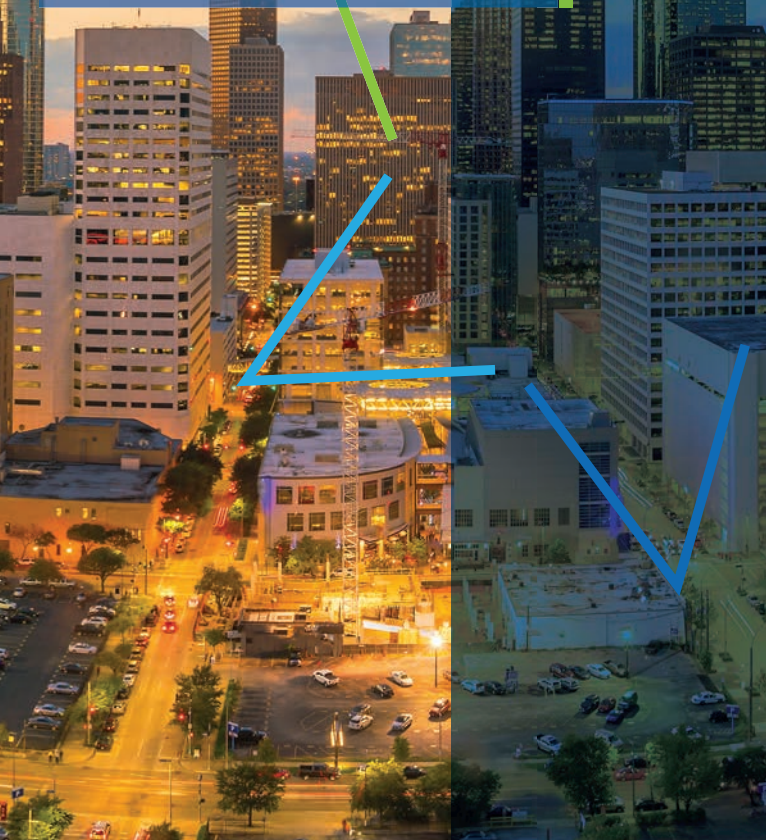




Your Guide to the

2018 ASHRAE ANNUAL CONFERENCE

Houston, TX | June 23–27, 2018



Technical program • Social events schedule • All education courses • Maps of meeting areas

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Your Guide to the ASHRAE Annual Conference

June 23–27, 2018

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ASHRAE 365 APP

ASHRAE has a new app to use at the conference. Download ASHRAE 365 for conference notifications, venue floor plans, Houston-area information and the option to connect with other attendees. You can also customize your schedule from ASHRAE 365, participate in live audience polls and provide speaker evaluations. ASHRAE 365 will be available year-round to connect you with the latest information and resources from ASHRAE.

ASHRAE 365 is made possible through support from the following sponsors:



Download ASHRAE 365 now on the App Store or Google Play. For additional information, go to <https://www.ashrae.org/365>

GEORGE R. BROWN CONVENTION CENTER (GRBCC) – LEVEL 3

From the Hilton, access the GRBCC by using the Sky Bridge on the 2nd floor (near the Ballroom of Americas) and take the escalators up one level to Level 3 or use the Sky Bridge on the 3rd floor of the Hilton (near the business center) to access Level 3 of the GRBCC.

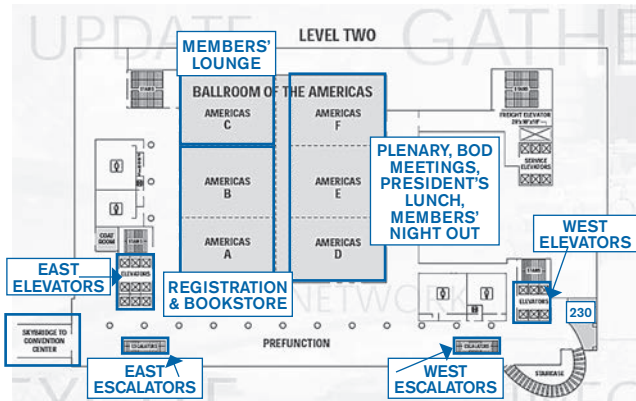
From the main entrance of the GRBCC, use Entrance E near the Hilton and take the escalators up two levels to Level 3.

There are also ADA elevators available near the escalators by the Sky Bridge and Entrance E on the ground floor.



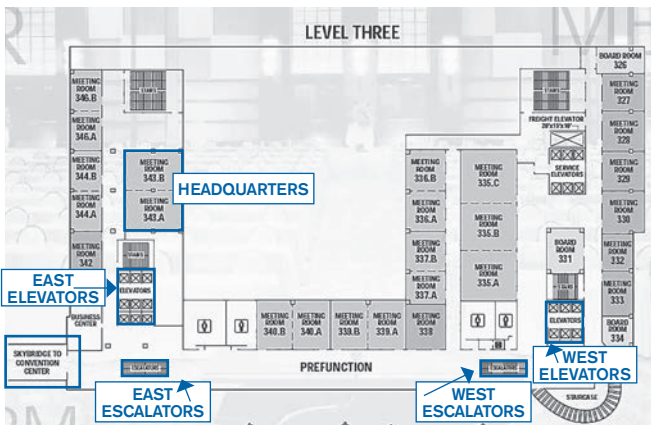
HILTON AMERICAS – 2ND FLOOR

You can access all meeting rooms on the 2nd floor using either the East or West elevator banks or escalators near the elevators. Access Level 2 of the GRBCC by using the Sky Bridge on the East side of this level.



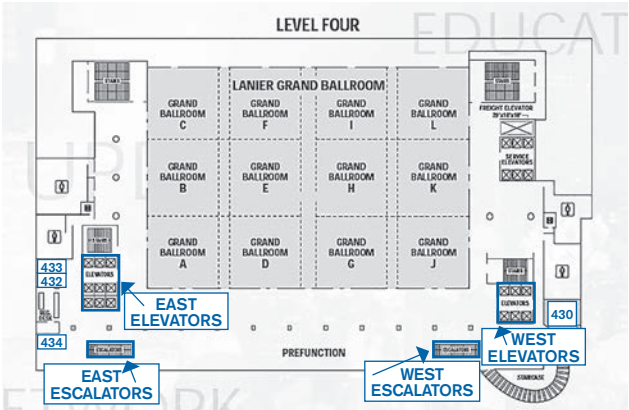
HILTON AMERICAS – 3RD FLOOR

Use the East or West elevator banks or escalators near both sets of elevators to access the meeting rooms on the 3rd floor. Access Level 3 of the GRBCC by using the Sky Bridge on the East side of this level.



HILTON AMERICAS – 4TH FLOOR

Use the East or West elevator or escalators near both sets of elevators to access the meeting rooms on the 4th floor.



CONFERENCE SPONSORS

ASHRAE thanks the following sponsors for their support of the 2018 ASHRAE Annual Conference:



Globally Recognized. Industry Respected.

Sponsor of the ASHRAE Bookstore



Munters

Your Perfect Climate

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DAIKIN

AIR INTELLIGENCE™

Sponsor of the Plenary



Sponsor of the Networking Coffee Break



Filtration Products

Supporting Conference Sponsor

CHAPTER AND SOCIETY OFFICIALS

A special thanks to all the members in the Houston Chapter who helped make the 2018 ASHRAE Annual Conference a success!

HOUSTON CHAPTER OFFICERS

Bill Chalmers, President
Kenneth Shifflett, II, President-Elect
Kurt McCulloch, Vice President
Josh Vanlandingham, Secretary
Greg Tinkler, Treasurer

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Vice Chair, Hugh McMillan
Sessions, Hugh McMillan
Entertainment, Robert (Alan) Neely, James Kubala, Jon Harper
Hospitality, Bruce Flaniken, John (J.J.) Burdin, John Walik
Information, Mitzi Coil
Tours, Michael J. Langton, Thomas Barrow, Jr., James S. Buckley,
Scott Sevigny, Jason Pierson
Sustainability Project, Keith Reihl, JB Mallay, Michael Langton,
Brian Bennick, Ayman Ashkar, Michael Largent, Greg Tinkler
Women in ASHRAE Happy Hour, Lauren Ramos,
Rachel (Downey) Haines
Honorary Chair, A. Damon Gowan (posthumously)

ASHRAE OFFICERS

Bjarne W. Olesen, Ph.D., Fellow ASHRAE, Life Member, President
Sheila J. Hayter, Fellow ASHRAE, President-Elect
Darryl K. Boyce, Treasurer
Julia A. Keen, Vice President
Michael CA Schwedler, Vice President
Ginger Scoggins, Vice President
Edward Tsui, Vice President
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Gary C. Debes	Richard M. Rose
Melanie Derby	Frank H. Schambach
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Richard D. Hermans	Jon Cohen, Consultant
Nivedita Jadhav	Daniel R. Rogers,
Bing Liu	BOD Ex-Officio
Corey B. Metzger	Sheila Hayter,
M. Maggie Moninksi	Coordinating Officer
Carrie Anne Monplaisir	
Cynthia L. Moreno,	
2018 Annual Conference Chair	

GENERAL INFORMATION

BADGE SCANNING AND SESSION EVALUATION

Badges must be worn for admission to the technical program. Room monitors will scan badges at the rooms. The scanning process will provide you with a summary of all sessions attended and will be emailed to you after the conference. Please keep track of the sessions that you attend. If you do not desire to have a summary of the sessions you do not need to be scanned. Response cards are distributed to audience members that comment during Technical Paper sessions. Please complete the question/comment card and return it to a monitor. Questions are given to the author for reply and published with the Technical Paper in ASHRAE Transactions. Please access the ASHRAE 365 app to complete the technical program speaker and session evaluations. Paper evaluation forms are distributed for Forum sessions only. Please return the completed Forum evaluation forms to the monitors.

VENUE ADDRESSES, TELEPHONE

Hilton Americas-Houston Hotel

1600 Lamar St, Houston, TX 77010
(713) 739-8000

George R. Brown Convention Center (GRBCC)

1001 Avenida De Las Americas, Houston, TX 77010
(713) 853-8000

The Hilton Americas is located directly across the street from the GRBCC. The buildings are connected via air-conditioned sky bridge on the 2nd and 3rd floors of the Hilton.

ONLINE REGISTRATION

Need to register or buy a ticket for social events, tours, or Learning Institute courses? You can register online throughout the conference. You can also register during registration hours in the Ballroom of the Americas AB on the 2nd floor of the Hilton Americas. Come to registration to pick up your tickets or badge.

INTERNET ACCESS

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

Wireless internet will be available in all meeting rooms at the Hilton and the GRBCC. Due to the number of users, please limit usage to functions that do not use excessive bandwidth such as Facebook, YouTube, streaming videos, etc.

The credentials are the same for the Hilton and the Convention Center:

Username: **ASHRAE2018**

Password: **houston18**

**network and passcode are case sensitive*

ASHRAE 365 App

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Download ASHRAE 365 now on the App Store or Google Play. For additional information, go to <https://www.ashrae.org/365>

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.

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 Hilton Americas or GRBCC.

SALE OF MERCHANDISE

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

SIGNS/DISPLAY OF AFFILIATE MEETING INFORMATION

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

PHOTO RELEASE

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

WHAT TO WEAR



Business casual attire is appropriate for meetings and social events.

LOST AND FOUND

Items found during the conference should be turned into the staff in the ASHRAE headquarters room, 343 on the 3rd floor of the Hilton Americas or ASHRAE registration located in the Ballroom of the Americas AB on the 2nd floor of the Hilton.

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 have been submitted for approval for the State of New York PDHs and AIA Learning Units. Those programs are indicated with a  symbol. Others have been submitted 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. Sign-in sheets are available in the session room for State of Florida and AIA licensees. Sessions are approved for 1, 1.5 or 2 PDHs depending on the length of the session.

CONFERENCE PAPERS

During the Annual and Winter Conferences, papers presented in the technical and conference paper sessions can be purchased in the ASHRAE Bookstore onsite, as individual hard copies or a collection of downloadable PDFs. After the conference, all papers can be purchased in the ASHRAE Bookstore online (ashrae.org/bookstore). Final technical papers are published with discussion in ASHRAE Transactions. Papers are not available for seminars, forums, panels, workshops or debates. All papers published between the years 1980–1997 may be searched online in the Abstract Archive Center. Access to the Abstract Archives is a member benefit. For ordering information, contact ASHRAE Customer Service at 1-800-527-4723 or cservice@ashrae.org.

VIRTUAL CONFERENCE

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

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations from all, conference paper sessions, seminars, technical paper sessions and workshops.
- Ability to post comments and rate presentations.
- Print presentation slides in notes format.

Presentations are available online for 18 months with the ability to post questions or answers for selected sessions through Monday, July 16.

A full slate of technical programs will be posted daily beginning Monday, June 25 through Thursday, June 28, of the sessions that were presented the previous day.

Access to the Houston Virtual Conference is free with your conference registration. To register for the Virtual Conference only, go to ASHRAE Registration in the Ballroom of the Americas AB on the 2nd floor of the Hilton Americas, or register online.

\$249 ASHRAE member; \$445 non-member

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. 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

In case of an emergency, follow these instructions for each venue:

Hilton Americas

Dial 55 from any hotel phone to contact security or call 911 directly from your personal phone.

The hotel has an emergency response team 24 hours a day. In the event of an emergency, 911 may be called from all phones within the hotel.

The Hilton Security Department, as well as a small number of other employees, are trained in CPR and First Aid.

In the event of an evacuation, the hotel will use the PA system to inform guests in affected areas to evacuate the hotel and inform them of an evacuation location.

George R. Brown Convention Center

In the event of an emergency, the GRBCC’s PA system will notify attendees of the emergency and will include instructions on how to evacuate if necessary. The PA message will repeat every 3 minutes until the threat or alarm has subsided or evacuation has commenced.

Please call GRBCC before dialing 911. GRBCC can be reached at (713) 853-8087.

An EMT will be onsite and available Sunday – Wednesday and will be located in the pre-function area in the main hallway outside of the 380 rooms on the third floor.

The closest hospital to the Hilton and GRBCC is St. Joseph Medical Center, 1919 LaBranch, approximately 1.2 miles away. The phone number is 713-757-7575.

The Houston Police Department is headquartered at 1200 Travis St, Houston, TX, approximately 1 mile away. The phone number is (713) 884-3131.

Fire Emergency... Preparedness in Hotels

Hilton Americas

In case of a fire, dial 55 from any house phone. It is important not to panic. If a fire emergency does in fact happen, take all cues from security and hotel staff. Emergency evacuation routes and procedures are located on the inside of all guest room doors. In the event of an evacuation, the hotel will use the PA system to inform guests to evacuate the hotel and inform them of the evacuation location.

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.

George R. Brown Convention Center

Dial (713) 853-8087 to reach GRBCC Security. The facilities PA system will provide instructions to attendees if an evacuation is needed.

The Houston Fire Department is located at 600 Jefferson St, Houston, TX, approximately 1 mile away. The phone number is (832) 394-6700.

MEALS

Meals are not included in your conference registration, however, we know that sometimes you have limited time to grab a quick meal between meetings and technical sessions. Here are few grab-and-go options, as well as other dining options at both locations.

Hilton Americas

Starbucks

Daily 6:00 a.m. – 8:00 p.m.

Located on the East side of the Lobby level near the Convention Center, this full-service Starbucks serves Starbucks beverages and breakfast and lunch grab-and-go options.

1600 Bar + Grille

Breakfast 6:00 a.m. – 11:00 a.m.

Lunch 11:00 a.m. – 2:00 p.m.

Dinner 2:00 p.m. – 10:00 p.m.

Located on the lobby, 1600 Bar + Grille features a standard breakfast, lunch and dinner menu with a Texas twist!

Lobby Bar

Monday – Friday 2:00 p.m. – 2:00 a.m.

Saturday – Sunday 12:00 p.m. – 2:00 a.m.

Located on the lobby level, the lobby bar is ideal for catching up with your ASHRAE friends after the sessions and meetings have ended for the day. Food service is available until 1:30 a.m.

Pappasito's Cantina

Daily 11:00 a.m. – 10:00 p.m.

Fridays and Saturdays, open until 11:00 p.m.

Pappasito's is known for their chips and salsa, and sizzling fajitas. It is located on the West side of the Lobby level of the Hilton Americas.

George R. Brown Convention Center

Starbucks

7 a.m. – 2 p.m.

2nd Floor across from the Hilton-Americas skybridge

Free WiFi is available in this area

Pappadeaux

Sunday – Thursday 11 a.m. – 9 p.m.

Friday – Saturday 11 a.m. – 11 p.m.

Pappadeaux Seafood Kitchen is located on the southern end of the GRB closest to Hall E on ground level.

McAlister's Deli

Sunday – Thursday 10:30 a.m. – 10 p.m.

Friday – Saturday – 10:30 a.m. – 11 p.m.

McAlister's Deli, is known for its sandwiches, salads, desserts and its sweet tea. With dine-in and take-out service. McAlister's is located on Avenida Plaza, near the Wharf and adjacent to Hall D on the concourse side.

Bud's Pitmaster BBQ

11 a.m. – 10 p.m.

Bud's Pitmaster BBQ brings more than 30 years of experience in a Southern-styled BBQ restaurant with modern flare inside the George R. Brown Convention Center neighboring Hall B.

Grotto Downtown

Monday – Thursday 11 a.m. – 10 p.m.

Friday – Saturday 11 a.m. – 11 p.m.

Sunday – 11 a.m. – 9 p.m.

Located at the north-end of Avenida Plaza closest to Hall A, offers a dynamic menu that features vibrant Italian flavors and fresh creation in small and shareable plates.

THINGS TO DO IN HOUSTON

Stop by the Host Committee desk in the ASHRAE Registration area in the Ballroom of the Americas AB on the 2nd floor at the Hilton Americas. The Houston host committee will also provide “Things to Do” recommendations as well as local restaurants.

FAMILY SERVICES

Visit Houston, the Houston Convention and Visitors Bureau, recommends the following company for child care services while in Houston:

College Nannies, Sitters & Tutors

www.collegenanniesandtutors.com
(713) 825-4828

The Hilton Americas refers their guests to the following company:

Mom’s Best Friend

www.momsbestfriend.com
713-776-2669 x204

The Hilton Americas Houston offers several choices for both health related and/or childcare services. Neither the Hilton nor its employees endorses, prefers or recommends any provider over another. Any questions regarding services should be directed towards that provider. You, the guest must directly arrange the scheduling of such services. The Hilton Americas acts only to extend the convenience of a list from which to make your own choice.

ASHRAE makes no representation as to the quality or suitability of the child care options available.

ASHRAE has done no investigation or inquiry into these options and accordingly assumes no liability for these services. All participants considering these facilities should perform their own investigation into the quality, suitability or desirability of these child care facilities.

MOTHERS’ ROOM

ASHRAE is pleased to offer a private room to nursing mothers. The Mothers’ rooms is located in room 433 on the 4th floor of the Hilton Americas. There is also a Mothers’ Room available in room 380 at the GRBCC. Please visit the Registration desk in the Ballroom of the Americas AB on the 2nd floor of the Hilton to receive a key to either room. A refrigerator is also available for storage in both rooms.

The Hilton America’s also offers a Mother’s Room on the 3rd floor, marked as a “Family Bathroom” that includes a comfortable chair, access to power and is lockable from the inside.

COMPANION/GUEST GUIDE

ASHRAE MEMBER LOUNGE

Ballroom of Americas C, 2nd Floor, Hilton Americas

The ASHRAE Member Lounge is open daily for all individuals who are registered for the conference. Light refreshments are available in the morning each day and beverages are available all afternoon. Members of the Houston Host Committee will be present to answer questions about local activities in the morning. 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 Ballroom of the Americas AB, right next door!

SPOUSE LOUNGE

434, 4th Floor, Hilton Americas (east side of the building)

The Spouse Lounge is open daily with light refreshments available in the morning and beverages available all day. The lounge is open to all registered spouses and is a great place to meet other spouses and guests of conference attendees.

Member and Spouse Lounge Hours:

Saturday, June 23	7:30 a.m. – 3:00 p.m.
Sunday, June 24	7:30 a.m. – 4:00 p.m.
*Monday, June 25	7:30 a.m. – 9:00 a.m.
.....	11:30 a.m. – 4:00 p.m.
Tuesday, June 26	7:30 a.m. – 4:00 p.m.
Wednesday, June 27	7:30 a.m. – 1:00 p.m.

**The ASHRAE Member Lounge will be temporarily closed on Monday, June 25 from 9:00 – 11:30 a.m. Coffee will be available in the pre-function area outside of Ballroom of the Americas C for members during this time. The spouse lounge will be open all day.*

MEET AND GREET

Ballroom of Americas C, 2nd Floor, Hilton Americas

Monday, June 25

9:30 – 11 a.m.

Join father and son duo, Phillip and Damon Pampolina, for an exciting lesson of one of Texas's most famous dances, line dancing!

Line dancing first started in the USA, sometime in the late 1970s to early 1980s. Early line dances were performed to disco music, country and western. Although many popular line dances were set to country music it is believed to have originated from folk music.

Phillip and Damon will teach classic western as well as modern line dancing featuring today's favorite line dancing tunes. You will not want to miss this experience while in Texas!

Light refreshments will be served.

SOCIAL EVENTS

PLENARY SESSION KEYNOTE SPEAKER – DR. AINISSA RAMIREZ

Ballroom of the Americas DEF,
2nd Floor, Hilton Americas
Saturday, June 23
3:15 – 5:30 p.m.



Our world is at a crossroads and needs a new generation that can think expansively and solve problems resourcefully. Fortunately, the topics of science, technology, engineering, and math (STEM) can help children gain these abilities, and scientific and engineering organizations can help. Dr. Ainissa Ramirez, research scientist and STEM evangelist, will share her insights, challenge us to inspire the next generation, and illustrate paths to engage children with STEM. She will make a case for the importance of STEM subjects, but for also the soft skills embedded in STEM—of imagination, creativity, curiosity, and making friends with failure—which are equally as important to create a brighter future.

Sponsored by:



WELCOME PARTY

The Grove
Saturday, June 23
7:00 – 9:00 p.m. • Cost: \$60

The Welcome Party will be held at The Grove, located across the street from the Hilton-Americas.

Enjoy a cocktail and hors d'oeuvres while catching up with old friends. Located in the Discovery Green Conservancy, the Grove has outdoor and indoor space overlooking Downtown.

Attendees are encouraged to take a two minute stroll from the Hilton Americas across the street to The Grove on Discovery Green. Host Committee members, dressed in Houston Astros jerseys, will help you find your way.

Two drink tickets are included with your ticket. Additional drink tickets may be purchased from ASHRAE staff at the door.

WOMEN IN ASHRAE HAPPY HOUR

House of Blues Houston
1204 Caroline St., Bronze Peacock Room
Monday, June 25
4:00 – 6:00 p.m. • Cost: \$20

Join women from around the world to share ideas and learn how to be active at the chapter, region, and/or Society level. Current ASHRAE members will share insight and experiences. This event requires pre-registration. Tickets includes light appetizers and two drink tickets.

House of Blues Houston is a five minute walk from the Hilton. From the Hilton's main entrance, head west on Dallas St. The

House of Blues is four blocks away on the corner of Dallas and Caroline St., with the entrance on Caroline St.

PRESIDENT'S LUNCHEON

Ballroom of the Americas DEF, 2nd Floor, Hilton Americas
Monday, June 25

12:15 – 2:00 p.m. • Cost: \$50

2018-19 ASHRAE President Sheila J. Hayter, P.E., Fellow ASHRAE, presents her presidential theme, Building a New Energy Future.

Certificates of appreciation to retiring Board members are presented, and the 2018-19 officers and Board of Directors installed.

LIFE MEMBERS' LUNCHEON

344, 3rd Floor, Hilton Americas
Tuesday, June 26

12:00 – 1:30 p.m. • Cost: \$35

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

MEMBERS' NIGHT OUT

Ballroom of the Americas DEF, 2nd Floor, Hilton Americas
Tuesday, June 26

Cost: \$60

Reception and Cash Bar

6:15 p.m. – 7:15 p.m.

Ballroom of the Americas Foyer

The evening will start with a reception at 6:15 p.m. where attendees can enjoy a cocktail and conversation while they create their own "alias" for the evening including a new name badge. Stop by the registration desk set up in the foyer to create your new name badge for the evening.

Dinner and Entertainment

7:15 – 10:00 p.m.

Whodunit? You'll have to come see for yourself! One of your fellow ASHRAE attendees may be responsible for the crime! Come join your friends and fellow attendees for a night full of mystery with an interactive and improvised comedic murder mystery set in the present day hosted by the Dinner Detective. The evening will include a three course meal with parts of the show taking place in between each course and a short ASHRAE program at the beginning. Throughout the event, murders and mayhem will occur, hidden clues will come forth and detectives will help everyone try to solve the crime. In the end, we have a prize package for the attendee who comes closest to solving the crime. Come if you dare!

HOW TO GET THE MOST OUT OF THE ASHRAE CONFERENCE

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

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

SHARING TECHNOLOGY:

The ASHRAE Conference Technical Program

The technical program for the ASHRAE Conference includes technical paper sessions, conference paper sessions, seminars, workshops, panels, and forums. Check the program book or conference app to see what you want to attend. You can jump between sessions if you want to hear one specific presentation in each session. Host committee volunteers will be at the door checking and scanning badges.

See page 41 for more information on the six types of sessions that are presented in the Technical Program.

PowerPoint presentations with audio descriptions are posted online in the Virtual Conference for all Technical Paper Sessions, Conference Paper Sessions, Seminars and Workshops. The Virtual Conference is included with full Conference registration.

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

ADVANCING THE INDUSTRY: SOCIETY MEETINGS

The technical expertise of ASHRAE is concentrated in its technical committees, task groups and technical resource groups, which are responsible for preparing the ASHRAE Handbook volumes, initiating and supervising Society research projects, presenting programs at ASHRAE conferences,

reviewing technical papers and evaluating the need for standards.

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

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

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

SUPPORT SERVICES

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

ASHRAE publications, including conference papers, are available for sale in the ASHRAE Bookstore. Located in the registration area the bookstore features a display of books devoted entirely to the HVAC&R industry. Publications from ASHRAE's publications catalog, as well as a variety of new publications and books from allied organizations are on display. ASHRAE publications may be purchased individually on site, or you may wish to order several books and have them shipped to you at a later date or use the online bookstore at www.ashrae.org/bookstore.

The membership desk is located in the registration area. Membership applications are available, as well as general information about ASHRAE membership. Registrants paying the non member registration fee receive their first year of membership free. To obtain membership an application form must be submitted with the meeting registration form or within 60 days following the meeting. A staff member will be present during registration hours to assist you.

Networking: Getting Involved

ASHRAE conferences and meetings provide an international setting for attendees to gather and exchange ideas, to explore possibilities in the industry and to examine its problems. Opportunities to get involved range from presenting a conference paper to participating in a seminar or attending committee meetings. By reviewing your program and planning ahead, you can ensure that the conference will be a success instead of a series of missed opportunities.

AWARDS PRESENTATION

Saturday, June 23, 2018, 3:15-5:30 p.m.
Plenary Session, Hilton Americas–Houston
Ballroom of Americas DEF, 2nd Floor

LINCOLN BOUILLON AWARD

“Given in recognition of outstanding work in increasing the membership of Society.”

Oscar Eduardo Ricaño Consejo, Ing., Monterrey, NL, Mexico
Monterrey Chapter

CHAPTER PROGRAM STAR AWARD

“Given in recognition of excellence in chapter program endeavors.”

Abhishek Khurana, Brampton, ON, Canada
Toronto Chapter

WILLIAM J. COLLINS, JR. RP AWARD

“Given in recognition of the chapter RP Chair who excels in raising funds for ASHRAE’s RP Campaign.”

Adam Graham, Ottawa, ON, Canada
Ottawa Valley Chapter

ENVIRONMENTAL HEALTH AWARD

“Given in recognition of excellence in volunteer service focused on environmental health issues.”

Pawel Wargocki, Ph.D., Kongens Lyngby, Denmark
Region XIV

HOMER ADDAMS AWARD

“Given in recognition of a graduate student who has been engaged in an ASHRAE research project.”

Alireza Behfar, P.E., BEAP, , Omaha, NB

GRASSROOTS GOVERNMENT ADVOCACY AWARD

“Given in recognition to an individual for outstanding effort and achievement in state, provincial, and local government activities in connection with technical issues important to the Society.”

Jui-Chen Roger Chang, P.E., Washington, DC
National Capital Chapter

LOU FLAGG HISTORICAL AWARD

“Given in recognition of a Chapter Gold Ribbon Award winner for compiling information on outstanding historical projects or persons related to HVAC&R.”

Bruce L. Flaniken, P.E., Houston, TX
Houston Chapter

STANDARDS ACHIEVEMENT AWARD

“Given in recognition for excellence in volunteer service for developing ASHRAE standards/guidelines.”

Gerald J. Kettler, P.E., Dallas, TX
Dallas Chapter

RALPH G. NEVINS PHYSIOLOGY & HUMAN ENVIRONMENT AWARD

Given to a promising investigator for significant accomplishment in the study of physiology and human response to the environment

Dusan Licina, Ph.D., Lausanne, Switzerland
New York Chapter

STUDENT ACTIVITIES AWARD

Given to a Chapter Student Activities Chairman for service related to the goals and growth of student activities at all levels.”

Yumei Mata Hi, San Nicolas de los Garza, NL, Mexico
Monterrey Chapter

ASHRAE JOURNAL PAPER AWARD

“Given in recognition of the best article published in the ASHRAE Journal in 2017.”

Omar John Hawit, Washington, DC
National Capital Chapter

Trevor Jaffe, P.E., Arlington, VA
National Capital Chapter

SCIENCE AND TECHNOLOGY FOR THE BUILT ENVIRONMENT BEST PAPER AWARD

“Given in recognition of the best referred paper published in the volume year of the Science and Technology for the Built Environment, the ASHRAE Research Journal.”

Daniel Bacellar, Ph.D., Beltsville, MD
National Capital Chapter

Vikram C. Aute, Ph.D., College Park, MD
National Capital Chapter

Zhiwei Huang, Ph.D., Norman, OK
Central Oklahoma

Reinhard Radermacher, Ph.D., College Park, MD
National Capital Chapter

CROSBY FIELD AWARD

“Given in recognition of the highest rated paper presented at a Technical Session or Symposium in 2017.”

Michael Roth, Ph.D., P.Eng, Guelph, ON, Canada for authoring *“Updating the ASHRAE Climate Design Data for 2017”*

ASHRAE TECHNICAL PAPER AWARD

“Given in recognition of the best paper presented at a Technical Paper Session at a Society Conference in 2017.”

Omar Abdelaziz, Ph.D., Dubai, UAE; **Som S. Shrestha**, Ph.D., Oak Ridge TN for authoring *“Evaluation of Alternative Refrigerants for Mini-Split Air Conditioners”*

Mohammad Rafati Nasr, Ph.D.; **Carey J. Simonson** Ph.D., P.Eng., Saskatoon, SK, Canada for authoring *“Experimental Measurement of Frosting Limits in Cross-Flow Air-to-Air Energy Exchangers”*

Alejandro Rivas Prieto, Miami, FL; **Li Song**, Ph.D., P.E., Norman OK; **Wesley Thomas**, Norman, OK; **Gang Wang**, Ph.D., Coral Gables, FL for authoring *“In-Situ Fan Curve Calibration for Virtual Airflow Sensor Implementation in VAV Systems”*

Bryan P. Rasmussen, Ph.D., P.E., College Station, TX; **Chao Wang**, Ph.D., Norman, OK; **Kyaw Wynn**, Sidney, OH for authoring *“Experimental Comparison of Energy-Optimal Coordinated Control Strategies for Heat Pump Systems”*

POSTER PRESENTATION AWARD

Given in recognition of the best Poster Session Paper from each Annual and Winter Meeting in 2017.

Robert J. Hitchcock, Ph.D., Sacramento, CA, **John R. Butterfield**, P.E., South Burlington, VM; **Elizabeth Ford Wilkins**, P.E., South Burlington, VM; and **Francisco Forns-Samso**, Helsinki, Finland, for authoring “BIM-Enabled Operations and Maintenance Work Processes”

**Presenter: Robert J. Hitchcock, Ph.D.*

WILLIS H. CARRIER AWARD

“Given in recognition of the best paper presented at a Society Conference in 2017 by a member thirty-two years of age or less.”

Mohammad Rafati Nasr, Ph.D., Vancouver, BC, Canada for co-authoring “Experimental Measurement of Frosting Limits in Cross-Flow Air-to-Air Energy Exchangers”

DISTINGUISHED SERVICE AWARD

“Given in recognition of faithful and distinguished service on behalf of the Society.”

