

# Your Guide to the ASHRAE Winter Conference

January 26–30, 2013

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## ASHRAE EVENTS APP

Find 2013 Winter Conference sessions by name, location, speaker or description; access education courses and social events with the touch of a button; have maps and floorplans in hand to find your way around; add sessions to your personal schedule and create a one-touch custom agenda of events; receive instant updates on time or location changes and more through ASHRAE Announcements, all on your smartphone or tablet. This app, available in the iTunes App Store and Google Play Store, serves as a digital version of Your Guide to the ASHRAE Winter Conference and functions as a one-stop shop for all of your program-related needs. The app is made possible through support from Premium Sponsor Taco and Gold Sponsors DuPont Refrigerants, AHRI, Systemair and Munters.



Get the free mobile app at  
<http://gettag.mobi>

## PERSONAL PROGRAM—PLAN YOUR OWN MEETING SCHEDULE!

FRIDAY, JANUARY 25	SATURDAY, JANUARY 26	SUNDAY, JANUARY 27
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
	<b>6:30 pm–8:30 pm</b> <b>Welcome Party</b> Dallas Sheraton Lone Star Ballroom C1-C4	3:00 pm–7:00 pm

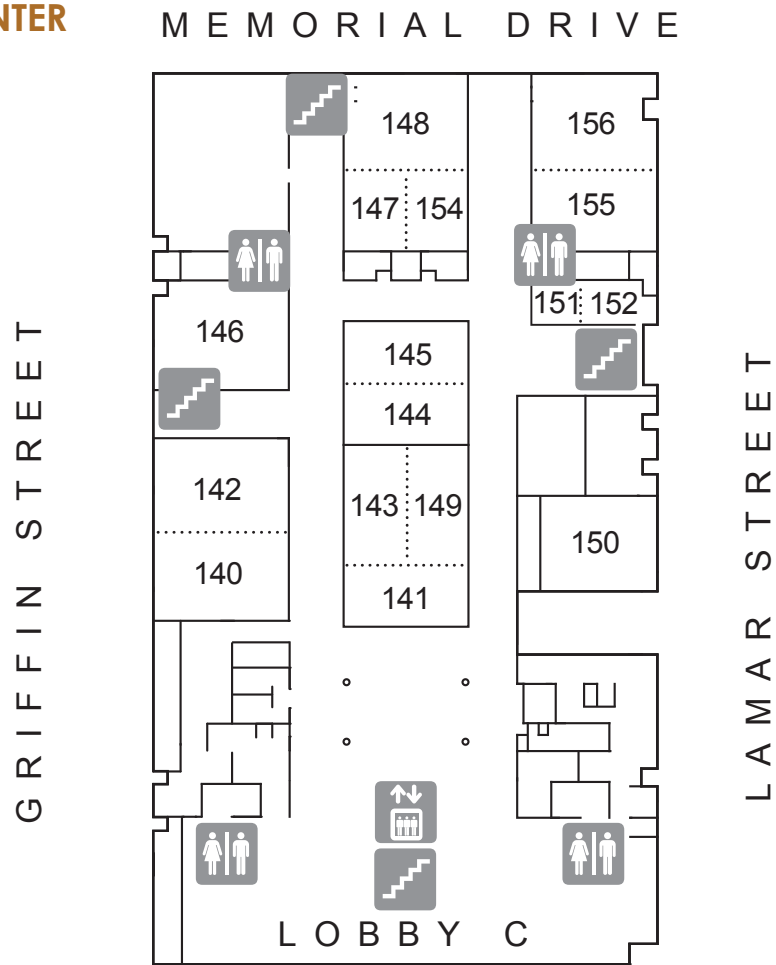
**NOTES:**

**PLAN YOUR OWN MEETING SCHEDULE!—PERSONAL PROGRAM**

<b>MONDAY, JANUARY 28</b>	<b>TUESDAY, JANUARY 29</b>	<b>WEDNESDAY, JANUARY 30</b>
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
<b>12:15 pm–2:00 pm</b> <b>President’s Lunch</b> Dallas Sheraton Lone Star Ballroom B	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	<b>6:15 pm–10:30 pm</b> <b>Members’ Night Out</b> Dallas Sheraton Lone Star Ballroom B	

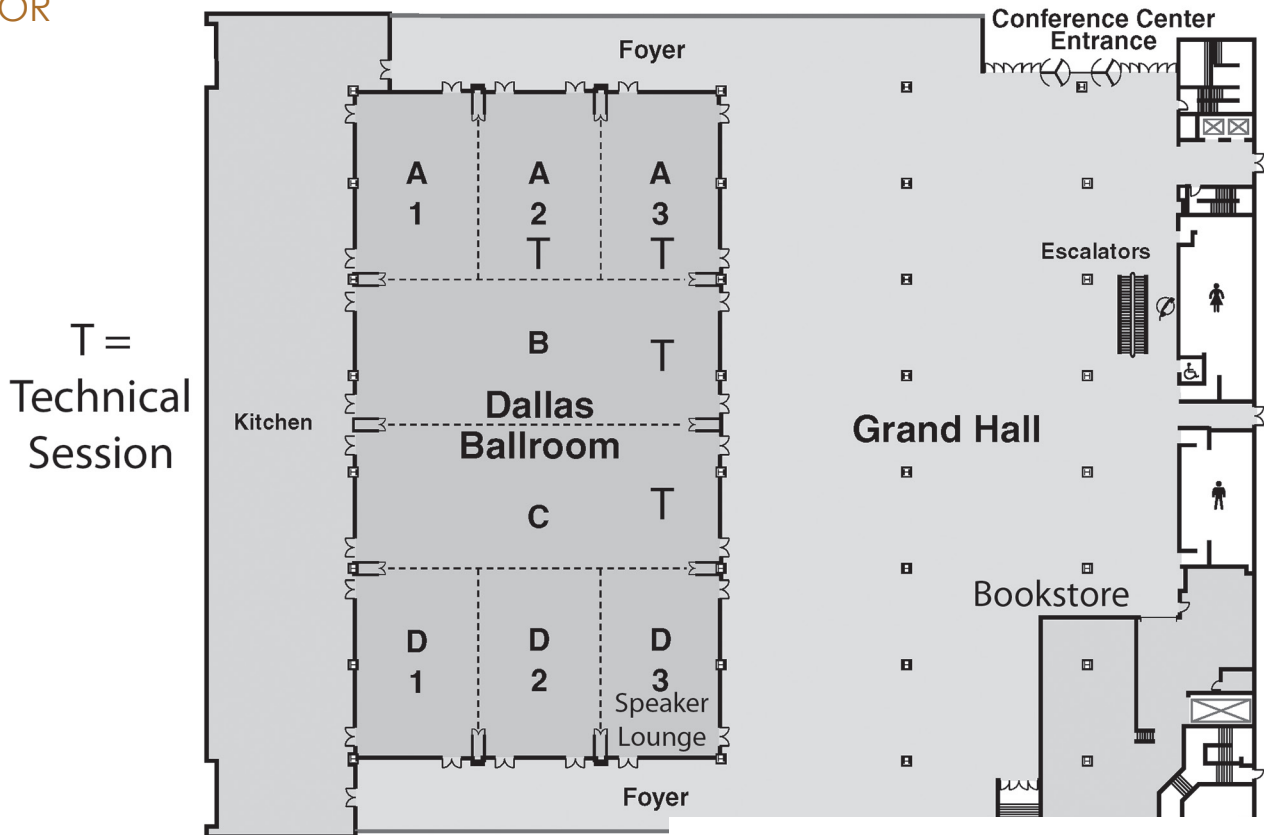
# DALLAS CONVENTION CENTER

Level 1 • C Rooms



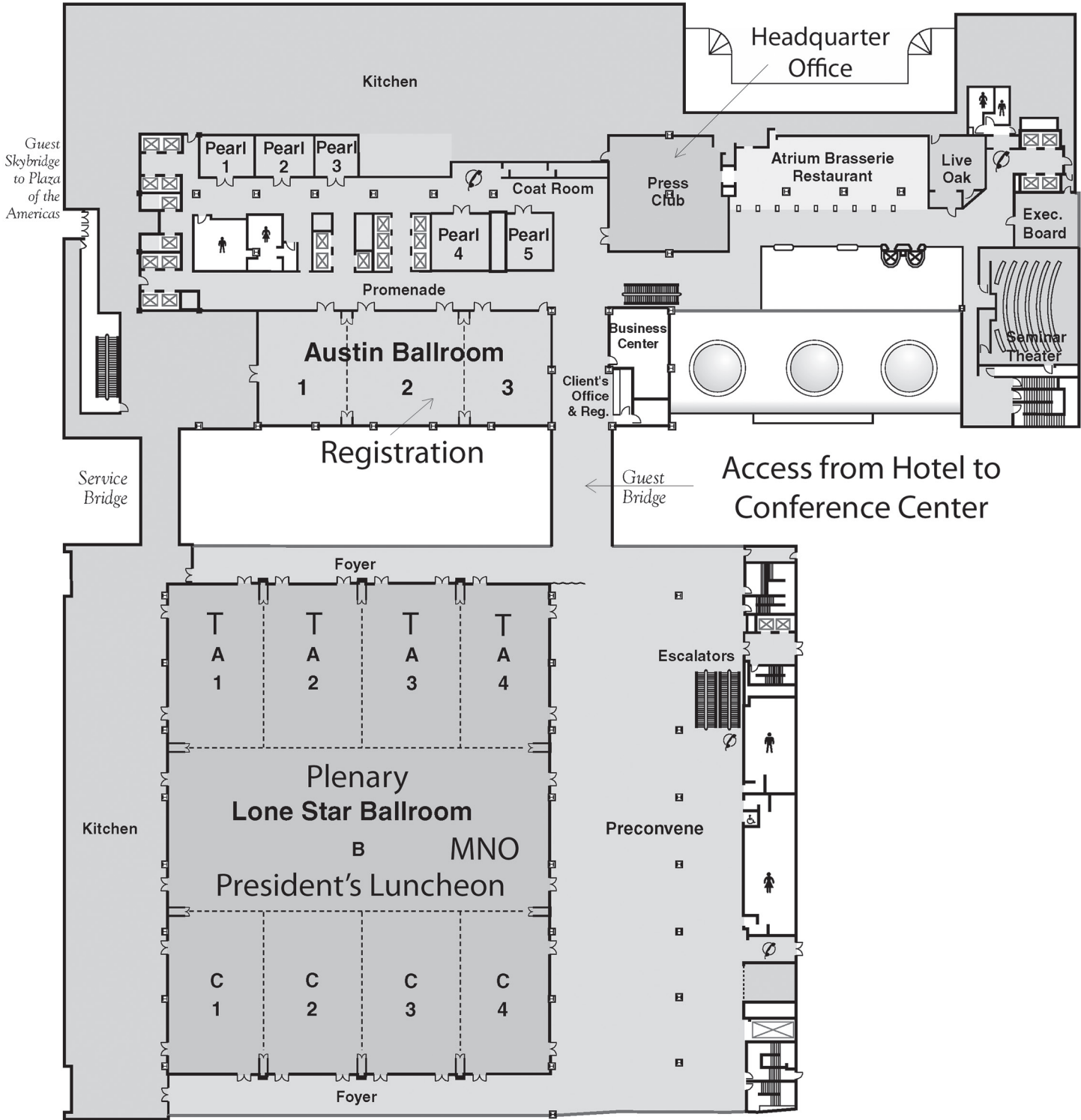
# SHERATON CONFERENCE CENTER

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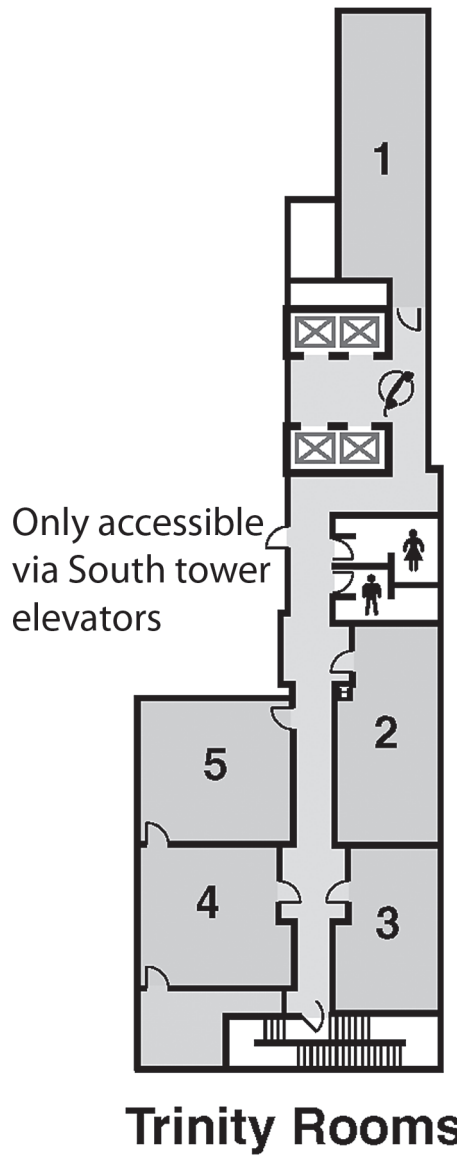
# SHERATON CONFERENCE CENTER

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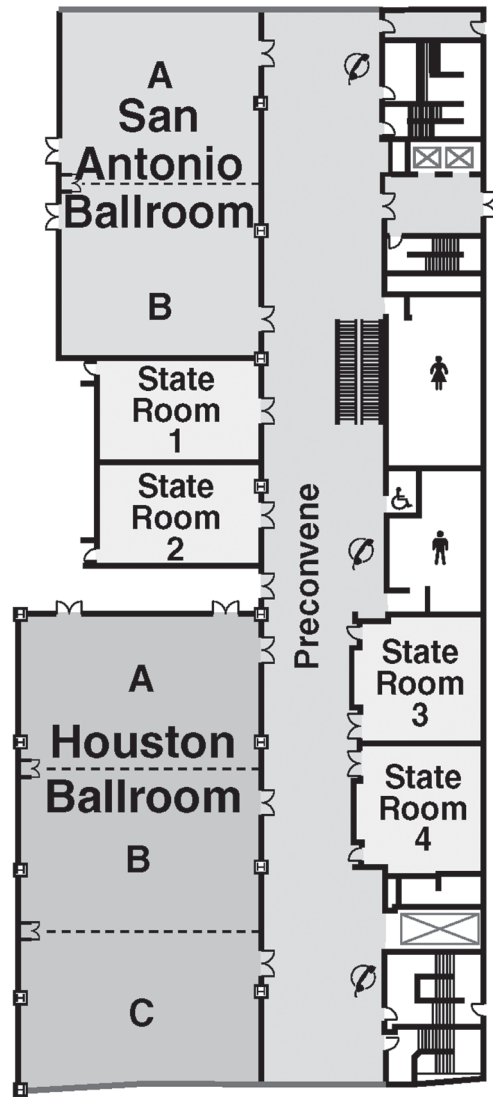


**SHERATON CONFERENCE CENTER**  
**3<sup>RD</sup> FLOOR**

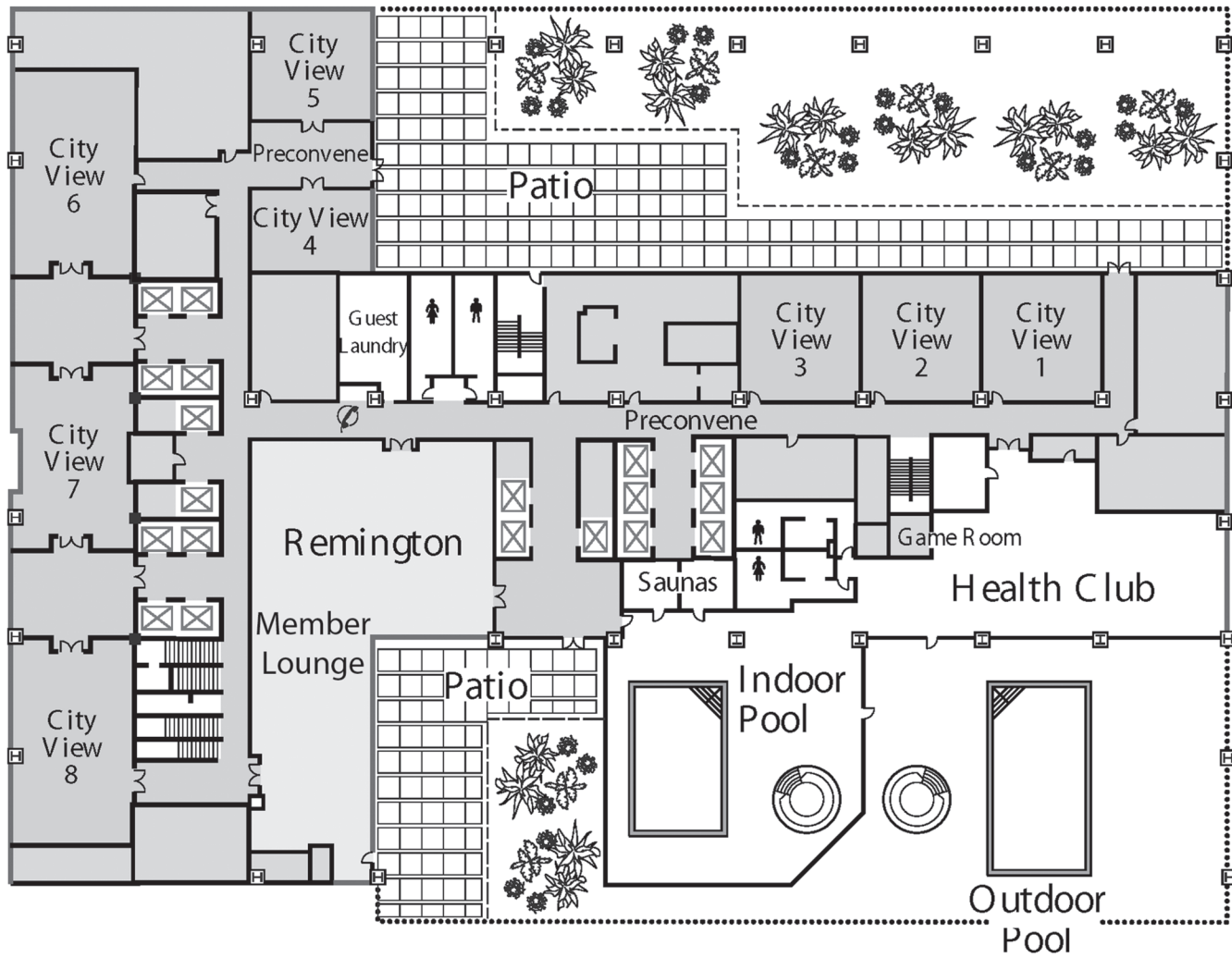
**HOTEL**



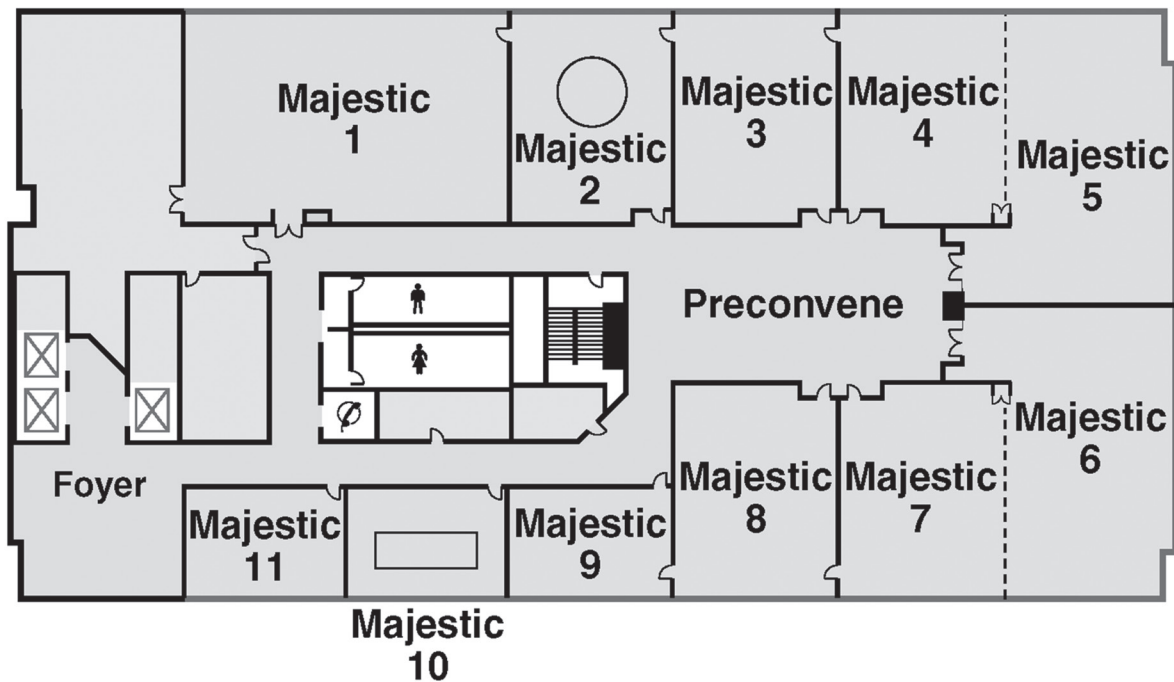
**CONFERENCE CENTER**



**SHERATON CONFERENCE CENTER**  
4<sup>TH</sup> FLOOR



**SHERATON CONFERENCE CENTER**  
37<sup>TH</sup> FLOOR





# GREEN KEY

## Eco-Rating Program

Upon completion of its 91 million dollar transformation the Sheraton Dallas will be all about GREEN leading and changing the way we think and do about our Mother Earth conservation. Some of the active initiatives include:

- Aggressive program is in place for the reduction of waste and increasing the recycling.
- Upgrading the lighting units in the Hotel guestrooms, public area and back of the house.
- Replacement of the entire laundry equipment.
- Upgrading the Energy management system.
- Installation of the latest technology in smart t-stats in guest rooms.

### Green Facts about the Sheraton Dallas

1. The Sheraton Dallas has an Environmental Committee which is led by our Six Sigma Black Belt.
2. The Sheraton Dallas monitors electric, gas, water, and waste usage information on a daily basis along with tracking recycling vs waste.
3. A hot water recirculation system has been installed as part of the property renovation reducing hot water heating demand. Interior landscape is a zero-scape project requiring no water or daily maintenance and is a zero carbon footprint
4. A Guest room digital Energy Management program and network enabled thermostats has been installed with Infra red occupancy and PMS interfaces.
5. Our "Make a Green Choice Program is averaging a 17.2% participation rate among our guests.
6. 2.5-gallons per minute showerheads have been added throughout the facility.
7. 1.6-gallon toilets are in all guestrooms.
8. Recycling bins have been added to all guest rooms and public space. In conjunction with the manufacturer we have sponsored and planted 1000 trees in Brazil through "Trees for the Future."
9. Recycling program for hazardous materials found in fluorescent bulbs, batteries, and lighting ballasts through licensed service providers is in place.
10. A New energy efficient Laundry plant has been installed, reducing water/sewer demands by 66%.
11. An overall property Star rating certification is in process.
12. All office paper products are 30% post consumer recycled content.

### Environmental Duties

#### Energy conservation

- The Sheraton Dallas has improved the lighting in the guest rooms and public areas replacing all the incandescent light bulbs for compact fluorescent lights.
- All guest rooms are equipped with the latest technology in smart t-stats include motion and infrared sensors but also are wireless interfacing with our POS and EMS computers for a remote operation. HVAC run time in guest rooms has seen a 45.3% reduction since its implementation.
- Variable frequency drives have been upgraded and added in our quarter million square feet banquet space and public area air handlers for energy savings.
- A Recirculation hot water system has been installed which enables instant, on demand hot water. This system allows for the reheating of hot water during off peak periods and reduces demand to draw off water that has cooled off in stand pipes during low demand periods.
- Upgrade of the software and probes of the EMS.
- Back of the house lighting is controlled by motion sensors to reduce lighting in non occupied areas.
- Sheraton Dallas laundry equipment is in the process of installing a tunnel washer to reduce the energy and water consumption by 70% and extending the life of the Hotel linen.
- LED lighting systems have been installed in exterior applications demanding 24 hour lighting. Reductions in energy consumption as well as bulb waste.
- During off peak demand the hotel is now set up to compress available rooms by tower reducing the footprint from three towers down to one tower and limiting available floors. All utilities are put in stand by mode during these periods.
- The kitchen table buffet is designed using the most current technology centered around induction heating. This technology reduces the demand for canned fuel and can be limited based on anticipated cover counts.
- Turbo cooking ovens have been introduced in all restaurant kitchens. Preprogrammed ovens using



both convection and high heat technology both reduces cooking time as well as energy consumption and ambient heat and ventilation requirements.

- The Majestic event space will begin using conference center table applications eliminating the requirement for table linen for all types of meeting set ups. Coffee break and dining service applications are also in place again eliminating the need for table linens and skirting décor.
- All audio/visual equipment has been replaced in 2009 with state of the art equipment with a focus on presentation technology as well as environmental savings and our carbon footprint.
- The Sheraton Dallas has introduced the use of Segway transportation within the property. Our Executive Meeting Specialists and Loss Prevention staff travel the hotel in this time saving and environmentally friendly transport.
- The Sheraton Dallas landscape plan is designed to accommodate significant savings both in the interior and exterior applications. With the exterior applications the landscape materials are all indigenous to the southwest and all watering will be addressed with the use of drip irrigation. Interior plants will be both drought resistant accented by artistic organic applications requiring no water at all.

#### Water conservation

- During our Hotel transformation all the bathroom fixtures in public areas are being replaced with electronic sensor faucets and infrared flushometers.
- We encourage our guests to conserve water by letting us know when they would like for us to change linen and clean their guest rooms during their stay. Guest have an option to opt out of daily cleaning in exchange for SPG or food and beverage financial credits.
- Keeping the conductivity levels 1800+ in our cooling tower to minimize water consumption.
- A Single stream hot water recirculation process has been installed to reduce hot water consumption as well as energy to heat cold water.
- New technology ice machines have been ordered for installation with energy miser and water conservation features
- Water Mister/low flow faucets have been installed in all 1841 guest rooms
- By the end of 2009 the Sheraton Dallas will install a state of the art laundry plant. The initiation of the new equipment will allow for 110 pounds of laundry

to be washed every two and a half minutes. Water resource consumption will be reduced by two thirds.

#### Waste and Recycling

- Sheraton Dallas redesigned the waste and recycling programs with the installation of a Recycling Baler which allows the associates to recycle cardboard, paper, plastic and aluminum cans without having to be sorted before pick-up, also we added 100 (95 gallon on wheels) totters on the guest floors, offices and back of the house to collect all the recycling items coming from all areas, reducing the amount of pulls by 20% at month. Also part of this program is the recycling of remote control batteries and fluorescent light ballast.
- Recycling receptacles will be added to all guest rooms by September 15th 2009. Recycling collection stations have been added to each guest floor for daily collection.

#### Reducing natural resources waste

- Electronic reporting to minimized paper and toners in printers and photocopy machines.
- Encourage guest to uses kiosk (check-in/out) to reduce paper at the front desk.
- Paperless protocols include electronic group contracts and proposals, email guest folio delivery, electronic contract distribution and recycling bins installed in all guest rooms.
- Sheraton Dallas implemented the use of environmentally friendly chemicals for rooms and public area cleaning.
- A power factor correction project is currently under review for installation later this year.
- All purchasing is done via Star Source with a paperless PO system inclusive of receiving and posting records
- We are reviewing the feasibility of corn, bamboo or sugar cane based disposable containers to replace Styrofoam products currently in use
- All event orders are distributed electronically on a daily basis, reducing the need for thousands of copied each week.
- Office printing applications have been centralized to two locations within the sales and administrative offices reducing the demand on toner.
- Scanners have been integrated into all offices for electronic distribution again reducing the need for copies.

# PREVIEW: DENVER

## 2013 ANNUAL CONFERENCE JUNE 22-26, 2013

The Denver Annual Conference will be held at the Sheraton Denver, 1550 Court Place (formerly the Adams Mark). Rates are \$189 single or double and reservation can be made by calling 888-627-8405 or online at <https://www.starwoodmeeting.com/Book/ashrae2013>

### Restaurants

#### 16th Street Mall – Pedestrian Mall – within walking distance of the Sheraton.

Built in 1982, the Mall is a tree-lined, pedestrian promenade of red-and-gray granite that runs through the center of Downtown and is lined with outdoor cafes, renovated historic office buildings, shops, restaurants and retail stores. Numerous fountains and plazas offer a variety of daily special events and entertainers. Free shuttle buses cruise the mile-long Mall seven days a week. VISIT DENVER's Visitor Information Center is located at 16th & California on the 16th Street Mall.

### Weather

In summer, Denver enjoys low relative humidity, making for beautiful, sun-filled days and cool, comfortable evenings. The average daily high temperature in June is a mild 81 degrees Fahrenheit. The mild weather is due in part to the city's altitude: 5,280 feet above sea level, or exactly a mile high.

### Colorado Rockies Baseball Club

Visit the Colorado Rockies at Coors Field. For ticket, tour or merchandise information, please call 303-ROCKIES

### New in Denver

The 1st Annual ASHRAE Research Track will present innovations in HVAC&R research with particular emphasis on Renewable Energy Research and its role as we strive towards a clean energy economy. Researchers will present papers, seminars, forums or participate in panel discussions. Also, highlights on ongoing ASHRAE funded research will be presented. Join us in this comprehensive compilation of research-related papers and programs that peer into what the future holds.

### SUSTAINABILITY PROJECT

ASHRAE has launched a program to provide technical and financial support for a sustainable project in the cities where Society Conferences take place, leaving a legacy demonstrating the Society's commitment to sustainability.

Beginning with the 2008 Salt Lake Annual Conference, ASHRAE is seeking donations from meeting attendees to go toward supporting a local green project or green enhancement to an existing project. The Denver project is described below.

### ASHRAE 2013 Annual Conference Sustainability Project

Denver Rescue Mission  
1130 Park Avenue West, Denver, CO 80205

### WE NEED YOUR SUPPORT!

10

For the sustainability project in Denver, the Rocky Mountain Chapter has committed to overhauling the Denver Rescue Mission's aged and deteriorating systems and replacing them to improve efficiency and increase occupant comfort.

While attending the Annual Conference, this is an opportunity to show your support of not only the ASHRAE community, but your local community as well. It's also an opportunity to support sustainability and gain valuable exposure for your business.

### WHAT IS THE PROJECT?

The project is an existing 3-story masonry structure located in downtown Denver. The building was constructed in 1928 and is approximately 24,000 square feet in size. The lower level of the building contains a dining room and commercial kitchen serving 1,000 meals per day, a commercial laundry, building library, boiler room and support areas. The second level of the building contains a chapel area, operation offices, medical clinic and support areas. The third level of the building has a large open dormitory that can house up to 200 occupants, a shower room, a restroom and support areas.

Preliminary energy use analysis determined that the building has an Energy Use Intensity of 199 kBtu/sqft/year, 75% coming from natural gas usage. An initial audit of the building HVAC, lighting, plumbing and support systems indicated that building energy use can be reduced through simple sustainable engineering means. The high building energy use and scalable nature of the projects made this facility an ideal candidate for the ASHRAE 2013 Summer Meeting Sustainability Project. Donations may be made during the registration process online.

### Welcome Party

Saturday, June 22

6:30 – 8:30 p.m.

Denver Art Museum

The Welcome Party will be held at the Denver Art Museum, a short one half mile walk from the Sheraton. In addition to several galleries being open there will be a caricature artist available to capture the fun!

Exhibits open during the Welcome party will be the Native American and Western Collections.

The Denver community has long embraced its western roots, and, as the city's premier visual arts institution, the Denver Art Museum has collected and exhibited western American art for over 50 years. In the early 1950s the first curator of western art was appointed and several masterworks such as Alfred Jacob Miller's Shoshone Indians at a Mountain Lake were acquired for the museum's permanent collection.

The Denver Art Museum's American Indian collection offers visitors the opportunity to experience the artistic vision of generations of American Indian artists from across North America. From ancient puebloan ceramics, to 19th century Arapaho beaded garments, to contemporary glass work, the museum offers a look at the rich diversity of art forms, histories, and artistic styles coming from American Indian artists and communities. True to the organizing theme of the galleries, Artist's Eye, Artist's Hand, visitors are reminded that American Indian art is a vibrant and continuing tradition advanced by individual artists and craftspeople.

## CONFERENCE SPONSORS

ASHRAE thanks the following sponsor for their support of the 2013 Dallas Conference



## CHAPTER AND SOCIETY OFFICIALS

*A special thanks to all the members in the Dallas Chapter who helped make the conference a success!*

### DALLAS CHAPTER OFFICERS

Shelley Z. Zhao, President  
Charles Crawford, President-Elect  
Gene A. Lowery, Secretary  
Brandon Damas, Treasurer

### DALLAS HOST COMMITTEE

General Chair, Fred Schroeder  
Honorary Chair, Leo Stambaugh  
Vice Chair, Alan Ash  
Tours, Nathan Hart  
Entertainment, Jeanine Bounds  
Sessions, Jay Martin  
Hospitality, Kym Dennis  
Information/Publicity, Marvin Thedford

### ASHRAE OFFICERS

Thomas Watson, P.E., President  
William Bahnfleth, Ph.D., P.E., President Elect  
Thomas H. Phoenix, P.E., Treasurer  
Constantinos A. Balaras, Ph.D., P.E., Vice President  
Daniel C. Pettway, Vice President  
Timothy G. Wentz, P.E., Vice President  
Thomas E. Werkema, Vice President  
Jeff H. Littleton, Executive Vice President

### CONFERENCES AND EXPOSITIONS COMMITTEE

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Monte G. Troutman, Vice Chair  
Pamela L. Androff  
Walid Chakroun  
David E. Claridge  
Douglas C. Cochrane  
Jon J. Cohen  
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K. William Dean  
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Mohammad H. Hosni  
Yunho Hwang  
Thomas H. Kuehn  
Dunstan L. Macauley III  
Sarah E. Maston  
Michael J. McDermott  
Keith C. Newcomer  
Robert B. Risley  
Steven L. Rosen  
Jeffrey D. Spitler  
Samir R. Traboulsi  
T. David Underwood  
Brandt H. Williams  
A. Damon Gowan

## 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 also distribute evaluation forms for each session. Please complete the form and return it to the monitor when you leave the session. Room monitors will also distribute and collect comment cards on which attendees are encouraged to submit written questions regarding papers presented at Technical Paper Sessions. Questions are given to the authors for reply and published in *ASHRAE Transactions*.

### HOTEL ADDRESS, TELEPHONE

Sheraton Dallas  
400 N. Olive Street  
Telephone: 214-922-8000

### ONLINE REGISTRATION

Need to register or buy a ticket for social events, tours, or Learning Institute courses? You can register online 24/7 throughout the conference. You can also register during registration hours in Austin Ballroom, 2nd floor of the Sheraton Dallas. 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.

### NOTICE

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

### CELL PHONES/PAGERS

Please be considerate and turn off your phones and pagers in committee meetings and technical paper and conference paper sessions, seminars, forums, and the poster session.

### 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 Sheraton Dallas, 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. All affiliate meeting information must be displayed in the literature kiosk. No literature will be displayed on tables.

### 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 will be casual. For Members' Night Out, sport coat and sport shirt.

### LOST AND FOUND



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

### INVITATION TO ALL NEW MEMBERS, FIRST-TIME ATTENDEES AND NON MEMBERS

2:45-3:45, Sheraton, Atrium, 2<sup>nd</sup> floor, January 27

If you've never attended an ASHRAE meeting before, join us and meet some of your fellow first timers. New Member, non-members and first time meeting attendees are invited, and feel free to bring your family members. The event is sponsored and hosted by the ASHRAE Membership Promotion Committee.

### 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  symbol. Others are approved for LEED AP credits and are indicated with a  symbol. Certain sessions may be acceptable for ASHRAE certification renewal. Send questions to [certification@ashrae.org](mailto:certification@ashrae.org). In order to report your attendance at the session, PDH and AIA sign-in sheets are 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

Abstracts of all poster papers and sessions are included in this program. During the conference, papers presented at the technical paper and conference paper sessions can be purchased in the ASHRAE Bookstore. 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](http://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 Dallas 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/dallasvirtual](http://www.ashrae.org/dallasvirtual) 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. 13. Presentations available online for 18 months.

A full slate of technical programs will be posted beginning Monday, Jan. 28, of the sessions that were presented the previous day, with additional content posted through Wednesday, Jan. 30.

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, Sheraton, Austin Ballroom, 2<sup>nd</sup> floor.

\$299 ASHRAE member

\$464 non member

If you register on site, your password will be emailed to you within 24 hours of your registration.

## AHR EXPO®

Dallas Convention Center  
650 South Griffin Street

### Hours:

Monday, January 28 10:00 a.m.–6:00 p.m.

Tuesday, January 29 10:00 a.m.–6:00 p.m.

Wednesday, January 30 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 \$20.00 and can be paid at the Dallas Convention Center. Registration for the AHR Expo® will be open from Noon to 4:00 p.m. on Sunday, January 27. 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 Dallas Convention Center will be provided from the Sheraton all day Monday through Wednesday. Shuttle pick-up will be from the Sheraton lobby level, near the North Tower 3 elevators, across from the gift shop and next to the Draft Sports Bar.

Signs will advertise the shuttle schedule, which will begin on Monday, January 28. Shuttle service does not operate from hotel to hotel. Shuttles will run from 7:00 am–7:00 pm on Monday, 8:00 am–7:00 pm on Tuesday and 8:00 am–6:00 pm on Wednesday.

## 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

Policy, fire and medical emergencies call the hotel operator. Hotel security is trained in emergency response and can get to the scene of an emergency quickly if medical assistance is needed.

### Hospitals

Baylor, 3500 Gaston Avenue, Dallas, 214-820-0111

Parkland, 1936 Medical District Drive, 214-590-5637

### Fire Emergency... Preparedness in Hotels

The hotel's PA system will advise you of the need to evacuate in the event of a fire. The PA system is used on all sleeping and meeting room floors. Plan ahead—when you check into your room, check the location of exits. Walk to the nearest exit; learn the route, obstacles, etc. Keep your room key on the night stand when you are in your room. Examine your room. Check the windows to see if they open and how. Examine the area outside your window.

## SPOUSE/GUEST GUIDE

### SATURDAY, JANUARY 26

7:30 a.m.-3:00 p.m.

ASHRAE Lounge

Dallas Sheraton, Remington (H4)

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 Dallas 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 Austin Ballroom, 2nd floor.

### SUNDAY, JANUARY 27

7:30 a.m. – 4:00 p.m.

ASHRAE Lounge

Dallas Sheraton, Remington (H4)

### MONDAY, JANUARY 28

7:30 a.m. – 4:00 p.m.

ASHRAE Lounge

Dallas Sheraton, Remington (H4)

### MONDAY, JANUARY 28

9:30 a.m. – 11:00 a.m.

ASHRAE Lounge

Dallas Sheraton, Remington (H4)

### ASHRAE Meet and Greet

#### *How To Make Natural Sugar Scrubs*

All registered spouses are invited to attend the ASHRAE Meet and Greet where you will see a demonstration on how to create organic sugar scrubs using all organic products from your kitchen, such as brown sugar, honey, lemon, and teas. As well you will learn the healing properties and health benefits of using a home made body product. Participants will be able to create a sample of their own scrub to take with them, along with various recipes to try at home.

### TUESDAY, JANUARY 29

7:30 a.m.-4:00 p.m.

ASHRAE Lounge

Dallas Sheraton, Remington (H4)

### WEDNESDAY, JANUARY 30

7:30 a.m.-1:00 p.m.

ASHRAE Lounge

Dallas Sheraton, Remington (H4)

## FUTURE ASHRAE MEETINGS

Winter	Date	Annual
Dallas January 26-30	2013	Denver June 22-26
New York January 18-22	2014	Seattle June 28-July 2
Chicago January 24-28	2015	Atlanta June 27-July 1

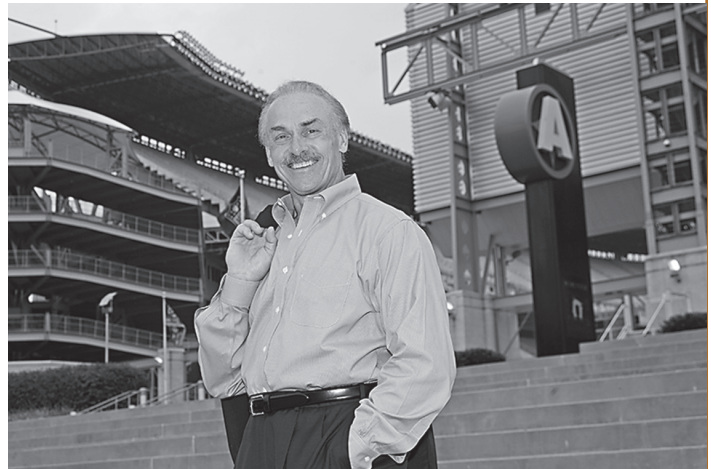
## PAST ASHRAE MEETINGS

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

## PLENARY SPEAKER

Saturday, January 26

**Rocky Bleier** had just been drafted for the Pittsburgh Steelers in 1968 when he received a different kind of draft: combat duty for Vietnam. Though he was wounded in both legs while fighting overseas, Bleier embarked on a two-year road to recovery, and eventually pressed on to become one of the Steelers' top leading ground-gainers, pass the 1,000-yard rushing mark in one season and contribute to four Super Bowl victories. His story is recounted in the book "Fighting Back," which was recreated in the 1980 ABC-TV movie of the same name. His speech, "Be the Best You Can Be," motivates audiences to keep on striving for greater accomplishments. He employs a dynamic style with real-life stories and brings it together with a warm, self-reflective humor to which audiences can relate. Bleier shares his remarkable story during the Plenary on Saturday.



## MEMBERS NIGHT OUT

Tuesday, January 29

Sheraton, Lone Star Ballroom B

Cash Bar Reception, 6:15–7:15 p.m.,  
Lone Star Ballroom Foyer

Dinner, 7:15–8:30 p.m.

### Menu:

Baby Greens Salad  
Grilled Ribeye with Tabasco fried onions  
Yukon Mashed Potatoes  
Triple Mousse  
Wine at table

Ticket required. **\$52**

The special entertainment for the Dallas Members Night Out has a global reputation of excellence, having entertained audiences in over 80 countries in the past eight years. This multi-award winning group has delighted heads of state, celebrities and Fortune 500 companies with their unique blend of world-class talent and winning personalities. We don't want to break the suspense for you but we do advise that you make sure to be present during dessert for this special treat.

