates passive design strategies to increase resilience when modeling high rise residential facilities with large glass loads.

1. Automated Data Mining Methods for Identifying Energy Efficiency Opportunities Using Whole-Building Electricity Data (OR-16-033)
Phillip Howard[1], *T. Agami Reddy, Ph.D., P.E., Member[2], George Runger, Ph.D.[1] and Srinivas Katipamula, Ph.D., P.E., Fellow ASHRAE[3], (1)Arizona State University, Tempe, AZ, (2)The Design School/The School of Sustainable Engineering and the Built Environment, Tempe, AZ, (3)Pacific Northwest National Laboratory, Richland, WA*

2. Determination of the Influence of Outside Air Intake Fraction on Choosing Independent Variable for Cooling Regression Modeling in Hot and Humid Climates (OR-16-034)
Xiaoli Li, *Juan-Carlos Baltazar, Ph.D., P.E., BEMP, Member and Lei Wang, Ph.D., P.E., Member, Texas A&M University, College Station, TX*

3. Optimization under Economic Uncertainty Using a Net-Zero Energy Commercial Office Case-Study (OR-16-035)
Scott Bucking, Ph.D., *Carleton University, Ottawa, ON, Canada*

4. Simulation-Based Evaluation of High-Rise Residential Building Thermal Resilience (OR-16-036)
William O'Brien, Ph.D., Member, *Carleton University, Ottawa, ON, Canada*

5. Suitability of ASHRAE Guideline 14 Metrics for Calibration (OR-16-037)
Joshua New, Ph.D., Member[1] *and Aaron Garrett, Ph.D.[2], (1)Oak Ridge National Laboratory, Oak Ridge, TN, (2)Jacksonville State University, Jacksonville, AL*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 21 (INTERMEDIATE)

Improved Control Strategies for Building Systems

Track: Fundamentals and Applications
Room: Orlando Ballroom V
Chair: Jennifer E. Leach, P.E., Member, Cummins-Wagner Co, Inc., Annapolis Junction, RI

This session evaluates smart windows incorporated into a commercial building to help reduce energy consumption, while improving thermal and visual comfort and predicts building performance while utilizing discrete and continuous Bayesian network. The session also evaluates implementing machine learning algorithms to detect abnormalities in chilled water systems and minimizing redundancy and uncertainty of parameters when performing heat transfer equipment testing.

1. Smart Windows Control Strategies for Building Energy Savings in Summer Conditions: A Comparison between Optimal and Model Predictive Controllers (OR-16-C077)
Jean-Michel Dussault, Student Member, *Maarten Sourbron, Ph.D. and Louis Gosselin, Ph.D., P.E., Member, Université Laval, Québec, QC, Canada*

2. Bayesian Network-Based HVAC Energy Consumption Prediction Using Improved Fourier Series Decomposition (OR-16-C078)
Fuxin Niu, Student Member *and Zheng O'Neill, Ph.D., P.E., Member, University of Alabama, Tuscaloosa, AL*

3. Machine Learning Algorithms for Abnormality Detection of Chilled Water Systems (OR-16-C079)
Jose E. Valenzuela del Rio, Ph.D.[1], *Yanal Issac[2], Adam Coulon[2], Scott Duncan, Ph.D.[2] and Dimitri Mavris, Ph.D.[2], (1)Superior Talent, Orlando, FL, (2)Georgia Institute of Technology, Atlanta, GA*

4. Minimizing Data Reduction Uncertainty during Heat-Transfer Equipment Testing (OR-16-C080)
Liping Liu, Ph.D., Associate Member[1], *Young-Gil Park, Ph.D., Associate Member[2] and Anthony M. Jacobi, Ph.D., Fellow ASHRAE[3], (1)Lawrence Tech University, Southfield, MI, (2)University of Texas Rio Grande Valley, Edinburg, TX, (3)University of Illinois at Urbana-Champaign, Urbana, IL*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 22 (INTERMEDIATE)

Net Zero Energy Building and Photovoltaics

Track: Cutting-Edge Technologies
Room: Orange Ballroom B

This session evaluates a net zero energy (NZE) building in severe cold weather climates and the strategies that must be considered from initial design, through construction and into building operation and describes three tiers of demand response technology integration and what the future holds for NZE buildings. The path to NZE many times relies on on-site power generation and this session evaluates the economic feasibility of photovoltaics on universities and incorporating solar concentrated photovoltaic thermal (CPVT) systems to produce electricity and thermal energy simultaneously by filtering infrared light from visual light.

1. Design Strategies for a Net Zero Energy Building in Severe Cold Climate: A Case Study for China (OR-16-C081)
Rudai Shan, Member[1], *Xiaodong Xia2 and Tiemao Shi, Ph.D.[2], (1)University of Michigan, Ann Arbor, MI, (2)Shenyang Jian Zhu University, Shenyang, China*

2. University Investments in Solar Photovoltaics: The Solar Endowment (OR-16-C082)
William Hutzel, P.E., Member *and Samuel Landry, Purdue University, West Lafayette, IN*

3. Net Zero Energy Buildings and the Grid: Designing for Success on Both Sides of the Meter (OR-16-C083)
Alexi Miller, P.E., Associate Member *and Jim Edelson, Member, New Buildings Institute, Portland, OR*

4. Appropriate Solar Spectrum Usage: The Novel Design of Photovoltaic Thermal System (OR-16-C084)
Ebrahim Elshik, *Christiaan Bester and Andre Nel, University of Johannesburg, Johannesburg, South Africa*

11:00 AM-12:30 PM

SEMINAR 65 (ADVANCED)

Compression Challenges for Low-GWP Refrigerants

Track: Systems and Equipment
Room: Orange Ballroom D
Sponsor: 08.01 Positive Displacement Compressors, Refrigeration Committee
Chair: Georgi Kazachki, Ph.D., Fellow ASHRAE, Dayton Phoenix Group, Inc., Dayton, OH

Advanced methods for modeling the compression process with low-GWP refrigerants and the associated challenges are discussed and illustrated on existing and new compressor designs.

1. Design Improvements of the Spool Compressor Using Comprehensive Modeling Techniques
Craig Bradshaw, Ph.D., Member, *Torad Engineering, Cumming, GA*

2. Design Improvements of the Spool Compressor for Various Working Fluids Using Comprehensive Modeling Techniques
Margaret Mathison, Ph.D., Member, *Marquette University, Milwaukee, WI*

3. Modeling of an Oil-Free Carbon Dioxide Compressor Using Sanderson-Rocker Arm Motion (S-RAM) Mechanism
Eckhard Groll, Dr.Ing., Fellow ASHRAE, Purdue University, West Lafayette, IN

11:00 AM-12:30 PM

SEMINAR 66 (ADVANCED)

Energy Performance Run By Data

Track: Cutting-Edge Technologies
Room: Orange Ballroom C
Sponsor: 07.06 Building Energy Performance, REHVA
Chair: Karel Kabele, Dr.Ing., Member, REHVA, Brussels, Belgium

A consistent strategy for energy saving and sustainability should benefit from the all the opportunities opened by scientific and technological development. One of the biggest challenges in a building is to find the right equilibrium between the energy demand and the well-being provided to occupants. The evolution of information and communication technologies, together with the decrease of the cost of sensors and monitoring systems, opened new perspectives. Nowadays the decision-making process is much better informed and based on performance indicators, which are widely used in energy and environmental rating systems for buildings. The experiences of European leaders will be presented

1. Data Driven IEQ Control in Low Energy Buildings
Karel Kabele, Dr.Ing., Member, REHVA, Brussels, Belgium

2. Affordable IEQ Monitoring Solutions for Small and Medium-Size Buildings
Manuel Carlos Gameiro da Silva, Dr.Ing., Member, REHVA, Brussels, Belgium

3. Occupant Behavior Monitoring and Engagement: Low Investment Measures to Optimize IEQ and Save Energy in Buildings
Stefano Corgnati, Dr.Ing., REHVA, Brussels, Belgium

4. Environmental Performance of a Building Translated into Financial Performance
Frank Hovorka, REHVA, Brussels, Belgium

11:00 AM-12:30 PM

SEMINAR 67 (INTERMEDIATE)

Simulation for Cutting-Edge Building Design

Track: Cutting-Edge Technologies
Room: Orange Ballroom F
Sponsor: 04.07 Energy Calculations
Chair: Nathaniel Jones, MIT, Boston, MA

Cutting-edge simulation techniques have the power to expose design ideas that can radically reduce energy demands starting from an early point in the design process. However, integrating new simulation methods into existing design practices requires both creativity and depth of knowledge on the part of designers. This seminar brings together three experts from the industry to present how they have integrated advanced simulation techniques to increase energy efficiency, reduce resource consumption and further the design goals of a number of projects.

1. Modeling a Building Before It Has Been Designed: Cloud-Based Pre-Simulation to Build a Multi-Parameter Design Space
Arpan Bakshi, *Affiliate, Skidmore, Owings & Merrill LLP (SOM), N ew York, NY*

2. High Performance Computing in the Design Modeling Process
Jeffrey Boyer, Member, *University of Michigan, Ann Arbor, MI*

3. Designing an Energy and Water Efficient Hotel Using an Equation-Based Modeling Approach
Reymundo J. Miranda, P.E.[1], *Sen Huang, Student Member[2] and Wangda Zuo, Ph.D., Member[2], (1)UCI Engineering, Miami, FL, (2) University of Miami, Coral Gables, FL*

11:00 AM-12:30 PM

SEMINAR 68 (INTERMEDIATE)

Net Zero Energy Home Strategies from Coast to Coast

Track: Modern Residential Systems
Room: Orange Ballroom A

Sponsor: 04.03 Ventilation Requirements and Infiltration, Residential Buildings Committee, 02.08 Building Environmental Impacts and Sustainability

Chair: Dianne Griffiths, P.E., Member, Steven Winter Assoc., Norwalk, CT

Affordable and healthy high performance net zero energy (NZE) homes that combine energy efficiency improvements with onsite renewable energy production are possible throughout the country. However, it can be difficult to determine the appropriate strategy for achieving NZE performance while maintaining acceptable occupant comfort and indoor air quality. This seminar discusses technology issues and local conditions and practices and provides design guidance and cost-optimal performance packages that are applicable locally, regionally and nationally. Modeling tools, an experimental facility and real-world examples of affordable net zero energy home design packages are reviewed.

1. Ventilation and Indoor Air Quality in a Net Zero Energy Residential Test Facility
Lisa Ng, Ph.D., Member, *National Institute of Standards and Technology, Gaithersburg, MD*

2. Least-Cost Pathway to Net Zero Energy Homes
Jon Winkler[1] *and Dane Christensen, Ph.D.[1], (1)National Renewable Energy Laboratory, Golden, CO*

3. Natural Gas Options for Net Zero Energy Homes
Sue Kristjansson, *Southern California Gas Co., Los Angeles, CA*

11:00 AM-12:30 PM

SEMINAR 69 (INTERMEDIATE)

The Future of Demand Control Kitchen Ventilation (DCKV) and the Impact of Recent Significant Changes to Relevant Codes and Standards

Track: Standards, Guidelines and Codes
Room: Orange Ballroom E

Sponsor: 05.10 Kitchen Ventilation

Chair: Michael Watz Jr., P.E., Member, Greenheck Fan Corp, Schofield, WI

This seminar describes case studies of integrating demand control kitchen ventilation (DCKV) with energy management system (EMS). In addition, the session covers changes related to DCKV in California Title 24 and ASHRAE 90.1 and updates to UL 710 Exhaust Hoods for Commercial Cooking Equipment and ANSI/ASHRAE Standard 154 Ventilation for Commercial Cooking Operations.

1. Integrating DCKV with EMS: A Field-Study Perspective!
Don Fisher, P.Eng., *Life Member, Food Service Technology Center, San Ramon, CA*

2. The Role DCKV Plays within the Energy Efficiency Goals of Standard 90.1, California Title 24 and the Model Codes
Richard T. Swierczyna, Associate Member, *Food Service Technology Center, San Ramon, CA*

3. Impacts of Changes in Commercial Kitchen Ventilation Codes and Standards with a Focus on UL710, "Exhaust Hoods for Commercial Cooking Equipment"
Dwayne Sloan, UL LLC, *Research Triangle Park, NC*

4. Recent Updates to ASHRAE Standard 154 Ventilation for Commercial Cooking Operations
Stephen Brown, Member, *LC Systems Inc, Louisville, KY*

(Orlando Sustainability Project– continued from page 25)

C. DOAS with existing fan coils and chillers – we did not want to pursue this option alone because their energy costs will increase, and the water condition and usage of the cooling tower remains unchanged.

D. DOAS with DX split systems – we did not pursue this option because the space required for all separate condensing units will not fit the project site.

E. DOAS with Packaged Terminal Air Conditioners (window shaker A/C units) – we did not pursuing this option because it will not reduce their energy costs.

F. Rooftop Air Conditioners on grade with ducted VAV – we did not pursuing this option due to lack of ceiling space.

Along with the HVAC replacement project (Option A being selected), the design team has also determined to replace the old fuel oil boiler system which is costing WRCC over $1,000 in monthly fuel costs. The old system was used for both space heating and domestic heating. Leaky radiators and underground piping in the space heating portion of the system is a culprit for the high fuel costs and constantly running boiler. Natural gas is provided to the site by the utility company and a state of the art condensing boiler has been generously donated at no cost by equipment vendor for replacement. We feel this measure alone will ensure a quick overall payback of the project.

Project funding and awareness campaigns have already begun to support this project. All design phase services and commissioning services for project have been donated by local Central Florida engineering firms. The Coalition for the Homeless, in partnership with USGBC-CFL, has hosted an evening gala with a silent auction of donated gifts. They are also submitting an application for grant funding through the USGBC. The ASHRAE Central Florida Chapter is highlighting this project at our January 9th 2014 Technical meeting as a joint-meeting with USGBC-CFL. The program introduced this project to our membership and was presented from a technical perspective: using the WRCC campus as an example, a panel of energy modelers compared techniques and outputs of various popular energy modeling software tools and programs.

In addition, we anticipate directing our Resource Promotions fundraising efforts to be directed to aide in the funding of this project.

SOCIETY COMMITTEE MEETINGS

All rooms with names, i.e., Lake Down, Pocket Lake, Orange Ballroom are located in the Hilton. All rooms with a number, i.e., S331, are located in the Orange County Convention Center which is a short walk from the Hilton via the covered footbridge. All rooms at the Orange County Convention Center are in the South Building. The Lobby at the Hilton is indicated as (L) and the Lower Level at the Hilton is indicated as (LL). Subcommittees are indented.