Bruce Lee Billedeaux, P.E., Columbia, IL

Michael Blanford, Odenton, MD

Roland Charneux, Ing., Montreal, QC, Canada

Jeff Clarke, Montreal, QC, Canada

Gary L. Cooper, Omaha, NE

William Fox, Ph.D., La Crosse, WI

Michael W. Gallagher, P.E., Santa Fe Springs, CA

Peter B. Gardner, Mountainside, NJ

Danny M. Halel, Belleville, IL

Rick M. Heiden, La Crosse, WI

Bryan M. Holcomb, Greensboro, NC

Joseph A. Karnaz, The Woodlands, TX

Russell Lavitt, P.Eng., Winnipeg, MB, Canada

Isabelle Lavoie, Saint-Laurent, QC, Canada

Farooq Mehboob, Karachi, Pakistan

Svein Olav Morner, Ph.D., P.E., Middleton, WI

Kashif Nawaz, Ph.D., Oak Ridge, TN

Joshua New, Ph.D., Oak Ridge, TN

Gary W. Price, Buena Park, CA

Cedric S. Trueman, P.Eng., Victoria, BC, Canada

John O. Varley, P.E., Chicago, IL

EXCEPTIONAL SERVICE AWARD

“Given in recognition of faithful service with exemplary effort on behalf of the Society, in excess of that required for the Distinguished Service Award.”

Fred Betz, P.E., FASHRAE, Cincinnati, OH

Larry J. Fisher, Louisville, KY

H. Michael Newman, Ithaca, NY

Xudong Yang, Ph.D., Beijing, China

DISTINGUISEHD 50-YEAR MEMBER AWARD

“Given in recognition of fifty years of membership and performing outstanding service for the Society.”

Naim Azer, Ph.D., Manhattan, KS

Thomas A. Bathgate, P.E., Abington, PA

H.E. (Barney) Burroughs, Johns Creek, GA

Kenneth M. Clark, Olathe, KS

Byron W. Engen, Mount Dora, FL

M. David Gardner, P.E., Renton, WA

Vijay K. Gupta, Springfield, VA

Bill Harrison, Little Rock, AR

Richard B. Hayter, Ph.D, P.E., Manhattan, KS

Richard O. Hunton P.E., Houston, TX

Ronald Jensen, P.E., Hampton, VA

John E. Kampmeyer, P.E., Springfield, PA

Winfield Kelley, Hialeah, FL

Richard M. Kelso, Ph.D., P.E., Knoxville, TN

William Kimball, Centennial, CO

Charles L. Morse, III, Concord Township, OH

Bernard A. Nagengast, Sidney, OH

William S. Ostrander, Cincinnati, OH

Roger M. Pasch, P.E., Eden Prairie, MN

Herbert Phillips, P.E., Philadelphia, PA

Ramon Pons, Ph.D., P.Eng., Cabrera de Mar, Spain

Laurentino R. Punsalan, Makati City, Philippines

David W. Reid, Berwyn, PA

James L. Schulze, Sr., P.E., Grandbury, TX

Norman R. Scott, Ph.D., Ithaca, NY

Leo P. Stambaugh, Dallas, TX

Thomas H. Williams, Decatur, GA

George S. Yamamoto, Cortland, NY

ANDREW T. BOGGS SERVICE AWARD

“Given to a past Exceptional Service Award recipient in recognition of continuing, unselfish, dedicated and distinguished work on behalf of the Society.”

Van D. Baxter, P.E., Oak Ridge, TN

LOUISE & BILL HOLLADAY DISTINGUISHED FELLOW AWARD

“Given to a Fellow of the Society in recognition of continuing preeminence in engineering or research work.”

William P. Bahnfleth, Ph.D, P.E., University, Park, PA

ASHRAE HALL OF FAME AWARD

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

A. Damon Gowan

ROOMS/HOURS

FINDING YOUR ASSIGNED MEETING ROOM

Please refer to the Hilton Americas and GRBCC floor plans located on pages 2–4 in this program.

The Hilton's meeting space is located on level 2, 3 and 4. The meeting space at the Convention Center is located on floor 3. From the Hilton, access the GRBCC by using the Sky Bridge on 2nd floor (near the Ballroom of Americas) and take the escalators up one level to Level 3 or use the Sky Bridge on the 3rd floor of the Hilton (near the business center) to access Level 3 of the GRBCC.

CONFERENCE REGISTRATION

Ballroom of Americas AB, 2nd Floor

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

Friday, June 22	10:00 a.m. – 5:00 p.m.
Saturday, June 23	7:15 a.m. – 6:00 p.m.
Sunday, June 24	7:00 a.m. – 5:00 p.m.
Monday, June 25	7:00 a.m. – 5:00 p.m.
Tuesday, June 26	7:30 a.m. – 4:30 p.m.
Wednesday, June 27	7:30 a.m. – 11:00 a.m.

ASHRAE BOOKSTORE AND LOGO STORE

Ballroom of Americas AB, 2nd Floor

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

Friday, June 22	10:00 a.m. – 5:00 p.m.
Saturday, June 23	7:15 a.m. – 6:00 p.m.
Sunday, June 24	7:00 a.m. – 5:00 p.m.
Monday, June 25	7:00 a.m. – 5:00 p.m.
Tuesday, June 26	7:30 a.m. – 4:30 p.m.
Wednesday, June 27	7:30 a.m. – 1:00 p.m.

Sponsored by:



Globally Recognized. Industry Respected.

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

SPEAKER'S LOUNGE

381AB, George R. Brown Convention Center, Level 3

The Speaker's Lounge will be open during the following hours:

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

MEMBERSHIP DESK

Ballroom of the Americas AB, Hilton Americas, 2nd Floor

The membership information desk is available for paying dues, applying for membership, updating membership information.

This desk is open during the same hours as registration, so feel free to stop by if you have any questions concerning your ASHRAE membership.

HEADQUARTER OFFICE

343, Hilton Americas, 3rd Floor

The ASHRAE Headquarter office offers members complimentary copying, services of a typist and access to printers for laptop computers.

Friday, June 22	12:00 p.m. – 5:00 p.m.
Saturday, June 23	8:00 a.m. – 5:00 p.m.
Sunday, June 24	8:00 a.m. – 5:00 p.m.
Monday, June 25	8:00 a.m. – 5:00 p.m.
Tuesday, June 26	8:00 a.m. – 5:00 p.m.
Wednesday, June 27	8:00 a.m. – 1:00 p.m.

YEA ACTIVITY

Young Engineers in ASHRAE (YEA) Hospitality Reception, 4th Floor Foyer, Hilton Americas on the west side of the building.

Attention young professional members age 35 and younger! You are invited to visit the YEA Hospitality reception on Sunday, June 24, from 4:00 p.m. – 6:00 p.m. The reception offers social and networking opportunities and light refreshments will be served.

LEADERSHIP U

At each ASHRAE conference, the Leadership U program gives four future ASHRAE leaders the opportunity to shadow an ASHRAE Board member, providing a high level conference experience and unique networking opportunity. This program is operated by the Young Engineers in ASHRAE (YEA) Committee and more information can be found at www.ashrae.org/yea. The Leadership U participants for the 2018 ASHRAE Annual Conference are:

Elise Kiland, San Jose Chapter, Region X

Alekhya Kaianathbhatta, Toronto Chapter, Region II

Abhishek Khurana, Toronto Chapter, Region II

Charlotte Dean, Orange Empire, Region X

ASHRAE MEMBER LOUNGE

Ballroom of Americas C, Hilton Americas, 2nd Floor

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

Saturday, June 23	7:30 a.m. – 3:00 p.m.
Sunday, June 24.....	7:30 a.m. – 4:00 p.m.
Monday, June 25	7:30 a.m. – 9:00 a.m.
.....	11:30 a.m. – 4:00 p.m.
<i>*The ASHRAE Member Lounge will be closed on Monday, June 25th from 9:00 – 11:30 a.m. for an event. Coffee will be available in the pre-function area of Ballroom of the Americas C during this time*</i>	
Tuesday, June 26.....	7:30 a.m. – 4:00 p.m.
Wednesday, June 27.....	7:30 a.m. – 1:00 p.m.

More information about the ASHRAE Member Lounge can be found on page 13.

ASHRAE SPOUSE LOUNGE

434, Hilton Americas, 4th Floor

The lounge will be open to all registered spouses/guests during the following hours:

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

More information about the ASHRAE Spouse Lounge can be found on page 16.

HOUSTON HOST DESK

Ballroom of the Americas AB, Hilton Americas, 2nd Floor

Can't find what you're looking for on your smart phone? Or would like a local perspective? Stop by the Houston Host Committee Concierge Desk to find more information about the city of Houston, including maps, restaurant recommendations and things to do in Houston. Members of the host committee will be present on Friday, Saturday and Sunday to answer questions.

ATLANTA WINTER CONFERENCE INFORMATION,

Ballroom of the Americas AB, Hilton Americas, 2nd Floor

Information on the upcoming Winter Conference scheduled for January 12–16, 2019 at the Omni at the CNN Center Hotel and the Georgia World Congress Center in Atlanta, GA, will be available in the registration area. Information about the AHR Expo will also be available.

LOCATION OF MEETINGS

Please refer to the Hilton Americas and GRBCC floor plans located in this program on pages 2–4 for more information on locations of meeting rooms.

MEETING SCHEDULE

FRIDAY, JUNE 22

- 8:00 am–5:00 pm **Committee Meetings**
See listing on pages 82–112
- 10:00 am–5:00 pm **Registration and ASHRAE Bookstore**
Ballroom of the Americas AB, 2nd Floor,
Hilton Americas

SATURDAY, JUNE 23

- 7:30 am–3:00 pm **ASHRAE Member Lounge**
Ballroom of the Americas C, 2nd Floor,
Hilton Americas and Spouse Lounge,
434, 4th floor, Hilton Americas.
See description on page 13
- 7:15 am–6:00 pm **Registration and ASHRAE Bookstore**
Ballroom of the Americas AB, 2nd Floor,
Hilton Americas
- 8:00 am–5:00 pm **Committee Meetings**
See listing on pages 82–112
- 1:00 pm–3:00 pm **Speakers' Lounge**
381AB, Level 3, GRBCC

Special Event

- 3:15 pm–5:00 pm **Meeting of the Members**
Plenary Session, Ballroom of the
Americas DEF, 2nd Floor, Hilton
Americas
- Opening and Welcoming Remarks**
by ASHRAE President Bjarne Olesen
- Welcome** by Director and Chair, Region
VIII, Jon Symko
- Secretary's Report** by Executive Vice
President, Jeff H. Littleton
- Awards Presentation**
See description on page 18–21
- Keynote Address:** Dr. Ainissa Ramirez
See description on page 14
- Plenary Session is open, no badge
nor registration is required to attend.*

Special Event

7:00–9:00 p.m.

Welcome Party

The Grove, 1611 Lamar St.

Ticket required.

The Grove is located directly across the street from the Hilton Americas at the Discovery Green park. Houston Host Committee members will be dressed in Houston Astros shirts and will be scattered along the path to help direct attendees.

See description on page 14

SUNDAY, JUNE 24

7:00 am–5:00 pm

Speakers' Lounge

381AB, Level 3, GRBCC

7:00 am–5:00 pm

Registration and ASHRAE Bookstore

Ballroom of the Americas AB, 2nd Floor, Hilton Americas

7:30 am–4:00 pm

ASHRAE Member Lounge

Ballroom of the Americas C, 2nd Floor, Hilton Americas and Spouse Lounge, 434, 4th floor, Hilton Americas.

8:00 am–4:45 pm

Technical Sessions

370s, 371s, 372s, Level 3, GRBCC.

See Technical Program on pages 43–54

8:00 am–5:00 pm

Committee Meetings

See listing on pages 82–112

9:00 am–9:30 am

Networking Coffee Break

Prefunction Area in Main Hallway of Tech Session rooms, GRBCC

Sponsored by:



9:45 am–2:45 pm

General Tour:

Chinatown Culinary Tour

Ticket required.

See description on page 30

1:00 pm–6:00 pm

General Tour: Houston Museum of Natural Science

Ticket required.

See description on page 30

3:00 pm–6:00 pm

Technical Tour: Enwave District Cooling Plant and Esperson Building (1929) Water Wall 1 Tour

Ticket required.

See description on page 31

4:00 pm–6:00 pm **Young Engineers in ASHRAE (YEA) Hospitality Reception**
4th floor foyer, 4th floor, Hilton Americas, west side of building
Attention members age 35 and younger—you are invited to visit the YEA Hospitality Reception, offering social and networking opportunities. Light refreshments will be available.
See description on page 23

MONDAY, JUNE 25

7:00 am–12:15 pm **Speakers' Lounge**
381AB, Level 3, GRBCC

7:00 am–5:00 pm **Registration and ASHRAE Bookstore**
Ballroom of the Americas AB, 2nd Floor, Hilton Americas

7:30 am–4:00 pm **ASHRAE Member Lounge**
Ballroom of the Americas C, 2nd Floor, Hilton Americas and Spouse Lounge, 434, 4th floor, Hilton Americas
The ASHRAE Member Lounge will be temporarily closed from 9:00–11:30 a.m. Coffee will be available in the pre-function area outside of Ballroom of the Americas C for members during this time.

8:00 am–12:00 pm **Technical Sessions**
370s, 371s, 372s, Level 3, GRBCC.
Technical Program on pages 54–63

9:30 am–11:00 am **ASHRAE Meet and Greet**
Ballroom of the Americas C, 2nd floor, Hilton Americas.
See description on page 13

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 82–112

Special Event

12:15 pm–2:00 pm **President's Luncheon**
Ballroom of the Americas DEF, 2nd Floor, Hilton Americas
Doors open at 12:00 p.m.
Ticket required.
See description on page 15

1:30 pm–4:30 pm **Speakers' Lounge**
381AB, Level 3, GRBCC

2:15 pm–6:15 pm **General Tour: Museum of Fine Arts**
Ticket Required.

- 2:30 pm–6:30 pm **Technical Tour: Thermal Energy Corporation–Houston Medical Center Central Plant**
Ticket Required.
See descriptions on page 32
- 4:00 pm–6:00 pm **Women in ASHRAE Happy Hour**
House of Blues Houston
1204 Caroline St.
See description on page 14
- After 5:00 pm **Regional Dinners**
Sign up in ASHRAE registration area.

TUESDAY, JUNE 26

- 7:00 am–5:00 pm **Speakers' Lounge**
381AB, Level 3, GRBCC
- 7:30 am–4:00 pm **ASHRAE Member Lounge**
Ballroom of the Americas C, 2nd Floor,
Hilton Americas and Spouse Lounge,
434, 4th floor, Hilton Americas
- 7:30 am–4:30 pm **Registration and ASHRAE Bookstore**
Ballroom of the Americas AB, 2nd Floor,
Hilton Americas
- 8:00 am–4:45 pm **Technical Sessions**
370s, 371s, 372s, Level 3, GRBCC.
See Technical Program on pages 63–73
- 8:00 am–5:00 pm **Committee Meetings**
See listing on pages 82–112
- 9:00 am–3:00 pm **General Tour: Space Center Houston Tour and Lunch**
Ticket Required.
- 12:00 pm–1:30 pm **Life Members' Lunch**
344, 3rd floor, Hilton
Ticket required.
See description on page 15
- 1:00 pm–5:00 pm **General Tour: Bayou Bend Collection and Gardens Tour**
Ticket Required.
- 1:00 pm–5:00 pm **Technical Tour: NRG Park Stadium (home of the NFL Texans) and Central Plant Tour**
Ticket Required.
- 2:00 pm–5:00 pm **Technical Tour: Greater Houston Transportation and Emergency Management Center**
Ticket Required.
See descriptions on page 32
- 2:00 pm–5:30 pm **Certification Exams**
381C, Level 3, GRBCC
More information on page 40

Special Event

- 6:15 pm–7:15 pm **Reception**
Ballroom of Americas DEF
Pre-Function area, 2nd Floor, Hilton.
- 7:15 pm–10:30 pm **Members' Night Out**
Ballroom of Americas DEF,
2nd Floor, Hilton.
Ticket Required.
See description on page 15

WEDNESDAY, JUNE 27

- 7:00 am–1:00 pm **Speakers' Lounge**
381AB, Level 3, GRBCC
- 7:30 am–11:00 am **Registration and ASHRAE Bookstore**
Ballroom of the Americas AB, 2nd Floor,
Hilton Americas
- 7:30 am–1:00 pm **ASHRAE Bookstore**
Ballroom of the Americas AB, 2nd Floor,
Hilton Americas
- 7:30 am–1:00 pm **ASHRAE Member Lounge**
Ballroom of the Americas C, 2nd Floor,
Hilton Americas and Spouse Lounge,
434, 4th floor, Hilton Americas.
- 8:00 am–12:30 pm **Technical Sessions**
370s, 371s, 372s, Level 3, GRBCC.
See Technical Program on pages 73–81
- 8:00 am–5:00 pm **Committee Meetings**
See listing on pages 82–112

UPCOMING CONFERENCES

ASHRAE 2018 Building Performance Analysis Conference and SimBuild, co-organized by ASHRAE and IBPSA-USA

September 26–28, 2018 • Chicago, IL
www.ashrae.org/BuildPerform

The Third International Conference on Efficient Building Design

October 4–5 2018 • Beirut, Lebanon
www.ashrae.org/Beirut2018

Buildings XIV Conference

December 9–12, 2019 • Clearwater, FL

IAQ 2020

September 2020 • Greece

TOURS

Stand-by tour tickets will be distributed at ASHRAE registration after a tour sells out. Stand-by tickets are provided to ensure that a tour is filled in the event of last minute cancellations. If you have a stand-by ticket, please be prepared to pay by credit card or exact cash at the bus. Tour tickets may be purchased at the ASHRAE registration desk located in the Ballroom of Americas AB (2nd Floor) of the Hilton Americas.

Longer descriptions of tours can be found at www.ashrae.org/houston and on the ASHRAE 365 app.

All tours depart from the Lamar Street exit (in between the gift shop and Starbucks) on the Lobby Level of the Hilton Americas. Please arrive at least 10 minutes before the tour is scheduled to depart.

GENERAL TOURS

Chinatown Culinary Tour

Sunday, June 24

9:45 am – 2:45 pm

\$95

A guide will provide historical information on the tour to the supermarket about the area, Asian culture in Houston, etc. Guests will be taken to a local kitchen where a certified Chef will demonstrate and instruct meal preparations. After the delicious meal is prepared, guests will enjoy and taste test the ingredients they selected and prepared. A tasting at three difference cuisine locations is included.

Houston Museum of Natural Science

Sunday, June 24

1:00 pm – 6:00 pm

\$70

Enjoy a guided tour at of one of Houston's most popular destinations and the fourth most visited museum in the country. While at the museum, experience one of the special traveling exhibits that frequent the museum. The museum houses amazing permanent exhibitions, such as the Hall of Ancient Egypt, Cullen Hall of Gems and Minerals, Farish Hall of Texas Wildlife and many other interesting and fascinating exhibits.

Museum of Fine Arts

Monday, June 25

2:15 pm – 6:15 pm

\$75

The Museum of Fine Arts displays a permanent collection spanning more than 6,000 years of history from six continents. The museum houses marvelous permeant collections, such as American painting and sculpture, Antiquities, Arts of Asia, European Art, Modern and Contemporary Art and many others. A guided tour of the traveling exhibit will also be available.

Space Center Houston Tour and Lunch

Tuesday, June 26

9:00 am – 3:00 pm

\$180

Come and hear many great stories that will entertain you on the trip to Space Center Houston in Clear Lake. Upon arrival, you will take group tour, view actual spacecraft, spacesuits, moon rocks and other artifacts.

After exploring the Space Center Houston, you will take a private, guided tram tour of NASA's Johnson Space Center which will take a look behind the scenes at Mission Control and where astronauts train for their next mission.

Lunch is included in the tour as well as a meet and greet with an astronaut and a souvenir mission patch.

Bayou Bend Collection and Gardens Tour

Tuesday, June 26

1:00 pm – 5 pm

\$60

Bayou Bend Collection and Gardens is the home of the late Miss Ima Hogg and is a showcase for American antique furniture, decorative arts and elaborate gardens. Walking across the bayou on the suspended footbridge to view this 14-acre estate is like entering an impressionist landscape painting. The backyard of Ms. Hogg's home provides a lush, green entrance of a sloping lawn and gardens.

TECHNICAL TOURS

Enwave District Cooling Plant and Esperson Building (1929) Water Wall 1 Tour

Sunday, June 24

3:00 – 6:00 p.m.

\$30

The EnwaveUSA District Energy Plant currently provides chilled water to twenty four buildings (approximately 6 million square feet of space) in downtown Houston. Join us and learn about the economies of scale and operational benefits of connecting to a large, diverse portfolio of users, as well as the potential to reduce the capital cost of developing an office building. On this same tour, we will also visit the Esperson Building, an example of Italian Renaissance architecture built in 1927 and one of Houston's earliest buildings to receive air conditioning.

Thermal Energy Corporation – Houston Medical Center Central Plant

Monday, June 25

2:30 – 6:30pm

\$30

Houston-based Thermal Energy Corporation (TECO) provides reliable, cost-effective and energy-efficient cooling and heating to institutions in the Texas Medical Center. Formed in 1969, TECO uses district energy and combined heat and power (CHP) technology to produce chilled water and steam, which is piped underground to more than 19 million square feet of customer buildings at 18 institutions. In 2015 TECO was a US EPA Energy Star Award recipient. We will tour the plant accompanied by design engineers and operators and learn about several systems.

NRG Park (home of the NFL Texans) Stadium and Central Plant Tour

Tuesday, June 26

1:00 p.m. – 5:00 p.m.

\$30

NRG Park is Houston's premier sports, convention, tradeshow, and consumer show and entertainment complex. It encompasses four major facilities – NRG Stadium, NRG Center, NRG Arena and NRG Astrodome. It covers 350 acres. We will tour the central plant and mechanical areas of the Stadium. You will also learn about the current re-purposing of the 50 year old Astrodome- the world's first air-conditioned stadium- now being re-invented for its next 50 years.

Greater Houston Transportation and Emergency Management Center

Tuesday, June 26

2:00 p.m. – 5:00 p.m.

\$30

Houston TranStar is a unique partnership of representatives from the City of Houston, Harris County, METRO and TxDOT who share resources and exchange information under one roof to keep motorists informed, roadways clear and lives safe in the fourth most populated city in the United States. Join and tour the state-of-the-art Harris County Emergency Operations Center, built to withstand 150 miles per hour winds, has three backup generators, and can completely support emergency personnel and operations for days at a time with no outside assistance. The building is The HVAC system is configured to protect occupants from external airborne threats as well as UVGI to control mold and bacterial growth in the air handling units.

FUTURE ASHRAE CONFERENCES

Winter	Date	Annual
Atlanta, GA January 12–16	2019	Kansas City, MO June 22–26
Orlando, FL February 1–5	2020	Austin, TX June 27–July 1
Chicago, IL January 23–27	2021	Phoenix, AZ June 26–30

PAST ASHRAE MEETINGS

Los Angeles	1980	Denver
Chicago	1981	Cincinnati
Houston	1982	Toronto
Atlantic City	1983	Washington
Atlanta	1984	Kansas City
Chicago	1985	Honolulu
San Francisco	1986	Portland
New York	1987	Nashville
Dallas	1988	Ottawa
Chicago	1989	Vancouver
Atlanta	1990	St. Louis
New York	1991	Indianapolis
Anaheim	1992	Baltimore
Chicago	1993	Denver
New Orleans	1994	Orlando
Chicago	1995	San Diego
Atlanta	1996	San Antonio
Philadelphia	1997	Boston
San Francisco	1998	Toronto
Chicago	1999	Seattle
Dallas	2000	Minneapolis
Atlanta	2001	Cincinnati
Atlantic City	2002	Honolulu
Chicago	2003	Kansas City
Anaheim	2004	Nashville
Orlando	2005	Denver
Chicago	2006	Quebec City
Dallas	2007	Long Beach
New York	2008	Salt Lake City
Chicago	2009	Louisville
Orlando	2010	Albuquerque
Las Vegas	2011	Montreal
Chicago	2012	San Antonio
Dallas	2013	Denver
New York	2014	Seattle
Chicago	2015	Atlanta
Orlando	2016	St. Louis
Las Vegas	2017	Long Beach
Chicago	2018	Houston

2018 Houston Sustainability Project

The sustainability footprint program was launched by the Salt Lake City Host Committee at the 2008 Annual Conference and encourages members to examine ways to get more involved in their local communities. The goals of the program are to leave a legacy representing ASHRAE's commitment to sustainability and to offset the environmental impact from holding the Conference. It is now customary for the Conference host city to select a project with some funding provided by ASHRAE as seed money.

The Houston Chapter started an ongoing partnership with the Veterans of Foreign Wars (VFW) in 2017, with Chapter members donating their skills, time, and resources to the community.

The organization seeks to perform energy audits on all of the posts in the district and upgrade to more energy efficient equipment, lighting and other efficiency measures. The intent is to identify a plan of action for each VFW Post prioritizing the most gains to least with the energy audit performed by ASHRAE members. We then seek to have manufacturers donate equipment and contractors donate their time to complete the projects. This allows the money we have to go further.

The project the Houston Chapter has undertaken consists of a two-pronged approach to ensure that it will have the farthest-reaching impact to the local community.

Phase One: Energy Audit and VFW Post Education

- Each VFW post is audited by an ASHRAE member with experience performing these audits and a report of the current status and plan for upgrading is compiled.
- We review this plan with each Post Commander and educate them as to the benefits of each and how to maximize savings.
- Upon commander signoff we work with manufacturers to donate equipment or at least at a discounted price.

Phase Two: Efficiency-focused Upgrades to a VFW Post

- We walk the Post with contractors and the Post Commander and discuss the scope of work, times work can be done and exchange contact information.
- We review the contractors proposal with the Post Commander and everyone signs off on the work.
- The work is completed by the contractor and commissioned by the energy audit team.
- Additionally, a plan for future work and budgets is discussed.

A project overview and summary will be given by the Houston Host Committee at the President's Luncheon on Monday.



About the Veterans of Foreign Wars

The Veterans of Foreign Wars of the United States is a nonprofit veterans service organization comprised of eligible veterans and military service members from the active, guard and reserve forces.

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 Groups (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 conferences
- Reviewing papers for conferences
- Developing ASHRAE publications
- Evaluating the need for standards, and
- Advising the Society on all aspects of the technology it embraces

ASHRAE TCs and these other groups are comprised of volunteers who have a recognized proficiency in a specific field of interest. There are some active 100 TCs addressing all aspects of the HVAC&R and buildings industries.

Applying for Membership on a Technical Committee

ASHRAE welcomes new members to its technical committees. You can join a technical committee by accessing our website at www.ashrae.org/joinatc. You will immediately be assigned as a Provisional Corresponding Member for a two-year term, and be able to participate in committee activities. At the end of the term, you may be considered for a position that has voting membership.

Please note:

If you do not have an ASHRAE ID, please go to www.ashrae.org and click on the Log In tab at the top of the page. Next, click on “Need a Login?” to request an ID and PIN. You may also use that link if you already have an ASHRAE ID as a non-member.

Attending Technical Committee Meetings

TC meetings take place at the Society’s Winter and Annual Conferences, and they are open. Attend any meetings in which you have a technical interest. TC chairs welcome new attendees—a TC can never have too many willing and able volunteers.

See the listing of Technical Committee meetings in the Final Program, online or in the app.

HOW AND WHY TO JOIN AN ASHRAE PROJECT COMMITTEE

What Is a Project Committee?

ASHRAE Project Committees (PCs) develop ASHRAE standards and guidelines. ASHRAE PCs consist of people who have a recognized expertise in a specific field of interest. Standards produced by ASHRAE are used as authoritative documents throughout our industry.

Applying for Membership on a Project Committee

ASHRAE welcomes new members to its project committees. With the exception of PC Chairs and Vice Chairs, it is not necessary to be a member of ASHRAE to participate on any of ASHRAE's Standards Project Committee (SPC), Guideline Project Committee (GPC), or Standing Standard/Guideline Project Committees (SSPC, SGPC).

To be considered for project committee membership, you must:

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

After you correctly submit all necessary paperwork:

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

More details on applying for PC membership are available at www.ashrae.org/standards.

Attending Project Committee Meetings

A PC member is expected to attend meetings and pay attention to correspondence. The PC Chair may recommend removal of a PC member for lack of participation such as failing to attend at least half of the scheduled PC meetings in a year.

ASHRAE Project Committees meet at each Society Winter and Annual Conference. Attendance at these meetings is open to everyone. You are encouraged to attend any of these meetings in which you have a technical interest. PC Chairs welcome visitors to PC meetings – a PC can never have too many willing and able volunteers.

See the listing of Standards and Guidelines Committees meetings in the Final Program, online or in the app.

FULL-DAY PROFESSIONAL DEVELOPMENT SEMINARS

Registration fees: \$510 (ASHRAE Member \$415)

SATURDAY, JUNE 23, 2018

The Commissioning Process in New and Existing Buildings (Code 60)

8:00 a.m.–3:00 p.m., George R. Brown Convention Center | 382A

The fundamentals of the commissioning process through each step of a new construction project from pre-design to occupancy and operations are presented in this seminar. The seminar discusses commissioning documentation, including an overview of commissioning specifications for new construction.

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

Energy Modeling Best Practices and Applications (code 61)

8:00 a.m.–3:00 p.m., George R. Brown Convention Center | 382B

This seminar covers the fundamentals of building energy modeling and explains how to use modeling to guide design decisions, with an emphasis on HVAC. Integrating modeling into the design process from the programming stage through post-occupancy and measurements and verification will be discussed. The seminar explains modeling principles and provides modeling tips related to the building envelope, plug loads, lighting systems, and HVAC systems. Concluding with guidance on model calibration and the use of energy models for measurement and verification, this seminar also includes case studies and links to valuable modeling resources.

Instructors: Joe Deringer, AIA, Member ASHRAE, LEED AP; and Erik Kolderup, P.E., Member ASHRAE, BEMP, LEED AP

HALF-DAY SHORT COURSES

Registration fees: \$184 (ASHRAE Member \$139)

SATURDAY, JUNE 23, 2018

Energy Management Best Practices (code 62)

12:00 p.m.–3:00 p.m., George R. Brown Convention Center | 382C

Buildings use 40% of U.S. energy, of which one-third can be cost-effectively saved. To achieve this goal, building professionals can utilize energy management—an orderly process in which managers use resources at their disposal to accomplish clear, energy-saving objectives. This course weaves together energy management principles from case studies and the ASHRAE Handbook—HVAC Applications, ENERGY STAR guidelines, and ASHRAE/IES Standard 100-2015, Energy Efficiency in Existing Buildings.

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

SUNDAY, JUNE 24, 2018

Advanced Designs for Net Zero Buildings

(code 63)



3:30 p.m.–6:30 p.m., George R. Brown Convention Center | 382A

This advanced course is for professional engineers and architects who want to expand their practice to include the design, construction, and operation of net zero (zero energy) buildings. The first principle of net zero design is to make the building as energy efficient as possible. On-site renewable energy systems will then be added to achieve these efficiency goals. If adequate on-site net zero is not feasible, then options for off-site renewable energy should be explored. The test for net zero is at the energy meter, so proper commissioning and operator training are critical to success. The net zero principles outlined above will be presented with case studies and examples showing how other design professionals have met the net zero goal.

Instructors: Peter Simmonds, Ph.D., Fellow ASHRAE; and Charles Eley, P.E., AIA, CEM, Member ASHRAE, BEMP, LEED® AP

Latest in High-Performance Dedicated Outdoor Air Systems (DOAS) (code 64)



3:30 p.m.–6:30 p.m., George R. Brown Convention Center | 382B

The dedicated outdoor air system (DOAS) has become a very popular means to provide ventilation for buildings, particularly for low-energy, max tech, and zero energy buildings. DOAS and the accompanying room-level heating/cooling units provide many benefits, including low energy use, cost-effective humidity control, redundancy, and control simplicity. This new course covers the latest in DOAS application, design, and control.

Instructor: Art Hallstrom, P.E., Member ASHRAE, LEED® AP

MONDAY, JUNE 25, 2018

Save 30% Complying with Standard 90.1-2013

(code 65)



2:30 p.m.–5:30 p.m., George R. Brown Convention Center | 382A

Learn the background and development of ASHRAE/IES Standard 90.1-2013, its requirements and compliance paths, and how to understand and apply the requirements. Important updates for each of the major building systems will be discussed. This includes the HVAC system, lighting system, building envelope, service water heating, and power. The course also includes discussions of key mandatory and prescriptive requirements applicable to each system, as well as whole-building compliance options.

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

Designing and Operating High-Performing Healthcare HVAC Systems (code 66)

2:30 p.m.–5:30 p.m., George R. Brown Convention Center | 382B

This advanced course discusses in detail the interactions of the key elements of high performance in healthcare, infection control, comfort, reliability, safety, maintenance, energy, and sustainability. Numerous energy conservation strategies will be discussed in the context of achieving all the goals of a high-performing hospital. For example, the hardware and controls for setback of temperature and airflow and the relationship to temperature, relative humidity, air exchange, filtration, and pressurization requirements are discussed.

