Conference registrants receive a 10% PUBLICATIONS DISCOUNT!

Good only at ASHRAE Conference Bookstore or www.ashrae.org/bookstore

Applies to print and PDF formats in the online bookstore

Valid during dates of conference only.

Does not apply to network purchases or subscription products.
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**Your Guide to the ASHRAE Annual Conference**  
June 24–28, 2017

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### ASHRAE EVENTS APP

Update your ASHRAE App to access the meeting agenda with venue floor plans, social events and tips for your time in Long Beach. The app also features the ability to view Virtual Conference presentations, a customizable schedule, speaker evaluations, and live audience polling. New this year, message boards to interact with attendees! The app is made possible through support from the following sponsors:

![Taco](https://example.com/taco.png)  
**Premier Sponsor**

Get the free mobile app at: [www.ashrae.org/app](http://www.ashrae.org/app)
HYATT REGENCY – LOWER LEVEL (FIRST FLOOR)

From the lobby, take the escalator near The Cove Coffee Bar down to the 1st floor and turn right to access the meeting space on the 1st floor. An elevator is located next to The Cove Lounge in the main lobby that provides access as well to the Lower (1st) and Upper (4th) Levels.

HYATT REGENCY – UPPER LEVEL (FOURTH FLOOR)

From the main entrance of the hotel, enter the lobby and take the escalator or stairs on your right to access the 4th floor. The first set of escalators stop on the Mezzanine level which will take you to Convention Center.
RENAISSANCE – 1ST FLOOR
From the main entrance, go through the lobby and past the Promenade Café and turn left to access the meeting rooms on the 1st floor.

RENAISSANCE – 2ND FLOOR
From the main entrance, take the elevators or stairs on your right to the meeting space on the 2nd floor.

RENAISSANCE – 3RD FLOOR
From the main entrance, take the elevators on your right to the meeting space on the 3rd floor.
LONG BEACH CONVENTION AND ENTERTAINMENT CENTER – LEVEL 1

From the Hyatt Regency, exit the doors on the Mezzanine level (one floor up from the lobby) and enter the Convention Center door directly across which will put you in front of 104 (Registration, Bookstore and Speakers Lounge).

From the Renaissance, Westin and Courtyard, cross Ocean Blvd. and walk toward the Convention Center. The North Entrance will put you outside room 101.

From the Hyatt Centric, take a left out of the main entrance and walk through The Pike to the Main Entrance of the Convention Center. The Main Entrance will lead you into the main lobby on the 1st floor.
LONG BEACH CONVENTION AND ENTERTAINMENT CENTER – LEVEL 2

From the first floor take the elevators or stairs located outside of 103 to the 2nd level.
LONG BEACH CONVENTION AND ENTERTAINMENT CENTER – SEASIDE ROOMS

From the North Entrance of the Convention Center (outside room 100), walk outside and take the stairs on your left down to Seaside Way. Turn right on Seaside way and walk past the loading dock to the Seaside Entrance. Follow the ASHRAE signs to the entrance.
CONFERENCE SPONSORS

ASHRAE thanks the following sponsors for their support of the 2017 ASHRAE Annual Conference:

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Globally Recognized. Industry Respected.

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Munters
Your Perfect Climate

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CHAPTER AND SOCIETY OFFICIALS
A special thanks to all the members in the Orange Empire and Southern California Chapters who helped make the 2017 ASHRAE Annual Conference a success!

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Ken Golovko, President-Elect
Carlon Marcus Haywood, Secretary
Greg Glover, Treasurer

SOUTHERN CALIFORNIA CHAPTER OFFICERS
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Brian James, Treasurer

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Sessions, Rob Fried and Steve Linn
Entertainment, Lee Riback
Hospitality, Homeria Movahedi
Information, Ben Chesser, Ana Gutierrez, Heather Schopplein
Tours, John Sawyer
Sustainability Project and Women in ASHRAE Happy Hour,
Joanne Choi

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Long Beach Conference Chair
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Ashish Rakheja
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Leon Shapiro
Sarah E. Maston, Consultant
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Bjarne W. Olesen, Coordinating Officer
GENERAL INFORMATION

BADGES AND SCANNING
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 at the conclusion of the conference and will be emailed to you. Please keep track of the sessions that you attend at the conference. If you do not desire to have a summary of the sessions you do not need to be scanned. The room monitors will distribute evaluation forms for each session. Please complete the form and return it to the monitor when you leave the session. Room monitors will also distribute and collect comment cards on which attendees are encouraged to submit written questions regarding papers presented at the Poster Session. Questions are given to the authors for reply and published in ASHRAE Transactions.

VENUE ADDRESSES, TELEPHONE

Long Beach Convention and Entertainment Center (LBCC)
300 E Ocean Blvd, Long Beach, CA 90802
562-436-3636

Hyatt Regency Long Beach
200 S. Pine Ave., Long Beach, CA 90802
562-491-1234

Renaissance Long Beach
111 East Ocean Blvd, Long Beach, CA 90802
562-437-5900

Hyatt Centric at The Pike Long Beach
285 Bay St, Long Beach, CA 90802
562-432-1234

The Westin Long Beach
333 East Ocean Blvd, Long Beach, CA 90802
562-436-3000

Courtyard Long Beach
500 East First Street, Long Beach, CA 90802
562-435-8511

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 room 104 on the 1st floor of the LBCC. 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 Hyatt Regency, Renaissance and LBCC. 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 Hyatt and the Renaissance:
**Network:** PSAV_High_Speed  
**Passcode:** ashrae2017  
*network and passcode are case sensitive*

The credentials for the Long Beach Convention Center (LBCC) are:
**Network:** ashrae2017  
**Password:** longbeach  
*network and passcode are case sensitive*

**ASHRAE APP**
Download or update the ASHRAE App for access to content such as the meeting agenda, floor plans, social events, and tips for your time in Long Beach. App features also include the capability to view Virtual Conference presentations from your mobile device, a customizable schedule, an attendee list, and speaker evaluations. **New this year, message boards to interact with attendees!**

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

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

**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 Hyatt Regency nor the Renaissance.

**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 website.

WHAT TO WEAR
Business casual attire is appropriate for meetings and social events; however, Members’ Night Out will be beach attire.

LOST AND FOUND
Items found during the conference should be turned into the staff in the ASHRAE headquarters room, Seaview BC, 1st Floor of the Hyatt or ASHRAE registration located in room 104, 1st floor of the LBCC. The ASHRAE App also has a Message Board called “Lost and Found” where attendees can post about items lost or found while at the Conference.

TECHNICAL PROGRAM PDHs
All of the sessions presented in the technical program are approved for professional development hours (PDHs), including State of Florida PDHs. In addition, some sessions are approved for the State of New York PDHs and AIA Learning Units. Those programs are indicated with a ☑️ symbol. Others are approved for LEED AP credits and are indicated with a ☑️ symbol. Certain sessions may be acceptable for ASHRAE certification renewal. Send questions to certification@ashrae.org. In order to report your attendance at the session, PDH and AIA sign-in sheets are in the session room. Sessions are approved for 1, 1.5 or 2 PDHs depending on the length of the session.

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 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 Long Beach Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board.
If you registered for the complete Conference, as an attendee you should have or will receive an email with login information to access the Virtual Conference. One-day conference attendees you will also receive an email with login information to access the Virtual Conference for the single-day purchased. The email will include a link to the Long Beach Virtual Conference. If you do not have your password, go to www.ashrae.org/longbeachvirtual 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 and workshops.
- Ability to post comments and rate presentations.
- Print presentation slides in notes format.
- Ability to post questions or answers for selected sessions through Wednesday, July 12. Presentations available online for 18 months.

A full slate of technical programs will be posted beginning Monday, June 26, of the sessions that were presented the previous day, with additional content posted through Thursday, June 29.

Access to the Long Beach Virtual Conference is free with your conference registration. To register only for the Virtual Conference, go to ASHRAE Registration in 104, 1st floor of LBCC, 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. If you plan to participate in the city’s “Show Your Badge” program ([see page 17 for details](#)) to receive discounts at local restaurants and attractions, just simply take your badge with you.

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 the instructions below based on your location:

Long Beach Convention Center (LBCC)
Upon occurrence of a medical emergency, dial 515 immedia-
tely from any beige house phone to be connected to the
on-duty personnel responsible for treatment as well as any
outside emergency agencies deemed necessary. This allows
for better control over the speed and accuracy of information
given to authorities when a timely response is necessary. The
Security Office is 24/7 and is located in the service corridor
behind Hall C. An EMT will be onsite during the Conference
and located at the bottom of the exhibit hall escalators on the
right side. Escalators are located in the center of the lobby.

Hyatt Regency
The in-house number to call for emergencies is ext. 55. This
may be called from any house phone in the hotel. Security
operates 24-hours per day. Regularly scheduled patrols of the
hotel take place. Long Beach police, fire, and paramedics will
be contacted by hotel security when necessary.

Renaissance
From any house phone, dial 9 + 911 to reach the fire
department or police. Dial 0 to call the hotel operator
or 2675 for hotel security.

The closest hospital is St. Mary’s Hospital located at 1050
Linden Avenue. The phone number is 562-491-9000.

FIRE EMERGENCY... PREPAREDNESS IN HOTELS
In case of a fire, follow the instructions below based on your
location. It is important not to panic. If a fire emergency does
in fact happen, take all cues from security and hotel staff.

Long Beach Convention Center (LBCC)
In the event that we experience a fire alarm, strobe lights and
alarm horns will be activated. The Security Department will
make a general announcement over the PA system to
acknowledge the activation of the alarm, to inform everyone
that the Fire Department is responding and to advise them to
stand by for further instructions. After the Fire Department has
investigated the source of the alarm, there will be an an-
nouncement declaring any necessary action with follow up
announcements as required. If no action is necessary, as in
the case of a false alarm, an announcement will follow stating
that all areas are clear and systems are operational.

Hyatt Regency
In case of a fire, the fire alarm will sound and instructions will
be announced over the PA system. The PA system services
the entire hotel including meeting space and guest rooms.
**Renaissance**
Familiarize yourself with the meeting space and make sure you are aware of the closest emergency exits. In the event of a fire, an alarm will sound.

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.

**MOTHERS ROOM**
Stop by the registration desk located in room 104 at LBCCC for more information about a room available for nursing mothers.

**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, in and nearby our Conference venues. See page 17 for more information on discounts at local restaurants with the Show Your Badge Program.

**Hyatt Regency**

**COVE Coffee Bar**
5:30 am – 8:00 pm  
Located in the main lobby, COVE Coffee Bar serves Starbucks coffee and offers grab-and-go options for a quick breakfast, lunch and dinner.

**COVE Lounge**
4:00 pm – Midnight  
Located in the main lobby, behind COVE Coffee Bar, COVE Lounge serves local micro-brews on tap and appetizers. Dinner menus also available.