AEDG Steering Committee (10/10)
Monday (1/25) 2:15 pm – 5:00 pm Winter Park Bdrm (L)

Appointments Roadmap (22/0)
Sunday (1/24) 7:00 am – 8:00 am Conway Lake (L)

ASHRAE Foundation (25/10)
Monday (1/25) 7:30 am – 9:30 am Lake Sheen A (L)

ASHRAE Foundation Executive Subcommittee (10/5)
Saturday (1/23) 1:30 pm – 3:00 pm Celebration Bdrm (L)

ASHRAE/AHRI Joint Expo (25/10)
Sunday (1/24) 9:00 am – 11:00 am Lake Florence A (L)

Associate Society Alliance (65/70)
Monday (1/25) 4:15 pm – 6:15 pm Orlando Ballroom III (LL)

Associate Society Alliance Subcommittee (40/15)
Sunday (1/24) 1:30 pm – 4:30 pm Championsgate Bdrm (L)

Audit Committee (5/3)
Friday (1/22) 3:30 pm – 5:00 pm Bay Hill Bdrm (L)

Board of Directors (32/75)
Sunday (1/24) 1:30 pm – 5:30 pm Orlando Ballroom II (LL)
Wednesday (1/27) 2:00 pm – 6:00 pm Orlando Ballroom III (LL)

Board Planning (25/25)
Friday (1/22) 1:00 pm – 6:00 pm S319 (3)

Broadcasting ASHRAE Impact and Key Constituency Leadership Outreach Ad Hoc (12/6)
Saturday (1/23) 8:00 am – 10:00 am Lake Virginia B (L)

Building Energy Quotient Committee (15/15)
Sunday (1/24) 8:30 am – 11:30 am Clear Lake (L)

bEQ Marketing (5/5)
Saturday (1/23) 12:30 pm – 1:30 pm Winter Park Bdrm (L)

bEQ Methodology (5/5)
Saturday (1/23) 1:30 pm – 2:30 pm Winter Park Bdrm (L)

Building Envelope Committee (30/0)
Monday (1/25) 9:00 am – 12:00 pm Lake Highland B (L)

Building Performance Alliance Ad Hoc Committee (16/6)
Tuesday (1/26) 3:00 pm – 4:00 pm Lake Down A (L)

Certification (12/12)
Saturday (1/23) 8:00 am – 12:00 pm College Park Bdrm (L)

Chapter Technology Transfer Committee (30/15)
Friday (1/22) 8:00 am – 12:00 pm S310H (3)
Saturday (1/23) 8:00 am – 12:00 pm Lake Down B (L)

Chapter Technology Transfer Member Services (12/5)
Friday (1/22) 1:00 pm – 5:00 pm S321 (3)

Chapter Technology Transfer Operations (10/15)
Friday (1/22) 1:00 pm – 5:00 pm S310H (3)

Chapter Technology Transfer Executive (5/0)
Friday (1/22) 5:00 pm – 6:00 pm S310H (3)

Chapter Volunteerism and Engagement Presidential Ad Hoc (12/0)
Monday (1/25) 2:15 pm – 3:45 pm

CIBSE/ASHRAE Liaison (25/10)
Wednesday (1/27) 9:30 am – 12:00 pm Lake Down A (L)

CLIMA (12/0)
Saturday (1/23) 12:30 pm – 1:30 pm Lake Monroe B (L)

College of Fellows (25/5)
Sunday (1/24) 10:00 am – 12:00 pm Lake Highland B (L)

College of Fellows: Advisory Committee (15/5)
Sunday (1/24) 9:00 am – 10:00 am Lake Highland B (L)

Conferences and Expositions Committee (30/10)
Saturday (1/23) 8:00 am – 3:00 pm Lake Highland B (L)

Conferences and Expositions Executive (30/5)
Friday (1/22) 1:00 pm – 3:00 pm S310D (3)

Conferences and Expositions Annual and Winter Meetings (30/5)
Friday (1/22) 3:00 pm – 6:00 pm S310D (3)

CRC/Centralized Training Ad Hoc (15/20)
Monday (1/25) 8:00 am – 10:00 am Lake Down A (L)

Development Committee (24/10)
Monday (1/25) 9:45 am – 11:45 am Lake Sheen A (L)

Director and Regional Chairs (15/20)
Friday (1/22) 11:00 am – 1:00 pm S319 (3)
Wednesday (1/27) 12:00 pm – 2:00 pm Lake Concord B (L)

Electronic Communications Committee (12/10)
Saturday (1/23) 8:00 am – 3:00 pm Lake Virginia A (L)

Energy Efficiency in Buildings Position Document (10/0)
Tuesday (1/26) 3:00 pm – 4:00 pm Winter Park Bdrm (L)

Environmental Health (20/20)
Monday (1/25) 2:15 pm – 6:15 pm Lake Florence A (L)

Environmental Health Executive (20/20)
Monday (1/25) 7:00 am – 8:00 am Lake Florence A (L)

Environmental Health Handbook/Policy (20/20)
Monday (1/25) 8:00 am – 10:00 am Lake Florence A (L)

Environmental Health Program/Research (20/20)
Monday (1/25) 10:00 am – 12:00 pm Lake Florence A (L)

Executive Committee (22/12)
Saturday (1/23) 8:30 am – 1:00 pm Lake Concord A (L)
Wednesday (1/27) 7:30 am – 9:00 am Lake Concord A (L)
Thursday (1/28) 7:30 am – 11:00 am Bay Hill Bdrm (L)

Finance Committee (12/12)
Friday (1/22) 8:00 am – 1:00 pm OCCC– S331C (3)

Finance Investment Subcommittee (4/0)
Thursday (1/21) 5:00 pm – 7:00 pm Key Largo C (LL)

Finance Planning Subcommittee (8/8)
Thursday (1/21) 5:00 pm – 7:00 pm Key Largo B (LL)

Grassroots Government Advocacy Committee (35/30)
Saturday (1/23) 8:00 am – 12:15 pm Lake Eola B (L)

Grassroots Government Advocacy Executive (20/10)
Friday (1/22) 10:00 am – 12:00 pm S330A (3)

GGAC: Active Outreach Subcommittee (15/10)
Friday (1/22) 1:00 pm – 2:30 pm S330A (3)

GGAC: Responsive Engagement Subcommittee (15/10)
Friday (1/22) 1:00 pm – 2:30 pm S330B (3)

GGAC: Ad Hoc for MBO 1 (10/5)
Friday (1/22) 2:45 pm – 4:15 pm S330A (3)

GGAC: Ad Hoc for MBO 6 (10/5)
Friday (1/22) 2:45 pm – 4:15 pm S330B (3)

GGAC: Ad Hoc for MBO 2 (10/5)
Friday (1/22) 4:30 pm – 6:00 pm S330A (3)

GGAC: Ad Hoc for MBO 4 (10/5)
Friday (1/22) 4:30 pm – 6:00 pm S330B (3)

Handbook Committee (30/15)
Sunday (1/24) 10:30 am – 1:00 pm Lake Eola A (L)

Handbook Excom (5/5)
Saturday (1/23) 1:00 pm – 2:00 pm Ruby Lake (L)

Handbook Strategic Planning (5/5)
Saturday (1/23) 2:00 pm – 3:00 pm Ruby Lake (L)

Handbook Electronic Media (5/0)
Sunday (1/24) 8:00 am – 9:00 am Lake Eola A (L)

Handbook Functional (5/0)
Sunday (1/24) 8:00 am – 9:00 am College Park Bdrm (L)

Handbook International (5/5)
Sunday (1/24) 8:00 am – 9:00 am Heathrow Bdrm (L)

Handbook Training Workshop (50/0)
Sunday (1/24) 8:00 am – 9:00 am Turkey Lake (L)
Handbook 2017 Fundamentals/TCs Volume Subcommittee (15/0)
Sunday (1/24) 9:00 am – 10:00 am Lake George A (L)
Handbook 2018 Refrigeration Subcommittee (15/0)
Sunday (1/24) 9:00 am – 10:00 am Lake George B (L)
Handbook 2019 HVAC Applications TCs/Volume Subcommittee (15/0)
Sunday (1/24) 9:00 am – 10:00 am Lake Monroe A (L)
Handbook Volume Subcommittees (25/0)
Sunday (1/24) 10:00 am – 10:30 am Lake Eola A (L)

Historical Committee (20/0)
Sunday (1/24) 8:30 am – 12:00 pm Lake Concord B (L)

Honors & Awards (15/0)
Sunday (1/24) 1:00 pm – 5:00 pm Lake Virginia B (L)
Monday (1/25) 2:15 pm – 5:30 pm Lake Concord A (L)

IAQ 2016 Steering Committee (16/10)
Tuesday (1/26) 3:00 pm – 4:00 pm Lake Concord A (L)

IEQ–GA (20/0)
Tuesday (1/26) 4:00 pm – 5:30 pm Lake Concord A (L)

Indoor Air Quality PD (10/0)
Tuesday (1/26) 9:00 am – 10:30 am Thornton Park Bdrm (L)

Journal Advertising Sales Subcommittee (8/0)
Sunday (1/24) 7:00 am – 8:00 am Winter Park Bdrm (L)

Life Member Executive Board Meeting (10/0)
Tuesday (1/26) 9:00 am – 11:00 am Clermont Bdrm (L)

Life Members Lunch (40/0)
Tuesday (1/26) 11:30 am – 1:30 pm Lake Eola B (L)

Members Council (37/40)
Tuesday (1/26) 8:15 am – 12:00 pm Lake Mizell (L)
Members Council Planning Subcommittee (12/10)
Saturday (1/23) 8:00 am – 12:00 pm Celebration Bdrm (L)
Members Council Region Operations Subcommittee (12/10)
Sunday (1/24) 8:00 am – 12:00 pm Spring Lake (L)

Membership Promotion (24/15)
Saturday (1/23) 8:00 am – 4:00 pm Lake Lucerne (L)
Membership Promotion Subcommittees (20/10)
Friday (1/22) 1:00 pm – 6:00 pm S322 (3)

Nominating (48/0
Sunday (1/24) 7:30 am – 12:00 pm Championsgate Bdrm (L)

PEAC (19/0)
Tuesday (1/26) 12:00 pm – 2:00 pm Lake Sheen A (L)

Professional Development (15/15)
Monday (1/25) 8:00 am – 12:00 pm Pocket Lake (L)

Publications Committee (20/10)
Sunday (1/24) 8:00 am – 12:00 pm Lake Nona B (L)
Publications Planning Subcommittee (5/5)
Saturday (1/23) 10:00 am – 12:00 pm Ruby Lake (L)
Publishing and Education Council (35/30)
Tuesday (1/26) 8:00 am – 12:00 pm Lake Eola A (L)
Publishing and Education Council E–Learning (12/0)
Saturday (1/23) 1:30 pm – 3:00 pm Lake Monroe B (L)
Publishing and Education Council Fiscal (17/8)
Monday (1/25) 2:00 pm – 3:30 pm Lake Louise A (L)
Publishing and Education Council Functional (17/8)
Monday (1/25) 3:30 pm – 5:00 pm Lake Louise A (L)
Publishing and Education Council HVAC&R Research Journal Subcommittee (10/0)
Monday (1/25) 11:00 am – 12:00 pm Winter Park Bdrm (L)

Refrigeration Committee (20/20)
Sunday (1/24) 8:00 am – 12:00 pm Lake Florence B (L)
Refrigeration Excom (20/20)
Sunday (1/24) 7:00 am – 8:00 am Lake Florence B (L)
Refrigeration PMS for RP–1634 (15/0)
Monday (1/25) 4:30 pm – 6:30 pm S331A (3)

Region–at–Large (40/0)
Monday (1/25) 2:15 pm – 4:15 pm Championsgate Bdrm (L)

Research Administration Committee (25/20)
Friday (1/22) 3:00 pm – 7:00 pm S330E (3)
Saturday (1/23) 8:00 am – 3:00 pm Lake Florence B (L)
Wednesday (1/27) 7:00 am – 11:00 am Lake Florence B (L)
RAC Excom (6/0)
Friday (1/22) 1:00 pm – 2:30 pm S330E (3)

Research Promotion (25/5)
Saturda y (1/23) 7:30 am – 1:00 pm Lake Highland A (L)
Research Promotion Executive (10/0)
Friday (1/22) 2:00 pm – 6:00 pm Celebration Bdrm (L)
Research Promotion Subcommittee (10/0)
Saturday (1/23) 2:00 pm – 3:00 pm Bay Hill Bdrm (L)

Research Subcommittee Chairs (121/0)
Monday (1/25) 6:30 am – 9:00 am Orlando Ballroom I/II (LL)

Residential Building Committee (16/20)
Monday (1/25) 9:00 am – 12:00 pm Clear Lake (L)
Residential Building Committee: Conferences Subcommittee (15/5)
Sunday (1/24) 8:30 am – 9:30 am Lake Nona A (L)
Residential Building Committee: Program Subcommittee (15/5)
Sunday (1/24) 9:30 am – 10:30 am Lake Nona A (L)
Residential Building Committee: Technical Subcommittee (15/5)
Sunday (1/24) 10:30 am – 11:30 am Lake Nona A (L)
Residential Building Committee: Publication Subcommittee (15/5)
Sunday (1/24) 1:00 pm – 2:00 pm Lake Nona A (L)
Residential Building Committee: Stakeholders Subcommittee (25/10)
Sunday (1/24) 2:00 pm – 4:00 pm Lake Nona A (L)

Scholarship Trustees (10/0)
Tuesday (1/26) 8:00 am – 12:00 pm Celebration Bdrm (L)

Society Rules (12/6)
Tuesday (1/26) 2:00 pm – 6:00 pm Clermont Bdrm (L)

Standards (30/20)
Saturday (1/23) 8:00 am – 1:00 pm Lake Eola A (L)
Wednesday (1/27) 8:00 am – 10:00 am Orlando Ballroom III (LL)
Standards: Executive Committee (10/10)
Friday (1/22) 8:00 am – 12:00 pm S330C (3)
StdC Training Adhoc (10/10)
Friday (1/22) 12:00 pm – 1:00 pm S330C (3)
Standards: ILS/ISAS (10/3)
Friday (1/22) 1:00 pm – 4:00 pm S310C (3)
Standards: PPIS (6/10)
Friday (1/22) 2:00 pm – 6:00 pm S330C (3)
Standards: SPLS (20/20)
Friday (1/22) 2:00 pm – 6:00 pm Lake Nona A (L)
Standards PPIS (6/10)
Tuesday (1/26) 11:00 am – 2:00 pm Lake Louise B (L)
Standards SPLS (20/10)
Tuesday (1/26) 2:00 m – 6:00 pm Lake Louise B (L)
Standards SRS (8/4)
Tuesday (1/26) 5:00 pm – 6:00 pm Winter Park Bdrm (L)

Student Activities Committee (22/10)
Saturday (1/23) 8:00 am – 3:00 pm Pocket Lake (L)
Student Activities Executive (25/5)
Friday (1/22) 10:00 am – 12:00 pm S330D (3)
Student Activities K–12/STEM (20/5)
Friday (1/22) 12:00 pm – 2:00 pm S330D (3)
Student Activities ABET (15/5)
Friday (1/22) 2:00 pm – 4:00 pm Lake George B (L)
Student Activities Design Competition (15/5)
Friday (1/22) 4:00 pm – 6:00 pm S330D (3)
Student Activities Grants (15/5)
Friday (1/22) 4:00 pm – 6:00 pm Lake George B (L)

Student Activities Post High (15/5)
Friday (1/22) 2:00 pm – 4:00 pm S330D (3)

TC Program Subcommittee Training (30/0)
Tuesday (1/26) 11:15 am – 12:00 pm Lake Down B (L)

Technical Activities Committee (25/20)
Saturday (1/23) 8:00 am – 3:00 pm Lake Florence A (L)
Wednesday (1/27) 7:00 am – 10:00 am Lake Florence A (L)

TAC/Standing Committee Executive Interface (25/20)
Saturday (1/23) 7:00 am – 8:00 am Lake Florence A (L)

Technology Council (37/20)
Wednesday (1/27) 9:00 am – 12:00 pm Lake Mizell B (L)

Technology Council Special Projects (10/5)
Tuesday (1/26) 9:00 am – 10:30 am Lake Down A (L)

Technology Council: Document Review Subcommittee (10/10)
Tuesday (1/26) 10:30 am – 12:00 pm Lake Down A (L)

Technology Council: Operations Subcommittee (25/15)
Tuesday (1/26) 7:30 am – 9:00 am Lake Down A (L)

Young Engineers in ASHRAE Committee (20/15)
Saturday (1/23) 8:00 am – 3:00 pm Clear Lake (L)

CHRONOLOGICAL

THURSDAY, JANUARY 21

Finance Investment Subcommittee (4/0)
Thursday (1/21) 5:00 pm – 7:00 pm Key Largo C (LL)

Finance Planning Subcommittee (8/8)
Thursday (1/21) 5:00 pm – 7:00 pm Key Largo B (LL)

FRIDAY, JANUARY 22

Chapter Technology Transfer Committee (30/15)
Friday (1/22) 8:00 am – 12:00 pm S310H (3)

Standards: Executive Committee (10/10)
Friday (1/22) 8:00 am – 12:00 pm S330C (3)

Finance Committee (12/12)
Friday (1/22) 8:00 am – 1:00 pm S331C (3)

Grassroots Government Advocacy Executive (20/10)
Friday (1/22) 10:00 am – 12:00 pm S330A (3)

