YOUR GUIDE TO THE
ASHRAE
ANNUAL
CONFERENCE
JUNE 25–29, 2016 • ST. LOUIS

Included Inside:
- Complete technical program
- Social events schedule
- All education courses
- Maps of meeting areas
### ASHRAE EVENTS APP

Download or update the ASHRAE App for the Annual Conference to access the full meeting agenda with venue floor plans, a customizable personal schedule, and tips for your time in St. Louis. Aside from the complete conference program, the app also features the ability to view Virtual Conference presentations from your mobile device, digital speaker evaluations, and live in-session audience polling. Get it for your Android or Apple device today by visiting [www.ashrae.org/app](http://www.ashrae.org/app).

The app is made possible through support from the following sponsor:

![Titus](https://example.com/titus.png)

**Get the free mobile app at:** [www.ashrae.org/app](http://www.ashrae.org/app)
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<tr>
<th>Time Period</th>
<th>Friday, January 24</th>
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<td>Missouri History Museum</td>
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**NOTES:**
# Plan Your Own Meeting Schedule! — Personal Program

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<th>TUESDAY, JANUARY 28</th>
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<td><strong>Members’ Night Out</strong>&lt;br&gt;Marriott Majestic Ballroom D/E</td>
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CONFERENCE SPONSORS
ASHRAE thanks the following sponsors for their support of the 2016 Annual Conference

D I S T E C H  C O N T R O L S™
Innovative Solutions for Greener Buildings™

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Globally Recognized. Industry Respected.

Sponsor of the President’s Luncheon

Sponsor of the Bookstore

Sponsor of the lanyards

CHAPTER AND SOCIETY OFFICIALS
A special thanks to all the members in the St. Louis Chapter who helped make the conference a success!

ST. LOUIS CHAPTER OFFICERS
Jim Rosick, President
Christopher H. Swallow, President-Elect/Treasurer
Jessica Mangler, Secretary

ST. LOUIS HOST COMMITTEE
General Chair: Vinny Stanec
Vice Chair/Sustainability Mentor: Pat O’Brien
Sessions:
Stephen Duda, Chair
Chris Pelton, Vice Chair
Entertainment:
Scott Blackmore, Chair
Greg Hoekstra, Vice Chair
Transportation: Brian Ingenthron
Tours: Chuck Dale-Derks
Sustainability/Humanitarian Project Chair: Paul Cefaratti

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T. David Underwood, P.Eng., President
Timothy G. Wentz, P.E., President-Elect
Bjarne W. Olesen, Ph.D., Treasurer
Walid Chakroun, Ph.D., Vice President
Patricia Graef, P.E., Vice President
Charles E. Gульledge, III, P.E., Vice President
James K. Vallort, Vice President
Jeff H. Littleton, Executive Vice President

CONFERENCES AND EXPOSITIONS COMMITTEE
Sarah E. Maston, Chair
Jon J. Cohen, Vice Chair
Thomas H. Kuehn, St. Louis Conference Chair
Abderrazak “Rocky” Alazazi
Dennis Alejandro
Chris A. Balbach
Dimitris Charalambopoulos
David E. Claridge
Michael M. Collarin
Carrie Ann Crawford
Charlie D. Culin, Jr.
Gary Debes
Jason W. DeGraw
Kevin B. Gallen
Jennifer Leach
James F. Liston, Jr.
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. Traboulssi
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 checking and 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. Session and speaker evaluations are available through the event app. In addition, the room monitors will also 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 in the technical paper sessions. Questions are given to the authors for reply and published in ASHRAE Transactions.

HOTEL ADDRESS, TELEPHONE

Marriott St. Louis Grand
800 Washington Avenue
(314) 621-9600

INTERNET ACCESS

Internet access and computers for e-mail are 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.

Internet is also available for $1.00 in your sleeping room in the Marriott.

Log in instructions:

1. Select Marriott Guest as the WI-FI name
2. Enter in the last name on the reservation and your room number (there’s also an option for an access code, but don’t use that)
3. Accept the charges for the speed you would like to use, one is $9.95 and one is $13.95. If you accept the $9.95, you will be charged a $1 on your guest room folio. If they select the premium option at $13.95, you will be charged $5.00 on your guest room folio.

Log in for Marriott meeting rooms:

Network name – Marriott Conference
Password – ashr ae16

Log in for America’s Convention Center Complex meeting rooms:

Network name – ASHRAE
Password – ashr ae16

All passwords are case sensitive.

ASHRAE will be working with the internet provider to manage the bandwidth so that member expectations of accessibility and speed are fulfilled. We would like to request that everyone limit their usage to functions that do not use excessive bandwidth such as Facebook, YouTube, streaming video, etc.

CONFERENCE APP

Update your ASHRAE App for the Annual Conference to access the full meeting agenda with venue floor plans, social events, and tips for your time in St. Louis. The event app also features exclusive registrant-only features like the capability to view Virtual Conference presentations from your mobile device, a customizable personal schedule, an interactive attendee list, and digital speaker evaluations.

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

MEMBERSHIP BALLOT

Eligible Members will have the opportunity to cast online ballots for Society officers in the conference registration area (America’s Center Convention Complex across the street from the Marriott, Rooms 101/102). Polls will be open during registration hours on Friday, June 24 through Sunday, June 26 at 5:00 p.m. EDT. New Officers and Directors will be installed at the President’s Luncheon on Monday, June 27.

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 and pagers in committee meetings and in technical program sessions.

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 Marriott Grand, 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 Annual 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
Business-casual attire is appropriate for meetings and social events. The Welcome Party and Members’ Night Out are casual.

LOST AND FOUND
Items found during the conference should be turned in to the staff in the ASHRAE headquarters room, Westmoreland/Kingsbury of the Marriott or ASHRAE registration in America’s Center Convention Complex. If you have misplaced something during the conference please check these two locations as well as security with the hotel.

TECHNICAL PROGRAM PDHs
All of the sessions presented in the technical program are approved for professional development hours (PDHs). PDHs recognized by most U.S. states, AIA LUs and LEED®AP credits are available. In order to report your attendance at the session, please sign the PDH sign-in sheets that are in each room and include your license number for Florida. See program listing for specific information. Sessions are approved for 1, 1.5 or 2 PDHs depending on the length of the session. ASHRAE Certified Professionals may earn Professional Development Hours (PDHs) to meet recertification requirements by attending Tech Program sessions in a content area related to their certification. Send questions to certification@ashrae.org.

Badges are required for attendance at any of the technical sessions. Scanners will be used to capture the information located on your badge. Upon conclusion of the conference you will be able to get a complete record of all the sessions you attended.

CONFERENCE PAPERS
Abstracts of all sessions are included in this program. During the conference, papers presented at the technical paper and conference paper sessions can be purchased in the ASHRAE Bookstore as individual preprints or on the 2016 ASHRAE Annual Conference Papers (online). After the conference, papers will be posted in the online ASHRAE Bookstore. Papers are not available for seminars, workshops, or forums. Technical paper session papers will be published with discussion in ASHRAE Transactions. Prior 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 St. Louis 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 St. Louis Virtual Conference, www.ashrae.org/StLouisonline, and your login information.

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, July 6. Presentations available online through January 2018.
• A full slate of technical programs will be posted beginning Monday, June 27, of the sessions that were presented the previous day, with additional content posted through Thursday, June 30.

Access to the St. Louis Virtual Conference is free with your paid conference registration. To register only for the Virtual Conference, go to ASHRAE Registration, America’s Center. $249 ASHRAE member; $445 non member or register online.

MEMBERS’ NIGHT OUT RESERVED SEATING
Members’ Night Out will be in the St. Louis Marriott on Tuesday, June 28. If you have purchased a ticket for this event, you will receive an exchange coupon. Take this coupon to the Reserved Seating desk, located in the ASHRAE registration and exchange it for a reserved seat ticket by 2:00 p.m., Monday, June 27. Each table seats ten. A seating chart is available to help in deciding table preference. Seats are available on a first-come, first-served basis. When reserving your seat, please advise us of any special dietary requirements that at this time to ensure that we are able to accommodate your requests during the evening. Attire is casual.

Detailed information on the entertainment for Members’ Night Out is located in this program.

MEDICAL EMERGENCY
Medical emergencies should be directed to the hotel operator.

Closest Hospital:
Barnes-Jewish Hospital is one block north of the I-64/US40 and Kingshighway Boulevard intersection.
ROOMS/HOURS

FINDING YOUR ASSIGNED MEETING ROOM
To assist you in finding your meeting room at the Annual Conference, please refer to the floor plans located in this program. Meeting space is located in the Marriott Grand and America’s Center Convention Complex.

The Marriott’s meeting space is located in the main hotel and across the street in the Conference Building which is called Conference Plaza. Access to the Conference Plaza is via an underground tunnel that can be accessed from the Gateway level via either elevator or escalator. Escalators to Gateway level are located just past Zenia Bar & Grille on the lobby level. Codes for this level are (CL) which is Conference Plaza street level and (CP2) which is Conference Plaza 2nd level.

CONFERENCE REGISTRATION
America’s Convention Center Complex, Rooms 101/102, Level 1
Registration is required for all conference participants. Official badges must be worn at all functions and for admission into the technical sessions. ASHRAE conference registration will be open during the following hours:

- **Friday, June 24:** 10:00 a.m.–5:00 p.m.
- **Saturday, June 25:** 7:15 a.m.–6:00 p.m.
- **Sunday, June 26:** 7:00 a.m.–5:00 p.m.
- **Monday, June 27:** 7:30 a.m.–5:00 p.m.
- **Tuesday, June 28:** 7:30 a.m.–4:30 p.m.
- **Wednesday, June 29:** 7:30 a.m.–10:00 a.m.

ASHRAE BOOKSTORE
America’s Convention Center Complex, Room 100, Level 1
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, and ASHRAE logo items. The ASHRAE Bookstore will be open during the following hours:

- **Friday, June 24:** 10:00 a.m.–5:00 p.m.
- **Saturday, June 25:** 7:15 a.m.–6:00 p.m.
- **Sunday, June 26:** 7:00 a.m.–5:00 p.m.
- **Monday, June 27:** 7:30 a.m.–5:00 p.m.
- **Tuesday, June 28:** 7:30 a.m.–4:30 p.m.
- **Wednesday, June 29:** 7:30 a.m.–1:00 p.m.

ASHRAE’s eLearning system, from the ASHRAE Learning Institute, will be demonstrated at the bookstore. Take a hands-on demonstration and learn more about new ways to earn PDHs/CEUs, on demand, online.

SPEAKERS’ LOUNGE
America’s Convention Center Complex, Rooms 103/106, Level 1
The Speakers’ Lounge will be open during the following hours:

- **Saturday, June 25:** 1:00 p.m.–3:00 p.m.
- **Sunday, June 26:** 7:00 a.m.–5:00 p.m.
- **Monday, June 27:** 7:00 a.m.–12:15 p.m.
- **Tuesday, June 28:** 7:00 a.m.–5:00 p.m.
- **Wednesday, June 29:** 7:00 a.m.–1:00 p.m.

MEMBERSHIP INFORMATION DESK
America’s Convention Center Complex, Rooms 101/102, Level 1
The membership information desk is available for paying dues, applying for membership, updating membership information. 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.

HEADQUARTER OFFICE
Marriott, Kingsbury/Westmoreland (Conference Bldg. Street Level)
The ASHRAE Headquarters offers members complimentary copying, services of a typist, and access to printers for laptop computers.

- **Friday, June 24:** Noon–5:00 p.m.
- **Saturday, June 25:** 8:00 a.m.–5:00 p.m.
- **Sunday, June 26:** 8:00 a.m.–5:00 p.m.
- **Monday, June 27:** 8:00 a.m.–5:00 p.m.
- **Tuesday, June 28:** 8:00 a.m.–5:00 p.m.
- **Wednesday, June 29:** 8:00 a.m.–1:00 p.m.

YEA ACTIVITY
YOUNG ENGINEERS IN ASHRAE (YEA) HOSPITALITY SUITE
Marriott, Majestic Ballroom A (Conference Bldg. 2nd floor)
Attention young professional members age 35 and younger! You are invited to visit the YEA Hospitality Suite on Sunday, June 26, from 4:00 p.m.–6:00 p.m. The suite offers social and networking opportunities and light refreshments will be served.

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 Annual Conference are:

- **Pamela Duffy,** Dallas Chapter, Region VIII
- **Madison Schultz,** Central Oklahoma Chapter, Region VIII
- **Susan Nagel,** Kansas City Chapter, Region IX
- **Anoop Peediayakkan,** Kuwait Chapter, RAL

ASHRAE LOUNGE
Marriott, Washington (Conference Bldgs. Street Level)
The ASHRAE Lounge offers an opportunity to network with friends or stop for a cup of coffee between technical sessions. Coffee will be offered throughout the day and anyone who is registered for the conference is welcome in the lounge. Pastries served from 7:30 to 9:30 a.m.

The lounge will be open to all registered attendees during the following hours:

- **Saturday, June 25:** 7:30 a.m.–3:00 p.m.
- **Sunday, June 26:** 7:30 a.m.–4:00 p.m.
- **Monday, June 27:** 7:30 a.m.–4:00 p.m.
- **Tuesday, June 28:** 7:30 a.m.–4:00 p.m.
- **Wednesday, June 29:** 7:30 a.m.–1:00 p.m.
ST. LOUIS DESK
America’s Convention Center Complex, Rooms 101/102, Level 1
Information about the city of St. Louis will be available.

LAS VEGAS WINTER CONFERENCE INFORMATION
America’s Convention Center Complex, Rooms 101/102, Level 1
Information on the upcoming Winter Conference scheduled for January 28 – February 1, 2017 at the Caesar’s Palace will be available in the registration area. AHR Expo dates are January 30 – February 1, 2017 and will be held at the Las Vegas Convention Center.

ST. LOUIS WELCOME PARTY
Saturday, June 25
6:30 – 8:30 pm
Missouri History Museum
Located in Forest Park, the site of the 1904 World’s Fair, the Missouri History Museum houses countless treasures from St. Louis history. Three galleries are available for viewing at the Welcome Party, including “Route 66: A Saint Louis Street,” “Little Black Dress” and “the World’s Fair.”

Menu includes:
- Fresh fruit kebabs
- New potato basket with bacon & chive mousseline
- Trio of grilled paninis
- Caesar Salad
- Pasta station
- Tunisian chicken skewers

Shuttle service begins at 6:10 pm from St. Charles Street which is located right behind the Front Desk. There is a side door that leads out or you can go out the Front Doors of the hotel and turn right. Buses will begin boarding for the return to the hotel at 8:15 pm.

Cost: $60

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 St. Louis 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 America’s Convention Center Complex.

Lounge Location: Marriott Grand, Washington Room, Convention Plaza Building, Street level

HOURS
Saturday, June 25 ......... 7:30 a.m.–3:00 p.m.
Sunday, June 26 ........... 7:30 a.m.–4:00 p.m.
Monday, June 27 ........... 7:30 a.m.–4:00 p.m.
Tuesday, June 28 .......... 7:30 a.m.–4:00 p.m.
Wednesday, June 29 ...... 7:30 a.m.–1:00 p.m.

MEET AND GREET
Marriott Grand, Monday, June 27
Crystal Ballroom
(Elevator to Crystal is off the lobby level near escalators past Zenia’s Bar and Grill)
20th Floor
9:30 a.m.–11 a.m.

Please plan to attend the Meet and Greet to see the beautiful soaps made by Dr. King.

Dr. Eva King is the Founder & Soap Chef of Dr. King’s Little Luxuries. Eva has enjoyed making artisan soaps for a long time, and has experimented with many different ingredients and techniques over the years. Over the years, more and more people asked her why she didn’t sell her soaps, so in 2013 she started “Dr. King’s Little Luxuries” to do just that: Provide her creations to more than “just” friends and family.

All of Dr. King’s luxury soaps are handmade from high-quality vegetarian or vegan ingredients, in small batches under strict quality control. She uses food-grade vegetable oils and butters as the basis for her soaps – mainly coconut oil, canola oil, olive oil, avocado oil, and shea butter –, and uses the cold-process method of soap making. A word of caution: Many of our soaps look and smell really yummy, but please do not try to eat them! Take our words for it: taking a bite would be a very disappointing experience indeed... Just don’t do it!

In her “other life”, Eva is a PhD-level scientist, is on the Board of Directors of the Indoor Air Quality Association; and works with researchers and families to help solve problems with allergies, asthma and the indoor environment. Eva and her husband live on a little farm in Keswick, Virginia. They share their space with a friendly backyard contingent of free-range chickens, pigs, goats, dogs and cats, and a few bee hives. There is never a dull moment at “The Kings’ Menagerie”!

Light refreshments will be served.

PRESIDENT’S LUNCHEON
Monday, June 27
12:15 p.m.–2 p.m. (Doors open at 12:00)
Marriott Majestic Ballroom D/E

2016–17 ASHRAE President Tim Wentz, P.E., Fellow ASHRAE, HBDP, presents his presidential theme, “Adapt Today to Shape Tomorrow,” which is based upon the Society goal to Adapt found in our Strategic Plan. Together, we can create our future by adapting our resources, investments and technology to shape a more sustainable world.

Certificates of appreciation to retiring Board members are presented, and the 2016–17 officers and Board of Directors installed.

Attire: Business casual

Cost: $50
SCHEDULE

LOCATION OF MEETINGS
To assist you in finding your meeting room at the Annual Conference, please refer to the floor plans located in the front of this program. Meetings are scheduled in the St. Louis Marriott and America’s Convention Center Complex (ACCC).

The Marriott Grand has meeting space in the main hotel and in the Conference Plaza Building which is connected to the main hotel via a tunnel. Access to the Conference Plaza Building is from the Gateway level. From the main hotel lobby level take escalators or elevator down to Gateway. Escalators/elevators are located just past the hotel restaurant, Zenia’s Bar and Grill.

The America’s Convention Center Complex is across the street from the Marriott. Exit the Marriott to the left and walk across the street.

Conference Schedule

FRIDAY, JUNE 24

8:00 am–5:00 pm  Committee Meetings
  See listing on pages 53–68.
10:00 am–5:00 pm  Registration, America’s Convention Center Complex, Rooms 101/102, Level 1
10:00 am–5:00 pm  ASHRAE Bookstore, America’s Convention Center Complex, Room 100, Level 1

SATURDAY, JUNE 25

7:30 am–3:00 pm  ASHRAE Lounge, Marriott, Washington Room, Conference Plaza Building, Street level
7:15 am–6:00 pm  Registration, America’s Convention Center Complex, Rooms 101/102, Level 1
7:15 am–6:00 pm  ASHRAE Bookstore, America’s Convention Center Complex, Room 100, Level 1
8:00 am–5:00 pm  Committee Meetings
  See listing on pages 53–68.
1:00 pm–3:00 pm  Speakers’ Lounge, America’s Convention Center Complex, Rooms 103/106, Level 1

Special Event
3:15 pm–5:00 pm  Meeting of the Members
  Plenary Session, Marriott, Majestic Ballroom D/E, Conference Plaza, Level 2
  Opening and Welcoming Remarks by ASHRAE President T. David Underwood
  Welcome by Director and Chair, Region VI, Mark F. Miller
  Secretary’s Report by Executive Vice President Jeff H. Littleton
  Awards Presentation
  See page 16 for details.
  Keynote Speaker Jeff Henderson
  See page 21 for details.

6:30 pm–8:30 pm  Welcome Party
  Missouri History Museum

Note: $60 ticket per person required. Tickets may be purchased/picked up at the ASHRAE Registration Desk; advance-purchase tickets may be picked up at the door if after registration hours. Shuttle service to the History Museum will begin at 6:10 pm. Buses will depart from St. Charles Street which is located right behind the Front Desk. There is a side door that leads out or you can go out the Front Doors of the hotel and turn right.

See page 13 for details.

SUNDAY, JUNE 26

7:00 am–5:00 pm  Speakers’ Lounge, America’s Convention Center Complex, Rooms 103/106, Level 1
7:00 am–5:00 pm  Registration, America’s Convention Center Complex, Rooms 101/102, Level 1
7:00 am–5:00 pm  ASHRAE Bookstore, America’s Convention Center Complex, Room 100, Level 1
7:30 am–4:00 pm  ASHRAE Lounge, Marriott, Washington Room, Conference Plaza Building, Street level
8:00 am–4:45 pm  Technical Sessions (ACCC)
  See Technical Program on pages 27–51.
8:00 am–5:00 pm  Committee Meetings
  See listing on pages 53–68.
11:30 am–5:30 pm  Tour: A Little Taste of St. Louis Tour
3:00 pm–5:30 pm  Technical Tour: Center Ethanol Company, LLC
  See descriptions on pages 18–20.

Tours will depart from St. Charles Street which is located right behind the Front Desk. There is a side door that leads out or you can go out the Front Doors of the hotel and turn right.

4:00 pm–6:00 pm  Young Engineers in ASHRAE (YEA) Networking Event, Marriott, Majestic Ballroom A, Conference Plaza Building, 2nd level

Attention members age 35 and younger—you are invited to participate in the YEA Networking Event, offering social and networking opportunities.

MONDAY, JUNE 27

7:00 am–12:15 pm  Speakers’ Lounge, America’s Convention Center Complex, Rooms 103/106, Level 1
  and 1:30 pm–5:00 pm
7:30 am–5:00 pm  Registration, America’s Convention Center Complex, Rooms 101/102, Level 1
7:30 am–5:00 pm  ASHRAE Bookstore, America’s Convention Center Complex, Room 100, Level 1
7:30 am–4:00 pm  ASHRAE Lounge, Marriott, Washington Room, Conference Plaza Building, Street level
8:00 am–4:00 pm  Technical Sessions (ACCC)  
See Technical Program on pages 27–51.

8:00 am–5:00 pm  Committee Meetings  
See listing on pages 53–68.

Special Event
12:15 pm–2:00 pm  President’s Luncheon (doors open at noon), Majestic Ballroom D/E

President-Elect Timothy G. Wentz, presents his 2016–2017 presidential theme. Certificates of Appreciation will be presented to retiring Board members and the 2016–2017 Officers and new Board members will be installed. Spouses and guests are cordially invited to attend. Note: Ticket required and may be purchased at the ASHRAE Registration desk for $50.

2:30 pm–5:30 pm  Technical Tour: Convention Center Chiller Plant, Tour assembles at the main entrance of the America’s Conference Center Complex

Tours will depart from St. Charles Street which is located right behind the Front Desk. There is a side door that leads out or you can go out the Front Doors of the hotel and turn right.

Regional Dinners  
Sign up in ASHRAE registration area.

TUESDAY, JUNE 28

7:00 am–5:00 pm  Speakers’ Lounge, America’s Convention Center Complex, Rooms 103/106, Level 1

7:30 am–4:30 pm  Registration, America’s Convention Center Complex, Rooms 101/102, Level 1

7:30 am–4:30 pm  ASHRAE Bookstore, America’s Convention Center Complex, Room 100, Level 1

7:30 am–4:00 pm  ASHRAE Lounge, Marriott, Washington Room, Conference Plaza Building, Street level

8:00 am–4:45 pm  Technical Sessions (ACCC)  
See Technical Program on pages 27–51.

8:00 am–5:00 pm  Committee Meetings  
See listing on pages 53–68.

8:15 am–12 Noon  Tours:  
Beautiful Blooms & Historic Homes Gateway to St. Louis Introductory Tour  
See descriptions on pages 18–20.

Noon–1:30 pm  Life Members’ Luncheon, Marriott, Majestic Ballroom C, Conference Plaza Building, Level 2

Note: Ticket required and may be purchased at the ASHRAE registration desk for $30.

1:15 pm–5:15 pm  Technical Tour: St Louis Sheet Metal Workers Apprentice and Training

1:15 pm–5:15 pm  Tour: Microbrewery Madness  
Tours will depart from St. Charles Street which is located right behind the Front Desk. There is a side door that leads out or you can go out the Front Doors of the hotel and turn right.

8:00 am–12:30 pm  Technical Sessions (ACCC)  
See Technical Program on pages 27–51.

8:00 am–1:00 pm  Committee Meetings  
See listing on pages 53–68.

MEMBERS’ NIGHT OUT
Tuesday, June 28  
Marriott Grand, Majestic Ballroom, D/E

Reception, cash bar  
6:15 p.m. – 7:15 p.m.  
Majestic Ballroom Foyer

A Jazz trio will begin playing at 6:15 in the Ballroom

Dinner and Entertainment  
7:00 p.m. - 11:00 p.m.

Push the Limit band will be the entertainment for the evening. As their name suggests, this band pushes all limits to take every event to its highest potential with their high-energy and non-stop show with choreographed moves – guaranteed to entertain everyone. Voted #1 Party Band in Saint Louis!

Cost: $60
AWARDS PRESENTATION  
Saturday, June 25, 3:15-5:30 p.m.  
Plenary Session, Majestic Ballroom D/E

Lincoln Bouillon Award  
“Given in recognition of outstanding work in increasing the membership of the Society.”  
Jessica Mangler, P.E., St. Louis, MO  
St. Louis Chapter

William J. Collins, JR. RP Award  
“Given in recognition of the chapter RP Chair who excels in raising funds for ASHRAE’s RP Campaign.”  
Kimberly M. Thompson, P.E., Houston, TX  
Houston Chapter

Ralph G. Nevins Physiology and Human Environment Award  
“Given to a promising investigator for significant accomplishment in the study of physiology and human response to the environment.”  
Jovan Pantelic, Ph.D., Berkeley, CA  
Singapore Chapter

Environmental Health Award  
“Given in recognition of excellence in volunteer service focused on environmental health issues”  
Francis J. Offermann, P.E., San Francisco, CA  
Golden Gate Chapter

Government Advocacy Award  
“Given in recognition to an individual for outstanding effort and achievement in state, provincial, and local government activities in connection with technical issues important to the Society.”  
Arthur D. Hallstrom, P.E., Crestview, FL  
West Virginia Chapter

Lou Flagg Historical Award  
“Given in recognition of a Chapter Gold Ribbon Award winner for compiling information on outstanding historical projects or persons related to HVAC&R.”  
Faye C. McQuiston, Ph.D., P.E., Stillwater, OK  
Central Oklahoma Chapter

Standards Achievement Award  
“Given in recognition for excellence in volunteer service for developing ASHRAE standards/ guidelines.”  
Jerry M. Sipes, Ph.D., P.E., Suwanee, GA  
Atlanta Chapter

Student Activities Achievement Award  
“Given to a Chapter Student Activities Chairman for service related to the goals and growth of student activities at all levels.”  
Ather Naseem Siddiqui, Islamabad, Pakistan  
Northern Pakistan Chapter

2015 Technical Paper Award  
James W. Van Gilder, Andover, MA; Zachary M. Pardey, Andover, MA; Dustin W. Demetriou, Ph.D., Poughkeepsie, NY; H. Ezzat Khalifa, Ph.D., Syracuse, NY; Hamza Salih Erdem, Ph.D., Istanbul, Turkey; Roger R. Schmidt, Ph.D., P.E., Syracuse, NY, for authoring “Proposal for Standard Compact Server Model for Transient Data Center Simulations”

David Pommerenke, Ph.D., Rolla, MO; Xu Gao, Cupertino, CA; Atieh Talebzadeh, Rolla, MO; David E. Swenson, Round Rock, TX; Mahdi Moradian, Ph.D., Isfahan, Iran; Yunan Han, Ph.D., Beijing, China, for authoring “Dependence of ESD Charge Voltage on Humidity in Data Centers: Estimation of ESD Related Risk in Data Centers Using Voltage Level Extrapolation and Chebyshev’s Inequality”

Michael P. Case, Ph.D., Champaign, IL; Justine Yu, Champaign, IL; Richard J. Liesen, Ph.D., Champaign, IL; Alexander Zhivov, Ph.D., Champaign, IL; Matthew M. Swanson, Ph.D., Houghton, MI, for authoring “Integration of Master Planning and Energy Planning: From Detailed to Conceptual Analysis”

Dennis L. O’Neal, Ph.D., P.E., Waco, TX; Douglas Damon Ingram, Waco, TX; Carl L. Reid, Austin, TX for authoring “Modeling Fan-Powered Terminal Unit Fan/Motor Combinations Controlled by Silicon-Controlled Rectifiers”

Willis H. Carrier Award  
“Given in recognition of the best paper presented at a Society Conference in 2015 by a member thirty-two years of age or less.”  
Dustin W. Demetriou, Ph.D. and Hamza Salih Erdem, Ph.D., for co-authoring “Proposal for Standard Compact Server Model for Transient Data Center Simulations”

Ashrae Journal Paper Award  
“Given in recognition of the best article published in the ASHRAE Journal in 2015.”  
Philip Bartholomew, P.E., Cherry Hill, NJ

Crosby Field Award  
“Given in recognition of the highest rated paper presented at a Technical Session or Symposium in 2015.”  
DISTINGUISHED FIFTY-YEAR MEMBER AWARD
“Given in recognition of fifty years of membership and performing outstanding service for the Society.”
Herman F. Behls, P.E., Arlington Heights, IL
Charles E. Bullock, North Syracuse, NY
Eileen Duignan-Woods, P.E., Silver Spring, MD
Paul J. Halyard, P.E., Orlando, FL
Norman W. Johnson being recognized posthumously
Ping Ki Kwok, Happy Valley, Hong Kong
Denis J. Morris, P.E., Halifax, NS, Canada
Charles J. Procell, P.E., Hartsdale, NY
James A. Scriven, P.Eng., Halifax, NS, Canada
J. Thomas Sobieski, Johnstown, PA
Tseng-Yao Sun, P.E., Rancho Palos Verdes, CA
Carl A. Swenson, P.E., Golden, CA
Gordon B. Weld, P. Eng., Halifax, NS, Canada
John W. Welsh being recognized posthumously
Gary L. Wingfield, P.E., Sapphire, NC

DISTINGUISHED SERVICE AWARD
“Given in recognition of faithful and distinguished service on behalf of the Society.”
Omar A. Abdelaziz, Ph.D., Oak Ridge, TN
James Bochat, Phoenix, AZ
Wade H. Conlan, P.E., Maitland, FL
John D. Cowan, P.Eng., Toronto, ON, Canada
Chuck Dale-Derks, P.E., St. Louis, MO
Drake H. Erbe, Rockland, MA
Robert H. Fuller, P.E., Columbus, OH
Robert J. Hitchcock, Ph.D., Sacramento, CA
Walter D. Horn, P.E., Richardson, TX
Carl F. Huber, P.E., Fort Wayne, IN
Bruce D. Hunn, Ph.D., Raleigh, NC
Robert A. Jones, P.E., Washington, MO
Dennis R. Landsberg, Ph.D., P.E., Clifton Park, NY; Henderson, NV
Karine Leblanc, City of Industry, CA
Mark M. MacCracken, P.E., Fair Lawn, NJ
Michael F. Mamayek, P.E., West Allis, WI
Timothy P. McDowell, Madison, WI
Alex McGowan, P.Eng., Victoria, BC, Canada
Gregory L. Meeuwsen, La Crosse, WI
Matthew C. Middlebrooks, York, SC
Barbara Haviland Minor, Wilmington, DE
Ronald L. Petersen, Ph.D., Fort Collins, CO
Heather L. Platt, P.E., Greensboro, NC
Daniel R. Rogers, P.E., Tampa, FL
Steven Rosenstock, P.E., Washington, DC
Anand K. Seth, P.E., North Reading, MA
Frank Shadpour, P.E., San Diego, CA
Harris M. Steinman, P.E., Atlanta, GA
Som S. Shrestha, Ph.D., Oak Ridge, TN
Benjamin A. Skelton, P.E., Chicago, IL
Robert C. Sonderegger, Ph.D., Oakland, CA
Bodh R. Subherwal, P.E., Huntington Beach, CA
Scott Wayland, P.E., San Ramon, CA
Christopher K. Wilkins, P.E., Medford, MA

EXCEPTIONAL SERVICE AWARD
“Given in recognition of faithful service with exemplary effort on behalf of the Society, in excess of that required for the Distinguished Service Award.”
Pradeep Kumar Bansal, Ph.D., Knoxville, TN
Piotr A. Domanski, Ph.D., Gaithersburg, MD
Chad B. Dorgan, Ph.D., P.E., Newport Beach, CA
Brian A. Fricke, Ph.D., Oak Ridge, TN
Victor W. Goldschmidt, Ph.D., Northport, MI
A. Damon Gowan, Presidential Member, Galveston, TX
John L. Harrod, P.E., Edmond, OK
T. Randall Jones, Mount Pleasant, SC
Dennis J. Wessel, P.E., Hudson, OH
Craig P. Wray, P.Eng., Winnipeg, MB, Canada

ANDREW T. BOGGS SERVICE AWARD
“Given to a past Exceptional Service Award recipient in recognition of continuing, unselfish, dedicated and distinguished work on behalf of the Society.”
H.E. “Barney” Burroughs, Presidential Member, Johns Creek, GA

LOUISE AND BILL HOLLADAY DISTINGUISHED FELLOW AWARD
“Given to a Fellow of the Society in recognition of continuing preeminence in engineering or research work.”
Steven T. Taylor, P.E., Alameda, CA
ST. LOUIS 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 at the bus. Tour tickets may be purchased at the ASHRAE registration desk, America’s Center Convention Complex, Room 101, Level 1.

All tours depart from St. Charles Street which is located right behind the Front Desk. There is a side door that leads out or you can go out the Front Doors of the hotel and turn right.

A Little Taste of St. Louis Tour
Sunday, June 26 • 11:30 a.m.–5:30 p.m. • $95

Explore the original tastes of St. Louis, during a driving overview of most historic neighborhoods that feature delectable delights. Begin with a tour of “The Loop,” a historic district on the National Register of Historic Places. The Loop, a six-block area complete with restaurants, shopping, art and entertainment, is named after the old streetcar turn-around that was once a part of the Delmar line. A taste of a Loop staple, Fitz’s Root Beer, is included.

Enjoy a seated lunch on The Hill, home of a large Italian community in the southwest part of the city. The Hill features many elegant and moderately priced Italian restaurants, groceries, bakeries and bocce alleys.

While onboard the motor coach, en route to the next neighborhood, enjoy a savoury sweet treat from Ted Drewes Frozen Custard, a St. Louis tradition since 1929. Enjoy a specialty “concrete” shake – so thick you can turn it upside down.

Next, visit the Soulard neighborhood that boasts the oldest farmer’s market west of the Mississippi, and is home to Anheuser-Busch Brewery and local favorite Gus’ Pretzels. Enjoy a taste of Gus’ with an oven baked pretzel. Founded in 1836, Lafayette Park is St. Louis’ oldest public park located in the historic Lafayette Square neighborhood. Many of the homes in this area date back to the 1870s and have been painstakingly renovated. A taste of St. Louis’ Gooey Butter cake and lunch are included.

St. Louis Baseball
Monday, June 27 • 2:30 p.m.–5:30 p.m. • $65

The first stop is Busch Stadium, home to the 2011 World Series Champions, the St. Louis Cardinals. With seating for more than 40,000 fans, this field of dreams is like no other. The design of the ballpark takes into account the beautiful skyline of downtown St. Louis and the colorful history of the Cardinals.

From the classic arched openings echoing the nearby Cupples Station warehouses, to the rich warm colors of the Wainwright building, this ballpark is inspired by the traditions that St. Louisans love. The creative use of old and new materials, from brick and concrete to exposed steel and glass, creates an architectural statement that stands on its own. With its modern sensibility, the stadium is appropriate for the 21st century. Enjoy a walking tour of the home of St. Louis Cardinals.