## WELCOME PARTY

Saturday, January 26 • 6:30-8:30 p.m.

Sheraton, Lone Star Ballroom, C1 – C4

C'mon over, y'all, for a sophisticated take on a Texas backyard barbeque. The Welcome Party features:

Fruit and Cheese Kabobs with Honey Lime Dressing  
Old-fashioned Potato Salad  
Southwestern Coleslaw  
Honey Barbecue Chicken  
Mesquite Smoked Brisket of Beef with Jalapeno BBQ Sauce  
Texas Chili  
Sweet and Jalapeno Cornbreads  
2 Drinks  
Chocolate Bourbon Pecan Pie  
Sugared Pralines.

Good food, good times. The dress code is casual attire.

Ticket required. **\$62**

## PRESIDENT'S LUNCHEON

Monday, January 28, 12:15 pm – 2:00 pm

(doors open at noon)

Sheraton, Lone Star Ballroom B

President Tom Watson invites you to join him at the Presidential Luncheon where he updates attendees on his theme Broadening ASHRAE's Horizons, which emphasizes the role of ASHRAE members as leaders in the application of sustainable design and practices in our communities worldwide. Major Research Promotion Investors will be recognized.

### Menu:

Southwestern Salad  
Merlot Chicken topped with wild mushrooms  
Herbed Spinach  
Roasted Garlic Mashed Potatoes  
Berry Chocolate Crunch

Ticket required. **\$42**

## RESTAURANTS WITHIN WALKING DISTANCE OF THE SHERATON

**Press Box Grill** – from Buffalo burgers, BBQ brisket sandwiches, Chicken Caesar Salad to Flat Iron Steak and also 36 beers on tap, good place for happy hour and meet & greet some of the locals – **1680 Elm St. @ Ervay 214-747-8226**

**Campisi's Italian** – not just pizza and pasta, excellent choice of salads with Campisi's famous Italian dressing and specialty plates such as Grilled Chicken Picatta, family friendly, great place for lunch (full service bar too) – **1520 Elm St. @ Stone St. 214-752-0141**

**Sol Irlandes Mexican Grill/Tex-Mex** – good chips and salsa, tasty appetizers, empanadas, fajita or chicken nachos from the grill you have the choice of grilled salmon, carne asada and camerones de mesquite. Nice patio with ice cold imported beer! – **1525 Main St. @ Stone St. 214-744-9400**

**Iron Cactus Mexican Grill & Margarita Bar** – with 3 levels, restaurant, lounge and roof top patio along with fresh lime margaritas and a Mexican menu with a flare. You should try their signature margarita “El Agave” – **1520 Main St. before Akard 214-749-4766**

**Galilee Grill** – Mediterranean cuisine, buffet bar... hummus, babaganoush, chicken/beef/lamb dishes, different salads and naan, excellent choice for lunch – **1502 Elm St. @ Akard 214-760-7333**

**Ravenna Urban Italian Restaurant** – from seafood, veal, steaks, chicken and patio seating. A great place for lunch or looking for a good drink after a long day at work. Also a good place for late night pizza by the slice and try the hot garlic bread – **1301 Main St. @ Field St. 214-744-9333**

**Wild Salsa** – Who knew there were so many salsas? It may look like a guacamole den, but the restaurant's vibrant, energetic cooking makes this downtown cantina a destination for serious modern Mexican food – **1800 Main Street, the Mercantile Building between Main St. and St. Paul. 214-741-9453**

**Dallas Chop House** – Named in DFW Top Restaurants of 2010 – Steaks, Seafood – **1717 Main St. 214-736-7300**

**Dallas Fish Market** – Also named in DFW Top Restaurants of 2010 – offers the freshest seafood daily from sources around the world, the finest Texas grass-feed steaks and local produce. With a weekly changing menu you will dine on the finest, freshest ingredients of the season – **1501 Main St. 214-744-3474**

**Stephan Pyles Restaurant** – serves New Millennium Southwestern Cuisine with emphasis on cultures that are related to Spain. The Latin New World, the Mediterranean and Arabia – 1807 Ross Ave, Suite 200. 214-580-7000

**Samar by Stephan Pyles** – Local culinary legend Stephan Pyles serves small plates from India, Turkey, Spain and other far-flung locales across the globe. – **2100 Ross Ave. 214-922-9922**

**Dakota's Steakhouse** – **600 N. Akard St. 214-740-4001**

**Palm Restaurant** – The Classic American Steak House is renowned for its USDA prime aged steaks, jumbo Nova Scotia lobsters, Italian dishes, and the freshest of seafood. – **701 Ross Ave. 214-698-0470**

**Morton's the Steakhouse** – **2222 McKinney Ave. 214-741-2277**

Please see the Concierge, located in the lobby, for additional recommendations.

## notes



## AWARDS PRESENTATION

Saturday, January 26, 3:15-5:30 p.m.  
Plenary Session, Sheraton Dallas  
Lone Star Ballroom B

### STUDENT DESIGN PROJECT COMPETITION

*“Given in recognition of outstanding student research and design projects.”*

#### HVAC System Selection

First Place: **Adam Buck, Jami Harper, John May, Patrick MacBride, Alaina Williams**  
University of Nebraska-Lincoln (Faculty Advisor: Joe Hazel)

#### HVAC Design Calculations

First Place: **John Bisacquino, Joshua Dennis, Travis Westover**  
Temple University (Faculty Advisor: Steven Ridenour)

#### Integrated Sustainable Building Design

First Place: **Dustin Altschul, Prathamesh Chakradeo, Ravik Chandra, Saikrishna Ganesan, Timothy Hertel, Varun Krishnan, Charles Stratton**  
University of Cincinnati (Faculty Advisor: Raj Manglik)

### TECHNOLOGY AWARDS

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

#### First Place and Award of Engineering Excellence

*“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

**C.K. Joseph Tai, P.E.**, for the Research Support Facility,  
National Renewable Energy Laboratory  
The building is owned by NREL who is being represented  
by Shanti Pless

#### Category I – Commercial Buildings – Existing

**Shawn Oram** for Rice Fergus Miller Office & Studio  
**Steven M. Rice**, Owner, Fifth Street Hilltop Partners LLC

#### Category I – Other Institutional – NEW

**Jonathan Heller, P.E.**, for Eastside Fire & Rescue Station 72  
The building is owned by the City of Issaquah and is being  
represented by Brad Liljequist

#### Category II – Educational Facilities – NEW

**Mark Owen Koller, P.E.**, for Portland State University  
Academic & Student Recreation Center  
The building is owned by Portland State University and is being  
represented by Ernest Tipton

#### Category II – Health Care Facilities – NEW

**Jeremy McClanathan** for Swedish Issaquah Hospital  
The building is owned by Swedish Health System and is being  
represented by Lee Brei

#### Category IV – Public Assembly – Existing

**André-Benoît Allard, Eng.**, for Montréal Biodôme  
The building is owned by Espace pour la Vie and is being  
represented by Jean Bouvrette

### ASHRAE DISTINGUISHED PUBLIC SERVICE AWARD

*“Given in recognition of distinguished public service”*

#### **Harold R. Lewis, P.E.**

Sarasota, FL

#### Refrigeration Comfort Cooling Award

**Eric M. Fullerton, P.E.**, Arkansas Chapter  
ASHRAE-Certified Healthcare Facility Design Professional

### E.K. CAMPBELL AWARD OF MERIT

presented by the Life Members' Club

*“Given in recognition of outstanding service and achievement in teaching”*

#### **Michel Bernier, Ph.D., P.E.**

Montreal, QC, Canada

### JOHN F. JAMES INTERNATIONAL AWARD

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

#### **Roberto R. Aguilo, P.E.**

Buenos Aires, Argentina

### ASHRAE FELLOWS

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

**Barney L. Capehart, Ph.D.**, Gainesville, FL

**Dale E. Carter**, New Westminster, BC, Canada

**Thomas H. Durkin, P.E.**, Indianapolis, IN

**Mark W. Fly, P.E.**, Tulsa, OK

**Glenn Friedman, P.E.**, Alameda, CA

**Raymond H. Horstman, P.E.**, Seattle, WA

**William F. McQuade, P.E.**, York, PA

**B.J. Melton, P.E.**, Richardson, TX

**Ross Montgomery, P.E.**, ASHRAE-Certified Building Energy  
Modeling, Building Energy Assessment and Commissioning  
Process Management Professional, Palmetto, FL

**William B. Rose**, Champaign, IL

**N. Vaidyanathan**, Chennai, India

### 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”*

#### **Gilbert Carlson**

**William Fontaine**

### ASHRAE HALL OF FAME AWARD

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

**Wilbert F. Stoecker, Ph.D., P.E.**, Fellow ASHRAE, Life Member

### F. PAUL ANDERSON AWARD

*“Given in recognition of notable achievement, outstanding work, or service in any field of the Society”*

Presidential Member **Richard H. Rooley, FREng**, Bucks, UK

## 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. All meetings are scheduled in the Sheraton Dallas. Meeting room names are listed in this program followed by parentheses indicating the number of the floor the room is located on. (CC#) is the Sheraton Conference Center located across the 2<sup>nd</sup> floor skybridge and the floor location and (H#) is the hotel with the floor location

### CONFERENCE REGISTRATION

#### Sheraton, Austin Ballroom, (H2)

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 25	10:00 a.m. – 5:00 p.m.
Saturday, January 26	7:15 a.m. – 6:00 p.m.
Sunday, January 27	7:00 a.m. – 5:00 p.m.
Monday, January 28	7:00 a.m. – 5:00 p.m.
Tuesday, January 29	7:30 a.m. – 4:30 p.m.
Wednesday, January 30	7:30 a.m. – 11:00 a.m.

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

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

#### Sheraton, Grand Hall (CC1)

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 25	10:00 a.m. – 5:00 p.m.
Saturday, January 26	7:15 a.m. – 6:00 p.m.
Sunday, January 27	7:00 a.m. – 5:00 p.m.
Monday, January 28	7:00 a.m. – 5:00 p.m.
Tuesday, January 29	7:30 a.m. – 4:30 p.m.
Wednesday, January 30	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®

Dallas Convention Center, 650 S. Griffin Street

#### Hours:

Monday, January 28	10:00 a.m. – 6:00 p.m.
Tuesday, January 29	10:00 a.m. – 6:00 p.m.
Wednesday, January 30	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 \$20.00 and can be paid at the Dallas 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 convention center will be provided from the Sheraton all day Monday through Wednesday. Shuttle pick-up will be from the Sheraton lobby level, near the North Tower 3 elevators, across from the gift shop and next to the Draft Sports Bar. Signs will advertise the shuttle schedule, which will begin on Monday, January 28. Shuttle service does not operate from hotel to hotel. Shuttles will run from 7:00 am – 7:00 pm on Monday, 8:00 am – 7:00 pm on Tuesday and 8:00 am – 6:00 pm on Wednesday.

### 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.

### ALI COURSES

Registration for the ASHRAE Learning Institute courses being held at the Dallas Convention Center at either the ASHRAE registration at the Sheraton or at Dallas Convention Center, Lobby D, Exhibit Level. Registration will open at Dallas 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

#### Sheraton, Remington (H4)

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

#### This room will be open during the following hours:

Saturday, January 26	7:30 a.m. – 3:00 p.m.
Sunday, January 27	7:30 a.m. – 4:00 p.m.
Monday, January 28	7:30 a.m. – 4:00 p.m.
Tuesday, January 29	7:30 a.m. – 4:00 p.m.
Wednesday, January 30	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**

Sheraton, Dallas Ballroom D3 (CC1)

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

Saturday, January 26	1:00 p.m. – 3:00 p.m.
Sunday, January 27	7:00 a.m. – 5:00 p.m.
Monday, January 28	7:00 a.m. – 12:15 p.m. and 1:30 p.m. – 4:30 p.m.
Tuesday, January 29	7:00 a.m. – 5:00 p.m.
Wednesday, January 30	7:00 a.m. – 1:00 p.m.

## **PRESS ROOM**

Sheraton, Skybridge Office (H2)

The Press Room will be open during the following hours:

Saturday, January 26	8:00 a.m. – 3:00 p.m.
Sunday, January 27	8:00 a.m. – 3:00 p.m.
Monday, January 28	9:00 a.m. – 5:00 p.m.
Tuesday, January 29	9:00 a.m. – 3:00 p.m.
Wednesday, January 30	8:00 a.m. – 10:00 a.m.

## **HEADQUARTER OFFICE**

Sheraton, Press Club (H2)

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 25	Noon – 5:00 p.m.
Saturday, January 26	8:00 a.m. – 5:00 p.m.
Sunday, January 27	8:00 a.m. – 5:00 p.m.
Monday, January 28	8:00 a.m. – 5:00 p.m.
Tuesday, January 29	8:00 a.m. – 5:00 p.m.
Wednesday, January 30	8:00 a.m. – 1:00 p.m.

## **MEMBERSHIP INFORMATION DESK**

Sheraton, Austin Ballroom (H2)

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**

Sheraton, Atrium (H2)

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 27, from 4:00 p.m.–7:00 p.m. The suite offers social and networking opportunities and light refreshments will be available.

A YEA/student mixer will be held Saturday, January 26, from 5:00 p.m. – 6:30 p.m. in the Sheraton, Atrium, second floor of the hotel. Come join us to meet other young ASHRAE members!

## **STUDENT ACTIVITIES**

Sheraton, Lone Star Ballroom B (CC2)

Plan to join the Student Welcome and Orientation on Saturday, January 26 from 2:00 p.m. to 3:00 p.m. in Lone Star Ballroom A4 (CC2).

The Student Program will be held in the Lone Star Ballroom B at the Sheraton on Sunday, January 27 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 University of Texas Arlington will depart from the Sheraton lobby level, near the North Tower 3 elevators, across from the gift shop and next to the Draft Sports Bar.

First tour will be from 2:30–4:30 and second tour will depart at 3:30 and return at 5:30.

## **INVITATION TO ALL NEW MEMBERS, FIRST TIME ATTENDEES AND NON-MEMBERS**

Sunday, January 27, 2:45 p.m. to 3:45 p.m.

Sheraton, Atrium (H2)

If you've never attended an ASHRAE conference before, join us and meet some of your fellow first timers. New members, non-members, and first time meeting attendees are invited, and feel free to bring your family members. The event is sponsored and hosted by the ASHRAE Membership Promotion Committee,

## **DALLAS HOST COMMITTEE INFORMATION DESK**

Sheraton, Austin Ballroom (H2)

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 Dallas.

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 Big "D".

## **DENVER CONFERENCE INFORMATION**

Sheraton, Austin Ballroom (H2)

Information on the upcoming Annual Conference June 22–26, 2013, in Denver, CO will be available in the registration area.

## 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. All meetings are scheduled in the Sheraton Dallas. The Sheraton has a number of meeting rooms located in the conference center which is attached via skywalk from the 2nd floor of the hotel. When meeting rooms are listed as being in the conference center they are in the Sheraton Conference Center, not the Dallas Convention Center. (CC#) is the Sheraton Conference Center with the floor location; (H#) is the hotel with floor location. All tower elevators go to the 2nd floor. Center/North towers go to 4th floor as well.

### Meeting Schedule

#### FRIDAY, JANUARY 25

- 8:00 am – 5:00 pm **Committee Meetings**  
*See listing on pages 54 – 68.*
- 10:00 am – 5:00 pm **Registration**, Sheraton, Austin Ballroom, (H2)
- 10:00 am – 5:00 pm **ASHRAE Bookstore**, Sheraton, Grand Hall (CC1)

#### SATURDAY, JANUARY 26

- 7:30 am – 3:00 pm **ASHRAE Lounge**, Sheraton, Remington (H4)
- 7:15 am – 6:00 pm **Registration**, Sheraton, Austin Ballroom, (H2)
- 7:15 am – 6:00pm **ASHRAE Bookstore**, Sheraton, Grand Hall (CC1)
- 8:00 am – 3:00 pm **Press Room**, Sheraton, Skybridge Office (H2)
- 8:00 am – 5:00 pm **Committee Meetings**  
*See listing on pages 54 – 68.*
- 1:00 pm – 3:00 pm **Speakers' Lounge**, Sheraton, Dallas Ballroom D3 (CC1)
- 2:00 pm – 3:00 pm **Student Orientation**, Sheraton, Lone Star Ballroom A4 (CC2)

### Special Event

- 3:15 pm – 5:00 pm **Meeting of the Members, Plenary Session**, Sheraton, Lone Star Ballroom B (CC2)
- Opening and Welcoming Remarks by ASHRAE President **Thomas E. Watson**
- Welcome by Director and Chair, Region VIII, **John L. Harrod**
- Secretary's Report by Executive Vice President **Jeff H. Littleton**

#### Awards Presentation

*See page 17 for details.*

#### Keynote Speaker

*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**, Sheraton, Atrium (H2)

### Special Event

- 6:30 pm – 8:30 pm **Welcome Party**, Sheraton, Lone Star Ballroom C1-C4 (CC2)

*See page 15 for details.*

**Note:** \$62 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 27

- 7:00 am – 5:00 pm **Speakers' Lounge**, Sheraton, Dallas Ballroom D3 (CC1)
- 7:00 am – 5:00 pm **Registration**, Sheraton, Austin Ballroom, (H2)
- 7:00 am – 5:00 pm **ASHRAE Bookstore**, Sheraton, Grand Hall (CC1)
- 7:30 am – 4:00 pm **ASHRAE Lounge**, Sheraton, Remington (H4)
- 8:00 am – 4:45 pm **Technical Sessions**  
*See Technical Program on pages 32 – 53.*
- 8:00 am – 3:00 pm **Press Room**, Sheraton, Skybridge Office (H2)
- 8:00 am – 5:00 pm **Committee Meetings**  
*See listing on pages 54 – 68.*
- 9:00 am – 2:00 pm **Student Program**, Sheraton, Lone Star Ballroom B (CC2)
- 9:00 am – 4:00pm **General Tour: Fort Worth Highlights**
- 1:00 pm – 4:00 pm **General Tour: Dallas Highlights**  
*See description on page 22.*
- 2:30 pm – 5:00pm **Technical Tour: Baylor Charles A. Sammons Cancer Center**
- 2:30pm – 4:30pm **Student Technical Tour: University of Texas Arlington**
- 3:30pm – 5:30pm **Student Technical Tour (repeat of 2:30pm tour)**  
*See descriptions on page 24.*
- 2:45 pm – 3:45 pm **New Member Social**, Sheraton, Atrium (H2)
- 4:00 pm – 7:00 pm **Young Engineers in ASHRAE (YEA) Hospitality Suite**, Sheraton, Atrium (H2)

**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 16 for more details*

## MONDAY, JANUARY 28

- 7:00 am – 5:00 pm **Speakers' Lounge**, Sheraton, Dallas Ballroom D3 (CC1)
- 7:00 am – 5:00 pm **Registration**, Sheraton, Austin Ballroom, (H2)
- 7:00 am – 5:00 pm **ASHRAE Bookstore**, Sheraton, Grand Hall (CC1)
- 7:30 am – 4:00 pm **ASHRAE Lounge**, Sheraton, Remington (H4)
- 8:00 am – 12:00 pm **Technical Sessions**  
*See Technical Program on pages 32 – 53.*
- 9:00 am – 5:00 pm **Press Room**, Sheraton, Skybridge Office (H2)
- 8:00 am – 5:00 pm **Committee Meetings**  
*See listing on pages 54 – 68.*
- 10:00 am – 6:00 pm **AHR Expo®**, Dallas Convention Center 650 South Griffin St., Dallas, TX 75202

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 \$20.00 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 Dallas Convention Center will be provided from the Sheraton. Shuttle pick-up will be from the Sheraton lobby level, near the North Tower 3 elevators, across from the gift shop and next to the Draft Sports Bar. Shuttle service will begin at 7:00 a.m. Signs will advertise the shuttle schedule. Shuttle service does not operate from hotel to hotel.**

Those wishing to use DART can catch the train right out of the hotel on Pearl Street. Fares are \$2.50 per single ride, \$5 per day or \$25 for 7 days. Other fares also available based on time of day and other restrictions.

*See page 13 for more details.*

- 10:15 am – 11:45 am **Student Congress**, Sheraton, Majestic 3 (H37)

### Special Event

- 12:15 pm – 2:00 pm **President's Luncheon**  
(doors open at noon),  
Sheraton, Lone Star Ballroom B (CC2)

President **Thomas E. Watson** 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.

- 2:30 pm – 4:00 pm **Technical Sessions**  
*See Technical Program on pages 32 – 53.*
- 2:30 pm – 5:30 pm **Tours: Dallas Arts District**  
*See description on page 22.*
- 2:30 pm – 5:30 pm **Technical Tour: Cowboy Stadium**  
(both general and technical tour)  
*See description on page 23 and 24.*
- After 5:00 pm **Regional Dinners**  
*Sign up in ASHRAE registration area.*

## TUESDAY, JANUARY 29

- 7:00 am – 5:00 pm **Speakers' Lounge**, Sheraton, Dallas Ballroom D3 (CC1)
- 7:30 am – 4:30 pm **Registration**, Sheraton, Austin Ballroom, (H2)
- 7:30 am – 4:30 pm **ASHRAE Bookstore**, Sheraton, Grand Hall (CC1)
- 7:30 am – 4:00 pm **ASHRAE Lounge**, Sheraton, Remington (H4)
- 8:00 am – 4:45 pm **Technical Sessions**  
*See Technical Program on pages 32 – 53.*
- 9:00 am – 3:00 pm **Press Room**, Sheraton, Skybridge Office (H2)
- 8:00 am – 5:00 pm **Committee Meetings**  
*See listing on pages 54 – 68.*
- 10:00 am – 6:00 pm **AHR Expo®**, Dallas Convention Center 650 South Griffin St., Dallas, TX 75202
- 10:00am – 2:00pm **Tours: Historical Grapevine**  
*See descriptions on page 23.*
- Noon – 1:30 pm **Life Members' Lunch**, Sheraton, Chaparral, 38th Floor (accessible from Center Tower Elevators)  
**Note:** Ticket required.
- 1:00 pm – 2:30 pm **Technical Tour: SMU Central Plant**
- 1:45 pm – 3:15 pm **Technical Tour: SMU Central Plants**  
(Repeat of 1:00 tour)  
*See descriptions on page 25.*

### Special Event

- 6:15 pm – 7:00 pm **Reception, Sheraton**, Lone Star Ballroom Foyer (CC2)
- 7:00 pm – 10:00 pm **Members' Night Out**, Sheraton, Lone Star Ballroom B (CC2)  
*See page 15 for details.*  
**Note:** Ticket required.

## WEDNESDAY, JANUARY 30

- 7:30 am – 10:00 am **Registration, Sheraton**, Austin Ballroom, (H2)
- 7:30 am – 1:00 pm **ASHRAE Bookstore**, Sheraton, Grand Hall (CC1)
- 7:30 am – 1:00 pm **ASHRAE Lounge**, Sheraton, Remington (H4)
- 7:00 am – 1:00 pm **Speakers' Lounge**, Sheraton, Dallas Ballroom D3 (CC1)
- 8:00 am – 10:00 am **Press Room**, Sheraton, Skybridge Office (H2)
- 8:00 am – 12:30 pm **Technical Sessions**  
*See Technical Program on pages 32 – 53.*
- 8:00 am – 5:00 pm **Committee Meetings**  
*See listing on pages 54 – 68.*
- 10:00 am – 4:00 pm **AHR Expo®**, Dallas Convention Center 650 South Griffin St., Dallas, TX 75202

## GENERAL TOURS

All tours depart from the Sheraton Lobby level, North Tower, across from the gift shop and next to the Draft Sports bar.

Tour tickets may be purchased at the ASHRAE Registration desk in the Sheraton, Austin Ballroom, 2nd floor of the hotel or online 24/7.

Stand-by tour tickets are distributed at ASHRAE registration after a tour sells out. Stand-by tickets are provided to ensure that a tour is filled in the event of no-shows or last minute cancellations. If you have a stand-by ticket, please have the exact amount of the ticket cost available to pay at the bus.

### Fort Worth Highlights

Sunday, Jan. 27, 2013

9 a.m. – 4 p.m.

The History of Fort Worth reads like the history of the American West. Your tour guide introduces you to downtown's dazzling Sundance Square, a historically rich area, full of attractions and a beautiful setting for dining, theatre and exciting nightlife entertainment. The red brick streets and lush courtyards add to Sundance Square's authentic aura.

Walk the Heritage Trail for fascinating western history: hear tall tales about the Chisholm Trail and the famous outlaws, Butch Cassidy and the Sundance Kid. Don't miss the Fort Worth Water Gardens, the Bass Performance Hall, one of the world's finest concert and performance halls.

Learn about Hell's Half Acre where saloons, gambling parlors, shooting halls and dance halls once flourished, and hear stories of the cities colorful past! Visit the superb Sid Richardson Museum to enjoy western art by masters Russell and Remington. Stop by Hotel Texas where President Kennedy spent his last night.

Then, off to explore the Fort Worth Stockyards National Historic District, where the Old West comes to life! Enjoy a guided walk of the Stockyards and learn about the historic attractions that speak to a bygone era when the town was a stop for the legendary cattle drives on the Chisholm Trail. Experience before your eyes as a team of cowhands drives a herd of Texas Longhorns along Exchange Avenue. Every detail of this cattle drive, from the saddles to the chaps, from the hats to the boots, is authentic. Visit the Livestock Exchange, the "Wall Street of the West." See Cowtown Coliseum site of the world's first indoor rodeo. Step inside the White Elephant Saloon – the interior was used in the filming of Walker Texas Ranger. Tour the historic Stockyards Hotel and experience an era when cattle and cotton were common currency and outlaws were folk heroes.

Drop in Billy Bob's Texas the world's largest honky tonk, or the Bull Ring Saloon, the birthplace of Texas Hold'em, and see their interesting collection of Texas art. Try on cowboy boots at one of the many western stores or pick up a memento or gift from Stockyards Station – formerly sheep and hog barns, now home to many unique shops and restaurants!

Don't forget to tour the Kimbell Art Museum and its world class collection of art and artifacts from antiquity to the 20th century.

**Cost: \$62**

**22**

### Dallas Highlights Tour

Sunday, Jan. 27, 2013

1 p.m. – 4 p.m.

Join your tour guide, board your motorcoach and take off to enjoy the top sights and attractions of Dallas' downtown, uptown and Highland Park on this exciting tour!

Visit Dealey Plaza in the West End Historic District, birthplace of Dallas and site of the tragic JFK assassination. View the Grassy Knoll and learn little known details of that fateful day, and the world famous Sixth Floor Museum at Dealey Plaza, which is dedicated to the life, death and legacy of President John F. Kennedy.

At the Old Red Courthouse, hear about the colorful history of Dallas from the 1800s to present, and see Dallas founder John Neely Bryan's cabin and the Kennedy Memorial.

Visit Wild Bill's Western Store to experience first-hand that Texas friendly spirit for which cowboys and western heroes are known. Whether you are looking for a \$10 gift for Aunt Martha or a pair of custom handmade boots, Wild Bill's has it all!

Stop by spectacular Pioneer Plaza, a Dallas park which commemorates Dallas' western heritage. The park features a larger-than-life recreation of a cattle drive in bronze, and you can hear stories about Texas cowboys and western cattle drives

Next, tour the Dallas Arts District, a cultural gem and the home of the city's performing arts venues & museums. Learn about the Nasher Sculpture Center and the serene beauty of the Crow Collection of Asian Art. See the stunning Winspear Opera House, the Wyly Theatre and the world-class Meyerson Symphony. Learn about the Belo Mansion's ties to the infamous gangsters, Bonnie and Clyde!

Enjoy Uptown Dallas, a hip and trendy neighborhood, filled one-of-a-kind shops, cutting-edge restaurants and exciting nightlife. Tour the Victory Park entertainment area and see the American Airlines Center, home to 2011 NBA Champs, the Dallas Mavericks!

Drive scenic Turtle Creek to the exclusive and historic neighborhood of Highland Park, passing by beautiful mansions of well-known Dallasites. Enjoy Highland Park's beautiful landscaped areas and hear about the towns ties to Beverly Hills!

**Cost: \$42**

### Dallas Arts District Tour

Monday, Jan. 28, 2013

2:30 p.m.–5:30 p.m.

Experience world class Dallas art, architecture, parks and more on this elegant tour of Dallas' art and culture scene.

The Dallas Arts District, a rare jewel that is the centerpiece of the city's cultural life, is the largest urban arts district in the United States and home to some of the finest Pritzker award-winning architecture in the world!

Be the guest of the stunning, state-of-the-art Winspear Opera House and innovative design of the Wyly Theatre, where your private tour guide leads the way through these architectural wonders.

Step inside the cool marble interior of the Meyerson Symphony Center and enjoy your behind-the-scenes tour of the world renowned concert hall to learn about its legendary sound and famous architect, I.M. Pei.

Tour the historic Victorian Gothic jewel, the Cathedral Shrine of the Virgin of the Guadalupe, to see its exquisite and original European stained glass and its many other artistic treasures.

See the historic antebellum Belo Mansion, home of Horatio Belo, founder of the Dallas Morning News and hear about the mansion's ties to the infamous gangsters Bonnie & Clyde!

Visit the Crow Collection of Asian Art and enjoy its serene beauty on a tour of the Chinese Jade Room.

Situated in a quiet oasis in downtown Dallas, tour the Nasher Sculpture Center—outstanding works by virtually all the great masters of modern sculpture, such as Matisse, Giacometti and Rodin, are represented

Both Museum Tower and The Park are the newest and glittering additions to call the Arts District home...they will surprise and delight!

**Cost: \$47**

**Cowboys Stadium**  
Monday, Jan. 28, 2013  
2:30–5:30 p.m.

When they say it's bigger in Texas, it truly is! Designed by the Architectural Firm HKS, Inc, the Dallas Cowboys Stadium is the largest dome stadium and features the largest retractable roof, the largest column free interior and the largest high definition video screen in the world! Seats up to 100,000 during championship events making it one of the two largest in regards to seating capacity. Beginning at the Main Club your tour stops include a private suite, the print media press box, the Cotton Bowl office vestibule, and the Dr Pepper Star Bar or the Ford Motor Company Fountain. Your guide then takes you down to the event level where you'll see all of the stops on the Self-Guided Tours, including the field, the Miller Lite Club, the post-game interview room and both the Cowboys locker room and the Cheerleaders locker room. Your tour ends in the Cowboys Stadium Pro Shop.

The tour will include some of the mechanical spaces and discussion of some of the building systems as well.

Please note that still cameras are permitted in the stadium but video cameras are not.

**Cost: \$47**

**Historical Grapevine Tour**  
Tuesday, Jan. 29, 2013  
10 a.m.–2 p.m.

**Historic Downtown Grapevine, Texas: a destination for wine, shopping, entertainment and art galleries**

Step back in time at the Grapevine Historical Museum housed in the original Cotton Belt Railroad Depot. Stop for photos of the delightful 1896-steam-engine-powered Grapevine Vintage Railroad running open-air cars on the historic Cotton Belt Route.

Relax and watch the artists at Vetro Glassblowing, a beautiful art glass gallery and state-of-the-art glassblowing facility, work their skills in this dynamic studio.

Stroll picturesque Main Street as your guide introduces you to Grapevine's fascinating past; for some, it's the historic Palace Theater, featured in its pre-restoration days in the movie "Tender Mercies," and now home of the renowned Grapevine Opry. In Liberty Park Plaza, see the "Walking To Texas" statue, and learn of the brave the pioneer spirit of Grapevine forefathers.

Enjoy the diverse array of antique shops and art galleries and Grapevine's Public Art Trail, a series of public bronze sculptures located throughout town.

Tour Nash Farms, a restored farmstead consisting of the original house and barn and a family cemetery that reflects the life and times of the early farmers and settlers who established Grapevine. The farm offers a historical perspective on a disappearing part of Texas' heritage.

*Experience all the beauty of Grapevine's Botanical Gardens. Enjoy the tranquil surroundings of nature in this special garden with hundreds of varieties of plants, extraordinary scents to tantalize, and the therapeutic beauty that a day in the garden provides.*

Visit the poignant 9/11 Flight Crew Memorial, on sacred ground, a bronze and limestone monument dedicated to the 33 flight crewmembers that were lost. This memorial is important to the history of aviation; it remembers the lost and honors those who continue the quest for excellence in the skies each day.

**Cost: \$47**

## notes

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## TECHNICAL TOURS

All tours depart from the Sheraton lobby level, near the North Tower 3 elevators, across from the gift shop and next to the Draft Sports Bar.

Tour tickets may be purchased at the ASHRAE Registration desk in the Sheraton, Austin Ballroom, 2<sup>nd</sup> floor of the hotel or online 24/7.

Stand-by tour tickets are distributed at ASHRAE registration after a tour sells out. Stand-by tickets are provided to ensure that a tour is filled in the event of no-shows or last minute cancellations. If you have a stand-by ticket, please have the exact amount of the ticket cost available to pay at the bus.

### **Baylor Charles A. Sammons Cancer Center**

Sunday, January 27

2:30 p.m. – 5:00 p.m.

Baylor had a clearly defined objective when it embarked upon creating the first dedicated cancer hospital along with the largest outpatient cancer center in North Texas: endow the community with a preeminent, patient-centered, comprehensive cancer center revolving around convenience, safety and comfort. The Center features “living walls,” vertical gardens that improve indoor air quality by moderating temperature and humidity levels, as well as filtering the air; an open platform automation system integrating HVAC&R, electrical, lighting and life safety; and two large 770 ton centrifugal chillers with free cooling.

**Cost: \$22**

### **Student Technical Tour, University of Texas – Arlington**

Sunday January 27

**Tour 1:** 2:30–4:30 p.m.

**Tour 2:** 3:30–5:30 p.m.

Students will have the opportunity to attend one of two technical tours of University of Texas, Arlington’s main thermal energy plant (~14k tons of chiller, large boilers, cooling towers, pumping, free cooling HX, etc.) and the mechanical sections of the new Engineering Research Building (ERB). The ERB contains steam, HHW/DHW converters, DI/RO systems, lab air/vac, rainwater collection systems, and very large Temtrol 100% O/A AHU’s w/ Fanwall fans, redundant VFD’s, and UVC lighting. The adjacent switchgear room contains Main-Tie-Main 12.47kV gear. This tour is a must see.

**Background Information:** The University of Texas of Arlington underwent at \$9.9 million efficiency-boosting facility upgrade that will save the university money and decrease energy use. Siemens Building Technologies completed the first package of improvements in 2009. The University saved nearly \$3 million in energy costs the first year those changes were in place and reduced energy usage by more than 19 million kilowatt hours.

Dallas-based TD Industries Inc. carried out phase two of the project in 2010, which guaranteed that UT Arlington would save about \$1.1 million each year in energy and maintenance costs and reduce its energy usage by 9.8 million kilowatt hours annually. The initial evaluation of energy bills from March 2011 through September 2011 showed the University already had saved more than \$488,000

through the project. These projects help the University fulfill an important responsibility to promote economically-sustainable practices within their campus community and the greater North Texas region.

Fifty-five UT Arlington buildings were involved in the upgrade. Improvements included the replacement of two thermal energy plant chillers, upgrades to heating and air-conditioning systems and roofing repairs and improvements.

The project was funded through a low-interest loan from the 2009 American Recovery and Reinvestment Act. The loan initially will be repaid through the \$1.1 million in annual energy savings. The TD Industries project is the second major energy-savings initiative UT Arlington has completed since 2006.

**Cost: \$15**

### **Cowboys Stadium**

Monday, January 28

2:30–5:30 p.m.

When they say it’s bigger in Texas, it truly is! Designed by the Architectural Firm HKS, Inc, the Dallas Cowboys Stadium is the largest dome stadium and features the largest retractable roof, the largest column free interior and the largest high definition video screen in the world! Seats up to 100,000 during championship events making it one of the two largest in regards to seating capacity. Beginning at the Main Club your tour stops include a private suite, the print media press box, the Cotton Bowl office vestibule, and the Dr Pepper Star Bar or the Ford Motor Company Fountain. Your guide then takes you down to the event level where you’ll see all of the stops on the Self-Guided Tours, including the field, the Miller Lite Club, the post-game interview room and both the Cowboys locker room and the Cheerleaders locker room. Your tour ends in the Cowboys Stadium Pro Shop.

The tour will include some of the mechanical spaces and discussion of some of the building systems as well.

Please note that still cameras are permitted in the stadium but video cameras are not.

#### **Quick Facts:**

Sq. Ft.: 2.8 million

Construction time: 39 months

Opened: May 27, 2009

Construction cost: \$1.3 billion

Owner: City of Arlington

Architect: HKS, Inc.

General Contractor: Manhattan/Rayco/3i

Structure Engineer: Walter P. Moore Engineers and Consultants/  
Campbell & Associates Consulting Engineers, Inc.

MEP Engineer: TD Industries

**MEP information:** 11,000 tons of cooling capacity, 94 air handling units, 10 miles of hydronic piping and 25 million pounds of ductwork. The plumbing systems includes nearly 50 miles of pipe and over 3,400 plumbing fixtures including water closets,



lavatories, sinks, as well as numerous showers in various locker rooms and specialty fixtures in the holding cells. The amenities include 2,800 pieces of food service equipment in 46 concessions and 12 bar/club areas. Specialty fixtures were installed in the 348 suites and associated clubs.

**Cost: \$37**

### **Southern Methodist University (SMU)**

Tuesday, January 29

1–2:30 p.m.

1:45–3:15 p.m. (repeat of 1 p.m. tour)

SMU is harnessing the power of steam, water and sunlight to heat and cool its over 70 buildings on campus.

### **Harnessing Nature**

#### **Power of Wind**

SMU uses wind-generated electricity in the Embrey Engineering Building. This means that three percent of the electricity consumed by SMU is from wind, and the University has joined the U.S. Environmental Protection Agency's Green Power Partnership program.

#### **Power of the Sun**

Through research, a generous donation and incentive funds, SMU decided to harness the power of the sun to provide electricity to its campus. As an added bonus, they received two points for Leadership in Energy and Environmental Design® (LEED) designation, Optimize Energy performance and On Site Renewable Energy Credits.

#### **Power of Conservation**

Condensate water collection boxes were used to create a water recovery (referred to as "finn water") system to collect the condensate from air handlers. These are stainless steel enclosures that utilize a small sump pump to transport the recovered water back into the cooling towers as make-up water. An additional source of "finn water" is the blow-off water from the pressure relief valves in the chilled water system at the central plant. The pressure relief valves are piped to the condenser water return line to the tower in lieu of a floor drain. The pressure relief water and condensate recovery are combined into a single condenser water return connection to the cooling tower.

Central plant and HVAC controls upgrade to utilize the technology of today with new efficient chillers, cooling towers and every building's heating and air-conditioning control system were upgraded to the latest technology. Building management could truly be accomplished via dashboards and monitoring software, 70 buildings were now on the radar. The central plant produces and distributes chilled water, steam and compressed air to over 70 main campus buildings (steam only to Highland Park First Methodist Church). Staffed 24 hours per day, 7 days per week. Maintenance is accomplished with a combination of in-house staff and outside contractors.

### **Energy Savings were a focus through the following mechanisms:**

- Performance contracts to purchase items with energy savings dollars
- Excess energy is being recovered from the steam system and used to generate electricity in the central plant. It saves about 500 kilowatts, or \$80,000, annually.
- Heat recovery devices have been placed on boilers to recover heat that would normally go into the air and return it back to the water system.
- A waste-heat generator is being tested at the central plant for the next six months, allowing unprecedented educational access.

### **Equipment:**

- Photovoltaic System – 15,300 watt grid, 68 enphase micro-inverters, 68 REC 25 watt solar panels (each panel has 60 6.14" square multicrystalline solar cells), communication gateway/website monitoring, ballasted roof mount racking system, electrical components, wiring and conduit.

### **Plant Capacity:**

- Water – 12,000 tons, currently the summer peak is 8,000 tons (condensing water system pumps have a capacity of 30,000 gpm)
- Steam – 90,000 lbm/hr (although in the coldest of winters the steam load is below 60,000 lbm/hr)

**Cost: \$22**

## notes

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## ASHRAE 2013 WINTER CONFERENCE COURSES –

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

All ASHRAE Learning Institute (ALI) training will be held at either the Sheraton Dallas Hotel or Dallas Convention Center. Training sessions will carry Continuing Education Units (CEUs), Professional Development Hours (PDHs), and/or American Institute of Architects Learning Units (AIA LUs), and Green Building Certification Institute (GBCI) credits which can be applied toward maintaining your P.E. licensure.

Registration for the ASHRAE Learning Institute training sessions being held at the Dallas Convention Center can be done at either ASHRAE registration at the Sheraton Dallas Hotel or at the Dallas Convention Center. Registration will open at the Dallas Convention Center on Sunday from 9:00 a.m.–3:00 p.m., Monday from 7:30 a.m.–6:00 p.m. and Tuesday from 8:00 a.m.–4:00 p.m. Online registration will close at midnight before the start of each course.

Shuttle Service for the courses on Monday and Tuesday will operate all day from the Sheraton Dallas Hotel to the Dallas Convention Center.

Please refer to the map in this program to assist in finding the rooms for the ALI Courses. All courses at the Dallas Convention Center Building C.

## 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 continuing education credit requirements)

### SATURDAY, JANUARY 26, 2013

#### The Commissioning Process in New and Existing Buildings (code 60)

8:00 am – 3:00 pm, Sheraton Dallas Hotel,  
Room: Seminar Theater, 2<sup>nd</sup> Floor

This introductory seminar focuses on how the building commissioning process can be applied cost-effectively to new construction and existing facilities. The seminar describes the fundamentals of the commissioning process through each step of a new construction project from pre-design to occupancy and operations. Also discussed is how the commissioning process in existing facilities differs from new construction. Learn about the benefits of commissioning and understand how the process can improve the built environment, reduce environmental impacts through responsible resource utilization, improve the quality of design and construction, and raise the professional reputation of the entire commissioning team. Commissioning documentation, including an overview of commissioning specifications for new construction, is discussed.

Instructor: Rick Casault, P.E., Member ASHRAE

#### Data Center Energy Efficiency (code 61)

8:00 am – 3:00 pm, Sheraton Dallas Hotel,  
Room: City 7, 4<sup>th</sup> Floor

Data centers are using an increasing amount of the total energy used by commercial facilities. However, these increases have a downside in that they cause a significant increase in the power required and the heat dissipated by the computing equipment, such that it is becoming very difficult to power and cool these systems in data centers or telecommunication rooms. This seminar examines the best practices for data center energy efficiency by focusing on thermal guidelines for data processing, datacom facility energy efficiency, and actual high density data centers in operation today. The seminar discusses equipment environment specifications and the methods for measuring performance and developing means to evaluate effectiveness of data center cooling. The use of the U.S. DOE's DCPro web-based energy modeling tools for data centers is discussed.