Student Activities Executive (25/5)
Friday (1/22) 10:00 am – 12:00 pm S330D (3)

Director and Regional Chairs (15/20)
Friday (1/22) 11:00 am – 1:00 pm S319 (3)

StdC Training Adhoc (10/10)
Friday (1/22) 12:00 pm – 1:00 pm S330C (3)

Student Activities K–12/STEM (20/5)
Friday (1/22) 12:00 pm – 2:00 pm S330D (3)

GGAC: Active Outreach Subcommittee (15/10)
Friday (1/22) 1:00 pm – 2:30 pm S330A (3)

GGAC: Responsive Engagement Subcommittee (15/10)
Friday (1/22) 1:00 pm – 2:30 pm S330B (3)

RAC Excom (6/0)
Friday (1/22) 1:00 pm – 2:30 pm S330E (3)

Conferences and Expositions Executive (30/5)
Friday (1/22) 1:00 pm – 3:00 pm S310D (3)

Standards: ILS/ISAS (10/3)
Friday (1/22) 1:00 pm – 4:00 pm S310C (3)

Chapter Technology Transfer Member Services (12/5)
Friday (1/22) 1:00 pm – 5:00 pm S321 (3)

Chapter Technology Transfer Operations (10/15)
Friday (1/22) 1:00 pm – 5:00 pm S310H (3)

Board Planning (25/25)
Friday (1/22) 1:00 pm – 6:00 pm S319 (3)

Membership Promotion Subcommittees (20/10)
Friday (1/22) 1:00 pm – 6:00 pm S322 (3)

Student Activities ABET (15/5)
Friday (1/22) 2:00 pm – 4:00 pm Lake George B (L)

Student Activities Post High (15/5)
Friday (1/22) 2:00 pm – 4:00 pm S330D (3)

Research Promotion Executive (10/0)
Friday (1/22) 2:00 pm – 6:00 pm Celebration Bdrm (L)

Standards: PPIS (6/10)
Friday (1/22) 2:00 pm – 6:00 pm S330C (3)

Standards: SPLS (20/20)
Friday (1/22) 2:00 pm – 6:00 pm Lake Nona A (L)

GGAC: Ad Hoc for MBO 1 (10/5)
Friday (1/22) 2:45 pm – 4:15 pm S330A (3)

GGAC: Ad Hoc for MBO 6 (10/5)
Friday (1/22) 2:45 pm – 4:15 pm S330B (3)

Conferences and Expositions Annual and Winter Meetings (30/5)
Friday (1/22) 3:00 pm – 6:00 pm S310D (3)

Research Administration Committee (25/20)
Friday (1/22) 3:00 pm – 7:00 pm S330E (3)

Audit Committee (5/3)
Friday (1/22) 3:30 pm – 5:00 pm Bay Hill Bdrm (L)

Student Activities Design Competition (15/5)
Friday (1/22) 4:00 pm – 6:00 pm S330D (3)

Student Activities Grants (15/5)
Friday (1/22) 4:00 pm – 6:00 pm Lake George B (L)

GGAC: Ad Hoc for MBO 2 (10/5)
Friday (1/22) 4:30 pm – 6:00 pm S330A (3)

GGAC: Ad Hoc for MBO 4 (10/5)
Friday (1/22) 4:30 pm – 6:00 pm S330B (3)

Chapter Technology Transfer Executive (5/0)
Friday (1/22) 5:00 pm – 6:00 pm S310H (3)

SATURDAY, JANUARY 23

TAC/Standing Committee Executive Interface (25/20)
Saturday (1/23) 7:00 am – 8:00 am Lake Florence A (L)

Research Promotion (25/5)
Saturday (1/23) 7:30 am – 1:00 pm Lake Highland A (L)

Broadcasting ASHRAE Impact and Key Constituency Leadership Outreach Ad Hoc (12/6)
Saturday (1/23) 8:00 am – 10:00 am Lake Virginia B (L)

Certification (12/12)
Saturday (1/23) 8:00 am – 12:00 pm College Park Bdrm (L)

Chapter Technology Transfer (30/15)
Saturday (1/23) 8:00 am – 12:00 pm Lake Down B (L)

Members Council Planning Subcommittee (12/10)
Saturday (1/23) 8:00 am – 12:00 pm Celebration Bdrm (L)

Grassroots Government Advocacy Committee (35/30)
Saturday (1/23) 8:00 am – 12:15 pm Lake Eola B (L)

Standards Committee (30/20)
Saturday (1/23) 8:00 am – 1:00 pm Lake Eola A (L)

Conferences and Expositions Committee (30/10)
Saturday (1/23) 8:00 am – 3:00 pm Lake Highland B (L)

Electronic Communications Committee (12/10)
Saturday (1/23) 8:00 am – 3:00 pm Lake Virginia A (L)

Research Administration Committee (25/20)
Saturday (1/23) 8:00 am – 3:00 pm Lake Florence B (L)

Student Activities Committee (22/10)
Saturday (1/23) 8:00 am – 3:00 pm Pocket Lake (L)

Technical Activities Committee (25/20)
Saturday (1/23) 8:00 am – 3:00 pm Lake Florence A (L)

Young Engineers in ASHRAE Committee (20/15)
Saturday (1/23) 8:00 am – 3:00 pm Clear Lake (L)
Membership Promotion (24/15)
Saturday (1/23) 8:00 am – 4:00 pm Lake Lucerne (L)
Executive Committee (22/12)
Saturday (1/23) 8:30 am – 1:00 pm Lake Concord A (L)
Publications Planning Subcommittee (5/5)
Saturday (1/23) 10:00 am – 12:00 pm Ruby Lake (L)
bEQ Marketing (5/5)
Saturday (1/23) 12:30 pm – 1:30 pm Winter Park Bdrm (L)
CLIMA (12/0)
Saturday (1/23) 12:30 pm – 1:30 pm Lake Monroe B (L)
Handbook Excom (5/5)
Saturday (1/23) 1:00 pm – 2:00 pm Ruby Lake (L)
bEQ Methodology (5/5)
Saturday (1/23) 1:30 pm – 2:30 pm Winter Park Bdrm (L)
ASHRAE Foundation Executive Subcommittee (10/5)
Saturday (1/23) 1:30 pm – 3:00 pm Celebration Bdrm (L)
Publishing and Education Council E–Learning (12/0)
Saturday (1/23) 1:30 pm – 3:00 pm Lake Monroe B (L)
Handbook Strategic Planning (5/5)
Saturday (1/23) 2:00 pm – 3:00 pm Ruby Lake (L)
Research Promotion Subcommittee (10/0)
Saturday (1/23) 2:00 pm – 3:00 pm Bay Hill Bdrm (L)

SUNDAY, JANUARY 24

Appointments Roadmap (22/0)
Sunday (1/24) 7:00 am – 8:00 am Conway Lake (L)
Journal Advertising Sales Subcommittee (8/0)
Sunday (1/24) 7:00 am – 8:00 am Winter Park Bdrm (L)
Refrigeration Excom (20/20)
Sunday (1/24) 7:00 am – 8:00 am Lake Florence B (L)
Nominating (48/0)
Sunday (1/24) 7:30 am – 12:00 pm Championsgate Bdrm (L)
Handbook Electronic Media (5/0)
Sunday (1/24) 8:00 am – 9:00 am Lake Eola A (L)
Handbook Functional (5/0)
Sunday (1/24) 8:00 am – 9:00 am College Park Bdrm (L)
Handbook International (5/5)
Sunday (1/24) 8:00 am – 9:00 am Heathrow Bdrm (L)
Handbook Training Workshop (50/0)
Sunday (1/24) 8:00 am – 9:00 am Turkey Lake (L)
Members Council Region Operations Subcommittee (12/10)
Sunday (1/24) 8:00 am – 12:00 pm Spring Lake (L)
Publications Committee (20/10)
Sunday (1/24) 8:00 am – 12:00 pm Lake Nona B (L)
Refrigeration Committee (20/20)
Sunday (1/24) 8:00 am – 12:00 pm Lake Florence B (L)
Residential Building Committee: Conferences Subcommittee (15/5)
Sunday (1/24) 8:30 am – 9:30 am Lake Nona A (L)
Building Energy Quotient Committee (15/15)
Sunday (1/24) 8:30 am – 11:30 am Clear Lake (L)
Historical Committee (20/0)
Sunday (1/24) 8:30 am – 12:00 pm Lake Concord B (L)
College of Fellows: Advisory Committee (15/5)
Sunday (1/24) 9:00 am – 10:00 am Lake Highland B (L)
Handbook 2017 Fundamentals/TCs Volume Subcommittee (15/0)
Sunday (1/24) 9:00 am – 10:00 am Lake George A (L)
Handbook 2018 Refrigeration Subcommittee (15/0)
Sunday (1/24) 9:00 am – 10:00 am Lake George B (L)
Handbook 2019 HVAC Applications TCs/Volume Subcommittee (15/0)
Sunday (1/24) 9:00 am – 10:00 am Lake Monroe A (L)
ASHRAE/AHRI Joint Expo (25/10)
Sunday (1/24) 9:00 am – 11:00 am Lake Florence A (L)
Residential Building Committee: Program Subcommittee (15/5)
Sunday (1/24) 9:30 am – 10:30 am Lake Nona A (L)
Handbook Volume Subcommittees (25/0)
Sunday (1/24) 10:00 am – 10:30 am Lake Eola A (L)
College of Fellows (25/5)
Sunday (1/24) 10:00 am – 12:00 pm Lake Highland B (L)
Residential Building Committee: Technical Subcommittee (15/5)
Sunday (1/24) 10:30 am – 11:30 am Lake Nona A (L)
Handbook Committee (30/15)
Sunday (1/24) 10:30 am – 1:00 pm Lake Eola A (L)
Residential Building Committee: Publication Subcommittee (15/5)
Sunday (1/24) 1:00 pm – 2:00 pm Lake Nona A (L)
Honors & Awards (15/0)
Sunday (1/24) 1:00 pm – 5:00 pm Lake Virginia B (L)
Associate Society Alliance Subcommittee (40/15)
Sunday (1/24) 1:30 pm – 4:30 pm Championsgate Bdrm (L)
Board of Directors (32/75)
Sunday (1/24) 1:30 pm – 5:30 pm Orlando Ballroom II (LL)
Residential Building Committee: Stakeholders Subcommittee (25/10)
Sunday (1/24) 2:00 pm – 4:00 pm Lake Nona A (L)

MONDAY, JANUARY 25

Research Subcommittee Chairs (121/0)
Monday (1/25) 6:30 am – 9:00 am Orlando Ballroom I/II (LL)
Environmental Health Executive (20/20)
Monday (1/25) 7:00 am – 8:00 am Lake Florence A (L)
ASHRAE Foundation (25/10)
Monday (1/25) 7:30 am – 9:30 am Lake Sheen A (L)
CRC/Centralized Training Ad Hoc (15/20)
Monday (1/25) 8:00 am – 10:00 am Lake Down A (L)
Environmental Health Handbook/Policy (20/20)
Monday (1/25) 8:00 am – 10:00 am Lake Florence A (L)
Professional Development (15/15)
Monday (1/25) 8:00 am – 12:00 pm Pocket Lake (L)
Residential Building Committee (16/20)
Monday (1/25) 9:00 am – 12:00 pm Clear Lake (L)
Building Envelope Committee (30/0)
Monday (1/25) 9:00 am – 12:00 pm Lake Highland B (L)
Development Committee (24/10)
Monday (1/25) 9:45 am – 11:45 am Lake Sheen A (L)
Environmental Health Program/Research (20/20)
Monday (1/25) 10:00 am – 12:00 pm Lake Florence A (L)
Publishing and Education Council HVAC&R Research Journal Subcommittee (10/0)
Monday (1/25) 11:00 am – 12:00 pm Winter Park Bdrm (L)
Publishing and Education Council Fiscal (17/8)
Monday (1/25) 2:00 pm – 3:30 pm Lake Louise A (L)
Chapter Volunteerism and Engagement Presidential Ad Hoc (12/0)
Monday (1/25) 2:15 pm – 3:45 pm
Region–at–Large (40/0)
Monday (1/25) 2:15 pm – 4:15 pm Championsgate Bdrm (L)
AEDG Steering Committee (10/10)
Monday (1/25) 2:15 pm – 5:00 pm Winter Park Bdrm (L)

Honors & Awards (15/0)
Monday (1/25) 2:15 pm – 5:30 pm Lake Concord A (L)
Environmental Health (20/20)
Monday (1/25) 2:15 pm – 6:15 pm Lake Florence A (L)
Publishing and Education Council Functional (17/8)
Monday (1/25) 3:30 pm – 5:00 pm Lake Louise A (L)
Associate Society Alliance (65/70)
Monday (1/25) 4:15 pm – 6:15 pm Orlando Ballroom III (LL)
Refrigeration PMS for RP–1634 (15/0)
Monday (1/25) 4:30 pm – 6:30 pm S331A (3)

TUESDAY, JANUARY 26

Technology Council: Operations Subcommittee (25/15)
Tuesday (1/26) 7:30 am – 9:00 am Lake Down A (L)
Publishing and Education Council (35/30)
Tuesday (1/26) 8:00 am – 12:00 pm Lake Eola A (L)
Scholarship Trustees (10/0)
Tuesday (1/26) 8:00 am – 12:00 pm Celebration Bdrm (L)
Members Council (37/40)
Tuesday (1/26) 8:15 am – 12:00 pm Lake Mizell (L)
Indoor Air Quality PD (10/0)
Tuesday (1/26) 9:00 am – 10:30 am Thornton Park Bdrm (L)
Technology Council Special Projects (10/5)
Tuesday (1/26) 9:00 am – 10:30 am Lake Down A (L)
Life Member Executive Board Meeting (10/0)
Tuesday (1/26) 9:00 am – 11:00 am Clermont Bdrm (L)
Technology Council: Document Review Subcommittee (10/10)
Tuesday (1/26) 10:30 am – 12:00 pm Lake Down A (L)
Standards PPIS (6/10)
Tuesday (1/26) 11:00 am – 2:00 pm Lake Louise B (L)
TC Program Subcommittee Training (30/0)
Tuesday (1/26) 11:15 am – 12:00 pm Lake Down B (L)
Life Members Lunch (40/0)
Tuesday (1/26) 11:30 am – 1:30 pm Lake Eola B (L)
PEAC (19/0)
Tuesday (1/26) 12:00 pm – 2:00 pm Lake Sheen A (L)
Society Rules (12/6)
Tuesday (1/26) 2:00 pm – 6:00 pm Clermont Bdrm (L)
Standards SPLS (20/10)
Tuesday (1/26) 2:00 pm – 6:00 pm Lake Louise B (L)
Building Performance Alliance Ad Hoc Committee (16/6)
Tuesday (1/26) 3:00 pm – 4:00 pm Lake Down A (L)
Energy Efficiency in Buildings Position Document Committee (10/0)
Tuesday (1/26) 3:00 pm – 4:00 pm Winter Park Bdrm (L)
IAQ 2016 Steering Committee (16/10)
Tuesday (1/26) 3:00 pm – 4:00 pm Lake Concord A (L)
IEQ–GA (20/0)
Tuesday (1/26) 4:00 pm – 5:30 pm Lake Concord A (L)
Standards SRS (8/4)
Tuesday (1/26) 5:00 pm – 6:00 pm Winter Park Bdrm (L)

WEDNESDAY, JANUARY 27

Technical Activities Committee (25/20)
Wednesday (1/27) 7:00 am – 10:00 am Lake Florence A (L)
Research Administration Committee (25/10)
Wednesday (1/27) 7:00 am – 11:00 am Lake Florence B (L)
Executive Committee (10/20)
Wednesday (1/27) 7:30 am – 9:00 am Lake Concord A (L)
Standards (30/20)
Wednesday (1/27) 8:00 am – 10:00 am Orlando Ballroom III (LL)
Technology Council (37/20)
Wednesday (1/27) 9:00 am – 12:00 pm Lake Mizell B (L)
CIBSE/ASHRAE Liaison (25/10)
Wednesday (1/27) 9:30 am – 12:00 pm Lake Down A (L)
Director and Regional Chairs (15/20)
Wednesday (1/27) 12:00 pm – 2:00 pm Lake Concord B (L)
Board of Directors (32/75)
Wednesday (1/27) 2:00 pm – 6:00 pm Orlando Ballroom III (LL)

THURSDAY, JANUARY 28

Executive Committee (10/0)
Thursday (1/28) 7:30 am – 11:00 am Bay Hill Bdrm (L)

NETWORKING COFFEE BREAK AND CURLING MATCH

9:00 am–9:30 am, Sunday, January 24
Promenade (LL) (weather permitting)

What better way to celebrate the kick off of the completion of the ASHRAE Cold Climate Building Design Guide then attending a Curling Bonspiel.