Next, explore the Cardinals Hall of Fame and Museum inside Cardinals Nation, which is located across from Busch Stadium. Few franchises have the acclaim and heritage of the St. Louis Cardinals, and that history lives here, in the new Cardinals Museum. Featuring players and championship moments, the Cardinals Museum boasts one of the largest team-specific collections of artifacts and memorabilia in the world. The Museum’s seven galleries take you on a chronological journey through the rich history of the Cardinals, allowing you to learn about the birth of the franchise, relive special memories and interact with great exhibits.

Anheuser-Busch Brewery & Ted Drewes
Monday, June 27 • 2:30 p.m.–5:30 p.m. • $40

Learn about the rich history of the colorful Busch family en route to the King of Beers – the Anheuser-Busch Brewery. Situated in a 100-acre complex with over 70 red brick structures, the Brewery buildings are known for their unique architecture and several are National Historic Landmarks.

The tour includes a look at the world famous Clydesdales, the Beechwood Aging Cellar and the Brew House. No visit would be complete without sampling the family of Anheuser-Busch products!

After leaving Anheuser-Busch, you’re in for a sweet treat at Ted Drewes Frozen Custard, a St. Louis tradition since 1929. Enjoy a speciality ‘concrete’ shake – so thick you can turn it upside down.

Beautiful Blooms & Historic Homes
Tuesday, June 28 • 8:15 a.m.–noon • $60

Enjoy nature at its finest at the Missouri Botanical Garden. The oldest botanical garden in the country and a National Historic Landmark, the Garden has been internationally recognized for horticulture, education and scientific research since its founding in 1859.

A guided private tram tour winds its way through the 79 acres of flora from a variety of diverse climates. Visit the Climatron, the first geodesic dome greenhouse based on Buckminster Fuller’s futuristic design. Included is a visit to the 14-acre Japanese Garden, considered one of the finest outside Japan. There also is time to explore your favorite areas on your own.

Next, explore the real character of St. Louis through three of its most historic neighborhoods. The first neighborhood, Compton Heights, was developed in the late nineteenth century by the newly wealthy German beer barons. Lafayette Square features renovated Victorian mansions and row houses which surround Lafayette Park, the oldest public park west of the Mississippi River. Soulard is a delightful, old working-class neighborhood, which boasts the oldest continuous farmer’s market west of the Mississippi River. You will also see the 100-acre Anheuser-Busch Brewery Complex with over 70 red brick buildings, several of which are listed on the National Historic Registry.
**Gateway to St. Louis Introductory Tour**
**Tuesday, June 28 • 8:15 a.m.–noon • $55**

Trace the history of St. Louis beginning with the city’s original settlement, Laclede’s Landing. It is now a nine-block historic district filled with renovated turn-of-the-century buildings housing shops, eateries and offices.

Visit the famous Gateway Arch, the nation’s tallest monument, which commemorates the gateway to the west for thousands of 19th century pioneers. Take a tram ride to the top of this 630 foot stainless steel architectural wonder and get a bird’s-eye view of St. Louis. Those not wanting to ride the tram may enjoy Monument to the Dream, the film documenting the construction of the Arch.

Enjoy a view of the Old Cathedral, the oldest cathedral west of the Mississippi. Across the street is the Old Courthouse, the setting for cases involving slavery, the fur trade and equal rights. Of these cases, the Dred Scott Freedom Trial is the most notable. Other sights include Busch Stadium, home of the 2011 World Champion St. Louis Cardinals; Market Street; several civic buildings and plazas; as well as Citygarden, a unique urban oasis blending art, architecture and landscape. St. Louis Union Station, once the busiest rail terminal in the world, has undergone renovation and is home to a luxury hotel and restaurants.

At the Cathedral Basilica of St. Louis, also known as the New Cathedral, glimpse one of the largest collections of mosaics in the world – 84,000 square feet in 8,000 shades of tiny pieces of color! The tiny pieces of tesserae and glass portray scenes from both the Old and New Testaments, the life of Saint Louis IX, King of France, and many men and women prominent in the history of St. Louis.

**Microbrewery Madness**
**Tuesday, June 28 • 1:15 p.m.–5:15 p.m. • $65**

Start with beer the way it used to be made. Schlafly was the first new bottling brewery to open in St. Louis after the end of Prohibition. Now craft beer fans can see where and how their beer is made, just minutes from downtown St. Louis. This private tasting will teach you how Schlafly beer is handcrafted. From the milling and mashing of grains, to the production and fermentation of wort, to the filtration and bottling of beer, you’ll witness the fascinating art of brewing.

The next stop of the day is Square One Brewery & Distillery, which began operations as a Brewery & Restaurant in 2006. In 2008, it became the first micro distillery/restaurant in the state and one of the first in the country. Square One strives to produce the highest quality and unique flavors that are by combining the expertise of the distiller and master brewer. The possibilities for flavor combination are endless and like craft beer; with emphasis on small batches, quality ingredients and attention to detail will make fine tasting spirits for you to enjoy.

If time permits, explore Urban Chestnut Brewing Company Bierhall on your own. Urban Chestnut Brewing Company (UCBC) is an unconventional-minded, yet tradition-oriented brewer of craft beer. UCBC operates a unique brewing philosophy known as beer divergency where a new world meets old world brewing approach wherein the company contributes to the revolution of craft beer with artisanal creations of modern American beers, and pays reverence to the heritage of beer with classically-crafted offerings of timeless European beer styles.

**Architectural St. Louis Tour**
**Tuesday, June 28 • 1:15 p.m.–5:15 p.m. • $45**

This tour guide traces the history of St. Louis beginning with the city’s original settlement, Laclede’s Landing. It is now a nine-block historic district filled with renovated turn-of-the-century buildings housing shops, eateries and offices. View the famous Gateway Arch, the Nation’s tallest monument, which commemorates the gateway to the west for thousands of 19th century pioneers. Just east of the Arch, pass the excursion riverboats that call the Mississippi River home.

Enjoy a view of the Old Cathedral, the oldest cathedral west of the Mississippi. Across the street is the Old Courthouse, the setting for cases involving slavery, the fur trade and equal rights. Of these cases, the Dred Scott Freedom Trial is the most notable. You will pass Busch Stadium, home of the 2011 World Champion St. Louis Cardinals. Continuing west on Market Street, you will pass several of St. Louis’ civic buildings and plazas, as well as Citygarden, a unique urban oasis blending art, architecture and landscape.

Your first stop today will be one to remember. After an expansive $75 million renovation, the St. Louis institution formerly known as Kiel Opera House reopened as the Peabody Opera House. Take in the historic building, its grand architecture, classic design and modern amenities as you get to glimpse in backstage dressing rooms, take the same stage as well-known celebrities such as The Rolling Stones and Johnny Carson and marvel at the beauty in the details of the Grand Lobby and ballrooms (pending show schedule).

Enjoy an in-depth guided tour of the newly restored Central Library, the crown jewel of the St. Louis Public Library system. Following a two-year and $70 million restoration, the space now boasts a beautiful blend of old world and contemporary design. Natural light and inviting atmosphere elements seem like a working piece of art masterfully dedicated to housing an incredible collection of diverse literary works.

Your final stop of the day is at St. Louis Union Station, once the busiest rail terminal in the world. Today, the Grand Hall has undergone a magnificent renovation, returning the space to its original splendor. A most impressive feature of the Grand Hall is the “Allegorical Window,” a hand-made stained glass window with hand-cut Tiffany glass strategically positioned above the Station’s main entryway. The window features three women such as The Rolling Stones and Johnny Carson and marvel at the beauty in the details of the Grand Lobby and ballrooms (pending show schedule).

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TECHNICAL 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 at the bus. Tour tickets may be purchased at the ASHRAE registration desk, America’s Convention Complex, Room 101, Level 1.

All tours depart from St. Charles Street which is located right behind the Front Desk. There is a side door that leads out or you can go out the Front Doors of the hotel and turn right.

Center Ethanol Company
Sunday, June 26 • 3:00–5:30 p.m. • $30

Center Ethanol Company, LLC, was established in 2006 for the purpose of constructing an ethanol plant in the city of Sauget, Illinois on approximately 57 acres of land strategically located with access to road, river, and rail transportation systems. Production began in April of 2008. Forty-two employees work at the plant which is operational about 350 days per year on a 24 hour basis. Using approximately 19.2 million bushels of corn annually, the plant produces approximately 54 million gallons per year of ethanol. In addition, the plant produces approximately 150,000 tons of dry distillers grain (“DDGs”) and 2 million gallons of corn oil. The plant is engineered for expansion of production to 108 million gallons of ethanol per year.

Convention Center Chiller Plant
Monday, June 27 • 2:30 – 5:30 p.m. • $15

A walking tour of Convention Center Chiller Plant. America’s Center, a convention center totaling over 1,000,000 square feet, including five exhibition halls, thirty-four meeting rooms, a theatre, and a full-service kitchen. The Center took on a $48 million, 3-year project to upgrade the facility. The improvements were completed in 2011 and include chiller, cooling tower, AHU, boiler, and movable air wall replacement. Particular emphasis was placed on the implementation of a user-friendly and accurate user interface for the building’s HVAC and lighting control systems.

The facility replaced three boiler plants in the South expansion, and installed 13 new modular style boilers totaling 23,600 BTU. Upgrades to the energy efficient cooling plant included two new 1,100-ton capacity chillers, a new 360 ton chiller for low cooling load conditions and five new cooling towers with total capacity of 4,960 tons.

St Louis Sheet Metal Workers Apprentice and Training
Tuesday, June 28 • 1:15–5:15 p.m. • $30

Sheet Metal Workers’ Local 36 and the St. Louis chapter of the Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA) created the Sheet Metal Workers’ Training School. This Department of Labor, Office of Apprenticeship registered school is a state-of-the-art 56,000-square-foot facility, equipped with a service lab, welding lab, extensive architectural mockups, computer/CAD lab, and T.A.B. training, giving apprentices and journeymen alike a first-class education.

Each of these apprentices receives five years of instruction combined with jobsite experiences to equal 10,000 training hours in the following areas:

- Testing and air balancing (T.A.B.)
- Service
- Layout
- Computer-aided drafting (CAD)
- Foreman training
- AWS-certified welding
- Blueprint reading
- Drafting
- Architectural sheet metal
- Safety
- Codes
- Professional Educational Units (PEUs) for St. Louis County Mechanical License

LIFE MEMBERS’ LUNCHEON
Tuesday, June 28
12:00 Noon
Marriott Majestic Ballroom C

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.

Cost: $30

FUTURE ASHRAE SPECIALTY CONFERENCES

2016
Sept. 12–14: IAQ 2016 Defining Indoor Air Quality: Policy, Standards and Best Practices co-organized by AIVC – Alexandria, VA
Sept. 15–16 (tentative date): Residential Stakeholders Workshop – Alexandria, VA

2017
Jan. 11–13: Sustainable Management of Refrigeration Technologies in Mobile Marine and Fisheries Sectors – Bangkok, Thailand
Feb. 26–27: 2nd International Conference on High Ambient (Hot Climates) – Qatar
Sept. 27–29 (tentative date): ASHRAE Building Modeling Conference – Atlanta, GA
November: ASHRAE Developing Economies Conference – Delhi, India
KEYNOTE SPEAKER - CHEF JEFF HENDERSON

Inspiring Celebrity Chef, Food Network TV Star & Bestselling Author

Saturday, June 25
3:15 – 5:30, Majestic Ballroom D/E, Conference Plaza Building, 2nd level

Chef Jeff Henderson discovered his passion and gift for cooking in a most unlikely place—prison. Now an award-winning chef, bestselling author and Food Network television star, he is one of the most influential role models in the country. Drawing from his personal journey of redemption—from imprisoned drug dealer to renowned celebrity chef and TV star—he provides audiences with inspiration, real life strategies and unique life lessons to help others reboot their own dreams, expand their perspective and gain a new foothold on the ladder to success.

Chef Jeff is the creator of the Food Network’s reality series, The Chef Jeff Project, the host of Family Style with Chef Jeff, and the star of the popular current series, Flip My Food with Chef Jeff, in which he meets with guests from across the country and teaches them how to “flip” their favorite dishes and guilty food pleasures into healthier culinary masterpieces.

The bestselling author of two books, his most recent, If You Can See It, You Can Be It outlines his 12 street-smart recipes for success, helping readers discover their hidden business aptitudes, make life-changing decisions and strive for new levels of personal and professional success.

A frequent media guest, Chef Jeff has appeared on leading outlets, including The Today Show, Good Morning America and CNN, and has been featured in USA Today, the Wall Street Journal and the Washington Post. His inspiring life story is being adapted for a major feature film by Will Smith and Jada Pinkett Smith.

From effectively harnessing adversity to identifying one’s own personal gifts, Chef Jeff reveals his unique life lessons and real life roadmap to reinvention as he takes audiences through his journey of redemption from the streets to the stove.

CHAPPEE COTTAGE CHOSEN FOR SUSTAINABILITY PROJECT

An updated HVAC&R system will be provided to a home for adults and children with development disabilities under the Sustainable Footprint chosen by the Southern Illinois University Edwardsville (SIUE) Student Branch.

ASHRAE’s Sustainable Footprint Project was launched in 2008 by the Utah Chapter. The goals of the program are to leave a legacy representing ASHRAE’s commitment to sustainability and to offset the environmental impact from holding the Annual Conference. It is now customary for the Annual Conference host city to select a project with some funding provided by ASHRAE as seed money.

The SIUE branch has been given the opportunity to gain rare undergraduate engineering experience in taking on this project with professional engineers Pat O’Brien, vice chair/sustainability mentor of the St. Louis Host Committee, and Vinny Stanec, who is general chair of St. Louis Host Committee, as advisors.

The branch has chosen Chappee Cottage on the Beverly Farm Campus (www.beverlyfarm.org/) in Godfrey, Ill. The Beverly Farm Foundation provides a loving, caring home for adults with developmental disabilities, providing each individual with physical and emotional security and a dignified quality of life, with opportunities and challenges, within each individual’s functional capabilities. Chappee Cottage houses about 25 women and children. Their building currently has an old inefficient multi-zone system with radiant floor heating which has been all but disabled as a result of a grossly inefficient boiler.

The branch has selected three HVAC options and are currently looking into other ways to save energy in the building, such as the building envelope, windows, lighting and controls. The most viable option for this project is a single zone residential split system with a dedicated outdoor air system. There are plans to replace the current boiler with one that is more efficient and continue to use the radiant flooring in the space. This will allow for the most energy efficient usage of the equipment while maintaining comfort in the space.
ASHRAE 2016 ANNUAL 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 the America’s Center Convention Complex. Choose from two full-day seminars and eight half-day short courses to help you stay current on the latest HVAC technology. 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.

Register at www.ashrae.org/stlouiscourses or onsite at the ASHRAE registration booth at the Marriott St. Louis Grand Hotel.

Please refer to the map in this program to assist in finding the rooms for the ALI courses.

FULL-DAY PROFESSIONAL DEVELOPMENT SEMINARS
Registration fees: $510 per course; $415 for ASHRAE members
Completion of each seminar earns 6 PDHs/AIA LUs or 0.6 CEUs (check with your state for their continuing education credit requirements)

SATURDAY, JUNE 25, 2016

Introduction to Building Enclosure Commissioning (code 60)
(Co-Sponsored by Building Enclosure Commissioning Collaborative)
8:00 am – 3:00 pm, America’s Center Convention Complex, Room: 261/262
This seminar introduces the Building Enclosure Commissioning (BECx) process by outlining key quality-based activities that achieve a successful building enclosure. The seminar includes an overview on such design phase BECx activities as developing the Owner’s Project Requirements, the BECx plan, and critical building science and architectural issues to address in the design review and specifications, and construction phase BECx activities such as construction observation and performance testing. The seminar aids in understanding how BECx contributes towards commissioning goals and requirements and LEED®.
Instructors: Fiona Aldous, Member ASHRAE and William Nash, P.E., Member ASHRAE

Energy Modeling Best Practices and Applications (code 61)
(Co-sponsored by IBPSA-USA)
8:00 am – 3:00 pm, America’s Center Convention Complex, Room: 260
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 Sam Mason, P.E., Member ASHRAE, BEMP

HALF-DAY SHORT COURSES
Registration fees: $184 per course; $139 for ASHRAE members
Completion of each course earns 3 PDHs/AIA LUs or 0.3 CEUs (check with your state for its continuing education credit requirements)

SATURDAY, JUNE 25, 2016

Energy Management Best Practices (code 62)
12:00 pm – 3:00 pm, America’s Center Convention Complex, Room: 263
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

SUNDAY, JUNE 26, 2016

Variable Refrigerant Flow System Design & Application (code 63)
3:30 pm – 6:30 pm, America’s Center Convention Complex, Room: 260
Variable Refrigerant Flow (VRF) systems are now being used in many building across North America. This course provides non-manufacturer-specific concepts of how to apply VRF systems to a wide range of building types. The course supplements the fundamental technology introduction 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

Troubleshooting Humidity Control Problems (code 64)
3:30 pm – 6:30 pm, America’s Center Convention Complex, Room: 261/262
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
MONDAY, JUNE 27, 2016

**Commissioning for High-Performance Buildings (code 65)**
2:30 pm – 5:30 pm, America’s Center Convention Complex, Room: 260
This course presents the defining characteristics of the building commissioning process as expressed in *ASHRAE Guideline 0*. Guideline 0 has been well received by the North American design community and has spurred the development of numerous supporting guidelines and standards for the commissioning process. The course explores the implications of employing the ASHRAE commissioning process for high-performance buildings. Particular emphasis is placed on the value of developing a strong Owner’s Project Requirements document that can successfully guide verifications in the design, construction and operation phases for buildings with high expectations for performance.
Instructor: Walter Grondzik, P.E., Fellow/Life Member ASHRAE, LEED® AP

2:30 pm – 5:30 pm, America’s Center Convention Complex, Room: 261/262
Legionellosis is a health and safety concern for facility owners and operators, and those who manage and oversee a building’s water cooling system. *ASHRAE Standard 188-2015* establishes the minimum legionellosis risk management requirements for the design, construction, installation, commissioning, operation, maintenance and service of centralized building water systems and components. 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 comprehensive management strategy for the prevention of Legionellosis is also discussed. The course focuses on the compliance with Standard 188-2015 to provide a safer and healthier building environment.
Instructors: Michael Patton, Member ASHRAE and William Pearson, Member ASHRAE

TUESDAY, JUNE 28, 2016

**Designing Tall, Supertall and Megatall Building Systems (code 67)**
8:00 am – 11:00 am, America’s Center Convention Complex, Room: 260
This course provides substantial new information and design assistance on tall, supertall and megatall building systems. The course covers the main topics in the new ASHRAE Design Guide for Tall, Supertall, and Megatall Building Systems including: analyzing/optimizing the thermal performance of the building envelope; calculating the stack effect; selecting appropriate mechanical systems and central plant alternatives; ventilation and thermal comfort; code compliance; chilled and heating water distribution systems; evaluating pumping systems; fire and life safety systems; vertical transportation systems; high-rise residential design; and mechanically and naturally ventilated conditioning solutions. Also, energy modeling and Energy Use Index (EUI) are presented to enable designers to assess the efficiency of the building and its systems.
Instructor: Peter Simmonds, Ph.D., Fellow ASHRAE

**Complying with Standard 90.1-2013: HVAC/Mechanical (code 68)**
8:00 am – 11:00 am, America’s Center Convention Complex, Room: 261/262
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 that is 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.
Instructor: McHenry Wallace, P.E., Member ASHRAE, LEED® AP

**Designing High-Performance Healthcare HVAC Systems (code 69)**
12:00 pm – 3:00 pm, America’s Center Convention Complex, Room: 260
This advanced course provides an in-depth discussion of system design, control sequences and psychrometrics to meet the needs of high-performance healthcare facilities. The course covers the relationship of infection control and HVAC design, the key elements of high-performance in healthcare applications including, control sequences and setpoints, energy conservation strategies, and temperature / relative humidity requirements.
Instructor: Donald Burroughs, P.E., Member ASHRAE
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 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.
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 ANNUAL CONFERENCE
TECHNICAL PROGRAM

St. Louis – June 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 America’s Center Convention Complex.

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

ASHRAE’S CONFERENCES AND EXPOSITIONS COMMITTEE WELCOMES YOU TO THE 2016 ANNUAL 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 July 5, 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 St. Louis 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 St. Louis Virtual Conference, www.ashrae.org/stlouisonline, and your login information.

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, July 6. Presentations available online through January 2018.
• A full slate of technical programs will be posted beginning Monday, June 27, of the sessions that were presented the previous day, with additional content posted through Thursday, June 30.
• Access to the St. Louis Virtual Conference is free with your paid conference registration. To register only for the Virtual Conference, go to ASHRAE Registration, America’s Center Convention Complex. $249 ASHRAE member; $445 non member or register online.
Sunday, June 26

CONFERENCE PAPER SESSION 1 (INTERMEDIATE)

Advances in Absorption Refrigeration
Track: Advances in Refrigeration Systems and Alternative Refrigerants
Room: 225
Chair: Hyojin Kim, Ph.D., Member, Catholic University of America, Washington, DC

Vapor absorption chillers may be a viable alternative to vapor compression chillers and may provide significant energy savings. However, vapor absorption chillers may not be as competitive due to size and cost issues. This session explores various ways in which vapor absorption chillers can be designed and operated in a more efficient manner.

1. Modeling and Analysis of Bubble Pump Parameters for Vapor Absorption Refrigeration Systems (ST-16-C001)
   Julia Aman, Student Member, Paul Henshaw, Ph.D., P.E., Associate Member and David S-K Ting, Ph.D., P.E., Turbulence and Energy Laboratory, Centre for Engineering Innovation, University of Windsor, Windsor, ON, Canada

2. Experimental Investigation on the Surface Tension of LiBr/H2O Solutions with Additives at Low Pressure (ST-16-C002)
   Federico Lonardi and Andrea Luke, Dr.Ing., University of Kassel, Kassel, Germany

CONFERENCE PAPER SESSION 2 (INTERMEDIATE)

Airflow Requirements and Modeling Approaches
Track: Indoor Environment: Health, Comfort, Productivity
Room: 221
Chair: Joy Altwies, University of Wisconsin-Madison, Madison, WI

Different space applications and uses often dictate widely varying air flow and ventilation requirements. This session explores different and unique methods to model these requirements in three different applications: data center, laboratory and kitchens with multiple cooking appliances.

1. Experimental Study on Ventilation Requirements of Exhaust Hoods for Multiple Cooking Appliances (ST-16-C003)
   Toshiya Iwamatsu, Ph.D., Associate Member and Wataru Urabe, Central Research Institute of Electric Power Industry, Komae, Japan, (2)Central Research Institute of Electric Power Industry, Tokyo, Japan

2. Analysis of Contaminant Flow Path and Laboratory Ventilation Effectiveness (ST-16-C004)
   Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

3. A Hybrid Turbulence Model Coupling Strategy for CFD Simulation of a Data Center Model (ST-16-C005)
   Cheng-Xian Lin, Ph.D., Member, Long Phan, Student Member and Bin Liu, Florida International University, Miami, FL

Available at the Conference Bookstore

Conference Seminars DVD
64 Seminars (PowerPoint files synced with speakers’ audio)
$119 (ships September 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 October 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 Annual 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 Annual 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 Annual Conference Content Package
   (2016 ASHRAE Annual Conference – Papers (online), Seminars DVD, and ASHRAE Transactions)
   $174 – Purchase in the Conference Bookstore

All prices are special conference-only prices.
A school's indoor environment can have significant impacts on health and learning. It is important to protect IAQ during school building upgrades, including energy-efficiency upgrades. There can be a mistaken impression that energy efficiency and IAQ are at odds with each other. When energy efficiency and IAQ protection goals are integrated, schools can achieve strong results in both areas. Alternatively, if careful attention is not paid to the interaction between energy management and IAQ, occupant health can suffer. The U.S. EPA recently released Energy Savings Plus Health: IAQ Guidelines for School Building Upgrades, and this new guidance is presented.
newly introduced SFTool Submetering module and the interactive 
Submetering Wizard.

1. Developing the Business Case for Submetering: Leveraging 
GSA’s Portfolio to Demonstrate Submeter Functionalities, Range of 
Benefits and Cost Savings
Kinga Hydras, Member, U.S. General Services Administration, 
Washington, DC

2. Developing the Business Case for Submetering: Standards and 
Mandates
Martin Weiland, P.E., Member, US General Services Administration, 
Washington, DC

9:00 AM-9:30 AM

NETWORKING COFFEE BREAK
America’s Center Convention Complex (ACCC), 
Ballroom Foyer, Level 2
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 St. Louis.

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 3 (INTERMEDIATE)

Novel Modeling Approaches
Track: Research Summit
Room: 223
Chair: Ratnesh Tiwari, Ph.D., University of Maryland, College Park, MD

The session addresses modern energy modeling methods to better 
compare the operation of commercial buildings with self-learning 
modeling techniques and time-series auto regression. The session also 
discusses the development of baseline models for industrial facilities.

1. The Dynamic Modeling of Chilled Water HVAC Systems Using 
System Identification (ST-16-C006)
Jasmine Buford, Member and Nabil Nassif, Ph.D., P.E., Member, 
North Carolina A&T State University, Greensboro, NC

2. Development and Testing of Building Energy Model Using Non-
Linear Auto Regression Neural Networks (ST-16-C007)
Nabil Nassif, Ph.D., P.E., Member, North Carolina A&T State 
University, Greensboro, NC

3. Gaussian Process Baseline Regression Models in Industrial 
Facilities (ST-16-C008)
Joseph Carpenter, Zheng O’Neill, Ph.D., P.E., Member and Keith 
Woodbury, Ph.D., P.E., University of Alabama, Tuscaloosa, AL

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 4 (INTERMEDIATE)

Radiant Cooling Systems
Track: HVAC Systems and Equipment
Room: 228
Chair: Helen R. Cerra, Member, ChemTreat, Inc., Glen Allen, VA

This session explores three applications of radiant cooling systems to 
reduce energy consumption to meet building cooling demands. The first 
presentation evaluates three applications of radiant cooling in various 
Indian climate zones compared to an all air system. The second discusses 
the possibilities of passive cooling panels to lower water temperatures 
below ambient dry-bulb temperatures. Lastly, the session evaluates 
nighttime cooling of office building with radiative cooling panels, based 
on studies performed in Copenhagen, Milan and Athens.

1. Passively Cooling Water below the Ambient Temperature during 
the Day via Radiative Sky Cooling (ST-16-C009)
Eli Goldstein, Ph.D., Student Member, Aaswath Raman, Ph.D., 
Member and Shanhui Fan, Ph.D., Stanford University, Stanford, CA

2. Analysis of Different Configuration of Radiant Cooling System 
Integrated with Cooling Tower for Different Indian Climatic 
Zones (ST-16-C010)
Mahabir Bhandari, Ph.D., Member, Jyotirmay Mathur, Dr.Ing., 
Member, Robin Jain, Yasin Khan, P.E.1 and Prateek Srivastava1, (1) 
Oak Ridge National Laboratory, Oak Ridge, TN, (2)Malaviya National 
Institute of Technology, Jaipur, India

3. Simulation Study of Discharging PCM Ceiling Panels through 
Nighttime Radiative Cooling (ST-16-C011)
Eleftherios Bourdakis, Student Member, Ongun B. Kazanci, Student 
Member, Bjarne W. Olesen, Fellow ASHRAE and Fabio 
Grassule, Technical University of Denmark, Kongens Lyngby, Denmark

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 5 (INTERMEDIATE)

Recent Developments with Windows
Track: Indoor Environment:
Health, Comfort, Productivity
Room: 224
Chair: Marilyn Listvan, Ph.D., Member, Listvan & Assoc., Consulting, 
Edina, MN

As buildings continue to strive to reduce energy consumption we 
must look at building fenestration to minimize building heat loss and heat 
gain. This session evaluates options to improve window u-factor and 
solar heat gain while comparing occupant satisfaction based on comfort, 
control and visibility. This session also discusses a method for determining 
cost effective building envelopes for passive house applications, 
including glazing, insulation and window to wall ratio.

1. Benefits of Interior Installed High Performance Insulating Glass 
for Commercial Retrofit Applications: A Case Study (ST-16-C012)
Tracy Rogers, Quanex Building Products, Cambridge, OH

2. Occupants’ Preferences and Satisfaction with the Visual 
Environment in Perimeter Zone Offices: A Field Study in a Building 
with Advanced Technology (ST-16-C013)
Seyed Amir Sadeghi, Student Member, Purdue University, 
West Lafayette, IN

9:45 AM-10:45 AM

SEMINAR 4 (ADVANCED)

Energy Use Index (EUI): Breakdown of Energy Components of 
Tall, Supertall and Megatall Buildings Both Domestic and 
International
Track: Renewable Energy Systems 
and Net Zero Buildings
Room: 226
Sponsor: 09.12 Tall Buildings
Chair: Peter Simmonds, Ph.D., Fellow ASHRAE, Building and Systems 
Analytics LLC, Marina Del Rey, CA

Based on a very successful seminar held in Orlando, this session 
provides a breakdown of energy components for the buildings being 
presented. This seminar illuminates energy components of tall, supertall 
and megatall buildings which can be optimized to reduce energy 
consumption and provide opportunities for net zero buildings.

1. EUI Breakdown for Tall Buildings in Chicago and Internationally 
Mehdi Jalayerian, P.E., Member, ESD, Chicago, IL

2. Specifics of EUI for Selected Buildings around the World 
Stephen Ray, Ph.D., P.E., Member, North Park University, Chicago, IL

3. Energy Breakdown of Tall Buildings in the Bay Area 
Robert Henderson, ARUP, San Francisco, CA
Innovative Absorption System Applications for Both Heating and Cooling

Track: HVAC Systems and Equipment
Room: 223
Sponsor: 08.03 Absorption and Heat Operated Machines
Chair: Ervin Gereck, P.E., CPMP, Associate Member, Real Engineering Services LLC, Totowa, NJ

Absorption systems can be used in a variety of cooling and heating applications often simultaneously to improve overall system efficiency. This session introduces dual and triple lift (not stage) absorption systems with a case study. The session also covers modern absorption systems on district heating and cooling commercial water heating applications.

1. Practical Application of an Absorption Heat Pump to Commercial Water Heating
   Patrick Geoghegan, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

2. Using Double and Triple Lift Single Stage Absorption to Save Energy
   Douglas A. Davis, Associate Member, Broad USA, Hackensack, NJ

3. Absorption Heat Pumps for District Heating Applications
   Rajesh Sinha, Thermax Inc., Houston, TX

9:45 AM-10:45 AM

SEMINAR 6 (INTERMEDIATE)

Latest Technologies in Air-to-Air Energy Recovery

Track: Fundamentals and Applications
Room: 222
Sponsor: 05.05 Air-to-Air Energy Recovery
Chair: Ronnie Moffitt, P.E., Member, Trane, Lexington, KY

Total energy recovery devices transfer both temperature and moisture between the airstreams. Two of these newer technologies are membrane exchangers and liquid desiccant systems. This session covers the science of membrane exchangers and how they transfer water vapor and heat. It also reviews a liquid desiccant system and how this too can be used to transfer water vapor and heat between exhaust and outside airstreams.

1. Science of Polymeric Membranes Used in Energy Recovery
   Ryan Huizing, P.Eng., dPoint Technologies, Vancouver, BC, Canada

2. Liquid Desiccant Total Enthalpy Recovery
   Mark Piegay, Member, Alfa Laval - Kathabar, Tonawanda, NY

9:45 AM-10:45 AM

WORKSHOP 4 (INTERMEDIATE)

DDC for Smart Buildings and Smart Grid

Track: Smart Building Systems/Remote Monitoring and Diagnostics
Room: 227
Sponsor: 01.04 Control Theory and Application, 07.05 Smart Building Systems
Chair: Cynthia Moreno, T&M Mechanical Sales Company, Solana Beach, CA

Not all energy dashboards are created equally. This seminar reviews the established classification of energy dashboards. Energy dashboards are a graphical user interface that resembles an automobile dashboard. A web-based energy dashboard allows for display of real-time building performance and external information. This workshop discusses the latest technology in energy dashboards and DDC monitoring. Learn about smart metering and how its integration into energy dashboards can become an invaluable tool for today’s high performance green buildings.

1. Criteria for Building Automation Dashboards
   Frank Shadpour, P.E., HDFP, Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

2. Smart Metering through Controls
   Larry J. Fisher, Member, ECT Services, Louisville, KY

11:00 AM-12:30 PM
11:00 AM-12:30 PM

SEMINAR 7 (INTERMEDIATE)
Building Water Systems: Issues and Insights from Outbreaks of Legionnaires’ Disease
Track: Indoor Environment: Health, Comfort, Productivity
Room: 223
Sponsor: 03.06 Water Treatment
Chair: Joshua Ince, P.Eng., Member, Eldon Water Inc, West Chester, OH

This session delves into understanding issues that are associated with recent and past outbreaks. It dispels popular myths of Legionella bacteria and Legionnaires’ Disease, while introducing insights to aid system designers, facility managers and public health inspectors to collectively lower the risk of Legionella amplification within building water systems. Improved understanding of this disease’s root causes will allow the usage of appropriate legislation that is effective in reducing human exposure to Legionella. The expert panel answers questions regarding lessons learned from first-hand outbreak investigation experience, issues with conflicting code requirements and actions required to minimize incidence of Legionnaires’ disease.

   Janet Stout, Ph.D., Member, Special Pathogens Laboratory, Pittsburgh, PA

2. Lessons Learned from Potable Water Outbreak Investigations: Issues with Public Health and Plumbing Codes
   Tim Keane, Member, Legionella Risk Management Inc, Chalfont, PA

3. Policy Consequences of Outbreaks: Who Got It Right?
   Sarah Ferrari, Evapco Inc, Taneytown, MD

11:00 AM-12:30 PM

SEMINAR 8 (INTERMEDIATE)
Comfort Challenges in Commercial Kitchens
Track: Indoor Environment: Health, Comfort, Productivity
Room: 226
Sponsor: 05.10 Kitchen Ventilation, 04.01 Load Calculation Data and Procedures
Chair: Russell Robison, Member, Gaylord Industries, Tualatin, OR

With today’s focus on energy efficiency in our commercial buildings, kitchens present perhaps the greatest challenge of all. Balancing the most energy intense segment of our buildings with the oftentimes overlooked comfort of our kitchens must be a focus moving forward. This seminar presents the findings illustrating some of the current obstacles in this area and what our community is doing to bring back the balance.

1. Thermal Comfort in Commercial Kitchens: a Real-World Perspective!
   Donald Fisher, P.Eng., Life Member, Fisher Consultants, Danville, CA

2. Latent and Sensible Loads in Commercial Kitchens and Dishrooms
   Richard T. Swierczyna, Associate Member, Food Service Technology Center, San Ramon, CA

3. Considering Additional Loads Associated with Un-Tempered Kitchen Makeup Air
   Jimmy Sandusky, Associate Member, Halton Company, Scottsville, KY

4. Dew Point Designs for Commercial Kitchens
   Greg DuChane, Member, Trane, Columbus, OH

11:00 AM-12:30 PM

SEMINAR 9 (BASIC)
Gender Diversity: Will ASHRAE Lead or Lag?
Track: Professional Skills Beyond Engineering
Room: 227
Sponsor: 01.07 Business, Management & General Legal Education, Women in ASHRAE, YEA
Chair: Chris Gray, Ph.D., P.E., Member, Georgia Power Company, Columbus, GA

While the demographics of our industry are changing, there are still many groups of people that are underrepresented in ASHRAE. This seminar looks into how unconscious bias has affected our decision-making process over the years and how that has caused our industry to develop to its current make-up. A data analysis of ASHRAE’s membership is discussed and compared to membership data from our partner organizations in the built environment. The seminar discusses the significant benefits of changing these demographics and including personal accounts of diversity issues and successes in the workplace.

