Your Guide to the ASHRAE Winter Conference

January 24–28, 2015

Personal Program 2
Hotel Floor Plan 4
Chapter and Society Officials 11
General Information 12
Spouse/Guest Guide 14
President's Luncheon Information 14
Women In ASHRAE Continental Breakfast 14
Members' Night Out Information 14
Plenary Speaker 15
Welcome Party Information 15
Nearby Restaurants 16
Past and Future Meetings 17
Awards Presentation 18
Upcoming Conferences 19
How to Find your Meeting Room 20
Scheduled Events 22
General Tours 24
Technical Tours 25
Illinois Chapter Sustainability Project 27
ASHRAE Learning Institute Courses 28
What is a Technical Committee? 31
Types of Sessions 32
Technical Program Schedule 33
- Sunday 33
- Monday 39
- Tuesday 45
- Wednesday 51

Society Committee Meetings 56
Technical Committee Meetings 61
ASHRAE Staff 73
Speaker Listing 74

ASHRAE EVENTS APP

Download the ASHRAE App to stay up-to-date with ASHRAE events, publications, discussion, and more. All attendees can access the Winter event, which features a full conference agenda with venue floor plans. The event app also features exclusive registrant-only features like the ability to create a personal schedule, an interactive attendee list, and the new feature to submit speaker evaluation feedback digitally. The app is made possible through support from the following sponsors:

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

PERSONAL PROGRAM—PLAN YOUR OWN MEETING SCHEDULE!

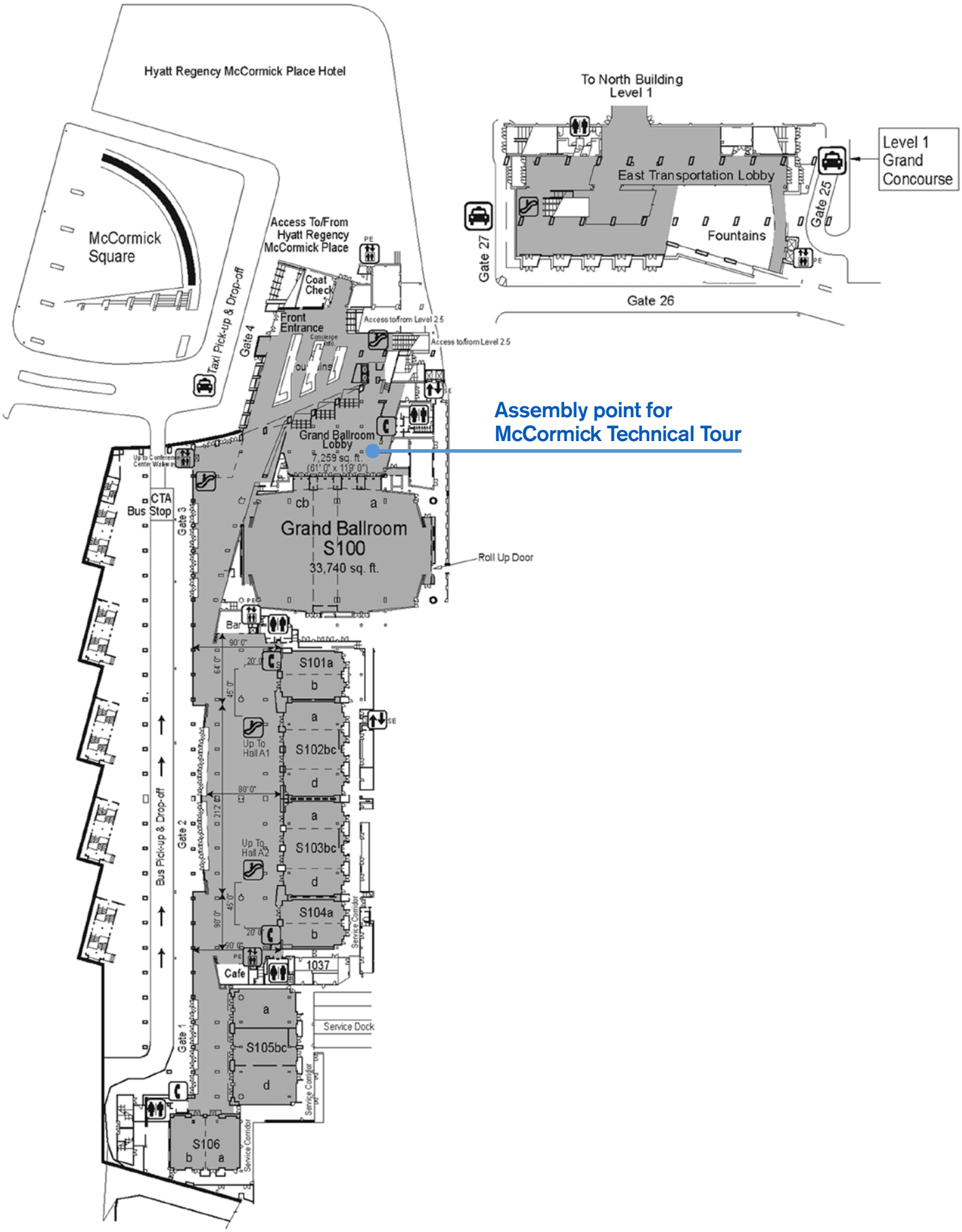
FRIDAY, JANUARY 23	SATURDAY, JANUARY 24	SUNDAY, JANUARY 25
8:00 am–12:00 noon	8:00 am–12:00 noon	8:00 am–9:30 am
1:00 pm–5:00 pm	8:00 am–3:00 pm	8:30 am–12:00 noon
5:00 pm–10:00 pm	1:00 pm–3:00 pm	9:45 am–10:45 am
	3:15 pm–5:00 pm	11:00 am–12:30 pm
		1:30 pm–3:00 pm
	6:30 pm–8:30 pm **Welcome Party** Chicago Cultural Center	3:00 pm–7:00 pm

NOTES:

PLAN YOUR OWN MEETING SCHEDULE!—PERSONAL PROGRAM

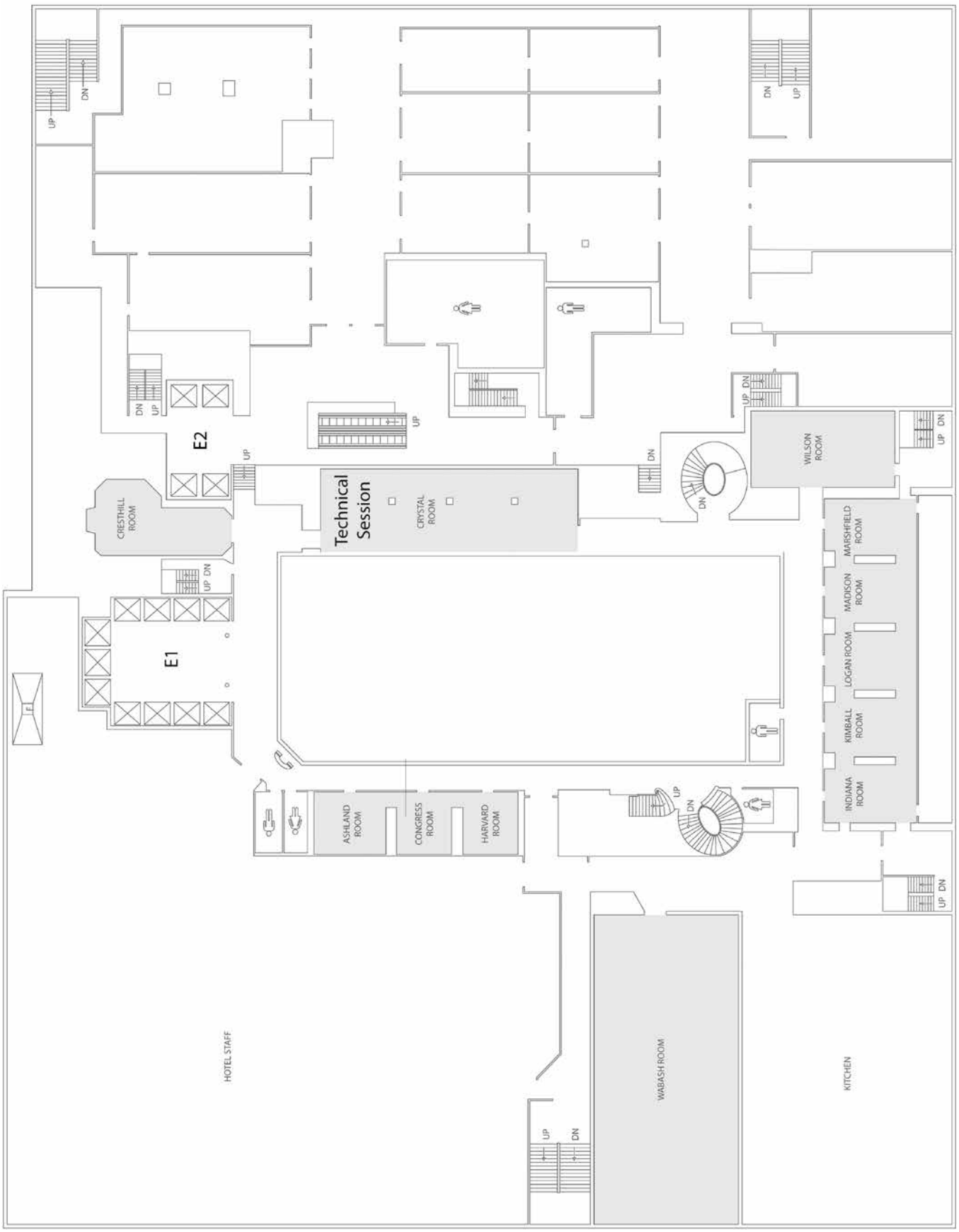
MONDAY, JANUARY 26	TUESDAY, JANUARY 27	WEDNESDAY, JANUARY 28
8:00 am–9:30 am	8:00 am–9:00 am	8:00 am–9:30 am
9:45 am–10:45 am	9:45 am–10:45 am	9:45 am–10:45 am
11:00 am–12:00 noon	11:00 pm–12:30 pm	11:00 am–12:30 pm
12:15 pm–2:00 pm **President's Lunch** Grand Ballroom	1:00 pm–3:30 pm	1:00 pm–5:00 pm
2:15 pm–4:15 pm	3:30 pm–6:00 pm	
4:15 pm–6:30 pm	6:15 pm–10:30 pm **Members' Night Out** Grand Ballroom	

McCORMICK PLACE



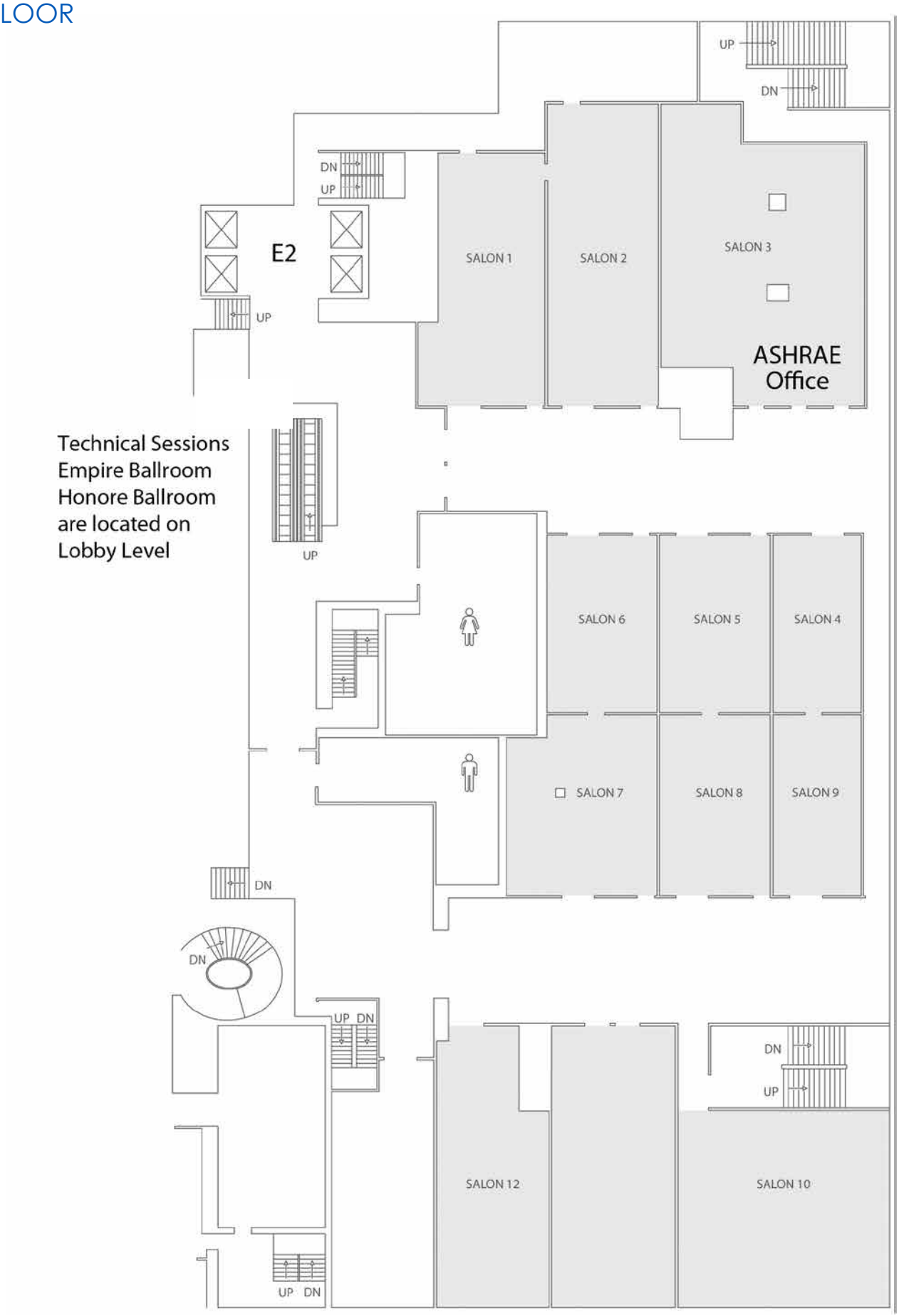
PALMER HOUSE HILTON

3RD FLOOR



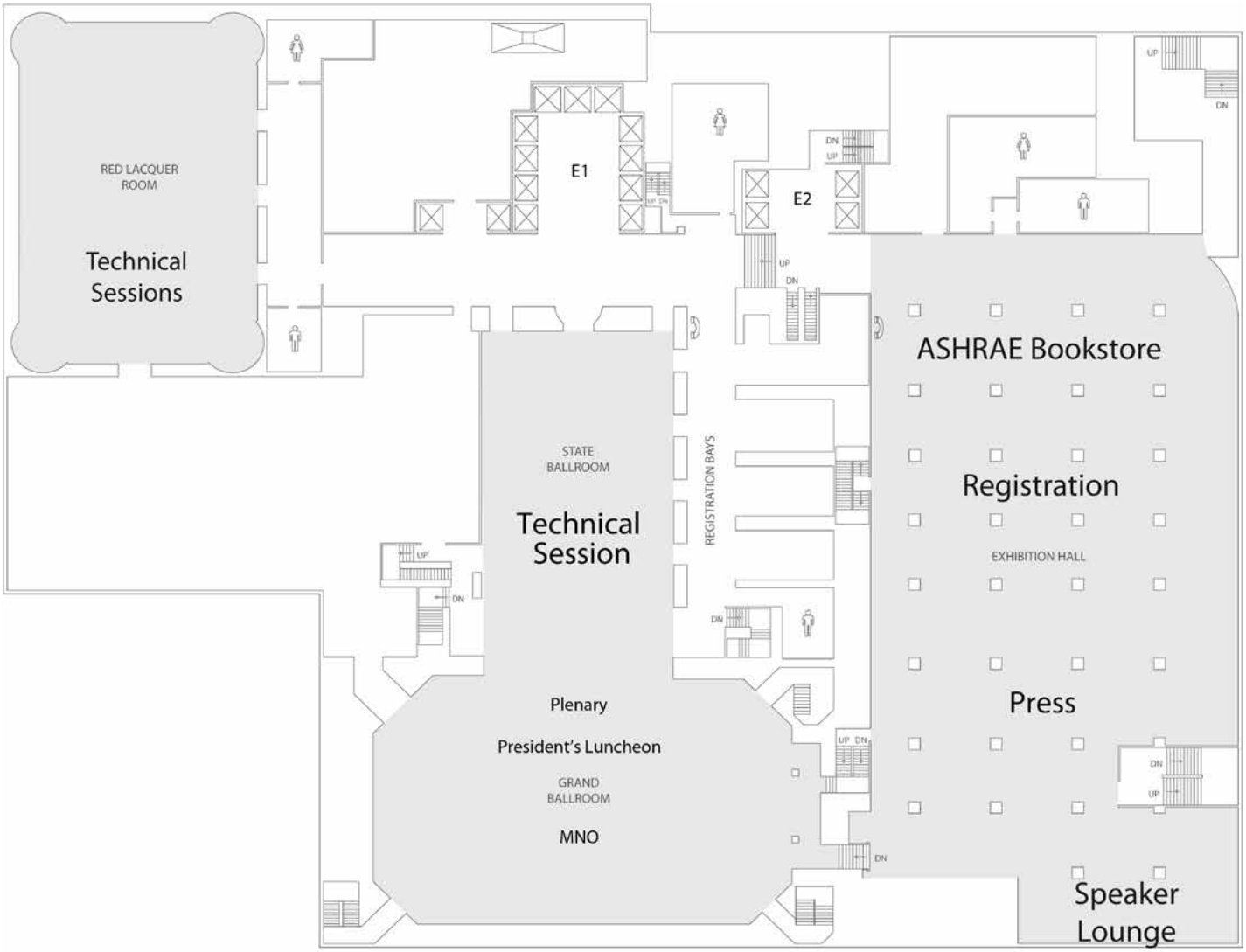
PALMER HOUSE HILTON

3RD FLOOR



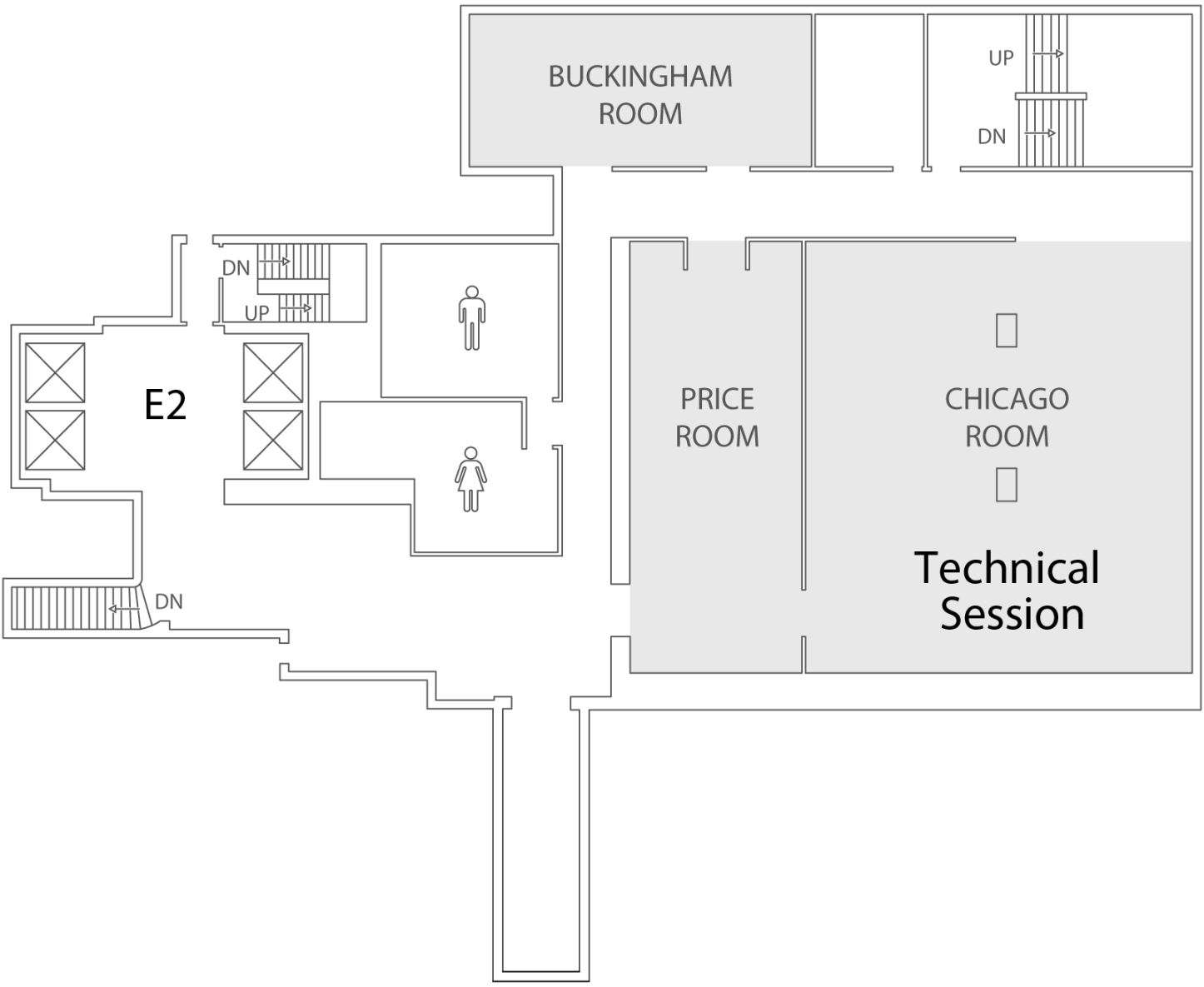
PALMER HOUSE HILTON

4TH FLOOR



PALMER HOUSE HILTON

5TH FLOOR

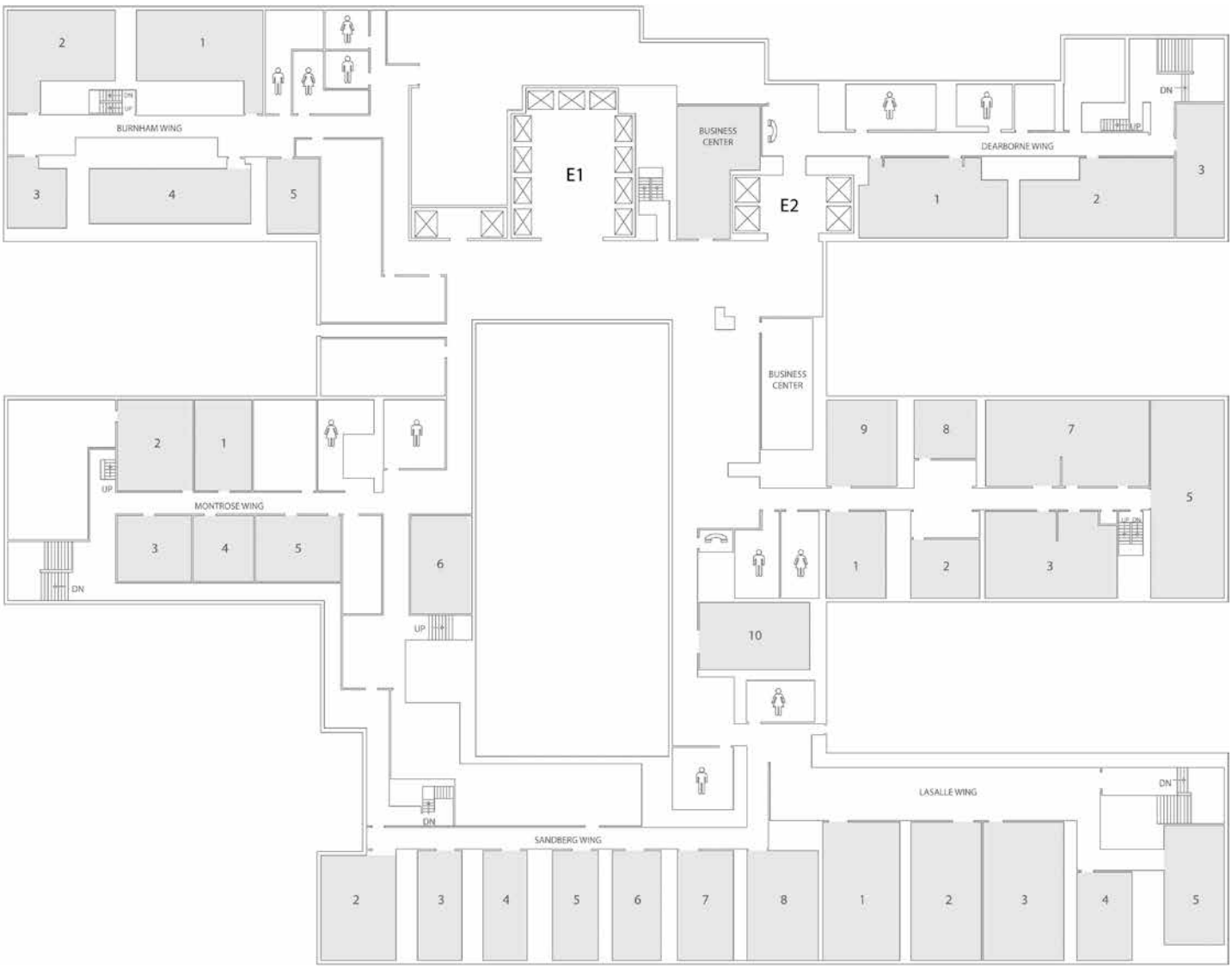


PALMER HOUSE HILTON

6TH FLOOR

PALMER HOUSE HILTON

7TH FLOOR



CONFERENCE SPONSORS

ASHRAE thanks the following sponsors for their support of the 2015 Chicago Conference

iSiB TURKISH HVAC&R EXPORTERS

Sponsor of the Keynote Speaker

AHRI AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE

we make life better®

Sponsor of the ASHRAE Bookstore

Bell & Gossett a xylem brand

Sponsor of the YEA Hospitality Lounge

Johnson Controls

Keycard and Welcome Party Sponsor

CHAPTER AND SOCIETY OFFICIALS

A special thanks to all the members in the Illinois Chapter who helped make the 2015 Winter Conference a success!

ILLINOIS CHAPTER OFFICERS

Laura C. Michel, President
Roland Schleicher, President-Elect
Frank Coccio, Secretary
Brian Medina, Treasurer

CHICAGO HOST COMMITTEE

General Chair, Benjamin Skelton
Tours, Mike Kuk and Cory Abramowicz
Entertainment, Mark Hegberg and Will Mak
Sessions, Jason Angeles, Chad Powell and Mike McDermott
Hospitality, Ron and Carolyn Vallort
Sustainability Project, Shona O'Dea and Fiona Martin
Chapter Sponsors, Brian Medina and Allen Merk
Website & Communication, Mike Infanger and Erik Raith

ASHRAE OFFICERS

Thomas H. Phoenix, P.E., President
T. David Underwood, P.Eng., President-Elect
Timothy G. Wentz, Treasurer
Darryl K. Boyce, P.Eng., Vice President
Charles E. Gulledge, III, Vice President
Bjarne W. Olesen, Ph.D., Vice President
James K. Vallort, Vice President
Jeff H. Littleton, Executive Vice President

CONFERENCES AND EXPOSITIONS COMMITTEE

Wade H. Conlan, Chair
Sarah E. Maston, Vice Chair
Abderrazak Alazazi
George W. Austin, Jr.
Chris A. Balbach
Walid Chakroun
Dimitris Charalambopoulos
David E. Claridge
Douglas C. Cochrane
Jon J. Cohen
Michael M. Collarin
Charlie D. Curlin, Jr.
Gary Debes
Kevin B. Gallen
Thomas H. Kuehn
Jennifer Leach
James F. Liston, Jr.
Cynthia Moreno
Robert A. Neely
Ann Peratt
Rachael Romero
Frank Schambach
Leon Shapiro
Jeffrey D. Spitler
Samir R. Traboulsi
Andrea Zarour
Dennis Alejandro, Consultant
Michael J. McDermott, Consultant

GENERAL INFORMATION

BADGES MUST BE WORN FOR ADMISSION TO SESSIONS

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

HOTEL ADDRESS, TELEPHONE

Palmer House Hilton, 17 East Monroe Street
Telephone: 312-726-7500 • Guest Fax: 312-263-2556

ONLINE REGISTRATION

Need to register or buy a ticket for social events, tours, or Learning Institute courses? You can register online throughout the conference. You can also register during registration hours in Upper Exhibit Hall, 4th floor of the Palmer House Hilton. Just come to registration to pick up your tickets or badge.

INTERNET ACCESS

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

Wireless internet will be available in all meeting rooms. ASHRAE will be working with the internet provider to manage the bandwidth so that member expectations of accessibility and speed are fulfilled. We have developed some history on how much bandwidth has been used during certain times but we would like to continue to request that everyone limit their usage to functions that do not use excessive bandwidth such as Facebook, YouTube, streaming video, etc. Access code for the wifi is ASHRAE15 and the code is case sensitive.

Take your 2015 ASHRAE Winter Conference experience into the 21st century with the ASHRAE App! This FREE App for mobile phones and tablets provides attendees with essential, real-time information.

Use the ASHRAE App as your digital guide to the 2015 ASHRAE Winter Conference in Chicago. This year's updated event lets you:

- Navigate the app with a newly streamlined dashboard
- Receive notifications of important announcements, such as schedule changes, straight to your device
- See what's around you in Chicago – find attractions, food, shopping and transportation
- Browse programs by day, type, topic or track
- Find your way around the conference with venue floor plans
- See and search a full list of conference presenters
- Learn more about our conference sponsors
- Message and set up appointments with fellow conference attendees (eligible-only feature)
- Access Virtual Conference presentations directly through your mobile device (registrant-only feature)

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

NOTICE

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

CELL PHONES/PAGERS

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

COMPANY-SPONSORED HOSPITALITY SUITE POLICY

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

SALE OF MERCHANDISE

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

SIGNS/DISPLAY OF AFFILIATE MEETING INFORMATION

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

PHOTO RELEASE

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

WHAT TO WEAR

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

LOST AND FOUND

Items found during the conference should be turned into the staff in the ASHRAE headquarters room, Salon 3, or ASHRAE registration. If you have misplaced something during the conference please check these two locations as well as security with the hotel and convention center.

TECHNICAL PROGRAM PDHs

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

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

SCANNING

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

MEETING PAPERS

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

VIRTUAL CONFERENCE *Free for Paid Conference Registrants*

ASHRAE is offering a virtual conference option so you won't miss the state-of-the-art concepts and latest design techniques presented in the Society's technical program. The Chicago 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 posted online. If you do not have your password and link, go to www.ashrae.org/Chicagovirtual and click on the link to access the Virtual Conference and put in your email address to request your password.

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations
- Access to all seminar presentations
- Access to all technical paper session presentations
- Ability to post questions or answers for selected sessions through Wednesday, Feb. 11. Presentations available online for 18 months.

A full slate of technical programs will be posted beginning Monday, Jan. 26, of the sessions that were presented the previous day, with additional content posted through Wednesday, Jan. 28.

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

AHR EXPO®

McCormick Place Convention Center
2301 South Lakeshore Drive

Hours:

Monday, January 26	10:00 a.m.–6:00 p.m.
Tuesday, January 27	10:00 a.m.–6:00 p.m.
Wednesday, January 28	10:00 a.m.–4:00 p.m.

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

If you are attending the exposition only and you did not register in advance, the fee for admission is $30.00 and can be paid at the McCormick Place Convention Center. Registration for the AHR Expo® will be open from Noon to 4:00 p.m. on Sunday, January 25. Starting Monday, you can register at 8:00 am and one hour before the doors open on Tuesday and Wednesday.

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

Shuttle service to and from the McCormick Place Convention Center will be provided from the Palmer House Hilton. Shuttle pick-up will be at the Wabash Street entrance.

Shuttle service on Monday will run from 7am-7pm and will run approximately every 20 minutes. Hours for Tuesday will be 8:00 am-7:00 pm and 8:00 am-6:00 pm on Wednesday.

Signs will advertise the shuttle schedule. Shuttle service does not operate from hotel to hotel.

SOME COMMON SENSE SAFETY TIPS

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

Hotel Safety. Some general safety tips include: Don't answer the door in a hotel room without verifying who it is. If a person claims to be an employee, call the front desk and ask if a staff person is supposed to have access to your room and for what purpose. Use the hotel safe-deposit box. When you're in your hotel room, use all of the locking devices provided. Don't reveal your room number or discuss plans for leaving the hotel within earshot of strangers.

EMERGENCY SITUATIONS

Hotel emergencies should be directed to the hotel operator; for police and fire department emergencies dial 911. Hotel security is trained in emergency response and can get to the scene of an emergency quickly if medical assistance is needed.

The closest hospital is **Northwestern Memorial**,
251 East Huron Street. General Information: (312) 926-2000,
Emergency: (312) 926-5188.

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 Chicago 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 Palmer House, 4th floor exhibit hall.

Location: Palmer House, Spire Parlor, 6th floor

Hours

Saturday, January 24 . . . . . 7:30 a.m. – 3:00 p.m.
Sunday, January 25 . . . . . 7:30 a.m. – 4:00 p.m.
Monday, January 26. . . . . 7:30 a.m. – 4:00 p.m.
Tuesday, January 27 . . . . . 7:30 a.m. – 4:00 p.m.
Wednesday, January 28 . . . . 7:30 a.m. – 1:00 p.m.

Meet and Greet

MONDAY, JANUARY 26
9:30 a.m. – 11:00 a.m.

Valerie Beck will be the speaker during the Meet and Greet
Eat Chocolate, Be Skinny: Chocolate-Enhanced Wellness

"One of the main questions I'm asked is 'how do you eat all that chocolate and stay so skinny?' I always reply that I eat artisan chocolate instead of commercial chocolate, and live a healthy lifestyle. Many of you have asked for more details, so I'll share them with you!

Hear my tips on chocolate-enhanced wellness, presented in a fun and uplifting way, including:

- the number 1 ingredient to beware of in commercial chocolate,
- how to decode chocolate bar labels and identify the right kind of artisan chocolate,
- how to maximize chocolate's health benefits,
- how to avoid GMOs and artificial ingredients,
- what "natural ingredients" are and why they sometimes mean you should back away from the shelf,
- how to taste and enjoy fine chocolate – which you will learn during the program"

Valerie Beck, a native of Chicago and lifelong chocolate aficionado, first had the idea to start chocolate tours when she was a 19-year-old Harvard College senior on a study-abroad trip to Paris. There, she tasted her first piece of truly first-class chocolate, and found her mission to share artisan chocolate with others. She led impromptu tours for friends, taking them to her favorite chocolate shops and bakeries, and took friends to Belgium to tour and sample chocolate shops there as well. This beginning led to Valerie's founding of Chicago Chocolate Tours and the Onward And Upward Travel Club.

There will be samples!

PRESIDENT'S LUNCHEON

Monday, January 26, 12:15-2 p.m.
(Doors open at 12N)
Palmer House, Grand Ballroom (4)

2014-15 ASHRAE President Tom Phoenix, P.E., Fellow ASHRAE, BEAP, BEMP, provides an update on his presidential theme, "People, Passion, Performance." Major contributors to the ASHRAE RP Campaign also are recognized.

Cost: **$50**

WOMEN IN ASHRAE CONTINENTAL BREAKFAST

Monday, January 28, 7:00 – 8:30 a.m.
Palmer House, Buckingham (5)

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

MEMBERS' NIGHT OUT

Reception, Cash Bar, 6:15 p.m. – 7:00 p.m.
Palmer House Ballroom Foyer
Dinner, 7:00 p.m.-9:00 p.m.
Grand Ballroom (4)

Entertainment

Shuffle up and Deal
State Ballroom
Come embrace another Chicago "back room" action casino party. Plan to test your skill or just stay and enjoy the fun. Enjoy a few songs performed by the Rat Pack singers.

Tickets for the event may be purchased at the ASHRAE registration desk, Palmer House, 4th floor exhibit hall. Online ticket purchases will be available until 4:15 p.m. on Tuesday.

Cost: **$60**

Attire: Business casual, sport coat, sport shirt for the gentlemen. Dressy casual for the ladies.

PLENARY SESSION KEYNOTE SPEAKER – ARON RALSTON

Saturday, January 24

Fearless Adventurer and Subject of the Film *127 Hours*

Growing up in Ohio and Indiana before moving to Colorado with his family in 1987, Aron Ralston had little exposure to the wild outdoors, but by the time he hiked into a remote area of Utah's canyon country in April of 2003, he was an experienced outdoorsman out for a walk in the park. Seven miles into the canyon that day, Aron accidentally dislodged a boulder that crushed and pinned his right hand. After six days of entrapment alone, he freed himself with a cheap multi-tool knife and hiked to a miraculous rescue.

Since his amputation, Aron has written an internationally bestselling book, Between a Rock and a Hard Place, spoken to hundreds of audiences around the world, and interviewed with Tom Brokaw, David Letterman, and Jay Leno.

With new prosthetic arms that he designed, Aron returned to his outdoor passions: he finished climbing Colorado's 59 "Fourteeners," in winter, solo; he's skied from the summit of Denali, North America's highest mountain; and, he's led a rafting expedition through the Grand Canyon.

Today, Aron lives in Boulder, Colorado, where he advocates for wilderness protection, and where, in February 2010, he embarked on his biggest adventure yet: raising his toddler son, Leo.

127 Hours, the major-motion-picture adaptation of his book, directed by Danny Boyle and starring James Franco, was nominated for 6 Oscars. Aron's only disappointment was that the soundtrack didn't have enough songs by his favorite band, Phish.

Aron was an associate member of ASHRAE for 5 years and was a corresponding member of TC 9.11.

WELCOME PARTY

Saturday, January 24
6:30–8:30 p.m.

The Welcome Party will be held at the Chicago Cultural Center, a few walkable blocks from the Palmer House Hilton.

About the Chicago Cultural Center
Drawn by its beauty and the fabulous free public events, hundreds of thousands of visitors come to the Chicago Cultural Center every year, making it one of the most visited attractions in Chicago. The stunning landmark building is home to two magnificent stained-glass domes, as well as free music, dance and theater events, films, lectures, art exhibitions and family events.

Completed in 1897 as Chicago's first central public library, the building was designed to impress and to prove that Chicago had grown into a sophisticated metropolis. The country's top architects and craftsmen used the most sumptuous materials, such as rare imported marbles, polished brass, fine hardwoods, and mosaics of Favrile glass, mother-of-pearl and colored stone, to create an architectural showplace. Located on the south side of the building, the world's largest stained glass Tiffany dome – 38 feet in diameter with some 30,000 pieces of glass – was restored to its original splendor in 2008. On the north side of the building is a 40-foot-diameter dome with some 50,000 pieces of glass in an intricate Renaissance pattern, designed by Healy & Millet.

Cost: $60

MENU:

- Carving Stations include Sage Roasted Turkey Breast and Honey Glazed Ham
- Antipasto Platter with Italian Meats and Cheeses, Marinated Olives, Roasted Peppers, Mushrooms, Crostini, Focaccia Chips, Sliced French Bread
- Crispy Breaded Baby Calamari
- Batter Dipped Garlic Oregano Chicken Wings
- Penne Pasta with Alfredo Sauce and Broccoli
- Baked Goat Cheese with Homemade Marinara Sauce
- Open bar

Desserts:

- Homemade Caramel, Fudge Walnut and Cream Cheese Brownie Wedges
- Gourmet Turtle, Raspberry Thumbprint & Dusted Wedding Cookies
- Mini pastries including Chocolate Mousse, Cheesecake, Lemon Chiffon & Carrot Cake
- White and Dark Chocolate Almond Bark

The Cultural Center is approximately a 6 minute walk. Take a right out of the Palmer House and a left on Wabash. Two blocks to E. Washington, cross at E. Washington and take a right. The Cultural Center is on E. Washington.

For those who prefer to take a shuttle we will begin shuttling from the Wabash Street entrance at 6:20 pm. The shuttles will run every 20 minutes from the Palmer House to Cultural Center and back. There will be staff at both locations to assist in loading and maintaining the schedule.

Price Per Entrée:
$=$5-$10 **$$**=$10-$15 **$$$**=$15-$25 **$$$$**=$25 & up

RESTAURANTS NEAR THE PALMER HOUSE

Atwood Café: 1 W. Washington (Continental / American)
($$) ** 312-368-1900 (GF) ***Reservations Suggested***
Exit the **State Street Door**, turn right and walk 2 ½ blocks north to **Washington**. The **Atwood Café** is on the southwest corner of **State & Washington**.

Berghoff: 17 W. Adams (German American)
($$) ** 312-427-3170 ***Reservations Suggested***
Exit the **State Street Door**, turn left on **State** and walk 1block south to **Adams**. At Adams turn right and cross the street**.** **Berghoff's** is on your left. (Closed on Sunday)

Catch 35: 35 W. Wacker (Seafood)
($$ – $$$) ** 312-346-3500 (GF) ***Reservations Suggested***
Exit the **State Street Door** and turn right. Walk north on **State** for approx. 5 blocks to **Wacker Drive** and turn left. **Catch 35** is on your left.

Elephant & Castle: 185 N Wabash (English Pub)
($ – $$) ** 312-345-1710 ***Reservations Not Necessary***
Exit the **Wabash Street Door**, turn left and walk 4½ blocks north on to the Pub. **Elephant & Castle** is on your right.

Flat Top Grill: 30 S Wabash (Asian / American)
($$) ** 312-726-8400 (GF) ***Reservations Not Necessary***
Exit the **Wabash Street Door** turn left and cross the street. **Flat Top Grill** will be on the left

The Gage: 24 S. Michigan Ave (Gastro Pub)
($$ – $$$) ** 312-372-4243 (GF upon request)
Reservation Suggested
Exit the **Monroe Street Door** and turn right. Walk 1 block east to **Michigan** turn left and cross the street The **Gage** is ½ block up on the left.

Giordano's: 135 E. Lake (Pizza)
($$) ** 312-616-1200 ***Reservations Not Accepted***
Exit the **Monroe Street Door** and turn right. Walk 1block east to **Michigan** and turn left. Cross the street **(Monroe)** and walk north to **Lake Street**. At **Lake** turn right and cross **Michigan.** The restaurant is on the right.

Grillroom: 33 W. Monroe (American)
($$$ – $$$$) ** 312-960-0000 (GF upon request)
Reservations Suggested
Exit the **Monroe Street Door** turn left and cross the street. The **Grillroom** will be on left, across from the **Bank of America Theatre.**

Heaven On Seven: 111 N. Wabash – 7th fl (Cajun)
($$) ** 312-263-6443 ***Open only for Breakfast & lunch***
Exit the **Wabash Door** and turn left. Walk 1 ½ bocks north on **Wabash**. It will be on your right across from Macy's.

Hot Woks / Cool Sushi: 30 S Michigan (Sushi / Pan Asian)
($$) ** 312-345-1234 ***Reservation Not Necessary***
Exit **Monroe Street Door** turn right and walk 1 ½ blocks to **Michigan.** At **Michigan** turn left, cross the street and walk ½ block north. **Hot Woks / Cool Sushi** is on your left.

Italian Village: 71 W. Monroe (Italian)
($$ – $$$) ** 312-332-7005 (open late) ***Reservations Suggested***
Exit the **Monroe Street Door** turn left and walk approx 1 ½ blocks. **Italian Village** is on the left.

Khyber Pass: 233 E. Wacker Dr (Indian Cafe)
($$ – $$$) ** *312-856-1810 ***Reservation Suggested***
Exit the **Monroe Street Door** and turn right. Walk 1 block east to **Michigan Ave** and turn left. Walk 6 blocks north to **Wacker Drive** and turn right. **Khyber Pass** will be on the right side.

Lou Malnati's: 805 S. State (Chicago style pizza)
**** 312-786-1000** ***Reservations Not Accepted***
Exit the **State Street Door** and turn left. Walk south on **State** for approx.7 blocks**. Lou Malnati's** is on your left.