**Tides Restaurant**
Breakfast served 6:00 am – 11:30 am and Lunch served from 11:30 am -2:00 pm.

**Long Beach Convention Center**

**Pacific Cafe**
Saturday/Sunday: 7:00 am – 2:00 pm  
Monday: 7:00 am – 6:00 pm  
Tuesday: 7:00 am – 5:00 pm  
Wednesday: 7:00 am – 1:00 pm  
Located in the main lobby of LBCC, near room 104, the Pacific Café offers Starbucks Specialty Coffee, Pastries, Grab-and-Go, Flat Bread Pizza, Paninis, Assorted Beverages, Chips, & Candy.
Food Cart in Seaside Foyer
Sunday-Tuesday: 7:00 am – 2:00 pm
A food cart will be set up in the Seaside rooms at the Convention Center which will include Starbucks coffee, Grab-and-Go sandwiches and salads, assorted beverages, chips and candy.

Food Trucks
Sunday – Tuesday: 11:00 am – 3:00 pm
Food Trucks, although not guaranteed, are often regular attendees at LBCC. Food trucks typically park around lunch time at the Promenade Plaza, near the main entrance to the LBCC. Most food trucks in Long Beach accept both cash and credit cards.

Renaissance

Starbucks
5:30 am – 4:00 pm (Mon-Fri) and
6:00 am -4:00 pm (Sat-Sun)
Starbucks is located in the main lobby and coffee, pastries and other grab-and-go items.

Promenade Café
6:00 am – 10:00 am (Mon-Fri) and
7:00 am – 11:00 am (Sat-Sun)
Promenade Café is located on the lobby level and is typically open for breakfast only.

SIP Bar + Lounge
11:00 am – 11:00 pm (Sun-Thurs) and
11:00 am – Midnight (Fri-Sat)
Enjoy a cocktail, apps and light lunch and dinner items. SIP is located on the lobby level.

THINGS TO DO IN LONG BEACH
The Long Beach Host Committee put together an interactive map highlighting great restaurants, fun attractions, and other things to do and places to see while you are in Long Beach. You can scan the QR code below to access the interactive map.

Stop by the Host Committee desk in room 104 at the LBCC to get more information.

THINGS TO DO IN LONG BEACH
The Long Beach Host Committee put together an interactive map highlighting great restaurants, fun attractions, and other things to do and places to see while you are in Long Beach. You can scan the QR code below to access the interactive map.

Stop by the Host Committee desk in room 104 at the LBCC to get more information.
SHOW YOUR BADGE PROGRAM

Thanks to the Long Beach Convention and Visitors Bureau (LBCVB), a program has been created called “Show Your Badge” specifically for conference attendees to enjoy your time in Long Beach with discounts at restaurants, attractions, shopping and more. All you have to do is take your ASHRAE Conference badge with you and show it at certain local businesses to receive discounts. Check out the ASHRAE app or stop by the Host Committee desk located in room 104 at the Long Beach Convention Center for specific details related to offered discounts.

The following local businesses are participating:

**Attractions**
- Harbor Breeze Cruises
- International City Theatre
- Long Beach Boat Rentals
- Sunseeker Tours
- The Laugh Factory
- Wheel Fun Rentals
- Long Beach Segway Tours

**Dining**
- Alegria Cocina Latina
- Berlin Bistro
- BO Beau Kitchen + Roof Tap
- Bubba Gump
- Buono’s Pizzeria
- District Wine
- Fuego at the Maya
- George’s Greek Café
- Gladstone’s
- Long Beach Café
- Michael’s Pizzeria
- P.F. Chang’s China Bistro
- Parkers Lighthouse
- Rock Bottom Brewery
- Sevilla
- Shannon’s on Pine
- The Sky Room
- The Spoon Bistro
- Utopia Restaurant
- The Pie Bar
- Modica’s
- The Brass Lamp

**Shopping**
- Raindance
- Village Treasures
- World Trade Office Supplies

**Other**
- Dapper Barber & Shop
- Secure Sedan
- Shore Business Center
- Reserve Limo

*All offers subject to availability and change per the CVB. Discounts do not include sales tax, gratuity or alcoholic beverages unless otherwise specified.*
ASHRAE MEMBER LOUNGE
Beacon A, 4th Floor, Hyatt Regency
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 Long Beach 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 room 104, 1st floor, LBCC.

SPOUSE LOUNGE
Seaview Rotunda, 1st Floor, Hyatt Regency
The Spouse Lounge has returned to ASHRAE Conferences! 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.

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

Use the ASHRAE App’s new “Let’s Hang Out” discussion board to connect with other guests. Download the ASHRAE app at www.ashrae.org/app.

MEET AND GREET
Beacon Rotunda, 4th Floor, Hyatt Regency
Monday, June 26
9:30–11 a.m.

The Meet and Greet, open to all registered guests, gives guests an opportunity to meet with old friends and greet new ones. The Meet and Greet features a special lecture on the interwar era Art Deco architecture of Long Beach by expert and enthusiast John Thomas, historic preservation consultant and co-author of Long Beach Art Deco and past president of the Art Deco Society of Los Angeles. The lecture is entitled “A New Deal for Long Beach Architecture: Art Deco, Streamline Moderne, and the Influence of the Modern Design Movement, 1925–1940.”

John will discuss the design influences of Art Deco, and its variant Streamline Moderne, which shaped Long Beach during the period of rapid growth from 1925 through 1940. Using both vintage and contemporary photography he will bring to life the use of “modern” architecture in Public Works Administration and related New Deal Projects. The lecture will also include an overview of the legendary RMS Queen Mary oceanliner.

Light refreshments will be served.
SOCIAL EVENTS

PLENARY SESSION KEYNOTE SPEAKER – DERRECK KAYONGO
Regency Ballroom, 4th Floor, Hyatt Regency
Saturday, June 24
3:15 – 5:30 p.m.

Derreck Kayongo will share his courageous story of survival and discovery with undeniable charm, palpable passion, and endearing wit at the Conference Plenary, Saturday June 24. Kayongo, CEO of the Center for Civil and Human Rights & Founder of the Global Soap Project, brings his story and guiding principles, coined as S.E.L.F. (Service, Education, Leadership and Faith) to life in emotionally packed presentations that stay with you long after his closing remarks.

WELCOME PARTY
Aquarium of the Pacific
Saturday, June 24
7:00 – 9:00 p.m.
Cost: $60

This is a Welcome Party you don't want to miss! The event takes place at the Aquarium of the Pacific. Enjoy a cocktail and hors d'oeuvres while catching up with old friends with a background of colorful, underwater views as the Conference kicks off with the traditional Welcome Party. The entire Aquarium will be open during the party with access to over 11,000 animals and over 50 exhibits. You may even be greeted by a special animal guest. Two Sea Otter shows will take place during the party.

Attendees are encouraged to take a 10 minute stroll on the boardwalk from partner hotels to the Aquarium. Host Committee members will be scattered along the path from the Hyatt to help you find your way. Limited shuttle service will be available from the main entrance of the Hyatt with shuttles departing at 6:45 p.m. Walking maps are available in the ASHRAE App and at the Registration desk located in 104 at the Long Beach Convention Center.

WOMEN IN ASHRAE HAPPY HOUR
BO-Beau Kitchen + Roof Tap
144 Pine Ave.
Monday, June 26
4:30 – 6:30 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 food and two drink tickets.
PRESIDENT’S LUNCHEON
Regency Ballroom, 4th Floor, Hyatt Regency
Monday, June 26
12:15 - 2:00 p.m.
Cost: $50

2017–18 ASHRAE President Bjarne W. Olesen, Ph.D., Fellow
ASHRAE, Life Member, presents his presidential theme,
“Extend”, which is based upon the Society goal to “Extend Our
Community” found in our Strategic Plan. Together, we can
extend our global community, our technological horizons, and
our value to Members.

Certificates of appreciation to retiring Board members are
presented, and the 2017–18 officers and Board of Directors
installed.

LIFE MEMBERS’ LUNCHEON
Seaview A, 1st Floor, Hyatt Regency
Tuesday, June 27
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.

MEMBER’S NIGHT OUT
Regency Ballroom ABC, 4th Floor, Hyatt Regency
Tuesday, June 27
Cost: $60

Reception and Cash Bar
6:15 p.m.–7:15 p.m.
Regency Foyer

Dinner and Entertainment
7:15–10:00 p.m.

Join us for a beach party! Come dressed in your best beach
attire and experience the next best thing to Jimmy Buffett
and the Coral Reefer Band concert. Mark Wood and the
Parrot Head Band perform songs from over 40 years of
Jimmy Buffet’s music. They will entertain you live and in
person at Member’s Night Out, so come join us!
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 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 46 for more information on the five 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 booth is located in the registration area. Membership applications are available, as well as brochures about the HVAC&R industry, information on student membership and information about the ASHRAE group insurance plan. Registrants paying the non member registration fee receive their first year of membership free. To obtain membership an application form must be submitted with the conference registration form or within 60 days following the conference. 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 24, 3:15-5:30 p.m.
Plenary Session, Hyatt Regency
Regency Ballroom, 4th Floor

LINCOLN BOUIillon AWARDS
“Given in recognition of outstanding work in increasing the
membership of Society.”
Jason R. Urso, P.E., Westfield, MA
Connecticut Chapter

CHAPTER PROGRAM STAR AWARD
“Given in recognition of excellence in chapter program
endeavors.”
Chun-Sing Wong, Ph.D., BEAP, Hong Kong
Hong Kong 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.”
Patrick Huang, C.Eng., Hong Kong
Hong Kong Chapter

ENVIRONMENTAL HEALTH AWARD
“Given in recognition of excellence in volunteer service focused
on environmental health issues.”
W. Gene Tucker, Ph.D., Cary, NC
Triangle Chapter

HOMER ADDAMS AWARD
“Given in recognition of a graduate student who has been
engaged in an ASHRAE research project.”
Parham Azimi, Chicago, IL
Illinois Chapter

GOVERNMENT ADVOCACY AWARD
“Given in recognition to an individual for outstanding effort and
achievement in state, provincial, and local government activities
in connection with technical issues important to the Society.”
Sam C. M. Hui, Ph.D., C.Eng., BEAP, BEMP, HBDP,
Hong Kong
Hong Kong 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.”
Dusty Stoabs, P.E., CPMP, Oklahoma City, OK
Central Oklahoma Chapter
STANDARDS ACHIEVEMENT AWARD
“Given in recognition for excellence in volunteer service for developing ASHRAE standards/guidelines.”
Steven T. Bushby, Fellow ASHRAE, Gaithersburg, MD
National Capital Chapter

ASHRAE JOURNAL PAPER AWARD
“Given in recognition of the best article published in the ASHRAE Journal in 2016.”
Hugh Crowther, P.Eng., Markham, ON, Canada, Hamilton Chapter, and Yi Teng Ma, Markham, ON, Canada, Toronto Chapter, authors of “Design Considerations for Dedicated OA Systems.”

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.”
Nesreen Ghaddar, Ph.D., Beirut, Lebanon, Lebanese Chapter, Bachir El Fil, Atlanta, GA, Atlanta Chapter, Kamel Ghali, Ph.D., Beirut, Lebanon, authors of “Optimizing Performance of Ceiling Mounted Personalized Ventilation System Assisted by Chair Fans: Assessment of Thermal Comfort and Indoor Air Quality.”

CROSBY FIELD AWARD
“Given in recognition of the highest rated paper presented at a Technical Session or Symposium in 2016.”