The international game of Curling was a lot like the development of the Cold Climate Building Design Guide which is a collaboration of international architects, engineers and experts.

Curling for those that have never played, is a game of strategy, team work, talent, high ethics (as there are no referees, umpires or officials) and of course is very cool and very fun.

Designing Buildings in Cold Climates, like curling, requires a great deal of strategy and teamwork into choosing the ideal building design path for each situation, and the skills of the design team, contractors and building operators will guide the project to the desired building systems target.

The Curling bonspiel "Team Canada Vs Team World," will take place from 8:30-9:30 am on Sunday on the Promenade (weather permitting) outside across from the Orange Ballroom on the lower level of the Hilton.

Please come and join us, throw a few rocks, learn some strategy and see what gives curling its nickname of "chess on ice."

A great deal of strategy and teamwork go into choosing the ideal path and placement of a stone for each situation, and the skills of the curlers determine how close to the desired result the stone will achieve.

TC/TG/SPC MEETINGS

The ASHRAE Technical Committees, Task Groups and Technical Resource Groups listed below usually meet at each Society Winter and Annual Conference. Attendance at these meetings is open to all society members, to all registered guests at scheduled Society Conferences, and to those invited by the chairman at the request of a member. You are encouraged to attend any of these meetings in which you have a technical interest.

Description of abbreviations:

GPC = Guideline Project Committee
RP = Research Project
SPC = Standard Project Committee
SSPC = Standing Standard Project Committee
TC = Technical Committee
TG = Task Group
TRG = Technical Resource Group

Finding your Meeting location:

All rooms with names, i.e., Lake Down, Pocket Lake, Orange Ballroom are located in the Hilton. All rooms with a number, i.e., S331, are located in the Orange County Convention Center which is a short walk from the Hilton via the covered footbridge. All rooms at the Orange County Convention Center are in the South Building. The Lobby at the Hilton is indicated as (L) and the Lower Level at the Hilton is indicated as (LL). Hospitality Suites are located on the floor of the first number, i.e., 340 is on floor (3).

Color Codes: If the meeting is not listed in color it has not been confirmed.

TC/TG Chair's Breakfast Section 1 (28/4)
Sunday (1/24) 6:30 am – 8:00 am Lake Down A (L)

TC/ TG Chair's Breakfast Section 2 (21/4)
Sunday (1/24) 6:30 am – 8:00 am Lake George A (L)

TC/TG Chair's Breakfast Section 3 (13/4)
Sunday (1/24) 6:30 am – 8:00 am Lake George B (L)

TC/TG Chair's Breakfast Section 4 (17/4)
Sunday (1/24) 6:30 am – 8:00 am Lake Monroe A (L)

TC/TG Chair's Breakfast Section 5 (23/4)
Sunday (1/24) 6:30 am – 8:00 am Lake Down B (L)

TC/TG Chair's Breakfast Section 6 (19/4)
Sunday (1/24) 6:30 am – 8:00 am Lake Highland A (L)

TC/TG Chair's Breakfast Section 7 (19/4)
Sunday (1/24) 6:30 am – 8:00 am Pocket Lake (L)

TC/TG Chair's Breakfast Section 8 (25/4)
Sunday (1/24) 6:30 am – 8:00 am Clear Lake (L)

TC/TG Chair's Breakfast Section 9 (23/4)
Sunday (1/24) 6:30 am – 8:00 am Lake Sheen B (L)

TC/TG Chair's Breakfast Section 10 (15/4)
Sunday (1/24) 6:30 am – 8:00 am Lake Sheen A (L)

TC/TG Chair's Training Workshop
Sunday (1/24) 9:45 am – 10:45 am Orlando Ballroom V (LL)

TC 1.1 Thermodynamics & Psychrometrics (10/15)
Monday (1/25) 2:15 pm – 4:15 pm Sand Lake (L)

TC 1.2 Instruments & Measurements (15/0)
Tuesday (1/26) 1:00 pm – 3:30 pm Spring Lake (L)
TC 1.2 Handbook (Fundamentals) Chap. 36 (10/4)
Monday (1/25) 4:15 pm – 6:30 pm Clermont Bdrm (L)

TC 1.3 Heat Transfer & Fluid Flow (25/25)
Tuesday (1/26) 1:00 pm – 3:30 pm Lake Down B (L)

TC 1.4 Control Theory & Application (20/80)
Tuesday (1/26) 1:00 pm – 3:30 pm Orange Ballroom G (LL)
Sponsoring: Seminar 4: Is Recovery Possible? Controls Challenges with Medical Codes and Standards; Seminar 7: Energy Submetering Fundamentals: Benchmarking, Baselining and Beyond! ; Seminar 33: Should You Use Your Building Automation System to Commission Your Building Systems?; Workshop 5: Design–Build for DDC: Yes, It Works! No, It Doesn't! A Healthy Debate by Two Experts; TC Seminar on 1/26 at 1 pm: The Latest Technologies and Solutions in Building Automation—An Open Session for YEA Members
TC 1.4 YEA (20/10)
Sunday (1/24) 2:30 pm – 3:00 pm Lake Monroe A (L)
TC 1.4 Control Components and Applications (20/10)
Sunday (1/24) 3:00 pm – 4:00 pm Lake Monroe A (L)
TC 1.4 Programs (20/10)
Sunday (1/24) 4:00 pm – 5:30 pm Lake Monroe A (L)
TC 1.4 Education (20/10)
Sunday (1/24) 5:30 pm – 6:30 pm Lake Monroe A (L)
TC 1.4 RP 1455
Monday (1/25) 9:00 am – 10:00 am S330F (3)
TC 1.4 Research (10/15)
Monday (1/25) 2:15 pm – 4:15 pm Lake Monroe A (L)
TC 1.4 Handbook (10/15)
Monday (1/25) 4:15 pm – 6:30 pm Lake Monroe A (L)
TC 1.4 Executive (8/3)
Tuesday (1/26) 7:00 am – 8:00 am Lake Monroe A (L)
TC 1.4 RP 1597 (6/2)
Tuesday (1/26) 9:30 am – 11:00 am Lake Monroe A (L)

TC 1.5 Computer Applications (25/25)
Monday (1/25) 6:30 pm – 9:00 pm Lake Highland A (L)
Sponsoring: Seminar 35: The Internet of Everything: How Smart and Connected Sensors Will Transform the HVAC Service Industry; Seminar 63: Cybersecurity for HVAC Automation Systems
TC 1.5 DBOSS (20/10)
Sunday (1/24) 3:00 pm – 4:00 pm Lake Florence B (L)
TC 1.5 Cyber Security (20/10)
Sunday (1/24) 4:00 pm – 5:00 pm Lake Florence B (L)
TC 1.5 Emerging Applications (20/15)
Sunday (1/24) 5:00 pm – 6:00 pm Lake Florence B (L)
TC 1.5 Research (20/15)
Sunday (1/24) 6:00 pm – 7:00 pm Lake Florence B (L)
TC 1.5 Program (20/15)
Sunday (1/24) 7:00 pm – 8:00 pm Lake Florence B (L)
TC 1.5 Handbook (20/10)
Monday (1/25) 6:00 pm – 6:30 pm Lake Down B (L)

TC 1.6 Terminology (10/8)
Monday (1/25) 4:15 pm – 6:30 pm Sand Lake (L)
TC 1.6 Handbook, Terminology and STD–134 (6/4)
Monday (1/25) 8:00 am – 12:00 pm Spring Lake (L)

TC 1.7 Business, Management & General Legal Education (20/5)
Monday (1/25) 10:15 am – 12:00 pm Lake Louise B (L)
Sponsoring: Seminar 55: Don't Call it a Comeback! The New and Improved Design–Build Survival Guide; Workshop 1: Case Studies in Engineering Ethics

TC 1.8 Mechanical Systems Insulation (6/6)
Monday (1/25) 4:15 pm – 6:30 pm College Park Bdrm (L)

TC 1.8 Research (10/6)
Sunday (1/24) 8:00 am – 9:00 am Thornton Park Bdrm (L)
TC 1.8 Handbook (10/6)
Sunday (1/24) 9:00 am – 11:00 am Thornton Park Bdrm (L)
TC 1.8 Program (10/6)
Sunday (1/24) 11:00 am – 12:00 pm Thornton Park Bdrm (L)

TC 1.9 Electrical Systems (8/4)
Tuesday (1/26) 3:30 pm – 6:00 pm Thornton Park Bdrm (L)

Sponsoring: Forum 1: Got Demand Response? How Should Buildings Be Designed to Connect to the Smart Grid?

TC 1.10 Cogeneration Systems (20/8)
Tuesday (1/26) 3:30 pm – 6:00 pm Lake Florence A (L)

Sponsoring: Seminar 6: Presenting ASHRAE's New CHP Design Guide and eTool

TC 1.10 Handbook, Program, Research, CTTC, Membership (20/8)
Tuesday (1/26) 1:00 pm – 3:00 pm Lake Florence A (L)

TC 1.11 Electric Motors and Motor Control (13/7)
Tuesday (1/26) 1:00 pm – 3:30 pm Celebration Bdrm (L)

TC 1.12 Moisture Management in Buildings (25/10)
Saturday (1/23) 1:00 pm – 3:00 pm Lake Down A (L)

TC 1.12 Research/Program/Standards (12/20)
Saturday (1/23) 8:00 am – 12:00 pm Lake Monroe A (L)

TC 1.13 Optimization (20/5)
Sunday (1/24) 1:00 pm – 3:00 pm Lake Concord B (L)

TC 2.1 Physiology & Human Environment (12/18)
Tuesday (1/26) 1:00 pm – 3:30 pm Pocket Lake (L)

TC 2.2 Plant and Animal Environment (10/5)
Monday (1/25) 4:15 pm – 6:30 pm Lake George B (L)

TC 2.3 Gaseous Air Contaminants /Removal Equip. (18/20)
Tuesday (1/26) 1:00 pm – 3:30 pm Clear Lake (L)

Sponsoring: Seminar 60: Do You Know What You Are Breathing? Contaminants of Emerging Concern

TC 2.3 Research (20/10)
Sunday (1/24) 5:00 pm – 7:00 pm Clear Lake (L)
TC 2.3 Publications (20/5)
Monday (1/25) 3:00 pm – 4:00 pm Clear Lake (L)
TC 2.3 Handbook (5/5)
Monday (1/25) 4:15 pm – 6:00 pm Clear Lake (L)
TC 2.3 Standards (20/10)
Monday (1/25) 6:00 pm – 8:00 pm Clear Lake (L)
TC 2.3 Planning (15/5)
Tuesday (1/26) 6:30 am – 8:00 am Clear Lake (L)
TC 2.3 Program (20/10)
Tuesday (1/26) 12:00 pm – 12:45 pm Clear Lake (L)

TC 2.4 Particulate Air Contaminants / Removal Equipment (18/40)
Tuesday (1/26) 3:30 pm – 6:00 pm Orange Ballroom F (LL)

TC 2.4 Handbook (10/10)
Saturday (1/23) 1:00 pm – 2:30 pm Sand Lake (L)
TC 2.4 1649–RP PES (5/5)
Saturday (1/23) 1:30 pm – 2:30 pm College Park Bdrm (L)
TC 2.4 Research (20/20)
Sunday (1/24) 3:00 pm – 5:00 pm Lake Nona B (L)
TC 2.4 Standards (20/20)
Monday (1/25) 4:15 pm – 6:00 pm Orange Ballroom E (LL)
TC 2.4 Planning (20/10)
Tuesday (1/26) 8:00 am – 10:00 am Lake Nona B (L)
TC 2.4 Program (20/10)
Tuesday (1/26) 10:00 am – 11:00 am Lake Nona B (L)

TC 2.5 Global Climate Change (20/10)
Tuesday (1/26) 1:30 pm – 3:30 pm Orange Ballroom B (LL)

Sponsoring: Seminar 27: The Drive to Regulate HFCs: A Patchwork of New Global HFC Rules

TC 2.6 Sound and Vibration Control (25/40)
Monday (1/25) 2:15 pm – 4:15 pm Orange Ballroom G (LL)

TC 2.6 Vibration Isolation (25/25)
Sunday (1/24) 9:00 am – 10:00 am Lake Down B (L)
TC 2.6 RP 1408 (25/25)
Sunday (1/24) 10:00 am – 11:00 am Lake Down B (L)
TC 2.6 Programs (25/25)
Sunday (1/24) 11:00 am – 12:00 pm Lake Down B (L)
TC 2.6 Seminar: Multi–Family Environments (25/25)
Sunday (1/24) 1:30 pm – 3:00 pm Lake Down B (L)
TC 2.6 Publications (25/25)
Sunday (1/24) 3:10 pm – 4:00 pm Lake Down B (L)
TC 2.6 Hot Topic 1 (25/25)
Sunday (1/24) 4:00 pm – 5:00 pm Lake Down B (L)
TC 2.6 Excom (25/25)
Sunday (1/24) 5:00 pm – 6:00 pm Lake Down B (L)
TC 2.6 RP 1529 (25/25)
Monday (1/25) 9:00 am – 10:00 am Lake Eola A (L)
TC 2.6 Research (25/25)
Monday (1/25) 10:00 am – 11:00 am Lake Eola A (L)
TC 2.6 Criteria (25/25)
Monday (1/25) 11:00 am – 12:00 pm Lake Eola A (L)

TC 2.7 Seismic and Wind Restraint Design (17/24)
Tuesday (1/26) 3:30 pm – 6:00 pm Orange Ballroom E (LL)

Sponsoring: Seminar 56: Avoiding Pesky Pitfalls Integrating Seismic and Sound Control

TC 2.7 Research, Publications, Programs and Long Range Plans (20/10)
Tuesday (1/26) 1:00 pm – 3:30 pm Orange Ballroom E (LL)

TC 2.8 Building Environmental Impacts and Sustainability (20/50)
Sunday (1/24) 5:00 pm – 7:00 pm Orlando Ballroom V (LL)

Sponsoring: Seminar 5: Commissioning: Closing the Loop; Seminar 13: Updates and Perspectives on the New Version of ICC 700, The Residential Green Building Standard; Seminar 17: Integrating ASHRAE Standard 189.1 and IgCC Compliance Requirements: Options and Issues; Seminar 23; Metrics Matter: How Should We Judge Energy Performance?