Mercat a la Planxa: 638 S. Michigan (Spanish Tapas)
($$ – $$$) ** 312-765-0524 (GF) ***Reservations Suggested***
Exit the **Monroe Street Door** and turn right. Walk 1 block to **Michigan Ave** and make a right. Proceed 6 blocks down **Michigan Ave**. **Mercat a la Planxa** is located on the right, inside of the Blackstone Hotel.

Morton's: 65 E. Wacker Place (Steak)
($$$$) ** 312-201-0410 (GF) ***Reservations Suggested***
Exit the **Wabash Street Door** and turn left. Walk approx.4 ½ blocks north to **Wacker Place (South Water Street)** and turn right. **Morton's** is on the right.

Park Grill: 11 N. Michigan (American)
($$-$$$) ** 312-521-7275 (GF upon request)
Reservations Suggested
Exit the **Monroe Street Door** and turn right. Walk 1 ½ blocks to **Michigan**. Turn left, cross the street **(Monroe**) and walk approx. 2 blocks north. **Park Grill** will be on your right in **Millennium Park.**

Petterino's: 150 N. Dearborn (Italian Steak House)
($$$) ** 312-422-0150 (GF) ***Reservations Suggested***
Exit the **Monroe Street Door** and turn left. Walk 1 ½ blocks west to **Dearborn** and make a right. Walk 3 blocks north to **Randolph** and cross the street. **Petterino's** will be on the left.

Pizano's: 61 E. Madison (Chicago style Pizza)
($$) ** 312-236-1777 (GF) ***Reservations Suggested***
Exit the **Wabash Street Door** turn left and walk 1 ½ blocks north to **Madison**. Turn right and cross the Street. **Pizano's** will be on the right.

Rhapsody: 65 E. Adams (American)
($$ – $$$) ** 312-786-9911 (GF upon request)
Reservations Suggested
Exit the **Wabash Street Door** turn right, walk to the corner **(Adams)** and cross the street**.** Turn left and cross the street **(Wabash).** Walk **½** block east, **Rhapsody** will be on your left.

Rosebud Prime: 1 S. Dearborn (Steak)
($$$$) ** 312-384-1900 **(GF)** ***Reservations Suggested***
Exit the **Monroe Street Door** turn left, walk 1 ½ blocks west to **Dearborn** and turn right. Cross the street **(Monroe)** and walk ½ block north. **Rosebud Prime** will be on the right.

Rosebud Theatre District: 70 W. Madison (Italian)
($$ – $$$) ** 312-332-9500 (GF request)
Reservations Suggested
Exit the **Monroe Street Door** turn left and walk 1½ blocks west to **Dearborn**. At **Dearborn** turn right and cross the street **(Monroe**). Walk 1 block north (**crossing Madison**). **Rosebud Theatre District** will be on your left. (Closed on Sundays)

Russian Tea Time: 77 E. Adams (Russian / Veg)
($$ – $$$) ** 312-360-0000 (GF upon request)
Reservations Suggested
Exit the **Wabash Street Door** and turn right. Walk south to the corner **(Adams).** Turn left, cross the street **(Adams)** and walk ½ block east. The **Russian Tea Time** will be on your right.

Sweetwater Tavern & Grille: 225 N. Michigan
($$$) ** 312-698-7111 (American Grill / Sports Bar)
Exit the **Monroe Street Door**, turn right and walk 1 ½ blocks east to **Michigan.** Turn left, cross the street **(Monroe)** and walk north on **Michigan** for approx. 4 – 5 blocks. **Sweetwater Tavern & Grille** will be on your right.

Tamarind: 614 S. Wabash (Pan Asian/Sushi)
($$) ** 312-379-0970 *Reservations Suggested*
Exit the **Wabash** Door, turn right and walk 5 blocks south on **Wabash. Tamarind** will be on the right.

Terzo Piano: 159 E Monroe (Cont. Italian)
($$ – $$$) ** 312-443-8650 *Reservations Suggested (Lunch)*
Exit the **Monroe Street Door,** turn right and walk approx 2 blocks east crossing **Michigan**. **Terzo Piano** is on the right inside the **Modern Wing of the Art Institute.**

Tavern at the Park: 130 E. Randolph (American)
($$ – $$$) ** 312-552-0070 (GF upon request)
Reservations Suggested
Exit the **Monroe Street Door**, turn right and walk 1½ blocks east to **Michigan.** Turn left, cross the street **(Monroe)** and walk 3 blocks north to **Randolph**. **Tavern at the P**ark is on the right.

Trattoria #10: 10 N. Dearborn (Northern Italian)
($$$) ** 312-984-1718 (GF request) ***Reservations Suggested***
Exit the **Monroe Street Door**, turn left and walk 1 ½ blocks west to **Dearborn**. At **Dearborn** turn right and walk 1-½ blocks north. **Trattoria #10** is on the left. (Closed on Sundays)

***** (GF) = Gluten Free, ****

FUTURE ASHRAE MEETINGS

Winter	Date	Annual
Chicago January 24–28	2015	Atlanta June 27–July 1
Orlando January 23–27	2016	St. Louis June 25–29
Las Vegas January 28–February 1	2017	Long Beach June 24–28

PAST ASHRAE MEETINGS

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

AWARDS PRESENTATION

Saturday, January 24, 3:15-5:30 p.m.
Plenary Session, Palmer House Hilton
Grand Ballroom

ASHRAE PIONEERS OF INDUSTRY AWARD

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

Carl Linde
Andrew Muhl

ASHRAE HONORARY MEMBER

"Given to recognize notable persons of preeminent professional distinction"

Stefano Marino, Ph.D.

STUDENT DESIGN PROJECT COMPETITION

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

HVAC System Selection
First Place: **John Gaito, Kathryn Helmer, Lexie Oliver, Alex Pint, Megan C. Walkowiak**, **Gordon Zimmerman**
Kansas State University (Faculty Advisors: Julia Keen and Fred Hasler)

HVAC Design Calculations
First Place: **Christopher Erickson, Ian Faulkner, DJ Marshall, Richard Suarez, Kristian Jack Szymanski, Ju Yong Yu**
University of Central Florida (Faculty Advisors: Nathaniel Boyd, Kyle Inge, Dr. Vazquez)

Applied Engineering Challenge
First Place: **Juan Silva, Nelson Echeverry**
California Polytechnic State University, San Luis Obispo (Faculty Advisors: Steffen Peuker, Jesse Maddren)

Integrated Sustainable Building Design
First Place: **Elyse Casper, Theresa Lindenau, Terra Moran, Mary Peterson, Martin Reaves**
Montana State University (Faculty Advisor: Kevin Amende)

TECHNOLOGY AWARDS

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

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

Category I – Commercial Buildings – New
Benjamin Frank Gozart, Tom J. Marseille, P.E., Charles Chaloeicheep, P.E. and **Tom C. Boysen Jr., P.E.** for
New Federal Center South – Building 12021
Owner, Duane Allen representing General Services Administration

Category I – Commercial Buildings – Existing
Roger (Jui-Chen) Chang, P.E. for Wayne N. Aspinall Federal Building & US Courthouse
Owner, Jason Sielcken representing General Services Administration

Category II – Educational Facilities – New
Brian A. Haugk, P.E. and **Brian B. Cannon** for Valley View Middle School
Owner, Snohomish School District No. 201

Category II – Other Institutional Buildings – New
Matthew William Longsine, P.E. and **Henry Di Gregorio** for Tacoma Center for Urban Waters
Owner, John Finke representing TES Properties

Category II – Other Institutional Buildings – Existing
Pietro Guerra, Ing. and **Kateri Heon, Ing.,** for Centre Civique de Dollard-des-Ormeaux
Owner, Guy Dube, Ville de Dollard-des-Ormeaux

Category III – Health Care Facilities – New
Mark Stavig, P.E. for Peace Island Medical Center
Owner, Ben Coon, PeaceHealth

Category IV – Industrial Facilities or Processes – Existing
William C. Weinaug, Jr., P.E. for Antarctica: Empire of the Penguin
Owner, Sea World Parks & Entertainment, Inc.

Category V – Public Assembly – New
Arthur Gilbert Sutherland, for Westhills Recreation Centre
Owner, City of Langford

Category V – Public Assembly – Existing
Jason Troy LaRosh, P.E., for Janesville Ice Arena Addition and Renovation
Owner, City of Janesville

ASHRAE DISTINGUISHED PUBLIC SERVICE AWARD

"Given in recognition of distinguished public service"

William A. Sigman, P.E.
Fishers, IN

E.K. CAMPBELL AWARD OF MERIT

presented by the Life Members' Club
"Given in recognition of outstanding service and achievement in teaching"

Charles H. Culp, Ph.D., P.E.
Texas A&M University

JOHN F. JAMES INTERNATIONAL AWARD

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

Kent Peterson, P.E.
Long Beach, CA

ASHRAE FELLOWS

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

Tony Costa, P.E., Napa, CA
Pankaj R. Dharkar, Ahmedabad, India
Egils Dzelzitis, Dr.-Ing., Ceng., Riga, Latvia
Bruce L. Flaniken, P.E., Houston, TX
Ravisankar Ganta, P.E., Waynesboro, GA
Donald J. Hay, Apodaca, N.L., Mexico
W. Luis Lagomarsino, Ing., Montevideo, Uruguay
Erin McConahey, P.E., Los Angeles, CA
Kirk T. Mescher, P.E., Columbia, MO
Daniel H. Nall, P.E., New York, NY
Ronald L. Petersen, Ph.D., Fort Collins, CO
Dusan Petras, Ph.D., Bratislava, Slovak Republic
Samir R. Traboulsi, Ph.D., P.Eng., Beirut, Lebanon
Donald J. Winston, P.E., Port Washington, NY

ASHRAE HALL OF FAME AWARD

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

Rolla Carpenter
Robert Tamblyn, P.Eng.

F. PAUL ANDERSON AWARD

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

Presidential Member A. Damon Gowan
Galveston, TX

UPCOMING CONFERENCES

2015 International Conference on Energy and Environment in Ships
May 22–24, 2015
Athens, Greece

ASHRAE 2015 Annual Conference
June 27–July 1, 2015
Atlanta, GA

ASHRAE Energy Modeling Conference
September 30–October 2, 2015
Atlanta, GA

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

Experience an ASHRAE conference first-hand!

www.ashrae.org/events

notes

ROOMS/HOURS

FINDING THE ASSIGNED MEETING ROOM

To assist you in finding your meeting room at the Winter Conference, please refer to the floor plans located in the front of this program. Meetings are scheduled in the Palmer House Hilton.

CONFERENCE REGISTRATION

Upper Exhibit Hall, 4th Floor

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

Friday, January 23	10:00 a.m.–5:00 p.m.
Saturday, January 24	7:15 a.m.–6:00 p.m.
Sunday, January 25	7:00 a.m.–5:00 p.m.
Monday, January 26	7:00 a.m.–5:00 p.m.
Tuesday, January 27	7:30 a.m.–4:30 p.m.
Wednesday, January 28	7:30 a.m.–11:00 a.m.

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

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

ASHRAE BOOKSTORE

Upper Exhibit Hall, 4th Floor

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

Friday, January 23	10:00 a.m.–5:00 p.m.
Saturday, January 24	7:15 a.m.–6:00 p.m.
Sunday, January 25	7:00 a.m.–5:00 p.m.
Monday, January 26	7:00 a.m.–5:00 p.m.
Tuesday, January 27	7:30 a.m.–4:30 p.m.
Wednesday, January 28	7:30 a.m.–1:00 p.m.

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

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

AHR EXPO®

McCormick Place Convention Center
2301 South Lakeshore Drive

Hours:

Monday, January 26	10:00 a.m.–6:00 p.m.
Tuesday, January 27	10:00 a.m.–6:00 p.m.
Wednesday, January 28	10:00 a.m.–4:00 p.m.

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

If you are attending the exposition only and you did not register in advance, the fee for admission is $30.00 and can be paid at the McCormick Place Convention Center. Registration for the AHR Expo® will be open from Noon to 4:00 p.m. on Sunday, January 26. Starting Monday, you can register one hour before the doors open.

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

Shuttle service to and from the McCormick Place Convention Center will be provided from the Palmer House Hilton. Shuttle pick-up will be at the Wabash Street entrance. Shuttle service will run from 7am-7pm and will run approximately every 20 minutes. Signs will advertise the shuttle schedule. Shuttle service does not operate from hotel to hotel.

AHR BAR CODES

Exhibitors will scan your badge if you have interest in receiving product information from an exhibitor. This is another step toward greening our events. Contact information provided on the bar code may be distributed to all AHR exhibitors but only includes name and mailing address. No emails are captured.

ALI COURSES

Registration for the ASHRAE Learning Institute courses being held at the McCormick Place Convention Center is available at either the ASHRAE registration at the Palmer House Hilton or at McCormick, North Hall Registration Lobby, 3rd Floor. Registration will open at McCormick Convention Center on Sunday from 9:00 a.m.–3:00 p.m., Monday from 8:00 a.m.–6:00 p.m. and Tuesday from 8:00 a.m.–6:00 p.m. Online registration will close at midnight on the evening prior to the course.

ASHRAE LOUNGE

Spire Parlor, 6th Floor

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

This room will be open during the following hours:

Saturday, January 24	7:30 a.m.–3:00 p.m.
Sunday, January 25	7:30 a.m.–4:00 p.m.
Monday, January 26	7:30 a.m.–4:00 p.m.
Tuesday, January 27	7:30 a.m.–4:00 p.m.
Wednesday, January 28	7:30 a.m.–1:00 p.m.

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

TOURS

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

SPEAKERS' LOUNGE

Upper Exhibit Hall, 4th Floor

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

Saturday, January 24	1:00 p.m.–3:00 p.m.
Sunday, January 25	7:00 a.m.–5:00 p.m.
Monday, January 26	7:00 a.m.–12:15 p.m. and 1:30 p.m.–4:30 p.m.
Tuesday, January 27	7:00 a.m.–5:00 p.m.
Wednesday, January 28	7:00 a.m.–1:00 p.m.

PRESS ROOM
Upper Exhibit Hall, 4th Floor
The Press Room will be open during the following hours:

Saturday, January 24	8:00 a.m.–3:00 p.m.
Sunday, January 25	8:00 a.m.–3:00 p.m.
Monday, January 26	9:00 a.m.–5:00 p.m.
Tuesday, January 27	9:00 a.m.–3:00 p.m.

HEADQUARTER OFFICE
Salon 3, 3rd Floor
The ASHRAE Headquarter Office offers members complimentary copying, services of a typist, and access to printers for laptop computers. The Headquarter Office will be open during the following hours:

Friday, January 23	Noon–5:00 p.m.
Saturday, January 24	8:00 a.m.–5:00 p.m.
Sunday, January 25	8:00 a.m.–5:00 p.m.
Monday, January 26	8:00 a.m.–5:00 p.m.
Tuesday, January 27	8:00 a.m.–5:00 p.m.
Wednesday, January 28	8:00 a.m.–1:00 p.m.

MEMBERSHIP INFORMATION DESK
Upper Exhibit Hall, 4th Floor
A Membership Information Desk is available for paying dues, applying for membership, updating membership information, and purchasing ASHRAE logo items. This desk is open during the same hours as registration, so feel free to stop by if you have any questions concerning your ASHRAE membership.

YOUNG ENGINEERS IN ASHRAE (YEA) HOSPITALITY SUITE
Potter's Lounge, Lobby Level
Attention members age 35 and younger! You are invited to visit the Young Engineers in ASHRAE (YEA) Hospitality Suite to be held on Sunday, January 25, from 4:00 p.m.–6:00 p.m. The hospitality offers social and networking opportunities and light refreshments will be available.

A YEA/student mixer will be held Saturday, January 24, from 5:00 p.m.–6:30 p.m. in the Red Lacquer room of the Hilton on the 4th floor. Come join us to meet other young ASHRAE members!

LEADERSHIP U
At each ASHRAE conference, the Leadership U program gives four future ASHRAE leaders the opportunity to shadow an ASHRAE Board member, providing a high level conference experience and unique networking opportunity. This program is operated by the Young Engineers in ASHRAE (YEA) Committee and more information can be found at www.ashrae.org/yea. The Leadership U participants for the 2015 ASHRAE Winter Conference are:

William (Burns) Bradford, Central Florida Chapter, Region XII
Yunzhi (Lucy) Huang, Mid-Columbia Chapter, Region XI
Richard Kimball, Central New York Chapter, Region I
Ted Zachwieja, West Virginia Chapter, Region VII

STUDENT ACTIVITIES
Red Lacquer, 4th Floor
Plan to join the Student Welcome and Orientation on Saturday, January 24 from 2:00 p.m.–3:00 p.m. in Red Lacquer room, 4th floor.

The Student Program will also be held in the Red Lacquer room on Sunday, January 25 from 9:00 a.m.–2:00 p.m. Take advantage of this opportunity to learn more about ASHRAE while becoming acquainted with your fellow students and ASHRAE members. There will be a speaker, design competition and grant award presentations, and a career panel. Don't miss the free student items and the raffle for your chance to win cool prizes! Activities for students are a unique feature of the ASHRAE Winter Conference—a foundation on which to build your network of resources for your future in the HVAC&R industry.

The Student Tour to Ann & Robert H. Lurie Children's Hospital of Chicago will depart from the Palmer House Hilton Wabash entrance at the following time:

First tour 2:15-3:15
Second tour 3:00-4:00
Third tour 4:00-5:00 p.m.

Tickets are $25 and may be purchased at the ASHRAE registration in the 4th floor exhibit hall.

WOMEN IN ASHRAE CONTINENTAL BREAKFAST
Monday, January 26, 7:00 – 8:30 a.m.
The purpose of this event is to encourage women to be active ASHRAE participants at the chapter, region, and/or society level and to give them ideas and information about how to do so. Current ASHRAE members will be on hand to provide insight and to share their experiences. Pastries and coffee will be served. The breakfast required a reservation and is now full.

CHICAGO HOST COMMITTEE INFORMATION DESK
Upper Exhibit Hall, 4th Floor
The Host Committee will have an information desk located at the ASHRAE registration area. General information about the sights of the city will be available, and a host committee member will be present to answer questions about Chicago.

Information Desk hours will be Saturday and Sunday from 8:00 a.m.–2:00 p.m. and Monday from 8:00 a.m.–Noon. Please take a few minutes to stop by and discover some of the activities available to you in the Windy City.

ATLANTA CONFERENCE INFORMATION
Upper Exhibit Hall, 4th Floor
Information on the upcoming Annual Conference June 27–July 1, 2015, in Atlanta, GA will be available in the registration area. Also, information is online at www.ashrae.org/Atlanta

SCHEDULE

Location of Meetings

To assist you in finding your meeting room at the Winter Conference, please refer to the floor plans located in the front of this program. Meetings are scheduled in the Palmer House Hilton. The number in parenthesis indicates the floor location. The floor plans also show which elevator (E1, E2) goes to what location on each floor. The conference app also has floor plans.

Meeting Schedule

FRIDAY, JANUARY 23

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 56–72

10:00 am–5:00 pm **Registration**, Palmer House, Upper Exhibit Hall (4)

ASHRAE Bookstore, Palmer House, Upper Exhibit Hall (4)

SATURDAY, JANUARY 24

7:30 am–3:00 pm **ASHRAE Lounge,** Palmer House, Spire Parlor (6)

7:15 am–6:00 pm **Registration**, Palmer House, Upper Exhibit Hall (4)

ASHRAE Bookstore, Palmer House, Upper Exhibit Hall (4)

8:00 am–3:00 pm **Press Room,** Palmer House, Upper Exhibit Hall (4)

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 56–72

1:00 pm–3:00 pm **Speakers' Lounge,** Palmer House, Upper Exhibit Hall (4)

2:00 pm–3:00 pm **Student Orientation,** Palmer House, Red Lacquer (4)

Special Event

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

Plenary Session, Grand Ballroom (4)

Opening and Welcoming Remarks by ASHRAE President **Thomas H. Phoenix**

Welcome by Director and Chair, Region VI, **Mark Miller**

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

Awards Presentation
See page 18 for details

Keynote Address: **Aron Ralston**
See page 15 for details

Plenary Session is open, no badge nor registration is required to attend.

5:00 pm–6:30 pm **YEA/Student Mixer**, Palmer House, Red Lacquer (4)

Special Event

6:30 pm–8:30 pm **Welcome Party**, Chicago Cultural Center
See page 15 for details

Note: $60 ticket per person required. Tickets may be purchased online 24/7 or at the ASHRAE Registration Desk; Pick up your ticket at ASHRAE Registration. Advance-purchase tickets may be picked up at the door if after registration hours.

SUNDAY, January 25

7:00 am-–5:00 pm **Speakers' Lounge,** Palmer House, Upper Exhibit Hall (4)

7:00 am-–5:00 pm **Registration**, Palmer House, Upper Exhibit Hall (4)

ASHRAE Bookstore, Palmer House, Upper Exhibit Hall (4)

7:30 am–4:00 pm **ASHRAE Lounge**, Palmer House, Spire Parlor (6)

8:00 am–12:00 pm **General Tour:** Something for Everyone, the City of Chicago

8:00 am–4:45 pm **Technical Sessions**
See Technical Program on pages 33–55

8:00 am–3:00 pm **Press Room**, Palmer House, Upper Exhibit Hall (4)

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 56–72

9:00 am–2:00 pm **Student Program**, Palmer House, Red Lacquer (4)
See description on page 21

1:00 pm–5:00pm **General Tour:** Devil in the White City

2:15 pm–3:15 pm **Student Technical Tour:** Ann & Robert H. Lurie Children's Hospital of Chicago

3:00 pm–4:00 pm **Student Technical Tour:** Ann & Robert H. Lurie Children's Hospital

4:00 pm–5:00 pm **Student Technical Tour:** Ann & Robert H. Lurie Children's Hospital
See descriptions on pages 24–26

4:00 pm–6:00 pm **Young Engineers in ASHRAE** (YEA) Hospitality Suite, Palmer House, Potter's Lounge, Lobby Level

Attention members age 35 and younger—you are invited to visit the YEA Hospitality Suite, offering social and networking opportunities Light refreshments will be available.
See page 21 for details

MONDAY, January 26

7:00 am–8:30 am **Women in ASHRAE Continental Breakfast**, Palmer House, Buckingham (5)

7:00 am–12:15 pm **Speakers' Lounge**, Palmer House, Upper Exhibit Hall (4)

7:00 am–5:00 pm **Registration**, Palmer House, Upper Exhibit Hall (4)

7:00 am–5:00 pm **ASHRAE Bookstore**, Palmer House, Upper Exhibit Hall (4)

7:30 am–4:00 pm **ASHRAE Lounge**, Palmer House, Spire Parlor (6)

8:00 am–12:00 pm **Technical Sessions**
See Technical Program on pages 33–55

9:00 am–9:30 am **Networking Coffee Break**, Two locations are available: **6th Floor** and **Mezzanine**

9:00 am–5:00 pm **Press Room**, Palmer House, Upper Exhibit Hall (4)

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 56–72

10:00 am–6:00 pm **AHR Expo®**, McCormick Place Convention Center
2301 South Lakeshore Drive

If you are registered for the ASHRAE Conference, your conference badge is admission into the exposition; if attending exposition only and not registered in advance, admission is $30.00 at the exposition. *Note:* No one under 16 admitted; ages 16 and 17 will be admitted only if accompanied by an adult. Shuttle service to and from the McCormick Place Convention Center will be provided from the Palmer House. Shuttle pick-up will be at the Wabash Street entrance.

Shuttle service will run from 7am–7pm on Monday and will run approximately every 20 minutes. Schedule for Tuesday will be 8:00 am–7:00 pm and 8:00 am– 6:00 pm on Wednesday. Signs will advertise the shuttle schedule. Shuttle service does not operate from hotel to hotel.
See page 20 for details

10:15 am–11:45 am **Student Congress**, Palmer House, Salon 1 (3)

Special Event

12:15 pm–2:00 pm **President's Luncheon**
(doors open at noon), Palmer House, Grand Ballroom (4)

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

1:30 pm–4:30 pm **Speakers' Lounge**, Palmer House, Upper Exhibit Hall (4)

2:15 pm–5:00 pm **Technical Sessions**
See Technical Program on pages 33–55

2:30 pm–4:30pm **Technical Tour:** Walgreens Net Zero Store

2:30 pm–5:00 pm **Technical Tour:** Refrigeration for Craft Brewing Half Acre Beer Co.

2:30 pm–5:30 pm **General Tour:** Immigrant to Elite

General Tour: Lifestyles of the Rich and Famous
See descriptions on pages 24–26

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

TUESDAY, January 27

7:00 am–5:00 pm **Speakers' Lounge**, Palmer House, Upper Exhibit Hall (4)

7:30 am–4:30 pm **Registration**, Palmer House, Upper Exhibit Hall (4)

ASHRAE Bookstore, Palmer House, Upper Exhibit Hall (4)

7:30 am–4:00 pm **ASHRAE Lounge**, Palmer House, Spire Parlor (6)

8:00 am–4:45 pm **Technical Sessions**
See Technical Program on pages 33–55

9:00 am–3:00 pm **Press Room**, Palmer House, Upper Exhibit Hall (4)

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 56–72

10:00 am–6:00 pm **AHR Expo®**, McCormick Place Convention Center

11:30am– 2:30pm **General Tour:** Chicago Film Tour
See description on page 25

Noon–1:30 pm **Life Members' Lunch**, Salon 2 (3)
Note: Ticket required.

2:00 pm–4:00 pm **Technical Tour:** Motorola Mobility Global Corporate Headquarters

2:30 pm–3:30 pm **Technical Tour:** McCormick Place Campus Energy Center Tour
See descriptions on page 26

Special Event

6:15 pm–7:15 pm **Reception**, Palmer House, Grand Ballroom Foyer (3)

7:30 pm–10:30 pm **Members' Night Out**, Palmer House, Grand Ballroom (4)
See page 14 for details
Note: Ticket required.

WEDNESDAY, January 28

7:00 am–1:00 pm **Speakers' Lounge**, Palmer House, Upper Exhibit Hall (4)

7:30 am–10:00 am **Registration**, Palmer House, Upper Exhibit Hall (4)

7:30 am–1:00 pm **ASHRAE Bookstore**, Palmer House, Upper Exhibit Hall (4)

7:30 am–1:00 pm **ASHRAE Lounge**, Palmer House, Spire Parlor (6)

8:00 am–12:30 pm **Technical Sessions**
See Technical Program on pages 33–55

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 56–72

10:00 am–4:00 pm **AHR Expo®**, McCormick Place Convention Center

CHICAGO GENERAL TOURS

All tours depart from the Wabash Street entrance of the Hilton. Tours will depart promptly at times indicated.

Tour tickets may be purchased at the ASHRAE Registration desk in the Upper Exhibit Hall, 4th floor of the Palmer House.

Stand-by tour tickets are distributed 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 at the bus. Credit cards are accepted.

Something for Everyone, the City of Chicago

Sunday, Jan. 25
8 a.m.-noon
Cost: $60

On this "very important person (VIP) access" guided tour, see highlights of the "Windy City". Because there are so many sites to see in this great city, your guide takes you through a special personalized tour of the city highlighting the best areas and must see attractions. Tour includes areas such as:

The Loop:
Old and new architecturally significant sites include the Daley Center, Marina City, Willis Tower, Merchandise Mat, Harold Washington Library, Chicago Board of Trade and LaSalle Street, St. Patrick's Church (oldest in the city!), The El, and the state-of-the-art State of Illinois Center and Chicago's public art-Calder's Flamingo, Picasso's sculpture at the Daley Center, Miro's lady, Oldenburg's bat column and Chagall's mosaic wall.

The Lakefront:
Drive through almost the entire 26 miles of Chicago's lakefront park system, including the new Millennium Park, passing major museums. Buckingham Fountain, Soldier Field, McCormick Place, renewed Navy Pier and the breathtaking Chicago skyline.

Near North Side:
Michigan Avenue's Magnificent Mile: John Hancock Building, Tribune Tower, Wrigley Building, Water Tower Place, old Chicago Water Tower, Chicago's Gold Coast, the Chicago archdiocese home, the Chicago Historic Society, Lincoln Park and the Lincoln Park Conservatory. Stops will include the Lincoln Park Conservatory for the Spring Garden Show and a local Pilsen Bakery.

Near West Side:
University of Illinois Chicago Campus, Jane Addams' Hull House, Maxwell Street Market, Greektown, and the Chicago Fire Academy, located where the Great Chicago Fire of 1871 began its devastating course, Pilsen neighborhood for some delicious treats.

South Side:
See the site of the World Columbian Exposition of 1893, the Museum of Science and Industry, the Gothic splendor of the University of Chicago, Frank Lloyd Wright's landmark Robie House, Rockefeller Chapel, and the site of the first self-sustaining nuclear reaction, commemorated by Henry Moore's sculpture "Nuclear Energy."

Devil in the White City

Sunday, Jan. 25
1-5 p.m.
Cost: $60

This tour recounts two simultaneous events in Chicago's history: the World's Columbian Exposition of 1893 and the emergence of America's first mass murderer. "The Devil in the White City" bus tour is based on Erik Larson's bestselling book. First, visit the Fair through a slideshow presentation featuring many period photographs. Next is a bus tour to see many of the buildings and places that Fairgoers would have seen, emphasizing the profound effect the Fair had on Chicagoans' lives and how, in turn, changing lifestyles shaped this built environment.

Guests begin their tour with a slideshow presentation at the Chicago Architecture Foundation on Michigan Avenue, a short two block walk from the Palmer House.

Immigrant to Elite

Monday, Jan. 26
2:30-5:30 p.m.
Cost: $55

Time spent in Chicago is a study in contrasts. Discover the contributions made by various ethnic groups, followed by experiencing the elegant lifestyle attained by successful citizens who became leaders of this community.

Jane Addams Hull House – visit the original suburban home of real estate developer Charles Hull, built in 1856. The exhibits tell the story of the changes of this area, the creation of America's first settlement house by Jane Addams and the ethnic groups that have passed through the neighborhood.

St. James Episcopal Cathedral – stop at the magnificent church built in the 1870s by the privileged class. Restored to its original decoration of the Arts and Craft movement, it is maintained today for all to share. The period stained glass windows created by master craftsmen still shine in all their glory.

Lifestyles of the Rich and Famous

Monday, Jan. 26
2:30-5:30 p.m.
Cost: $55

Even Robin Leach would be impressed by the lifestyles that early Chicagoans of means enjoyed. Spend the afternoon exploring where they lived, worked and played. The stories include how fortunes were made and what contributions were made to Chicago by these very successful people. See the elegant residences and churches created by and for the city's Who's Who.

Southside Mansion – Tour a once suburban mansion built in 1870 in the first elite neighborhood of the city. Built on the southern outskirts, today very much within the city's center. This "Prairie Avenue" neighborhood still has several of its palatial homes.

South Shore Country Club – Visit the beautifully restored South Shore Country Club. The spacious and period grand halls recall the leisure life of its illustrious membership.

1870's Church – Stop at a magnificent church created by the privileged class of 1870's. Restored to its original beauty, it continues to be a perfect backdrop for its grand collection of Tiffany windows.

College Gothic Campus – The distinguished University of Chicago developed with the early support of John D. Rockefeller and continued by family members. Architect Henry Cobb created the initial campus.

Hyde Park – Drive through the area developed for the World Columbian Exposition of 1893. After the Exposition many of Chicago's wealthy and well to do choose to build their elegant residences here ... 7 miles south of downtown.

Chicago Film Tour

Tuesday, January 27
11:30 a.m.-2:30 p.m.
Cost: $105 *(includes lunch, a Chicago gift bag and refreshments)*

Hop aboard the Chicago Film Tour to cover 30 miles, venturing from Chinatown to Uptown, Lakeview to Downtown and everything in between. The Chicago Film Tour hits more than 30 sites where over 80 movies were shot, from Hollywood blockbusters like The Dark Knight and The Fugitive to Chicago favorites like Ferris Bueller's Day Off and The Blues Brothers to movie classics like North by Northwest and The Sting.

Climb into a luxury motor coach and see the city from the director's chair. At each location, watch scenes come to life on multiple video screens while getting up close and personal with memorable locations. Whether you are a movie lover or just a couch potato looking for a novel way to experience the Windy City, Chicago Film Tours has something for you.

Halfway into the tour is a stop at O'Brien's Steakhouse in Old Town, famous for the scenes shot for the Color of Money starring Tom Cruise. Other stops include Union Station, the Green Mill and Oz Park, where guests will be able to get off the bus and explore on their own. The tour includes lunch.

ASHRAE TECHNICAL TOURS

ASHRAE Conference technical tours give you a first-hand look at technology developed by members to further the industry.

All tours depart from the Wabash Street entrance of the Hilton. Tours will depart promptly at times indicated.

Tour tickets may be purchased at the ASHRAE Registration desk in the Upper Exhibit Hall, 4th floor of the Palmer House. There is limited space per tour.

Stand-by tour tickets are distributed 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 at the bus. Credit cards are accepted.

Student Tour

Sunday, Jan. 25

Three tour times are offered due to capacity limitations at the facility. Each tour can accommodate 45 participants.

2:15-3:15 p.m.
3:00-4:00 p.m.
4:00-5:00 p.m.

Cost: $25

The Ann & Robert H. Lurie Children's Hospital of Chicago (formerly Children's Memorial Hospital) is the largest inpatient pediatric hospital in Chicago. The facility is a 1.25 million square foot, 288-bed hospital, constructed on the Northwestern University Feinberg School of Medicine campus. The facility provides clinical, academic, and research opportunities. It is one of the world's greenest children's hospitals.

The tour will take approximately an hour and will include an overview/presentation and give students access to Generators, AHU's, Boilers, Med Gas, etc

Walgreens Net Zero Store

Monday, Jan. 26
2:30-4:30 p.m.
Cost: $35

The Walgreens Co., a global retail pharmacy brand with over 8,000 stores, set out with a vision to create a showcase for innovative, sustainable, high-performance design at a retail location without altering the operational characteristics of the building in order to make it as highly-scalable as possible. The company also had a goal to share this information with the sustainability, architecture, and retail communities as a means of encouraging the adoption of green building practices wherever reasonably feasible.

This tour goes behind the scenes of the design, construction and on-going operation of the building. The store features 840 photovoltaic panels, two wind turbines, light-emitting diode (LED) lighting and a geo-exchange coupled transcritical carbon-dioxide refrigerant heat pump system that provides chilled water, heating hot water, service hot water pre-heat and refrigeration.

The store opened in November 2013 and is on track to achieve net zero energy use by the U.S. Department of Energy's most stringent standard (building footprint). Additionally the project is on track to earn Living Building Challenge certification and has already been awarded Green Globes Certification, Green Chill Platinum by the U.S. Environmental Protection Agency and LEED Platinum by the U.S. Green Building Council.

Refrigeration for Craft Brewing Half Acre Beer Co.

Monday, Jan. 26
2:30-5 p.m.
Cost: $35

Started in the 1970s with Fritz Maytag's renaissance of the Anchor Brewing Co., the craft brewery movement bloomed in the 80s and exploded in recent years. The Brewer Association counts 3,040 U.S. breweries in mid- 2014 with another 2,000 "in planning."

Essential to brewing process is the refrigeration system. Brewing and refrigeration have evolved from pre-history to the modern era resulting in complex cooling system for the large "macro-breweries."

Craft breweries tend to step back to rediscover simpler systems that meet their needs under limited start-up budgets. As the craft brewers grow, so do their refrigeration systems.

The tour provides a glimpse of the new system being built at the rapidly expanding Half Acre Beer Co. Tour Half Acre's new facility and see the latest and greatest options for both craft brewing and meeting their refrigeration needs. Samples may be available.

Motorola Mobility Global Corporation Headquarters

Tuesday, January 27
2 – 4 p.m.
Cost: $35

Project Description

Comprising approximately 600,000 sf of an iconic building in downtown Chicago, Motorola features an open plan concept with exposed mechanical, engineering and plumbing systems (MEP) was coordinated with project designers to align with the company's vision of a fluid and collaborative space. The design included an aggressive lighting power reduction benchmarks coupled with use of daylight harvesting and high efficiency MEP systems to achieve a substantial incentive from the local utility.

Building on Motorola's commitment to indoor air quality, upgrades for the legacy constant volume air handlers into modern variable air volume air handlers serving the new work space were included.

In order to meet continuous cooling loads from the approximately 80,000 square feet of labs and technology spaces, dedicated MEP infrastructure included a new electrical service with targeted metering, modular chilled water plant with free cooling, low temperature ventilation system with heat recovery and active chilled beam cooling system.

McCormick Place Campus Energy Center Tour

Tuesday, Jan. 27
2:30-3:30 p.m.
Cost: $15

The McCormick Place campus is comprised of the North, South, West, Lakeside Center, Corporate Center, the Energy Center, the Hyatt McCormick Hotel and Hyatt Conference Center. Within the campus buildings are three central utility plants that provide steam, chilled water and hot water to the complex as well as several external customers in the Digital Reality Data Center located across from the Energy Center.

The tour focuses on the main central plant, the Energy Center which consists of a central chiller plant, boiler plant, pump houses and equipment serving the McCormick Place Campus and adjacent hotel and technology center. The center, which was purchased by the authority in 2005, was originally owned and operated by a third part partnership. Located in the Energy Center is the 8.5 million gallon thermal energy storage tank (TES), which is the heart of the campus chilled water system. The TES tank is charged with 30F brine produced during night-time to take advantage of low electric utility rates. Three 2200 ton ammonia screw compressors, along with the six 1400 centrifugal chillers of the West building mechanical plant and three 1300 ton and two 2500 ton centrifugal in the east plant can be used to charge the tank or self-cool their specific buildings.

High pressure steam is also produced in the Energy Center Plant and distributed to other buildings in the campus through two 80,000 PPH gas fired boilers. Steam from this plant is sent to the other buildings in the complex through the interconnect piping. Condensate is returned from all locations back to the plant. The Energy Center equipment is backed up electrically through three 2 megawatt diesel generators, which allows full operation in the event of power loss. In addition to a tour of the energy center, and overview of all of the interconnected mechanical systems in the McCormick Place Campus is given.

Transportation for this tour will be on your own via the AHR shuttles going to McCormick. The tour will meet in the Ballroom foyer on the first floor of the South Building. See the map in this program for location.

Illinois Chapter Sustainability Project

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 an ASHRAE Conference. It is now customary for the ASHRAE Conference host city to select a project with some funding provided by ASHRAE as seed money.

The Illinois Chapter of ASHRAE has a deep history of education and community outreach. With support from ASHRAE in conjunction with the 2015 Winter Conference in Chicago, we plan to expand our mission to foster stronger communities through fundamental education and building a foundation for sustainable business and professional growth.

One of the biggest issues facing our industry is the lack of professionals coming into the science, technology, engineering and mathematics (STEM) fields. With a theme Sustaining Community, the 2015 Winter Meeting sustainability project is more about creating an environment than a project. Working with local community colleges on STEM oriented classes with an emphasis on HVAC&R and renewable energy. The project will lay the foundation for investment in communities by building a technically educated workforce and steer talented young professionals to higher education and careers in our profession.

Two local community college projects have been identified as catalyst:

1) A solar domestic hot water heating retrofit at Harold Washington College;

2) A new solar photovoltaic installation at Pembroke Community School in conjunction with Kankakee Community College.

Illinois Chapter volunteers will be helping with the design, installation and ongoing operation of the identified renewable energy projects. They will also work with Harold Washington College and Kankakee Community College (associated with Pembroke Community School) to establish a recurring educational series where Chapter volunteers will present at a class each spring and fall on HVAC&R and renewable technology and ASHRAE's role.

Donations are being accepted. Please contact Benjamin Skelton at 312.520.0025 or bskelton@cyclonegrp.com if you're interested in supporting these projects.

notes

ASHRAE 2015 WINTER CONFERENCE TRAINING

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

ASHRAE Learning Institute (ALI) courses will be held at either the Palmer House Hilton or McCormick Place. Courses will carry Continuing Education Units (CEUs), Professional Development Hours (PDHs), and/or American Institute of Architects Learning Units (AIA LUs) which can be applied toward maintaining your P.E. licensure.

Registration for the ASHRAE Learning Institute Courses being held at McCormick Place can be done at either the Palmer House Hilton or at McCormick Place, North Hall Registration Lobby, 3rd Floor. Registration will open at McCormick Place on Sunday from 9:00 am–3:00 pm, Monday from 7:30 am–6:00 pm, and Tuesday from 8:00 am–6:00 pm. Online registration will close at midnight on the evening prior to the course.

On Monday and Tuesday, shuttle service will run to McCormick all day from the Palmer House Wabash Street entrance. Please refer to the schedule located there. Shuttle service on Monday will run from 7am-7pm and will run approximately every 20 minutes. Hours for Tuesday will be 8:00 am–7:00 pm. There is no shuttle service on Sunday.

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

SATURDAY, JANUARY 24, 2015

Designing HVAC Systems to Control Noise & Vibration (code 60)

8:00 am – 3:00 pm, Palmer House Hilton, Chicago (5th Floor)
This seminar emphasizes the important design information in ASHRAE's *Practical Guide to Noise and Vibration Control for HVAC Systems*. Beginning with a fundamental discussion of acoustics, the seminar focuses on the proper design and selection of HVAC equipment. Special attention is given to fans and air distribution systems. Also discussed are noise/vibration problems associated with central plant equipment, piping systems, and outdoor equipment.
Instructor: Curtis Eichelberger, P.E., Member ASHRAE

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

8:00 am – 3:00 pm, Palmer House Hilton, Honore (Lobby)
This introductory seminar focuses on how the building commissioning process can be applied cost-effectively to new construction and existing facilities. The fundamentals of the commissioning process through each step of a new construction project from pre-design to occupancy and operations are presented in this seminar. The seminar discusses commissioning documentation, including an overview of commissioning specifications for new construction.
Instructor: Rick Casault, P.E., Member ASHRAE

Commercial Building Energy Audits (code 62)

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

TUESDAY, JANUARY 27, 2015

Introduction to Building Enclosure Commissioning (code 74)

(Co-sponsored by Building Enclosure Commissioning Collaborative)
9:00 am – 4:00 pm, McCormick Place, Room S104a
This seminar introduces the Building Enclosure Commissioning (BECx) process by outlining key quality-based activities that achieve a successful building enclosure. The seminar will include overviews 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 will aid in understanding how BECx contributes towards commissioning goals and requirements and LEED® certification.
Instructors: David Altenhofen, AIA, Member ASHRAE; Harry Enck, P.E., Member ASHRAE, HBDP, CPMP, BEAP, LEED® AP; and William Nash, P.E., Member ASHRAE

Energy Modeling Best Practices and Applications (code 75)

(Co-sponsored by IBPSA-USA)
9:00 am – 4:00 pm, McCormick Place, Room S105d
This seminar focuses on topics critical to the effective delivery of energy modeling services, including modeling fundamentals, modeling best practices and quality control, and 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: Margaret Curtz, P.E., Member ASHRAE, BEMP, LEED® AP; and Samuel Mason, P.E., Member ASHRAE, BEMP, LEED® AP

HALF-DAY SHORT COURSES

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

SUNDAY, JANUARY 25, 2015

Air-to-Air Energy Recovery Applications: Best Practices (code 63)

3:30 pm – 6:30 pm, McCormick Place, Room S105a

Air-to-air energy recovery provides one of the most cost-effective and efficient ways to recycle waste energy and create superior indoor environments. This course reviews real-world examples of where and how air-to-air energy recovery technologies are integrated into some of the most commonly used commercially available systems. Particular configurations that are often used in high-performance buildings and how they can best be used to meet strict goals for IEQ, energy efficiency and thermal comfort will be examined with respect to established performance metrics, peak performance results and annual energy savings.