1. Beyond the Comfort Zone: Unconscious Bias for the Analytical Mind
   Erin McConahey, P.E., HBDE, Fellow ASHRAE, Arup, Los Angeles, CA

2. Women in ASHRAE, By the Numbers
   Jessica Mangler, P.E., Member, Ross & Baruzzini, St. Louis, MO

3. Personal Experiences of Diversity in the Workplace and in Your ASHRAE Chapter
   Karine Leblanc, Member, US Air Conditioning Distributors, Los Angeles, CA

11:00 AM-12:30 PM

SEMINAR 10 (INTERMEDIATE)
Performance Monitoring and Systems Testing Per ASHRAE Standards 184, 30 and the 41 Series
Track: Fundamentals and Applications
Room: 221
Sponsor: 08.02 Centrifugal Machines
Chair: Frederick Betz, P.E., Life Member, Hall Consultants, LLC, Worthington, OH

In order to be able to evaluate and maintain the efficiency of a chilled water system, you must know how to measure the many variables for comparing the operation. ASHRAE has developed standard methods of testing field performance and test stand performance of liquid chilling equipment and systems. These Standards are Standard 184 and 30. The 41 Series of Standards describes methods for testing system variables such as liquid and airflow, temperature and humidity. The presenters in this seminar describe these Standards and their development and use.

1. ASHRAE Standard 30
   Phillip Johnson, P.E., Member, Daikin Applied, Staunton, VA

2. ASHRAE Standard 184
   Robert Blanton, P.E., Member, Johnson Controls, Inc., York, PA

3. 41 Series Standards
   Richard Hall, Member, Hall Consultants, LLC, Worthington, OH

11:00 AM-12:30 PM

SEMINAR 11 (INTERMEDIATE)
Smart Grid in the Heartland:
See What Happens Next
Track: Smart Building Systems/Remote Monitoring and Diagnostics
Room: 228
Sponsor: 07.05 Smart Building Systems
Chair: Richard Hackner, P.E., Member, GDS Associates, Madison, WI

This seminar introduces ASHRAE members to the rapidly developing world of smart grid implementation by utilities and others in the Midwest. Building owners, operators and designers will need to know what options and opportunities they will have in the not too distant future to manage and control their energy use and costs. The seminar also discusses what resources will be available for them in the future.
1. Where's the Data?
Christopher DeMarco, Ph.D., University of Wisconsin - Madison, Madison, WI

2. Ameren Smart Grid Implementation
Bruno Stopka, Ameren Illinois, Marion, WI

3. Demand Response through Advanced Lighting Controls
Scott Schuetter, P.E., Member, Seventhwave, Madison, WI

4. Smart Grid Implementation in Michigan
Glenn Remington, Member, CMS Energy, Jackson, WI

11:00 AM-12:30 PM

SEMINAR 12 (BASIC)

The ABCs of UVC
Track: HVAC Systems and Equipment
Room: 222
Sponsor: 02.09 Ultraviolet Air and Surface Treatment
Chair: Sam Guzman, American Ultraviolet Company, Hackettstown, NJ

This session covers the following UVC related topics: Why use UVC and how does UVC work? Designing/engineering a proper UVC system for your HVAC unit (understanding the levels of UVC dose necessary for different Pathogens), installation and commissioning a UVC system, and Operation & Maintenance.

1. Design Understanding the Levels of UVC Dose Necessary for Different Pathogens
Ashish Mathur, Ph.D., UVDI, Valencia, CA

2. Operation and Maintenance of a UVC System
Scott Sherwood, Eco Care Corporation, New York, NY

3. Commissioning a UVC System in an HVAC Unit
John Putnam, CPMP and HFDP, Member, IEQ Health, Washington, DC

12:30 PM-1:30 PM

FORUM 1 (BASIC)

Behind the Curtains: A Discussion about How to Submit a Program, Mini-Track or Track Suggestion for the ASHRAE Biannual Conferences
Track: Fundamentals and Applications
Room: 224
Sponsor: Conferences and Expositions Committee
Chair: Jon Cohen, Member, ChemTreat, Inc., Richmond, VA

The Conference and Expositions Committee is responsible for selecting the technical programs for the Biannual ASHRAE Conferences. If you have had difficulty submitting a program in the past, have a great track suggestion for a future conference, or just have questions on the process, please join us for a look into our selection process and learn how technical committees and members alike can proactively support the process.

1:30 PM-3:00 PM

TECHNICAL PAPER SESSION 1 (ADVANCED)

Airflow Measurements and Predictions
Track: Fundamentals and Applications
Room: 224
Sponsor: 05.06 Control of Fire and Smoke
Chair: Paul Turnbull, Member, Siemens Building Technologies, Inc., Buffalo Grove, IL

Air velocity can impact a number of situations including the minimum duct wall thickness required for handling the reduced commercial kitchen exhaust velocity now allowed by NFPA 96. The results of an important CFD study on the impact of make-up air velocity used to control smoke in atriums is reported. Full scale fire tests show the influence of pressure compensating systems for stairwells. The results of a CFD study on ventilated patient isolation rooms show that portions of a room are not well ventilated when the standard ventilation rate is used. A simpler and more precise method has been developed to predict the necessary separation distance between a variety of exhaust configurations and make-up air inlets. An additional presentation on this topic will be held during the TC 5.06 meeting, Monday, June 27, 4:15 pm - 4:30 pm in room 227.

1. Analyzing the Performance of a Kitchen Exhaust Air Duct with Regards to Recent Standards: A CFD/Thermal Stress Simulation (ST-16-001)
Ali M. Hasan, CEng, Member, KEO International Consulting Engineers, Doha, Qatar

2. A CFD Study to Identify Methods to Increase Maximum Velocity of Make-up Air for Atrium Smoke Control (RP-1600) (ST-16-002)
James Milke, Ph.D., P.E.1, Christine Pongratz2 and Arnaud Trouvé1, (1) University of Maryland, College Park, MD, (2)Arup Group Limited, London, United Kingdom

Ronald Petersen, Ph.D., Member1 and Jared Ritter2, (1)CPP Inc., Fort Collins, CO, (2)CPP Wind Engineering and Air Quality Consultants, Fort Collins, CO

1:30 PM-3:00 PM

CONFERENCE PAPER SESSION 8 (ADVANCED)

System Design, Diagnostics and Operation
Track: Smart Building Systems/Remote Monitoring and Diagnostics
Room: 225
Chair: David E. Claridge, Ph.D., P.E., Fellow ASHRAE, Texas A&M University, College Station, TX

This session discusses different methods to evaluate fault readings within a building HVAC system. The first study evaluates water and air system faults with system head and power to minimize computational down time, while another looks at a hazard and operability analysis (HAZOP) for the whole building and a third study looks at incorporating fundamental psychometric equations in the DDC control logic to locate defective sensors. Lastly, this session evaluates the importance of ongoing commissioning on smart building systems to help operators maintain energy efficiency.

1. No-Cost Air Conditioning System Diagnostics Using Fundamental Equations and Existing Controls (ST-16-C021)
Maribella Ibarra, P.E., Associate Member, Vermont Energy Investment Corporation, Burlington, VT

2. Handling Discrepancies in Building Reactive Management Using HAZOP and Diagnosis Analysis (ST-16-C022)
Mahendra Singh, KIC-innoenergy, Grenoble, France

Koosha Kiamehr1, Alejandro Rivas Prieto2, Wesley M. Thomas2, Gang Wang, Ph.D., P.E.1 and Li Song, Ph.D., P.E.2, (1)University of Miami, Coral gables, FL, (2)University of Oklahoma, Norman, OK, (3) University of Miami, Coral Gables, FL

4. Smart Building Systems Help Maintain the Sustainable Edge of an Award Winning Laboratory (ST-16-C024)
Donald L. Walker, P.E. and G. Brendan Gardes, P.E., HBDP, Member, Newcomb & Boyd, Atlanta, GA
SEMINAR 13 (INTERMEDIATE)

Advancements in Compressor Design, Testing and Performance Modeling for New Efficiency Standards and Alternative Refrigerants

Track: Advances in Refrigeration Systems and Alternative Refrigerants
Room: 221

Sponsor: 08.01 Positive Displacement Compressors, Refrigeration Committee
Chair: Georgi Kazachki, Ph.D., Fellow ASHRAE, Dayton Phoenix Group, Inc., Dayton, OH

The industry is driving toward lowering the carbon footprint of air-conditioning and refrigeration systems through more stringent efficiency standards and lower GWP refrigerants. This is creating a strong demand from compressor manufacturers to produce more data regarding the operation of the compressors without sacrificing accuracy. Adapting compressor standards and more economical test methods are needed for developing compressor performance maps. The proper assessment of the actual compressor performance in a system or unit derived from the compressor performance maps that are developed at standardized rating conditions is a key prerequisite for a successful system design and operation.

1. Analysis of the Performance Rating Standards of Positive Displacement Refrigerant Compressors
   **Joe Sanchez, Member.** Bitzer US, Inc., Flowery Branch, GA

2. Representation of a Positive Displacement Compressor Map with Vapor Injection
   **Gordon Powell, Ingersoll Rand, La Crosse, WI**

3. A Study of Methods to Represent Compressor Performance Data over an Operating Envelope Based on a Finite Set of Test Data
   **Vikrant Aute, Ph.D., Member.** University of Maryland, College Park, MD

4. Sizing Low and High Compression Stages of Reciprocating Compressor for Optimum Vapor Injection Performance in Economized Cycle
   **Alex Lifson, P.E., Member.** Carrier Corporation, Syracuse, NY

SEMINAR 14 (INTERMEDIATE)

Ammonia and CO2: Advances in Application

Track: Advances in Refrigeration Systems and Alternative Refrigerants
Room: 222

Sponsor: 10.01 Custom Engineered Refrigeration Systems, 10.05 Refrigerated Distribution and Storage Facilities
Chair: Tom Wolgamot, P.E., CPMP, DC Engineering, Missoula, MT

Ammonia and CO2 are considered alternative refrigerants in some sectors. This seminar presents the background behind the movement to natural refrigerants, successful design approaches employed in Europe and North America using ammonia. An end-user’s perspective, experience and decision-making parameters that affect the choice of refrigerants, including the use of low-charge ammonia systems is presented. Lessons learned about the design, installation and operation of a transcritical CO2 system in a Refrigerated Distribution Center are also discussed. The overall objective of this session is to demonstrate the benefits of natural refrigerants and ways to employ them cost effectively.

1. The Transition to Natural Refrigerants
   **Brandon France.** Stellar, Jacksonville, FL

2. Low Charge Ammonia Case Studies
   **Caleb Nelson, P.E., Associate Member.** Azane, Inc., Missoula, MT

3. An Owner’s Perspective: Electronic Refrigerant Injection Control (ERIC) Ammonia Applications
   **John Scherer.** LA Cold Storage, Los Angeles, CA

4. Transcritical CO2 in a Refrigerated Warehouse
   **John Gallaher, Hill Phoenix, Atlanta, GA**
1:30 PM-3:00 PM

**SEMINAR 17 (INTERMEDIATE)**

Plumbing System Design Criteria to Minimize the Potential for Legionella Growth

**Track:** Indoor Environment: Health, Comfort, Productivity

**Room:** 227

**Sponsor:** 06.06 Service Water Heating Systems, 05.06 Water Treatment

**Chair:** Tim Keane, Member, Legionella Risk Management Inc, Chalfont, PA

ASHRAE 188-2015 provides legionella risk management requirements for the design and operation of plumbing systems. ASHRAE Guideline 12, being updated, provides direction on how to accomplish them. Legionnaires disease, a disease of plumbing systems, is frequently caused by issues related to plumbing system design. Misperceptions are all too common and many think it is an accident that can’t be avoided. This seminar focuses on the design, construction and commissioning of building potable water systems. A discussion from three different perspectives, the key factors impacting Legionella growth in piping systems: velocity, turnover, temperature, materials and complexity of components is held.

1. Are Energy Efficiency and Legionella Risk Mitigation at Odds?
   **Gary Klein, Associate Member, Gary Klein and Associates, Inc., Rancho Cordova, CA**

2. The Role Materials Can Play in Legionella Risk Mitigation
   **Domenic DeCaria, Labrozil Advanced Materials Inc., Cleveland, OH**

3. Lessons Learned from Failure Analysis
   **Tim Keane, Member, Legionella Risk Management Inc, Chalfont, PA**

1:30 PM-3:00 PM

**SEMINAR 18 (BASIC)**

Water Treatment Programs: Designing for Asset Management and Long-Term Efficiency

**Track:** HVAC Systems and Equipment

**Room:** 226

**Sponsor:** 03.06 Water Treatment, 08.06 Cooling Towers and Evaporative Condensers

**Chair:** William E. Pearson II, Associate Member, Southeastern Laboratories, Raleigh, NC

Designing a cooling water system to provide proper water treatment is a fundamental aspect of design to provide long term asset management and maintaining efficiency over the life of the system. Current system design for energy efficiency and commissioning for proper operation must be maintained over the life of the equipment and designing and operating the water treatment program to enhance these efforts is necessary. This session provides the engineer, commissioning agent and owner the tools necessary to accomplish these goals.

1. Water Treatment Fundamentals and Performance Metrics
   **Jon Cohen, Member, ChemTreat, Inc., Richmond, VA**

2. Control and Monitoring Equipment for Cooling Tower Water Treatment
   **Patrick Racine, Klenzoid Canada, Mississauga, ON, Canada**

3. Water Treatment for HVAC Specifications
   **Jeff Boldt, P.E., HBDP, Member, KJWW Engineering Consultants, Madison, WI**

3:15 PM-4:45 PM

**SEMINAR 19 (INTERMEDIATE)**

Energy Management for Multi-Building Portfolios from the Owner-Operator and the Consultant Perspectives

**Track:** Fundamentals and Applications

**Room:** 226

**Sponsor:** 07.06 Building Energy Performance

**Chair:** Annie Smith, Associate Member, Ross & Baruzzini, St. Louis, MO

When it comes to energy management of large commercial and institutional multi-building portfolios, owner-operators have a lot of questions to answer. Where to start with energy upgrades? What energy projects should be implemented and which buildings should they be implemented in? What goes in an energy master plan and why is one necessary? How valuable are energy audits and how many should be paid for? How can a central plant be optimized? This seminar focuses on answering these questions, using case studies and providing insights into successful energy management through the experiences of both consultants and owner-operators.

1. Implementing an Integrated Sustainability Energy Master Plan
   **Darryl Boyce, P.Eng., Fellow ASHRAE, Carleton University, Ottawa, ON, Canada**

2. 8760 Hours of Campus Energy Data
   **Ryan Corrigan, P.E., Affiliate and Eric Uterson, P.E., Affiliate, 8760 Engineering, St. Louis, MO**

3. Phased Implementation for Reducing Energy Consumption on a Commercial Campus
   **Gwenn Ivester, Affiliate, Cushman & Wakefield, St. Louis, MO**

Monday, June 27

8:00 AM-9:30 AM

**TECHNICAL PAPER SESSION 2 (INTERMEDIATE)**

Challenges and Opportunities with Refrigerants

**Track:** Fundamentals and Applications

**Room:** 224

**Sponsor:** 03.02 Refrigerant System Chemistry

**Chair:** Neil P. Leslie, Ph.D., P.E., Member, Gas Technology Institute, Des Plaines, IL

Current phase out programs to transition away from higher global warming potential refrigerants have not come without their own challenges: high ambient temperature environments, contaminants in new and reclaimed refrigerants and instances of counterfeit refrigerants to name a few. The mixing of counterfeit refrigerants with R134a has been reported in mobile refrigeration units around the world, causing violent and unexpected explosions, resulting in multiple fatalities. In addition, counterfeit refrigerants have caused system reliability issues in numerous air-conditioning applications. On the flip side, there are opportunities in improving the performance of heat pumps in cold climates by applying refrigerant mixtures.

1. Evaluation of Refrigerant Mixtures in Three Different Cold Climates Residential Air-Source Heat Pumps (ST-16-006)
   **Ali Hakkaki-Fard, Ph.D., Zine Aidoon, Ph.D. and Parham Estamimejdeh. (1)CanmetENERGY, Varennes, QC, Canada, (2)Natural Resources Canada, Varennes, QC, Canada**

2. Examination of the Reactions of R40 with R134a and POE Refrigeration System Materials (RP-1665) (ST-16-007)
   **Stephen Kufak, Member, Trane, Ingersoll Rand, La Crosse, WI**

3. Effects of Halogenated Unsaturated Contaminants on the Reliability of HVAC&R Equipment (RP-1641) (ST-16-008)
   **Ngoc Dung (Rosine) Rohutgi, Ph.D., Member, Spauschus Associates, Inc., Clyde, NC**

8:00 AM-9:30 AM

**TECHNICAL PAPER SESSION 3 (INTERMEDIATE)**

Efficiency Gains for Refrigeration and Chilled Water Systems

**Track:** HVAC Systems and Equipment

**Room:** 225

**Chair:** David Yashar, Ph.D., P.E., Member, NIST, Gaithersburg, MD

Commercial and industrial refrigeration systems consume a significant portion of electrical energy costs and can represent a high capital cost to an owner. These papers look at optimizing operating conditions and components to improve efficiency, improve the overall life cycle of the equipment and discuss the different available methodologies for measuring and verifying the efficiencies in chilled water system upgrades.

1. Quantifying Efficiency Gains of Refrigeration Systems Using Advanced Expansion Valve Technology (ST-16-009)
8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 9 (INTERMEDIATE)

Ground Coupled Heat Pumps
Track: Research Summit
Room: 221

Chair: Alamelu Brooks, BEMP, Associate Member, Estes McClure & Associates, Tyler, TX

Accurately designing a ground source heat pump system is dependent on the site conditions and well field layout. This session discusses low cost options to determine the site soil condition, proposes improvements to past vertical borehole sizing and evaluates the life cycle cost of hybrid ground source systems and coupling GSHP with supermarket refrigeration systems.

Kent Beason, P.E., BEMP, Associate Member, Estes McClure & Associates, Tyler, TX

2. Operational and Economic Analysis of GSHP Coupled with Refrigeration Systems in UK Supermarkets (ST-16-C026)
Pietro Dalpane, Salvador Acha, Ph.D. and Nilay Shah, Ph.D., Imperial College London, London, United Kingdom

3. Accounting for Borehole Thermal Capacity When Designing Vertical Geothermal Heat Exchangers (ST-16-C027)
Laurent Gagné-Boisvert, Student Member and Michel Bernier, Ph.D., P.E., Member, École Polytechnique de Montréal, Montreal, QC, Canada

Kyle Larsen, Ph.D., P.E. and Kayleen Teachman, Eastern Washington University, Cheney, WA

8:00 AM-9:30 AM

SEMINAR 20 (ADVANCED)

Computer Aided Renewable Energy System Design with Case Studies
Track: Renewable Energy Systems and Net Zero Buildings
Room: 227

Sponsor: 04.10 Indoor Environmental Modeling, 06.07 Solar Energy Utilization

Chair: Wangda Zuo, Ph.D., Member, University of Miami, Coral Gables, FL

Renewable energy is essential for the realization of net zero buildings. This seminar invites researchers from both architecture and engineering disciplines to demonstrate how to use modeling technologies such as computational fluid dynamics to improve the design of the renewable energy systems in buildings. The researchers introduce the applications of modeling technologies in the design of building envelopes and building systems such as the heating system with various renewable energy sources. The impacts of the renewable energy on the building energy performance, CO2 emission and the indoor thermal comfort are also discussed.

Xudong Yang, Ph.D., Fellow ASHRAE, Tsinghua University, Beijing, China

2. Utilizing CFD for Passive Solar Design Validation
Shan He and Ulrike Passe, AIA, Associate Member, Iowa State University, Ames, IA

3. Semitransparent PV Glazed Second Façade in Building’s Refurbishment: Indoor and Outdoor CFD Analysis
Marija Todorovic, Ph.D., P.E., Fellow ASHRAE, University of Belgrade, vea-invi.ltd director, Belgrade, Serbia

8:00 AM-9:30 AM

SEMINAR 21 (INTERMEDIATE)

Evolving Research on Embedded Tube Radiant Applications
Track: Research Summit
Room: 228

Sponsor: 06.05 Radiant Heating and Cooling

Chair: Devin Abellon, Member, Uponor, Apple Valley, MN

As engineers and building owners look to embedded-tube radiant heating and cooling applications to maximize energy efficiency while providing optimum occupant comfort, additional research is underway to prove the system’s effectiveness and provide better understanding. This seminar covers three different studies that help provide deeper insight into how radiant systems can be applied on both residential and commercial buildings.

1. The System-Wide Effects of Heating System Cost in High Bay Spaces
Omar Hwaid, P.E., Member and Trevor Jaffe, P.E., Member, Westlake Reed Leskosky, Washington, DC

2. Phase Change Materials in Radiant Heating and Cooling Applications
Eleftherios Bourdakis, Student Member, Technical University of Denmark, Kongens Lyngby, Denmark

3. Application of Radiant Heating and Cooling in Plus-Energy Houses
Ongun B. Kazanci, Student Member, Technical University of Denmark, Kongens Lyngby, Denmark

8:00 AM-9:30 AM

SEMINAR 22 (INTERMEDIATE)

Large-Scale Computing
Track: Fundamentals and Applications
Room: 222

Sponsor: 04.07 Energy Calculations

Chair: Harshul Singhal, Associate Member, Performance Systems Development, Ithaca, NY

Although building energy modeling has been common for many years, tools that support large-scale modeling analysis by leveraging vast cloud computing power are now both affordable and accessible. While these approaches make it easy to analyze tens of thousands of model variants, they may not take the shortest path to lead users to the answers they seek. In this session, presenters share case studies involving large scale modeling and results analysis. Attendees learn how to effectively efficiently design a large scale simulation study.

1. Design of Experiments: Statistical Confidence with Fewer Simulations
New Joshua, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

2. Exercising Occam’s Razor: Sensitivity Screening Methods as Applied to Building Energy Models
David Bosworth, Member, BUILDlab, LLC, Dryden, NY

3. How to Do Energy Model Uncertainty Analysis with Correlated Input Variables
Ralph Muehleisen, Ph.D., P.E., Member and Joshua Bergerson, Ph.D., Argonne National Laboratory, Lemont, IL

Monday, June 27 35
Parting the Clouds to See the Future of Residential Load Calculations

Track: Fundamentals and Applications
Room: 226
Sponsor: 04.01 Load Calculation Data and Procedures
Chair: Glenn Friedman, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

No one can afford the risk of getting load calculations wrong. If load calculations are too fat you lose the job, and if too skinny you have a liability you don’t want. This session presents important information about residential loads calculations including their science, the art, their code requirements and their state of the art. The session also presents information about residential load calculation methods in wide use today, explores the impact of technology on how these methods are applied and speculates on the techniques that may underlie “next generation” procedures.

1. Code Requirements for Residential Load Calculations and Manual J
Luis Escobar, Associate Member, Home Innovation Research Labs, Upper Marlboro, MD

2. Residential Load Calculations Using the Heat Balance Method
Charles S. Barnaby, BEMP, Life Member, Retired, Moultonborough, NH

Stephen Roth, P.E., Member, Carmel Software Corp., San Rafael, CA

8:00 AM-9:30 AM

Using ASHRAE Performance Measurement Protocols for Measuring and Benchmarking Commercial Building Performance

Track: Fundamentals and Applications
Room: 223
Sponsor: 07.06 Building Energy Performance
Chair: Bruce Hunn, Ph.D., Fellow ASHRAE, Retired, Raleigh, NC

ASHRAE published the Performance Measurement Protocols for Commercial Buildings (PMP) for building operators, facility managers, engineers and architects with respect to measuring and benchmarking commercial building performance. The PMP aims to provide a standardized set of protocols for a range of cost/accuracy (i.e., Basic, Intermediate and Advanced levels), to facilitate the appropriate comparison of measured energy, water and indoor environmental quality (thermal comfort, indoor air quality, lighting and acoustics) performance. This seminar introduces the PMP and their use with example case studies that show the various applications of the protocols to real buildings.

1. PMP Energy Protocols
Jeff S. Haberl, Ph.D., BEMP, Fellow ASHRAE, Texas A&M University, College Station, TX

2. Measurement and Conservation of Water Use
Jim Bochat, Member, Commissioning Concepts, Phoenix, AZ

3. PMP Indoor Environmental Quality Protocols: Overall Application
Hyojin Kim, Ph.D., Member, Catholic University Of America, Washington, DC

David Heinzerling, Associate Member, Taylor Engineering, Alameda, CA

9:45 AM-10:45 AM

Measurements and Modeling of Heat and Mass Transfer

Track: Fundamentals and Applications
Room: 224
Chair: Dennis O’Neal, Ph.D., P.E., Fellow ASHRAE, Baylor University, Waco, TX

Three papers dealing with experimental methodology and optimization of heat and mass transfer applications. Laboratory experiments were conducted in paper one to investigate the frosting conditions for two geometrically identical air-to-air cross-flow plate exchangers. Active mechanisms as a potential effective means to achieve the enhancement of heat and mass transfer in sorption fluids to improve the overall performance of an absorption chiller were posed in paper two. And in paper three, the application of Robust Design Engineering Methodology (RDEM) is used to assess minimum temperature and cold mass fraction gradient for the performance of Counter flow Vortex Tube.

Ali M. Hasan, CEng, Member, KEO International Consulting Engineers, Doha, Qatar

2. Experimental Setup and Methodology on Active Mechanisms for Enhancing Heat and Mass Transfer in Sorption Fluids (RP-1462) (ST-16-013)
Jiebin Yu, Ph.D., Associate Member, Ziqi Shen and Josephine Lau, Ph.D., Member, University of Nebraska-Lincoln, Omaha, NE

Advances in VFD Control and Building Operations and Maintenance

Track: HVAC Systems and Equipment
Room: 225
Sponsor: 07.05 Smart Building Systems
Chair: Li Song, Ph.D., P.E., University of Oklahoma, Norman, OK

Variable frequency drives (VFDs) are widely applied on induction motors in various HVAC applications. However, field studies and research shows that few variable flow systems are optimally controlled and never realize their full potential savings. These papers examine various factors and use simulations, experimental data and field measurements to unlock greater potential savings when using variable frequency drives.

1. Data and Interfaces for Advanced Building Operations and Maintenance (RP-1633) (ST-16-014)
Dr. Nicholas T. Gayeski, Ph.D., KGS Buildings, LLC, Cambridge, MA

2. Improving Variable Speed Pumping Control to Maximize Savings (ST-16-015)
Kathleen Sturtevant, Student Member1, Alexandra Brogan1, Vijay Gopalakrishnan1, Zachary Valigosky1 and Kelly Kissock, Ph.D., P.E.1, (1)University of Dayton, Dayton, OH, (2)Plug Smart, Columbus, OH, (3)Energy and Resource Solutions, North Andover, MA

Gang Wang, Ph.D., P.E.1 and Koosha Kiamehr2, (1)University of Miami, Coral Gables, FL, (2)University of Miami, Coral Gables, FL
9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 10 (BASIC)

Residences and Moisture
Track: Renewable Energy Systems and Net Zero Buildings
Room: 221
Chair: Kimberly Pierson, Moser Mayer Phoenix Associates, Greensboro, NC
This session compares the modeled energy consumption with utility bills of two houses and provides steps to yield more accurate modeled data; including construction materials, equipment performance curves, roof elevation and weather data. Secondly this session addresses the thermal comfort of multi-family facilities based on ASHRAE Standard 55-2013 and compare to occupant surveys and their perception of the space.
1. Pre-Retrofit Assessment of Thermal Comfort and Excess Moisture in Post-War Multi-Unit Residential Buildings in Toronto (ST-16-C029)
Daniel Haaland, Student Member1, Ekaterina Tzekova, Ph.D., Student Member1 and Jeffrey Siegel, Ph.D., (1)University of Toronto, Toronto, ON, Canada, (2)Toronto Atmospheric Fund, Toronto, ON, Canada
2. Development and Use of the Energy Model of a Research and Demonstration House with Advanced Design Features (ST-16-C030)
Vicente Bortone, P.E.1 and Nelson Fumo, Ph.D., Associate Member2, (1)Johnsson Controls, Inc., Lenexa, KS, (2)University of Texas at Tyler, Tyler, TX

9:45 AM-10:45 AM

SEMINAR 25 (BASIC)
Designing for a Net-Zero 1740ft² (530m) Super High Rise Building
Track: Renewable Energy Systems and Net Zero Buildings
Room: 228
Chair: Sergio Sádaba, P.E., BEMP, Member, Skidmore Owings & Merrill, Chicago, IL
This seminar explains the various methods high performance designers follow during the high performance design process. It particularly focuses on the design methodology used in a 1740-ft² (530m) super tall net zero building on a 3,450,000-ft² campus in the heart of Jakarta, Indonesia. Pertamina’s new headquarters and campus are a mixed use development for the more than 20,000 employees and visitors expected to work daily on the campus. Low enthalpy geothermal system in a combined heat and power scheme using binary cycle technology as a primary source of energy will make Pertamina’s Energy Tower the tallest net-zero building in the world.
1. Designing for a Net-Zero 1740ft² (530m) Super High Rise Building
Sergio Sádaba, P.E., BEMP, Member, Skidmore Owings & Merrill, Chicago, IL

9:45 AM-10:45 AM

SEMINAR 26 (INTERMEDIATE)
Dos and Don’ts for Residential Radiant Systems for Heating and Cooling
Track: HVAC Systems and Equipment
Room: 223
Sponsor: 06.05 Radiant Heating and Cooling, Residential Building Committee, SSPC 55
Chair: Devin Abellon, Member, Uponor, Apple Valley, MN
Radiant heating and cooling systems are being installed in many residences as a way of improving occupant comfort. But how do these systems respond to owners’ expectations and even more important do contractors understand the complexities of installing and operating radiant systems?
1. Residential Case Study: Project Lessons Learned from Designing a Hybrid Radiant Based HVAC System
Robert Beun, Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

9:45 AM-10:45 AM

SEMINAR 27 (INTERMEDIATE)
Energy Savings via ASHRAE Level III Auditing, Retrofit and Recommissioning: A Case Study at Hameetman Science Center, Occidental College
Track: Fundamentals and Applications
Room: 222
Sponsor: 07.03 Operation and Maintenance Management
Chair: Robyn Ellis, Associate Member, City of Hamilton - Public Works, Hamilton, ON, Canada
An HVAC systems assessment and HVAC retrofit was required and completed on a science building just 10 years old. Using ASHRAE Level III Auditing combined with a unique test method of installed HVAC system approach assessing the building generating a unique and surgical approach to improving building efficiency. The project was supported through the efforts of the Occidental maintenance professionals as well as the local LADWP utility. Past ASHRAE fellow Bob Baker contributed guidance for this project. This data was then used to diagnose the systems and create a scope of work for the project.
1. Utilities Perspective
Mel Johnson, Associate Director, Los Angeles, CA
2. Energy Perspective
Rob Falke, Member, National Comfort Institute, Avon Lake, OH

9:45 AM-10:45 AM

SEMINAR 28 (BASIC)
Engineering Licensure in the U.S.
Track: Professional Skills Beyond Engineering
Room: 227
Sponsor: Young Engineers in ASHRAE (YEA)
Chair: Richard Hayter, Ph.D., P.E., Presidential Fellow Life Member, Kansas State University Retired, Manhattan, KS
In the U.S. engineering licensure is required in each state or territory in which an engineer is providing design services. This seminar provides insight as well as details of the licensure process.
1. Personal Experience in Becoming Licensed
Jacob Taylor, P.E., Member, Heapy Engineering, Columbus, OH

9:45 AM-10:45 AM

SEMINAR 29 (INTERMEDIATE)
Why Be Concerned with Indoor Carbon Dioxide Concentration?
Track: Indoor Environment: Health, Comfort, Productivity
Room: 226
Sponsor: SSPC 62.1
Chair: Hoy Bohanon, P.E., BEAP, Member, Hoy Bohanon Engineering, PLLC, Clemmons, NC
Indoor carbon dioxide (CO2) has long been discussed in the context of ventilation and indoor air quality (IAQ), focusing on the impacts of CO2 on building occupants, how CO2 concentrations relate to perception of bioeffluents, the use of indoor CO2 to estimate ventilation rates and demand control ventilation. While measured indoor CO2 concentrations are rarely close to health guidelines, much confusion has resulted regarding CO2 in ventilation and IAQ standards. Is there anything in recent research that indicates that we should revise ASHRAE’s approach to CO2 in standards and guidelines?
1. Indoor Carbon Dioxide Concentrations in Ventilation and Indoor Air Quality Standards
Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

2. Indoor Carbon Dioxide Concentration: Effects on Subjective and Physiological Responses and Mental Work
Paweł Warzocki, Technical University of Denmark, Kongens Lyngby, Denmark

11:00 AM-12:00 PM
TECHNICAL PAPER SESSION 6 (INTERMEDIATE)

Ground Source Heat Pumps
Track: HVAC Systems and Equipment
Room: 225
Chair: William Murphy, University of Kentucky

These papers address various aspects of ground source heat pumps including field measurements and predictions of utilizing water from abandoned mines as the heat source and sink. A hybrid system that included both ground source and air source features was compared with strictly ground source or air source units for a residence in a northern climate. Improved water pump control was shown to substantially decrease the pumping energy required for large distributed ground source heat pump systems.

1. Performance Analysis of a Ground Source Heat Pump System Using Mine Water as Heat Sink and Source (ST-16-017)
Mini Malhotra, Associate Member, Xiaobing Liu, Ph.D., Member, Adam Walburger, Member, Donald Blackketter, Ph.D., P.E.1 and Jack L. Skinner, Ph.D., P.E.2, (1)Oak Ridge National Laboratory, Roane County, TN, (2)Oak Ridge National Laboratory, Oak Ridge, TN, (3)CDH Energy Corp., Cazenovia, NY, (4)Montana Tech, Butte, MT

2. Assessment of Ground Source Air Source and Hybrid Heat Pumps for a Single Family Building in Cold Climates (ST-16-027)
Parham Eslami Nejad, Ph.D.,1 Ali Hakakz Fard, Ph.D.,2 Zine Aidoun, Ph.D.2 and Mohamed Ouzzane3, (1)CanmetENERGY-NRC, Varennes, QC, Canada, (2)CanmetENERGY, Varennes, QC, Canada, (3)Canmet Energy Technology Centre-Varennes, Varennes, QC, Canada

3. A Simulation-Based Study on Different Control Strategies for Variable Speed Pump in Distributed Ground Source Heat Pump Systems (ST-16-018)
Xiaobing Liu, Ph.D., Member, Zheng O’Neill, Ph.D., P.E., Member and Fuxin Niu, Student Member, (1)Oak Ridge National Laboratory, Oak Ridge, TN, (2)University of Alabama Tuscaloosa, AL

11:00 AM-12:00 PM
CONFERENCE PAPER SESSION 11 (INTERMEDIATE)

Airflow Measurements
Track: Fundamentals and Applications
Room: 221
Chair: David E. Claridge, Ph.D., P.E., Fellow ASHRAE, Texas A&M University, College Station, TX

Improving the accuracy of air flow measurements in commercial and residential HVAC systems can result in better IAQ, thermal comfort and improved energy efficiency. This session explores different methods of improving air flow measurement as well as verification of their accuracy.