TC 2.8 International (12/6)
Sunday (1/24) 11:30 am – 12:00 pm Pocket Lake (L)
TC 2.8 Green Guide (15/8)
Sunday (1/24) 12:00 pm – 1:00 pm Pocket Lake (L)
TC 2.8 Water–Energy Nexus (8/8)
Sunday (1/24) 1:00 pm – 1:30 pm Pocket Lake (L)
TC 2.8 Research (10/6)
Sunday (1/24) 1:30 pm – 2:45 pm Pocket Lake (L)
TC 2.8 Handbook (10/4)
Sunday (1/24) 2:45 pm – 3:45 pm Pocket Lake (L)
TC 2.8 Programs (10/8)
Sunday (1/24) 3:45 pm – 4:15 pm Pocket Lake (L)
TC 2.8 Existing Buildings (8/8)
Sunday (1/24) 4:15 pm – 4:45 pm Pocket Lake (L)

TC 2.9 Ultraviolet Air and Surface Treatment (10/20)
Monday (1/25) 10:00 am – 12:00 pm Turkey Lake (L)

TC 2.9 Programs (15/7)
Sunday (1/24) 8:00 am – 10:00 am Sand Lake (L)
TC 2.9 Handbook (8/5)
Sunday (1/24) 10:00 am – 12:00 pm Sand Lake (L)
TC 2.9 Standards (6/6)
Sunday (1/24) 1:00 pm – 3:00 pm Winter Park Bdrm (L)
TC 2.9 Research (10/8)
Monday (1/25) 8:00 am – 10:00 am Turkey Lake (L)

TC 3.1 Refrigerants & Secondary Coolants (10/30)
Monday (1/25) 4:15 pm – 6:30 pm Lake Nona A (L)

TC 3.1 Research and Program (8/20)
Monday (1/25) 11:00 am – 12:30 pm Lake George B (L)
TC 3.1 Handbook (10/30)
Monday (1/25) 3:00 pm – 4:00 pm Lake Sheen A (L)

TC 3.2 Refrigerant System Chemistry (12/40)
Monday (1/25) 2:15 pm – 4:15 pm Orange Ballroom E (LL)

TC 3.2 Research (12/20)
Sunday (1/24) 4:00 pm – 5:00 pm Lake George B (L)

TC 3.3 Refrigerant Contaminant Control (14/25)
Tuesday (1/26) 3:30 pm – 6:00 pm Orange Ballroom C (LL)

TC 3.3 Research (12/20)
Sunday (1/24) 5:00 pm – 5:30 pm Lake George B (L)

TC 3.4 Lubrication (20/40)
Tuesday (1/26) 1:00 pm – 3:30 pm Orange Ballroom C (LL)

Sponsoring: Seminar 16: Making the Commercialization of Low–GWP Refrigerants a Reality

TC 3.4 Research (12/20)
Sunday (1/24) 5:30 pm – 6:00 pm Lake George B (L)

TC 3.6 Water Treatment (18/10)
Tuesday (1/26) 1:00 pm – 3:30 pm Turkey Lake (L)

Sponsoring: Workshop 3: ASHRAE Standard 188–2015, Legionellosis: Risk Management for Building Water Systems: What's Your Responsibility?

TC 3.6 Handbook/Program/Research (12/10)
Sunday (1/24) 3:00 pm – 5:00 pm Lake Hart A (L)

TC 3.8 Refrigerant Containment (9/5)
Monday (1/25) 4:15 pm – 6:30 pm Heathrow Bdrm (L)

TC 4.1 Load Calculation Data and Procedures (20/10)
Monday (1/25) 2:15 pm – 4:15 pm Lake Eola B (L)

Sponsoring: Seminar 24: Back to Basics: The Science, Application and Art of Load Calculations; Seminar 50: Double Skin Facade Design and Application

TC 4.1 RP–1681 PMS (15/10)
Sunday (1/24) 2:00 pm – 3:00 pm Ruby Lake (L)
TC 4.1 Handbook (15/10)
Sunday (1/24) 3:00 pm – 4:00 pm Ruby Lake (L)
TC 4.1 Research (15/10)
Sunday (1/24) 4:00 pm – 5:00 pm Ruby Lake (L)
TC 4.1 Programs (15/10)
Sunday (1/24) 5:00 pm – 6:00 pm Ruby Lake (L)
TC 4.1 Standards (15/10)
Sunday (1/24) 6:00 pm – 7:00 pm Ruby Lake (L)

TC 4.2 Climatic Information (20/10)
Tuesday (1/26) 1:00 pm – 3:30 pm Lake Louise A (L)

TC 4.2 1699–RP PMS (20/0)
Sunday (1/24) 1:00 pm – 2:30 pm S331C (3)
TC 4.2 Program (20/0)
Sunday (1/24) 2:30 pm – 3:30 pm S331C (3)
TC 4.2 1561–RP PES (20/0)
Sunday (1/24) 3:30 pm – 5:00 pm S331C (3)
TC 4.2 Research (20/0)
Monday (1/25) 4:15 pm – 6:30 pm Conway Lake (L)

TC 4.3 Ventilation Requirements & Infiltration (10/20)
Monday (1/25) 4:15 pm – 6:30 pm Pocket Lake (L)

Sponsoring: Seminar 68: Net Zero Energy Home Strategies from Coast to Coast

TC 4.3/4.1 PMS for RP1747 Implementation of DCV for Multiple Zone Systems (12/0)
Tuesday (1/26) 9:45 am – 10:45 am Lake Concord B (L)

TC 4.4 Building Materials and Building Envelope Performance (40/10)
Monday (1/25) 2:15 pm – 4:15 pm S331A (3)

TC 4.4 PMS 1696–RP (20/10)
Sunday (1/24) 11:30 am – 1:00 pm S330E (3)
TC 4.4 Research (40/10)
Sunday (1/24) 1:00 pm – 3:30 pm S330E (3)
TC 4.4 Handbook (40/10)
Sunday (1/24) 3:30 pm – 4:30 pm S330E (3)
TC 4.4 Program (20/10)
Sunday (1/24) 4:30 pm – 5:00 pm S330E (3)
TC 4.4 Standards (20/10)
Sunday (1/24) 5:00 pm – 5:30 pm S330E (3)

TC 4.5 Fenestration (15/15)
Tuesday (1/26) 2:00 pm – 4:00 pm Sand Lake (L)

TC 4.5 Research (10/10)
Monday (1/25) 2:15 pm – 3:15 pm Thornton Park Bdrm (L)
TC 4.5 Program (10/10)
Monday (1/25) 3:15 pm – 4:15 pm Thornton Park Bdrm (L)
TC 4.5 Handbook (10/10)
Monday (1/25) 4:15 pm – 5:30 pm Thornton Park Bdrm (L)
TC 4.5 Calculational Methods (15/10)
Tuesday (1/26) 1:00 pm – 2:00 pm Sand Lake (L)

TC 4.7 Energy Calculations (25/50)
Tuesday (1/26) 6:00 pm – 8:30 pm Orange Ballroom B (LL)

Sponsoring: Seminar 59: Simulation Calibration Methods: Which Should I Choose?; Seminar 67: Simulation for Cutting–Edge Building Design; Workshop 2: ASHRAE Standard 205P: Better Data, Better Models, Better Results

TC 4.7 1588–RP PMS (8/2)
Sunday (1/24) 6:45 pm – 8:15 pm Heathrow Bdrm (L)
TC 4.7 Simulation and Component Models (20/20)
Monday (1/25) 6:00 pm – 7:30 pm Lake Sheen A (L)
TC 4.7 Data–Driven Models (20/20)
Monday (1/25) 7:30 pm – 9:00 pm Lake Sheen A (L)
TC 4.7 Applications (20/10)
Tuesday (1/26) 3:30 pm – 5:00 pm Orange Ballroom B (LL)
TC 4.7 Handbook (20/10)
Tuesday (1/26) 5:00 pm – 6:00 pm Orange Ballroom B (LL)

TC 4.10 Indoor Environmental Modeling (20/20)
Monday (1/25) 2:15 pm – 4:15 pm Lake Down A (L)

Sponsoring: Seminar 11: New CFD Techniques for Design of Air Distribution Systems

TC 4.10 Program (10/10)
Sunday (1/24) 3:00 pm – 4:00 pm Lake Sheen B (L)
TC 4.10 Handbook (10/10)
Sunday (1/24) 4:00 pm – 5:00 pm Lake Sheen B (L)
TC 4.10 Research (20/5)
Sunday (1/24) 5:00 pm – 6:00 pm Lake Sheen B (L)

TC 5.1 Fans (20/20)
Monday (1/25) 4:15 pm – 6:30 pm Lake Nona B (L)

TC 5.1 Handbook (10/10)
Sunday (1/24) 2:00 pm – 3:00 pm Lake Louise B (L)
TC 5.1 Research (10/10)
Sunday (1/24) 3:00 pm – 4:00 pm Lake Louise B (L)
TC 5.1 Program (10/10)
Sunday (1/24) 4:00 pm – 4:30 pm Lake Louise B (L)
TC 5.1 Hot Topics (15/15)
Sunday (1/24) 4:30 pm – 5:30 pm Lake Louise B (L)

TC 5.2 Duct Design (12/20)
Tuesday (1/26) 3:30 pm – 6:00 pm Lake Monroe A (L)

Sponsoring: TC Seminar on 1/25 at 10 am: Study to Identify CFD Models for Use in Determining HVAC Duct Fitting Loss Coefficients

TC 5.2 Duct Design Guide (20/20)
Monday (1/25) 8:00 am – 12:00 pm Lake Nona A (L)

TC 5.3 Room Air Distribution (30/30)
Tuesday (1/26) 1:00 pm – 3:30 pm Lake Mizell AB (L)
TC 5.3 Handbook (20/20)
Friday (1/22) 12:00 pm – 5:00 pm S331B (3)
TC 5.3 Handbook (20/20)
Saturday (1/23) 8:00 am – 3:00 pm Conway Lake (L)
TC 5.3 Fan Coils (30/20)
Sunday (1/24) 8:00 am – 9:00 am Lake Highland A (L)
TC 5.3 Chilled Beams (30/20)
Sunday (1/24) 9:00 am – 10:00 am Lake Highland A (L)
TC 5.3 Air Curtains (30/20)
Sunday (1/24) 10:00 am – 10:45 am Lake Highland A (L)
TC 5.3 Underfloor Air Distribution (11/6)
Sunday (1/24) 10:45 am – 12:15 pm Lake Highland A (L)
TC 5.3 Research/Handbook/Program (30/20)
Sunday (1/24) 1:00 pm – 3:00 pm Lake Highland A (L)

TC 5.4 Industrial Process Air Cleaning (11/6)
Monday (1/25) 2:15 pm – 4:15 pm Clermont Bdrm (L)

TC 5.5 Air–to–Air Energy Recovery (22/4)
Tuesday (1/26) 3:30 pm – 6:00 pm Lake Down B (L)
TC 5.5 Handbook, Program, Research (40/10)
Monday (1/25) 4:15 pm – 6:30 pm Lake Eola B (L)

TC 5.6 Control of Fire & Smoke (23/30)
Monday (1/25) 4:15 pm – 6:30 pm Orange Ballroom C (LL)
TC 5.6 Program (23/30)
Sunday (1/24) 3:00 pm – 4:00 pm Orange Ballroom F (LL)
TC 5.6 Research (23/30)
Sunday (1/24) 4:00 pm – 5:30 pm Orange Ballroom F (LL)
TC 5.6 Handbook (23/30)
Sunday (1/24) 5:30 pm – 7:00 pm Orange Ballroom F (LL)

TC 5.7 Evaporative Cooling (20/10)
Monday (1/25) 4:15 pm – 6:30 pm Lake Virginia A (L)

TC 5.8 Industrial Ventilation Systems (20/5)
Monday (1/25) 4:15 pm – 6:30 pm Lake Sheen B (L)
TC 5.8 Ventilation of Hazardous Spaces (5/5)
Tuesday (1/26) 3:30 pm – 6:00 pm Key West D (LL)

TC 5.9 Enclosed Vehicular Facilities (35/15)
Tuesday (1/26) 3:30 pm – 6:00 pm Lake Eola A (L)
TC 5.9 Handbook. Standards, Program, Research, Membership (35/15)
Tuesday (1/26) 1:00 pm – 3:30 pm Lake Eola A (L)

TC 5.10 Kitchen Ventilation (20/15)
Monday (1/25) 6:00 pm – 7:00 pm Lake Concord B (L)
Sponsoring: Forum 4: What Can We Do to Manage CKV Odor and Keep our Favorite Restaurant from Becoming an Unwelcome Neighbor?; Seminar 69: The Future of Demand Control Kitchen Ventilation (DCKV) and the Impact of Recent Significant Changes to Relevant Codes and Standards
TC 5.10 PMS 1631 (5/10)
Saturday (1/23) 1:00 pm – 3:00 pm Lake Hart B (L)
TC 5.10 Handbook (20/15)
Monday (1/25) 2:00 pm – 3:30 pm Lake Concord B (L)
TC 5.10 Program (20/15)
Monday (1/25) 3:30 pm – 4:30 pm Lake Concord B (L)
TC 5.10 Research (20/15)
Monday (1/25) 4:30 pm – 6:00 pm Lake Concord B (L)

TC 5.11 Humidifying Equipment (10/3)
Monday (1/25) 2:15 pm – 4:15 pm College Park Bdrm (L)
TC 5.11 PMS 1630 (5/2)
Monday (1/25) 8:30 am – 10:00 am Key Largo B (LL)
TC 5.11 Research (5/2)
Sunday (1/24) 4:00 pm – 5:00 pm Key West C (LL)

TC 6.1 Hydronic & Steam Htg. Equip & Sys (20/25)
Tuesday (1/26) 1:00 pm – 3:30 pm Orange Ballroom A (LL)
Sponsoring: Seminar 3: Control Valves in Hydronics: A Painted Picture Seminar 28: Introduction to Biomass Heating and Hydronics for Young Engineers; Seminar 34: Hydronic Systems: Doing More with Less Seminar 36: HVAC Pumps: New ECM Motor and Control Technologies
TC 6.1 Handbook (12/10)
Sunday (1/24) 5:00 pm – 6:00 pm Lake Down A (L)
TC 6.1 Chilled Water Plant (12/10)
Sunday (1/24) 6:00 pm – 7:00 pm Lake Down A (L)
TC 6.1 Program (12/10)
Monday (1/25) 2:15 pm – 3:15 pm Ruby Lake (L)
TC 6.1 Research (12/10)
Monday (1/25) 3:15 pm – 4:15 pm Ruby Lake (L)

TC 6.2 District Energy (20/10)
Sunday (1/24) 3:00 pm – 5:00 pm Conway Lake (L)
Sponsoring: Seminar 47: The Campus Planning Question: To Centralize Energy or Decentralize?
TC 6.2 Programs, Research, Handbook (20/22)
Sunday (1/24) 1:00 pm – 3:00 pm Conway Lake (L)

TC 6.3 Central Forced Air Htg. & Cooling Sys (20/12)
Tuesday (1/26) 1:00 pm – 3:30 pm Lake Virginia A (L)

TC 6.5 Radiant Heating and Cooling (17/10)
Monday (1/25) 2:15 pm – 4:15 pm Lake George B (L)
TC 6.5 Research, Special Pubs, Journal, Program, Handbook (15/20)
Sunday (1/24) 3:00 pm – 5:00 pm Orlando Ballroom V (LL)
TC 6.5 Strategic Meeting on Future Research and Dissemination Needs for Radiant Heating and Cooling (15/5)
Wednesday (1/27)12:00 pm – 5:00 pm Lake George A (L)

TC 6.6 Service Water Heating Systems (18/15)
Monday (1/25) 4:15 pm – 6:30 pm Turkey Lake (L)
Sponsoring: Technical Paper Session 10: Commercial Hot Water Use Research
TC 6.6 Programming, Research and Handbook (5/5)
Monday (1/25) 2:15 pm – 4:15 pm Turkey Lake (L)

TC 6.7 Solar Energy Utilization (20/55)
Tuesday (1/26) 1:00 pm – 3:30 pm Orange Ballroom F (LL)
Sponsoring: Seminar 38: Cooling with the Sun: Solar PV Cooling; Seminar 49: Cooling with the Sun: Solar Thermal Cooling; TC Seminar on 1/26 at 1 pm: Building Integrated PV (BIPV) Standardization is an International and Global Need
TC 6.7 Research, Standards, Programs and Handbook (25/10)
Monday (1/25) 4:15 pm – 8:30 pm Lake Down A (L)

TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25)
Tuesday (1/26) 3:30 pm – 6:00 pm Lake Highland B (L)
Sponsoring: Seminar 2: Centralized vs. Distributed Geothermal Heat Pump Applications; Seminar 30: New Bi–National GLHE/GSHP Standards and Translating GLHE Standards to Code: Good, Bad or Really Ugly?
TC 6.8 Handbook, Research, Programs, Standards (20/15)
Sunday (1/24) 5:00 pm – 7:00 pm Lake Highland A (L)