Instructor: Paul Pieper, P.Eng., Member ASHRAE

Fundamentals of Risk Management (code 64)

3:30 pm – 6:30 pm, McCormick Place, Room S104a

This course discusses various risk management and insurance issues surrounding accessibility and energy efficiency, and engages the participants on the topic of jobsite safety and their role and responsibility. Preferred contract language to address codes, regulations, etc., on contract issues as well as rules and regulations governing the architecture practice are reviewed. Protecting your firm and public through insurance and various risk management techniques are addressed.

Instructors: Daniel Buelow, AIA; Thomas Harkins, AIA; and Robert Stanton

Laboratory Design: The Basics and Beyond (code 65)

3:30 pm – 6:30 pm, McCormick Place, Room S105bc

A comprehensive overview of HVAC design for laboratories is examined in this course. The course focuses on the essential elements of the design process that are unique to laboratory HVAC systems. Topics include: planning steps; determining exhaust/supply requirements; load calculation; pressure mapping; evaluating system options; layout of ducts and rooms; sizing primary air systems; designing exhaust stacks; sustainability in laboratories and control strategies. Example problems and case studies will also be presented.

Instructor: John Varley, P.E., Member ASHRAE, HBDP, LEED® AP

Energy Management Best Practices (code 66)

3:30 pm – 6:30 pm, McCormick Place, Room S105d

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

MONDAY, JANUARY 26, 2015

Designing High-Performance Healthcare HVAC Systems (code 67)

8:30 am – 11:30 am, McCormick Place, Room S105a

This advanced course provides an in-depth discussion of system design, controls sequences and psychrometrics to meet the aggressive performance, maintenance, reliability, energy and sustainability goals of high-performance healthcare facilities. The course covers the relationship of infection control and HVAC design, detailed definitions of the key elements of high performance in healthcare, control sequences and setpoints, and energy conservation strategies and relationship to temperature/relative humidity requirements.

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

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

8:30 am – 11:30 am, McCormick Place, Room S105bc

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

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

Energy Efficiency in Data Centers (code 69)

8:30 am – 11:30 am, McCormick Place, Room S105d

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

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

Design of Commercial Ground Source Heat Pumps (code 70)

8:30 am – 11:30 am, McCormick Place, Room S104a

This course describes the best design practices of ground source heat pump systems to achieve maximum customer benefit. The course examines the economic analysis of ground source vs. more traditional systems and what is necessary to design an effective and efficient ground source system. The course covers energy analysis, equipment selection, drilling technologies, testing requirements, hydronic system design and system controls. Participants will learn all that is necessary for the design and installation of a successful ground source heat pump system.

Instructor: Kirk Mescher, P.E., Member ASHRAE, LEED® AP

Complying with Standard 90.1-2013: HVAC/ Mechanical (code 71)

2:45 pm – 5:45 pm, McCormick Place, Room S105a

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

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

Commissioning for High-Performance Buildings (code 72)

2:45 pm – 5:45 pm, McCormick Place, Room S105bc

This course presents the defining characteristics of the building commissioning process as expressed in ASHRAE Guideline 0. This Guideline 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 will also explore the implications of employing the ASHRAE commissioning process for high-performance buildings. Particular emphasis will be placed on the value of developing a strong Owner's Project Requirements document that can successfully guide verifications of success 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

Building Demand Response and the Coming Smart Grid (code 73)

2:45 pm – 5:45 pm, McCormick Place, Room S105d

This course presents applications of new technologies and design concepts that are leading the way to how buildings and their systems will interact with a coming smart electrical grid. The course focuses on demand response measures and programs, although smart buildings and their new system concepts are also included. Finally, the course summarizes the future driving trends toward high-performance buildings across the globe.

Instructor: Tom Lawrence, Ph.D., P.E., Member ASHRAE, LEED® AP

TUESDAY, JANUARY 27, 2015

Combined Heat and Power: Creating Efficiency through Design & Operations (code 76)

9:00 am – 12:00 pm, McCormick Place, Room S105a

The successful implementation and operation of a cogeneration plant is the focus of this course. The course progresses from design through construction and operations, and concludes with three case studies. The design section includes key issues that affect equipment sizes and selections, as well as the effects of those selections on plant performance and heat recovery. The construction section provides an overview of the key steps in a project's construction phase that differ from more typical central plant or general construction projects. The operations section shows the methods that should be implemented to prolong equipment life and promote operational efficiency. Each case study provides background information for the campus, and the corresponding results of the combined heat and power plant installation.

Instructor: Lucas Hyman, P.E., Member ASHRAE, LEED® AP

Commissioning Process & Standard 202 (code 77)

9:00 am – 12:00 pm, McCormick Place, Room S105bc

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

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

Fundamentals and Applications of Standard 55 (code 78)

1:00 pm – 4:00 pm, McCormick Place, Room S105a

Based on ANSI/ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy, this course covers the theory and principles of the standard and has been updated for the 2013 version. It is intended to bridge the gap between the design practitioner's knowledge of the built environment and its thermal relationship to the occupants' physiology and psychology. Using examples, the course illustrates how to achieve compliance with the standard for the purposes of satisfying the requirements of various building performance programs such as LEED®.

Instructors: Robert Bean, R.E.T., Member ASHRAE; Lawrence Schoen, P.E., Fellow ASHRAE; and Peter Alspach, P.E., Member ASHRAE, LEED® AP

Advanced High-Performance Building Design (code 79)

1:00 pm – 4:00 pm, McCormick Place, Room S105bc

Based on ASHRAE Standards 90.1 and 189.1, this course explores the integrated process application essential for delivering a high-performance green building. Covering all phases of a building life, from concept to design, construction, operation and removal, and using specific case studies, the course will help students integrate their expertise into the green building delivery process and go beyond the minimum requirements of these standards. Course content is suitable for architects and engineers.

Instructor: Jeff Ross-Bain, P.E., Member ASHRAE, LEED® AP, BEMP

WHAT IS A TECHNICAL COMMITTEE?

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

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

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

APPLYING FOR MEMBERSHIP ON A TECHNICAL COMMITTEE

ASHRAE welcomes new members to its technical committees.

To be considered for technical committee membership, you must:

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

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

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

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

ATTENDING TECHNICAL COMMITTEE MEETINGS

During the Annual and Winter Conference

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

ASHRAE WINTER CONFERENCE TECHNICAL PROGRAM

Chicago – January 2015

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. Please keep track of the sessions that you attend at the conference.

Technical sessions are in the Palmer House Hilton.

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

ASHRAE'S CONFERENCES AND EXPOSITIONS COMMITTEE WELCOMES YOU TO THE 2015 WINTER CONFERENCE

Five types of sessions are presented:

Technical Paper Sessions. These sessions present papers on current applications or procedures, as well as papers resulting from research on fundamental concepts and basic theory. Papers presented in these sessions have successfully completed a rigorous peer review. You are invited to comment on these papers. Forms for written comment are available at each session, and if received by February 9, 2015, 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 Chicago Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board. All conference attendees paying the full registration fee should have received via email their password and link prior to arriving in Chicago. If you do not have your password and link Go to www.ashrae.org/chicagovirtual and click on the link to access the Virtual Conference and put in your email address to request your password.

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations
- Access to all seminar, technical paper and conference paper presentations
- Ability to post questions or answers for selected sessions through Wednesday, Feb. 11. Presentations available online for 18 months.
- A full slate of technical programs will be posted beginning Monday, Jan. 26, of the sessions that were presented the previous day, with additional content posted through Wednesday, Jan. 28.

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

2015 ASHRAE Winter Conference—Papers (download)
Technical Paper and Conference Paper Session papers as presented at this Conference
$79 (includes five FREE hard copies of preprint papers)
Available at the Conference Bookstore

Conference Seminars DVD
64 Seminars (PowerPoint files synced with speakers' audio)
$119 (ships April 2015)

Conference Preprints (individual papers, in print)
Technical Paper and Conference Paper Session papers as presented at this Conference
$6 each
Available at the Conference Bookstore

***ASHRAE Transactions* (Print Volume)**
Technical Paper Session papers with discussion questions and answers for papers in bound, library-quality form.
$79 (ships May 2015)

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

GBCI LEED AP CE Credits

Packages

1. 2015 ASHRAE Winter Conference – Papers (download) and Seminars DVD
Get five FREE hard copies of preprint papers when you purchase this package.
$149 – *Purchase in the Conference Bookstore*

2. 2015 ASHRAE Winter Conference – Papers (download) and *ASHRAE Transactions*
(See description at left.)
Get five FREE hard copies of preprint papers when you purchase this package.
$124 – *Purchase in the Conference Bookstore*

3. Complete Winter Conference Content Package (2015 ASHRAE Winter Conference – Papers (download),Seminars DVD, and *ASHRAE Transactions*)
$174 – *Purchase in the Conference Bookstore*

All prices are special conference-only prices.

Sunday, January 25

8:00 AM-9:00 AM

TECHNICAL PAPER SESSION 1 (ADVANCED)

Analytical Methods for HVAC Design
Track: Fundamentals and Applications
Room: Honore Ballroom (Lobby)
Chair: Joy Altwies, P.E., University of Wisconsin-Madison, Madison, WI

Computational analysis and modeling techniques are valuable tools to aid the design engineer. This session explores practical applications of computational fluid dynamics (CFD) in design mathematical models used for CFD analysis and evaluation of mathematical models used in building design.

1. CFD Analysis of Turbulence Development in Flat Oval Ducts for Various Entrances (CH-15-001)
Devendra Kulkarni, Ph.D., Associate Member[1], *Stephen A. Idem, Ph.D., Member*[2] *and Jie Cui, Ph.D.*[2], *(1)ComeFri USA, Hopkinsville, KY, (2)Tennessee Tech University, Cookeville, TN*

2. Effect of CFD Grid Resolution and Turbulent Quantities on the Jet Flow Prediction (CH-15-002)
Waleed Abdelmaksoud, Ph.D.*, Cairo University, Cairo, Egypt*

3. Use of Random Forest Algorithm to Evaluate Model Based EUI Benchmarks (CH-15-003)
Apoorva Kaskhedikar*, T. Agami Reddy, Ph.D., P.E., Member and George Runger, Ph.D., Arizona State University, Tempe, AZ*

8:00 AM-9:00 AM

CONFERENCE PAPER SESSION 1 (INTERMEDIATE)

Energy Use Analysis in Retail and Small/Medium Office Applications
Track: Systems and Equipment
Room: Empire (Lobby)
Chair: Monte G. Troutman, PE, Member, B.C. Engineering, Inc., Evansville, IN

The session begins with the evaluation of the heat transfer rate in potable refrigeration systems. The second paper establishes a pre-simulated database on the energy savings for screening and evaluation of retrofit measures targeting the small- and medium-sized buildings for offices and retail spaces. The third paper focuses on the fault-finding methodologies of events that increase energy demands for food retail refrigeration applications. The final paper develops a practical control algorithm with low sensor requirements for multiple RTU coordination that leads to reduced on/off cycling and reduced energy consumption with good comfort control for retail applications.

1. The Application of the Energy Balance Equation of the TEC Unit and Performance of TEC Refrigerator (CH-15-C001)
Huanan Shen, Member*, Tianwei Wang, Student Member and A. G. Agwu Nnann, Purdue University Calumet, Hammond, IN*

2. A Pre-Simulated Database to Screen and Evaluate Retrofit Measures for Small and Medium Size Office and Retail Buildings in California (CH-15-C002)
Sang Hoon Lee*, Tianzhen Hong, Ph.D., P.E., Member, Yixing Chen and Mary Ann Piette, Lawrence Berkeley National Laboratory, Berkeley, CA*

3. The Operational Efficiency of Commercial Food Refrigeration Systems: A Data Mining Approach (CH-15-C003)
Maria S Spyrou, Student Member[1], *Malcolm J. Cook, Ph.D., Member*[1], *John Mardaljevic, Ph.D.*[1], *Richard Lee*[2] *and James Pitcher*[2], *(1) Loughborough University, Loughborough, United Kingdom, (2)Tesco PLC, Welwyn Garden City, United Kingdom*

4. Performance Evaluation of an RTU Coordination Controller Using Reduced-Order Models (CH-15-C004)
Donghun Kim[1], *James Braun, Ph.D., Member*[1], *Eugene M Cliff, Ph.D.*[2], *Jeff Borggaard, Ph.D.*[2] *and Jianghai Hu, Ph.D.*[1], *(1)Purdue University, West Lafayette, IN, (2)Virginia Tech, Blacksburg, VA*

8:00 AM-9:00 AM

SEMINAR 1 (ADVANCED)

An Update on Energy Efficiency Analysis using ABSIM Absorption Simulator, Triple Duty Chillers and Type 2 Absorption Heat Pumps

Track: Energy Efficiency
Room: Adams Room
Sponsor: 08.03 Absorption and Heat Operated Machines
Chair: Ersin Gercek, P.E., Associate Member, Real Engineering Services LLC, Totowa, NJ

This seminar provides an update on recent developments on ABSIM, which is an ASHRAE-sponsored Absorption System Simulator. An analysis of open-and-closed cycle absorption chillers using ABSIM is presented. The next seminar presents recent improvements on triple-effect absorption chillers and type-2 absorption heat pumps, which can generate high-grade heat unlike conventional heat pump systems.

1. Type II Absorption Heat Pumps and Triple Effect Absorption Chillers
Piyush V. Patel, Associate Member*, Thermax Ltd., Pune, India*

2. ABSIM: Modular and Flexible Simulation of Absorption Systems in Closed and Open Cycles
Gershon Grossman, DSc, Fellow ASHRAE*, Technion, Haifa, Israel*

8:00 AM-9:00 AM

SEMINAR 2 (INTERMEDIATE)

Fan and System Integration for Maximizing Energy Efficiency Design

Track: Design of Energy and Water efficient Systems
Room: State Ballroom
Sponsor: 05.01 Fans, 05.09 Enclosed Vehicular Facilities
Chair: Asesh Raychaudhuri, P.E., Member, US Department of Veterans Affairs, Washington, DC

Fans and HVAC systems are integrated to meet a variety of application-specific constraints. Future minimum energy efficiency regulations may limit the available pool of fans acceptable for a given application and influence the fan selection process to assure reduced energy consumption. This seminar offers a review of the basic steps involved in matching fans to HVAC systems in the context of energy consumption and the trade-offs necessary to meet other practical constraints. In addition, a review of HVAC system pressure drop and how it relates to fan selection practices is presented.

1. Filtering the Pool of Fans for a Specific Application
John Cermak, Ph.D., Member*, ACME Engineering & Manufacturing Corp., Tulsa, OK*

2. Fans for Minimum Energy Consumption
Michael Brendel, Ph.D., Member*, Lau Industries/Ruskin Company, Dayton, OH*

8:00 AM-9:00 AM

SEMINAR 3 (INTERMEDIATE)

Relative Energy Efficiencies of Active Chilled Beams and Fan Coil Unit Systems

Track: Energy Efficiency
Room: Monroe Room
Chair: Michael Holland, Member, Ability Projects, Poole, United Kingdom

With reference to recent energy studies undertaken to look at the variations in energy efficiencies of both active chilled beams and fan coils, this seminar analyzes those results. By looking at the effect of changing various operating parameters, this seminar shows where/how energy can be best saved and provides a comparison of both systems' energy efficiency credentials.

1. The Relative Energy Efficiencies of Active Chilled Beams and Fan Coil Unit Systems
Michael Holland, Member*, Ability Projects, Poole, United Kingdom*

8:00 AM-9:00 AM

SEMINAR 4 (INTERMEDIATE)

Lab Safety and Fire Alarm Response

Track: Life Safety
Room: Crystal Room
Sponsor: 09.10 Laboratory Systems
Chair: James Coogan, P.E., Member, Siemens, Buffalo Grove, IL

Exposure control in laboratories and fire safety are usually separate topics. When they overlap, designers face special challenges and opportunities. The typical ventilation response to a fire alarm, to cut off supply air while maintaining exhaust, may not apply in laboratories. It can produce pressure gradients that hold doors shut and prevent egress. There is also an inherent fire risk within a laboratory's fume hoods. Engineers can be reluctant to allow sprinklers in an exhaust system, but alternate means of fire suppression may be desirable. Detection and suppression technologies are reviewed briefly, and a system suitable to fume hood application is presented. This seminar highlights the conditions that result in a series of case studies.

1. Lab Pressurization and Fire Alarm Response
Reinhard Seidl, Member*, Taylor Engineering, Alameda, CA*

2. Applying Fire Detection and Fire Suppression Technology in a Chemical Laboratory
Paul Fuson, Member*, Siemens Industry Inc., Buffalo Grove, IL*

8:00 AM-9:00 AM

WORKSHOP 1 (BASIC)

I Scream, You Scream, We All Scream for Refrigeration Basics of Ice Cream

Track: Industrial Facilities
Room: Chicago Room
Sponsor: 10.08 Refrigeration Load Calculations, 10.05 Refrigerated Distribution and Storage Facilities
Chair: John Davis, University of Wisconsin—Madison, Madison, WI

Ice cream is one of the simple pleasures of life but also one of the most complex frozen products available today. Unlike ice, which freezes in a crystalline structure, ice cream is an amorphous solid similar to glass. Its structure is primarily air held in a complex lattice of sugars and fats. Likewise, the process of producing ice cream is far more complex than most frozen foods, with multiple variations from traditional ice cream to frozen novelty bars and cakes. This session explores the process of making ice cream, leads the participants through the cooling load calculations and finishes up with a chance to participate in the ice cream making process . . . but you have to correctly calculate the cooling load before you get to taste the final product.

1. What Is Ice Cream?
Daniel J. Dettmers, Member*, University of Wisconsin—Madison, Madison, WI*

2. The Methods and Cooling Loads Encountered in the Ice Cream Industry
Douglas Reindl, Ph.D., P.E., Member*, University of Wisconsin—Madison, Madison, WI*

9:00 AM to 9:45 AM

NETWORKING COFFEE BREAK

(Mezzanine and 6th Floor)

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 Chicago.

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 2 (ADVANCED)

Data Center Initiatives

Track: Industrial Facilities
Room: Adams Room
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Joy Altwies, P.E., University of Wisconsin—Madison, Madison, WI

This session presents several papers on data center initiatives. One paper describes a new regenerative filter to conserve energy. Another presents the methodology for studying electrostatic discharge in data centers, and another discusses the data analysis inequality. Another presents the risks associated with electrostatic discharge in data centers.

1. Energy Saving Potential of Flash Heat Transfer (CH-15-004)
Robert Topper[1] *and Kenneth Kessler*[2]*, (1)Maine Stay Design, Walpole, ME, (2)Hunter Defense Technologies, Inc., Solon, OH*

2. Dependence of ESD Charge Voltage on Humidity in Data Centers: Test Methods (CH-15-007)
Atieh Talebzadeh[1]*, Mahdi Moradian, Ph.D.*[1]*, Yunan Han*[2]*, Abhishek Patnaik*[1]*, David Swenson*[3] *and David Pommerenke, Ph.D.*[1]*, (1)Missouri University of Science and Technology, Rolla, MO, (2)Beijing University of Chemical Technology, Beijing, China, (3)Affinity Static Control Consulting, LLC, Round Rock, TX*

3. Dependence of ESD Charge Voltage on Humidity in Data Centers: Data Analysis Inequality (CH-15-005)
Atieh Talebzadeh[1]*, Abhishek Patnaik*[1]*, Xu Gao*[1]*, Mahdi Moradian, Ph.D.*[1]*, Yunan Han*[2]*, David Swenson*[3] *and David Pommerenke, Ph.D.*[1]*, (1)Missouri University of Science and Technology, Rolla, MO, (2) Beijing University of Chemical Technology, Beijing, China, (3)Affinity Static Control Consulting, LLC, Round Rock, TX*

4. 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 (CH-15-006)
Xu Gao[1]*, Atieh Talebzadeh*[1]*, Mahdi Moradian, Ph.D.*[1]*, Yunan Han*[2]*, David Swenson*[3] *and David Pommerenke, Ph.D.*[1]*, (1)Missouri University of Science and Technology, Rolla, MO, (2)Beijing University of Chemical Technology, Beijing, China, (3)Affinity Static Control Consulting, LLC, Round Rock, TX*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 2 (INTERMEDIATE)

HVAC Refrigerants

Track: Fundamentals and Applications
Room: Empire (Lobby)
Sponsor: 08.04 Air-to-Refrigerant Heat Transfer Equipment
Chair: Steve Kujak, Member, Ingersoll Rand, La Crosse, WI

Characterizing the compatibility and performance of new and existing materials for use in HVACR systems is a significant design challenge. New materials like nanosized particles and new low global warming potential (GWP) refrigerants present new and unique challenges to the performance and reliability of HVACR systems. This session presents a historical overview of chemical stability and materials compatibility challenges for HVACR systems, experimental chemical stability investigations of materials with next generation low GWP refrigerants and the impact of nanosized particles of Al2O3 on the heat transfer performance and properties of oil-refrigerant mixtures.

1. A Historical Perspective of Refrigerant Chemical Stability and Materials Compatibility for HVAC&R Systems (CH-15-C006)
Steve Kujak, Member*, Ingersoll Rand, La Crosse, WI*

2. Chemical Compatibility of Low GWP Refrigerants with HVAC&R System Materials (CH-15-C005)
Elyse Sorenson, Member *and Julie Majurin, Ingersoll Rand, La Crosse, WI*

3. Experimental Investigation on Heat Transfer and Thermophysical Properties of Mixtures of Al2O3 Nanolubricants and Refrigerant R410A (CH-15-C007)
Andrea A. M. Bigi, Student Member*, Thiam Wong, Student Member, Amy Wong, Student Member and Lorenzo Cremaschi, Ph.D., Member, Oklahoma State University, Stillwater, OK*

9:45 AM-10:45 AM

SEMINAR 5 (BASIC)

Make the Most of Your ASHRAE Experience

Track: Fundamentals and Applications
Room: Crystal Room
Sponsor: Conferences and Expositions Committee
Chair: Dunstan Macauley, P.E., Member, TAI Engineers, Owings Mills, MD

What's the purpose of ASHRAE? How is it structured? What are TCs, SPCs and all the other acronyms I hear? Where is the AHR Expo? And how does this all fit together? This seminar is perfect for first-time attendees or anyone else who would like to get more out of their ASHRAE Winter Conference experience.

1. Make the Most of Your ASHRAE Experience
Dunstan Macauley, P.E., Member, WSP, Arlington, VA

2. First Time at an ASHRAE Meeting
Alan Veeck, Member, MWA, Inc. Virginia Beach, VA

9:45 AM-10:45 AM

SEMINAR 6 (ADVANCED)

Online Optimal Scheduling for Demand Response under Real-Time Price

Track: Energy Efficiency
Room: Honore Ballroom (Lobby)
Sponsor: TG1 Optimization
Chair: Peter Armstrong, Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates

Buildings represent a large energy storage resource. Real-time and day-ahead market pricing can be used to evoke appropriate responses to a supplier's need for demand relief by solving an optimization problem in which the objective is to minimize some combination of energy, cost and discomfort. The potential for demand response is also influenced by equipment size and performance characteristic and the capacity of thermal storage. Thus one is given a design optimization problem as well as an optimal control problem and many system parameters to consider.

1. Initial Exploration of Demand Responsive Cooling with TABS
Alex Niswander*, Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates*

2. Implications of Online Optimal Control on Demand Side Participation in Electricity Networks
David H. Blum, Student Member*, Massachusetts Institute of Technology, Cambridge, MA*

9:45 AM-10:45 AM

SEMINAR 7 (INTERMEDIATE)

Controlling a Minimum Impact Data Center

Track: Large Buildings: Mission Critical Facilities and Applications
Room: State Ballroom
Sponsor: 01.04 Control Theory and Application, 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Joseph Kilcoyne, P.E., Member, SC Engineers, Inc., San Diego, CA

Due to new energy code requirements and a heightened corporate environmental sensitivity, organizations have been implementing non-traditional methods to cool data center and IT spaces more efficiently. One of the more popular methods include the installation of some form of water- or air-side economizer to leverage outdoor conditions for free cooling. This seminar focuses on using advanced automation to minimize the risk of downtime and equipment failures in economizing data centers. The speakers present detailed control sequences for each type of economizer, which have been honed over time based on testing and numerous data center implementations.

1. Using Automation to Minimize the Risk of Downtime and Equipment Failures in Economizing Data Centers
Alex Mathers, P.E., Member*, Qualcomm Inc, San Diego, CA*

2. Advanced Control Sequences to Optimize Energy Performance of Economizing Data Centers
Jeff Stein, P.E., Member*, Taylor Engineering, Alameda, CA*

9:45 AM-10:45 AM

SEMINAR 8 (INTERMEDIATE)

Design of Safe, Healthy and Energy Efficient Air Distributions for Hospitals

Track: Hospital Design and Codes
Room: Monroe Room
Sponsor: 04.10 Indoor Environmental Modeling
Chair: Wangda Zuo, Ph.D., Member, University of Miami, Coral Gables, FL

Effective ventilation is critical to the prevention of cross-infection resulting from airborne pathogens in hospitals. This seminar discusses the air distributions in hospital operating rooms and wards. Both experiment and Computational Fluid Dynamics are used in the analysis of the air pattern. Using the validated CFD tools, we can explore the design options to create a safe, healthy and energy efficient air distribution in hospitals. As an example, a case study of using natural ventilation in hospital wards is discussed.

1. Natural Ventilation in Hospital Wards: Delivering Fresh Air Where It Is Needed
*Zulfikar Adamu, **Malcolm J. Cook, Ph.D., Member** and Andrew Price, Loughborough University, Loughborough, United Kingdom*

2. Experimental and CFD Investigation of Hospital Operating Room (OR) Air Distribution (TRP-1397)
***John Zhai, Ph.D., Member**, University of Colorado, Boulder, CO*

11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 3 (ADVANCED)

Airflow Modeling and Control

Track: Systems and Equipment
Room: Chicago Room
Chair: Erich Binder, Member, Worley Parsons, Calgary, AB, Canada

Real-time corrections for sensors in variable air volume (VAV) systems are discussed. Dynamic reset is described to optimize VAV system performance. Two models are compared to predict duct pressure loss. Fan speed and coupled damper control are investigated for energy-efficient air distribution. Approaches used by the US General Services Administration are addressed for aggressive energy reduction strategies.

1. Energy Modeling of a Botanical Air Filter in Energy Efficient Residences (CH-15-008)
***Daniel W. Newkirk, Student Member**, William Hutzel, P.E., Member ASHRAE, Michael N. Dana, Ph.D. and Ming Qu, Ph.D., Associate Member, Purdue University, West Lafayette, IN*

2. Predicted Pressure Loss in Low Pressure Wire-Wound Flexible Ducts (CH-15-009)
***Herman Behls, Member**[1] and Stephen A. Idem, Ph.D., Member[2], (1) Behls & Associates, Arlington Heights, IL, (2)Tennessee Tech University, Cookeville, TN*

3. Energy Efficient Static Pressure Reset in VAV Systems (CH-15-010)
***Yin Ma, Associate Member**, Ahmed Tukur, Student Member and Kelly Kissock, Ph.D., P.E., University of Dayton, Dayton, OH*

4. Investigation on the Energy and Control Performance of Different Damper Control Strategies in Air Handling Units (CH-15-011)
***Gang Wang, Ph.D., Member**, University of Miami, Coral Gables, FL*

5. Investigating Duct Effective Length Estimation Methods for a Centrifugal Air Fan-Duct Interface System by Monitoring the Stabilization of Velocity and Pressure Levels (CH-15-012)
***Ali Hasan, Member**, KEO International Consulting Engineers, Doha, Qatar*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 3 (INTERMEDIATE)

Modern Data Center Design

Track: Large Buildings: Mission Critical Facilities and Applications
Room: Monroe Room
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Charles E. Henck, Whitman, Requardt & Associates LLP, Baltimore, MD

The causes of poor agreement between CFD models and reality in data centers are identified and what might reasonably be done to ensure that models can be maintained for ongoing management. A new approach suggests selecting the proper orthogonal decomposition system enables qualitative tuning of the prediction accuracy of the CFD effort. Air delivery efficiency can be increased by adding containment, installing rear door heat exchangers or installing other supplemental air coolers. Containment offers great potential for energy savings and reduction in risk from air recirculation, but it also introduces a variety of issues that can potentially undermine the containment plan.

1. Fast Prediction of Control Insights in Air-Cooled Data Centers Using Proper Orthogonal Decomposition (CH-15-C008)
***Anirudh Deodhar**[1], Harshad Bhagwat[1], Amarendra K Singh, Ph.D.[1], Anand Sivasubramaniam, Ph.D.[2], Umesh Singh[1] and Sankaranarayanan Dharmarajan[3], (1)Tata Consultancy Services, Pune, India, (2) Pennsylvania State University, State College, PA, (3)Tata Consultancy Services, Chennai, India*

2. How Do I Choose from a Myriad of Options to Upgrade My Data Center and Improve Cooling Efficiency? (CH-15-C009)
***Mark Seymour, Member**, Future Facilities, London, United Kingdom*

3. Aisle Containment: Just How Important Is It to Worry about By-Pass and Leakage Paths? (CH-15-C010)
***Christian Pastrana, P.E., Member**[1] and Mark Seymour, Member[2], (1) Future Facilities, New York, NY, (2)Future Facilities, London, United Kingdom*

4. Are Simulation Models of the Air Delivery for Operating Data Centers Accurate Enough to be Useful? (CH-15-C011)
***Matthew F Renner**[1] and Mark Seymour, Member[2], (1)Future Facilities, San Jose, CA, (2)Future Facilities, London, United Kingdom*

11:00 AM-12:30 PM

SEMINAR 9 (INTERMEDIATE)

Modeling and Simulation of Occupant Behavior in Buildings

Track: Energy Efficiency
Room: State Ballroom
Sponsor: 07.05 Smart Building Systems, 04.07 Energy Calculations
Chair: Bing Dong, Ph.D., Member, University of Texas at San Antonio, San Antonio, TX

This seminar aims to highlight related research on occupant behavior by Lawrence Berkeley National Laboratory under the US-China Clean Energy Research Center for Building Energy Efficiency, by Carnegie Mellon University under the Energy Efficient Buildings Hub, by University of Texas at San Antonio and by Karlsruhe Institute of Technology. This seminar is part of IEA EBC Annex 66 activities.

1. Data Mining of Occupant Behavior and Heating System Operation in Affordable Housing
***Tianzhen Hong, Ph.D., P.E., Member**, Lawrence Berkeley National Laboratory, Berkeley, CA*

2. Occupant's Interaction with Their Environment: Results from Experiments in a Indoor Climate Test-Facility
***Andreas Wagner, Dr.Ing.**, Karlsruhe Institute of Technology, Karlsruhe, Germany*

3. Occupancy Schedule Modeling for Building Energy Simulation through Office Appliance Power Consumption Data Mining
***Khee Poh Lam, Ph.D.**, Carnegie Mellon University, Pittsburgh, PA*

4. The Impact of Occupancy Behavior on Energy Consumption in Low Income Residential Buildings
***Bing Dong, Ph.D., Member**, University of Texas at San Antonio, San Antonio, TX*

11:00 AM-12:30 PM

SEMINAR 10 (ADVANCED)

REHVA Seminar: Operation of Energy Efficient Buildings

Track: Energy Efficiency
Room: Honore Ballroom (Lobby)
NY PDH DVD G
Sponsor: 07.06 Building Energy Performance, REHVA
Chair: Karel Kabele, Dr.Ing., Member, REHVA, Brussels, Belgium

Buildings represent the largest slice of energy demand in the EU and US and a consistent strategy for energy saving in this sector should take into account the savings potential in all the life phases of buildings, e. g. design, construction, operation, maintenance, retrofitting, etc. As far as operation, well-designed, commissioned and maintained buildings are essential for their cost-effective use. As buildings are becoming more complex, including more systems and their respective controls, the objective of this seminar is to present an updated vision of the best solutions and new ideas to improve energy efficiency considering the interaction with occupants.

1. Heating of Energy Efficient Buildings
***Karel Kabele, Dr.Ing., Member**, REHVA, Brussels, Belgium*

2. Effect of Occupant Behavior in Energy Operation of Buildings
***Stefano Paolo Corgnati, Dr.Ing.**, Polytechnic of Turin, Turin, Italy*

3. Managing Ventilation and Infiltration Rates in NZEBs
***Manuel Gameiro da Silva, Ph.D., Member**, Universidade de Coimbra— Pólo II, Coimbra, Portugal*

11:00 AM-12:30 PM

SEMINAR 11 (INTERMEDIATE)

ASHRAE Design Guide for Tall, Mega Tall and Super Tall Building Systems

Track: Fundamentals and Applications
Room: Crystal Room
NY PDH DVD G
Sponsor: 09.12 Tall Buildings
Chair: Peter Simmonds, Ph.D., Fellow ASHRAE, Buildings and Systems Analytics LLC, Marina Del Rey, CA

This seminar provides insight into the revised ASHRAE HVAC Design Guide for Tall Buildings. The previous ASHRAE definition of a tall building is a building that is taller than 300ft (100m). The scope of ASHRAE's subcommittee for tall buildings has been revised to include mega-tall, 300m, and super-tall, 600m, buildings. With the increase of a building's height come engineering challenges which must be resolved, and the revised Design Guide includes additional data on vertical climate changes, façade engineering and fire and life safety, among others.

1. Variations and Influence of Ambient Conditions on Super Tall Buildings
***Duncan Phillips**, Rowan Williams Davies & Irwin, Guelph, ON, Canada*

2. Design Features of Pressurization Airflow and Pressure Differential
***John H. Klote, Ph.D., P.E., Fellow ASHRAE**, Fire and Smoke Consulting, Leesburg, VA*

3. Energy Use in Tall Buildings and Is Taller Healthier?
***Luke Leung, P.E., Member**, Skidmore, Owings and Merrill LLP, Chicago, IL*

11:00 AM-12:30 PM

SEMINAR 12 (INTERMEDIATE)

Emerging Technologies in Real-time Particle-Microbial Sensing and Demand Flow Control for Cleanrooms

Track: Industrial Facilities
Room: Adams Room
NY PDH DVD G
Sponsor: 09.11 Clean Spaces
Chair: Peter B. Gardner, P.E., Member, Torcon, Red Bank, NJ

Emerging real-time particle-microbial sensing technologies have led to new developments of integrated technologies for enhanced air cleanliness, better assurance of product quality and personnel safety and even energy conservation. This seminar firstly introduces new strategies of using particle sensing to automatically control airflow rate in cleanrooms to ensure air cleanliness class in 24/7/365 and to reduce energy consumption. The second speaker illustrates detail mechanisms of real-time airborne microbial sensing and how to apply this technology to monitor bio-tech, healthcare and pharmaceutical cleanrooms where microbial contamination is very critical to control. The last speaker demonstrates some new performance-enhancing and energy-efficient solutions in Europe to overcome the challenges in "hybrid" operating rooms typically designed as ISO 8 cleanrooms. Test results are visualized through interesting video clips.

1. Strategies of Real-Time Particle Sensing to Automatically Control Airflow Rate for Industrial Cleanrooms
***Wei Sun, P.E., Member**, Engsysco Inc., Ann Arbor, MI*

2. Real-Time Airborne Microbe Sensing and Monitoring Technologies for Bio-Tech, Healthcare and Pharmaceutical Cleanroom Facilities
***Koji Miyasaka, Member**, Kanomax USA, Andover, NJ*

3. Challenges and Solutions for Hybrid Operating Rooms to Ensure Air Cleanliness Based on Particle and Microbial Sensing
***Rupert Mack, P.E., Member**, Weiss Klimatechnik GmbH, Reiskirchen-Lindenstruth, Germany*

11:00 AM-12:30 PM

SEMINAR 13 (INTERMEDIATE)

Variable System Field Results and Why Load Based Testing Is Needed for Residential Equipment Applications

Track: Systems and Equipment
Room: Empire (Lobby)
NY PDH DVD G
Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps, 06.03 Central Forced Air Heating and Cooling Systems
Chair: Jon Douglas, Member, Lennox Industries, Carrollton, TX

Load-based testing is intended to better represent the energy consumption of HVAC equipment in real-world conditions and is used to develop a more detailed performance map for the equipment that takes into account the variation of efficiency with capacity. This type of testing is also intended to capture the performance impact of accessories and controls, like variable-speed fan control, staging and various thermostat control schemes. This seminar covers some experimental results with different types of residential HVAC equipment using a load-based testing approach and some of the implications for interested parties.

1. Exploring the Role for Load-Based Testing of Variable Capacity Heat Pumps in Utility Efficiency Programs
***Mira Vowles, Member**, Bonneville Power Administration, Portland, OR*

2. Long Term Field Testing of Residential Variable Speed Heat Pumps
***Ronald Domitrovic, Ph.D., Member**, Electric Power Research Institute, Knoxville, TN*

3. Ductless Mini-Split Heat Pumps in the Wild – Implications for Performance Modeling
***Bob Davis, Associate Member**, Ecotope Inc., Seattle, WA*

4. Testing Residential Air Conditioners at Conditions More Closely Associated with in-Situ Situations
***John P. Proctor, P.E., Member**, Proctor Engineering Group, San Rafael, CA*

1:30 PM-3:00 PM

TECHNICAL PAPER SESSION 4 (INTERMEDIATE)

Master Energy Planning and Net Zero Energy

Track: Energy Efficiency
Room: Crystal Room
NY PDH G
Chair: Katherine Hammack, Member, U.S. Army, Washington, DC

Designing and building net zero energy (NZE) buildings and low energy consuming communities are growing sectors worldwide. Several government agencies are looking into energy reduction toward NZ, as well as sustainable technologies that provide synergy across this spectrum. These papers describe research and planning tools for NZ buildings, low-energy communities and synergistic, sustainable technologies.

1. Integration of Master Planning and Energy Planning: From Detailed to Conceptual Analysis (CH-15-013)
***Michael Case, Ph.D., Associate Member**, Matthew Swanson, Ph.D., Associate Member, Alexander Zhivov, Ph.D., Member and Justine Yu, Engineer Research & Development Center, U.S. Army Corps of Engineers, Champaign, IL*

2. Energy Master Planning Towards Net Zero Energy Installation: U.S. Military Academy, West Point (CH-15-014)
Alexander Zhivov, Ph.D., Member[1], *Michael Case, Ph.D., Associate Member*[1], *Richard J. Liesen, Ph.D., Member*[1], *Matthew Swanson, Ph.D., Associate Member*[1], *Benjamin Barnes, Associate Member*[1], *Alfred Woody, P.E., Fellow ASHRAE*[2] *and Stephan Richter, Ph.D.*[3], *(1)Engineer Research & Development Center, U.S. Army Corps of Engineers, Champaign, IL, (2)Ventilation/Energy Applications PLLC, Norton Shores, MI, (3)GEF Ingenieur AG, Liemen, Germany*

3. Energy Master Planning Toward Net Zero Installation: Portsmouth Naval Shipyard (CH-15-015)
Richard J. Liesen, Ph.D., Member[1], *Matthew Swanson, Ph.D., Associate Member*[1], *Michael Case, Ph.D., Associate Member*[1], *Alexander Zhivov, Ph.D., Member*[1], *Anthony Latino*[2] *and David Dreyer*[3], *(1)Engineer Research & Development Center, U.S. Army Corps of Engineers, Champaign, IL, (2)The PERTAN Group, Champaign, IL, (3) Portsmouth Naval Shipyard, Portsmouth, NH*

4. Implementation of Energy Strategies in Communities from Pilot Project in Salzburg, Austria to Urban Strategy (CH-15-016)
Helmut Strasser*, Salzburg Institute of Regional Planning and Housing, Salzburg, Austria*

5. Energy Fault Detection in Office Building Service by Machine Learning Methods (CH-15-017)
Masaki Shioya, Ph.D.[1]*, Yoshio Masukawa*[2]*, Takehisa Yairi, Ph.D.*[3] *and Keigo Yoshida*[4]*, (1)Building Environment Group, Kajima Technical Research Institute, Tokyo, Japan, (2)Kajima Corporation, Tokyo, Japan, (3)University of Tokyo, Tokyo, Japan, (4)Mitsubishi Research Institute, Inc., Tokyo, Japan*

1:30 PM-3:00 PM

CONFERENCE PAPER SESSION 4 (INTERMEDIATE)

Increasing Building Efficiency with Modeling and Controls

Track: Energy Efficiency
Room: Empire (Lobby)
Chair: Suzanne LeViseur, P.E., Member, Haddad Engineering, Inc., Atlantic Beach, FL

This session is a compilation of conference papers to assist engineers in the design of building systems. Topics include energy modeling ideas to more accurately predict system energy use, control methods to better optimize building systems and a primer on emergency power generation auxiliaries design.

1. Mechanical Auxiliaries for Emergency Power Generation Systems (CH-15-C012)
Stephen W. Duda, P.E., Fellow ASHRAE*, Ross & Baruzzini, Inc., St. Louis, MO*

2. Improving Monthly Weather-Normalized Energy Use Model: How to Classify Building Energy Use Based on Occupancy (CH-15-C013)
Hyojin Kim, Ph.D., Member[1] *and Jeff Haberl, Ph.D., P.E., Member*[2]*, (1)The Catholic University Of America, Washington, DC, (2)Texas A&M University, College Station, TX*

3. Self-Optimizing Efficient Operation of Chiller-Tower Plant with Multi-Variable Extremum Seeking Control (CH-15-C014)
Baojie Mu, Ph.D. *and Yaoyu Li, Ph.D., Member, University of Texas at Dallas, Richardson, TX*

4. Representing Building System Hierarchies with Corresponding BAS Data Structures (CH-15-C015)
James Coogan, P.E., Member*, Siemens, Buffalo Grove, IL*

1:30 PM-3:00 PM

SEMINAR 14 (INTERMEDIATE)

Alternative Refrigerants for Residential Refrigerator-Freezers

Track: Fundamentals and Applications
Room: State Ballroom
Sponsor: 08.09 Residential Refrigerators and Food Freezers
Chair: Edward A. Vineyard, P.E., Member, Oak Ridge National Laboratory, Oak Ridge, TN

The objective of this seminar is to present current information on alternative refrigerants under consideration in residential refrigerators. This includes information on performance, stability, flammability, component design changes and future EPA regulations.

1. Cycle Efficiency, Charge Minimization, and Service of Household Refrigerators with R-600a
Brent Junge, P.E., Member*, General Electric, Louisville, KY*

2. A Performance Comparison of R-1234yf and R-134a in Residential Refrigerator Applications
Michael Pate, Ph.D., P.E., Member*, Texas A&M University, College Station, TX*

3. Low GWP Options for Self-Contained Refrigeration Systems
Barbara Minor*, Thomas J. Leck, Ph.D., Member and Charles C. Allgood, Ph.D., Member, Dupont, Wilmington, DE*

1:30 PM-3:00 PM

SEMINAR 15 (INTERMEDIATE)

Computational Analysis for Fire-Life Safety

Track: Life Safety
Room: Honore Ballroom (Lobby)
Sponsor: 05.09 Enclosed Vehicular Facilities, 05.06 Control of Fire and Smoke
Chair: Igor Maevski, Ph.D., P.E., Member, Jacobs Engineering, New York, NY

This seminar represents a number of recent computational analysis studies in fire and life safety. For a flammable liquid cargo fire in a road tunnel, the fire size and amount of smoke and heat were determined by the plume area from CFD analysis and confirmed by the experimentation. CFD analysis was also performed to evaluate the effect of tunnel fire suppression system by analyzing the tenability condition in the tunnel and the heat exposure on the structure. The final speaker will introduce the use of pedestrian modeling software in the development of emergency response plans for a city-wide evacuation.