Instructor: Donald Burroughs, P.E., Member ASHRAE

TUESDAY, JUNE 26, 2018

Cool Thermal Energy Storage Systems for Air Conditioning (code 67)



8:00 a.m.–11:00 a.m., George R. Brown Convention Center | 382A

Building air-conditioning systems are the single greatest contributor to aggregate peak electrical demand. As a technology, thermal energy storage enables shifting a significant proportion of a facility's demand for electricity from daytime to nighttime periods. Furthermore, thermal energy storage enables flexibility in the demand for electricity by building air-conditioning systems—principally operating during time periods where renewable energy is plentiful and idling during time periods where renewable energy is sparse or unavailable. Through this course, participants will come to understand how thermal energy storage can enable greater use of renewable energy generation and learn whether an existing or new facility may benefit from the application of a thermal energy storage system.

Instructor: Douglas Reindl, Ph.D., P.E., Fellow ASHRAE

Variable Refrigerant Flow System: Design and Application (code 68)

8:00 a.m.–11:00 a.m., George R. Brown Convention Center | 382B

Variable refrigerant flow (VRF) systems are now being applied in many building types across North America. This course provides non-manufacturer-specific concepts of how to apply VRF systems to buildings. The course supplements the fundamental technology presented in the 2012 ASHRAE Handbook—HVAC Systems and Equipment, offering consulting engineers who already have a basic knowledge of VRF technology comprehensive system design and application guidance using building specific scenarios.

Instructors: Paul Doppel, Member ASHRAE and Jocelyn Léger, P.Eng., CEM, Member ASHRAE, LEED® AP

Humidity Control II: Real-World Problems and Solutions (code 69)

12:00 p.m.–3:00 p.m., George R. Brown Convention Center | 382A

Based on ASHRAE's best-selling Humidity Control Design Guide for Commercial and Institutional Buildings, this course 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: Mark Nunnally, P.E., Member ASHRAE, BEMP, LEED® AP

ASHRAE CERTIFICATION EXAMS

Tuesday, June 26

2:00 p.m. – 5:30 p.m.

381C, GRBCC, 3rd Floor

Recognized by over 35 national, state and local government bodies – and with over 2,500 certifications earned – ASHRAE certifications increasingly have become the must-have credential for built-environment professionals.

ASHRAE certification exams will be administered to candidates in these key, built-environment fields: Commissioning, Energy Assessment, Energy Modeling, Healthcare Facility Design, High-Performance Building Design and Building Operations.

Pre-application required.



ASHRAE 2018 ANNUAL CONFERENCE TECHNICAL PROGRAM

Earn Professional Development Hour (PDH) credits by attending sessions listed in the Technical Program. Each hour attended in a session equals one PDH. For forums and other one-hour sessions, you must be present for the entire 50-minute program to earn a PDH. Sign in sheets will be available in all session rooms for attendees to complete. State PDHs, AIA LUs and LEED AP credits are awarded for select sessions.

Types of sessions presented:

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

Debates. Debates highlight hot-button issues. Experts, either on teams or as individuals, present different sides of an issue in debate format. Each participant presents evidence for or against a specific statement or question such as ‘Is Sustainability Really Sustainable?’.

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.

Panels. Panel discussions can feature a broad range of subjects and explore different perspectives on issues in the industry. A panel may feature discussions about integrated project delivery among designers, builders and facility management professionals.

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. A permanent record of the seminar presentations will be available online. Orders can be taken in the ASHRAE Bookstore.

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. Power point presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Preprints of papers and an online papers collection are available for purchase in the ASHRAE bookstore.

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



2018 ASHRAE Annual Conference Papers (subscription) – \$65



Conference Seminars (subscription) – \$105



Conference Preprints (individual papers, in print) – \$6 each



ASHRAE Transactions (print volume) – \$45



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



Approved for GBCI LEED AP CE Credits

Packages: *Purchase in the Conference Bookstore*

1. 2018 ASHRAE Annual Conference

Papers (subscription) and Conference Seminars (subscription); \$149

2. 2018 ASHRAE Annual Conference

Papers (subscription) and *ASHRAE Transactions*; \$124

3. Complete Annual Conference Content Package

(2018 ASHRAE Annual Conference – Papers (subscription), Conference Seminars (subscription), and *ASHRAE Transactions*); \$174

All prices are special conference-only prices.

Sunday, June 24

8:00 a.m. – 9:00 a.m.

Conference Paper Session 1 (Intermediate)

Identifying Energy and Cost Saving Measures for Combined Heat and Power Applications

Track: District Energy and Cogeneration Plants

Room: 370CF, (3), GRBCC

Chair: Hyojin Kim, Ph.D, The Catholic University of America, Washington, D.C.

1. Optimal CHP Investments Applying Sensitivity Analyses and Financial Risk Management Indicators (HO-18-C001)

Salvador Acha, Ph.D., Member, Niccolo Le Brun, Christos N. Markides, Member, Nilay Shah, Romain Lambert, Ph.D., Imperial College London, London, United Kingdom

2. Fuel Cells as CHP Systems in Commercial Buildings: a Case Study for the Food Retail Sector (HO-18-C002)

Salvador Acha, Ph.D., Romain Lambert, Niccolo Le Brun, Christos N. Markides, Member, Nilay Shah, Imperial College London, London, United Kingdom

8:00 a.m. – 9:00 a.m.

Seminar 1 (Intermediate)

Division 25 Challenges! When Integrated Automation Isn't!

Track: HVAC&R Control Freaks

Room: 370ABDE, (3), GRBCC

Sponsors: 1.4 - Control Theory and Application and 7.1 - Integrated Building Design

Chair: Ron Bernstein, RBCG Consulting, Encinitas, CA

1. Division 25 Challenges! When Integrated Automation Isn't! (1)

Ron Bernstein, Member, RBCG Consulting, Encinitas, CA

2. Division 25 Challenges! When Integrated Automation Isn't! (2)

David Wilts, Member, Arup Engineering, Chicago, IL

3. Division 25 Challenges! When Integrated Automation Isn't! (3)

Chariti Young, Member, Automated Logic, Kennesaw, GA

8:00 a.m. – 9:00 a.m.

Seminar 2 (Intermediate)

Energy Analytics in Virtual Energy Audits

Track: HVAC&R Analytics

Room: 372AD, (3), GRBCC

Sponsors: 7.6 - Building Energy Performance and 7.5 - Smart Building Systems

Chair: Eric Yang, P.E., Energy Systems Group, Vienna, VA

1. Finding Residential Water Heaters in the Data

Dane Christensen, Member, NREL, Golden, CO

2. A Virtual Energy Audit for Commercial Building Energy Savings

Arash Khalilnejad, Case Western Reserve University, Cleveland, OH

3. A Virtual Energy Audit Based on Historical Trending

Eric Yang, Member, Energy Systems Group, Vienna, VA

8:00 a.m. – 9:00 a.m.

Seminar 3 (Intermediate)



New Advances in Simulating Fenestration Systems

Track: HVAC&R Systems and Equipment

Room: 372BE, (3), GRBCC

Sponsor: 4.7 – Energy Calculations

Chair: Jeff S. Haberl, Ph.D., Texas A&M University, College Station, TX

- 1. ASHRAE Research Project RP-1588: Development of the Solver**
Neal Kruis, Member, Big Ladder Software, Denver, CO
- 2. RP-1311 ASHWAT Detailed Fenestration Model**
Charles S. Barnaby, Life Member, Moultonborough, NH
- 3. ASHRAE Research Project RP-1588: Application of the Solver**
Yu Joe Huang, Member, White Box Technologies, Berkeley, CA

8:00 a.m. – 9:00 a.m.

Seminar 4 (Basic)



Positive-Displacement Compressors: Back to Basics

Track: HVAC&R Systems and Equipment

Room: 372CF, (3), GRBCC

Sponsor: 8.1 - Positive Displacement Compressors

Chair: Rick Heiden, Trane - Ingersoll Rand, LaCrosse, WI

1. Compressor Types

Craig Robert Bradshaw, Member, Oklahoma State University, Stillwater, OK

2. Typical Applications, Capacity Unloading and Volume Ratio

David Halbrooks, Student Member, Purdue University, Centerville, TN

3. Test Methods and Rating programs

Connor Hayes, Associate Member, La Crosse, WISA

8:00 a.m. – 9:00 a.m.

Seminar 5 (Intermediate)



Trials and Tribulations of Dishroom HVAC Design, Comfort and IAQ (Pt. 1)

Track: Fundamentals and Applications

Room: 371DE, (3), GRBCC

Sponsor: 5.10 - Kitchen Ventilation

Chair: Derek Schrock, Halton Company, Scottsville, KY

1. Dishroom HVAC: More than Just Dishwasher Exhaust!

Don Fisher, Life Member, Frontier Energy Inc., San Ramon, CA

2. That's A Lot of Heat: Sensible and Latent Loads

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

8:00 a.m. – 9:00 a.m.

Workshop 1 (Basic)**Generation Z: Ready or Not, Our Industry's Future Depends on Them and It's Sooner Than You Might Think***Track: Professional Skills**Room: 371AB, (3), GRBCC***Sponsor: 1.7 - Business, Management & General Legal Education***Chair: Cindy Moreno, TM Mechanical, Mesa, AZ***1. Generation Z: Ready or Not, Our Industry's Future Depends on Them and It's Sooner Than You Might Think****David Palty¹, Member, Chris Kopach², (1) AEMEP Group, Phoenix, AZ, (2), University of Arizona, Tucson, AZ**

8:00 a.m. – 9:00 a.m.

Workshop 2 (Intermediate)**Writing Scientific Journal Research Papers***Track: Research Summit**Room: 371CF, (3), GRBCC***Sponsor: Publication and Education Council***Chair: Reinhard Radermacher, Ph.D., University of Maryland, College Park, MD***1. Tips for Manuscript Formatting, Finding the Right Journal and Negotiating the Review Process***Mary Baugher, University of Maryland, College Park, MD***2. Publishing Open Access: Is It Right for You?***Stephanie Loeh, Taylor & Francis Group, Abingdon, United Kingdom*

9:45 a.m. – 10:45 a.m.

Conference Paper Session 2 (Intermediate)**HVAC Applications in Transportation***Track: Fundamentals and Applications**Room: 371CF, (3), GRBCC**Chair: Jaya Mukhopadhyay, Montana State University, Bozeman, MT***1. Effect of Gasper Jets on Human Thermal Comfort in Aircraft Cabins (HO-18-C003)****Essam E. Khalil, Ph.D., P.E., Fellow ASHRAE, Alaa Abdullah, P.E., Eslam S. Abdelghany, Ph.D., P.E., Taher Abou Dief, Ph.D., P.E., Cairo, Egypt****2. Viral Particle Dispersion and Viability in Commercial Aircraft Cabins (HO-18-C004)****John Lynch, Fellow ASHRAE, James S. Bennett, Byron Jones, M.H. Hosni., Kansas State University., Manhattan, Kansas****3. Air Flow Regimes and Thermal Comfort in Passengers' Car Cabin (HO-18-C005)****Essam E. E Khalil, Ph.D., P.E., Fellow ASHRAE, Ahmed ElDewgy, Ph.D., Cairo University, Cairo, Egypt**

9:45 a.m. – 10:45 a.m.

Seminar 6 (Intermediate)



Challenges Venting High Efficiency Appliances

Track: HVAC&R Systems and Equipment

Room: 370ABDE, (3), GRBCC

Sponsor: 6.10 - Fuels and Combustion

Chair: Thomas Butcher, Ph.D., Brookhaven National Laboratory, Upton, NY

1. Sidewall Venting of High Efficiency Equipment: How Close is Too Close?

Larry Brand, *Gas Technology Institute., Davis, CA*

2. Common Venting High Efficiency Equipment

Tim McNulty, *U.S. Draft Co., Fort Worth, TX*

9:45 a.m. – 10:45 a.m.

Seminar 7 (Intermediate)



Field vs. Factory Programmed Controls

Track: HVAC&R Control Freaks

Room: 372CF, (3), GRBCC

Sponsor: 1.4 - Control Theory and Application

Chair: Chariti Young, Automated Logic Corp., Kennesaw, GA

1. Choose Wisely

Gaylen Atkinson, *Member, Atkinson Electronics, Salt Lake City, UT*

2. Ask Well

Larry Scholl, *Member, Automated Logic, Kennesaw, GA*

9:45 a.m. – 10:45 a.m.

Seminar 8 (Intermediate)



Optimization for Intelligent Building Controls

Track: HVAC&R Control Freaks

Room: 372BE, (3), GRBCC

Sponsors: 1.13 - Optimization and 7.5 - Smart Building Systems

Chair: Zheng O'Neill, Ph.D., P.E., University of Alabama, Tuscaloosa, AL

1. Gaps to Fill for Widespread Deployment of Model Predictive Control from Experience with Multiple Applications

David H. Blum, *Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA*

2. Equipment-Level Model Predictive Control for Smart Building Applications

Christopher R. Laughman, *Member, Mitsubishi Electric Research Laboratories, Waltham, MA*

3. Optimized Control of Building-PV-Battery Systems: Tradeoffs Between Utility Cost and Battery Degradation

Jie Cai, *University of Oklahoma, Norman, OK*

9:45 a.m. – 10:45 a.m.

Seminar 9 (Basic)



The ASHRAE Conference Crash Course

Track: Professional Skills

Room: 371DE, (3), GRBCC

Sponsor: YEA Committee

Chair: Stephanie Kunkel, JMT, Sparks, MD

1. The Ins and Outs of ASHRAE

Rachel Romero, Member, NREL, Golden, CO

2. Make the Most of Your Conference Experience

Vanessa Freidberg, Member, Siemens Building Technologies, Austin, TX

9:45 a.m. – 10:45 a.m.

Seminar 10 (Intermediate)



Trials and Tribulations of Dishroom HVAC Design, Comfort and IAQ (Pt. 2)

Track: Fundamentals and Applications

Room: 371AB, (3), GRBCC

Sponsor: 5.10 - Kitchen Ventilation

Chair: Derek Schrock, Halton Company, Scottsville, KY

1. Experiences from a Restaurant Chain Perspective

Curt Sawan, Associate Member, Red Lobster Restaurants, LLC, Midlothian, VA

2. How Can Dishmachine Manufacturers Be Part of the Solution?

Joel Hipp, Hobart, Troy, OH

3. Field Experiences with HVAC Design

Gregory DuChane, Member, Trane, Columbus, OH

9:45 a.m. – 10:45 a.m.

Forum 1 (Intermediate)

Expanding Our Perceptions of Building Performance: Updating Standard 105

Track: HVAC&R Systems and Equipment

Room: 370CF, (3), GRBCC

Sponsors: 7.6 - Building Energy Performance and 2.8 - Building Environmental Impacts and Sustainability

Chair: J. Patrick Carpenter, P.E., Facility Performance Engineers, Cinnaminson, NJ

9:45 a.m. – 10:45 a.m.

Workshop 3 (Advanced)



New ASHRAE Hot Climate Design guide

Track: Residential Modern Buildings in Hot and Humid Climates

Room: 372AD, (3), GRBCC

Sponsors: MTG.HCDG - Hot Climate Design Guide , 2.8 - Building Environmental Impacts and Sustainability and Publications Committee

Chairs: Melvin G Glass, EMC Engineers, El Paso, TX and Frank Mills, CEng, Frank Mills Consulting, Leyland, United Kingdom

1. The New ASHRAE Hot Climate Design Guide

Melvin G Glass, Member, EMC Engineers, El Paso, TX

11:00 a.m. – 12:30 p.m.

Technical Paper Session 1 (Intermediate)

Testing for Change in HVAC



Track: HVAC&R Systems and Equipment

Room: 370CF, (3), GRBCC

Chair: Peng Yin, University of Louisiana at Lafayette, Lafayette, LA

1. Measurement of Wind Pressure for an Inflatable Fabric Evaporative Cooling Tower (HO-18-001)

D. Kulkarni, Tennessee Tech University, Cookeville, TN

2. The Role of Gravity in a Hydrocyclone Water/Solids Separation Performance: A CFD Investigation (HO-18-002)

Ali Hasan, Amanties, Doha, Qatar

3. Using Thermal Comfort Models in Health Care Settings (HO-18-003)

Mike Meteyer, ERDMAN, Madison, WI

11:00 a.m. – 12:30 p.m.

Seminar 11 (Intermediate)



Applying Analytics to Existing HVAC Systems: Benefits, Challenges and Lessons Learned

Track: HVAC&R Analytics

Room: 371DE, (3), GRBCC

Sponsors: 1.4 - Control Theory and Application and 7.5 - Smart Building Systems

Chair: Chariti Young, Automated Logic Corp., Kennesaw, GA

1. Deploying HVAC Analytics: Case Studies

Hayden Reeve, UTRC, East Hartford, CT

2. Whole Building FDD Using Data Driven Methods

Jin Wen, Member, Drexel University, Philadelphia, PA

3. Real Life Deployment of Smart Building Platforms

Dennis Krieger, Switch Automation, Denver, CO

11:00 a.m. – 12:30 p.m.

Seminar 12 (Intermediate)

Flooding: Safeguarding HVACR Systems: Hurricane Harvey: Strategies Implemented and Lessons Learned

Track: Safeguarding Your HVAC&R System

Room: 372CF, (3), GRBCC

Sponsors: 2.5 - Global Climate Change, 2.7 - Seismic, Wind and Flood Resistant Design and 4.2 Climatic Information

Chair: Scott Sherwood, Eco Care Corporation, New York, NY

1. Disaster Engineering and Planning

Robert Simmons, Member, Petra Seismic Design, Houston, TX

2. Hurricane Harvey: Houston Will Never Be the Same Again

Lisa Dickson, Member, Arup, Boston, MA

3. Hurricane Harvey vs. Superstorm Sandy: Lessons Learned

Roel Garcia, City of Houston Code Enforcement Division, Houston, TX

4. Climate Change: The Fundamentals and Facts

Scott Sherwood, Member, Eco Care Corporation, New York, NY

11:00 a.m. – 12:30 p.m.

Seminar 13 (Intermediate)



High CO2 and Other Contaminant Levels in Schools

Track: Fundamentals and Applications

Room: 370ABDE, (3), GRBCC

Sponsor: 4.10 - Indoor Environmental Modeling

Chair: Donghyun Rim, Ph.D., Pennsylvania State University, University Park, PA

1. Ventilation and Corresponding CO2 Levels in Classrooms

Atila Novoselac, Member, University of Texas at Austin, Austin, TX

2. CO2 Sensors Used in Building HVAC Applications: How Reliable Are They?

Som Shrestha, Member, Oak Ridge National Laboratory, Oak Ridge, TN

3. How to Ventilate Schools in Cold Climate with Possible Outdoor Air Pollution: A Proposal of Improvement

Xudong Yang, Fellow ASHRAE, Tsinghua University, Beijing, China

4. CFD Optimization of Carbon Dioxide Removal Efficiency in a Displacement Ventilation System

Ramin Rezaei, Associate Member, Southland Industries, Dulles, VA

5. The Day that Fire Trucks, Ambulances and Engineering Analysis Adversely Impacted Elementary School Students

Duncan Phye, Associate Member, ARL, Alden, MA

11:00 a.m. – 12:30 p.m.

Seminar 14 (Intermediate)



How Can Net Zero Energy Goals, Low Sensible Loads and Ventilation Work in a Hot Humid Climate?

Track: Residential Modern Buildings in Hot and Humid Climates

Room: 371CF, (3), GRBCC

Sponsors: 1.12 - Moisture Management in Buildings, MTG.

BD - Building Dampness and Residential Building Committee

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

1. It's Not the Heat, It's the Humidity!

Robert Bean, P.L.(Eng.), Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

2. Houston, We Have a Problem!

Kristof Irwin, M.Eng., Member, Positive Energy, Austin, TX

3. Sensible Heat Ratios for Ultra-Low Load Homes Present Challenges for High Efficiency Equipment

Nikki Krueger, Therma-Stor LLC, Madison, WI

4. Hot Humid Holistic HVAC Solutions

Kimberly LLeWellyn, Mitsubishi Electric Cooling & Heating, Suwanee, GA

11:00 a.m. – 12:30 p.m.

Seminar 15 (Basic)



Unblock the Road to Your Career

Track: Professional Skills

Room: 372BE, (3), GRBCC

Sponsor: YEA Committee

Chair: Emilia Targonska, Foster and Partners, London, United Kingdom

1. The Highway to the Perfect Elevator Speech

Rachel Romero, Member, NREL, Lakewood, CO

2. Open the Communication Street for Differing Viewpoints

Lindsey King, Associate Member, JCI, New Freedom, PA

3. The Professional Engineer Avenue

Stephen Wren, Member, Mesa Associates, Inc, Chattanooga, TN

11:00 a.m. – 12:30 p.m.

Seminar 16 (Intermediate)



Urban-Scale Energy Modeling, Part 8

Track: Fundamentals and Applications

Room: 372AD, (3), GRBCC

Sponsors: 1.5 - Computer Applications and 4.7 - Energy Calculations

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

1. A Comparison of Two Modeling Approaches for Establishing and Implementing Energy Use Reduction Targets for a University Campus

Shreshth Nagpal, MIT, Boston, MA

2. Impacts of Building Geometry Simplification on Energy Simulation Results of Urban Building Energy Models

Tianzhen Hong, Member, Lawrence Berkeley National Lab, Berkeley, CA

3. Stepping Outside the Door: Using Building Energy Modeling to Understand the Impact of Energy Choices

Matt Cox, The Greelink Group, Atlanta, GA

11:00 a.m. – 12:30 p.m.

Workshop 4 (Intermediate)



Achieving Acceptability and Minimizing Adverse Health Effects through Ventilation: What You Thought You Knew

Track: Research Summit

Room: 371AB, (3), GRBCC

Sponsors: EHC and SSPC 62.1 is primary sponsor

Chair: Jennifer Isenbeck, P.E., Sodexo, Tampa, FL

1. Airborne Disease Transmission

Mark Buttner, Nevada State Public Health Laboratory, UNLV Branch, Las Vegas, NV

2. Infection Control

Erica Stewart, Member, Kaiser Permanente National EH&S, Pasadena, CA

3. Ventilation: Health and Productivity

William Fisk, Lawrence Berkeley National Laboratory, Berkeley, CA

4. Ventilation Effectiveness

Hoy Bohanon, Member, Hoy Bohanon Engineering PLLC, Clemmons, NC

1:30 p.m. – 3:00 p.m.

Technical Paper Session 2 (Intermediate)**New Developments in HVAC Fundamentals***Track: Fundamentals and Applications**Room: 370CF, (3), GRBCC*

Chair: Marija Todorovic, Ph.D, University of Belgrade, Belgrade, Serbia

1. Non-Singular Terminal Sliding Mode Control of Compression Refrigeration System with a Disturbance Observer (HO-18-004)

Junjian Liu, Ph.D, Innovent Biologics, Beijing, China

2. Development of a Distributed Building Fault Detection, Diagnostic and Evaluation System (HO-18-005)

Zixiao Shi, Carleton University, Ottawa, ON, Canada

3. An Evaluation of Two Cooling Control Strategies with Variable Airflow Series Fan Powered Terminal Units (HO-18-006)

Dennis O'Neal, Member, Baylor University, Waco, TX

4. Regression and Artificial Neural Network Models with Data Classifications for Building Energy Predictions (HO-18-007)

Nihal AlRaei, North Carolina A&T University, Greensboro, NC

1:30 p.m. – 3:00 p.m.

Conference Paper Session 3 (Intermediate)

Balancing Indoor Climate Control with Aesthetics and Energy Efficient Construction of Residential Buildings

*Track: Residential Modern Buildings in Hot and Humid Climates**Room: 371CF, (3), GRBCC*

Chair: Mini Malhotra, Ph.D, Oak Ridge National Lab, Oak Ridge, TN

1. Field Test and Comparative Analysis of the Ground Source Heat Pump Systems With Different Air-Conditioning Units for Residential Buildings in the Hot Summer and Cold Winter Zone (HO-18-C006)

Mingyang Qian, Da Yan, Ph.D., Tsinghua University, Beijing, China

2. The Effect of Fenestration System on Building Daylighting and Solar Radiation: An Experimental Study in Humid Subtropical Climate (HO-18-C007)

Joseph Rendall¹, Student Member, Stephanie Chin², Student Member, Hui Shen¹, Ph.D., Associate Member, Xiaoyu Liu¹, (1) Texas A&M University-Kingsville., Kingsville, TX, (2) Massachusetts Institute of Technology, Cambridge, MA

3. An Evaluation of the Effect of Age of House Construction on Electrical Energy Consumption in Montgomery County, Texas (HO-18-C008)

Melina Cedillo¹, Ben Bigelow², Ph.D., (1) Texas A&M University, College Station, TX, (2) University of Oklahoma, Norman, OK

4. Assessing the Risk of Overheating in High-Performance Social Housing Buildings With the Use of Regression Analysis (HO-18-C009)

Jean Rouleau, Student Member, Louis Gosselin, Member, Université Laval, Québec, QC, Canada

1:30 p.m. – 3:00 p.m.

Seminar 17 (Intermediate)



**Documented HVAC System Efficiency Deterioration:
A Case Study**

Track: HVAC&R Systems and Equipment

Room: 370ABDE, (3), GRBCC

Sponsor: 7.3 - Operation and Maintenance Management

*Chair: Mina Agarabi, P.E., Agarabi Engineering PLLC,
New York, NY*

**1. Documented HVAC System Efficiency Deterioration:
A Case Study (1)**

Mel Johnson, Member, National Comfort Institute, Pekin, IL

**2. Documented HVAC System Efficiency Deterioration:
A Case Study (2)**

Ben Lipscomb, Member, National Comfort Institute, Whitefish, MT

**3. Documented HVAC System Efficiency Deterioration:
A Case Study (3)**

Rob Falke, Member, National Comfort Institute, Avon Lake, OH

1:30 p.m. – 3:00 p.m.

Seminar 18 (Intermediate)



**Outcomes from IEA EBC Annex 66 Project on Occupant
Behavior**

Track: HVAC&R Analytics

Room: 372BE, (3), GRBCC

**Sponsors: MTG.OBB - Occupant Behavior in Buildings and
7.5 - Smart Building Systems**

*Chair: Bing Dong, Ph.D., University of Texas at San Antonio,
San Antonio, TX*

**1. Sensing Occupant Behavior and Associated Data Analytics in
Buildings**

*Bing Dong, Associate Member, University of Texas at San Antonio,
San Antonio, TX*

**2. Assumptions and Models of Occupant Behavior in Building
Performance Simulation: Do They Matter?**

Tianzhen Hong, Member, LBNL, Berkeley, CA

3. Lessons Learned From Applications of Occupant Behavior Modeling

*Clinton J. Andrews, Member, Rutgers, The State University of
New Jersey, New Brunswick, NJ*

**4. Development of Data Analytic Techniques to Integrate Occupant
Behavior Into Building Design**

Da Yan, Tsinghua University, Beijing, China

1:30 p.m. – 3:00 p.m.

Seminar 19 (Intermediate)



Secondary Disinfection of Building Water Systems

Track: Fundamentals and Applications

Room: 372CF, (3), GRBCC

Sponsor: 3.6 - Water Treatment

Chair: Dan B. Weimar, Chem-Aqua, Inc, Irving, TX

**1. Secondary Disinfection of Building Water Systems: Preventing
Disease due to Legionella and Other Waterborne Pathogens**

*Janet Stout, Associate Member, Special Pathogens Laboratory,
Pittsburgh, PA*

2. Secondary Disinfection of Building Water Systems

Tim Keane, Member, Legionella Risk Management Inc., Chalfont, PA

3. Chemistry and Control of Secondary Disinfection Applications

Jon Cohen, ChemTreat, Naperville, IL

1:30 p.m. – 3:00 p.m.

Seminar 20 (Basic)

The Future of CHP: Packaged Systems, Resilience and Microgrids

Track: District Energy and Cogeneration Plants

Room: 371DE, (3), GRBCC

Sponsors: 1.10 - Cogeneration Systems, 6.2 - District Energy and 6.9 Thermal Storage and 8.3 Absorption and Heat Operated Machines

Chair: Timothy Wagner, Ph.D., United Technologies Research Center, East Hartford, CT

1. CHP Systems: Reducing Risk and Improving Design, Packaged Systems Under 10 MW

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

2. CHP and Resilience Planning

Bruce Hedman, Entropy Research. LLC, Arlington, VA

3. Resilient CHP Microgrid Design: Hospital Case Study

Gearoid Foley, Member, Integrated CHP Systems Corp., Princeton Junction, NJ

1:30 p.m. – 3:00 p.m.

Seminar 21 (Basic)



Your Ethics Tool Box: Building a Framework for Ethical Decision-Making With Case Studies

Track: Professional Skills

Room: 371AB, (3), GRBCC

Sponsor: 1.7 - Business, Management & General Legal Education

Chair: Michael Bilderbeck, P.E., Pickering Firm, Memphis, TN

1. Case Studies in Engineering Ethics, Part 1

James Arnold, Member, Haslett Heating and Cooling, Columbus, OH

2. Case Studies in Engineering Ethics, Part 2

Kristin Schaefer, Member, Schaefer Engineering, Katy, TX

3. Case Studies in Engineering Ethics, Part 3

Scott Fanning, Member, Fanning and Fanning, Lubbock, TX

4. Case Studies in Engineering Ethics, Part 4

Michael Bilderbeck, Fellow ASHRAE, Pickering Firm, Memphis, TN

1:30 p.m. – 3:00 p.m.

Workshop 5 (Basic)



Load Calculations Missing Link: Taking Load Calculations Through to Equipment Sizing

Track: Fundamentals and Applications

Room: 372AD, (3), GRBCC

Sponsor: 4.1 - Load Calculation Data and Procedures

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

Monday, June 25

1. Load Calculations Missing Link: Taking Load Calculations Through to Equipment Sizing: The Vendor Perspective

James Pegues, Member, Carrier Corporation, Syracuse, NY

2. Load Calculations Missing Link: Taking Load Calculations Through to Equipment Sizing: The Design Engineer Perspective

Steve Bruning, Fellow ASHRAE, Newcomb & Boyd, Atlanta, GA

3:15 p.m. – 4:45 p.m.

Seminar 22 (Intermediate)



New ASHRAE Standard 209 on Simulation Aided Design for Buildings

Track: HVAC&R Systems and Equipment

Room: 372BE, (3), GRBCC

Sponsors: 4.7 - Energy Calculations and SPC 209

Chair: Erik Kolderup, P.E., Kolderup Consulting, San Francisco, CA

1. Introduction to the New ASHRAE Standard 209 on Simulation Aided Design

Jason Glazer, Member, GARD Analytics, Inc., Arlington Heights, IL

2. Climate Analysis Examples for ASHRAE Standard 209

Alejandra Menchaca, Resource Refocus LLC, Menlo Park, CA

3. Analysis of Conceptual Building Designs in Compliance with ASHRAE Standard 209

Clark Denson, Member, Smith Seckman Reid, Nashville, TN

4. Optimization of Hospital Window Design in Compliance with ASHRAE Standard 209

Andy Brophy Associate Member, Smith Seckman Reid, Spring Hill, TN

5. Innovative Graphical Presentations of Early Design Simulation Results

Jacob Dunn, Eskew+Dumez+Ripple, New Orleans, LA

Monday, June 25

8:00 a.m. – 9:30 a.m.

Conference Paper Session 4 (Intermediate)

Filtration for Improved Air Quality

Track: HVAC&R Systems and Equipment

Room: 371CF, (3), GRBCC

Chair: John Dunlap, P.E., Dunlap & Partners, Richmond, VA

1. Comparison of Air Resistance Between Electrospun Nanofiber Filters and Conventional Filters (HO-18-C010)

Chun Chen, Ph.D., Associate Member, Tongling Xia, Student Member, The Chinese University of Hong Kong, Hong Kong

2. Particulate Matter Emission Rates from Common Scent Sources (HO-18-C011)

Ernesto Diaz Lozano Patino, Alireza Mahdavi, Student Member, Jeffrey Siegel, Ph.D., University of Toronto, ON, Canada

3. In-Situ Integrated Filter Efficiency Measurement (HO-18-C012)

Masih Alavy, Student Member, Alireza Mahdavi, Student Member, Jeffrey Siegel, Ph.D., Tianyuan Li, Student Member, Fellow ASHRAE, University of Toronto, Toronto, ON, Canada

4. Evaluation of Low-Cost Particulate Matter (PM) Sensors: A Preliminary Investigation (HO-18-C013)

Defeng Qian, Student Member, Zheng O'Neill, Ph.D., P.E., Zhihong Pang, Student Member, University of Alabama, Tuscaloosa, AL



8:00 a.m. – 9:30 a.m.