Instructors: Don Beaty, P.E., Member ASHRAE  
Roger Schmidt, Ph.D., P.E., Member ASHRAE  
Jack Glass, P.E., Member ASHRAE

#### Healthcare Facilities:

#### Best Practice Design & Applications (code 62)

8:00 am – 3:00 pm, Sheraton Dallas Hotel,  
Room: City 6, 4<sup>th</sup> Floor

Based on the ASHRAE book *HVAC Design Manual for Hospitals and Clinics*, this course will introduce many unique and up-to-date healthcare design considerations and applications. The course will cover chapters 1–4, 6–11, and 13–16. During the first half of the course, common medical terminology is introduced and how some terms have very different meanings between the medical and engineering communities will be explained. Infection particles and their transport mechanisms are covered, followed by infection control methods. A major emphasis is on the necessary considerations for various diagnostic and treatment and support areas. The second half of the course focuses on air distribution designs for surgical and patient rooms. Various control and energy efficiency techniques for cooling and heating plants are presented along with O&M and other commissioning topics. Lastly, smoke control and life safety best practices and application issues finish the course.

Instructors: Robert L. Cox, P.E., Member ASHRAE  
Daniel Koenigshofer, P.E., Member ASHRAE, HFDP  
Michael Sheerin, P.E., Member ASHRAE

### TUESDAY, JANUARY 29, 2013

#### Complying with Standard 90.1-2010 (code 72)

9:00 am – 4:00 pm, Dallas Convention Center,  
Room: C-140

This seminar is targeted at design professionals, code officials and building owners. Since 1989, the various versions of Standard 90.1 have been the benchmarks for commercial building energy codes in the United States and a key basis for standards in more than 15 countries around the world. The 2010 update of Standard 90.1 is a major revision with a goal of saving 30% more energy than the 2004 version. The 2010 version includes changes to Scope and Purpose along with other changes based on the 122 addenda that were considered.

**Instructors:** Mack Wallace, P.E., Member ASHRAE, LEED® AP  
Joseph Deringer, AIA, Member ASHRAE,  
LEED® AP

### **Energy Modeling Best Practices and Applications (code 73)**

*(Co-sponsored by IBPSA-USA and RMI)*

**9:00 am – 4:00 pm, Dallas Convention Center,**

**Room: C-142**

This seminar focuses on topics critical to the effective delivery of energy modeling services, including modeling fundamentals, modeling best practices and quality control, modeling to inform design, measurement and verification. This seminar presents case studies and discusses modeling tools for streamlining quality control procedures and the development of input data for building characterization.

**Instructors:** Ellen Franconi, Ph.D., Member ASHRAE, BEMP,  
LEED® AP

**Kendra Tupper, P.E., Associate Member ASHRAE**

## **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 continuing education credit requirements)*

## **SUNDAY, JANUARY 27, 2013**

### **Air-to-Air Energy Recovery Fundamentals (code 63)**

**2:00 pm – 5:00 pm, Dallas Convention Center,**

**Room: C-140**

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 provides an introduction to recommendations in the latest ASHRAE and AHRI standards, codes and guidelines with respect to air-to-air energy recovery technology to help determine where and when energy recovery is mandated and why. Finally, the course explores the construction, psychrometrics, thermodynamic theory of operation, and important operations and maintenance considerations for long life and consistent performance.

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

### **Humidity Control: Applications, Control Levels and Mold Avoidance (code 64)**

**2:00 pm – 5:00 pm, Dallas Convention Center,**

**Room: C-142**

This course puts the attendee on the fast track to understanding the effects of successful humidity control. It includes an in-depth discussion of moisture load calculations and how humidity control can be added to HVAC designs for seven different types of commercial buildings. The course also covers the effects of different humidity levels on thermal comfort, corrosion, mold growth and airborne microorganisms – information that helps the owner and designer define the optimal humidity control level for each application.

**Instructor:** Lew Harriman, Fellow ASHRAE

## **MONDAY, JANUARY 28, 2013**

### **Air-to-Air Energy Recovery Applications: Best Practices NEW! (code 65)**

**8:30 am – 11:30 am, Dallas Convention Center,**

**Room: C-140**

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 and energy efficiency and thermal comfort will be examined with respect to established performance metrics, peak performance results and annual energy savings.

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

### **Application of Standard 62.1-2010:**

#### **Multiple Spaces Equations & Spreadsheets (code 66)**

**8:30 am – 11:30 am, Dallas Convention Center,**

**Room: C-146**

Applying *ASHRAE Standard 62.1-2010* to multiple spaces can be challenging even for advanced HVAC practitioners. This advanced course covers the new Appendix A method and focuses on using the new spreadsheet from the 2010 *Users Manual*. The subject material includes both constant volume and VAV applications and then examines certain cases 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 2010 Standard. A copy of the spreadsheet will be provided and **attendees are strongly encouraged to bring their laptops** to learn the power of the spreadsheet and the effect on total outdoor air required when changing different design parameters. In-class exercises will be conducted, so attendees will benefit from using their own PC.

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

### **Combined Heat & Power: Design through Operations NEW! (code 67)**

**8:30 am – 11:30 am, Dallas Convention Center,**

**Room: C-142**

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

### Understanding Standard 189.1-2011 for High-Performance Green Buildings (code 68)

2:45 pm – 5:45 pm, Dallas Convention Center,  
Room: C-140

Based on Standard 189.1-2011, this course provides the minimum requirements for the design, construction, and plans for operation of high-performance green buildings, including new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings. Water use efficiency, indoor environmental quality, energy efficiency, site sustainability, and a building's impact on the atmosphere are covered. The course presents the goals of establishing mandatory criteria in all topical areas, providing simple compliance options, and the complement of green building rating programs for Standard 189.1. Upon completion of this course, participants will understand the basic requirements of Standard 189.1; understand the background that led to the development of these requirements; and become familiar with how to apply the requirements in the Standard to new commercial buildings and major renovation projects.

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

### Introduction to Ultraviolet Germicidal Irradiation (UVGI) Systems NEW! (code 69)

2:45 pm – 5:45 pm, Dallas Convention Center,  
Room: C-142

A comprehensive introduction to how ultraviolet germicidal irradiation (UVGI) can be used in conjunction with HVAC systems to improve indoor environmental quality (IEQ) and reduce airborne disease transmission is the focus of the course. The course surveys the history of the development of UVGI from its beginnings in the 19th Century to the present. The course describes the fundamentals of the germicidal action of UVGI and characteristics of UVGI sources, common system types and their applications, the economics of UVGI, and practical considerations including material degradation, maintenance and safety. Case studies are used to illustrate typical applications.

**Instructor:** William Bahnfleth, Ph.D., P.E., Fellow ASHRAE

### The Commissioning Process & Guideline 0 (code 70)

(co-sponsored with BCA, IES, NEBB)

2:45 pm – 5:45 pm, Dallas Convention Center,  
Room: C-155

This course targets building owners, facility managers, design engineers, building designers, architects, equipment manufacturers, and others interested in the commissioning process as outlined in *Guideline 0*. The course focuses on process intent, activities and deliverables. It is intended as an entry-level course that will provide attendees with a fundamental background of the ASHRAE-promoted commissioning process—which may then be supplemented by attending a more advanced course (such as ASHRAE's existing full-day commissioning course).

**Instructor:** Walter Grondzik, P.E., Fellow/Life Member  
ASHRAE, LEED® AP

### Evaluating the Performance of LEED®-Certified Buildings (code 71)

2:45 pm – 5:45 pm, Dallas Convention Center,  
Room: C-156

This course provides an overview of performance verification methods under LEED EB/O&M and BD&C 2009 as well as a preview of LEED 2012. Existing buildings earn Energy & Atmosphere credits by achieving or exceeding a specific Portfolio Manager score based on actual energy use. For BD&C, projected energy use must be less than a particular threshold and can earn additional points through further energy reductions. This course describes the Energy & Atmosphere prerequisites and credits available related to achieving and verifying performance of LEED certified buildings under the EB/O&M and BD&C programs.

**Instructor:** Mark Stetz, P.E., Member ASHRAE, BEAP

## TUESDAY, JANUARY 29, 2013

### Energy Management in New and Existing Buildings (code 75)

9:00 am – 12:00 pm, Dallas Convention Center,  
Room: C-155

Buildings use 40% of US energy, of which one-third can be easily saved. To achieve this goal, building professionals can utilize energy management. This is an orderly process in which managers use resources at their disposal to accomplish clear, energy-saving objectives. Sustained energy management is the quickest, cheapest, cleanest way to expand our world's energy supplies and reduce greenhouse gas emissions. This course weaves together energy management principles of the *ASHRAE Handbook—HVAC Applications*, Energy Star guidelines and practical experience of successful energy managers.

**Instructor:** Richard J. Pearson, P.E., Fellow/Life Member  
ASHRAE

### Avoiding IAQ Problems (code 76)

9:00 am – 12:00 pm, Dallas Convention Center,  
Room: C-156

Based on ASHRAE's *IAQ Guide, Best Practices for Design, Construction and Commissioning*, this course provides a systematic overview of the key objectives that must be met to achieve good indoor air quality. A review of the most common causes of IAQ problems in buildings, as well as the process management strategies that owners and design teams can use during design, construction and turnover to help avoid IAQ problems are discussed. The course discusses the state-of-the-art strategies to prevent IAQ problems related to moisture and mold in building assemblies, outdoor contaminants, moisture and dirt in air handling systems, material emissions, outdoor air monitoring and control and more. Case studies and examples are provided to help make the *IAQ Guide* easy to use on your next project.

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

## Designing Toward Net-Zero Energy Commercial Buildings (code 77)

**1:00 pm – 4:00 pm, Dallas Convention Center,  
Room: C-146**

Net-zero energy buildings are those which, on an annual basis, use no more energy from the utility grid than is provided by on-site renewable energy sources. These buildings use 50% to 70% less energy than comparable traditional buildings. The remaining energy use comes from renewable sources, like solar panels or wind turbines incorporated into the facility itself. The course provides application knowledge of the design and operating principles for energy efficient buildings and available technologies and systems to achieve net-zero energy building design. Building design strategies, review of current policy and regulation, energy, environmental and economic assessment of building's performance, energy efficiency in HVAC, lighting and appliances, and on-site renewable energy sources are reviewed.

**Instructors: Dunstan Macauley, P.E., Member ASHRAE, HBDP  
Frank Mills, P.Eng., Member ASHRAE**

## Understanding & Designing Dedicated Outdoor Air Systems (code 78)

**1:00 pm – 4:00 pm, Dallas Convention Center,  
Room: C-155**

This course presents some of the issues that emphasize the advantages of separate dedicated outdoor air systems (DOAS) and the disadvantages of delivering the ventilation via single all-air variable air volume systems. The course discusses the consequent issue of the thermodynamic state of delivered ventilation air that arises from the design paradigm of a separate DOAS.

**Instructor: Stanley Mumma, Ph.D., P.E., Fellow/Life Member  
ASHRAE**

## Laboratory Design: The Basics and Beyond NEW! (code 79)

**1:00 pm – 4:00 pm, Dallas Convention Center,  
Room: C-156**

A comprehensive overview of HVAC design for laboratories is examined in the course. The course focuses on the essential elements of the design process that are unique to laboratory HVAC systems. Course 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 be presented.

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

# notes

## 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](mailto: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](http://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

Dallas – January 2013

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. New York 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](mailto: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 Dallas Sheraton.

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

## ASHRAE'S CONFERENCES AND EXPOSITIONS COMMITTEE WELCOMES YOU TO THE 2013 WINTER CONFERENCE

Four 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 15, 2013, 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 a Winter Conference CD 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 a Winter Conference CD 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.

### 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 Dallas 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 Dallas. If you do not have your password and link go to [www.ashrae.org/dallasonline](http://www.ashrae.org/dallasonline), click on the link to access the Virtual Conference Online, 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. 13. Presentations available online for 18 months.

A full slate of technical programs will be posted beginning Monday, Jan. 28, of the sessions that were presented the previous day, with additional content posted through Wednesday, Jan. 30.

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, Sheraton, Austin Ballroom, 2nd floor, \$299 ASHRAE member; \$464 non member. If you register on site, your password will be emailed to you within 24 hours of your registration.



### Winter Conference CD (All Papers on CD)

Technical Papers and Conference Papers as presented at this Conference

\$98 (includes five FREE hard copies of preprint papers)

Available at the Conference Bookstore



### Conference Seminar DVD

54 Seminars (PowerPoint files synced with speakers' audio)

\$119 (ships April 2013)



### Conference Preprints (Individual Papers, In Print)

Technical Papers and Conference Papers as presented at this Conference

\$6 each

Available at the Conference Bookstore



### ASHRAE Transactions (Print Volume)

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

\$129 (ships May 2013)



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



GBCI LEED AP CE Credits

### Packages

1. Winter Conference CD and *ASHRAE Transactions* (See descriptions at left.)

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

\$169 – Available at the Conference Bookstore

2. Winter Conference CD and Seminar DVD

\$169 – Purchase in the Conference Bookstore

3. Winter Conference Package (Seminar DVD, Conference CD and *ASHRAE Transactions*)

\$199 – Purchase in the Conference Bookstore

All prices are special conference-only member prices.

## Sunday, January 27

8:00 AM-9:30 AM

### Conference Paper Session 1 (Intermediate)

#### Advances in Performance and Efficiency of Air Conditioning Systems

Track: HVAC&R Systems & Equipment



Room: Lone Star A4

Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps

Chair: Vance W. Payne, Ph.D., Member, NIST, Gaithersburg, MD

Air conditioning systems affect a variety of aspects of building performance, from energy efficiency to IEQ. Methods and models to improve energy efficiency, IEQ and system performance are presented. These papers illustrate how new materials for component construction and use of modern refrigerants affect performance of air conditioning systems.

1. Performance Improvement of a Roof Top Air Conditioning Unit by Refrigerant Circuitry Optimization (DA-13-C001)

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

2. Application of a Linear Fit Mixed System Rating Method for Single Speed Unitary Air Conditioners (DA-13-C003)

Vance W. Payne, Ph.D., Member, NIST, Gaithersburg, MD

3. Volume Optimization of Polymer Tube-Bundle Heat Exchangers in Air-Heating Applications (DA-13-C004)

Lingjun Meng, Student Member and Anthony M. Jacobi, Ph.D., Fellow ASHRAE, University of Illinois at Urbana-Champaign, Urbana, IL

4. WITHDRAWN – Development and Validation of a Mechanistic Model for Variable-Speed Multi-Split Heat Pumps (DA-13-C005)

Howard Cheung, Student Member, Simbarashe Nyika, Student Member and James Braun, Ph.D., Fellow ASHRAE, Purdue University, West Lafayette, IN

### Conference Paper Session 2 (Intermediate)

#### Innovative Energy Efficiency Strategies for Commercial Buildings

Track: Energy Conservation



Room: Lone Star A3

Chair: Michael Deru, Ph.D., Member, National Renewable Energy Laboratory, Golden, CO

Commercial buildings are among the largest energy consumers in North America. This can be especially true for retail spaces. Several innovative strategies for minimizing energy consumption are presented along with case studies identifying the use of these strategies. Comparisons with DOE initiatives and ASHRAE standards, including 90.1, are included.

1. High Efficiency Retrofit Lessons for Retail From a Supertarget (DA-13-C006)

Rois Langner, Associate Member<sup>1</sup>, Michael Deru<sup>1</sup>, Adam Hirsch<sup>1</sup> and Scott Williams<sup>2</sup>, (1)National Renewable Energy Laboratory, Golden, CO, (2)Target, Minneapolis, MN

2. Control Strategy for Minimizing Energy Usage with Economizer and Energy Recovery Systems (DA-13-C007)

Stephen J. Treado, Ph.D., P.E., Member and Xing Liu, Student Member, Pennsylvania State University, University Park, PA

3. Whole Building Efficiency for Whole Foods (DA-13-C008)

Michael Deru, Ph.D., Member, National Renewable Energy Laboratory, Golden, CO

4. Manitoba Hydro Place: Energy Efficiency 2.0 (DA-13-C009)

Mark Pauls, P.Eng.<sup>1</sup>, Alexander Knirsch<sup>2</sup>, Tom Akerstream<sup>1</sup> and Thomas Auer<sup>2</sup>, (1)Manitoba Hydro, Winnipeg, MB, Canada, (2)Transsolar Energietechnik GmbH, Stuttgart, Germany



## Seminar 1 (Basic)

### Ask Not What Your Industrial Committee Can Do For You – Ask What You Can Do For Your Industrial Committee

Track: *Industrial & Transportation Ventilation*

Room: Dallas A3

Sponsor: 09.02 Industrial Air Conditioning, 5.4, 5.8, 5.9, 9.3, 09.03 Transportation Air Conditioning

Chair: Michael Connor, P.E., Member, Connor Engineering Solutions, Alpharetta, GA

ASHRAE's Industrial and Transportation Committees are concerned with standards, handbook chapters and other publications and programs for environmental systems in industrial facilities. These are among the oldest standing technical committees in our society. Industrial and Transportation facilities also offer the greatest potential for energy conservation and resource conservation. According to the US Department of Energy, the Industrial and Transportation sectors of our economy are responsible for 59% of the total energy consumed in the USA (2010). Being "green" in this area has always been the custom as it represents good business: it lowers the cost of goods sold and increases the bottom line. This session will introduce ASHRAE's Industrial and Transportation Technical Committees, their activities and the latest green efforts in these sectors. This session also discusses "hot button" issues facing these committees.

#### 1. TC 5.8 Industrial Ventilation

Kenneth R. Mead, Ph.D., P.E., Member, CDC - National Institute for Occupational Safety and Health (NIOSH), Cincinnati, OH

#### 2. TC 5.9 Enclosed Vehicular Facilities

Greg Sanchez, P.E., Member, MTA New York City Transit, New York, NY

#### 3. TC 9.2 Industrial Air Conditioning

Michael Connor, P.E., Member, Connor Engineering Solutions, Alpharetta, GA

#### 4. TC 9.3 Transportation Air Conditioning

Richard Fox, Member, Honeywell Aerospace, Tempe, AZ



## Seminar 3 (Basic)

### Fundamental Pump Selection and Control

Track: *HVAC Fundamentals and Applications*

Room: Dallas C

Sponsor: 06.01 Hydronic and Steam Equipment and Systems

Chair: Julia Keen, Ph.D., P.E., Member, Kansas State University, Manhattan, KS

This seminar provides a quick review of common centrifugal pump types installed in HVAC systems and how they are selected, operated and controlled. It describes how to read and interpret manufacturers pump curves for a wealth of information.

#### 1. Centrifugal Pumping and Pump Types

Reddy Palicharla, Aurora Pump/Pentair Water, North Aurora, IL

#### 2. Pump Selection for Open and Closed Loop Systems

Larry Konopacz, Xylem Bell & Gossett, Morton Grove, IL

#### 3. Differential Pressure Controlled Pumps

Niels Bidstrup, Ph.D., Grundfos Management A/S, Bjerringbro, Denmark



## Seminar 4 (Intermediate)

### Heat Exchanger Tests with Alternative Refrigerants

Track: *Refrigeration*

Room: Lone Star A2

Sponsor: 08.04 Air-to-Refrigerant Heat Transfer Equipment

Chair: Edward A. Vineyard, P.E., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Low global warming potential refrigerants are a recent topic of interest as the result of potential regulations limiting the use of existing refrigerants in many types of building equipment. Advantages and disadvantages of several proposed alternatives, including hydrocarbons, ammonia, and CO<sub>2</sub>, will be discussed along with test results in equipment and heat exchangers.

#### 1. Evaluation of Alternative Refrigerant Performance in Air to Refrigerant Heat Exchangers

Omar Abdelaziz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

#### 2. Opportunities for Using Low GWP Refrigerants with Microchannel Heat Exchanger Technology

Chad Bowers, Ph.D., P.E., Member, Creative Thermal Solutions, Urbana, IL

#### 3. High Performance-Low Global Warming Potential Refrigerants in Heat Exchangers for Residential Air-Source Heat Pump Systems

Lorenzo Cremaschi, Ph.D., Member, Oklahoma State University, Stillwater, OK



## Seminar 2 (Intermediate)

### Diagnosing and Fixing Building Moisture Problems – Case Histories From Hot & Humid Climates

Track: *HVAC Fundamentals and Applications*

Room: Dallas B

Sponsor: 01.12 Moisture Management in Buildings

Chair: Steve Cornick, Member, National Research Council Canada, Ottawa, ON, Canada

Moisture and humidity problems are often a complex mixture of decisions made by different professionals at different times about HVAC systems, architecture and building operations. Untangling the causes of problems and planning solutions requires understanding of the typical interactions between the building and its HVAC systems plus an appreciation of the practical aspects of operating buildings with limited budgets. Case histories presented in this seminar can help building owners and facility managers avoid classic moisture problems and solve them when they occur.

#### 1. Diagnosing & Fixing a Major Mold Growth Problem in a Health Clinic

Lew Harriman III, Fellow ASHRAE, Mason Grant, Portsmouth, NH

#### 2. The Unintended Consequences of the New IGCC (Green Code) On HVAC and Mold Problems in Humid Climates

George Dubose, Member, Liberty Building Forensics Group, Zellwood, FL

#### 3. Sources and Solutions of Classic Moisture Problems – Lessons Learned in Hot & Humid Climates

Raoul A. Webb, P.E., Member, ENVIRON International Corp., Tampa, FL



## Seminar 5 (Intermediate)

### Improving the IEQ in Public School Classrooms

Track: *Facility Management; Operations, Technology and Energy Improvements*

Room: Lone Star A1

Sponsor: 02.03 Gaseous Air Contaminants and Gas Contaminant Removal Equipment, SSPC 62.1, Environmental Health Committee

Chair: Gerald Lamping, Member, Take Care of Your Classroom Air (TCYCA), Boerne, TX

There are strong relationships between a school classroom's healthy indoor environment (IEQ) and its student wellness and productivity. The seminar describes why reductions in classroom contaminant levels are needed to create and maintain healthy schools. Arguments for the inclusion of contaminant level measurements in an IEQ improvement program, for reducing the amount of contaminants in a classroom, and for the implementation of a school environmental health program are also discussed. Recent research projects and actual case studies will substantiate the relationship between healthy public school classrooms and student attendance, health and performance.

#### 1. Schools as Pediatric Environments

Larry Lowry, Ph.D., The Southwest Center for Pediatric Environmental Health (SWCPEH), Tyler, TX

#### 2. Research Studies on IEQ in Classrooms

Richard Shaughnessy, Ph.D., University of Tulsa: Indoor Air Program, Tulsa, OK



### 3. School IEQ Sensor Development and Application

*John J. Vasselli, The Texas Allergy, Indoor Environment, and Energy (TxAIRE) Institute, Tyler, TX*

### 4. Elements of EPA's School Environmental Health and IAQ Programs

*Stacy Murphy, U.S. Environmental Protection Agency - Region 6, Dallas, TX*

## Seminar 6 (Intermediate)

### Smart Methods to Prevent Electrical Harmonics Problems in Buildings

*Track: Large Building Design*

*Room: Dallas A2*

*Sponsor: 01.11 Electric Motors and Motor Control, 1.9 Electrical Systems, 09.01 Large Building Air-Conditioning Systems*

*Chair: Armin Hauer, Member, ebm-papst Inc., Farmington, CT*

Granted, harmonics in electrical systems have caused unforeseen problems. But overly cautious consultants insist on load-side harmonics mitigation devices even when they are not technically necessary and not economically justified. IEEE519 relates to electrical systems, while variable speed drives are just individual pieces in commercial building HVAC/R. This session provides practical guidance for applications of non-linear loads that are grid-operated and loads that are running off standby power supplies. Examples of reliable, economical, standard 6-pulse inverter drives will be contrasted against cases that should employ low harmonic drives. Case studies of large buildings are included. The session teaches about cost avoidance without jeopardized electrical performance. Specifying engineers will gain assurance for their variable speed drive selections in new construction. Facilities engineers will benefit from hearing about the most suitable remedies in retrofit situations.

#### 1. Proper Application of IEEE 519

*Michael R. Olson, Member, ABB, Inc., New Berlin, WI*

#### 2. Economics of Low Harmonic Drives

*Jim Chmielewski, Member, Emerson Control Techniques, Eden Prairie, MN*

#### 3. Study of Two Large Building Harmonic Mitigation Cases

*Albert Archambault, Mirus International Inc., Brampton, ON, Canada*



# Sunday, January 27

## 11:00 AM-12:30 PM

## Technical Paper Session 1 (Intermediate)

### Towards Net-Zero Homes, Contemporary Building Materials to Improve Energy Efficiency

*Track: HVAC Fundamentals and Applications*

*Room: Dallas A2*

*Sponsor: 01.01 Thermodynamics and Psychrometrics*

*Chair: Larry Sun, Member, Tsuchiyama, Kaino Sun & Carter, Irvine, CA*

Building materials play an important role in improving the energy efficiency of buildings. The papers in this session investigate newer technologies and their impact on energy efficiency.

#### 1. Understanding a Potential for Application of Phase Change Materials (PCMs) in Building Envelopes (DA-13-001)

*Jan Kosny, Ph.D., Member<sup>1</sup> and Elizabeth Kossecka<sup>2</sup>, (1)Sustainable Energy Systems, Cambridge, MA, (2)Institute of Fundamental Technological Research, Warsaw, Poland*

#### 2. Parametric Investigation of PCM Thermal Properties on Energy Demand of Buildings in Toronto (DA-13-002)

*M. Ebrahim Poulad, Student Member and Alan Fung, Ryerson University, Toronto, ON, Canada*

#### 3. Evaluation of Calculation Models for Predicting Thermal Performance of Various Window Systems (DA-13-003)

*Yuichi Takemasa, Ph.D., P.E., Member<sup>1</sup>, Satoshi Togari, Ph.D.<sup>2</sup>, Katsuhiro Miura, Ph.D., Member<sup>1</sup>, Masahiro Katoh<sup>1</sup>, Masaya Hiraoka<sup>3</sup> and Jun Owada<sup>3</sup>, (1)Building Environment Group, Kajima Technical Research Institute, Tokyo, Japan, (2)Kajima Technical Research Institute, Tokyo, Japan, (3)Kajima Design, Kajima Corp., Tokyo, Japan*



## Conference Paper Session 3 (Intermediate)

### Designing Automation and Control in HVAC Systems

*Track: HVAC&R Systems & Equipment*

*Room: Lone Star A2*

*Chair: Michael R. Brambley, Ph.D., Fellow ASHRAE, Pacific Northwest National Laboratory, Richland, WA*

Twenty-first century buildings are fully integrated from an automation and control perspective. Concepts of automated design and mechanical system control are fundamental requirements that engineers must incorporate. These techniques must also meet or exceed the modeled characteristics developed through complex simulation. Theory, practical application and case studies provide cutting edge tools for automation and control for engineers designing and retrofitting efficient and modern buildings.

#### 1. Automated Design of Buildings: Need, Conceptual Approach, and Illustrative Example (DA-13-C010)

*Steven Snyder, Associate Member<sup>1</sup>, Marlin Addison, Member<sup>2</sup> and T. Agami Reddy, Ph.D., P.E., Fellow ASHRAE<sup>2</sup>, (1)Johnson Controls, Inc., Philadelphia, PA, (2)The Design School/The School of Sustainable Engineering and the Built Environment, Tempe, AZ*

#### 2. Water Cooled Chiller Plant Design and Control (DA-13-C011)

*Richard Franseen, P.E., Member, Honeywell Building Solutions, Charlotte, NC*

#### 3. Uncertainty Propagation for Virtual Sensors Using Combination of Device's Characteristic Curves and Physical Sensor Measurements (DA-13-C012)

*Li Song, Ph.D., P.E., Member<sup>1</sup> and Gang Wang, Ph.D., P.E., Member<sup>2</sup>, (1)University of Oklahoma, Norman, OK, (2)University of Miami, Coral Gables, FL*



# Sunday, January 27

## 9:45 AM-10:45 AM

## Technical Plenary 1 (Basic)

### Ethical Practice by Engineers

*Track: Standards, Guidelines and Codes*

*Room: Dallas B*

*Sponsor: 01.07 Business, Management & General Legal Education*

*Chair: Norm Maxwell, P.E., Member, Environmental Air Quality, Great Neck, NY*

This Technical Plenary Session will be discussing the day to day concerns that engineers should have regarding their dealings with the owners, contractors, manufacturers and other entities involved in normal communications for design and construction projects. With the advent of the requirement of Professional Development Hours for Professional Engineers, it has been noted that many of the states are requiring topics on ethics. It is anticipated that this session will be an ongoing discussion of ethical concerns at future meetings.

#### 1. ASHRAE Policies and Differences with Other Societies

*Richard Rooley, P.Eng., Presidential Member, Rooley Consultants, Bucks, United Kingdom*

#### 2. Profession Stamping of Plans and Specifications

*Michael Bilderbeck, P.E., Member, Pickering, Inc., Memphis, TN*

#### 3. International Ethics

*Farooq Mehboob, Member, S Mehboob, Karachi, Pakistan*

## Seminar 7 (Basic)

### Commercial Kitchen Ventilation: The Design Process (Part 1)

Track: HVAC Fundamentals and Applications

Room: Lone Star A4



Sponsor: 05.10 Kitchen Ventilation

Chair: Richard T. Swierczyna, Associate Member, Food Service Technology Center, San Ramon, CA

First of two seminars to address the design of commercial kitchen ventilation systems. This seminar presents the overall design process along with best practices for hood selection, filtration and exhaust air quality, duct design and fan considerations, and fire safety and protection.

#### 1. Hood Selection and Appliances

Derek W. Schrock, Member, Halton Co., Scottsville, KY

#### 2. Exhaust Air Quality

Russell R. Robison, Member, Gaylord Industries, Tualatin, OR

#### 3. Exhaust Ductwork, Duct Design, Fan Considerations and Selection

John Clark, P.E., Member, Karges-Faulconbridge, Inc., Minneapolis, MN

#### 4. Fire Safety and Protection

Michael Morgan, Associate Member, Captive Aire Systems, Allentown, PA

## Seminar 8 (Intermediate)

### Designing Energy Efficient Ventilation Systems for Transportation Using Jet Fans

Track: Industrial & Transportation Ventilation

Room: Dallas A3



Sponsor: 05.09 Enclosed Vehicular Facilities, 05.01 Fans

Chair: Greg Sanchez, P.E., Member, MTA New York City Transit, New York, NY

Tunnel ventilation of transportation systems is key for public transport. Equipment used in such systems consume a lot of energy. Furthermore, energy efficiency becomes critical. This seminar presents some critical topics in dealing with the use of jet fans in tunnel ventilation, and how to efficiently design this critical transportation ventilation system.

#### 1. Efficiencies in Rail Tunnel Ventilation Design From Jet Fans

Mark Colino, P.E., Member, Parsons Brinckerhoff, Inc., New York, NY

#### 2. Using Variable Frequency Drives in Jet Fan Systems for Tunnel Ventilation

Robert Z. Smith, Member, Innerquest LLC, Dowagiac, MI

#### 3. Specifications for High Temperature Testing of Fire Life Safety Fans: A Contrast and Comparison

George A. Gamble, P.E., Member, Clarage, Akron, OH

## Seminar 9 (Intermediate)

### Foundation Heat Exchangers for Low Cost Residential Ground Source Heat Pump Systems

Track: HVAC&R Systems & Equipment

Room: Dallas C



Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Michel Bernier, Ph.D., Member, Ecole Polytechnique de Montreal, Montreal, QC, Canada

Foundation heat exchangers (FHX) are an alternative to more costly ground heat exchangers utilized in ground-source heat pump (GSHP) systems serving detached or semi-detached houses. FHX are placed within the excavation made for the basement and foundation along with other excavations used for utility trenching. This seminar describes a model and its validation against experimental measurements in two test houses in Tennessee. In addition, the effects of various US climates on the performance of FHX are reported.

#### 1. Foundation Heat Exchangers - Modeling and Validation

Jeffrey Spitzer, Ph.D., P.E., Oklahoma State University, Stillwater, OK

#### 2. Foundation Heat Exchangers - Measurements at Two Test Houses in Oak Ridge, Tennessee

Piljae Im, Ph.D., Oak Ridge National Laboratory, Oak Ridge, TN

## 3. Foundation Heat Exchangers - Feasible Climates for Utilization

Daniel Fisher, Ph.D., P.E., Fellow ASHRAE, Oklahoma State University, Stillwater, OK

## Seminar 10 (Intermediate)

### Integrated Building Energy Retrofits

Track: Energy Conservation

Room: Lone Star A3



Sponsor: 07.01 Integrated Building Design

Chair: Gregory Dobbs, Ph.D., Member, Pennsylvania State University, Philadelphia, PA

Energy retrofits in small and medium buildings are uncommon because the assessment cost is too high and energy conservation measure predictions are too uncertain. Moving beyond conventional lighting and simple-equipment retrofits yielding 10-20% improvement to achieve gains of 30-50% is not conceivable under current market conditions and without significant proof of performance. This is a highly-integrated problem focusing on modeling, assessment, project delivery, building science, technology integration, controls, public policy, market structures, education, workforce training, business models, capital formation and human behavior. This seminar presents case studies and research on energy savings measures for commercial, institutional and multi-family buildings.

#### 1. Building 101 Case Study

Richard Sweetser, Member, Exergy Partners Corp., Herndon, VA

#### 2. Metering, Sub-Metering for Inverse Modeling, a Potential Tool for Risk Reduction in Integrated Building Retrofit Planning

James Freihaut, Ph.D., Member, Pennsylvania State University, State College, PA

#### 3. The New Nexus: Building Benchmarking and Energy Efficiency Retrofits

Mark B. Stutman, Pennsylvania State University, Pennsylvania, PA

## Seminar 11 (Intermediate)

### Moisture Control in Commissioning of New and Existing Buildings

Track: Facility Management; Operations, Technology and Energy Improvements

Room: Lone Star A1



Sponsor: 07.09 Building Commissioning, 04.04 Building Materials and Building Envelope Performance

Chair: Mike Eardley, P.E., Member, Cannon Design, Boston, MA

Moisture control in the commissioning process is based on project requirements for moisture problem avoidance, building assessment, field testing, and building science. This seminar focuses on the interaction of building systems that affect moisture in buildings and demonstrates important lessons learned by use of case studies.

#### 1. Providing Moisture Control Solutions in Building Commissioning

Donald Snell, Member and George Dubose, Member, Liberty Building Forensics Group, Zellwood, FL

#### 2. The Art and Science of Building Enclosure Commissioning

Fiona Aldous, Wiss, Janney, Elstner Associates, Inc., Irving, TX

## Seminar 12 (Intermediate)

### Smoothing Bumps on the Road to Net Zero Energy Buildings – Part 1

Track: Energy Conservation

Room: Dallas B



Sponsor: 02.08 Building Environmental Impacts and Sustainability, 07.06 Building Energy Performance

Chair: Ray Patenaude, P.E., Member, The Holmes Agency, Tierra Verde, FL

The road to net zero energy is paved with good intentions. Voluntary initiatives, consensus standards, mandatory codes, and government regulations are focusing more effort on setting worthy goals for sustainable buildings that engineers, architects, and designers must ultimately achieve through real designs that work. Unfortunately, it will be challenging and often impossible

for many high performance buildings to achieve net zero energy consumption on their own. This seminar highlights the significant value of cost-effective energy efficiency measures, while illustrating the need for more flexibility in determining and implementing energy targets for high performance buildings.

### 1. The Role and Limits of Stretch Codes in Reducing Building Energy Consumption

**R. Christopher Mathis, Member, MC<sup>2</sup> Mathis Consulting Company, Asheville, NC**

### 2. Measured Home Performance – Moving Residential Energy Consumption Closer to Net Zero

**Lew Harriman III, Fellow ASHRAE, Mason Grant, Portsmouth, NH**

### 3. Analysis of Energy Reduction Opportunities in a High Rise Office Building

**Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL**

## Sunday, January 27

1:30 PM-3:00 PM

### Technical Paper Session 2 (Intermediate)

#### Advanced Building Modeling

*Track: Energy Conservation*



*Room: Dallas A2*

**Sponsor: 04.07 Energy Calculations**

*Chair: Jeffrey Spitler, Ph.D., P.E., Oklahoma State University, Stillwater, OK*

Advances in predictive modeling and commissioning have been paramount in energy and operational savings. The most current research on modern, predictive energy modeling including multi-room, 3D and uncommon-shaped spaces along with advances in automated building commissioning are presented.

#### 1. A Ground-Coupled Dynamic Wall System for New and Existing Structures (DA-13-004)

**Utpal Roy and Lowell Lingo, Syracuse University – Mechanical and Aerospace Engineering, Syracuse, NY**

#### 2. A Statistical Approach to Detect Abnormal Building Energy Consumption with ABCAT (DA-13-005)

**Guanjing Lin, Student Member and David E. Claridge, Ph.D., P.E., Fellow ASHRAE, Texas A & M University, College Station, TX**

#### 3. Thermostat Set Point Temperature Prediction Using an Integrated Zonal Model (DA-13-006)

**Yao Yu and Ahmed Cherif Megri, University of Wyoming, Laramie, WY**

### Conference Paper Session 4 (Intermediate)

#### Advances in Efficient Residential Design

*Track: Energy Conservation*



*Room: Lone Star A2*

*Chair: Thomas H. Kuehn, Ph.D., Fellow ASHRAE, University of Minnesota, Minneapolis, MN*

From low GWP materials to energy efficiency, the design of residential buildings is advancing quickly. Novel design considerations and simulation analysis of advanced residential design will be presented. Considerations including materials, life cycle costs and performance for high end to low income are included.

#### 1. An Experimental Study of the Performance of New Low Global Warming Potential (LGWP) Refrigerants at Extreme High Temperature Ambient Conditions in Residential AC Ducted Split Systems (DA-13-C013)

**Auvi Biswas, Student Member, Atharva Barve, Student Member and Lorenzo Cremaschi, Ph.D., Member, Oklahoma State University, Stillwater, OK**

#### 2. Air Flow Regimes and Thermal Comfort in a Living Room (DA-13-C014)

**Essam E. Khalil, Ph.D., Fellow ASHRAE and Esmail ElBially, Ph.D., Cairo University, Cairo, Egypt**

#### 3. Performance of Residential Building Energy Models Using Localized Weather Networks (DA-13-C015)

**Michael J. Siemann, Student Member and Jungho Kim, Ph.D., Member, University of Maryland, College Park, MD**

### 4. Energy Analysis of Habitat for Humanity Home Designs (DA-13-C016)

**Brandon S. Field, Ph.D., Associate Member and Matthew McConnell, Student Member, University of Southern Indiana, Evansville, IN**

### Seminar 13 (Basic)

#### Commercial Kitchen Ventilation: The Design Process (Part 2)

*Track: HVAC Fundamentals and Applications*

*Room: Lone Star A4*



**Sponsor: 05.10 Kitchen Ventilation**

*Chair: Michael L. Watz Jr., P.E., Member, Greenheck Fan Corp, Schofield, WI*

Second of two seminars addressing the design of commercial kitchen ventilation systems. Designing a ventilation system for a commercial kitchen can present many challenges. Several factors must be considered to make the system as effective and efficient as possible. This seminar covers design considerations, HVAC load calculations, and three methods of MUA considerations. In addition, the integration of commercial kitchen ventilation (including commercial kitchen – demand controlled ventilation) into the building HVAC system is discussed. Also presented are impacts of codes, standards, and energy on the overall system design.

#### 1. The CKV Engineers Perspective: Incorporating the HVAC Load Calculations and the Replacement Air Into Your Overall Design

**Francis Kohout, P.E., Member, McDonald's Corp., Oak Brook, IL**

#### 2. Integration of the CKV System with Building HVAC

**Don Fisher, P.Eng., Associate Member, Food Service Technology Center, San Ramon, CA**

#### 3. Kitchen Ventilation of Overall System Design - Codes, Standards, Energy Considerations

**Michael Morgan, Associate Member, Captive Aire Systems, Allentown, PA**

### Seminar 14 (Intermediate)

#### Desiccant Enhanced Air Conditioning

*Track: HVAC&R Systems & Equipment*



*Room: Dallas C*

**Sponsor: 08.12 Desiccant Dehumidification Equipment and Components**

*Chair: Michael S. Sherber, P.E., Member, The Firma Group, Avon, CT*

Liquid desiccant cooling and dehumidification systems have the ability to provide significant energy savings and superior dehumidification performance over conventional compressor based air conditioning systems. Three different membrane based systems are discussed along with their performance and ability to prevent carryover. A fourth liquid desiccant system based on plastic film finned tubes with wicking surfaces is also discussed.

#### 1. Desiccant Enhanced Evaporative Air Conditioning

**Eric Kozubal, Member, National Renewable Energy Laboratory, Golden, CO**

#### 2. A Liquid Membrane Air Conditioner

**Peter Vandermeulen, Associate Member, 7AC Technologies, Inc., Woburn, MA**

#### 3. A Proof of Concept Model of a Liquid Desiccant Assisted Vapor Compression Air Conditioner

**Andrew Lowenstein, Ph.D., Member, AIL Research, Inc., Princeton, NJ**

#### 4. Membrane Energy Exchangers - Raising the Bar of Efficiency

**Blake Erb, Venmar CES, Saskatoon, SK, Canada**

### Seminar 15 (Basic)

#### The First Standards on Legionnaires' Disease – Why Cringe When You Can Be Prepared for Proposed Standards 188, Guideline 12 and CTI Guideline and Standard 159

*Track: Standards, Guidelines and Codes*

*Room: Dallas B*



**Sponsor: 03.06 Water Treatment, SPC 188, 08.06 Cooling Towers and Evaporative Condensers**

*Chair: Scott Mayes, LAKOS, Olathe, KS*

There are several new standards either published or proposed on Legionnaires' Disease. If you have been concerned about how these documents will affect you and your business or operations, this seminar is a must for you.

Learn how to make use of these new tools to minimize your legal liability with respect to LD.

#### 1. Standard 188

*William E. Pearson II, Member, Southeastern Labs, Raleigh, NC*

#### 2. Guideline 12

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

#### 3. What CTI Standard 159 Will Mean to You

*Helen R. Cerra, Member<sup>1</sup> and Paul Lindahl<sup>2</sup>, (1)ChemTreat, Inc., Glen Allen, VA, (2)SPX Thermal Equipment and Services, Overland Park, KS*

### Seminar 16 (Intermediate)

#### Tools and Methods to Manage Animal Research Facilities for Effective and Efficient Long-term Operations

*Track: Facility Management; Operations, Technology and Energy Improvements*

*Room: Lone Star A1*

*Sponsor: 02.02 Plant and Animal Environment, 09.10*

#### Laboratory Systems

*Chair: Carol Donovan, Associate Member, Sebesta Blomberg & Associates, Woburn, MA*

Animal research facilities and biosafety laboratories present a unique challenge to designers, owners and operators with their inherent complexity of systems, health and safety requirements, regulatory compliance, energy use intensity, and environmental impacts. These mission critical facilities require a unique approach to sustainability and energy saving strategies to ensure maximum system reliability and safe operations. The three papers presented in this seminar provide three perspectives to broaden our understanding of how sustainability options combined with quality facility management achieve effective and efficient long-term operations.