ASHRAE TECHNICAL PAPER AWARD
Dennis L. O’Neal, Ph.D., P.E., Fellow ASHRAE, Life Member, Waco, TX; Carl Lewis Reid, Austin, TX; and Peng Yin, Ph.D., Lafayette, LA for authoring “Characterizing the Performance of Fixed-Airflow Series Fan-Powered Terminal Units Using a Mass and Energy Balance Approach”

James A. Milke, Ph.D., P.E., College Park, MD; Christine Pongratz, London, UK; and Arnaud Trouvé, Ph.D., College Park, MD for authoring “A CFD Study to Identify Methods to Increase Maximum Velocity of Makeup Air for Atrium Smoke Control”

Nicholas Gayeski, Ph.D., Maynard, MA; Stephen Samouhlos, Ph.D. P.E., West Orange, NJ; Siân Kleindienst, Ph.D., Somerville, MA; Ryan Cruz, Somerville, MA; Jaime
Gagne, Ph.D., Somerville, MA; and Bradley Werntz, Newton Center, MA for authoring “Data and Interfaces for Advanced Building Operations and Maintenance”

Kathleen Sturtevant, North Andover, MA; Alexandra Brogan, Columbus, OH; Zachary Valigosky, West Des Moines, IA; Vijay Gopalakrishnan, North Andover, MA and John Kelly Kissock, Ph.D., P.E., Dayton, OH for authoring “Improving Variable-Speed Pumping Control to Maximize Savings”

WILLIS H. CARRIER AWARD
“Given in recognition of the best paper presented at a Society Conference in 2016 by a member thirty-two years of age or less.”

Carl Lewis Reid, Austin, TX; and Peng Yin, Ph.D., Lafayette, LA for authoring “Characterizing the Performance of Fixed-Airflow Series Fan-Powered Terminal Units Using a Mass and Energy Balance Approach”

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

Eric W. Adams, Ph.D., Indianapolis, IN
Nerses (Nick) Agopian, Madison, WI
Jason A. Atkinson, P.E., Madison, WI
Vikrant C. Aute, Ph.D., College Park, MD
Robert Bean, Calgary, AB, Canada
Barry B. Bridges, P.E., CPMP, Life Member, St. Paul, MN
Tina M. Brueckner, Eagan, MN
Oswaldo de Siqueira Bueno, P.Eng., BEAP, Life Member, Sao Paulo, Brazil
Douglas Cane, Mississauga, ON, Canada
James A. Carlson, Omaha, NE
Joseph A. Chin, P.E., Menlo Park, CA
Leonard A. Damiano, Loris, SC
Abdel K. Darwich, P.E., HFDP, Sacramento, CA
Hywel Davies, Ph.D., London, UK
Larry O. Degelman, P.E., Life Member, College Station, TX
John F. Dunlap, P.E., Fellow ASHRAE, Life Member, Richmond, VA
Annette Dwyer, Fort Myers Beach, FL
Jim Earley, P.E., Roswell, GA
Blake E. Ellis, P.E., Overland Park, KS
Christopher M. Gray, Ph.D., P.E., Columbus, GA
Kamel Haddad, Ph.D., Ottawa, ON, Canada
Paul M. Haydock, P.E., Indianapolis, IN
Roger L. Hedrick, Boulder, CO
N. Eileen Jensen, P.E., Vancouver, WA
Amir Jokar, Ph.D., P.E., Irvine, CA
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.”

Erich Binder, Calgary, AB, Canada
Steven T. Bushby, Fellow ASHRAE, Gaithersburg, MD
Samuel D. Cummings, Jr., P.E., Fellow ASHRAE, Life Member, Little Rock, AR
Patricia T. Graef, P.E., Fellow ASHRAE, Life Member, Ft. Myers, FL
Essam E. Khalil, Ph.D., Fellow ASHRAE, Cairo, Egypt
Kishor Khankari, Ph.D., Fellow ASHRAE, Ann Arbor, MI
Bert Phillips, P.Eng., Life Member, Winnipeg, MB, Canada
DISTINGUISHED 50-YEAR MEMBER AWARD
“Given in recognition of fifty years of membership and performing outstanding service for the Society.”
Luc Bertrand, ING., Fellow ASHRAE, Life Member,
Saint-Lambert, QC, Canada
Raymond Cohen, Ph.D., P.E., Fellow ASHRAE, Life Member,
Valparaiso, IN
Emil E. Friberg, P.E., Fellow ASHRAE, Life Member,
Arlington, TX
Warren G. Hahn, P.E., Fellow ASHRAE, Life Member,
Tampa, FL
Gordon V.R. Holness, P.E., Presidential Fellow ASHRAE,
Life Member, West Palm Beach, FL
S. Louis Kelter, P.E., Fellow ASHRAE, Life Member,
Somerset, NJ
Rodney H. Lewis, P.E., Fellow ASHRAE, Life Member,
Austin, TX
Richard P. Lortie, Fellow ASHRAE, Life Member,
Winston Salem, NC
George E. Menzies, P.Eng., Life Member, Hamilton, ON, Canada
Erling J. Olsen, P.E., Fellow ASHRAE, Life Member,
Bainbridge Island, WA
Robert D. Pagliasotti, Life Member, Lakewood, CO
Richard J. Pearson, P.E., Fellow ASHRAE, Life Member,
Madison, WI
Alberto J. Sanchez, P.E., Fellow ASHRAE, Life Member,
Blue Bell, PA
Eugene Stamper, P.E., Fellow ASHRAE, Life Member,
Teananck, NJ
Laurence S. Staples, Jr., Life Member, Prairie Village, KS
Sunny C.L. Tan, Fellow ASHRAE, Life Member, Singapore

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.”
Steven T. Taylor, P.E., Fellow ASHRAE, Alameda, CA

LOUISE & BILL HOLLADAY DISTINGUISHED FELLOW AWARD
“Given to a Fellow of the Society in recognition of continuing preeminence in engineering or research work.”
Zahid H. Ayub, Ph.D., P.E., Arlington, TX
**ROOMS/HOURS**

**FINDING YOUR ASSIGNED MEETING ROOM**

The ASHRAE Annual Conference and committee meetings are located in three different venues: Hyatt Regency (H), Renaissance (R) and the Long Beach Convention Center (LBCC). Please refer to pages 2–7 for floor plans and page 87 for descriptions on how to access meeting rooms in each venue. All venues are within easy walking distance of one another.

**CONFERENCE REGISTRATION, 104, Long Beach Convention Center (LBCC), 1st 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 23: 10:00 a.m.–5:00 p.m.
- Saturday, June 24: 7:15 a.m.–6:00 p.m.
- Sunday, June 25: 7:00 a.m.–5:00 p.m.
- Monday, June 26: 7:30 a.m.–5:00 p.m.
- Tuesday, June 27: 7:30 a.m.–4:30 p.m.
- Wednesday, June 28: 7:30 a.m.–10:15 a.m.

**ASHRAE BOOKSTORE, 104, Long Beach Convention Center (LBCC), 1st 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 23: 10:00 a.m.–5:00 p.m.
- Saturday, June 24: 7:15 a.m.–6:00 p.m.
- Sunday, June 25: 7:00 a.m.–5:00 p.m.
- Monday, June 26: 7:30 a.m.–5:00 p.m.
- Tuesday, June 27: 7:30 a.m.–4:30 p.m.
- Wednesday, June 28: 7:30 a.m.–1:00 p.m.

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

**SPEAKER'S LOUNGE, 104, Long Beach Convention Center (LBCC), 1st Floor**

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

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

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MEMBERSHIP DESK, 104, Long Beach Convention Center (LBCC), 1st 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, Seaview BC, Hyatt Regency (H), 1st Floor (Lower Level)
The ASHRAE Headquarter office offers members complimentary copying, services of a typist and access to printers for laptop computers.

Friday, June 23 12:00 p.m.–5:00 p.m.
Saturday, June 24 8:00 a.m.–5:00 p.m.
Sunday, June 25 8:00 a.m.–5:00 p.m.
Monday, June 26 8:00 a.m.–5:00 p.m.
Tuesday, June 27 8:00 a.m.–5:00 p.m.
Wednesday, June 28 8:00 a.m.–1:00 p.m.

YEA ACTIVITY
Young Engineers in ASHRAE (YEA) Hospitality Reception
Regency DEF, Hyatt Regency (H), 4th Floor (Upper Level)
Attention young professional members age 35 and younger! You are invited to visit the YEA Hospitality Suite on Sunday, June 25, 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 2017 ASHRAE Annual Conference are:

Akshay Bhargava, Spacecoast Chapter, Region, Region XII
Tiffany Biagini, Illinois Chapter, Region VI
Joseph Chin, San Jose Chapter, Region X
James Gallick, Columbus Chapter, Region V
ASHRAE MEMBER LOUNGE, Beacon A, Hyatt Regency (H), 4th Floor (Upper Level)
The lounge will be open to all registered attendees during the following hours:
Saturday, June 24..................7:30 a.m.–3:00 p.m.
Sunday, June 25....................7:30 a.m.–4:00 p.m.
Monday, June 26....................7:30 a.m.–4:00 p.m.
Tuesday, June 27...................7:30 a.m.–4:00 p.m.
Wednesday, June 28.................7:30 a.m.–1:00 p.m.
More information about the ASHRAE Member Lounge can be found on page 18.

ASHRAE SPOUSE LOUNGE, Seaview Rotunda, Hyatt Regency (H), 1st Floor (Lower Level)
The lounge will be open to all registered spouses/guests during the following hours:
Saturday, June 24..................7:30 a.m.–3:00 p.m.
Sunday, June 25....................7:30 a.m.–4:00 p.m.
Monday, June 26....................7:30 a.m.–4:00 p.m.
Tuesday, June 27...................7:30 a.m.–4:00 p.m.
Wednesday, June 28.................7:30 a.m.–1:00 p.m.
More information about the ASHRAE Spouse Lounge can be found on page 18.

LONG BEACH HOST COMMITTEE DESK, 104, Long Beach Convention Center (LBCC), 1st Floor
Information about the city of Long Beach will be available.

CHICAGO WINTER CONFERENCE INFORMATION, 104, Long Beach Convention Center (LBCC), 1st Floor
Information on the upcoming Winter Conference scheduled for January 20–24, 2018 at the Palmer House Hilton will be available in the registration area.

UPCOMING CONFERENCES
ASHRAE 2017 Building Performance Analysis Conference
September 27–29, 2017 • Atlanta, GA
Second ASHRAE Developing Economies Conference
November 10-11, 2017 • Delhi, India
CONFERENCE AND MEETING SCHEDULE

FRIDAY, JUNE 23
8:00 am–5:00 pm  
Committee Meetings  
Hyatt Regency, Long Beach Convention Center, and Renaissance.  
See listing on pages 88–120

10:00 am–5:00 pm  
Registration and ASHRAE Bookstore,  
104, LBCC, 1st floor

SATURDAY, JUNE 24
7:30 am–3:00 pm  
ASHRAE Member Lounge, Beacon A,  
Hyatt Regency, 4th Floor (Upper Level)  
and Spouse Lounge, Seaview Rotunda,  
Hyatt Regency, 1st floor (Lower Level).  
See description on page 18.