Conference Paper Session 5 (Intermediate)**Thermal Comfort in Buildings Around the World:
Case Study Analysis and Control Approach***Track: HVAC&R Analytics**Room: 370CF, (3), GRBCC**Chair: Marilyn Listvan, Ph.D, Listvan & Assoc., Edina, MN***1. Application of Mobile-Internet-Based Occupancy Data in Building Energy Model Calibration: A Case Study (HO-18-C014)****Zhihong Pang¹**, Student Member, Peng Xu², Ph.D., P.E., Member, Zheng O'Neill¹, Ph.D., P.E., Member, (1) The University of Alabama, Tuscaloosa, AL., (2) Tongji University, Shanghai, China**2. Results From a Case Study: Fault-Detection in Air Handling Units in Commercial Buildings (HO-18-C015)****Suhrid Deshmukh**, Student Member, Leon Glicksman, Fellow ASHRAE, Leslie Norford, MIT, Cambridge, MA**3. Performance and Economical Analyses of a Dew Point Evaporative Cooling System Using Stepwise Regression Approach (HO-18-C016)****Hamidreza Hasani Balyani¹**, Student Member, Ali Sohani², Hoseyn Sayyaadi², Ph.D., Member, Valeriy Maisotsenko³, Ph.D., Member, (1) University of Wisconsin Milwaukee, Milwaukee, WI, (2) KN Toosi University of Technology, Tehran, Iran, (3) Colorado Corp and Idalex Inc, Arvada, CO**4. Low-Lift Cooling for Non-Residential Buildings in Hot-Humid Climates: A Case Study of the 3 for 2 Project in Singapore (HO-18-C017)****Bharath Seshadri¹**, Adam Martin Rysanek², Ph.D., Arno Schlueter¹, Ph.D., (1) ETH Zurich, Zurich, Switzerland, (2) University of British Columbia, Vancouver, Canada

8:00 a.m. – 9:30 a.m.

Seminar 23 (Intermediate)**Faster, Cheaper, More Accessible: The Latest Research in Airflow and Thermal Modeling of Indoor Environments***Track: Research Summit**Room: 371DE, (3), GRBCC**Sponsors: 4.10 - Indoor Environmental Modeling and 9.9 - Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment**Chair: James VanGilder, P.E., Schneider Electric, Andover, MA***1. Use of Proper Orthogonal Decomposition to Study Data Center Thermally: Aware, Energy-Based Load Placement****Dustin Demetriou**, IBM, Poughkeepsie, NY**2. A Fast and Self-Learning Reduced Order Model for Indoor Airflow Simulation****Wangda Zuo**, University of Colorado Boulder, Boulder, CO**3. Adaptive Coarse-Grid Generation Methods Used in Simulating Indoor Airflow by Fast Fluid Dynamics****Qingyan Chen**, Fellow ASHRAE, Purdue University, West Lafayette, IN**4. Adaptive-Time Step and High-Order Fast Fluid Dynamics for Building Airflow Modeling****Liangzhu (Leon) Wang**, Member, Concordia University, Montreal, QC, Canada

8:00 a.m. – 9:30 a.m.

Seminar 24 (Intermediate)



How to Hit the Bulls-EUI: Setting Targets, Using Tools and Outcome-Based Compliance

Track: Fundamentals and Applications

Room: 370ABDE, (3), GRBCC

Sponsor: 7.6 - Building Energy Performance

Chair: David Stewart Eldridge, P.E., Grumman/Butkus Associates, Evanston, IL

1. Building Energy Performance: Closing the Design-Operations Gap
Scott West, Member, HFA, Fort Worth, TX

2. On-Site and Off-Site Renewable Energy for Zero-Net-Energy Buildings

Charles Eley, Member, Eley Associates, San Francisco, CA

3. Can Codes Deliver EUI Outcomes?

Mark Frankel, Affiliate, New Buildings Institute, White Salmon, WA

8:00 a.m. – 9:30 a.m.

Seminar 25 (Intermediate)



Modeling Durable Residential Buildings in Hot and Humid Climates and Their Impact to HVAC Systems

Track: Residential Modern Buildings in Hot and Humid Climates

Room: 371AB, (3), GRBCC

Sponsor: 4.4 - Building Materials and Building Envelope Performance

Chair: Paulo Cesar Tabares-Velasco, Ph.D., Colorado School of Mines, Golden, CO

1. Modeling Moisture Buffering in Building Energy Simulations
Jason Woods, Member, National Renewable Energy Laboratory, Golden, CO

2. Residential Whole Building Energy and Moisture Modeling for Integral Building Design for Hot and Humid Weather
Florian Antretter, Member, Fraunhofer-Institut für Bauphysik, Munich, Germany

3. What is Behind the Building Science Advisor?
Philip R Boudreaux, Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

4. Modeling of HVAC Systems Interactions with the Building Envelope
Peter Adams, Morrison Hershfield Ltd, Toronto, ON, Canada

8:00 a.m. – 9:30 a.m.

Seminar 26 (Basic)



Reanalysis Data: How Good is It, How Do We Get It and How Useful is It?

Track: Fundamentals and Applications

Room: 372AD, (3), GRBCC

Sponsor: 4.2 - Climatic Information

Chair: Juan Carlos Baltazar, Texas University, TX

1. Introduction to Climate Reanalysis for Use in ASHRAE Applications

Michael Roth, Klimaat, Guelph, ON, Canada

2. ASHRAE Climatic Design Parameters Derived from Reanalysis Data and Delivered Via a GIS-Enabled Web Portal

David John Westberg, Member, *SSAI/NASA Langley Research Center, Hampton, VA*

3. Evaluation of Impact of MERRA-2 Hourly Data on Building Energy Performance

Drury Crawley, Fellow ASHRAE, *Bentley Systems, Inc., Washington, D.C.*

4. Comparison of Reanalysis to Observational Weather Data in Different Climates and an Analysis of Their Impact on Building Load Calculations and Energy Simulations

Yu Joe Huang, Member, *White Box Technologies, Berkeley, CA*

8:00 a.m. – 9:30 a.m.

Seminar 27 (Intermediate)



Supermarket Refrigeration System Diagnostics: Opportunities and State of the Art

Track: Research Summit

Room: 372BE, (3), GRBCC

Sponsors: 7.5 - Smart Building Systems and 10.7 – Commercial Food and Beverage Refrigeration Equipment

Chair: David Yuill, Ph.D., P.E., University of Nebraska – Lincoln, Omaha, NE

1. Delivering Supermarket Energy and Maintenance Savings

Utilizing Fault Detection and Diagnostic, Controls and Cloud-Based Analytics

John Wallace, Member, *Emerson Commercial & Residential Solutions, Kennesaw, GA*

2. Opportunities for Fault Detection and Diagnostic in Supermarket Refrigeration

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

3. Fault Detection and Diagnostic (FDD) Methods for Supermarkets (RP-1615)

Alireza Behfar, Student Member, *University of Nebraska – Lincoln-Omaha, NE*

8:00 a.m. – 9:30 a.m.

Seminar 28 (Intermediate)



Using District Energy to Survive a Storm: Case Studies in Disaster Preparedness

Track: Safeguarding Your HVAC&R System

Room: 372CF, (3), GRBCC

Sponsors: 6.2 - District Energy, 1.10 - Cogeneration Systems and TC8.3 and TC6.9

Chair: Tim M. Anderson, P.E., Applied Engineering Services, Inc, Indianapolis, IN

1. Dealing with Hurricane Harvey Using the Resiliency of the District Energy System

Bruce Flaniken, Fellow Life Member, *Methodist Hospital, Houston, TX*

2. Wading Through Harvey at Houston Airports

Eren Selcen, Member, *Houston Airport System, Houston, TX*

3. University of Texas at Austin: Disaster Preparedness using a Microgrid with CHP and District Energy

Juan Ontiveros, *University of Texas, Austin, TX*

9:45 a.m. – 10:45 a.m.

Conference Paper Session 6 (Intermediate)

Effective Ways to Address Thermal Comfort and Cooling Load

Track: Fundamentals and Applications



Room: 371DE, (3), GRBCC

Chair: Ratnesh Tiwari, Ph.D, University of Maryland, Hyattsville, MD

1. Energy Performance of Automated Dynamic Interior Venetian Blinds in Commercial Buildings (HO-18-C018)

Niraj Kunwar, Student Member, Kristen Cetin, Ph.D., P.E., Ulrike Passe, Associate Member, Iowa State University, Ames, IA

2. Professional PV Design and Management Systems: Effects of PV on the Cooling Load of Buildings (HO-18-C019) – WITHDRAWN

Rebecca Yang, W. M. Pabasara Upalakshi Wijeratne, RMIT University, Melbourne, VIC, Australia

3. Use of Optical Distributed Sensors for Spatial Temperature Measurements in HVAC&R Research (HO-18-C020)

Brian M Fronk, Greg DuChane, Member, Tabeel A Jacob, Student Member, Oregon State University, Corvallis, OR

9:45 a.m. – 10:45 a.m.

Conference Paper Session 7 (Intermediate)

HVAC Ventilation Control for Maximum Efficiency and Comfort

Track: HVAC&R Analytics



Room: 371CF, (3), GRBCC

Chair: Samir Traboulsi, Ph.D, P.E., Thermotrade/Ranec, Beirut, Lebanon

1. Testing Occupancy-Driven Controls to Reduce Energy Consumption of a VAV System (HO-18-C021)

Joel Dickie, University of Wyoming, Laramie, WY

2. Data Driven Ventilation Reset Control for Educational Institutions (HO-18-C022)

Lourdes Marozas-Aliaga, Roger Chen, Ph.D., Thomas Trabold, Rochester Institute of Technology, Rochester, New York

3. A Statistical Approach for Estimating Ventilation Rates in an Office Environment (HO-18-C023)

Tomas Novotny, Member, Samy Clinchard, Ulla Haverinen-Shaughnessy, DSc, 720 Degrees Ltd., New York, NY

9:45 a.m. – 10:45 a.m.

Conference Paper Session 8 (Intermediate)

The “Design Team”: How to Improve Design Team Cooperation, Performance and Effectiveness

Track: Professional Skills



Room: 370CF, (3), GRBCC

Chair: Bass Abushakra, United States Military Academy, West Point, NY

1. The Different Effects of a Morphological Approach on Design Team Cooperation With Students and Professionals (HO-18-C024)

Wim Zeiler, Eindhoven University of Technology, Eindhoven, Netherlands

2. Forming Design Teams for Improved Performances (HO-18-C025)

Wim Zeiler, Eindhoven University of Technology, Eindhoven, Netherlands

9:45 a.m. – 10:45 a.m.

Conference Paper Session 9 (Intermediate)**Thermal Comfort at the Forefront of HVAC Design***Track: HVAC&R Control Freaks**Room: 372AD, (3), GRBCC**Chair: Chris Laughman, Mitsubishi Electric Research Lab, Waltham, MA***1. PCM Cooling Vests of Different Melting Temperatures in a Two-Bout Strategy to Enhance Comfort and Sensation: An Experimental Study (HO-18-C026)***Mariam Itani¹, Nesreen Ghaddar¹, Ph.D, Kamel Abou Ghali¹, Beatrice Khater¹, M.D., Djamel Ouahrani², Ph.D., (1) American University of Beirut, Beirut, Lebanon, (2) Qatar University, Doha, Qatar***2. Application of Model Predictive Control to Building Energy Systems with Thermal Energy Storage (HO-18-C027)***Ryozo Ooka¹, Member, Doyun Lee¹, Shintaro Ikeda¹, Wonjun Choi¹, Ph.D., Associate Member, Younghoon Kwak², Ph.D., (1) University of Tokyo, Tokyo, Japan, (2) Kyonggi University, Suwon, South Korea***3. Thermal Comfort in Educational Buildings Using Computer Simulation as a Tool: The Challenge of a Brazilian Public University (HO-18-C028)***Ana Julia Campos Kfourri, Student Member, Cristóvão Vicente Scapulatempo Fernandes, Ph.D., Federal University of Parana, Curitiba, Brazil*

9:45 a.m. – 10:45 a.m.

Seminar 29 (Intermediate)**Control Freaks and Internet of Things Geeks: The Future of Building Automation***Track: HVAC&R Control Freaks**Room: 371AB, (3), GRBCC**Sponsors: 1.4 – Control Theory and Application and 7.5 – Smart Building Systems**Chair: Joseph Kilcoyne, P.E., SC Engineers, Inc., San Diego, CA***1. IoT is Here: An Internet of Things Readiness Guide***Tunji Asiwaju, Member, Armstrong Fluid Technology, Toronto, ON, Canada***2. Big Data and the Cognitive Era: What Does It Mean for Our Buildings?***Claire Penny, IBM, Dublin, Ireland*

9:45 a.m. – 10:45 a.m.

Seminar 30 (Intermediate)**Have We Succeeded in Decoding Low Delta T?***Track: Fundamentals and Applications**Room: 372BE, (3), GRBCC**Sponsors: 6.1 – Hydronic and Steam Equipment and Systems and 6.2 – District Energy**Chair: Rex Scare, P.E., Armstrong International Inc, Three Rivers, MI***1. Pressure Independent Technology and its Effect on Systems and Energy***Tricia Bruenn, Member, Belimo Americas, Danbury, CT*

Monday, June 25

2. A District Cooling Case Study: Chilled Water Delta T Improvement at LAX

Steve Tredinnick, Member, Burns & McDonnell, Downers Grove, IL

3. Retro-Commissioning of Chilled Water System at Northwestern Memorial Hospital

Mark Chmura, Burns & McDonnell, Downers Grove, IL

9:45 a.m. – 10:45 a.m.

Seminar 31 (Intermediate)



Leveraging Compressor Methods of Test for Research and Development

Track: Research Summit

Room: 370ABDE, (3), GRBCC

Sponsor: 8.1 - Positive Displacement Compressors

Chair: Craig Robert Bradshaw, Ph.D., Oklahoma State University, Stillwater, OK

1. Measurements of a Refrigerant Vapor Injected Scroll Compressor Using a Calorimeter

Daive Ziviani, Purdue University, West Lafayette, IN

2. Development of a Light-Commercial Hot-Gas Bypass Load Stand for Accelerated Compressor Development

Drew Schmidt, Student Member, Oklahoma State University, Stillwater, OK

3. Lubricant and Other Studies for Optimized Compressor Reliability and Performance

Joe Karnaz, Member, Shrieve Chemical, Houston, TX

9:45 a.m. – 10:45 a.m.

Seminar 32 (Intermediate)



State of the Art in Moist Air Properties Calculations

Track: Fundamentals and Applications

Room: 372CF, (3), GRBCC

Sponsor: 1.1 - Thermodynamics and Psychrometrics

Chair: Omar Abdelaziz, Ph.D., CLEAT Consulting, Dubai, United Arab Emirates

1. Overview of SPC213P Equations for Calculating Thermodynamic Properties of Moist Air

Vikrant Aute, Member, University of Maryland, College Park, MD

2. Updated Transport Properties of Moist Air

Sebastian Herrmann, Universitat Rostock, Rostock, Germany

11:00 a.m. – 12:00 p.m.

Conference Paper Session 10 (Intermediate)**Consumption, Diversity and Efficiency of Energy Use in Public Communities and the Demand on District Energy Systems***Track: District Energy and Cogeneration Plants**Room: 370CF, (3), GRBCC**Chair: Hyojin Kim, Ph.D, The Catholic University of America, Washington, D.C.***1. Sustainability and Resilience: Examples of Community and Campus Energy Assessments (HO-18-C029)***Chonghui Liu, P.E., Member, IPD Engineering, Syracuse, NY***2. Analysis of Load Diversity in China Residential Districts and Its Influence on District HVAC System Design (HO-18-C030)***Jingjing An, Da Yan, Ph.D., Tsinghua University, Beijing, China***3. Influence of the Rate of Renovation of the Public Communities on the Efficiency of the District Heating Systems (HO-18-C031)***Aleksandrs Zajacs, Anatolijs Borodinecs, Member, Raimonds Bogdanovics, Riga Technical University, Riga, Latvia*

11:00 a.m. – 12:00 p.m.

Conference Paper Session 11 (Intermediate)**Life Safety System Design***Track: Fundamentals and Applications**Room: 371CF, (3), GRBCC***TC 5.6 – Control of Fire and Smoke***Chair: Paul Turnbull, Seimens Industry, Inc., Buffalo Grove, IL***1. CFD Modeling of Flammable Refrigerant Leaks Inside Machine Rooms: Emergency Ventilation Rate for Different Size Chillers (HO-18-C032)***Paul Papas, Larry Burns, Member, Parmesh Verma, Richard Lord Fellow ASHRAE, Shiling Zhang, Ph.D., United Technologies Research Center, East Hartford, CT, Carrier Corporation, East Hartford, CT***2. A New Look at Door Opening Forces in Smoke Control Systems (HO-18-C033)***John Klote, Fellow Life Member, John Klote Fire and Smoke Consulting, Leesburg, VA***3. Design Considerations for Modulating Stair Pressurization Systems (HO-18-C034)***Steven M. Strege, Member, Brandon Charles Ingram, P.E., Jensen Hughes Inc., Baltimore, MD*

11:00 a.m. – 12:00 p.m.

Seminar 33 (Intermediate)**Blade vs. Venturi Laboratory Controls: Proper Application and Testing to Safeguard Your Lab***Track: Safeguarding Your HVAC&R System**Room: 370ABDE, (3), GRBCC**Sponsors: 7.7 - Testing and Balancing and 9.10 – Laboratory Systems**Chair: Thomas Schlachter, P.E., Engineered Air Balance Co Inc, Richardson, TX*

1. Fundamental and Sustainable Strategies Using Venturi-Type Air Valves (VAV Terminals) in Lab Applications

David Rausch, *Phoenix Controls, Acton, MA*

2. Fundamental and Sustainable Strategies Using Blade-Type Air Valves (VAV Terminals) in Lab Applications

Paul Fuson, *Siemens Building Technologies, Buffalo Grove, IL*

3. Blade vs. Venturi Laboratory Controls: Proper Application and Testing to Safeguard Your Lab

Justin Garner, Member, *Engineered Air Balance Company, Inc., Houston, TX*

11:00 a.m. – 12:00 p.m.

Seminar 34 (Advanced)



Industrial HVAC 101

Track: Fundamentals and Applications

Room: 372CF, (3), GRBCC

Sponsor: 1.7 - Business, Management & General Legal Education

Chair: Eileen Jensen, Bonneville Power Administration, Vancouver, WA

1. Industrial HVAC Design and Construction 101

Erich Binder, Member, *Erich Binder Consulting Limited, Calgary, AB, Canada*

2. Industrial Commissioning 101

Michael C. Connor, P.E., Member, *WSP USA, Atlanta, GA*

11:00 a.m. – 12:00 p.m.

Seminar 35 (Intermediate)



Inverse Design and Modeling for Indoor Environment

Track: Research Summit

Room: 372BE, (3), GRBCC

Sponsor: 4.10 - Indoor Environmental Modeling

Chair: Liangzhu (Leon) Wang, Ph.D., P.E., Concordia University, Montreal, QC, Canada

1. Inverse Indoor Environment Designs by CFD-Based Genetic Algorithm Method

John Zhai, Member, *University of Colorado, Boulder, CO*

2. Inverse Indoor Environment Designs by CFD-Based Adjoint Method

Qingyan Chen, Fellow ASHRAE, *Purdue University, West Lafayette, IN*

3. Inverse Indoor Environment Designs by CFD-Based Proper Orthogonal Decomposition Method

Tengfei (Tim) Zhang, *Dalian University Of Technology, Dalian, China*

11:00 a.m. – 12:00 p.m.

Seminar 36 (Advanced)



Let's Optimize the Usability of Building Automation Systems

Track: HVAC&R Control Freaks

Room: 371AB, (3), GRBCC

Sponsor: 7.6 - Building Energy Performance

Chair: Wade H. Conlan, P.E., Hanson Professional Services, Maitland, FL

1. Let's Optimize Your BAS GUI for Operation and Maintenance Management Savings

Nate Boyd, Member, *Hanson Professional Services Inc., Maitland, FL*

2. Standardization and Managing Building Automation for Large Campuses

Alex Parlato, Member, University of Central Florida, Orlando, FL

11:00 a.m. – 12:00 p.m.

Seminar 37 (Intermediate)**Selection and Application Considerations of Fans Used in Variable Air Volume Systems**

Track: HVAC&R Systems and Equipment

Room: 371DE, (3), GRBCC

Sponsors: 5.1 - Fans and 5.9 - Enclosed Vehicular Facilities

Chair: Walter Mecozzi, P.E., ClimateCraft, Inc, Edmond, OK

1. Selection Considerations for Fans Used in Variable Air Volume Systems

Mark W Fly, Fellow ASHRAE, AAON, Inc., Tulsa, OK

2. Fan Systems: Part-Load Energy Performance and TAB/Commissioning Opportunities

Craig Wray, P.Eng, Member, Retired, Winnipeg, MB, Canada

2:15 p.m. – 3:45 p.m.

Debate 1 (Intermediate)**College of Fellow's Debate: Are Cities Sustainable?**

Track: Fundamentals and Applications

Room: 372BE, (3), GRBCC

Sponsors: College of Fellows and EHC

Moderator: Larry Spielvogel, P.E., Consulting Engineer, Bala Cynwyd, PA

Recently, the world's population made a subtle but significant shift: 54% of the world's population now live in cities. In North America, 82% live in urban areas. By 2050, 62% of the world's population will live in cities with over 40 cities at populations over 10 million by 2030. But investment in infrastructure, services and other necessities and accoutrements has lagged behind this movement. Will this density of people overtax the energy, infrastructure and resource carrying capacity of these human-made socio-ecosystems or are we headed for a colossal collapse? Come to hear this debate on the question are cities sustainable?

1. Don Beaty, P.E., Member, DLB Associates, Eatontown, NJ

2. Frank Mills, CEng, Life Member, Frank Mills Consulting, Leyland, United Kingdom

3. Jin Jin Huang, Member, Con Edison of New York, Harrison, NJ

4. Ashish Rakheja, P.E., Member, AEON, Noida, India

5. Larissa Williams, Sustainability Division of Department of Administration and Regulatory Affairs, Houston, TX

6. E. Mitchell Swann, P.E., Member, MDCSystems LLC, Paoli, PA

6:30 p.m. – 9:00 p.m.

Seminar TC (Intermediate)**Early HVAC System Modeling and Efficiency Comparison Tool using the New Building Energy Efficiency Ratio (BEER)**

Track: HVAC&R Analytics

Room: 370CF, (3), GRBCC

Sponsor: 1.5 – Computer Applications

Chair: Richard M. Bostian, HIA-C, Edmond, OK

Tuesday, June 26

8:00 a.m. – 9:30 a.m.

Technical Paper Session 3 (Intermediate)

Optimization and Simulation of HVAC Systems

Track: HVAC&R Analytics

Room: 371CF, (3), GRBCC



Chair: Bass Abushakra, United States Military Academy, West Point, NY

1. Indoor Air Quality Modeling and Assessment (HO-18-008)

Ronald Dougherty, Ph.D, University of Kansas, Lawrence, KS

2. Airflow and Energy Simulations to Assess Energy Savings from Vestibules and Air Curtains (HO-18-009)

Liangzhu (Leon) Wang, Member, Concordia University, Montreal, QC, Canada

3. Simulation Tool for Ground Source Heat Pump System with Multiple Ground Heat Exchangers (HO-18-010)

Takao Katsura, Hokkaido University, Sapporo, Japan

4. Optimizing the Performance of Air Elimination Devices Used in HVAC Water Systems: A CFD Investigation (HO-18-011)

Ali Hasan, Amanties, Doha, Qatar

8:00 a.m. – 9:30 a.m.

Conference Paper Session 12 (Intermediate)

Optimization and Performance of Heat Pumps

Track: HVAC&R Analytics

Room: 370CF, (3), GRBCC



Chair: David A. Yashar, Ph.D, NIST, Gaithersburg, MD

1. Investigation and Evaluation of Multi-Source Heat Pump Units for Maximizing System Efficiency (HO-18-C035)

Yao Yu, Ph.D., Associate Member, Grylord Olson, Rui Miao, Student Member, North Dakota State University, Fargo, ND

2. Real-time Optimization of Vapor-Injection Air-Source Heat Pump Based Water Heating with Extremum Seeking (HO-18-C036)

Yaoyu Li¹, Feng Cao², Ph.D., Wenyi Wang¹, (1) University of Texas at Dallas, Richardson, TX, (2) Xi'An Jiaotoong University, Xi'an, China

3. Performance Mapping and Modelling of Residential Gas-Fired Absorption Heat Pump in Cooling Mode (HO-18-C037)

Kajen Ethirveerasingham, Student Member, Alan S. Fung, Member, Ryerson University, Toronto, ON, Canada

4. Energy, Cost and CO2e Savings Analyses of Reversible, Hybrid and Heating-Only Liquid Fuel Fired Absorption Heat Pumps in the Northeastern United States (HO-18-C038)

Christopher Keinath¹, Ph.D., Member, Michael Garrabrant¹, Thomas Butcher², Ph.D., Member, (1) Stone Mountain Technologies, Inc., Johnson City, TN, (2) National Oilheat Research Alliance

8:00 a.m. – 9:30 a.m.

Seminar 38 (Intermediate)



Energy Efficient Building Technologies

Track: Research Summit

Room: 372AD, (3), GRBCC

Sponsor: Publication and Education Council

Chair: Reinhard Radermacher, Ph.D., University of Maryland, College Park, MD

1. An Experimental Study on Energy Saving Analysis in the Defrost Cycle of Residential Heat Pumps with the Use of Reverse Air Flow During Defrost

Michael M. Ohadi, Fellow ASHRAE, University of Maryland, College Park, MD

2. Effects of an Ultraviolet Coil Irradiation System on the Air-Side Heat Transfer Coefficient and Low ΔT Syndrome in a Hot and Humid Climate

Chandra Sekhar, Fellow ASHRAE, National University of Singapore, Singapore, Singapore

3. Heat Pump Application in NZEB

Carsten Wemhoener, HSR Hochschule für Technik Rapperswil, Rapperswil, Switzerland

8:00 a.m. – 9:30 a.m.

Seminar 39 (Intermediate)



How to Field-Measure and Score the Performance of an Installed HVAC System

Track: HVAC&R Systems and Equipment

Room: 370ABDE, (3), GRBCC

Sponsor: 7.3 - Operation and Maintenance Management

Chair: John Constantinide, Alpha MRC Architects Engineers, Merritt Island, FL

1. How to Field-Measure and Score the Performance of an Installed HVAC System (1)

Don Langston, Member, Aire Rite Air Conditioning, Huntington Beach, CA

2. How to Field-Measure and Score the Performance of an Installed HVAC System (2)

Rob Falke, Member, National Comfort Institute, Avon Lake, OH

8:00 a.m. – 9:30 a.m.

Seminar 40 (Intermediate)



Noise and Vibration Impacts of Safeguarding Buildings and HVAC Systems

Track: Safeguarding Your HVAC&R System

Room: 371AB, (3), GRBCC

Sponsors: 2.6 - Sound and Vibration and 2.7 - Seismic, Wind and Flood Resistant Design

Chair: Erik Miller-Klein, P.E., A3 Acoustics, LLP, Seattle, WA

1. Vibration Control of HVACR Systems that Require Seismic, Wind or Thermal Restraint

Roman Wowk, Associate Member, Papadimos Group, San Francisco, CA

2. Generator Noise Control

Dan LaForgia, Member, Vibro-Acoustics, New York, NY

3. Seismic Source International

James Carlson, Member, *Seismic Source International, Springfield, NE*

8:00 a.m. – 9:30 a.m.

Seminar 41 (Advanced)



The Future of Thermal Cooling to Support Resilient CHP Systems

Track: District Energy and Cogeneration Plants

Room: 372CF, (3), GRBCC

Sponsors: 8.3 - Absorption and Heat Operated Machines, 1.10 - Cogeneration Systems and 6.2 District Energy & 6.9 Thermal storage

Chair: William Arthur Ryan, Ph.D., P.E., Univ. of Illinois at Chicago, Chicago, IL

1. Pinellas County Jail: Decoupled “CCHP” in the Sunshine State with Modern Absorption

Douglas A. Davis, Associate Member, *Broad USA, Hackensack, NJ*

2. Busting the Myths of Absorption Cooling Technology

Rajesh Dixit, Associate Member, *Johnson Controls, Inc., York, PA*

3. Best Method to Utilize Heat of Trigenation: Exergy Transfer Issues in Absorption Cooling

Birol Kilkis, Fellow ASHRAE, *Baskent University, Ankara, Turkey*

8:00 a.m. – 9:30 a.m.

Seminar 42 (Intermediate)



Thermal Energy Storage at the Small Scale: Technologies and Applications for Residential and Small Commercial Buildings

Track: Residential Modern Buildings in Hot and Humid Climates

Room: 371DE, (3), GRBCC

Sponsors: 6.9 - Thermal Storage and TC4.4, Residential Building Committee (RBC)

Chair: Chris Mincey, P.E., Crom LLC, Gainesville, FL

1. Estimating Cost Savings for Residential TES

Paulo Cesar Tabares-Velasco, Member, *Colorado School of Mines, Golden, CO*

2. Isolated Microgrids: An Analysis of Off-Grid Energy Storage

Charles Upshaw, Member, *University of Texas at Austin, Austin, TX*

3. PCM Based Thermal Energy Storage for Residential Applications

Stephen Bourne, Member, *University of Texas at Austin, Austin, TX*

4. Case Study: PCM Performance in Residential Applications

Sajith Wijesuriya, Member, *Colorado School of Mines, Golden, CO*

8:00 a.m. – 9:30 a.m.

Seminar 43 (Intermediate)



What is BACnet Tagging About?

Track: HVAC&R Control Freaks

Room: 372BE, (3), GRBCC

Sponsors: 7.5 - Smart Building Systems, 1.4 - Control Theory and Application and SSPC 135, TC 1.5

Chair: Carol Lomonaco, Johnson Controls, Milwaukee, WI

1. Semantic Information on Building Data

Bernhard Isler, *Siemens Switzerland, Zug, Switzerland*

- 2. Why the Tagging Model is Essential to Having Interoperable Smart Devices That Can Communicate on an M2M Basis**
 Grant Wichenko, Member, *Appin Associate, Winnipeg, MB, Canada*
- 3. The Vision for Using Tags Moving Forward**
 Clifford Copas, *Johnson Controls, Milwaukee, WI*

9:45 a.m. – 10:45 a.m.

**Conference Paper Session 13 (Intermediate)****Energy Flexibility and Demand Control Systems are Important for Building Energy Consumption***Track: District Energy and Cogeneration Plants**Room: 371CF, (3), GRBCC**Chair: Stephen Duda, P.E., Ross & Baruzzini, Inc., Saint Louis, MO***1. Active Participation of Buildings as a Source of Energy Flexibility (HO-18-C039)***Wim Zeiler¹Kevin de Bont², Student Member, Michiel Voerman¹, (1) TU Eindhoven, Eindhoven, Netherlands, (2) Kropman Building Services, Netherlands***2. Buildings' Energy Flexibility from the User to the Smart Grid to Cope with Fluctuations of Renewable Energy (HO-18-C040)***Wim Zeiler, Kennedy Aduda, Kevin de Bont, Student Member, Eindhoven University of Technology, Eindhoven, Netherlands***3. Energy Flexibility of Battery Electricity Storage System: Design, Commissioning and Application (HO-18-C041)***Wim Zeiler¹, Kevin de Bont², Student Member, Michiel Voerman², (1) Eindhoven University of Technology, Eindhoven, Netherlands, (2) Kropman Building Services, Netherlands*

9:45 a.m. – 10:45 a.m.

Seminar 44 (Intermediate)**Advanced Sequences are Optimal: Getting There, Not So Much!***Track: HVAC&R Control Freaks**Room: 370ABDE, (3), GRBCC**Sponsor: 1.4 - Control Theory and Application**Chair: James Del Monaco, P.E., P2S Engineering, San Diego, CA***1. ASHRAE GP36 Case Study for High Performance Sequences***Bill Gnerre, Interval Data Systems, Waltham, MA***2. Reinhardt Seidle Session: Implementation and Pitfalls of Advanced Controls***Reinhard Seidl, Member, Taylor Engineering, Alameda, CA*

9:45 a.m. – 10:45 a.m.

Seminar 45 (Intermediate)**Case Studies to Evaluate Performance Measurement Protocols***Track: HVAC&R Analytics**Room: 372CF, (3), GRBCC**Sponsor: 7.6 - Building Energy Performance**Chair: Bruce Hunn, Ph.D., Hunn Building Energy, Raleigh, NC***1. Lessons Learned From the Building Case Study on Performance Measurement Protocols (PMP) in Laramie, WY***Liping Wang, Member, University of Wyoming, Laramie, WY*

2. Lessons Learned From the Building Case Study in Tuscaloosa, AL
Zheng O'Neill, Member, *University of Alabama, Tuscaloosa, AL*

3. Lessons Learned From the Building Case Study in Des Moines, IA
Xiaohui Zhou, Member, *Seventh Wave, Madison, WI*

9:45 a.m. – 10:45 a.m.