TC 6.9 Thermal Storage (14/26)
Monday (1/25) 4:30 pm – 6:00 pm Lake Down B (L)
Sponsoring: Seminar 18: Integrating Cutting–Edge Technology: Renewable Energy and Thermal Energy Storage
TC 6.9 Standards (14/26)
Monday (1/25) 2:15 pm – 2:40 pm Lake Down B (L)
TC 6.9 Programs (14/26)
Monday (1/25) 2:40 pm – 3:10 pm Lake Down B (L)
TC 6.9 Handbook (14/26)
Monday (1/25) 3:10 pm – 3:30 pm Lake Down B (L)
TC 6.9 Long Range Planning and Website (14/26)
Monday (1/25) 3:30 pm – 3:50 pm Lake Down B (L)

TC 6.9 Research (14/26)
Monday (1/25) 3:50 pm – 4:10 pm Lake Down B (L)

TC 6.10 Fuels & Combustion (20/10)
Tuesday (1/26) 3:30 pm – 6:00 pm Pocket Lake (L)
TC 6.10 Handbook (11/3)
Monday (1/25) 2:15 pm – 4:15 pm Maitland Bdrm (L)

TC 7.1 Integrated Building Design (25/10)
Monday (1/25) 8:15 am – 10:30 am Lake Sheen B (L)
Sponsoring: Seminar 8: BIM Strategies for Energy Modeling and MEP Design Consulting
TC 7.1 Research (15/5)
Sunday (1/24) 5:00 pm – 6:00 pm Lake Concord A (L)
TC 7.1 Programs (15/5)
Sunday (1/24) 6:00 pm – 7:00 pm Lake Concord A (L)

TC 7.2 HVAC Construction and Design Build Technology (10/5)
Sunday (1/24) 10:00 am – 12:00 pm Winter Park Bdrm (L)

TC 7.3 Operations & Maintenance Management (25/7)
Tuesday (1/26) 1:00 pm – 3:30 pm Lake Sheen B (L)
Sponsoring: Seminar 12: Operations and Maintenance for Optimal Performance of Efficient HVAC&R; Seminar 62: Variable Refrigerant Flow Systems: Best Practices for System Efficiency and Longevity
TC 7.3 Standards/Program (14/15)
Monday (1/25) 2:15 pm – 4:15 pm Lake Monroe B (L)
TC 7.3 Research/Handbook/Education (14/15)
Monday (1/25) 4:15 pm – 6:30 pm Lake Monroe B (L)

TC 7.4 Exergy Analysis for Sustainable Buildings (14/8)
Sunday (1/24) 8:00 am – 10:00 am Celebration Bdrm (L)

TC 7.5 Smart Building Systems (11/50)
Tuesday (1/26) 3:30 pm – 6:00 pm Orange Ballroom A (LL)
Sponsoring: Seminar 31: The Impacts of Operable Windows on Building Performance; Seminar 41: Residential Smart Appliances: Enabling Electric Grid Resilience and Demand Response; Seminar 58: Considering Occupancy Behavior in Design and Operation for Residential Buildings
TC 7.5 Program
Sunday (1/24) 2:15 pm – 3:00 pm Lake Eola B (L)
TC 7.5 Fault Detection & Diagnosis (11/50)
Sunday (1/24) 2:15 pm – 3:00 pm Lake Eola B (L)
TC 7.5 Enabling Technologies (11/50)
Sunday (1/24) 3:45 pm – 4:30 pm Lake Eola B (L)
TC 7.5 Smart Grid (11/50)
Sunday (1/24) 4:30 pm – 5:15 pm Lake Eola B (L)
TC 7.5 Handbook (11/50)
Sunday (1/24) 5:15 pm – 6:00 pm Lake Eola B (L)
TC 7.5 Buildings Operations Dynamics (11/50)
Monday (1/25) 4:30 pm – 5:15 pm Orange Ballroom B (LL)
TC 7.5 Research (11/50)
Monday (1/25) 5:15 pm – 7:15 pm Orange Ballroom B (LL)

TC 7.6 Building Energy Performance (15/30)
Tuesday (1/26) 1:00 pm – 3:30 pm Ruby Lake (L)
Sponsoring: Seminar 66: Energy Performance Run By Data
TC 7.6 Federal Buildings (25/25)
Saturday (1/23) 9:00 am – 3:00 pm Lake Sheen B (L)
TC 7.6 Federal Buildings (25/25)
Sunday (1/24) 9:00 am – 12:00 pm Lake Down A (L)
TC 7.6 Research (10/15)
Sunday (1/24) 1:00 pm – 2:00 pm Lake Down A (L)
TC 7.6 Commercial Building Energy Audit (10/15)
Sunday (1/24) 2:00 pm – 3:00 pm Lake Down A (L)
TC 7.6 Handbook (10/15)
Sunday (1/24) 3:00 pm – 4:00 pm Lake Down A (L)
TC 7.6 Monitoring and Energy Performance (10/30)
Monday (1/25) 2:15 pm – 4:15 pm Lake Lucerne (L)
TC 7.6 Energy Management (10/15)
Monday (1/25) 4:15 pm – 5:15 pm Lake Lucerne (L)
TC 7.6 Standards (10/15)
Monday (1/25) 5:15 pm – 6:15 pm Lake Lucerne (L)
TC 7.6 Executive and Programs (10/15)
Monday (1/25) 6:15 pm – 7:00 pm Lake Lucerne (L)

TC 7.7 Testing & Balancing (20/30)
Monday (1/25) 2:15 pm – 4:15 pm Orlando Ballroom V (LL)
TC 7.7 Handbook/Programs (15/10)
Saturday (1/23) 1:00 pm – 3:00 pm Lake Virginia B (L)

TC 7.8 Owning & Operating Costs (20/5)
Monday (1/25) 2:15 pm – 4:15 pm Conway Lake (L)
TC 7.8 Handbook, Program, Research (6/3)
Sunday (1/24) 3:00 pm – 5:00 pm Key West D (LL)

TC 7.9 Building Commissioning (40/20)
Sunday (1/24) 3:00 pm – 5:00 pm Orange Ballroom G (LL)
TC 7.9 Handbook, Research, Program (12/20)
Saturday (1/23) 8:00 am – 12:00 pm Lake Hart B (L)

TC 8.1 Positive Displacement Compressors (12/14)
Tuesday (1/26) 3:30 pm – 6:00 pm Spring Lake (L)
Sponsoring: Seminar 65: Compression Challenges for Low–GWP Refrigerants

TC 8.2 Centrifugal Machines (20/8)
Monday (1/25) 2:15 pm – 4:15 pm S331B (3)

TC 8.3 Absorption and Heat Operated Machines (20/10)
Monday (1/25) 3:30 pm – 6:00 pm Lake George A (L)
Sponsoring: Seminar 29: Modern Absorption Systems and Application for Both Cooling and Heating
TC 8.3 Research/Handbook (7/20)
Monday (1/25) 2:15 pm – 3:30 pm Lake George A (L)

TC 8.4 Refrigerant to Air Heat Transfer Equipment (20/10)
Tuesday (1/26) 3:30 pm – 6:00 pm Lake George A (L)
TC 8.4 Research/Standards/Handbook (50/10)
Monday (1/25) 6:30 pm – 9:30 pm Lake Mizell AB (L)

TC 8.5 Liquid to Refrigerant Heat Exchangers (47/18)
Monday (1/25) 4:15 pm – 6:30 pm Championsgate Bdrm (L)
TC 8.5/1.3 Research (30/20)
Sunday (1/24) 3:00 pm – 7:00 pm Orange Ballroom C (LL)

TC 8.6 Cooling Towers and Evaporative Condensers (20/5)
Monday (1/25) 2:15 pm – 4:15 pm Lake Virginia A (L)
TC 8.6 Handbook/Program/Research (10/4)
Monday (1/25) 9:00 am – 10:00 am Lake Virginia A (L)

TC 8.7 Variable Refrigerant Flow (20/30)
Monday (1/25) 4:15 pm – 6:30 pm Orange Ballroom G (LL)
Sponsoring: Seminar 21: Demand Response Using Variable Refrigerant Flow Systems

TC 8.8 Refrigerant System Controls & Accessories (10/10)
Tuesday (1/26) 1:00 pm – 3:30 pm Lake George A (L)
TC 8.8 Research, Program, Handbook (10/20)
Sunday (1/24) 6:30 pm – 7:30 am Key Largo B (LL)

TC 8.9 Residential Refrigerators and Food Freezers (6/10)
Monday (1/25) 2:15 pm – 4:15 pm Key West C (LL)

TC 8.10 Mechanical Dehumidifiers & Heat Pipes (16/10)
Tuesday (1/26) 3:30 pm – 6:00 pm Lake George B (L)
TC 8.10 PMS 1712–RP Development of the ASHRAE Dedicated Outdoor Air System Design Guide (8/4)
Sunday (1/24) 9:00 am – 11:00 am Clermont Bdrm (L)
TC 8.10 Program/Handbook/Research/Standards (16/10)
Tuesday (1/26) 1:00 pm – 3:30 pm Lake George B (L)

TC 8.11 Unitary and Room Air Conditioners and Heat Pumps (20/30)

Monday (1/25) 4:15 pm – 6:30 pm Orlando Ballroom V (LL)

Sponsoring: Seminar 1: An Assessment of Unconventional Heat Pump Sizing with Variable Capacity Technology

TC 8.11 Handbook/Program/Research (14/15)
Sunday (1/24) 3:00 pm – 5:00 pm Orange Ballroom B (LL)

TC 8.12 Desiccant Dehumidification Equipment and Components (15/15)

Monday (1/25) 2:15 pm – 4:15 pm Pocket Lake (L)

Sponsoring: Seminar 26: Achieving Comfort and Energy Savings Using Desiccant Technologies

TC 9.1 Large Building Air–Conditioning Systems (23/20)

Tuesday (1/26) 1:00 pm – 3:30 pm Lake Nona B (L)

Sponsoring: Seminar 57: How Does the Criterion Engineer's Role Affect the Design Build Contractor's and Design Build Engineer's Roles during All Phases of a Design Build Project?

TC 9.1 Programs/Research/Handbook (10/5)
Tuesday (1/26) 12:00 pm – 1:00 pm Lake Nona B (L)

TC 9.2 Industrial Air Conditioning (25/10)

Tuesday (1/26) 1:00 pm – 3:30 pm Lake Highland B (L)

TC 9.2 Industrial Air Conditioning Programs/Research/Handbook (12/2)
Sunday (1/24) 4:00 pm – 6:00 pm Turkey Lake (L)
TC 9.2 Nuclear Subcommittee (6/6)
Monday (1/25) 2:15 pm – 4:15 pm Key West D (LL)

TC 9.3 Transportation Air Conditioning (14/20)

Monday (1/25) 2:15 pm – 3:00 pm Lake Eola A (L)

TC 9.3 Research Final Report Presentation RP 1262–2 (14/20)
Monday (1/25) 3:00 pm – 4:00 pm Lake Eola A (L)
TC 9.3 Research Subcommittee (14/20)
Monday (1/25) 4:00 pm – 4:45 pm Lake Eola A (L)
TC 9.3 Handbook Subcommittee (8/10)
Monday (1/25) 4:45 pm – 5:15 pm Lake Eola A (L)
TC 9.3 Automobile Subcommittee (6/0)
Monday (1/25) 5:15 pm – 6:30 pm Key Largo D (LL)
TC 9.3 Aviation Subcommittee (6/0)
Monday (1/25) 5:15 pm – 6:30 pm Key West C (LL)
TC 9.3 Rail Subcommittee (14/20)
Monday (1/25) 5:15 pm – 6:30 pm Lake Eola A (L)
TC 9.3 Ship Subcommittee (6/0)
Monday (1/25) 5:15 pm – 6:30 pm Key West D (LL)

TC 9.4 Justice Facilities (20/5)

Sunday (1/24) 8:00 am – 10:00 am Pocket Lake (L)

TC 9.6 Health Care Facilities (20/60)

Sunday (1/24) 5:00 pm – 7:00 pm Orange Ballroom B (LL)

Sponsoring: Seminar 44: Energy Savings Technologies for Hospitals

TC 9.6 Water (10/5)
Sunday (1/24) 9:00 am – 10:00 am Lake Sheen A (L)
TC 9.6 Infectious Diseases (20/25)
Sunday (1/24) 10:00 am – 12:00 pm Lake Sheen A (L)
TC 9.6 Research (20/5)
Sunday (1/24) 1:00 pm – 2:00 pm Lake Sheen A (L)
TC 9.6 Handbook (15/5)
Sunday (1/24) 2:00 pm – 3:00 pm Lake Sheen A (L)
TC 9.6 Energy (20/5)
Sunday (1/24) 3:00 pm – 4:00 pm Lake Sheen A (L)
TC 9.6 Programs (20/5)
Sunday (1/24) 4:00 pm – 5:00 pm Lake Sheen A (L)

TC 9.7 Educational Facilities (13/10)

Sunday (1/24) 1:00 pm – 3:00 pm Spring Lake (L)

Sponsoring: Seminar 32: Educational Facility Design From an International Perspective

TC 9.8 Large Building Air–Conditioning Applications (20/10)

Monday (1/25) 2:15 pm – 4:15 pm Lake Virginia B (L)

TC 9.8 Handbook/Research/Program (12/6)
Monday (1/25) 9:00 am – 12:00 pm Lake Virginia B (L)

TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment (25/75)

Monday (1/25) 2:15 pm – 6:30 pm Orange Ballroom A (LL)

Sponsoring: Seminar 64: Pursuing Energy Efficiency May Put Your Data Center IT At Risk

TC 9.9 Programs, Handbook and Research (30/30)
Sunday (1/24) 5:00 pm – 7:00 pm Orange Ballroom E (LL)

TC 9.10 Laboratory Systems (20/10)

Tuesday (1/26) 3:30 pm – 6:00 pm Lake Monroe B (L)

TC 9.10 Standards (20/20)
Sunday (1/24) 3:00 pm – 3:45 pm Lake Monroe B (L)
TC 9.10 Research (20/20)
Sunday (1/24) 3:45 pm – 4:30 pm Lake Monroe B (L)
TC 9.10 Program (20/20)
Sunday (1/24) 4:30 pm – 5:15 pm Lake Monroe B (L)
TC 9.10 Lab Classification (20/20)
Sunday (1/24) 5:15 pm – 7:00 pm Lake Monroe B (L)
TC 9.10 Labs Energy Efficiency (20/20)
Tuesday (1/26) 1:00 pm – 2:30 pm Lake Monroe B (L)
TC 9.10 Handbook (20/20)
Tuesday (1/26) 2:30 pm – 3:30 pm Lake Monroe B (L)

TC 9.11 Clean Spaces (30/45)

Monday (1/25) 2:15 pm – 4:00 pm Orange Ballroom F (LL)

Sponsoring: Forum 2: Air Change Rates: Friend or Foe?