1. Numerical Modeling of Design Fire Scenario Verified By Small-Scale Tests
Raymond C. Klein, P.E., Member*,* ***Yuan Li, P.E., Member****, Hyun Soo Ko, P.E. and Igor Maevski, Ph.D., P.E., Member, Jacobs Engineering, New York, NY*

2. Fire Tenability and Tunnel Surface Heat Exposure Analysis for the Ohio River Bridge Tunnel
Yuan Li, P.E., Member*, David Hahm, Member and Igor Maevski, Ph.D., P.E., Member, Jacobs Engineering, New York, NY*

3. Use of Pedestrian Modeling Software in Emergency Response Planning
David G. Newman, P.E., Member*, Hatch Mott MacDonald, Westwood, MA*

1:30 PM-3:00 PM

SEMINAR 16 (INTERMEDIATE)

"Can't We All Just Get Along?": Keeping Your Eye on the Ball After You've Been Poked in It

Track: Fundamentals and Applications
Room: Adams Room
Sponsor: 01.07 Business, Management & General Legal Education, TC 7.2 HVAC Design Build
Chair: E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA, and David Lechner, J.D., Falk Metz, Chicago, PA

Most projects are a complicated, one-time only performance by a one-time only ensemble carried out in a never-before used place. Given that newness, it isn't unusual to have some bumps and bruises along the path. Design and construction are both science and art. Human ingenuity and technology—the science—have provided a wide array of tools and techniques to do and make projects better. There are also certain understood (sometimes unspoken) expectations and intentions regarding their use—the art. Together science and art become the custom and practice of the industry. Custom and practice create an understood standard of action or care, which professionals are expected to meet in the performance of their duties. But remember, projects can be complicated things. One person's expectations may not align exactly with another person's intentions. Stuff happens—and stuff always has a story to tell. This program's mock arbitration scenario will feature our esteemed team of professionals to represent the engineer, the owner and the contractor—and their respective legal counsels—to tell their side of the story.

1. The Engineer Is Always Right!
***Larry Spielvogel, P.E., Fellow Life Member**, Consulting Engineer, Bala Cynwyd, PA*

2. It's My Money so I Get What I Want!
***Richard Dames, Member**, Boone County Schools, Florence, KY*

3. Well If You're so Smart, You Build It!
***James Fields, Member**, Superior Mechanical Services, Inc, Greensboro, NC*

4. Well, This Is a Fine Kettle of Fish We've All Waded into
***Richard Rooley, Presidential Fellow Life Member**, Rooley Consultants, Bucks, United Kingdom*

1:30 PM-3:00 PM

SEMINAR 17 (INTERMEDIATE)

Cutting-Edge Japanese Technologies SHASE Annual Award for Energy Efficiency for Existing Buildings in 2014

Track: Energy Efficiency
Room: Monroe Room
Chair: Shin-ichi Tanabe, Ph.D., Fellow ASHRAE, Department of Architecture, Waseda University, Tokyo, Japan

This seminar covers retrofitting of four buildings prioritizing energy efficiency. One is also unique from the perspective of conversion from an office to a chemical research facility. The second achieved a CO2 reduction in 36% with various conventional energy efficiency measures. The third is a unique retrofit that achieved a reduction in peak electricity demand exceeding 50%. The fourth is a kind of zero-energy building with actual energy consumption of 380MJ/m²/year. During the same period, electricity generation with PV exceeded this figure.

1. Challenges of Conversion Work from an Office Building to a Chemical Laboratory
***Kazukiyo Numata**, Mechanical & Electrical Design Dept., Obayashi Corporation, Tokyo, Japan*

2. Renovation of an Existing Tenant Office Building in Japan to Reduce CO2 By 36%
***Tomohisa Takebe**, Environment & MEP Engineering Dept., Nihon Sekkei Inc., Tokyo, Japan*

3. Achieving Highly Effective Energy-Saving and Load-Leveling By a Repair; Establishing an Optimal Heat Source and Air-Conditioning/Lighting Systems Using Technology in General
***Toshimasa Kakegawa**, Architecture Group, Tama Branch Office, Tokyo Electric Power Company Inc., Tokyo, Japan*

4. Renovation Technologies That Optimize Renewable Energies; Targeting a Zero-Energy Building (ZEB)
***Ryosuke Yuki**, Technical Institute, Sanken Setsubi Kogyo Co., Ltd., Ibaraki, Japan*

1:30 PM-3:00 PM

SEMINAR 18 (INTERMEDIATE)

Walgreens' Pursuit of a Net-Zero Store

Track: Energy Efficiency
Room: Chicago Room
Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications, 10.01 Custom Engineered Refrigeration Systems
Chair: Scott P. Hackel, P.E., Associate Member, Energy Center of Wisconsin, Madison, WI

This seminar explores net zero building fundamentals and shares the approach for the Walgreens store in Evanston, IL, which is expected to achieve net zero status and LEED Platinum certification. The store utilizes an innovative ground-source, CO2-based refrigeration system to meet not only its heating and cooling needs but also a significant refrigeration load and domestic hot water. The team discusses the steps it took to plan, design, implement and commission such an innovative system.

1. From Concept to Net Zero: The Use of Energy Analysis
***Scott P. Hackel, P.E., Associate Member**, Energy Center of Wisconsin, Madison, WI*

2. Net Zero the Natural Way: Incorporating Natural Refrigerants into Net Zero Design
***Jason Robbins, P.E., Member**, Walgreens, Inc., Deerfield, IL*

3. Commissioning to Net Zero Using Measurement and Verification
***Ben Skelton, P.E., Member**, Cyclone Energy Group, Chicago, IL*

4. The Impact of System Selection, Right Sizing of Systems and Control Sequences in the Pursuit of a Net Zero Retail Store
***Steve Sovak, Member**, WMA Consulting Engineers, Ltd., Chicago, IL*

3:15 PM-4:45 PM

SEMINAR 19 (INTERMEDIATE)

Cutting Edge Japanese Technologies SHASE Annual Award for Energy Efficiency for New Buildings in 2014

Track: Energy Efficiency
Room: Empire (Lobby)
Chair: Shinsuke Kato, Ph.D., Fellow ASHRAE, University of Tokyo Institute of Industrial Science, Tokyo, Japan

Three new buildings are introduced this seminar. One is an R&D center, which requires high intellectual productivity and environmental awareness. The second is an office building consuming almost half the energy of conventional office buildings. The third is a bicycle sports center. Major energy efficiency measures presented at this seminar include: underground water (15–20°C year-round) for precooling to AHU, a double- and triple-skin structure and an indirect heat exchanger.

1. A Pharmaceutical Research Facility That Helped Save Energy and Improve Workplace Productivity
***Toshihiro Kitamura**, Mechanical & Electrical Design Dept., Takenaka Corporation, Osaka, Japan*

2. Energy-Efficient Office Building By Synthesizing Architecture and Equipment, Including an Efficient Double Skin
***Makiko Kasahara**, Mechanical Design Engineer, Design Division, Shimizu Co., Ltd., Tokyo, Japan*

3. A First in Japan—a Cycle Stadium with a 250m Indoor Wooden Cycle Track
***Hideo Nishimura**, Mechanical Design Engineer, Design Division, Shimizu Co., Ltd., Tokyo, Japan*

Monday, January 26

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 5 (INTERMEDIATE)

Thermal Comfort in a Conservation Society

Track: Life Safety
Room: Chicago Room
Chair: Pam Androff, Associate Member, Mitsubishi Electric, Atlanta, GA

Thermal comfort is a key parameter of current building design. Building owners want to provide a comfortable environment for their employees. The session provides methods of designing for thermal comfort, while maintaining the stringent energy efficiencies and other sustainability initiatives dictated by current codes, standards and expectations.

1. A Database of Static Clothing Thermal Insulation and Vapor Permeability Values of Non-western Ensembles for Use in ASHRAE Standard 55, ISO 7730 and 9920: Results from Project 1504-RP (CH-15-018)
***George Havenith, Ph.D.**[1], Kalev Kuklane, Ph.D.[2], Jintu Fan, Ph.D.[3], Simon Hodder, Ph.D.[1], Yacine Ouzzahra, Ph.D.[1], Karin Lundgren, Ph.D.[2], Yuhan Au, Ph.D.[4] and Dennis Loveday, Ph.D., Member[1], (1) Loughborough University, Loughborough, United Kingdom, (2)Lund University, Lund, Sweden, (3)Cornell University, Ithaca, NY, (4)Hong Kong Polytechnic University, Hong Kong, Hong Kong*

2. Stairwell Pressurization and the Movement of Smoke During a High-Rise Fire (CH-15-019)
***William Black, Ph.D., P.E., Member**, Georgia Institute of Technology, Atlanta, GA*

3. Energy Savings and Thermal Comfort Optimization in Office Cubicle Environment (CH-15-020)
***Waleed Abdelmaksoud, Ph.D.** and Essam E. Khalil, Ph.D., Member, Cairo University, Cairo, Egypt*

4. Economizer Performance and Verification: The Effect of Human Behavior on Economizer Efficiency and Thermal Comfort in Southern California (CH-15-021)
Tighe Lanning[1], *Karen Kensek*[2], *Tim Kohut*[2] *and Joon-Ho Choi, Ph.D., Associate Member*[2], *(1)Architecture 2030, Santa Fe, NM, (2)University of Southern California, Los Angeles, CA*

5. Incident Response Monitoring Technologies for Aircraft Cabin (CH-15-022)
John B. Havermans, Ph.D.[1], *Marc M.G. Houtzager, P.E.*[1] *and Piet Jacobs*[2], *(1)TNO Applied Environmental Chemistry, Delft, Netherlands, (2)TNO Fluid Dynamics, Delft, Netherlands*

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 5 (INTERMEDIATE)

Health-Care Ventilation

Track: Hospital Design and Codes
Room: Adams Room
Chair: Monte G. Troutman, PE, Member, B.C. Engineering, Inc., Evansville, IN

Ventilation in health-care facilities is a critical part of any HVAC design. This session discusses various aspects of health-care ventilation, including: differences in US and UK standards; a comparison of ASHRAE Standard 170 with California standards; ventilation vs. thermal comfort; all air systems vs. chilled beams; and headboard ventilation for lowering airborne infections.

1. Comparative Analysis of Overhead Air Supply and Active Chilled Beam HVAC Systems for Patient Room (CH-15-C016)
Kishor Khankari, Ph.D., Member*, AnSight LLC, Ann Arbor, MI*

2. Effect of a Local Ventilation/Filtration Intervention on Health-Care Worker Exposure to Airborne Infection in a Traditional Hospital Room (CH-15-C017)
Urmila Ghia, Ph.D.[1], *Santosh R. Dungi, Student Member*[1], *Kenneth R. Mead, Ph.D., P.E., Member*[2], *Michael Gressel, Ph.D., Member*[2] *and G. Scott Earnest, Ph.D., P.E., Member*[2], *(1)University of Cincinnati, Cincinnati, OH, (2)CDC- National Institute for Occupational Safety and Health (NIOSH), Cincinnati, OH*

3. The Natural Experiment in California Hospital Ventilation Rates (CH-15-C018)
David C. Castillo, P.E., Member[1], *Travis R. English, P.E., Member*[2] *and Abdel Darwich, P.E., Member*[3], *(1)Office of Statewide Health Planning and Development, Sacramento, CA, (2)Kaiser Permanente, Oakland, CA, (3)Guttmann & Blaevoet, Sacramento, CA*

4. Comparison of Standard Comfort Ranges in Health Care Settings (CH-15-C019)
Travis R. English, P.E., Member*, Kaiser Permanente, Oakland, CA*

5. Benchmarking the US Healthcare Ventilation Standard with the UK Healthcare Ventilation Standard (CH-15-C020)
Travis R. English, P.E., Member[1] *and Richard Moeller, P.E., Member*[2], *Frank A. Mills, P.E., Member*[3], *(1)Kaiser Permanente, Oakland, CA, (2) Mazzetti, Irvine, CA, (3)Low Carbon Design Consultants, Liverpool, United Kingdom*

8:00 AM-9:30 AM

SEMINAR 20 (INTERMEDIATE)

ASHRAE and the Residential Construction Market: Status and Strategic Opportunities

Track: Fundamentals and Applications
Room: Honore Ballroom (Lobby)
Sponsor: Residential Ad Hoc Committee
Chair: Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL

The residential sector represents a significant portion of the built environment. In support of the 2014 ASHRAE Strategic Plan, activities are underway to better understand the residential market and stakeholders, ASHRAE's role in that market and ASHRAE strategic activities in support of the continued success of residential buildings. This seminar summarizes the activity and findings of the Residential Construction Ad Hoc Committee, including current activities, a stakeholders workshop and recommendations to the Board of Directors.

1. Residential: The Other "R" in ASHRAE
Max Sherman*, Residential Building Systems Group, Lawrence Berkeley National Laboratory, Berkeley, CA*

2. Residential Stakeholders Workshop: Issues and Observations
R. Christopher Mathis, Member*, MC*[2] *Mathis Consulting Company, Asheville, NC*

3. ASHRAE and the Residential Construction Market: Current Activities and Recommendations for Future Activities and Collaboration
Theresa A. Weston, Ph.D., Member*, DuPont Building Innovations, Richmond, VA*

8:00 AM-9:30 AM

SEMINAR 21 (INTERMEDIATE)

Blue Is the New Green: The Emerging Focus on Integrated Water Management

Track: Design of Energy and Water efficient Systems
Room: State Ballroom
Sponsor: 02.08 Building Environmental Impacts and Sustainability
Chair: Calina Ferraro, P.E., Associate Member, Randall Lamb Associates, Inc., La Mesa, CA

The domestic consumption of water is expected to nearly triple by the year 2050. Until recently, water in its various classifications has been viewed in individual silos, which limit the adoption of integrated solutions. The basic nature of our design teams tends to limit how we provide design solutions. Integrated solutions require stacking of benefits in order to achieve reasonable returns in competing with current technologies. The emerging concept of net zero requires that water is approached in a much different integrated fashion. This seminar continues to explore innovative case studies that approach water in integrated solutions that cross professional practice areas.

1. A Comprehensive Approach to Water for Multiple Benefits
David J. Yocca*, Conservation Design Forum, Elmhurst, IL*

2. A Landscape Architect's Approach to Water Modeling of Landscape and Sites
Jeffrey Bruce*, Jeffrey L Bruce & Company, LLC, North Kansas City, MO*

3. A New Approach to Modeling Efficient Water Systems
Fred J. Betz, Ph.D.*, Affiliated Engineers, Inc., Madison, WI*

8:00 AM-9:30 AM

SEMINAR 22 (BASIC)

Refrigeration for Craft Brewing

Track: Industrial Facilities
Room: Crystal Room
Sponsor: 10.05 Refrigerated Distribution and Storage Facilities, 10.01 Custom Engineered Refrigeration Systems
Chair: John Davis, University of Wisconsin—Madison, Madison, WI

Started in the 1970s with Fritz Maytag's renaissance of the Anchor Brewing Company, the craft brewery movement bloomed in the '80s and exploded in recent years. The Brewer Association counts 3,040 US breweries in June 2014 with another 2,000 "in planning." Essential to the brewing process is the refrigeration system. This seminar provides an introduction to the comingled history of brewing and refrigeration, a look into the current practices and options for craft brewery refrigeration and finishes off with a preview of this conference's Technical Tour of Half Acre Beer Company's new facility. Sorry, no samples during the seminar.

1. The Comingled History of Brewing and Refrigeration
Daniel J. Dettmers, Member*, University of Wisconsin—Madison, Madison, WI*

2. Introduction to the Brewing Process at Half Acre Beer Company
Matt Gallagher*, Half Acre Beer Co., Chicago, IL*

3. Craft Brewery Refrigeration: From Shoestring to State of the Art
Phil McConnell, Associate Member*, Thermastor, Madison, WI*

8:00 AM-9:30 AM

SEMINAR 23 (ADVANCED)

Data Center and IT Equipment Liquid Cooling: Performance Capabilities, Implementation and Emerging Technologies

Track: Large Buildings: Mission Critical Facilities and Applications
Room: Red Lacquer Room
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Robin A. Steinbrecher, Member, Intel Corp., Dupont, WA

IT performance and density demands continue to drive improvements in required cooling technologies in the data center. Liquid cooling has been successfully deployed for many years where required to meet customer workload and density demands. The thermal performance capability of liquid cooling creates the opportunity to trade off density, performance and total cost of ownership in ways not possible with air cooling. This seminar compares thermal performance between air- and liquid-cooling, quantifies considerations, quantifies risks and implementation concerns and highlights emerging liquid-cooling technologies and likely uses.

1. Liquid Cooling Performance Capability
***Dustin Demitriou, Ph.D.**, IBM, Poughkeepsie, NY*

2. Conventional Liquid Cooling Deployment Considerations
***Thomas Howe, P.E.**, Argonne National Lab, Chicago, IL*

3. Considerations of Non-Conventional Liquid Cooling Immersion Technologies
***Michael K. Patterson, Ph.D., P.E., Member**, Intel Corp., Dupont, WA*

8:00 AM-9:30 AM

SEMINAR 24 (INTERMEDIATE)

What Makes a Hospital's HVAC System High(er) Performing?

Track: Hospital Design and Codes
Room: Monroe Room
Sponsor: 09.06 Healthcare Facilities
Chair: Michael Meteyer, P.E., Member, Erdman Company, Madison, WI

Today's hospitals are a unique building type in a turbulent and challenging business environment. Their mission for healing remains constant and the top priority. How that happens and how it is paid for is anything but constant. Despite the tremendous pressure to lower operational costs with fewer resources and money, ASHRAE and our members can help find ways to continue to make them better. High performing—higher than what? Come find out the characteristics of high-performing HVAC systems that serve a hospital facility. There is certainly more to it than energy efficiency. A building owner provides perspective on common barriers and road blocks that prevent higher-performing designs and operations from occurring. Lastly, recent case studies and examples of high-performance HVAC systems in hospitals are presented that may refute some of the common perceptions.

1. Can Somebody Tell Me What Makes a Hospital HVAC System "High Performing"?
***Dan Koenigshofer, P.E., Member**, IES Engineers, Chapel Hill, NC*

2. Road Blocks and Barriers in Hospitals for Achieving Higher Performing HVAC Systems
***David Thomsen, P.E., Member**, Providence Health & Services, Portland, OR*

3. Hospital HVAC Systems: Case Studies and Examples of High Performance
***Heather Burpee**, University of Washington Integrated Design Lab, Seattle, WA*

8:00 AM-9:30 AM

WORKSHOP 2 (BASIC)

Fellows Debate: In a World of Disruptive, Perpetual Change, History Creates a Bad Baseline

Track: Design of Energy and Water efficient Systems
Room: Empire (Lobby)
Sponsor: College of Fellows
Chair: Victor Goldschmidt, Fellow ASHRAE, Consultant, Northport, MI

This workshop is part of the College of Fellows debate series. The design of HVAC systems, their construction commissioning and use mainly depends on past experience, research and proof of what works. The pace of change, however, in design method, manufacturing and communications challenges this concept. The use of electronics with shortened lines of communication and methods of monitoring and control now suggests that the historical approach to design construction and use inhibits progress. This change is debated and hard lessons of overreliance on either history or on changes in technology are debated as well.

1. Team 1
***Larry Spielvogel, P.E., Fellow Life Member**[1], **M. Ginger Scoggins, P.E., Member**[2] and **Richard Rooley, FREng, Presidential Fellow Life Member**[3], (1)Consulting Engineer, Bala Cynwyd, PA, (2)Engineered Designs Inc., Raleigh, NC, (3)Rooley Consultants, Bucks, United Kingdom*

2. Team 2
***Don Beaty, P.E., Fellow ASHRAE**[1], **Peter Kinsella**[2] and **Katherine Hammack, Member**[3], (1)DLB Associates, Eatontown, NJ, (2)Lehr Consultants International, Melbourne, Australia, (3)U.S. Army, Washington, DC*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 6 (INTERMEDIATE)

Energy Efficient, Hydronic HVAC Systems

Track: Design of Energy and Water Efficient Systems
Room: Crystal Room
Chair: Pam Androff, Associate Member, Mitsubishi Electric, Atlanta, GA

Hydronic systems for heating and cooling are extremely efficient processes for heat transfer. However, they are still energy consumers in building systems. This session provides information on energy-efficient strategies for hydronic systems to capitalize on both efficiencies.

1. Reducing Energy Consumption in Grocery Stores: Assessing the Performance of CHP Systems (CH-15-023)
***Jaya Mukhopadhyay** and Jeff Haberl, Ph.D., P.E., Member, Texas A&M University, College Station, TX*

2. Data Center Trigeneration with Absorption Refrigeration and Economizer Technologies (CH-15-024)
***Robert Tozer, Ph.D.** and Sophia Flucker, Operational Intelligence Ltd., Kingston upon Thames, United Kingdom*

3. Data Center Energy Efficiency Improvement Case Study (CH-15-025)
***Robert Tozer, Ph.D.** and Sophia Flucker, Operational Intelligence Ltd., Kingston upon Thames, United Kingdom*

9:45 AM-10:45 AM

SEMINAR 25 (BASIC)

Hydronics 101: Design Basics for Young Engineers and Complying with Standard 90.1

Track: Design of Energy and Water efficient Systems
Room: State Ballroom
Sponsor: 06.01 Hydronic and Steam Equipment and Systems, Student Activities Committee
Chair: Jason A. Atkisson, P.E., Member, Affiliated Engineers, Inc., Madison, WI

A properly designed hydronic system uses significantly less energy to distribute heating and/or cooling to where it is needed than an all-air system. This seminar focuses on the fundamentals of hydronic system design, including the various types of hydronic systems and associated components. The application of Standard 90.1 to hydronic systems is discussed.

1. Hydronics Basics: Part 1
***Julia Keen, Ph.D., P.E., Member**, Kansas State University, Manhattan, KS*

2. Hydronics Basics: Part 2
***Jeff Boldt, P.E., Member**, KJWW Engineering Consultants, Madison, WI*

9:45 AM-10:45 AM

SEMINAR 26 (INTERMEDIATE)

Microgrids, Resiliency and CHP: Implications for the Future of Building Design and Retrofit

Track: Large Buildings: Mission Critical Facilities and Applications
Room: Monroe Room
Sponsor: 01.10 Cogeneration Systems
Chair: James Freihaut, Ph.D., Pennsylvania State University, University Park, PA

As extreme weather events become more common and more expensive to endure, organizations are looking for ways to maintain resiliency and have reliable power. The ability to use distributed energy and operate in island mode, isolated from the utility supply, is what fundamentally makes a microgrid. It is the balance of cost to risk that is the essential question to consider. During Hurricane Sandy, CHP enabled a number of large facilities to continue their operations when the electric grid went down. This seminar covers the growing landscape of microgrid activities, CHP's role and implications for building design and retrofit.

1. Microgrids, Resiliency and CHP Development in the United States Today
***Richard Sweetser, Member**, Exergy Partners Corp., Herndon, VA*

2. Microgrids, Resiliency and CHP Design and Retrofit Implications
***Gearoid Foley, Member**, Integrated CHP Systems Corp., Princeton, NJ*

9:45 AM-10:45 AM

SEMINAR 27 (INTERMEDIATE)

Cutting Edge Japanese Technologies SHASE Annual Award for System and Equipment in 2014

Track: Systems and Equipment
Room: Adams Room
Chair: Toshio Yamanaka, Ph.D., Department of Architectural Engineering, Osaka University, Osaka, Japan

This seminar covers two different types of technologies, one of which is a large district heating and cooling (DHC) plant in Osaka. It covers 218,000 m² of office buildings, shopping malls and railway stations, with an annual operating COP of 1.3, which is one of the highest in Japan. Another is a new type of gas engine heat pump with a power-generating function, to be operated independently when the power supply is shut off. This function is important for areas where the power supply might be shut down suddenly and/or intentionally.

1. Development of an Autonomous Power Supply Air-Conditioning System Based on a Gas Engine-Driven Heat Pump with Power Generator
***Yuma Furuhashi**, Solution Technology Dept., Tokyo Gas Co., Ltd., Tokyo, Japan*

2. District Heating and Cooling System in Osaka with Optimal System Design and Energy Efficient Operation
***Osamu Takada**, Urban Energy Consulting Dept., Mitsubishi Jisho Sekkei Inc., Tokyo, Japan*

9:45 AM-10:45 AM

SEMINAR 28 (INTERMEDIATE)

System Effects from Inlet of Centrifugal and Plenum Fans

Track: Systems and Equipment
Room: Empire (Lobby)
Sponsor: 05.01 Fans, 05.09 Enclosed Vehicular Facilities
Chair: Asesh Raychaudhuri, P.E., Member, US Department of Veterans Affairs, Washington, DC

This seminar is based on two research projects undertaken by AMCA. These research projects obtained a body of measured system effects on both air and sound from different inlet conditions of centrifugal fans and also for different inlet and discharge conditions of airfoil plenum fans. The inlet and outlet conditions used with other appurtenances for each tested fans are described and discussed. Review of the results and final derived conclusions are a part of this seminar.

1. System Effects from Fans
***Mark Stevens**, AMCA International, Arlington Heights, IL*

9:45 AM-10:45 AM

SEMINAR 29 (BASIC)

The Need for Energy Modeling Software for Data Centers

Track: Large Buildings: Mission Critical Facilities and Applications
Room: Red Lacquer Room
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Nick Gangemi, Member, ASHRAE TC9.9, Rochester, NY

Hourly energy simulation programs such as DOE-2.2, eQUEST and Energy Plus have become more sophisticated through constant maintenance over many years. Those who have attempted to model data center design loads and annual energy consumption have found that the suite of available public domain programs for occupied office spaces is not easily adaptable to data center projects. Data centers have very simplistic load-contributing components but highly complex load growth and system growth modeling challenges. This seminar addresses modeling needs that are unique to data centers, including using both hourly energy simulation programs (such as the public domain ones noted above), as well as more simplistic spreadsheet approaches.

1. The Need for Energy Modeling Software for Data Centers
***Vali Sorell, P.E., Member**, Syska Hennessy Group, Charlotte, NC*

2. The Need for Energy Modeling Software for Data Centers
***Jeff Sloan, P.E., Member**, McKinstry Company, Seattle, WA*

9:45 AM-10:45 AM

SEMINAR 30 (INTERMEDIATE)

What the F-gas Is Going on in Europe: What the HFC Phasedown Means for Our Industry

Track: Systems and Equipment
Room: Honore Ballroom (Lobby)
Sponsor: 02.05 Global Climate Change, MTG: Low GWP Alternative Refrigerants, 08.02 Centrifugal Machines
Chair: Eric Sturm, Member, Trane, La Crosse, WI

The European Union (EU) has modified its rules and regulations on the use of fluorinated gas (F-gas), including hydrofluorocarbons (HFCs). The implementation of the new F-gas regulation began on January 1, 2015. This seminar prepares attendees for the rollout of the new regulations. It details the changes made to the F-gas regulation, outlines the requirements for importers and producers, and discusses the implications of the bans and phasedowns on the refrigerating and air-conditioning markets. Additionally, the seminar also addresses the effect of the F-gas legislation on other regions of the world.

1. The New F-Gas Rules in Europe: Challenges and Opportunities for Industry
***Andrea Voigt**, The European Partnership for Energy and the Environment, Brussels, Belgium*

2. The Impact of New F-Gas Regulations for Producers and Importers of Materials and Equipment; Implications of Revised European F-Gas on Producers
***Matthew Ritter, Member**, Arkema Inc., King of Prussia, PA*

3. Implications of the Revised F-Gas Regulations on Manufacturers Producing for the European Market
***William F. McQuade**, Johnson Controls Corporation, York, PA*

9:45 AM-10:45 AM

FORUM 1 (ADVANCED)

Conquering Infectious Diseases in Healthcare: A Grassroots Movement for Rapid Prototyping of Code-Compliant Solutions (and Ideas to Avoid!)

Track: Hospital Design and Codes
Room: Chicago Room
Sponsor: 09.06 Healthcare Facilities
Chair: Traci Hanegan, P.E., Member, Coffman Engineers, Inc., Spokane, WA

Emerging infectious diseases are growing stronger. A current work group has been compiling published statistics of the modes of transmission of infectious diseases in toilet rooms. Solutions have been proposed, but testing is required to determine which solutions are effective and which should be avoided. The forum is a critical venue for participants to develop a template for approaching facilities to do rapid prototyping of these solutions and then report on the outcomes. From the discussion, an ASHRAE Journal article would present the template for use by others to fast-track this effort, and the outcome would likely fuel a conference paper.

11:00 AM-12:00 PM

TECHNICAL PAPER SESSION 7 (INTERMEDIATE)

IEA Annex 61: Deep Energy Retrofits, Part 1

Track: Energy Efficiency
Room: Adams Room
Chair: Richard Kidd, U.S. Army, Washington, DC

The purpose of the Annex is to improve the decision-making process to achieve deep energy retrofits of government/public buildings. This session addresses goals, example projects, financing issues and potential limitations due to budgetary constraints.

1. First Experience in Extending the Reach of an Energy Concept through an Advanced ESPC Model (CH-15-026)
***Rüdiger Lohse, Ph.D.**, Leiter Contracting, Baden-Württemberg, Germany*

2. Analysis and Monitoring of Energy Consumption and Indoor Climate in a School Before and After Deep Energy Renovation (CH-15-027)
***Kirsten E. Thomsen**[1], Jorgen Rose[1], Ove C. Moerck, Ph.D.[2] and Niels C. Bergsoe[1], (1)Danish Building Research Institute, Copenhagen, Denmark, (2)CENERGIA, Copenhagen, Denmark*

3. Extending the Reach of Campus Renovation through Combined Financing (CH-15-028)
***Mark Wheeler Jr., Member**[1], Phillip L. Smith, P.E.[1], Eric James, P.E.[2] and Luis Ayala[3], (1)Honeywell, Washington, DC, (2)Washington Gas Energy Systems, Mclean, VA, (3)Defense Intelligence Agency, Quantico, VA*

11:00 AM-12:00 PM

CONFERENCE PAPER SESSION 6 (INTERMEDIATE)

Analysis of Variable Capacity Heat Pumps, Ground Source Heat Pumps Hydronics and Rainwater, Gray Water and AC Condensate Collection

Track: Systems and Equipment
Room: Empire (Lobby)
Chair: Henry Becker, Member, H-O-H Water Technology, Inc., Palatine, IL

This session begins examining the performance characteristics of a variable-capacity heat pump within a controlled laboratory setting. The session also presents the results of an experimentally validated ground heat exchanger model to explore pumping energy, heat pump energy and backup electric resistance heating energy uses for ground source heat pump (GSHP) systems. It also includes information from a broader research effort aimed at reducing both water consumption and on-peak electricity load using integrated thermal energy and water systems. The session provides an overview of rainwater, gray water and AC-condensate collection, and then models and analyzes systems for residential buildings.

1. Effects of Ground Heat Exchanger Design Flow Velocities on System Performance of Ground Source Heat Pump Systems in Cold Climates (CH-15-C021)
***Signhild E. A. Gehlin, Ph.D., Member**[1] and Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE[2], (1)Swedish Centre for Shallow Geothermal Energy, Lund, Sweden, (2)Oklahoma State University, Stillwater, OK*

2. Performance Characteristics of Residential Variable Capacity Heat Pump (CH-15-C022)
***Walter E. Hunt, Associate Member**[1], Ronald Domitrovic, Ph.D., Member[1], Jack Callahan, P.E., Associate Member[2] and Kacie Rossman, P.E.[2], (1)Electric Power Research Institute, Knoxville, TN, (2)Bonneville Power Administration, Portland, OR*

3. Estimating Water Savings from an Auxiliary Water Collection System, as Part of an Integrated Thermal Energy and Water Storage System for Residential Buildings
***Charles R. Upshaw, Student Member**, Joshua D. Rhodes, Student Member and Michael E. Webber, University of Texas, Austin, TX*

11:00 AM-12:00 PM

SEMINAR 31 (ADVANCED)

Back to Basics towards Energy Efficient HVAC Design

Track: Design of Energy and Water efficient Systems
Room: Red Lacquer Room
Sponsor: 09.01 Large Building Air-Conditioning Systems, 07.06 Building Energy Performance
Chair: Charles E. Henck, Whitman, Requardt & Associates LLP, Baltimore, MD

The strategy is to reduce demand, maximize efficiency and harvest site energy. Orientation, facade properties, shading, inside design conditions and demand ventilation for outside air for meeting IAQ are the important areas on which this seminar focuses. Equipment selection with hybrid chillers, dual fluid precision units, chilled beams, variable-air volume units, variable-speed drives for AHUs and pumpsets, thermal storage, vapor absorption system and car park exhaust system can be optimized. A building automation system can be handy in reducing the energy costs and validates the design by providing quality inputs. Installation, commissioning, operation and maintenance lead further to saving of energy. One unit saved is two units produced. Energy saving is only a relative term and it is a continuous process with no limits. All energy-saving concepts are brought out with energy-saving figures.

1. Back to Basics towards Energy Efficient HVAC Design
***Nirmal Ram, P.Eng., Fellow ASHRAE**, Cerebration Consultants, Bangalore, India*

11:00 AM-12:00 PM

SEMINAR 32 (BASIC)

A Day in the Life of an IAQ Consultant

Track: Fundamentals and Applications
Room: Honore Ballroom (Lobby)
Sponsor: Indoor Air Quality Association
Chair: Ian D. Cull, P.E., Member, Indoor Sciences, Inc., Chicago, IL

In July 2014, it was announced that the Indoor Air Quality Association is being merged into ASHRAE. The association's membership consists of indoor air quality (IAQ) consultants and other practitioners. But what are IAQ consultants, and what do they do? In this seminar, projects that involve IAQ consultants are described. Examples include: finding moisture and mold issues; hunting down odors; and measuring contaminants (e.g. VOCs,

radon, asbestos, allergens, etc.). ASHRAE members learn when to include IAQ consultants to help prevent IAQ problems during the design phase or help diagnose problems in existing buildings.

1. A Day in the Life of an IAQ Consultant
Ian D. Cull, P.E., Member[1] *and Don Weekes*[2]*, (1)Indoor Sciences, Inc., Chicago, IL, (2)InAIR Environmental Ltd., Ottawa, ON, Canada*

2. IAQ and Mechanical Engineering: A Future Together
Don Weekes*, InAIR Environmental Ltd., Ottawa, ON, Canada*

11:00 AM-12:00 PM

SEMINAR 33 (INTERMEDIATE)

Recent ASHRAE Research in Air-to-Refrigerant Heat Exchangers

DVD

Track: Energy Efficiency
Room: Monroe Room
Sponsor: 10.07 Commercial Food and Beverage Cooling Display and Storage
Chair: Sankar Padhmanabhan, Ph.D., Danfoss HX, Baltimore, MD

Recently ASHRAE sponsored two research projects which are nearing completion related to design and performance of air-to-refrigerant heat exchangers. The research projects deal with a) oil retention characteristics of microchannel heat exchangers and b) air side performance of louvered heat exchangers in low-Reynolds number operation. Both are of significant impact in modern HVAC equipment due to increasing adoption of microchannel heat exchangers.

1. Effect of Oil Retention on the Refrigerant-Side Heat Transfer Capacity and Pressure Drops of Microchannel Condensers for AC and Refrigeration Systems
Ardiyansyah S. Yatim, Associate Member *and Lorenzo Cremaschi, Ph.D., Member, Oklahoma State University, Stillwater, OK*

2. An Experimental Investigation of Microchannel Heat Exchangers at Low Air-Side Reynolds Numbers
Cheng-Xian (Charlie) Lin, Ph.D., Member*, and Pradeep Shinde, Student Member, Florida International University, Miami, FL 3. Walk-in Freezer Energy*

11:00 AM-12:00 PM

FORUM 2 (INTERMEDIATE)

AASA: A Dream Come True?

Track: Fundamentals and Applications
Room: Crystal Room
Sponsor: 02.08 Building Environmental Impacts and Sustainability, AASA and Planning Committee
Chair: Thomas E. Watson, P.E., Presidential Fellow Life Member, Daikin Applied, Staunton, VA, and Ashish Rakheja, P.E., Member, Managing Director, Building Engineering – India, AECOM, New Delhi, India

ASHRAE, in its desire to broaden its scope of activities in the world and thereby make possible a more effective and fruitful exchange of knowledge and ideas among engineers engaged in the arts and sciences of HVAC&R, created the ASHRAE Associate Society Alliance (AASA). The purpose of AASA is to enable its members to participate collaboratively in the advancement of the arts and sciences of air-conditioning, heating and refrigerating technologies and to foster effective and fruitful exchanges of ideas and information between international participants. This forum invites a discussion on the effectiveness of AASA and discusses the ways to further enhance the participation of its members.

11:00 AM-12:00 PM

FORUM 3 (BASIC)

Demystifying ASHRAE Technical Committees

Track: Fundamentals and Applications
Room: Chicago Room
Sponsor: TAC and YEA
Chair: Megan M Tosh, P.E., Member, Integrated Environmental Solutions, Atlanta, GA; and T.M. Lawrence, Ph.D., P.E., Member, University of Georgia, Athens, GA

For many members of ASHRAE, the Technical Committee process is quite unclear. What do they do? How does one join? What if I just want to learn? What do I do if I have a problem with material I have found in a Handbook chapter? What's the difference between a Corresponding Member and a Provisional Corresponding Member? This forum addresses these questions as well as many more from members who are interested in participating in our technical society and would like to know where to begin.

11:00 AM-12:00 PM

WORKSHOP 3 (INTERMEDIATE)

Code and Safety Standard Requirements: Working with 2L Low GWP Refrigerants

Track: Life Safety
Room: State Ballroom
Sponsor: 03.01 Refrigerants and Secondary Coolants, MTG LowGWP
Chair: Robert G Richard, Member, Honeywell Int. Inc., Buffalo, NY

This session looks at code and standard requirements for implementing the low GWP refrigerants of classification 2L (flammable with burning velocity below 10 cm/sec). We invited two panel members that are experts in the ASHRAE standards process and ASHRAE's role in other standard-making bodies. The panel also discusses potential obstacles moving forward and work that still needs to be done.

2:15 PM-3:45 PM

SEMINAR 34 (INTERMEDIATE)

Testing Filters for Removal of Gas-Phase Air Contaminants

NY PDH DVD G

Track: Fundamentals and Applications
Room: Red Lacquer Room
Sponsor: 02.03 Gaseous Air Contaminants and Gas Contaminant Removal Equipment
Chair: M. Kathleen Owen, Member, Research Triangle Institute, Research Triangle Park, NC

Breathing clean air is essential to our health and well-being. However, our air contains many unwanted gas-phase contaminants (e.g., ozone, SO2 and organic compounds). To remove these compounds, gas phase air cleaners may be needed. ASHRAE has two test methods to help determine how these air cleaners work: one for the full-scale HVAC units (145.2) and one for the sorbents that remove the gases (145.1). Since these methods are relatively new, few people understand them and their uses in selecting air cleaners. This seminar introduces the methods, their benefits and limitations, and how to use the data in practical applications.

1. Testing Gas-Phase Air Cleaners for Contaminant Removal Efficiency
M. Kathleen Owen, Member*, Research Triangle Institute, Research Triangle Park, NC*

2. Lab Testing and Evaluation of ASHRAE 145.1 for Different Filter Media: Possibilities and Limitations
KwangHoon Han, Ph.D., Associate Member*, Syracuse University, Syracuse, NY*

3. Application of ASHRAE Standards 145.1 and 145.2 for Testing Gas-Phase Media
William Lull, Member*, Garrison/Lull Inc., Princeton Junction, NJ*

4. Interpreting 145.2 Results: Which Filter Is Best?
W. Brad M. Stanley, Associate Member*, AAF International, Atlanta, GA*

3:00 PM-4:30 PM

AHR EXPO SESSION 1 (BASIC)

New 2015 Regional Standards and the Effects on Different Areas of the HVAC Industry

NY PDH G

Track: Energy Efficiency
Room: S106a
Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps, 06.03 Central Forced Air Heating and Cooling Systems
Chair: Kristin Heinemeier, Ph.D., Member, Western Cooling Efficiency Center UC Davis, Davis, CA

OPEN SESSION: no badge required. New US Federal efficiency standards go into effect in 2015 that mandate different efficiency levels for residential air conditioners, heat pumps and furnaces based on location in the US. This poses many different issues and concerns for all parties who are in some way involved in the HVAC industry. OEMs, distributors, contractors, local officials and others have unique challenges and implications that the new regulations impart on their businesses and practices. This seminar presents a background of regional standards and recommendations from different parties within the industry about how to make the best of the situation.

1. Regional Standards for Residential Air-Conditioners, Heat Pumps and Furnaces: Background and Prognosis
***Harvey Sachs, Ph.D., Member**, American Council for an Energy-Efficient Economy, Washington, DC*

2. Enforcement of Regional Standards with Manufacturers in the United States
***Karim Amrane, Ph.D., Member**, AHRI, Arlington, VA*

3. Regional Standards: Distribution Challenges
***Ted Duffy, P.E., Member**, Hughes Supply, Savannah, GA*

4. Main Street's View of Regional Efficiency Standards
***Harlan Krepcik, Member**, Tidewater Community College, Portsmouth, VA*

4:00 PM-5:00 PM

WORKSHOP 4 (INTERMEDIATE)

Energy Rating and Auditing Your Commercial Building Using the ASHRAE bEQ Program (Building Energy Quotient): How to Do It, and Why You Should

Track: Energy Efficiency
Room: Red Lacquer Room
Sponsor: 07.06 Building Energy Performance, bEQ Committee
Chair: Ross Montgomery, Fellow ASHRAE, Quality Systems and Technology Inc., Parish, FL

The workshop outlines the role of building Energy Quotient (bEQ) in improving building energy performance and efficiency. It explores energy management tools, including modeling, monitoring and benchmarking, that building owners and operators have at their disposal to evaluate their buildings' performance and compare their buildings to similar buildings in the marketplace. The purpose is to make ASHRAE members aware of the ASHRAE bEQ program and its opportunities for use in their businesses and for their clients. bEQ identifies and rewards good energy efficiency practices on the path toward net zero energy buildings. It also follows the theme of ASHRAE President Tom Phoenix.

1. How to Obtain a bEQ As-Designed and/or in-Operation Rating: Requirements, Technical Aspects, and Resources
***Michael Brandemuehl, Ph.D., P.E., Fellow ASHRAE**, University of Colorado, Boulder, CO*

2. Benefits of Obtaining a bEQ Rating
***Ray Patenaude, P.E., Member**, The Holmes Engineering Group, Tierra Verde, FL*

Tuesday, January 27

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 8 (INTERMEDIATE)

Control and Monitoring for Improved Building Energy Efficiency

Track: Design of Energy and Water efficient Systems
Room: State Ballroom
Chair: Dunstan Macauley, P.E., Member, US Army Corps of Engineers, Washington, DC

Energy efficiency is a key consideration for building design. To provide the net effect of the design, proper control and monitoring are required to generate the results and verify that the systems are operating as designed. This session provides strategies for monitoring and control of energy-efficient systems and design. Additionally, it provides analysis of how controls and monitoring can be used to impact energy efficiency.

1. Control Accuracy and its Impact on Building Energy Efficiency (CH-15-029)
***John Zhou, Ph.D., Associate Member**, The Trane Company, Onalaska, WI*

2. Improvement of Building Energy Simulation Accuracy with Occupancy Schedules Derived from Hourly Building Electricity Consumption (CH-15-030)
***Yang-Seon Kim, Student Member**, Pennsylvania State University, University Park, PA*

4. Continuous Building Energy Data Monitoring Using Recursive Least Squares Filter and CUSUM Change Detection: Application to Energy Load Data (CH-15-031)
***Hiroko Masuda, Member**, Energy Systems Laboratory, Texas A&M University, College Station, TX*

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 7 (INTERMEDIATE)

A Paradigm Shift for HVAC Design

Track: Energy Efficiency
Room: Chicago Room
Chair: Charles E. Henck, Whitman, Requardt & Associates LLP, Baltimore, MD

The first paper describes an optimum-efficiency design approach for large buildings using air-side dedicated outdoor air systems (DOASs) and electronically commutated motor (ECM) fan terminal units and water-side chillers with heat recovery. The second paper follows two multifamily buildings located in Madison, WI, from design and predictive energy modeling through to two years of accumulated utility bill data. The third paper presents a new simple radiant cooling calculating method for predicting the cooling capacity of radiant floors in large space buildings. The fourth paper analyzes radiant AC systems, consisting of passive chilled beams installed into a suspended ceiling and perforated ceiling panels.