7:15 am–6:00 pm  
Registration and ASHRAE Bookstore,  
104, LBCC, 1st floor

8:00 am–5:00 pm  
Committee Meetings  
Hyatt Regency, Long Beach Convention Center, and Renaissance.  
See listing on pages 88–120

1:00 pm–3:00 pm  
Speakers' Lounge, 104, LBCC, 1st floor

Special Event
3:15 pm–5:00 pm  
Meeting of the Members,  
Plenary Session, Regency Ballroom,  
Hyatt Regency, 4th Floor (Upper Level)

Opening and Welcoming Remarks by ASHRAE President Timothy G. Wentz

Welcome by Director and Chair,  
Region X, Karine Leblanc

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

Awards Presentation  
See description on page 23.

Keynote Address: Derreck Kayongo  
See description on page 19.

Plenary Session is open, no badge nor registration is required to attend.
Special Event
7:00–9:00 p.m. Welcome Party, Aquarium of the Pacific
Ticket required.
See description on page 19.

SUNDAY, JUNE 25
7:00 am–5:00 pm Speakers’ Lounge, 104, LBCC, 1st floor
7:00 am–5:00 pm Registration and ASHRAE Bookstore, 104, LBCC, 1st Floor
7:30 am–4:00 pm ASHRAE Member Lounge, Beacon A, Hyatt Regency, 4th Floor (Upper Level) and Spouse Lounge, Seaview Rotunda, Hyatt Regency, 1st floor (Lower Level).
See description on page 18.
8:00 am–4:45 pm Technical Sessions, LBCC, 1st and 2nd Floors,
See Technical Program on pages 48–59.
8:00 am–5:00 pm Committee Meetings, Hyatt Regency, LBCC, Seaside rooms at the LBCC and Renaissance.
See listing on pages 88–120.
9:00 am–9:30 am Networking Coffee Break, Outside of 100 rooms at the LBCC, 1st Floor
2:00 pm–5:30 pm General Tour: Whale Watching
See description on page 35.
4:00 pm–6:00 pm Young Engineers in ASHRAE (YEA) Hospitality Reception, Regency DEF, Hyatt Regency, 4th Floor
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 29.

MONDAY, JUNE 26
7:00 am–12:15 pm Speakers’ Lounge, 104, LBCC, 1st Floor
7:30 am–5:00 pm Registration and ASHRAE Bookstore, 104, LBCC, 1st Floor
7:30 am–4:00 pm ASHRAE Member Lounge, Beacon A, Hyatt Regency, 4th Floor (Upper Level) and Spouse Lounge, Seaview Rotunda, Hyatt Regency, 1st floor (Lower Level).
See description on page 18.
8:00 am–12:00 pm Technical Sessions, LBCC, 1st and 2nd Floors,
See Technical Program on pages 59–66.
9:30 am–11:00 am ASHRAE Meet and Greet, Beacon Rotunda, Hyatt Regency, 4th Floor.
See description on page 18.
8:00 am–5:00 pm Committee Meetings, Hyatt Regency, LBCC, Seaside rooms at the LBCC and Renaissance.
    See listing on pages 88–120.

**Special Event**

12:15 pm–2:00 pm President’s Luncheon, Regency Ballroom, Hyatt Regency, 4th Floor
    Doors open at 12:00 p.m. Ticket required.
    See description on page 20.

1:30 pm–4:30 pm Speakers’ Lounge, 104, LBCC, 1st Floor

2:15 pm–3:45 pm Technical Sessions, LBCC, 1st and 2nd Floors
    See Technical Program on page 67.

2:00 pm–4:30 pm General Tour: Queen Mary and Ghost Stories Tour. Ticket Required.

2:30 pm–4:30 pm General Tour: Biking the Coast. Ticket Required.

2:30 pm–4:30 pm Technical Tour: Engineering Tour of the Queen Mary. Ticket Required.
    See tour descriptions on page 37.

4:30 pm–6:30 pm Women in ASHRAE Happy Hour, BO-Beau’s Kitchen + Roof Tap.
    Pre-registration required.
    See description on page 19.

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

**TUESDAY, JUNE 27**

7:00 am–5:00 pm Speakers’ Lounge, 104, LBCC, 1st Floor

7:30 am–4:00 pm ASHRAE Member Lounge, Beacon A, Hyatt Regency, 4th Floor (Upper Level) and Spouse Lounge, Seaview Rotunda, Hyatt Regency, 1st Floor (Lower Level).
    See description on page 18.

7:30 am–4:30 pm Registration and ASHRAE Bookstore, 104, LBCC, 1st Floor

8:00 am–4:45 pm Technical Sessions, LBCC, 1st and 2nd Floors
    See Technical Program on pages 67–76.

8:00 am–5:00 pm Committee Meetings, Hyatt Regency, LBCC, Seaside rooms at the LBCC and Renaissance.
    See listing on pages 88–120.

9:30 am–12:00 pm General Tour: U.S.S. Iowa Tour. Ticket Required.
    See descriptions on page 36.
12:00 pm–1:30 pm Life Members’ Lunch, Seaview A, Hyatt Regency, 1st Floor
Ticket Required.
See description on page 20.

1:00 pm–3:00 pm Technical Tour: Cal State Long Beach Central Plant. Ticket Required.

2:00 pm–4:00 pm Technical Tour: Cal State Long Beach Central Plant. Ticket Required.

2:00 pm–5:00 pm Certification Exams: 203C, LBCC, 2nd Floor.
More information on page 45.

2:30 pm–5:00 pm General Tour: California Coastline Nature Walk. Ticket Required.
See tour descriptions on page 36.

Special Event
6:15 pm–7:15 pm Reception, Regency Foyer, Hyatt Regency, 4th Floor

7:15 pm–10:30 pm Members’ Night Out, Regency ABC, Hyatt Regency, 4th Floor. Beach attire.
Ticket Required.
See description on page 20.

WEDNESDAY, JUNE 28

7:00 am–1:00 pm Speakers’ Lounge, 104, LBCC, 1st Floor

7:30 am–10:15 am Registration, 104, LBCC, 1st Floor

7:30 am–1:00 pm ASHRAE Bookstore, 104, LBCC, 1st Floor

7:30 am–1:00 pm ASHRAE Member Lounge, Beacon A, Hyatt Regency, 4th Floor (Upper Level) and Spouse Lounge, Seaview Rotunda, Hyatt Regency, 1st Floor (Lower Level). See description on page 18.

8:00 am–12:30 pm Technical Sessions, LBCC, 1st and 2nd Floors
See Technical Program on pages 77–86.

8:00 am–5:00 pm Committee Meetings, Hyatt Regency, LBCC, Seaside rooms at the LBCC and Renaissance.
See listing on pages 88–120.
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 online and at the ASHRAE registration desk located in 104 and the Long Beach Convention Center on the 1st floor.

All tours depart from the main entrance of the Hyatt Regency. Please arrive at least 10 minutes before the tour is scheduled to depart.

GENERAL TOURS

Whale Watching
Sunday, June 25
2:00 pm – 5:30 pm.
$185.00

Experience the rush of the Pacific Ocean -- California sunshine above and the cool sea mist rising from the waves! Guests will have the opportunity to experience the open waters as they search for breathtaking marine mammals including whales and dolphins. Boat trip is approximately (2 – 2.5) hours. Guests are encouraged to dress in layers and to wear tennis shoes or deck shoes.

Biking The Coast
Monday, June 26
2:30 pm – 4:30 pm
$170.00

On this scenic bike tour, enjoy views of the shoreline and ocean while our expert guides give insight into all the hidden gems the area has to offer. The ride is done at a rather easy pace and give guests the perfect opportunity to take in the fresh ocean air and see the local sights. Tour includes bicycle, helmet, safety vest and bottled water. Ride is approximately (2) hours long and is a relatively easy ride. Guests should be comfortable on a bike and are required to wear closed toe shoes, and athletic apparel and layers are suggested.

Queen Mary and Ghost Stories Tour
Monday, June 26
2:00 pm – 4:30 pm
$85

The Queen Mary tour includes ghost stories of the dangerous past of the Queen Mary’s long service in its thousand journeys across the ocean during WWII service as a troop carrier and cruise liner afterward. Explore the ship’s foremost paranormal hot spots and discover the history behind her most notable
and intriguing apparitions. You will have time to explore and enjoy the ship on your own. Guests must be 13 years of age or older to attend the ghost stories tour.

**U.S.S. Iowa Tour**  
**Tuesday, June 27**  
**9:30 a.m. – 12:00 p.m.**  
**$100**

Built in 1940, the U.S.S. Iowa was designated the “World’s Greatest Naval Ship” due to her big guns, heavy armor, fast speed, longevity and modernization. Having served her country for fifty years, the USS Iowa now calls the Port of Los Angeles in San Pedro her new home. Guests will enjoy a tour of the USS Iowa, from the boiler room to President Roosevelt's private quarters, the past comes to life as guests explore this great battleship. Guests are encouraged to wear shoes comfortable to walk and stand in for long periods of time. Guests should be comfortable climbing stairs.

**California Coastline Nature Walk**  
**Tuesday, June 27**  
**2:30 pm – 5:00 pm**  
**$135**

This educational walk leads you past several nature viewing points where guests get the chance to spot some rare birds and endemic butterflies. Get some breathtaking views of the dramatic coastline and learn about whale migration. Afterwards, head down along the coast to the water that leads to a secret cove with amazing coastal tide pools. As the water recedes, diverse marine life reveals themselves within the pools. From flowery anemones to elusive octopi and starfish, prepare to see the best the ocean has to offer.
TECHNICAL TOURS

Engineering Tour of the Queen Mary
Monday, June 26
2:30 pm – 4:30 pm
$55

Join us for a tour of the Queen Mary Engine Room with an HVAC spin.

The Queen Mary’s maiden voyage was made in 1936. Initial stint of cruise ship service was followed by North Atlantic transport duty during WWII. Following hostilities Queen Mary was used to transport troupes and families home. Queen Mary’s final voyage brought her to Long Beach in 1967 where she was re-fitted for tourism duty.

The hotel aboard the Queen Mary opened in 1972; however Queen Mary was built for the North Atlantic. Spaces were conditioned by bringing in cold North Atlantic air.

To support the Queen Mary role as a hotel in Southern California, the ship was refitted with hydronic heating and cooling systems. The ship is now supplied with chilled water from a landside central chiller plant, located at the parking structure associated with Carnival Cruises. The current central plant began providing chilled water in February of 2003. A steam plant sits pier side.

Original HVAC designs utilized vent trunks where incoming air is cooled by chilled water coils and delivered to air handling rooms from where the cooled air is distributed throughout the ship.

The ship/hotel currently does not recycle conditioned air, the spaces are served by “100 % outside air”. Likewise, integrated control of heating and cooling coils (many of which utilize 3-way valves), of air side equipment does not yet exist.

Cal State Long Beach Central Plant
Tuesday, June 27
1:00 pm – 3:00 pm AND
2:00 pm – 4:00 pm
$40

The Central Plant serves as the vast majority of the campus’s heating and cooling needs through heating hot water and chilled water distribution networks. Currently the Central Plant provides services to approximately 2.7 million square feet of building space on campus. Come see a behind-the-scenes tour of the campus’s heating and cooling systems. More information about the tour can be found on the ASHRAE App.
### FUTURE ASHRAE CONFERENCES

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<td>Chicago, IL</td>
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### PAST ASHRAE MEETINGS

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With the 2017 ASHRAE Annual Conference being held in Long Beach, the ASHRAE SoCal and Orange Empire Chapters were given the opportunity to identify a local sustainability project to represent ASHRAE’s commitment to sustainability and to help offset the environmental impact from holding the Annual Conference here. We decided to partner with Rebuilding Together Long Beach, an organization that serves to transform and revitalize the low-income communities in Long Beach, to help a local family in need to retrofit their home and provide educational materials on energy efficiency in Southern California.