Seminar 46 (Intermediate)



Comparing the Energy, Emissions and Economic Impacts of Buildings in Energy Performance Calculations

Track: Fundamentals and Applications

Room: 371AB, (3), GRBCC

Sponsors: 2.8 - Building Environmental Impacts and Sustainability and Residential Building Committee

Chair: Larry Brand, Gas Technology Institute, Davis, CA

1. EEE Impacts Framework for Determining Energy Performance

Neil Leslie, Member, *Gas Technology Institute, Des Plaines, IL*

2. Application of EEE Impacts Methodology Options to Meet Multiple Policy Objectives

David Goldstein, *Natural Resources Defense Council, San Francisco, CA*

9:45 a.m. – 10:45 a.m.

Seminar 47 (Intermediate)



Controls and Fault Detection

Track: Research Summit

Room: 372AD, (3), GRBCC

Sponsor: Publication and Education Council

Chair: Reinhard Radermacher, Ph.D., University of Maryland, College Park, MD

1. Transient Operation Characteristics and Control Method in Combined Air-Conditioning System

Jongsoo Jeong, *Waseda University, Tokyo, Japan*

2. A Review of Fault Detection and Diagnostics Methods for Building Systems

Srinivas Katipamula, Fellow ASHRAE, *Pacific Northwest National Laboratory, Richland, WA*

9:45 a.m. – 10:45 a.m.

Seminar 48 (Advanced)



New ASHRAE Hot Climate Design Guide

Track: Residential Modern Buildings in Hot and Humid Climates

Room: 372BE, (3), GRBCC

Sponsors: MTG.HCDG - Hot Climate Design Guide and

2.8 - Building Environmental Impacts and Sustainability

Chair: Frank Mills, CEng, Frank Mills Consulting, Leyland, United Kingdom

1. The New ASHRAE Hot Climate Design Guide

Melvin Glass¹, Frank Mills², (1) *EMC, El Paso, TX*, (2) *Frank Mills Consulting, Leyland, United Kingdom*

2. Low Energy Cooling Techniques in Hot Climates Including External

Frank Mills, Life Member, *Frank Mills Consulting, Leyland, United Kingdom*

9:45 a.m. – 10:45 a.m.

Seminar 49 (Advanced)**Uncertainty Analysis for Methods of Measurement and Test***Track: Fundamentals and Applications**Room: 371DE, (3), GRBCC**Sponsors: 1.2 - Instruments and Measurements, 6.6 – Service Water Heating Systems and SSPC 41, SPC 118.2**Chair: Richard L Hall, P.E., Hall Consultants LLC, Worthington, OH***1. Uncertainty Analysis for Method of Test of Positive Displacement Compressors****Christopher Stone, Member, Air-Conditioning, Heating and Refrigeration Institute (AHRI), Arlington, VA****2. Using Uncertainty Analysis to Identify the Impact of Different Parameters****Adam Michalson, Montana State University, Bozeman, MT**

9:45 a.m. – 10:45 a.m.

Forum 2 (Intermediate)**Lead, Follow or Get Out of the Way: ASHRAE Standards in the Residential Market Space***Track: Residential Modern Buildings in Hot and Humid Climates**Room: 370CF, (3), GRBCC**Sponsor: Residential Building Committee, SSPC 90.2**Chair: Chris Mathis, Mathis Consulting, Asheville, NC*

11:00 a.m. – 12:30 p.m.

Technical Paper Session 4 (Intermediate)**Advancements in HVAC Control***Track: HVAC&R Control Freaks**Room: 370CF, (3), GRBCC**Chair: Marija Todorovic, Ph.D, University of Belgrade, Belgrade, Serbia***1. Experimental Comparison of Pressure Loss in Typical Flexible and Sheet Metal Residential Duct Systems (HO-18-012)****D. Kulkarni, Tennessee Tech University, Cookeville, TN****2. An Evaluation of HVAC Failure and Maintenance Equipment Data for Facility Resiliency and Reliability (HO-18-013)****Christopher Thompson, Ph.D, P.E., U.S. Army Corps of Engineers, Fort Belvoir, VA****3. Utilization of the Air System Components as Orifice Meter for Air Flow Control Systems (HO-18-014)****Mikhail Nudelman, Aero Building Solutions, Franklin Park, IL****4. A Quantitative Model-Based Fault Detection and Diagnostics (FDD) System for Zone-Level Inefficiencies (HO-18-015)****Justin Berquist, Student Member, Carleton University, Merrickville, ON, Canada**

11:00 a.m. – 12:30 p.m.

Conference Paper Session 14 (Intermediate)

Diverse Applications of Ventilation Design



Track: HVAC&R Systems and Equipment

Room: 371CF, (3), GRBCC

Chair: John Dunlap, P.E., Dunlap & Partners, Richmond, VA

1. Comparison on Ventilation Requirements for Electric Cooking Appliances Between Wall-Mounted Hood and Single Island Hoods (HO-18-C042)

Toshiya Iwamatsu, Associate Member, Wataru Urabe, Central Research Institute of Electric Power Industry, Komae, Japan

2. Analysis of Spread Index: A Measure of Laboratory Ventilation Effectiveness (HO-18-C043)

Kishor Khankari, Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

3. Effect of Intermittent Personalized Ventilator Coupled with Mixing Ventilation on the Dispersion of Contaminants in the Macroclimate of a Typical Office Space (HO-18-C044)

Douaa Al Assaad¹, Carine Habchi², Kamel Abou Ghali¹, Member, Nesreen Ghaddar¹, Member, (1) American University of Beirut, Lebanon, (2) Lebanese University, Beirut, Lebanon

4. Food Service Building Asset Rating Methodology and Analysis (HO-18-C045)

Supriya Goel, Alex Vlachokostas, Ph.D., Juan Gonzalez Matamoros, Na Wang, Ph.D., Pacific Northwest National Laboratory, Portland, OR

11:00 a.m. – 12:30 p.m.

Seminar 50 (Basic)



Assessing the Impacts of Extreme and Future Weather Scenarios on the Building, City and Grid Scale

Track: Safeguarding Your HVAC&R System

Room: 371AB, (3), GRBCC

Sponsor: 7.5 - Smart Building Systems

Chair: Paulo Cesar Tabares-Velasco, Ph.D., Colorado School of Mines, Golden, CO

1. Prediction and Uncertainty Quantification of Future Heat Waves on the City Scale

Elham Jahani, Student Member, Iowa State University, Ames, IA

2. Climate Change Impacts on Building Performance

Scott Schuetter, Member, Seventhwave, Madison, WI

3. Robust Asset-and-User-Aware Power Grid Dispatch during Extreme Temperatures

Salman Mohagheghi, Colorado School of Mines, Golden, CO

11:00 a.m. – 12:30 p.m.

Seminar 51 (Intermediate)



Demonstration of Conventional and Advanced Hot Water Systems in Commercial Kitchens

Track: HVAC&R Systems and Equipment

Room: 372BE, (3), GRBCC

Sponsor: 6.6 - Service Water Heating Systems

Chair: Denis Livchak, Frontier Energy, San Ramon, CA

1. Results from a Hot Water System Replacement Project in an Elementary School

Michael Slater, Fisher Nickel Inc., San Ramon, CA

2. Results from an In-Depth Hot Water System Replacement Project in a Full Service Restaurant

Don Fisher, Life Member, Frontier Energy Inc., San Ramon, CA

3. Results from 2nd- Generation Commercial Hot Water System Testing Laboratory at PG&E

Edwin Huestis, PG&E, San Ramon, CA

4. Demonstration of Commercial Hot Water System Design Tool and Cost Calculator

Denis Livchak, Frontier Energy, San Ramon, CA

11:00 a.m. – 12:30 p.m.

Seminar 52 (Advanced)



HVAC for Tall and Super Tall Buildings in Hot Humid Climates

Track: Residential Modern Buildings in Hot and Humid Climates

Room: 372CF, (3), GRBCC

Sponsor: 9.12 - Tall Buildings

Chair: Duncan A Phillips, Rowan Williams Davies & Irwin, Guelph, ON, Canada

1. Meteorological Data in a Humid Climate at Grade and 1970ft / 600m

Duncan A Phillips, Rowan Williams Davies & Irwin, Guelph, ON, Canada

2. Natural Ventilation in Supertall Buildings in Hot Humid Climates

Peter Simmonds, Fellow ASHRAE, Building and Systems Analytics LLC, Marina Del Rey, CA

3. Designing Supertall Buildings with Geography and Height in Mind

Medhi Jalayerian, Member, Environmental Systems Design, Inc., Chicago, IL

4. Active Systems at Grade and Height in Tall and Supertall Buildings

Luke Leung, Member, Skidmore, Owings, & Merrill LPP, Chicago, IL

11:00 a.m. – 12:30 p.m.

Seminar 53 (Intermediate)



HVACR Novel Measurement Techniques: The Next Generation

Track: Research Summit

Room: 372AD, (3), GRBCC

Sponsors: 1.3 - Heat Transfer and Fluid Flow and 1.2 – Instruments and Measurements

Chair: Melanie Derby, Ph.D., Kansas State University, Manhattan, KS

1. CP 71 Title: Exploring Potential of Distributed Fiber Temperature Sensing in HVACR Applications

Brian M Fronk, Oregon State University, Corvallis, OR

2. Quantification of Local Air-Side Heat Transfer Through a Novel Optical Method

Stefan Elbel, Member, University of Illinois, Urbana, IL

3. A Novel Measurement Technique for Refrigerant and Oil Charge Measurements in Heat Exchanger Coils (ASHRAE RP-1785)

Christian Bach, Associate Member, Oklahoma State University, Stillwater, OK

4. Capacitive Void Fraction Sensors: Working Principle, Calibration and Applications

Davide Ziviani, Purdue University, West Lafayette, IN

11:00 a.m. – 12:30 p.m.

Seminar 54 (Intermediate)



Projecting the Adoption of Building Efficiency Technologies: An Introduction to Interdisciplinary Modeling Approaches

Track: HVAC&R Analytics

Room: 371DE, (3), GRBCC

Sponsor: MTG.OBB - Occupant Behavior in Buildings

Chair: Jared Langevin, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA

1. Modeling Decision Makers in Technology Adoption Agent Based Models

Ralph Muehleisen, Member, Argonne National Laboratory, Argonne, IL

2. Modeling at the Speed of Light: The Challenges of Forecasting the U.S. LED Market

Mary Yamada, Navigant Consulting, Washington, D.C.

3. Impact Model for US-China Clean Energy Research Center for Building Energy Efficiency

Robert Nachtreib, Lutron Electronics, Coopersburg, PA

4. Bottom-up Electric Vehicles Growth Model

Yoonsoo Lee, National Grid, New York, NY

11:00 a.m. – 12:30 p.m.

Seminar 55 (Intermediate)



The Future of Thermal Energy Storage Supporting Resilient District Energy, CHP Systems and Microgrids

Track: District Energy and Cogeneration Plants

Room: 370ABDE, (3), GRBCC

Sponsors: 6.9 - Thermal Storage, 8.8 - Refrigerant System Controls and Accessories and 1.10 - Cogeneration

Chair: Geoffrey Bares, Enwave Chicago, Chicago, IL

1. Sustainable Microgrids with Renewable Generation: Decoupling the Load with Cool TES

Douglas Reindl, Fellow ASHRAE, University of Wisconsin-Madison, Madison, WI

2. Better than Batteries: Creating Resiliency in District Energy Systems Utilizing Thermal Energy Storage

Mark MacCracken, Member, CALMAC Corp, Fair Lawn, NJ

3. Case Studies in Resiliency: Deploying Thermal Energy Storage on District Energy Systems During Times of Crisis

Steve Swinson, Thermal Energy Corporation (TECO), Houston, TX

4. Case Studies in Resiliency: Deploying Thermal Energy Storage on District Energy Systems During Times of Crisis

Geoffrey Bares, Associate Member, Enwave Chicago, Chicago, IL

1:30 p.m. – 3:00 p.m.

Seminar 56 (Intermediate)



Advances in Compressor Bearing Technology

Track: HVAC&R Systems and Equipment

Room: 372BE, (3), GRBCC

Sponsors: 8.2 - Centrifugal Machines, 8.1 - Positive Displacement Compressors and YEA

Chair: Ahmad Abu-Heiba, Oak Ridge National Laboratory, Oak Ridge, TN

1. Overview of Bearing Types and Applications

Raymond Good, *Danfoss Turbocor Compressors, Inc., Tallahassee, FL*

2. Ceramic Hybrid Bearings for Low GWP Compressors

Ulf Jonsson, *United Technologies Research Center, East Hartford, CT*

3. Magnetic Bearings: Fundamentals and Application

Jeff Morgan, *Daikin Applied, Bridgeton, MO*

4. Advances in High Speed Rolling Element Bearings

Joseph Heger, *Member, Trane International, La Crosse, WI*

3:15 p.m. – 4:45 p.m.

Seminar 57 (Basic)



Centrifugal Machines in Unusual/Niche Applications

Track: HVAC&R Systems and Equipment

Room: 372BE, (3), GRBCC

Sponsor: 8.2 - Centrifugal Machines

Chair: Lindsey King, JCI, New Freedom, PA

1. Evaluation of Centrifugal Chillers for Fundamental, Unusual and Niche Applications

Trenton Hunt, *Member, Mechanical Products Intermountain, Midvale, UT*

2. Benefits and Challenges of Using Centrifugal Compressors in Small Scale Heat Pumps

Ahmad Abu-Heiba, *Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN*

3. Operating Centrifugal Machines Outside the Standard Operating Map

Maccrae Monteith, *Johnson Controls, Inc., New Freedom, PA*

Wednesday, June 27

8:00 a.m. – 9:30 a.m.

Conference Paper Session 15 (Intermediate)

Not Just Blowing in the Wind

Track: Fundamentals and Applications

Room: 370CF, (3), GRBCC

Chair: Chris Laughman, Mitsubishi Electric Research Lab, Waltham, MA

1. Simplifying ASHRAE Standard 62.1 for Application to Existing Buildings: A Comparative Analysis with Real-World Data (HO-18-C046)

Meghan McNulty, *Associate Member, Barry Abramson, P.E., Member, Pamela Moua-Vargas, Associate Member, Servidyne, LLC, Atlanta, GA*

2. Transient Air Flow Regimes in a Large Scale High Density Data Centers (HO-18-C047)

Essam E. E Khalil, Ph.D., P.E., *Fellow ASHRAE, Yousri AbdelRahman, P.E., Cairo University, Cairo, Egypt*

3. Net Zero Energy Schools: Their Systems, Energy Use and Indoor Air Quality (HO-18-C048)

Wim Zeiler, *Milad Golshan, Eindhoven University of Technology, Eindhoven, Netherlands*

4. The Effects of Ventilation on Indoor Air Quality in Schools (HO-18-C049)

Lexuan Zhong, Ph.D., Member, *University of Alberta, Edmonton, AB, Canada*



8:00 a.m. – 9:30 a.m.

Seminar 58 (Intermediate)



ASHRAE's First Standard for Commercial Energy Audits or "How I Spent My Summer Vacations"

Track: Fundamentals and Applications

Room: 371DE, (3), GRBCC

Sponsor: 7.6 - Building Energy Performance

Chair: Jim Kelsey, KW Engineering, Oakland, CA

1. Meet ASHRAE's Newest Standard: How Energy Audit Levels 1, 2 and 3 Have Changed

Jim Kelsey, Member, KW Engineering, Oakland, CA

2. New York City Experience: How the Largest Mandatory Energy Audit Program Informed Standard 211

John H. Lee, NYC Mayor's Office of Long-Term Planning and Sustainability, New York City, NY

3. Raising the Bar Through Improved ASHRAE Energy Audit Forms
Ben O'Donnell, Associate Member, CodeGreen Solutions, New York, NY

4. Linking Energy Audits and Building Simulation Using BuildingSync
Supriya Goel, Member, Pacific Northwest National Laboratory, Portland, OR

8:00 a.m. – 9:30 a.m.

Seminar 59 (Intermediate)



Beneficial Carbon Reduction Strategies: Cogeneration, Electrification and Consumer Options

Track: District Energy and Cogeneration Plants

Room: 372BE, (3), GRBCC

Sponsor: 2.8 - Building Environmental Impacts and Sustainability

Chair: Kevin Brown, P.E., The Linc Group, Atlanta, GA

1. Getting to Zero Carbon: Distributed Energy Source Strategies and Options

Jim Edelson, Member, New Building Institute, Vancouver, WA

2. Electrification, Cogeneration and Emissions Efficiency

David Farnsworth, Regulatory Assistance Project, Montpelier, VT

3. Retaining Worthy Consumer Options for Carbon Reduction

Neil Leslie, Member, Gas Technology Institute, Des Plaines, IL

8:00 a.m. – 9:30 a.m.

Seminar 60 (Intermediate)



Building Simulation Tools and Models Needed for Assessing the Impacts of Extreme and Future Weather Scenarios on the Building, City and Grid Scale

Track: Safeguarding Your HVAC&R System

Room: 372AD, (3), GRBCC

Sponsor: 7.5 - Smart Building Systems

Chair: Kristen Cetin, Ph.D., P.E., Iowa State University, Ames, IA

1. Reduce Building Order Models for Grid Optimization and Analysis
Paulo Cesar Tabares-Velasco, Associate Member, Colorado School of Mines, Golden, CO

2. Data Driven Energy Consumption Prediction

Mina Sartipi, University of Tennessee-Chattanooga, Chattanooga, TN

3. On-Off Cycling Controller in EnergyPlus for Residential HVAC Systems

Niraj Kunwar, Student Member, Iowa State University, Ames, IA

8:00 a.m. – 9:30 a.m.

Seminar 61 (Intermediate)



Convective Vs. Radiant Load Calculations: Are They Different?

Track: Research Summit

Room: 372CF, (3), GRBCC

Sponsor: 4.1 - Load Calculation Data and Procedures

Chair: Som Shrestha, Ph.D., Oak Ridge National Laboratory, Oak Ridge, TN

1. Why ASHRAE Needed the Research on Cooling Load Calculations for the Radiant Cooling System?

Christopher K. Wilkins, Member, CBR USA, Cambridge, MA

2. Navigating ASHRAE Research: Research Project RP 1729 Journey from Concept Through Research

Glenn Friedman, Fellow ASHRAE, Taylor Engineering, Alameda, CA

3. Can We use Heat Balance Method and Radiant Time Series Method for Load Calculation with Radiant Cooling Systems?

Atila Novoselac, Member, University of Texas at Austin, Austin, TX

4. Comparison of Radiant Cooling and All-Air systems, Methodology for Experimental and Numerical Load Analysis

Stephen Bourne, Member, University of Texas at Austin, Austin, TX

5. Difference in Cooling Loads for Radiant and All-Air Systems for Different Types of Heat Gains and Control (Operative vs. Air) Temperature

Ardeshir Moftakhari, Student Member, University of Texas (UT) at Austin, Austin, TX

8:00 a.m. – 9:30 a.m.

Seminar 62 (Intermediate)



Design and Implementation of Solar-Assisted Geothermal Systems: From A to Z

Track: Fundamentals and Applications

Room: 370ABDE, (3), GRBCC

Sponsors: 6.7 – Solar and Other Renewable Energies, 6.8 – Geothermal Heat Pump and Energy Recovery Applications and 7.1 – Integrated Building Design

Chair: Janice Means, P.E., Lawrence Technological University, Southfield, MI

1. Optimizing the Ground Heat Exchanger for a Renewable System
Edward Lohrenz, GEOptimize Inc, Winnipeg, MB

2. The Integrated Renewable System, Thermal Storage and Hybrid
Cary Smith, Member, Sound Geothermal Corp., Sandy, UT

3. Active Chilled Beam with GSHP and Solar Together: Highest Efficiency Becomes Possible

Khalid Nagidi, Member, Energy Management Consulting Group, Wantagh, NY

4. Commissioning of Geothermal Fields

Andy DeRocher, Member, Sustainable Engineering Group LLC, Middleton, WI

8:00 a.m. – 9:30 a.m.

Seminar 63 (Intermediate)



Moisture-Induced Residential Building Failures: Lessons Learned in Recent Humid Climate Residential Construction

Track: Residential Modern Buildings in Hot and Humid Climates

Room: 371CF, (3), GRBCC

Sponsors: 1.12 - Moisture Management in Buildings, 4.4 - Building Materials and Building Envelope Performance

Chair: Norman Nelson, P.E., CH2M - Jacobs, Portland, OR

1. The Coming Stuccopolis and Other Wet Home Trepidations

Presenter: Paul Haas, *Building & Forensic Sciences, LLC, West Palm Beach, FL*

2. Resolution of Mold Issues in New Home Construction

Presenter: Ed Light, *Building Dynamics, LLC, Ashton, MD*

3. Deja Vu All Over Again: Risks for Moisture and Mold Problems in Modern Modular Domicile Construction

Presenter: Donald Snell, P.E., *Liberty Building Forensics Group, Zellwood, FL*

8:00 a.m. – 9:30 a.m.

Seminar 64 (Intermediate)



Radiant Heating and Cooling Systems: Past, Present and Future

Track: HVAC&R Systems and Equipment

Room: 371AB, (3), GRBCC

Sponsors: 6.5 - Radiant Heating and Cooling and SSPC 55

Chair: Devin Anthony Abellon, P.E., Uponor, Phoenix, AZ

1. The History of Radiant Heating and Cooling Systems

Robert Bean, P.L.(Eng.), Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

2. Radiant Best Practices: Leveraging Yesterday’s Lessons Learned to Design Effective Systems Today

Peter Simmonds, Fellow ASHRAE, Building and Systems Analytics LLC, Marina Del Rey, CA

3. Using Today’s Radiant Research to Improve Tomorrow’s Indoor Thermal Environment

Ongun Berk Kazanci, Associate Member, Technical University of Denmark, Kgs. Lyngby, Denmark

4. Radiant Research on Indoor Thermal Comfort: Are We Missing the Diversity Factor?

Dolaana Khovaly, Technical University of Denmark, Lyngby, Denmark

9:45 a.m. – 10:45 a.m.

Conference Paper Session 16 (Intermediate)

Comparison of New Refrigerants

Track: Research Summit

Room: 371CF, (3), GRBCC

Chair: Jaya Mukhopadhyay, Montana State University, Bozeman, MT

1. Examination of a Novel R410A (HO-18-C050) – WITHDRAWN

Kenneth Schultz, Member, Stephen Kujak, Member, Ingersoll Rand, La Crosse, WI

2. Comparison of Pressure Drop and Cooling Duty of Green Secondary Refrigerant (Ice Slurry) with Chilled Water in a Plate Heat Exchanger (HO-18-C051)

Rajinder Singh, Member, Pusa Institute of Technology, New Delhi, India



3. Design-Guidelines for Liquid Tub in Immersion System Using Natural Convection Below PUE = 1.04 (HO-18-C052)

Morito Matsuoka¹, Member, Hideo Kubo², Ph.D., Kazuhiro Matsuda¹,
(1) Osaka University, Osaka, Japan, (2) Fujitsu LTD, Kawasaki, Japan

9:45 a.m. – 10:45 a.m.

Conference Paper Session 17 (Intermediate)

Variable Speed, Variable Options



Track: Fundamentals and Applications

Room: 372AD, (3), GRBCC

Chair: Xiufeng Pang, Ph.D, Berkeley Lab, Walnut Creek, CA

1. Experimental Comparison of Energy Consumption between Constant and Variable Speed Air-Conditioner under the Korean and Saudi Arabian Climate Conditions (HO-18-C053)

JaeHun Lim¹, MyungSup Yoon¹, Ph.D., Turki Al-Qahtani², Yujin Nam¹,
(1) Pusan National University & Korea Testing Laboratory, Jinju,
(2) Saudi Standards, Quality and Metrology Organization, Riyadh,
Saudi Arabia

2. Variable Speed HVAC Systems and the Moving Target for Designing Noise Treatments (HO-18-C054)

Roman Wowk, Associate Member, Papadimos Group, San Francisco, CA

3. Energy and Economic Analysis of Variable-Speed Operation for Packaged Rooftop Units (HO-18-C055)

Jie Cai, Ph.D., James E. Braun, Ph.D., P.E., Fellow ASHRAE,
University of Oklahoma, Norman, OK

9:45 a.m. – 10:45 a.m.

Seminar 65 (Intermediate)



Air Flow Control from Text Book to Test Standard

Track: HVAC&R Control Freaks

Room: 372CF, (3), GRBCC

Sponsors: 1.4 - Control Theory and Application, 9.10 – Laboratory Systems and SPC 195

Chair: James Coogan, P.E., Siemens Industry, Inc., Buffalo Grove, IL

1. Control and Instrument Principles Applied to Air Flow at Terminals Xiaohui Zhou, Member, Seventh Wave, Madison, WI

2. Achieving Air Flow Control Performance

James Coogan, Associate Member, Siemens Industry, Inc., Buffalo Grove, IL

3. Energy Efficiency, Air Flow Control and ASHRAE Test Standard 195

Jeff Stein, Member, Taylor Engineering, LLC, Alameda, CA

9:45 – 10:45

Seminar 66 (Intermediate)



Foodservice Design for Hot and Humid Climates

Track: Fundamentals and Applications

Room: 372BE, (3), GRBCC

Sponsor: 5.10 - Kitchen Ventilation

Chair: Fuoad Parvin, P.E., Halton Company, Scottsville, KY

1. Energy Efficient and Comfortable Restaurant Design: Hood, Makeup and Fan

Russ Robison, Member, Gaylord Industries, Tualatin, OR

2. Demand-Control Ventilation (DCV) Integration with Foodservice Facilities

Jason Brown, Melink Corporation, Cincinnati, OH

**3. Integrated Whole Building Design With Replacement Air:
Limitations of Standard Rooftop Units**

Greg DuChane, Member, Trane, Columbus, OH

9:45 a.m. – 10:45 a.m.

Seminar 67 (Basic)



Fundamentals of Thermal Bridging and Mathematical Models

Track: Fundamentals and Applications

Room: 370ABDE, (3), GRBCC

Sponsor: 4.4 - Building Materials and Building Envelope Performance

Chair: Diana Fisler, Ph.D., Johns Manville, Littleton, CO

1. Fundamentals of Thermal Bridging

Jay Crandell, Ares Consulting, Paris, France

2. New Methods for Calculating Whole Wall Assemblies

Alexander McGowan, WSP Canada, Richmond, BC, Canada

3. Mathematical Models for Addressing Thermal Bridging

Dave Yarborough, Ph.D, P.E., R&D Services, Inc., Cookeville, Tennessee

9:45 a.m. – 10:45 a.m.

Seminar 68 (Basic)



Racing to Zero Through Innovative Residential Design

Track: Residential Modern Buildings in Hot and Humid Climates

Room: 371AB, (3), GRBCC

Sponsor: Student Activities, Residential Buildings Committee

Chair: Megan Sterl, P.E., Monstate State University, Bozeman, MT

1. Modern Residential Design through the Race to Zero

Rachel Romero, Member, NREL, Golden, CO

2. Independence in Residential Design

Shelley Pottorf, Prairie View A&M University, Prairie View, TX

9:45 a.m. – 10:45 a.m.

Forum 3 (Intermediate)

Operation and Maintenance Management Training:

How Useful Is It Really?

Track: Professional Skills

Room: 370CF, (3), GRBCC

Sponsors: 7.3 - Operation and Maintenance Management and 7.9 - Building Commissioning

Chair: Mina Agarabi, P.E., Agarabi Engineering, pllc, NY, NY

9:45 a.m. – 10:45 a.m.

Workshop 6 (Intermediate)



Speaking the Same Language: Best Practices in Standards Authoring

Track: Safeguarding Your HVAC&R System

Room: 371DE, (3), GRBCC

Sponsor: Publication and Education Council

Chair: Art Hallstrom, P.E., AD Hall and Associates, Lexington, KY

1. ASHRAE Standards Authorship: Moving Toward a Convention

Kyle Kisebach, P.E., Kisebach Consulting, Olympia, WA

11:00 a.m. – 12:30 p.m.

Conference Paper Session 18 (Intermediate)**Design and Implementation of Energy Efficient HVAC Systems***Track: Research Summit**Room: 371AB, (3), GRBCC**Chair: Marilyn Listvan, Ph.D, Listvan & Assoc., Edina, MN***1. Comparison of Four Methods to Generate Typical Summer Days Using in HVAC Design (HO-18-C056)***Siyue GUO, Da Yan, Ying CUI, Tsinghua University, Beijing, China***2. Design and Commissioning of Photovoltaic-Generation System (HO-18-C057)***Wim Zeiler, Kevin de Bont, Student Member, Eindhoven University of Technology, Eindhoven, Netherlands***3. Design Requirements for Renewable Energy Systems as Building Facility (HO-18-C058)***Wim Zeiler, Kevin de Bont, Student Member, Eindhoven University of Technology, Eindhoven, Netherlands***4. Using Bluetooth Based Occupancy Estimation for HVAC Set-Back to Reduce Energy Consumption in Buildings (HO-18-C059)***Zoltan Nagy, Jose Vazquez-Canteli, June Young Park, The University of Texas at Austin, Austin, TX*

11:00 a.m. – 12:30 p.m.

Conference Paper Session 19 (Intermediate)**Energy and Water: Ways to Improve Efficiency***Track: Fundamentals and Applications**Room: 372AD, (3), GRBCC**Chair: Peng Yin, University of Louisiana at Lafayette***1. Beneficial Use of Air Handling Unit Condensate for Laboratory Building HVAC Energy and Water Recovery in Hot and Humid Climates (HO-18-C060)***William Eades, P.E., Member, US EPA, Research Triangle Park, NC***2. Calculating Energy Savings on Air Conditioners in Industrial Facilities Using Simple Physics (HO-18-C061)***Joseph Carpenter, Keith Woodbury, Ph.D., P.E., Member, Zheng O'Neill, Member, University of Alabama, Tuscaloosa, AL***3. An Interaction Between Occupant Related Energy Consumption Among Different Spaces (HO-18-C062)***Prashant Anand, Student Member, Chandra Sekhar, Ph.D., Fellow ASHRAE, David Cheong, Ph.D., Member, Junjing Yang National University of Singapore, Singapore, Singapore***4. Estimating Energy Consumption Using Instantaneous Temperature (HO-18-C063)***Donald Reising, Ameer Patel, Mina Sartipi, Ph.D., Mohammed Fadul, T. Daniel Loveless, Ph.D., University of Tennessee at Chattanooga, Chattanooga, TN*

11:00 a.m. – 12:30 p.m.

Conference Paper Session 20 (Intermediate)**Heating and Cooling Applications with Improved Operation***Track: HVAC&R Systems and Equipment**Room: 371CF, (3), GRBCC**Chair: Mini Malhotra, Ph.D, Oak Ridge National Lab, Oak Ridge, TN*

1. Nationwide Energy Saving Analysis of Radiant Floor System in the United States (HO-18-C064)

Yanfei Li, *Fuxin Niu, Defeng Qian, Zheng O'Neill, University of Alabama, Tuscaloosa, AL*

2. Comparison of Cooling Load Between Radiant Slab and Air Systems in Large Space Buildings With Solar Radiation (HO-18-C065)

Haida Tang, *Tao Zhang, Xiaohua Liu, Department of Building Science, Tsinghua University, Beijing, China*

3. Effectiveness of Parallel versus Counter Flow in Liquid Desiccant Permeable Membrane Cooled Ceiling in Preventing Condensation (HO-18-C066)

Nesreen Ghaddar¹, *Member, Assaad Assaad Zoughaib*⁵, *Fracastoro Giovanni Vincenzo*³, *Joseph Virgone*⁴, *Kamel Ghali*¹, *Marco Simonetti*³, *Mohamad Hout*¹, *Naghm Ismaïl*², *Racha Syblany*¹, *(1) American University of Beirut, Beirut, Lebanon, (2) Hariri University, Beirut, Lebanon (3) Politecnico Di Torino, Turin, Italy, (4) Claude Bernard University, Villeurbanne, France, (5) ARMINES Mines Paristech, Paris, France*

4. Application of Internally Cooled Desiccant Wheel in Air-Conditioning System (HO-18-C067)

Xingchao Zhou, *UNSW&CSIRO, Newcastle, Australia*

11:00 a.m. – 12:30 p.m.

Seminar 69 (Basic)



Fundamentals of Centrifugal Chillers

Track: HVAC&R Systems and Equipment

Room: 371DE, (3), GRBCC

Sponsor: 8.2 - Centrifugal Machines

Chair: Meagan Gibbs, Henderson Engineers, Lenexa, KS

1. Centrifugal Chiller Basics

Frederick Betz, *Life Member, PEDCO E & A Services, LLC, Cincinnati, OH*

2. Operation and Efficiencies of Compressor, Evaporator and Condenser

Lindsey King, *Associate Member, New Freedom, PA*

3. Compressors, Motors and Starters

Brandon Moss, *Carrier Corporation, Charlotte, NC*

11:00 a.m. – 12:30 p.m.