1. A Paradigm Shift for HVAC Design (CH-15-C024)
***Richard Franseen, P.E., Member**, Honeywell Building Solutions, Charlotte, NC*

2. Energy Modeling Multifamily Buildings: A Case Study of Prediction Versus Reality (CH-15-C025)
***Sharon Gould, P.E., Member**[1] and Marcus Hawkins, Associate Member[2], (1)Franklin Energy Services, LLC, Madison, WI, (2) Wisconsin Energy Conservation Corporation, Madison, WI*

3. A Simple Calculating Method of Longwave Radiant Heat Exchange of Radiant Floor Cooling in Large Space Building (CH-15-C026)
***Kang Zhao** and Xiaohua Liu, Tsinghua University, Beijing, China*

4. Basic Study on Air-Conditioning System Using Passive Chilled Beams and Perforated Ceiling Panels (CH-15-C027)
***Saya Amemiya, Ph.D.**, Takuji Nakamura, Ph.D., Koji Murakami, Naoto Kumano, Shinya Ikeda, Hideki Morita, Yoshito Arai and Minoru Kawashima, Ph.D., Member, Shimizu Corporation, Tokyo, Japan*

8:00 AM-9:30 AM

SEMINAR 35 (INTERMEDIATE)

Alternative Fire and Smoke Detection Technologies for Smoke Control Applications

Track: Life Safety
Room: Crystal Room
Sponsor: 05.06 Control of Fire and Smoke
Chair: Paul Turnbull, Member, Siemens Building Technologies, Inc., Buffalo Grove, IL

Smoke control systems are now being used in spaces that are very challenging from a fire detection standpoint. High ceilings, high airflows, automobile exhaust, dust and dirt can preclude the use of traditional spot-type smoke detectors in these spaces. This seminar provides an overview of other fire and smoke detection technologies that are currently available and presents the results of tests comparing the performance of these different detection technologies in warehouse, high ceiling and tunnel

environments. The information presented should help designers choose appropriate fire and smoke detection technologies for activation of smoke control strategies in specialized environments.

1. Comparative Testing of Various Detection Technologies
***Matthew Davy, P.E., Member**, Arup, Cambridge, MA*

2. Video Image Fire and Smoke Detection for Large Spaces with High Ceilings
***George Hadjisophocleous, Ph.D., Member**, Carleton University, Ottawa, ON, Canada*

3. Performance of Detection Systems in Tunnels
***Ahmed Kashef, Ph.D., P.E., Member**, National Research Council Canada, Ottawa, ON, Canada*

SEMINAR 36 (BASIC)

Building Energy Prediction and Measurement: Avoiding Fantasy and Heading toward Fact

NY PDH DVD G

Track: Fundamentals and Applications
Room: Empire (Lobby)
Sponsor: MTG.ET Energy Targets, CIBSE ASHRAE Liaison Committee and bEQ Committee
Chair: Tim Dwyer, Fellow ASHRAE, UCL Institute for Environmental Design and Engineering, The Bartlett, University College London, London, United Kingdom

This seminar considers the tools and systems that are used around the world to both predict and report on building energy use. It also considers why predicted energy use frequently does not match up to reality. Importantly, it discusses what measures are needed to close this so-called performance gap.

1. Energy Labeling: A European Experience
***Hywel Davies, Ph.D., Member**, Chartered Institution of Building Services Engineers, London, England*

2. Building Energy Rating Schemes Around the World: Assessing Issues and Impacts
***Adam Hinge, P.E., Member**, Sustainable Energy Partnerships, Tarrytown, NY*

3. Living up to Expectations: the Differences between Predicted and Delivered Energy Consumption
***Peter Kinsella**, Lehr Consultants International, Melbourne, Australia*

8:00 AM-9:30 AM

SEMINAR 37 (INTERMEDIATE)

Case Studies in Engineering Ethics

NY PDH DVD G

Track: Fundamentals and Applications
Room: Honore Ballroom (Lobby)
Sponsor: 01.07 Business, Management & General Legal Education
Chair: Mike Bilderbeck, P.E., Fellow ASHRAE, Pickering Firm, Memphis, TN

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

1. Serving Multiple Masters: Part 1
***Mike Bilderbeck, P.E., Fellow ASHRAE**, Pickering Firm, Memphis, TN*

2. Serving Multiple Masters: Part 2
***Jennifer E. Leach, P.E., Member**, Cummins-Wagner Co, Inc., Annapolis Junction, MD*

3. Serving Multiple Masters: Part 3
***Kristin Schaefer, P.E., Member**, Schaefer Engineering, College Station, TN*

8:00 AM-9:30 AM

SEMINAR 38 (INTERMEDIATE)

Effective Deployment of UVC in Healthcare Environment

NY PDH DVD G

Track: Hospital Design and Codes
Room: Adams Room
Sponsor: 02.09 Ultraviolet Air and Surface Treatment, Environmental Health Committee
Chair: Sam Guzman, Member, American Ultraviolet Company, Schooleys Mountain, NJ

This seminar covers the use and application of UVC (short-wave ultraviolet radiation) energy for the next generation of healthcare facility design, construction and retrofit applications. The seminar opens with a discussion of the ASHRAE position paper on airborne infectious diseases. The subsequent presenters discuss the use of UVC for in-duct and in-room air and surface disinfection as a preventative measure for infection and disease transmission and control in health-care environments.

1. ASHRAE Position Paper on Airborne Infectious Diseases
***Shelly L. Miller, Ph.D., Member**, University of Colorado at Boulder, Boulder, CO*

2. Upper Air UVC in a Health-Care Setting
***Richard L. Vincent, Member**, Mount Sinai School of Medicine, New York, NY*

3. UVC for In-Room Surface Disinfection
***Ashish Mathur, Ph.D., Member**, UltraViolet Devices, Inc., Valencia, CA*

4. UVC for In-Duct Healthcare Applications
***William P. Bahnfleth, Ph.D., P.E., Presidential Fellow Life Member**, Pennsylvania State University, University Park, PA*

8:00 AM-9:30 AM

SEMINAR 39 (INTERMEDIATE)

Efficiency Prediction of Motors and Variable Speed Drives with Compressors and with Fans

NY PDH DVD G

Track: Systems and Equipment
Room: Red Lacquer Room
Sponsor: 01.11 Electric Motors and Motor Control, 01.09, 05.01 Fans
Chair: Armin Hauer, Member, ebm-papst Inc., Farmington, CT

"Extended product" is the jargon to mean a pump, compressor or fan, entirely packed with a motor, an optional mechanical transmission and an electronic variable-speed drive. The DOE prescribes motor test methods and had established mandatory minimum efficiencies, including certification requirements for motors as standalone components. The Canadian Standards Association's standard CSA C838-13 Energy Efficiency Test Methods for Three-Phase Variable Frequency Drive Systems pioneered measurement of induction motors with VFDs. The Air Conditioning, Heating and Refrigeration Institute now offers rating certification for VFDs. This seminar discusses Alternate Efficiency Determination Methods (AEDMs) for practitioners, electric utility incentive program administrators and regulators to predict performance and efficiency for extended products from component data.

1. Variable-Speed Motor Systems Effects
***Emmanuel Agamloh, Ph.D.**, Advanced Energy, Raleigh, NC*

2. Compressors Thrive with VSDs
***Rainer Grosse-Kracht, Member**, BITZER SE, Sindelfingen, Germany*

3. Extended Product Efficiency Approach with Fans
***Uwe Sigloch**, ebm-papst GmbH & Co. KG, Mulfingen, Germany*

8:00 AM-9:30 AM

SEMINAR 40 (INTERMEDIATE)

The IAQ Procedure Is Alive and Well: Current Status of Standard 62.1, TRG4.IAQP, and LEED v4.0

Track: Energy Efficiency
Room: Monroe Room
Sponsor: 02.03 Gaseous Air Contaminants and Gas Contaminant Removal Equipment, SSPC 62.1, SSPC 145, TRG4.IAQP, 02.04 Particulate Air Contaminants and Particulate Contaminant Removal Equipment
Chair: Christopher O. Muller, Member, Purafil Inc., Doraville, GA

The IAQ Procedure (IAQP) is an "on-again, off-again" method of determining the required outdoor ventilation rates in ASHRAE Standard 62.1-2013—Ventilation for Acceptable Indoor Air Quality. There is renewed interest in using this method for energy conservation as well as improving and maintaining IAQ. This seminar provides an update on current activities related to the IAQP with regard to Standard 62.1; ASHRAE TGR4 Indoor Air Quality Procedure Development; U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) EQpc68, and a recent case study describing successful application of the IAQ Procedure.

1. The IAQ Procedure and Contaminants of Concern: Who, What, Where and Why?
***Charles Seyffer, Member**, Camfil, Riverdale, NJ*

2. Standard 62.1: The IAQ Procedure and the Concept of Additivity
***Dennis Stanke, Life Member**, Trane (Retired), LaCrosse, WI*

3. LEED Certification and the IAQ Procedure: It Can be Done
***Charlene Bayer, Ph.D., Member**, Georgia Tech Research Institute, Atlanta, GA, USA and Hygieia Sciences LLC, Atlanta, GA*

4. A Practical Example of the IAQ Procedure in Practice
***Scott Williams**, Target Corp., Minneapolis, MN*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 9 (INTERMEDIATE)

IEA Annex 61: Deep Energy Retrofits, Part 2

Track: Energy Efficiency
Room: Monroe Room
Chair: George Lea, P.E., US Army Corps of Engineers, Washington, DC

The purpose of the Annex is to improve the decision-making process to achieve deep energy retrofits of government/public buildings. This session addresses goals, example projects, financing issues and potential limitations due to budgetary constraints.

1. Achieving Deeper Energy Savings in Federal Energy Performance Contracts (CH-15-032)
***John A. Shonder, Member**, Oak Ridge National Laboratory, Oak Ridge, TN*

3. Deep Energy Savings in Existing Buildings: Nine Case Studies(CH-15-033)
***Alexi Miller**, New Buildings Institute, Vancouver, WA*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 10 (INTERMEDIATE)

Ventilation, Moisture and Thermal Comfort

Track: Fundamentals and Applications
Room: Adams Room
Chair: Bill Dietrich, Member, Daikin Applied, Staunton, VA

The first paper focuses on the speed optimization of parallel-connected variable-speed pumps and their total power consumption. The second paper outlines the electrostatic discharge potential as affected by the indoor humidity. Economizer performance is discussed as it relates to energy use and human involvement. Personal ventilation systems are described that provide not only the necessary ventilation but also the desired thermal comfort.

1. Speed Optimization of Parallel Connected Variable Speed Pumps (CH-15-034)
***Yunchuang Dai, Ph.D., Student Member**, Tsinghua University, Beijing, China*

2. Optimizing Performance and Emissions of Diesel: LPG Fuel Mixture in a Combustor Nozzle Using Computer Numerical Techniques (CH-15-035)
***Ali Hasan, Member**, KEO International Consulting Engineers, Doha, Qatar*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 8 (INTERMEDIATE)

Using Solar to Improve Efficiency

Track: Fundamentals and Applications
Room: Crystal Room
Chair: Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

As world energy demand is projected to be more than doubled by 2050, all US government agencies set a 20% renewable energy generation target by 2020. In order to facilitate the solar energy utilization in buildings, this session provides three different approaches as follows: a more accurate building load forecasting approach is proposed by using LIDAR data and lumped thermal circuit model; and an integrated solar utilization systems approach is proposed to maximize solar energy utilization. In addition, an innovative HVAC system with integrated PVT and PCM thermal storage is suggested for a net-zero energy retrofitted house.

1. Experimental Investigation of an Innovative HVAC System with Integrated PVT and PCM Thermal Storage for a Net-Zero Energy Retrofitted House (CH-15-C028)
***Massimo Fiorentini**, Paul Cooper and Zhenjun Ma, University of Wollongong, Wollongong, Australia*

2. Maximum Solar Energy Utilization in the Built Environment: Evaluation of Energy Capture and Conversion Technologies for Maximum Practical Use in Buildings (CH-15-C029)
***James A. Leidel, Member**, Oakland University, Rochester, MI*

3. Load Forecasting Using LIDAR Data and Lumped Thermal Circuit Model (CH-15-C030)
***Gaelen P. McFadden, Student Member**, Zhaoxuan Li and Bing Dong, Ph.D., Member, University of Texas at San Antonio, San Antonio, TX*

9:45 AM-10:45 AM

SEMINAR 41 (INTERMEDIATE)

Is Air-to-Air Energy Recovery Mutually Exclusive with Demand Control Ventilation and/or Airside Economizers?

Track: Systems and Equipment
Room: State Ballroom
Sponsor: 05.05 Air-to-Air Energy Recovery
Chair: Helen Davis, P.E., Member, AHRI, Arlington, VA

This seminar reviews the proper application of exhaust air energy recovery with systems that utilize air-side economizing and demand control ventilation. Systems that incorporate demand control ventilation are reviewed, including advantages and disadvantages and what considerations need to be made for partial occupancy. Next, different options for using exhaust air energy recovery with an economizer to ensure compliance with Standard 90.1 are reviewed. Both presentations cover the most common and effective strategies used for sensible, total and passive air-to-air energy recovery devices to optimize the design for energy savings and proper operation.

1. Exhaust Air Energy Recovery and Demand Control Ventilation
***Ronnie Moffitt, P.E., Member**, Trane, Inc., Lexington, KY*

2. Outside Air, Economizers and Exhaust Air Energy Recovery
***Paul Pieper, P.Eng., Member**, Venmar CES, St-Leonard-d'Aston, QC, Canada*

9:45 AM-10:45 AM

SEMINAR 42 (INTERMEDIATE)

Data Centers: Getting Outside Your Comfort Zone and Pushing the Envelope into New Metrics and New Focus Areas

Track: Large Buildings: Mission Critical Facilities and Applications
Room: Red Lacquer Room
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Michael K. Patterson, Ph.D., P.E., Member, Intel Corp., Dupont, WA

To date, the TC 9.9 activity has been much focused on the data center physical side, with the IT side attention focused on compute. In this seminar, we go further toward the IT side, first into new IT-focused efficiency metrics that link nicely to data center efficiency metrics and then secondly into discussions of overall data center efficiency practices. This seminar looks at the data center as a multitiered system, with a much deeper view of the network and storage and how all the parts fit together.

1. Data Centers: Getting Outside Your Comfort Zone and Pushing the Envelope into New Metrics and New Focus Areas
***Jon T. Fitch, Ph.D., Member**, Dell, Round Rock, TX*

2. Beyond PUE: Extending Efficiency Metrics into the IT Equipment with ITUE and TUE
***Michael K. Patterson, Ph.D., P.E., Member**, Intel Corp., Dupont, WA*

9:45 AM-10:45 AM

SEMINAR 43 (INTERMEDIATE)

Ventilation Research

Track: Fundamentals and Applications
Room: Honore Ballroom (Lobby)
Sponsor: 01.04 Control Theory and Application, Publishing and Education Council
Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD

This seminar offers presentations based on a select group of recently published papers from the ASHRAE HVAC&R Research Journal regarding new developments in person-to-person contaminant transport and low pressure air-handling system leakage in large buildings.

1. Systematic Study of Person-to-Person Contaminant Transport in Mechanically Ventilated Spaces (RP-1458)
***Chun Chen**[1], Qingyan Chen, Ph.D., Fellow ASHRAE[1], Juncheng Zhu[1], Zije Qu[1], Chao-Hsin Lin, Ph.D., Fellow ASHRAE[2] and Zheng Jiang[3], (1)Purdue University, West Lafayette, IN, (2)The Boeing Company, Seattle, WA, (3)Tianjin University, Tianjin, China*

2. Low Pressure Air-Handling System Leakage in Large Commercial Buildings: Diagnosis, Prevalence, and Energy Impacts
***Mark Modera, Ph.D., P.E., Fellow ASHRAE**[1], Wray Craig, P.Eng., Member[2] and Darryl Dickerhoff[3], (1)Western Cooling Efficiency Center, University of California at Davis, Davis, CA, (2)Lawrence Berkeley National Laboratory, Oakland, CA, (3)Residential Building Systems Group, Lawrence Berkeley National Laboratory, Berkeley, CA*

9:45 AM-10:45 AM

FORUM 4 (BASIC)

Opportunities for Young Engineers in ASHRAE to Get Involved

Track: Fundamentals and Applications
Room: Empire (Lobby)
Sponsor: Young Engineers in ASHRAE and College of Fellows
Chair: Richard B. Hayter, Ph.D., P.E., Presidential Fellow Life Member, Kansas State University, Retired, Manhattan, KS, and Megan M Tosh, P.E., Member, Integrated Environmental Solutions, Atlanta, GA

Through ASHRAE, members serve a global society in advancing the arts and science of HVAC&R. This forum explores opportunities for young engineers in ASHRAE to become involved in our Society both in their local community or chapter, as well as throughout the world. In addition, forum participants discuss additional opportunities that may not have been considered or explored by our Society.

9:45 AM-10:45 AM

WORKSHOP 5 (BASIC)

Who Needs a Residential IAQ Guide?

Track: Fundamentals and Applications
Room: Chicago Room
Sponsor: Environmental Health Committee
Chair: Lawrence Schoen, P.E., Fellow ASHRAE, Schoen Engineering Inc., Columbia, MD

Does the world need a residential IAQ Guide? Should ASHRAE develop it? Is there enough difference between a residential guide and the IAQ Guide for nonresidential buildings? If one is needed, should a committee of experts or a contractor develop it? What is the essential content? Why did nobody bid on a Work Statement to produce the guide for $150,000? Did the request for delivering a series of presentations, a website, web video(s), social media material or mobile device applications discourage bidders? This workshop presents several views and then solicits input from attendees.

1. A European Perspective on Residential IAQ
***Constantinos A. Balaras, Ph.D., P.E., Member**, Institute of Environmental Research and Sustainable Development, Athens, Greece*

2. Maximizing the Utility of a Residential IAQ Guide
***Paul W. Francisco, Member**, University of Illinois, Champaign, IL*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 9 (INTERMEDIATE)

Evaluating Building Efficiency Using Case Studies

Track: Energy Efficiency
Room: Crystal Room
Chair: Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

Buildings have a substantial impact on energy use and the environment. They account for almost 39% of total US energy consumption and 38% of US CO2 emissions. This session provides a case study of historical zero energy building (ZEB) renovation, describes options for improving elevator energy efficiency and suggested standardized approaches for determining the optimal time of HVAC replacement under hot climate conditions. Information provided in this session assists in enhancing building energy efficiency toward ZEBs, which should be encouraged in future buildings as the US DOE targets for marketable commercial ZEBs by 2025.

1. Historical Net Zero Building Renovation: Wayne N. Aspinall Federal Building and US Courthouse (CH-15-C031)
***Jason Sielcken**[1], Kinga Porst, Associate Member[2], Ravi Maniktala[3] and Roger Chang[4], (1)U.S. General Services Administration, Denver, CO, (2)U.S. General Services Administration, Washington, DC, (3)ME Group, Lincoln, NE, (4)Westlake, Reed, Leskosk, Washington, CO*

2. Elevator Efficiency: 90.1 and Beyond (CH-15-C032)
***Sameer Kwatra**, Harvey Sachs, Ph.D., Member and Harry Misuriello, Member, American Council for an Energy-Efficient Economy, Washington, DC*

3. A Systems Approach for Corporate Energy Efficiency: A Case Study for HVAC Replacement Under Hot Conditions (CH-15-C033)
***Ayman Youssef, P.E., Member** and Adel Hamid, Member, Saudi Aramco, Dhahran, Saudi Arabia*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 10 (INTERMEDIATE)

Ventilation Controls

Track: Systems and Equipment
Room: Chicago Room
Chair: Bill Dietrich, Member, Daikin Applied, Staunton, VA

This session covers a study of PV applied to a Double Skin Façade (DSF) and airflow optimization for buildings and kitchen hoods. It begins with a CFD analysis of PV applied to a DSF building design. It then moves to management of airflow, focusing on optimization of the air volume for energy savings. The session discusses the advantages of DVC equipment for monitoring cooking activity. It then presents and reviews tools and methods for determining proper airflow rates in buildings.

1. Assessment of Active Double Skin Façade Integrated with PV Cell (CH-15-C034)
Hagar H. Elarga, M.D.[1], *Michele DeCarli, Ph.D.*[1], *Angelo Zarella, Ph.D.*[1], *Constantina Alvarez, Ph.D.*[2] *and Mohamed Abo Elazm, Ph.D.*[3], *(1)University of Padua, Padova, Italy, (2)Oviedo University, Oviedo, Spain, (3)Arab Academy for Science and Technology, Alexandria, Egypt*

2. Use of Demand Control Ventilation on Kitchen Hoods in U.S. Army/Air Force Dining Facilities (CH-15-C035)
David M. Underwood, Member[1], *Alfred Woody, P.E., Fellow ASHRAE*[2] *and Vernon Smith, P.E., Member*[3], *(1)U.S. Army Corps of Engineers, Champaign, IL, (2)Ventilation/Energy Applications PLLC, Norton Shores, MI, (3)Smith Energy Engineers, LLC, Berthoud, CO*

3. Airflow System Identification Tool for Optimizing Commercial Building VAV Settings for Improved Energy Efficiency (CH-15-C036)
Michael Gevelber, Ph.D., Member[1], *Stefan Gunnsteinsson*[1] *and Alan Morse, Associate Member*[2], *(1)Boston University, Boston, MA, (2) Aeolus Building Efficiency, Newton, MA*

4. Ventilation Calculation and Control Made Easy (CH-15-C037)
Dennis Jones, P.E., Member[1] *and Xia Fang, P.E., Associate Member*[1], *(1)Group14 Engineering, Inc., Denver, CO*

11:00 AM-12:30 PM

SEMINAR 44 (INTERMEDIATE)

Air-Conditioning Research

Track: Fundamentals and Applications
Room: Honore Ballroom (Lobby)
Sponsor: 09.01 Large Building Air-Conditioning Systems, Publishing and Education Council
Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD

This seminar offers presentations based on a select group of recently published papers from the ASHRAE HVAC&R Research Journal regarding new research in the evaluation of energy performance and thermal comfort of air conditioners, the thermophysical properties and pressure drop performance potentials of single and blended hydrofluoro- and hydrochlorofluoro-olefins, and air distribution for a variety of finned-tube heat exchangers.

1. Thermophysical Properties and Heat Transfer and Pressure Drop Performance Potentials of Hydrofluoro-Olefins, Hydrochlorofluoro-Olefins, and Their Blends
J. Steven Brown, Ph.D., P.E., Fellow[1], *Claudio Zilio, Ph.D.*[2], *Riccardo Brignoli, Ph.D.*[2] *and Alberto Cavallini, Ph.D.*[2], *(1)The Catholic University of America, Washington, DC, (2)University of Padova, Padova, Italy*

2. An Experimental and Computational Study of Approach Air Distribution for Slanted and a-Shaped Finned-Tube Heat Exchangers
David Yashar, Ph.D., Member[1], *Piotr Domanski, Ph.D., Fellow ASHRAE*[1] *and Honghyun Cho, Ph.D.*[2], *(1)National Institute of Standards and Technology, Gaithersburg, MD, (2)Chosun University, Gwangju, South Korea*

3. Evaluation of the Energy Performance and Thermal Comfort of an Air Conditioner with Temperature and Humidity Controls in a Cooling Season
Honjun Moon, Ph.D.[1] *and Soo Hyeun Yang*[1], *(1)Dankook University, Gyeonggi-do, South Korea*

11:00 AM-12:30 PM

SEMINAR 45 (INTERMEDIATE)

BIM Pays its Way: Showing Return of Investment for BIM in Real Day- to-Day Applications

Track: Fundamentals and Applications
Room: Empire (Lobby)
Sponsor: 01.05 Computer Applications, MTG.BIM Building Information Modeling
Chair: Tim Dwyer, Fellow ASHRAE, UCL Institute for Environmental Design and Engineering, The Bartlett, University College London, London, United Kingdom

This seminar shows how building information modeling (BIM) can drive a project from concept to completion and deliver tangible benefits and profitable working in the process. The tools required at each stage are introduced by highlighting key aspects where software enables the design, thus allowing an unprecedented flow of information through the process. Examples of real-world projects are used to evidence the positive benefit of integrated BIM working.

1. Evolution of HVAC Software and the Revolution of BIM! Projects from Concept to Completion
Joe Simmons, P.E., Associate Member*, HVAC Solution, Salt Lake City, UT*

2. BIM to SIM (Or, How do I get that Rich Data into Computer Simulations without Retyping it in Once Again?)
Drury Crawley, Ph.D., Fellow ASHRAE*, Bentley Systems, Inc., Washington, DC*

3. BIM Bang Bucks: What Is the True ROI?
Steven Rosen*, R.G. Vanderweil Engineers, LLP, Boston, MA*

11:00 AM-12:30 PM

SEMINAR 46 (INTERMEDIATE)

Energy Modeling of Tall and Very-Tall Buildings

Track: Energy Efficiency
Room: Adams Room
Sponsor: 04.07 Energy Calculations, 09.12 Tall Buildings
Chair: Joe Huang, Member, White Box Technologies, Moraga, CA

ASHRAE TC 9.12 had defined the following classes of tall buildings: (1) tall, 300 to 984 ft (91 to 300 m), (2) mega tall, 984 to 1968 ft (300 to 600 m), and (3) super tall, over 1968 ft (600 m) in height. When buildings are so tall, the environmental conditions encountered by the building, including temperature, pressure and wind, are substantially different from what they are at ground level, with serious impacts on load calculations and energy performance. This seminar presents information on what should be done in doing load calculations and energy modeling of such buildings.

1. Is Natural Ventilation Practical and Applicable to Tall Buildings?
Peter Simmonds, Ph.D., Fellow ASHRAE*, Buildings and Systems Analytics LLC, Marina Del Rey, CA*

2. Natural Ventilation in Tall Buildings: Study of Natural Ventilation in Kunming Project on a 450 M Tall Tower in China
Luke Leung, P.E., Member*, Skidmore, Owings and Merrill LLP, Chicago, IL*

3. Parameters that Influence Overall Tall Building Energy Performance and Sustainability - Existing and New: Willis Tower and Kingdom Tower
Mehdi Jalayerian, P.E., Member*, ESD, Chicago, IL*

4. Simulating Outdoor Air Systems in High Rise Buildings
Craig Burton*, PositivEnergy Practice, LLC, Chicago, IL*

11:00 AM-12:30 PM

SEMINAR 47 (INTERMEDIATE)

How Do Cleanrooms Fit Into Today's Modern Energy Codes?

Track: Industrial Facilities
Room: State Ballroom
Sponsor: 09.11 Clean Spaces
Chair: Philip Naughton, P.E., Member, Applied Materials Inc., Austin, TX

Reducing the type of occupancies that can be exempted from energy codes encourages designers to provide innovative solutions to their designs. Cleanrooms have been exempt due to manufacturing or life safety reasons, but the time has come for clean spaces to meet the challenge that modern energy codes are requiring, yet meet the stringent requirements for clean manufacturing environments and maintain life safety best practices. This seminar addresses opportunities and incentives that can enable improvements in cleanroom design criteria, which can provide a road map for cleanroom energy improvements and maintain the critical nature of the cleanroom.

1. Going Beyond Title 24 and Thinking inside the Cleanroom
***Mark Horner, P.E.**, GLUMAC, Santa Clara, CA*

2. A Utility Perspective on Energy Efficiency Incentives for Cleanroom Customers
***Stephen Fok, P.E., Member**, Pacific Gas and Electric Company, San Francisco, CA*

3. How Can ASHRAE 90.1 Help Cleanroom Designers Achieve More Efficient Cleanroom?
***Philip Naughton, P.E., Member**, Applied Materials Inc., Austin, TX*

4. Cleanroom Energy Best Practice for the Future: Considerations from BS 8568, Cleanroom Energy Code of Practice
***Clint Peterson, P.E., Member**, CH2M Hill, Spartanburg, SC*

11:00 AM-12:30 PM

SEMINAR 48 (ADVANCED)

International Codes and Standards Issues Impacting use of A2L Refrigerants in Unitary Heat Pump and Air-Conditioning Equipment

Track: Systems and Equipment
Room: Red Lacquer Room
Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps, 03.01 Refrigerants and Secondary Coolants
Chair: Van D. Baxter, P.E., Fellow ASHRAE, Oak Ridge National Laboratory, Oak Ridge, TN

International efforts to address climate change are putting pressure on the HVAC&R industry to limit use of HFC refrigerants that have relatively high global warming potential (GWP) and transition to equipment designed around low GWP alternatives. To meet this challenge without compromising energy performance, companies are evaluating the use of mildly flammable (A2L) refrigerants. The presentations discuss recent activities to modify product safety standards to facilitate A2L use, recent R&D advances on A2L refrigerants and A2L implications for unitary product designs. An update on the impact of F-gas regulations on heat pump refrigerant options in Europe is also provided.

1. Standards Development for 2L Flammable Refrigerants
***Brian Rodgers, Member**, Underwriters Laboratories, Northbrook, IL*

2. Product Design Considerations for 2L Refrigerants
***Paul Papas, Ph.D.**, United Technologies Research Center, East Hartford, CT*

3. Update on Research to Support Implementation of 2L Refrigerants
***Steve Kujak, Member**, Ingersoll Rand, La Crosse, WI*

4. Progress in Drafting Amended Wording for Safety Standards to Accommodate the Use of A2L Refrigerants
***Dutch Uselton, P.E., Fellow ASHRAE**, Lennox Industries, Carrollton, TX*

5. Availability of Refrigerants for Heat Pumps in Europe
***Rainer M. Jakobs, P.Eng., Member**, Information Centre on Heat pumps and Refrigeration, IZW e.V., Breuberg, Germany*

11:00 AM-12:30 PM

SEMINAR 49 (INTERMEDIATE)

Isolation Room Design, Research and Construction (Case Study)

Track: Hospital Design and Codes
Room: Monroe Room
Sponsor: 09.06 Healthcare Facilities
Chair: Timothy M. Earhart, P.E., Member, HF Lenz Company, Johnstown, PA

Airborne infectious isolation rooms are in almost every area of the hospital. Research and design guidance tells us the "theoretical" requirements for design, construction and operation of these rooms. However, existing conditions, room locations and other factors have led to isolation rooms that have not been able to meet the theoretical desired design or were able to maintain pressure differential without modifying the HVAC system after construction. This seminar presents on-the-job practical issues impacting the research, design and construction of isolation rooms to maintain the containment effectiveness.

1. Isolation Room Design Issues
***Traci Hanegan, P.E., Member**, Coffman Engineers, Inc., Spokane, WA*

2. Isolation Room Research: Provider Movement on Airborne Infection Isolation Room (AIIR) Containment Effectiveness
***Dr. David L. Johnson, Ph.D.**, University of Oklahoma Health Sciences Center, Oklahoma City, OK*

3. Isolation Room Case Study at the Cleveland Clinic
***Timothy M. Earhart, P.E., Member**, HF Lenz Company, Johnstown, PA*

1:00 PM-1:30 PM

SEMINAR (BASIC)

Three Emerging Technologies in Building Automation

Track: Fundamentals and Applications
Room: Empire (Lobby)
Sponsor: 01.04 Control Theory and Application
Chair: Frank Shadpour, P.E., Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. This interactive seminar addresses the latest and most innovative solutions in building automation systems. Get an overview of industry trends. The first presentation covers the latest available technology in the wireless world of DDC. Topics include cellular, RF and Zigbee communication protocols; their applications; and how they relate to BACnet and integration. The second presentation covers energy dashboards and describes how building automation systems can be used to produce compelling dashboard graphics and view a variety of actual building automation dashboards. The third presentation covers DDC system integration and focuses on technology for the integration of various smart systems and discusses the building automation engineer's role in designing fully integrated buildings.

1:30 PM-3:00 PM

SEMINAR 50 (INTERMEDIATE)

Case Studies on Chilled Beams in Health Care HVAC Design

Track: Hospital Design and Codes
Room: Red Lacquer Room
Sponsor: 09.06 Healthcare Facilities
Chair: Roger Lautz, P.E., Member, Affiliated Engineers, Madison, WI

Standard 170 has clarified that chilled beams meet the requirements for supplemental conditioning with a dry coil. This allows them to use a lower primary air change rate than all-air systems to save energy and provide a better patient experience. Three applications that have all been in operation for at least a year are examined in this seminar.

1. St. Elizabeth's Hospital, Appleton, WI
***Fred J. Betz, Ph.D.**, Affiliated Engineers, Inc., Madison, WI*

2. Moses Cone, Greensboro, NC
***Bob Sherman, P.E.**, Affiliated Engineers, Chapel Hill, NC*

3. Memorial Hospital, Jasper, in Chilled Beam Applications
***Doug Fick**, BSA LifeStructures, Indianapolis, IN*

3:15 PM-4:45 PM

SEMINAR 51 (INTERMEDIATE)

Energy Efficiency of Novel and Conventional Compressors using Low-GWP Refrigerants

Track: Systems and Equipment
Room: Red Lacquer Room
Sponsor: 08.01 Positive Displacement Compressors
Chair: Craig Bradshaw, Ph.D., Member, Torad Engineering, Cumming, GA

This seminar examines a variety of compressor technologies and their attributes in various applications, particularly investigations that include less ubiquitous and/or challenging refrigerants. These studies help the audience understand how to predict the performance of compressors and understand their behavior as the landscape of refrigerant types within systems becomes more stratified to include low-GWP refrigerants as well as increased system efficiency standards. Additionally, the audience has a better understanding of what work is being done on conventional compressor technologies, as well as the types of novel compressors and how they behave with low-GWP refrigerants.

1. Thermodynamic Models for Predicting Compressor Performance with Low-GWP Refrigerants
***Margaret M. Mathison, Ph.D.**, Marquette University, Milwaukee, WI*

2. A Bayesian Method to Predict Performance of Compressors Using Novel Lower-GWP Refrigerants Based on Test Data for Existing Refrigerants
***Vikrant Aute, Ph.D., Member**, University of Maryland, College Park, MD*

3. Performance of Novel Compression Concepts for Heat Pumping, Air Conditioning and Refrigeration Applications
***Eckhard Groll, Ph.D., Fellow ASHRAE**, Purdue University, West Lafayette, IN*

Wednesday, January 28

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 11 (ADVANCED)

Air Flow in Data Centers

Track: Large Buildings: Mission Critical Facilities and Applications
Room: Empire (Lobby)
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Stephanie Kunkel, JMT, Sparks, MD

Cooling in data centers is critical to proper operation of equipment. Air distribution is a key parameter in the design of data centers to provide appropriate ambient conditions and allow the data center to perform within deigned conditions. This session outlines several aspects of airflow distribution and design as well as monitoring to provide real-time management in data centers.

1. Proposal for Standard Compact Server Model for Transient Data Center Simulations (CH-15-036)
*Zachary Pardey[1] and **James VanGilder, P.E., Member**[2], (1)Northeastern University, Boston, MA, (2)Schneider Electric, Billerica, MA*

2. Bypass Airflow in Raised Floor Data Centers (CH-15-037)
***Jim Fink, Member**, Kleinholz Inc., Providence, RI*

3. Characteristics of the Air-Cooled Package Air Conditioners with Refrigerant Pump Cycle for Data Centers (CH-15-038)
***Yuji Kohata**, NTT Facilities Inc., Tokyo, Japan*

4. Coordinated Real Time Management of Return Air Temperature Controlled Cooling Units in Data Centers (CH-15-039)
***Anirudh Deodhar**, Tata Consultancy Services, Pune, India*

5. Data Center Air Segregation Efficiency (CH-15-040)
***Robert Tozer, Ph.D.**, and Sophia Flucker, Operational Intelligence Ltd., Kingston upon Thames, United Kingdom*

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 11 (INTERMEDIATE)

Advances in Cooling Heat Exchangers and Refrigerants

Track: Design of Energy and Water efficient Systems
Room: Honore Ballroom (Lobby)
Sponsor: 08.04 Air-to-Refrigerant Heat Transfer Equipment, 03.02 Refrigerant System Chemistry
Chair: Omar Abdelaziz, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

The HVAC&R industry continues to strive for improved heat exchanger designs in order to improve energy efficiency, reduce cost and reduce the environmental impact. This session presents papers dealing with different aspects of heat exchanger designs. The first paper presents a survey of heat exchanger designs optimization summarizing various mathematical techniques and formulations used in literature. The second paper introduces a novel design based on computational fluid dynamics coupled with approximation-assisted optimization. The third paper discusses the proper design methods for evaporators with zeotropic mixtures on the refrigerant side—a common problem with current and alternative lower GWP refrigerants.

1. A Survey of Optimization Formulations and Techniques for the Design of Heat Exchangers Using Lower GWP Refrigerants (CH-15-C039)
***Vikrant Aute, Ph.D., Member**, Long Huang and Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD*

2. Novel Heat Exchanger Design Using Computational Fluid Dynamics and Approximation Assisted Optimization (CH-15-C040)
Daniel Bacellar[1], Vikrant Aute, Ph.D., Member[1], Omar Abdelaziz, Ph.D., Member[2] and Reinhard Radermacher, Ph.D., Fellow ASHRAE[1], (1)University of Maryland, College Park, MD, (2)Oak Ridge National Laboratory, Oak Ridge, TN

3. Design Methods for Evaporators with Zeotropic Mixtures on the Refrigerant Side (CH-15-C038)
***Yongfang Zhong, Ph.D., Associate Member**[1], Paul Glanville, P.E., Associate Member[1], Michael Garrabrant[2] and Roger Stout[2], (1)Gas Technology Institute, Des Plaines, IL, (2)Stone Mountain Technologies, Inc., Erwin, TN*

8:00 AM-9:30 AM

SEMINAR 52 (INTERMEDIATE)

Alternative Sources of Recycle/Makeup Water: Practical Considerations for What *SHOULD* be a Good Idea

Track: Design of Energy and Water efficient Systems
Room: Crystal Room
Sponsor: 08.06 Cooling Towers and Evaporative Condensers, 03.06 Water Treatment, 05.07 Evaporative Cooling
Chair: Leon Shapiro, Member, Evoqua Water Technologies, Oak Park, CA

Dwindling fresh water supplies (exacerbated by extreme drought and climate change) are bringing ever-greater pressures to utilize water-conservation strategies. Increasingly, standards and codes are mandating the use of recycled water as one strategy to achieve this; another is to employ seawater for evaporative cooling systems. These strategies can be successfully utilized to relieve the stress on fresh water supplies; however, there are practical matters to consider in order to ensure that today's good idea does not become tomorrow's nightmare. This seminar explores some of these considerations and provides technical and valuation guidance to engineers and building owners/operators.

1. Considerations in Using Recycled Water in Your Water Conservation Efforts
***Dan Weimar, Member**, Chem-Aqua, Tallahassee, FL*

2. On-Site Water Reclamation for Recycled Water Conservation
***Reid Alan Spence, P.E., Member**, Emcor Facilities Services, Arlington, VA*

3. Applications for Use of Reclaim Water for Evaporative Air Coolers
***Patricia Graef, P.E., Fellow ASHRAE**, Munters Corporation, Fort Myers, FL*

8:00 AM-9:30 AM

SEMINAR 53 (INTERMEDIATE)

Life Safety through HVAC Security and System Resilience

Track: Life Safety
Room: Chicago Room
NY PDH DVD G

Sponsor: TG2 Heating Ventilation and Air-Conditioning Security
Chair: Bose Thomas, P.E., Member, US General Services Administration, Washington, DC

This seminar gives a summary of the different aspects of the HVAC security elements in a building and describes the resiliency of buildings and the basic requirements during an emergency or natural disaster. The HVAC designs resilient to natural disasters and man-made hazards can absorb and rapidly recover from a disruptive event. The presenters explain the fundamentals with examples of projects and buildings. The seminar also discusses the current initiatives and programs available for the HVAC community.

1. HVAC Security
***William P. Bahnfleth, Ph.D., P.E., Presidential Fellow Life Member**, Pennsylvania State University, University Park, PA*

2. HVAC System Resilience to Natural Disasters through Proper Restraint
***Richard Sherren, P.E., Member**, Kinetics Noise Control, Dublin, OH*

3. Control Strategies Applications for Resilient Buildings
***Carol Lomonaco, Associate Member**, Johnson Controls, Inc., Milwaukee, WI*

8:00 AM-9:30 AM

SEMINAR 54 (INTERMEDIATE)

Modeling Radiant Heating and Cooling Systems: Tools and Analysis

Track: Design of Energy and Water efficient Systems
Room: Red Lacquer Room
NY PDH DVD G

Sponsor: 06.05 Radiant Heating and Cooling
Chair: Devin A. Abellon, P.E., Member, Uponor, Phoenix, AZ

Radiant heating and cooling systems have been shown to effectively reduce the energy consumption of buildings while improving overall occupant comfort. Radiant floor cooling systems can also be effective in areas with high direct solar heat gain by absorbing. However, one of the challenges of incorporating a radiant system is properly and accurately modeling the system for energy usage and optimal comfort, especially when most engineers utilize applications designed around more conventional air-side systems. This seminar explores a number of tools that are available to effective model radiant systems. Case studies are also presented.

1. Evaluating Embedded Pipe Radiant Floor Cooling and Heating Panels Using Finite Element Analysis
***Robert Bean PL(Eng.) R.E.T., Member**, Indoor Climate Consultants Inc., Calgary, AB, Canada*

2. Overview of the Radiant Performance Explorer
***Charles S. Barnaby, Member**, Wrightsoft Corp., Lexington, MA*

3. Using a Simulation Program to Emulate the Performance of a Radiant System
***Peter Simmonds, Ph.D., Fellow ASHRAE**, Building and Systems Analytics LLC, Marina Del Rey, CA*

8:00 AM-9:30 AM

SEMINAR 55 (INTERMEDIATE)

Simulation Calibration

Track: Energy Efficiency
Room: Monroe Room
NY PDH DVD G

Sponsor: 04.07 Energy Calculations
Chair: Chris Balbach, P.E., Member, Performance Systems Development, Ithaca, NY

This seminar highlights the ongoing work of three researchers, representing three different national labs, with each researcher discussing his work toward the development of automated methods for creating calibrated energy models. The three approaches vary in scope, scalability and complexity, and the seminar discusses the distinct advantages and disadvantages of each.

1. Autotune Calibration
***Joshua New, Ph.D., Member**, Oak Ridge National Laboratory, Oak Ridge, TN*

2. Bayesian Calibration of Building Energy Models
***Ralph T. Muehleisen, Ph.D., P.E., Member**, Matthew Riddle, Ph.D. and Yuming Sun, Ph.D., Student Member, Argonne National Laboratory, Lemont, IL*

3. Calibration and Optimization with OpenStudio
***Brian L. Ball, Ph.D.**, Nicholas Long, Member, Katherine A. Fleming, Ph.D. and Larry Brackney, Ph.D., National Renewable Energy Laboratory, Golden, CO*

8:00 AM-9:30 AM

SEMINAR 56 (INTERMEDIATE)

The Future is Now: Small, Simple, Efficient and Comfortable Residential HVAC Systems

Track: Design of Energy and Water efficient Systems
Room: Adams Room
NY PDH DVD G

Sponsor: Residential Ad Hoc Committee
Chair: Theresa A. Weston, Ph.D., Member, DuPont Building Innovations, Richmond, VA

ASHRAE activities and products are more focused on commercial and institutional HVAC systems than on residential systems. But with code adoption of Standard 62.2, more attention is inevitable from those who design residential HVAC systems, and increasing attention by the Society is focused on residential comfort and energy efficiency. This seminar provides examples of areas in which ASHRAE members can help deliver high-performance residential HVAC design and construction and ways in which the Society can more fully support the efforts of residential HVAC stakeholders in the future.