The family in need consists of a father, mother, and son who need assistance addressing health and safety issues in their home. The father is disabled with congestive heart disease and is unable to work, and the son is autistic and suffers from cerebral palsy. The list of tasks needed to retrofit their home includes installing AC equipment and ductwork, new windows, and an attic fan and insulation.

This sustainability project was designed to have a holistic approach – helping this family but also having an impact on the Long Beach community – and is comprised of three parts:

1. **Helping conduct an audit of the home, and specify and procure equipment with the assistance of local companies.**

2. **A Volunteer Day (June 3, 2017) where our chapter members donated their time and physical labor.**

3. **A presentation on energy efficiency and incentives at a Rebuilding Together Long Beach General Volunteer Meeting and a guide on energy efficiency and incentives in Southern California for the organization to distribute and have on hand in the future.**

We are excited for our sustainability project that will directly improve the lives of this local family and to provide resources that Rebuilding Together Long Beach can use well after this project ends.
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
- 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 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 24, 2017

Effective Energy Management in New & Existing Buildings
8:00 a.m. – 3:00 p.m., Long Beach Convention Center, Room: 102C
This course weaves together energy management principles of the ASHRAE Handbook-HVAC Applications; Energy Star Guidelines; and new ASHRAE Standard 100-2015 “Energy Efficiency in Existing Buildings.” Practical experience of successful energy managers is presented. Numerous case studies are discussed, including a hospital, high-rise building, bank, and convention center.
Instructor: Lucas Hyman, P.E., Member ASHRAE, BEAP, LEED® AP

Commissioning Process in New & Existing Buildings
8:00 a.m. – 3:00 p.m., Long Beach Convention Center, Room: 103C
Learn how the application of the commissioning process in existing facilities differs from new construction. This seminar covers the benefits of commissioning, the reduction of environmental impact, and the improvement of design and construction quality. Take away compelling information that demonstrates the value of investing in the commissioning process.
Instructor: Rick Casault, P.E., Member ASHRAE

HALF-DAY SHORT COURSES

Registration fees: $184 (ASHRAE Member $139)

SATURDAY, JUNE 24, 2017

Designing High-Performance Healthcare HVAC Systems
12:00 p.m. – 3:00 p.m., Long Beach Convention Center, Room: 204
This course details the relationship of infection control and HVAC design including application of ANSI/ASHRAE/ASHE Standard 170-2013, Ventilation of Health Care Facilities. Discuss 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 are discussed in the context of achieving all the goals of a high performing hospital.
Instructor: Daniel Koenigshofer, P.E., Member ASHRAE, HFDP
SUNDAY, JUNE 25, 2017

Air-to-Air Energy Recovery Applications: Best Practices
3:30 p.m. – 6:30 p.m., Long Beach Convention Center, Room: 102C
Review real-world examples of where and how air-to-air energy recovery technologies are integrated into some of the most common commercially available systems. Particular configurations that are most commonly used in high-performance buildings and how they can best be used to meet stretch goals for IEQ and energy efficiency and thermal comfort will be examined with respect to established performance metrics, peak performance results and annual energy savings. Best practices for mechanical design, exchanger selection and control strategies are discussed.
Instructor: Paul Pieper, P.Eng., Member ASHRAE

Laboratory Design: The Basic and Beyond
3:30 p.m. – 6:30 p.m., Long Beach Convention Center, Room: 103C
Learn the essential elements of the design process that are unique to laboratory HVAC systems. The course evaluates planning, risk assessment, exhaust/supply requirements, load calculation, pressure mapping, evaluating system options, layout of ducts and rooms, sizing primary air systems, designing exhaust stacks, sustainability in laboratories, and control strategies. Example problems and case studies are presented.
Instructor: John Varley, P.E., HBDP, LEED® AP

MONDAY, JUNE 26, 2017

Complying with Standard 90.1-2016 Appendix G
2:30 p.m. – 5:30 p.m., Long Beach Convention Center, Room: 102C
Based on ASHRAE Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings, learn the addendum bm, which allows Appendix G to be used as a compliance path within the Standard. Focus is placed on the importance of the recent changes in the lighting and envelope requirements and how they reduce loads on the HVAC systems and on overall energy use. Topics include the significant new mandatory requirements for air barriers and daylighting.
Instructors: McHenry Wallace, P.E., Member ASHRAE, LEED® AP; and Joseph Deringer, AIA, Member ASHRAE, LEED® AP
Understanding & Designing Dedicated Outdoor Air Systems (DOAS)
2:30 p.m. – 5:30 p.m., Long Beach Convention Center, Room: 103C
Discover the advantages of separate dedicated outdoor air systems (DOAS) and the disadvantages of delivering the ventilation via single all-air variable air volume (VAV) systems. Review the inherent problems with the energy saving potential of the top HVAC technologies and the engineering design score sheet for a DOAS project. The course addresses over 30 frequently asked questions and draws conclusions.
**Instructor:** Stanley Mumma, Ph.D., P.E., Fellow/Life Member ASHRAE

TUESDAY, JUNE 27, 2017

Complying with Standard 90.1-2016: HVAC/Mechanical
8:00 a.m. – 11:00 a.m., Long Beach Convention Center, Room: 102C
In 2007, ASHRAE determined that the 2010 version of Standard 90.1 would show a 30% reduction in energy use when compared to the 2004 edition. The 2016 edition added an 8.5% source energy savings and 7.6% site energy savings, for a total of nearly 40% below that required for a 2004-compliant building. The new and updated Mandatory and Prescriptive requirements for HVAC and Service Water Heating systems, along with insights on how to comply during building design and construction.
**Instructor:** McHenry Wallace, P.E., Member ASHRAE, LEED® AP

High-Performance Building Design: Applications & Future Trends
12:00 p.m. – 3:00 p.m., Long Beach Convention Center, Room: 102C
High performance is more than just energy efficiency, and this course addresses issues and methods for providing high performance in areas beyond energy efficiency, such as indoor environmental quality. Learn the applications of new technologies and design concepts to achieve the goal of high-performance buildings, including net-zero or nearly net-zero energy buildings. Discuss the future trends toward high-performance buildings across the globe, and summarizes how ASHRAE Standards address them.
**Instructor:** Tom Lawrence, Ph.D., P.E., Fellow ASHRAE, LEED® AP
Variable Refrigerant Flow System: Design & Application
12:00 p.m. – 3:00 p.m., Long Beach Convention Center, Room: 103C
Variable Refrigerant Flow (VRF) systems are now becoming increasingly utilized across North America. Based on the 2012 ASHRAE HVAC Systems and Equipment Handbook, the course provides a comprehensive system design application guidance using building specific scenarios. Learn non-manufacturer specific concepts of how to apply VRF systems to buildings using building-specific scenarios.

Instructors: Paul Doppel, Member ASHRAE; and Jocelyn Leger, P.Eng., Member ASHRAE

ASHRAE CERTIFICATION EXAMS
Tuesday, June 27
2:00 p.m. – 5:30 p.m.
203C, Long Beach Convention Center, 2nd Floor
Recognized by over 30 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.
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, and access will also be available for purchase. 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.

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2017 ASHRAE Annual Conference Papers (online) – $79

2017 ASHRAE Annual Conference Seminars (online) – $119

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

ASHRAE Transactions (Print Volume) – $79

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. 2017 ASHRAE Annual Conference – Papers (online) and 2017 ASHRAE Annual Conference Seminars (online); $149

2. 2017 ASHRAE Annual Conference – Papers (online) and ASHRAE Transactions; $124

3. Complete Annual Conference Content Package (2017 ASHRAE Annual Conference – Papers (online), 2017 ASHRAE Annual Conference Seminars (online), and ASHRAE Transactions); $174

*All prices are special conference-only prices.*
Sunday, June 25

8:00 AM – 9:00 AM
Forum 1 (Advanced)

Commissioning Experience with California Title 24 VAV Lab Exhaust
Room: 101A
Sponsor: 9.10 Laboratory Systems
Moderator: Victor Neuman, P.E., Member, Laboratory Exhaust Certification LLC, San Diego, CA

8:00 AM – 9:00 AM
Workshop 1 (Basic)

Are We Afraid of What We’ll Find? Using Real Buildings to Improve ASHRAE Standards and Publications
Room: 201A
Sponsor: 2.8 Building Environmental Impacts and Sustainability
Chair: Joy Altwies, Ph.D., P.E., Member, University of Wisconsin-Madison, Madison, WI
Dennis Jones, P.E., Member, Group14 Engineering Inc., Denver, CO
J. Kevin Cross, P.E., Member, Honeywell, Fort Collins, CO

8:00 AM – 9:00 AM
Workshop 2 (Intermediate)

Are You Ready For 21st Century Building Automation?
Room: 101B
Sponsor: 1.4 Control Theory and Application, 7.5 Smart Building Systems
Chair: Marcelo Acosta, P.Eng., Member, Armstrong Fluid Technologies, Toronto, ON, Canada
1. Potentials and Disappointments: The Slow Adoption of Advanced Building Automation
Marcelo Acosta, P.Eng., Member, Armstrong Fluid Technologies, Toronto, ON, Canada
2. Are Millennials Ready for Advanced Building Automation?
Michelle Shadpour, Student Member, SC Engineers, Inc., San Diego, CA

8:00 AM – 9:00 AM
Workshop 3 (Intermediate)

Bringing Standard 90.1 to the World: The Addition of Climate Zone 0
Room: 103AB
Sponsor: Chapter Technology Transfer Committee
Chair: Andy Cochrane, Member, Industrial Air Inc., Greensboro, NC
1. Bringing ASHRAE 90.1 to the World: The Addition of Climate Zone 0
Chris Mathis, Member, Mathis Consulting, Montreal, AL
Sunday, June 25

8:00 AM – 9:00 AM

Workshop 4 (Basic)

Common Commissioning Terminology for the Building Industry: An International Overview
Room: 203AB
Sponsor: AICARR, CIBSE, SSPC 202
Chair: Livio de Santoli, P.Eng., Member, AICARR, Milano, Italy
1. ASHRAE Overview
   Walter Grondzik, P.E., Fellow Life Member, ASHRAE, Atlanta, GA
2. CIBSE Overview
   Hywel Davies, CIBSE, London, United Kingdom

8:00 AM – 9:00 AM

Workshop 5 (Advanced)

Engineers of Trial: You Decide Guilt or Innocence
Room: 102AB
Sponsor: 7.2 HVAC&R Construction & Design Build Technologies, 1.7 Business, Management & General Legal Education
Chair: Michael Cooper, P.E., Member, MCC, Metairie, LA
1. The Case for the Plaintiff
   E. Mitchell Swann, P.E., Member, Virtual Construction/BIM Manager, Paoli, PA
2. The Case for the Defense
   Michael Connor, P.E., Member, WSP, Atlanta, GA