Seminar 70 (Intermediate)



Optimization for HVAC Systems

Track: Research Summit

Room: 372CF, (3), GRBCC

Sponsor: Publication and Education Council

Chair: Reinhard Radermacher, Ph.D., University of Maryland, College Park, MD

1. Optimal Tuning Cascaded of Control Architectures for Nonlinear HVAC Systems

Christopher Price, *Student Member, Texas A&M University, College Station, Texas*

2. Development and Implementation of a Thermostat Learning Algorithm

Burak Gunay, *Carleton University, Ottawa, ON, Canada*

3. Design Optimization and Validation of High Performance Heat Exchangers Using Approximation Assisted Optimization and Additive Manufacturing

Daniel Bacellar, *University of Maryland, College Park, MD*

11:00 a.m. – 12:30 p.m.

Seminar 71 (Advanced)



Recent Advances in Solid-State Cooling Technologies

Track: HVAC&R Systems and Equipment

Room: 372BE, (3), GRBCC

Sponsors: Refrigeration Committee, 1.1 - Thermodynamics and Psychrometrics and 8.1 Positive Displacement Compressors; 10.7 Commercial Refrigeration

Chair: Georgi Kazachki, Ph.D., Dayton Phoenix Group, Inc., Dayton, OH

1. CaloriCool: Caloric Materials Consortium: Creating Materials Foundation for Caloric Cooling and Heat Pumping Technologies
Vitalij K. Pecharsky, Iowa State University, Ames, IA

2. Electrocaloric Cooling: Current States and Future Perspective
Qiming Zhang, Penn State University, University Park, PA

3. Overview of Elastocaloric Cooling
Yunho Hwang, Member, University of Maryland, College Park, MD

11:00 a.m. – 12:30 p.m.

Seminar 72 (Intermediate)



What will ASHRAE Standard 62.1-2019 Look Like with the Proposed Changes to the IAQA, NVP and VRP?

Track: Fundamentals and Applications

Room: 370ABDE, (3), GRBCC

Sponsors: TRG4 - Indoor Air Quality Procedure Development and SSPC 62.1 is primary sponsor of this session

Chair: Daniel Pettway, Hobbs and Associates, Chesapeake, VA

1. Overall Direction for Modifications to Standard 62.1
Hoy Bohanon, Member, Hoy Bohanon Engineering PLLC, Clemmons, NC

2. The New NVP
Stephen Ray, Associate Member, North Park University, Chicago, IL

3. The New IAQP
Marwa Zaatari, University of Texas at Austin, Austin, TX

4. Changes to the VRP
Brian Hafendorfer, Member, Trane, Lexington, KY

11:00 a.m. – 12:30 p.m.

Forum 4 (Intermediate)

Gauging Current Interest in Forming a Multi Task Group to Combine All Available Air Cleaning Technologies with the Goal of Establishing a Test Method and/or Standard to Validate the Contribution of Each Technology When Combined

Track: Fundamentals and Applications

Room: 370CF, (3), GRBCC

Sponsors: 2.9 - Ultraviolet Air and Surface Treatment, 2.3 – Gaseous Air Contaminants and Gas Contaminant Removal Equipment and 2.4 - Particulate Air Contaminates and Particulate Containment Removal Equipment

Chair: Sam Guzman, American Ultraviolet Company, Hackettstown, NJ

SOCIETY COMMITTEE MEETINGS

Most Society committee meetings are located at the Hilton Americas on the 2nd, 3rd and 4th floors. There are a few meetings at the GRBCC on Level 3. GRBCC is connected to the Hilton via Sky Bridge on the 2nd and 3rd floor of the Hilton. Please see pages 2–4 for meeting space floor plans and descriptions on how to access the meeting room floors.

The floor levels are indicated in parenthesis in the listing below as well as the venue location for each meeting (Hilton and GRBCC). Subcommittees are indented in the listing below. Rooms will be set as best as possible as indicated in the parentheses beside the committee, i.e., (20/20) will accommodate at least 20 people at the conference table and at least 20 chairs for the audience. Any audiovisual or electrical ordered will be listed. If AV is not ordered in advance there is no guarantee it will be available onsite.

AEDG Steering Committee (15/10) Electric

Monday (6/25) 2:15 pm – 5:00 pm 329 (3), Hilton

Appointments Roadmap (32/0)

Sunday (6/24) 7:00 am – 8:00 am 346AB (3), Hilton

ASHRAE Foundation (35/15) Electric

Monday (6/25) 7:30 am – 9:45 am Grand B (4), Hilton

ASHRAE Foundation Executive Subcommittee (10/5) Electric

Saturday (6/23) 1:30 pm – 3:00 pm 342 (3), Hilton

ASHRAE/CIBSE Liaison Meeting (14/15)

Wednesday (6/27) 9:30 am – 11:00 am Boardroom 326 (3), Hilton

Associate Society Alliance (35/35) Screen

Monday (6/25) 4:15 pm – 6:15 pm Grand F (4), Hilton

Audit Committee (5/3)

Friday (6/22) 3:30 pm – 5:00 pm Boardroom 326 (3), Hilton

Board of Directors (41/100) Screen /Electric

Sunday (6/24) 1:30 pm – 5:30 pm BOA EF (2), Hilton

Wednesday (6/27) 2:00 pm – 6:00 pm BOA DEF (2), Hilton

Building EQ Committee (15/25) Screen /Electric

Sunday (6/24) 8:30 am – 11:30 am 346AB (3), Hilton

Building EQ Methodology Subcommittee (8/8) Screen/Electric

Saturday (6/23) 11:00 am – 12:45 pm Boardroom 334 (3), Hilton

Building EQ Business Development Subcommittee (8/8) Screen/Electric

Saturday (6/23) 1:15 pm – 3:00 pm Boardroom 334 (3), Hilton

Buildings XIV (30/0)

Sunday (6/24) 9:00 am – 12:00 pm 381C (3), GRBCC

Certification (12/12) Screen/Electric

Saturday (6/23) 8:00 am – 12:00 pm 332 (3), Hilton

Chapter Technology Transfer Committee (30/15) Screen/Electric

Friday (6/22) 8:00 am – 12:00 pm Grand G (4), Hilton

Saturday (6/23) 8:00 am – 12:00 pm Grand G (4), Hilton

Chapter Technology Transfer Member Services (15/15) Screen

Friday (6/22) 1:30 pm – 5:00 pm 342 (3), Hilton

Chapter Technology Transfer Operations (10/5) Screen

Friday (6/22) 1:30 pm – 5:00 pm Grand G (4), Hilton

Chapter Technology Transfer Executive (7/0)

Friday (6/22) 5:00 pm – 6:00 pm Grand G (4), Hilton
Chapter Technology Transfer Committee New Member Orientation
(10/5) Screen/Electric

Saturday (6/23) 1:15 pm – 2:30 pm Grand G (4), Hilton

CLIMA 2019 (12/0)

Saturday (6/23) 12:15 pm – 1:30 pm 342 (3), Hilton

College of Fellows (25/10)

Sunday (6/24) 10:00 am – 12:00 pm 339AB (3), Hilton

College of Fellows: Advisory Committee (15/10)

Sunday (6/24) 9:00 am – 10:00 am 339AB (3), Hilton

Conferences and Expositions Committee (30/10) Screen/Electric

Saturday (6/23) 8:00 am – 12:00 pm Grand J (4), Hilton

Conferences and Expositions Executive (30/5)

Friday (6/22) 1:00 pm – 3:30 pm Grand J (4), Hilton

Conferences and Expositions Annual and Winter Subcommittee (30/5)

Friday (6/22) 3:45 pm – 6:00 pm Grand J (4), Hilton

Development Committee (25/15) Screen/Electric

Monday (6/25) 10:00 am – 12:00 pm Grand C (4), Hilton

Director and Regional Chairs and Regional Members Council Representatives (15/20)

Friday (6/22) 11:00 am – 1:00 pm 340A (3), Hilton

Wednesday (6/27) 12:00 pm – 2:00 pm 329 (3), Hilton

Directors-At-Large (15/20)

Wednesday (6/27) 12:00 pm – 2:00 pm 328 (3), Hilton

Electronic Communications Committee (13/10) Screen

Saturday (6/23) 11:00 am – 3:00 pm 230 (2), Hilton

Electronic Communications Subcommittees (13/10) Screen/Electric

Saturday (6/23) 8:00 am – 11:00 am 230 (2), Hilton

Energy Efficiency in Buildings Position Document Committee (10/0)

Tuesday (6/26) 3:00 pm – 4:00 pm 336B (3), Hilton

Environmental Health (20/20) Screen/Electric

Monday (6/25) 2:15 pm – 6:15 pm 339AB (3), Hilton

Environmental Health Executive (20/20) Screen/Electric

Monday (6/25) 7:00 am – 8:00 am 339AB (3), Hilton

Environmental Health Handbook/Policy (20/20) Screen/Electric

Monday (6/25) 8:00 am – 10:00 am 339AB (3), Hilton

Environmental Health Program/Research (20/20) Screen/Electric

Monday (6/25) 10:00 am – 12:00 pm 339AB (3), Hilton

Executive Committee (12/15) Screen/Electric

Saturday (6/23) 8:30 am – 1:00 pm Boardroom 326 (3), Hilton

Wednesday (6/27) 7:30 am – 9:00 am Boardroom 326 (3), Hilton

Thursday (6/28) 7:30 am – 11:00 am Boardroom 326 (3), Hilton

Finance Committee (13/20) Electric

Friday (6/22) 8:00 am – 12:00 pm 344AB (3), Hilton

Finance Investment Subcommittee (4/0)

Thursday (6/21) 5:00 pm – 7:00 pm 332 (3), Hilton

Finance Planning Subcommittee (8/8) Electric

Thursday (6/21) 5:00 pm – 7:00 pm 333 (3), Hilton

Grassroots Government Advocacy Committee (30/15) Screen/Electric

Saturday (6/23) 8:00 am – 12:30 pm Grand D (4), Hilton

GGAC: Member Training (30/15) Screen/Electric

Friday (6/22) 8:00 am – 10:00 am Grand D (4), Hilton

Grassroots Government Advocacy Executive (15/10) Screen/Electric

Friday (6/22) 10:15 am – 12:00 pm Grand D (4), Hilton

GGAC: Policy and Programs Subcommittee (15/10) Screen/Electric
 Friday (6/22) 1:15 pm – 2:45 pm Grand D (4), Hilton
 GGAC: Member Mobilization Subcommittee (15/10) Screen/Electric
 Friday (6/22) 1:15 pm – 2:45 pm 430 (4), Hilton
 GGAC: MBO # 3 Ad Hoc Subcommittee on Residential Codes and
 Construction (15/10) Screen/Electric
 Friday (6/22) 3:00 pm – 3:30 pm Grand D (4), Hilton
 GGAC: MBO # 5 Ad Hoc Subcommittee on Global Issues Plan
 Implementation (15/10) Screen/Electric
 Friday (6/22) 3:00 pm – 3:30 pm 430 (4), Hilton
 GGAC: MBO # 9 Ad Hoc Subcommittee on Publications (15/10)
 Screen/Electric
 Friday (6/22) 3:45 pm – 4:15 pm Grand D (4), Hilton
 GGAC: MBO # 11 Ad Hoc Subcommittee on Global Issues (15/10)
 Screen/Electric
 Friday (6/22) 3:45 pm – 4:15 pm 430 (4), Hilton
 GGAC: MBO # 10 Ad Hoc Subcommittee on Maps Project (15/10)
 Screen/Electric
 Friday (6/22) 4:30 pm – 5:00 pm Grand D (4), Hilton

Handbook Committee (30/15) Screen

Sunday (6/24) 10:30 am – 1:00 pm Grand A (4), Hilton
 Handbook Excom (5/5)
 Saturday (6/23) 1:00 pm – 2:00 pm 430 (4), Hilton
 Handbook Strategic Planning (5/5)
 Saturday (6/23) 2:00 pm – 3:00 pm 430 (4), Hilton
 Handbook Electronic Media (5/0)
 Sunday (6/24) 8:00 am – 9:00 am Grand A (4), Hilton
 Handbook Functional (5/0)
 Sunday (6/24) 8:00 am – 9:00 am 335AB (3), Hilton
 Handbook Review (5/5)
 Sunday (6/24) 8:00 am – 9:00 am 340AB (3), Hilton
 Handbook Training Workshop (50/0) Screen
 Sunday (6/24) 8:00 am – 9:00 am 327 (3), Hilton
 Handbook 2019 HVAC Applications TCs/Volume Subcommittee (25/0)
 Sunday (6/24) 9:00 am – 10:00 am Grand A (4), Hilton
 Handbook 2020 HVAC Systems and Equipment TCs/Volume
 Subcommittee (25/0)
 Sunday (6/24) 9:00 am – 10:00 am 340AB (3), Hilton
 Handbook 2021 Fundamentals TCs/Volume Subcommittee (25/0)
 Sunday (6/24) 9:00 am – 10:00 am 335AB (3), Hilton
 Handbook Volume Subcommittees (25/0)
 Sunday (6/24) 10:00 am – 10:30 am Grand A (4), Hilton

Historical Committee (20/5) Screen

Sunday (6/24) 8:30 am – 12:00 pm 328 (3), Hilton

Honors & Awards (20/0) Screen/Electric

Sunday (6/24) 1:30 pm – 5:00 pm 328 (3), Hilton
 Monday (6/25) 2:15 pm – 5:30 pm 328 (3), Hilton
 Honors & Awards New Member Orientation (5/5) Screen/Electric
 Sunday (6/24) 12:30 pm – 1:30 pm 328 (3), Hilton

IAQ 2020 (20/0) Screen/Electric

Tuesday (6/26) 2:00 pm – 3:30 pm 342 (3), Hilton

IEQ-GA (20/0) Screen/Electric

Tuesday (6/26) 3:30 pm – 5:00 pm 342 (3), Hilton

Indoor Air Quality Position Document Committee (10/5) Screen/Electric

Tuesday (6/26) 9:00 am – 10:30 am Boardroom 326 (3), Hilton

Life Member Executive Board Meeting (10/0)

Tuesday (6/26) 9:00 am – 11:00 am 335C (3), Hilton

Life Member Lunch

Tuesday (6/26) 12:00 pm – 1:30 pm 344AB (3), Hilton

Members Council (37/40) Screen/Electric

Tuesday (6/26) 8:15 am – 12:00 pm Grand J (4), Hilton

Members Council Region Operations Subcommittee (12/10) Electric

Saturday (6/23) 8:00 am – 12:00 pm Boardroom 331 (3), Hilton

Members Council Planning Subcommittee (12/10) Electric

Sunday (6/24) 8:00 am – 12:00 pm Boardroom 331 (3), Hilton

Membership Models Ad Hoc Committee (10/5)

Thursday (6/21) 4:00 pm – 5:00 pm 337 (3), Hilton

Membership Promotion (24/15) Screen/Electric

Saturday (6/23) 8:00 am – 3:00 pm 340AB (3), Hilton

Membership Promotion Subcommittees (20/10) Screen/Electric

Friday (6/22) 8:00 am – 2:00 pm 335C (3), Hilton

Nominating (48/0) Screen/Electric

Sunday (6/24) 7:30 am – 12:00 pm Grand B (4), Hilton

PEAC (20/20) Screen/Electric

Tuesday (6/26) 12:00 pm – 2:00 pm Grand I (4), Hilton

Planning (25/25) Screen/Electric

Friday (6/22) 1:00 pm – 6:00 pm Grand A (4), Hilton

Professional Development (15/15) Screen/Electric

Monday (6/25) 8:00 am – 12:00 pm 330 (3), Hilton

Publications Committee (15/10) Screen

Sunday (6/24) 8:00 am – 12:00 pm 332 (3), Hilton

Publications Planning Subcommittee (5/5)

Saturday (6/23) 10:00 am – 12:00 pm 430 (4), Hilton

Publishing and Education Council (35/30) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm Grand H (4), Hilton

Publishing and Education Council Research Journal Associate Editor Meeting (12/4) Screen

Sunday (6/24) 10:00 am – 2:00 pm Boardroom 326 (3), Hilton

Publishing and Education Council Fiscal (25/10) Screen

Monday (6/25) 2:00 pm – 3:30 pm Grand B (4), Hilton

Publishing and Education Council Functional (25/10) Screen

Monday (6/25) 3:30 pm – 5:00 pm Grand B (4), Hilton

Publishing and Education Council Orientation (35/30) Screen/Electric

Tuesday (6/26) 2:00 pm – 4:00 pm Grand H (4), Hilton

Refrigeration Committee (20/20) Screen/Electric

Sunday (6/24) 8:00 am – 12:00 pm 335C (3), Hilton

Refrigeration Excom (20/20) Screen

Sunday (6/24) 7:00 am – 8:00 am 335C (3), Hilton

Region-at-Large (40/0) Screen

Monday (6/25) 2:15 pm – 4:15 pm Grand K (4), Hilton

Research Administration Committee (25/20) Screen/Electric

Saturday (6/23) 8:00 am – 3:00 pm Grand H (4), Hilton

Wednesday (6/27) 7:00 am – 11:00 am 339AB (3), Hilton

Research Promotion (25/5) Screen/Electric

Saturday (6/23) 7:30 am – 1:00 pm 346AB (3), Hilton

Research Promotion Executive (10/0)

Friday (6/22) 9:30 am – 11:30 am 337AB (3), Hilton

Research Promotion RVC Training (25/5) Screen

Friday (6/22) 1:30 pm – 5:00 pm 337AB (3), Hilton

Research Promotion Subcommittee (10/0)

Saturday (6/23) 2:00 pm – 3:00 pm 346AB (3), Hilton

Residential Building Committee (20/25) Screen/Electric

Monday (6/25) 8:30 am – 11:30 pm 346AB (3), Hilton

Residential Building Committee: Conferences Subcommittee (8/10)

Sunday (6/24) 8:30 am – 9:30 am 342 (3), Hilton

Residential Building Committee: Programs Subcommittee (8/10)
 Sunday (6/24) 9:30 am – 10:30 am 342 (3), Hilton
 Residential Building Committee: Technical Subcommittee (8/10)
 Sunday (6/24) 10:30 am – 11:30 am 342 (3), Hilton
 Residential Building Committee: Publications Subcommittee (8/10)
 Sunday (6/24) 1:00 pm – 2:00 pm 342 (3), Hilton
 Residential Building Committee: Stakeholders Subcommittee (8/10)
 Sunday (6/24) 2:00 pm – 3:00 pm 342 (3), Hilton
 Residential Building Committee: New Member Orientation (8/10)
 Sunday (6/24) 3:00 pm – 4:00 pm 342 (3), Hilton

**Resiliency Position Document Committee (10/10) Screen/
 Electric**

Sunday (6/24) 3:00 pm – 4:30 pm 335C (3), Hilton

Scholarship Trustees (10/5) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm Boardroom 331 (3), Hilton

Society Rules (12/6) Screen/Electric

Tuesday (6/26) 2:00 pm – 6:00 pm Boardroom 331 (3), Hilton

Standards Committee (30/20) Screen /Electric

Saturday (6/23) 8:00 am – 12:00 pm Grand A (4), Hilton

Wednesday (6/27) 8:00 am – 10:00 am BOA DEF (2), Hilton

Standards: Executive Committee (10/10) Screen/Electric

Friday (6/22) 8:00 am – 12:00 pm 346B (3), Hilton

StdC Training Adhoc (10/10) Screen/Electric

Friday (6/22) 12:00 pm – 1:00 pm 346B (3), Hilton

Standards: ILS/ISAS (10/3) Screen/Electric

Friday (6/22) 1:00 pm – 4:00 pm 346A (3), Hilton

Standards: PPIS (6/10) Screen/Electric

Friday (6/22) 2:00 pm – 6:00 pm 346B (3), Hilton

Standards: SPLS (20/20) Screen/Electric

Friday (6/22) 2:00 pm – 6:00 pm 344AB (3), Hilton

Standards: Code Interaction Subcommittee (CIS) (15/10) Screen/Electric

Sunday (6/24) 6:00 pm – 9:30 pm 333 (3), Hilton

Standards PPIS (6/10) Screen/Electric

Tuesday (6/26) 11:00 am – 2:00 pm 335C (3), Hilton

Standards SPLS (20/10) Screen/Electric

Tuesday (6/26) 2:00 pm – 4:00 pm 335C (3), Hilton

Standards SRS (8/4) Screen/Electric

Tuesday (6/26) 5:00 pm – 6:00 pm 335C (3), Hilton

Student Activities Committee (22/10) Screen/Electric

Saturday (6/23) 8:00 am – 3:00 pm 337AB (3), Hilton

Student Activities RVC Training (15/5) Screen/Electric

Friday (6/22) 8:30 am – 9:30 am 339AB (3), Hilton

Student Activities Executive (25/5) Screen/Electric

Friday (6/22) 9:30 am – 11:30 am 339AB (3), Hilton

Student Activities K-12/STEM (20/5) Screen/Electric

Friday (6/22) 12:00 pm – 2:00 pm 339AB (3), Hilton

Student Activities ABET (15/5) Screen/Electric

Friday (6/22) 12:00 pm – 2:00 pm 338 (3), Hilton

Student Activities Post High (15/5) Screen/Electric

Friday (6/22) 2:00 pm – 4:00 pm 339AB (3), Hilton

Student Activities Design Competition (15/5) Screen/Electric

Friday (6/22) 4:00 pm – 6:00 pm 339AB (3), Hilton

Student Activities Grants (15/5) Screen/Electric

Friday (6/22) 4:00 pm – 6:00 pm 338 (3), Hilton

TC/TG Chair's Training Workshop (3/100) Screen /Electric

Sunday (6/24) 9:45 am – 10:45 am 382A (3), GRBCC

Technical Activities Committee (25/20) Screen /Electric

Saturday (6/23) 8:00 am – 3:00 pm Grand I (4), Hilton

Wednesday (6/27) 7:00 am – 10:00 am 340AB (3), Hilton

TAC/Standing Committee Executive Interface (25/20) Screen /Electric
Saturday (6/23) 7:00 am – 8:00 am Grand I (4), Hilton

Technology Council (37/20) Screen/Electric

Wednesday (6/27) 9:00 am – 12:00 pm 335AB (3), Hilton
Technology Council: Operations Subcommittee (20/10) Screen/Electric
Tuesday (6/26) 9:00 am – 10:00 am 339AB (3), Hilton
Technology Council: Special Projects Subcommittee (8/5) Screen/
Electric
Tuesday (6/26) 8:00 am – 9:00 am 339AB (3), Hilton
Technology Council: Document Review Subcommittee (10/10)
Screen/Electric
Tuesday (6/26) 10:30 am – 11:30 am 339AB (3), Hilton

UNEP/ASHRAE Coordination Meeting

Saturday (6/23) 5:15 pm – 6:15 pm Boardroom 334 (3), Hilton

Young Engineers in ASHRAE Committee (20/15) Screen/Electric

Saturday (6/23) 8:00 am – 3:00 pm 329 (3), Hilton

YEA Hospitality (125/0)

Sunday (6/24) 4:00 pm – 6:00 pm 4th Floor Foyer (4)

TC/TG/SPC MEETINGS

The ASHRAE Technical Committees, Project 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.

Abbreviations:

GPC = Guideline Project Committee
MTG = Multidisciplinary Task Group
RP = Research Project
SPC = Standard Project Committee
SSPC = Standing Standard Project Committee
TC = Technical Committee
TG = Task Group
TRG = Technical Research Group

Finding your Meeting Location:

Committee meetings are located at the Hilton Americas on the 2nd, 3rd and 4th floors. And at the GRBCC on Level 3. GRBCC is connected to the Hilton via Sky Bridge on the 2nd and 3rd floor of the Hilton. Please see pages 2–4 for meeting space floor plans and descriptions on how to access the meeting room floors.

The floor levels are indicated in parenthesis in the listing below as well as the venue location for each meeting (Hilton and GRBCC). Subcommittees are indented in the

listing below. Rooms will be set as best as possible as indicated in the parentheses beside the committee, i.e., (20/20) will accommodate at least 20 people at the conference table and at least 20 chairs for the audience. Any audiovisual or electrical ordered will be listed. If AV is not ordered in advance there is no guarantee it will be available onsite.

Color Codes: If the meeting has not been listed in color it was NOT confirmed prior to the meeting.

TECHNICAL COMMITTEES (TC)

TC/TG Chair's Breakfast Section 1 (32/4)

Sunday (6/24) 6:30 am – 8:00 am Grand C (4), Hilton

TC/TG Chair's Breakfast Section 2 (26/4)

Sunday (6/24) 6:30 am – 8:00 am Grand D (4), Hilton

TC/TG Chair's Breakfast Section 3 (17/4)

Sunday (6/24) 6:30 am – 8:00 am Grand F (4), Hilton

TC/TG Chair's Breakfast Section 4 (19/4)

Sunday (6/24) 6:30 am – 8:00 am Grand G (4), Hilton

TC/TG Chair's Breakfast Section 5 (31/4)

Sunday (6/24) 6:30 am – 8:00 am Grand H (4), Hilton

TC/TG Chair's Breakfast Section 6 (23/4)

Sunday (6/24) 6:30 am – 8:00 am Grand I (4), Hilton

TC/TG Chair's Breakfast Section 7 (23/4)

Sunday (6/24) 6:30 am – 8:00 am Grand J (4), Hilton

TC/TG Chair's Breakfast Section 8 (34/4)

Sunday (6/24) 6:30 am – 8:00 am Grand E (4), Hilton

TC/TG Chair's Breakfast Section 9 (24/4)

Sunday (6/24) 6:30 am – 8:00 am Grand K (4), Hilton

TC/TG Chair's Breakfast Section 10 (18/4)

Sunday (6/24) 6:30 am – 8:00 am Grand L (4), Hilton

MTG Chairs' Section Breakfast (11/4)

Sunday (6/24) 6:30 am – 8:00 am Boardroom 334 (3), Hilton

TC/TG Chair's Training Workshop (3/100)

Sunday (6/24) 9:45 am – 10:45 am 382A (3), GRBCC

TC Program Subcommittee Training (30/5) Screen

Tuesday (6/26) 11:15 am – 12:00 pm 382C (3), GRBCC

Research Subcommittee Chairs (137/0) Screen

Monday (6/25) 6:30 am – 9:00 am BOA DEF (2), Hilton

TC 1.1 Thermodynamics and Psychometrics (10/15)

Monday (6/25) 2:15 pm – 4:15 pm 332 (3), Hilton

TC 1.2 Instruments and Measurements (TC Seminar) (15/40)

Tuesday (6/26) 1:00 pm – 3:30 pm 370CF (3), GRBCC

TC 1.2 Research, Program, Handbook (4/2)

Monday (6/25) 4:15 pm – 6:30 pm 335B (3), Hilton

TC 1.3 Heat Transfer and Fluid Flow (25/25)

Tuesday (6/26) 1:00 pm – 3:30 pm Grand L (4), Hilton

TC 1.3/8.5 Research Subcommittee Meeting and Project Review (12/38) Screen/Electric

Sunday (6/24) 3:00 pm – 7:00 pm 372AD (3), GRBCC

TC 1.4 Control Theory and Application (20/80) Screen

Tuesday (6/26) 1:00 pm – 3:30 pm 371CF (3), GRBCC

TC 1.4 YEA/Education (10/15) Screen

Sunday (6/24) 2:00 pm – 3:00 pm 344AB (3), Hilton

TC 1.4 Control Components and Applications (10/15) Screen

Sunday (6/24) 3:00 pm – 4:00 pm 344AB (3), Hilton

TC 1.4 Programs (12/15) Screen

Sunday (6/24) 4:00 pm – 5:30 pm 344AB (3), Hilton

TC 1.4 Research (15/20) Screen/Electric

Monday (6/25) 2:30 pm – 4:30 pm 340A (3), Hilton

TC 1.4 Handbook (10/10) Screen

Monday (6/25) 4:30 pm – 6:30 pm 340A (3), Hilton

TC 1.4 RP-1711 Advanced Sequences of Operation for HVAC Systems – Phase II Central Plants and Hydronic Systems (8/10) Screen

Tuesday (6/26) 9:30 am – 10:30 am 330 (3), Hilton

TC 1.4 Executive (10/0) Screen

Monday (6/25) 8:30 am – 9:30 am 340A (3), Hilton

TC 1.5 Computer Applications (25/25) Screen/Electric

Monday (6/25) 6:30 pm – 9:00 pm 370CF (3), GRBCC

TC 1.5 Cyber Security (15/5)

Sunday (6/24) 4:00 pm – 5:00 pm 372CF (3), GRBCC

TC 1.5 Emerging Applications (10/5)

Sunday (6/24) 5:00 pm – 6:00 pm 372CF (3), GRBCC

TC 1.5 Research (15/5)

Sunday (6/24) 7:00 pm – 8:00 pm 372CF (3), GRBCC

TC 1.5 Program (15/5)

Sunday (6/24) 6:00 pm – 7:00 pm 372CF (3), GRBCC

TC 1.5 Handbook (15/5)

Monday (6/25) 6:00 pm – 6:30 pm 370CF (3), GRBCC

TC Seminar: Early HVAC System Modeling and Efficiency Comparison Tool using the New Building Energy Efficiency Ratio (BEER)

Monday (6/25) 6:30 pm – 9:00 pm 370CF (3), GRBCC

TC 1.6 Terminology (10/4) Screen/Electric

Monday (6/25) 4:30 pm – 6:00 pm 336A (3), Hilton

TC 1.6 Terminology Working File Development (10/3) Screen/Electric

Monday (6/25) 9:00 am – 12:00 pm 336A (3), Hilton

TC 1.7 Business, Management and General Legal Education (20/5) Screen/Electric

Monday (6/25) 10:15 am – 12:00 pm 344A (3), Hilton

TC 1.7 Code of Ethics (8/8) Screen/Electric

Saturday (6/23) 2:00 pm – 4:00 pm 338 (3), Hilton

TC 1.8 Mechanical Systems Insulation (25/10) Screen

Monday (6/25) 4:15 pm – 6:30 pm 332 (3), Hilton

TC 1.8 Handbook (20/5) Screen /Electric

Sunday (6/24) 8:00 am – 10:30 am 333 (3), Hilton

TC 1.8 Program (20/5) Screen /Electric

Sunday (6/24) 10:30 am – 11:00 am 333 (3), Hilton

TC 1.8 Research (20/5) Screen /Electric

Sunday (6/24) 11:00 am – 12:00 pm 333 (3), Hilton

TC 1.9 Electrical Systems (8/4) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm 336A (3), Hilton

TC 1.10 Cogeneration Systems (20/8) Electric

Tuesday (6/26) 2:30 pm – 4:00 pm 335B (3), Hilton

TC1.10 PMS 1762-RP (20/8)

Tuesday (6/26) 12:30 pm – 1:00 pm 335B (3), Hilton

TC1.10 Handbook, Program, Research, CTIC, Membership
Subcommittee (20/15) Electric

Tuesday (6/26) 1:00 pm – 2:30 pm 335B (3), Hilton

TC 1.11 Electric Motors and Motor Control (13/7) Screen

Tuesday (6/26) 1:00 pm – 3:30 pm 336A (3), Hilton

TC 1.12 Moisture Management in Buildings (20/20) Screen/Electric

Saturday (6/23) 1:00 pm – 3:00 pm 330 (3), Hilton

TC 1.12 Research, Program, Handbook, Standards (15/5)
Screen/Electric

Saturday (6/23) 8:00 am – 12:00 pm 330 (3), Hilton

TC 1.13 Optimization (20/5)

Sunday (6/24) 1:00 pm – 3:00 pm 335C (3), Hilton

TC 2.1 Physiology and Human Environment (25/30) Electric

Tuesday (6/26) 1:00 pm – 5:00 pm 371AB (3), GRBCC

TC 2.2 Plant and Animal Environment (10/5) Screen/ Electric

Monday (6/25) 4:15 pm – 6:30 pm Boardroom 334 (3), Hilton

TC 2.3 Gaseous Air Contaminants /Removal Equip. (30/30) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm 372CF (3), GRBCC

TC 2.3 Research (15/20) Electric

Sunday (6/24) 5:00 pm – 7:00 pm 381C (3), GRBCC

TC 2.3 Standards (8/5) Electric

Monday (6/25) 2:15 pm – 3:15 pm 335C (3), Hilton

TC 2.3 Handbook (7/3) Electric

Monday (6/25) 4:15 pm – 6:30 pm 338 (3), Hilton

TC 2.3 Planning (10/2)