1. California's HVAC Secrets: Superior Results Using Old-School Equipment Plus in-Process Measurements
***Lew Harriman, Fellow ASHRAE**, Mason Grant, Portsmouth, NH*

2. Partial Conditioning and Partial Use for Residential Building Energy Efficiency
***Charles Culp, P.E., Fellow ASHRAE**, Texas A&M University, College Station, TX*

3. The Race to Zero Energy and the High Performance Home Imperative
***Eric D. Werling, Member**, U.S. Department of Energy, Washington, DC*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 12 (INTERMEDIATE)

Data Center Cooling for Increased Performance

Track: Systems and Equipment
Room: Honore Ballroom (Lobby)
NY PDH G

Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Stephanie Kunkel, JMT, Sparks, MD

Practical considerations for underfloor cooling systems are addressed. A packaged AC unit is described that uses cold outside air whenever it is available to reduce the operating cost of the unit. A coordinated real-time monitoring and control algorithm is described that ensures efficient cooling for data centers equipped with return-air-temperature-controlled cooling units.

1. Methodology for Energy and Economic Modelling of Net-Zero Energy Communities (CH-15-041)
***Scott Bucking, Ph.D., Member**[1] and James S. Cotton, Ph.D., P.E., Member*[2]*, (1)Concordia University, Hamilton, ON, Canada, (2) McMaster University, Hamilton, ON, Canada*

2. Simulation Assessment of Free Cooling Technology for a Large Campus (CH-15-042)
***James Braun, Ph.D., Member,** Bonggil Jeon, Rita Jaramillo, Travis Horton, Ph.D., Member and Dan Schuster, Purdue University, West Lafayette, IN*

3. A General Assessment of Heat Pump Technologies for Prototypical Residential Buildings in the United States (CH-15-043)
Seth O. Holloway, Associate Member[1], *Simbarashe Nyika*[2], *Travis Horton, Ph.D., Member*[1] *and James Braun, Ph.D., Member*[1], *(1)Purdue University, West Lafayette, IN, (2)Whirlpool Corporation, Benton Harbor, MI*

4. Residential Application of a Natural Gas based Tri-Generation System for Cold Climates (CH-15-044)
Navid Ekrami, Student Member*, Zannatul Moit Hasib, Seth Dworkin, Ph.D., P.E., Alan Fung, Ph.D., P.E., Member and David Naylor, Ph.D., P.E., Ryerson University, Toronto, ON, Canada*

9:45 AM-10:45 AM

SEMINAR 57 (INTERMEDIATE)

Energy and Water Efficient Systems? Impossible Without Controls!

Track: Energy Efficiency
Room: Monroe Room
Sponsor: 01.04 Control Theory and Application
Chair: Chariti Young, Member, Automated Logic Corp., Kennesaw, GA

As we strive to reduce our environmental footprint and get the most out of every energy dollar and drop of water we spend, controls have emerged as the essential ingredient for creating, maintaining and optimizing an efficient system. As we introduce nontraditional technologies and control strategies into a building automation system to conserve energy and water, we introduce both challenges and opportunities. Speakers share success stories and lessons learned from unexpected subsystem interactions, from irrigation system integration and from the ongoing monitoring of highly energy- and water-efficient systems.

1. Achieving Exceptional Energy Savings Using Your Automation System
Gaylen Atkinson, Member*, Atkinson Electronics, Salt Lake City, UT*

2. Integration of Irrigation Controls into Building Automation Systems
John Fordemwalt, Member*, Baseline Inc., Boise, ID*

9:45 AM-10:45 AM

SEMINAR 58 (ADVANCED)

Environmentally Sound Refrigeration

Track: Fundamentals and Applications
Room: Empire (Lobby)
Sponsor: 01.01 Thermodynamics and Psychrometrics
Chair: Howard Cheung, Ph.D., Member, Purdue University, West Lafayette, IN

In the recent discussion involving low-greenhouse-gas-emission refrigeration, one viable candidate is always missing: thermoacoustic refrigeration. Thermoacostic refrigeration is a refrigeration system based on acoustically induced heat transfer. In this seminar, a review of thermoacoustic development in the past is presented to explain why thermoacoustic refrigeration is a viable option for environmentally friendly refrigeration. The review is followed by a presentation on how resonator curvature can affect the thermoacoustic effect and their applications in thermoacoustic refrigeration.

1. Review and Recent Advancements in Thermoacoustic Refrigeration
Ralph T. Muehleisen, Ph.D., P.E., Member*, Argonne National Laboratory, Lemont, IL*

2. Thermoacoustic Sound Generation Under the Influence of Resonator Curvature
Laura A. Schaefer, Ph.D.*, University of Pittsburgh, Pittsburgh, PA*

9:45 AM-10:45 AM

SEMINAR 59 (INTERMEDIATE)

ASHRAE's Cold Climate Design Guide

Track: Fundamentals and Applications
Room: Adams Room
Sponsor: 09.08 Large Building Air-Conditioning Applications, MTG CCDG
Chair: Erich Binder, Member, Worley Parsons, Calgary, AB, Canada

Following the Cold Climate Conference held in Calgary in November 2012, ASHRAE, the Federation of European Heating and Air-Conditioning Association (REHVA) and ScanVac members formed a working group to produce a new cold climate guide. The initial proposal was to pull together the material presented during the two-day conference, which contained state-of-the-art technical solutions from North America, Scandinavia, Europe and as far away as Antarctica. Published as a collaboration effort between ASHRAE, REHVA and SCANVAC, the guide includes new material to help designers meet energy and carbon targets in sustainable ways.

1. ASHRAE's Cold Climate Design Guide
Craig Freeden*, Worley Parsons, Calgary, AB, Canada*

2. Building Right in Cold Climates: Fabric Is Key
Justin Packer*, Calgary City Council, Calgary, BC, Canada*

3. Designing HVAC Systems for Cold Climates
Heather Hayne*, Government of the Northwest Territories, Yellowknife, NT, Canada*

4. Commissioning in Cold Climates
Bill Dean*, National Research Council of Canada, Saskatoon, SK, Canada*

9:45 AM-10:45 AM

SEMINAR 60 (INTERMEDIATE)

Current Topics in Heat Recovery for Industrial Facilities

Track: Industrial Facilities
Room: Red Lacquer Room
Sponsor: 09.02 Industrial Air Conditioning
Chair: Michael Connor, P.E., Member, Connor Engineering Solutions, Alpharetta, GA

This seminar presents issues surrounding heat and other resource recovery in industrial process air systems. The practice of not wasting thermal or chemical resources is not new to industrial processes. Many processes operate at conditions that are considered extreme compared to simple AC applications. As such, there is a greater opportunity for energy recovery from industrial processes than in commercial AC applications. However, coupled with the opportunity for greater resource recovery is the reality that in some cases this may not be possible because the recovery airstream may be laden with dangerous or outright toxic vapors and chemicals.

1. Industrial Waste Energy Heat Recovery: Discuss and Evaluate Alternatives
Vinod P. (V. P.) Gupta, P.E., Member*, 3M Company, Saint Paul, MN*

2. Ultra-Low Dewpoints for Jet Engine Test Facility
Ravisankar Ganta, P.E., Life Member*, CB&I, Waynesboro, GA*

9:45 AM-10:45 AM

FORUM 5 (INTERMEDIATE)

Supermarket Hot Gas Defrost Piping Guidelines for Best Performance, Reliability and Leak Reduction

Track: Systems and Equipment
Room: Chicago Room
Sponsor: 10.07 Commercial Food and Beverage Cooling Display and Storage, 10.03 Refrigerant Piping
Chair: Carl Roberts, Member, Zero Zone, Inc., North Prairie, WI

What design guidelines are available for piping supermarket hot gas defrost systems? Where are they published? Which questions remain unanswered by the available guidelines? Who could contribute industry expertise on this topic? This forum is the first step in gathering the best

available hot gas defrost piping design guidelines to add to the ASHRAE Refrigeration Handbook for the benefit of future engineers. The pathway from forum to Handbook might include ASHRAE Research, a Technical Paper and a Conference Seminar, so this forum is also an opportunity to help steer the process.

9:45 AM-10:45 AM

WORKSHOP 6 (INTERMEDIATE)

Smart Inverter Standards, to Manage Your Smart Building While Connected to the Smart Grid

Track: Fundamentals and Applications
Room: Crystal Room
Sponsor: 01.09 Electrical Systems
Chair: Lawrence Markel, Fellow ASHRAE, SRA, Knoxville, TN

The number of buildings installing photovoltaic panels is rapidly increasing, and it is becoming more difficult for the grid to manage this variable energy resource. Utilities and public utility commissions are developing standards and requirements for advanced functions, controls and communications for onsite energy resources. This workshop informs attendees of these new grid requirements and standards, such as International Electrotechnical Commission (IEC) 61850, California Rule 21 and Institute of Electrical and Electronics Engineers (IEEE) 1547a. The panel leads discussion of the resulting need for integration of renewable energy management with ASHRAE standards and guidelines for HVAC controls, demand response, thermal energy storage and cogeneration.

1. Utility Perspective
***Steven Faulkner, Member**, Georgia Power, Marietta, GA*

2. Distributed Energy Resource Vendor Perspective
***Robert Helt, Member**, A123 Systems, Westborough, MA*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 12 (INTERMEDIATE)

Efficiency of Residential Domestic Water Heating

Track: Design of Energy and Water efficient Systems
Room: Chicago Room
Sponsor: 06.06 Service Water Heating Systems
Chair: Ben Schoenbauer, Center for Energy and Environment, Minneapolis, MN

As domestic water heating has become one of the largest energy consumers, much focus has been put on increasing the efficiency of these systems. This program covers advances in residential heat pump water heaters, hybrid natural gas/solar systems and test procedures and standards for evaluating energy efficiency. Also included are the results of a hybrid system installed in a net zero residential installation.

1. Single-Pass Heat Pump Water Heaters for Improved Efficiency and Demand Response (CH-15-C041)
***John Bush, Associate Member**[1], Ron Domitrovic, Ph.D., Member[1] and Ammi Amarnath[2], (1)Electric Power Research Institute, Knoxville, TN, (2)Electric Power Research Institute, Palo Alto, CA*

2. Field Evaluation and Laboratory Optimization of Residential Gas-Solar Hot Water Systems (CH-15-C042)
***Hillary Vadnal, Associate Member**, Gas Technology Institute, Des Plaines, IL*

3. Comparison of the New International Test Standards for Rating the Energy Efficiency of Residential Water Heaters (CH-15-C043)
***J.D. Lutz, P.E., Member**, Lawrence Berkeley National Laboratory, Berkeley, CA*

4. The Effect of Piping Heat Losses on the Efficiency of Solar Thermal Water Heating in a Net-Zero Energy Home
***Tania Ullah, Member** and William M. Healy, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD*

5. The Revised Method of Test for Residential Water Heating and Its Impact on Incentive Program (CH-15-C045)
***Paul Glanville, P.E., Associate Member** and David Kalensky, Member, Gas Technology Institute, Des Plaines, IL*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 13 (INTERMEDIATE)

Energy Associated with Building Envelopes

Track: Fundamentals and Applications
Room: Crystal Room
Sponsor: 04.05 Fenestration
Chair: Athanasios (Thanos) Tzempelikos, Ph.D., Member, Purdue University, West Lafayette, IN

This session discusses building envelopes as they relate to cooling and daylighting. Papers review techniques for evaluating shading on glazing, free cooling using natural ventilation, glare associated with glazing and guidelines for architectural layouts based on glazing area ratios.

1. Assessing Convective Heat Transfer Coefficients Associated with Indoor Shading Attachments Using a New Numerical Technique (CH-15-C046)
***John Wright, Ph.D., P.E., Member**[1], David Naylor, Ph.D., P.E.[2], Seyed Foroushani, Student Member[1] and Michael Collins, Ph.D., P.E., Member[1], (1)University of Waterloo, Waterloo, ON, Canada, (2)Ryerson University, Toronto, ON, Canada*

2. Rethinking Energy Design Guidelines for Building Form Articulation (CH-15-C047)
***Shreshth Nagpal, Member**[1], Rohit Manudhane[2] and Shrikar Bhave[3], (1)Atelier Ten, New York, NY, (2)Ove Arup & Partners, New York, NY, (3)Transsolar, New York, NY*

3. Integration of Occupant Interactions with Window Blinds on Model Predictive Control of Mixed-mode Buildings (CH-15-C048)
*Panagiota Karava, Ph.D., Associate Member and **Seyed Amir Sadeghi**, Purdue University, West Lafayette, IN*

4. Daylight Glare Probability Measurements in Offices with Dynamic Facades (CH-15-C049)
***Iason Konstantzos, P.E., Student Member** and Athanasios (Thanos) Tzempelikos, Ph.D., Member, Purdue University, West Lafayette, IN*

11:00 AM-12:30 PM

SEMINAR 61 (INTERMEDIATE)

Biomass Combustion Strategies for Building Applications: Energy Efficiency with Low Emissions

Track: Design of Energy and Water efficient Systems
Room: Red Lacquer Room
Sponsor: 02.08 Building Environmental Impacts and Sustainability
Chair: Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL

Biomass combustion can play a useful role in helping reduce reliance on fossil fuel energy in buildings. To achieve its potential value in energy-efficiency programs and green building initiatives, biomass combustion must continually address a range of technology, education, policy and regulatory challenges. This seminar describes efforts by the biomass industry to provide environmentally beneficial technology solutions for a range of building applications. Technology solutions and standards information focus on particulate emission control and sustainable supply practices.

1. Education, Outreach, Codes and Standards: A Road Map for Improved Utilization of Woody Biomass Heating in the US
***Bede W. Wellford, Member**, Viessmann Manufacturing Company (U.S.), Inc., Warwick, RI*

2. If We Call It Renewable Energy, It Has to Renew: How Sustainability Boundaries for Using Biomass for Energy Define the Markets and the Case for CO2 Neutrality
***William Strauss, Ph.D.**, FutureMetrics, LLC, Albany Township, ME*

3. Biomass CHP Strategies with Low-Particulate Emissions for Buildings
***David Sjoding**, WSU Energy Program, Olympia, WA*

Tech Program

11:00 AM-12:30 PM

SEMINAR 62 (BASIC)

Chill Out: Hospital Chiller Plant Upgrades and System Retrofits Improve Energy Efficiency, Reduce Carbon Footprint and Improve Reliability

Track: Hospital Design and Codes
Room: Monroe Room
Sponsor: 09.06 Healthcare Facilities
Chair: Jeremy Fauber, P.E., Member, Heapy Engineering, Dayton, OH

Existing hospital facilities face many challenges in their mission to provide favorable patient outcomes while maintaining safety and reliability and minimizing maintenance and energy costs in a sustainable manner. Chiller plants that were constructed 20 or 30 years ago may pose several difficulties to the facility operations team. Total cooling load in the facility has likely increased due to expansions, while the load in any one building may be reduced compared to the original design due to efficiency measures in specific buildings. Redundancy levels may be affected by the changing load profiles. Chiller plant replacements can be a key component in a hospital facility's strategy to address these concerns.

1. Open-Loop Geothermal Chiller Plant Replacement Reduces Energy Usage
***Jeremy Fauber, P.E., Member**, Heapy Engineering, Dayton, OH*

2. Chiller Plant Replacement Reduces Energy, Improves Reliability and Maintenance
***Dan Doyle, P.E., Member**[1] and Craig McKenzie[2], (1)Grumman/Butkus Associates, Evanston, IL, (2)Advocate Health Care, Chicago, IL*

3. Successful Implementation of a Strategic Energy Master Plan
***Robert Cox, P.E., Member**, Jacobs Carter Burgess, Cary, NC*

11:00 AM-12:30 PM

SEMINAR 63 (INTERMEDIATE)

Energy Reducing Design Developments for Ice Arenas

Track: Energy Efficiency
Room: Empire (Lobby)
Sponsor: 10.02 Automatic Icemaking Plants and Skating Rinks
Chair: Greg Scrivener, Cold Dynamics, Meadow Lake, SK, Canada

Significantly reducing an ice arena's total energy consumption involves a holistic approach; the heating requirements for a typical facility are well matched with the waste heat available from the refrigeration process. However, ice rinks require a mix of higher-grade heat for the hot water used in showers and ice resurfacers, as well as lower-grade heat used for building and makeup air heating. Without careful design integration, these buildings frequently fall short of their maximum energy-saving potential. Several integrated designs are compared, and successful design solutions for both the refrigeration and building HVAC are presented.

1. Transcritical CO_2 Ice Rink Systems
***Benoit Rodier, P.Eng.**, CIMCO Refrigeration, Montreal, QC, Canada*

2. A Comparative Study of Refrigeration Systems for Ice Rinks
***John Scott, Member**, Natural Resources Canada, Varennes, QC, Canada*

3. Utilizing Recovered Heat in the Building
***Ian Storey, P.Eng., Member**, I.B.Storey Inc., Charlottetown, PE, Canada*

11:00 AM-12:30 PM

WORKSHOP 7 (ADVANCED)

Applicable Standards for Ventilation and Air Conditioning of Hazardous Spaces

Track: Life Safety
Room: Honore Ballroom (Lobby)
Sponsor: 05.08 Industrial Ventilation Systems, 09.02 Industrial Air Conditioning
Chair: Michael Baucom, Member, Bebco Industries ECU Corporation, La Marque, TX; Deep Ghosh, Member, Southern Nuclear, Birmingham, AL; and Erich Binder, Member, Worley Parsons, Calgary, AB, Canada

This workshop informs attendees about a proposed design guide tentatively titled "Ventilation & Air Conditioning of Hazardous Spaces" and seeks their input to determine applicable domestic and international standards. The proposed guide's development has been approved by the Publications Committee during the Annual Meeting in Seattle, has been urgently requested by the U.S. Chemical Safety and Hazard Investigation Board and will be an invaluable resource to readers, in the promotion of safe and effective techniques for the design of ventilation, AC and gas phase filtration systems for use in hazardous spaces.

1. Applicable Standards for Hazardous Spaces
***Michael Baucom, Member**[1] and Deep Ghosh, Member[2], (1)Bebco Industries ECU Corporation, La Marque, TX, (2)Southern Nuclear, Birmingham, AL*

11:00 AM-12:30 PM

WORKSHOP 8 (INTERMEDIATE)

Lies, Damn Lies, and…EUIs?

Track: Energy Efficiency
Room: Adams Room
Sponsor: 07.06 Building Energy Performance
Chair: David S. Eldridge Jr., P.E., Member, Grumman/Butkus Associates, Evanston, IL

The application of energy use intensity (EUI) to benchmark performance of buildings is increasing. At the same time, there is growing realization that this simplistic characterization, based on annual energy use vs. building area, limits its ability to address: 1) many buildings (or collections of buildings) that are not easily characterized as "peers" for comparison, and 2) aspects of building performance beyond annual energy use that are critical to operational, infrastructural and sustainability decision making. This session explores and provides for public discussion of options for expanded definition and use of EUIs or alternative definitions of building performance.

1. Background and Current Use of Energy Benchmarking (EUI)
***Dennis R. Landsberg, Ph.D., P.E., Member**, L&S Energy Services, Inc., Clifton Park, NY*

2. Challenges and Benefits of an Expanded Definition of Building Performance
***J. Patrick Carpenter, P.E., Life Member**, Facility Performance Engineers, Cinnaminson, NJ*

SOCIETY COMMITTEE MEETINGS

All committee meetings are scheduled in the Palmer House Hilton. Numbers in parenthesis indicate the floor location of the meeting room.

Advocacy
Friday 3:00 PM–5:30 PM Burnham 4 (7)

AEDG Steering Committee
Monday 2:15 AM–5:00 PM LaSalle 3 (7)

ASHRAE Foundation
Monday 8:00 AM–10:00 AM Clark 7 (7)

ASHRAE Foundation Executive Subcommittee
Saturday 1:30 PM–3:00 PM Montrose 1 (7)

ASHRAE/AHRI Joint Expo
Sunday 9:00 AM–11:00 AM Wilson (3)

Associate Society Alliance
Sunday 1:30 PM–4:30 PM Salons 6/7 (3)

Associate Society Alliance
Monday 4:15 PM–6:00 PM Water Tower (6)

Audit Committee
Friday 1:30 PM–3:00 PM Sandburg 6 (7)

Board of Directors
Sunday 1:30 PM–5:30 PM Grand Ballroom (4)

Board of Directors
Wednesday 2:00 PM–6:00 PM Grand Ballroom (4)

Building Energy Quotient Committee
Sunday 8:30 AM–11:30 AM LaSalle 3 (7)

bEQ Marketing
Saturday 12:30 PM–1:30 PM Sandburg 6 (7)

bEQ Methodology
Saturday 1:30 PM–2:30 PM Sandburg 6 (7)

Certification
Saturday 8:00 AM–12:00 PM Montrose 3 (7)

Chapter Technology Transfer
Friday 8:00 AM–12:00 PM Wabash (3)

Chapter Technology Transfer
Saturday 8:00 AM–12:00 PM Wilson (3)

Chapter Technology Transfer Member Services
Friday 1:30 PM–5:00 PM Indiana (3)

Chapter Technology Transfer Operations
Friday 1:30 PM–5:00 PM Kimball (3)

Chapter Technology Transfer Executive
Friday 5:00 PM–6:00 PM Indiana (3)

CIBSE/ASHRAE Liaison
Wednesday 9:30 AM–12:00 PM Salon 1 (3)

CLIMA
Saturday 12:30 PM–1:30 PM Clark 3 (7)

College of Fellows Board/Advisory
Sunday 8:00 AM–10:00 AM Burnham 1 (7)

College of Fellows
Sunday 10:00 AM–12:00 PM Burnham 1 (7)

Conferences and Expositions Annual and Winter Meetings
Friday 3:00 PM–6:00 PM Wabash (3)

Conferences and Expositions Committee
Saturday 8:00 AM–12:00 PM Price (5)

Conferences and Expositions Executive
Friday 1:00 PM–3:00 PM Wabash (3)

Developing Economies Ad Hoc
Monday 8:00 AM–12:00 PM Burnham 1 (7)

Development Committee
Monday 10:15 AM–12:00 PM Clark 7 (7)

Electronic Communications
Saturday 11:00 AM–3:00 PM Clark 1 (7)

Environmental Health
Monday 2:15 PM– 6:15 PM Price (5)

Environmental Health Executive
Monday 7:00 AM–8:00 AM Price (5)

Environmental Health Handbook/Policy
Monday 8:00 AM–10:00 AM Price (5)

Environmental Health Program/Research
Monday 10:00 AM–12:00 PM Price (5)

Executive Committee
Saturday 8:30 AM–1:00 PM Salon 10 (3)

Executive Committee
Wednesday 7:30 AM–9:00 AM Cresthill (3)

Executive Committee
Thursday 7:30 AM–11:00 AM Cresthill (3)

Finance Committee
Friday 8:00 AM–1:00 PM Salon 2 (3)

Finance Investment Subcommittee
Thursday 5:00 PM–7:00 PM Kimball (3)

Finance Planning Subcommittee
Thursday 5:00 PM–7:00 PM Logan (3)

Grassroots Government Activities Committee
Friday 9:00 AM–10:30 AM Burnham 4 (7)

Grassroots Government Activities Executive
Friday 8:00 AM–8:45 AM Burnham 4 (7)

Grassroots Government Activities Member Services
Friday 10:45 AM–11:45 AM Burnham 4 (7)

Grassroots Government Activities Operations
Friday 10:45 AM–11:45 AM Burnham 1 (7)

Grassroots Government Activities International Task Force
Friday 1:00 PM–2:00 PM Burnham 4 (7)

Grassroots Government Activities Committee
Friday 2:15 PM– 2:45 PM Burnham 4 (7)

Grassroots Government Activities Committee
Saturday 8:00 AM–12:30 PM Clark 5 (7)

Grassroots Government Activities Executive
Saturday 12:45 PM–1:15 PM Clark 5 (7)

Handbook
Sunday 10:30 AM–1:00 PM Salon 1 (3)

Handbook 2016 HVAC Systems and Equipment/TCs/Volume Subcommittee
Sunday 9:00 AM–10:00 AM Sandburg 5 (7)

Handbook 2017 Fundamentals/TCs Volume Subcommittee
Sunday 9:00 AM–10:00 AM Sandburg 6 (7)

Handbook 2018 Refrigeration TCs/Volume Subcommittee
Sunday 9:00 AM–10:00 AM Montrose 5 (7)

Handbook Electronic Media
Sunday 8:00 AM–9:00 AM Montrose 5 (7)

Handbook Excom
Saturday 1:00 PM–2:00 PM Burnham 5 (7)

Handbook Functional
Sunday 8:00 AM–9:00 AM Sandburg 6 (7)

Handbook International
Sunday 8:00 AM–9:00 AM Sandburg 5 (7)

Handbook Strategic Planning
Saturday 2:00 PM–3:00 PM Burnham 5 (7)

Handbook Training for TC Handbook Chairs
Sunday 8:00 AM–9:00 AM Water Tower (6)

Handbook Volume Subcommittees
Sunday 10:00 AM–10:30 AM Salon 1 (3)

Historical Committee
Sunday 8:30 AM–12:00 PM Marshfield (3)

Honors & Awards
Sunday 1:00 PM–5:00 PM Clark 3 (7)

Honors & Awards
Monday 2:15 PM–5:30 PM Burnham 5 (7)

IAQ 216 Steering Committee
Tuesday 3:00 PM–4:00 PM Indiana (3)

IEQ-GA
Tuesday 12:30 PM–2:45 PM Indiana (3)

Journal Advertising Sales Subcommittee
Sunday 7:00 AM–8:00 AM Montrose 2 (7)

Life Members' Executive Board
Tuesday 9:00 AM–11:00 AM Marshfield (3)

Members Council
Tuesday 8:00 AM–12:00 PM Price (5)

Members Council Region Operations
Sunday 8:00 AM–12:00 PM Cresthill (3)

Members Council Planning
Sunday 8:00 AM–12:00 PM Salons 4/9 (3)

Membership Promotion
Saturday 8:00 AM– 3:00 PM Salons 6/7 (3)

Membership Promotion Subcommittee
Friday 1:00 PM–6:00 PM Salon 10 (3)

Nominating
Sunday 7:30 AM–12:00 PM Salons 6/7 (3)

PEAC
Tuesday 12:00 PM–2:00 PM Dearborn 2 (7)

Planning
Friday 1:00 PM–6:00 PM LaSalle 3 (7)

Planning Subcommittee
Friday 1:00 PM–3:00 PM LaSalle 5 (7)

Presidential Ad Hoc on Effective Use of Volunteer Time
Monday 10:00 AM–12:00 PM Madison (3)

Professional Development
Monday 8:00 AM–12:00 PM Montrose 4 (7)

Publications Committee
Sunday 8:00 AM–12:00 PM Burnham 2 (7)

Publications Planning Subcommittee
Saturday 10:00 AM–12:00 PM Burnham 5 (7)

Publishing and Education Council
Tuesday 8:00 AM–12:00 PM Water Tower (6)

Publishing and Education Council E-Learning
Saturday 1:30 PM–3:00 PM Clark 3 (7)

Publishing and Education Council Fiscal
Monday 2:00 PM–3:30 PM Burnham 2 (7)

Publishing and Education Council Functional
Monday 3:30 PM–5:00 PM Burnham 2 (7)

Publishing and Education Council HVAC&R Research Journal Subcommittee
Monday 11:00 AM–12:00 PM Burnham 3 (7)

Refrigeration Excom
Sunday 7:00 AM–8:00 AM Clark 5 (7)

Refrigeration Committee
Sunday 8:00 AM–12:00 PM Clark 5 (7)

Refrigeration RP 1634 PMS
Monday 4:30 PM–6:30 PM Madison (3)

Region-at-Large Planning
Monday 2:15 PM–4:15 PM Water Tower (6)

REHVA/ASHRAE MOU Coordinating Committee
Monday 10:00 AM–11:15 AM Burnham 5 (7)

Research Administration
Friday 3:00 PM–7:00 PM Wilson (3)

Research Administration
Saturday 8:00 AM–3:00 PM Salon 2 (3)

Research Administration
Wednesday 7:00 AM–11:00 AM Grant Park (6)

Research Administration Executive
Friday 1:00 PM–2:30 PM Wilson (3)

Research Promotion
Saturday 7:30 AM–1:00 PM Burnham 1 (7)

Research Promotion Executive
Friday 2:00 PM– 6:00 PM Sandburg 3 (7)

Research Subcommittee Chairs
Monday 6:30 AM–9:00 AM Grand Ballroom (4)

Residential Market Ad Hoc
Sunday 8:30 AM–11:30 AM Dearborn 1 (7)

Scholarship Trustees
Tuesday 8:00 AM–12:00 PM Burnham 5 (7)

Society Rules
Tuesday 2:00 PM–5:00 PM Marshfield (3)

Special Publications Design Guide for Selection of Air Terminal Units
Friday 8:00 AM–5:00 PM Sandburg 7 (7)

Special Publications Design Guide for Selection of Air Terminal Units
Saturday 8:00 AM–3:00 PM Sandburg 7 (7)

Special Publications Design Guide for Selection of Air Terminal Units
Sunday 8:00 AM–10:30 AM Sandburg 7 (7)

Standards
Saturday 8:00 AM–1:00 PM Crystal (3)

Standards
Wednesday 7:30 AM–9:30 AM Grand Ballroom (4)

Standards Code Interaction
Sunday 7:00 PM–10:00 PM Marshfield (3)

Standards Executive
Friday 8:00 AM–12:00 PM Marshfield (3)

Standards ILS/ISAS
Friday 1:00 PM–4:00 PM Montrose 6 (7)

Standards PC Chair Breakfast
Sunday 7:00 AM–9:00 AM Grand Ballroom (4)

Standards PPIS
Friday 2:00 PM–6:00 PM Marshfield (3)

Standards PPIS
Tuesday 11:00 AM–2:00 PM Burnham 1 (7)

Standards SPLS
Friday 2:00 PM–6:00 PM Salon 10 (3)

Standards SPLS
Tuesday 2:00 PM–6:00 PM Burnham 1 (7)

Standards SRS
Tuesday 5:00 PM–6:00 PM Montrose 4 (7)

Student Activities
Saturday 8:00 AM–3:00 PM Marshfield (3)

Student Activities Executive
Friday 10:00 AM–12:00 PM Madison (3)

Student Activities K-12/STEM
Friday 12:00 PM–2:00 PM Madison (3)

Student Activities Post High
Friday 2:00 PM–4:00 PM Madison (3)

Student Acitivities ABET
Friday 2:00 PM–4:00 PM Logan (3)

Student Activities Design Competition
Friday 4:00 PM–6:00 PM Madison (3)

Student Activities Grants
Friday 4:00 PM–6:00 PM Logan (3)

Student Welcome and Orientation
Saturday 2:00 PM–3:00 PM Red Lacquer (4)

Student/YEA Mixer
Saturday 5:00 PM–6:30 PM Red Lacquer (4)

Student Program
Sunday 9:00 AM–2:00 PM Red Lacquer (4)

Student Congress
Monday 10:00 AM–12:00 PM Salon 1 (3)

Student Branch Advisor Congress
Monday 10:00 AM–12:00 PM Salons 4/9 (3)

TAC/CEC Executive
Saturday 7:00 AM–8:00 AM Salon 1 (3)

TC/CEC Training
Tuesday 11:00 AM–12:00 PM Kimball (3)

Technical Activities
Saturday 8:00 AM–3:00 PM Salon 1 (3)

Technical Activities
Wednesday 7:00 AM–10:00 AM Hancock (6)

Technology Council
Wednesday 8:00 AM–12:00 PM Salon 12 (3)

Technology Council Document Review Subcommittee
Tuesday 9:00 AM–10:30 AM Salon 1 (3)

Technology Council Operation/Planning
Tuesday 7:30 AM–9:00 AM Salon 1 (3)

Technology Council Special Projects
Tuesday 10:30 AM–12:00 PM Salon 1 (3)

YEA Hospitality
Sunday 4:00 PM–6:00 PM Potter's Lounge (Lobby)

Young Engineers in ASHRAE Committee
Saturday 8:00 AM–3:00 PM Buckingham (5)

CHRONOLOGICAL

THURSDAY, JANUARY 22

Finance Investment Subcommittee
Thursday 5:00 PM–7:00 PM Kimball (3)

Finance Planning Subcommittee
Thursday 5:00 PM–7:00 PM Logan (3)

FRIDAY, JANUARY 23

Advocacy
Friday 3:00 PM–5:30 PM Burnham 4 (7)

Audit Committee
Friday 1:30 PM–03:00 PM Sandburg 6 (7)

Chapter Technology Transfer
Friday 8:00 AM–12:00 PM Wabash (3)

Chapter Technology Transfer Member Services
Friday 1:30 PM–5:00 PM Indiana (3)

Chapter Technology Transfer Operations
Friday 1:30 PM–5:00 PM Kimball (3)

Chapter Technology Transfer Executive
Friday 5:00 PM–6:00 PM Indiana (3)

Conferences and Expositions Annual and Winter Meetings
Friday 3:00 PM–6:00 PM Wabash (3)

Conferences and Expositions Executive
Friday 1:00 PM–3:00 PM Wabash (3)

Finance Committee
Friday 8:00 AM–1:00 PM Salon 2 (3)

Grassroots Government Activities Committee
Friday 9:00 AM–10:30 AM Burnham 4 (7)

Grassroots Government Activities Executive
Friday 8:00 AM–8:45 AM Burnham 4 (7)

Grassroots Government Activities Member Services
Friday 10:45 AM–11:45 AM Burnham 4 (7)

Grassroots Government Activities Operations
Friday 10:45 AM–11:45 AM Burnham 1 (7)

Grassroots Government Activities International Task Force
Friday 1:00 PM–2:00 PM Burnham 4 (7)

Grassroots Government Activities Committee
Friday 2:15 PM–2:45 PM Burnham 4 (7)

Membership Promotion Subcommittee
Friday 1:00 PM–6:00 PM Salon 1 (3)

Planning
Friday 1:00 PM–6:00 PM LaSalle 3 (7)

Planning Subcommittee
Friday 1:00 PM–3:00 PM LaSalle 5 (7)

Research Administration
Friday 3:00 PM–7:00 PM Wilson (3)

Research Administration Executive
Friday 1:00 PM–2:30 PM Wilson (3)

Research Promotion Executive
Friday 2:00 PM–6:00 PM Sandburg 3 (7)

Special Publications Design Guide for Selection of Air Terminal Units
Friday 8:00 AM–5:00 PM Sandburg 7 (7)

Standards Executive
Friday 8:00 AM–12:00 PM Marshfield (3)

Standards ILS/ISAS
Friday 1:00 PM–4:00 PM Montrose 6 (7)

Standards PPIS
Friday 2:00 PM–6:00 PM Marshfield (3)

Standards SPLS
Friday 2:00 PM–6:00 PM Salon 10 (3)

Student Activities Executive
Friday 10:00 AM–12:00 PM Madison (3)

Student Activities K-12/STEM
Friday 12:00 PM–02:00 PM Madison (3)

Student Activities Post High
Friday 2:00 PM–4:00 PM Madison (3)

Student Acitivities ABET
Friday 02:00 PM–04:00 PM Logan (3)

Student Activities Design Competition
Friday 4:00 PM–6:00 PM Madison (3)

Student Activities Grants
Friday 4:00 PM–6:00 PM Logan (3)

SATURDAY, JANUARY 24

ASHRAE Foundation Executive Subcommittee
Saturday 1:30 PM–3:00 PM Montrose 1 (7)

bEQ Marketing
Saturday 12:30 PM–1:30 PM Sandburg 6 (7)

bEQ Methodology
Saturday 1:30 PM–2:30 PM Sandburg 6 (7)

Certification
Saturday 8:00 AM–12:00 PM Montrose 3 (7)

Chapter Technology Transfer
Saturday 8:00 AM–12:00 PM Wilson (3)

CLIMA
Saturday 12:30 PM–1:30 PM Clark 3 (7)

Conferences and Expositions Committee
Saturday 8:00 AM–12:00 PM Price (5)

Electronic Communications
Saturday 11:00 AM–3:00 PM Clark 1 (7)

Executive Committee
Saturday 8:30 AM–1:00 PM Salon 10 (3)

Grassroots Government Activities Committee
Saturday 8:00 AM–12:30 PM Clark 5 (7)

Grassroots Government Activities Executive
Saturday 12:45 PM–1:15 PM Clark 5 (7)

Handbook Excom
Saturday 1:00 PM–2:00 PM Burnham 5 (7)

Handbook Strategic Planning
Saturday 2:00 PM–3:00 PM Burnham 5 (7)

Membership Promotion
Saturday 8:00 AM –3:00 PM Salons 6/7 (3)

Publications Planning Subcommittee
Saturday 10:00 AM–12:00 PM Burnham 5 (7)

Publishing and Education Council E-Learning
Saturday 1:30 PM–3:00 PM Clark 3 (7)

Research Administration
Saturday 8:00 AM–3:00 PM Salon 2 (3)

Research Promotion
Saturday 7:30 AM–1:00 PM Burnham 1 (7)

Special Publications Design Guide for Selection of Air Terminal Units
Saturday 8:00 AM–3:00 PM Sandburg 7 (7)

Standards
Saturday 8:00 AM–1:00 PM Crystal (3)

Student Activities
Saturday 8:00 AM–3:00 PM Marshfield (3)

Student Welcome and Orientation
Saturday 2:00 PM–3:00 PM Red Lacquer (4)

Student/YEA Mixer
Saturday 5:00 PM–6:30 PM Red Lacquer (4)

TAC/CEC Executive
Saturday 7:00 AM–8:00 AM Salon 1 (3)

Technical Activities
Saturday 8:00 AM–3:00 PM Salon 1 (3)

Young Engineers in ASHRAE Committee
Saturday 8:00 AM–3:00 PM Buckingham (5)

SUNDAY, JANUARY 25

ASHRAE/AHRI Joint Expo
Sunday 9:00 AM–11:00 AM Wilson (3)

Associate Society Alliance
Sunday 1:30 PM–4:30 PM Salons 6/7 (3)

Board of Directors
Sunday 1:30 PM–5:30 PM Grand Ballroom (4)

Building Energy Quotient Committee
Sunday 8:30 AM–11:30 AM LaSalle 3 (7)

College of Fellows Board/Advisory
Sunday 8:00 AM–10:00 AM Burnham 1 (7)

College of Fellows
Sunday 10:00 AM–12:00 PM Burnham 1 (7)

Handbook
Sunday 10:30 AM–1:00 PM Salon 1 (3)

Handbook 2016 HVAC Systems and Equipment/TCs/Volume Subcommittee
Sunday 9:00 AM–10:00 AM Sandburg 5 (7)

Handbook 2017 Fundamentals/TCs Volume Subcommittee
Sunday 9:00 AM–10:00 AM Sandburg 6 (7)

Handbook 2018 Refrigeration TCs/Volume Subcommittee
Sunday 9:00 AM–10:00 AM Montrose 5 (7)

Handbook Electronic Media
Sunday 8:00 AM–9:00 AM Montrose 5 (7)

Handbook Functional
Sunday 8:00 AM–9:00 AM Sandburg 6 (7)

Handbook International
Sunday 8:00 AM–9:00 AM Sandburg 5 (7)

Handbook Training for TC Handbook Chairs
Sunday 8:00 AM–9:00 AM Water Tower (6)

Handbook Volume Subcommittees
Sunday 10:00 AM–10:30 AM Salon 1 (3)

Historical Committee
Sunday 8:30 AM–12:00 PM Marshfield (3)

Honors & Awards
Sunday 1:00 PM–5:00 PM Clark 3 (7)

Journal Advertising Sales Subcommittee
Sunday 7:00 AM–8:00 AM Montrose 2 (7)

Members Council Region Operations
Sunday 8:00 AM–12:00 PM Cresthill (3)

Members Council Planning
Sunday 8:00 AM–12:00 PM Salons 4/9 (3)

Nominating
Sunday 7:30 AM–12:00 PM Salons 6/7 (3)

Publications Committee
Sunday 8:00 AM–12:00 PM Burnham 2 (7)

Refrigeration Excom
Sunday 7:00 AM–8:00 AM Clark 5 (7)

Refrigeration Committee
Sunday 8:00 AM–12:00 PM Clark 5 (7)

Residential Market Ad Hoc
Sunday 8:30 AM–11:30 AM Dearborn 1 (7)

Special Publications Design Guide for Selection of Air Terminal Units
Sunday 8:00 AM–10:30 AM Sandburg 7 (7)

Standards Code Interaction
Sunday 7:00 PM–10:00 PM Marshfield (3)

Standards PC Chair Breakfast
Sunday 7:00 AM–9:00 AM Grand Ballroom (4)

Student Program
Sunday 9:00 AM–2:00 PM Red Lacquer (4)

YEA Hospitality
Sunday 4:00 PM–6:00 PM Potter's Lounge Lobby

MONDAY, JANUARY 26

AEDG Steering Committee
Monday 2:15 PM–5:00 PM LaSalle 3 (7)

ASHRAE Foundation
Monday 8:00 AM–10:00 AM Clark 7 (7)

Associate Society Alliance
Monday 4:15 PM–6:00 PM Water Tower (6)

Developing Economies Ad Hoc
Monday 8:00 AM–12:00 PM Burnham 1 (7)

Development Committee
Monday 10:15 AM–12:00 PM Clark 7 (7)

Environmental Health
Monday 2:15 PM–6:15 PM Price (5)

Environmental Health Executive
Monday 7:00 AM–8:00 AM Price (5)

Environmental Health Handbook/Policy
Monday 8:00 AM–10:00 AM Price (5)

Environmental Health Program/Research
Monday 10:00 AM–12:00 PM Price (5)

Honors & Awards
Monday 2:15 PM–5:30 PM Burnham 5 (7)

Presidential Ad Hoc on Effective Use of Volunteer Time
Monday 10:00 AM–12:00 PM Madison (3)

Professional Development
Monday 8:00 AM–12:00 PM Montrose 4 (7)

Publishing and Education Council Fiscal
Monday 2:00 PM–3:30 PM Burnham 2 (7)

Publishing and Education Council Functional
Monday 3:30 PM–5:00 PM Burnham 2 (7)

Publishing and Education Council HVAC&R Research Journal Subcommittee
Monday 11:00 AM–12:00 PM Burnham 3 (7)

Refrigeration RP 1634 PMS
Monday 4:30 PM–6:30 PM Madison (3)

Region-at-Large Planning
Monday 2:15 PM–4:15 PM Water Tower (6)

REHVA/ASHRAE MOU Coordinating Committee
Monday 10:00 AM–11:15 AM Burnham 5 (7)

Research Subcommittee Chairs
Monday 6:30 AM–9:00 AM Grand Ballroom (4)

Student Congress
Monday 10:00 AM–12:00 PM Salon 1 (3)

Student Branch Advisor Congress
Monday 10:00 AM–12:00 PM Salons 4/9 (3)

TUESDAY, JANUARY 27

IAQ 2016 Steering Committee
Tuesday 3:00 PM–4:00 PM Indiana (3)

IEQ-GA
Tuesday 12:30 PM–2:45 PM Indiana (3)

Life Members' Executive Board
Tuesday 9:00 AM–11:00 AM Marshfield (3)

Members Council
Tuesday 8:00 AM–12:00 PM Price (5)

PEAC
Tuesday 12:00 PM–2:00 PM Dearborn 2 (7)

Publishing and Education Council
Tuesday 8:00 AM–12:00 PM Water Tower (6)

Scholarship Trustees
Tuesday 8:00 AM–12:00 PM Burnham 5 (7)

Society Rules
Tuesday 2:00 PM–5:00 PM Marshfield (3)

Standards PPIS
Tuesday 11:00 AM–2:00 PM Burnham 1 (7)

Standards SPLS
Tuesday 2:00 PM–6:00 PM Burnham 1 (7)

Standards SRS
Tuesday 5:00 PM–6:00 PM Montrose 4 (7)

TC/CEC Training
Tuesday 11:00 AM–12:00 PM Kimball (3)

Technology Council Document Review Subcommittee
Tuesday 9:00 AM–10:30 AM Salon 1 (3)

Technology Council Operation/Planning
Tuesday 7:30 AM–9:00 AM Salon 1 (3)

Technology Council Special Projects
Tuesday 10:30 AM–12:00 PM Salon 1 (3)

WEDNESDAY, JANUARY 28

Board of Directors
Wednesday 2:00 PM–6:00 PM Grand Ballroom (4)

CIBSE/ASHRAE Liaison
Wednesday 9:30 AM–12:00 PM Salon 1 (3)

Executive Committee
Wednesday 7:30 AM–9:00 AM Cresthill (3)

Research Administration
Wednesday 7:00 AM–11:00 AM Grant Park (6)

Standards
Wednesday 7:30 AM–9:30 AM Grand Ballroom (4)

Technical Activities
Wednesday 7:00 AM–10:00 AM Hancock (6)

Technology Council
Wednesday 8:00 AM–12:00 PM Salon 12 (3)

THURSDAY, JANUARY 29

Executive Committee
Thursday 7:30 AM–11:00 AM Cresthill (3)

notes

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.