8:00 AM – 9:00 AM

Workshop 6 (Intermediate)

Science and Technology for the Built Environment Writer’s Workshop: Authoring Research Papers with Impact
Room: 202AB
Sponsor: Publishing and Education Council
Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD
1. Writing for Maximum Impact
   Alexa Flood, Taylor and Francis, Philadelphia, PA
2. Writing Research Papers that Get Published
   Alexa Flood and Mary Baugher, (1)Taylor and Francis, Philadelphia, PA, (2)University of Maryland, College Park, MD

8:00 AM – 9:00 AM

Workshop 7 (Intermediate)

Status of Standards and Codes in the USA, In View of the Application of Low GWP Refrigerants
Room: 201B
Sponsor: Refrigeration Committee
Chair: Steven Eckels, Ph.D., Member, Kansas State University Institute for Environmental Research, Manhattan, KS
1. Status of ASHRAE 15, Related Codes and SNAP
   Phillip Johnson, P.E., Member, Daikin Applied, Staunton, VA
2. Status of UL Standards and Related Codes
   Bill Hansen, P.E., Member, Ingersoll Rand, La Crosse, WI
Sunday, June 25

9:45 AM – 10:45 AM

Panel 1 (Intermediate)

The US Department of Energy’s Recent Regulatory Activity on Water Heaters
Room: 202AB

Sponsor: 6.6 Service Water Heating Systems
Moderator: James D. Lutz, P.E., Member, Hot Water Research, Oakland, CA
1. Harvey Sachs, Member, ACEEE, Washington, DC
2. Frank Stanonik, Life Member, Air Conditioning, Heating and Refrigeration Institute, Washington, DC
4. James Lutz, Member, Lawrence Berkeley National Laboratory, Berkeley, CA

9:45 AM – 10:45 AM

Debate 1 (Intermediate)

Cumbersome and Correct vs. Half-Baked and High-Speed
Room: 203AB

Sponsor: 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment, 4.10 Indoor Environmental Modeling
Moderator: Nick Gangemi, Life Member, James W. VanGilder, P.E., Member
1. Mark Seymour, CEng, Member, Future Facilities Ltd, London, United Kingdom
2. James W. VanGilder, P.E., Member, Schneider Electric, Andover, MA
3. Nick Gangemi, Life Member, Northern Air Systems, Rochester, NY

9:45 AM – 10:45 AM

Conference Paper Session 1 (Intermediate)

Weather Modeling Applications
Room: 103AB

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

1. Typical and Design Weather Year for Building Energy Simulation (LB-17-C001)
Yusuke Arima, BEAP¹, Ooka Ryozo, Ph.D., OPMP, HBDP and BEAP¹ and Hideki Kikumoto, Ph.D., BEAP¹, (1) The University of Tokyo, Tokyo, Japan

David Coley¹, Alfonso Ramallo-González², Manuel Herrera² and Matthew E. Eames, Ph.D.², (1)University of Bath, Bath, United Kingdom, (2)University of Exeter, Exeter, United Kingdom

3. CFD and Wind Tunnel Study of the Performance of Outdoor Commercial Plaza Air-Conditioning System (LB-17-C003)
E. M. ElBialy, Ph.D.¹ and SA Ghani, Ph.D.¹, (1) Qatar University, Doha, Qatar
9:45 AM – 10:45 AM
Conference Paper Session 2 (Intermediate)

How Healthcare Facilities and Infection Control Are Affected by HVAC Systems
Room: 101B
Chair: Sonya Pouncy, Member, Walker-Miller Energy Services, Detroit, MI

1. Analysis of HVAC Configurations for a Hospital Operating Room (LB-17-C004)
Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

2. An Efficient Ventilation Configuration for Preventing Bioaerosol Exposures to Health Care Workers in Airborne Infection Isolation Rooms (LB-17-C005)
Deepthi Sharan Thatiparti, Student Member, Urmila Ghia, Ph.D., and Kenneth R. Mead, Ph.D., P.E., Member, (1)University of Cincinnati, Cincinnati, OH, (2)CDC- National Institute for Occupational Safety and Health (NIOSH), Cincinnati, OH

3. Cross Infection Due to Pathogen Transport in Indoor Environments: Investigative Study Assessing Impact of Ventilation Type, Air Changes and Furniture Layout (LB-17-C006)
Shamia Hoque, Ph.D., Associate Member, University of South Carolina, Columbia, SC

9:45 AM – 10:45 AM
Seminar 1 (Intermediate)

Psychrometrics of Chilled Beam Systems
Room: 201B
Sponsor: 5.3 Room Air Distribution
Chair: Donald E Larsson, Member, United States Green Building Council, Washington, DC

1. Psychrometrics of Chilled Beam Systems
Donald Larsson, Member, United States Green Building Council, Washington, DC

2. Application of Chilled Beam Systems
Thomas Rice, Member, Semco LLC, Columbia, MO

3. Successful Chilled Beam System Installations
Paul Christy, Clark County Public Schools, Winchester, KY

9:45 AM – 10:45 AM
Seminar 2 (Intermediate)

Commissioning Complex Labs: Stories from the Field
Room: 102AB
Sponsor: 9.10 Laboratory Systems, 7.7 Testing and Balancing
Chair: Wade H. Conlan, P.E., Member, Hanson Professional Services, Orlando, FL

1. Lab Building Case Study: Safety vs. Energy Conservation
Justin Garner, P.E., Member, Engineered Air Balance Company, Inc., Houston, TX

2. Continuous Improvement of Commissioning / Certification of Bsl-3 Laboratories
Carol Donovan, Member, Alares LLC, Quincy, MA
Sunday, June 25

9:45 AM – 10:45 AM

Seminar 3 (Intermediate)

Smart Buildings, Smart Cities
Room: 201A

Sponsor: 1.4 Control Theory and Application
Chair: Joseph Kilcoyne, P.E., Member, SC Engineers, Inc., San Diego, CA

1. What Is Smart? The Architecture of a Smart City
   Ron Bernstein, Member, RBCG, LLC, Encinitas, CA

2. Turning Modern Cities into SMART Cities
   Parita Ammerlahn, City of San Diego – Environmental Services
   Department, San Diego, CA

11:00 AM – 12:30 PM

Conference Paper Session 3 (Intermediate)

Air Conditioning Large Spaces: Air Flow, Energy Efficiency and Tower Water Treatment
Room: 201A

Chair: Yu Joe Huang, Member, White Box Technologies, Moraga, CA

1. Air Flow Regimes in an Air Conditioned Playground Zone of Open-Roof Football Stadium (LB-17-C007)
   Essam E. Khalil, Fellow ASHRAE, Esmail ElBialy, Dr.Ing.,1, Waleed AbdelMaksoud, Ph.D., P.E.1 and Mohamed E. Ashmawy, P.E.1, (1)Cairo University Faculty of Engineering, Cairo, Egypt

2. Legionella Bacteria Control in Cooling Tower Water Systems - An Independent Study Indicates Current Acceptable Microbiological Control Methods are Ineffective Industry Standard Levels of Acceptable Bacteria Need to Change (LB-17-C008)
   Paul Puckorius1 and John Dresty2, (1)Puckorius & Associates, Inc.
   Water & Wastewater Consultants, Westminster, CO, (2)Griswold Water Systems, Irvine, CA

3. Case Study of Chiller Selection for the Retrofit of a Large Building Cooling System (LB-17-C009)
   James Turcato, Student Member1 and Kevin Anderson, Ph.D., P.E., Member1, (1) California State Polytechnic University at Pomona, Pomona, CA

11:00 AM – 12:30 PM

Conference Paper Session 4 (Intermediate)

HVAC Equipment Components
Room: 101A

Chair: Daniel Pettway, Life Member, Hobbs & Associates, Norfolk, VA

1. Rapid Modelling of Air Flow through Louvers (LB-17-C011)
   Vaibhav Arghode, Ph.D.1 and Taaresh Taneja1, (1) Indian Institute of Technology - Kanpur, Kanpur, India

2. Efficiency Enhancement of a V-Shaped Evaporator (LB-17-C012)
   Zongqin Zhang, Ph.D., Member1, Haijin Xu, P.E.1, Xinyu Zhang, P.E.2, Weixin Zhang, P.E.1 and Donna M. L. Meyer, Ph.D.2, (1)Nanjing Canatal A/C Co., Ltd, Nanjing, China, (2)University of Rhode Island, Kingston, RI

   Arindom Joardar, Ph.D., Associate Member1 and Anthony Jacobi2, (1) Carrier Corporation, Syracuse, NY, (2)University of Illinois at Urbana Champaign, Urbana, IL

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4. A Systematic Classification for HVAC Systems and Components (LB-17-C014)

Han Li, Student Member¹, Yan Chen¹, Jian Zhang, Ph.D., Member², Rahul Athalye, Associate Member², Vrushali Mendon, Member² and Yulong Xie, Ph.D.², (1) Carnegie Mellon University, Pittsburgh, PA, (2) Pacific Northwest National Laboratory, Richland, WA

11:00 AM – 12:30 PM
Seminar 4 (Basic)

Designing, Operating and Living at a Net Zero Energy and Net Zero Water Building
Room: 103AB

Sponsor: 7.6 Building Energy Performance
Chair: Hyojin Kim, Ph.D., Member, The Catholic University of America, Washington, DC

1. Owner’s Perspective
Mary Tod Winchester, Chesapeake Bay Foundation, Annapolis, MD

2. Engineer’s Perspective
Brian Coffield, P.E., Associate Member, SmithGroupJJR, Washington, DC

3. Occupants’ Perspectives
Hyojin Kim, Ph.D., Member, The Catholic University of America, Washington, DC

11:00 AM – 12:30 PM
Seminar 5 (Basic)

(WITHDRAWN) Drones Have Arrived: Unmanned Aerial Systems (UAS) in the Built Environment
Room: 102AB

Sponsor: 1.5 Computer Applications

11:00 AM – 12:30 PM
Seminar 6 (Intermediate)

Going Small in Exhaust Air Energy Recovery, for Multi-Family Buildings Size Doesn’t Matter
Room: 203AB

Sponsor: 5.5 Air-to-Air Energy Recovery
Chair: Marc Tardif, Innerytech Inc., Drumminville, QC, Canada

1. Introduction to the Residential Air-to-Air Energy Recovery Ventilator
Adam Fecteau, Member, Aldes, Saint-Léonard-d’Aston, QC, Canada

2. Energy Recovery Ventilation Applications for Mutifamily High Rise Dwelling Units in Northeastern Climate
Manalee Nabar, Bright Power Inc., New York, NY

Peter Grinbergs, Associate Member, Airia Residential Systems Inc., London, ON, Canada

4. Energy Recovery Ventilators for High Rise Residential Buildings
James Dean, dpoint Technologies, Inc., Vancouver, BC, Canada
Sunday, June 25

11:00 AM – 12:30 PM  
**Seminar 7 (Intermediate)**

NZEB from Foundation to Financing: Nonresidential Buildings
Room: 201B

**Sponsor:** 6.7 Solar Energy Utilization, 6.8 Geothermal Heat Pump and Energy Recovery Applications, TC 2.8

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

1. Introduction to Solar Electric Design and Installation  
*Khalid Nagidi, BEAP, Member, Energy Management Consulting Group, Wantagh, NY*