#### 1. Information Tools for Long Term Sustainability in Labs

*James Coogan, P.E., Member, Siemens, Buffalo Grove, IL*

#### 2. ASU Biodesign Institute: Best-in-Class Sustainability and Energy Cost Controls for Research Facilities

*Mike McLeod<sup>1</sup> and David Rausch, Associate Member<sup>2</sup>, (1)Arizona State University, Phoenix, AZ, (2)Phoenix Controls, Andover, MA*

#### 3. KSU's Operating Assurance Model for Safety and Research Quality

*Scott Rusk, Kansas State University, Manhattan, KS*

### Seminar 17 (Intermediate)

#### Ventilation of the Industrial Environment

*Track: Industrial & Transportation Ventilation*

*Room: Dallas A3*

*Sponsor: 05.08 Industrial Ventilation Systems*

*Chair: Gerhard Knutson, Ph.D., Knutson Ventilation, Edina, MN*

Industrial facilities frequently generate airborne contaminants while adding value in the manufacturing process. To reduce any potential adverse consequence of contaminant release, industrial ventilation has become the mainstay of the engineering controls. This seminar addresses engineering controls in new industries (nanomanufacturing) and established industries (food and foundry). The seminar also introduces a new tool for design – computational fluid dynamics.

#### 1. Engineering Control Strategies for Nanomanufacturing

*Li-Ming Lo, National Institute for Occupational Safety and Health, Cincinnati, OH*

#### 2. Engineering Controls in the Flavorings Industry that Focused on the Protection of Workers from Acquiring Popcorn Lung (Bronchiolitis obliterans)

*Alberto Garcia, United Boilers, San Juan, PR*

#### 3. Foundry Application – Removal of Triethylamines and Sand Simultaneously

*Raoul A. Webb, P.E., Member, ENVIRON International Corp., Tampa, FL*

#### 4. CFD Modeling of Ventilation of a Composting Facility

*Duncan Phyfe, Alden Research Laboratory, Alden, MA*

### Seminar 18 (Intermediate)

#### What Mechanical Engineers Need to Know about Envelopes for High Performance Buildings

*Track: HVAC Fundamentals and Applications*



*Room: Lone Star A3*

*Sponsor: 04.04 Building Materials and Building Envelope Performance*

*Chair: Peter Adams, P.Eng., Member, Morrison Hershfield, Toronto, ON, Canada*

High performance building design requires careful coordination between many parties, most notably the designer of the building enclosure and the designer of the mechanical systems. This seminar explores the complex interactions between the interior environment, mechanical systems, and building enclosures, and demonstrates how mismatching these systems can result in inefficient buildings with low durability and long-term performance.

#### 1. Heat, Air, and Moisture Migration in Building Enclosures

*Alex McGowan, P.Eng., Member, Levelton Consultants Ltd., Victoria, BC, Canada*

#### 2. Interior Building Environments and Their Impacts On Building Enclosures

*Hugo Hens, Ph.D., Fellow ASHRAE, K.U.Leuven, Leuven, Belgium*

#### 3. Designing Retrofit Systems for Existing Buildings

*Sean O'Brien, P.E., Member, Simpson Gumpertz & Heger, Inc., New York, NY*

## Sunday, January 27

3:00 PM-5:00 PM

### Seminar (Intermediate)

#### Fundamental Thermal Properties of New Lower GWP Refrigerants for Heat Transfer Analysis

*Track: Refrigeration*

*Room: Lone Star A3*

*Sponsor: 01.03 Heat Transfer and Fluid Flow, MTG: Alternative Low GWP Refrigerants*

*Chair: Ken Schultz, Member, Trane Co., LaCrosse, WI*

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. Research efforts are ongoing that explore the performance of refrigerants that have lower global warming potential (GWP) than the refrigerants currently used by HVAC and Refrigeration industry. This seminar provides an overview of the thermal and transport properties of low GWP refrigerants. Speakers will give an overview of data and modeling efforts on topics from boiling heat transfer to the effect of refrigerant thermodynamic parameters on the vapor compression system characteristics. The seminar will disseminate fundamental technical information on low GWP refrigerants that will assist engineers in the design and operation of AC systems and of heat exchangers.

#### 1. Boiling of R1234ze On Enhanced Boiling Tubes

*Eugene van Rooyen, Member, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*

#### 2. Refrigerant Properties for Heat Transfer Analysis

*Mark McLinden, Ph.D., Member, NIST, Boulder, CO*

#### 3. Heat Transfer of Low GWP Refrigerants

*Ankit Sethi, Member, Honeywell, Buffalo, NY*

#### 4. Low GWP Refrigerant Convective Boiling in a Micro-Fin Tube

*Mark A. Kedzierski, Ph.D., Member, NIST, Gaithersburg, MD*

**Sunday, January 27**

**3:15 PM-4:45 PM**

**Seminar 19 (Intermediate)**

**The “Road Less Traveled” Becomes a Highway:  
Design-Build Execution of Cleanroom Projects**

*Track: Industrial & Transportation Ventilation*

*Room: Dallas C*



**Sponsor: 09.11 Clean Spaces, TC 7.2 Design Build , 01.07 Business, Management & General Legal Education**

*Chair: E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA*

Design-build has been growing in its popularity and frequency of use as a project delivery method; however, there are still some in the industry who remain skeptical about the use of design-build on technically complex projects. Cleanrooms are some of the most challenging HVAC projects you can encounter. This seminar presents a sample of cleanroom projects delivered using a design-build approach. It points out the good points and the challenges in using the D-B approach. It also covers both life science and microelectronics projects as well as offering us a view of project delivery in East Asia.

**1. Design-Build At 10,000 Feet (What Did I Get Myself Into?)**

*E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA*

**2. What Academic Institutions Don't Know Will Cost Them**

*Steve Penson, Austin Commercial, L.P., Dallas, TX*

**3. The View From the Middle Kingdom –**

**Executing Design-Build in the China and East Asia Markets**

*Selina Yi Yin, Shanghai Tofflon-Dehui Cleanroom and HVAC System Co., Ltd., Shanghai, China*

**Monday, January 28**

**8:00 AM-9:30 AM**

**Technical Paper Session 3 (Intermediate)**

**Development of Fundamentals for HVAC Design and Modeling**

*Track: HVAC&R Systems & Equipment*

*Room: Dallas A3*



*Chair: Daniel Fisher, Ph.D., P.E., Fellow ASHRAE, Oklahoma State University, Stillwater, OK*

Fundamental research is paramount for the development of predictive models and design for HVAC systems. Novel methods for determining fundamental information required for such design and modeling are presented.

**1. Comparison of CFD Simulations of Hospital Operating Room (OR) Air Distribution with Experimental PIV Results (DA-13-007)**

*Sheldon M. Jeter, Ph.D., P.E., Member and Tyler C. Stevenson, GWW School of Mechanical Engineering/Georgia Tech, Atlanta, GA*

**2. An Infrared Sphere Method to Measure Mean Radiant Temperature (DA-13-008)**

*Christopher Leung, Affiliate and Hua Ge, Ph.D., P.E., Member, Ryerson University, Toronto, ON, Canada*

**3. Experimental Study of Surgical Wound Temperatures (DA-13-009)**

*Sheldon M. Jeter, Ph.D., P.E., Member<sup>1</sup>, Milton S. Goldman<sup>1</sup> and Nelson C. Goldman, M.D.<sup>2</sup>, (1)GWW School of Mechanical Engineering/Georgia Tech, Atlanta, GA, (2)University of Florida, Jacksonville, FL*

**4. Pumping System Bypass Orifice Testing and Analysis (DA-13-010)**

*Greg Towsley<sup>1</sup>, Arturo Benavente<sup>2</sup> and Ronald L. Dougherty, Ph.D., P.E.<sup>3</sup>, (1) Grundfos Pumps Corp., Olathe, KS, (2)ConocoPhillips, Tananger, Norway, (3) Department of Mechanical Engineering, University of Kansas, Lawrence, KS*

**Technical Paper Session 4 (Intermediate)**

**From Predictive to Practice: Air Flow and Energy Studies**

*Track: Industrial & Transportation Ventilation*

*Room: Dallas A2*



**Sponsor: 09.11 Clean Spaces, 05.08 Industrial Ventilation Systems**

*Chair: Stephen W. Duda, P.E., Member, Ross & Baruzzini, Inc., St. Louis, MO*

Predictive modeling has become vogue for engineers in the 21st century. Implementation of predictive designs must be followed to ensure adequate models. Results providing detailed studies on performance of the built environment based on predictive models are presented.

**1. Cleanroom Pressurization Strategy Update: Quantification and Validation of Minimum Pressure Differentials, Part 1: For Basic Configurations and Applications (RP-1344) (DA-13-011)**

*Wei Sun, P.E., Member<sup>1</sup>, Keith Flyzik<sup>2</sup> and John Mitchell<sup>3</sup>, (1)Engsysco Inc., Ann Arbor, MI, (2)Micro-Clean Inc., Bethlehem, PA, (3)Particle Measuring Systems Inc., Boulder, CO*

**2. Cleanroom Pressurization Strategy Update: Quantification and Validation of Minimum Pressure Differentials, Part 2: When Using Auxiliary Devices (RP-1344) (DA-13-012)**

*Wei Sun, P.E., Member<sup>1</sup>, Keith Flyzik<sup>2</sup> and John Mitchell<sup>3</sup>, (1)Engsysco Inc., Ann Arbor, MI, (2)Micro-Clean Inc., Bethlehem, PA, (3)Particle Measuring Systems Inc., Boulder, CO*

**3. Energy Efficiency Improvements for a Large Tire Manufacturing Plant (DA-13-013)**

*Jeremy Moyer and James Mathias, Ph.D., P.E., Associate Member, Southern Illinois University, Carbondale, IL*

**4. Modeling of Proposed Changes to SIUC Central Heating, Air Conditioning, and Power Plant Incorporating Variable Frequency Drives and High Efficiency Turbine (DA-13-014)**

*James Mathias, Ph.D., P.E., Associate Member, Heyin Su and Justin Harrell, Southern Illinois University, Carbondale, IL*

**Seminar 20 (Intermediate)**

**Seismic Certification of Equipment –  
Code, Analysis and Testing**

*Track: Standards, Guidelines and Codes*



*Room: Lone Star A3*

**Sponsor: 02.07 Seismic and Wind Restraint Design**

*Chair: E. Doug Fitts, P.E., Life Member, Fitts HVAC Consulting, LLC, Sunrise Beach, MO*

The International Building Code and the American Society of Civil Engineers Standard ASCE 7 have directed all manufactured equipment that must continue to function properly after a seismic event be certified for that purpose. The certification can be done by shake table testing of the equipment or by computational analysis. This seminar discusses the requirements of the Building Code and the ASCE 7 Standard and what is involved and required with each method of the certification process.

**1. The ABC's of the IBC Seismic Compliance**

*Robert E. Simmons, P.E., Member, Petra Seismic Design, LLC, Houston, TX*

**2. Special Seismic Certification Required for Active or Energized Components Per ASCE7 Section 13.2.2**

*John Giuliano, P.E., Member, The VMC Group, Bloomington, NJ*

**3. Seismic Qualification of HVACR Equipment by Analysis**

*Dr. Scott D. Campbell, Ph.D., Member, Structural Analysis Consulting Group, Milwaukee, WI*

**Seminar 21 (Intermediate)**

**Smoothing Bumps on the Road to Net Zero Energy Buildings – Part 2**

*Track: Energy Conservation*



*Room: Dallas B*

**Sponsor: 02.08 Building Environmental Impacts and Sustainability, 07.06 Building Energy Performance**

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

The road to net zero energy is paved with good intentions. Voluntary initiatives, consensus standards, mandatory codes, and government regulations are focusing more effort on setting worthy goals for sustainable buildings that engineers, architects, and designers must ultimately achieve through real designs that work. While it will be challenging for many high performance buildings to achieve net zero energy consumption, innovative designs can help. This seminar explores strategies for smoothing some of the bumps on the road to net zero

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energy in several specific applications by coupling energy efficiency technology options with on-site, neighborhood, or regional renewable energy solutions.

### 1. Trade Secrets for Making Deep Retrofits Work

*Kendra Tupper, P.E., Member, Rocky Mountain Institute, Boulder, CO*

### 2. Building, Neighborhood, and Regional Energy Efficiency Solutions for Government Buildings

*Alexander Zhivov, Ph.D., Member, U.S. Army Corps of Engineers, Champaign, IL*

### 3. Building Envelopes: The Final Frontier

*Ray Patenaude, P.E., Member, The Holmes Agency, Tierra Verde, FL*

## Seminar 22 (Intermediate)

### The FM Perspective: Reducing Energy Consumption and the True Cost of Maintenance

*Track: Facility Management; Operations, Technology and Energy Improvements*



*Room: Lone Star A1*

*Sponsor: 07.03 Operation and Maintenance Management, 07.08 Owning and Operating Costs*

*Chair: Angela Lewis, Ph.D., P.E., Associate Member, Facility Engineering Associates, Fairfax, VA*

Energy consumption is often well recognized as a part of sustainable, high performance building operations. However, without proper maintenance it can be difficult to achieve high performance building operations goals. The focus of this session is to quantitatively demonstrate the true cost of maintenance within sustainable facility management and provide a case study of a successful sustainable facility management organization. Quantitative data is used to build a case for the value of maintenance, including the overall cost of not performing maintenance and the impacts on energy consumption from not performing maintenance.

#### 1. Sustainable Facility Management

*Camala Jones, Austin Convention Center Department, Austin, TX*

#### 2. The Cost of Doing Nothing: The True Cost of Ignoring Your Energy Systems

*Matthew Mullen, P.E., Member, EMCOR Services New England Mechanical, Coventry, CT*

#### 3. Predicting Outcomes of Maintenance and Repair on Energy Conservation

*Jim Whittaker, P.E., Facility Engineering Associates, Fairfax, VA*

## Seminar 23 (Intermediate)

### The Future of Refrigerants: Policy and Technical Considerations

*Track: Refrigeration*

*Room: Lone Star A2*

*Sponsor: 02.05 Global Climate Change, Co-Sponsor: TC 3.1, Refrigeration Committee*

*Chair: Cynthia Gage, Ph.D., Fellow ASHRAE, EPA, Research Triangle Park, NC*

With the transition from chlorinated compounds to HFCs well underway, the refrigerant market should have settled for the HVAC&R industry. But instead the market seems to be moving towards another transition from HFCs to HFOs or natural refrigerants. What are the international actions giving momentum to these next-generation refrigerants? What are the multiplicity of considerations that are important to refrigerant selection? This seminar addresses the European, US, and international policies which are impacting HFCs, HFOs, and natural refrigerants. It also discusses both technical and environmental factors important to refrigerant selection.

#### 1. European Experience of CFC, HCFC and HFC Restrictions

*Andy Pearson, Ph.D., Member, Star Refrigeration, Ltd., Glasgow, United Kingdom*

#### 2. Domestic and International Policy for HFCs and Next Generation Refrigerants

*Matthew Ritter, Member, Arkema Inc., King of Prussia, PA*

#### 3. Factors Driving Refrigerant Selection

*Douglas Reindl, Ph.D., P.E., Member, IRC, University of Wisconsin- Madison, Madison, WI*

## Seminar 24 (Basic)

### The Potential Unintended Conflicts Between Well-Intentioned Codes and the Physics of Hot Water Delivery

*Track: Standards, Guidelines and Codes*



*Room: Dallas C*

*Sponsor: 06.06 Service Water Heating Systems*

*Chair: Ben Schoenbauer, Associate Member, Center for Energy and Environment, Minneapolis, MN*

This seminar presents the current state of hot water delivery as defined by several building, energy and plumbing codes, the guidance documents provided by the American Society of Plumbing Engineers and several relevant ASHRAE committees. Early in 2010, the International Association of Plumbing and Mechanical Officials published the Green Plumbing and Mechanical Code Supplement. This document dramatically reduced the allowable volume from the source of hot water to the fixtures to 32 ounces from a water heater or boiler or 16 ounces from a recirculation loop or heat traced line. It also promulgated a revised insulation requirement intended to result in equal heat loss per foot of pipe, regardless of the pipe diameter. The GPMCS set the standard to increase the performance of hot water delivery systems in terms of energy, water and time by incorporating the results of research into hot water delivery systems into code language. The 2012 International Plumbing Code has just recently adopted a change to reduce the length from the source of hot water to the fixture from 100 to 50 feet. Nothing similar was done in the 2012 International Residential Code. The 2012 International Energy Conservation Code adopted a different rubric, which requires insulation on long, large diameter piping and none if the volume is kept to less than 1 quart. The International Green Construction Code Public Version 2 has a table to figure out the length for each type of pipe so that the volume in the piping will be less than either 80 ounces when the source of hot water is a water heater or boiler or 16 ounces depending when the source is recirculation loop or heat traced line. There is a proposal to revise this language still further to address the special case of delivery problems at low flow rate public lavatory faucets. The language from the IAPMO and ICC codes has been shared with several ASHRAE committees including 189.1, 189.2 and 191 for inclusion in their respective standards.

#### 1. Distribution Research and Plumbing Codes

*Gary Klein, Member, Affiliated International Management, LLC, Ek Grove, CA*

#### 2. Green Plumbing Code

*Pete Demarco, International Association of Plumbing and Mechanical Officials (IAPMO), Dayton, NJ*

## Seminar 25 (Basic)

### When Is the Load Not What You Think?

### The Radiant Effect of Non-uniform Surface Temperatures

*Track: HVAC Fundamentals and Applications*



*Room: Lone Star A4*

*Sponsor: 04.01 Load Calculation Data and Procedures*

*Chair: Glenn Friedman, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA*

This seminar describes different instances when a traditional load calculation is not the complete description of room heat gain and heat loss. The radiant effect of non-uniform surface temperatures, window blinds and building internal mass shall be discussed.

#### 1. Load Impacts of Window Shades

*Charles S. Barnaby, Member, Wrightsoft Corp., Lexington, MA*

#### 2. Design Zone Cooling Loads for Radiant Systems

*Fred S. Bauman, P.E., Member, Jingjuan Feng, Student Member and Stefano Schiavon, Ph.D., P.E., Associate Member, Center for the Built Environment (CBE), University of California, Berkeley, CA*

#### 3. Furniture

*Daniel Fisher, Ph.D., P.E., Fellow ASHRAE and Edwin Lee, Student Member, Oklahoma State University, Stillwater, OK*

## Monday, January 28

9:45 AM–10:45 AM

### Seminar 26 (Intermediate)

#### Decoupling the Latent Load Through Psychometrics

Track: HVAC Fundamentals and Applications

Room: Lone Star A4

Sponsor: Student Activities

Chair: Joel Primeau, P.Eng., Member, GENIVAR, Ottawa, ON, Canada

This session illustrates the psychometric analysis for both human comfort and critical operation for many HVAC systems in commercial buildings. With the growth of Dedicated Outdoor Air systems used with many other HVAC systems (chilled beams, radiant cooling, fan coils, etc.), understanding how the space latent load is decoupled from the space sensible load is critical for proper HVAC system application, design, commissioning and operation. Within this session the space load is illustrated as a two part psychometric requirement where the latent load is shown separate such that the space sensible load could be handled via many HVAC approaches.

#### 1. Decoupling the Latent Load Through Psychometrics

Douglas F. Zentz, Associate Member, Ferris State University, Big Rapids, MI



### Seminar 27 (Intermediate)

#### Energy Targets for the Future

Track: Energy Conservation

Room: Dallas B

Sponsor: MTG.ET Energy Targets

Chair: Don Brandt, Member, Trane Co., Phoenix, AZ

Energy Targets MTG members present the highlights of the Energy Targets Adhoc report and the research work statement. A research contractor was selected in the spring of 2012 and has begun the four step process of the modeling that is expected to take approximately 2 years to complete. A member that cares about our future energy usage will find this seminar of interest.

#### 1. ET Adhoc Report Update

Richard D. Hermans, P.E., Member, McQuay International, Minneapolis, MN

#### 2. Development of Maximum Technically Achievable Energy Targets for Commercial Buildings (Ultra-Low-Energy Use Buildings)

Drury Crawley, Ph.D., Fellow ASHRAE, Bentley Systems, Inc., Washington, DC



### Seminar 28 (Intermediate)

#### Grid-Interactive Thermal Energy Storage – Challenges and Lessons Learned with Real-Time Pricing

Track: HVAC&R Systems & Equipment

Room: Lone Star A2

Sponsor: 06.09 Thermal Storage

Chair: Mike Filler, P.E., Member, Trane Co., Pueblo, CO

Smart grid has many different definitions; however, at its core will be the two way communication of information, including pricing, so that customers and utilities will be able to make informed decisions on energy use and production. First, a case study in Texas is described, including results, with an automatic control system that has been operating a building with ice storage on real-time pricing for the past 4 years. The second presentation details how grid-connected and integrated electric storage space heaters and water heaters, utilizing smart controls, can factor in real-time supply/demand imbalance and other critical needs of the grid.

#### 1. Using Ice Storage with Real Time Pricing – A Case Study From Texas

Alan Ash, Member, Trane Co., Carrollton, TX

#### 2. Cost-Effective, Grid-Interactive Thermal Energy Storage – Challenges and Lessons Learned in Pilot Trials

Paul Steffes, P.E., Member, Steffes Corp., Dickinson, ND



### Seminar 29 (Basic)

#### Make the Most of Your ASHRAE Experience

Track: HVAC Fundamentals and Applications

Room: Dallas A3

Sponsor: Conferences and Expositions Committee

Chair: Dunstan Macauley, P.E., Member, TAI Engineers, Owings Mills, MD

What's the purpose of ASHRAE? How's it structured? What's the difference between an Affiliate Member and a Member? What's a TC, SPC and all the other acronyms I hear? Do grassroot committees discuss lawn fertilizer?! If you've ever asked yourself any of those questions, then this seminar is for you. Whether you're new to ASHRAE or any old timer who wants to learn more about the great Society, this seminar answers all your questions and offers insight to all the opportunities that ASHRAE has to offer.

\*(as presented in Vegas)



### Seminar 30 (Intermediate)

#### Outbreak: You Don't Want a Part in This Movie: What to Do If You Find Legionella in Your Facility, Part 1

Track: Facility Management; Operations, Technology and Energy Improvements

Room: Dallas C

Sponsor: 07.03 Operation and Maintenance Management, 07.08

Owning and Operating Costs

Chair: Sonya Pouncy, Member, Walker-Miller Energy Services, Livonia, MI

Since 2000, the number of reported cases of Legionnaires' disease (LD) has been escalating. LD is a potentially fatal lung infection caused by the aquatic bacterium Legionella pneumophila. With water temperatures between 77°F and 108°F being favorable for growth, the bacteria have an affinity for cooling towers, hot water tanks, and other parts of HVAC and domestic water systems. Thus, they have become the bane of the facility manager's existence. This two-part seminar addresses the legal risks and responsibilities, the minimum standard of care, advanced water treatment protocols, and "triple bottom line" impact considerations associated with preventing the deadly disease.

#### 1. Legionella and the Law: Legal Issues Associated with Legionnaires' Disease Claims

Steven D. Soden, J.D., Shook, Hardy and Bacon, LLP, Kansas City, MO

#### 2. The Industry Standard of Care to Prevent the Legionellosis Associated with Building Water Systems

Richard Rooley, P.Eng., Presidential Member, Rooley Consultants, Bucks, United Kingdom



### Seminar 31 (Intermediate)

#### Reducing Industrial Exhaust System Energy Use Without Affecting Performance

Track: Industrial & Transportation Ventilation

Room: Dallas A2

Sponsor: 05.04 Industrial Process Air Cleaning (Air Pollution Control)

Chair: Tim Hudson, Associate Member, Camfil Farr APC, Jonesboro, AR

Industrial exhaust systems are critical to protecting workers from the ill effects of harmful gasses and airborne contaminants resulting from manufacturing operations. Their performance can be improved by proper design and operation. The key considerations include: placement of the exhaust hoods to capture the generated contaminants effectively, efficient duct design and proper selection of the air cleaning device. Additional energy savings can be obtained by improving system control, applying recovered energy to the make-up air system and using more efficient equipment. This presentation discusses considerations for improving exhaust system performance while achieving a lower energy use.

#### 1. Applications and Mis-Applications of Energy Recovery

Wayne Lawton, P.E., Merrick & Company, Aurora, CO

#### 2. How to Sell Your Industrial Energy Recovery Project

Tom Axley, Member, Tennessee Valley Authority, Chattanooga, TN





## Forum 1 (Intermediate)

### ASHRAE Apps: What Do You Want? Do They Need To Be Free?

*Track: Facility Management; Operations, Technology and Energy Improvements*

*Room: Lone Star A1*

*Sponsor: 01.05 Computer Applications, Publications Committee*

*Chair: Mick Schwedler, P.E., Member, Trane Co., La Crosse, WI*

Many people use apps on their non-commercial cellular devices to help complete project work quickly. ASHRAE has a psychrometric app available today. What other apps do you want? How would they help your productivity? Can they help draw in younger engineers to the profession? Should they be developed by ASHRAE? Do they need to be free? Please come and share your thoughts.

## Forum 2 (Basic)

### Energy Monitoring of Systems and Equipment in ASHRAE Standards 90.1 and 189.1: How Far Should Building Codes Go?

*Track: Standards, Guidelines and Codes*

*Room: Lone Star A3*

*Sponsor: SSPC 189.1*

*Chair: Wayne H. Stoppelmoor Jr., Member, Schneider Electric, Cedar Rapids, IA*

Standard 189.1-2011, the ASHRAE standard for High Performance Green Buildings, includes mandatory requirements for measurement devices with remote communication capability for energy sources above specified thresholds. Starting in 2013, ASHRAE Standard 90.1 will also require submetering of specific equipment or systems, but its provisions are based on different criteria and thresholds. This forum seeks input from ASHRAE members on several issues related to energy consumption management in ASHRAE standards, including the purpose of metering, alignment of metering provisions across standards, appropriate thresholds for requiring system or equipment metering, creative compliance approaches, and usage of the metered data.

## Monday, January 28

11:00 AM-12:00 PM

### Technical Paper Session 5 (Intermediate)

#### Optimizing Air-Cooled Systems for Data Center Applications

*Track: HVAC&R Systems & Equipment*

*Room: Dallas A3*

*Chair: Bill Dietrich, Member, Daikin McQuay, Staunton, VA*

The papers in this session investigate options for maximizing the efficiencies of air cooled systems for data center applications. The papers analyze compressor efficiency in mid-to-low outdoor air temperature applications as well as improvements in heat rejection systems.

#### 1. Development of an Outdoor Air Cooling-Type Air-Cooled Package Air Conditioner for Data Centers (DA-13-015)

*Yosuke Udagawa, Keisuke Sekiguchi and Tsuneo Uekusa, NTT Facilities, Tokyo, Japan*

#### 2. The Impact of Barometric Pressure, Temperature, and Operating Temperature Difference on Air Cooled Data Centers (DA-13-016)

*Keith Dunnivant, P.E., Member, Munters/Des Champs Laboratories, Buena Vista, VA*



## Seminar 32 (Intermediate)

### Data Visualization 101

*Track: Energy Conservation*

*Room: Lone Star A4*

*Sponsor: 04.07 Energy Calculations*

*Chair: Chris Balbach, P.E., Member, Performance Systems Development, Ithaca, NY*

Energy use in existing buildings is most often related to influencing variables, such as ambient temperature, solar radiation, humidity and occupant schedules. Unfortunately, during the process of calibrating a simulation to an existing building's energy use, the simulator needs to quickly and easily determine whether a misbehaving model is due to adjustment in factors relating to temperature, time-of-day, humidity or other unknown parameters. Most often simple graphs of an existing building's energy use are compared to similar parameters from the simulation. Examples include time series, line graphs, scatter plots, horizontal and vertical bar charts, pie charts and most recently 3-D surface plots. Unfortunately, many of these graphic formats fail to produce meaningful graphs when overwhelmed by more than 8,000 data points on a plot. In addition, many of the graphs found in the ASHRAE Transactions from the 1950s to the present suffer from one or more graphical errors that can make a graph hard to read, or worse, misleading. This presentation reviews graphical presentation do's and don'ts, and presents several advance graphical display techniques that combine statistics and animations to more effectively display useful comparisons between actual and simulated data to assist the calibration process.

#### 1. Data Visualization 101 - Getting the Right Graph for Your Purpose

*Jeff Haberl, Ph.D., P.E., Fellow ASHRAE, Texas A&M University, College Station, TX*

#### 2. Effective Data Visualization

*Joe Huang, Member, White Box Technologies, Moraga, CA*

#### 3. Development of Effective Animated Graphical Presentation Methods for Visualization of Weather Data

*John Kie-Whan Oh, Ph.D., Dongseo University, Busan, South Korea*



## Seminar 33 (Intermediate)

### Future Directions in Sizing Residential and Small Commercial HVAC Equipment

*Track: HVAC&R Systems & Equipment*

*Room: Lone Star A3*

*Sponsor: 06.03 Central Forced Air Heating and Cooling Systems, TC9.5, 08.11 Unitary and Room Air Conditioners and Heat Pumps*

*Chair: Jon Douglas, Member, Lennox Industries, Carrollton, TX*

The seminar focuses on the key issues related to the sizing of modern residential and small commercial HVAC equipment. Industry updates of historical HVAC sizing procedures assist manufacturers, designers and installers working with new innovative multi and variable capacity HVAC equipment. This equipment is quickly gaining popularity in the residential and small commercial HVAC market. One presentation provides an overview of the recently updated industry accepted, residential and small commercial HVAC equipment sizing procedures (e.g. ACCA Manual S), which is referenced in energy codes and home performance contracting energy conservation programs. Another presentation focuses on research conducted to justify greater sizing flexibility when sizing heat pumps in heating dominated climates to reduce back-up electric resistance heating, in climates where humidity control has been addressed or is not a critical design issue. A third presentation focuses on "sizing for humidity control" based on dehumidification modeling analysis efforts conducted as part of ASHRAE RP-1449.

#### 1. An Overview of RP-1449 Energy Efficiency and Cost Assessment of Humidity Control Options for Residential Buildings

*Hugh Henderson, P.E., CDH Energy Corp., Cazenovia, NY*

#### 2. Air Source Heat Pump Sizing in Heating Dominated Climates

*Michael Lubliner, Member, Washington State University Extension Energy Program, Olympia, WA*

#### 3. Capacity Oversizing Limits for Residential HVAC Applications

*Glenn Hourahan, P.E., Fellow ASHRAE, Air Conditioning Contractors of America (ACCA), Arlington, VA*



## Seminar 34 (Intermediate)

### Industry-Wide Efforts to Evaluate Lower GWP Refrigerants

Track: Refrigeration

Room: Lone Star A2

**Sponsor:** 03.01 Refrigerants and Secondary Coolants, MTG.LowGWP  
**Chair:** Barbara Minor, Member, DuPont, Wilmington, DE

Due to increasing concern about climate change, members of the HVAC&R industry are working together cooperatively to evaluate lower GWP refrigerant options and share results. This seminar provides updates on two specific efforts. First, the AHRI low-GWPAREP program is discussed, where over 30 refrigerant candidates are being evaluated by 20 participating companies globally. Second, a new Multi-Disciplinary Task Group (MTG) has been formed to coordinate ASHRAE research projects and programs related to lower GWP refrigerants.

#### 1. AHRI Low-GWP Alternative Refrigerants Evaluation Program

**Xudong Wang, Member, Air-Conditioning, Heating and Refrigeration Institute (AHRI), Arlington, VA**

#### 2. Roadmap Towards Lower GWP Alternative Solutions for HVAC&R

**Omar Abdelaziz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN**



## Seminar 35 (Intermediate)

### Introduction to the ASHRAE/REHVA Chilled Beam Design Guide

Track: HVAC&R Systems & Equipment

Room: Lone Star A1

**Sponsor:** 05.03 Room Air Distribution

**Chair:** Andrey Livchak, Ph.D., Halton Group Americas, Bowling Green, KY

The seminar will present results of joint ASHRAE/REHVA group work on the design guide for chilled beams. Authors will cover active and passive beams best design practices, describe controls solutions used in these applications, and present energy efficiency and life cycle cost analysis comparing chilled beam systems to alternatives.

#### 1. Active Beams

**Christopher S. Lowell, Member, Halton, Scottsville, KY**

#### 2. Passive Beams

**Julian Rimmer, P.Eng., Associate Member, Price Industries, Suwanee, GA**

#### 3. Control of Chilled Beam Systems

**Kenneth J. Loudermilk, P.E., Member, TROX USA, Cumming, GA**

#### 4. Energy Analysis and Total Cost of Ownership

**Carlos Lisboa, Member<sup>1</sup> and Rafael Urculo, Member<sup>2</sup>, (1)BLC Navitas, Lda, Lisbon, Portugal, (2)R. Urculo Ingenieros Consultores S.A., Lisbon, Portugal**



## Seminar 37 (Intermediate)

### Performance Contracting in Public Schools: Energy Conservation Methods that Lead to Superior Returns

Track: Energy Conservation

Room: Dallas B

**Sponsor:** 7.02 HVAC&R Contractors and Design Build Firms

**Chair:** Michael McLaughlin, P.E., Associate Member, Southland Industries, Dulles, VA

As Pennsylvania's public schools face the competing challenges of budget deficits and aging buildings, they seek energy-based performance contracts that fund capital upgrades through cash flows created by guaranteed energy and operational savings. By managing contractual energy guarantees, performance contractors determine what energy conservation measures lead to superior returns. In this seminar, one contractor shares best practices learned through retrofitting 15 million+ square feet of K-12 school space. Its case studies illustrate approaches to lowering Energy Use Intensity (EUI) through upgrades to HVAC, lighting, and building envelopes plus small-scale renewable energy systems. Several unique geothermal design concept outcomes are shared.

#### 1. Performance Contracting in Public Schools: Energy Conservation Methods that Lead to Superior Returns

**Daniel Kerr, P.E., Member and Matthew G. Tressler, P.E., Member, McClure Co., Harrisburg, PA**



## Forum 3 (Advanced)

### Design of Atrium Buildings

Track: Large Building Design

Room: Dallas A2

**Sponsor:** 09.08 Large Building Air-Conditioning Applications, 02.08 Building Environmental Impacts and Sustainability

**Chair:** Frank A. Mills, P.E., Member, McGrath Mills Consulting Engineers, Leyland, United Kingdom

TC 9.8 proposes to develop a new chapter dealing with the design of Atrium Buildings. This focuses on all aspects including energy efficiency, passive solar design, integrated design and usage within various building types: hotels, residential, offices, retail, hospitals, etc. This form allows members to contribute to this aim.

# Monday, January 28

## 2:30 PM-4:00 PM

### Special Session 1 (Intermediate)

#### Dallas Conference Breaking News on 90.1, 62.1 and 189.1

Track: Standards, Guidelines and Codes

Room: Dallas C

**Chair:** Jon J. Cohen, H-O-H Water Technology, Inc., Palatine, IL

For the first time, attendees will be the first to know and hear first-hand the newest updates to Standards 90.1, 62.1 and 189.1. Chairs of these standards will report on the actions their committees have taken during their meetings at the Dallas Conference. The updates provide current and valuable news you can take back to your office, such as what new addenda, interpretations and public reviews are planned. The session begins with a thought-provoking perspective on several alternative formats that could be used to create the next generation of more efficient energy codes and standards.

#### 1. Advantages and Disadvantages of Alternative Formats to Achieve More Efficient Energy Codes for Commercial Buildings (DA-13-C041)

**Michael Rosenberg, Member; David R. Conover, Member, Mark A. Halverson, Member, Eric J. Makela and Zachary T. Taylor, Pacific Northwest National Laboratory, Richland, WA**

#### 2. Standard 62.1

**Roger Hedrick, Architectural Energy Corp., Boulder, CO**

#### 3. Standard 189.1

**Dennis Stanke, Member, Trane, La Crosse, WI**

#### 4. Standard 90.1

**Stephen V. Skalko, P.E., Member, Stephen V. Skalko, P.E. & Associates, LLC, Macon, GA**



## Seminar 36 (Intermediate)

### Outbreak: You Don't Want a Part in This Movie: What to Do If You Find Legionella in Your Facility, Part 2

Track: Facility Management; Operations, Technology and Energy Improvements

Room: Dallas C

**Sponsor:** 07.03 Operation and Maintenance Management, 07.08

**Owning and Operating Costs**

**Chair:** Sonya Pouncy, Member, Walker-Miller Energy Services, Livonia, MI

Since 2000, the number of reported cases of Legionnaires' disease (LD) has been escalating. LD is a potentially fatal lung infection caused by the aquatic bacterium Legionella pneumophila. With water temperatures between 77°F and 108°F being favorable for growth, the bacteria have an affinity for cooling towers, hot water tanks, and other parts of HVAC and domestic water systems. Thus, they have become the bane of the facility manager's existence. This two-part seminar addresses the legal risks and responsibilities, the minimum standard of care, advanced water treatment protocols, and "triple bottom line" impact considerations associated with preventing the deadly disease.

#### 1. Reducing the Risks From Legionella

**Michael Halpin, Nalco, Miami, FL**

#### 2. Where, Why and When Should an Owner Be Concerned with Legionella and Other Pathogens

**Jennifer Isenbeck, P.E., Sodexo, Tampa, FL**



# 42 Monday, January 28

## Monday, January 28

5:30 PM-7:00 PM

### Seminar (Advanced)

#### Improving Data Center Efficiency with a Better Match of HVAC and IT Systems

Track: HVAC&R Systems & Equipment

Room: D1 Dallas

Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment

Chair: David Moss, Dell, Inc., Austin, TX

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. Data center efficiency improves with a higher operating temperature and a better volumetric match between HVAC and IT systems. This three part presentation will explore volumetric flowrate and delta-T trends for IT systems, temperature limitations for IT systems (primarily in network switch equipment), and methods of volumetric control for different containment solutions.

##### 1. Server Interaction in the Data Center: A Discussion On Delta T Trends and Effects of External Pressure

Katie L. Pizzolato and Arden L. Moore, Ph.D., IBM, Austin, TX

##### 2. Thermal Guidelines and Best Practices for IT Networking Equipment

Jon Fitch, Ph.D., Member, Dell, Round Rock, TX

##### 3. Methods of Volumetric Control within Containment Systems

David Moss, Dell, Inc., Austin, TX

## Monday, January 28

7:00 PM-8:00 PM

### Seminar (Intermediate)

#### CFD Modeling, Control Scheme Efficiency & IT Ride through for Cold Aisle Containment

Track: HVAC Fundamentals and Applications

Room: D1 Dallas

Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment

Chair: Nick Gangemi, Member, Facility Gateway Construction, Madison, WI

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. In order to adequately cool modern IT Equipment cabinets in an energy efficient manner, previous ASHRAE presenters have recommended the use of CFD analysis, containment of the hot / cold aisles, raising cold aisle temperature set points, and using control schemes that decouple the airflow and capacity control loops from each other. This work presents a combination of data center lab testing and CFD modeling intended to address these issues. An additional study presents the thermal transient data for a series of tests conducted at a data center lab, with intent to simulate a cooling system failure. The results reveal an interesting phenomenon that puts Cold Aisle Containment at an advantage over open hot aisle / cold aisle configurations.

##### 1. CFD Modeling and Control Scheme Efficiency Measurements for Cold Aisle Containment

Saurabh Shrivastava, Ph.D., Panduit Corp., Tinley Park, IL

##### 2. IT Equipment Ride Through Time in Cold Aisle Containment Configuration

Saurabh Shrivastava, Ph.D., Panduit Corp., Tinley Park, IL

## Tuesday, January 29

8:00 AM-9:30 AM

### Technical Paper Session 6 (Intermediate)

#### System Impacts on Indoor Air Quality (IAQ)

Track: Energy Conservation

Room: Dallas A2

Chair: Kevin Gallen, Gallen Engineering



HVAC&R systems and equipment play an important role in maintaining the indoor environmental conditions in a building. The papers in this session investigate the impact of systems on Indoor Air Quality (IAQ).

##### 1. A Solar PV-Thermal Energy Design Optimization Study of a Building Footprint Limited Net-Zero Energy Facility (DA-13-017)

James S. Cotton, Ph.D., P.E., Member, R. Cuthbert, F. Pan, Student Member, K. Nieminen, Student Member, Kelton Friedrich and D. Wilkinson, Ph.D., P.E., McMaster University, Hamilton, ON, Canada

##### 2. Study the Degradation of Typical HVAC Materials, Filters and Components Irradiated by UVC Energy (RP-1509) (DA-13-018)

Robert E. Kauffman, Ph.D. and J. Douglas Wolf, University of Dayton Research Institute, Dayton, OH

### Seminar 38 (Basic)

#### BIM for Dummies

Track: HVAC Fundamentals and Applications



Room: Lone Star A4

Sponsor: 07.01 Integrated Building Design

Chair: Krishnan Gowri, Ph.D., Member, Pacific Northwest National Lab, Seattle, WA

Building Information Modeling (BIM) has transformed the construction industry to focus on integrated project delivery and interoperable data of the building. The productivity gains and business case for BIM are well documented by several recent case studies and projects. Major CAD vendors and energy simulation tools offer BIM interoperability for energy analysis during conceptual design stages. BIM is a mandatory requirement for new GSA building projects. The American Institute of Architects, the Association of General Contractors and other leading industry associations have embraced BIM as part of their business practices. However, for many ASHRAE members BIM is still a buzz word. TC 7.1 and BIM MTG have published a BIM Guide and working on research projects to increase the awareness and help members take advantage of BIM. This session brings together three international experts to provide an overview of BIM concepts, information exchange standards and practical application in a real building project.

##### 1. Getting Started with BIM: An Introduction

Tim Dwyer, Fellow ASHRAE, Bartlett School of Architecture, University College London, London, United Kingdom

##### 2. Information Exchange Standards and Why You Should Care

Robert J. Hitchcock, Member, Hitchcock Consulting, Kelsey, CA

##### 3. BIM in Practice: A Case Study of Work Flow, Tools and Lessons Learned

Michael Smith, BIMworks Inc., Lakewood, WA

### Seminar 39 (Advanced)

#### Evaluating Particle Concentration and Distribution in Industrial and Transportation Ventilation

Track: Industrial & Transportation Ventilation

Room: Dallas A3

Sponsor: 04.10 Indoor Environmental Modeling

Chair: Wangda Zuo, Ph.D., Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA



Public health and indoor air quality are major concerns of industrial and transportation ventilation. Particles of concentration and distribution are critical indicators of indoor air quality. The particle motion can also have adverse effects on industrial processes. The transportation, deposition and resuspension of particles are under the impact of ventilation system, human activities, and buoyance force due to the thermal loads from human, different kinds of equipment, and solar radiation. This seminar discusses how to model the

particle distribution under such complex conditions using modern computer technique. The presentations in this seminar provide some guidelines for better designs of industrial and transportation ventilation.