TC 9.11 Cleanroom Energy Efficiency (9/5)
Monday (1/25) 4:00 pm – 5:00 pm Orange Ballroom F (LL)
TC 9.11 Handbook (9/5)
Monday (1/25) 5:00 pm – 5:30 pm Orange Ballroom F (LL)
TC 9.11 Design Guide (9/5)
Monday (1/25) 5:30 pm – 6:00 pm Orange Ballroom F (LL)

TC 9.12 Tall Buildings (12/8)

Tuesday (1/26) 3:30 pm – 6:00 pm Maitland Bdrm (L)

Sponsoring: Conference Paper Session 6: Cooling Tower Filtration and Water Treatment

TC 10.1 Custom Engineered Refrigeration Systems (30/10)

Monday (1/25) 2:15 pm – 4:15 pm Lake Nona A (L)

TC 10.2 Automatic Ice Making Plants/Skating Rinks (12/3)

Monday (1/25) 4:30 pm – 6:30 pm Spring Lake (L)

TC 10.3 Refrigerant Piping, Controls and Accessories (20/10)

Tuesday (1/26) 1:00 pm – 3:30 pm Lake Florence B (L)

TC 10.3 PMS RP–1569 (10/2)
Tuesday (1/26) 8:00 am – 10:00 am Winter Park Bdrm (L)

TC 10.5 Refrigerated Processing and Storage (15/10)

Tuesday (1/26) 3:30 pm – 6:00 pm Turkey Lake (L)

TC 10.6 Transport Refrigeration (14/20)

Monday (1/25) 4:45 pm – 7:00 pm S331B (3)

TC 10.7 Commercial Food and Beverage Cooling Display and Storage (24/30)

Monday (1/25) 2:15 pm – 4:15 pm Orange Ballroom B (LL)

Sponsoring: Seminar 61: Improving the Efficiency of Low–GWP Commercial Refrigeration Systems

TC 10.7 Program (20/20)
Sunday (1/24) 5:15 pm – 6:00 pm Lake Nona B (L)
TC 10.7 Research (20/20)
Sunday (1/24) 6:00 pm – 6:45 pm Lake Nona B (L)
TC 10.7 Handbook (20/20)
Sunday (1/24) 6:45 pm – 7:30 pm Lake Nona B (L)

TC 10.8 Refrigeration Load Calculations (10/10)
Sunday (1/24) 3:00 pm – 5:00 pm Key Largo C (LL)

Task Groups (TG), Technical Resource Groups (TRG) and Multidisciplinary Task Groups (MTG)

TG1.Optimization (10/5)
Sunday (1/24) 1:00 pm – 3:00 pm Key Largo B (LL)

TG2 HVAC Security (20/6)
Tuesday (1/26) 9:00 am – 12:00 pm Turkey Lake (L)

TRG4.IAQP (12/8)
Sunday (1/24) 10:30 am – 12:30 pm Celebration Bdrm (L)

MTG Building Information Modeling (20/0)
Monday (1/25) 10:15 am – 12:00 pm Lake Monroe A (L)

MTG Cold Climate Design Guide (20/0)
Wednesday (1/27) 9:00 am – 11:00 am Lake Louise B (L)

MTG Energy Targets (10/1)
Tuesday (1/26) 12:00 pm – 3:00 pm Winter Park Bdrm (L)

MTG Hot Climate Design Guide (20/0)
Sunday (1/24) 8:00 am – 9:00 am Lake Hart A (L)

MTG Low GWP Refrigerants (15/5)
Wednesday (1/27) 10:00 am – 11:00 am Lake George A (L)

Standard Project Committee (SPC) and Standing Project Committee (SSPC)

PC Chairs Training Breakfast (104/0)
Sunday (1/24) 7:00 am – 9:00 am Orlando Ballroom I (LL)

SSPC 15 Safety Standards for Refrigeration Systems (20/25)
Sunday (1/24) 1:00 pm – 5:00 pm Lake Concord A (L)

SSPC 15 Safety Standards for Refrigeration Systems Ad Hoc (20/25)
Sunday (1/24) 8:00 am – 12:00 pm Lake Louise A (L)

SSPC 15 Safety Standards for Refrigeration Systems Rewrite (20/25)
Saturday (1/23) 1:00 pm – 3:00 pm Lake George B (L)

SSPC 15 Subcommittee 15.2 Safety Standard for Refrigeration Systems in Residential Applications (9/12)
Tuesday (1/26) 8:00 am – 12:00 pm Ruby Lake (L)

SPC 16/58 MOT/Rating Room Air Conditioners and PTAC/PTHP (7/12)
Tuesday (1/26) 8:00 am – 12:00 pm Clear Lake (L)

SPC 20 MOT/Rating Remote Mechanical–Draft Air–Cooled Refrigerant Condensers (6/2)
Sunday (1/24) 12:00 pm – 2:00 pm Key West C (LL)

SPC 23.1 MOT/for Performance Rating Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant (10/10)
Monday (1/25) 2:15 pm – 4:15 pm S330F (3)

SPC 25 MOT/Forced Convection and Natural Convection Air Coolers for Refrigeration (6/2)
Monday (1/25) 8:00 pm – 10:00 pm Key Largo B (LL)

SPC 26 Mechanical Refrigeration & Air–Conditioning Installation Aboard Ship (8/0)
Monday (1/25) 2:15 pm – 6:15 pm Key Largo B (LL)

SPC 28 MOT Flow Capacity of Refrigerant Capillary Tubes (5/5)
Sunday (1/24) 5:00 pm – 7:00 pm Key West C (LL)

SPC 30 MOT Liquid Chillers (7/10)
Monday (1/25) 8:00 am – 11:00 am S330H (3)

SPC 32.1 MOT for Rating Vending Machines for Sealed Beverages (6/10)
Sunday (1/24) 10:30 am – 1:00 pm Lake Monroe A (L)

SPC 32.2 MOT for Rating Pre–Mix and Post–Mix Beverage Dispensing Equipment (6/2)
Tuesday (1/26) 8:30 am – 11:30 am Key Largo C (LL)

SPC 33 MOT/ Forced Circulation Air Cooling and Air Heating Coils (6/6)
Tuesday (1/26) 8:00 am – 12:00 pm Key West C (LL)

SSPC 34 Designation and Safety Classification of Refrigerants (20/25)
Monday (1/25) 6:30 pm – 10:00 pm Lake Nona A (L)

SSPC 34 Designation and Nomenclature Subcommittee (12/25)
Saturday (1/23) 7:00 am – 10:00 am Lake George A (L)

SSPC 34 Flammability Subcommittee (17/25)
Saturday (1/23) 10:00 am – 3:00 pm Lake George A (L)

SSPC 34 Toxicity Subcommittee (5/5)
Sunday (1/24) 6:30 pm – 10:00 pm Lake Sheen A (L)

SSPC 34 Executive Committee (7/0)
Monday (1/25) 9:00 am – 10:30 am Key Largo D (LL)

SPC 37 MOT for Rating Electrically Driven Unitary Air–Conditioners and Heat Pump Equipment (7/15)
Wednesday (1/27) 8:00 am – 12:00 pm Lake Concord B (L)

SSPC 41 Standard Methods for Measurement (15/10)
Sunday (1/24) 1:00 pm – 4:00 pm Turkey Lake (L)

SSPC 41.9 Standard Methods for Volatile–Refrigerant Mass Flow Measurement Using Calorimeters (10/5)
Monday (1/25) 8:00 am – 12:00 pm Maitland Bdrm (L)

SSPC 52.2 Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size (16/45)
Saturday (1/23) 8:00 am – 12:00 pm Lake Down A (L)

SSPC 55 Thermal Env. Cond. for Human Occupancy (25/10)
Saturday (1/23) 8:00 am – 3:00 pm Lake Nona A (L)

SSPC 55 Thermal Env. Cond. for Human Occupancy (25/10)
Sunday (1/24) 9:00 am – 12:00 pm Lake Eola B (L)

SSPC 62.1 Ventilation for Acceptable Indoor Air Quality (30/30)
Saturday (1/23) 9:00 am – 3:00 pm Key West AB (LL)
Sunday (1/24) 1:00 pm – 7:00 pm Key West AB (LL)

SSPC 62.1 Administration Subcommittee (20/15)
Friday (1/22) 1:00 pm – 5:00 pm S330G (3)

SSPC 62.1 Education Subcommittee (15/10)
Friday (1/22) 1:00 pm – 5:00 pm S330F (3)

SSPC 62.2 Ventilation and Acceptable IAQ in Residential Buildings (30/15)
Friday (1/22) 9:00 am – 2:30 pm S310G (3)
Saturday (1/23) 8:00 am – 3:00 pm Lake Nona B (L)

SSPC 62.2 Envelope Subcommittee (20/2)
Friday (1/22) 2:30 pm – 5:00 pm Lake Nona B (L)

SSPC 62.2 IAQ Subcommittee (12/20)
Friday (1/22) 2:30 pm – 5:00 pm Lake Florence B (L)

SSPC 62.2 System Subcommittee (12/2)
Friday (1/22) 2:30 pm – 5:00 pm Sand Lake (L)

SPC 63.2 Method of Testing Liquid–Line Filter Drier Filtration Capability (10/5)
Sunday (1/24) 2:00 pm – 3:00 pm Heathrow Bdrm (L)

SPC 70 MOT/for Rating the Performance of Air Outlets and Air Inlets (9/20)
Monday (1/25) 8:00 am – 12:00 pm Lake Concord B (L)

SSPC 72 Standard 72–2014, Method of Testing Open and Closed Commercial Refrigerators and Freezers (10/12)
Sunday (1/24) 1:00 pm – 5:00 pm Clermont Bdrm (L)

SSPC 90.1 Energy Eff. Design of New Bldg. (50/60)
Saturday (1/23) 8:00 am – 12:00 pm Lake Mizell AB (L)
Sunday (1/24) 9:00 am – 12:00 pm Lake Mizell AB (L)
Monday (1/25) 8:00 am – 12:00 pm Lake Mizell AB (L)

SSPC 90.1 Envelope Subcommittee (15/30)
Friday (1/22) 9:00 am – 7:00 pm S310A (3)
Saturday (1/23) 1:00 pm – 8:00 pm Lake Louise A (L)
Sunday (1/24) 1:00 pm – 8:00 pm Lake George A (L)

SSPC 90.1 Lighting Subcommittee (12/10)
Friday (1/22) 9:00 am – 7:00 pm S310E
Saturday (1/23) 1:00 pm – 7:00 pm Clermont Bdrm (L)
Sunday (1/24) 1:00 pm – 8:00 pm Bay Hill Bdrm (L)

SSPC 90.1 Mechanical Subcommittee (25/25)
Friday (1/22) 9:00 am – 7:00 pm S310B (3)
Saturday (1/23) 1:00 pm – 7:00 pm Lake Mizell AB (L)
Sunday (1/24) 1:00 pm – 8:00 pm Lake Eola A (L)

SSPC 90.1 Format & Compliance Subcommittee (6/6)
Friday (1/22) 5:00 pm – 10:00 pm Thornton Park Bdrm (L)
Saturday (1/23) 1:00 pm – 5:00 pm Thornton Park Bdrm (L)
Sunday (1/24) 4:00 pm – 7:00 pm Maitland Bdrm (L)

SSPC 90.1 ECB Subcommittee (12/18)
Friday (1/22) 5:00 pm – 10:00 pm Maitland Bdrm (L)
Saturday (1/23) 1:00 pm – 5:00 pm Maitland Bdrm (L)
Sunday (1/24) 1:00 pm – 4:00 pm Maitland Bdrm (L)

SSPC 90.2 Energy Eff. Design of New Low Rise Res. Bldg. (26/20)
Monday (1/25) 2:15 pm – 6:15 pm Lake Florence B (L)
Tuesday (1/26) 1:00 pm – 5:00 pm Lake Highland A (L)

SSPC 90.2 Envelope (11/15)
Monday (1/25) 6:30 pm – 9:15 pm Sand Lake (L)
Tuesday (1/26) 8:00 am – 12:00 pm Sand Lake (L)

SSPC 90.2 Lighting (4/4)
Monday (1/25) 6:30 pm – 9:15 pm College Park Bdrm (L)
Tuesday (1/26) 8:00 am – 12:00 pm College Park Bdrm (L)

SSPC 90.2 Mechanical (6/6)
Monday (1/25) 6:30 pm – 9:15 pm Heathrow Bdrm (L)
Tuesday (1/26) 8:00 am – 12:00 pm Heathrow Bdrm (L)

SPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings (17/20)
Saturday (1/23) 9:00 am – 1:00 pm Lake Sheen A (L)
Monday (1/25) 7:30 am – 11:30 am Lake Lucerne (L)

SPC 94.2 MOT/Thermal Storage Devices with Electrical Input and Thermal Output based on Thermal Performance (5/3)
Monday (1/25) 8:00 am – 11:00 am Bay Hill Bdrm (L)

SPC 97 Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use Within Refrigerant Systems (9/6)
Tuesday (1/26) 9:30 am – 11:00 am Lake Monroe B (L)

SPC 99 Refrigerant Oil Description (9/6)
Tuesday (1/26) 8:00 am – 9:30 am Lake Louise A (L)

SSPC 100 Energy Efficiency in Existing Buildings (20/10)
Tuesday (1/26) 8:00 am – 12:00 pm Lake Highland B (L)

SSPC 100 Alternative to EUI (WG5) (16/10)
Sunday (1/24) 12:00 pm – 2:00 pm Clear Lake (L)

SSPC 100 International Target Table and Climate Zones (WG4) (4/5)
Sunday (1/24) 4:00 pm – 6:00 pm Key Largo B (LL)

SSPC 100 Operation and Maintenance (WG3) (5/5)
Sunday (1/24) 8:00 am – 10:00 am Key Largo B (LL)

SSPC 100 Site/Source and Boundary (WG2) (20/10)
Monday (1/25) 6:30 pm – 8:30 pm Lake George A (L)

SPC 103–2007R MOT Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers (12/15)
Sunday (1/24) 6:00 pm – 10:00 pm Spring Lake (L)

SPC 110 MOT/Performance of Laboratory Fume Hoods (12/5)
Tuesday (1/26) 8:00 am – 12:00 pm Conway Lake (L)

SPC 113 Preliminary/Informational Committee Meeting (1/20)
Tuesday (1/26) 3:30 pm – 4:30 pm Lake Mizell AB (L)

SPC 116 MOT/for Rating Seasonal Efficiency of Unitary Air–Conditioners and Heat Pumps (7/12)
Wednesday (1/27) 10:00 am – 12:00 pm Lake Concord A (L)

SPC 118.1 Method of Testing for Rating Commercial Gas, Electric and Oil Service Water (16/20)
Sunday (1/24) 9:00 am – 11:00 am Lake Sheen B (L)

SPC 118.2 Method of Testing for Rating Residential Water Heaters (15/15)
Tuesday (1/26) 1:00 pm – 5:00 pm Conway Lake (L)

SPC 124 MOT/Rating Combinations Space–Heating an Water Heating Appliances (18/15)
Wednesday (1/27)8:00 am – 12:00 pm Lake George B (L)

SPC 127 MOT/for Rating Computer and Data Processing Room Unitary Air Conditioners (12/4)
Saturday (1/23) 11:00 am – 3:00 pm Spring Lake (L)

SPC 130 MOT/for Rating Ducted Air Terminal Units (15/20)
Sunday (1/24) 2:00 pm – 6:00 pm Lake Florence A (L)

SSPC 135 BACnet (20/5)
Thursday (1/21) 8:00 am – 5:00 pm Key Largo B (LL)

SSPC 135 BACnet (20/5)
Friday (1/22) 8:00 am – 5:00 pm S329 (3)

SSPC 135 BACnet Working Group (20/5)
Friday (1/22) 8:00 am – 5:00 pm S330H (3)

SSPC 135 BACnet (40/15)
Saturday (1/23) 8:00 am – 3:00 pm Championsgate Bdrm (L)

SSPC 135 BACnet (20/5)
Sunday (1/24) 8:00 am – 5:00 pm Lake Hart B (L)

SSPC 135 BACnet (20/5)
Sunday (1/24) 8:00 am – 5:00 pm Lake Lucerne (L)

SSPC 135 BACnet (40/15)
Monday (1/25) 8:00 am – 12:00 pm Championsgate Bdrm (L)

SSPC 140 Standard MOT for Evaluation of Bldg. Energy Analysis Computer Program (16/10)
Monday (1/25) 2:15 pm – 6:15 pm Lake Hart B (L)

SSPC 145 Test Methods for Assessing Performance of Gas Phase Air Clean. Equip. (13/15)
Sunday (1/24) 12:00 pm – 3:00 pm Thornton Park Bdrm (L)

SPC 146 Method of Testing and Rating Pool Heaters (8/4)
Tuesday (1/26) 8:00 am – 10:00 am Spring Lake (L)

SPC 147 Reducing the Release of Halogenated Refrigerants from Refrigerating and Air–Conditioning Equipment (10/5)
Tuesday (1/26) 8:00 am – 12:00 pm Maitland Bdrm (L)

SSPC 154 Ventilation for Commercial Cooking Operations (15/10)
Sunday (1/24) 1:00 pm – 5:00 pm Sand Lake (L)