2. Photovoltaic (PV) Systems Impact on Electric Demand  
*Svein Olav Morner, Ph.D., P.E., CPMP, Member, Sustainable Engineering Group, Madison, WI*

3. Financing and Ownership Alternatives for Large Scale Solar PV Projects  
*James Leidel, Member, Oakland University, Rochester, MI*

4. Deep Energy Refurbishment of Historic and Heritage Buildings to Reach NZEB Status  
*Marija Todorovic, Ph.D., P.E., Fellow ASHRAE, University of Belgrade, VEA-INVI.Ltd Director, Belgrade, Serbia*

11:00 AM – 12:30 PM  
**Seminar 8 (Intermediate)**

Occupant Behavior Based Modeling Predictive Control
Room: 202AB

**Sponsor:** MTG.OBB Occupant Behavior in Buildings

**Chair:** Da Yan, Tsinghua University, Beijing, China

1. Occupant-Integrated Model Predictive Control of Building HVAC Systems: Benefits, Drawbacks and Challenges  
*David Blum, Ph.D., Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA*

2. Behavior Driven Model Predictive Controls for Future Smart Buildings  
*Bing Dong, Associate Member, University of Texas at San Antonio, San Antonio, TX*

3. Fault and Occupant Tolerant Model Predictive Control of Building HVAC System  
*Pengfei Li, Ph.D., United Technologies Research Center, East Hartford, CT*

4. The Combination and Application of Model Predictive Control and Occupant Behavior  
*Da Yan, Tsinghua University, Beijing, China*
Using Optimization to Squeeze More Performance Out of Existing Systems
Room: 101B

Sponsor: 1.13 Optimization
Chair: Christopher R. Laughman, Ph.D., Member, Mitsubishi Electric Research Laboratories, Waltham, MA

1. Optimization of Small Diameter Tube-Fin Heat Exchangers to Enable Performance Improvements, Charge Reduction and Cost Savings
Daniel Bacellar, University of Maryland, College Park, MD

2. Improving Heat Exchanger Circuitry by Using Derivative-Free Optimization
Christopher R. Laughman, Ph.D., Member, Mitsubishi Electric Research Laboratories, Waltham, MA

3. Optimizing Mini-Split Air Conditioning Units Using Alternative Refrigerants
Bo Shen, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

4. Operation Optimization of Buildings as Virtual Batteries for the Grid with High Penetrations of Renewables
Zheng O’Neill, Ph.D., P.E., Member, University of Alabama, Tuscaloosa, AL

1:30 PM – 3:00 PM

Conference Paper Session 5 (Intermediate)
Room: 101A

Chair: Edward A. Vineyard, Fellow ASHRAE, Texas A&M University, College Station, TX

Tobias Dehne, CPMP, Johannes Bosbach, Daniel Schmeling, Pascal Lange, and Andre Volkmann, (1) German Aerospace Center (DLR) Institute of Aerodynamic and Flow Technology, Göttingen, Germany

Essam E. Khalil, Fellow ASHRAE, Esmail ElBialy, Dr.Ing., Moustafa Salah, P.Eng., and Ahmed Fahim, Ph.D., P.E., (1) Cairo University Faculty of Engineering, Cairo, Egypt, (2) HBRC, Cairo, Egypt

3. Effects of Diffuser Arrangements for Mixing and Displacement Ventilations on Indoor Environmental Qualities in Two Adjacent Spaces (LB-17-C017)
Hyeunguk Ahn, Student Member, and Donghyun Rim, Ph.D., Associate Member, (1) Pennsylvania State University, State College, PA, (2) Pennsylvania State University, University Park, PA

Yasuhiro Tanoue, Hideaki Nagano, Ph.D., Shinsuke Kato, Dr.Ing., Fellow ASHRAE, and Itsuhei Khori, (1) Tokyo City University, Tokyo, Japan, (2) University of Tokyo Institute of Industrial Science, Tokyo, Japan
Sunday, June 25

1:30 PM – 3:00 PM

Seminar 10 (Intermediate)

Research Methods to Achieve Superior Comfort, Health and Well-Being in Buildings
Room: 203AB
Sponsor: SGPC 10
Chair: Eric Adams, Ph.D., Member, Indiana University Purdue University Indianapolis, Indianapolis, IN
1. Health and Wellness in the Built Environment
   Eric Saunders, Ph.D., International WELL Building Institute, Brooklyn, NY
2. Humidity Interaction Effect on the Building and Occupants
   Eric Brodsky, P.E., Member, Research Products Corporation, Madison, WI
3. Implications of Modern Indoor Lighting on Circadian Health
   Frederick Marks, AIA, Visiting Scholar, Salk Institute for Biological Studies, La Jolla, CA
   Nicholas Clements, Ph.D., Well Living Lab, Rochester, MN

1:30 PM – 3:00 PM

Seminar 11 (Intermediate)

Absorption Heat Pump Applications: Industrial, Space Heating and Water Heating
Room: 102AB
Sponsor: 8.3 Absorption and Heat Operated Machines, 9.2 Industrial Air Conditioning
Chair: Patrick Geoghegan, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN
   Jürgen Scharfe, P.E., Member, JS Energie & Beratung GmbH, Erding, Germany
2. Case Studies from Around the World that Are Using Modern Absorption Heat Pumps to Save Energy and Water Resources on Planet Earth
   Douglas A. Davis, Associate Member, Broad USA, Hackensack, NJ
   Kyle Gluesenkamp, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

1:30 PM – 3:00 PM

Seminar 12 (Intermediate)

An Interdisciplinary Framework and Survey for Investigating Cross-Country Occupant Behavior in Buildings
Room: 201A
Sponsor: MTG.OBB Occupant Behavior in Buildings
Chair: Tianzhen Hong, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA
1. An Interdisciplinary Research Approach to Energy-Related Behavior in Buildings
   Simona D’Oca, Ph.D., LBNL, Berkeley, CA
Da Yan, Tsinghua University, Beijing, China

3. Insights on Social Psychological and Contextual Factors Affecting Energy Behaviors and Conservation Intentions in Residential and Commercial Buildings  
Chien-fei Chen, Ph.D., University of Tennessee, Knoxville, TN

Carol Menassa, Ph.D., University of Michigan, Ann Arbor, MI

1:30 PM – 3:00 PM  
Seminar 13 (Basic)

Building EQ: ASHRAE and APPA Adapting to Energy Challenges Today  
Room: 101B  
Sponsor: Building EQ Committee  
Chair: Hoy Bohanon, P.E., Member, Hoy Bohanon Engineering, PLLC, Clemmons, NC

1. The New Building EQ  
Hugh Crowther, Member, Swegon North America, Inc., Markham, ON, Canada

2. Adapt Building EQ  
Michael Brandemuehl, Fellow Member, University of Colorado, Boulder, CO

3. ASHRAE’s Partnership with APPA  
Daniel Redmond, Carleton University, Ottawa, ON, Canada

4. APPA’s Opportunity and Expectations of Building EQ  
Charles Scott, Illinois State University, Normal, IL

1:30 PM – 3:00 PM  
Seminar 14 (Intermediate)

Commissioning of Commercial Kitchen Ventilation Systems, Including Examples of Real World Successes and Failures  
Room: 201B  
Sponsor: 5.10 Kitchen Ventilation, 7.9 Building Commissioning  
Chair: Francis Kohout, P.E., Member, Cyclone Energy Group, Chicago, IL

1. What Is Commercial Kitchen Ventilation Commissioning?  
Donald Fisher, P.Eng. Life Member, Fisher Consultants, Danville, CA

2. Overall CKV Commissioning and the Critical Role of Testing and Balancing  
Jason Brown, Associate Member, Melink Corp., Milford, OH

3. Commercial Kitchen Ventilation Operation and Performance: Reality Check from the Field  
Michael Morgan, Associate Member, Captive Aire Systems, Inc., Allentown, PA
Sunday, June 25

1:30 PM – 3:00 PM
Seminar 15 (Intermediate)

The IoT for Better Building Operation and Control
Room: 202AB

Sponsor: 7.5 Smart Building Systems, 1.4 Control Theory and Application

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

1. Smart Plug Enabled Intelligent Commercial Building Operations
   Gang Wang, P.E., Member, University of Miami, Coral Gables, FL

2. IoT Technologies Make Buildings More Energy Efficient and Way Smarter
   Xin (Sherry) Hu, Ph.D., P.E., Member, BriteThings, San Francisco, CA

3. An Energy Balance Model for Detecting Anomalies in Residential Buildings
   Brent Huchuk, ecobee, Toronto, ON, Canada

4. Connected Appliances for the Win-Win!
   Dane Christensen, Ph.D., Member, National Renewable Energy Laboratory, Golden, CO

1:30 PM – 3:00 PM
Seminar 16 (Intermediate)

Use of Geothermal Heat Pumps to Achieve Net Zero
Room: 103AB

Sponsor: 6.8 Geothermal Heat Pump and Energy Recovery Applications

Chair: William Murphy, Ph.D., P.E., Fellow ASHRAE, University of Kentucky, Paducah, KY

1. Evolution of Zero Energy Geothermal Schools from 2010 to 2016
   Ken Seibert, P.E., Member, CMTA Inc., Louisville, KY

2. Use of Geothermal and Biofuels to Reach Net Zero in a Northern Public Transit Center
   Erin McConahey, P.E., HBDP, Fellow ASHRAE, Arup, Los Angeles, CA

3. Big Data on a Net Zero Energy Building
   Benjamin Skelton, P.E., CPMP and BEMP, Member, Cyclone Energy Group, Chicago, IL

4. Geothermal Design for a 24/7/365 Net Zero Police Station
   Spivey Lipsey, P.E., Member, CMTA Engineers, Lexington, KY

3:15 PM – 4:45 PM
Seminar 17 (Basic)

Those Who Cannot Remember the Past are Condemned to Repeat It: Modeling, Performance and Lessons Learned from Installation of Solar Energy Systems
Room: 103AB

Sponsor: 6.7 Solar Energy Utilization, 2.8 Building Environmental Impacts and Sustainability, 6.8 Geothermal Heat Pump and Energy Recovery Applications

Chair: Michael Case, Ph.D., Associate Member, US Army Corps of Engineers, Champaign, IL

1. Learning from History: Lesson Learned over 35 Years of Solar Energy at Fort Huachuca, AZ
   William Stein, US Army Corps of Engineers, Champaign, IL
2. Solar Thermal Sizing, Modeling and Verification for an Army Barracks  
Jay Tulley, U.S. Army Garrison, Monterey, CA

Farzin Masoumi, Member, Union Gas Limited, Toronto, ON, Canada

Monday, June 26

8:00 AM – 9:30 AM  
Panel 2 (Intermediate)

How Not to Design a Radiant Heating and Cooling System: Lessons Learned and Strategies for Success  
Room: 202AB
Sponsor: 6.5 Radiant Heating and Cooling  
Moderator: Devin Abellon, P.E., Member, Uponor, Apple Valley, MN
1. Peter Simmonds, Ph.D., Fellow ASHRAE, Building and Systems Analytics LLC, Marina Del Rey, CA
2. Dan Nall, AIA, Fellow ASHRAE, Syska Hennessy, New York, NY
3. Peter Rumsey, Point Energy Innovations, Oakland, CA
4. Robert Bean, Healthy Heating, Calgary, AB, Canada
5. Devin Abellon, P.E., Member, Uponor, Apple Valley, MN