1. Verification of the Accuracy of Air Flow Measurement Using the Multi-Nozzle Chamber Method (ST-16-C031)
Patrick Collins, P.E., Member, Terry Beck, Ph.D., Member2 and James Schaefer, P.E., Member, (1)Johnson Controls, Inc., Ventura, CA, (2)Kansas State University, Manhattan, KS, (3)Jacobs Engineering, Houston, TX

2. A Method of Efficacy Estimation for ECM Blowers in Residential Gas Furnaces by Using Blower Rotational Speed (ST-16-C032)
Peng Yin, Ph.D., Student Member, Michael Pate, Ph.D., P.E., Member, and James F. Sweeney, Associate Member, (1)Baylor University, Waco, TX, (2)Texas A&M University, College Station, TX

3. Uncertainty Studies of Airflow Measurements in Non-Ideal Conditions in Variable Air Volume Air Handling Units (ST-16-C033)
Alejandro Rivas Prieto, Student Member, Jesus Elizondo, Gang Wang, Ph.D., P.E.2 and Li Song, Ph.D., P.E.1, (1)University of Oklahoma, Norman, OK, (2)University of Miami, Coral Gables, FL

11:00 AM-12:00 PM
CONFERENCE PAPER SESSION 12 (INTERMEDIATE)

Heat Pumps, Combined Heat and Power
Track: HVAC Systems and Equipment
Room: 222
Chair: Henry A. Becker, Member, H-O-H Water Technology, Inc., Palatine, IL

This session evaluates ways to improve efficiency in air to water heat pumps, through improved heat exchanger micro-channel, refrigerant type and optimizing fan and compressor operation. The session also examines the feasibility of bio-methane combined heat and power (CHP) systems in commercial buildings and micro fuel cell CHP systems for residential applications and evaluates the energy and emission reduction for each system.

Andreas Zottl1, Thomas Fleckl1 and Bjorn Palm2, (1)AIT (Austrian Institute of Technology), Vienna, Austria, (2)KTH Royal Institute of Technology, Stockholm, Sweden

2. Opportunities and Obstacles in Residential, Fuel Cell Based, Micro-CHP: A Review and Analysis (ST-16-C035)
Ryau Milcarek, Student Member, Jeongmin Ahn, Ph.D. and Jianshan Zhang, Ph.D., Fellow ASHRAE, Syracuse University, Syracuse, NY

3. Optimal Technology Selection and Operation of Bio-Methane CHP Units for Commercial Buildings (ST-16-C036)
Dogoberto Celledios, Salvador Acha, Ph.D., Associate Member and Nilsay Shah, Ph.D., Imperial College London, London, United Kingdom

11:00 AM-12:00 PM
CONFERENCE PAPER SESSION 13 (INTERMEDIATE)

Occupant Predictions and Thermal Comfort
Track: HVAC Systems and Equipment
Room: 226
Chair: Helen R. Cerra, Member, ChemTreat, Inc., Glen Allen, VA

This session addresses the difference in modeled occupancy behavior and actual building usage. The session also evaluates the perception of space temperature and thermal comfort and how one’s climate and culture may alter this perception.

1. An Agent-Based Occupancy Simulator for Building Performance Simulation (ST-16-C037)
Yixing Chen, Ph.D., Associate Member, Xuan Luo, Tianzhen Zhang, Ph.D. Member and Sarah Taylor-Lange, Ph.D., (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Carnegie Mellon University, Pittsburgh, PA

2. An Evaluation of Recent Models in Demand Side Flexibility: The Case of Thermal Comfort Systems in Office Buildings (ST-16-C038)
Wim Zeiler and Kennedy O. Aduda, Eindhoven University of Technology, Eindhoven, Netherlands

3. Thermal Comfort and Perception inside Air-Conditioned Areas (ST-16-C039)
Kyle Reed, Ph.D., Ahmad Manasrah, Student Member and Rasim Guldiken, Ph.D., University of South Florida, Tampa, FL
11:00 AM-12:00 PM

CONFERENCE PAPER SESSION 14 (BASIC)

Ventilation Requirements in Healthcare
Track: Indoor Environment: Health, Comfort, Productivity
Room: 223
Chair: Roger Lautz, P.E., HFDP, Member, Affiliated Engineers, Madison, WI

The first two papers in this session compare ventilation standards from four countries, the U.S., Germany, The United Kingdom and Spain, for both operating rooms and patient bed areas. The third presentation discusses ventilation requirements in outpatient facilities in the context of both patient protection and energy use.

1. Minimum Ventilation Requirements in Operating and Procedure Rooms: A Comparison of International Standards (ST-16-C040)
   Travis R. English, P.E., Member and Maya Salabasheva, P.E., Member, Kaiser Permanente, Oakland, CA

   Travis R. English, P.E., Member and Maya Salabasheva, P.E., Member, Kaiser Permanente, Oakland, CA

3. Application of Health Care Ventilation Standards to Outpatient Facilities (ST-16-C042)
   Maya Salabasheva, P.E., Member and Travis R. English, P.E., Member, Kaiser Permanente, Oakland, CA

11:00 AM-12:00 PM

SEMINAR 30 (BASIC)

It's Official: ANSI/ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy is for Residential Buildings
Track: Indoor Environment: Health, Comfort, Productivity
Room: 227
Sponsor: 06.05 Radiant Heating and Cooling, Residential Building Committee, SSPC 55, 02.01 Physiology and Human Environment
Chair: Devin A. Abellon, P.E., Member, Uponor, Phoenix, AZ

In a 2014 official interpretation ASHRAE ruled that Standard 55 is applicable to houses. It has been referenced in ASHRAE 62.2 for many years and is listed as a residential resource at the ASHRAE website. Thermal comfort is becoming a front and center issue in residential buildings. Leading the way in research and Standard develop is ASHRAE SSPC 55 and cognizant committee T.C. 2.1. This seminar gives those interested in using Standard 55, a background in its development, current applicable modelling tools and how to use it for housing projects.

   Abhijeet Pande, Member, TRC Solutions, Kensington, CA

2. Case Study: Using ASHRAE Standard 55 to Solve Potential Comfort Problems in a Cold Climate Residence
   Robert Bean, R.E.T., P.L.(Eng.), Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

11:00 AM-12:00 PM

FORUM 2 (BASIC)

A Discussion of 185.1 & 185.2: The New Standards
Track: Fundamentals and Applications
Room: 224
Sponsor: 02.09 Ultraviolet Air and Surface Treatment
Chair: Sam Guzman, American Ultraviolet Company, Hackettstown, NJ

SPC 185 was organized in 2005 to develop a method of test to determine inactivation rates of airborne microorganisms in air-handling units and air ducts. In 2007 it was divided into SPC-185.1 which deals with Airborne Microorganisms while SPC-185.2 deals with Microorganisms on Irradiated Surfaces. These test method standards, are used to compare UVGI equipment on a standardized basis irrespective of their application. Results are used to give the design engineer an easy-to-use basis for specifying UV devices or estimating the relative performance of UVGI for a given application. This forum discusses the practical application of the new standards.

11:00 AM-12:00 PM

WORKSHOP 5 (BASIC)

Answering the Call: How ASHRAE Standards Can Meet State and Local Demand for High Performance Green Building
Track: Renewable Energy Systems and Net Zero Buildings
Room: 228
Sponsor: Grassroots Government Advocacy Committee
Chair: Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

States and cities around the world are promoting construction of net zero energy and high performance green buildings as part of larger national and global efforts to reduce atmospheric emissions in pursuit of climate change mitigation efforts. ASHRAE standards, such as Standard 189.1 can help meet this demand. This workshop presents attendees with hands-on tools for educating policymakers and effecting positive change in the built environment based on sound technical research.

1. Standard 189.1: A Pathway to Achieving Emissions Reductions
   Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

2. European Activities on High Performance Green Buildings
   Martin Dieryckx, Member and Andrea Voigt, The European Partnership for Energy and the Environment, Brussels, Belgium

2:15 PM-3:00 PM

FORUM 3 (INTERMEDIATE)

Financing for HVAC & Home Energy Improvements: Picking a Program That Works for You and Your Customers
Track: Professional Skills Beyond Engineering
Room: 226
Chair: Emeline Minor, Spruce Finance, San Francisco, CA

Homeowners often put off home improvements such as upgrading an HVAC unit because they lack financing options. The right financing program can help you close more sales. This session looks at various financing options available to HVAC contractors and anyone working in the home environment industry, and explain how to pick a financing program that supports your business and helps you close more deals.

3:15 PM-4:00 PM

WORKSHOP 6 (INTERMEDIATE)

The Leadership Advantage: Achieving Greater Effectiveness through Influence
Track: Professional Skills Beyond Engineering
Room: 226
Chair: Jon Cohen, Member, ChemTreat, Inc., Richmond, VA

Many of us are talented and skilled in our professions but our effectiveness can only go so far if we cannot influence others. Talent, skills, and educational background are not enough for success but with improved leadership, one has the ability to become more effective. Leadership is all about influence; developing and raising one’s influence effectiveness can only go so far if we cannot influence others. Talent, skills, and educational background are not enough for success but with improved leadership, one has the ability to become more effective. Leadership is all about influence; developing and raising one’s influence results in a multiplying effect on success, helps one stand out amongst the person of influence.

1. The Leadership Advantage
   Kemi Sorinmade, The Growth Studio, Easton, MA

Monday, June 27
In a commercial refrigeration system with natural refrigerants and low GWP synthetic refrigerants, recent advances in refrigeration technology have led to the development of new systems and methods. Natural refrigerants such as CO2, ammonia propane, and R600a are being increasingly used due to their environmental benefits. This seminar presents the most recent study of commercial refrigeration systems using natural refrigerants. The seminar discusses the successful conversion of light commercial refrigeration systems originally designed for R134a to R600a and low GWP synthetic blends. The seminar highlights the performance and energy consumption improvements achieved with these new systems, showcasing the potential for a sustainable future in refrigeration technology.
Low-cost ammonia chiller installation and a propane freezer compared to traditional HFC systems? How to improve the efficiency of stand-alone applications with low GWP synthetic refrigerants?

1. Natural, Low-GWP Refrigerants for Light Commercial Refrigeration: Examples of Successfully Converted Applications Using R290, R600a and R744
   Stefan Elbel, Ph.D., Associate Member, Creative Thermal Solutions, Urbana, IL

2. Reducing GWP with a Low Charge Ammonia/CO2 Chiller
   Scott Mitchell, Southern California Edison, Irwindale, CA

3. Decreasing Environmental Impact by Using Propane in Refrigerated Display Cases
   Sean Gouw, P.E., Associate Member, Southern California Edison, Irwindale, CA

4. Advanced Low-GWP Alternatives for Stand-Alone Refrigeration Systems
   Michael Petersen, Associate Member, Honeywell - Buffalo Research Laboratory, Buffalo, NY

8:00 AM-9:30 AM
SEMINAR 34 (ADVANCED)
Low-Cost High-Performance Building Simulation: Is That Too Good to Be True?
Track: Research Summit
Room: 228
Sponsor: 04.07 Energy Calculations
Chair: Wangda Zuo, Ph.D., Member, University of Miami, Coral Gables, FL

Building simulation can be used to help achieve energy efficient buildings. However, contemporary building simulation tends to be computationally intensive, which prevents building simulation from being widely applied in the real building process such as building design and operation. This seminar invites experts from both academic and industrial field to share ideas regarding how they improve the performance of different building simulations in terms of the computing demand and cost by taking full advance of cutting-edge computing technologies.

1. Fast Answers to Complex Problems for Dummies
   Nathaniel Jones, MIT, Boston, MA

2. Building Energy Simulation Workflows in the Age of Low Cost Computing
   David Bosworth, Member, BUILDBal, LLC, Dryden, NY

3. Using High Performance Computers to Improve Foundation Heat Transfer Calculations
   Neal Kruijs, Ph.D., Student Member, Big Ladder Software, Denver, CO

8:00 AM-9:30 AM
SEMINAR 35 (INTERMEDIATE)
Air Change Rates: Philosophy and Practice
Track: Fundamentals and Applications
Room: 225
Sponsor: 09.11 Clean Spaces, 9.6, 09.10 Laboratory Systems
Chair: Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

Air Change Rates (ACR) are often specified in standards, codes and design guidelines as supply airflow requirements for healthcare, cleanrooms, laboratories and other similar facilities. This legacy practice has been implemented for several decades. With increased awareness of energy efficiency and cost of HVAC operations it is essential now to review this philosophy. This seminar provides historical perspective; current practices and recommendations; and pros and cons of ACR philosophy in the three major industry sectors. In addition the supply airflow path and the distribution of the supply air on effectiveness of contaminant removal will also be presented.

1. ACR Philosophy and Practice: Health-Care Facilities
   Travis R. English, P.E., Member, Kaiser Permanente, Oakland, CA

2. ACR Philosophy and Practice: Laboratory Systems
   Thomas Smith, Member, Exposure Control Technologies, Inc., Cary, NC

8:00 AM-9:30 AM
SEMINAR 36 (INTERMEDIATE)
Standard 62.2-2016 Revisions and Impacts
Track: Indoor Environment
Health, Comfort, Productivity
Room: 223
Sponsor: Residential Building Committee
Chair: Max H. Sherman, Lawrence Berkeley Laboratory, Berkeley, CA

Standard 62.2 is the most used and only ANSI-approved residential ventilation standard in the country. It has continuously evolved to meet the needs of the residential market since 2003. The latest version is just hitting the streets now. It covers a larger span of the market than before, includes new flexibilities and provides a host of small improvements. This seminar teaches the new compliance requirements, discusses what has changed, examines the application of the revised standard in existing homes and describes ongoing initiatives and options being explored by the committee.

1. Standard 62.2-2016: Overview and Major New Changes
   Paul W. Francisco, Member, University of Illinois at Urbana-Champaign, Champaign, IL

2. Tips and Traps for Existing Home Ventilation Strategies Under 62.2
   Richard Karg, Residential Energy Dynamics, Bethel, ME

3. Equivalence and Superposition in ASHRAE 62.2
   Iain Walker, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

8:00 AM-9:30 AM
SEMINAR 37 (INTERMEDIATE)
The Impact of Net Zero Energy Buildings on the Electric Grid
Track: Renewable Energy Systems and Net Zero Buildings
Room: 225
Sponsor: 07.05 Smart Building Systems
Chair: Kristen Cetin, Ph.D., P.E., Associate Member, Iowa State University, Ames, IA

In recent years there have been significant efforts to implement net zero energy (NZE) buildings throughout the United States. This seminar covers several of these recent efforts, highlighting various alternative energy systems and new design strategies to reach NZE as well as how these buildings interact with the electric grid.

   Jon McHugh, P.E., McHugh Energy Consultants Inc., Fair Oaks, CA

   Brett Moss, Electrical Training Institute, Los Angeles, CA

   Carlos Haidar, P.E., Member, JCH Energy Management Solutions, Inc., Phillips Ranch, CA

9:45 AM-10:45 AM
TECHNICAL PAPER SESSION 7 (INTERMEDIATE)
Climate Prediction and Load Shifting
Track: Fundamentals and Applications
Room: 225
Chair: Alameda Brooks, BEAP, HBDP, ICF International, Columbia, MD

The results of numerical modeling and observed data are shared in these two papers. The first paper provides the results of ASHRAE Research Project RP-1561, “Procedures to Adjust Observed Climatic Data for Regional or Mesoscale Variations” and the latter shows that
precooling strategies in residential buildings in the Phoenix, Arizona climate offer significant peak energy demand savings.

Xin Qiu, Ph.D., Member\(^1\), Michael Roth, Ph.D.,\(^2\), Hamish Corbett-Hains,\(^3\) and Fuquan Yang, Ph.D.,\(^4\), (1)Novus Environmental Inc., Guelph, ON, Canada, (2)Klimaat, Guelph, ON, Canada

2. Modeling and Testing Multiple Precooling Strategies in Three Residential Building Types in the Phoenix Climate (ST-16-020)
Reza Arababadi, Student Member\(^3\) and Kristen Parrish, Ph.D., Arizona State University, Tempe, AZ

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 16 (INTERMEDIATE)

Advances in Desiccant Technology

Track: HVAC Systems and Equipment

Room: 221

Chair: Kyle Knudten, CPMP, McClure Engineering, St. Louis, MO

Desiccant systems, both liquid and dry, can be effective in increasing the use of outside air for improved IAQ without degrading energy efficiency. This session explores advancements in desiccant technology as well as improvement in system design and modeling through the use of hybrid systems combining desiccant and evaporative components.

1. Achieving Comfort and Energy Savings Using Desiccant Technologies (ST-16-C047)
Mark Piegay, Member\(^1\), Alfa Laval - Kathabar, Tonawanda, NY

2. A Variable Volume and Temperature (VVT) Control Strategy for a Liquid-Desiccant and Dew Point Evaporative Cooler-Assisted 100% Outdoor Air System (LDEOS) (ST-16-C048)
Sang-Woo Ham, Student Member\(^2\), Hui-Jeong Kim, Student Member, Sang-Hyeon Cho, Student Member and Jae-Weon Jeong, Ph.D., Member, Hanyang University, Seoul, South Korea

3. Energy Performance of a Liquid Desiccant and Evaporative Cooling-Assisted 100% Outdoor Air System in Commercial Ships (ST-16-C049)
Joonyoung Park, Ph.D., Student Member, SungJoon Lee, M.D., Student Member, Dongseob Yoon, M.D., Student Member and Jae-Weon Jeong, Ph.D., Member, Hanyang University, Seoul, South Korea

9:45 AM-10:45 AM

SEMINAR 38 (INTERMEDIATE)

ASHRAE Research: Airflow and Ducts

Track: Research Summit

Room: 223

Sponsor: 01.02 Instruments and Measurements, Publishing and Education Council

Chair: Reinhard Radlasmacher, 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 the influence of single-path and multiple-path duct disturbances on volumetric air flow rate measurements, and the development of guidelines for more accurate volumetric airflow measurements in rectangular ducts during test and balance operations of rectangular ducts during test and balance operations.

1. Effect of Fittings on Volumetric Airflow Measurements (RP-1245): Single-Path Duct Disturbances
Craig Hickman\(^1\), Terry Beck, Ph.D., Member\(^2\) and Bruce Babin\(^3\), (1)SPX Cooling Technologies, Inc., Overland Park, KS, (2)Kansas State University, Manhattan, KS, (3)Highland Park High School, Topeka, KS

2. Effect of Fittings on Volumetric Airflow Measurements (RP-1245): Multiple-Path (tee) Duct Disturbances
Terry Beck, Ph.D., Member\(^3\), Craig Hickman, Associate Member\(^1\) and Bruce Babin\(^1\), (1)Kansas State University, Manhattan, KS, (2)SPX Cooling Technologies, Inc., Overland Park, KS, (3)Highland Park High School, Topeka, KS

9:45 AM-10:45 AM

SEMINAR 39 (INTERMEDIATE)

Data Sources toward Urban-Scale Energy Modeling, Part 1

Track: Smart Building Systems/Remote Monitoring and Diagnostics

Room: 226

Sponsor: 01.05 Computer Applications

Chair: Joshua New, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Development of urban-scale building energy models is becoming of increased interest for many applications including city-wide energy supply/demand strategies, urban development planning, electrical grid stability and urban resilience. This seminar has assembled several leaders in the field of urban-scale energy models to discuss an overview of the field as well as the data, algorithms, workflow and practical challenges addressed to create useful models of individual buildings at the scale of a city.

1. Improving Urban Building Energy Models (UBEM) through Building Archetype Calibration
Carlos Davila, Ph.D., MIT, Cambridge, MA

2. Urban-Scale Energy Analyses of the Built Environment
Yeonsook Heo, Ph.D. and Ruchi Choudhary, University of Cambridge, Cambridge, United Kingdom

9:45 AM-10:45 AM

SEMINAR 40 (BASIC)

Facebook and Social Media: Guidelines and Best Practices for Groups

Track: Professional Skills Beyond Engineering

Room: 222

Sponsor: Electronic Communications Committee

Chair: Heather Schopplein, P.E., Member, Haldeman Inc, San Diego, CA

Social media is always changing and evolving, with new sites and tools being added constantly. With so many options, how does one determine which tool or site will work best for their group or business? This presentation covers best practices of some of the most common social media forums (Facebook, Twitter, LinkedIn, Pinterest, Instagram and YouTube) with emphasis on social media tools for ASHRAE chapters. Learn some dos and don’ts for using social media to market your group and increase your online presence.

1. Facebook and Social Media
Heather Schopplein, P.E., Member, Haldeman Inc, San Diego, CA

2. Facebook and Social Media: Guidelines and Best Practices for Groups
Pamela Duffy, P.E., Lennox International, Dallas, TX

9:45 AM-10:45 AM

WORKSHOP 7 (BASIC)

Answering the Call: Encouraging Code Adoption and Enforcement with Policy Leaders

Track: Renewable Energy Systems and Net Zero Buildings

Room: 228

Sponsor: Grassroots Government Advocacy Committee

Chair: Keith H. Reihl, P.E., Member, Reihl Engineering, Cypress, TX

Within the past several years legislation has been introduced in virtually every state which would extend current code cycles beyond the traditional three year cycle. It is important for ASHRAE members to work with policymakers to stress the importance of maintaining the three-year code cycle to ensure that states and local jurisdictions incorporate the latest techniques and practices into their minimum codes, while providing ease of application. This workshop informs members and conference attendees how they can educate policymakers at the state and local levels.

1. Demystifying State and Local Code Development and Adoption
Sara Verkes, International Code Council, Washington, DC

2. Best Practices for Working with State Energy Officials
David Terry, National Association of State Energy Officials, Arlington, VA
1. Evaluation of Convective Heat Transfer and Pressure Loss in temperature conditions. (PCM) in a triplex-tube heat exchanger heated under constant surface effects of nanoparticle dispersion in melting of a phase change material insulation system for use in retrofit construction applications; and the performance of vacuum insulation panels as a high-efficiency wall channels using different rib shapes (Trapezoidal, Triangle and semi-

2. First US Commercial Building with Walls Retrofitted Using Vacuum Insulation Panels (VIPs): Results of Field Performance Study of VIP-Based Exterior Wall Insulation System (WITHDRAWN)
Ali Fallahi, Jan Kosny, Ph.D., Member², Nitin Shukla², Tony Fontanini³, Alliston Watts¹, Lawrence D Carberry¹ and Roland Serino³,

Emmanuel C. Nsofor, CEng and Jasim M. Mahdi, Student Member, Southern Illinois University, Carbondale, IL

Have you ever wondered why a new technology is readily accepted by some but resisted by others? In this workshop, discover the five characteristics of any technology or strategy that will determine its chances of being adopted successfully on projects. Based on technology adoption research from Everett Roger’s “Diffusion of Innovations,” learn to be more strategic when selecting design options for projects. The goal of this simple technique is to choose the best options for clients – ones that will be embraced and maintained for the life of the building.

1. How to Predict the Long-Term Success of Your Green Design: The Five Characteristics That Determine Technology Adoption
Jaye Allwies, University of Wisconsin-Madison, Madison, WI

2. Facilitator for Session
E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

10:30 AM-12:00 PM
TC SEMINAR (BASIC)
Safeguarding Critical Facility Operation: Hardening Essential Equipment to Survive Seismic Wind and Flood
Track: HVAC Systems and Equipment
Room: 230
Sponsor: 02.08 Building Environmental Impacts and Sustainability, 01.07 Business, Management & General Legal Education
Chair: Kevin Brown, HBDP, The Linc Group, Atlanta, GA

OPEN SESSION: no badge required; no PDHs awarded; presented during the TCs meeting. This seminar provides a practical guide in planning, testing and design considerations to help ensure equipment will meet IBC requirements to keep critical facilities up and running. Jim Carlson, Seismic-Source International, presents “FEMA P-1019 Emergency Power Systems for Critical Facilities: A Best Practice Guide to Improving Survival.” John Giuliano, Vibration Mountings & Controls, presents “Lessons Learned From Shake Table Testing.” Steve Stoyanac, Chillicothe Metal Company, Inc., presents “Certifying Your GenSet Will Work after an Earthquake or Storm.”

11:00 AM-12:30 PM
SEMINAR 41 (INTERMEDIATE)
Fellows Debate: Productivity is the Measure of Indoor Air Quality
Track: Indoor Environment: Health, Comfort, Productivity
Room: 226
Sponsor: College of Fellows, Indoor Air Quality Association
Chair: Larry Spielvogel, P.E., Fellow Life Member, Consulting Engineer, Bala Cynwyd, PA

In the Fellows Debate both sides of a controversial subject are debated. Can productivity be measured? Does perception of comfort increase productivity, or is it irrelevant? The science of indoor air quality is implied in the requirements of standards and other guidance documents. Can the designer and commissioning engineer apply the science effectively? Are comfort, sense of well-being and of health a measure of productivity? Is personal productivity a true measure in buildings such as operating theaters and data centers? Can existing science support performance-based definitions? Legally, can the designer or operator be liable for health or productivity or any other such outcome?

Debaters: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA; Bjarne Wilkens Olsen, Ph.D., Fellow ASHRAE, Technical University of Denmark, Lyngby, Denmark; Don Beatty, P.E., Fellow ASHRAE, DLB Associates,Eatontown, NJ; Richard Rooley, FREng, OMMP, Presidential Fellow ASHRAE, Project Management Partnership, Stoke Poges, United Kingdom; Derrick A. Denis, Clark Seif Clark, Inc. (CSC), Tempe, AZ; and Donald Weckes, Member, InAIR Environmental Ltd., Ottawa, ON, Canada

11:00 AM-12:30 PM
SEMINAR 42 (INTERMEDIATE)
Heat and Cooling with Woody Biomass for Sustainable and Resilient Buildings and Communities
Track: Renewable Energy Systems and Net Zero Buildings
Room: 223
Sponsor: 09.08 Large Building Air-Conditioning Applications, 6.09 8.03 and 6.02
Chair: Frank Mills, Member, Low Carbon Design Consultants, Liverpool, United Kingdom

Combining a high capacity factor renewable heat source, thermal storage and absorption cooling expands Near-Net-Zero building and district energy opportunities. Woody biomass offers solar-derived heat on demand; implemented together, these three technologies assure comfort, with savings in power consumption, cost and emissions. Engineers add resilience potential by adapting thermal systems to support safe occupancy during and after disruptive events, like wide-area weather caused grid failure and disrupted delivery of petroleum-based fuels for emergency generators and HVAC. Functional buildings data illustrates qualitative and economic value opportunities for efficient, low impact daily operation and resilience in the face of adversity.

He has been presented with awards at various conferences for his work in the field of renewable energy systems and net zero buildings.
Lubrication Effects Beyond the Compressor

Chair: Raymond Rite, Ph.D., Member, Ingersoll Rand - Trane, Tyler, TX
08.04 Air-to-Refrigerant Heat Transfer Equipment
Sponsor: 03.03 Heat Transfer and Fluid Flow, TC 1.13, 01.03 Heat Transfer and Fluid Flow, TC 1.13
Room: 222
Track: HV AC Systems and Equipment
Optimization of Air-to-Refrigerant Heat Exchangers
Kok-Hiong Kee, Scott Wujek, Ph.D., Member, Parker Hannifin, Washington, MO
Christopher Reeves, Associate Member, Sporlan Valve Division of Parker Hannifin, Washington, MO

Lubricants are an essential component to effective operation of air conditioning and refrigeration compressors which are exhaustively studied by compressor engineers and tribology experts. But there are other aspects to lubrication effects beyond the compressor which can also be key to effective operation and performance of air conditioning and refrigeration systems. This seminar presents examples of how the lubricant circulated from the compressor into the system can affect system components, oil management and overall system performance with existing and alternate refrigerants.

1. Managing Lubricants in a Large Commercial Refrigeration System
Danny Halel, Member, Hussman Corporation, Bridgeton, MO

2. Lubricant Management Heuristics and Impacts on System Chemistry, Valves and Other System Components
Christopher Reeves, Associate Member, Sporlan Valve Division of Parker Hannifin, Washington, MO

3. Lubricants in Heat Exchangers: A Slippery Slope
Scott Wujek, Ph.D., Member, Creative Thermal Solutions, Urbana, IL

4. Oil Separator Efficiency Rating Dilemma
Kok-Hiong Kee, Emerson Climate Technologies, Inc., St. Louis, MO

11:00 AM-12:30 PM
SEMINAR 43 (ADVANCED)

Lubrication Effects Beyond the Compressor
Track: Advances in Refrigeration Systems and Alternative Refrigerants
Room: 225
Sponsor: 03.04 Lubrication, 03.03 Refrigerant Contaminant Control
Chair: Joseph A. Karnaz, Member, CPI Fluid Engineering/Lubrizol, Midland, MI

Lubricants are an essential component to effective operation of air conditioning and refrigeration compressors which are exhaustively studied by compressor engineers and tribology experts. But there are other aspects to lubrication effects beyond the compressor which can also be key to effective operation and performance of air conditioning and refrigeration systems. This seminar presents examples of how the lubricant circulated from the compressor into the system can affect system components, oil management and overall system performance with existing and alternate refrigerants.

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4. Oil Separator Efficiency Rating Dilemma
Kok-Hiong Kee, Emerson Climate Technologies, Inc., St. Louis, MO

11:00 AM-12:30 PM
SEMINAR 44 (ADVANCED)

Optimization of Air-to-Refrigerant Heat Exchangers
Track: HVAC Systems and Equipment
Room: 222
Sponsor: 01.03 Heat Transfer and Fluid Flow, TC 1.1
08.04 Air-to-Refrigerant Heat Transfer Equipment
Chair: Raymond Rite, Ph.D., Member, Ingersoll Rand - Trane, Tyler, TX

In the quest to reduce energy consumption and the amount of refrigerant in systems, the air-to-refrigerant heat exchanger is a prime area of interest. Although reducing heat exchanger cost and maximizing performance have always been of great interest to the HVAC community, recently new thoughts on tube size, materials, manufacturing processes, as well as computational analysis methodologies have been gaining traction. This program presents all of these facets of modern heat exchanger optimization.

1. Optimization and Validation of Novel Designs for Air-to-Refrigerant Heat Exchangers
Vikrant Aute, Ph.D., Member, University of Maryland, College Park, MD

Man-Hoe Kim, Ph.D., Member, Kyungpook National University, Buk-gu, Daegu, South Korea

3. Metal Foam Heat Exchanger Design Optimization for Improved Thermal-Hydraulic Performance under Dry Operating Conditions
Kashif Nawaz, Ph.D., Johnson Controls, Inc., Norman, OK

11:00 AM-12:30 PM
SEMINAR 45 (INTERMEDIATE)

Planes, Trailers and Ships: Advances in Transport Refrigeration System Technologies
Track: Advances in Refrigeration Systems and Alternative Refrigerants
Room: 221
Sponsor: 10.06 Transport Refrigeration
Chair: Robert Chopko, Member, Carrier Transicold, Syracuse, NY

Advances in transport refrigeration and air-conditioning systems used in “Planes, Trailers and Ships” have evolved over many years. Today’s systems must incorporate the latest available technologies, taking into consideration current and future regulatory requirements for refrigerants with low Global Warming Potential, energy efficiency, indoor air quality, food quality standards and customer expectations around total operating costs. A summary of transport refrigeration system technologies generally, along with marine air conditioning systems, are presented and includes associated technical challenges, trade-offs and potential design impacts.

1. Ships: Advances in Transport Refrigeration System Technologies
Glover Kevin, Member, United Technologies, Carrier Marine Systems, Syracuse, NY

Igor Vaisman, Ph.D., Member, Rolls-Royce North American Technologies, Indianapolis, IN

3. Airplanes, Part 2: Advances in Aerospace Galley Refrigeration System Technologies
Qiao Lu, B.E. Aerospace Inc., Placentia, CA

4. Trucks, Trailers: Advances in Transport Refrigeration System Technologies
Casey Briscoe, Ph.D., Member, Ingersoll Rand, Minneapolis, MN

11:00 AM-12:30 PM
SEMINAR 46 (INTERMEDIATE)

Regulatory Process Overview for Smart Grid, Smart Building and Demand Response Programs as Applicable to Building Owners and Utility Tariffs
Track: Smart Building Systems/Remote Monitoring and Diagnostics
Room: 228
Sponsor: 07.05 Smart Building Systems, NA
Chair: Glenn Remington, Member, Consumers Energy, Jackson, MI

This seminar presents a top down overview of how smart grid and demand response federal policy and laws make their way through the Federal Energy Regulatory Commission to the various regional transmission authorities then to the state level and how it impacts building owner/operators and electricity tariffs.

1. Overview of the Regulatory Process Related to Smart Grid and Demand Response
Tom Lawrence, Ph.D., Member, University of Georgia College of Engineering, Athens, MI

2. Overview of Public Utilities Regulation at the State Level and Contested Case Tariff Process
Robert Schallenberg, Missouri Public Service Commission, Jefferson City, MO

3. The Role of Third Party Aggregators in Demand Response Programs
Greg Poulos, J.D., EnerNOC, Columbus, OH

11:00 AM-12:30 PM
11:00 AM-12:30 PM

SEMINAR 47 (BASIC)

Update on the ASHRAE Innovative Research Grant Program and Future Plans for It

Track: Research Summit
Room: 227
Sponsor: Research Administration Committee
Chair: Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

The ASHRAE Innovative Research Grant (IRG) was established in 2011 to provide seed funding for novel research deemed to have the potential to significantly advance the state-of-the-art in HVAC&R engineering. The idea is to encourage out-of-the-box research to complement the research proposed and guided by technical committees. This session provides an update on the results from the first two and only grants awarded from the program and RAC’s plans for this program in the future.

1. Irq-021: Smart Nanolubricants for HVAC&R Systems
   Lorenzo Cremaschi, Ph.D., Member, Auburn University, Auburn, AL

2. Irq-024, Biowall Research
   William Hutzel, P.E., Member, Purdue University, West Lafayette, IN

3. Future Plans for the ASHRAE Irq Program
   Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

1:30 PM-3:00 PM

SEMINAR 48 (BASIC)

The Philosophy and Ethics of the Different Building Industry Professionals

Track: Professional Skills Beyond Engineering
Room: 226
Sponsor: 01.07 Business, Management & General Legal Education
Chair: Richard Rooley, FREng, OPMP, Presidential Fellow ASHRAE, Project Management Partnership, Stoke Poges, United Kingdom

Great buildings are created by constructive confrontation. Each commercial company in the process enters into a contract for its part of the work. Theoretically there is consistency among the many contracts. In the real world a lack of consistency combined with misunderstandings can create conflict. The team of building industry professionals people are drawn together for the project with different education, training, method of working, communication skills and membership of professional bodies who each have codes of ethics. In the education of each, a different philosophy is taught or implied. The audience has their own individual background.