Tuesday (6/26) 6:30 am – 8:00 am 382C (3), GRBCC

TC 2.3 Programs (10/3) Electric

Tuesday (6/26) 12:00 pm – 12:45 pm 382C (3), GRBCC

TC 2.4 Particulate Air Contaminants / Removal Equipment (18/50) Screen/Electric

Tuesday (6/26) 3:30 pm – 6:00 pm 372CF (3), GRBCC

TC 2.4 Handbook (18/0) Screen/Electric

Saturday (6/23) 1:00 pm – 2:30 pm 230 (2), Hilton

TC 2.4 1649-RP PMS (5/25) Screen/Electric

Saturday (6/23) 1:30 pm – 2:30 pm 381C (3), GRBCC

TC 2.4 Research (18/30) Screen/Electric

Sunday (6/24) 3:00 pm – 5:00 pm 381C (3), GRBCC

TC 2.4 1734-RP PMS (18/25) Screen/Electric

Sunday (6/24) 1:00 pm – 2:00 pm 381C (3), GRBCC

TC 2.4 1756-RP PMS (18/25) Screen/Electric

Sunday (6/24) 2:00 pm – 3:00 pm 381C (3), GRBCC

TC 2.4 Standards (18/15) Screen/Electric

Monday (6/25) 4:15 pm – 5:15 pm 335C (3), Hilton

TC 2.4 Planning (18/20) Screen/Electric

Tuesday (6/26) 8:00 am – 10:00 am 382C (3), GRBCC

TC 2.4 Program (20/10) Screen/Electric

Monday (6/25) 3:15 pm – 4:15 pm 335C (3), Hilton

TC 2.5 Global Climate Change (20/10) Screen

Tuesday (6/26) 1:30 pm – 3:30 pm 340A (3), Hilton

TC 2.5 Research, Programs (6/10) Electric

Monday (6/25) 2:15 pm – 4:15 pm 337B (3), Hilton

TC 2.6 Sound and Vibration (20/30) Screen/Electric

Monday (6/25) 2:15 pm – 4:15 pm Grand A (4), Hilton

TC 2.6 Vibration Isolation (15/8) Screen/Electric

Sunday (6/24) 8:00 am – 9:00 am Grand H (4), Hilton

TC 2.6 Hot Topic - 189.1 Acoustic Control (20/5) Screen/Electric

Sunday (6/24) 11:00 am – 12:00 pm Grand H (4), Hilton

TC 2.6 Programs (14/6) Screen/Electric

Sunday (6/24) 3:00 pm – 4:00 pm Grand H (4), Hilton

TC 2.6 Executive Committee (7/0) Electric

Sunday (6/24) 4:00 pm – 5:00 pm Grand H (4), Hilton

TC 2.6 Publications (19/8) Screen/Electric

Sunday (6/24) 9:00 am – 10:00 am Grand H (4), Hilton

TC 2.6 Research (16/8) Screen/Electric

Sunday (6/24) 2:00 pm – 3:00 pm Grand H (4), Hilton

TC 2.6 Standards/Criteria (16/8) Screen/Electric

Sunday (6/24) 1:00 pm – 2:00 pm Grand H (4), Hilton

TC 2.7 Seismic and Wind Restraint Design (17/24) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm 338 (3), Hilton

TC 2.7 Programs, Publications, Research, Long Range

Planning (15/10) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm 338 (3), Hilton

TC 2.8 Building Environmental Impacts and Sustainability (20/50)

Sunday (6/24) 5:30 pm – 7:00 pm 382C (3), GRBCC

TC 2.8 Green Guide (8/10) Screen/Electric

Sunday (6/24) 12:00 pm – 12:30 pm 382C (3), GRBCC

TC 2.8 Existing and Future Building Challenges (6/10) Screen/Electric

Sunday (6/24) 12:30 pm – 1:15 pm 382C (3), GRBCC

TC 2.8 Water-Energy Nexus (6/10) Screen/Electric

Sunday (6/24) 1:15 pm – 2:30 pm 382C (3), GRBCC

TC 2.8 International (4/10) Screen/Electric

Sunday (6/24) 2:30 pm – 3:00 pm 382C (3), GRBCC

TC 2.8 Research (4/6) Screen/Electric
Sunday (6/24) 3:00 pm – 3:45 pm 382C (3), GRBCC
TC 2.8 Handbook (6/6) Screen/Electric
Sunday (6/24) 3:45 pm – 4:15 pm 382C (3), GRBCC
TC 2.8 Programs (8/8) Screen/Electric
Sunday (6/24) 4:15 pm – 5:00 pm 382C (3), GRBCC

TC 2.9 Ultraviolet Air and Surface Treatment (10/20) Screen

Monday (6/25) 10:00 am – 12:00 pm 335B (3), Hilton
TC 2.9 Programs (10/10)
Sunday (6/24) 8:00 am – 10:00 am 430 (4), Hilton
TC 2.9 Handbook (10/10)
Sunday (6/24) 10:00 am – 12:00 pm 430 (4), Hilton
TC 2.9 Research (15/10)
Monday (6/25) 8:00 am – 10:00 am 335B (3), Hilton

TC 3.1 Refrigerants and Secondary Coolants (10/30) Screen/Electric

Monday (6/25) 4:15 pm – 6:30 pm Grand E (4), Hilton
TC 3.1 Research (combined with 3.2, 3.3, 3.4 and 3.8 Research) (15/40) Screen/Electric
Sunday (6/24) 3:00 pm – 6:00 pm 371DE (3), GRBCC
TC 3.1 Program (Combined with 3.2, 3.3, 3.4 and 3.8 Program) (15/40) Screen/Electric
Monday (6/25) 10:30 am – 12:00 pm Grand D (4), Hilton
TC 3.1 Handbook (5/0) Screen/Electric
Tuesday (6/26) 10:00 am – 11:00 am 329 (3), Hilton

TC 3.2 Refrigerant System Chemistry (12/40) Screen/Electric

Monday (6/25) 2:15 pm – 4:15 pm Grand D (4), Hilton
TC 3.2 Research (combined with 3.1, 3.3, 3.4, 3.8 Research) (15/40) Screen/Electric
Sunday (6/24) 3:00 pm – 6:00 pm 371DE (3), GRBCC
TC 3.2 Program (Combined with 3.1, 3.3, 3.4 and 3.8 Program) (15/40) Screen/Electric
Monday (6/25) 10:30 am – 12:00 pm Grand D (4), Hilton

TC 3.3 Refrigerant Contaminant Control (14/25) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm 330 (3), Hilton
TC 3.3 Research (combined with 3.1, 3.2, 3.4, 3.8 Research) (15/40) Screen/Electric
Sunday (6/24) 3:00 pm – 6:00 pm 371DE (3), GRBCC
TC 3.3 Program (Combined with 3.1, 3.2, 3.4 and 3.8 Program) (15/40) Screen/Electric
Monday (6/25) 10:30 am – 12:00 pm Grand D (4), Hilton

TC 3.4 Lubrication (20/40) Screen

Tuesday (6/26) 1:30 pm – 3:30 pm Grand K (4), Hilton
TC 3.4 Research (combined with 3.1, 3.2, 3.3, 3.8 Research) (15/40) Screen/Electric
Sunday (6/24) 3:00 pm – 6:00 pm 371DE (3), GRBCC
TC 3.4 Program (Combined with 3.1, 3.2, 3.3 and 3.8 Program) (15/40) Screen/Electric
Monday (6/25) 10:30 am – 12:00 pm Grand D (4), Hilton

TC 3.6 Water Treatment (18/10) Screen

Tuesday (6/26) 1:00 pm – 3:30 pm 333 (3), Hilton
TC 3.6 Handbook/Program/Research (20/5) Screen /Electric
Sunday (6/24) 5:00 pm – 7:00 pm 346AB (3), Hilton

TC 3.8 Refrigerant Containment (9/5) Screen

Monday (6/25) 4:15 pm – 6:30 pm 336B (3), Hilton
TC 3.8 Research (combined with 3.1, 3.2, 3.3, 3.4 Research)
(15/40) Screen/Electric
Sunday (6/24) 3:00 pm – 6:00 pm 371DE (3), GRBCC
TC 3.8 Program (Combined with 3.1, 3.2, 3.3 and 3.4
Program) (15/40) Screen/Electric
Monday (6/25) 10:30 am – 12:00 pm Grand D (4), Hilton

TC 4.1 Load Calculation Data and Procedures (20/10) Screen

Monday (6/25) 2:15 pm – 4:15 pm 338 (3), Hilton
TC 4.1 RP-1729 PMS (8/2) Electric
Sunday (6/24) 8:00 am – 9:00 am 337A (3), Hilton
TC 4.1 Handbook (10/10)
Sunday (6/24) 3:00 pm – 4:00 pm 340AB (3), Hilton
TC 4.1 Research (10/10)
Sunday (6/24) 4:00 pm – 5:00 pm 340AB (3), Hilton
TC 4.1 Programs and Standards (10/10)
Sunday (6/24) 5:00 pm – 6:00 pm 340AB (3), Hilton
TC 4.1 RP-1742 PMS (8/5) Screen
Sunday (6/24) 6:00 pm – 7:00 pm 340AB, Hilton

TC 4.2 Climatic Information (20/10) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm 330 (3), Hilton
TC 4.2 Handbook (7/7) Screen/Electric
Sunday (6/24) 2:30 pm – 3:30 pm 332 (3), Hilton
TC 4.2 Program (7/7) Screen/Electric
Sunday (6/24) 3:30 pm – 4:30 pm 332 (3), Hilton
TC 4.2 Research (10/5) Screen/Electric
Monday (6/25) 4:15 pm – 6:30 pm 344B (3), Hilton

TC 4.3 Ventilation Requirements and Infiltration (10/20)

Monday (6/25) 4:15 pm – 6:30 pm 346AB (3), Hilton

TC 4.4 Building Materials and Building Envelope Performance (40/10) Screen

Monday (6/25) 2:15 pm – 4:15 pm 382C (3), GRBCC
TC 4.4 PMS 1696-RP (20/10) Screen
Sunday (6/24) 10:30 am – 11:30 am 335 (3), Hilton
TC 4.4 PMS 1759-TRP (20/10) Screen
Sunday (6/24) 11:30 am – 12:30 pm 335 (3), Hilton
TC 4.4 Program (30/15) Screen/Electric
Sunday (6/24) 1:00 pm – 2:30 pm Grand L (4), Hilton
TC 4.4 Handbook (30/15) Screen/Electric
Sunday (6/24) 2:30 pm – 3:30 pm Grand L (4), Hilton
TC 4.4 Research (30/15) Screen/Electric
Sunday (6/24) 3:30 pm – 5:00 pm Grand L (4), Hilton
TC 4.4 Standards (30/15) Screen/Electric
Sunday (6/24) 5:00 pm – 5:30 pm Grand L (4), Hilton

TC 4.5 Fenestration (10/8)

Tuesday (6/26) 2:00 pm – 4:00 pm Boardroom 326 (3), Hilton

TC 4.5 Research (10/10)

Monday (6/25) 2:15 pm – 3:15 pm 340B (3), Hilton

TC 4.5 Program (10/10)

Monday (6/25) 3:15 pm – 4:15 pm 340B (3), Hilton

TC 4.5 Calculation Methods (15/10)

Tuesday (6/26) 1:00 pm – 2:00 pm Boardroom 326 (3), Hilton

TC 4.7 Energy Calculations (25/50) Screen

Tuesday (6/26) 6:00 pm – 8:30 pm 370 ABDE (3), GRBCC

TC 4.7 Simulation and Component Models (20/20) Screen/
Electric

Monday (6/25) 6:00 pm – 7:30 pm Grand J (4), Hilton

TC 4.7 Data-Driven Models (20/10) Screen/Electric

Monday (6/25) 7:30 pm – 9:00 pm Grand J (4), Hilton

TC 4.7 Multi-scale Building Energy Modeling (20/20)
Screen/Electric

Tuesday (6/26) 3:30 pm – 5:00 pm 370 ABDE (3),
GRBCC

TC 4.7 Handbook (10/10) Screen/Electric

Tuesday (6/26) 5:00 pm – 6:00 pm 370 ABDE (3),
GRBCC

TC 4.10 Indoor Environmental Modeling (30/15) Electric

Monday (6/25) 2:15 pm – 4:15 pm Grand C (4), Hilton

TC 4.10 RP-1675 PMS (5/10) Electric

Sunday (6/24) 2:00 pm – 3:00 pm 337B (3), Hilton

TC 4.10 Program (20/10) Electric

Sunday (6/24) 3:00 pm – 4:00 pm 337B (3), Hilton

TC 4.10 Handbook (20/10) Electric

Sunday (6/24) 4:00 pm – 5:00 pm 337B (3), Hilton

TC 4.10 Research (20/10) Electric

Sunday (6/24) 5:00 pm – 6:00 pm 337B (3), Hilton

TC 5.1 Fans (20/20) Screen

Monday (6/25) 4:15 pm – 6:30 pm 371DE (3), GRBCC

TC 5.1 Handbook (12/12) Screen/Electric

Sunday (6/24) 2:00 pm – 3:00 pm Grand G (4), Hilton

TC 5.1 Research (12/15) Screen/Electric

Sunday (6/24) 3:00 pm – 4:00 pm Grand G (4), Hilton

TC 5.1 Program (10/10) Screen

Sunday (6/24) 4:00 pm – 4:30 pm Grand G (4), Hilton

TC 5.2 Duct Design (12/20) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm 337A (3), Hilton

TC 5.2 Duct Design Guide Subcommittee (30/30) Screen/
Electric

Monday (6/25) 8:00 am – 12:00 pm Grand H (4), Hilton

TC 5.3 Room Air Distribution (30/30) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm 370 ABDE (3), GRBCC

TC 5.3 Handbook (20/10) Screen/Electric

Friday (6/22) 12:00 pm – 5:00 pm Grand K (4), Hilton

TC 5.3 Handbook (20/10) Screen/Electric

Saturday (6/23) 8:00 am – 3:00 pm 335C (3), Hilton

TC 5.3 Fan Coils (20/10) Screen/Electric

Sunday (6/24) 8:00 am – 9:00 am Grand G (4), Hilton

TC 5.3 Air Curtains (20/10) Screen/Electric

Sunday (6/24) 9:00 am – 10:00 am Grand G (4), Hilton

TC 5.3 Research, Programs (25/10) Screen/Electric

Sunday (6/24) 10:00 pm – 12:30 pm Grand G (4), Hilton

TC 5.4 Industrial Process Air Cleaning (Air Pollution Control) (11/6)

Monday (6/25) 2:15 pm – 4:15 pm 336A (3), Hilton

TC 5.5 Air-to-Air Energy Recovery (30/10) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm Grand L (4), Hilton

TC 5.5 Handbook, Program, Research (12/4) Screen/Electric

Monday (6/25) 2:15 pm – 4:15 pm 370ABDE (3),

GRBCC

TC 5.6 Control of Fire and Smoke (23/30) Screen

Monday (6/25) 4:15 pm – 6:30 pm Grand C (4), Hilton

TC 5.6 Program/Research/Handbook (12/20)

Sunday (6/24) 3:00 pm – 6:30 pm Grand A (4), Hilton

TC 5.7 Evaporative Cooling (20/10)

Monday (6/25) 4:15 pm – 6:30 pm Grand D (4), Hilton

TC 5.7 Programs, Handbook, Research, Standards and Design Guide (6/6) Screen

Sunday (6/24) 5:00 pm – 7:00 pm 230 (2), Hilton

TC 5.9 Enclosed Vehicular Facilities (30/10) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm Grand F (4), Hilton

TC 5.9 Program, Standards, Handbook, Research (30/10) Screen

Tuesday (6/26) 1:00 pm – 3:30 pm Grand F (4), Hilton

TC 5.10 Kitchen Ventilation (20/15) Screen

Monday (6/25) 6:30 pm – 7:30 pm 335A (3), Hilton

TC 5.10 ASHRAE RP-1614 PMS Meeting (8/8) Screen / Electric

Sunday (6/24) 2:00 pm – 4:00 pm Boardroom 326 (3), Hilton

TC 5.10 Handbook (20/10) Screen /Electric

Monday (6/25) 2:00 pm – 3:30 pm 335A (3), Hilton

TC 5.10 Program (20/10) Screen/Electric

Monday (6/25) 3:30 pm – 4:30 pm 335A (3), Hilton

TC 5.10 Research (20/10) Screen/Electric

Monday (6/25) 4:30 pm – 6:30 pm 335A (3), Hilton

TC 5.11 Humidifying Equipment (10/5) Screen/Electric

Monday (6/25) 2:15 pm – 4:15 pm 230 (2), Hilton

TC 5.11 Research (6/4) Screen/Electric

Sunday (6/24) 3:00 pm – 5:00 pm 336A (3), Hilton

TC 6.1 Hydronic and Steam Equipment and Systems (20/25) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm Grand G (4), Hilton

TC 6.1 Handbook (12/8) Screen /Electric

Sunday (6/24) 5:00 pm – 6:00 pm 327 (3), Hilton

TC 6.1 Chilled Water Plant (12/8) Screen /Electric

Sunday (6/24) 6:00 pm – 7:00 pm 327 (3), Hilton

TC 6.1 Program (12/8) Screen /Electric

Monday (6/25) 2:15 pm – 3:15 pm 336B (3), Hilton

TC 6.1 Research (12/8) Screen /Electric

Monday (6/25) 3:15 pm – 4:15 pm 336B (3), Hilton

TC 6.2 District Energy (15/50) Screen/Electric

Sunday (6/24) 3:00 pm – 5:00 pm Grand B (4), Hilton

TC 6.2 Programs, Research, Handbook (15/50) Screen/
Electric

Sunday (6/24) 1:00 pm – 3:00 pm Grand B (4), Hilton

TC 6.3 Central Forced Air Heating and Cooling Systems (20/12) Screen

Tuesday (6/26) 1:00 pm – 3:30 pm 328 (3), Hilton

TC 6.5 Radiant Heating and Cooling (30/10) Screen/ Electric

Monday (6/25) 2:15 pm – 4:15 pm Grand H (4), Hilton

TC 6.5 Research (15/20) Screen/Electric

Sunday (6/24) 3:00 pm – 4:00 pm 339AB (3), Hilton

TC 6.5 Program (15/20) Screen/Electric

Sunday (6/24) 4:00 pm – 5:00 pm 339AB (3), Hilton

TC 6.5 Handbook (15/20) Screen/Electric

Sunday (6/24) 5:00 pm – 6:00 pm 339AB (3), Hilton

TC 6.6 Service Water Heating Systems (25/10) Screen/ Electric

Monday (6/25) 4:15 pm – 6:30 pm Grand L (4), Hilton

TC 6.6 Research, Handbook, and Program (20/10) Screen/
Electric

Monday (6/25) 2:15 pm – 4:15 pm Grand L (4), Hilton

TC 6.7 Solar and Other Renewable Energies (20/55) Screen

Tuesday (6/26) 1:00 pm – 3:30 pm 372AD (3), GRBCC

TC 6.7 Research, Standards, Programs and Handbook (12/6)
Electric

Monday (6/25) 4:15 pm – 8:30 pm 340B (3), Hilton

TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25) Screen/Electric

Tuesday (6/26) 3:30 pm – 6:00 pm 371CF (3), GRBCC

TC 6.8 Handbook: Geothermal Energy (10/10) Screen/
Electric

Sunday (6/24) 3:00 pm – 5:00 pm 371AB (3), GRBCC

TC 6.8 Programs (10/10) Screen/Electric

Sunday (6/24) 5:00 pm – 7:00 pm 371AB (3), GRBCC

TC 6.8 Research (15/10) Screen/Electric

Monday (6/25) 4:15 pm – 6:15 pm 430 (4), Hilton

TC 6.9 Thermal Storage (14/25) Screen/Electric

Monday (6/25) 4:30 pm – 6:00 pm Grand G (4), Hilton

TC 6.9 Standards, Programs, Handbook, Research and LRP
(30/20) Screen/Electric

Monday (6/25) 2:15 pm – 4:15 pm Grand G (4), Hilton

TC 6.10 Fuels and Combustion (20/10) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm 382C (3), GRBCC

TC 6.10 Handbook (8/6)

Monday (6/25) 2:15 pm – 4:15 pm 344B (3), Hilton

TC 7.1 Integrated Building Design (25/10)

Monday (6/25) 8:15 am – 10:30 am Grand D (4), Hilton

TC 7.2 HVAC&R Construction and Design Build Technologies (10/5)

Sunday (6/24) 10:00 am – 12:00 pm 382C (3), GRBCC

TC 7.3 Operations and Maintenance Management (25/7) Electric

Tuesday (6/26) 1:00 pm – 3:30 pm Grand D (4), Hilton

TC 7.3 Standards, Programs (15/10) Electric

Monday (6/25) 2:15 pm – 4:15 pm Boardroom 326 (3), Hilton

TC 7.3 Research, Handbook (15/10) Electric

Monday (6/25) 4:15 pm – 6:30 pm Boardroom 326 (3), Hilton

TC 7.3 Education & Training (10/5) Electric

Sunday (6/24) 1:30 pm – 3:00 pm 327 (3), Hilton

TC 7.3 RP-1650 PMS (6/0)

Tuesday (6/26) 8:00 am – 9:00 am 333 (3), Hilton

TC 7.4 Exergy Analysis for Sustainable Buildings (14/8)

Sunday (6/24) 8:00 am – 10:00 am 230 (2), Hilton

TC 7.5 Smart Building Systems (11/50) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm 370CF (3), GRBCC

TC 7.5 Fault Detection and Diagnosis (11/50) Electric

Sunday (6/24) 2:30 pm – 3:15 pm Grand C (4), Hilton

TC 7.5 Enabling Technologies (11/50) Electric

Sunday (6/24) 3:15 pm – 4:00 pm Grand C (4), Hilton

TC 7.5 Smart Grid (11/50) Electric

Sunday (6/24) 4:00 pm – 4:45 pm Grand C (4), Hilton

TC 7.5 Handbook (11/50) Electric

Sunday (6/24) 4:45 pm – 5:30 pm Grand C (4), Hilton

TC 7.5 Program (11/50) Electric

Sunday (6/24) 5:30 pm – 6:00 pm Grand C (4), Hilton

TC 7.5 Buildings Operations Dynamics (11/50) Electric

Monday (6/25) 4:30 pm – 5:15 pm 370 ABDE (3), GRBCC

TC 7.5 Research (11/50) Electric

Monday (6/25) 5:15 pm – 6:00 pm 370 ABDE (3), GRBCC

TC 7.6 Building Energy Performance (10/30)

Tuesday (6/26) 1:00 pm – 3:30 pm 337A (3), Hilton

TC 7.6 Federal Buildings (25/25) Electric

Saturday (6/23) 9:00 am – 3:00 pm 339AB (3), Hilton

TC 7.6 Federal Buildings (25/25) Electric

Sunday (6/24) 9:00 am – 12:00 pm Grand J (4), Hilton

TC 7.6 Research (10/10) Electric

Sunday (6/24) 1:00 pm – 2:00 pm Grand J (4), Hilton

TC 7.6 Commercial Building Energy Audit (10/10) Electric

Sunday (6/24) 2:00 pm – 3:00 pm Grand J (4), Hilton

TC 7.6 Handbook (10/10)

Sunday (6/24) 3:00 pm – 4:00 pm Grand J (4), Hilton

TC 7.6 Monitoring and Energy Performance (10/30)

Monday (6/25) 2:15 pm – 4:15 pm 381C (3), GRBCC

TC 7.6 Energy Management (10/15) Electric

Monday (6/25) 4:15 pm – 5:15 pm 381C (3), GRBCC

TC 7.6 Standards and Programs (10/10) Electric

Monday (6/25) 5:15 pm – 6:15 pm 381C (3), GRBCC

TC 7.6 Executive (10/0) Electric

Monday (6/25) 6:15 pm – 7:00 pm 381C (3), GRBCC

TC 7.7 Testing and Balancing (20/30)

Monday (6/25) 2:15 pm – 4:15 pm 371DE (3), GRBCC

TC 7.7 Program/Handbook/Research (8/3)

Saturday (6/23) 8:00 am – 10:30 am 342 (3), Hilton

TC 7.8 Owning and Operating Costs (20/5)

Monday (6/25) 2:15 pm – 4:15 pm 346AB (3), Hilton

TC 7.8 Handbook, Program, Research

Sunday (6/24) 3:00 pm – 5:00 pm 327 (3), Hilton

TC 7.9 Building Commissioning (40/20) Screen/Electric

Sunday (6/24) 3:00 pm – 5:00 pm 370ABDE (3), GRBCC

TC 7.9 Handbook, Programs, Research (15/10) Screen/Electric

Saturday (6/23) 7:00 am – 10:00 am 344AB (3), Hilton

TC 8.1 Positive Displacement Compressors (12/14) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm 327 (3), Hilton

TC 8.1 Research and Programs (8/4) Electric

Sunday (6/24) 6:00 pm – 7:00 pm 328 (3), Hilton

TC 8.2 Centrifugal Machines (20/8)

Monday (6/25) 2:15 pm – 4:15 pm 335B (3), Hilton

TC 8.2 Programs, Research and Handbook (14/0) Screen/Electric

Sunday (6/24) 5:00 pm – 7:00 pm 336B (3), Hilton

TC 8.3 Absorption and Heat Operated Machines (20/10) Screen

Monday (6/25) 3:30 pm – 6:00 pm Grand J (4), Hilton

TC 8.3 Research/Handbook (8/5) Electric

Monday (6/25) 2:15 pm – 3:30 pm Grand J (4), Hilton

TC 8.4 Air-to-Refrigerant Heat Transfer Equipment (20/10) Screen

Tuesday (6/26) 3:30 pm – 6:00 pm Grand J (4), Hilton

TC 8.4 Research, Standards, Handbook (10/30) Screen/Electric

Monday (6/25) 6:30 pm – 8:30 pm Grand I (4), Hilton

TC 8.5 Liquid to Refrigerant Heat Exchangers (47/18) Screen

Monday (6/25) 4:15 pm – 6:30 pm Grand H (4), Hilton

TC 8.5/1.3 Research Subcommittee Meeting and Project Review (20/30) Screen/Electric

Sunday (6/24) 3:00 pm – 7:00 pm 372AD (3), GRBCC

TC 8.6 Cooling Towers and Evaporative Condensers (20/5)

Monday (6/25) 2:15 pm – 4:15 pm 372AD (3), GRBCC
TC 8.6 Handbook/Program/Research (5/7) Electric
Monday (6/25) 9:00 am – 10:00 am 342 (3), Hilton

TC 8.7 Variable Refrigerant Flow (VRF) (20/30)

Monday (6/25) 4:15 pm – 6:30 pm 372AD (3), GRBCC

TC 8.8 Refrigerant System Controls and Accessories (10/10) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm 337B (3), Hilton
TC 8.8 Research, Program, Handbook (5/5)
Sunday (6/24) 6:30 pm – 7:30 pm 342 (3), Hilton

TC 8.9 Residential Refrigerators and Food Freezers (6/10)

Monday (6/25) 2:15 pm – 4:15 pm 430 (4), Hilton

TC 8.10 Mechanical Dehumidification and Heat Pipes (16/10)

Tuesday (6/26) 3:30 pm – 5:00 pm 329 (3), Hilton
TC 8.10 Program/Handbook/Research/Standards (20/5)
Electric
Tuesday (6/26) 1:00 pm – 3:30 pm 329 (3), Hilton

TC 8.11 Unitary and Room Air Conditioners and Heat Pumps (20/40)

Monday (6/25) 4:15 pm – 6:30 pm Grand A (4), Hilton
TC 8.11 Handbook, Program, Research (12/20) Electric
Sunday (6/24) 3:00 pm – 6:30 pm 370CF (3), GRBCC

TC 8.12 Desiccant Dehumidification Equipment and Components (15/15)

Monday (6/25) 2:15 pm – 4:15 pm 333 (3), Hilton

TC 9.1 Large Building Air-Conditioning Systems (14/10) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm 327 (3), Hilton
TC 9.1 Program and Handbook (10/2) Screen/Electric
Tuesday (6/26) 12:00 pm – 1:00 pm 327 (3), Hilton

TC 9.2 Industrial Air Conditioning (Combined with TC 5.8 Main) (45/15) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm Grand E (4), Hilton
TC 9.2 Programs/Research/Handbook (10/5) Electric
Sunday (6/24) 4:00 pm – 6:00 pm 342 (3), Hilton

TC 9.3 Transportation Air Conditioning (14/20) Screen/Electric

Monday (6/25) 3:00 pm – 5:00 pm Grand I (4), Hilton
TC 9.3 Rail/Mass Transit Subcommittee (14/20) Electric
Monday (6/25) 10:00 am – 12:00 pm Grand I (4), Hilton
TC 9.3 Research Subcommittee (14/20) Electric
Monday (6/25) 9:00 am – 10:00 am Grand I (4), Hilton
TC 9.3 Handbook Subcommittee (14/20) Electric
Monday (6/25) 2:15 pm – 3:00 pm Grand I (4), Hilton

TC 9.4 Justice Facilities (20/5) Electric

Sunday (6/24) 3:00 pm – 5:00 pm 371CF (3), GRBCC
TC 9.4 Justice Facilities Design Guide (8/6) Electric
Sunday (6/24) 5:00 pm – 7:00 pm 371CF (3), GRBCC

TC 9.6 Healthcare Water (15/15) Screen/Electric

Sunday (6/24) 9:00 am – 10:00 am Grand D (4), Hilton
TC 9.6 Infectious Diseases (30/25) Electric
Sunday (6/24) 10:00 am – 12:00 pm Grand D (4), Hilton
TC 9.6 Research (15/15) Electric
Sunday (6/24) 1:00 pm – 2:00 pm Grand D (4), Hilton
TC 9.6 Handbook (20/15) Electric
Sunday (6/24) 2:00 pm – 3:00 pm Grand D (4), Hilton
TC 9.6 Energy (20/15) Electric
Sunday (6/24) 3:00 pm – 4:00 pm Grand D (4), Hilton
TC 9.6 Program (15/15) Electric
Sunday (6/24) 4:00 pm – 5:00 pm Grand D (4), Hilton

TC 9.7 Educational Facilities (15/15) Screen /Electric

Sunday (6/24) 1:00 pm – 3:00 pm 336A (3), Hilton (20/10)

TC 9.8 Large Building Air-Conditioning Applications (20/10)

Monday (6/25) 2:15 pm – 4:15 pm 337A (3), Hilton
TC 9.8 Handbook (10/5) Screen/Electric
Monday (6/25) 9:00 am – 10:00 am 337A (3), Hilton
TC 9.8 Programs (10/5) Screen/Electric
Monday (6/25) 10:00 am – 11:00 am 337A (3), Hilton
TC 9.8 International and Membership (10/5) Screen/Electric
Monday (6/25) 11:00 am – 12:00 pm 337A (3), Hilton

TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment (25/90) Screen/Electric

Monday (6/25) 2:15 pm – 7:00 pm 371AB (3), GRBCC
TC 9.9 Programs, Handbook and Research (55/20) Screen/
Electric
Sunday (6/24) 5:00 pm – 7:00 pm 370ABDE (3), GRBCC
TC 9.9 RP-1755 PMS (8/7) Screen/Electric
Monday (6/25) 7:30 am – 9:00 am 336B (3), Hilton
TC 9.9 IT Equipment Manufacturers Subcommittee Working
Group Part 1 (12/0)
Monday (6/25) 8:00 am – 10:00 am 338 (3), Hilton
TC 9.9 IT Equipment Manufacturers Subcommittee Working
Group Part 2 (12/0)
Monday (6/25) 10:00 am – 12:00 pm 338 (3), Hilton

TC 9.10 Laboratory Systems (20/40) Screen/Electric

Tuesday (6/26) 3:30 pm – 5:30 pm 371DE (3), GRBCC
TC 9.10 RP-1573 PMS Monitoring Subcommittee (10/2)
Electric
Sunday (6/24) 1:00 pm – 3:00 pm 346AB (3), Hilton
TC 9.10 Standards (20/5) Screen/Electric
Sunday (6/24) 3:00 pm – 3:30 pm 346AB (3), Hilton
TC 9.10 Research (25/5) Screen/Electric
Sunday (6/24) 3:30 pm – 4:15 pm 346AB (3), Hilton