Finding your meeting location:

Technical committees are scheduled in the Palmer House Hilton. Numbers in parenthesis indicate the floor location of the meeting room.

Meetings listed in color are confirmed. Those not in color may or may not be meeting.

TC/TG Chair's Breakfast Section 1 29
Sunday 6:30 AM–8:00 AM Salon 1 (7)

TC/TG Chair's Breakfast Section 2 21
Sunday 6:30 AM–8:00 AM Clark 3 (7)

TC/TG Chair's Breakfast Section 3 15
Sunday 6:30 AM–8:00 AM Clark 1 (7)

TC/TG Chair's Breakfast Section 4 17
Sunday 6:30 AM–8:00 AM Clark 7 (7)

TC/TG Chair's Breakfast Section 5 29
Sunday 6:30 AM–8:00 AM Wilson (3)

TC/TG Chair's Breakfast Section 6 25
Sunday 6:30 AM–8:00 AM Salon 2 (3)

TC/TG Chair's Breakfast Section 7 23
Sunday 6:30 AM–8:00 AM Logan (3)

TC/TG Chair's Breakfast Section 8 23
Sunday 6:30 AM–8:00 AM LaSalle 3 (7)

TC/TG Chair's Breakfast Section 9 25
Sunday 6:30 AM–8:00 AM Burnham 4 (7)

TC/TG Chair's Breakfast Section 10 25
Sunday 6:30 AM–8:00 AM LaSalle 1 (7)

TC/TG Chair's Training Workshop
Sunday 9:45 AM–10:45 AM Chicago (5)

TC Program Subcommittee Training
Tuesday 11:15 AM–12:00 PM Kimball (3)

Research Subcommittee Breakfast
Monday 6:30 AM–8:00 AM Grand Ballroom (4)

TC 1.1 Thermodynamics & Psychrometrics (10/15)
Monday 2:15 PM–4:15 PM Clark 7 (7)
Seminar 58: Environmentally Sound Refrigeration

TC 1.2 Instruments & Measurements (15/)
Tuesday 1:00 PM–3:30 PM Burnham 5 (7)

TC 1.2 Standards/Handbook (5/2)
Monday 4:15 PM–6:30 PM Sandburg 6 (7)

TC 1.3 Heat Transfer & Fluid Flow (25/25)
Tuesday 1:00 PM–3:30 PM Honore (Lobby)

TC 1.3/8.5 Research (15/20) Screen
Sunday 3:00 PM–7:00 PM Monroe (6)

TC 1.4 Control Theory & Application (20/20) Screen
Tuesday 1:00 PM–3:30 PM Empire Ballroom (Lobby)
Seminar on 1/27 at 1:00 p.m.: Three Emerging Technologies in Building Automation, Seminar 7: Controlling a Minimum Impact Data Center, Seminar 43: Ventilation Research, Seminar 57: Energy and Water Efficient Systems? Impossible Without Controls!

TC 1.4 Control Components and Applications (10/15) Screen
Sunday 3:00 PM–4:00 PM LaSalle 2 (7)

TC 1.4 YEA (10/10) Screen
Sunday 4:00 PM–4:30 PM LaSalle 2 (7)

TC 1.4 Education (10/10)
Sunday 4:30 PM–5:30 PM LaSalle 2 (7)

TC 1.4 Programs (20/5) Screen
Sunday 5:30 PM–7:00 PM LaSalle 2 (7)

TC 1.4 Research (6/14) Screen
Monday 2:15 PM–4:15 PM Clark 10 (7)

TC 1.4 Handbook (10/5) Screen
Monday 4:15 PM–6:30 PM Clark 10 (7)

TC 1.4 RP 1455
Monday 9:00 AM–10:00 AM Sandburg 6 (7)

TC 1.4 Executive (8/3) Screen
Tuesday 7:00 AM–8:00 AM Burnham 3 (7)

TC 1.4 RP 1597 (6/2) Screen
Tuesday 10:00 AM–11:00 AM Burnham 3 (7)

TC 1.5 Computer Applications (20/5) E
Monday 6:30 PM–9:00 PM Salon 12 (3)
Seminar 45: BIM Pays its Way: Showing Return of Investment for BIM in Real Day- to-Day Applications

TC 1.5 Emerging Applications (10/10) Screen/E
Sunday 5:00 PM–6:00 PM Kimball (3)

TC 1.5 Research (10/10) Screen/E
Sunday 6:00 PM–7:00 PM Kimball (3)

TC 1.5 Program (10/10)
Sunday 7:00 PM–8:00 PM Kimball (3)

TC 1.5 Handbook (10/10)
Monday 6:00 PM–6:30 PM Salons 5/8 (3)

TC 1.6 Terminology (10/8)
Monday 4:15 PM–6:30 PM Sandburg 7 (7)

TC 1.6 Program, Handbook, Terminology and STD-134 (6/4) Screen/E
Monday 8:00 AM–12:00 PM Salon 10 (3)

TC 1.7 Business, Management & General Legal Education (20/5)
Monday 10:15 AM–12:00 PM Kimball (3)
Seminar 16: "Can't We All Just Get Along?": Keeping Your Eye on the Ball After You've Been Poked in It, Seminar 37: Case Studies tin Engineering Ethics

TC 1.8 Mechanical Systems Insulation (6/6)
Monday 4:15 PM–6:30 PM Montrose 3 (7)

TC 1.8 Research, Handbook, Programs (10/6)
Sunday 8:00 AM–10:30 AM Medinah (7)

TC 1.9 Electrical Systems (8/4)
Tuesday 3:30 PM–6:00 PM Montrose 5 (7)
Workshop 6: Smart Inverter Standards, to Manage Your Smart Building While Connected to the Smart Grid

TC 1.10 Cogeneration Systems (20/10)
Tuesday 3:30 PM–5:00 PM Grant Park (6)
Seminar 26: Microgrids, Resiliency and CHP: Implications for the Future of Building Design and Retrofit

TC 1.10 Handbook, CTIC, Program, Research, Membership (20/10)
Tuesday 12:00 PM–3:00 PM Grant Park (6)

TC 1.11 Electric Motors and Motor Control (13/7) Screen
Tuesday 1:00 PM–3:30 PM Montrose 5 (7)
Seminar 39: Efficiency Prediction of Motors and Variable Speed Drives with Compressors and with Fans

TC 1.12 Moisture Management in Buildings (15/25) Screen
Saturday 1:00 PM–3:00 PM Water Tower (6)

TC 1.12 Handbook/Research/Program/Research (12/20)
Saturday 8:00 AM–12:00 PM Water Tower (6)

TC 2.1 Physiology & Human Environment (12/18)
Tuesday 1:00 PM–3:30 PM Burnham 4 (7)

TC 2.1 Research (13/7)
Sunday 1:00 PM–3:00 PM Sandburg 4 (7)

TC 2.1 Programs
Sunday 3:00 PM–4:00 PM Sandburg 4 (7)

TC 2.1 Handbook
Sunday 4:00 PM–5:00 PM Sandburg 4 (7)

TC 2.2 Plant and Animal Environment (10/5)
Monday 4:15 PM–6:30 PM Dearborn 3 (7)

TC 2.3 Gaseous Air Contaminants /Removal Equip. (18/20) Screen
Tuesday 1:00 PM–3:30 PM Price (5)
Seminar 34: Testing Filters for Removal of Gas-Phase Air Contaminants, Seminar 40: The IAQ Procedure Is Alive and Well: Current Status of Standard 62.1, TRG4.IAQP, and LEED v4.0

TC 2.3 Research (20/5)
Sunday 5:00 PM–7:00 PM Honore (L)

TC 2.3 Handbook (5/5)
Monday 4:15 PM–6:00 PM Sandburg 3 (7)

TC 2.3 Standards (20/5)
Monday 6:00 PM–8:00 PM Honore Lobby

TC 2.3 Publications (20/5) Screen
Monday 3:00 PM–4:00 PM Indiana (3)

TC 2.3 Planning (15/5)
Tuesday 6:30 AM–8:00 AM Marshfield (3)

TC 2.3 Program (20/5)
Tuesday 12:00 PM–12:45 PM Price (5)

TC 2.4 Particulate Air Contaminants /Removal Equip. (18/30)
Tuesday 3:30 PM–6:00 PM Price (5)

TC 2.4 Handbook (10/20) Flipchart Screen
Saturday 1:00 PM–2:30 PM Salons 5/8 (3)

TC 2.4 PMS RP 1691
Sunday 2:00 PM–3:00 PM Burnham 1 (7)

TC 2.4 Research (20/40) Screen/Flipchart
Sunday 3:00 PM–5:00 PM Honore (L)

TC 2.4 Standards (20/30) Screen/Flipchart
Monday 4:15 PM–6:00 PM Honore Lobby

TC 2.4 Planning (20/10) Screen/Flipchart
Tuesday 8:00 AM–10:00 AM Grant Park (6)

TC 2.4 Program (20/20) Flipchart Screen
Tuesday 10:00 AM–11:00 AM Grant Park (6)

TC 2.5 Global Climate Change (20/10)
Tuesday 1:30 PM–3:30 PM Madison (3)
Seminar 30: What the F-gas Is Going on in Europe: What the HFC Phasedown Means for Our Industry

TC 2.5 Climate Change Chapter (15/0)
Sunday 5:00 PM–7:00 PM Dearborn 3 (7)

TC 2.6 Sound & Vibration Control (25/40) Screen/E
Monday 2:15 PM–4:15 PM Monroe (6)

TC 2.6 Vibration Isolation (25/25)Screen/E
Sunday 9:00 AM–10:00 AM Salon 2 (3)

TC 2.6 Programs
Sunday 10:00 AM–11:00 AM Salon 2 (3)

TC 2.6 Hot Topic 1
Sunday 11:00 AM–12:00 PM Salon 2 (3)

TC 2.6 Publications
Sunday 1:00 PM–2:00 PM Salon 2 (3)

TC 2.6 Hot Topic 2
Sunday 2:00 PM–3:00 PM Salon 2 (3)

TC 2.6 RP 148
Sunday 3:00 PM–4:00 PM Salon 2 (3)

TC 2.6 Excom
Sunday 4:00 PM–5:00 PM Salon 2 (3)

TC 2.6 RP 1529 (25/25) Screen/E
Monday 9:00 AM–10:00 AM Salon 2 (3)

TC 2.6 Research
Monday 10:00 AM–11:00 AM Salon 2 (3)

TC 2.6 Criteria
Monday 11:00 AM–12:00 PM Salon 2 (3)

TC 2.7 Seismic and Wind Restraint Design (16/20) Screen/E
Tuesday 3:30 PM–6:00 PM Burnham 2 (7)

TC 2.7 Research/Program/Publications (16/10) Screen/E
Tuesday 1:00 PM–3:30 PM Burnham 2 (7)

TC 2.8 Building Environmental Impacts and Sustainability (20/50)
Sunday 5:00 PM–7:00 PM Adams (6)
Seminar 21: Blue Is the New Green: The Emerging Focus on Integrated Water Management, Forum 2: AASA: A Dream Come True?, Seminar 61: Biomass Combustion Strategies for Building Applications: Energy Efficiency with Low Emissions

TC 2.8 International (8/4)
Sunday 12:30 PM–1:15 PM Montrose 6 (7)

TC 2.8 Green Guide (12/12)
Sunday 1:15 PM–1:45 PM Montrose 6 (7)

TC 2.8 Research (10/4)
Sunday 1:45 PM–2:15 PM Montrose 6 (7)

TC 2.8 Handbook (10/4)
Sunday 2:15 PM–3:00 PM Montrose 6 (7)

TC 2.8 Programs (15/4)
Sunday 3:00 PM–3:45 PM Montrose 6 (7)

TC 2.8 Existing Buildings (12/8)
Sunday 3:45 PM–4:15 PM Montrose 6 (7)

TC 2.9 Ultraviolet Air and Surface Treatment (20/10)
Monday 10:00 AM–12:00 PM Logan (3)
Seminar 38: Effective Deployment of UVC in Healthcare Environment

TC 2.9 Program, Standards (15/7) Screen
Sunday 8:00 AM–10:00 AM Clark 10 (7)

TC 2.9 Research, Handbook (15/7)
Sunday 10:00 AM–12:00 PM Clark 10 (7)

TC 3.1 Refrigerants & Secondary Coolants (20/25) Screen/E
Monday 4:15 PM–6:30 PM Clark 5 (7)
Workshop 3: Code and Safety Standard Requirements: Working with 2L Low GWP Refrigerants

TC 3.1 Research and Program (10/25) Screen
Monday 11:00 AM–12:00 PM Clark 5 (7)

TC 3.1 Handbook (5/10)
Monday 3:00 PM–4:00 PM Clark 5 (7)

TC 3.2 Refrigerant System Chemistry (12/40)
Monday 2:15 PM–4:15 PM Honore (Lobby)

TC 3.2 Research (12/14)
Sunday 4:00 PM–5:00 PM Montrose 5 (7)

TC 3.3 Refrigerant Contaminant Control (14/25)
Tuesday 3:30 PM–6:00 PM Adams (6)

TC 3.3 Research (12/14)
Sunday 5:00 PM–5:30 PM Montrose 5 (7)

TC 3.4 Lubrication (20/40)
Tuesday 1:30 PM–3:30 PM Adams (6)

TC 3.4 Research (12/14)
Sunday 5:30 PM–6:00 PM Montrose 5 (7)

TC 3.6 Water Treatment (18/10)
Tuesday 1:00 PM–3:30 PM Montrose 4 (7)

TC 3.6 Handbook/Program/Research (12/10)
Sunday 3:00 PM–5:00 PM Clark 1 (7)

TC 3.8 Refrigerant Containment (9/5)
Monday 4:15 PM–6:30 PM Clark 1 (7)

TC 4.1 Load Calculation Data and Procedures (15/10)
Monday 2:15 PM–4:15 PM LaSalle 5 (7)

TC 4.1 RP-1681 PMS (5/10) Screen
Sunday 2:00 PM–3:00 PM Medinah (6)

TC 4.1 Handbook (10/10)
Sunday 3:00 PM–4:00 PM Medinah (6)

TC 4.1 Research
Sunday 4:00 PM–5:00 PM Medinah (6)

TC 4.1 Programs (10/10)
Sunday 5:00 PM–6:00 PM Medinah (6)

TC 4.1 Standards (10/10)
Sunday 6:00 PM–7:00 PM Medinah (6)

TC 4.2 Climatic Information (20/10) Screen
Tuesday 1:00 PM–3:30 PM Buckingham (5)

TC 4.2 1699-RP PMS (10) Screen
Sunday 1:00 PM–2:30 PM Salon 10 (3)

TC 4.2 Program (20/0) Screen
Sunday 2:30 PM–3:30 PM Salon 10 (3)

TC 4.2 1561-RP PES (20/0) Screen
Sunday 3:30 PM–5:00 PM Salon 10 (3)

TC 4.2 Research (20/0) Screen
Monday 4:15 PM–6:00 PM Clark 7 (7)

TC 4.3 Ventilation Requirements & Infiltration (15/10) Screen
Monday 4:15 PM–6:30 PM Clark 3 (7)

TC 4.4 Bldg. Materials and Bldg. Envelope Performance (20/20) Screen
Monday 2:15 PM–4:15 PM Dearborn 1 (7)

TC 4.4 Research (20/10) Screen
Sunday 1:00 PM–3:00 PM LaSalle 1 (3)

TC 4.4 Handbook (20/10) Screen
Sunday 3:00 PM–3:30 PM LaSalle 1 (3)

TC 4.4 Program (20/10) Screen
Sunday 3:30 PM–5:00 PM LaSalle 1 (3)

TC 4.4 Standards (20/10) Screen
Sunday 5:00 PM–5:30 PM LaSalle 1 (3)

TC 4.5 Fenestration (10/20)
Monday 2:15 PM–4:15 PM Clark 2 (7)
Conference Paper Session 13: Energy Associated with Building Envelopes

TC 4.5 Calculational Methods (8/10)
Sunday 2:00 PM–3:15 PM Burnham 5 (7)

TC 4.5 Research & Long Range Planning
Sunday 3:15 PM–4:00 PM Burnham 5 (7)

TC 4.5 Program
Sunday 4:00 PM–5:00 PM Burnham 5 (7)

TC 4.5 Handbook
Sunday 5:00 PM–6:30 PM Burnham 5 (7)

TC 4.7 Energy Calculations (25/50) Screen
Tuesday 3:30 PM–8:30 PM Empire Ballroom (Lobby)
Seminar 46: Energy Modeling of Tall and Very-Tall Buildings, Seminar 55: Simulation Calibration

TC 4.7 Simulation and Component Models (20/20) Screen
Monday 6:00 PM–7:30 PM Monroe (6)

TC 4.7 Data-Driven Models
Monday 7:30 PM–9:00 PM Monroe (6)

TC 4.7 1588-RP PMS (8/2) Screen
Tuesday 1:00 PM–3:30 PM Ashland (3)

TC 4.7 Applications (20/10) Screen
Tuesday 3:30 PM–5:00 PM Empire Ballroom (Lobby)

TC 4.7 Handbook
Tuesday 5:00 PM–6:00 PM Empire Ballroom (Lobby)

TC 4.10 Indoor Environmental Modeling (20/20)
Monday 2:15 PM–4:15 PM Chicago (5)
Seminar 8: Design of Safe, Healthy and Energy Efficient Air Distributions for Hospitals

TC 4.10 Program (20/10)
Sunday 3:00 PM–4:00 PM LaSalle 3 (7)

TC 4.10 Handbook (20/10)
Sunday 4:00 PM–5:00 PM LaSalle 3 (7)

TC 4.10 Research (20/10)
Sunday 5:00 PM–6:00 PM LaSalle 3 (7)

TC 5.1 Fans (20/5)
Monday 4:15 PM–6:30 PM Dearborn 2 (7)
Seminar 2: Fan and System Integration for Maximizing Energy Efficiency Design, Seminar 28: System Effects from Inlet of Centrifugal and Plenum Fans

TC 5.1 Research (5/15)
Sunday 3:15 PM–4:15 PM Salons 4/9 (3)

TC 5.1 Program (5/15)
Sunday 4:15 PM–4:45 PM Salons 4/9 (3)

TC 5.1 Handbook (5/15)
Sunday 4:45 PM–5:45 PM Salons 4/9 (3)

TC 5.2 Duct Design (12/20)
Tuesday 3:30 PM–6:00 PM Logan (3)

TC 5.2 Vision, Honors&Awards, Handbook, Membership, Program (20/5)
Sunday 1:30 PM–2:00 PM Wilson (3)

TC 5.2 Duct Design Guide
Sunday 2:00 PM–2:30 PM Wilson (3)

TC 5.2 Code Interaction, Webmaster, Liaison Reports
Sunday 2:30 PM–3:00 PM Wilson (3)

TC 5.2 Research and Standards
Sunday 3:00 PM–3:30 PM Wilson (3)

TC 5.2 Action Items and Flexible Duct & Air Connectors
Sunday 3:30 PM–4:00 PM Wilson (3)

TC 5.2 Duct Design Guide (20/5)
Monday 8:00 AM–10:00 AM LaSalle 2 (7)

TC 5.2 Flexible Duct & Air Connectors
Monday 10:00 AM–12:00 PM LaSalle 2 (7)

TC 5.3 Room Air Distribution (30/30) Screen/E
Tuesday 1:00 PM–3:30 PM Monroe (6)

TC 5.3 Handbook (20/20) Screen/E
Friday 12:00 PM–5:00 PM Burnham 1 (7)

TC 5.3 Handbook (20/20) Screen/E
Saturday 8:00 AM–3:00 PM Burnham 4 (7)

TC 5.3 Fan Coils (30/20) Screen/E
Sunday 8:00 AM–8:30 AM Price (5)

TC 5.3 Chilled Beams (30/20) Screen/E
Sunday 8:30 AM–9:30 AM Price (5)

TC 5.3 Air Curtains (30/20) Screen/E
Sunday 9:30 AM–10:15 AM Price (5)

TC 5.3 Underfloor Air Distribution (11/6)
Sunday 10:15 AM–11:45 AM Price (5)

TC 5.3 Research/Handbook/Program(30/20) Screen/E
Sunday 12:00 PM–2:00 PM Price (5)

TC 5.4 Industrial Process Air Cleaning (11/6)
Monday 2:15 PM–4:15 PM Dearborn 3 (7)

TC 5.5 Air-to-Air Energy Recovery (22/4)
Tuesday 3:30 PM–6:00 PM Clark 3 (7)
Seminar 41: Is Air-to-Air Energy Recovery Mutually Exclusive with Demand Control Ventilation and/or Airside Economizers?

TC 5.5 Handbook, Program, Research (8/4)
Monday 4:15 PM–6:30 PM LaSalle 5 (7)

TC 5.6 Control of Fire & Smoke (23/30)
Monday 4:15 PM–6:30 PM Salon 2 (3)
Seminar 35: Alternative Fire and Smoke Detection Technologies for Smoke Control Applications

TC 5.6 Program (12/4)
Sunday 3:00 PM–4:00 PM LaSalle 4 (7)

TC 5.6 Research
Sunday 4:00 PM–5:30 PM LaSalle 4 (7)

TC 5.6 Handbook
Sunday 5:30 PM–7:00 PM LaSalle 4 (7)

TC 5.7 Evaporative Cooling (20/10)
Monday 4:15 PM–6:30 PM LaSalle 2 (7)

TC 5.7 Programs, Research, Handbook (7/8) Screen/E
Sunday 3:00 PM–5:00 PM Kimball (3)

TC 5.8 Industrial Ventilation Systems (20/5)
Monday 4:15 PM–6:30 PM Indiana (3)
Workshop 7: Applicable Standards for Ventilation and Air Conditioning of Hazardous Spaces

TC 5.8 Ventilation of Hazardous Spaces (5/5)
Sunday 7:00 PM–9:00 PM Burnham 3 (7)

TC 5.9 Enclosed Vehicular Facilities (30/10)
Tuesday 3:30 PM–6:00 PM Hancock (6)
Seminar 15: Computational Analysis for Fire-Life Safety

TC 5.9 Program, Handbook, Research
Tuesday 1:00 PM–3:30 PM Hancock (6)

TC 5.10 Kitchen Ventilation (15/10) Screen
Sunday 11:00 AM–12:00 PM Salon 10 (3)

TC 5.10 PMS 1631 (10/0)
Saturday 1:00 PM–3:00 PM Dearborn 3 (7)

TC 5.10 Handbook 15/10)
Sunday 8:00 AM–9:00 AM Salon 10 (3)

TC 5.10 Program
Sunday 9:00 AM–10:00 AM Salon 10 (3)

TC 5.10 Research (15/10)
Sunday 10:00 AM–11:00 AM Salon 10 (3)

TC 5.11 Humidifying Equipment (10/3)
Monday 2:15 PM–4:15 PM Sandburg 8 (7)

TC 5.11 Handbook (5/3) Screen
Sunday 10:00 AM–12:00 PM Burnham 5 (7)

TC 5.11 Research (8/2)
Sunday 3:00 PM–5:00 PM Clark 8 (7)

TC 5.11 PMS 1630 (6/0)
Monday 8:30 AM–10:30 AM Sandburg 8 (7)

TC 6.1 Hydronic & Steam Htg. Equip & Sys (20/25)
Tuesday 1:00 PM–3:30 PM Water Tower (6)
Seminar 25: Hydronics 11: Design Basics for Young Engineers and Complying with Standard 90.1

TC 6.1 Handbook (12/15)
Sunday 5:00 PM–7:00 PM Salon 2 (3)

TC 6.1 Chilled Water Plant (12/15)
Sunday 7:00 PM–8:00 PM Salon 2 (3)

TC 6.1 Program (12/10)
Monday 2:15 PM–3:15 PM Hancock (6)

TC 6.1 Research (12/10)
Monday 3:15 PM–4:15 PM Hancock (6)

TC 6.2 District Energy (20/10)
Sunday 3:00 PM–5:00 PM Clark 10 (7)

TC 6.2 Programs, Research, Handbook (8/7)
Sunday 1:00 PM–3:00 PM Clark 10 (7)

TC 6.3 Central Forced Air Htg. & Cooling Sys (20/12)
Tuesday 1:00 PM–3:30 PM Logan (3)

TC 6.5 Radiant Heating and Cooling (17/10)
Monday 2:15 PM–4:15 PM LaSalle 1 (7)
Seminar 54: Modeling Radiant Heating and Cooling Systems: Tools and Analysis

TC 6.5 Research, Spec Pubs, Journal, Program, Handbook (8/20)
Sunday 3:00 PM–7:00 PM Dearborn 1 (7)

TC 6.6 Service Water Heating Systems (18/15)
Monday 4:15 PM–6:30 PM Buckingham (5)
Conference Paper Session 12: Efficiency of Residential Domestic Water Heating

TC 6.6 Research/Program (5/5)
Monday 2:15 PM–4:15 PM Buckingham (5)

TC 6.7 Solar Energy Utilization (20/10)
Tuesday 1:00 PM–3:30 PM Cresthill (3)

TC 6.7 Research (7/5)
Monday 4:15 PM–5:00 PM Sandburg 2 (7)

TC 6.7 Standards
Monday 5:00 PM–5:45 PM Sandburg 2 (7)

TC 6.7 Program
Monday 5:45 PM–6:30 PM Sandburg 2 (7)

TC 6.7 Handbook
Monday 6:30 PM–8:30 PM Sandburg 2 (7)

TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25)
Tuesday 3:30 PM–6:30 PM Salon 12 (3)
Seminar 18: Walgreens' Pursuit of a Net-Zero Store

TC 6.8 Applied Heat Recovery Handbook (6/5)
Saturday 1:00 PM–3:00 PM Montrose 5 (7)

TC 6.8 Handbook/Research/Programs (20/5)
Sunday 5:00 PM–7:00 PM Salon 10 (3)

TC 6.9 Thermal Storage (18/15) Screen/E
Monday 4:30 PM–6:00 PM Grant Park (6)

TC 6.9 Standards (18/15) Screen/E
Monday 2:15 PM–2:40 PM Grant Park (6)

TC 6.9 Program (18/15) Screen/E
Monday 2:40 PM–3:10 PM Grant Park (6)

TC 6.9 Handbook (18/15) Screen/E
Monday 3:10 PM– 3:30 PM Grant Park (6)

TC 6.9 LRP /Website (18/15) Screen/E
Monday 3:30 PM–3:50 PM Grant Park (6)

TC 6.9 Research (18/15)
Monday 3:50 PM–4:15 PM Grant Park (6)

TC 6.10 Fuels & Combustion (20/10)
Tuesday 3:30 PM–6:00 PM Kimball (3)

TC 6.10 Handbook (5/3) Screen/E
Monday 2:15 PM–4:15 PM Montrose 3 (7)

TC 7.1 Integrated Building Design (25/10) E
Monday 8:15 AM–10:30 AM LaSalle 3 (7)

TC 7.1 Research (4/2) E
Sunday 5:00 PM–6:00 PM Clark 1 (7)

TC 7.1 Programs
Sunday 6:00 PM–7:00 PM Clark 1 (7)

TC 7.2 HVAC Construction and Design Build Technology (10/5)
Sunday 10:00 AM–12:00 PM Montrose 2 (7)

TC 7.3 Operations & Maintenance Management (25/7) E
Tuesday 1:00 PM–3:30 PM Salon 1 (3)

TC 7.3 Standards/Program (15/10) Screen/E
Monday 2:15 PM–4:15 PM Medinah (6)

TC 7.3 Research/Handbook/Education(15/10) Screen
Monday 4:15 PM–6:30 PM Medinah (6)

TC 7.4 Exergy Analysis for Sustainable Buildings (14/8)
Sunday 8:00 AM–10:00 AM Dearborn 2 (7)

TC 7.5 Smart Building Systems (13/25) Screen
Tuesday 3:30 PM–6:00 PM Water Tower (6)
Seminar 9: Modeling and Simulation of Occupant Behavior in Buildings

TC 7.5 Fault Detection & Diagnosis (13/25)
Sunday 3:00 PM–3:45 PM Price (5)

TC 7.5 Enabling Technolgies
Sunday 3:45 PM–4:30 PM Price (5)

TC 7.5 Smart Grid
Sunday 4:30 PM–5:15 PM Price (5)

TC 7.5 Handbook
Sunday 5:15 PM–6:15 PM Price (5)

TC 7.5 Buildings Operations Dynamics (13/25)
Monday 4:00 PM–4:45 PM Dearborn 1 (7)

TC 7.5 Research
Monday 4:45 PM–5:45 PM Dearborn 1 (7)

TC 7.6 Building Energy Performance (20/30) Screen
Tuesday 1:00 PM–3:30 PM Salons 6/7 (3)
Seminar 10: REHVA Seminar: Operation of Energy Efficient Buildings, Workshop 4: Energy Rating and Auditing Your Commercial Building Using the ASHRAE bEQ Program (Building Energy Quotient): How to Do It, and Why You Should, Workshop 8: Lies, Damn Lies, and…EUIs?

TC 7.6 Research (8/10)
Sunday 1:00 PM–2:00 PM Montrose 4 (7)

TC 7.6 Commercial Building Energy Audit
Sunday 2:00 PM–3:00 PM Montrose 4 (7)

TC 7.6 Handbook
Sunday 3:00 PM–4:00 PM Montrose 4 (7)

TC 7.6 Federal Buildings (25/10) Screen
Saturday 9:00 AM–3:00 PM LaSalle 1 (7)

TC 7.6 Federal Buildings (25/10) Screen
Sunday 9:00 AM–12:00 PM Salons 5/8 (3)

TC 7.6 Monitoring and Energy Performance (8/10)
Monday 2:15 PM–4:15 PM Sandburg 5 (7)

TC 7.6 Energy Management (8/10)
Monday 4:15 PM–5:15 PM Sandburg 5 (7)

TC 7.6 Standards
Monday 5:15 PM–6:15 PM Sandburg 5 (7)

TC 7.6 Executive
Monday 6:15 PM–6:45 PM Sandburg 5 (7)

TC 7.7 Testing & Balancing (20/30)
Monday 2:15 PM–4:15 PM Wabash (3)

TC 7.7 Program/Handbook (6/3)
Saturday 12:00 PM–3:00 PM Montrose 4 (7)

TC 7.8 Owning & Operating Costs (20/5)
Monday 2:15 PM–4:15 PM Logan (3)

TC 7.8 Program, Handbook, Research(10/2)
Sunday 3:00 PM–5:00 PM Sandburg 6 (7)

TC 7.9 Building Commissioning (25/25)
Sunday 2:15 PM–5:00 PM Water Tower (6)

TC 7.9 Handbook, Research, Program (15/8)
Saturday 8:00 AM–12:00 PM Montrose 5 (7)

TC 8.1 Positive Displacement Compressors (12/14)
Tuesday 3:30 PM–6:00 PM Montrose 6 (7)
Seminar 51: Energy Efficiency of Novel and Conventional Compressors using Low-GWP Refrigerants

TC 8.1 Research/Program (5/3)
Sunday 4:00 PM–5:00 PM Wrigley (6)

TC 8.2 Centrifugal Machines (20/8)
Monday 2:15 PM–4:15 PM LaSalle 2 (7)

TC 8.2 Research and Program (10/5)
Sunday 5:00 P–7:00 PM Sandburg 6 (7)

TC 8.2 Handbook
Sunday 7:00 PM–8:00 PM Sandburg 6 (7)

TC 8.3 Absorption and Heat Operated Machines (20/10)
Monday 3:30 PM–6:00 PM Burnham 1 (3)
Seminar 1: An Update on Energy Efficiency Analysis using ABSIM Absorption Simulator, Triple Duty Chillers and Type 2 Absorption Heat Pumps

TC 8.3 Research/Handbook (8/15)
Monday 2:15 PM–3:30 PM Burnham 1 (7)

TC 8.4 Air-to-Refrigerant Heat Transfer Equip (20/10) Screen/E
Tuesday 3:30 PM–6:00 PM Salon 10 (3)
Conference Paper Session 2: HVAC Refrigerants, Conference Paper Session 11: Advances in Cooling Heat Exchangers and Refrigerants

TC 8.4 Research/Standards/Handbook (15/15) Screen/E
Monday 6:30 PM–9:30 PM Wabash (3)

TC 8.5 Liquid to Refrigerant Heat Transfer (25/10) Screen
Monday 4:15 PM–6:30 PM Hancock (6)

TC 8.5/1.3 Research
Sunday 3:00 PM–7:00 PM Monroe (6)

TC 8.6 Cooling Towers and Evaporative Condensers (10/10)
Monday 2:15 PM–4:15 PM Clark 1 (7)
Seminar 52: Alternative Sources of Recycle/Makeup Water: Practical Considerations for What SHOULD be a Good Idea

TC 8.6 Handbook/Program/Research (10/4)
Monday 8:00 AM–10:00 AM Clark 1 (7)

TC 8.7 Variable Refrigerant Flow (20/30)
Monday 4:15 PM–6:30 PM Wabash (3)

TC 8.8 Refrigerant System Controls & Accessories (10/10) Screen
Tuesday 1:00 PM–3:30 PM Salon 10 (3)

TC 8.9 Residential Refrigerators and Food Freezers (6/10)
Monday 2:15 PM–4:15 PM Sandburg 7 (7)
Seminar 14: Alternative Refrigerants for Residential Refrigerator-Freezers

TC 8.10 Mechanical Dehumidifiers & Heat Pipes (8/20)
Tuesday 3:30 PM–6:00 PM Chicago (5)

TC 8.10 PMS 1712-RP (10/0)
Sunday 10:00 AM–12:00 PM Dearborn 3 (7)

TC 8.10 Program/Handbook/Research/Standards (8/8)
Tuesday 1:00 PM–3:30 PM Chicago (5)

TC 8.11 Unitary and Room Air Conditioners & Heat Pumps (20/30)
Monday 4:15 PM–6:30 PM Chicago (5)
Seminar 13: Variable System Field Results and Why Load Based Testing Is Needed for Residential Equipment Applications, AHR Expo Session 1: New 215 Regional Standards and the Effects on Different Areas of the HVAC Industry, Seminar 48: International Codes and Standards Issues Impacting use of A2L Refrigerants in Unitary Heat Pump and Air-Conditioning Equipment

TC 8.11 Handbook/Program/Research (14/10) Screen
Sunday 3:00 PM–5:00 PM Logan (3)

TC 8.12 Desiccant Dehumidification Equipment and Components (15/15)
Monday 2:15 PM–4:15 PM Marshfield (3)

TC 9.1 Large Building Air-Conditioning Systems (23/20)
Tuesday 1:00 PM–3:30 PM Dearborn 1 (7)
Seminar 31: Back to Basics towards Energy Efficient HVAC Design, Seminar 44: Air-Conditioning Research

TC 9.1 Research/Program/Handbook (20/10)
Tuesday 12:00 PM–1:00 PM Dearborn 1 (7)

TC 9.2 Industrial Air Conditioning (25/10) Screen
Tuesday 1:00 PM–3:30 PM Salon 12 (3)
Seminar 60: Current Topics in Heat Recovery for Industrial Facilities

TC 9.2 Nuclear (12/4)
Monday 2:15 PM–4:15 PM Sandburg 3 (7)

TC 9.2 Program/Handbook (8/2)
Sunday 4:00 PM–7:00 PM Ashland (3)

TC 9.3 Transportation Air Conditioning (15/15) Screen/E
Monday 2:15 PM–6:30 PM Salon 1 (3)

T C 9.4 Justice Facilities (20/5)
Sunday 8:00 AM–10:00 AM Kimball (3)

TC 9.6 Health Care Facilities (20/60) Screen
Sunday 5:00 PM–7:00 PM State (4)
Seminar 24: What Makes a Hospital's HVAC System High(er) Performing?, Forum 1: Conquering Infectious Diseases in Healthcare: A Grassroots Movement for Rapid Prototyping of Code-Compliant Solutions (and Ideas to Avoid!), Seminar 49: Isolation Room Design, Research and Construction (Case Study), Seminar 50: Case Studies on Chilled Beams in Health Care HVAC Design, Seminar 62: Chill Out: Hospital Chiller Plant Upgrades and System Retrofits Improve Energy Efficiency, Reduce Carbon Footprint and Improve Reliability

TC 9.6 Water (10/5)
Sunday 9:00 AM–10:00 AM Burnham 4 (7)

TC 9.6 Infectious Diseases (20/25) Screen
Sunday 10:00 AM–12:00 PM Burnham 4 (7)

TC 9.6 Research (20/5) Screen
Sunday 1:00 PM–2:00 PM Burnham 4 (7)

TC 9.6 Handbook (15/5)
Sunday 2:00 PM–3:00 PM Burnham 4 (7)

TC 9.6 Energy (20/5) Screen
Sunday 3:00 PM–4:00 PM Burnham 4 (7)

TC 9.6 Program (20/5)
Sunday 4:00 PM–5:00 PM Burnham 4 (7)

TC 9.7 Educational Facilities (13/10)
Sunday 1:00 PM–3:00 PM Clark 9 (7)

TC 9.8 Large Building Air-Conditioning Applications (20/10)
Monday 2:15 PM–4:15 PM Salons 5/8 (3)
Seminar 59: ASHRAE's Cold Climate Design Guide

TC 9.8 Handbook/Research/Program (20/5)
Monday 9:00 AM–12:00 PM Cresthill (3)

TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment (25/75) Screen
Monday 2:15 PM–9:30 PM Adams (6)
Conference Paper Session 3: Modern Data Center Design, Seminar 23: Data Center and IT Equipment Liquid Cooling: Performance Capabilities, Implementation and Emerging Technologies, Seminar 29: The Need for Energy Modeling Software for Data Centers, Seminar 42: Data Centers: Getting Outside Your Comfort Zone and Pushing the Envelope into New Metrics and New Focus Areas

TC 9.9 Program/ Handbook/ Research (25/40) Screen
Sunday 5:00 PM–7:00 PM Empire Ballroom (Lobby)

TC 9.10 Laboratory Systems (20/50) Screen/E
Tuesday 3:30 PM–6:00 PM Monroe (6)
Seminar 4: Lab Safety and Fire Alarm Response

TC 9.10 Standards (20/10) Screen/E
Sunday 3:00 PM–3:45 PM Salon 1 (3)

TC 9.10 Research
Sunday 3:45 PM–4:30 PM Salon 1 (3)

TC 9.10 Program
Sunday 4:30 PM–5:15 PM Salon 1 (3)

TC 9.10 Lab Classification
Sunday 5:15 PM–6:00 PM Salon 1 (3)

TC 9.10 Labs Energy Efficiency
Sunday 6:00 PM–7:00 PM Salon 1 (3)

TC 9.10 Design Guide (10/10) Screen/E
Tuesday 1:00 PM–2:30 PM Montrose 3 (7)

TC 9.10 Handbook
Tuesday 2:30 PM–3:30 PM Montrose 3 (7)

TC 9.11 Clean Spaces (30/45)
Monday 2:15 PM–4:00 PM State Ballroom (4)
Seminar 12: Emerging Technologies in Real-time Particle-Microbial Sensing and Demand Flow Control for Cleanrooms, Seminar 47: How Do Cleanrooms Fit Into Today's Modern Energy Codes?