1. The Philosophy and Ethics of the Architect
   Leonard Sciarr, AIA, Gentler, Chicago, IL

2. The Philosophy and Ethics of the Design Engineer
   Ginger Scoggins, P.E., Member, Engineering Designs, Cary, NC

3. The Philosophy and Ethics of the Contractor
   Michael Cooper, P.E., Member, MCC, Metairie, LA

4. The Philosophy and Ethics of the Manufacturer
   Tom Watson, P.E., Presidential Fellow ASHRAE, Daikin Applied, Staunton, VA

3:15 PM-4:45 PM

SEMINAR 49 (INTERMEDIATE)

Bringing a New Look and Energy to a Federal Building in Houston

Track: HVAC Systems and Equipment
Room: 226
Sponsor: 09.01 Large Building Air-Conditioning Systems
Chair: Alonzo Blalock, P.E., Member, Jacobs Engineering, Fort Worth, TX

This program explains the multi-year project to provide new ‘skin’ to the existing 22 story Federal Office building in Downtown Houston – and the process of renovation of complete interior HVAC and lighting systems; working thru two floors per cycle, while all other aspects of the building remained in use for occupants. The project includes: use of VAV diffusers for room air distribution; use of Fan Wall in the replacement AHUs; complete new DDC control that includes overlay control to the new lighting system; large PV system installed on remote parking structure; and the enhanced performance of new envelope.

1. Designing the New Look
   Thomas Shelton, Gensler, Dallas, TX

2. Planning Renovation of an Occupied Building
   James Penland, Gilbane Co., Houston, TX

3. Upgrades to the HVAC, Electrical and Plumbing Systems
   Gary Poole, P.E., Member, Bury Inc., Houston, TX

4. We Taught the Old Dog a New Trick
   Kendall Waldie, P.E., Member, Greater Southwest Region GSA, Fort Worth, TX

3:30 PM-5:00 PM

TC SEMINAR (INTERMEDIATE)

Is Poor Bedroom Ventilation Affecting Your Next-Day Performance?

Track: Indoor Environment: Health, Comfort, Productivity
Room: 225
Sponsor: 02.01 Physiology and Human Environment, SSPC-55
Chair: Pawel Wargocki, Technical University of Denmark, Lyngby, Denmark

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC’s meeting. This seminar discusses how poor air quality negatively affects sleep and reduces next-day performance. Dr. Dennis Loveday, Loughborough University presents “What’s Been Happening to Thermal Conditions in UK Bedrooms over the Last Forty Years?” Chandra Sekhar, National University of Singapore, presents “Overnight Air Quality in Bedrooms in Hot and Humid Climates.” Dr. Lan Li, Shanghai Jiao Tong University, presents “Sleeping Thermal Environment, Thermal Comfort and Sleep Quality.” Pawel Wargocki, the Technical University of Denmark, presents “The Effects of Bedroom Air Quality on Sleep and Next-Day Performance.”

5:00 PM-6:00 PM

TC SEMINAR (INTERMEDIATE)

Indoor Air Quality in Underground Stations and Tunnels: Development of a New ASHRAE Standard

Track: Indoor Environment: Health, Comfort, Productivity
Room: 223
Sponsor: 05.09 Enclosed Vehicular Facilities, SPC 217, 04.10 Indoor Environmental Modeling
Chair: Igor Maevski, Ph.D., P.E., Member, Jacobs Engineering, New York, NY

Wednesday, June 29

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 9 (INTERMEDIATE)

Fan and Airflow Diagnostics and Modeling
Track: Fundamentals and Applications
Room: 224
Chair: Kimberly Pierson, Moser Mayer Phoenix Associates, Greensboro, NC

Mathematical models, experimental data and field observations are used in various ways in these papers to characterize performance of fan-powered terminal units, determine system effects on plenum/plug fans, detect low evaporator airflow using fan power for rooftop units and model airflow through a perforated duct.

1. Modeling Airflow through a Perforated Duct (ST-16-023)
   Jesse Maddren1, John Farrell2, Alan Fields3 and Cesar Juarquín4, (1) California Polytechnic State University, San Luis Obispo, CA, (2)MHC Engineers, Inc., San Francisco, CA, (3)Sanugy, Oakland, CA, (4) Glenair, Inc., Glendale, CA

2. Low Evaporator Airflow Detection Using Fan Power for Rooftop Units (ST-16-024)
   Yunhua Li, Associate Member1, John Farrell2, Alan Fields3 and Cesar Juarquín4, (1) California Polytechnic State University, San Luis Obispo, CA, (2)MHC Engineers, Inc., San Francisco, CA, (3)Sanugy, Oakland, CA, (4) Glenair, Inc., Glendale, CA

3. Characterizing the Performance of Fixed Airflow Series Fan-Powered Terminal Units Using a Mass and Energy Balance Approach (ST-16-025)
   Dennis O’Neal, Ph.D., P.E., Fellow ASHRAE1, Carl Reid1 and Peng Yin, Ph.D., Student Member1, (1)Baylor University, Waco, TX, (2)Bee, Austin, TX

4. Using a Mass and Energy Balance Approach to Model the Performance of Parallel Fan-Powered Terminal Units with Fixed Airflow Fans (ST-16-026)
   Peng Yin, Ph.D., Student Member1, Dennis O’Neal, Ph.D., P.E., Fellow ASHRAE1, and Carl Reid1, (1)Baylor University, Waco, TX, (2)Bee, Austin, TX

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 17 (INTERMEDIATE)

Field Data and Ensuing Recommendations
Track: Research Summit
Room: 225
Chair: Juan-Carlos Baltazar, Ph.D., P.E., BEMP, Member, Texas A&M University, College Station, TX

This session evaluates measured energy and water usage in residential buildings and the variations due to occupancy and users and the changes over six years. This session also looks at the performance of office and K-12 facilities that were designed to meet the ASHRAE 30% AEDG, and where they stand compared to code-minimum facilities. Lastly, this session discusses the development of benchmarking data for Army buildings based on metered data obtained from new construction facilities.

   Dennis Jones, P.E., Member, Group 14 Engineering Inc, Denver, CO

2. Developing Benchmarks for US Army Buildings Using Data from the Metering Data Management System (ST-16-C051)
   Rahul A. Athalye, Associate Member1, Daniel Carpenter2 and Kim Fowler1, (1)Pacific Northwest National Laboratory, Richland, WA, (2)US Army Corps of Engineers, Los Angeles, CA

3. Variations in Use of Household Electricity between Years: Measurements in 539 Apartments during Six Years (ST-16-C052)
   Dennis Johansson, Ph.D., Associate Member1 and Hans Bagge, Ph.D., Associate Member, Lund University, Lund, Sweden

4. Correlations between Apartment Occupancy Levels and Use of Household Electricity and Domestic Hot Water (ST-16-C053)
   Hans Bagge, Ph.D., Associate Member1 and Dennis Johansson, Ph.D., Associate Member, Lund University, Lund, Sweden

8:00 AM-9:30 AM

SEMINAR 50 (BASIC)

ASHRAE + STEM = ?!
Track: Professional Skills Beyond Engineering
Room: 223
Sponsor: 07.05 Smart Building Systems
Chair: Kristen Cetin, Ph.D., P.E., Associate Member, Iowa State University, Ames, IA

What is all the hype about STEM (Science, Technology, Engineering, Mathematics)? Why should ASHRAE members care about it? How do they talk to kids about it? What is the difference in dealing with K-12 or post-high? This session not only answers these questions but also shares what the society committee has developed for member use.

1. Why Should an Engineer Care about Talking to Kids?
   Kristin Schaefer, P.E., Member, Schaefer Engineering, Katy, TX

2. What Does ASHRAE Have to Help You with Students?
   Joe Chin, P.E., Western Allied Mechanical, Inc., Menlo Park, CA

3. How to Do a K-12 STEM Classroom Visit
   Chuck Curlin, P.E., Member, Shultz Engineering Group, Charlotte, NC
assess current building performance and more intelligently operate building systems. This seminar covers various advances in the collection and use of residential building energy and performance data for more smart assessment and operation of buildings.

1. Energy Use Insights from Inverse Thermodynamic-Based Modeling of Residential Buildings
   Kristen Cetin, Ph.D., P.E., Associate Member, Iowa State University, Ames, IA

2. Demand Prediction Using Connected Thermostat Residential Building Energy Models
   Rattneesh Tiwari, Ph.D., University of Maryland, College Park, MD

3. Cornell Temperature Datalogger Project
   Howard Chong, Ph.D., Cornell University, Ithaca, NY

8:00 AM-9:30 AM

SEMINAR 53 (INTERMEDIATE)

Smart Equipment: the Intelligent Buildings Revolution Is Happening in the Edge
Track: Smart Building Systems/Remote Monitoring and Diagnostics
Room: 228
Sponsor: 01.04 Control Theory and Application, 06.01 Hydronic and Steam Equipment and Systems
Chair: Marcelo Acosta, P.E., Member, Armstrong Fluid Technology, Toronto, ON, Canada

Will highly efficient buildings intelligence reside in the Cloud or in the Edge? This session presents three examples of Smart Equipment already in the market, showing how in depth manufacturer knowledge of the equipment embedded in distributed intelligence surpasses generic and distant intelligence in energy savings, diagnostics, auto-commissioning, redundancy and reliability. The session also shows how full systems optimization and really useful user interfaces can be achieved with the addition of lightweight integration.

1. Smart Pumps Keep Your HVAC System Running High
   David Lee, P.Eng., Member, Armstrong Fluid Technology, Toronto, ON, Canada

2. Smart Valves: the Cool New Kids Are Doing Flow Balancing and Control
   Miha Kavcic, Member, Danfoss Trata Dd, Chicago, IL

3. Smart Compressors: Are They Magic? No...But They Are Amazing!
   Jose Alvares, Member, Danfoss Turbocor Compressors, Inc., Tallahassee, FL

4. Integrating Smart Equipment Made Easy
   Marcelo Acosta, P.E., Member, Armstrong Fluid Technology, Toronto, ON, Canada

8:00 AM-9:30 AM

SEMINAR 54 (INTERMEDIATE)

Standard 100-2015 Overview and the Potential of Its High-Performance Existing Building Metrics
Track: Fundamentals and Applications
Room: 222
Sponsor: 07.06 Building Energy Performance, SSPC 100, 02.08 Building Environmental Impacts and Sustainability
Chair: Wayne H. Stoppelmoor Jr., Member, Schneider Electric, Cedar Rapids, IA

Existing building renovations comprise 86% of annual construction cost in the United States. Improving the energy performance of existing buildings represents one of our greatest opportunities for a more sustainable future. This seminar provides information on new provisions in Standard 100-2015. The revised standard provides comprehensive and detailed descriptions of the processes and procedures for the retrofit of existing residential and commercial buildings to achieve greater energy efficiency. Development and application of newly developed energy targets for compliance will be described, along with detailed energy audit procedures included in the standard.
CONFERENCE PAPER SESSION 19 (INTERMEDIATE)

9:45 AM-10:45 AM

What’s New in Water Heating
Track: HVAC Systems and Equipment
Room: 225
Chair: Henry A. Becker, Member, H-O-H Water Technology, Inc., Palatine, IL

The three papers in this session focus on various aspects of energy efficient and environmentally conscience water heating. Heating using sorbent technology is discussed that uses primary thermal energy bypassing the need to convert thermal energy into electrical power. Advanced heat pump technologies and system designs that sustain water storage tank stratification are also reported.

1. Bounding Limitations in the Practical Design of Adsorption Heat Pump Water Heaters (ST-16-C056)
Moonis Ally, Ph.D., and Kyle Gluesenkamp, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

2. Energy Factor Analysis for Gas Heat Pump Water Heaters (ST-16-C057)
Kyle Gluesenkamp, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Kyle Gluesenkamp, Ph.D., Member, and John Bush, P.E., Member, (1)Oak Ridge National Laboratory, Oak Ridge, TN, (2)Electric Power Research Institute, Knoxville, TN

9:45 AM-10:45 AM

SEMINAR 56 (INTERMEDIATE)

Data Sources toward Urban-Scale Energy Modeling, Part 2
Track: Smart Building Systems/Remote Monitoring and Diagnostics
Room: 227
Sponsor: 01.05 Computer Applications
Chair: Joshua New, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Development of urban-scale building energy models is becoming of increased interest for many applications including city-wide energy supply/demand strategies, urban development planning, electrical grid stability and urban resilience. This seminar assembles several leaders in the field of urban-scale energy models to discuss an overview of the field as well as the data, algorithms, workflow and practical challenges addressed to create useful models of individual buildings at the scale of a city.

1. Integration of Reduced Order Energy Model with Geographical Information for Urban-Scale Building Energy Modelling under Urban Context
Jason Brown and Qi Li, Georgia Institute of Technology, Atlanta, GA

2. Urban Microclimate for Building Energy Models
Melissa Allen, Ph.D., Oak Ridge National Laboratory, Oak Ridge, TN

3. Techniques for Rapid Generation of Urban-Scale Energy Models
David Scheer, Autodesk, San Francisco, CA

9:45 AM-10:45 AM

SEMINAR 57 (INTERMEDIATE)

Energy Savings via ASHRAE Level III Auditing, Retrofit and Recommissioning: A Case Study at Hameetman Science Center, Occidental College II
Track: Fundamentals and Applications
Room: 223
Sponsor: 07.03 Operation and Maintenance Management
Chair: Robyn Ellis, Associate Member, City of Hamilton - Public Works, Hamilton, ON, Canada

A previous related session was presented about the initial assessment and the creation of the scope of work of this project. This session focuses on the actual work completed and the obstacles and opportunities encountered. Data is presented detailing the deterioration effect of distribution systems on equipment rated capacity and efficiency. An analysis of the impact of the completed scope of work on the energy, comfort and increased reliability of the buildings is offered in this segment of the seminar. The bearing of the improvements on peak load are also discussed.

1. Occidental College Hameetman Science Building HVAC Retrofit and Recommissioning
Rob Falke, Member, National Comfort Institute, Avon Lake, OH

2. Increases to Energy Efficiency, Reliability and Comfort
Ben Lipscomb, P.E., Associate Member, NCI, Sheffield Lake, OH

9:45 AM-10:45 AM

SEMINAR 58 (INTERMEDIATE)

Improved Modeling Characteristics of a Data Center without Compromising Physics or Breaking The Bank
Track: Fundamentals and Applications
Room: 222
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment, 04.10 Indoor Environmental Modeling
Chair: Nick Gangemi, Member, Northern Air Systems, Rochester, NY

CFD modeling is a powerful tool to simulate and analyze an existing data center or explore the multiple design parameters of a new data center. The challenge is the extreme run time required. Often times this necessitates making choices on what to leave in and what to take out. This session explores several ways to speed up run time for multiple options while preserving accuracy and not sacrificing the physics. The session also takes a look at stanchions and why they should not be excluded in any raised floor model and validated from actual measurements.

1. Improving Model Calculation Time without Sacrificing Physics
Mark Seymour, CEng, Member, Future Facilities Ltd, London, United Kingdom

2. The Compact Modeling of Raised-Floor Stanchions
Zachary Purdue, Schneider Electric, Andover, MA

3. Data Center Modeling Using Response Surface Methodology
Cheng-Xian Lin, Ph.D., Member, Florida International University, Miami, FL

9:45 AM-10:45 AM

SEMINAR 59 (INTERMEDIATE)

Solar Decathlon 2015: Lessons Learned from the Largest Student-Led Solar Powered Housing Competition
Track: Renewable Energy Systems and Net Zero Buildings
Room: 226
Sponsor: 07.05 Smart Building Systems
Chair: Joshua Rhodes, Ph.D., Student Member, University of Texas at Austin, Austin, TX

The U.S. Department of Energy Solar Decathlon challenges collegiate teams to design, build and operate solar-powered houses that are cost-effective, energy-efficient, net-zero and attractive. This seminar hosts two teams, including the overall winners as they talk about what worked and what didn’t in the competition. Many teams tried moon-shot ideas including residential hydronic TES HVAC systems and fully connected, occupant-responding homes. This seminar gives the audience a deep look at some of the submissions to the competition.

Ed May, Stevens Institute of Technology, Hoboken, NJ

Charles Upshaw, Student Member, University of Texas at Austin, Austin, TX
To Centralize or Decentralize a Thermal Energy System: The Great Debate Continues
Track: HVAC Systems and Equipment
Room: 224
Sponsor: 06.02 District Energy
Chair: Alan Neely, Member, Pittsburgh Corning Corporation, The Woodlands, TX

This forum panel comprised of a manufacturer, a design consultant and a district energy provider, provides a short presentation of their opinion on the pros/cons of the centralized vs a decentralized thermal system. A question and answer period will then follow. Questions presented by the moderator will be directed to get into the detail of the benefits of each system.

9:45 AM-10:45 AM
FORUM 4 (INTERMEDIATE)

To Centralize or Decentralize a Thermal Energy System: The Great Debate Continues
Track: HVAC Systems and Equipment
Room: 224
Sponsor: 06.02 District Energy
Chair: Alan Neely, Member, Pittsburgh Corning Corporation, The Woodlands, TX

This forum panel comprised of a manufacturer, a design consultant and a district energy provider, provides a short presentation of their opinion on the pros/cons of the centralized vs a decentralized thermal system. A question and answer period will then follow. Questions presented by the moderator will be directed to get into the detail of the benefits of each system.

9:45 AM-10:45 AM
WORKSHOP 9 (ADVANCED)

The Busted BIM Building Blues
Track: Fundamentals and Applications
Room: 228
Sponsor: 07.02 HVAC&R Contractors and Design Build Firms, TC 1.07 Business, Management and General Legal Education, 07.01

Integrated Building Design
Chair: E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

BIM has become a growing industry practice over the past 10 years. Inconsistencies in approach, application and intended use have made the realization of the theoretical benefits of BIM uneven. The lure of BIM is fewer field conflicts, fewer RFIs, fewer change orders and a better project. What can you do with BIM when you have it? How should an engineer “do” BIM? A Contractor? An owner? Wouldn’t you like to know? Well then, you had better come to this program to find out! (But remember, the blues can be happy too!)

1. You’ve Got Friends: the Successful Execution of BIM for MEP Work
Eli P. Howard, III, Member, SMACNA, Chantilly, PA

2. When You Believe in Things You Don’t Understand, You Suffer
E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

11:00 AM-12:30 PM
CONFERENCE PAPER SESSION 20 (INTERMEDIATE)

Environmentally Conscious Building Designs
Track: Renewable Energy Systems and Net Zero Buildings
Room: 221
Chair: Kyle Knudten, CPMP, McClure Engineering, St. Louis, MO

HVAC modeling and design can take on some unique variations as engineers seek to make buildings more environmentally sound. This session examines better ways to integrate both building energy modeling and life cycle environmental impacts. It also provides a look at an earth-to-air heat exchange system used in a cold climate application; and reviews a hybrid system utilizing solar and geothermal for renewable energy.

1. Solar Hybrid and Geothermal Combined: New System Solution for Renewables (ST-16-C059)
Pernilla Gervind and Jessica Benson, SP Technical Research Institute of Sweden, Gothenburg, Sweden

2. Energy Performance of Concrete Earth Tubes for the Pre-Heating and Pre-Cooling of Supply Air in Cold Climate (ST-16-C060)
Michel Tardif, P.Eng., Natural Resources Canada, Ottawa, ON, Canada

3. Expansion in Number of Parameters: Simulation of Energy and Indoor Climate in Combination with LCA (ST-16-C061)
Aleksander P. Otovic, Lottie M. B. Jensen, Ph.D. and Kristoffer Negendahl, Technical University of Denmark, Kongens Lyngby, Denmark

4. Reducing Uncertainty in Predicting Life-Cycle Environmental Impacts of HVAC Systems (ST-16-C062)
Mike Medas1, Andrew Cripps2, John Connaughton1 and Dave Cheshire1, (1)AECOM & The University of Reading, London, United Kingdom, (2)AECOM, St. Albany, United Kingdom, (3)University of Reading, Reading, United Kingdom, (4)AECOM, London, United Kingdom

11:00 AM-12:30 PM
CONFERENCE PAPER SESSION 21 (ADVANCED)

Experience with Alternative Refrigerants
Track: Advances in Refrigeration Systems and Alternative Refrigerants
Room: 224
Chair: Michael Pate, Ph.D., P.E., Member, Texas A&M University, College Station, TX

Due to continuing regulatory pressures, the search for low-GWP alternative refrigerants is ongoing. This session provides results of extensive testing of various low-GWP refrigerants in various HVAC applications, including a high temperature heat pump.

1. Measured Performance of a High Temperature Heat Pump with HFO-1336mzz-Z as the Working Fluid (ST-16-C063)
Franz Helminger1, Konstantinos Kontomaris, Ph.D., Member2, Julian Pfajfar1, Michael Hartl1 and Thomas Fleckl1, (1)AIT - Austrian Institute of Technology, Vienna, Austria, (2)Chemours Fluorochemicals, Wilmington, DE, (3)BITZER Kühlmachinenbau GmbH, Sindelfingen, Germany

2. Performance of a Four-Ton Rooftop Unit with Low GWP R410A Alternatives (ST-16-C064)
Kenneth Schultz, Ph.D., Member1 and Stephen Kajak, Member2, (1)Ingersoll Rand, La Crosse, WI, (2)Trane, Ingersoll Rand, La Crosse, WI

3. Drop-in Tests and Simulation Results of R410A and R32/1234ze Blend in a R32 Dedicated Mini-Split (ST-16-C065)
Osami Kataoka, Member1 and Fumio Ota2, (1)Daikin Industries, Ltd., Osaka, Japan, (2)Daikin Industries, Ltd., Sakai, Japan

4. Performance of R-410A Alternative Refrigerants in a Reciprocating Compressor Designed for Air Conditioning Applications (ST-16-C066)
Som Shrestha, Ph.D., BEMP, Member1, Edward A. Vineyard, Fellow ASHRAE1, James Lenz, Member2 and Kevin Mumpower, Member3, (1)Oak Ridge National Laboratory, Oak Ridge, TN, (2)Bristol Compressors International, Inc., Bristol, TN

5. Hot Surface Ignition Testing for 2L Class Refrigerants (ST-16-C067)
Mary E. Koban, Member1 and Patrick E. Coughlan, Chemours Fluoroproducts, Wilmington, DE

11:00 AM-12:30 PM
CONFERENCE PAPER SESSION 22 (INTERMEDIATE)

System Alternatives, Design Options and BIM Productivity
Track: HVAC Systems and Equipment
Room: 225
Chair: David Yashar, Ph.D., P.E., Member, NIST, Gaithersburg, MD

This session compares multiple HVAC systems, including water-based, air-based or refrigerant-based systems and the benefits they provide to a building. The session also addresses the concept of hybrid systems in large facilities with multiple types of occupancies, space operation and thermal loading. This session also reviews the benefits of integrating information into BIM for the use of design of these systems and improving quality control.

1. Evaluation of VRF Systems with Comparisons to Traditional HVAC Systems (ST-16-C068)
Guolian Wu, Ph.D.1, Member1, Dochul Choi, Ph.D.2, Wanyong Kim3 and Gyounghae Seo1, (1)Samsung Electronics of America, Pine Brook, NJ, (2)Samsung Electronics, Suwon, South Korea

2. Hybrid Approaches to HVAC Systems Design of a R&D Complex to Achieve Green Building Certification and Optimal Comfort (ST-16-C069)
Guolian Wu, Ph.D.1, Member1, Dochul Choi, Ph.D.2, Wanyong Kim3 and Jason Kim2, (1)Samsung Electronics of America, Pine Brook, NJ, (2)Samsung Electronics, Suwon, South Korea

Wednesday, June 29 49

Ongun B. Kazanci, Student Member, Masanori Shukuya, Ph.D. and Bjarne W. Olesen, Ph.D., Fellow ASHRAE, (1) Technical University of Denmark, Kongens Lyngby, Denmark, (2) Tokyo City University, Tokyo, Japan

4. Enhancing Mechanical Engineering Productivity with BIM
Blake Guitther, P.E., BEMP, Associate Member, Gausman & Moore Engineers, St. Paul, MN

11:00 AM-12:30 PM

SEMINAR 60 (INTERMEDIATE)

BIM and HVAC System Design
Track: Fundamentals and Applications
Room: 222
Sponsor: 01.05 Computer Applications, MTG.BIM Building Information Modeling
Chair: Stephen Roth, P.E., Member, Carmel Software Corp., San Rafael, CA

This seminar discusses how Building Information Modeling (BIM) tools are changing the way engineers perform HVAC system design including duct design, hot and cold water piping design, plumbing and fabrication. One speaker discusses how BIM authoring tools are helping to: Coordinate duct design, calculate duct/piping pressure drop, perform design validation and more. A second speaker discusses how conceptual HVAC design schematic tools work with BIM authoring tools. A third speaker discusses how these various tools from different vendors are able to communicate with one another using open source interoperability languages.

1. BIM Software and HVAC System Design
Martin Schmid, P.E., Autodesk, Boston, MA

2. HVAC Schematic System Design
Joe Simmons, P.E., Associate Member, HVAC Solution, Salt Lake City, UT

3. Sharing Information between BIM and HVAC Design Software Tools
Stephen Roth, P.E., Member, Carmel Software Corp., San Rafael, CA

11:00 AM-12:30 PM

SEMINAR 61 (INTERMEDIATE)

How Deep Can We Go? Designing and Drilling Deeper Geothermal Systems
Track: HVAC Systems and Equipment
Room: 223
Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications
Chair: Scott Hackel, P.E., Member, Seventhwave, Madison, WI

Space limitations and other constraints are forcing engineers to design deeper boreholes for ground-source heat pump systems in buildings. There are advantages and disadvantages to doing deeper than typical boreholes, and there are specific limitations on depth in some circumstances. This seminar covers these considerations, both through calculation and design examples, as well as practical lessons learned from the field. The new, deep/ultradeep borehole, hydrostatic differential calculations from the 2015 ASHRAE Applications Handbook are also presented. The latest developments in non-cementitious grouts are introduced to help designers avoid pipe collapse in deeper boreholes without sacrificing performance.

1. Installation Practices and Hydrostatics of Deep Boreholes
Ryan Carda, P.E., Geo-Connections Inc, Elkton, SD

2. Swedish Practices and Experience with Deep Boreholes
Jose Acuna, Ph.D., Associate Member, KTH Royal Institute of Technology, Stockholm, Sweden

3. Evolution of High and Low Density Geothermal Grouts
Charles P Remund, Ph.D., Member, GeoPro, Inc., Elkton, SD

11:00 AM-12:30 PM

SEMINAR 62 (INTERMEDIATE)

Is It My Home or Is It Me? Latest Knowledge about IAQ in Homes
Track: Indoor Environment: Health, Comfort, Productivity
Room: 226
Sponsor: Environmental Health Committee
Chair: Kevin Kennedy, Children’s Mercy Hospital and Clinics, Kansas City, MO

With increasing interest by homeowners in the role environmental exposure in their home might play in the health and well-being of themselves and their families, how much do we know about the role indoor environmental exposure from the building sources serves in causing chronic health conditions vs. the role human activity plays in indoor exposure? Which is more important? This seminar includes experts on different aspects of this discussion. Come and learn about the significant and complicated role both play in health.

1. It Is Definitely You: The Role of Human Activities
Jeffrey Siegel, Ph.D., University of Texas at Austin, Austin, TX

2. Indoor Environmental Exposure in Children: What We Know
Gary Adamkiewicz, Ph.D., Harvard School of Public Health, Boston, MA

3. Ventilation, Indoor Air and Health Outcomes
Dave Jacobs, National Center for Healthy Housing, Columbia, MD

4. Ventilation, Indoor Air Quality and Where the CO Comes from
Paul W. Francis, Member, University of Illinois at Urbana-Champaign, Champaign, IL

11:00 AM-12:30 PM

SEMINAR 63 (INTERMEDIATE)

Moving Beyond Typical Year Weather Data
Track: Research Summit
Room: 228
Sponsor: 04.02 Climatic Information
Chair: Didier Thevenard, Ph.D., P.E., Member, Numerical Logics Inc., Waterloo, ON, Canada

The common practice in building performance modeling is to use ‘Typical Year’ weather data. Such data is statistically selected from the long-term record based on representative statistics for solar radiation and dry bulb temperature. However, although the use of a single typical year is convenient, it often leads to severe inaccuracies in the estimation of building loads and energy consumption. It is time to rethink alternatives to the use of Typical Year files. This seminar provides a deeper understanding of the problems linked to the use of Typical Years and walks the audience through several alternatives.

1. How Much Does Energy Use Vary with ‘Actual’ Weather from Year to Year?
Drury Crawley, Ph.D., BEMP, Fellow ASHRAE, Bentley Systems, Inc., Washington, DC

2. How Much Do HVAC Loads Change Due to the Variability of Year-to-Year Weather?
Yu Joe Huang, BEMP, White Box Technologies, Moraga, CA

3. Understanding the Temporal and Spatial Variability of New Generation Gridded TMYs
Aron Habte, NREL, Golden, CO
SEMINAR 64 (INTERMEDIATE)

N-ZERO from Foundation to Financing: Residential Buildings
Track: Renewable Energy Systems and Net Zero Buildings
Room: 227
Sponsor: 06.07 Solar Energy Utilization
Chair: Janice Means, P.E., Life Member, Lawrence Technological University, Southfield, MI

This session discusses the strategies that can be implemented which will lead a home to become Near/Net Zero Energy Building. Also, financing models for the U.S. residential PV market are explored, including third-party power purchase agreements (PPAs) and lease based financing. In addition, review of The European Directive on the Energy Performance in Buildings (EPBD) that mandates nearly-zero energy new buildings by 2020 is discussed, including characteristics and benchmarks of NZEBs from within existing building stock.

1. NZEB Multidisciplinary Project Development to Reach a Zero CO2 Emission Sustainable Eco-Settlement: Technical, Physical, Legal, Financial and Regulatory Issues
Marija Todorovic, Ph.D., P.E., Fellow ASHRAE, University of Belgrade, vea-invi.ltd director, Belgrade, Serbia

2. NZEB Characteristics of European Residential Buildings and Assessment of Refurbishment Scenarios Using Building Typologies
Constantinos Balaras, Ph.D., Fellow ASHRAE, Group Energy Conservation (IERSD-NOA), Athens, Greece

3. What Does It Take for a Residential Home to be NZEB?
Khalid Nagidi, BEAP, Member, Energy Management Consulting Group, Wantagh, NY

4. Options, Trends and Regulatory Challenges in Residential Solar PV Finance and Ownership
James Leidel, Member, Oakland University, Rochester, MI
As the 2015–16 Society year draws to a close, I want to thank you for serving as a standing committee chair. Your assistance over the past year has been invaluable.

This year, my presidential theme focused on Making Connections. It has been said that human connections are the “invisible threads that are the strongest ties.” Forging stronger connections amongst people working in the built environment is a priority for me.

Making Connections means connecting with industry, communities, governments and the public. ASHRAE’s mission is to advance the arts and sciences of heating, ventilating, air conditioning and refrigerating to serve humanity and promote a sustainable world. For us to succeed, we have to build connections. The members of the ASHRAE standing committees are most certainly among those strong connections.

The imaginations of people in our industry are literally changing the world. We’ve made decisions to invest in top talent – and big, bold ideas. Imagine improving the quality of life for everyone. John Lennon said “A dream you dream alone is only a dream. A dream you dream together is reality.” Our reality at ASHRAE is making connections that advance our world through viable, affordable, green technology.

We must all work together to make our dream for a sustainable future come true. ASHRAE cannot do its job without the creativity and passion from all its members, connecting colleagues within our industry and beyond. Again, thank you for your work over the past year and moving forward.

Sincerely,

David Underwood, P.Eng., Fellow ASHRAE, Life Member, CPMP
2015–16 ASHRAE President
SOCIETY COMMITTEE MEETINGS

All society committee meeting rooms are located in the Marriott St. Louis Grand. The Marriott’s meeting space is located in the main hotel and across the street in the Conference Building which is called Conference Plaza. Access to the Conference Plaza is via an underground tunnel that can be accessed from the Gateway level via either elevator or escalator. Escalators to Gateway level are located just past Zenia Bar & Grille on the lobby level. Codes for this level are (CL) which is Conference Plaza street level and (CP2) which is Conference Plaza 2nd level. Subcommittees are indented.