### 1. Resuspension of Particles Due to Falling Objects

*H. Ezzat Khalifa, Ph.D., Fellow ASHRAE, Syracuse University, Syracuse, NY*

### 2. Modeling Expiratory Particles Transport in a Mechanical Ventilation Space

*Qingyan Chen, Ph.D., Purdue University, West Lafayette, IN*

### 3. Comparison of RANS and LES Turbulence Models Applied in Person to Person Exposure Analysis

*Atila Novoselac, Ph.D., Associate, University of Texas at Austin, Austin, TX*

## Seminar 40 (Basic)

### Fellows Debate - Sustainability is Sustainable

*Track: Energy Conservation*

*Room: Dallas B*

*Sponsor: College of Fellows*

*Chair: Charles Culp, P.E., Fellow ASHRAE, Texas A&M University, College Station, TX*

This is in the series of Fellows Debates. Opposing teams present the initial arguments on both sides of the sustainability dilemma. The audience will then join in the debate. There are real disagreements on the future direction of sustainability. Is there a need for engineers, construction professionals, building owners, industry pressure groups and politicians to continue to have high profile activity, or is it now set fully on course? Have the pressures and procedures resulted in real sustainability, or is it a fiction? Is it possible to move sustainability to the next level, or has the effect on buildings in use peaked?

#### 1. Team A

*Larry Spielvogel, P.E., Fellow Life Member<sup>1</sup>, Victor Goldschmidt, Fellow ASHRAE<sup>2</sup> and David Fisk, Ph.D.<sup>3</sup>, (1)Consulting Engineer, Bala Cynwyd, PA, (2)Consultant, Northport, MI, (3)Imperial College London, London, United Kingdom*

#### 2. Team B

*Bill Coad, P.E., Presidential Fellow Life Member<sup>1</sup>, Richard Rooley, P. Eng., Presidential Member<sup>2</sup> and Ronald Jarnagin, Member<sup>3</sup>, (1)Coad Engineering Enterprises, St. Louis, MO, (2)Rooley Consultants, Bucks, United Kingdom, (3)Pacific Northwest National Laboratory, Richland, WA*

## Seminar 41 (Basic)

### How Federal and State Energy Policy Impact ASHRAE Members

*Track: Standards, Guidelines and Codes*

*Room: Dallas C*

*Sponsor: Advocacy Committee*

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

Energy and energy efficiency have long been at the heart of ASHRAE's standards development process and its federal government affairs public policy efforts. Soon, they will be a primary focus of the Society's grassroots government activities at the jurisdictional level. This session, centered around a moderated dialogue between energy policy and ASHRAE standards development experts, examines how federal and state government energy policy impacts ASHRAE and its members' work on a day-to-day basis and the ways in which ASHRAE members may participate more fully in the crafting of laws and regulations guiding the HVAC&R field. Ample time is given for attendee questions for the panel.

#### 1. Federal Energy Efficiency Policy

*John Henry Cymbalsky, Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, Washington, DC*

#### 2. State and Local Energy Efficiency Policy

*Jeff Harris, Alliance to Save Energy, Washington, DC*

#### 3. History, Current Status, and Possible Future of Standard 90.1

*Stephen V. Skalko, P.E., Member, Stephen V. Skalko, P.E. & Associates, LLC, Macon, GA*

## Seminar 42 (Basic)

### Incentive Based Maintenance: How Utility Rebates Can Help You Maintain the Performance of Your HVAC Equipment

*Track: Facility Management; Operations, Technology and Energy Improvements*

*Room: Lone Star A3*

*Sponsor: 07.03 Operation and Maintenance Management*

*Chair: Sonya Pouncy, Member, Walker-Miller Energy Services, Livonia, MI*

Our national energy policy is designed to bring together communities, businesses and citizens to promote dependable, affordable and environmentally sound energy for our future. Local utilities partake in this effort, in part, by offering energy optimization (EO) programs that provide rebates to customers implementing energy efficiency improvements at their facilities. Most EO programs are equipment-based, but a growing number are incorporating HVAC maintenance measures into their portfolios. This seminar explores the financial and energy impacts of maintenance, the development of utility incented maintenance measures, and the opportunities and challenges that Standard 180 presents in helping to achieve national energy-saving goals.

#### 1. The Economic Impact of O&M Management

*Robert G. Baker, BBJ Environmental Solutions, Riverview, FL*

#### 2. A Utility's Perspective on an HVAC Market Transformation Program: SCE HVAC Optimization

*Mel Johnson, Southern California Edison, Rosemead, CA*

#### 3. SCE HVAC Optimization: Operationalizing the ANSI/ASHRAE/ACCA Standard 180

*Monica Thilges, PEI, Rosemead, CA*

#### 4. The SCE HVAC Optimization Program: A Service Contractor's Implementation of ANSI/ASHRAE/ACCA Standard 180

*Mike Gallagher, P.E., Member, Western Allied Corp., Santa Fe Springs, CA*

## Seminar 43 (Intermediate)

### Sealed Systems Research

*Track: HVAC&R Systems & Equipment*

*Room: Lone Star A1*

*Sponsor: 06.03 Central Forced Air Heating and Cooling Systems, Education and Publishing*

*Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD*

This session offers a select group of recently published papers from the ASHRAE HVAC&R Research Journal.

#### 1. Factors Affecting the Cylinder Displacement of a Wankel Compressor in a Micro-Cooling System

*Yilin Zhang, Student Member and Wen Wang, Ph.D., Member, Institute of Refrigeration and Cryogenics, Shanghai Jiao Tong University, Shanghai, China*

#### 2. CO2 Transcritical Vapor Compression Cycle with Thermoelectric Subcooler

*Jonathan Schoenfeld, Ph.D., Member<sup>1</sup>, Yunho Hwang, Ph.D., Member<sup>2</sup> and Reinhard Radermacher, Ph.D., Fellow ASHRAE<sup>2</sup>, (1)Glacier Bay, Union City, CA, (2)University of Maryland, College Park, MD*

## Seminar 44 (Advanced)

### System and Components Performance and Efficiency with Low-GWP Refrigerants

*Track: Refrigeration*

*Room: Lone Star A2*

*Sponsor: Refrigeration Committee, TC 03.01, TC 08.01, TC 10.07, 08.01 Positive Displacement Compressors*

*Chair: Georgi S. Kazachki, Ph.D., Fellow ASHRAE, CRYOTHERM Consulting, Atlanta, GA*

The properties of the new low-GWP refrigerants have an impact on the performance and efficiency of the refrigeration and air-conditioning systems and their components. The purpose of the seminar is to illustrate through theoretical and experimental results the design approaches leading to an uncompromised system and components performance and efficiency compared to the current

refrigerants. The subject of the seminar includes also the performance and efficiency of refrigeration and air-conditioning systems with natural refrigerants, which have the lowest GWP and are a well-established viable alternative to the current refrigerants with high GWP in many applications.

**1. Testing of Low GWP R-404A Alternatives in Commercial Refrigeration Systems**

*Barbara Minor, Member, DuPont, Wilmington, DE*

**2. Developments in Very Low-GWP Refrigerants for Stationary HVAC&R Systems**

*Laurent Abbas, Member, Arkema, King of Prussia, PA*

**3. Technology Issues Regarding Refrigeration Blends**

*Gustavo Pottker, Member, Honeywell - Buffalo Research Laboratory, Buffalo, NY*

**4. A Multifunctional Two-Stage Transcritical CO2 System with Parallel Compression**

*Klaas Visser, Member, KAV Consulting Pty. Ltd., Kangaroo Flat, Australia*

## Tuesday, January 29

9:45 AM-10:45 AM

### Conference Paper Session 5 (Intermediate)

**Cool Tools for Building Modeling Applications**

*Track: Facility Management; Operations, Technology and Energy Improvements*

*Room: Dallas A3*

*Chair: David E. Claridge, Ph.D., P.E., Fellow ASHRAE, Texas A & M University, College Station, TX*

HVAC systems usually consume the largest portion of energy in buildings. Optimizing the building envelope can lead to “right-sizing” systems and equipment which can result in improved efficiency. The papers in this session investigate building modeling applications that lead to overall system efficiency.

**1. Archi Bond Graphs: The Connection Between Spatial Representation and Technical Representation (DA-13-C017)**

*Wim Zeiler, Rik Maaijen and Gert Boxwm, TU Eindhoven, Eindhoven, Netherlands*

**2. Intelligent Model Based Fault Detection and Diagnosis for HVAC Systems Using Statistical Machine Learning Methods (DA-13-C018)**

*Ying Guo, Ph.D.<sup>1</sup>, Josh Wall, Ph.D., Member<sup>2</sup>, Jiaming Li<sup>2</sup> and Sam West<sup>2</sup>, (1)CSIRO, Sydney, Australia, (2)CSIRO, Newcastle, Australia*

### Seminar 45 (Intermediate)

**Hydraulic Modeling**

*Track: Large Building Design*

*Room: Lone Star A1*

**Sponsor: 09.01 Large Building Air-Conditioning Systems, 06.01 Hydronic and Steam Equipment and Systems**

*Chair: William Klock, P.E., Member, EEA Consulting Engineers, Austin, TX*

This seminar discusses the use of hydraulic modeling, both as a tool for new projects and for identifying problems in existing systems. Hydraulic modeling provides another tool for practitioners and owners to understand how system components interact with one another. This knowledge then allows for proper design and operation of hydraulic systems.

**1. What Is Hydraulic Modeling?**

*Joe Simmons, P.E., Member, HVAC Solutions, Inc., Salt Lake City, UT*

**2. Hydraulic Modeling of a University Chilled Water System**

*Morgan Stinson, P.E., Member, EEA Consulting Engineers, Austin, TX*

### Seminar 46 (Intermediate)

**If Failure is Random, Why Does it Happen Quicker When the Budget is Cut?**

*Track: Facility Management; Operations, Technology and Energy Improvements*



*Room: Lone Star A3*

**Sponsor: 07.08 Owning and Operating Costs, 07.03 Operation and Maintenance Management**

*Chair: Charles E. Dale-Derks, P.E., Member, McClure Engineering, St. Charles, MO*

The deterioration of the equipment with age is modeled as a random process; therefore, how can maintenance reduce or have an impact on failures? This seminar discusses interval maintenance, predictive maintenance, corrective maintenance, reactive maintenance, and more.

**1. Real World Cell Tower Maintenance**

*Matthew Mullen, P.E., Member, EMCOR Services New England Mechanical, Coventry, CT*

**2. Maintenance Mayhem**

*Keith H. Reihl, P.E., Member, Reihl Engineering, Cypress, TX*

### Seminar 47 (Intermediate)

**Optimization in HVAC**

*Track: HVAC Fundamentals and Applications*



*Room: Lone Star A4*

**Sponsor: TG1 Optimization, Education and Publishing**

*Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD*

This session is a selection of two papers in a special collection of papers on optimization published by the ASHRAE HVAC&R Research Journal.

**1. Auto-Calibration and Control Strategy Determination for a Variable-Speed Heat Pump Water Heater Using Optimization**

*Bo Shen, Omar Abdelaziz, Ph.D., Associate Member and Keith Rice, Oak Ridge National Laboratory, Oak Ridge, TN*

**2. Optimal Coordination of Heat > Pump Compressor and Fan Speeds and Subcooling Over a Wide Range of Loads and Conditions**

*Tea Zakula, Student Member<sup>1</sup>, Peter Armstrong, Ph.D., Member<sup>2</sup> and Leslie Norford, Ph.D., Member<sup>1</sup>, (1)Massachusetts Institute of Technology, Cambridge, MA, (2)Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates*

### Seminar 48 (Intermediate)

**The Mission Critical Data Center:**

**Resetting the Definition and the Human Element**

*Track: HVAC Fundamentals and Applications*



*Room: Dallas C*

**Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment**

*Chair: Nick Gangemi, Member, Facility Gateway Construction, Madison, WI*

Technology has changed. There is more technology in a Ford F-150 than in the original Mercury capsule. You have 64 GB of music in your pocket with more processing power than a 1970's era mainframe and 1tB of storage on your desktop at home. This seminar will review where data centers have been, where they are today and what is in store for the future. There is not a focus on any individual subsystem in the mission critical space but a brief review of the core components, technologies and installation configurations currently deployed and being considered for future applications. Performance metrics and regulatory requirements are also addressed. And one final goal – to create a foundation for defining the data center/mission critical/IT space and the components in the room that lead to continued discussion and updating as new products, services and efficiencies are realized in the future.

**1. The Mission Critical Data Center: Resetting the Definition**

*Herb Villa, Member, DC Professional Development, Newark, NJ*

**2. Data Centers: The Human Element**

*Robert Tozer, Ph.D., Member, Operational Intelligence Ltd., Kingston upon Thames, United Kingdom*

Tuesday, January 29 45

## Forum 4 (Basic)

### Specifying BAS Networks and Integration: Ensure that Guideline 13 Provides the Guidance You Need!

Track: Standards, Guidelines and Codes

Room: Dallas B

Sponsor: 01.04 Control Theory and Application

Chair: Chariti Young, Member, Automated Logic Corp., Kennesaw, GA

Guideline 13 provides recommendations for specifying building automation systems, as well as recommendations for specifying integration of other building systems into a building automation system. Since this Guideline was originally published, the landscape of networks and integration has changed significantly as existing technologies and architectures have matured and additional system architectures have emerged. SGPC 13 is updating Guideline 13 to provide better and more current guidance for specifying BAS network infrastructure and integration. Come share your experiences and pain in these arenas to help shape the future direction of the Guideline and ensure that the update will address your needs.

## Forum 5 (Intermediate)

### The DOE Buildings Performance Database – How Can It Help You and How Can You Help It?

Track: Facility Management; Operations, Technology and Energy Improvements

Room: Dallas A2

Sponsor: 07.06 Building Energy Performance

Chair: Kris Subbarao, Ph.D., Member, Pacific Northwest National Laboratory, Richland, WA; Cody Taylor, Department of Energy, Washington, DC

The DOE's Buildings Performance Database is a decision-support platform that enables engineering and financial practitioners to benchmark and evaluate, through an actuarial method, energy efficiency retrofits in commercial and residential buildings. In addition to the database, it has tools for Energy Performance Forecasting Tool and Financial Forecasting. The Energy Tool provides, from the peer group in the database, the energy savings probability distribution for a building or portfolio of buildings based on a selection of different efficiency measures. The forum is to stimulate discussions on making the BPD more useful, and contributing data to the BPD to enhance its value.

## Forum 6 (Intermediate)

### What Contaminates are Important in Low GWP Refrigerant Systems?

Track: Refrigeration

Room: Lone Star A2

Sponsor: 03.03 Refrigerant Contaminant Control, AHRI 700, 03.02 Refrigerant System Chemistry

Chair: Robert W. Yost, Member, National Refrigerants, Rosenhayen, NJ

HVAC/R systems using low GWP refrigerants are likely to be sensitive to contaminants in ways different than traditional systems. This forum discusses the contaminants most likely to affect system reliability with low GWP refrigerants, and what acceptable levels of contaminants may be needed. Methods to control these contaminants will also be discussed.

## Tuesday, January 29

11:00 AM-12:30 PM

### Technical Paper Session 7 (Intermediate)

#### Residential Design for Improved Performance

Track: HVAC Fundamentals and Applications

Room: Dallas A2

Chair: Darcy Carbone, Member, Stebbins-Duffy, Inc., Peabody, MA

Current design of residential HVAC and hot water heating to meet advanced energy and design requirements is presented. Methods of achieving modern energy standards while maintaining environmental comfort factors for homeowners are incorporated in these studies.



#### 1. Inter Unit Heat Flows in a Residence During District Heating in a Multistory Residential Building (DA-13-019)

Milorad Bojic, Student Member, University of Kragujevac, Kragujevac, Serbia

#### 2. Monitored Performance of Advanced Gas Water Heaters in California Homes (DA-13-020)

Marc A. Hoeschele, P.E., Davis Energy Group, Davis, CA

#### 3. Least Cost Upgrade Solutions to Achieve Improved Energy Efficiency Standards for Residential New Housing in Canada (DA-13-021)

Aya Dembo, Student Member, Farhan Khaddad and Alan Fung, Ryerson University, Toronto, ON, Canada

## Conference Paper Session 6 (Intermediate)

### Designing for Energy Conservation and Operational Cost Reduction

Track: Energy Conservation



Room: Dallas A3

Chair: Steven Rosen, Member, EYP Architecture & Engineering, P.C., Boston, MA

Environmental considerations are often balanced with capital and operational costs. Performance costing and life-cycle analysis are important tools to consider, as well as efficiency technologies. Energy and cost saving studies and methodologies for HVAC engineers and operations personnel are presented.

#### 1. Life Cycle Performance Costing Based Building Design Decision Support (DA-13-C019)

Wim Zeiler<sup>1</sup>, Rik Maaijen<sup>1</sup> and Wim Maassen<sup>2</sup>, (1)TU Eindhoven, Eindhoven, Netherlands, (2)Royal Haskoning DHV, Rotterdam, Netherlands

#### 2. Dedicated Outside Air System (DOAS): Design vs. Actual Operation – Are Aggressive Energy Targets Achievable? (DA-13-C020)

Jason J. Burbank, P.E., Associate Member, Justin M. Marmaras, Student Member and Dragoljub B. Kosanovic, Ph.D., University of Massachusetts Amherst, Amherst, MA

#### 3. Comparison of Data Center Classes on Energy Use (DA-13-C021)

John C. Peterson, P.E., Member and Doug McLellan, P.E., Member, Hewlett Packard, Takoma Park, MD

#### 4. Impact of Ice Thermal Storage on HVAC Cooling Energy Cost (DA-13-C022)

Nabil Nassif, Ph.D., P.E., Associate Member, North Carolina A&T State University, Greensboro, NC

#### 5. Using Locational Marginal Pricing to Implement Peak Load Shifting with a Grid Connected Water Heater (DA-13-C023)

Harshal Upadhye, Associate Member<sup>1</sup>, Ronald Domitrovic, Ph.D., Associate Member<sup>1</sup> and Ammi Amarnath<sup>2</sup>, (1)Electric Power Research Institute, Knoxville, TN, (2)Electric Power Research Institute, Palo Alto, CA

## Conference Paper Session 7 (Intermediate)

### Numerical Methods for Noise and Vibration Simulation of HVAC&R Systems

Track: HVAC Fundamentals and Applications



Room: Lone Star A4

Sponsor: 02.06 Sound and Vibration Control

Chair: Curt Eichelberger, P.E., Member, Johnson Controls, York, PA

The challenge for high performance building design is to balance sustainability or "green" objectives with traditional indoor environmental quality (IEQ). Of all the IEQ factors surveyed in over 350 buildings by the CBE, the one causing the greatest occupant dissatisfaction is acoustics, including both noise level and speech privacy issues. This session includes two papers that apply finite element (FE) and statically energy analysis (SEA) numerical methods to model the sound attenuation of two very important HVAC air distribution elements: plena and ducts. A third paper applies structural FE methods to the development of refrigerant piping in HVAC equipment, with the goal of lower vibration and better reliability.

#### 1. Prediction of Insertion Loss of Plenums Above the Plane Wave Cutoff Frequency (DA-13-C024)

D. W. Herrin, Ph.D., P.E., Member and S. Ramalingam, Student Member, University of Kentucky, Lexington, KY

## 2. Using Statistical Energy Analysis to Analyze Sound and Vibration Energy Propagation in HVAC Ducts (DA-13-C025)

*S. Ramalingam, Student Member and D. W. Herrin, Ph.D., P.E., Member, University of Kentucky, Lexington, KY*

## 3. Numerical Vibration Simulation Applied to the Design of HVAC Refrigeration Piping Systems (DA-13-C026)

*Jack Wang, Member, Ingersol Rand, La Cross, WI*

### Seminar 49 (Intermediate)

#### Cutting-Edge Japanese Technologies (HVAC&R Systems and Equipment): Japan, Two Years After the Earthquake and SHASE-Awarded HVAC&R Systems

*Track: HVAC&R Systems & Equipment*



*Room: Dallas B*

*Chair: Shinsuke Kato, Ph.D., Fellow ASHRAE, University of Tokyo Institute of Industrial Science, Tokyo, Japan*

Since the March 2011 Great East Japan Earthquake, the Japanese design concept of HVAC systems and their operation has dramatically changed. A broad view of these changes is introduced as a keynote lecture topic. A couple of the SHASE-awarded buildings will be introduced, including: a ductless HVAC system using a Coanda effect and horizontal cooling panel for storing herb medicine in Yubari, Hokkaido; and an HVAC design with an energy security and reliability concept.

#### 1. How Did the Situation Involving the Japanese HVAC System and Office Environment Change After the Great East Japan Earthquake?

*Shinsuke Kato, Ph.D., Fellow ASHRAE, University of Tokyo Institute of Industrial Science, Tokyo, Japan*

#### 2. Ductless Air-Conditioning System Using a Coanda Effect and a Horizontal Cooling Panel for Herb Medicine Storage in Yubari Project

*Daisuke Shibuya and Mutsumi Yokoi, Taisei Corporation, Tokyo, Japan*

#### 3. The Reliability of the Energy Supply and the Latest Building Equipment Plan for Large Buildings in Osaka

*Yu-suke Miyazaki, Kajima Corporation, Osaka, Japan*

### Seminar 50 (Intermediate)

#### Deep Energy Retrofit

*Track: Energy Conservation*



*Room: Lone Star A1*

*Sponsor: 07.01 Integrated Building Design*

*Chair: Ery Djunaedy, Ph.D., Member, University of Idaho, Boise, ID*

Our existing building infrastructure consumes tremendous energy resources. This creates an opportunity for conservation on an expansive scale if progress can be made toward identifying a replicable technical and economic template for deep-energy renovations. Fundamentally, this is a question about what our existing buildings of today will be and how they will operate a generation from now. This seminar presents the interim results of the development phase of an initiative that targets deep energy savings in the retrofit of existing buildings into high performance buildings. The sessions present lessons learned to date from pilot projects on large and medium office buildings.

#### 1. Integrated Measure Packages for Existing Building Renewal: High-Rise Office Buildings

*Christopher Meek, University of Washington, Seattle, WA*

#### 2. Integrated Measure Packages for Existing Building Renewal: Medium Office Buildings

*Ery Djunaedy, Ph.D., Member, University of Idaho, Boise, ID*

#### 3. Integrated Property Assessment for Existing Building Renewals

*Michael Hatten, P.E., Member, Solarc Architecture and Engineering, Eugene, OR*

### Seminar 51 (Intermediate)

#### Energy Benchmarks: Setting Standards or Feeding Fantasies?

*Track: Standards, Guidelines and Codes*



*Room: Dallas C*

*Sponsor: MTG.BPM Building Performance Metrics, ASHRAE CIBSE Liaison, 07.06 Building Energy Performance*

*Chair: Tim Dwyer, Fellow ASHRAE, Bartlett School of Architecture, University College London, London, United Kingdom*

This seminar presents aspects of energy benchmarks that reflect their evolution, their perception, their fiscal value, and their application in the fairly mature, and increasingly congested, European market. These three speakers have extensive experience covering the development, roll-out and hands-on application of benchmarks from institutional, governmental and consultative viewpoints. Their presentations provide critical and informed lessons so that others may benefit from their hard won experience.

#### 1. Energy Benchmarks: Mirage or Reality?

*Hywel Davies, Ph.D., Member, Chartered Institution of Building Services Engineers, London, England*

#### 2. Financial Advantages of Benchmarked Buildings and MEP Systems

*David Arnold, Ph.D., Fellow Life Member, London South Bank University, London, United Kingdom*

#### 3. Benchmarking: Gaming or Winning?

*David Fisk, Ph.D., Imperial College London, London, United Kingdom*

### Seminar 52 (Advanced)

#### Systems and Components Performance and Efficiency with Low-GWP and Natural Refrigerants, Part 2

*Track: Refrigeration*



*Room: Lone Star A2*

*Sponsor: Refrigeration Committee, TC10.7, 03.01 Refrigerants and Secondary Coolants*

*Chair: Georgi S. Kazachki, Ph.D., Fellow ASHRAE, CRYOTHERM Consulting, Atlanta, GA*

The properties of the new low-GWP and natural refrigerants, such as HFO, R-32, R-152a, ammonia, hydrocarbons, CO<sub>2</sub>, etc. have an impact on the performance and efficiency of the refrigeration and air-conditioning systems and their components. A special attention in this session is dedicated to the design, operation, and servicing equipment with flammable refrigerants, such as hydrocarbons and ammonia. The issues and challenges are illustrated in the example of a household refrigerator/freezer with R600a for use on the U.S. market. Two presentations provide a comprehensive analysis of efficiency and operational aspects of equipment with ammonia.

#### 1. Cycle Efficiency, Charge Minimization, and Service of Household Refrigerators with R-600a

*Brent Junge, P.E., Member, General Electric, Louisville, KY*

#### 2. Minimum Energy Design Practice for Air Blast Freezing

*Klaas Visser, Member, KAV Consulting Pty. Ltd., Kangaroo Flat, Australia*

#### 3. Elimination of Condensation in Meat Packing Plants

*Klaas Visser, Member, KAV Consulting Pty. Ltd., Kangaroo Flat, Australia*

### Seminar 53 (Intermediate)

#### Wireless Sensing for Commissioning Existing Buildings

*Track: Facility Management; Operations, Technology and Energy Improvements*



*Room: Lone Star A3*

*Sponsor: 07.05 Smart Building Systems*

*Chair: Michael R. Brambley, Ph.D., Fellow ASHRAE, Pacific Northwest National Laboratory, Richland, WA*

This session explores the potential for use of wireless sensors in commissioning existing commercial buildings. Wireless sensing shows promise for making retro-commissioning of smaller commercial buildings without building automation systems cost effective. The presentations provide examples of wireless sensing systems for retro-commissioning existing buildings, identify technology needs, and illustrate applications of wireless sensing in case studies.

### 1. Wireless Sensors Solutions for Existing-Building Commissioning: One Size Does Not Fit All

*George R. Hernandez, P.E., Pacific Northwest National Laboratory, Washington, DC*

### 2. Retro-Commissioning of Buildings Using Wireless Sensors for Improved Energy Efficiency

*Teja Kuraganti, Oak Ridge National Laboratory, Oak Ridge, TN*

### 3. Wireless Sensing for Existing Building Commissioning: A Michigan Example

*Glen T. Remington, Member, Michigan State University, East Lansing, MI*

## Tuesday, January 29

1:30 PM-3:00 PM

### Seminar 54 (Intermediate)

#### Building Labeling in Europe: European Standardization to Meet the Energy Performance Directive

*Track: Standards, Guidelines and Codes*



*Room: Dallas C*

*Chair: Bjarne W. Olesen, International Center for Indoor Environment and Energy, Technical University of Denmark, Lyngby, Denmark*

In the US, LEED, Energy Star, and ASHRAE's bEQ are being used to label building energy performance. In the EU, countries follow EPBD. The session reviews the European initiatives to evaluate building energy performance and to couple energy use with environmental quality. This involves revision of several CEN standards of which some will be developed as combined ISO and CEN standards. Therefore the ongoing and planned activities and what is happening in Europe and other parts of the world is also relevant for North America.

#### 1. EU Mandate to Develop the Second Generation Energy Performance Standards

*Jaap Hogeling, Fellow ASHRAE, ISSO, Lienden, Netherlands*

#### 2. Nearly Zero Energy Buildings nZEB Definitions and System Boundaries: The REHVA View

*Jarek Kurnitski, Dr.Ing., Finnish Innovation Fund Sitra, Helsinki, Finland*

#### 3. Revision of EN15251: Indoor Environmental Criteria

*Bjarne W. Olesen, International Center for Indoor Environment and Energy, Technical University of Denmark, Lyngby, Denmark*

## Tuesday, January 29

2:00 PM-3:30 PM

Dallas Convention Center

### AHR Expo Session 1 (Basic)

#### Basics of HVAC Noise Control

*Track: HVAC Fundamentals and Applications*



*Room: C147 - Convention Ctr*

*Sponsor: 02.06 Sound and Vibration Control*

*Chair: Erik Miller-Klein, P.E., Associate Member, SSA Acoustics, LLP, Seattle, WA*

Designing HVAC systems with good acoustic performance can be a challenge: this session addresses three common issues to improve acumen for sound and vibration. Explore the idiosyncrasies of selecting fans that optimize acoustic and energy performance for improved system design. Learn about the physics of sound that explains the performance and limitations of silencers and acoustic louvers. Fine tune the most valuable and effective tool for acoustics: your ears. This session also provides audio examples to connect you with the fundamental aural experience.

#### 1. Fan Selection Impact on Noise

*Mark E. Schaffer, P.E., Member, Schaffer Acoustics Inc., Pacific Palisades, CA*

#### 2. Understanding the Physics of Silencers

*Dan LaForgia, Member, Industrial Acoustics, Bronx, NY*

#### 3. What Does That Sound Like and Mean? (Ear Training)

*Erik Miller-Klein, P.E., Associate Member, SSA Acoustics, LLP, Seattle, WA*

## Tuesday, January 29

3:15 PM-4:45 PM

### Seminar 55 (Intermediate)

#### BIM To Energy Simulation: ASHRAE Research Project 1468

*Track: HVAC Fundamentals and Applications*



*Room: Dallas C*

*Sponsor: 01.05 Computer Applications*

*Chair: David Branson, Compliance Services Group, Lubbock, TX*

The maturing of Building Information Modeling (BIM) as a design platform within the HVAC&R Industry has led to the desire by design professionals to have readily available tools for thermal modeling that will interoperate with BIM and produce stable Building Energy Simulation (BES) results. ASHRAE has been conducting research through RP1468 to address the rapidly growing need to provide methodologies by which software developers could accurately and efficiently represent graphical and supporting non-graphical data for automated use with BES models. This research has uncovered numerous growth opportunities and challenges to be faced in the near future of building energy modeling.

#### 1. Development of a Reference Building Information Model (BIM) for Thermal Model Compliance Testing: 1468-RP

*Mark Clayton, Ph.D., Texas A&M University, College Station, TX*

#### 2. Challenges of BIM to BEM Translations

*John F. Kennedy, Member, Autodesk, Santa Rosa, CA*

## Wednesday, January 30

8:00 AM-9:30 AM

### Technical Paper Session 8 (Intermediate)

#### Contemporary Steam and Hot Water Design

*Track: HVAC&R Systems & Equipment*



*Room: Dallas A3*

*Chair: Samir Traboulsi, Ph.D., P.E., Member, Thermtrade/Ranec, Beirut, Lebanon*

Contemporary steam and hot water for humidification and potable use are presented. Design considerations, modeling techniques and verification for newer, advanced hydronic systems are discussed.

#### 1. Humidification Requirements in Economizer-Type HVAC Systems (DA-13-022)

*Viktor T. Toth, Ottawa, ON, Canada*

#### 2. Short-Term Performance of Gas-Fired Tankless Water Heater: Laboratory Characterization (DA-13-023)

*Paul Glanville, P.E., Associate Member, Douglas Kosar and Jason Stair, Gas Technology Institute, Des Plaines, IL*

#### 3. A New Easy-to-Parameterize Boiler Model for Dynamic Simulation (DA-13-024)

*Jens Glembin, Gunter Rockendorf and Jan Steinweg, P.E., Institute for Solar Energy Research, Hamelin, Germany*

#### 4. New Correlation Equations for Ammonia Water Vapor-Liquid Equilibrium (VLE) Thermodynamic Properties (DA-13-025)

*Syed Said, M.A. El-Shaarawi and Muhammad Siddiqui, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia*

### Conference Paper Session 8 (Intermediate)

#### Design and Optimization of Building Controls to Meet Energy Targets

*Track: Facility Management; Operations, Technology and Energy Improvements*



*Room: Dallas A2*

*Chair: Gary C. Debes, Member, Coward Environmental Systems, Coatesville, PA*



Today's challenges in building controls frequently hinge around system integration and reducing, predicting and flattening site energy consumption. While achieving energy reduction targets, engineers must also meet occupant requirements, health and safety considerations and thermal comfort. Various approaches to meet these challenges, which are often conflicting, along with modern design strategies are presented.

#### 1. Role of Optimization in the Design and Operation of Building Control Systems (DA-13-C027)

**Stephen J. Treado, Ph.D., P.E., Member, Pennsylvania State University, University Park, PA**

#### 2. Building Energy Simulation and Optimization of Industrial Halls (DA-13-C028)

**Bruno Lee, Student Member<sup>1</sup>, Marija Trcka, Ph.D., Member<sup>2</sup> and Jan L.M. Hensen, Ph.D., Fellow ASHRAE<sup>2</sup>, (1)Materials Innovation Institute (M2i), Delft, Netherlands, (2)Eindhoven University of Technology (TU/e), Eindhoven, Netherlands**

#### 3. A Decision Making Structure for Distributed, Multiagent Building Control (DA-13-C029)

**Andrew W. Windham, Student Member and Stephen J. Treado, Ph.D., P.E., Member, Pennsylvania State University, University Park, PA**

#### 4. WITHDRAWN - Collaborative Building Control to Optimize Energy Saving and Improve Occupants' Experience (DA-13-C030)

**Zhen Song, Ph.D., Sam Zheng, Ph.D., Kun Ji, Ph.D., and Yan Lu, Ph.D., Siemens Corporate Research, Princeton, NJ**

### Seminar 56 (Basic)

#### Calibration Case Studies, Fleets of Buildings, Individual Building and Algorithm

*Track: Energy Conservation*

*Room: Lone Star A3*

**Sponsor: 04.07 Energy Calculations**

*Chair: David Bosworth, Member, BuildLab, Dryden, NY*

The building industry is increasingly interested in how well modeling predicts actual savings. This panel explores calibration and modeling accuracy on three different scales from 10 buildings, to a single building to a specific algorithm. The first presentation explores how well 10 buildings match the predicted EUIs when corrected for occupancy and weather. The second presentation discusses how metered energy consumption data can be used to refine energy models used in the design of new multifamily buildings. The third presentation goes to the algorithm scale to see how well the heat transfer through an attic floor matches between two detailed simulation programs and compares with measured heat flows.

##### 1. Calibrating a Portfolio of Buildings

**Jason Stienbeck, Associate Member, The Weidt Group, Minnetonka, MN**

##### 2. Actual Energy Use and Informing Multifamily Design

**Xia Fang, P.E., Member, Group 14, Denver, CO**

##### 3. Uncertainty and Shortcomings in Using Building Energy Simulations

**Joe Huang, Member, White Box Technologies, Moraga, CA**

### Seminar 57 (Intermediate)

#### Cutting-Edge Japanese Technologies (Energy Conservation): SHASE-Awarded Energy-Efficient Buildings in Japan

*Track: Energy Conservation*

*Room: Dallas B*

*Chair: Shuichi Hokoi, Ph.D., Kyoto University, Kyoto, Japan*

Three buildings that received awards from SHASE for being energy efficient are introduced. These include: a large-scale hospital with advanced BEMS and a combination of thermal storage and cogeneration; a junior and senior high school with environmentally friendly technologies; and a building with ten years of quality operations in the area of urban development and in District heating and cooling using a large thermal storage tank

##### 1. Realization of Green Building Services for a Large General Hospital

**Koji Kasuya, Nikken Sekkei Ltd., Tokyo, Japan**

##### 2. Environmentally Conscious Design for a Junior and Senior High School by "Biomimicry" of a Tree

**Hisashi Wakayama, Nihon Sekkei Corp., Tokyo, Japan**

#### 3. Life-Cycle Management for More Than Ten Years of Operations at a Large-Scale Urban Redevelopment

**Akira Okagaki, Nikken Sekkei Research Institute, Tokyo, Japan**

### Seminar 58 (Advanced)

#### Leading Edge Advances in Absorption Cooling Technologies

*Track: HVAC&R Systems & Equipment*

*Room: Dallas C*

**Sponsor: 08.03 Absorption and Heat Operated Machines**

*Chair: Ersin Gercek, P.E., Associate Member, Real Energy Consulting Services, LLC, Totowa, NJ*

In this session, four different research and implementation facets towards improving performance and efficiency of heat operated cooling technologies are evaluated. The first author evaluates utilization of ionic fluids in absorption systems instead of traditional salts. The second author introduces new generation membrane-based absorption technology, which utilizes ultra thin absorbent films constrained by highly permeable nanoporous membranes. The third author compares adsorption and absorption cooling technologies and demonstrates a residential trigeneration system using adsorption cooling system. Finally, the last authors present implementation of triple effect and multi-energy chillers.

##### 1. Ionic Fluid Design for Absorption Heat Pump Applications

**Omar Abdelaziz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN**

##### 2. New Generation Membrane-Based Absorption Refrigeration System (ARS)

**Saeed Moghaddam, Ph.D., University of Florida, Nanoengineered Energy Systems (NES) Laboratories, Gainesville, FL**

##### 3. Low Regeneration Temperature Adsorption Heat Pump in a Micro-Trigeneration System

**Reinhard Radermacher, Ph.D., Fellow ASHRAE, Kyle Gluesenkamp, Student Member and Suxin Qian, Student Member, University of Maryland, College Park, MD**

##### 4. High Efficiency Absorption Chiller-Heaters & Triple Effect Chillers

**Piyush V. Patel, Associate Member, Thermax Ltd., Northville, MI**

### Seminar 59 (Basic)

#### New Mobile Applications for HVAC Field Work and Building Retrofits

*Track: Facility Management; Operations, Technology and Energy Improvements*

*Room: Lone Star A1*

**Sponsor: 01.05 Computer Applications, 07.01 Integrated Building Design**

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

This seminar focuses on mobile applications for HVAC field work. As mobile devices such as smartphones and tablets evolve, so does the software (or apps) that runs on them. More and more businesses are using these mobile devices to accomplish work in the field, thus saving time and providing instant reports and proposal for clients. The HVAC industry is no exception since many field-based HVAC apps are available for technicians and engineers to use. This seminar highlights the types of apps being used by these professionals and the challenges presented to developers of these apps.

##### 1. Overview of Mobile HVAC Field Apps

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

##### 2. Discussion of Mobile Apps for Building Energy Retrofits

**Richard Szydlowski, Center for Energy and Environment, Minneapolis, MN**

##### 3. The Need for Standardized Data From Building Asset Field Surveys

**Colin Davis, kWhOURS, Inc., Boston, MA**

## Seminar 60 (Intermediate)

### Standards, Guidelines and Codes Affecting Design and Operation of Laboratories

Track: *Industrial & Transportation Ventilation*



Room: Lone Star A2

Sponsor: 09.10 Laboratory Systems

Chair: James Coogan, P.E., Member, Siemens, Buffalo Grove, IL

Design and operation of laboratory facilities is affected by standards and guidelines set by a variety of organizations. This seminar examines a selected sample of those constraints and requirements to see how they affect the jobs of HVAC designers and suppliers. Recent updates and long-standing requirements are both addressed.

#### 1. Establishing Appropriate Airflow Rates for Laboratories and Chemical Fume Hoods During Energy Reduction Projects

Thomas Smith, Member, Exposure Control Technologies, Inc., Cary, NC

#### 2. Biosafety Requirements in Laboratory Design

Chris Kiley, P.E., Member, Merrick & Company, Atlanta, GA

#### 3. Energy Codes for Labs: 90.1-2010 and Title 24-2013

Mark Hydeman, P.E., Taylor Engineering, LLC, Alameda, CA

## Seminar 61 (Intermediate)

### Zero Refrigerant Emissions:

### What's Changing in the New SPC 147 Standard

Track: *Refrigeration*



Room: Lone Star A4

Sponsor: 03.08 Refrigerant Containment

Chair: Mark Adams, Member, Johnson Controls, York, PA

Upcoming phase outs and production reductions for some refrigerants, combined with increasing emissions and scrutiny from regulatory and environmental groups, could lead to additional regulations on, restricted availability of, and even phase outs of certain refrigerants. Learn how you can take actions today to prevent the loss of refrigerant from your equipment and systems. This session looks at the new SPC 147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems. This seminar covers the changes and new requirements imposed by the new standard. This includes changes for equipment manufacturers, installing contractors, service technicians, and owners. This session also covers general changes to the standard, new leak checking requirements for equipment, and new requirements for active leak monitoring methods.

#### 1. General Overview of Changes to SPC 147: Reducing the Release of Halogenated Refrigerants From Refrigerating and Air-Conditioning Equipment and Systems

Paul Solberg, Member, Trane Co., La Crosse, WI

#### 2. Product and Field Leak Testing: Overview of the New SPC 147 Requirements and Presentation of the Various Methods Pros and Cons

Dan Miles, Ph.D., Member, Vacuum Technology Inc., Oak Ridge, TN

#### 3. Overview of New Active System Monitoring Requirements and Field Examples of Operating Systems

Robert Sperl, Member, Wegmans, Hunt Valley, MD

## Wednesday, January 30

9:45 AM-10:45 AM

## Seminar 62 (Intermediate)

### Corrosion in Refrigeration Piping Systems

Track: *Refrigeration*



Room: Lone Star A4

Sponsor: 10.03 Refrigerant Piping

Chair: John J. Sluga, Member, Hansen Technologies Corp., Bolingbrook, IL

Refrigerant piping and insulation are key components in a refrigeration system. Breakdown in these areas can affect the system's overall performance. In addition, its integrity and life can be compromised. This seminar will discuss the causes, prevention and effects of corrosion of the various components in

the refrigeration piping. Degradation of the piping insulation directly affects system performance but can lead to pipe corrosion. The resultant pipe corrosion can affect the mechanical integrity of the system.

#### 1. Causes and Prevention of Corrosion on the Interior Surface of Metal Jacketing Used on Mechanical Insulation

Jim Young, Member, Dow Chemical Co., Midland, MI

#### 2. Corrosion in Refrigeration Piping Systems

James Price Sr., Hansen Technologies Corp., Bolingbrook, IL

## Seminar 63 (Intermediate)

### Effective Use of Rate Rational and Spreadsheet for Standard 62.1

Track: *HVAC Fundamentals and Applications*



Room: Lone Star A2

Sponsor: SSPC 62.1

Chair: Jeff K. Smith, Georgia Power Co., McDonough, GA

This seminar demonstrates the effective use of the Rate Rational spreadsheet for ASHRAE Standard 62.1. The spreadsheet was developed to educate designers on the proper implementation of the standard and its effective use to meet both today's ventilation and energy requirements.