SSPC 154 Ventilation for Commercial Cooking Operations (15/10)
Monday (1/25) 2:15 pm – 6:15 pm S331C (3)

SPC 155P Method of Testing for Rating Commercial Space Heating Boiler Systems (10/6)
Sunday (1/24) 1:00 pm – 5:00 pm College Park Bdrm (L)

SPC 158.1 MOT Capacity of Refrigerant Solenoid Valves (5/5)
Sunday (1/24) 5:00 pm – 7:00 pm Key West C (LL)

SPC 158.2 MOT Capacity of Refrigerant Pressure Regulators (5/5)
Sunday (1/24) 5:00 pm – 7:00 pm Key West C (LL)

SSPC 160 Criteria for Moisture Control Design Analysis (20/5)
Tuesday (1/26) 8:00 am – 12:00 pm Lake Concord A (L)

SSPC 161P Air Quality Within Commercial Aircraft (21/10)
Monday (1/25) 9:00 am – 12:00 pm Lake Highland A (L)

SPC 164 MOT for Humidifiers (6/4)
Monday (1/25) 9:00 am – 12:00 pm Key Largo C (LL)

SSPC 169 Climatic Data for Building Design Standards (10/5)
Monday (1/25) 10:00 am – 12:00 pm Lake Monroe B (L)

SSPC 170 Ventilation of Health Care Facilities, Natural Ventilation Work Group (10/10)
Monday (1/25) 2:00 pm – 4:00 pm Key Largo C (LL)

SSPC 170 Ventilation of Healthcare Facilities (30/20)
Monday (1/25) 4:00 pm – 6:00 pm Key West AB (LL)
Tuesday (1/26) 8:00 am – 1:00 pm Lake Nona A (L)

SPC 171 Method of Testing & Rating Seismic Restraint Devices for HVAC & R Equipment (15/10)
Tuesday (1/26) 8:00 am – 12:00 pm Lake George B (L)

SPC 172 MOT/Insoluble Materials in Synthetic Lubricants and HFC Refrigerant Systems (8/4)
Monday (1/25) 10:00 am – 12:00 pm College Park Bdrm (L)

SPC 174P (7/5)
Monday (1/25) 10:00 am – 12:00 pm Heathrow Bdrm (L)

SPC 180 Standard Practice for Inspection and Maintenance of Commercial–Building HVAC Systems (21/10)
Friday (1/22) 2:00 pm – 6:00 pm Lake Louise A (L)

SPC 182 MOT Absorption Water–Chilling and Water–Heating Packages (5/5)
Monday (1/25) 11:00 am – 12:00 pm Key Largo B (LL)

SPC 184P: Method of Test for Field Performance of Liquid Chilling Systems (13/6)
Tuesday (1/26) 8:00 am – 12:00 pm Lake Sheen B (L)

SPC 185 MOT/UVC Lights for Use in Air Handling Units or Air Ducts to Inactivate Airborne Microorganisms (6/6)
Saturday (1/23) 12:00 pm – 1:00 pm Key Largo B (LL)

SPC 188 Legionellosis: Risk Management for Building Water Systems (40/30)
Tuesday (1/26) 8:00 am – 12:00 pm Lake Hart AB (L)
Tuesday (1/26) 3:45 pm – 5:30 pm Lake Hart AB (L)
Wednesday (1/27) 8:00 am – 12:00 pm Lake Mizell A (L)
Wednesday (1/27) 1:00 pm – 3:00 pm Lake Mizell A (L)

SSPC 189.1 ASHRAE/USGBC/IES Standard for the Design of High–Performance Green Buildings except Low–Rise Residential Buildings (45/50)
Tuesday (1/26) 7:30 am – 9:30 am Florida Ballroom 5–7 (LL)
Wednesday (1/27) 8:00 am – 12:00 pm Florida Ballroom 5–7 (LL)

SSPC 189.1 Working Group 6 (Water Use) (20/20)
Tuesday (1/26) 9:30 am – 11:30 am Championsgate Bdrm (L)

SSPC 189.1 Working Group 7 (Energy Efficiency) (30/30)
Tuesday (1/26) 9:30 am – 12:30 pm Florida Ballroom 5–7 (LL)

SSPC 189.1 Working Group 5 (Site Sustainability) (20/20)
Tuesday (1/26) 12:00 pm – 2:00 pm Championsgate Bdrm (L)

SSPC 189.1 Working Group 7.5 (30/30)
Tuesday (1/26) 1:00 pm – 4:00 pm Florida Ballroom 5–7 (LL)

SSPC 189.1 Working Group 9 (Materials and Resources) (20/20)
Tuesday (1/26) 2:30 pm – 4:30 pm Championsgate Bdrm (L)

SSPC 189.1 Working Group 8 (IEQ) (30/30)
Tuesday (1/26) 4:00 pm – 7:00 pm Florida Ballroom 5–7 (LL)

SSPC 189.1 Working Group 10 (20/20)
Tuesday (1/26) 5:00 pm – 7:00 pm Championsgate Bdrm (L)

SPC 189.3P Design, Construction and Operation of Sustainable High Performance Health Care Facilities (20/15)
Monday (1/25) 8:00 am – 12:00 pm Lake Nona B (L)
Monday (1/25) 2:15 pm – 4:15 pm Lake Nona B (L)

SPC 190P Method of Testing the Performance of Industrial Pulse Cleaned Dust Collectors (14/6)
Sunday (1/24) 8:00 am – 12:00 pm Lake Concord A (L)

SPC 191 Standard for Efficient Water Use in Buildings (15/10)
Monday (1/25) 9:00 am – 11:00 am S331C (3)

SPC 191 Standard for Efficient Water Use in Buildings (7/0)
Monday (1/25) 2:15 pm – 4:15 pm S330H (3)

SPC 191 Standard for Efficient Water Use in Buildings (8/2)
Sunday (1/24) 9:00 am – 12:00 pm Maitland Bdrm (L)

SPC 194 MOT/Direct–Expansion Ground Source Heat Pumps (6/6)
Sunday (1/24) 1:00 pm – 5:00 pm Key Largo D (LL)

SPC 196P MOT/ Measuring Refrigerant Leak Rates (8/8)
Sunday (1/24) 6:00 pm – 10:00 pm Lake Concord B (L)

SPC 197 MOT/Attenuation Characteristics of Vibration Isolators (8/4) (10/10)
Monday (1/25) 4:30 pm – 6:00 pm Maitland Bdrm (L)

SPC 199P Method of Testing the Performance of Industrial Pulse Cleaned Dust Collectors (14/6)
Sunday (1/24) 8:00 am – 12:00 pm Lake Monroe B (L)

SPC 201P Task Groups (6/2)
Sunday (1/24) 1:00 pm – 5:00 pm Hospitality Suite 340 (3)

SPC 201P Task Groups (6/2)
Monday (1/25) 8:00 am – 12:00 pm Key West D (LL)

SPC 201P: Facility Smart Grid Information Model (15/10)
Monday (1/25) 2:15 pm – 6:15 pm Lake Highland A (L)

SPC 201P: Facility Smart Grid Information Model (15/10)
Tuesday (1/26) 8:00 am – 12:00 pm Lake George A (L)

SSPC 202 Commissioning Process for Buildings and Systems (15/20)
Monday (1/25) 8:00 am – 12:00 pm Lake Louise A (L)

SSPC 202 Subcommittee: GLD 0–2013 The Commissioning Process (8/15)
Saturday (1/23) 8:00 am – 12:00 pm Lake Hart A (L)

SSPC 202 Subcommittee: GLD 1.1 The HVAC&R Technical Requirements for Commissioning Process (8/15)
Saturday (1/23) 1:00 pm – 3:00 pm Lake Hart A (L)

SPC 204P MOT/Rating Micro Combined Heat and Power Devices (14/10)
Monday (1/25) 6:30 pm – 9:30 pm Ruby Lake (L)

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment (20/20)
Tuesday (1/26) 8:00 am – 11:00 am Lake Down B (L)

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Working Group (20/5)
Sunday (1/24) 9:00 am – 12:00 pm Conway Lake (L)

SPC 207P Laboratory Method of Test of Fault Detection and Diagnostics Applied Commercial Air–Cooled Packaged Systems (20/20)
Monday (1/25) 8:00 am – 10:00 am Lake Hart A (L)

SPC 207 Airflow Working Group (20/0)
Monday (1/25) 10:00 am – 12:00 pm Lake Hart A (L)

SPC 207 Economizer Working Group (20/0)
Monday (1/25) 4:30 pm – 6:30 pm Lake Hart A (L)

SPC 207 Refrigerant Working Group (20/0)
Monday (1/25) 6:30 pm – 8:30 pm Lake Hart A (L)

SPC 208P Method of Test for Determining Hydronic System Balance Valve Capacity (10/5)
Tuesday (1/26) 7:00 am – 9:00 am Lake Concord B (L)

SPC 209 Conceptual design/Schematic design (10/5)
Monday (1/25) 8:00 am – 12:00 pm Celebration Bdrm (L)

SPC 209 Construction/Operations Subcommittee (10/5)
Sunday (1/24) 6:00 pm – 10:00 pm Clermont Bdrm (L)

SPC 209 Design Development/Construction Documents (10/5)
Sunday (1/24) 6:00 pm – 10:00 pm Thornton Park Bdrm (L)

SPC 209 Energy Simulation Aided Design (45/15)
Monday (1/25) 2:15 pm – 6:15 pm Lake Mizell AB (L)

SPC 209 Predesign Subcommittee (10/5)
Sunday (1/24) 6:00 pm – 10:00 pm Celebration Bdrm (L)

SPC 209 Resources Subcommittee (10/5)
Monday (1/25) 8:00 am – 12:00 pm Clermont Bdrm (L)

SPC 210 MOT/for Rating Commercial Walk–in Refrigerators and Freezers (5/35)
Monday (1/25) 8:00 am – 12:00 pm Conway Lake (L)

SPC 211 Commercial Building Energy Audits (20/20)
Monday (1/25) 8:00 am – 12:00 pm Lake George A (L)

SPC 212 MOT/for Determining Energy Performance and Water–Use Efficiency of Add–On Evaporative Pre–Coolers for Unitary Air Conditioning Equipment (7/4)
Tuesday (1/26) 8:00 am – 12:00 pm Pocket Lake (L)

SPC 213P Method of Calculating Moist Air Thermodynamics (6/4)
Tuesday (1/26) 8:00 am – 10:00 am Key Largo B (LL)

SPC 214P Standard for Measuring and Expressing Building Energy Performance in a Rating Program (12/7)
Monday (1/25) 2:15 pm – 6:15 pm Celebration Bdrm (L)

SPC 215P Method of Test to Determine Leakage Airflows and Fractional Leakage of Operating Air–Handling Systems (15/10)
Monday (1/25) 2:15 pm – 4:15 pm Spring Lake (L)

SPC 216 MOT for Determining Application Data of Overhead Circulator Fans (10/5)
Monday (1/25) 8:00 am – 11:00 am Thornton Park Bdrm (L)

SPC 217 Non–Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities (10/5)
Tuesday (1/26) 8:00 am – 12:00 pm Lake Virginia B (L)

SPC 218P – MOT for Lubricant and Refrigerant Miscibility Determination (8/4)
Monday (1/25) 8:00 am – 10:00 am Lake Concord A (L)

SPC 219 Method of Testing the Ability of Liquid Line Filter Driers or Absorbents to Remove Organic and Inorganic Acid (6/5)
Tuesday (1/26) 10:00 am – 12:00 pm Key West D (LL)

GPC 1.2P Technical Requirements for the Commissioning Process for Existing HVAC&R Systems and Assemblies (18/5)
Friday (1/22) 8:00 am – 12:00 pm S310F (3)

GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process (10/2)
Tuesday (1/26) 1:00 pm – 5:00 pm Heathrow Bdrm (L)

GPC 11 Field Testing of HVAC Controls Components (10/3)
Saturday (1/23) 9:00 am – 12:00 pm Winter Park Bdrm (L)

GPC 22 Instrumentation for Monitoring Central Chilled Water Plants (5/3)
Wednesday (1/27)10:00 am – 12:00 pm Lake Louise A (L)

GPC 23 Guideline for the Design/Application of HVAC Equip. for Rail Passenger Vehicles (10/5)
Monday (1/25) 8:00 am – 12:00 pm Ruby Lake (L)

GPC 27P Measurement Procedures for Gaseous Contaminants in Indoor Environments (7/4)
Sunday (1/24) 3:00 pm – 5:00 pm Thornton Park Bdrm (L)

GPC 34P Energy Guideline for Historical Buildings and Structures (7/4)
Tuesday (1/26) 7:00 am – 9:00 am Thornton Park Bdrm (L)

GPC 35 Method for Determining the Energy Consumption Caused By Air–Cleaning and Filtration Devices (10/40)
Monday (1/25) 8:00 am – 12:00 pm Lake Eola B (L)

GPC 36P High Performance Sequences of Operation for HVAC Systems (11/34)
Monday (1/25) 8:00 am – 12:00 pm Lake Florence B (L)

GPC 37 Upper Room Ultraviolet Germicidal (UV–C) Devices to Control the Transmission of Airborne Pathogens (6/6)
Saturday (1/23) 1:00 pm – 3:00 pm Heathrow Bdrm (L)

GPC 38P Guideline for Using Metal Pressure Vessels to Test Materials Used in Refrigeration Systems (6/6)
Monday (1/25) 4:15 pm – 6:15 pm Key Largo C (LL)

SGPC 0–General Commissioning Process (10/2)
Saturday (1/23) 8:00 am – 3:00 pm Lake Louise B (L)

SGPC 10 Interaction Affecting the Achievement of Acceptable Indoor Environments (8/5)
Sunday (1/24) 9:00 am – 12:00 pm Bay Hill Bdrm (L)

SGPC 13 Guideline for Specifying Direct Digital Control Systems (11/6)
Saturday (1/23) 9:00 am – 1:00 pm Lake Concord B (L)

US TAG to ISO/TC 86 (20/10)
Monday (1/25) 8:00 am – 10:00 am Lake Louise B (L)

US TAG to ISO/TC 142 Cleaning Equipment for Air and other Gases (35/25)
Saturday (1/23) 2:30 pm – 3:00 pm Lake Eola A (L)

JWG ISO/TC 163/WG4 and ISO/TC 205 (18/11)
Tuesday (1/26) 2:30 pm – 3:00 pm Lake Lucerne (L)

US TAG to ISO/TC 163 Thermal Performance and Energy in a Building Environment (18/11)
Tuesday (1/26) 3:00 pm – 4:30 pm Lake Lucerne (L)

JWG ISO/TC 163/WG4 and ISO/TC 205 (20/20)
Tuesday (1/26) 5:00 pm – 7:00 pm Lake Lucerne (L)

US Tag to ISO/TC 205 (22/12)
Tuesday (1/26) 1:00 pm – 2:30 pm Lake Lucerne (L)

ISO 817 MA (23/11)
Tuesday (1/26) 8:00 am – 12:00 pm Lake Lucerne (L)

ISO 817 MA – Design and Nomenclature (15/10)
Monday (1/25) 9:00 am – 10:00 am Lake Monroe A (L)

ISO 817 MA–Flammability (15/10)
Monday (1/25) 8:00 am – 9:00 am Lake Monroe A (L)

ISO 817 MA–Toxicity (15/10)
Monday (1/25) 8:00 am – 10:00 am Lake Monroe B (L)

OTHER

Energy Efficiency in Buildings Position Document Committee (10/0)
Tuesday (1/26) 3:00 pm – 4:00 pm Winter Park Bdrm (L)

gbXML (10/0)
Tuesday (1/26) 12:00 pm – 1:00 pm Thornton Park Bdrm (L)

IEA Annex 41 Cold Climate Heat Pumps (15/0)
Friday (1/22) 1:00 pm – 6:00 pm S331A (3)

USNC/IIR (20/20)
Tuesday (1/26) 2:00 pm – 4:00 pm Lake Virginia B (L)

USNT/IEA (20/10)
Tuesday (1/26) 4:00 pm – 6:00 pm Lake Virginia B (L)

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