AEDG Steering Committee (10/10) Electric
Monday (6/27)  2:15 pm – 5:00 pm  Landmark 3 (CL)

Appointments Roadmap (22/0)
Sunday (6/26)  7:00 am – 8:00 am  Benton (M)

ASHRAE Foundation (25/10) Screen/Electric
Monday (6/27)  7:30 am – 9:45 am  Majestic A (CP2)
ASHRAE Foundation Executive Subcommittee (10/5) Electric
Saturday (6/25)  1:30 pm – 3:00 pm  Portland (M)

ASHRAE/UNEP Coordination Meeting (12/4)
Saturday (6/25)  1:00 pm – 3:00 pm  Aubert (M)

Associate Society Alliance (30/30) Screen
Monday (6/27)  4:15 pm – 6:15 pm  Landmark 4 (CL)

Audit Committee (5/3)
Friday (6/24)  3:30 pm – 5:00 pm  Lafayette (M)

Building Energy Quotient Committee (15/15) Screen/Electric
Sunday (6/26)  8:30 am – 11:30 am  Majestic (CP2)
bEQ Marketing (5/5) Screen
Saturday (6/25)  12:30 pm – 1:30 pm  Laclede (20)
bEQ Methodology (5/5) Screen
Saturday (6/25)  1:30 pm – 2:30 pm  Laclede (20)

Board of Directors (41/100) Screen/Electric
Sunday (6/26)  1:30 pm – 5:30 pm  Majestic D/E (CP2)
Wednesday (6/29)  2:00 pm – 6:00 pm  Majestic D/E (CP2)

Broadcasting ASHRAE Impact and Key Constituency
Leadership Outreach Ad Hoc (30/6) Screen
Saturday (6/25)  8:00 am – 10:00 am  Majestic F (CP2)

Building Performance Alliance Ad Hoc Committee (16/6)
Friday (6/24)  10:00 am – 11:00 am  Lucas (21)

Certification (12/12) Screen/Electric
Saturday (6/25)  8:00 am – 2:00 pm  Lafayette (M)
OPMP Exam Subcommittee (17/0) Screen/Electric
Friday (6/24)  7:30 am – 12:00 pm  Majestic G (CP2)
CPMP Exam Subcommittee (14/0) Screen/Electric
Friday (6/24)  8:00 am – 5:00 pm  Laclede (20)
BEMP Exam Subcommittee (17/0) Screen/Electric
Friday (6/24)  1:00 pm – 5:30 pm  Majestic G (CP2)

Chapter Technology Transfer Committee (30/15) Screen/Electric
Friday (6/24)  8:00 am – 12:00 pm  Majestic F (CP2)
Saturday (6/25)  8:00 am – 12:00 pm  Landmark 7 (CL)
Chapter Technology Transfer Executive (5/0)
Friday (6/24)  5:00 pm – 6:00 pm  Majestic F (CP2)
Chapter Technology Transfer Member Services (12/10) Screen/Electric
Friday (6/24)  1:00 pm – 5:00 pm  Shaw (M)
Chapter Technology Transfer Operations (10/5) Electric
Friday (6/24)  1:00 pm – 5:00 pm  Majestic F (CP2)
CTTC New Member Orientation (10/5) Screen/Electric
Saturday (6/25)  1:15 pm – 2:30 pm  Landmark 7 (CL)

College of Fellows (25/10)
Sunday (6/26)  10:00 am – 12:00 pm  Landmark 6 (CL)
College of Fellows: Advisory Committee (15/10)
Sunday (6/26)  9:00 am – 10:00 am  Landmark 6 (CL)

Conferences and Expositions Committee (30/10) Screen/Electric
Saturday (6/25)  8:00 am – 3:00 pm  Majestic C (CP2)
Conferences and Expositions Executive (30/5)
Friday (6/24)  1:00 pm – 3:00 pm  Majestic C (CP2)
Conferences and Expositions Annual and Winter Meetings (30/5)
Friday (6/24)  3:00 pm – 6:00 pm  Majestic C (CP2)
CEC Training for TC Programs Subcommittee Chairs (30/5)
Tuesday (6/28)  11:15 am – 12:00 pm  ACCC 220

Developing Economies (20/0) Screen
Monday (6/27)  8:00 am – 10:00 am  Landmark 6 (CL)

Development Committee (24/10) Screen/Electric
Monday (6/27)  10:00 am – 12:00 pm  Majestic A (CP2)

Director and Regional Chairs (15/20)
Friday (6/24)  11:00 am – 1:00 pm  Landmark 6 (CL)
Wednesday (6/29)  12:00 pm – 2:00 pm  Majestic A (CP2)

Electronic Communications Committee (13/10) Screen
Saturday (6/25)  11:00 am – 3:00 pm  Benton (M)
Electronic Communications Subcommittees (13/10) Screen
Saturday (6/25)  8:00 am – 11:00 am  Benton (M)

Energy Efficiency in Buildings Position Document Committee (10/10) Screen/Electric
Tuesday (6/25)  3:00 pm – 4:00 pm  Lindell (CL)

Environmental Health (20/20) Screen/Electric
Monday (6/27)  2:15 pm – 6:15 pm  Majestic H (CP2)
Environmental Health Executive (20/20) Screen/Electric
Monday (6/27)  7:00 am – 8:00 am  Majestic H (CP2)
Environmental Health Handbook/Policy (20/20) Screen/Electric
Monday (6/27)  8:00 am – 10:00 am  Majestic H (CP2)
Environmental Health Program/Research (20/20) Screen/Electric
Monday (6/27)  10:00 am – 12:00 pm  Majestic H (CP2)

Executive Committee (12/20) Screen/Electric
Saturday (6/25)  8:30 am – 1:00 pm  Parkview/Aubert (M)
Wednesday (6/29)  7:30 am – 9:00 am  Benton (M)
Thursday (6/30)  7:30 am – 11:00 am  Shaw (M)

Finance Committee (13/10) Electric
Friday (6/24)  8:00 am – 1:00 pm  Landmark 7 (CL)
Finance Investment Subcommittee (4/0)
Thursday (6/23)  5:00 pm – 7:00 pm  Benton (M)
Finance Planning Subcommittee (8/8) Electric
Thursday (6/23)  5:00 pm – 7:00 pm  Aubert (M)

Grassroots Government Advocacy Committee (30/15) Screen/Electric
Saturday (6/25)  8:00 am – 12:30 pm  Landmark 2 (CL)
GGAC: New Member Orientation (15/10) Screen/Electric
Friday (6/24)  8:00 am – 10:00 am  Landmark 2 (CL)
GGAC: Executive (15/10) Screen/Electric
Friday (6/24)  10:15 am – 12:00 pm  Landmark 2 (CL)
GGAC: Active Outreach Subcommittee (15/10) Screen/Electric
Friday (6/24)  1:00 pm – 2:30 pm  Landmark 2 (CL)
GGAC: Responsive Engagement Subcommittee (15/10) Screen/Electric
Friday (6/24)  1:00 pm – 2:30 pm  Landmark 1 (CL)
GGAC: Ad Hoc for MBO 1 (15/10) Screen/Electric
Friday (6/24)  2:45 pm – 4:15 pm  Landmark 2 (CL)
GGAC: Ad Hoc for MBO 6 (15/10) Screen/Electric
Friday (6/24)  2:45 pm – 4:15 pm  Landmark 1 (CL)
GGAC: Ad Hoc for MBO 2 (15/10) Screen/Electric
Friday (6/24)  4:30 pm – 6:00 pm  Landmark 2 (CL)
GGAC: Ad Hoc for MBO 4 (15/10) Screen/Electric
Friday (6/24)  4:30 pm – 6:00 pm  Landmark 1 (CL)

Handbook Committee (30/15) Screen
Sunday (6/26)  10:30 am – 1:00 pm  Majestic C (CP2)
Handbook Excom (5/5)
Saturday (6/25)  1:00 pm – 2:00 pm  Shaw (M)
Handbook Strategic Planning (5/5)
Saturday (6/25)  2:00 pm – 3:00 pm  Shaw (M)

Handbook Training Workshop (50/0) Screen
Sunday (6/26)  8:00 am – 9:00 am  Aubert (M)

Floor Comm Mgs

53
Handbook Functional (5/0)
Sunday (6/26) 8:00 am – 9:00 am Flora (21)
Handbook International (5/5)
Sunday (6/26) 8:00 am – 9:00 am Majestic H (CP2)
Handbook Electronic Media (5/0)
Sunday (6/26) 8:00 am – 9:00 am Majestic C (CP2)
Handbook 2017 Fundamentals TCs/Volume Subcommittee (25/0)
Sunday (6/26) 9:00 am – 10:00 am Majestic H (CP2)
Handbook 2018 Refrigeration TCs/Volume Subcommittee (25/0)
Sunday (6/26) 9:00 am – 10:00 am Majestic C (CP2)
Handbook 2019 HVAC Applications TCs/Volume Subcommittee (25/0)
Sunday (6/26) 9:00 am – 10:00 am Majestic B (CP2)
Handbook Volume Subcommittees (25/0)
Sunday (6/26) 10:00 am – 10:30 am Majestic C (CP2)
Historical Committee (20/0) Screen
Sunday (6/26) 8:30 am – 12:00 pm Lindell (CL)
Honors & Awards (15/0) Electric
Sunday (6/26) 1:30 pm – 5:00 pm Lindell (CL)
Monday (6/27) 2:15 pm – 5:30 pm Lindell (CL)
H&A New Member Orientation (5/5) Screen/Electric
Sunday (6/26) 12:30 pm – 1:30 pm Lindell (CL)
IAQ 2016 Steering Committee (16/10) Screen
Tuesday (6/28) 3:00 pm – 4:00 pm Portland (M)
IEQ-GA (20/0) Screen/Electric
Tuesday (6/28) 4:00 pm – 5:30 pm Portland (M)
Indoor Air Quality PD (10/0) Screen/Electric
Tuesday (6/28) 9:00 am – 10:30 am Portland (M)
Journal Advertising Sales Subcommittee (8/0)
Sunday (6/26) 7:00 am – 8:00 am Flora (21)
Life Member Executive Board Meeting (10/0)
Tuesday (6/28) 9:00 am – 11:00 am Aubert (M)
Members Council (37/40) Screen/Electric
Tuesday (6/28) 8:15 am – 12:00 pm Landmark 4 (CL)
Members Council Planning Subcommittee (12/10) Electric
Saturday (6/25) 8:00 am – 12:00 pm Portland (M)
Members Council Region Operations Subcommittee (12/10)
Electric
Sunday (6/26) 8:00 am – 12:00 pm Portland (M)
Members Council Orientation (35/15) Screen
Tuesday (6/28) 2:00 pm – 4:00 pm Majestic G (CP2)
Membership Promotion (24/15) Screen/Electric
Saturday (6/25) 8:00 am – 3:00 pm Majestic H (CP2)
Membership Promotion Subcommittees (20/10) Screen/Electric
Friday (6/24) 8:00 am – 2:00 pm Majestic H (CP2)
Mobile Marine and Fisheries Conference Organizing Committee (15/1)
Sunday (6/26) 3:00 pm – 4:00 pm Aubert (M)
Mobile Marine and Fisheries Conference Technical Committee (15/1)
Sunday (6/26) 1:00 pm – 3:00 pm Aubert (M)
Nominating (48/0) Electric
Sunday (6/26) 7:30 am – 12:00 pm Landmark 4 (CL)
P.EAC (20/20) Screen/Electric
Tuesday (6/28) 12:00 pm – 2:00 pm Landmark 5 (CL)
Planning (25/25) Screen/Electric/flipchart
Friday (6/24) 1:00 pm – 6:00 pm Majestic A (CP2)
Presidential Ad Hoc on TC Structure Review (10/6)
Saturday (6/25) 1:00 pm – 3:00 pm Majestic F (CP2)
Professional Development (15/15)
Monday (6/27) 8:00 am – 12:00 pm Landmark 3 (CL)
Publications Committee (15/10) Screen
Sunday (6/26) 8:00 am – 12:00 pm Landmark 7 (CL)
Publications Planning Subcommittee (5/5)
Saturday (6/25) 10:00 am – 12:00 pm Shaw (M)
Publishing and Education Council (35/30) Screen/Electric
Tuesday (6/28) 8:00 am – 12:00 pm Majestic F (CP2)
Publishing and Education Council Orientation (35/30) Screen/Electric
Tuesday (6/28) 2:00 pm – 4:00 pm Majestic F (CP2)
Refrigeration Committee (20/20) Screen/Electric
Sunday (6/26) 8:00 am – 12:00 pm Pershing (CL)
Refrigeration Excom (20/20) Screen
Sunday (6/26) 7:00 am – 8:00 am Pershing (CL)
Refrigeration PMS for RP-1634 (15/0)
Monday (6/27) 4:30 pm – 6:30 pm Landmark 2 (CL)
Region Members Council Representative/Regional Vice Chair Training (32/10) Screen
Friday (6/24) 3:00 pm – 5:00 pm Majestic H (CP2)
Region-at-Large (40/0) Screen
Monday (6/27) 2:15 pm – 4:15 pm Majestic C (CP2)
Research Administration Committee (25/20) Screen/Electric
Friday (6/24) 3:00 pm – 7:00 pm Majestic B (CP2)
Saturday (6/25) 8:00 am – 3:00 pm Majestic B (CP2)
Wednesday (6/29) 7:00 am – 11:00 am Majestic B (CP2)
RAC Excom (6/0) Screen
Friday (6/24) 1:00 pm – 2:30 pm Majestic B (CP2)
Research Promotion (25/5)
Saturday (6/25) 7:30 am – 1:00 pm Hawthorne (21)
Research Promotion Executive (10/0)
Friday (6/24) 9:30 am – 11:30 am Aubert (M)
Research Promotion RVC Training (25/5) Screen
Friday (6/24) 1:30 pm – 5:00 pm Aubert (M)
Research Promotion Subcommittee (10/0)
Saturday (6/25) 2:00 pm – 3:00 pm Hawthorne (21)
Residential Building Committee (16/20) Screen
Monday (6/27) 9:00 am – 12:00 pm Landmark 7 (CL)
Residential Building Committee: Programs Subcommittee (15/5)
Sunday (6/26) 8:30 am – 9:30 am Landmark 5 (CL)
Residential Building Committee: Conferences Subcommittee (15/5)
Sunday (6/26) 9:30 am – 10:30 am Landmark 5 (CL)
Residential Building Committee: Publications Subcommittee (15/5)
Sunday (6/26) 10:30 am – 11:30 am Landmark 5 (CL)
Residential Building Committee: Technical Subcommittee (15/5)
Sunday (6/26) 1:00 pm – 2:00 pm Landmark 5 (CL)
Residential Building Committee: Stakeholders Subcommittee (25/10)
Sunday (6/26) 2:00 pm – 4:00 pm Landmark 5 (CL)
Scholarship Trustees (10/5) Screen/Electric
Tuesday (6/28) 8:00 am – 12:00 pm Parkview (M)
Society Rules (12/6) Screen/Electric
Tuesday (6/28) 2:00 pm – 6:00 pm Parkview (M)
Standards Committee (30/20) Screen/Electric
Saturday (6/25) 8:00 am – 12:00 pm Landmark 1 (CL)
Wednesday (6/29) 8:00 am – 10:00 am Majestic D/E (CP2)
Standards: Executive Committee (10/10) Screen/Electric
Friday (6/24) 8:00 am – 12:00 pm Benton (M)
StdC Training Adhoc (10/10) Screen/Electric
Friday (6/24) 12:00 pm – 1:00 pm Benton (M)
Standards: ILS/ISAS (10/3) Screen/Electric
Friday (6/24) 1:00 pm – 4:00 pm Flora (21)
Standards: SPLS (20/20) Screen/Electric
Friday (6/24) 2:00 pm – 6:00 pm Portland (M)
Standards: PPIS (6/10) Screen/Electric
Friday (6/24) 2:00 pm – 6:00 pm Benton (M)
Standards: Code Interaction Subcommittee (CIS) (15/10) Screen
Sunday (6/26) 5:00 pm – 6:30 pm Landmark 1 (CL)
Standards PPIS (6/10) Screen/Electric
Tuesday (6/28) 11:00 am – 2:00 pm Benton (M)
Standards SPLS (20/10) Screen/Electric
Tuesday (6/28) 2:00 pm – 4:00 pm Benton (M)
Standards SRS (8/4) Screen/Electric
Tuesday (6/28) 5:00 pm – 6:00 pm Benton (M)

Student Activities Committee (22/10) Screen/Electric
Saturday (6/25) 8:00 am – 3:00 pm Pershing (CL)
Student Activities RVC Training (15/5) Screen/Electric
Friday (6/24) 8:00 am – 9:30 am Pershing (CL)
Research Promotion Executive (10/0)
Friday (6/24) 9:00 am – 9:30 am Aubert (M)

Student Activities Executive (25/5) Screen/Electric
Friday (6/24) 9:30 am – 11:30 am Pershing (CL)
Student Activities K-12/STEM (20/5) Screen/Electric
Friday (6/24) 2:00 pm – 4:00 pm Lindell (CL)
Student Activities ABET (15/5) Screen/Electric
Friday (6/24) 2:00 pm – 4:00 pm Lindell (CL)

Technology Council (37/20) Screen/Electric
Wednesday (6/29) 9:00 am – 12:00 pm Majestic H (CP2)
Technology Council: Operations Subcommittee (25/15) Screen/Electric
Tuesday (6/28) 7:30 am – 9:00 am Majestic H (CP2)
Technology Council: Special Projects Subcommittee (10/10) Screen/Electric
Tuesday (6/28) 9:00 am – 10:30 am Majestic H (CP2)
Technology Council: Document Review Subcommittee (10/10) Screen/Electric
Tuesday (6/28) 10:30 am – 12:00 pm Majestic H (CP2)
Technology Council Planning (25/10) Screen/Electric
Tuesday (6/28) 2:00 pm – 4:00 pm Majestic H (CP2)
Young Engineers in ASHRAE Committee (20/15) Electric
Saturday (6/25) 8:00 am – 3:00 pm Lindell (CL)

CHRONOLOGICAL

THURSDAY, JUNE 23

Finance Investment Subcommittee (4/0)
Thursday 5:00 pm – 7:00 pm Benton (M)

Finance Planning Subcommittee (8/8) Electric
Thursday 5:00 pm – 7:00 pm Aubert (M)

FRIDAY, JUNE 24

OPMP Exam Subcommittee (17/0) Screen/Electric
Friday 7:30 am – 12:00 pm Majestic G (CP2)

GGAC: New Member Orientation (15/10) Screen/Electric
Friday 8:00 am – 10:00 am Landmark 2 (CL)

Chapter Technology Transfer Committee (30/15) Screen/Electric
Friday 8:00 am – 12:00 pm Majestic F (CP2)

Standards: Executive Committee (10/10) Screen/Electric
Friday 8:00 am – 12:00 pm Benton (M)

Finance Committee (13/10) Electric
Friday 8:00 am – 1:00 pm Landmark 7 (CL)

Membership Promotion Subcommittees (20/10) Screen/Electric
Friday 8:00 am – 2:00 pm Majestic H (CP2)
Research Administration Committee (25/20) Screen/Electric  
Friday 3:00 pm – 7:00 pm Majestic B (CP2)

Audit Committee (5/3)  
Friday 3:30 pm – 5:00 pm Lafayette (M)

Student Activities Design Competition (15/5) Screen/Electric  
Friday 4:00 pm – 6:00 pm Pershing (CL)

Student Activities Grants (15/5) Screen/Electric  
Friday 4:00 pm – 6:00 pm Lindell (CL)

GGAC: Ad Hoc for MBO 2 (15/10) Screen/Electric  
Friday 4:30 pm – 6:00 pm Landmark 2 (CL)

GGAC: Ad Hoc for MBO 4 (15/10) Screen/Electric  
Friday 4:30 pm – 6:00 pm Landmark 1 (CL)

Chapter Technology Transfer Executive (5/0)  
Friday 5:00 pm – 6:00 pm Majestic F (CP2)

SUNDAY, JUNE 26

Appointments Roadmap (22/0)  
Sunday 7:00 am – 8:00 am Benton (M)

Journal Advertising Sales Subcommittee (8/0)  
Sunday 7:00 am – 8:00 am Flora (21)

Refrigeration Excom Subcommittee (20/20) Screen  
Sunday 7:00 am – 8:00 am Pershing (CL)

Nominating (48/0) Electric  
Sunday 7:30 am – 12:00 pm Landmark 4 (CL)

Handbook Electronic Media (5/0)  
Sunday 8:00 am – 9:00 am Majestic C (CP2)

Handbook Functional (5/0)  
Sunday 8:00 am – 9:00 am Flora (21)

Handbook International (5/5)  
Sunday 8:00 am – 9:00 am Majestic H (CP2)

Handbook Training Workshop (50/0) Screen  
Sunday 8:00 am – 9:00 am Aubert (M)

Members Council Region Operations Subcommittee (12/10) Electric  
Sunday 8:00 am – 12:00 pm Portland (M)

Publications Committee (15/10) Screen  
Sunday 8:00 am – 12:00 pm Landmark 7 (CL)

Refrigeration Committee (20/20) Screen/Electric  
Sunday 8:00 am – 12:00 pm Pershing (CL)

Residential Building Committee: Programs Subcommittee (15/10) Electric  
Sunday 8:00 am – 9:00 am Aubert (M)

Building Energy Quotient Committee (15/15) Screen/Electric  
Sunday 8:30 am – 11:30 am Majestic G (CP2)

Handbook 2017 Fundamentals TCs/Volume Subcommittee (25/0)  
Sunday 9:00 am – 10:00 am Landmark 5 (CL)

Handbook 2018 Refrigeration TCs/Volume Subcommittee (25/0)  
Sunday 9:00 am – 10:00 am Majestic H (CP2)

Handbook 2019 HVAC Applications TCs/Volume Subcommittee (25/0)  
Sunday 9:00 am – 10:00 am Majestic C (CP2)

APPENDIX
### Monday, June 27

**Environmental Health Executive (20/20) Screen/Electric**  
Monday 7:00 am – 8:00 am Majestic H (CP2)

**ASHRAE Foundation (25/10) Screen/Electric**  
Monday 7:30 am – 9:45 am Majestic A (CP2)

**Developing Economies (20/0) Screen**  
Monday 8:00 am – 10:00 am Landmark 6

**Environmental Health Handbook/Policy (20/20) Screen/Electric**  
Monday 8:00 am – 10:00 am Majestic H (CP2)

**Professional Development (15/15)**  
Monday 8:00 am – 12:00 pm Landmark 3 (CL)

**Residential Building Committee (16/20) Screen**  
Monday 9:00 am – 12:00 pm Landmark 7 (CL)

**Development Committee (24/10) Screen/Electric**  
Monday 10:00 am – 12:00 pm Majestic A (CP2)

**Environmental Health Program/Research (20/20) Screen/Electric**  
Monday 10:00 am – 12:00 pm Majestic H (CP2)

**Publishing and Education Council Research Journal Subcommittee (10/5)**  
Monday 11:00 am – 12:00 pm Flora (21)

**Publishing and Education Council Fiscal (17/8) Screen**  
Monday 2:00 pm – 3:30 pm Landmark 7 (CL)

**Region-at-Large (40/0) Screen**  
Monday 2:15 pm – 4:15 pm Majestic C (CP2)

**AEDG Steering Committee (10/10) Electric**  
Monday 2:15 pm – 5:00 pm Landmark 3 (CL)

**Honors & Awards (15/0) Electric**  
Monday 2:15 pm – 5:30 pm Lindell (CL)

**Environmental Health (20/20) Screen/Electric**  
Monday 2:15 pm – 6:15 pm Majestic H (CP2)

**Publishing and Education Council Functional (17/8) Screen**  
Monday 3:30 pm – 5:00 pm Landmark 7 (CL)

**Associate Society Alliance (30/30) Screen**  
Monday 4:15 pm – 6:15 pm Landmark 4 (CL)

**Refrigeration PMS for RP-1634 (15/0)**  
Monday 4:30 pm – 6:30 pm Landmark 2 (CL)

### Tuesday, June 28

**Technology Council: Operations Subcommittee (25/15) Screen/Electric**  
Tuesday 7:30 am – 9:00 am Majestic H (CP2)

**Publishing and Education Council (35/30) Screen/Electric**  
Tuesday 8:00 am – 12:00 pm Majestic F (CP2)

**Scholarship Trustees (10/5) Screen/Electric**  
Tuesday 8:00 am – 12:00 pm Parkview (M)

**Members Council (37/40) Screen/Electric**  
Tuesday 8:15 am – 12:00 pm Landmark 4 (CL)

**Indoor Air Quality PD (10/0) Screen/Electric**  
Tuesday 9:00 am – 10:30 am Portland (M)

**Technology Council: Special Projects Subcommittee (10/10) Screen/Electric**  
Tuesday 9:00 am – 10:30 am Majestic H (CP2)

**Life Member Executive Board Meeting (10/0)**  
Tuesday 9:00 am – 11:00 am Aubert (M)

**Technology Council: Document Review Subcommittee (10/10) Screen/Electric**  
Tuesday 10:30 am – 12:00 pm Majestic H (CP2)

**Standards PPIS (6/10) Screen/Electric**  
Tuesday 11:00 am – 2:00 pm Benton (M)

**CEC Training for TC Program Subcommittee Chairs (30/5)**  
Tuesday 11:15 am – 12:00 pm ACCC 220

**PEAC (20/20) Screen/Electric**  
Tuesday 12:00 pm – 2:00 pm Landmark 5 (CL)

**Members Council Orientation (35/15) Screen**  
Tuesday 2:00 pm – 4:00 pm Majestic G (CP2)

**Publishing and Education Council Orientation (35/30) Screen/Electric**  
Tuesday 2:00 pm – 4:00 pm Majestic F (CP2)

**Standards SPLS (20/10) Screen/Electric**  
Tuesday 2:00 pm – 4:00 pm Benton (M)

**Technology Council Planning (25/10) Screen/Electric**  
Tuesday 2:00 pm – 4:00 pm Majestic H (CP2)

**Society Rules (12/6) Screen/Electric**  
Tuesday 2:00 pm – 4:00 pm Parkview (M)

**Energy Efficiency in Buildings Position Document Committee (10/10) Screen/Electric**  
Tuesday 3:00 pm – 4:00 pm Lindell (CL)

**IAQ 2016 Steering Committee (16/10) Screen**  
Tuesday 3:00 pm – 4:00 pm Portland (M)

**IEQ-GA (20/0) Screen/Electric**  
Tuesday 4:00 pm – 5:30 pm Portland (M)

**Standards SRS (8/4) Screen/Electric**  
Tuesday 5:00 pm – 6:00 pm Benton (M)

### Wednesday, June 29

**Technical Activities Committee (25/10) Electric**  
Wednesday 7:00 am – 10:00 am Majestic A (CP2)

**Research Administration Committee (25/6) Electric**  
Wednesday 7:00 am – 11:00 am Majestic B (CP2)

**Executive Committee (12/20) Screen/Electric**  
Wednesday 7:30 am – 9:00 am Benton (M)

**Standards Committee (30/20) Screen/Electric**  
Wednesday 8:00 am – 10:00 am Majestic D/E (CP2)
Technology Council (37/20) Screen/Electric
Wednesday 9:00 am – 12:00 pm Majestic H (CP2)
Director and Regional Chairs (15/20)
Wednesday 12:00 pm – 2:00 pm Majestic A (CP2)
Board of Directors (32/50) Screen/Electric
Wednesday 2:00 pm – 6:00 pm Majestic D/E (CP2)

THURSDAY, JUNE 30
Executive Committee (9/10) Screen/Electric
Thursday 7:30 am – 11:00 am Shaw (M)

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:
GPS = Guideline Project Committee
MTG = Multidisciplinary Task Group.
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:
Society technical committee meeting rooms are located in the Marriott St. Louis Grand, America's Convention Center Complex, or Embassy Suites. All rooms with a number, i.e., 280, are located in America's Convention Center Complex. The rooms at Embassy Suites are: Boardroom, Laurel A, B and C, and Mercantile N and S. All other rooms with names, i.e. Portland or Landmark 2, are located in the Marriott. The Marriott’s meeting space is located in the main hotel and across the street in the Conference Building which is called Conference Plaza. Access to the Conference Plaza is via an underground tunnel that can be accessed from the Gateway level via either elevator or escalator. Escalators to Gateway level are located just past Zenia Bar & Grille on the lobby level. Codes for this level are (CL) which is Conference Plaza street level and (CP2) which is Conference Plaza 2nd level. (M) is Mezzanine which is in the main building. Rooms on the 20 and 21st floor are accessible via the elevator on the lobby level past Zenia Bar & Grille.

Otherwise, floor levels are indicated by numbers. Subcommittees are indented. Rooms will be set as indicated in the parenthesis beside the committee, i.e., (20/20) will accommodate 20 at the conference table and 20 chairs for the audience. Any audiovisual or electrical ordered will be listed. If a/v is not ordered in advance there is no guarantee it will be available on-site.

Color codes: If the meeting has not been listed in color it has not been confirmed.

TECHNICAL COMMITTEES (TC)
TC/TG Chair's Breakfast Section 1 (32/4)
Sunday (6/26) 6:30 am – 8:00 am Majestic H (CP2)
TC/TG Chair’s Breakfast Section 2 (26/4)
Sunday (6/26) 6:30 am – 8:00 am Landmark 2 (CL)
TC/TG Chair's Breakfast Section 3 (17/4)
Sunday (6/26) 6:30 am – 8:00 am Landmark 3 (CL)
TC/TG Chair's Breakfast Section 4 (19/4)
Sunday (6/26) 6:30 am – 8:00 am Landmark 1 (CL)
TC/TG Chair's Breakfast Section 5 (31/4)
Sunday (6/26) 6:30 am – 8:00 am Majestic G (CP2)
TC/TG Chair's Breakfast Section 6 (23/4)
Sunday (6/26) 6:30 am – 8:00 am Landmark 6 (CL)
TC/TG Chair’s Breakfast Section 7 (23/4)
Sunday (6/26) 6:30 am – 8:00 am Landmark 7 (CL)
TC/TG Chair’s Breakfast Section 8 (34/4)
Sunday (6/26) 6:30 am – 8:00 am Majestic C (CP2)
TC/TG Chair’s Breakfast Section 9 (24/4)
Sunday (6/26) 6:30 am – 8:00 am Majestic F (CP2)
TC/TG Chair’s Breakfast Section 10 (18/4)
Sunday (6/26) 6:30 am – 8:00 am Landmark 5 (CL)
TC/TG Chair’s Training Workshop (50/20)
Sunday (6/26) 9:45 am – 10:45 am 221 (2)
TC Program Subcommittee Training (30/0) Screen
Tuesday (6/28) 11:15 am – 12:00 pm 220 (2)

Research Subcommittee Chairs (137/0) Screen
Monday (6/27) 6:30 am – 9:00 am Majestic D/E (CP2)

TC 1.1 Thermodynamics & Psychrometrics (10/15)
Monday (6/27) 2:15 pm – 4:15 pm 200 (2)

TC 1.2 Instruments & Measurements (15/0)
Tuesday (6/28) 1:00 pm – 3:30 pm 265 (2)
Sponsoring: Seminar 38; ASHRAE Research: Airflow and Ducts
TC 1.2 Handbook (Fundamentals) Chap. 36 (10/4)
Monday (6/27) 4:15 pm – 6:30 pm 265 (2)

TC 1.3 Heat Transfer & Fluid Flow (25/25)
Tuesday (6/28) 1:00 pm – 3:30 pm 224 (2)
Sponsoring: Seminar 44; Optimization of Air-to-Refrigerant Heat Exchangers
TC 1.3/8.5 Research Review (30/20) Screen
Sunday (6/26) 3:00 pm – 7:00 pm 224 (2)
Tuesday (6/28) 1:00 pm – 3:30 pm 228 (2)

TC 1.4 Control Theory & Application (20/80) Screen
Sponsoring: Workshop 4; DDC for Smart Buildings and Smart Grid; Seminar 53; Smart Equipment: the Intelligent Buildings Revolution Is Happening in the Edge
TC 1.4 YEAA (20/10)
Sunday (6/26) 2:30 pm – 3:00 pm Landmark 7 (CL)
TC 1.4 Components and Applications (20/10)
Sunday (6/26) 3:00 pm – 4:00 pm Landmark 7 (CL)
TC 1.4 Programs (20/10)
Sunday (6/26) 4:00 pm – 5:30 pm Landmark 7 (CL)
TC 1.4 Education (20/10)
Sunday (6/26) 5:30 pm – 6:30 pm Landmark 7 (CL)
TC 1.4 1746-RP (10/0)
Monday (6/27) 10:00 am – 11:00 am Pershing (CL)
TC 1.4 Research (10/15)
Monday (6/27) 2:15 pm – 4:15 pm 131 (1)
**TC 1.5 Computer Applications (25/25) Screen/Electric**

**Monday (6/27) 6:30 pm – 9:00 pm 240 (2)**

Sponsoring: Workshop 2: ASHRAE’s Strategic Plan for Mobile and Web Apps; Seminar 39: Data Sources towards Urban-Scale Energy Modeling, Part 1; Seminar 56: Data Sources toward Urban-Scale Energy Modeling, Part 2; Seminar 60: BIM and HVAC System Design

TC 1.5 DBOSS (20/10)
- Sunday (6/26) 3:00 pm – 4:00 pm Majestic F (CP 2)
- Sunday (6/26) 4:00 pm – 5:00 pm Majestic F (CP2)
- Sunday (6/26) 5:00 pm – 6:00 pm Majestic F (CP2)
- Sunday (6/26) 6:00 pm – 7:00 pm Majestic F (CP2)
- Sunday (6/26) 7:00 pm – 8:00 pm Majestic F (CP2)
- Monday (6/27) 6:00 pm – 6:30 pm 130 (1)

TC 1.6 Terminology (10/8)
**Monday (6/27) 4:15 pm – 6:30 pm 200 (2)**

TC 1.6 Handbook, Terminology and STD-134 (6/4)
- Monday (6/27) 8:00 am – 12:00 pm 127 (1)

TC 1.7 Business, Management & General Legal Education (20/5)
**Monday (6/27) 10:15 am – 12:00 pm 230 (2)**


TC 1.8 Mechanical Systems Insulation (6/6)
**Monday (6/27) 4:15 pm – 6:30 pm 266 (2)**

TC 1.8 Research (10/6)
- Sunday (6/26) 8:00 am – 9:00 am 231 (2)
- Sunday (6/26) 9:00 am – 11:00 am 231 (2)
- Sunday (6/26) 11:00 am – 12:00 pm 231 (2)

TC 1.9 Electrical Systems (8/4)
**Tuesday (6/28) 3:30 pm – 6:00 pm Laclede (20)**

TC 1.10 Cogeneration Systems (20/8)
**Tuesday (6/28) 3:30 pm – 6:00 pm 264 (2)**

TC 1.10 Handbook, Program, Research, CTTC, Membership (20/8)
- Tuesday (6/28) 1:00 pm – 3:00 pm 264 (2)

TC 1.11 Electric Motors and Motor Control (13/7)
**Tuesday (6/28) 1:00 pm – 3:30 pm 121 (1)**

TC 1.12 Moisture Management in Buildings (20/20) Screen/Electric
**Saturday (6/25) 1:00 pm – 3:00 pm 240 (2)**

TC 1.12 Research/Program/Standards (15/10) Screen/Electric
**Saturday (6/25) 8:00 am – 12:00 pm 240 (2)**

TC 1.13 Optimization (20/5)
**Sunday (6/26) 1:00 pm – 3:00 pm 126 (1)**

TC 2.1 Physiology & Human Environment (25/30)
**Tuesday (6/28) 1:00 pm – 5:00 pm 225 (2)**

Sponsoring: TC Seminar on 6/28 at 3:30 pm: Is Poor Bedroom Ventilation Affecting Your Next-Day Performance?

TC 2.1 Research (18/10)
- Sunday (6/26) 1:00 pm – 3:00 pm Pershing (CL)

TC 2.1 Programs (10/5)
- Sunday (6/26) 5:00 pm – 6:00 pm Pershing (CL)
- Sunday (6/26) 6:00 pm – 7:00 pm Pershing (CL)

TC 2.2 Plant and Animal Environment (10/5) Screen/Electric
**Monday (6/27) 4:15 pm – 6:30 pm 222 (2)**

TC 2.3 Gaseous Air Contaminants /Removal Equip. (18/20) Screen
**Tuesday (6/28) 1:00 pm – 3:30 pm Landmark 2 (CL)**

TC 2.3 Research (20/10) Screen/Electric
- Sunday (6/26) 5:00 pm – 7:00 pm 231 (2)

TC 2.3 Standards (20/10) Screen/Electric
- Monday (6/27) 2:15 pm – 4:15 pm Landmark 1 (CL)

TC 2.3 Publications (20/5) Screen/Electric
- Monday (6/27) 3:15 pm – 4:15 pm Landmark 1 (CL)

TC 2.3 Handbook (5/5) Screen/Electric
- Monday (6/27) 4:15 pm – 6:30 pm Landmark 1 (CL)

TC 2.3 Planning (15/5) Screen/Electric
- Tuesday (6/28) 6:30 am – 8:00 am Landmark 2 (CL)

TC 2.3 Programs (20/10) Screen/Electric
- Tuesday (6/28) 12:00 pm – 12:45 pm Landmark 2 (CL)

TC 2.4 Particulate Air Contaminants /Removal Equipment (18/20) Screen
**Tuesday (6/28) 3:30 pm – 6:00 pm Landmark 2 (CL)**

Sponsoring: Workshop 1: Are Rumors of MERV’s Death Exaggerated?