#### 1. Effective Use of Rate Rational and Spreadsheet

Hoy R. Bohanon, P.E., Member<sup>1</sup> and Andrew K. Persily, Ph.D., Member<sup>2</sup>,

(1)Working Buildings, Winston-Salem, NC, (2)National Institute of Standards and Technology, Gaithersburg, MD

## Seminar 64 (Basic)

### Healthcare Commissioning and the Authority Having Jurisdiction

Track: *Facility Management; Operations, Technology and Energy Improvements*



Room: Lone Star A1

Sponsor: 07.09 Building Commissioning

Chair: Rocky Alazazi, Member, Executive Director, City of Taylor, Taylor, MI

The University of Michigan Health System just opened a new 1.1 million square foot children's and women's hospital. The University utilized extensive commissioning from the design phase through completion. This session demonstrates how the commissioning authority played a very large role in preparing for the final inspections and achieving the certificate of occupancy.

#### 1. Opening a New Hospital: A Case Study

Matthew Tunnard, Member, Horizon Engineering Associates, Detroit, MI

## Seminar 65 (Basic)

### Weathering the Storm – HVAC & Extreme Weather

Track: *Standards, Guidelines and Codes*



Room: Dallas C

Sponsor: 02.07 Seismic and Wind Restraint Design

Chair: Karl Peterman, Vibro-Acoustics, Markham, ON, Canada

Extreme wind and rain events in recent years have resulted in billions of dollars in building damage with a significant portion of this damage resulting from failure of the building envelope in repelling water. Building codes have recently been significantly enhanced to address this problem and since HVAC systems are typically part of building envelopes, it is vital that owners, designers and contractors be aware of current code requirements and design guidelines. Part of the session will highlight results from a new large scale testing facility built to investigate extreme weather events and their effects on HVAC equipment.

#### 1. Wind Loads on Buildings and Roof-mounted Equipment and Mitigation Strategies

Chuck Miccolis, Institute for Business Home and Safety, Richburg, SC

#### 2. Identifying and Preparing for Flooding Hazards for HVAC Equipment

James A. Carlson, Member, Seismic-Source International, Omaha, NE

## Seminar 66 (Intermediate)

### Reliability Concerns for Data Center IT Equipment: Contamination Issues, Standards Actions, and Case Studies

Track: HVAC Fundamentals and Applications

Room: Dallas B



Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment, 02.03 Gaseous Air Contaminants and Gas Contaminant Removal Equipment

Chair: Christopher O. Muller, Member, Purafil Inc., Doraville, GA

Lead-free manufacturing regulations, reduction in circuit board feature sizes and the miniaturization of components to improve hardware performance makes data center IT equipment more prone to attack by corrosive contaminants. Manufacturers are under pressure to maintain equipment uptime; the need to control airborne contaminants in the data center environment and specify acceptable limits is now critical to the continued reliable operation of datacom and IT equipment. This seminar presents updates on ongoing contamination concerns, standards activities, and cases studies illustrating the successful application of contamination assessment, control, and monitoring programs to eliminate equipment failures.

#### 1. Particulate and Gaseous Contamination in Data Centers: Recent Developments

Prabjit Singh, Ph.D., Member, IBM, Poughkeepsie, NY

#### 2. Data Center Case Studies: Contamination Assessment, Control, and Monitoring

Christopher O. Muller, Member, Purafil Inc., Doraville, GA

## Forum 7 (Intermediate)

### Cold Climate Design Guide: Scope and Content

Track: HVAC Fundamentals and Applications

Room: Dallas A2

Sponsor: 09.08 Large Building Air-Conditioning Applications, Publications Committee

Chair: Frank A. Mills, P.E., Member, McGrath Mills Consulting Engineers, Leyland, United Kingdom

ASHRAE has formed a working group with input from REHVA to publish a new design guide for Cold Climates which will be the most up to date technical publication covering this subject. It will be published in 2014 and must deal with topics across all ASHRAE membership areas including North and South America, Europe, Scandinavia, Asia and any other areas that members work in or design for. It must deal with zero carbon energy usage, which is an upcoming requirement, and advise on technical risks associated with newly emerging renewable technologies and other areas of development. This forum invites members to advise the scope and content to be covered to help guide this work.

## Forum 8 (Intermediate)

### Fan Energy Efficiency: Quantifying the Savings

Track: HVAC&R Systems & Equipment

Room: Lone Star A3

Sponsor: 05.01 Fans, 2.6 & 9.10, 05.09 Enclosed Vehicular Facilities

Chair: Tim Mathson, Member, Greenheck, Schofield, WI

In an effort to reduce energy consumption of fans, minimum Fan Efficiency Grades are being considered in several national standards, including ASHRAE 90.1. The attempt to use a single minimum FEG requirement for all fan applications has brought about exemptions for many fans. This leaves a significant portion of the market without any regulation. An alternative requirement that considers the minimum fan efficiency at design conditions would eliminate these exemptions and result in significantly higher energy savings. The forum discusses this requirement, along with the potential energy savings for each method.

## Forum 9 (Intermediate)

### What Should An ASHRAE Certified Integrated Building Control Design Professional (IBCDP) Know?

Track: HVAC&R Systems & Equipment

Room: Dallas A3

Sponsor: 01.04 Control Theory and Application, SGPC-13 Specifying DDC

Chair: Barry B. Bridges, P.E., Member, Sebesta Blomberg, Roseville, MN

This forum explores the possibility of a new ASHRAE certification for a building control design professional. What specific knowledge should an individual with this certification have? The fundamentals of control, valve selection criteria, damper sizing, temperature sensor span, and PID loop tuning are only a portion of what is relevant to today's systems. An HVAC controls expert must also know IT standards, networking protocols, gateways, routers, integration to non HVAC systems, network security, backup requirements, uninterruptable power and similar IT or IP issues.

# Wednesday, January 30

## 11:00 AM-12:30 PM

## Technical Paper Session 9 (Intermediate)

### Predictive Modeling and Simulation of Novel HVAC Design

Track: Energy Conservation

Room: Dallas A3



Sponsor: 04.07 Energy Calculations

Chair: Douglas C. Cochran, Carrier Canada Sales & Distribution, Mississauga, ON, Canada

Predictive modeling approaches, both numerical and physical, are presented for novel HVAC applications. Approaches using various systems including cogeneration cycles for simultaneous heating and cooling, novel numerical methods and unique approaches to common issues are presented.

#### 1. A Variable Refrigerant Flow Heat Pump Air Conditioner Computer Model in Energyplus (DA-13-026)

Richard Raustad, Florida Solar Energy Center, Cocoa, FL

#### 2. Investigation of Electric and Reverse Cycle Hot-Gas Defrosting for Evaporators in Refrigeration Systems (DA-13-028)

Syed Zahid Hussain Rizvi, Johnson Controls Inc - IR Industrial Refrigeration, Dubai, United Arab Emirates

## Conference Paper Session 9 (Intermediate)

### Geothermal Systems: Simulation, Design and Operation

Track: HVAC&R Systems & Equipment

Room: Lone Star A1



Chair: Brandt H. Williams, Engineered Systems Design, Inc.

Efficient heating and cooling through exchange with the environment is increasing in popularity due to recent advances and energy efficiency. Adoption and expansion of these systems internationally and in residential buildings has become significant due to recent advancements. New advancements and experience with these systems is presented for several markets, both domestically and internationally.

#### 1. WITHDRAWN – Design of a Vertical, Closed-Loop, Geothermal Condenser for Domestic Air Conditioning (DA-13-C031)

Rehan Khalid<sup>1</sup>, Abdul Rasheed Choudhry, Student Member<sup>1</sup>, Muhammad Faizan Rabbani<sup>1</sup>, Muhammad Faseeh Imam<sup>1</sup>, Dr. Mohammad Sultan Khan, Member<sup>2</sup> and Dr. Tariq Saeed Khan, Associate Member<sup>1</sup>, (1)Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, Topi, Swabi, KPK, Pakistan, (2)Mohammad Ali Jinnah University, Islamabad, Pakistan

#### 2. Simulation and Experimental Study of a Thermosiphon Defrosting Technique for Air-Source Heat Pumps (DA-13-C032)

Paul Byrne, Jacques Miriel, Redouane Ghouali and Laurent Serres, Ph.D., Université de Rennes, Rennes, France

# Wednesday, January 30 51

### 3. Development of Residential Ground-Source Integrated Heat Pump (DA-13-C033)

Keith Rice<sup>1</sup>, Van D. Baxter, P.E., Fellow ASHRAE<sup>1</sup>, Jeffrey Munk<sup>1</sup>, Bo Shen<sup>1</sup>, Shawn Herr<sup>2</sup> and Timothy McDowell<sup>3</sup>, (1)Oak Ridge National Laboratory, Oak Ridge, TN, (2)ClimateMaster, Inc., Oklahoma City, OK, (3)Thermal Energy System Specialists, LLC, Madison, WI

### 4. Ground Source Heat Pump Operation and Optimal Entering Liquid Temperature Control (DA-13-C034)

Justin M. Marmaras, Student Member, Jason J. Burbank, P.E., Associate Member and Dragoljub B. Kosanovic, Ph.D., University of Massachusetts Amherst, Amherst, MA

### 5. Development of Fuel Fired Multi-Function Heat Pump (DA-13-C035)

Isaac Mahderekal, Ph.D., P.E., Associate Member, Bo Shen and Edward A. Vineyard, P.E., Member, Oak Ridge National Laboratory, Oak Ridge, TN

## Conference Paper Session 10 (Intermediate)

### Innovative Energy Efficient Technologies

Track: HVAC Fundamentals and Applications

Room: Dallas A2

Chair: Michelle Contri, P.E., Member, DLB Associates, Eatontown, NJ

A significant portion of energy consumption can be contributed to the HVAC&R systems. Accurate estimation of system performance is a key element in maximizing efficiency. The papers in this session elaborate on energy efficient technologies and strategies to improve on energy consumption.

#### 1. A Comparative Analysis of Displacement Ventilation with the Overhead Mixing Systems (DA-13-C036)

Kishor Khankari, Ph.D., Member, Syska Hennessy Group, Ann Arbor, MI

#### 2. Developing and Validation of a Fan Model In HVAC Systems (DA-13-C037)

Nabil Nassif, Ph.D., P.E., Associate Member, North Carolina A&T State University, Greensboro, NC

#### 3. Field Evaluation of SEER Rating in Hot Dry Climates (DA-13-C038)

John Bush, Associate Member<sup>1</sup>, Loren Kirkeide<sup>2</sup>, Bo Xing<sup>2</sup>, Jan Miller<sup>2</sup> and Ronald Domitrovic, Ph.D., Associate Member<sup>1</sup>, (1)Electric Power Research Institute, Knoxville, TN, (2)SRP, Phoenix, AZ

#### 4. A Field Study of Occupant Thermal Comfort with Radiant Ceiling Panel Systems (DA-13-C039)

Zachary E. Heise, Student Member and Huafen Hu, Portland State University, Portland, OR

#### 5. Avoiding System Problems When Using Expansion Tanks (DA-13-C040)

Robert Polchinski, P.E., Member, New York City College of Technology, Brooklyn, NY

## Seminar 67 (Intermediate)

### ASHRAE Position on Limiting Indoor Mold and Dampness in Buildings, Unvented Combustion Devices and Indoor Air Quality: Review of 3 Recently Published ASHRAE Position Documents

Track: Standards, Guidelines and Codes

Room: Dallas C

Sponsor: Environmental Health Committee

Chair: Pawel Wargocki, Ph.D., Member, Technical University of Denmark, Lyngby, Denmark

The objective of this seminar is to inform the ASHRAE community on three recently published PDs prepared by EHC. PD on indoor mold and dampness in buildings describes 64 specific decisions have been observed to either minimize or increase the risks associated with indoor moisture accumulation. PD on unvented combustion devices informs on the state of knowledge about gas- and liquid-burning unvented combustion devices, and recommends needed research. PD on indoor air quality informs on the state of knowledge about IAQ

and its health and economic benefits from the perspectives of an individual building as well as national levels.

#### 1. The Revised ASHRAE Position Document On Limiting Indoor Mold and Dampness in Buildings

Lew Harriman III, Fellow ASHRAE, Mason Grant, Portsmouth, NH

#### 2. ASHRAE Position Document On Unvented Combustion Devices

Paul W. Francisco, Member, University of Illinois, Champaign, IL

#### 3. ASHRAE Position Document On Indoor Air Quality

Chandra Sekhar, Fellow ASHRAE, National University of Singapore, Singapore, Singapore

## Seminar 68 (Intermediate)

### Lubricant Effects on Heat Transfer and Pressure Drops in Heat Exchangers

Track: HVAC&R Systems & Equipment



Room: Lone Star A2

Sponsor: 01.03 Heat Transfer and Fluid Flow

Chair: Steve Eckels, Ph.D., Member, Kansas State University, Manhattan, KS

In space conditioning vapor compression cycles often provide cooling and heating to the building all year around. The working fluid is a refrigerant and oil mixture. A small amount of lubricating oil is needed to lubricate and to seal the sliding parts of the compressors. In heat exchangers the oil in excess penalizes the heat transfer and increases the flow losses: both effects are highly undesired but yet unavoidable. This seminar provides an overview of the heat transfer and pressure drop characteristics of refrigerant and lubricant mixtures in heat exchangers. The seminar covers various applications from ammonia systems to HFO refrigerants. The seminar will assist engineers in the proper selection of the lubricant and refrigerant pairs.

#### 1. Effects of Lubricants on Refrigerant Flow Boiling Heat Transfer: Past Work, Present Research, and Future Possibilities

Lorenzo Cremaschi, Ph.D., Member, Oklahoma State University, Stillwater, OK

#### 2. The Effect of Oil and Fouling on the Thermal Performance of an Enhanced Tube Shell-and-Tube Ammonia DX Evaporator

Zahid Ayub, Ph.D., P.E., Fellow ASHRAE, Isotherm, Inc., Arlington, TX

#### 3. Properties of Low Global Warming HFO-1234ze(E) and HFO-1234ze(E) Blends with Lubricants for the Design of Heat Exchangers

Christopher Seeton, Ph.D., Member, Honeywell, Buffalo, NY

## Seminar 69 (Intermediate)

### Recent Developments in High Rise Building Design

Track: Large Building Design



Room: Lone Star A4

Sponsor: 09.12 Tall Buildings, 05.06 Control of Fire and Smoke

Chair: John J. Carter, Member, CPP, Inc., Fort Collins, CO

Tall buildings are getting taller. This seminar highlights emerging techniques that can be used to deal with HVAC and fire issues in tall, and taller, buildings. Topics range from basic principles to using elevators for egress and the mis-use and mis-understanding of stack effect pressures. The god-father of smoke control summarizes the contents of the new Handbook of Smoke Control engineering.

#### 1. Tall Buildings and the New ASHRAE Smoke Control Book

John H. Klote, Ph.D., P.E., Fellow ASHRAE, Fire and Smoke Consulting, Leesburg, VA

#### 2. It's Not Just Stack Effect – Latest Advances in Elevator Shaft Pressure Measurements

Luke Leung, P.E., Member, Skidmore, Owings and Merrill LLP, Chicago, IL

#### 3. Total Evacuation with Elevators?

William A. Webb, P.E., Fellow ASHRAE, WEBB FIRE Protection Consulting, LLC, Brooksville, FL

## Seminar 70 (Intermediate)

### Save Energy and Improve Occupant Comfort with Advanced VAV Zone Controls

Track: HVAC&R Systems & Equipment



Room: Dallas B

Sponsor: 02.01 Physiology and Human Environment

Chair: John L. Stoops, Ph.D., Member, DNV KE

Despite significant energy savings and over 10 years of installation history, dual-maximum VAV controls have not seen wide market adoption. Most market barriers, both technical and perceived, have been addressed in the past 5 years and the industry is now at the point where wide market adoption is likely. This presentation will provide an overview of dual-maximum controls, hardware selection, and design calculations including calculation of ASHRAE Standard 62.1 minimum ventilation rates. Dual Maximum control sequences with low minimum flow setpoints reduce fan, cooling, and reheat energy. Energy savings occur during periods of low load when conventional minimum setpoints are delivering more air than is needed to meet the load. This presentation will summarize detailed energy monitoring results of a California Public Interest Energy Research project that ran in parallel to the ASHRAE RP-1515 project (Comfort & Air Quality effects of low minimums) that carried out a field study in 6 large buildings, five on the Yahoo! campus and one county government building. Energy savings predictions will be compared to measurements and summaries of trends for over 1000 zones and will illustrate the dynamics of real systems in operation. The comfort impacts of the dual setpoints will also be reported.

#### 1. Advanced VAV Zone Control Overview

Steve Taylor, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

#### 2. Energy Savings From Reduced VAV Box Minimum Flow

Gwelen Paliaga, Member, Taylor Engineering, Alameda, CA

#### 3. Occupant Comfort Under Reduced Minimum VAV Flow Rates

Edward A. Arens, Ph.D., Member, University of California, Berkeley, CA

## Seminar 71 (Advanced)

### Thermoelectric Cooling: New Applications for an Old Idea

Track: HVAC&R Systems & Equipment



Room: Lone Star A3

Sponsor: 01.01 Thermodynamics and Psychrometrics

Chair: J. Steven Brown, Ph.D., Member, The Catholic University of America, Washington, DC

Thermoelectric effect, which induces heat flow through thermoelectric (TE) materials by electric current, is widely used in niche cooling application and was not able to penetrate the HVAC&R industry due to performance limitation at high temperature lift conditions. Thermoelectric cooling is an environmentally benign technology; it eliminates the need for refrigerant flow in the system. Furthermore, the system involves solid state operation with no moving parts except for fans; hence quiet operation. These desirable characteristics spurred the need for continuous research to widen TE application in the HVAC&R. This seminar presents recent developments in thermoelectric cooling technology and potential HVAC&R system efficiency improvements. The topics covered include a hybrid vapor compression cycle -TE system for cold climate operation, a high performance thin film thermoelectric device, and optimal design methodology of TE for cost effective cooling, heating and power.

#### 1. Application of Thermoelectric Modules for Vapor Injection Heat Pump System Under Cold Climate Operation

Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

#### 2. Electro-Thermal Co-Optimum Design of Thermoelectric for Cost Effective CHP Generation

Kazuaki Yazawa, Ph.D., Purdue University, West Lafayette, IN

#### 3. High Performance Thin Film Thermoelectric Devices for HVAC Applications

Uttam Ghoshal, Ph.D., Sheetak Inc., Austin, TX

## notes

## SOCIETY COMMITTEE MEETINGS

### (Subcommittees are indented)

All Society Standing Committee Meetings will be scheduled in the Dallas Sheraton.

The Sheraton has meeting rooms in their conference center which is located across the skywalk on the 2nd floor and they have meeting space in the hotel side. Following the day and time of the meeting is the meeting room name, codes in parenthesis provide the location of the meeting room. (H#) is the hotel side and floor location and (CC#) is the convention center side and floor location. Room assignments are subject to change.

## ALPHABETICAL LISTING

### Advocacy,

Sun., 1/27, 6:30 a.m.–8:30 a.m., State Room 2 (CC3)

### AEDG Steering Committee,

Mon., 1/28, 2:15 p.m.–5:00 p.m., State Room 2 (CC3)

### ASHRAE/AHRI Joint Expo,

Sun., 1/27, 9:00 a.m.–11:00 a.m., City View 8 (H4)

### ASHRAE Foundation,

Mon., 1/28, 8:00 a.m.–10:00 a.m., City View 7 (H4)

#### Executive Subcommittee,

Sat., 1/26, 1:30 p.m.–3:00 p.m., Pearl 3 (H2)

### Associate Society Alliance,

Sun., 1/27, 1:30 p.m.–4:30 p.m., Houston Ballroom C (CC3)

Mon., 1/28, 4:15 p.m.–6:00 p.m., Houston Ballroom A/B (CC3)

### Board of Directors,

Sun., 1/27, 1:30 p.m.–5:30 p.m., Lone Star Ballroom C3/4 (CC2)

Wed., 1/30, 2:00 p.m.–6:00 p.m., Houston Ballroom A/B (CC3)

### Building Energy Quotient Committee

Sun., 1/27, 8:30 a.m.–11:30 a.m., San Antonio Ballroom A (CC3)

### CBEA RTU,

Tues., 1/29, 4:00 p.m.–5:00 p.m., Majestic 1 (H37)

### Certification,

Sat., 1/26, 8:00 a.m.–Noon, City View 2 (H4)

### Chapter Technology Transfer,

Fri., 1/25, 8:00 a.m.–Noon, City View 6 (H4)

Sat., 1/26, 8:00 a.m.–Noon, Majestic 5 (H37)

#### Member Services,

Fri., 1/25, 1:30 p.m.–5:00 p.m., City View 6 (H4)

#### Operations,

Fri., 1:30 p.m.–5:00 p.m., City View 4 (H4)

#### Executive,

Fri., 5:00 p.m.–6:00 p.m., City View 6 (H4)

### CIBSE/ASHRAE Liaison,

Wed., 1/30, 9:30 a.m.–Noon, Executive Boardroom (H2)

### CLIMA,

Sat., 1/26, 12:30 p.m.–1:30 p.m., Pearl 2 (H2)

### College of Fellows Board/Advisory,

Sun., 1/27, 8:00 a.m.–10:00 a.m., Majestic 4 (H37)

### College of Fellows,

Sun., 1/27, 10:00 a.m.–Noon, Majestic 4 (H37)

### Conferences and Expositions Committee,

Sat., 1/26, 8:00 a.m.–12:00 p.m., City View 8 (H4)

#### Executive,

Fri., 1/25, 1:00 p.m.–3:00 p.m., Majestic 4 (H37)

#### TAC/CEC Executive,

Sat., 1/26, 7:00 a.m.–8:00 a.m., Dallas Ballroom D2 (CC1)

#### Annual and Winter Meetings,

Fri., 1/25, 3:00 p.m.–6:00 p.m., Majestic 4 (H37)

#### TC Program Subcommittee Training,

Tues., 1/29, 11:15 a.m.–Noon, State Room 3 (CC3)

#### Specialty,

Tues., 1/29, 1:30 p.m.–3:00 p.m., City View 2 (H4)

### Electronic Communications,

Sat., 1/26, 11:00 a.m.–3:00 p.m., City View 3 (H4)

### Environmental Health,

Mon., 1/28, 2:15 p.m.–6:15 p.m., City View 6 (H4)

#### Executive,

Mon., 1/28, 7:00 a.m.–8:00 a.m., City View 6 (H4)

#### Handbook/Research,

Mon., 1/28, 8:00 a.m.–10:00 a.m., City View 6 (H4)

#### Policy/Program,

Mon., 1/28, 10:00 a.m.–Noon, City View 6 (H4)

### Executive,

Sat., 1/26, 8:30 a.m.–1:00 p.m., Executive Boardroom (H2)

Wed., 1/30, 7:30 a.m.–9:00 a.m., Executive Boardroom (H2)

Thurs., 1/31, 7:30 a.m.–11:00 a.m., Executive Boardroom (H2)

### Finance,

Fri., 1/25, 8:00 a.m.–1:00 p.m., City View 8 (H4)

#### Investment Subcommittee,

Thurs., 1/24, 5:00 p.m.–7:00 p.m., City View 3 (H4)

#### Planning Subcommittee,

Thurs., 1/24, 5:00 p.m.–7:00 p.m., City View 4 (H4)

### Grassroots Government Activities Committee Ad Hoc,

Sat., 1/26, 1:30 p.m.–2:30 p.m., Pearl 4 (H2)

### Grassroots Government Activities Committee Training,

Sun., 1/27, 9:00 a.m.–Noon, City View 7 (H4)

### Handbook,

Sun., 1/27, 10:30 a.m.–1:00 p.m., State Room 2 (CC3)

#### Electronic Media

Sun., 8:00 a.m.–9:00 a.m., Pearl 1 (H2)

#### Functional

Sun., 8:00 a.m.–9:00 a.m., Pearl 2 (H2)

#### Publicity

Sun., 8:00 a.m.–9:00 a.m., Pearl 3 (H2)

#### Practical Applications

Sun., 8:00 a.m.–9:00 a.m., Pearl 4 (H2)

#### Program

Sun., 8:00 a.m.–9:00 a.m., Pearl 5 (H2)

#### Handbook 2014 Refrigeration TCs/Volume Subcommittee

Sun., 9:00 a.m.–10:00 a.m., Pearl 5 (H2)

#### Handbook 2015 HVAC Applications TCs/Volume Subcommittee

Sun., 9:00 a.m.–10:00 a.m., Pearl 2 (H2)

#### Handbook 2016 HVAC Systems and Equipment TCs/Volume Subcommittee

Sun., 9:00 a.m.–10:00 a.m., Pearl 4 (H2)

#### Volume Subcommittees,

Sun., 1/27, 10:00 a.m.–10:30 a.m., State Room 2 (CC3)

#### SPO/Excom,

Sat., 1/26, Noon–3:00 p.m., City View 4 (H4)

#### Handbook Training for TC Handbook Chairs,

Sun., 1/27, 8:00–9:00 a.m., Seminar Theater (H2)

### Historical,

Sun., 1/27, 8:30 a.m.–Noon, State Room 3 (CC3)

### Honors & Awards,

Sun., 1/27, 1:00 p.m.–5:00 p.m., City View 5 (H4)

Mon., 1/28, 2:15 p.m.–5:30 p.m., City View 1 (H4)

Mon., 1/28, 2:15 p.m.–5:30 p.m., City View 1 (H4)

### IAQ 2013 Steering Committee,

Mon., 1/28, 6:30 p.m.–8:30 p.m., City View 6 (H4)

### Life Members' Executive Board,

Tues., 1/29, 9:00 a.m.–11:00 a.m., Majestic 2 (H37)

### Members Council,

Tues., 1/29, 7:30 a.m.–Noon, Lone Star Ballroom C3 (CC2)

#### Region Operations Subcommittee,

Sat., 1/26, 8:00 a.m.–Noon, Pearl 4 (H2)

### Membership Promotion,

Fri., 1/25, 1:00 p.m.–6:00 p.m., Majestic 6 (H37)

Sat., 1/26, 8:00 a.m.–3:00 p.m., Majestic 7 (H37)

### Nominating,

Sun., 1/27, 7:30a–3:00 p.m., Lone Star Ballroom C1 (CC2)

### PEAC,

Tues., 1/29, Noon–2:00 p.m., Majestic 3 (H37)

### **Planning,**

Fri., 1/25, 1:00 p.m.–6:00 p.m., City View 8 (H4)

### **Professional Development,**

Mon., 1/28, 8:00 a.m.–Noon, State Room 4 (CC3)

### **Publications Committee,**

Sun., 1/27, 8:00 a.m.–Noon, City View 3 (H4)

#### **Planning Subcommittee,**

Sat., 1/26, 10:00 a.m.–Noon, City View 4 (H4)

### **Publishing and Education Council,**

Tues., 1/29, 8:00 a.m.–Noon, Lone Star Ballroom C4 (CC2)

#### **E-Learning**

Sat., 1/26, 1:30 p.m.–3:00 p.m., Pearl 2 (H2)

#### **Research Journal,**

Mon., 1/28, 11:00 a.m.–Noon, City View 4 (H4)

#### **Fiscal,**

Mon., 1/28, 2:00 p.m.–3:30 p.m., City View 5 (H4)

#### **Functional,**

Mon., 1/28, 3:30 p.m.–5:00 p.m., City View 5 (H4)

### **Refrigeration,**

Sun., 1/27, 8:00 a.m.–Noon, City View 6 (H4)

#### **RP-1634 PMS**

Sat., 1/26, 10:00 a.m.–Noon, State Room 3 (CC3)

### **Region-at-Large Planning,**

Mon., 1/28, 2:15 p.m.–4:15 p.m., Houston A/B (CC3)

### **Research Administration,**

Fri., 1/25, 2:00 p.m.–6:00 p.m., Houston Ballroom C (CC3)

Sat., 1/26, 8:00 a.m.–3:00 p.m., Dallas Ballroom D1 (CC1)

Wed., 1/30, 7:00 a.m.–11:00 a.m., San Antonio Ballroom B (CC3)

#### **Executive,**

Fri., 1/25, 1:00 p.m.–2:00 p.m., Houston Ballroom C (CC3)

#### **Research Subcommittee Chairs,**

Mon., 1/28, 6:30 a.m.–9:00 a.m., Lone Star Ballroom B (CC2)

### **Research Promotion,**

Sat., 1/26, 7:30 a.m.–1:00 p.m., State Room 2 (CC3)

#### **Executive Subcommittee,**

Fri., 1/25, 2:00 p.m.–6:00 p.m., Executive Boardroom (H2)

### **Scholarship Trustees,**

Tues., 1/29, 8:00 a.m.–Noon, Live Oak (H2)

### **Society Rules,**

Tues., 1/29, 2:00 p.m.–5:00 p.m., Majestic 2 (H37)

### **Standards,**

Sat., 1/26, 8:00 a.m.–1:00 p.m., Houston Ballroom C (CC3)

Wed., 1/30, 7:30–9:30 a.m., Houston Ballroom A/B (CC3)

#### **Executive,**

Fri., 1/25, 8:00 a.m.–Noon, City View 2 (H4)

#### **TCLS,**

Tues., 1/29, 5:00 p.m.–5:30 p.m., Majestic 6 (H37)

#### **PPIS,**

Fri., 1/25, 2:00 p.m.–6:00 p.m., City View 2 (H4)

Tues., 1/29, 11:00 a.m.–1:00 p.m., Majestic 6 (H37)

#### **ILS/ISAS**

Fri., 1/25, 1:00 p.m.–4:00 p.m., City View 1 (H4)

#### **SPLS,**

Fri., 1/25, 2:00 p.m.–6:00 p.m., City View 7 (H4)

Tues., 1/29, 1:30 p.m.–3:30 p.m., Majestic 6 (H37)

#### **SRS,**

Tues., 1/29, 5:30 p.m.–6:00 p.m., Majestic 6 (H37)

#### **Code Interaction,**

Sun., 1/27, 7:00 p.m.–10:00 p.m., City View 8 (H4)

#### **PC Chair Breakfast,**

Sun., 1/27, 7:00–9:00 a.m., Lone Star Ballroom C2 (CC2)

### **Student Activities,**

Sat., 1/26, 8:00 a.m.–3:00 p.m., Majestic 8 (H37)

#### **Executive,**

Fri., 1/25, 10:00 a.m.–Noon, Pearl 2 (H2)

#### **K-12/STEM,**

Fri., Noon–2:00 p.m., Pearl 2 (H2)

#### **Post High**

Fri., 2:00–4:00 p.m., Pearl 1 (H2)

### **ABET,**

Fri., 2:00 p.m.–4:00 p.m., Pearl 2 (H2)

### **Design Competition,**

Fri., 4:00 p.m.–6:00 p.m., Pearl 2 (H2)

### **Grants,**

Fri., 4:00 p.m.–6:00 p.m., Pearl 1 (H2)

### **Student Program,**

#### **Welcome and Orientation**

Sat., 1/26, 2:00 p.m.–3:00 p.m., Lone Star Ballroom A4 (CC2)

#### **Program,**

Sun., 1/27, 9:00 a.m.–2:00 p.m., Lone Star Ballroom B (CC2)

#### **Student/Yea Mixer**

Sat., 1/26, 5:00 p.m.–6:30 p.m., Atrium (H2)

#### **Student Congress,**

Mon., 1/28, 10:00 a.m.–Noon, Majestic 3 (H37)

### **Technical Activities,**

Sat., 1/26, 8:00 a.m.–3:00 p.m., Dallas Ballroom D2 (CC1)

Wed., 1/30, 7:00 a.m.–10:00 a.m., San Antonio Ballroom A (CC3)

#### **TAC/CEC Executive,**

Sat., 1/26, 7:00 a.m.–8:00 a.m., Dallas Ballroom D2 (CC1)

### **TC/TG Chair's Training Workshop,**

Sun., 1/27, 9:45–10:45 a.m., Dallas Ballroom A3 (CC1)

### **TAC: TC/TG Section Meetings**

Sun., 6:30 a.m.–8:00 a.m.

Section 1, Majestic 5 (H37)

Section 2, Majestic 3 (H37)

Section 3, Majestic 8 (H37)

Section 4, Executive Boardroom (H2)

Section 5, Majestic 1 (H37)

Section 6, San Antonio Ballroom B (CC3)

Section 7, Houston Ballroom C (CC3)

Section 8, Majestic 6 (H37)

Section 9, Majestic 7 (H37)

Section 10, San Antonio Ballroom A (CC3)

### **Technology Council,**

Tues., 1/29, 8:00 a.m.–Noon, Majestic 1 (H37)

Wed., 1/30, 9:00a.m.–11:00 a.m., Houston Ballroom C (CC3)

#### **Special Projects,**

Mon., 1/28, 7:30 a.m.–9:30 a.m., Pearl 3 (H2)

#### **Document Review Subcommittee,**

Mon., 1/28, 8:00 a.m.–9:00 a.m., Pearl 2 (H2)

#### **Planning,**

Mon., 1/28, 9:00 a.m.–11:00 a.m., Pearl 2 (H2)

#### **Operations,**

Mon., 1/28, 10:30 a.m.–Noon, Pearl 3 (H2)

#### **Airborne Infectious Diseases Position Document Committee**

Mon., 1/28, 8:30 p.m.–10:30 p.m., City View 2 (H4)

#### **Air Filtration and Cleaning Position Document Committee**

Tues., 1/29, 11:00 a.m.–2:00 p.m., Pearl 5 (H2)

### **YEA,**

Sun., 1/27, 7:00 a.m.–Noon, State Room 4 (CC3)

## **CHRONOLOGICAL LISTING**

### **FRIDAY, JANUARY 25**

#### **Chapter Technology Transfer (CTTC)**

Fri., 8:00 a.m.–Noon, City View 6 (H4)

##### **Standards Executive,**

Fri., 8:00 a.m.–Noon, City View 2 (H4)

#### **Finance,**

Fri., 8:00 a.m.–1:00 p.m., City View 8 (H4)

##### **Student Activities Executive,**

Fri., 10:00 a.m.–Noon, Pearl 2 (H2)

##### **Research Administration Executive,**

Fri., 1:00 p.m.–2:00 p.m., Houston Ballroom C (CC3)

##### **CEC Executive,**

Fri., 1:00 p.m.–3:00 p.m., Majestic 4 (H37)

##### **Standards ILS/ISAS**

Fri., 1:00 p.m.–4:00 p.m., City View 1 (H4)

**Membership Promotion,**

Fri., 1:00 p.m.–6:00 p.m., Majestic 6 (H37)

**Planning,**

Fri., 1:00 p.m.–6:00 p.m., City View 8 (H4)

**CTTC Member Services,**

Fri., 1:30 p.m.–5:00 p.m., City View 6 (H4)

**CTTC Operations,**

Fri., 1:30 p.m.–5:00 p.m., City View 4 (H4)

**Student Activities K-12/STEM,**

Fri., Noon–2:00 p.m., Pearl 2 (H2)

**Student Activities Post High**

Fri., 2:00–4:00 p.m., Pearl 1 (H2)

**Student Activities ABET,**

Fri., 2:00 p.m.–4:00 p.m., Pearl 2 (H2)

**Research Administration,**

Fri., 2:00 p.m.–6:00 p.m., Houston Ballroom C (CC3)

**Research Promotion Executive Subcommittee,**

Fri., 2:00 p.m.–6:00 p.m., Executive Boardroom (H2)

**Standards PPIS,**

Fri., 2:00 p.m.–6:00 p.m., City View 2 (H4)

**Standards SPLS,**

Fri., 2:00 p.m.–6:00 p.m., City View 7 (H4)

**CEC Annual and Winter Meetings,**

Fri., 3:00 p.m.–6:00 p.m., Majestic 4 (H37)

**Student Activities Design Competition,**

Fri., 4:00 p.m.–6:00 p.m., Pearl 2 (H2)

**Student Activities Grants,**

Fri., 4:00 p.m.–6:00 p.m., Pearl 1 (H2)

**CTTC Executive,**

Fri., 5:00 p.m.–6:00 p.m., City View 6 (H4)

## SATURDAY, JANUARY 26

**TAC/CEC Executive,**

Sat., 7:00 a.m.–8:00 a.m., Dallas Ballroom D2 (CC1)

**Research Promotion,**

Sat., 7:30 a.m.–1:00 p.m., State Room 2 (CC3)

**Chapter Technology Transfer,**

Sat., 8:00 a.m.–Noon, Majestic 5 (H37)

**Members Council Region Operations Subcommittee,**

Sat., 8:00 a.m.–Noon, Pearl 4 (H2)

**Standards,**

Sat., 8:00 a.m.–1:00 p.m., Houston Ballroom C (CC3)

**Certification,**

Sat., 8:00 a.m.–Noon, City View 2 (H4)

**Conferences and Expositions Committee (CEC),**

Sat., 8:00 a.m.–Noon, City View 8 (H4)

**Membership Promotion,**

Sat., 8:00 a.m.–3:00 p.m., Majestic 7 (H37)

**Research Administration,**

Sat., 8:00 a.m.–3:00 p.m., Dallas Ballroom D1 (CC1)

**Student Activities,**

Sat., 8:00 a.m.–3:00 p.m., Majestic 8 (H37)

**Technical Activities,**

Sat., 8:00 a.m.–3:00 p.m., Dallas Ballroom D2 (CC1)

**Executive,**

Sat., 8:30 a.m.–1:00 p.m., Executive Boardroom (H2)

**Publications Planning Subcommittee,**

Sat., 10:00 a.m.–Noon, City View 4 (H4)

**Refrigeration RP-1634 PMS**

Sat., 10:00 a.m.–Noon, State Room 3 (CC3)

**Electronic Communications,**

Sat., 11:00 a.m.–3:00 p.m., City View 3 (H4)

**Handbook SPO/Excom,**

Sat., Noon–3:00 p.m., City View 4 (H4)

**CLIMA,**

Sat., 12:30 p.m.–1:30 p.m., Pearl 2 (H2)

**Grassroots Government Activities Committee Ad Hoc,**

Sat., 1:30 p.m.–2:30 p.m., Pearl 4 (H2)

**ASHRAE Foundation Executive Subcommittee,**

Sat., 1:30 p.m.–3:00 p.m., Pearl 3 (H2)

**Publishing and Education Council E-Learning**

Sat., 1:30 p.m.–3:00 p.m., Pearl 2 (H2)

**Student Welcome and Orientation**

Sat., 2:00 p.m.–3:00 p.m., Lone Star Ballroom A4 (CC2)

**Student/Yea Mixer**

Sat., 5:00 p.m.–6:30 p.m., Atrium (H2)

## SUNDAY, JANUARY 27

**TAC: TC/TG Section Meetings**

Sun., 6:30 a.m.–8:00 a.m.