TC 9.11 Cleanroom Energy Efficiency (10/10)
Monday 4:00 PM–5:00 PM State Ballroom (4)

TC 9.11 Handbook
Monday 5:00 PM–5:30 PM State Ballroom (4)

TC 9.11 Design Guide
Monday 5:30 PM–6:00 PM State Ballroom (4)

TC 9.12 Tall Buildings (12/8)
Tuesday 3:30 PM–6:00 PM Clark 2 (7)
Seminar 11: ASHRAE Design Guide for Tall, Mega Tall and Super Tall Building Systems

TC 9.12 RP 1673 Screen
Tuesday 2:00 PM–3:30 PM Clark 2 (7)

TC 10.1 Custom Engineered Refrig Systems (25/10)
Monday 2:15 PM–4:15 PM Wilson (3)

TC 10.1 Cryogenic Refrigerants (5/5)
Sunday 3:00 PM–5:00 PM Burnham 2 (7)

TC 10.1 Research, Program, Handbook (25/10)
Sunday 5:00 PM–7:00 PM Burnham 2 (7)

TC 10.2 Automatic Ice Making Plants/Skating Rinks (12/3)
Monday 4:30 PM–6:30 PM Salon 10 (3)
Seminar 63: Energy Reducing Design Developments for Ice Arenas

TC 10.2 Research/Handbook (3/2)
Monday 8:00 AM–10:00 AM Harvard (3)

TC 10.3 Refrigerant Piping, Controls and Accessories (20/10)
Tuesday 1:00 PM–3:30 PM Clark 3 (7)

TC 10.5 Refrigeration Distrib and Storage Facilities (15/10)
Tuesday 3:30 PM–6:00 PM Medinah (6)
Seminar 22: Refrigeration for Craft Brewing

TC 10.6 Transport Refrigeration (8/10)
Monday 4:45 PM–7:00 PM Wrigley (6)

TC 10.6 Handbook
Monday 2:15 PM–3:00 PM Wrigley (6)

TC 10.7 Commercial Food and Beverage Refrigeration Equipment (25/25)
Monday 2:15 PM–4:15 PM Salon 2 (3)
Forum 5: Supermarket Hot Gas Defrost Piping Guidelines for Best Performance, Reliability and Leak Reduction

TC 10.7 Program (15/15)
Sunday 5:15 PM–6:00 PM Burnham 4 (7)

TC 10.7 Research
Sunday 6:00 PM–6:45 PM Burnham 4 (7)

TC 10.7 Handbook
Sunday 6:45 PM–7:30 PM Burnham 4 (7)

TC 10.8 Refrigeration Load Calculations (10/10)
Sunday 3:00 PM–5:00 PM Clark 9 (7)
Workshop 1: I Scream, You Scream, We All Scream for Refrigeration Basics of Ice Cream

Task Groups (TG), Technical Resource Groups (TRG), and Multidisciplinary Task Groups (MTG)

TG1.Optimization (10/5)
Sunday 1:00 PM–3:00 PM LaSalle 3 (7)
Seminar 6: Online Optimal Scheduling for Demand Response under Real Time Price

TG2.HVAC Security (20/6)
Tuesday 9:00 AM–12:00 PM Dearborn 1 (7)
Seminar 53: Life Safety through HVAC Security and System Resilience

TRG4.IAQP (12/8)
Sunday 10:30 AM–12:30 PM Sandburg 4 (7)

MTG Building Information Modeling
Friday 1:00 PM–3:00 PM Clark 7 (7)

MTG Energy Targets Multidisciplinary Task Group (8/7)
Tuesday 1:00 PM–3:30 PM Montrose 1 (7)
Seminar 36: Building Energy Prediction and Measurement: Avoiding Fantasy and Heading toward Fact

MTG Low GWP Refrigerants (15/5)
Wednesday 10:00 AM–11:00 AM Clark 5 (7)

Standard Project Committee (SPC) and Standing Standard Project Commitee (SSPC)

SPC Chair Training Breakfast
Sunday 7:00 AM–9:00 AM Grand Ballroom (4)

SSPC 15 Safety Standards for Refrigeration Systems (20/5) Screen
Saturday 11:00 AM–3:00 PM Dearborn 2 (7)

SSPC 15 Safety Standards for Refrigeration Systems (20/5) Screen
Sunday 8:00 AM–12:00 PM Indiana (3)

SSPC 15 Safety Standards for Refrigeration Systems (15/30) Screen
Sunday 1:00 PM–5:00 PM Salon 12 (3)

SPC 16/58 MOT/Rating Room Air Conditioners and PTAC/PTHP (6/6) Screen
Tuesday 8:00 AM–12:00 PM Sandburg 8 (7)

SPC 17 MOT/Capacity of TEV's (5/5)
Sunday 5:00 PM–7:00 PM Indiana (3)

SPC 20 MOT/Rating Remote Mechanical-Draft Air-Cooled Referigerant Condensers (6/4) Screen
Sunday 12:00 PM–2:00 PM LaSalle 5 (7)

SPC 23.1 MOT/for Performance Rating Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant (10/8) Screen/E
Monday 2:15 PM–4:15 PM LaSalle 4 (7)

SPC 25 MOT/Forced Convection and Natural Convection Air Coolers for Refrigeration (6/2)
Monday 8:00 PM–10:00 PM Montrose 6 (7)

SPC 26 Mechanical Refrigeration & Air-Conditioning Installation Aboard Ship (8/4) Screen/E
Monday 2:15 PM–6:15 PM Montrose 6 (7)

SPC 29 MOT/Automatic Ice Makers (10/4)
Monday 4:15 PM–7:15 PM Clark 2 (7)

SPC 30 MOT Liquid Chilling Packages(7/10) Screen
Monday 8:00 AM–11:00 AM Montrose 3 (7)

SPC 32.1 MOT for Rating Vending Machines for Sealed Beverages (15/5)
Sunday 10:30 AM–1:00 PM Wrigley (6)

SPC 32.2 MOT for Rating Pre-Mix and Post-Mix Beverage Dispensing Equipment (6/4)
Tuesday 8:30 AM–10:30 AM Sandburg 6 (7)

SPC 33 MOT/ Forced Circulation Air Cooling and Air Heating Coils (6/3)
Tuesday 8:00 AM–12:00 PM Madison (3)

SSPC 34 Designation & Safety Class. of Refrig.(20/25) Screen/E
Monday 6:30 PM–10:00 PM Clark 5 (7)

SSPC 34 Designation Nomenclature (10/10) Screen/E
Saturday 7:00 AM–9:30 AM Grant Park (6)

SSPC 34 Flammability (15/20) Screen/E
Saturday 9:30 AM–12:30 PM Grant Park (6)

SSPC 34 Toxicity (10/20) Screen/E
Sunday 6:30 PM–10:00 PM Wilson (3)

SPC 37 MOT for Rating Electrically Driven Unitary Air-Conditioners and Heat Pump Equipment (7/12) Screen/E
Wednesday 8:00 AM–10:00 AM Medinah (6)

SSPC 41 Standard Methods for Measurement (15/10)
Sunday 1:00 PM–4:00 PM Montrose 3 (7)

SSPC 41.2 Laboratory Airflow-Standard Method for Laboratory Airflow Measurement (10/5) Screen
Monday 8:00 AM–12:00 PM LaSalle 4 (7)

SSPC 41.8 Standard Methods for Liquid Flow Measurement (10/5) Screen
Tuesday 8:00 AM–12:00 PM Montrose 6 (7)

SSPC 41.9 Standard Methods for Volatile-Refrigerant Mass Flow Measurement Using Calorimeters (10/5) Screen
Sunday 10:00 AM–12:00 PM Montrose 3 (7)

SPC 51 Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating (15/10)
Sunday 12:30 PM–3:00 PM Buckingham (5)

SSPC 52.2 MOT/Part Size Eff. Proc. for Testing Air Cleaning Devices (18/30) Screen/E
Saturday 8:00 AM–12:00 PM Salons 5/8 (3)

SSPC 55 Thermal Env. Cond. for Human Occupancy (23/6) Screen
Sunday 9:00 AM–12:00 PM Clark 7 (7)

SSPC 62.1 Ventilation for Acceptable Indoor Air Quality (30/30) Screen/E
Saturday 9:00 AM–3:00 PM Adams (6)

SSPC 62.1 Ventilation for Acceptable Indoor Air Quality
Sunday 1:00 PM–7:00 PM Wabash (3)

SSPC 62.1 Administration Subcommittee (15/15) Screen
Friday 1:00 PM–5:00 PM Montrose 5 (7)

SSPC 62.1 Education Subcommittee (15/15) Screen
Friday 1:00 PM–5:00 PM Montrose 4 (7)

SSPC 62.2 Ventilation and Acceptable IAQ in Low-Rise Residential Buildings (28/13) Screen/E
Friday 1:00 PM–5:00 PM Grant Park (6)

SSPC 62.2 Ventilation and Acceptable IAQ in Low-Rise Residential Buildings (28/13) Screen/E
Saturday 12:00 PM–3:00 PM Hancock (6)

SSPC 62.2 Technical Ad Hoc (12/20) Screen
Friday 9:00 AM–12:00 PM Grant Park (6)

SSPC 62.2 Envelope Subcommittee -20
Saturday 8:30 AM–11:00 AM Medinah (6)

SSPC 62.2 IAQ Subcommittee
Saturday 8:30 AM–11:00 AM Hancock (6)

SSPC 62.2 System Subcommittee -12
Saturday 8:30 AM–11:00 AM Wrigley (6)

SPC 63.1 MOT/Liquid-Line Refrigerant Driers (5/5)
Sunday 6:00 PM–10:00 PM Montrose 5 (7)

SPC 63.2 MOT/Filtration Capacity of Liquid Line Filter Driers (6/6)
Sunday 3:00 PM–4:00 PM Sandburg 3 (7)

SPC 70 MOT/for Rating the Performance of Air Outlets and Air Inlets (9/6)
Sunday 5:00 PM–8:00 PM Wrigley (6)

SPC 72 MOT/Commercial Refrigerators and Freezers (14/14)
Sunday 1:00 PM–5:00 PM Marshfield (3)

SPC 78 MOT/Flow Capacity of Sunction Line Filters and Filter Driers (8/3)
Sunday 2:00 PM–3:00 PM Sandburg 3 (7)

SPC 79 Room Fan Coil Standard Committee (6/12) Screen
Saturday 8:00 AM–12:00 PM Clark 2 (7)

SSPC 90.1 Energy Eff. Design of New Bldg. (50/60) Screen/E
Saturday 8:00 AM–12:00 PM Wabash (3)

SSPC 90.1 Energy Eff. Design of New Bldg. (50/60) Screen/E
Sunday 9:00 AM–12:00 PM Wabash (3)

SSPC 90.1 Energy Eff. Design of New Bldg. (50/60) Screen/E
Monday 8:00 AM–12:00 PM Wabash (3)

SSPC 90.1 Format & Compliance Subcommittee (4/6) E
Friday 5:00 PM–10:00 PM Montrose 6 (7)

SSPC 90.1 Format & Compliance Subcommittee
Saturday 1:00 PM–5:00 PM Montrose 3 (7)

SSPC 90.1 Format & Compliance Subcommittee
Sunday 4:00 PM–7:00 PM Clark 2 (7)

SSPC 90.1 Mechanical Subcommittee (25/25) Screen/E
Friday 9:00 AM–10:00 PM Salons 6/7 (3)

SSPC 90.1 Mechanical Subcommittee
Saturday 1:00 PM–7:00 PM Wabash (3)

SSPC 90.1 Mechanical Subcommittee
Sunday 1:00 PM–8:00 PM Clark 5 (7)

SSPC 90.1 Lighting Subcommittee (12/10) Screen/E
Friday 9:00 AM–10:00 PM LaSalle 1 (7)

SSPC 90.1 Lighting Subcommittee
Saturday 1:00 PM–7:00 PM Madison (3)

SSPC 90.1 Lighting Subcommittee
Sunday 1:00 PM–8:00 PM Dearborn 2 (7)

SSPC 90.1 ECB Subcommittee (8/10) Screen/E
Friday 5:00 PM–10:00 PM Montrose 1 (7)

SSPC 90.1 ECB Subcommittee
Saturday 1:00 PM–5:00 PM Clark 2 (7)

SSPC 90.1 ECB Subcommittee
Sunday 1:00 PM–4:00 PM Clark 2 (7)

SSPC 90.1 Envelope Subcommittee (15/30) Screen/E
Friday 9:00 AM–10:00 PM Salon 12 (3)

SSPC 90.1 Envelope Subcommittee
Saturday 1:00 PM–7:00 PM Wilson (3)

SSPC 90.1 Envelope Subcommittee
Sunday 1:00 PM–8:00 PM Salons 5/8 (3)

SSPC 90.2 Energy Eff. Design of New Low Rise Res. Bldg. (29/20) Screen/E
Monday 2:15 PM–6:15 PM Salons 6/7 (3)

SSPC 90.2 Energy Eff. Design of New Low Rise Res. Bldg. (29/20)
Tuesday 1:00 PM–5:00 PM Salons 5/8 (3)

SSPC 90.2 Envelope (11/15) Screen/E
Monday 6:15 PM–9:15 PM Salons 6/7 (3)

SSPC 90.2 Envelope (11/15)
Tuesday 8:00 AM–12:00 PM Salons 5/8 (3)

SSPC 90.2 Lighting (4/4) Screen/E
Monday 6:15 PM–9:15 PM Montrose 2 (7)

SSPC 90.2 Lighting (4/4) Screen/E
Tuesday 8:00 AM–12:00 PM Sandburg 4 (7)

SSPC 90.2 Mechanical (6/6) Screen/E
Monday 6:15 PM–9:15 PM Montrose 1 (7)

SSPC 90.2 Mechanical (6/6) Screen/E
Tuesday 8:00 AM–12:00 PM Sandburg 3

SPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings (25/20) Screen/E
Saturday 9:00 AM–1:00 PM Salon 12 (3)

SPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings Screen/E
Monday 7:00 AM–11:00 AM Salons 5/8 (3)

SPC 94.2 MOT/Thermal Storage Devices with Electrical Input and Thermal Output based on Thermal Performance (6/4)
Sunday 3:30 PM–5:00 PM Montrose 2 (7)

SPC 97 Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use Within Refrigerant Systems (8/6) Screen/E
Tuesday 9:30 AM–11:00 AM Medinah (6)

SPC 99 Refrigerant Oil Description (5/2) Screen /E
Tuesday 9:00 AM–9:30 AM Medinah (6)

SPC 100 Energy Efficiency in Existing Buildings (17/20) Screen
Tuesday 8:00 AM–12:00 PM Salon 12 (3)

SPC 13/MOT Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers (12/10) Screen/E
Sunday 6:00 PM–10:00 PM Montrose 3 (7)

SPC 110 MOT/Performance of Laboratory Fume Hoods (12/5)
Tuesday 8:00 AM–12:00 PM Dearborn 3 (7)

SPC 111 Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation and Air-Conditioning Systems (12) (6/4) Screen/E
Friday 8:00 AM–12:00 PM Montrose 1 (7)

SPC 116 MOT/for Rating Seasonal Efficiency of Unitary Air-Conditioners and Heat Pumps (7/12) Screen/E
Wednesday 10:00 AM–12:00 PM Medinah (6)

SPC 118.1 MOT/Commercial Water Heaters (14/6) Screen/E
Sunday 9:00 AM–11:00 AM Montrose 4 (7)

SPC 118.2R MOT/Rating Residential Water Heaters (18/10)
Tuesday 1:00 PM–5:00 PM Clark 5 (7)

SPC 124 MOT/Rating Combinations Space-Heating an Water Heating Appliances (13/5)
Wednesday 8:00 AM–12:00 PM Buckingham (5)

SPC 127 MOT/for Rating Computer and Data Processing Room Unitary Air Conditioners (12/4) Screen
Saturday 11:00 AM–3:00 PM Montrose 2 (7)

SPC 130 MOT/for Rating Ducted Air Terminal Units (15/5) Screen
Sunday 2:00 PM–6:00 PM LaSalle 5 (7)

SSPC 135 BACnet (5/0)
Thursday 1:00 PM–5:00 PM Marshfield (3)

SSPC 135 BACnet (20/5)
Friday 8:00 AM–5:00 PM Burnham 2 (7)

SSPC 135 BACnet (20/5)
Friday 8:00 AM–5:00 PM LaSalle 2 (7)

SSPC 135 BACnet (40/15) microphone/Screen
Saturday 8:00 AM–3:00 PM Monroe (6)

SSPC 135 BACnet (20/5) Screen
Sunday 8:00 AM–5:00 PM Grant Park (6)

SSPC 135 BACnet (20/5)
Sunday 8:00 AM–5:00 PM Hancock (6)

SSPC 135 BACnet (40/15) microphone
Monday 8:00 AM–12:00 PM Salons 6/7 (3)

SSPC 140 Standard MOT for Evaluation of Bldg. Energy Analysis Computer Program (12/10) Screen
Monday 2:15 PM–6:15 PM Clark 9 (7)

SSPC 145 Test Methods for Assessing Performance of Gas Phase Air Clean. Equip. (13/15)
Sunday 12:00 PM–3:00 PM Montrose 5 (7)

SPC 147 Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment (16/5) Screen/E+E346
Tuesday 8:00 AM–12:00 PM Montrose 5 (7)

SPC 150 MOT/Performance of Cool Storage Systems (10/3)
Sunday 5:30 PM–7:00 PM Clark 9 (7)

SPC 153 MOT/ for Mass Flow Capacity of Four-Way Refrigerant Reversing Valves (5/3) (10/5)
Sunday 5:00 PM–7:00 PM Indiana (3)

SSPC 154 Ventilation for Commercial Cooking Operations (15/10) Screen
Monday 2:15 PM–6:15 PM Montrose 4 (7)

SPC 155P MOT/Rating Commercial Space Heating Boiler Systems (12/12) Screen
Sunday 1:00 PM–5:00 PM Indiana (3)

SPC 158.1 MOT Capacity of Refrigerant Solenoid Valves (5/5)
Sunday 5:00 PM–7:00 PM Indiana (3)

SSPC 160 Criteria for Moisture Control Design Analysis (17/5) Screen/E
Tuesday 8:00 AM–12:00 PM Buckingham (5)

SPC 161P Air Quality Within Commercial Aircraft (22/8) Screen/E
Monday 7:30 AM–12:00 PM Salon 12 (7)

SPC 164.3 MOT/Commercial and Industrial Humidifiers (11/5)
Monday 10:00 AM–12:00 PM Montrose 1 (7)

SSPC 169 Climatic Data for Building Design Standards (10/5) Screen
Monday 10:00 AM–12:00 PM Indiana (3)

SSPC 170 Clinical (15/5) Screen/E
Monday 4:00 PM–6:00 PM Montrose 5 (7)

SSPC 170 Task Group for Natural Ventilation (15/5) Screen/E
Monday 2:15 PM–4:00 PM Montrose 5 (7)

SSPC 170 Ventilation of Healthcare Facilities (18/30) Screen/E
Tuesday 8:00 AM–1:00 PM Burnham 4 (7)

SPC 171 MOT/ of Seismic Restraint Devices for HVAC&R Equipment (7/5) (15/10)
Tuesday 8:00 AM–12:00 PM Clark 1 (7)

SPC 172 MOT/Insoluable Materials in Synthetic Lubricants and HFC Refrigerant Systems (9/3)
Monday 8:00 AM–12:00 PM Sandburg 5 (7)

SPC 175 Metal Pressure Vessel Testing (5/5)
Monday 4:15 PM–6:15 PM Montrose 2 (7)

SPC 177P MOT/Fractionation Measurement of Refrigerant Blends (6/8)
Monday 8:00 AM–10:00 AM Wrigley (6)

SPC 180 Standard Practice for Inspection and Maintenance of Commercial-Building HVAC Systems (15/10) Screen
Friday 2:00 PM–6:00 PM Montrose 3 (7)

SPC 184 MOT/Field Test of Liquid Package Chillers (9/5) Screen
Tuesday 8:00 AM–12:00 PM Clark 3 (7)

SPC 185 MOT/UVC Lights for Use in Air Handling Units or Air Ducts to Inactivate Airborne Microorganisms (6/6)
Monday 8:00 AM–9:00 AM Sandburg 3 (7)

SPC 188 Legionellosis: Risk Management for Building Water Systems (22/30) Screen
Tuesday 8:00 AM–12:00 PM Salons 6/7 (3)

SPC 188 Legionellosis: Risk Management for Building Water Systems (22/30)
Tuesday 3:45 PM–5:30 PM Honore (Lobby)

SPC 188 Legionellosis: Risk Management for Building Water Systems
Wednesday 8:00 AM–12:00 PM Water Tower (6)

SPC 188 Legionellosis: Risk Management for Building Water Systems
Wednesday 1:00 PM–2:30 PM Water Tower (6)

SSPC 189.1 ASHRAE/USGBC/IES Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (40/40)
Tuesday 7:30 AM–9:30 AM Wabash (3)

SSPC 189.1 ASHRAE/USGBC/IES Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (40/40) Screen/E
Wednesday 8:00 AM–12:00 PM Wabash (3)

SSPC 189.1 Working Group 10 (20/10) Screen/E
Tuesday 5:00 PM–7:00 PM Wabash (3)

SSPC 189.1 Working Group 5 (Site Sustainability)
Tuesday 12:00 PM–2:00 PM Wabash (3)

SSPC 189.1 Working Group 6 (Water Use)
Tuesday 9:30 AM–11:30 AM Wabash (3)

SSPC 189.1 Working Group 7 (Energy Efficiency)
Tuesday 9:30 AM–12:30 PM Wilson (3)

SSPC 189.1 Working Group 7.5
Tuesday 1:00 PM–4:00 PM Wilson (3)

SSPC 189.1 Working Group 8 (IEQ)
Tuesday 4:00 PM–7:00 PM Wilson (3)

SSPC 189.1 Working Group 9 (Materials and Resources)
Tuesday 2:30 PM–4:30 PM Wabash (3)

SPC 189.3 Design, Construction and Operation of High-Performance Green Healthcare Facilities (22/12) Screen/E
Monday 8:00 AM–12:00 PM Dearborn 2 (7)

SPC 189.3 Design, Construction and Operation of High-Performance Green Healthcare Facilities
Monday 2:15 PM–4:00 PM Dearborn 2 (7)

SPC 191 Water Conservation (15/10)
Monday 9:00 AM–11:00 AM Marshfield (3)

SPC 194 MOT/Direct-Expansion Ground Source Heat Pumps (6/3)
Sunday 1:00 PM–5:00 PM Dearborn 3 (7)

SPC 196P MOT/ Measuring Refrigerant Leak Rate (15/3)
Sunday 6:00 PM–10:00 PM Logan (3)

SPC 197 MOT/Attenuation Characteristics of Vibration Isolators (8/4) (10/2) Screen/E
Monday 4:30 PM–6:00 PM Sandburg 4 (7)

SPC 199 MOT/Rating the performance of Industrial Pulse Cleaned Dust Collectors (9/4) Screen
Friday 1:00 PM–5:00 PM Sandburg 5 (7)

SPC 199 MOT/Rating the performance of Industrial Pulse Cleaned Dust Collectors (9/6) Screen
Sunday 8:00 AM–12:00 PM Clark 9 (7)

SPC 200 MOT/Chilled Beams (17/5) Screen/E
Monday 8:00 AM–12:00 PM LaSalle 5 (7)

SPC 201P: Facility Smart Grid Information Model (15/15) Screen/E
Monday 2:15 PM–6:15 PM Salon 12 (3)

SPC 201P: Facility Smart Grid Information Model (15/15) Screen/E
Tuesday 8:00 AM–12:00 PM Salon 10 (3)

SPC 201P Task Groups (6/2)
Sunday 1:00 PM–5:00 PM Sandburg 2 (7)

SPC 201P Task Groups
Monday 8:00 AM–12:00 PM Sandburg 2 (7)

SPC 202 Commissioning Process for Buildings & Systems (15/20) E
Monday 8:00 AM–12:00 PM Burnham 2 (7)

SSPC 203P MOT/Determining Heat Gain of Office Equip. Used in Buildings (10/4) Screen
Saturday 11:00 AM–3:00 PM Clark 10 (7)

SPC 204P MOT/Rating Micro Combined Heat and Power Devices (14/7)
Monday 6:30 PM–8:30 PM Clark 10 (7)

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Working Group (20/5) Screen/E
Sunday 9:00 AM–12:00 PM LaSalle 2 (7)

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment (20/20) Screen/E
Tuesday 8:00 AM–11:00 AM Hancock (6)

SPC 207P Laboratory Method of Test of Fault Detection and Diagnostics Applied Commercial Air-Cooled Packaged Systems (20/20) Screen
Monday 8:00 AM–10:00 AM Grant Park (6)

SPC 207 Airflow Working Group (15/0) Screen
Monday 10:00 AM–12:00 PM Grant Park (6)

SPC 207 Economizer Working Group (10/0) Screen
Monday 4:30 PM–6:30 PM LaSalle 4 (7)

SPC 207 Refrigerant Working Group (10/0) Screen
Monday 6:30 PM–8:30 PM LaSalle 4 (7)

SPC 208 Control Valve Test (10/5)
Friday 1:00 PM–4:00 PM Montrose 2 (7)

SPC 209 Energy Simulation Aided Design (30/20) Screen
Monday 2:15 PM–6:15 PM Empire Ballroom Lobby

SPC 209 Construction/Operations Subcommittee (10/5) Screen
Sunday 6:00 PM–10:00 PM Montrose 2 (7)

SPC 209 Design Development/Construction Documents (10/5) Screen
Sunday 6:00 PM–10:00 PM Montrose 1 (7)

SPC 209 Predesign Subcommittee (10/15) Screen
Sunday 6:00 PM–10:00 PM Montrose 4 (7)

SPC 209 Conceptual design/Schematic design (10/5) Screen
Monday 8:00 AM–12:00 PM Montrose 5 (7)

SPC 209 Resources Subcommittee (10/5) Screen
Monday 8:00 AM–12:00 PM Montrose 6 (7)

SPC 210 MOT/for Rating Commercial Walk-in Refrigerators and Freezers (5/35) Screen
Monday 8:00 AM–12:00 PM Hancock (6)

SPC 211 Commerical Building Energy Audits (22/15) Screen/E
Monday 8:00 AM–12:00 PM Wilson (3)

SPC 212 MOT/for Determining Energy Performance and Water-Use Efficiency of Add-On Evaporative Pre-Coolers for Unitary Air Conditiong Equipment (7/5) Screen
Tuesday 8:00 AM–12:00 PM Montrose 1 (7)

SPC 213P Method of Calculating Moist Air Thermodynamics (6/4)
Tuesday 8:00 AM–10:00 AM Sandburg 7 (7)

SPC 214 P Standard for Measuring and Expressing Building Energy Performance in a Rating Program (10/7)Screen
Monday 2:15 PM–6:15 PM Salons 4/9 (3)

SPC 215 MOT to Determine Leakage Airflows and Fractional Leakage of Operating Air-Handling Systems (15/10) Screen
Monday 2:15 PM–4:15 PM Salon 10 (3)

SPC 216 MOT for Determining Application Data of Overhead Circulator Fans (10/5) Screen/E
Monday 8:00 AM–11:00 AM Dearborn 3 (7)

SPC 217 Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities (10/10) Screen
Tuesday 10:00 AM–12:00 PM Montrose 3 (7)

GPC 1.2 Commissioning Process for Existing HVAC&R Systems (21/8) Screen
Friday 8:00 AM–3:00 PM Salons 5/8 (3)

GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process (10/2)
Tuesday 1:00 PM–5:00 PM Dearborn 3 (7)

GPC 6, Refrigerant Information Recommended (6/3) Screen
Sunday 12:00 PM–1:00 PM Kimball (3)

GPC 11 Field Testing of HVAC Controls Components (7/3) Screen/E
Saturday 9:00 AM–12:00 PM Montrose 4 (7)

GPC 14 Measuring Energy Demand and Water (8/2) Screen
Sunday 6:00 PM–10:00 PM Montrose 6 (7)

GPC 23 Guideline for the Design/Application of HVAC Equip. for Rail Passenger Vehicles (12/5) Screen
Monday 8:00 AM–12:00 PM Clark 3 (7)

GPC 27P Procedures for Measurement of Gases in Indoor Environments (7/6) Flipchart
Sunday 3:00 PM–5:00 PM Montrose 1 (7)

GPC 34P Energy Guideline for Historical Buildings and Structures (6/6)
Tuesday 7:00 A M–9:00 AM Montrose 4 (7)

GPC 35 Method for Determining the Energy Consumption Caused By Air-Cleaning and Filtration Devices (9/35) Screen/E
Monday 8:00 AM–12:00 PM Water Tower (6)

GPC 36 High Performance Sequences of Operation for HVAC Systems (12/25) Screen/E
Monday 8:00 AM–12:00 PM LaSalle 1 (7)

GPC 37 Upper Room Ultraviolet Germicidal (UV-C) Devices to Control the Transmission of Airborne Pathogens (5/6)
Monday 9:00 AM–10:00 AM Sandburg 3 (7)

SGPC 0-General Commissioning Process (10/2)
Saturday 8:00 AM–3:00 PM Montrose 6 (7)

SGPC 10 Interaction Affecting the Achievement of Acceptable Indoor Environments (16/8) Screen
Sunday 9:00 AM–12:00 PM Buckingham (5)

SGPC 13 Guideline for Specifying Direct Digital Control Systems (10/3) Screen
Saturday 8:00 AM–12:00 PM Clark 3 (7)

SGPC 20 Documenting HVAC&R Work Processes and Data Exchange Requirements (12/10) Screen
Monday 10:15 AM–12:00 PM Clark 10 (7)

US TAG to ISO/TC 142 (25/20)
Saturday 2:30 PM–3:15 PM Dearborn 1 (7)

US TAG to ISO/TC 163
Tuesday 2:30 PM–4:00 PM Clark 1 (7)

US Tag to ISO/TC 25 (15/5)
Tuesday 12:30 PM–2:00 PM Clark 1 (7)

US Tag to ISO/TC25 & US TAG to ISO/TC 163 (15/6)
Tuesday 2:00 PM–2:30 PM Clark 1 (7)

US TAG to ISO/TC 86 (20) Screen
Monday 8:00 AM–10:00 AM Madison (3)

ISO/TC86/SC8-Refrigerants and Refrigeration Lubricants (15/0) Screen
Tuesday 8:00 AM–12:00 PM Logan (3)

USNC/IIR (20/10)
Tuesday 2:00 PM–4:00 PM Salons 4/9 (3)

USNT/IEA (20/10)
Tuesday 4:00 PM–6:00 PM Salons 4/9 (3)

Thermal Performance of the Exterior Envelopes of Whole Buildings (30/0)
Monday 9:00 AM–12:00 PM Dearborn 1 (7)

ASHRAE STAFF

Accounting
Annmarie Wilhoit, Manager
Marie Ingram, Asst. Manager
Jamond Madison
Wayne Madkins
Lily Cheng

Administration
Jeff Littleton, Executive Vice President
Lois Benedict
Mary Townsend, Asst. to BOD
Claire Neme

Administrative Services
Cindy Simmons, Director
Linda Gdovin

Advertising Sales
Greg Martin, Manager
Vanessa Johnson
Jim Colton

Certification
Tim Kline, Manager
Erin Dupree

Chapter Programs
Candace Pettigrew, Manager
Jennifer Baker
Chandrias Jacobs

Communications
Jodi Scott, Manager

Conferences
Tony Giometti, Manager
Tiffany Cox
Hannah Doyle
Judy Marshall, Manager
Tracy Keller, Assistant Manager
Lizzy Seymour, Assistant Manager

Data Center
Candice Richards, Manager
Camiel Schroeter
Pacia Wright

Development
Margaret Smith, Manager

Electronic Communications and Applications
Joselyn Ratcliff, Manager
Krystin Gilstrap
Alison Loughman
Emily Sigman
Chris Walter

Fund Raising
Patricia Adelmann, Manager
Megan Hezlep
Meredith Gunter

Government Affairs – DC Office
Mark Ames, Sr. Manager
Pat Ryan
Jim Scarborough, Manager

Handbook
Mark Owen, Editor/Group Manager
Heather Kennedy, Managing Editor
Nancy Thysell

Human Resources
Sharon Priebe, Manager

Information Technology
Brian Unrein, Manager
Kristi Baer
Tom Cahill
Shawn Hall
Roxanne Jackson
Amy Lin
David Reeds
Daniel Robinson

Journal
Sarah Foster, Managing Editor
Rebecca Matyasovski
Christopher Weems
Jeri Eader
Charlotte Tubbs
Tani Palefski

Mailroom
Lamont Jackson

Member Services
Joyce Abrams, Director

Membership Development and Customer Service
Daniel Gurley, Manager
Rhiannon Masterson, Assistant Mgr Membership
Nancy Kasey, Assistant Mgr. Customer Service
Anne Cannone
Linda Allen-Meriweather
Jeanette McCray

Professional Development
Karen Murray, Manager
Marty Kraft
Kelly Arnold

Publications & Education
Steve Comstock, Publisher/Director
Julie Harr
Bryan Haynes

Publishing Services
David Soltis, Group Manager
Kimberly Gates, Inventory and Subscription Manager
Tracy Becker
Tracee Dowdell
Jayne Jackson
Emma Smith

Region Activities
Vickie Grant, Manager
Tammy Catchings

Research & Technical Services
Michael Vaughn, Manager
Steve Hammerling, Asst. Manager
Tara Thomas
Donna Daniel

Special Projects
Lilas Pratt, Manager

Special Publications
Cindy Michaels, Managing Editor
Michshell Phillips
Matt Walker
Sarah Boyle
Lauren Ramsdell

Standards
Stephanie Reiniche, Senior Manager
Steve Ferguson, Manager – Codes
Mark Weber, Manager – American Stds.
Nicole Jones, Assistant Manager International Stds.
Bert Etheredge, Assistant Manager – Codes
Beverly Fulks
Angela McFarlin
Tanisha Meyers-Lisle
Susan LeBlanc
Katrina Shingles
Carmen Manning

Student Activities
Justin Ledford, Assistant Manager

Technology
Claire Ramspeck, Director
Denise Latham

SPEAKERS LIST

A
Abdelmaksoud, Waleed, *Technical Paper Sessions 1 & 5*
Agamloh, Emmanuel, *Seminar 39*
Amemiya, Saya, *Conference Paper Session 7*
Amrane, Karim, *AHR Expo Session 1*
Atkinson, Gaylen, *Seminar 57*
Aute, Vikrant, *Conference Paper Session 11 & Seminar 51*

B
Bacellar, Daniel, *Conference Paper Session 11*
Bahnfleth, William P., *Seminars 38 & 53*
Balaras, Constantinos A., *Workshop 5*
Ball, Brian L., *Seminar 55*
Barnaby, Charles S., *Seminar 54*
Baucom, Michael, *Workshop 7*
Bayer, Charlene, *Seminar 40*
Bean, Robert, *Seminar 54*
Beaty, Don, *Workshop 2*
Behls, Herman, *Technical Paper Session 3*
Betz, Fred J., *Seminars 21 & 50*
Bigi, Andrea A. M., *Conference Paper Session 2*
Bilderbeck, Mike, *Seminar 37*
Black, William, *Technical Paper Session 5*
Blum, David H., *Seminar 6*
Boldt, Jeff, *Seminar 25*
Brandemuehl, Michael, *Workshop 4*
Braun, James, *Technical Paper Session 12*
Brendel, Michael, *Seminar 2*
Brown, J. Steven, *Seminar 44*
Bruce, Jeffrey, *Seminar 21*
Bucking, Scott, *Technical Paper Session 12*
Burpee, Heather, *Seminar 24*
Burton, Craig, *Seminar 46*
Bush, John, *Conference Paper Session 12*

C
Carpenter, J. Patrick, *Workshop 8*
Case, Michael, *Technical Paper Session 4*
Castillo, David C., *Conference Paper Session 5*
Cermak, John, *Seminar 2*
Chen, Chun, *Seminar 43*
Coogan, James, *Conference Paper Session 4*
Cook, Malcolm J., *Seminar 8*
Corgnati, Stefano Paolo, *Seminar 10*
Cox, Robert, *Seminar 62*
Crawley, Drury, *Seminar 45*
Cull, Ian D., *Seminar 32*
Culp, Charles, *Seminar 56*

D
Dai, Yunchuang, *Technical Paper Session 10*
Dames, Richard, *Seminar 16*
Davies, Hywel, *Seminar 36*
Davis, Bob, *Seminar 13*
Davy, Matthew, *Seminar 35*
Dean, Bill, *Seminar 59*
Demitriou, Dustin, *Seminar 23*
Deodhar, Anirudh, *Conference Paper Session 3 & Technical Paper Session 11*
Dettmers, Daniel J., *Seminar 22 & Workshop 1*
Domitrovic, Ronald, *Seminar 13*
Dong, Bing, *Seminar 9*
Doyle, Dan, *Seminar 62*
Duda, Stephen W., *Conference Paper Session 4*
Duffy, Ted, *AHR Expo Session 1*

E
Earhart, Timothy M., *Seminar 49*
Ekrami, Navid, *Technical Paper Session 12*
Elarga, Hagar, *Conference Paper Session 10*
English, Travis R., *Conference Paper Session 5*

F
Fauber, Jeremy, *Seminar 62*
Faulkner, Steven, *Workshop 6*
Fick, Doug, *Seminar 50*
Fields, James, *Seminar 16*
Fink, Jim, *Technical Paper Session 11*
Fiorentini, Massimo, *Conference Paper Session 8*
Fitch, Jon T., *Seminar 42*
Fok, Stephen, *Seminar 47*
Foley, Gearoid, *Seminar 26*
Fordemwalt, John, *Seminar 57*
Francisco, Paul W., *Workshop 5*
Franseen, Richard, *Conference Paper Session 7*
Freeden, Craig, *Seminar 59*
Furuhashi, Yuma, *Seminar 27*
Fuson, Paul, *Seminar 4*

G
Gallagher, Matt, *Seminar 22*
Ganta, Ravisankar, *Seminar 60*
Gao, Xu, *Technical Paper Session 2*
Gehlin, Signhild E. A., *Conference Paper Session 6*
Gevelber, Michael, *Conference Paper Session 10*
Ghia, Urmila, *Conference Paper Session 5*
Glanville, Paul, *Conference Paper Session 12*
Gould, Sharon, *Conference Paper Session 7*
Graef, Patricia, *Seminar 52*
Groll, Eckhard, *Seminar 51*
Grosse-Kracht, Rainer, *Seminar 39*
Grossman, Gershon, *Seminar 1*
Gupta, Vinod P. (V. P.), *Seminar 60*

H
Hackel, Scott P., *Seminar 18*
Hadjisophocleous, George, *Seminar 35*
Hammack, Katherine, *Workshop 2*
Han, KwangHoon, *Seminar 34*
Hanegan, Traci, *Seminar 49, Forum 1*
Harriman, Lew, *Seminar 56*
Hasan, Ali, *Technical Paper Sessions 3 & 10*
Havenith, George, *Technical Paper Session 5*
Havermans, John B., *Technical Paper Session 5*
Hayne, Heather, *Seminar 59*
Hayter, Richard B., *Forum 4*

Helt, Robert, *Workshop 6*
Hinge, Adam, *Seminar 36*
Holland, Michael, *Seminar 3*
Holloway, Seth O., *Technical Paper Session 12*
Hong, Tianzhen, *Seminar 9*
Horner, Mark, *Seminar 47*
Howe, Thomas, *Seminar 23*
Hunt, Walter E., *Conference Paper Session 6*

J
Jakobs, Rainer M., *Seminar 48*
Jalayerian, Mehdi, *Seminar 46*
Jeon, Bonggil, *Technical Paper Session 12*
Johnson, Dr. David L., *Seminar 49*
Jones, Dennis, *Conference Paper Session 10*
Junge, Brent, *Seminar 14*

K
Kabele, Karel, *Seminar 10*
Kakegawa, Toshimasa, *Seminar 17*
Kasahara, Makiko, *Seminar 19*
Kashef, Ahmed, *Seminar 35*
Kaskhedikar, Apoorva, *Technical Paper Session 1*
Keen, Julia, *Seminar 25*
Khankari, Kishor, *Conference Paper Session 5*
Kim, Donghun, *Conference Paper Session 1*
Kim, Hyojin, *Conference Paper Session 4*
Kim, Yang-Seon, *Technical Paper Session 8*
Kinsella, Peter, *Seminar 36 & Workshop 2*
Kitamura, Toshihiro, *Seminar 19*
Klein, Raymond C., *Seminar 15*
Klote, John H., *Seminar 11*
Koenigshofer, Dan, *Seminar 24*
Kohata, Yuji, *Technical Paper Session 11*
Konstantzos, Iason, *Conference Paper Session 13*
Krepcik, Harlan, *AHR Expo Session 1*
Kujak, Steve, *Conference Paper Session 2 & Seminar 48*
Kulkarni, Devendra, *Technical Paper Session 1*
Kwatra, Sameer, *Conference Paper Session 9*

L
Lam, Khee Poh, *Seminar 9*
Landsberg, Dennis R., *Workshop 8*
Lanning, Tighe, *Technical Paper Session 5*
Lawrence, T. M., *Forum 3*
Leach, Jennifer E., *Seminar 37*
Lee, Sang Hoon, *Conference Paper Session 1*
Leidel, James A., *Conference Paper Session 8*
Leung, Luke, *Seminars 11 & 46*
Li, Yuan, *Seminar 15*
Liesen, Richard J., *Technical Paper Session 4*
Lin, Cheng-Xian, *Seminar 33*
Lohse, Rüdiger, *Technical Paper Session 7*
Lomonaco, Carol, *Seminar 53*
Lull, William, *Seminar 34*
Lutz, J.D., *Conference Paper Session 12*

M
Ma, Yin, *Technical Paper Session 3*
Macauley, Dunstan, *Seminar 5*
Mack, Rupert, *Seminar 12*
Masuda, Hiroko, *Technical Paper Session 8*
Mathers, Alex, *Seminar 7*
Mathis, R. Christopher, *Seminar 20*
Mathison, Margaret M., *Seminar 51*
Mathur, Ashish, *Seminar 38*
McConnell, Phil, *Seminar 22*
McFadden, Gaelen P., *Conference Paper Session 8*
McQuade, William F., *Seminar 30*
Miller, Shelly L., *Seminar 38*
Miller, Alexi, *Technical Paper Session 9*
Minor, Barbara, *Seminar 14*
Miyasaka, Koji, *Seminar 12*
Modera, Mark, *Seminar 43*
Moffitt, Ronnie, *Seminar 41*
Montgomery, Ross, *Workshop 4*
Moon, Honjun, *Seminar 44*
Mu, Baojie, *Conference Paper Session 4*
Muehleisen, Ralph T., *Seminars 55 & 58*
Mukhopadhyay, Jaya, *Technical Paper Session 6*

N
Nagpal, Shreshth, *Conference Paper Session 13*
Naughton, Philip, *Seminar 47*
New, Joshua, *Seminar 55*
Newkirk, Daniel W., *Technical Paper Session 3*
Newman, David G., *Seminar 15*
Nishimura, Hideo, *Seminar 19*
Niswander, Alex, *Seminar 6*
Numata, Kazukiyo, *Seminar 17*

O
Owen, M. Kathleen, *Seminar 34*

P
Packer, Justin, *Seminar 59*
Papas, Paul, *Seminar 48*
Pastrana, Christian, *Conference Paper Session 3*
Pate, Michael, *Seminar 14*
Patel, Piyush V., *Seminar 1*
Patenaude, Ray, *Workshop 4*
Patterson, Michael K., *Seminar 23 & 42*
Peterson, Clint, *Seminar 47*
Phillips, Duncan, *Seminar 11*
Pieper, Paul, *Seminar 41*
Proctor, John P., *Seminar 13*

R
Rakheja, Ashish, *Forum 2*
Ram, Nirmal, *Seminar 31*
Reindl, Douglas, *Workshop 1*
Renner, Matthew F, *Conference Paper Session 3*
Ritter, Matthew, *Seminar 30*
Robbins, Jason, *Seminar 18*

Roberts, Carl, *Forum 5*
Rodgers, Brian, *Seminar 48*
Rodier, Benoit, *Seminar 63*
Rooley, Richard, *Seminar 16 & Workshop 2*
Rosen, Steven, *Seminar 45*

S
Sachs, Harvey, *AHR Expo Session 1*
Sadeghi, Seyed Amir, *Conference Paper Session 13*
Schaefer, Kristin, *Seminar 37*
Schaefer, Laura A., *Seminar 58*
Scoggins, M. Ginger, *Workshop 2*
Scott, John, *Seminar 63*
Seidl, Reinhard, *Seminar 4*
Seyffer, Charles, *Seminar 40*
Seymour, Mark, *Conference Paper Session 3*
Shen, Huanan, *Conference Paper Session 1*
Sherman, Max, *Seminar 20*
Sherman, Bob, *Seminar 50*
Sherren, Richard, *Seminar 53*
Shioya, Masaki, *Technical Paper Session 4*
Shonder, John A., *Technical Paper Session 9*
Sielcken, Jason, *Conference Paper Session 9*
Sigloch, Uwe, *Seminar 39*
Silva, Manuel Gameiro da, *Seminar 10*
Simmonds, Peter, *Seminars 46 & 54*
Simmons, Joe, *Seminar 45*
Sjoding, David, *Seminar 61*
Skelton, Ben, *Seminar 18*
Sloan, Jeff, *Seminar 29*
Sorell, Vali, *Seminar 29*
Sorenson, Elyse, *Conference Paper Session 2*
Sovak, Steve, *Seminar 18*
Spence, Reid Alan, *Seminar 52*
Spielvogel, Larry, *Seminar 16 & Workshop 2*
Spyrou, Maria S, *Conference Paper Session 1*
Stanke, Dennis, *Seminar 40*
Stanley, W. Brad M., *Seminar 34*
Stein, Jeff, *Seminar 7*
Stevens, Mark, *Seminar 28*
Storey, Ian, *Seminar 63*
Strasser, Helmut, *Technical Paper Session 4*
Strauss, William, *Seminar 61*
Sun, Wei, *Seminar 12*
Sweetser, Richard, *Seminar 26*

T
Takada, Osamu, *Seminar 27*
Takebe, Tomohisa, *Seminar 17*
Talebzadeh, Atieh, *Technical Paper Session 2*
Thomsen, David, *Seminar 24*
Thomsen, Kirsten E., *Technical Paper Session 7*
Topper, Robert, *Technical Paper Session 2*
Tosh, Megan M., *Forums 3 & 4*
Tozer, Robert, *Technical Paper Sessions 6 & 11*

U
Ullah, Tania, *Conference Paper Session 12*
Underwood, David M., *Conference Paper Session 10*
Upshaw, Charles R., *Conference Paper Session 6*
Uselton, Dutch, *Seminar 48*

V
Vadnal, Hillary, *Conference Paper Session 12*
VanGilder, James, *Technical Paper Session 11*
Veeck, Alan, *Seminar 5*
Vincent, Richard L., *Seminar 38*
Voigt, Andrea, *Seminar 30*
Vowles, Mira, *Seminar 13*

W
Wagner, Andreas, *Seminar 9*
Wang, Gang, *Technical Paper Session 3*
Watson, Thomas E., *Forum 2*
Weekes, Don, *Seminar 32*
Weimar, Dan, *Seminar 52*
Wellford, Bede W., *Seminar 61*
Werling, Eric D., *Seminar 56*
Weston, Theresa A., *Seminar 20*
Wheeler, Mark, *Technical Paper Session 7*
Williams, Scott, *Seminar 40*
Wright, John, *Conference Paper Session 13*

Y
Yashar, David, *Seminar 44*
Yatim, Ardiyansyah S., *Seminar 33*
Yocca, David J., *Seminar 21*
Youssef, Ayman, *Conference Paper Session 9*
Yuki, Ryosuke, *Seminar 17*

Z
Zhai, John, *Seminar 8*
Zhao, Kang, *Conference Paper Session 7*
Zhivov, Alexander, *Technical Paper Session 4*
Zhong, Yongfang, *Conference Paper Session 11*
Zhou, John, *Technical Paper Session 8*