TC 2.4 1649-RP PES (5/20) Screen
- Saturday (6/25) 1:30 pm – 2:30 pm 123 (1)

TC 2.4 Research (20/20) Screen
- Sunday (6/26) 3:00 pm – 5:00 pm 231 (2)

TC 2.4 Standards (20/10) Screen/Electric
- Monday (6/27) 2:15 pm – 4:15 pm Landmark 1 (CL)

TC 2.4 Publications (10/20)
- Monday (6/27) 3:15 pm – 4:15 pm Landmark 1 (CL)

TC 2.4 Planning (20/10) Screen/flipchart
- Tuesday (6/28) 8:00 am – 10:00 am 120 (1)

TC 2.4 Program (20/10)
- Tuesday (6/28) 10:00 am – 11:00 am 120 (1)

TC 2.5 Global Climate Change (20/10)
**Tuesday (6/28) 1:30 pm – 3:30 pm 132 (1)**

TC 2.6 Sound and Vibration (20/30) Screen/Electric
**Monday (6/27) 2:15 pm – 4:15 pm Landmark 2 (CL)**

TC 2.6 Vibration Isolation (20/30) Screen/Electric
- Sunday (6/26) 9:00 am – 10:00 am Landmark 2 (CL)

TC 2.6 RP 1408 (20/30) Screen/Electric
- Sunday (6/26) 10:00 am – 11:00 am Landmark 2 (CL)

TC 2.6 Programs (20/30) Screen/Electric
- Sunday (6/26) 11:00 am – 12:00 pm Landmark 2 (CL)

TC 2.6 Hot Topic 1 (20/30) Screen/Electric
- Sunday (6/26) 2:00 pm – 3:00 pm Landmark 2 (CL)

TC 2.6 Executive Committee (20/30) Screen/Electric
- Sunday (6/26) 3:00 pm – 4:00 pm Landmark 2 (CL)

TC 2.6 Publications (20/30) Screen/Electric
- Monday (6/27) 9:00 am – 10:00 am Landmark 2 (CL)

TC 2.6 Research (20/30) Screen/Electric
- Monday (6/27) 10:00 am – 11:00 am Landmark 2 (CL)

TC 2.6 Standards/Criteria (20/30) Screen/Electric
- Monday (6/27) 11:00 am – 12:00 pm Landmark 2 (CL)

TC 2.7 Seismic and Wind Restraint Design (17/24) Screen/Electric
**Tuesday (6/28) 3:30 pm – 6:00 pm 230 (2)**

TC Seminar on 6/28 at 10:30 am: Safeguarding Critical Facility Operation: Hardening Essential Equipment to Survive Seismic Wind and Flood
TC 2.7 Codes and Specifications (20/20) Electric
Tuesday (6/28) 8:00 am – 10:00 am 230 (2)
TC 2.7 Certification (20/75) Screen/Electric
Tuesday (6/28) 10:00 am – 12:00 pm 230 (2)
TC 2.7 Research, Publications, Programs and Long Range Plans (20/20) Electric
Tuesday (6/28) 1:30 pm – 3:30 pm 230 (2)

TC 2.8 Building Environmental Impacts and Sustainability (20/50)
Sunday (6/26) 5:00 pm – 7:00 pm 130 (1)
Sponsoring: Workshop 8: How to Predict the Long-Term Success of Your Green Design: The Five Characteristics that Determine Technology Adoption
TC 2.8 International (12/6)
Sunday (6/26) 11:30 am – 12:00 pm 130 (1)
TC 2.8 Green Guide (15/8)
Sunday (6/26) 12:00 pm – 1:15 pm 130 (1)
TC 2.8 Water-Energy Nexus (8/8)
Sunday (6/26) 1:15 pm – 1:45 pm 130 (1)
TC 2.8 Research (10/6)
Sunday (6/26) 1:45 pm – 2:45 pm 130 (1)
TC 2.8 Handbook (10/4)
Sunday (6/26) 2:45 pm – 3:45 pm 130 (1)
TC 2.8 Programs (10/8)
Sunday (6/26) 3:45 pm – 4:15 pm 130 (1)
TC 2.8 Existing Buildings (8/8)
Sunday (6/26) 4:15 pm – 4:45 pm 130 (1)

TC 2.9 Ultraviolet Air and Surface Treatment (10/20)
Monday (6/27) 10:00 am – 12:00 pm 120 (1)
Sponsoring: Seminar 12: The ABCs of UVC; Forum 1: A Discussion of 185.1 & 185.2, The New Standards
TC 2.9 Programs (8/5)
Sunday (6/26) 8:00 am – 10:00 am 120 (1)
TC 2.9 Handbook (5/5)
Sunday (6/26) 10:00 am – 12:00 pm 120 (1)
TC 2.9 Standards (6/6)
Sunday (6/26) 1:00 pm – 3:00 pm 120 (1)
TC 2.9 Research (10/8)
Monday (6/27) 8:00 am – 10:00 am 120 (1)

TC 3.1 Refrigerants & Secondary Coolants (10/30) Screen/Electric
Monday (6/27) 4:15 pm – 6:30 pm Landmark 5 (CL)
Sponsoring: Seminar 55: System Efficiency Impacts of Low-GWP Refrigerants: Is This Our Fall from Grace?
TC 3.1 Research and Program (12/20) Screen/Electric
Monday (6/27) 11:00 am – 12:30 pm Landmark 5 (CL)

TC 3.2 Refrigerant System Chemistry (12/40) Screen/Electric
Monday (6/27) 2:15 pm – 4:15 pm 227 (2)
Sponsoring: Technical Paper Session 2: Challenges and Opportunities with Refrigerants
TC 3.2 Research (12/20)
Sunday (6/26) 4:00 pm – 5:00 pm 122 (1)

TC 3.3 Refrigerant Contaminant Control (14/25)
Tuesday (6/28) 3:30 pm – 6:00 pm 122 (1)
TC 3.3 Research (12/20)
Sunday (6/26) 5:00 pm – 5:30 pm 122 (1)

TC 3.4 Lubrication (20/40)
Tuesday (6/28) 1:30 pm – 3:30 pm 122 (1)
Sponsoring: Seminar 43: Lubrication Effects Beyond the Compressor
TC 3.4 Research (12/20)
Sunday (6/26) 5:30 pm – 6:00 pm 122 (1)

TC 3.6 Water Treatment (18/10)
Tuesday (6/28) 1:00 pm – 3:30 pm 125 (1)
Sponsoring: Seminar 7: Building Water Systems: Issues and Insights from Outbreaks of Legionnaires’ Disease; Seminar 18: Water Treatment Programs: Designing for Asset Management and Long-Term Efficiency
TC 3.6 Handbook/Program/Research (12/10)
Sunday (6/26) 3:00 pm – 5:00 pm 125 (1)

TC 3.8 Refrigerant Containment (9/5)
Monday (6/27) 4:15 pm – 6:30 pm Shaw (M)

TC 4.1 Load Calculation Data and Procedures (20/10)
Monday (6/27) 2:15 pm – 4:15 pm 220 (2)
Sponsoring: Seminar 23: Parting the Clouds to See the Future of Residential Load Calculations
TC 4.1 RP 1729 Project Evaluation (15/10)
Sunday (6/26) 10:00 am – 11:00 am 264 (2)
TC 4.1 RP 1742 PMS (10/10)
Sunday (6/26) 11:00 am – 12:00 pm 264 (2)
TC 4.1 RP 1681 PMS (15/10)
Sunday (6/26) 2:00 pm – 3:00 pm 264 (2)
TC 4.1 Handbook (15/10)
Sunday (6/26) 3:00 pm – 4:00 pm 264 (2)
TC 4.1 Research (15/10)
Sunday (6/26) 4:00 pm – 5:00 pm 264 (2)
TC 4.1 Programs (15/10)
Sunday (6/26) 5:00 pm – 6:00 pm 264 (2)
TC 4.1 Standards (15/10)
Sunday (6/26) 6:00 pm – 7:00 pm 264 (2)

TC 4.2 Climatic Information (20/10) Screen/Electric
Tuesday (6/28) 1:00 pm – 3:30 pm 231 (2)
Sponsoring: Seminar 63: Moving Beyond Typical Year Weather Data
TC 4.2 Research (15/10)
Monday (6/27) 4:15 pm – 6:30 pm 120 (1)

TC 4.3 Ventilation Requirements & Infiltration (10/20)
Monday (6/27) 4:15 pm – 6:30 pm 274 (2)

TC 4.4 Building Materials and Building Envelope Performance (40/10) Screen
Monday (6/27) 2:15 pm – 4:15 pm 229 (2)
TC 4.4 PMS 1696-RP (20/10) Screen/Electric
Sunday (6/26) 11:30 am – 1:00 pm 229 (2)
TC 4.4 Research (40/10)
Sunday (6/26) 1:00 pm – 3:00 pm 229 (2)
TC 4.4 Handbook (40/10)
Sunday (6/26) 3:30 pm – 4:30 pm 229 (2)
TC 4.4 Program (20/10)
Sunday (6/26) 4:30 pm – 5:00 pm 229 (2)
TC 4.4 Standards (20/10)
Sunday (6/26) 5:00 pm – 5:30 pm 229 (2)

TC 4.5 Fenestration (15/15)
Tuesday (6/28) 2:00 pm – 4:00 pm 220 (2)
TC 4.5 Research (10/10)
Monday (6/27) 2:15 pm – 3:15 pm 220 (2)
TC 4.5 Program (10/10)
Monday (6/27) 3:15 pm – 4:15 pm 220 (2)
TC 4.5 Handbook (10/10)
Monday (6/27) 4:15 pm – 5:30 pm 220 (2)
TC 4.5 Calculation Methods (15/10)
Tuesday (6/28) 1:00 pm – 2:00 pm 220 (2)

TC 4.7 Energy Calculations (25/50) Screen
Tuesday (6/28) 6:00 pm – 8:30 pm 132 (1)
Sponsoring: Seminar 22: Large-Scale Computing; Seminar 34: Low-Cost High-Performance Building Simulation. Is That Too Good to Be True?
**TC 4.7 Simulation and Component Models (20/20) Screen**
Monday (6/27) 6:00 pm – 7:30 pm Majestic G (CP2)
**TC 4.7 Data-Driven Models (20/20)**
Monday (6/27) 7:30 pm – 9:00 pm Majestic G (CP2)
**TC 4.7 1588-RP PMS (8/2)**
Sunday (6/26) 6:45 pm – 8:15 pm Flora (21)
**TC 4.7 Applications (20/10)**
Tuesday (6/28) 3:30 pm – 5:00 pm 132 (1)
**TC 4.7 Handbook (20/10)**
Tuesday (6/28) 5:00 pm – 6:00 pm 132 (1)

**TC 4.10 Indoor Environmental Modeling (20/20) Screen**
Monday (6/27) 2:15 pm – 4:15 pm 132 (1)
Sponsoring: Seminar 16: Energy Saving and Thermal Comfort
**TC 4.10 RP-1675 PMS (5/10)**
Saturday (6/25) 2:00 pm – 3:00 pm 232 (2)
**TC 4.10 Program (12/15) Screen**
Sunday (6/26) 3:00 pm – 4:00 pm 132 (1)
**TC 4.10 Handbook (12/15)**
Sunday (6/26) 4:00 pm – 5:00 pm 132 (1)
**TC 4.10 Research (12/15)**
Sunday (6/26) 5:00 pm – 6:00 pm 132 (1)
**TC 5.1 Fans (20/20) Screen**
Monday (6/27) 4:15 pm – 6:30 pm 264 (2)
**TC 5.1 Handbook (10/10) Screen**
Sunday (6/26) 2:00 pm – 3:00 pm 267 (2)
**TC 5.1 Research (10/10) Screen**
Sunday (6/26) 3:00 pm – 4:00 pm 267 (2)
**TC 5.1 Program (10/10) Screen**
Sunday (6/26) 4:00 pm – 4:30 pm 267 (2)
**TC 5.1 Hot Topics (15/15) Screen**
Sunday (6/26) 4:30 pm – 5:30 pm 267 (2)

**TC 5.2 Duct Design (12/20)**
Tuesday (6/28) 3:30 pm – 6:00 pm 229 (2)
**TC 5.2 Duct Design Guide (20/20)**
Monday (6/27) 8:00 am – 12:00 pm 229 (2)

**TC 5.3 Room Air Distribution (30/30) Screen/Electric**
Tuesday (6/28) 1:00 pm – 3:30 pm 124 (1)
**TC 5.3 Handbook (20/20) Screen/Electric**
Friday (6/24) 12:00 pm – 5:00 pm Lucas (21)
**TC 5.3 Handbook (20/20) Screen/Electric**
Saturday (6/25) 8:00 am – 3:00 pm 124 (1)
**TC 5.3 Fan Coils (30/20) Screen/Electric**
Sunday (6/26) 8:00 am – 8:30 am 124 (1)
**TC 5.3 Chilled Beams (30/20) Screen/Electric**
Sunday (6/26) 8:30 am – 9:30 am 124 (1)
**TC 5.3 Air Curtains (30/20) Screen/Electric**
Sunday (6/26) 9:30 am – 10:15 am 124 (1)
**TC 5.3 Underfloor Air Distribution (11/6) Screen/Electric**
Sunday (6/26) 10:15 am – 11:45 am 124 (1)
**TC 5.3 Research/Handbook/Program (30/20) Screen/Electric**
Sunday (6/26) 12:00 pm – 2:00 pm 124 (1)

**TC 5.4 Industrial Process Air Cleaning (11/6)**
Monday (6/27) 2:15 pm – 4:15 pm 265 (2)
**TC 5.5 Air-to-Air Energy Recovery (30/10)**
Tuesday (6/28) 3:30 pm – 6:00 pm 123 (1)
Sponsoring: Seminar 6: Latest Technologies in Air-to-Air Energy Recovery
**TC 5.5 Handbook, Program, Research (30/10)**
Sunday (6/26) 5:00 pm – 7:00 pm Majestic G (CP2)

**TC 5.6 Control of Fire & Smoke (23/30)**
Monday (6/27) 4:15 pm – 6:30 pm 227 (2)
Sponsoring: Technical Paper Session 1: Airflow Measurements and Predictions
**TC 5.6 Program (13/20)**
Sunday (6/26) 3:00 pm – 4:00 pm 227 (2)
**TC 5.6 Research (13/20)**
Sunday (6/26) 4:00 pm – 5:30 pm 227 (2)
**TC 5.6 Handbook (13/20)**
Sunday (6/26) 5:30 pm – 7:00 pm 227 (2)

**TC 5.7 Evaporative Cooling (20/10)**
Monday (6/27) 4:15 pm – 6:30 pm Parkview (M)

**TC 5.8 Industrial Ventilation Systems (20/5) Screen/Electric**
Monday (6/27) 4:15 pm – 6:30 pm 229 (2)
**TC 5.8 Ventilation of Hazardous Spaces (5/5)**
Tuesday (6/28) 3:30 pm – 6:00 pm 228 (2)

**TC 5.9 Enclosed Vehicular Facilities (40/20) Screen**
Tuesday (6/28) 3:30 pm – 6:00 pm 223 (2)
**TC 5.9 Program, Standards, Handbook, Research (40/20) Screen/Electric**
Tuesday (6/28) 1:00 pm – 3:30 pm 223 (2)

**TC 5.10 Kitchen Ventilation (20/15) Screen**
Monday (6/27) 6:00 pm – 7:00 pm 122 (1)
Sponsoring: Seminar 8: Comfort Challenges in Commercial Kitchens
**TC 5.10 Handbook (20/15) Screen**
Monday (6/27) 2:00 pm – 3:30 pm 122 (1)
**TC 5.10 Program (20/15) Screen**
Monday (6/27) 3:30 pm – 4:30 pm 122 (1)
**TC 5.10 Research (20/15) Screen/Electric**
Monday (6/27) 4:30 pm – 6:00 pm 122 (1)

**TC 5.11 Humidifying Equipment (10/5) Electric**
Monday (6/27) 2:15 pm – 4:15 pm Lafayette (M)
**TC 5.11 Research (10/5) Screen/Electric**
Sunday (6/26) 3:00 pm – 5:00 pm Lafayette (M)

**TC 6.1 Hydronic & Steam Htg. Equip & Sys (20/25) Screen**
Tuesday (6/28) 1:00 pm – 3:30 pm 222 (2)
**TC 6.1 Handbook (12/10) Screen**
Sunday (6/26) 5:00 pm – 6:00 pm 222 (2)
**TC 6.1 Chilled Water Plant (12/10) Screen**
Sunday (6/26) 6:00 pm – 7:00 pm 222 (2)
**TC 6.1 Program (12/8) Screen**
Monday (6/27) 2:15 pm – 3:15 pm 222 (2)
**TC 6.1 Research (12/8) Screen**
Monday (6/27) 3:15 pm – 4:15 pm 222 (2)

**TC 6.2 District Energy (20/10)**
Sunday (6/26) 3:00 pm – 5:00 pm 123 (1)
Sponsoring: Forum 3: To Centralize or Decentralize a Thermal Energy System: The Great Debate Continues
**TC 6.2 Programs, Research, Handbook (20/10) Screen/Electric**
Sunday (6/26) 1:00 pm – 3:00 pm 123 (1)

**TC 6.3 Central Forced Air Htg. & Cooling Sys (20/12)**
Tuesday (6/28) 1:00 pm – 3:30 pm 131 (1)

**TC 6.5 Radiant Heating and Cooling (17/10)**
Monday (6/27) 2:15 pm – 4:15 pm 124 (1)
**TC 6.5 Research, Special Pubs, Journal, Program, Handbook (15/20)**
Sunday (6/26) 3:00 pm – 5:00 pm 221 (2)
**TC 6.5 Handbook Working Session (5/5)**
Sunday (6/26) 5:00 pm – 6:00 pm 221 (2)
TC 6.6 Service Water Heating Systems (18/15)
Monday (6/27) 4:15 pm – 6:30 pm Portland (M)
Sponsoring: Seminar 17: Plumbing System Design Criteria to Minimize the Potential for Legionella Growth
TC 6.6 Programming, Research and Handbook (5/5)
Monday (6/27) 2:15 pm – 4:15 pm Portland (M)

TC 6.7 Solar Energy Utilization (20/55) Screen
Tuesday (6/28) 1:00 pm – 3:30 pm 227 (2)
Sponsoring: Seminar 64: N-ZERO from Foundation to Financing: Residential Buildings
TC 6.7 Research, Standards, Programs and Handbook (25/10)
Monday (6/27) 4:15 pm – 8:30 pm 132 (1)

TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25) Screen/Electric
Tuesday (6/28) 3:30 pm – 6:00 pm 232 (2)
Sponsoring: Seminar 61: How Deep Can We Go? Designing and Drilling Deeper Geothermal Systems
TC 6.8 Handbook, Research, Programs, Standards (20/15)
Sunday (6/26) 5:00 pm – 7:00 pm 124 (1)

TC 6.9 Thermal Storage (14/25) Screen/Electric
Monday (6/27) 4:30 pm – 6:00 pm 130 (1)
TC 6.9 Standards (14/25) Screen/Electric
Monday (6/27) 2:15 pm – 2:40 pm 130 (1)
TC 6.9 Programs (14/25) Screen/Electric
Monday (6/27) 2:40 pm – 3:10 pm 130 (1)
TC 6.9 Handbook (14/25) Screen/Electric
Monday (6/27) 3:10 pm – 3:30 pm 130 (1)
TC 6.9 Long Range Planning and Website (14/25) Screen/Electric
Monday (6/27) 3:30 pm – 3:50 pm 130 (1)
TC 6.9 Research (14/25) Screen/Electric
Monday (6/27) 3:50 pm – 4:10 pm 130 (1)

TC 6.10 Fuels & Combustion (20/10) Screen/Electric
Tuesday (6/28) 3:30 pm – 6:00 pm 266 (2)
TC 6.10 Handbook (8/0) Screen/Electric
Monday (6/27) 2:15 pm – 4:15 pm 280 (2)

TC 7.1 Integrated Building Design (25/10)
Monday (6/27) 8:15 am – 10:30 am Landmark 1 (CL)
TC 7.1 Research, Program, Handbook (15/2) Screen/Electric
Sunday (6/26) 5:00 pm – 7:00 pm 241 (2)

TC 7.2 HVAC Construction and Design Build Technologies (10/5)
Sunday (6/26) 10:00 am – 12:00 pm Laclede (20)
Sponsoring: Workshop 9: The Busted BIM Building Blues

TC 7.3 Operations & Maintenance Management (25/7)
Electric
Tuesday (6/28) 1:00 pm – 3:30 pm 240 (2)
Sponsoring: Seminar 1: A Better Writer is a Better Engineer: TC 7.3 O&M Management Perspective on Good Communication;
Seminar 27: Energy Savings via ASHRAE Level III Auditing, Retrofit and Recommissioning: A Case Study at Hameetman Science Center, Occidental College I; Seminar 57: Energy Savings via ASHRAE Level III Auditing, Retrofit and Recommissioning: A Case Study at Hameetman Science Center, Occidental College II
TC 7.3 Standards/Program (10/2) Screen/Electric
Monday (6/27) 2:15 pm – 4:15 pm 231 (2)
TC 7.3 Research, Handbook, and Education & Training (10/2) Screen/Electric
Monday (6/27) 4:15 pm – 6:30 pm 231 (2)

TC 7.4 Exergy Analysis for Sustainable Buildings (14/8)
Sunday (6/26) 8:00 am – 10:00 am 126 (1)

TC 7.5 Smart Building Systems (11/50) Screen
Tuesday (6/28) 3:30 pm – 6:00 pm 221 (2)
TC 7.5 Fault Detection and Diagnostics (11/50)
Sunday (6/26) 2:30 pm – 3:15 pm 276 (2)
TC 7.5 Enabling Technologies (11/50)
Sunday (6/26) 3:15 pm – 4:00 pm 276 (2)
TC 7.5 Smart Grid (11/50)
Sunday (6/26) 4:00 pm – 4:45 pm 276 (2)
TC 7.5 Handbook (11/50)
Sunday (6/26) 4:45 pm – 5:30 pm 276 (2)
TC 7.5 Program (11/50)
Sunday (6/26) 5:30 pm – 6:00 pm 276 (2)
TC 7.5 Building Operations Dynamics (11/50) Screen
Monday (6/27) 4:30 pm – 5:15 pm 223 (2)
TC 7.5 Research (11/50) Screen
Monday (6/27) 5:15 pm – 7:15 pm 223 (2)

TC 7.6 Building Energy Performance (15/30)
Tuesday (6/28) 1:00 pm - 3:30 pm Landmark 3 (CL)
TC 7.6 Federal Buildings (25/25)
Saturday (6/25) 9:00 am - 3:00 pm 127 (1)
TC 7.6 Federal Buildings (25/25)
Sunday (6/26) 9:00 am - 12:00 pm Landmark 3 (CL)
TC 7.6 Project Monitoring Committee for 1702-RP (8/0)
Sunday (6/26) 11:30 am - 1:00 pm 127 (1)
TC 7.6 Research (10/15)
Sunday (6/26) 1:00 pm - 2:00 pm Landmark 3 (CL)
TC 7.6 Commercial Building Energy Audit (10/15)
Sunday (6/26) 2:00 pm - 3:00 pm Landmark 3 (CL)
TC 7.6 Handbook (10/15)
Sunday (6/26) 3:00 pm - 4:00 pm Landmark 3 (CL)
TC 7.6 Monitoring and Energy Performance (10/30)
Monday (6/27) 2:15 pm - 4:15 pm 127 (1)
TC 7.6 Energy Management (10/15)
Monday (6/27) 4:15 pm - 5:15 pm 127 (1)
TC 7.6 Standards (10/15)
Monday (6/27) 5:15 pm - 6:15 pm 127 (1)
TC 7.6 Executive and Programs (10/15)
Monday (6/27) 6:15 pm - 7:00 pm 127 (1)

TC 7.7 Testing & Balancing (20/30)
Monday (6/27) 2:15 pm - 4:15 pm 221 (2)
TC 7.7 Handbook/Programs (15/10)
Saturday (6/25) 1:00 pm - 3:00 pm 120 (1)

TC 7.8 Owning & Operating Costs (20/5)
Monday (6/27) 2:15 pm - 4:15 pm 120 (1)
TC 7.8 Handbook, Program, Research (6/4)
Sunday (6/26) 3:00 pm – 5:00 pm Benton (M)

TC 7.9 Building Commissioning (40/20) Screen/Electric
Sunday (6/26) 3:00 pm – 5:00 pm 232 (2)
TC 7.9 Handbook, Research, Program (24/6) Electric
Saturday (6/25) 8:00 am – 12:00 pm 241 (2)
TC 8.1 Positive Displacement Compressors (12/14)
Tuesday (6/28) 3:30 pm – 6:00 pm 265 (2)

TC 8.2 Centrifugal Machines (20/8)
Monday (6/27) 2:15 pm – 4:15 pm Lucas (21)
Sponsoring: Seminar 10: Performance Monitoring and Systems Testing Per ASHRAE Standards 184, 30, and the 41 Series; Seminar 31: Centrifugal Chiller Design: Back to Basics
TC 8.2 Programs, Research and Handbook (12/4) Screen/Electric
Sunday (6/26) 5:00 pm – 7:00 pm Lucas (21)

TC 8.3 Absorption and Heat Operated Machines (20/10)
Monday (6/27) 3:30 pm – 6:00 pm 123 (1)
Sponsoring: Seminar 5: Innovative Absorption System Applications for Both Heating and Cooling
TC 8.3 Research/Handbook (7/20)
Monday (6/27) 2:15 pm – 3:30 pm 123 (1)

TC 8.4 Refrigerant to Air Heat Transfer Equipment (20/10) Screen/Electric
Tuesday (6/28) 3:30 pm – 6:00 pm 241 (2)
TC 8.4 Research/Standards/Handbook (30/20) Screen/Electric
Monday (6/27) 6:30 pm – 9:30 pm Landmark 4 (CL)

TC 8.5 Liquid to Refrigerant Heat Exchangers (47/18) Screen
Monday (6/27) 4:15 pm – 6:30 pm 224 (2)
TC 8.5/1.3 Research Subcommittee (30/20)
Sunday (6/26) 3:00 pm – 9:00 pm 224 (2)

TC 8.6 Cooling Towers and Evaporative Condensers (20/5)
Monday (6/27) 2:15 pm – 4:15 pm Parkview (M)
TC 8.6 Handbook/Program/Research (10/4)
Monday (6/27) 9:00 am – 10:00 am Parkview (M)

TC 8.7 Variable Refrigerant Flow (20/30)
Monday (6/27) 4:15 pm – 6:30 pm 225 (2)

TC 8.8 Refrigerant System Controls & Accessories (10/10) Screen/Electric
Tuesday (6/28) 1:00 pm – 3:30 pm 241 (2)
TC 8.8 Research/Program, Handbook (5/5)
Sunday (6/26) 6:30 pm – 7:30 am 280 (2)

TC 8.9 Residential Refrigerators and Food Freezers (6/10)
Monday (6/27) 2:15 pm – 4:15 pm 225 (2)

TC 8.10 Mechanical Dehumidifiers & Heat Pipes (16/10)
Tuesday (6/28) 3:30 pm – 6:00 pm 267 (2)
TC 8.10 Program/Handbook/Research/Standards (16/10)
Tuesday (6/28) 1:00 pm – 3:30 pm 267 (2)

TC 8.11 Unitary and Room Air Conditioners and Heat Pumps (20/30)
Monday (6/27) 4:15 pm – 6:30 pm 221 (2)
TC 8.11 Handbook, Program, Research (14/15)
Sunday (6/26) 3:00 pm – 5:00 pm 223 (2)

TC 8.12 Desiccant Dehumidification Equipment and Components (15/15)
Monday (6/27) 2:15 pm – 4:15 pm 274 (2)

TC 9.1 Large Building Air-Conditioning Systems (23/20)
Tuesday (6/28) 1:00 pm – 3:30 pm 229 (2)
Sponsoring: Seminar 49: Bringing a New Look and Energy to a Federal Building in Houston
TC 9.1 Programs/Research/Handbook (13/5) Screen/Electric
Tuesday (6/28) 12:00 pm – 1:00 pm 229 (2)

TC 9.2 Industrial Air Conditioning (25/10) Screen/Electric
Tuesday (6/28) 1:00 pm – 3:30 pm 232 (2)

TC 9.2 Industrial Air Conditioning Programs/Research/Handbook (8/2)
Sunday (6/26) 4:00 pm – 6:00 pm 242 (2)
TC 9.2 Nuclear Subcommittee (8/4)
Monday (6/27) 2:15 pm – 4:15 pm 242 (2)

TC 9.3 Transportation Air Conditioning (14/20) Screen/Electric
Monday (6/27) 2:15 pm – 3:00 pm Aubert (M)
TC 9.3 Automobile Subcommittee (6/0)
Sunday (6/26) 5:00 pm – 7:00 pm 131 (1)
TC 9.3 Research Subcommittee (14/20)
Monday (6/27) 3:00 pm – 4:00 pm Aubert (M)
TC 9.3 Handbook Subcommittee (14/20)
Monday (6/27) 4:00 pm – 4:45 pm Aubert (M)
TC 9.3 Aviation Subcommittee (6/0)
Monday (6/27) 4:45 pm – 6:00 pm Flora (21)
TC 9.3 Ship Subcommittee (6/0)
Monday (6/27) 4:45 pm – 6:00 pm Lucas (21)
TC 9.3 Rail Subcommittee (14/20)
Monday (6/27) 4:45 pm – 6:00 pm Aubert (M)
TC 9.3 Transportation Air Conditioning
Monday (6/27) 6:00 pm – 6:30 pm Aubert (M)

TC 9.4 Justice Facilities (20/5)
Sunday (6/26) 8:00 am – 10:00 am 130 (1)

TC 9.6 Health Care Facilities (18/60) Screen
Sunday (6/26) 5:00 pm – 7:00 pm 131 (1)
TC 9.6 Healthcare Water (18/60) Screen
Sunday (6/26) 9:00 am – 10:00 am 131 (1)
TC 9.6 Infectious Diseases (18/60) Screen
Sunday (6/26) 10:00 am – 12:00 pm 131 (1)
TC 9.6 Research (18/60) Screen
Sunday (6/26) 1:00 pm – 2:00 pm 131 (1)
TC 9.6 Handbook (18/60) Screen
Sunday (6/26) 2:00 pm – 3:30 pm 131 (1)
TC 9.6 Healthcare Energy (18/60) Screen
Sunday (6/26) 3:00 pm – 4:00 pm 131 (1)
TC 9.6 Program (18/60) Screen
Sunday (6/26) 4:00 pm – 5:00 pm 131 (1)

TC 9.7 Educational Facilities (13/10)
Sunday (6/26) 1:00 pm – 3:00 pm 280 (2)
Sponsoring: Seminar 7: U.S. EPA Guidance for Protecting Indoor Air Quality during School Building Upgrades

TC 9.8 Large Building Air-Conditioning Applications (20/10)
Monday (6/27) 2:15 pm – 4:15 pm 266 (2)
Sponsoring: Seminar 42: Heat and Cooling with Woody Biomass for Sustainable and Resilient Buildings and Communities
TC 9.8 Handbook/Research/Program (12/6) Electric
Monday (6/27) 9:00 am – 12:00 pm 266 (2)

TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment (25/75) Screen/Electric
Monday (6/27) 2:15 pm – 6:30 pm 275 (2)
Sponsoring: Seminar 58: Improved Modeling Characteristics of a Data Center without Compromising Physics or Breaking The Bank
TC 9.9 Programs, Handbook and Research (15/60)
Sunday (6/26) 5:00 pm – 7:00 pm 225 (2)

TC 9.10 Laboratory Systems (20/10) Screen/Electric
Tuesday (6/28) 3:30 pm – 6:00 pm 127 (1)
TC 9.10 Standards (20/20) Screen/Electric
Sunday (6/26) 3:00 pm – 3:45 pm 127 (1)
TC 9.10 Research (20/20)
Sunday (6/26) 3:45 pm – 4:30 pm 127 (1)
TC 9.10 Program (20/20)
Sunday (6/26) 4:30 pm – 5:15 pm 127 (1)
TC 9.10 Lab Classifications (20/20)
Sunday (6/26) 5:15 pm – 7:00 pm 127 (1)
TC 9.10 Labs Energy Efficiency (20/20) Screen/Electric
Tuesday (6/28) 1:30 pm – 2:30 pm 127 (1)
TC 9.10 Handbook (20/20) Screen
Tuesday (6/28) 2:30 pm – 3:30 pm 121 (1)

TC 9.11 Clean Spaces (30/45) Screen
Monday (6/27) 2:15 pm – 4:00 pm 228 (2)
Sponsoring: Seminar 35: Air Change Rates: Philosophy and Practice

TC 10.1 Custom Engineered Refrig Systems (30/10)
Monday (6/27) 2:15 pm – 4:15 pm 224 (2)
Sponsoring: Seminar 14: Ammonia and CO2: Advances in Application

TC 10.2 Automatic Ice Making Plants/Skating Rinks (12/3)
Screen/Electric
Monday (6/27) 4:30 pm – 6:30 pm 242 (2)
TC 10.2 Research, Handbook, Programs (6/2)
Monday (6/27) 8:00 am – 10:00 am 231 (2)

TC 10.3 Refrigerant Piping, Controls and Accessories (20/10)
Screen/Electric
TC 10.3 RP-1569 PMS (8/2) Screen/Electric
Tuesday (6/28) 1:00 pm – 3:30 pm 242 (2)
TC 10.3 Research, Handbook, Programs (6/2)
Tuesday (6/28) 8:00 am – 10:00 am 240 (2)

TC 10.5 Refrigeration Distrib and Storage Facilities (15/10)
Tuesday (6/28) 3:30 pm – 6:00 pm 125 (1)

TC 10.6 Transport Refrigeration (8/10)
Monday (6/27) 4:45 pm – 7:00 pm 242 (2)
Sponsoring: Seminar 45: Planes, Trailers and Ships: Advances in Transport Refrigeration System Technologies

TC 10.6 Handbook (10/0)
Monday (6/27) 2:15 pm – 4:15 pm Laclede (20)

TC 10.7 Commercial Food and Beverage Cooling Display and Storage (24/30)
Monday (6/27) 2:15 pm – 4:15 pm 223 (2)
Sponsoring: Seminar 33: Innovation in a Commercial Refrigeration System with Natural Refrigerants and Low GWP Synthetic Refrigerants

TC 10.8 Refrigeration Load Calculations (10/10)
Sunday (6/26) 3:00 pm – 5:00 pm Shaw (M)

Task Groups (TG), Technical Resource Groups (TRG), and Multidisciplinary Task Groups (MTG)

TG1. Optimization (10/5)
Sunday (6/26) 1:00 pm – 3:00 pm Lafayette (M)

TG2 HVAC Security (20/6)
Tuesday (6/28) 9:00 am – 12:00 pm 229 (2)

TRG4 IAQP – Indoor Air Quality Procedure (12/20) Screen/Electric
Sunday (6/26) 10:30 am – 12:00 pm 126 (1)

MTG Chairs’ Section Breakfast (11/4)
Sunday (6/26) 6:30 am – 8:00 am Lucas (21)

MTG Hot Climate Design Guide (20/0)
Sunday (6/26) 8:00 am – 9:00 am 125 (1)

MTG Occupant Behavior in Buildings (20/30) Screen
Monday (6/27) 8:00 am – 10:00 am Majestic C (CP2)

MTG Building Information Modeling (20/0)
Monday (6/27) 10:15 am – 12:00 pm

MTG Energy Targets (10/10) Screen/Electric
Tuesday (6/28) 12:00 pm – 3:00 pm Lindell (CL)
Sponsoring: Seminar 2: Results of RP-1651 Development of Maximum Technically Achievable Energy Targets for Ultra-Low Energy Use Commercial Buildings

MTG Cold Climate Design Guide (20/0)
Wednesday (6/29) 9:00 am – 11:00 am Hawthorne (21)

MTG Low GWP Refrigerants (17/25)
Wednesday (6/29) 10:00 am – 12:00 pm Landmark 5 (CL)

Standard Project Committees (SPC) and Standing Standard Project Committee (SSPC)

PC Chairs Training Breakfast (100/0) Screen
Sunday (6/26) 7:00 am – 9:00 am Majestic A (CP2)

SSPC 15 Safety Standard for Refrigeration Systems 2L Working Group (14/30) Screen
Saturday (6/25) 1:00 pm – 4:00 pm Landmark 1 (CL)

SSPC 15 Safety Standard for Refrigeration Systems Rewrite (14/30) Screen
Sunday (6/26) 10:00 am – 12:00 pm Landmark 1 (CL)