Section 1, Majestic 5 (H37)

Section 2, Majestic 3 (H37)

Section 3, Majestic 8 (H37)

Section 4, Executive Boardroom (H2)

Section 5, Majestic 1 (H37)

Section 6, San Antonio Ballroom B (CC3)

Section 7, Houston Ballroom C (CC3)

Section 8, Majestic 6 (H37)

Section 9, Majestic 7 (H37)

Section 10, San Antonio Ballroom A (CC3)

**Advocacy,**

Sun., 6:30 a.m.–8:30 a.m., State Room 2 (CC3)

**Standards PC Chair Breakfast,**

Sun., 7:00 a.m.–9:00 a.m., Lone Star Ballroom C2 (CC2)

**YEA,**

Sun., 7:00 a.m.–Noon, State Room 4 (CC3)

**Nominating,**

Sun., 7:30a–3:00 p.m., Lone Star Ballroom C1 (CC2)

**Handbook Electronic Media**

Sun., 8:00 a.m.–9:00a.m., Pearl 1 (H2)

**Handbook Functional**

Sun., 8:00 a.m.–9:00 a.m., Pearl 2 (H2)

**Handbook Publicity**

Sun., 8:00 a.m.–9:00 a.m., Pearl 3 (H2)

**Handbook Practical Applications**

Sun., 8:00 a.m.–9:00 a.m., Pearl 4 (H2)

**Handbook Program**

Sun., 8:00 a.m.–9:00 a.m., Pearl 5 (H2)

**Handbook Training for TC Handbook Chairs,**

Sun., 8:00–9:00 a.m., Seminar Theater (H2)

**College of Fellows Board/Advisory,**

Sun., 8:00 a.m.–10:00 a.m., Majestic 4 (H37)

**Publications Committee,**

Sun., 8:00 a.m.–Noon, City View 3 (H4)

**Refrigeration,**

Sun., 8:00 a.m.–Noon, City View 6 (H4)

**Building Energy Quotient Committee**

Sun., 8:30 a.m.–11:30 a.m., San Antonio Ballroom A (CC3)

**Historical,**

Sun., 8:30 a.m.–Noon, State Room 3 (CC3)

**Handbook 2014 Refrigeration TCs/Volume Subcommittee**

Sun., 9:00 a.m.–10:00 a.m., Pearl 5 (H2)

**Handbook 2015 HVAC Applications TCs/Volume Subcommittee**

Sun., 9:00 a.m.–10:00 a.m., Pearl 2 (H2)

**Handbook 2016 HVAC Systems and Equipment TCs/****Volume Subcommittee**

Sun., 9:00 a.m.–10:00 a.m., Pearl 4 (H2)

**ASHRAE/AHRI Joint Expo,**

Sun., 9:00 a.m.–11:00 a.m., City View 8 (H4)

**Grassroots Government Activities Committee Training,**

Sun., 9:00 a.m.–Noon, City View 7 (H4)

**Student Program,**

Sun., 9:00 a.m.–2:00 p.m., Lone Star Ballroom B (CC2)



**TC/TG Chair's Training Workshop,**  
Sun., 9:45 a.m.–10:45 a.m., Dallas Ballroom A3 (CC1)

**Handbook Volume Subcommittees,**  
Sun., 10:00 a.m.–10:30 a.m., State Room 2 (CC3)

**College of Fellows,**  
Sun., 10:00 a.m.–Noon, Majestic 4 (H37)

**Handbook,**  
Sun., 10:30 a.m.–1:00 p.m., State Room 2 (CC3)

**Honors & Awards,**  
Sun., 1:00 p.m.–5:00 p.m., City View 5 (H4)

**Associate Society Alliance,**  
Sun., 1:30 p.m.–4:30 p.m., Houston Ballroom C (CC3)

**Board of Directors,**  
Sun., 1:30 p.m.–5:30 p.m., Lone Star Ballroom C3/4 (CC2)

**Standards Code Interaction,**  
Sun., 7:00 p.m.–10:00 p.m., City View 8 (H4)

## MONDAY, JANUARY 28

**Research Administration Research Subcommittee Chairs,**  
Mon., 6:30 a.m.–9:00 a.m., Lone Star Ballroom B (CC2)

**Environmental Health Executive,**  
Mon., 7:00 a.m.–8:00 a.m., City View 6 (H4)

**Technology Council Special Projects,**  
Mon., 7:30 a.m.–9:30 a.m., Pearl 3 (H2)

**Technology Council Document Review Subcommittee,**  
Mon., 8:00 a.m.–9:00 a.m., Pearl 2 (H2)

**ASHRAE Foundation,**  
Mon., 8:00 a.m.–10:00 a.m., City View 7 (H4)

**Environmental Health Handbook/Research,**  
Mon., 8:00 a.m.–10:00 a.m., City View 6 (H4)

**Professional Development,**  
Mon., 8:00 a.m.–Noon, State Room 4 (CC3)

**Technology Council Planning,**  
Mon., 9:00 a.m.–11:00 a.m., Pearl 2 (H2)

**Student Congress,**  
Mon., 10:00 a.m.–Noon, Majestic 3 (H37)

**Environmental Health Policy/Program,**  
Mon., 10:00 a.m.–Noon, City View 6 (H4)

**Technology Council Operations,**  
Mon., 10:30 a.m.–Noon, Pearl 3 (H2)

**Publishing and Education Council Research Journal,**  
Mon., 11:00 a.m.–Noon, City View 4 (H4)

**Publishing and Education Council Fiscal,**  
Mon., 2:00 p.m.–3:30 p.m., City View 5 (H4)

**Region-at-Large Planning,**  
Mon., 2:15 p.m.–4:15 p.m., Houston A/B (CC3)

**AEDG Steering Committee,**  
Mon., 2:15 p.m.–5:00 p.m., State Room 2 (CC3)

**Honors & Awards,**  
Mon., 2:15 p.m.–5:30 p.m., City View 1 (H4)

**Environmental Health,**  
Mon., 2:15 p.m.–6:15 p.m., City View 6 (H4)

**Publishing and Education Council Functional,**  
Mon., 3:30 p.m.–5:00 p.m., City View 5 (H4)

**Associate Society Alliance,**  
Mon., 4:15–6:00 p.m., Houston Ballroom A/B (CC3)

**IAQ 2013 Steering Committee,**  
Mon., 6:30 p.m.–8:30 p.m., City View 6 (H4)  
**Airborne Infectious Diseases Position Document Committee**  
Mon., 8:30 p.m.–10:30 p.m., City View 2 (H4)

## TUESDAY, JANUARY 29

**Members Council,**  
Tues., 7:30 a.m.–Noon, Lone Star Ballroom C3 (CC2)

**Publishing and Education Council,**  
Tues., 8:00 a.m.–Noon, Lone Star Ballroom C4 (CC2)

**Scholarship Trustees,**  
Tues., 8:00 a.m.–Noon, Live Oak (H2)

**Technology Council,**  
Tues., 8:00 a.m.–Noon, Majestic 1 (H37)

**Life Members' Executive Board,**  
Tues., 9:00 a.m.–11:00 a.m., Majestic 2 (H37)

**Standards PPIS,**  
Tues., 11:00 a.m.–1:00 p.m., Majestic 6 (H37)

**Air Filtration and Cleaning Position Document Committee**  
Tues., 11:00 a.m.–2:00 p.m., Pearl 5 (H2)

**PEAC,**  
Tues., Noon–2:00 p.m., Majestic 3 (H37)

**CEC TC Program Subcommittee Training,**  
Tues., 11:15 a.m.–Noon, State Room 3 (CC3)

**CEC Specialty,**  
Tues., 1:30 p.m.–3:00 p.m., City View 2 (H4)

**Standards SPLS,**  
Tues., 1:30 p.m.–3:30 p.m., Majestic 6 (H37)

**Society Rules,**  
Tues., 2:00 p.m.–5:00 p.m., Majestic 2 (H37)

**CBEA RTU,**  
Tues., 4:00 p.m.–5:00 p.m., Majestic 1 (H37)

**Standards TCLS,**  
Tues., 5:00 p.m.–5:30 p.m., Majestic 6 (H37)

**Standards SRS,**  
Tues., 5:30 p.m.–6:00 p.m., Majestic 6 (H37)

## WEDNESDAY, JANUARY 30

**Technical Activities,**  
Wed., 7:00 a.m.–10:00 a.m., San Antonio Ballroom A (CC3)

**Research Administration,**  
Wed., 7:00 a.m.–11:00 a.m., San Antonio Ballroom B (CC3)

**Executive,**  
Wed., 7:30 a.m.–9:00 a.m., Executive Boardroom (H2)

**Standards,**  
Wed., 7:30 a.m.–9:30 a.m., Houston Ballroom A/B (CC3)

**Technology Council,**  
Wed., 9:00 a.m.–11:00 a.m., Houston Ballroom C (CC3)

**CIBSE/ASHRAE Liaison,**  
Wed., 9:30 a.m.–Noon, Executive Boardroom (H2)

**Board of Directors,**  
Wed., 2:00 p.m.–6:00 p.m., Houston Ballroom A/B (CC3)

## THURSDAY, JANUARY 31

**Executive,**  
Thurs., 7:30 a.m.–11:00 a.m., Executive Boardroom (H2)

## TC/TG/MTG/TRG/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.

### CODES for room locations:

**(CC)** is the Sheraton Conference Center which is located across the skybridge walkway on the second floor or from the street level.

There are three levels in the Conference Center and numbers indicate the floor location.

**(H)** is the Sheraton Hotel with numbers indicating the floor location.

**NOTE:** if the meetings listed below are not printed in color they have not been confirmed.

### Format of Listings

#### Committee Number and Title

**Day**      **Time**      **Location**

*Session(s) the committee is sponsoring*

### TCs

#### TC/TG Chair's Breakfast

**Sunday 6:30–8:00 a.m.**

Section 1, (29),	Majestic 5 (H37)
Section 2, (21),	Majestic 3 (H37)
Section 3, (15),	Majestic 8 (H37)
Section 4, (17),	Executive Boardroom (H2)
Section 5, (29),	Majestic 1 (H37)
Section 6, (25),	San Antonio Ballroom B (CC3)
Section 7, (23),	Houston Ballroom C (CC3)
Section 8, (23),	Majestic 6 (H37)
Section 9, (25),	Majestic 7 (H37)
Section 10, (25),	San Antonio Ballroom A (CC3)

### TECHNICAL COMMITTEES (TC)

#### TC/TG Chair's Training Workshop

**Sunday 9:45–10:45a Dallas Ballroom A3 (CC1)**

#### Research Subcommittee Breakfast

**Monday 6:30–8:00a Lone Star Ballroom B (CC2)**

#### TC Program Subcommittee Training

**Tuesday 11:15–Noon State Room 3 (CC3)**

#### TC 1.1 Thermodynamics & Psychrometrics (10/15)

**Monday 2:15–4:15p Majestic 2 (H37)**

#### TC 1.2 Instruments & Measurements (15)

**Tuesday 1:00–3:30p Live Oak (H2)**

##### TC 1.2 Standards/Handbook (8/3)

**Monday 4:15–6:30p State Room 3 (CC3)**

#### TC 1.3 Heat Transfer & Fluid Flow (25/15)

**Tuesday 1:00–3:30p Lone Star Ballroom C3 (CC2)**

*Sponsoring: Forum: Fundamental Thermal Properties of New Lower GWP Refrigerants for Heat Transfer Analysis*

#### TC 1.3 Handbook

**Sunday 1:00–3:00p Trinity 4 (H3)**

#### TC 8.5/1.3 Research (20/30)

**Sunday 3:00–7:00p Lone Star Ballroom A3 (CC2)**

#### TC 1.4 Control Theory & Application (40) (Screen)

**Tuesday 1:00–3:30p Lone Star Ballroom C4 (CC2)**

*Sponsoring: Forum 4: Specifying BAS Networks and Integration: Ensure that Guideline 13 Provides the Guidance You Need! and Forum 9: What Should An ASHRAE Certified Integrated Building Control Design Professional (IBCDP) Know?*

#### TC 1.4 RP 1597 PMS (8)

**Sunday 10:00–11:00 Pearl 3 (H2)**

#### TC 1.4 Control Components and Applications /Green Buildings (20/5)

**Sunday 3:00–4:45p Majestic 3 (H37)**

#### TC 1.4 Program (20/5)

**Sunday 4:45–5:30p Majestic 3 (H37)**

#### TC 1.4 Reference Applications (20/10)

**Sunday 5:30–6:30p Majestic 3 (H37)**

#### TC 1.4 RP-1455 PMS (8)

**Monday 9:00–10:30a City View 4 (H4)**

#### TC 1.4 Research (25/5)

**Monday 2:15–4:15p Houston Ballroom C (CC3)**

#### TC 1.4 Handbook (20/5)

**Monday 4:15–6:15p Houston Ballroom C (CC3)**

#### TC 1.4 Executive (8)

**Tuesday 7:00–8:00a City View 3 (H4)**

#### TC 1.4 RP-1633 (8)

**Tuesday 9:00–10:00a City View 3 (H4)**

#### TC 1.5 Computer Applications (20/5)

**Monday 6:30–9:00p City View 7 (H4)**

*Sponsoring: Forum 1: ASHRAE Apps: What Do You Want? Do They Need To Be Free?*

#### TC 1.5 PMS 1468

**Sunday 10:00–Noon Trinity 4 (H3)**

#### TC 1.5 Emerging Applications (6/10)

**Sunday 5:00–6:00p City View 7 (H4)**

#### TC 1.5 Research (15)

**Sunday 6:00–7:00p City View 7 (H4)**

#### TC 1.5 Program (15)

**Sunday 7:00–8:00p City View 7 (H4)**

#### TC 1.5 Handbook (15)

**Monday 6:00–6:30p City View 7 (H4)**

#### TC 1.6 Terminology (10/8) (Screen/E)

**Monday 4:15–6:30p Live Oak (H2)**

#### TC 1.7 Business, Management & General Legal Education (20/5)

**Monday 10:15a–Noon Majestic 7 (H37)**

#### TC 1.8 Mechanical Systems Insulation (20) (Screen)

**Monday 4:15–6:30p Pearl 5 (H2)**

#### TC 1.8 Research (10)

**Sunday 8:00–9:30a City View 5 (H4)**

#### TC 1.8 Handbook (10)

**Sunday 9:30–10:30 City View 5 (H4)**

#### TC 1.8 Program

**Sunday 10:30–11:00a City View 5 (H4)**

**TC 1.9 Electrical Systems (8/4)**

Tuesday 3:30–6:00p Majestic 8 (H37)

**TC 1.10 Cogeneration Systems (20/10)**

Tuesday 3:00–5:00p State Room 2 (CC3)

**TC 1.10 Program/Research/Handbook (15/10)**

Tuesday 1:00–3:00p State Room 2 (CC3)

**TC 1.10 CTIC (10/5)**

Monday 4:15–6:30p Lone Star A1 (CC2)

**TC 1.11 Electric Motors and Motor Control (13/7)**

Tuesday 1:00–3:30p Majestic 8 (H37)

*Sponsoring: Seminar 6: Smart Methods to Prevent Electrical Harmonics Problems in Buildings*

**TC 1.12 Moisture Management in Buildings (15/25) (Screen/E)**

Saturday 1:00–3:00p Dallas Ballroom A3 (CC1)

*Sponsoring: Seminar 2: Diagnosing and Fixing Building Moisture Problems – Case Histories From Hot & Humid Climates*

**TC 1.12 Programs/Handbook/Research (10)**

Saturday 8:00a–Noon Trinity 5 (H3)

**TC 2.1 Physiology & Human Environment (12/18) (Screen)**

Tuesday 1:00–3:30p Trinity 1 (H3)

**TC 2.1 Research (13/7) (Screen/E)**

Sunday 1:00–3:00p City View 7 (H4)

**TC 2.1 Programs (5/5)**

Sunday 3:00–4:00p City View 7 (H4)

**TC 2.1 Handbook**

Sunday 4:00–5:00p City View 7 (H4)

**TC 2.1 1504-TRP**

Tuesday 8:00–9:00a Majestic 7 (H37)

**TC 2.1 1515-TRP**

Tuesday 9:00–10:00a Majestic 7 (H37)

**TC 2.2 Plant and Animal Environment (10/5)**

Monday 4:15–6:30p Trinity 3 (H3)

*Sponsoring: Seminar 16: Tools and Methods to Manage Animal Research Facilities for Effective and Efficient Long-term Operations*

**TC 2.3 Gaseous Air Contaminants /Removal Equip. (18/30)**

Tuesday 1:00–3:30p San Antonio Ballroom A (CC3)

*Sponsoring: Seminar 5: Improving the IEQ in Public School Classrooms*

**TC 2.3 RP 1557 (5/15) (Screen)**

Sunday 11:00–12:00 Trinity 2 (H3)

**TC 2.3 Research (20/20) (Screen/Flipchart)**

Sunday 5:00–7:00p Lone Star Ballroom A2 (CC2)

**TC 2.3 Handbook (10/10)(Flipchart/screen)**

Monday 4:15–6:00p Dallas Ballroom A1 (CC1)

**TC 2.3 Standards (15/10)**

Monday 6:00–8:00p Lone Star Ballroom C2 (CC2)

**TC 2.3 Planning (15)**

Tuesday 6:30–8:00a State Room 3 (CC3)

**TC 2.3 Program (20/20)(Flipchart/Screen)**

Tuesday 12–12:45p San Antonio Ballroom A (CC3)

**TC 2.4 Particulate Air Contaminants /Removal Equip. (18/30)**

Tuesday 3:30–6:00p San Antonio Ballroom A (CC3)

**TC 2.4 Handbook (10/10)(flipchart)**

Saturday 1:00–2:30p San Antonio Ballroom B (CC3)

**TC 2.4 Research (20/20) (Screen)**

Sunday 3:00–5:00p Lone Star Ballroom A2 (CC2)

**TC 2.4 Planning (20/10)(Screen/flipchart)**

Monday 8:00–10:00a City View 8 (H4)

**TC 2.4 Program (20/10) (flipchart)**

Monday 10:00–11:00a City View 8 (H4)

**TC 2.4 Standards (20/20) (screen)**

Monday 4:15–6:00p Lone Star Ballroom C2 (CC2)

**TC 2.5 Global Climate Change (20/10)**

Tuesday 1:30–3:30p City View 7 (H4)

*Sponsoring: Seminar 23: The Future of Refrigerants:*

*Policy and Technical Considerations*

**TC 2.6 Sound & Vibration Control (20/350) (Screen)**

Monday 2:15–4:15p San Antonio Ballroom A (CC3)

*Sponsoring: Conference Paper Session 7: Numerical Methods for Noise and Vibration Simulation of HVAC&R Systems and AHR Expo Session 1: Basics of HVAC Noise Control*

**TC 2.6 RP 1408 PMS (Lined Duct) (20/30) (Screen)**

Sunday 9:00–10:00a State Room 1 (CC3)

**TC 2.6 RP 1529 (20/25)**

Sunday 10:00–11:00a State Room 1 (CC3)

**TC 2.6 Research (20/25) (Screen)**

Sunday 11:00–12:00p State Room 1 (CC3)

**TC 2.6 Hot Topic (20/25)**

Sunday 1:00–2:00p State Room 1 (CC3)

**TC 2.6 Criteria (20/25) (Screen)**

Sunday 2:00–3:30p State Room 1 (CC3)

**TC 2.6 Excom (10)**

Sunday 3:30–4:30p State Room 1 (CC3)

**TC 2.6 Vibration Isolation (20/25) (Screen)**

Monday 9:00–10:00a San Antonio Ballroom A (CC3)

**TC 2.6 Publications (20/25)**

Monday 10:00–11:00a San Antonio Ballroom A (CC3)

**TC 2.6 Programs (20/25)**

Monday 11:00–12p San Antonio Ballroom A (CC3)

**TC 2.7 Seismic and Wind Resistant Design (24/6)(Screen)**

Tuesday 4:30–6:00p State Room 4 (CC3)

*Sponsoring: Seminar 20: Seismic Certification of Equipment-Code, Analysis and Testing*

**TC 2.7 Publications/Handbook**

Tuesday 1:00–2:00p State Room 4

**TC 2.7 Research/Wind**

Tuesday 2:00–3:00p State Room 4

**TC 2.7 Program/Hot Topic**

Tuesday 3:00–4:00p State Room 4

**TC 2.7 Membership**

Tuesday 4:00–4:15p State Room 4

**TC 2.8 Building Environmental Impacts and Sustainability (75) (Screen)**

Sunday 5:00–7:00p Dallas Ballroom D2 (CC1)

*Sponsoring: Seminar 12: Smoothing Bumps on the Road to Net Zero Energy Buildings – Part 1 and Seminar 21: Smoothing Bumps on the Road to Net Zero Energy Buildings – Part 2*

**TC 2.8 International (15/15) (Screen)**

Sunday 12:00–12:45p Dallas Ballroom D2 (CC1)

**TC 2.8 Green Guide (25)**

Sunday 12:45–1:45p Dallas Ballroom D2 (CC1)

**TC 2.8 Research**

Sunday 1:45–2:45p Dallas Ballroom D2 (CC1)

**TC 2.8 Handbook (25)**  
**Sunday 2:45–3:30p Dallas Ballroom D2 (CC1)**

**TC 2.8 Program (25)**  
**Sunday 3:30–4:15p Dallas Ballroom D2 (CC1)**

**TC 2.8 Existing Buildings**  
**Sunday 4:15–4:50p Dallas Ballroom D2 (CC1)**

**TC 2.9 Ultraviolet Air and Surface Treatment (30)**  
**(Screen/Flipchart)**

**Monday 10:00a–Noon Majestic 5 (H37)**

**TC 2.9 Program, Handbook, Standards (30) (Screen/Flipchart)**  
**Sunday 8:00–1:00p Dallas Ballroom A1 (CC1)**

**TC 2.9 Research (Flipchart)**  
**Monday 8:00–10:00a Majestic 5 (H37)**

**TC 3.1 Refrigerants & Secondary Coolants (20/15) (Screen/E)**

**Monday 4:15–6:30p Majestic 6 (H37)**

*Sponsoring: Seminar 34: Industry-Wide Efforts to Evaluate Lower GWP Refrigerants*

**TC 3.1 Research (10/10) (screen/E)**  
**Monday 12:00–1:00p Majestic 6**

**TC 3.1 Program and Handbook (6/4)**  
**Monday 2:15–3:45p Majestic 6**

**TC 3.2 Refrigerant System Chemistry (12/40) (Screen/E)**

**Monday 2:15–4:15p Dallas Ballroom B (CC1)**

**TC 3.2 Research (12/12)**  
**Sunday 4:00–5:00p City Room 3 (H4)**

**TC 3.3 Refrigerant Contaminant Control (50)**

**Tuesday 3:30–6:00p Lone Star Ballroom C2 (CC2)**

*Sponsoring: Forum 6: What Contaminates are Important in Low GWP Refrigerant Systems?*

**TC 3.3 Research (12/12)**  
**Sunday 5:00–5:30p City Room 3 (H4)**

**TC 3.4 Lubrication (60)**  
**Tuesday 1:30–3:30p Lone Star Ballroom C2 (CC2)**

**TC 3.4 Research (12/12)**  
**Sunday 5:30–6:00 City Room 3 (H4)**

**TC 3.6 Water Treatment (18/10)**

**Tuesday 1:00–3:30p City View 1 (H4)**

*Sponsoring: Seminar 15: The First Standards on Legionnaires' Disease – Why Cringe When You Can Be Prepared for Proposed Standards 188, Guideline 12 and CTI Guideline and Standard 159*

**TC 3.6 Handbook/Program/Research (12/4)**  
**Sunday 3:00–5:00p Lone Star A4 (CC2)**

**TC 3.8 Refrigerant Containment (9/5)**

**Monday 4:15–6:30p City View 4 (H4)**

**TC 4.1 Load Calculation Data and Procedures (20/10)**

**Monday 2:15–4:15p Majestic 3 (H37)**

*Sponsoring: Seminar 25: When Is the Load Not What You Think? The Radiant Effect of Non-uniform Surface Temperatures*

**TC 4.1 Handbook (12/8)**  
**Sunday 3:00–4:00p Dallas Ballroom A2 (CC1)**

**TC 4.1 Research (12/8)**  
**Sunday 4:00–5:00p Dallas Ballroom A2 (CC1)**

**TC 4.1 Programs & Standards**  
**Sunday 5:00–7:00p Dallas Ballroom A2 (CC1)**

**TC 4.2 Climatic Information (20/10) (Screen)**

**Tuesday 1:00–3:30p City View 6 (H4)**

**TC 4.2 1561-PES (20) (Screen)**  
**Sunday 9:00–10:00a Majestic 2 (H37)**

**TC 4.2 1413-RP (20)(Screen)**  
**Sunday 10:00–11:30a Majestic 2 (H37)**

**TC 4.2 1613-TRP PES/Handbook (20)**  
**Sunday 12–1:30p Majestic 2 (H37)**

**TC 4.2 Program (20) (Screen)**  
**Sunday 1:30–2:30a Majestic 2 (H37)**

**SSPC 169 (10/8) (Screen)**  
**Monday 10a–Noon City View 2 (H4)**

**TC 4.2 Research (20) (Screen)**  
**Monday 4:15–6:00p Trinity 4 (H3)**

**TC 4.3 Ventilation Requirements & Infiltration (14/20)**

**Monday 4:15–6:30p Majestic 7(H37)**

**TC 4.3 1596 RP (SP98) PMS (10) (Screen/E)**  
**Sunday 7:00–9:00p Majestic 6 (H37)**

**TC 4.4 Bldg. Materials and Bldg. Envelope Performance (30/10) (Screen)**

**Monday 2:15–4:15p Lone Star Ballroom A1 (CC2)**

*Sponsoring: Seminar 18: What Mechanical Engineers Need to Know about Envelopes for High Performance Buildings*

**TC 4.4 Research (30/10) (Screen)**  
**Sunday 1:00–3:00p City View 6 (H4)**

**TC 4.4 Handbook (30/10)**  
**Sunday 3:00–3:30p City View 6 (H4)**

**TC 4.4 Program (20/5)**  
**Sunday 3:30–5:00p City View 6 (H4)**

**TC 4.4 Standards (20/5)**  
**Sunday 5:00–5:30p City View 6 (H4)**

**TC 4.5 Fenestration (10/10)**

**Monday 2:15–4:15p State Room 3 (CC3)**

**TC 4.5 Calculational Methods**  
**Sunday 1:00–3:00p Pearl 5 (H2)**

**TC 4.5 Research & Long Range Planning (20)**  
**Sunday 3:00–4:00p Pearl 5 (H2)**

**TC 4.5 Program (20)**  
**Sunday 4:00–5:00p Pearl 5 (H2)**

**TC 4.5 Handbook (10)**  
**Sunday 5:00–6:30p Pearl 5 (H2)**

**TC 4.7 Energy Calculations (75) (Screen)**

**Tuesday 6:00–8:30p Lone Star Ballroom C4 (CC2)**

*Sponsoring: Seminar 32: Data Visualization 101*

**TC 4.7 Simulation and Component Models (20/20) (Screen)**  
**Monday 6:00–7:30p Lone Star Ballroom C3 (CC2)**

**TC 4.7 Data-Driven Models (25)**  
**Monday 7:30–9:00p Lone Star Ballroom C3 (CC2)**

**TC 4.7 Applications (40) (Screen)**  
**Tuesday 3:30–5:00p Lone Star Ballroom C4 (CC2)**

**TC 4.7 Handbook**  
**Tuesday 5:00–6:00p Lone Star Ballroom C4 (CC2)**

**TC 4.10 Indoor Environmental Modeling (40)**

**Monday 2:15–4:15p San Antonio Ballroom B (CC3)**

*Sponsoring: Seminar 39: Evaluating Particle Concentration and Distribution in Industrial and Transportation Ventilation*

**TC 4.10 RP 1512 PMS (15) (Screen)**  
**Sunday 1:00–2:30p State Room 4 (CC3)**

**TC 4.10 RP 1458 PMS (15) (Screen)**  
**Sunday 2:30–3:30p State Room 4 (CC3)**

**TC 4.10 Program (20)**  
**Sunday 3:30–4:30p State Room 4 (CC3)**

**TC 4.10 Handbook (20)**  
**Sunday 4:30–5:00p State Room 4 (CC3)**

**TC 4.10 Research (30)**  
**Sunday 5:00–6:00p State Room 4 (CC3)**

**TC 5.1 Fans (25) (Screen)**  
**Monday 4:15–6:30p San Antonio Ballroom A (CC3)**  
*Sponsoring: Forum 8: Fan Energy Efficiency: Quantifying the Savings*

**TC 5.1 Research, Handbook, Program (12/5)**  
**Sunday 3:00–5:00p Majestic 4 (H37)**

**TC 5.1 PMS 1420 Inlet/Discharge Installation Effects Plenum Fans (5/15) (Screen)**  
**Sunday 5:00–7:00p Majestic 4 (H37)**

**TC 5.2 Duct Design (12/20)**  
**Tuesday 3:30–6:00p Lone Star Ballroom A1 (CC2)**

**TC 5.2 Duct Leakage (20)**  
**Sunday 12:30–1:00p Trinity 3 (H3)**

**TC 5.2 Duct Fitting Database (20)**  
**Sunday 1:00–1:30p Trinity 3 (H3)**

**TC 5.2 Research (20)**  
**Sunday 1:30–2:30p Trinity 3 (H3)**

**TC 5.2 Handbook (20)**  
**Sunday 2:30–3:00p Trinity 3 (H3)**

**TC 5.2 Standards (20)**  
**Sunday 3:00–3:30p Trinity 3 (H3)**

**TC 5.2 Programs (20)**  
**Sunday 3:30–4:00p Trinity 3 (H3)**

**TC 5.2 1180 Design Guide for Duct Design (20)**  
**Monday 10:00a–Noon Lone Star Ballroom C1**

**TC 5.3 Room Air Distribution (30/30) (Screen/E)**  
**Tuesday 1:00–3:30p Lone Star Ballroom A1 (CC2)**  
*Sponsoring: Seminar 35: Introduction to the ASHRAE/REHVA Chilled Beam Design Guide*

**TC 5.3 Handbook (20/20)(screen/E)**  
**Friday 8:00–5:00p Majestic 1 (H37)**

**TC 5.3 Handbook (20/20) (screen/E)**  
**Saturday 8:00–3:00p State Room 1 (CC3)**

**TC 5.3 Fan Coils (30/20) (Screen/E)**  
**Sunday 8:30–9:30a Majestic 6 (H37)**

**TC 5.3 Chilled Beams (30) (Screen/E)**  
**Sunday 9:30–10:30a Majestic 6 (H37)**

**TC 5.3 Research Projects (30/20) (Screen/E)**  
**Sunday 10:30–Noon Majestic 6 (H37)**

**TC 5.3 Research/ Handbook/Program (30/20) (screen/E)**  
**Sunday Noon–2:00p Majestic 6 (H37)**

**TC 5.4 Industrial Process Air Cleaning (11/6)**  
**Monday 2:15–4:15p Live Oak (H2)**  
*Sponsoring: Seminar 31: Reducing Industrial Exhaust System Energy Use Without Affecting Performance*

**TC 5.5 Air-to-Air Energy Recovery (22/4)**  
**Tuesday 3:30–6:00p State Room 1 (CC3)**

**TC 5.5 Handbook, Program, Research (12)**  
**Monday 4:15–6:30p Majestic 2 (H37)**

**TC 5.6 Control of Fire & Smoke (23/30) (Screen)**  
**Monday 4:15–6:30p San Antonio Ballroom B (CC3)**

**TC 5.6 Program (12/4)**  
**Sunday 3:00–4:00p Dallas Ballroom A3 (CC1)**

**TC 5.6 Research**  
**Sunday 4:00–5:30p Dallas Ballroom A3 (CC1)**

**TC 5.6 Handbook**  
**Sunday 5:30–7:00p Dallas Ballroom A3 (CC1)**

**TC 5.6 Guideline 5 Subcommittee**  
**Monday 2:15–4:15p Trinity 4 (H3)**

**TC 5.7 Evaporative Cooling (30)**  
**Monday 4:15–6:30p Dallas Ballroom A2 (CC1)**

**TC 5.7 Program, Handbook, Research (9/7)**  
**Sunday 3:00–5:00p Pearl 2 (H2)**

**TC 5.8 Industrial Ventilation Systems (20/5)**  
**Monday 4:15–6:30p Majestic 5 (H37)**  
*Sponsoring: Seminar 17: Ventilation of the Industrial Environment*

**TC 5.8 Ventilation of Hazardous Spaces (5/5)**  
**Sunday 7:00–9:00p Majestic 2 (H37)**

**TC 5.9 Enclosed Vehicular Facilities (30/10)**  
**Tuesday 3:30–6:00p Dallas Ballroom D2 (CC1)**  
*Sponsoring: Seminar 8: Designing Energy Efficient Ventilation Systems for Transportation Using Jet Fans*

**TC 5.9 Handbook, Research Program (25/10)**  
**Tuesday 1:00–3:30p Dallas Ballroom D2 (CC1)**

**TC 5.10 Kitchen Ventilation (30/15) (Screen/E)**  
**Monday 10:30–Noon Dallas Ballroom D2 (CC1)**  
*Sponsoring: Seminar 7: Commercial Kitchen Ventilation: The Design Process (Part 1) and Seminar 13: Commercial Kitchen Ventilation: The Design Process (Part 2)*

**TC 5.10 Handbook (20) (Screen)**  
**Sunday 8:00–9:30a Houston Ballroom C (CC3)**

**TC 5.10 Program (20) (Screen)**  
**Monday 8:00–9:00a Dallas Ballroom D2**

**TC 5.10 Research (20) (Screen)**  
**Monday 9:00–10:30a Dallas Ballroom D2**

**TC 5.11 Humidifying Equipment (10/3)**  
**Monday 2:15–4:15p City View 3 (H4)**

**TC 5.11 Handbook/Program (9/5)**  
**Sunday 10:00–Noon City View 2 (H4)**

**TC 6.1 Hydronic & Steam Htg. Equip & Sys (35/15)**  
**Tuesday 1:00–3:30p Dallas Ballroom D1 (CC1)**  
*Sponsoring: Seminar 3: Fundamental Pump Selection and Control*

**TC 6.1 Handbook**  
**Sunday 5:00–6:00p City View 5 (H4)**

**TC 6.1 Chilled Water Plant (10/10)**  
**Sunday 6:00–7:00p City View 5 (H4)**

**TC 6.1 Program (10/10)**  
**Monday 2:15–3:15p Dallas Ballroom A1 (CC1)**

**TC 6.1 Research (10/10)**  
**Monday 3:15–4:15p Dallas Ballroom A1 (CC1)**

**TC 6.2 District Energy (20/10) (Screen)**  
**Sunday 3:00–5:00p Trinity 1 (H3)**

**TC 6.2 Programs, Research, Handbook, Planning, (14)**  
**Sunday 2:00–3:00p Trinity 1 (H3)**

**TC 6.3 Central Forced Air Htg. & Cooling Sys (30)****Tuesday 1:00–3:30p Majestic 4 (H37)***Sponsoring: Seminar 33: Future Directions in Sizing Residential and Small Commercial HVAC Equipment***TC 6.5 Radiant Heating and Cooling (17/10)****Monday 2:15–4:15p State Room 4 (CC3)****TC 6.5 RP 1383 (4/20) (Screen)****Sunday 2:00–3:00p City View 8 (H4)****TC 6.5 Research, Spec Pubs, Journal, Program, Handbook (8/20)****Sunday 3:00–5:00p City View 8 (H4)****TC 6.6 Service Water Heating Systems (18/15)****Monday 4:15–6:30p Majestic 1 (H37)***Sponsoring: Seminar 24: The Potential Unintended Conflicts Between Well-Intentioned Codes and the Physics of Hot Water Delivery***TC 6.6 Handbook (15)****Monday 10:00–12N Live Oak (H2)****TC 6.6 Research/Handbook/Program (18/15)****Monday 2:15–4:15p Majestic 1 (H37)****TC 6.7 Solar Energy Utilization (20/10)****Tuesday 1:00–3:30p City View 3 (H4)****TC 6.7 Research (5/5)****Monday 2:15–3:15p Pearl 1 (H2)****TC 6.7 Program (5/5)****Monday 4:15–5:30p Pearl 1 (H2)****TC 6.7 Handbook (5/5)****Monday 6:30–8:30p Pearl 1 (H2)****TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25) (Screen)****Tuesday 3:30–6:30p Dallas Ballroom A3 (CC1)***Sponsoring: Seminar 9: Foundation Heat Exchangers for Low Cost Residential Ground Source Heat Pump Systems***TC 6.8 Research/Handbook/Program (15/10)****Sunday 5:00–7:00p Dallas Ballroom A1 (CC1)****TC 6.9 Thermal Storage (20/5)****Monday 4:30–6:00p Dallas Ballroom D2 (CC1)***Sponsoring: Seminar 28: Grid-Interactive Thermal Energy Storage – Challenges and Lessons Learned with Real-Time Pricing***TC 6.9 Standards (15/5)****Monday 2:15–2:40p Dallas Ballroom D2****TC 6.9 Program (15)****Monday 2:40–3:10p Dallas Ballroom D2****TC 6.9 Handbook (15)****Monday 3:10–3:30p Dallas Ballroom D2****TC 6.9 LRP /Website (15)****Monday 3:30–3:50p Dallas Ballroom D2****TC 6.9 Research (10)****Monday 3:50–4:30p Dallas Ballroom D2****TC 6.10 Fuels & Combustion (30)****Tuesday 3:30–6:00p Lone Star Ballroom C3 (CC2)****TC 6.10 Handbook (4/4)****Monday 2:15–4:15p City View 4 (H4)****TC 7.1 Integrated Building Design (25/10)****Monday 8:15–10:30a Trinity 1 (H3)***Sponsoring: Seminar 10: Integrated Building Energy Retrofits and Seminar 38: BIM for Dummies***TC 7.1 Subcommittees (15)****Sunday 5:00–7:00p City View 1 (H4)****TC 7.2 HVAC Construction and Design Build Technology (15) (Screen)****Sunday 10:00a–Noon Live Oak (H2)***Sponsoring: Seminar 37: Performance Contracting in Public Schools: Energy Conservation Methods that Lead to Superior Returns***TC 7.3 Operations & Maintenance Management (25/7)****Tuesday 1:00–3:30p State Room 1 (CC3)***Sponsoring: Seminar 22: The FM Perspective: Reducing Energy Consumption and the True Cost of Maintenance, Seminar 30: Outbreak: You Don't Want a Part in This Movie: What to Do If You Find Legionella in Your Facility, Part 1, and Seminar 36: Outbreak: You Don't Want a Part in This Movie: What to Do If You Find Legionella in Your Facility, Part 2***TC 7.3 Standards/Program (7/3)****Monday 2:15–4:15p Pearl 3 (H2)****TC 7.3 Research/Handbook/Education (7/3)****Monday 4:15–6:30p Pearl 3 (H2)****TC 7.4 Exergy Analysis for Sustainable Buildings (14/8)****Sunday 8:00–10:00a City View 2 (H4)****TC 7.5 Smart Building Systems (16/24) (Screen)****Tuesday 3:30–6:00p Lone Star Ballroom C1 (CC2)****TC 7.5 Fault Detection & Diagnosis (40)****Sunday 3:00–3:45p Lone Star Ballroom C1 (CC2)****TC 7.5 Wireless Applications (40)****Sunday 3:45–4:30p Lone Star Ballroom C1 (CC2)****TC 7.5 Smart Grid****Sunday 4:30–5:15p Lone Star Ballroom C1 (CC2)****TC 7.5 Handbook****Sunday 5:15–6:00p Lone Star Ballroom C1 (CC2)****TC 7.5 Buildings Operations Dynamics****Monday 4:15–5:30p Trinity 1 (H3)****TC 7.5 Research****Monday 5:30–6:30p Trinity 1 (H3)****TC 7.6 Building Energy Performance (50)****Tuesday 1:00–3:30p Lone Star Ballroom C1 (CC2)***Sponsoring: Forum 5: The DOE Buildings Performance Database – How Can It Help You and How Can You Help It?***TC 7.6 Research (12)****Sunday 1:00–2:00p City View 3 (H4)****TC 7.6 Commercial Building Energy Audit (15)****Sunday 2:00–3:00p City View 3 (H4)****TC 7.6 Handbook (8)****Sunday 3:00–4:00p City View 3 (H4)****TC 7.6 Monitoring & Energy Performance (24)****Monday 2:15–4:15p Pearl 2 (H2)****TC 7.6 Energy Management (12)****Monday 4:15–5:15p Pearl 2 (H2)****TC 7.6 Standards (12)****Monday 5:15–6:15p Pearl 2 (H2)****TC 7.6 Executive (12)****Monday 6:15–6:45p Pearl 2 (H2)****TC 7.7 Testing & Balancing (20/30)****Monday 2:15–4:15p Lone Star Ballroom A2 (CC2)****TC 7.7 Program/Handbook (5/5)****Saturday 1:00–3:00p Pearl 1 (H2)****TC 7.8 Owning & Operating Costs (25)****Monday 2:15–4:15p Majestic 7 (H37)**

**TC 7.8 Program, Handbook, Research (5/5)**  
**Sunday 3:00–5:00p Lone Star Ballroom A1 (CC2)**

**TC 7.9 Building Commissioning (75) (E)**  
**Sunday 3:00–5:00 Dallas B (CC1)**  
*Sponsoring: Seminar 11: Moisture Control in Commissioning of New and Existing Buildings*

**TC 7.9 Research (25)(E)**  
**Saturday 9:00–10:30a Trinity 1 (H3)**

**TC 7.9 Program**  
**Sunday 9:00–10:30 Majestic 3 (H37)**

**TC 8.1 Positive Displacement Compressors (12/14)**  
**Tuesday 3:30–6:00p Trinity 1 (H3)**

**TC 8.1 Research (6/2)**  
**Monday 2:15–4:15p Trinity 5 (H3)**

**TC 8.2 Centrifugal Machines (20/8)**  
**Monday 2:15–4:15p State Room 1 (CC3)**

**TC 8.2 Research/Program (9/2)**  
**Sunday 5:00–7:00p Pearl 1 (H2)**

**TC 8.2 Handbook (5/2)**  
**Sunday 7:00–8:00p Pearl 1 (H2)**

**TC 8.3 Absorption and Heat Operated Machines (30)**  
**Monday 3:30–6:00p Lone Star Ballroom C3 (CC2)**

**TC 8.3 Research/Handbook (8/8)**  
**Monday 2:00–3:30p Lone Star Ballroom C3 (CC2)**

**TC 8.4 Air-to-Refrigerant Heat Transfer Equip (20/10)**  
**Tuesday 3:30–6:00p City View 6 (H4)**  
*Sponsoring: Seminar 4: Heat Exchanger Tests with Alternative Refrigerants*

**TC 8.4 Research (15/15)**  
**Monday 6:30–9:30p Majestic 3 (H37)**

**TC 8.5 Liquid to Refrigerant Heat Transfer (25/10)**  
**Monday 4:15–6:30p State Room 1 (CC3)**

**TC 8.5.1.3 Research (20/30)**  
**Sunday 3:00–7:00p Lone Star Ballroom A3 (CC2)**

**TC 8.6 Cooling Towers and Evaporative Condensers (20)**  
**Monday 2:15–4:15p Majestic 5 (H37)**

**TC 8.6 Research (5/5)**  
**Sunday 5:00–7:00p San Antonio B (CC3)**

**TC 8.6 Handbook/Program/Research (10)**  
**Monday 8:00–10:00a Pearl 1 (H2)**

**TC 8.7 Variable Refrigerant Flow (20/30)**  
**Monday 4:15–6:30 Lone Star Ballroom A2 (CC2)**

**TC 8.8 Refrigerant System Controls & Accessories (10/10)**  
**Tuesday 1:00–3:30p Trinity 4 (H3)**

**TC 8.8 Program, Research, Handbook (10/5)**  
**Monday 2:15–4:15p Trinity 3 (H3)**

**TC 8.9 Residential Refrigerators and Food Freezers (6/10)**  
**Monday 2:15–4:15p Executive Boardroom (H2)**

**TC 8.10 Mechanical Dehumidifiers & Heat Pipes (12/4)**  
**Tuesday 3:30–6:00p City View 5 (H4)**

**TC 8.10 PMS for RP-1565, DOAS Design Guide (11/4) (Screen)**  
**Tuesday 11:00–noon Majestic 5 (H37)**

**TC 8.10 Program/Handbook/Research/Standards (8/8)**  
**Tuesday 2:00–3:30p City View 5 (H4)**

**TC 8.11 Unitary and Room Air Conditioners & Heat Pumps (20/30)**

**Monday 4:15–6:30p City View 8 (H4)**  
*Sponsoring: Conference Paper Session 1: Advances in Performance and Efficiency of Air Conditioning Systems*

**TC 8.11 Handbook/Program/Research (10/10)**  
**Sunday 3:00–6:00p Majestic 2 (H37)**

**TC 8.12 Desiccant Dehumidification Equipment and Components (30)**

**Monday 2:15–4:15p Lone Star Ballroom C2 (CC2)**  
*Sponsoring: Seminar 14: Desiccant Enhanced Air Conditioning*

**TC 9.1 Large Building Air-Conditioning Systems (23/5)**  
**Tuesday 1:00–3:30p Majestic 7 (H37)**

**TC 9.1 Research /Program/Handbook/Standards (23/5)**  
**Tuesday 12:00–1:00p Majestic 7**

**TC 9.2 Industrial Air Conditioning (25/10)**

**Tuesday 1:00–3:30p Dallas Ballroom A1 (CC1)**  
*Sponsoring: Seminar 1: Ask Not What Your Industrial Committee Can Do For You – Ask What You Can Do For Your Industrial Committee*