TC 9.10 Program (25/5) Screen/Electric

Sunday (6/24) 4:15 pm – 4:45 pm 346AB (3), Hilton

TC 9.10 Handbook (20/5) Screen/Electric

Tuesday (6/26) 1:00 pm – 1:45 pm 371DE (3), GRBCC

TC 9.10 Labs Energy Efficiency (25/5) Screen/Electric

Tuesday (6/26) 2:30 pm – 3:30 pm 371DE (3), GRBCC

TC 9.10 Standard 110 (20/5) Screen/Electric

Tuesday (6/26) 1:45 pm – 2:30 pm 371DE (3), GRBCC

TC 9.11 Clean Spaces (30/45) Screen

Monday (6/25) 3:00 pm – 4:30 pm 372CF (3), GRBCC

TC 9.11 Research (12/6) Screen/Electric

Monday (6/25) 2:15 pm – 3:00 pm 372CF (3), GRBCC

TC 9.11 Energy Efficiency (12/6) Screen/Electric

Monday (6/25) 4:30 pm – 5:00 pm 372CF (3), GRBCC

TC 9.11 Handbook (12/6) Screen/Electric

Monday (6/25) 5:00 pm – 5:30 pm 372CF (3), GRBCC

TC 9.11 Design Guide (12/6) Screen/Electric

Monday (6/25) 5:30 pm – 6:00 pm 372CF (3), GRBCC

TC 9.11 Energy Efficiency Subcommittee (12/6) Screen/Electric

Sunday (6/24) 9:00 am – 10:00 am Boardroom 326 (3), Hilton

TC 9.12 Tall Buildings (12/8)

Sunday (6/24) 12:15 pm – 2:00 pm 337B (3), Hilton

TC 10.1 Custom Engineered Refrigeration Systems (30/10) Screen

Monday (6/25) 2:00 pm – 4:00 pm Grand F (4), Hilton

TC 10.1 Program/Research (30/10)

Sunday (6/24) 5:30 pm – 7:30 pm 344AB (3), Hilton

TC 10.2 Automatic Ice Making Plants and Skating Rinks (12/3) Screen/Electric

Monday (6/25) 4:30 pm – 6:30 pm 337B (3), Hilton

TC 10.3 Refrigerant Piping, Controls and Accessories (20/10) Screen

Tuesday (6/26) 1:00 pm – 3:30 pm 230 (2), Hilton

TC 10.3 RP-1569 PMS (15/0) Electric

Tuesday (6/26) 8:00 am – 10:00 am Grand L (4), Hilton

TC 10.5 Refrigerated Processing and Storage (15/10)

Tuesday (6/26) 3:30 pm – 6:00 pm 340A (3), Hilton

TC 10.6 Transport Refrigeration (10/20) Electric

Monday (6/25) 4:45 pm – 7:00 pm Boardroom 331 (3), Hilton

TC 10.7 Commercial Food and Beverage Refrigeration Equipment (30/40) Screen

Monday (6/25) 2:15 pm – 4:15 pm Grand E (4), Hilton

TC 10.7 Program (10/10)

Sunday (6/24) 5:15 pm – 6:00 pm 332 (3), Hilton

TC 10.7 Research (10/10) Electric

Sunday (6/24) 6:00 pm – 6:45 pm 332 (3), Hilton

TC 10.7 Handbook (10/10) Electric

Sunday (6/24) 6:45 pm – 7:15 pm 332 (3), Hilton

TC 10.8 Refrigeration Load Calculations (10/10)

Sunday (6/24) 3:00 pm – 5:00 pm 336B (3), Hilton

TASK GROUPS (TG), TECHNICAL RESOURCE GROUPS (TRG), AND MULTIDISCIPLINARY TASK GROUPS (MTG)

TG2 HVAC Security (10/5) Screen/Electric

Tuesday (6/26) 9:00 am – 12:00 pm 327 (3), Hilton

TRG4.IAQP – Indoor Air Quality Procedure (12/8) Screen/Electric

Sunday (6/24) 10:30 am – 12:00 pm 340AB (3), Hilton

TRG9 Cold Climate Building Design Guide (20/0) Screen/Electric

Wednesday (6/27) 9:00 am – 11:00 am 333 (3), Hilton

MTG.HCDG Hot Climate Building Design Guide 2018 Working Session (12/0)

Monday (6/25) 8:00 am – 12:00 pm Boardroom 334 (3), Hilton

MTG.BIM - Building Information Modeling (20/0) Screen

Monday (6/25) 10:15 am – 12:00 pm Grand B (4), Hilton

MTG Hot Climate Design Guide (20/0)

Sunday (6/24) 8:00 am – 9:00 am Grand C (4), Hilton

MTG.IAST - Impact of ASHRAE Standards and Technology on Energy Savings/Performance (15/10) Electric

Saturday (6/23) 1:00 pm – 2:30 am Grand A (4), Hilton

MTG.LowGWP - Lower Global Warming Potential Alternative Refrigerants (28/30) Screen

Sunday (6/24) 5:00 pm – 6:00 pm Grand B (4), Hilton

Wednesday (6/27) 10:00 am – 12:00 pm 346AB (3), Hilton

MTG.LowGWP Research Subcommittee (37/20) Screen/Electric

Sunday (6/24) 12:00 pm – 2:00 pm Grand C (4), Hilton

MTG.LowGWP Codes and Standards (30/30) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:30 pm 382C (3), GRBCC

MTG.OBB - Occupant Behavior in Buildings (30/10) Screen

Monday (6/25) 8:00 am – 10:00 am Grand C (4), Hilton

STANDARD PROJECT COMMITTEES (SPC) AND STANDING STANDARD PROJECT COMMITTEES (SSPC)

PC Chairs Training Breakfast (100/0) Screen

Sunday (6/24) 7:30 am – 9:00 am BOA D (2), Hilton

SSPC 15 Safety Standard for Refrigeration Systems (25/60) Screen /Electric

Sunday (6/24) 1:00 pm – 5:00 pm Grand I (4), Hilton
SSPC 15 Safety Standards for Refrigeration Systems Rewrite (25/60) Screen/Electric

Saturday (6/23) 1:00 pm – 4:00 pm Grand C (4), Hilton
SSPC 15 Safety Standards for Refrigeration Systems Ad Hoc and Rewrite (25/60) Screen/Electric

Sunday (6/24) 9:00 am – 12:00 pm Grand I (4), Hilton
SSPC 15 Subcommittee 15.2 Safety Standard for Refrigeration Systems in Residential Applications (20/30) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm 346AB (3), Hilton

SPC 20 Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (6/6) Screen/Electric

Sunday (6/24) 12:00 pm – 2:00 pm 333 (3), Hilton

SPC 24 Methods of Testing for Rating Evaporators Used for Cooling Liquids (6/10) Screen/Electric

Monday (6/25) 8:00 am – 10:00 am 335A (3), Hilton

SPC 26 Mechanical Refrigeration & Air-Conditioning Installation Aboard Ship (4/4) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm 336B (3), Hilton

SPC 28 MOT Flow Capacity of Refrigerant Capillary Tubes (5/5) Electric

Sunday (6/24) 5:00 pm – 7:00 pm 336A (3), Hilton

SPC 30 Method of Testing Liquid-Chilling Packages (8/10) Screen/Electric

Monday (6/25) 8:00 am – 11:00 am Boardroom 326 (3), Hilton

SSPC 34 Designation and Safety Classification of Refrigerants (17/58) Screen /Electric

Monday (6/25) 6:30 pm – 10:00 pm Grand E (4), Hilton
SSPC 34 Designation and Nomenclature Subcommittee (14/21) Screen /Electric

Saturday (6/23) 7:00 am – 10:00 am Grand B (4), Hilton

SSPC 34 Flammability Subcommittee (16/45) Screen/Electric

Saturday (6/23) 10:00 am – 3:00 pm Grand B (4), Hilton

SSPC 34 Toxicity Subcommittee (10/25) Screen/Electric

Sunday (6/24) 6:30 pm – 10:00 pm Grand A (4), Hilton

SPC 35-2014 Revision Committee (4/3) Screen/Electric

Tuesday (6/26) 8:00 am – 10:00 am 340B (3), Hilton

SPC 37 MOT for Rating Electrically Driven Unitary Air-Conditioners and Heat Pump Equipment (20/30) Screen/Electric

Wednesday (6/27) 8:00 am – 12:00 pm 381C (3), GRBCC

SSPC 41 Standard Methods for Measurement (22/10) Electric

Sunday (6/24) 1:00 pm – 3:00 pm 339AB (3), Hilton

41.3 Subcommittee, Standard Methods for Pressure Measurement (15/5) Screen/Electric

Sunday (6/24) 10:00 am – 12:00 pm 338 (3), Hilton

41.6 Subcommittee, Standard Methods for Humidity Measurement (15/5) Screen/Electric

Monday (6/25) 10:00 am – 12:00 pm 342 (3), Hilton

41.11 Subcommittee, Standard Methods for Power Measurement (15/5) Screen/Electric

Monday (6/25) 2:15 pm – 4:15 pm 342 (3), Hilton

41.4 Subcommittee, Standard Methods for Proportion of Lubricant in Liquid Refrigerant Measurement (7/3) Screen/Electric

Monday (6/25) 4:15 pm – 6:15 pm 342 (3), Hilton

41.10 Subcommittee, Standard Methods for Refrigerant Mass Flow Measurement Using Flowmeters (15/5) Screen/Electric

Tuesday (6/26) 8:00 am – 10:00 am 342 (3), Hilton

41.1 Subcommittee, Standard Methods for Temperature Measurement (15/5) Screen/Electric

Tuesday (6/26) 10:00 am – 12:00 pm 342 (3), Hilton

SSPC 52.2 Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size (17/50) Screen/Electric

Saturday (6/23) 8:00 am – 12:00 pm Grand F (4), Hilton

SSPC 62.1 Ventilation for Acceptable Indoor Air Quality (30/30) Screen/Electric

Saturday (6/23) 8:00 am – 12:00 pm 335AB (3), Hilton

Sunday (6/24) 1:00 pm – 7:00 pm 335AB (3), Hilton

SSPC 62.1 IAQ Guideline Subcommittee (15/15) Screen/Electric

Friday (6/22) 8:00 am – 12:00 pm 328 (3), Hilton

SSPC 62.1 Administration Subcommittee (15/15) Screen/Electric

Friday (6/22) 1:00 pm – 5:00 pm 327 (3), Hilton

Saturday (6/23) 1:00 pm – 3:00 pm 327 (3), Hilton

SSPC 62.1 Research and Education Subcommittee (15/15) Screen/Electric

Friday (6/22) 1:00 pm – 5:00 pm 328 (3), Hilton

Saturday (6/23) 1:00 pm – 3:00 pm 332 (3), Hilton

SSPC 62.1 Buildings, Systems and Equipment (15/15) Screen/Electric

Friday (6/22) 1:00 pm – 5:00 pm 330 (3), Hilton

Saturday (6/23) 1:00 pm – 3:00 pm 335AB (3), Hilton

SSPC 62.1 Ventilation Subcommittee (15/15) Screen/Electric

Friday (6/22) 1:00 pm – 5:00 pm 333 (3), Hilton

Saturday (6/23) 1:00 pm – 3:00 pm 328 (3), Hilton

SSPC 62.1 Natural Ventilation Working Group (15/15) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm 381C (3), GRBCC

SSPC 62.2 Ventilation and Acceptable IAQ in Residential Buildings (30/20) Screen/Electric

Friday (6/22) 9:00 am – 2:30 pm Grand L (4), Hilton

Saturday (6/23) 8:00 am – 3:00 pm Grand L (4), Hilton

SSPC 62.2 Envelope Subcommittee (20/20) Screen/Electric

Friday (6/22) 2:30 pm – 5:00 pm Grand L (4), Hilton

SSPC 62.2 IAQ Subcommittee (12/20) Screen/Electric
Friday (6/22) 2:30 pm – 5:00 pm 340B (3), Hilton
SSPC 62.2 System Subcommittee (12/20) Screen/Electric
Friday (6/22) 2:30 pm – 5:00 pm 340A (3), Hilton

SPC 63.1 Method of Testing Liquid-Line Refrigerant Driers (4/4)

Tuesday (6/26) 10:00 am – 11:00 am Grand D (4), Hilton

SPC 64 Methods of Lab Testing Remote Mechanical Draft Evaporative Refrigerant Condensers (6/5)

Monday (6/25) 10:00 am – 11:00 am 337B (3), Hilton

SPC 70 Method of Testing for Rating the Performance of Air Outlets and Air Inlets (15/10) Screen/Electric

Monday (6/25) 8:00 am – 12:00 pm 430 (4), Hilton

SSPC 72 Method of Testing Open and Closed Commercial Refrigerators and Freezers (16/14) Screen / Electric

Sunday (6/24) 1:00 pm – 5:00 pm 230 (2), Hilton

SPC 84 Method of Testing Air-to-Air Heat/Energy Exchangers (9/9) Screen/Electric

Monday (6/25) 4:15 pm – 6:15 pm 230 (2), Hilton

SSPC 90.1 Energy Eff. Design of New Bldg. (50/60) Screen/Electric

Saturday (6/23) 8:00 am – 12:00 pm Grand E (4), Hilton

Sunday (6/24) 9:00 am – 12:00 pm Grand E (4), Hilton

Monday (6/25) 8:00 am – 12:00 pm Grand E (4), Hilton

SSPC 90.1 Envelope Subcommittee (15/30) Screen/Electric

Friday (6/22) 9:00 am – 10:00 pm Grand F (4), Hilton

Saturday (6/23) 1:00 pm – 8:00 pm Grand F (4), Hilton

Sunday (6/24) 1:00 pm – 8:00 pm Grand F (4), Hilton

SSPC 90.1 Lighting Subcommittee (12/10) Screen/Electric

Friday (6/22) 9:00 am – 10:00 pm 336A (3), Hilton

Saturday (6/23) 1:00 pm – 7:00 pm Boardroom 331 (3), Hilton

Sunday (6/24) 1:00 pm – 8:00 pm Boardroom 331 (3), Hilton

SSPC 90.1 Mechanical Subcommittee (25/25) Screen/Electric

Friday (6/22) 9:00 am – 10:00 pm Grand E (4), Hilton

Saturday (6/23) 1:00 pm – 7:00 pm Grand E (4), Hilton

Sunday (6/24) 1:00 pm – 8:00 pm Grand E (4), Hilton

SSPC 90.1 ECB Subcommittee (12/18) Screen/Electric

Friday (6/22) 3:00 pm – 8:00 pm 336B (3), Hilton

Saturday (6/23) 1:00 pm – 5:00 pm Grand D (4), Hilton

Sunday (6/24) 1:00 pm – 4:00 pm 337A (3), Hilton

SSPC 90.1 Envelope Subcommittee Working Group (15/30) Screen/Electric

Friday (6/22) 4:00 pm – 6:00 pm Grand I (4), Hilton

Saturday (6/23) 4:00 pm – 6:00 pm Grand I (4), Hilton

SSPC 90.1 Format & Compliance Subcommittee (6/6) Electric

Friday (6/22) 5:00 pm – 10:00 pm 340B (3), Hilton

Saturday (6/23) 1:00 pm – 5:00 pm 336B (3), Hilton

Sunday (6/24) 4:00 pm – 7:00 pm 337A (3), Hilton

SSPC 90.1 Renewable Energy Working Group (10/10)
Sunday (6/24) 3:00 pm – 4:00 pm 372CF (3), GRBCC

SSPC 90.2 Energy-Efficient Design of Low-Rise Residential Buildings (20/15) Screen/Electric

Monday (6/25) 2:15 pm – 6:15 pm 330 (3), Hilton

Tuesday (6/26) 1:00 pm – 5:00 pm 335A (3), Hilton

SSPC 90.2 Envelope (10/10) Screen/Electric

Monday (6/25) 6:30 pm – 9:30 pm 330 (3), Hilton

Tuesday (6/26) 8:00 am – 12:00 pm 335A (3), Hilton

SSPC 90.2 Lighting (3/5) /Electric

Monday (6/25) 6:30 pm – 9:30 pm 332 (3), Hilton

Tuesday (6/26) 8:00 am – 12:00 pm 332 (3), Hilton

SSPC 90.2 Mechanical (5/10) Screen/Electric

Monday (6/25) 6:30 pm – 9:30 pm 335C (3), Hilton

Tuesday (6/26) 8:00 am – 12:00 pm Boardroom 334 (3), Hilton

SPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings (17/20) Screen

Saturday (6/23) 9:00 am – 1:00 pm 338 (3), Hilton

Monday (6/25) 7:30 am – 11:30 am 230 (2), Hilton

SPC 97 Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use within Refrigerant Systems (8/4) Screen/Electric

Tuesday (6/26) 9:30 am – 11:00 am 333 (3), Hilton

SSPC 100 Energy Efficiency in Existing Buildings (20/10) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm 337B (3), Hilton

SSPC 100 Alternative to EUI (WG5) (16/10) Screen/Electric

Sunday (6/24) 12:00 pm – 2:00 pm 338 (3), Hilton

SSPC 100 International Target Table and Climate Zones (WG4) (5/5) Screen/Electric

Sunday (6/24) 4:00 pm – 6:00 pm 338 (3), Hilton

SSPC 100 – Operation and Maintenance (WG3) (5/5) Screen/Electric

Sunday (6/24) 8:00 am – 10:00 am 338 (3), Hilton

SPC105 Standard Methods of Determining, Expressing and Comparing Building Energy Performance and Greenhouse Gas Emissions (12/25) Screen/Electric

Sunday (6/24) 5:00 pm – 9:00 pm 335C (3), Hilton

SPC 111 Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation and Air-Conditioning Systems (12) (7/5) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm 336A (3), Hilton

SPC 113 Method of Testing for Room Air Diffusion (10/10) Screen/Electric

Tuesday (6/26) 3:30 pm – 5:00 pm 337B (3), Hilton

SPC 118.2 Method of Testing for Rating Residential Water Heaters (15/15)

Tuesday (6/26) 1:00 pm – 5:00 pm 340B (3), Hilton

SPC 124 MOT/Rating Combinations Space-Heating and Water Heating Appliances (13/7) Electric

Tuesday (6/26) 9:00 am – 12:00 pm Grand I (4), Hilton

SPC 127 Method of Testing for Rating Air Conditioning Units Serving Data Center (DC) and Other Information Technology Equipment (ITE) Spaces (12/12) Screen/Electric

Tuesday (6/26) 1:00 pm – 5:00 pm Boardroom 334 (3), Hilton

SPC 128 Method of Rating Portable Air Conditioners (10/0)

Tuesday (6/26) 11:00 am – 12:00 pm 333 (3), Hilton

SSPC 135 BACnet (40/10) Electric

Saturday (6/23) 8:00 am – 3:30 pm Grand K (4), Hilton

Monday (6/25) 8:00 am – 12:00 pm Grand K (4), Hilton

SSPC 135 BACnet Working Groups (10/5) Electric

Thursday (6/21) 8:00 am – 5:00 pm 336B (3), Hilton

Friday (6/22) 8:00 am – 5:00 pm 329 (3), Hilton

Friday (6/22) 8:00 am – 5:00 pm 332 (3), Hilton

Sunday (6/24) 8:00 am – 5:00 pm 329 (3), Hilton

Sunday (6/24) 8:00 am – 5:00 pm 330 (3), Hilton

SSPC 140 Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs (15/12) Screen/Electric

Monday (6/25) 2:15 pm – 6:15 pm 370CF (3), GRBCC

SSPC 145 Test Method for Assessing the Performance of Gas Phase Air Cleaning Equipment (10/15) Screen/Electric

Sunday (6/24) 12:00 pm – 3:00 pm 340AB (3), Hilton

SPC 146 Method of Testing and Rating Pool Heaters (8/5) Electric

Tuesday (6/26) 10:00 am – 12:00 pm 335B (3), Hilton

SSPC 147 Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Systems (5/5) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm 230 (2), Hilton

SPC 150-2000: Method of Testing for Performance of Cool Storage Systems (8/2) Electric

Sunday (6/24) 5:00 pm – 6:00 pm 329 (3), Hilton

SSPC 154 Ventilation for Commercial Cooking Operations (10/15) Screen/Electric

Sunday (6/24) 4:00 pm – 8:00 pm Boardroom 326 (3), Hilton

SPC 155 Method of Testing for Rating Commercial Space Heating Boiler Systems (12/12) Screen/Electric

Sunday (6/24) 1:00 pm – 5:00 pm Boardroom 334 (3), Hilton

SPC 158.1 MOT Capacity of Refrigerant Solenoid Valves (5/5) Electric

Sunday (6/24) 5:00 pm – 7:00 pm 336A (3), Hilton

SSPC 160 Criteria for Moisture Control Design Analysis in Buildings (20/5) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm Grand F (4), Hilton

SPC 164.4 Method of Test for Commercial / Industrial Adiabatic Humidifiers (10/10) Screen/Electric

Monday (6/25) 9:00 am – 11:00 am Boardroom 331 (3), Hilton

SSPC 169 Climatic Data for Building Design Standards (8/8) Screen/Electric

Monday (6/25) 10:00 am – 12:00 pm 328 (3), Hilton

SSPC 170 Ventilation of Healthcare Facilities (23/75) Screen/Electric

Monday (6/25) 4:00 pm – 6:00 pm 371 CF (3), GRBCC

Tuesday (6/26) 8:00 am – 1:00 pm Grand A (4), Hilton

SSPC 170 Ventilation of Health Care Facilities, Natural Ventilation Work Group (15/15) Screen/Electric

Monday (6/25) 2:00 pm – 4:00 pm 371CF (3), GRBCC

SPC 180 Standard Practice for Inspection and Maintenance of HVAC Systems (17/5) Screen /Electric

Friday (6/22) 2:00 pm – 6:00 pm Grand C (4), Hilton

SPC 182 Method of Test for Absorption Chillers (5/5) Electric

Monday (6/25) 10:00 am – 12:00 pm 340A (3), Hilton

SPC 184 Method of Test for Field Performance of Liquid-Chilling Systems (9/6) Screen/Electric

Tuesday (6/26) 8:00 am – 10:00 am 430 (4), Hilton

SSPC 185 Methods of Test to Inactivate Microorganisms in HVAC Systems with UV-C Lights (10/10)

Saturday (6/23) 8:00 am – 9:00 am 328 (3), Hilton

SSPC 188 Legionellosis: Risk Management for Building Water Systems (40/10) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm Grand E (4), Hilton

Tuesday (6/26) 3:45 pm – 5:30 pm Grand E (4), Hilton

Wednesday (6/27) 8:00 am – 12:00 pm 382C (3), GRBCC

SSPC 189.1 ASHRAE/USGBC/IES Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (45/50) Electric

Tuesday (6/26) 8:00 am – 10:00 am Grand B (4), Hilton

Wednesday (6/27) 8:00 am – 12:00 pm 382AB (3), GRBCC

SSPC 189.1 Working Group 6 (Water Use) (20/20) Screen/Electric

Tuesday (6/26) 10:00 am – 12:30 pm Grand C (4), Hilton

SSPC 189.1 Working Group 7 (Energy Efficiency) (30/30) Screen/Electric

Tuesday (6/26) 10:00 am – 1:00 pm Grand B (4), Hilton

SSPC 189.1 Working Group 9 (Materials and Resources)
(20/20) Screen/Electric

Tuesday (6/26) 1:00 pm – 3:00 pm Grand C (4), Hilton
SSPC 189.1 Working Group 8 (IEQ) (30/30) Screen/Electric

Tuesday (6/26) 1:00 pm – 4:00 pm Grand A (4), Hilton
SSPC 189.1 Working Group 7.5 (30/30) Screen/Electric

Tuesday (6/26) 1:30 pm – 4:30 pm Grand B (4), Hilton
SSPC 189.1 Working Group 5 (Site Sustainability) (20/20)
Screen/Electric

Tuesday (6/26) 4:00 pm – 6:00 pm Grand A (4), Hilton
SSPC 189.1 Working Group 10 (20/20) Screen /Electric

Tuesday (6/26) 5:00 pm – 7:00 pm Grand C (4), Hilton

SSPC 189.3P Design, Construction and Operation of Sustainable High Performance Health Care Facilities (18/12) Screen/Electric

Monday (6/25) 8:00 am – 12:00 pm 333 (3), Hilton

SPC 191 Standard for the Efficient Use of Water in Building and Mechanical Systems (12/6) Screen/Electric

Tuesday (6/26) 10:00 am – 12:00 pm Grand L (4), Hilton

SPC 195 Method of Test for Rating Air Terminal Unit Controls (7/4) Screen

Tuesday (6/26) 10:00 am – 12:00 pm 430 (4), Hilton

SPC 196 Method of Test for Measuring Refrigerant Leak Rates (7/14) Screen/Electric

Sunday (6/24) 6:00 pm – 10:00 pm Grand D (4), Hilton

SPC 198 Method of Test for Rating DX-Dedicated Outdoor Air Systems for Moisture Removal Capacity and Moisture Removal Efficiency (16/10)

Sunday (6/24) 12:00 pm – 1:00 pm Grand K (4), Hilton

SPC 200 MOT Chilled Beams (20/10) Electric

Monday (6/25) 8:00 am – 10:00 am Grand F (4), Hilton

SPC 204 Method of Test for Rating Micro Combined Heat and Power Devices (15/10) Electric

Monday (6/25) 6:30 pm – 9:30 pm 327 (3), Hilton

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment (25/15) Screen /Electric

Tuesday (6/26) 8:00 am – 12:00 pm Grand G (4), Hilton
SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment – Working Groups (20/15) Screen/Electric

Sunday (6/24) 9:00 am – 12:00 pm Grand L (4), Hilton

SPC 207P Laboratory Method of Test of Fault Detection and Diagnostics Applied Commercial Air-Cooled Packaged Systems (20/30) Screen

Monday (6/25) 8:00 am – 10:00 am Grand G (4), Hilton

SPC 207 Planning for Advisory Public Review (20/0) Screen

Monday (6/25) 10:00 am – 12:00 pm Grand G (4), Hilton

Standard 209 2018 Energy Simulation Aided Design for Buildings Except Low-Rise Residential Buildings

Monday (6/25) 2:15 pm – 5:00 pm 327 (3), Hilton

SPC 210 Method of Testing for Rating Commercial Walk-in Cooler and Freezer Equipment (15/15) Screen/Electric

Monday (6/25) 8:00 am – 12:00 pm 329 (3), Hilton

SPC 211 Commercial Building Energy Audits (18/20) Screen/Electric

Monday (6/25) 8:00 am – 12:00 pm 381C (3), GRBCC

SPC 212 MOT/for Determining Energy Performance and Water-Use Efficiency of Add-On Evaporative Pre-Coolers for Unitary Air Conditioning Equipment (7/4) Screen/Electric

Tuesday (6/26) 1:00 pm – 5:00 pm 332 (3), Hilton

SPC 213P Method of Calculating Moist Air Thermodynamics (8/5)

Tuesday (6/26) 8:00 am – 12:00 pm 340A (3), Hilton

SPC 216 MOT for Determining Application Data of Overhead Circulator Fans (11/10) Screen/Electric

Monday (6/25) 2:15 pm – 5:15 pm 344A (3), Hilton

SPC 217 Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities (12/5) Screen/Electric

Tuesday (6/26) 7:30 am – 12:00 pm 328 (3), Hilton

SPC 218P – MOT for Lubricant and Refrigerant Miscibility Determination (9/10) Screen/Electric

Monday (6/25) 8:00 am – 10:00 am 337B (3), Hilton

SPC 219 Method of Testing the Ability of Liquid Line Filter Driers or Absorbents to Remove Organic Acid (5/3) Screen

Wednesday (6/27) 8:00 am – 10:00 pm 332 (3), Hilton

SPC 220 Method of Testing for Rating Small Commercial Blast Chillers, Blast Chiller-Freezers, and Blast Freezers (12/10) Electric

Monday (6/25) 4:30 pm – 6:30 pm 327 (3), Hilton

SPC 221 Test Method to Measure and Score the Operating Performance of an Installed Constant Volume Unitary HVAC System (12/10) Screen/Electric

Monday (6/25) 10:00 am – 12:00 pm 340B (3), Hilton

SPC 222 Standard Method of Test for Electrical Power Drive Systems (5/2) Screen/Electric

Sunday (6/24) 7:30 am – 10:30 am 337B (3), Hilton

SSPC 300 Commissioning Process for Buildings and Systems (16/20) Screen/Electric

Monday (6/25) 8:00 am – 12:00 pm 335C (3), Hilton

SSPC 300 Guideline 0 subcommittee, The Commissioning Process (14/10) Screen/Electric

Saturday (6/23) 10:00 am – 11:30 am 344AB (3), Hilton

SSPC 300 Guideline 1.1 subcommittee, The HVAC Commissioning Process (14/10) Screen/Electric

Saturday (6/23) 12:00 pm – 1:30 pm 344AB (3), Hilton

SSPC 300 Standard 202 subcommittee, The Commissioning Process for Buildings and Systems (14/10) Screen/Electric

Saturday (6/23) 2:00 pm – 3:30 pm 344AB (3), Hilton

SSPC 300 Guideline 1.4 subcommittee meeting, Systems Manual (10/10) Screen/Electric

Sunday (6/24) 10:00 am – 12:00 pm 230 (2), Hilton

SSPC 300 Guideline 1.6 Subcommittee (12/10) Screen/Electric

Sunday (6/24) 12:30 pm – 2:30 pm 332 (3), Hilton

GUIDELINE PROJECT COMMITTEE (GPC), STANDARD GUIDELINE PROJECT COMMITTEE (SGPC)

GPC 1.2 The Commissioning Process for Existing HVAC&R Systems (18/10) Screen/Electric

Friday (6/22) 1:00 pm – 3:00 pm 335A (3), Hilton

GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process (8/2) Electric

Tuesday (6/26) 1:00 pm – 5:00 pm 430 (4), Hilton

GPC 4-2008R Preparation of Operating and Maintenance Documentation for HVAC&R Systems (6/2)

Sunday (6/24) 8:00 am – 12:00 pm 336B (3), Hilton

GPC 14 Measurement of Energy, Demand and Water Savings (6/6) Electric

Sunday (6/24) 6:00 pm – 10:00 pm 329 (3), Hilton

GPC 22 Instrumentation for Monitoring Central Chilled Water Plants (8/4) Screen/Electric

Tuesday (6/26) 10:00 am – 12:00 pm 338 (3), Hilton

GPC 29 Guideline for Risk Management (8/2)

Sunday (6/24) 1:00 pm – 3:00 pm 336B (3), Hilton

GPC 35 Method for Determining the Energy Consumption Caused By Air-Cleaning and Filtration Devices (12/40) Screen/Electric

Monday (6/25) 8:00 am – 12:00 pm Grand L (4), Hilton

GPC 36P High Performance Sequences of Operation for HVAC Systems (24/20) Screen/Electric

Monday (6/25) 8:00 am – 12:00 pm Grand J (4), Hilton

GPC 37 Upper Room Ultraviolet Germicidal (UV-C) Devices to Control the Transmission of Airborne Pathogens (10/10)

Saturday (6/23) 9:00 am – 12:00 pm 328 (3), Hilton

GPC 41 Design, Installation and Commissioning of Variable Refrigerant Flow Systems (24/8) Electric

Monday (6/25) 8:00 am – 12:00 pm 344B (3), Hilton

SGPC 10 Interaction Affecting the Achievement of Acceptable Indoor Environments (10/10) Electric

Sunday (6/24) 9:00 am – 12:00 pm 336A (3), Hilton

SGPC 13 Specifying Building Automation Systems (15/15) Screen/Electric

Saturday (6/23) 8:00 am – 12:00 pm 336B (3), Hilton

US TAG to ISO/TC 142 Cleaning Equipment for Air and other Gases (37/30) Screen/Electric

Saturday (6/23) 2:30 pm – 3:30 pm Grand G (4), Hilton

US TAG to ISO/TC 163 Thermal Performance and Energy in a Building Environment (18/11) Screen/Electric

Tuesday (6/26) 3:00 pm – 4:30 pm 346AB (3), Hilton

JWG ISO/TC 163/WG4 and ISO/TC 205 (18/11) Screen/Electric

Tuesday (6/26) 2:30 pm – 3:00 pm 346AB (3), Hilton

US Tag to ISO/TC 205 (22/12) Screen/Electric

Tuesday (6/26) 1:00 pm – 2:30 pm 346AB (3), Hilton

ISO 817 MA (23/11) Screen/Electric

Tuesday (6/26) 8:00 am – 12:00 pm Grand K (4), Hilton

ISO 817 MA-Flammability (15/10) Screen/Electric

Sunday (6/24) 9:00 am – 11:00 am 337A (3), Hilton

ISO 817 MA-Toxicity (15/10) Screen/Electric

Monday (6/25) 8:00 am – 9:00 am 337A (3), Hilton

ISO 817 MA - Design and Nomenclature (15/10) Screen/Electric

Monday (6/25) 9:00 am – 10:00 am 328 (3), Hilton

ISO 17584 (15/10) Screen/Electric

Wednesday (6/27) 7:00 am – 9:00 am 330 (3), Hilton

OTHER

gbXML (10/0)

Monday (6/25) 2:00 pm – 3:00 pm Boardroom 334 (3), Hilton

UL Workshop

Sunday (6/24) 8:00 am – 10:00 am 334 (3), Hilton

USNC/IIR (20/20)

Tuesday (6/26) 2:00 pm – 4:00 pm Grand I (4), Hilton

USNT/IEA (20/10)

Tuesday (6/26) 4:00 pm – 6:00 pm Grand I (4), Hilton

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