SSPC 15 Safety Standard for Refrigeration Systems (14/30) Screen
Sunday (6/26) 1:00 pm – 5:00 pm Landmark 1 (CL)
SSPC 15 Subcommittee 15.2 Safety Standard for Refrigeration Systems in Residential Applications (12/12) Screen/Electric
Tuesday (6/28) 8:00 am – 12:00 pm Landmark 1 (CL)

SPC 20 MOT/Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (6/2) Screen/Electric
Sunday (6/26) 12:00 pm – 2:00 pm 241 (2)

SPC 23 MOT for Rating Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant (13/5) Screen/Electric
Monday (6/27) 2:15 pm – 6:15 pm Benton (M)

SPC 25 MOT/Forced Convection and Natural Convection Air Coolers for Refrigeration (6/6)
Monday (6/27) 7:30 pm – 10:30 pm Lafayette (M)

SPC 26 Mechanical Refrigeration & Air-Conditioning Installation Aboard Ship (6/2) Screen/Electric
Tuesday (6/28) 1:00 pm – 5:00 pm 200 (2)

SPC 28 MOT Flow Capacity of Refrigerant Capillary Tubes (5/5) Electric
Sunday (6/26) 5:00 pm – 7:00 pm Lafayette (M)

SPC 30 MOT Liquid Chillers (7/10) Screen
Monday (6/27) 8:00 am – 11:00 am Flora (21)
SSPC 34 Designation and Safety Classification of Refrigerants (15/45) Screen/Electric
Monday (6/27) 6:30 pm – 10:00 pm Landmark 5 (CL)
SSPC 34 Designation and Nomenclature Subcommittee (8/40) Screen/Electric
Saturday (6/25) 7:00 am – 10:00 am Landmark 5 (CL)
SSPC 34 Flammability Subcommittee (18/40) Screen/Electric
Saturday (6/25) 10:00 am – 3:00 pm Landmark 5 (CL)
SSPC 34 Toxicity Subcommittee (10/30) Screen/Electric
Sunday (6/26) 6:30 pm – 10:00 pm Landmark 5 (CL)

SSPC 37 MOT for Rating Electrically Driven Unitary Air-Conditioners and Heat Pump Equipment (7/15) Screen/Electric
Wednesday (6/29) 8:00 am – 12:00 pm Pershing (CL)
SSPC 41 Standard Methods for Measurement (15/10) Electric
Sunday (6/26) 1:00 pm – 4:00 pm s;242 (2)
41.1 Subcommittee, Standard Methods for Temperature Measurement (10/5) Screen/Electric
Tuesday (6/28) 10:00 am – 12:00 pm 242 (2)
41.9 Subcommittee, Standard Methods for Refrigerant Mass Flow Measurement Using Calorimeters (10/5) Screen/Electric
Monday (6/27) 8:00 am – 12:00 pm 280 (2)
Tuesday (6/28) 8:00 am – 10:00 am 242 (2)
SSPC 52.2 Method of Testing General Ventilation Air (CL) eaning Devices for Removal Efficiency by Particles Size (16/45) Screen/Electric
Saturday (6/25) 8:00 am – 12:00 pm Landmark 4 (CL)
SSPC 55 Thermal Env. Cond. for Human Occupancy (20/5) Screen/Electric
Saturday (6/25) 8:00 am – 3:00 pm 230 (2)
SSPC 55 Thermal Env. Cond. for Human Occupancy (20/5) Screen/Electric
Sunday (6/26) 9:00 am – 12:00 pm 230 (2)
SSPC 62.1 Ventilation for Acceptable Indoor Air Quality (30/30) Screen/Electric
Saturday (6/25) 8:00 am – 12:00 pm Landmark 6 (CL)
SSPC 62.1 Ventilation for Acceptable Indoor Air Quality (30/30) Screen/Electric
Sunday (6/26) 1:00 pm – 7:00 pm Landmark 6 (CL)
SSPC 62.1 IAQ Guideline Subcommittee (15/15) Screen/Electric
Friday (6/24) 8:00 am – 12:00 pm Landmark 3 (CL)
SSPC 62.1 Administration Subcommittee (15/15) Screen/Electric
Friday (6/24) 1:00 pm – 3:00 pm Landmark 4 (CL)
Saturday (6/25) 1:00 pm – 3:00 pm Landmark 4 (CL)
SSPC 62.1 Research and Education Subcommittee (15/15) Screen/Electric
Friday (6/24) 1:00 pm – 3:00 pm Landmark 3 (CL)
Saturday (6/25) 1:00 pm – 3:00 pm Landmark 3 (CL)
SSPC 62.1 Buildings, Systems and Equipment (15/15) Screen/Electric
Friday (6/24) 3:00 pm – 5:00 pm Landmark 4 (CL)
Saturday (6/25) 1:00 pm – 3:00 pm Landmark 6 (CL)
SSPC 62.1 Ventilation Subcommittee (15/15) Screen/Electric
Friday (6/24) 3:00 pm – 5:00 pm Landmark 3 (CL)
Saturday (6/25) 1:00 pm – 3:00 pm Landmark 2 (CL)
SSPC 62.2 Ventilation and Acceptable IAQ in Residential Buildings (30/15) Screen/Electric
Friday (6/24) 9:00 am – 2:30 pm Landmark 5 (CL)
SSPC 62.2 Ventilation and Acceptable IAQ in Residential Buildings (30/15) Screen/Electric
Saturday (6/25) 8:00 am – 3:00 pm 125 (1)
SSPC 62.2 Envelope Subcommittee (20/2) Screen
Friday (6/24) 2:30 pm – 5:00 pm Landmark 7 (CL)
SSPC 62.2 IAQ Subcommittee (12/20) Screen
Friday (6/24) 2:30 pm – 5:00 pm Landmark 6 (CL)
SSPC 62.2 System Subcommittee (12/2) Screen
Friday (6/24) 2:30 pm – 5:00 pm Landmark 5 (CL)
SSPC 63.1 Method of Testing Liquid-Line Refrigerant Driers (5/6)
Sunday (6/26) 6:00 pm – 8:00 pm 122 (1)
SSPC 63.2 Method of Testing Liquid-Line Filter Drier Filtration Capability (10/5)
Sunday (6/26) 2:00 pm – 3:00 pm 122 (1)
SSPC 64 Methods of Lab Testing Remote Mechanical Draft Evaporative Refrigerant Condensers (6/2)
Monday (6/27) 10:00 am – 11:00 am Parkview (M)
SSPC 70 MOT for Rating the Performance of Air Outlets and Air Inlets (9/20) Electric
Monday (6/27) 8:00 am – 12:00 pm 122
SSPC 72 Standard 72-2014, Method of Testing Open and Closed Commercial Refrigerators and Freezers (15/12)
Sunday (6/26) 1:00 pm – 5:00 pm 220 (2)
SSPC 78 Method of Testing Flow Capacity of Suction Line Filters and Filter-Driers (6/6)
Sunday (6/26) 3:00 pm – 4:00 pm 122 (1)
SSPC 84 Method of Testing Air-to-Air Heat/Energy Exchangers (12/0) Screen/Electric
Monday (6/27) 4:15 pm – 6:30 pm 267 (2)
SSPC 90.1 Energy Eff. Design of New Bldg. (50/60) Screen/Electric
Saturday (6/25) 8:00 am – 12:00 pm 274 (2)
SSPC 90.1 Energy Eff. Design of New Bldg. (50/60) Screen/Electric
Sunday (6/26) 9:00 am – 12:00 pm 274 (2)
SSPC 90.1 Energy Eff. Design of New Bldg. (50/60) Screen/Electric
Monday (6/27) 8:00 am – 12:00 pm 274 (2)
SSPC 90.1 Envelope Subcommittee (15/30) Screen/Electric
Friday (6/24) 9:00 am – 10:00 pm Embassy/Laurel A (4)
Saturday (6/25) 1:00 pm – 8:00 pm 275 (2)
Sunday (6/26) 1:00 pm – 8:00 pm 275 (2)
SSPC 90.1 Lighting Subcommittee (12/10) Screen/Electric
Friday (6/24) 9:00 am – 10:00 pm Embassy/Mercantile S (4)
Saturday (6/25) 1:00 pm – 7:00 pm 266 (2)
Sunday (6/26) 1:00 pm – 8:00 pm 266 (2)
SSPC 90.1 Mechanical Subcommittee (25/25) Screen/Electric
Friday (6/24) 9:00 am – 10:00 pm Embassy/Laurel B (4)
Saturday (6/25) 1:00 pm – 7:00 pm 274 (2)
Sunday (6/26) 1:00 pm – 8:00 pm 274 (2)
SSPC 90.1 ECB Subcommittee (12/18) Screen/Electric
Friday (6/24) 3:00 pm – 8:00 pm Embassy/Mercantile N (4)
Saturday (6/25) 1:00 pm – 5:00 pm 265 (2)
Sunday (6/26) 1:00 pm – 4:00 pm 265 (2)
SSPC 90.1 Envelope Subcommittee Working Group (15/30) Screen/Electric
Friday (6/24) 4:00 pm – 6:00 pm Embassy/Laurel C (4)
Saturday (6/25) 4:00 pm – 6:00 pm 276 (2)
SSPC 90.1 Format & Compliance Subcommittee (6/6) Electric
Friday (6/24)  5:00 pm – 10:00 pm  Embassy/Boardroom (4)
Saturday (6/25)  1:00 pm – 5:00 pm  280 (2)
Sunday (6/26)  4:00 pm – 7:00 pm  265 (2)

Monday (6/27)  2:15 pm – 6:15 pm  Hawthorne (21)

Tuesday (6/28)  1:00 pm – 5:00 pm  Hawthorne (21)
  SSPC 90.2 Envelope (11/15) Screen/Electric
  Monday (6/27)  6:30 pm – 9:15 pm  Hawthorne (21)
  Tuesday (6/28)  8:00 am – 12:00 pm  Hawthorne (21)
  SSPC 90.2 Lighting (4/4) Screen/Electric
  Monday (6/27)  6:30 pm – 9:15 pm  Flora (21)
  Tuesday (6/28)  8:00 am – 12:00 pm  Flora (21)
  SSPC 90.2 Mechanical (6/6) Screen/Electric
  Monday (6/27)  6:30 pm – 9:15 pm  Shaw (M)
  Tuesday (6/28)  8:00 am – 12:00 pm  Shaw (M)

SSPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings (17/20) Screen/Electric
Saturday (6/25)  9:00 am – 1:00 pm  265 (2)

SSPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings (17/20) Screen/Electric
Monday (6/27)  7:30 am – 11:30 am  265 (2)

SSPC 94.2 MOT/Thermal Storage Devices with Electric Input and Thermal Output based on Thermal Performance (5/3)
Monday (6/27)  8:00 am – 11:00 am  126 (1)

SSPC 97 Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use Within Refrigerant Systems (9/6)
Screen/Electric
Tuesday (6/28)  9:30 am – 11:00 am  127 (1)

SSPC 99 Refrigerant Oil Description (9/6) Screen/Electric
Tuesday (6/28)  8:00 am – 9:30 pm  127 (1)

SSPC 100 Energy Efficiency in Existing Buildings (20/10) Screen/Electric
Tuesday (6/28)  8:00 am – 12:00 pm  232 (2)
  SSPC 100 Operation and Maintenance (WG3) (5/5) Screen
  Sunday (6/26)  8:00 am – 10:00 am  280 (2)
  SSPC 100 Alternative to EUI (WG5) (16/10) Screen
  Sunday (6/26)  12:00 pm – 2:00 pm  232 (2)
  SSPC 100 International Target Table and Climate Zones (WG4) (4/5) Screen
  Sunday (6/26)  4:00 pm – 6:00 pm  280 (2)
  SSPC 100 Site/Source and Boundary (WG2) (20/10) Screen
  Monday (6/27)  6:30 pm – 8:30 pm  Landmark 7 (CL)

SSPC 110P MOT Performance of Laboratory Fume Hoods (20/20)
Tuesday (6/28)  1:00 pm – 1:30 pm  127 (1)

Tuesday (6/28)  8:00 am – 12:00 pm  264 (2)

SSPC 113 Preliminary/Informational Committee Meeting (1/20)
Tuesday (6/28)  3:30 pm – 4:30 pm  124 (1)

SSPC 118.1 Method of Testing for Rating Commercial Gas, Electric and Oil Service Water (16/20) Screen/Electric
Sunday (6/26)  9:00 am – 11:00 am  241 (2)

SSPC 118.2 Method of Testing for Rating Residential Water Heaters (15/15)
Tuesday (6/28)  1:00 pm – 5:00 pm  126 (1)

SSPC 124 MOT/Rating Combinations Space-Heating and Water Heating Appliances (16/12) Screen/Electric
Tuesday (6/28)  9:00 am – 12:00 pm  Majestic G (CP2)

SSPC 127 MOT/for Rating Computer and Data Processing Room Unitary Air Conditioners (12/8) Screen
Tuesday (6/28)  8:00 am – 12:00 pm  200 (2)

SSPC 128 Method of Rating Portable Air Conditioners (10/0)
Tuesday (6/28)  11:00 am – 12:00 pm  131 (1)

SSPC 130 MOT/for Rating Ducted Air Terminal Units (15/20)
Sunday (6/26)  2:00 pm – 6:00 pm  230 (2)

SSPC 135 BAConet (40/15) Electric
Saturday (6/25)  8:00 am – 3:30 pm  Majestic G (CP2)

SSPC 135 BAConet (40/15) Electric
Monday (6/27)  8:00 am – 12:00 pm  Majestic G (CP2)
  SSPC 135 BAConet Working Groups (20/5) Electric
  Thursday (6/23)  8:30 am – 4:30 pm  Aubert (M)
  SSPC 135 BAConet Working Groups (20/5) Electric
  Friday (6/24)  8:00 am – 5:00 pm  Hawthorne (21)
  Sunday (6/26)  8:00 am – 5:00 pm  Hawthorne (21)
  SSPC 135 BAConet Working Groups (20/5) Electric
  Friday (6/24)  8:00 am – 5:00 pm  Parkview (M)
  Sunday (6/26)  8:00 am – 5:00 pm  Parkview (M)

SSPC 140 Standard MOT for Evaluation of Bldg. Energy Analysis Computer Program (16/10) Screen
Monday (6/27)  2:15 pm – 6:15 pm  121 (1)

SSPC 145 Test Method for Assessing the Performance of Gas Phase Air Cleaning Equipment (10/10) Screen/Electric
Sunday (6/26)  12:00 pm – 3:00 pm  231 (2)

SSPC 146 Method of Testing and Rating Pool Heaters (7/6)
Tuesday (6/28)  8:00 am – 12:00 pm  276 (2)

SSPC 147 Reducing the Release of Halogenated Refrigerants from Refrigerating and Air–Conditioning Equipment (10/10) Screen/Electric
Monday (6/27)  6:30 pm – 9:30 pm  Lindell (CL)

SSPC 154 Ventilation for Commercial Cooking Operations (15/10) Screen
Sunday (6/26)  8:00 am – 12:00 pm  121 (1)

Sunday (6/26)  1:00 pm – 5:00 pm  200 (2)

SSPC 158.1 MOT Capacity of Refrigerant Solenoid Valves (5/5) Electric
Sunday (6/26)  5:00 pm – 7:00 pm  Lafayette (M)

SSPC 158.2 MOT Capacity of Refrigerant Pressure Regulators (5/5) Electric
Sunday (6/26)  5:00 pm – 7:00 pm  Lafayette (M)

SSPC 160 Criteria for Moisture Control in Building Design Standards (10/5) Screen/Electric
Tuesday (6/28)  8:00 am – 12:00 pm  121 (1)

SSPC 164 MOT for Humidifiers (7/5) Screen/Electric
Monday (6/27)  9:00 am – 12:00 pm  Lucas (21)

SSPC 169 Climatic Data for Building Design Standards (10/5) Screen/Electric
Monday (6/27)  9:00 am – 12:00 pm  Lucas (21)

SSPC 170 Ventilation of Healthcare Facilities (25/25) Screen
Monday (6/27)  4:00 pm – 6:00 pm  Majestic B (CP2)

SSPC 170 Ventilation of Healthcare Facilities (25/25) Screen
Tuesday (6/28)  8:00 am – 1:00 pm  Majestic B (CP2)
SSPC 170 Ventilation of Health Care Facilities, Natural Ventilation Work Group (15/25) Screen
Monday (6/27) 2:00 pm – 4:00 pm  Majestic B (CP2)

SPC 171 Method of Testing & Rating Seismic Restraint Devices for HVAC & R Equipment (17/15)
Tuesday (6/28) 8:00 am – 12:00 pm 122 (1)

SPC 172P Methods of Testing the Particulate Formation Temperature of Refrigeration Grade Oils (10/0)
Tuesday (6/28) 8:00 am – 12:00 pm 125 (1)

SPC 174P Method of Test for Rating Desiccant Based Dehumidification Equipment (6/3)
Monday (6/27) 10:00 am – 12:00 pm Shaw (M)

SPC 180 Standard Method of Inspection and Maintenance of HVAC Systems (20/10) Screen Electric
Friday (6/24) 2:00 pm – 6:00 pm 274 (2)

SPC 182 MOT Absorption Water-Chilling and Water-Heating Packages (5/5)
Monday (6/27) 11:00 am – 12:00 pm Lafayette (M)

SPC 184P: Method of Test for Field Performance of Liquid Chilling Systems (11/6) Electric
Tuesday (6/28) 8:00 am – 12:00 pm 266 (2)

SSPC 185 Methods of Test to Inactivate Microorganisms in HVAC Systems with UV-C Lights (6/6)
Saturday (6/25) 10:00 am – 12:00 pm 200 (2)

SPC 188 Legionellosis: Risk Management for Building Water Systems (22/30) Screen/Electric
Tuesday (6/28) 8:00 am – 12:00 pm 231 (2)
Wednesday (6/28) 3:45 pm – 5:45 pm 231 (2)

SSPC 189.1 ASHRAE/USGBC/IES Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (45/50) Screen/Electric
Tuesday (6/28) 8:00 am – 10:00 am 276 (2)
Wednesday (6/29) 8:00 am – 12:00 pm 220 (2)
SSPC 189.1 Working Group 6 (Water Use) (20/20) Screen/Electric
Tuesday (6/28) 10:00 am – 1:00 pm 275 (2)
SSPC 189.1 Working Group 7 (Energy Efficiency) (30/30) Screen/Electric
Tuesday (6/28) 10:00 am – 1:00 pm 276 (2)
SSPC 189.1 Working Group 5 (Site Sustainability) (20/20) Screen/Electric
Tuesday (6/28) 1:00 pm – 4:00 pm 274 (2)
SSPC 189.1 Working Group 9 (Materials and Resources) (20/20) Screen/Electric
Tuesday (6/28) 1:00 pm – 4:00 pm 276 (2)
SSPC 189.1 Working Group 7.5 (30/30) Screen/Electric
Tuesday (6/28) 1:30 pm – 4:30 pm 275 (2)
SSPC 189.1 Working Group 10 (20/20) Screen/Electric
Tuesday (6/28) 4:00 pm – 7:00 pm 276 (2)
SSPC 189.1 Working Group 8 (IEQ) (30/30) Screen/Electric
Tuesday (6/28) 4:00 pm – 7:00 pm 274 (2)

SPC 189.3P Design, Construction and Operation of Sustainable High Performance Health Care Facilities (14/10) Screen
Monday (6/27) 8:00 am – 12:00 pm 264 (2)

SPC 191 Standard for Efficient Water Use in Buildings (8/3) Screen/Electric
Monday (6/27) 8:00 am – 12:00 pm 125 (1)

SPC 194 MOT/Direct-Expansion Ground Source Heat Pumps (5/8)
Sunday (6/26) 1:00 pm – 3:00 pm Lucas (21)

SPC 196P MOT/ Measuring Refrigerant Leak Rates (8/8) Screen
Sunday (6/26) 6:00 pm – 10:00 pm Lindell (CL)

SPC 199P Method of Testing the Performance of Industrial Pulse Cleaned Dust Collectors (10/10)
Sunday (6/26) 8:00 am – 12:00 pm 132 (1)

SPC 200 MOT/Chilled Beams (20/20) Screen
Monday (6/27) 8:00 am – 12:00 pm Majestic Ballroom B (CP2)

SSPC 202 Commissioning Process for Buildings and Systems (15/15) Screen/Electric
Monday (6/27) 8:00 am – 12:00 pm 242 (2)
SSPC 202 Subcommittee: GLD 0-2013 The Commissioning Process (8/10) Screen/Electric
Saturday (6/25) 8:00 am – 10:00 am 121 (1)
SSPC 202 Subcommittee: GLD 1.1 The HVAC&R Technical Requirements for Commissioning Process (8/10) Screen/Electric
Saturday (6/25) 10:00 am – 12:00 pm 121 (1)
SSPC 202 Subcommittee Standard 202-2013 (14/10) Screen/Electric
Saturday (6/25) 1:00 pm – 3:00 pm 121 (1)

SPC 204P MOT/Rating Micro Combined Heat and Power Devices (15/10)
Monday (6/27) 6:30 pm – 9:30 pm Lucas (21)

SSPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Working Group (20/5) Screen/Electric
Sunday (6/26) 9:00 am – 12:00 pm 123 (1)
Tuesday (6/28) 8:00 am – 12:00 pm 123 (1)

SSPC 207P Laboratory Method of Test of Fault Detection and Diagnostics Applied Commercial Air-Cooled Packaged Systems (20/30) Screen/Electric
Monday (6/27) 8:00 am – 10:00 am 124 (1)
SSPC 207 Airflow Working Group (15/0) Screen
Monday (6/27) 10:00 am – 12:00 pm 124 (1)
SSPC 207 Economizer Working Group (10/0) Screen
Monday (6/27) 4:30 pm – 6:30 pm 124 (1)
SSPC 207 Refrigerant Working Group (10/0) Screen
Monday (6/27) 6:30 pm – 8:30 pm 124 (1)

Balance Valve Capacity (10/5) Screen/Electric
Tuesday (6/28) 7:00 am – 9:00 am 274 (2)

SSPC 209P Energy Simulation Aided Design (45/15) Screen/Electric
Monday (6/27) 2:15 pm – 6:15 pm 232 (2)
SSPC 209P Construction/Operations Subcommittee (10/5) Screen
Sunday (6/26) 6:00 pm – 10:00 pm Benton (M)
SSPC 209P Design Development/Construction Documents Subcommittee (10/5) Screen
Sunday (6/26) 6:00 pm – 10:00 pm Aubert (M)
SSPC 209P Predesign Subcommittee (10/5) Screen
Sunday (6/26) 6:00 pm – 10:00 pm Portland (M)
SSPC 209P Conceptual Design/Schematic design (10/5) Screen
Monday (6/27) 8:00 am – 12:00 pm Portland (M)
SSPC 209P Resources Subcommittee (10/5) Screen
Monday (6/27) 8:00 am – 12:00 pm Benton (M)

SSPC 210 MOT/for Rating Commercial Walk-in Refrigerators and Freezers (5/30) Screen
Monday (6/27) 8:00 am – 12:00 pm 275 (2)

SSPC 211 Commercial Building Energy Audits (18/20) Screen/Electric
Monday (6/27) 8:00 am – 12:00 pm 123 (1)
SPC 212 MOT/for Determining Energy Performance and Water-Use Efficiency of Add-On Evaporative Pre-Coolers for Unitary Air Conditioning Equipment (7/5)
Tuesday (6/28) 8:00 am – 12:00 pm Lafayette (M)

SPC 213P Method of Calculating Moist Air Thermodynamics (6/4)
Tuesday (6/28) 8:00 am – 10:00 am Lindell (CL)

SPC 214P Standard for Measuring and Expressing Building Energy Performance in a Rating Program (14/10) Screen
Monday (6/27) 2:15 pm – 6:15 pm 125 (1)

SPC 215P Method of Test to Determine Leakage Airflows and Fractional Leakage of Operating Air-Handling Systems (15/10) Screen/Electric
Monday (6/27) 2:15 pm – 6:15 pm 241 (2)

SPC 216 MOT for Determining Application Data of Overhead Circulator Fans (11/5) Screen/Electric
Monday (6/27) 2:15 pm – 5:15 pm 125 (1)

SPC 217 Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities (12/5) Screen/Electric
Tuesday (6/28) 7:30 am – 12:00 pm Lucas (21)

SPC 218P – MOT for Lubricant and Refrigerant Miscibility Determination (9/4) Screen/Electric
Monday (6/27) 8:00 am – 10:00 am 200 (2)

SPC 219 Method of Testing the Ability of Liquid Line Filter Driers or Absorbents to Remove Organic and Inorganic Acid (5/2)
Monday (6/27) 10:00 am – 12:00 pm Laclede (20)

Guideline Project Committees (GPC) and (SGPC)

GPC 1.2P Technical Requirements for the Commissioning Process for Existing HVAC&R Systems and Assemblies (18/5) Screen
Friday (6/24) 8:00 am – 12:00 pm 266 (2)

GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process (12/2) Electric
Tuesday (6/28) 1:00 pm – 5:00 pm Lafayette (M)

GPC 4-2008R Preparation of Operating and Maintenance Documentation for HVAC&R Systems (7/8)
Monday (6/27) 8:00 am – 12:00 pm Lindell (CL)

GPC 11 Field Testing of HVAC Controls Components (7/3) Screen/Electric
Saturday (6/25) 9:00 am – 12:00 pm Flora (21)

GPC 21 Guideline for the Ventilation and Thermal Management of Batteries for Stationary Applications (5/5)
Tuesday (6/28) 10:00 am – 11:00 am 131 (1)

GPC 22 Instrumentation for Monitoring Central Chilled Water Plants (5/3) Screen
Tuesday (6/28) 10:00 am – 12:00 pm 124 (1)

GPC 27P Measurement Procedures for Gaseous Contaminants in Indoor Environments (5/4)
Sunday (6/26) 3:00 pm – 5:00 pm Portland (M)

GPC 29 Guideline for Risk Management (6/0)
Sunday (6/26) 3:00 pm – 5:00 pm Lafayette (M)

GPC 32 Sustainable, High Performance Operations & Maintenance (5/6)
Saturday (6/25) 12:00 pm – 2:00 232 (2)

GPC 34P Energy Guideline for Historical Buildings and Structures (8/8)
Tuesday (6/28) 7:00 am – 9:00 am Laclede (20)

GPC 35 Method for Determining the Energy Consumption Caused By Air-Cleaning and Filtration Devices (10/40) Screen/Electric
Monday (6/27) 8:00 am – 12:00 pm Majestic F (CP2)

GPC 36P High Performance Sequences of Operation for HVAC Systems (30/20) Screen/Electric
Monday (6/27) 8:00 am – 12:00 pm 232 (2)

GPC 37 Upper Room Ultraviolet Germicidal (UV-C) Devices to Control the Transmission of Airborne Pathogens (6/6)
Saturday (6/25) 1:00 pm – 3:00 pm 200 (2)

GPC 38P Guideline for Using Metal Pressure Vessels to Test Materials Used in Refrigeration Systems (6/6)
Monday (6/27) 4:15 pm – 6:15 pm Pershing (CL)

GPC 41 Design, Installation and Commissioning of Variable Refrigerant Flow Systems
Monday (6/27) 8:00 am – 12:00 pm Hawthorne (21)

SGP 10 Interaction Affecting the Achievement of Acceptable Indoor Environments (8/4)
Sunday (6/26) 9:00 am – 12:00 pm 200 (2)

SGPC 13 Specifying Automation Systems (12/5) Screen/Electric
Saturday (6/25) 8:00 am – 12:00 pm 232 (2)

US TAG to ISO/TC 86 (20/10) Screen/Electric
Monday (6/27) 8:00 am – 10:00 am 230 (2)

US TAG to ISO/TC 142 Cleaning Equipment for Air and other Gases (20/25) Screen/Electric
Saturday (6/25) 2:30 pm – 3:15 pm 220 (2)

JWG ISO/TC 163/WG4 and ISO/TC 205 (18/11) Screen/Electric
Tuesday (6/28) 2:30 pm – 3:00 pm 130 (1)

US TAG to ISO/TC 163 Thermal Performance and Energy in a Building Environment (18/11) Screen/Electric
Tuesday (6/28) 3:00 pm - 4:30 pm 130 (1)

US Tag to ISO/TC 205 (22/12) Screen/Electric
Tuesday (6/28) 1:00 pm - 2:30 pm 130 (1)

ISO 817 MA (23/11) Screen/Electric
Tuesday (6/28) 8:00 am - 12:00 pm 130 (1)

ISO 817 MA-Flammability (15/10) Screen/Electric
Monday (6/27) 8:00 am - 9:00 am 131 (1)

ISO 817 MA-Toxicity (15/10) Screen/Electric
Tuesday (6/28) 1:00 pm - 2:30 pm 130 (1)

ISO 817 MA-Other Gases (20/25) Screen/Electric
Saturday (6/25) 2:30 pm – 3:15 pm 220 (2)

US TAG to ISO/TC 163 (18/11) Screen/Electric
Tuesday (6/28) 3:00 pm - 4:30 pm 130 (1)

US TAG to ISO/TC 163 Thermal Performance and Energy in a Building Environment (18/11) Screen/Electric
Tuesday (6/28) 3:00 pm - 4:30 pm 130 (1)

ISO 817 MA - Design and Nomenclature (15/10) Screen/Electric
Monday (6/27) 9:00 am - 10:00 am 131 (1)

OTHER

USNC/IIR (20/20)
Tuesday (6/28) 2:00 pm - 4:00 pm Landmark 6 (CL)

USNT/IEA (20/10)
Tuesday (6/28) 4:00 pm - 6:00 pm Landmark 6 (CL)

IEA Annex 41 Cold Climate Heat Pumps (15/0)
Friday (6/24) 1:00 pm - 6:00 pm 266 (2)

gbXML (10/0)
Tuesday (6/28) 12:00 pm - 1:00 pm Laclede (20)

Thermal Envelope Conference (30/0)
Monday (6/27) 9:00 am – 12:00 pm Landmark 4 (CL)
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Abellon, Devin, Seminar 21, 26 & 30
Acosta, Marcelo, Seminar 53
Acuna, Jose, Seminar 61
Adamkiewicz, Gary, Seminar 62
Agarabi, Mina, Seminar 1
Allen, Melissa, Seminar 56
Ally, Moonis, Conference Paper Session 19
Altwies, Joy, Conference Paper Session 2 & Workshop 8
Alvares, Jose, Seminar 53
Aman, Julia, Conference Paper Session 1
Arababadi, Reza, Technical Paper Session 7
Athalye, Rahul A., Conference Paper Session 17
Aute, Vikrant, Seminar 13 & 44

B
Bagge, Hans, Conference Paper Session 17
Bahnfleth, William, Seminar 41
Balaras, Constantinos, Seminar 15 & 64
Baltazar, Juan-Carlos, Conference Paper Session 17
Barnaby, Charles S., Seminar 23
Bay, Christopher, Technical Paper Session 3
Bean, Robert, Seminar 26 & 30
Beason, Kent, Conference Paper Session 9
Beaty, Don, Seminar 41
Beck, Terry, Seminar 38
Becker, Henry A., Conference Paper Session 12 & 19
Betz, Frederick, Seminar 10
Bhandari, Mahabir, Conference Paper Session 4
Blalock, Alonzo, Seminar 49
Banton, Robert, Seminar 10
Bochat, Jim, Seminar 24
Bohanon, Hoy, Seminar 29
Boldt, Jeff, Seminar 18
Bortone, Vicente, Conference Paper Session 10
Bosworth, David, Seminar 22 & 34
Bourdakis, Eleftherios, Conference Paper Session 4 & Seminar 21
Boyce, Darryl, Seminar 19
Brandt, Don, Seminar 2
Briscoe, Casey, Seminar 45
Brooks, Alamelu, Conference Paper Session 9 & Technical Paper Session 7
Brown, Cillian, Conference Paper Session 6
Brown, Jason, Seminar 56
Brown, Kevin, Workshop 8
Brunner, Gregory, Seminar 3
Buford, Jasmine, Conference Paper Session 3

C
Carda, Ryan, Seminar 61
Carpenter, Joseph, Conference Paper Session 3
Cedillos, Dagoberto, Conference Paper Session 12
Cerra, Helen R., Conference Paper Session 4 & 13
Cetin, Kristen, Seminar 37 & 52
Chen, Yixing, Conference Paper Session 13
Chin, Joe, Seminar 50
Chmielewski, Donald, Seminar 32
Chong, Howard, Seminar 52
Chopko, Robert, Seminar 45
Claridge, David E., Conference Paper Session 8 & 11
Coenen, Anja, Workshop 1
Cohen, Jon, Seminar 18 & Workshop 6
Collins, Patrick, Conference Paper Session 11
Colombo, Ina, Conference Paper Session 15

Comstock, Steve, Workshop 2
Cooper, Michael, Seminar 48
Corrigan, Ryan, Seminar 19
Crawley, Drury, Seminar 2 & 63
Cremaschi, Lorenzo, Seminar 47
Curlin, Chuck, Seminar 50

D
Dalpane, Pietro, Conference Paper Session 9
Davila, Carlos, Seminar 39
Davis, Aika, Conference Paper Session 18
Davis, Douglas A., Seminar 5
DeCaria, Domenic, Seminar 17
DeMarco, Christopher, Seminar 11
Denis, Derrick A., Seminar 41
Dieryckx, Martin, Workshop 5
Doppel, Paul, Seminar 51
DuChane, Greg, Seminar 8
Duffy, Pamela, Seminar 40

E
Eftekhari, Mahroo, Seminar 16
Elbel, Stefan, Seminar 33
Ellis, Robyn, Seminar 27 & 57
English, Travis R., Conference Paper Session 14 & Seminar 35
Escobar, Luis, Seminar 23
Eslami Nejad, Parham, Technical Paper Session 6

F
Fad, Mohamed Sakr, Technical Paper Session 8
Falk, Rob, Seminar 27 & 57
Fallahi, Ali, Technical Paper Session 8
Felts, Margaret, Conference Paper Session 15
Ferrari, Sarah, Seminar 7
Fisher, Donald, Seminar 8
Fisher, Larry J., Workshop 4
France, Brandon, Seminar 14
Francisco, Paul W., Seminar 36 & 62
Fricke, Brian, Seminar 55
Friedman, Glenn, Seminar 23

G
Gagné-Boisvert, Laurent, Conference Paper Session 9
Gallagher, John, Seminar 14
Gangemi, Nick, Seminar 38
Gao, Kaimi, Technical Paper Session 3
Gayeski, Dr. Nicholas T., Technical Paper Session 5
Geoghegan, Patrick, Seminar 5
Gercek, Ersin, Seminar 5
Gervind, Pernilla, Conference Paper Session 20
Ghias, Reza, Seminar 16
Glafelter, Seth, Seminar 31
Glazer, Jason, Seminar 2
Gluesenkamp, Kyle, Conference Paper Session 19
Goldstein, Eli, Conference Paper Session 4
Gouw, Sean, Seminar 33
Gray, Chris, Seminar 9
Guither, Blake, Conference Paper Session 22
Guzman, Sam, Forum 1 & Seminar 12

H
Haaland, Daniel, Conference Paper Session 10
Haberl, Jeff S., Seminar 24
Habte, Aron, Seminar 63
Hackel, Scott, Seminar 61
Hackner, Richard, Seminar 11
Haid, Carlos, Seminar 37
Haider, Ali, Technical Paper Session 3