**TC 9.2 Program, Research, Handbook (12) (Screen)**  
**Sunday 4:00–7:00p Majestic 8 (H37)**

**TC 9.2 Nuclear (15/5)**  
**Monday 2:15–4:15p City View 7 (H4)**

**TC 9.3 Transportation Air Conditioning (25/20)**

**Monday 3:30–6:00p Dallas Ballroom A3 (CC1)**

**TC 9.3 Handbook (4/4)**  
**Sunday 9:00–10:00a Majestic 8 (H37)**

**TC 9.3 Aviation (20/10) (Screen)**  
**Sunday 10a–Noon Majestic 8 (H37)**

**TC 9.3 Automotive (6/4) (Screen)**  
**Sunday 5:00–7:00p Trinity 1 (H3)**

**TC 9.3 Research (25/25) (Screen)**  
**Monday 2:15–3:30p Dallas Ballroom A3 (CC1)**

**TC 9.4 Justice Facilities (20/5)**

**Monday 8:00–10:00a City View 1 (H4)**

**TC 9.5 Residential and Small Bldg. Applications (20/10)**

**Tuesday 3:30–6:00p Majestic 4 (H37)**

**TC 9.6 Health Care Facilities (20/60) (Screen)**

**Sunday 5:00–7:00p Dallas Ballroom D1 (CC1)**

**TC 9.6 Handbook (20) (Screen)**  
**Sunday 8:15–10:00a Dallas Ballroom D1 (CC1)**

**TC 9.6 Infectious Diseases (25)**  
**Sunday 10:00–12:00p Dallas Ballroom D1 (CC1)**

**TC 9.6 Research (20) (Screen)**  
**Sunday 12:30–2:30p Dallas Ballroom D1 (CC1)**

**TC 9.6 Energy (20) (Screen)**  
**Sunday 2:30–4:00p Dallas Ballroom D1 (CC1)**

**TC 9.6 Program (10) (screen)**  
**Sunday 4:00–5:00p Dallas Ballroom D1 (CC1)**

**TC 9.7 Educational Facilities (13/10)**

**Sunday 1:00–3:00p City View 2 (H4)**

**TC 9.8 Large Building Air-Conditioning Applications (30)**

**Monday 2:15–4:15p Trinity 1 (H3)**  
*Sponsoring: Forum 3: Design of Atrium buildings and Forum 7: Cold Climate Design Guide: Scope and Content*

**TC 9.8 Museums, Galleries, Archives & Libraries (6/2)**

Monday 8:00–9:00a Trinity 2 (H3)

**TC 9.8 Research (5/1)**

Monday 9:00–10:00a Trinity 2 (H3)

**TC 9.8 Handbook (8/2)**

Monday 10:00–11:00a Trinity 2 (H3)

**TC 9.8 Program (6/5)**

Monday 11:00a–Noon Trinity 2 (H3)

**TC 9.9 Mission Critical Facilities (25/50) (Screen)**

Monday 2:15–9:30p Dallas Ballroom D1 (CC1)

*Sponsoring: Forum: Improving Data Center Efficiency with a Better Match of HVAC and IT Systems and**Forum: CFD Modeling, Control Scheme Efficiency & IT Ride through for Cold Aisle Containment***TC 9.9 Program/ Handbook/ Research (25/10)**

Sunday 5:00–7:00p Lone Star Ballroom A1 (CC2)

**TC 9.10 Laboratory Systems (75)(Screen)**

Tuesday 3:30–6:00p Lone Star Ballroom A3 (CC2)

**TC 9.10 Standards, Research (10/5)**

Sunday 3:00–5:00p Pearl 4 (H2)

**TC 9.10 Program (10)**

Sunday 5:00–6:00p Pearl 4

**TC 9.10 Handbook, Design Guide (8)**

Tuesday 1:00–3:30p City View 4 (H4)

**TC 9.11 Clean Spaces (30/45)(Screen/E)**

Monday 2:15–4:00p Lone Star Ballroom C1 (CC2)

*Sponsoring: Seminar 19: The “Road Less Traveled” Becomes a Highway: Design-Build Execution of Cleanroom Projects***TC 9.11 RP-1604 PMS (5/10) (Screen)**

Sunday 3:00–5:00p Pearl 1 (H2)

**TC 9.11 Handbook (10/12)(Screen)**

Monday 4:00–4:30p Lone Star Ballroom C1

**TC 9.11 Design Guide (10)**

Monday 4:30–5:30p Lone Star Ballroom C1

**TC 9.11 Short Course (10)**

Monday 5:30–6:00p Lone Star Ballroom C1

**TC 9.12 Tall Buildings (12/5)**

Tuesday 3:30–6:00p Live Oak (H2)

**TC 10.1 Custom Engineered Refrig Systems (30)**

Monday 2:15–4:15p City View 8 (H4)

**TC 10.1 Research/Handbook, Standards/ Program (15/5)**

Sunday 5:00–7:00p Executive Boardroom (H2)

**TC 10.1 Cryogenics Refrigerants Subcommittee (10)**

Sunday 3:00–5:00p Executive Boardroom (H2)

**TC 10.2 Automatic Ice Making Plants/Skating Rinks (15)**

Monday 4:15–6:30p City View 3 (H4)

**TC 10.3 Refrigerant Piping, Controls and Accessories (30)**

Tuesday 1:00–3:30p City View 8 (H4)

**TC 10.5 Refrigeration Distrib and Storage Facilities (15/10)**

Tuesday 3:30–6:00p City View 8 (H4)

**TC 10.6 Transport Refrigeration (8/10)**

Monday 4:45–7:00p Executive Boardroom (H2)

**TC 10.6 Handbook (6/2)**

Monday 2:15–3:00p Trinity 2 (H3)

**TC 10.7 Commercial Food. Beverage Display & Storage (25/25)**

Monday 2:15–4:15p Dallas Ballroom A2 (CC1)

**TC 10.7 1467-RP PMS (4/2)**

Sunday 7:00–8:00a City View 4 (H4)

**TC 10.7 Program (5/5)**

Sunday 5:15–6:00p City View 4 (H4)

**TC 10.7 Research (5/10)**

Sunday 6:00–6:45p City View 4 (H4)

**TC 10.7 Handbook (5/10)**

Sunday 6:45–7:30p City View 4 (H4)

**TC 10.8 Refrigeration Load Calculations (10/10)**

Sunday 3:00–5:00p City View 2 (H4)

**Task Groups (TG), Technical Resource Groups (TRG), and Multidisciplinary Task Groups (MTG)****TG1.Optimization (15)**

Sunday 1:00–3:00p Executive Boardroom (H2)

**TG2.HVAC Security (20/6)**

Tuesday 9:00–12N State Room 1 (CC3)

**TRG4 Sustainable Building Guidance & Metrics (17/10)**

Saturday 1:00–3:00p Majestic 5 (H37)

**TRG4.IAQP (12/8)**

Sunday 10:30a–12:30p Executive Boardroom (H2)

**TRG7-Under Floor Air Distribution (Screen/E) (40)**

Wednesday 8:00–Noon Dallas Ballroom A1 (CC1)

**MTG Building Performance Metrics (15/10) (Screen)**

Sunday 1:00–4:00p Majestic 8 (H37)

**MTG Energy Efficiency Classification of General Ventilation Air-Cleaning Devices (15/5) (Screen)**

Tuesday 8:00–Noon Trinity 1 (H3)

**MTG Building Information Modeling (15/15)(E)**

Saturday 1:00–3:00p City Room 8 (H4)

**MTG Energy Targets Multidisciplinary Task Group (20/10)**

Saturday 1:00–3:00p State Room 3 (CC3)

**MTG Cold Climate Design Guide**

Wednesday 8:00–9:30a State Room 3 (CC3)

**Standard Project Committees (SPC) and Standing Standard Project Committee (SSPC)****SPC Chair Training Breakfast**

Sunday 7:00–9:00a Lone Star Ballroom C2 (CC2)

**SSPC 15 Safety Standards for Refrigeration Systems (15/40) (screen)**

Sunday 10:00a–Noon Majestic 1 (H37)

Sunday 1:00–5:00p Majestic 1 (H37)

**SSPC 15 Ad Hoc 2L Classification Working Group (11/20) (Screen)**

Sunday 9:00a–10:00a Majestic 1 (H37)

**SPC 16/58 MOT/Rating Room Air Conditioners and PTAC/ PTHP (5/3) (Screen)**

Tuesday 8:00–Noon City View 5 (H4)

**SPC 17 MOT/Capacity of TEV's (6/4)**

Sunday 5:00–7:00p Pearl 3 (H2)





**SPC 20 MOT/Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (5/10) (Screen)**

Sunday 12:00–2:00p Pearl 4 (H2)

**SPC 22 MOT Water-cooled Refrigerant Condensers (6/10) (Screen)**

Sunday 9:30a–12:30 Houston Ballroom C (CC3)

**SPC 23.2 MOT/Rating Positive Displacement Compressors that Operate at Supercritical Pressures of the Refrigerant (7/4)**

Monday 10:00a–Noon Trinity 5 (H3)

**SPC 29 MOT/Automatic Ice Makers (12)**

Monday 4:15–6:15p Majestic 3 (H37)

**SPC 30 MOT Liquid Chilling Packages (6/10) (Screen)**

Wednesday 8:00–10:00 State Room 1 (CC3)

**SSPC 34 Designation & Safety Class. Of Refrig. (25/25) (Screen/E)**

Monday 6:30–10:00p Majestic 1 (H37)

**SSPC 34 Designation Nomenclature (10/10) (screen/E)**

Saturday 7:00–10:00a Majestic 4 (H37)

**SSPC 34 Flammability (15/20)(screen/E)**

Saturday 10:00–3:00p Majestic 4 (H37)

**SSPC 34 Toxicity (10/20) (screen/E)**

Sunday 6:30–10:00p City View 6 (H4)

**SPC 37 MOT for Rating Electrically Driven Unitary Air-Conditioners and Heat Pump Equipment (10) (Screen/E)**

Wednesday 8:00–10:00a City View 6 (H4)

**SPC 40 MOT/Rating Heat Operated Unitary Air-Conditioning and Heat-Pump Equipment (5/5)**

Monday 10:00–Noon Majestic 2 (H37)

**SSPC 41 Standard Methods for Measurement (15/10)**

Sunday 1:00–4:00p Trinity 2 (H3)

**41.1 Temperature-Standard Method for Temperature Measurement (10/5)**

Monday 8:00–10:00a Trinity 4 (H3)

**41.2 Laboratory Airflow-Standard Method for Laboratory Airflow Measurement (10/5)**

Monday 10a–Noon Trinity 4 (H3)

**41.3 Pressure-Standard Method for Pressure Measurement (10/5)**

Sunday 4:00–6:00p Trinity 2 (H3)

**41.4 Lubricant Content-Standard Method for Measurement of Proportion of Lubricant in Liquid Refrigerant (10/5)**

Monday 10:00–Noon Pearl 5 (H2)

**41.6 Humidity-Standard Methods for Measurement of Moist Air Properties (10/5)**

Sunday 10:00a–Noon Pearl 1 (H2)

**41.7 Standard Methods for Gas Flow Measurement (10/5)**

Tuesday 8:00 – 10:00a Majestic 8 (H37)

**41.8 Standard Methods for Liquid Flow Measurement (10/5)**

Tuesday 10:00–Noon Majestic 8 (H37)

**41.10 Calorimeter Test Methods for Volatile Refrigerants Mass Flow Measurements Using Flowmeters (10/5)**

Monday 2:15–4:15 Pearl 5 (H2)

**41.11 Power-Standard Methods for Power Measurement (10/5)**

Monday 8:00a–10:00a Pearl 5 (H2)

**SPC 51 Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating (15/10) (Screen) (E/Flip)**

Sunday 12:30–3:00p Majestic 4 (H37)

**SSPC 52.2P MOT/Part Size Eff. Proc. for Testing Air Cleaning Devices (20/30) (Screen)**

Saturday 8:00–Noon San Antonio Ballroom B (CC3)

**SSPC 55 Thermal Env Cond. for Human Occupancy (19/6) (Screen)**

Saturday 8:00a–3:00p Majestic 3 (H37)

Sunday 9:00a–12p Majestic 7 (H37)

**SSPC 62.1 Ventilation and Acceptable IAQ in Commercial, Institutional and High-Rise Residential Buildings (40/30) (E/Screen)**

Friday 1:00–5:00p Dallas Ballroom A1 (CC1)

Saturday 8:00–3:00p Dallas Ballroom A1 (CC1)

Sunday 1:00–7:00p Houston Ballroom A/B (CC3)

**SSPC 62.2 Ventilation and Acceptable IAQ in Low-Rise Residential Buildings (28/13)(Screen/Electric)**

Friday 1:00–2:30p San Antonio Ballroom A (CC3)

Saturday 8:30–3:00p San Antonio Ballroom A (CC3)

**SSPC 62.2 IAQ Subcommittee**

Friday 9:00–Noon Majestic 2 (H37)

**SSPC 62.2 IAQ Subcommittee (12)**

Friday 2:30–5:00p State Room 2 (CC3)

**SSPC 62.2 System Subcommittee (12)**

Friday 2:30–5:00p State Room 3 (CC3)

**SSPC 62.2 Envelope Subcommittee (20)**

Friday 2:30–5:00p San Antonio Ballroom A (CC3)

**SPC 63.1 MOT/Liquid-Line Refrigerant Driers**

Sunday 6:00–7:00 City View 3 (H4)

**SPC 72 MOT/Commercial Refrigerators and Freezers (11/11)**

Sunday 5:00–9:00p State Room 1 (CC3)

**SPC 79 Room Fan Coil Standard Committee (7/10)(Screen)**

Saturday 8:00–Noon Trinity 4 (H3)

**SPC 84-2008 MOT/Air-to-Air Heat/Energy Exchangers (10/4) (Screen/E)**

Tuesday 8:00–12:00p Trinity 2 (H3)

**SSPC 90.1 Energy Eff. Design of New Bldg. (Screen/E) (50/60)**

Saturday 8:00a–12p Houston Ballroom A/B (CC3)

Sunday 9:00a–12p Houston Ballroom A/B (CC3)

Monday 8:00a–12p Houston Ballroom A/B (CC3)

**Format & Compliance Subcommittee (4/6) (E)**

Friday 5:00–10:00p State Room 1 (CC3)

Saturday 1:00–5:00p Trinity 3 (H3)

Sunday 4:00–7:00p Live Oak (H2)

**Mechanical Subcommittee (25/25) (Screen/E)**

Friday 9:00a–10p Houston Ballroom A (CC3)

Saturday 1:00–7:00p Houston Ballroom A/B (CC3)

Sunday 1:00–8:00p San Antonio Ballroom A (CC3)

**Lighting Subcommittee (12/10) (Screen/E)**

Friday 9:00a–10p San Antonio Ballroom B (CC3)

Saturday 1:00–7:00p Trinity 4 (H3)

Sunday 1:00–8:00p State Room 3 (CC3)

**ECB Subcommittee (8/10) (Screen/E)**

Friday 5:00–10:00p San Antonio Ballroom A (CC3)

Saturday 1:00–5:00p Trinity 2 (H3)

Sunday 1:00–4:00p Live Oak (H2)

**Envelope Subcommittee (screen/E)(15/30)**

Friday 9:00a–10:00p Houston Ballroom B (CC3)

Saturday 1:00–7:00p Houston Ballroom C (CC3)

Sunday 1:00–7:00p State Room 2 (CC3)

**Users Manual (12/5) (E)**

Friday 3:00–5:00p Live Oak (H2)

**SSPC 90.2 Energy Eff. Design of New Low Rise Res. Bldg. (21/44) (Screen/E)**

Monday 2:15–6:15p Lone Star Ballroom A3 (CC2)

Tuesday 1:00–5:00p Houston Ballroom C (CC3)

**SSPC 90.2 Lighting (4/4) (Screen/E)**

Monday 6:30–9:15p State Room 4 (CC3)

Tuesday 8:00–Noon State Room 2 (CC3)

**SSPC 90.2 Mechanical (6/6) (Screen/E)**

Monday 6:30–9:15p State Room 3 (CC3)

Tuesday 8:00–Noon State Room 4 (CC3)

**SSPC 90.2 Envelope (11/15) (Screen/E)**

Monday 6:30–9:15 State Room 1 (CC3)

Tuesday 8:00–Noon Houston Ballroom C (CC3)

**SPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings (25/40) (Screen/E)**

Saturday 9:00–1:00p Lone Star Ballroom A2 (CC2)

Monday 7:00–11:00a Houston Ballroom C (CC3)

**SPC 97 Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use Within Refrigerant Systems (6/10)**

Tuesday 9:30–11:00a Trinity 3 (H3)

**SPC 99 Refrigeration Oil Description (6/10)**

Tuesday 8:00–9:30a Trinity 5 (H3)

**SPC 100 Energy Efficiency in Existing Buildings (20/20) (E/Screen)**

Tuesday 8:00–12:00p City View 6 (H4)

**SSPC 100 Section 5&6 Working Groups (15/5)**

Sunday 8:30–10:30a Trinity 3 (H3)

**SSPC 100 Section 4&7 Working Groups (15/10)**

Monday 3:15–4:15p Trinity 2 (H4)

**SSPC 100 Lighting (5/5)**

Monday 4:15–6:15p Trinity 2

**SSPC 100 Sections 8, 9 & 10 Working Groups (15/10)**

Monday 6:15–9:15p Trinity 2

**SPC 103/MOT for Annual Fuel Utilization Efficiency (12/10)**

Sunday 6:00–10:00p Majestic 5 (H37)

**SPC 105 Standard Methods of Measuring and Expressing Building Energy Performance (7/20) (Screen)**

Sunday 9:00a–1:00p Trinity 1 (H3)

**SPC 110 MOT/Performance of Laboratory Fume Hoods**

Tuesday 8:00–Noon Pearl 2 (H2)

**SPC 111 Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation and Air-Conditioning Systems (12)**

Friday 12:00–5:00p City View 5 (H4)

**SPC 116 MOT/for Rating Seasonal Efficiency of Unitary Air-Conditioners and Heat Pumps**

Wednesday 10:00a–Noon City View 7 (H4)

**SPC 118.1 MOT/Commercial Water Heaters (6/6)**

Sunday 9:00–11:00a Trinity 2 (H3)

**SPC 118.2R MOT/Rating Residential Water Heaters (19/15)**

Tuesday 1:00–5:00p Majestic 5 (H37)

**SPC 120 MOT/to Determine Flow Resistance of HVAC Ducts and Fittings (10)**

Sunday 10:00–Noon Pearl 5 (H2)

**SPC 124 MOT/Rating Combination Space-Heating and Water Heating Appliances (5/10) (Screen/E)**

Wednesday 8:00–Noon State Room 2 (CC3)

**SPC 126 MOT/HVAC Air Ducts (10)(screen)**

Sunday 8:15–10:15 City View 4 (H4)

**SPC 129 Measuring Air Change Effectiveness (15/10)**

Sunday 5:00–7:00p Lone Star Ballroom A4 (CC2)

**SPC 130 MOT/for Rating Ducted Air Terminal Units (10/25) (Screen/E)**

Sunday 2:00–6:00p Majestic 6 (H37)

**SSPC 135 BACnet (45/15)**

Saturday 8:00–3:00p Majestic 1 (H37)

Monday 8:00a–Noon San Antonio Ballroom B (CC3)

**SSPC 135 (25)**

Thursday (6/21) 8:00a–5:00p City View 8 (H4)

**SSPC 135 Working Group (25)**

Friday 8:00a–5:00p Majestic 7 (H37)

Friday 8:00a–5:00p Majestic 8 (H37)

**SSPC 135 BACnet Working Group (25)**

Sunday 8:30a–5:00p San Antonio Ballroom B (CC3)

Sunday 8:00a–5:00p Majestic 5 (H37)

**SPC 139R MOT/for Rating Desiccant Dehumidifiers Utilizing Heat for the Regeneration Process (4/2)**

Monday 8:00–10:00a City View 5 (H4)

**SSPC 140 Standard MOT for Evaluation of Bldg. Energy Analysis Computer Program (11/10) (screen)**

Monday 2:15–6:15p Majestic 8 (H37)

**SSPC 145P Test Methods for Assessing Performance of Gas Phase Air Clean. Equip. (12/15)**

Sunday Noon–3:00p Majestic 3 (H37)

**SPC 147 Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment (15/6) (Screen/E)**

Sunday 6:00–10:00p Majestic 7 (H37)

**SPC 150 MOT/Performance of Cool Storage Systems (6/2)**

Sunday 5:30–7:00p Pearl 2 (H2)

**SPC 152R MOT/Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems (8/6)**

Sunday 8:00–10:00 Trinity 4 (H3)

**SPC 153 MOT/ for Mass Flow Capacity of Four-Way Refrigerant Reversing Valves (5/3)**

Sunday 5:00–7:00p Pearl 3 (H2)

**SPC 154 Ventilation for Commercial Cooking Operations (10/10) (Screen)**

Monday 2:15–6:15p City View 2 (H4)

**SPC 155P MOT/Rating Commercial Space Heating Boiler Systems (12/9)**

Sunday 1:00–5:00p City View 1 (H4)

**SSPC 160 Criteria for Moisture Control Design Analysis (12/6) (Screen)**

Tuesday 9:00a–Noon Executive Boardroom (H2)

**SPC 161P Air Quality Within Commercial Aircraft (18/8) (Screen/E)**

Sunday 1:00–5:00p Majestic 7 (H37)

Monday 8:00a–Noon State Room 1 (CC3)

**SPC 164.3 MOT/Commercial and Industrial Humidifiers (10/4) (Screen)**

Monday 9:00–11:00a Trinity 3 (H3)

**SSPC 169 Weather Data for Building Design Standards (10/5) (screen)**

Monday 10a–Noon City View 2 (H4)

**SSPC 170 Ventilation of Healthcare Facilities (22/20) (Screen)**

Tuesday 8:00–1:00p City View 8 (H4)

**SSPC 170 Clinical Subcommittee (14/10)**

Monday 4:15–6:15p Majestic 4 (H37)

**SPC 171 MOT/ of Seismic Restraint Devices for HVAC&R Equipment (13/5)**

Tuesday 8:00–Noon Trinity 4 (H3)

**SPC 172P MOT/Insoluble Materials in Synthetic Lubricants and HFC Refrigerant Systems (8)**

Monday 8:00–Noon City View 3 (H4)

**SPC 174R MOT/ for Rating Desiccant-Based Dehumidification Equipment**

Monday 8:00–10:00 City View 5 (H4)

**SPC 175 Metal Pressure Vessel Testing (5/5)**

Monday 4:15–6:15p Trinity 5 (H3)

**SPC 177P MOT/Fractionation Measurement of Refrigerant Blends (6/6) (Screen/E)**

Monday 8:00–11:00a Majestic 6 (H37)

**SPC 179P MOT/Life Testing Positive Displaced Compressors (6/12)**

Sunday 1:00–5:00p Trinity 5 (H3)

**SPC 181 MOT/Liquid-to-Liquid Heat Exchangers (8/10) (Screen)**

Tuesday 9:00a–Noon City View 7 (H4)

**SPC 184 MOT/Field Testing Chillers (9/5) (screen)**

Tuesday 8:00–Noon City View 1 (H4)

**SPC 185 MOT/UVC Lights for Use in Air Handling Units or Air Ducts to Inactivate Airborne Microorganisms (15/15) (Flipchart/Screen)**

Saturday 8:00a–3:00p Majestic 6 (H37)

**SPC 188 Minimizing the Risk of Legionellosis Associated with Building Water Systems (30/30) (screen)**

Tuesday 9:00–Noon Dallas Ballroom A1 (CC1)

Tuesday 3:30–6:00p Dallas Ballroom A1

**SSPC 189.1 ASHRAE/USGBC/IESNA Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (40/40) (E/screen)**

Tuesday 7:30–9:30a Houston Ballroom A/B (CC3)

Wednesday 8:00a–Noon Lone Star Ballroom C4 (CC2)

**Working Group 6 (Water Use)(30/20)(E/Screen)**

Tuesday 9:30–11:30a Houston Ballroom A/B

**Working Group 5 (Site Sustainability)(10/10)(E/Screen)**

Tuesday 12–2:00p Houston Ballroom A/B

**Working Group 9 (Materials and Resources) (10/10)**

Tuesday 2:30–4:30p Houston Ballroom A/B

**Working Group 10 (Plans and Operation) (30/20) (E/Screen)**

Tuesday 5:00–7:00p Houston Ballroom A/B

**Working Group 7 (Energy Efficiency)(20/20) (E/Screen)**

Tuesday 9:30–12:30p San Antonio Ballroom B

**Working Group 7.5 (Energy Performance) (20/20)**

Tuesday 1:00–4:00p San Antonio Ballroom B

**Working Group 8 (IEQ) (20/20) (E/Screen)**

Tuesday 4:00–7:00p San Antonio Ballroom B

**SPC 189.3 Design, Construction and Operation of Sustainable High Performance Health Care Facilities (14/10) (Screen)**

Monday 8a–Noon Majestic 4 (H37)

Monday 2:15–4:00p Majestic 4

**SPC 190 MOT/Rating Indoor Pool Dehumidifiers for Moisture Removal Capacity and Moisture Removal Efficiency (6/6)**

Tuesday 1:30–2:00p City View 5 (H4)

**SPC 191 Water Conservation (15/10) (Screen)**

Sunday 9:00–11:00a Dallas Ballroom D2 (CC1)

Tuesday 8:00–Noon Majestic 4 (H37)

**SPC 194 MOT/Direct-Expansion Ground Source Heat Pumps (5/10)**

Sunday 1:00–2:00p City View 4 (H4)

**SPC 195P MOT/for Airflow Controls (10/2)**

Tuesday 8:00–Noon Pearl 5 (H2)

**SPC 196P MOT/ Measuring Refrigerant Leak Rates (12/8)**

Sunday 6:00–10:00p Majestic 1 (H37)

**SPC 197 MOT/Attenuation Characteristics of Vibration Isolators (6/6) (Screen)**

Monday 4:15–6:30p Dallas B (CC1)

**SPC 199 MOT/Rating the Performance of Industrial Pulse Cleaned Dust Collectors (9/4)(Screen)**

Friday 1:00–5:00p Pearl 4 (H2)

Sunday 8:00a–Noon Trinity 5 (H3)

**SPC 200 MOT/Chilled Beams (20/20)(screen/E)**

Monday 8:00–Noon Majestic 1 (H37)

**SPC 201P: Facility Smart Grid Information Model (35/20) (Screen/E)**

Monday 2:15–6:30p Lone Star Ballroom C4 (CC2)

Tuesday 8:00a–Noon Dallas Ballroom D1 (CC1)

**SPC 202 The Commissioning Process for Buildings & Systems (15/15) (Screen/E)**

Monday 8:00–Noon State Room 2 (CC3)

**SSPC 203 MOT/Determining Heat Gain of Office Equipment Used in Buildings (10/4) (Screen)**

Saturday 1:00–3:00 City Room 5 (H4)

**SPC 204P MOT/Rating Micro Combined Heat and Power Devices (13/7)**

Monday 6:30–9:30p Majestic 8 (H37)

**SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment (13/20) (Screen)**

Tuesday 8:00–10:00a San Antonio Ballroom A (CC3)

**SPC 206 MOT/for Rating of Multi-Purpose Residential Heat Pumps for Space Conditioning, Water Heating and Dehumidification (14/6)**

Monday 2:15–5:00 p Pearl 4 (H2)

**SPC 207P-Laboratory Method of Test of Fault Detection and Diagnostics Applied Commercial Air-Cooled Packaged Systems (21/30) (Screen)**

Monday 8:00a–Noon Lone Star Ballroom C4 (CC2)

**SPC 209 Energy Simulation Aided Design (30/25) (Screen)**

Monday 2:15–6:15p Lone Star Ballroom A4 (CC2)

**SPC 209 Masterplanning/Pre-design Subcommittee (9/6)**

Sunday 6:00–10:00p Trinity 3 (H3)

**SPC 209 Design development/Construction documents (10/5) (Screen)**

Sunday 6:00–10:00p Trinity 4 (H3)

**SPC 209 Construction/Commissioning/As-Built/Operations**

Sunday 6:00–10:00p Trinity 5 (H3)

**SPC 209 Resources/References/Definitions Subcommittee (8/5) (Screen)**

Monday 8:00a–Noon Executive Boardroom (H2)

**SPC 209 Conceptual design/Schematic design (8/8) (Screen)**

Monday 8:00a–Noon Pearl 4 (H2)

**SPC 210 MOT/for Rating Commercial Walk-in Refrigerators and Freezers**

Monday 8:00–Noon Dallas Ballroom A1 (CC1)

**SPC 211 Standard for Commercial Building Energy Audits (13/12) (Screen/E)**

Monday 8:00–Noon Majestic 8 (H37)

**SPC 212 Evaporative Pre-Cooler Test Standard (6/5)**

Tuesday 8:00–Noon City View 4 (H4)

**Guideline Project Committees (GPC) and (SGPC)**

**SGPC 0-General Commissioning Process (17/20)**

Saturday 8:00–12:00p State Room 4 (CC3)

**GPC 1.2 Commissioning Process for Existing HVAC&R Systems (25/5) (Screen/E)**

Friday 8:00a–5:00p City View 3 (H4)

**GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process (10/5)**

Tuesday 1:00–5:00p State Room 3 (CC3)

**GPC 1.4 Systems Manual Preparation for the Commissioning Process (7/7)(E)**

Saturday 1:00–3:00p City Room 2 (H4)

**GPC 1.5 Commissioning Smoke Control Systems (11/10)**

Monday 2:15–4:15 Trinity 4 (H3)

**GPC 6, Refrigerant Information Recommended for Product Development and Standards (6)**

Sunday 12:00–1:00p Pearl 2 (H2)

**SGPC-10 Interactions Affecting the Achievement of Acceptable Indoor Environments (13/7) (Screen)**

Sunday 9:00–Noon City View 1 (H4)

**GPC 11 Field Testing of HVAC Controls Components**

Saturday 10:00–Noon City View 5 (H4)

**SGPC 13 Guideline for Specifying Direct Digital Control Systems (9/5) (Screen/E)**

Saturday 8:00–Noon City Room 1 (H4)

**GPC 14 Measuring Energy Demand and Water (8/6) (Screen)**

Sunday 6:00–10:00p Pearl 4 (H2)

**SGPC 20 Documenting HVAC&R Work Processes and Data Exchange Requirements (7/7)**

Monday 10:15a–12:15p City View 1 (H4)

**GPC 23 Guideline for the Design/Application of HVAC Equip. for Rail Passenger Vehicles (10/5) (screen)**

Monday 8:00–Noon State Room 3 (CC3)

Tuesday 8:00–Noon City View 2 (H4)

**GPC 27P Procedures for Measurement of Gases in Indoor Environments (5/5) (Flipchart)**

Sunday 3:00–5:00p Pearl 3 (H2)

**GPC 33P Guideline for Documenting Airflow and Contaminant Transport Modeling Studies (9/6)**

Tuesday 11:00–Noon City View 3 (H4)

**OTHER**

**Thermal Performance of the Exterior Envelopes of Whole Buildings (30)**

Monday 9:00 a.m.–Noon Lone Star C2 (CC2)

**USNC/IIR (20/10)**

Tuesday 2:00–4:00p Dallas Ballroom A2 (CC1)

**USNT/IEA (20/10)**

Tuesday 4:00–6:00p Dallas Ballroom A2 (CC1)

**US TAG to ISO/TC 142 (30/10) (Screen)**

Saturday 2:30–3:15p San Antonio Ballroom B (CC3)

**ISO TC 142 Working Group 2 (20)**

Sunday 5:15 – 7:00p City View 2 (H4)

**US TAG to ISO/TC 205 (20) (Screen)**

Tuesday 12–2:00p Majestic 2 (H37)

**ISO/TC 86/SC 1/WG 1 (20) (Screen)**

Wednesday (1/30) 9:30 a–5:30p State 2 (CC3)

Thursday (1/31) 9:30a–5:30p State 2

Friday (2/1) 9:30a–12:00p State 2

**ISO/TC 86/SC 1 (20) (Screen)**

Friday (2/1) 1:30p–5:30p

**gbXML (10)**

Tuesday 12:00–1:00p Trinity 3 (H3)

**POLICY FOR SCHEDULING TC/TG/SPC MEETINGS**

TC and TG meetings will be automatically scheduled on the same day and time based upon the previous meeting schedule. Any changes to the time slot must be made in writing. All TC/TG subcommittees must be scheduled for each meeting. All SPC meetings must be confirmed prior to scheduling

Audiovisual equipment and electric for laptops must be ordered for each meeting and only advance orders will be guaranteed. LCD projectors are not available.

NOTE: The parenthesis beside each committee represent the number of people expected to attend the meeting and any audiovisual equipment ordered. We encourage you to order audiovisual equipment in advance, as we are unable to guarantee that equipment will be available on-site. Every effort is made to accommodate room size versus number of committee members. If you have not supplied the Conferences Department with the number of members on your committee or subcommittee, we have no basis for room assignments.

## ASHRAE STAFF

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Christopher Weems  
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Susan LeBlanc  
Katrina Shingles  
Carmen Manning

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### Technology

Claire Ramspeck, Director  
Denise Latham

## SPEAKERS LIST

### A

Abbas, Laurent, *Seminar 44*  
Abdelaziz, Omar, *Seminar 4, Seminar 34 and Seminar 58*  
Aldous, Fiona, *Seminar 11*  
Archambault, Albert, *Seminar 6*  
Arens, Edward A., *Seminar 70*  
Arnold, David, *Seminar 51*  
Ash, Alan, *Seminar 28*  
Axley, Tom, *Seminar 31*  
Ayub, Zahid, *Seminar 68*

### B

Baker, Robert G., *Seminar 42*  
Barnaby, Charles S., *Seminar 25*  
Bauman, Fred S., *Seminar 25*  
Baxter, Van D., *Conference Paper Session 9*  
Bidstrup, Niels, *Seminar 3*  
Bilderbeck, Michael, *Technical Plenary 1*  
Bohanon, Hoy R., *Seminar 63*  
Bojic, Milorad, *Technical Paper Session 7*  
Bowers, Chad, *Seminar 4*  
Bridges, Barry B., *Forum 9*  
Burbank, Jason J., *Conference Paper Session 6*  
Bush, John, *Conference Paper Session 10*  
Byrne, Paul, *Conference Paper Session 9*

### C

Campbell, Dr. Scott D., *Seminar 20*  
Carlson, Jim, *Seminar 65*  
Cerra, Helen R., *Seminar 15*  
Chen, Qingyan, *Seminar 39*  
Chmielewski, Jim, *Seminar 6*  
Clark, John, *Seminar 7*  
Clayton, Mark, *Seminar 55*  
Coad, Bill, *Seminar 40*  
Colino, Mark, *Seminar 8*  
Connor, Michael, *Seminar 1*  
Conover, David R., *Special Session 1*  
Coogan, James, *Seminar 16*  
Crawley, Drury, *Seminar 27*  
Cremaschi, Lorenzo, *Conference Paper Session 4, Seminar 4, and Seminar 68*  
Cymbalsky, John Henry, *Seminar 41*

### D

Davies, Hywel, *Seminar 51*  
Davis, Colin, *Seminar 59*  
Demarco, Pete, *Seminar 24*  
Deru, Michael, *Conference Paper Session 2*  
Djunaedy, Ery, *Seminar 50*  
Dougherty, Ronald, *Technical Paper Session 3*  
Dubose, George, *Seminar 2*  
Dunnavant, Keith, *Technical Paper Session 5*  
Dwyer, Tim, *Seminar 38*

### E

Erb, Blake, *Seminar 14*

### F

Fang, Xia, *Seminar 56*  
Field, Brandon S., *Conference Paper Session 4*  
Fisher, Daniel, *Seminar 9*  
Fisher, Don, *Seminar 13*  
Fisk, David, *Seminar 40 and Seminar 51*  
Fox, Richard, *Seminar 1*  
Francisco, Paul W., *Seminar 67*  
Franseen, Richard, *Conference Paper Session 3*  
Freihaut, James, *Seminar 10*  
Friedrich, Kelton, *Technical Paper Session 6*  
Fung, Alan, *Technical Paper Session 1 and Technical Paper Session 7*

### G

Gallagher, Mike, *Seminar 42*  
Gamble, George A., *Seminar 8*  
Ghoshal, Uttam, *Seminar 71*  
Giuliano, John, *Seminar 20*  
Glanville, Paul, *Technical Paper Session 8*  
Goldschmidt, Victor, *Seminar 40*

### H

Haberl, Jeff, *Seminar 32*  
Halpin, Michael, *Seminar 36*  
Harriman, Lew, *Seminar 2, Seminar 12, and Seminar 67*  
Harris, Jeff, *Seminar 41*  
Hatten, Michael, *Seminar 50*  
Hedrick, Roger, *Special Session 1*  
Henderson, Hugh, *Seminar 33*  
Hens, Hugo, *Seminar 18*  
Hermans, Richard D., *Seminar 27*  
Hernandez, George R., *Seminar 53*  
Herrin, D. W., *Conference Paper Session 7*  
Hitchcock, Robert J., *Seminar 38*  
Hoeschele, Marc A., *Technical Paper Session 7*  
Hogeling, Jaap, *Seminar 54*  
Hourahan, Glenn, *Seminar 33*  
Hu, Huaifen, *Conference Paper Session 10*  
Huang, Joe, *Seminar 32 and Seminar 56*  
Hwang, Yunho, *Seminar 43 and Seminar 71*  
Hydeman, Mark, *Seminar 60*

### I

Im, Piljae, *Seminar 9*  
Isenbeck, Jennifer, *Seminar 36*

### J

Jarnagin, Ronald, *Seminar 40*  
Jeter, Sheldon M., *Technical Paper Session 3*  
Johnson, Mel, *Seminar 42*  
Jones, Camala, *Seminar 22*  
Junge, Brent, *Seminar 52*

## K

Kasuya, Koji, *Seminar 57*  
Kato, Shinsuke, *Seminar 49*  
Kauffman, Robert E., *Technical Paper Session 6*  
Kennedy, John F., *Seminar 55*  
Kerr, Daniel, *Seminar 37*  
Khalil, Essam E., *Conference Paper Session 4*  
Khankari, Kishor, *Conference Paper Session 10*  
Kiley, Chris, *Seminar 60*  
Klein, Gary, *Seminar 24*  
Klote, John H., *Seminar 69*  
Knirsch, Alexander, *Conference Paper Session 2*  
Kohout, Francis, *Seminar 13*  
Konopacz, Larry, *Seminar 3*  
Kosny, Jan, *Technical Paper Session 1*  
Kozubal, Eric, *Seminar 14*  
Kuraganti, Teja, *Seminar 53*  
Kurnitski, Jarek, *Seminar 54*

## L

LaForgia, Dan, *AHR Expo Session 1*  
Langner, Rois, *Conference Paper Session 2*  
Lawton, Wayne, *Seminar 31*  
Lee, Bruno, *Conference Paper Session 8*  
Lee, Edwin, *Seminar 25*  
Leslie, Neil P., *Seminar 12*  
Leung, Christopher, *Technical Paper Session 3*  
Leung, Luke, *Seminar 69*  
Lin, Guanjing, *Technical Paper Session 2*  
Liu, Xing, *Conference Paper Session 2*  
Lisboa, Carlos, *Seminar 35*  
Lo, Li-Ming, *Seminar 17*  
Loudermilk, Kenneth J., *Seminar 35*  
Lowell, Christopher S., *Seminar 35*  
Lowenstein, Andrew, *Seminar 14*  
Lowry, Larry, *Seminar 5*  
Lubliner, Michael, *Seminar 33*

## M

Maassen, Wim, *Conference Paper Session 6*  
Macauley, Dunstan, *Seminar 29*  
Mahderekal, Isaac, *Conference Paper Session 9*  
Marmaras, Justin M., *Conference Paper Session 9*  
Mathias, James, *Technical Paper Session 4*  
Mathis, R. Christopher, *Seminar 12*  
Mathson, Tim, *Forum 8*  
McGowan, Alex, *Seminar 18*  
McLeod, Mike, *Seminar 16*  
Mead, Kenneth R., *Seminar 1*  
Meek, Christopher, *Seminar 50*  
Mehboob, Farooq, *Technical Plenary 1*  
Meng, Lingjun, *Conference Paper Session 1*  
Miccolis, Chuck, *Seminar 65*  
Miles, Dan, *Seminar 61*  
Miller-Klein, Erik, *AHR Expo Session 1*  
Mills, Frank A., *Forum 3 and Forum 7*  
Minor, Barbara, *Seminar 44*  
Miyazaki, Yu-suke, *Seminar 49*  
Moghaddam, Saeed, *Seminar 58*

Morgan, Michael, *Seminar 7 and Seminar 13*  
Moyer, Jeremy, *Technical Paper Session 4*  
Mullen, Matthew, *Seminar 22 and Seminar 46*  
Muller, Christopher O., *Seminar 66*  
Murphy, Stacy, *Seminar 5*

## N

Nassif, Nabil, *Conference Paper Session 6 and  
Conference Paper Session 10*  
Novoselac, Atila, *Seminar 39*

## O

O'Brien, Sean, *Seminar 18*  
Oh, John Kie-Whan, *Seminar 32*  
Okagaki, Akira, *Seminar 57*  
Olesen, Bjarne W., *Seminar 54*  
Olson, Michael R., *Seminar 6*

## P

Paliaga, Gwelen, *Seminar 70*  
Palicharla, Reddy, *Seminar 3*  
Patel, Piyush V., *Seminar 58*  
Patenaude, Ray, *Seminar 21*  
Pauls, Mark, *Conference Paper Session 2*  
Payne, Vance W., *Conference Paper Session 1*  
Pearson, Andy, *Seminar 23*  
Pearson, William E., *Seminar 15*  
Penson, Steve, *Seminar 19*  
Peterson, John C., *Conference Paper Session 6*  
Phyfe, Duncan, *Seminar 17*  
Polchinski, Robert, *Conference Paper Session 10*  
Pottker, Gustavo, *Seminar 44*  
Price, James, *Seminar 62*

## R

Radermacher, Reinhard, *Seminar 58*  
Raustad, Richard, *Technical Paper Session 9*  
Reihl, Keith H., *Seminar 46*  
Reindl, Douglas, *Seminar 23*  
Remington, Glen T., *Seminar 53*  
Rimmer, Julian, *Seminar 35*  
Ritter, Matthew, *Seminar 23*  
Rizvi, Syed Zahid Hussain, *Technical Paper Session 9*  
Robison, Russell R., *Seminar 7*  
Rooley, Richard, *Seminar 30, Seminar 40, and Technical Plenary 1*  
Roth, Stephen, *Seminar 59*  
Roy, Utpal, *Technical Paper Session 2*  
Rusk, Scott, *Seminar 16*

## S

Said, Syed, *Technical Paper Session 8*  
Sanchez, Greg, *Seminar 1*  
Schaffer, Mark E., *AHR Expo Session 1*  
Schrock, Derek W., *Seminar 7*  
Schwedler, Mick, *Forum 1*  
Seeton, Christopher, *Seminar 68*  
Sekhar, Chandra, *Seminar 67*  
Shaughnessy, Richard, *Seminar 5*  
Shen, Bo, *Seminar 47*

Siemann, Michael J., *Conference Paper Session 4*  
Simmons, Joe, *Seminar 45*  
Simmons, Robert E., *Seminar 20*  
Singh, Prabjit, *Seminar 66*  
Skalko, Stephen V., *Seminar 41 and Special Session 1*  
Smith, Michael, *Seminar 38*  
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