8:00 AM – 9:30 AM  
Conference Paper Session 6 (Advanced)

Utilizing Predictive Occupant Behavior and Counting to Better Determine Hot Water and Heating Demand Loads and IAQ  
Room: 101A
Chair: Vikrant Aute, Ph.D., Member, University of Maryland, College Park, MD
1. Sizing Methodology for Domestic Hot Water Systems Based on Accurate Occupant Behavior (LB-17-C019)  
Jean Rouleau, Student Member¹, Louis Gosselin, Ph.D., P.E., Member¹ and Alfonso Ramallo-Gonzalez², (1) Université Laval, Québec, QC, Canada, (2) University of Bath, Bath, United Kingdom
2. Modelling Residential Building Stock Heating Load Demand, Integration of Occupancy Models (LB-17-C020)  
Giuseppina Buttitta, Student Member¹, William Turner¹, Donal Finn¹ and Oliver Neu¹, (1) University College of Dublin (UCD), Dublin, Ireland
3. Development and Comparison of Four Different Occupancy Counting and Estimation Solutions (LB-17-C021)  
Junjing Yang, Ph.D., Associate Member¹, Alexandros Pantazaras¹, Arun Kumar Chandran, Ph.D.¹, Siow Eang Lee, Ph.D.¹, Mat Santamouris, Ph.D.², Kwok Wai Tham, Ph.D.¹ and Lawrence Wong¹, (1) National University of Singapore, Singapore, Singapore, Singapore, (2) UNSW, Sydney, Australia
4. A Low-Cost Bi-Directional People Counter for Building Control (LB-17-C022)  
Peng Yin, Ph.D., Associate Member¹ and Xiaoguang Xiao, Student Member¹, (1) University of Louisiana at Lafayette, Lafayette, LA
Monday, June 26

8:00 AM – 9:30 AM

Seminar 18 (Intermediate)

Bridging the Information Gaps to Operation Management
Room: 102AB
Sponsor: 7.3 Operation and Maintenance Management, 7.9 Building Commissioning, 7.8 Owning and Operating Costs
Chair: Robyn Ellis, Associate Member, City of Hamilton - Public Works, Hamilton, ON, Canada

1. Bridging the Information Gap during Commissioning and Project Turnover to Operations
   Chuck Dale-Derks, P.E., Member, McClure Engineering, St. Louis, MO

2. Commissioning Documentation for Operations Management
   John Gibbemeyer, P.E., Member, George Mason University, Fairfax, VA

3. Building Re-Tuning with Automated Data-Logger Networks
   Paul Reale, Building Performance Lab, City University of New York, New York, NY

4. Commissioning in the Cloud
   Kris Kinney, Member, Highwoods Properties, Raleigh, NC

8:00 AM – 9:30 AM

Seminar 19 (Intermediate)

Changes to Heat Gain Tables in the Handbook Commercial Load Calculations Chapter 18
Room: 201A
Sponsor: 4.1 Load Calculation Data and Procedures, 5.10 Kitchen Ventilation
Chair: Jeff Stein, P.E., Member, Taylor Engineering, LLC, Alameda, CA

1. RP-1742 Update to Measurements of Office Equipment Heat Gain Data: Experimental Approach and Results Overview
   Christian Bach, Ph.D., Associate Member, Oklahoma State University, Stillwater, OK

2. RP-1742 Update to Measurements of Office Equipment Heat Gain Data: Data Analysis and Parametric Studies
   Omer Sarfraz, Student Member, Oklahoma State University, Stillwater, OK

3. RP-1631 Update to Kitchen Appliance Heat Gain Data
   Rich Swierczyna, Associate Member, Fisher-Nickel, San Ramon, CA

8:00 AM – 9:30 AM

Seminar 20 (Basic)

Preventing Headlines: Securing Building Automation Systems
Room: 103AB
Sponsor: 1.4 Control Theory and Application, 1.5 Computer Applications, 7.5 Smart Building Systems
Chair: Michael Pouchak, P.E., Member, Honeywell International, Golden Valley, MN

   Ron Bernstein, Member, RBCG, LLC, Encinitas, CA

2. The 20 Minute Risk Assessment
   Bruce Billedeaux, P.E., Member, Maverick Technologies, Portage, MI
3. Using a Systems Approach to Secure Networks  
Mike Pouchak, P.E., Member, Honeywell, Golden Valley, CA  
4. Cybersecurity Compliance Testing  
Paul Forney, Schneider Electric, Lake Forest, CA

8:00 AM – 9:30 AM  
Seminar 21 (Intermediate)  

Passive and Net Zero: An Envelope Perspective  
Room: 201B  
Sponsor: 4.4 Building Materials and Building Envelope Performance  
Chair: Achilles Karagozis, Ph.D., Member, Owens Corning, Granville, OH

1. Climate Specific Passive Building Challenges  
Katrin Klingenberg, Passive House Institute US | PHIUS, Urbana, IL  
2. Building Energy and Envelope Performance of a Near Net Zero Energy Building  
Stanley Gatland II, Member, Saint Gobain Corp., Philadelphia, PA  
3. Hygrothermal Considerations for Building Envelopes in Passive Buildings  
Florian Antretter, Member, Fraunhofer-Institut für Bauphysik, Munich, Germany

8:00 AM – 9:30 AM  
Seminar 22 (Intermediate)  

What Is the Prospect for Low-Cost Chemical and Biological Threat Detection and Response in Commercial Buildings?  
Room: 101B  
Sponsor: 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment, 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment  
Chair: Russell Taylor, Ph.D., Member, United Technologies Research Center, East Hartford, CT

1. Biological and Chemical Threat Detection in Commercial Buildings: A DHS Perspective  
Matthew Davenport, Department of Homeland Security, Washington, DC  
2. The Need for Low Cost Biological Agent Detection in Buildings: A DOD Perspective  
Patricia Buckley, US Army ECBC (Edgewood Chemical Biological Center), Parkville, MD  
3. A Decision Support Framework for Automated Building Systems Response to Mitigate Occupant and Facility Impacts from Chemical and Biological Agents  
Angela Waterworth, Pacific Northwest National Labs, Richland, WA  
4. A Study of Hazardous Agent Propagation in an Office Building to Evaluate HVAC Threat Mitigation Strategies  
Russell Taylor, Ph.D., BEMP, Member, United Technologies Research Center, East Hartford, CT
Monday, June 26

8:00 AM – 9:30 AM

**Seminar 23 (Intermediate)**

Contamination Control and Lubricant Considerations during Retrofits to Low GWP Refrigerants

*Room: 203AB*

**Sponsor:** 3.3 Refrigerant Contaminant Control, 3.2 Refrigerant System Chemistry, 3.4, MTG Low GWP

**Chair:** Ed Hessell, Ph.D., Associate Member, Chemtura Corp., Fords, NJ

1. Lubricant Considerations during Retrofits to Low GWP Refrigerants

*Joe Karnaz, DSc, Member, Shrieve Chemical, Houston, TX*

2. Impact of Contamination on the Stability of Low GWP Refrigerants

*Sarah Kim, Ph.D., Associate Member, Arkema, Inc., King of Prussia, PA*

3. Key Learnings from Conversions of Commercial Refrigeration Systems to Low GWP Alternatives

*Andrew Pansulla, Chemours, Wilmington, DE*

9:45 AM – 10:45 AM

**Debate 2 (Intermediate)**

Commissioning Agents For Smart Buildings: Whose Side Am I On?

*Room: 203AB*

**Sponsor:** 1.4 Control Theory and Application, 7.5 Smart Building Systems, HVAC Security TG2

**Moderator:** Frank Shadpour, P.E., Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

1. *George Rogers,* RQ Construction, Carlsbad, CA
2. *Daniel Farrow,* Palomar Health, San Diego, CA
3. *Frank Shadpour,* P.E., HFDP, Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

9:45 AM – 10:45 AM

**Technical Paper Session 1 (Intermediate)**

How Will Technology Lead Us to a More Efficient Built Environment?

*Room: 102AB*

**Chair:** Rachel Romero, P.E., Member, National Renewable Energy Laboratory, Golden, CO

1. Autonomous Robotic Building Energy Audits: Demonstrated Technology and Open Challenges (LB-17-001)

*Christopher Bay,* Student Member¹, Trevor Terrill¹ and Bryan Rasmussen, Ph.D., P.E., Member¹, (1)Texas A&M University, College Station, TX

2. First-Year Calibration of a Design Energy Model at a Medical Office Building (LB-17-002)

*Thomas Langran,* P.E.¹ and Michael Weller², (1)Kaiser Permanente, Anaheim, CA, (2)Glumac, Irvine, CA

3. Development of Maximum Technically Achievable Energy Targets for Commercial Buildings (RP-1651) (LB-17-003)

*Jason Glazer,* P.E., Member, GARD Analytics, Inc., Arlington Heights, IL
Monday, June 26

9:45 AM – 10:45 AM
Conference Paper Session 7 (Basic)

Improving Refrigeration in the Retail Food Establishments
Room: 101B
Chair: Xiwang Li, Student Member, Drexel University, Philadelphia, PA

1. Defining Room Area for Connected Spaces for Flammable Refrigerants (LB-17-C023)
   William Hansen, P.E., Member1 and Stephen Kujak, Member1, (1) Trane, Ingersoll Rand, La Crosse, WI

2. Long-Term Thermal Performance of Polyurethane Insulation within Cold Storage Panel Systems Used in U.S. Retail Grocery Environments (LB-17-C024)
   James M Costanza, Member, KPS Global LLC, Fort Worth, TX

3. Analysis of Water-Cooled Refrigeration Systems for the Food Retail Industry (LB-17-C025)
   Maria-Aliki Efstratiadi, M.D.1, Salvador Acha, Ph.D., Associate Member1, Nilah Shah, Ph.D.1 and Christos N. Markides, Ph.D.1, (1) Imperial College London, London, United Kingdom

9:45 AM – 10:45 AM
Conference Paper Session 8 (Intermediate)

Considerations in Stairway Pressurization and Underground Structure’s Life Safety
Room: 101A
Chair: Peter McDonnell, McClure Engineering, Inc., Twin Falls, ID

1. Pressurized Stairwells with Open Doors and the IBC (LB-17-C026)
   John Klote, P.E., Fellow Life Member1, Paul Turnbull, Member2 and Douglas H. Evans3, (1)John Klote Fire and Smoke Consulting, Leesburg, VA, (2)Siemens Building Technologies, Inc., Buffalo Grove, IL, (3)Clark County Building Division, Las Vegas, NV

2. Fire and Life Safety Systems at Delhi Metro Underground Stations (LB-17-C027)
   Anoop Kumar Gupta, Member1, Abdhesh Kumar Singh, Member1 and Rajesh Kumar Jain1, (1)Delhi Metro Rail Corp. Limited, New Delhi, India

3. Life Safety Considerations in Tunnel Smoke Control (LB-17-C028)
   Yoon Ko, Ph.D., Member1 and Ahmed Kashef, P.E., Member1, (1)National Research Council Canada, Ottawa, ON, Canada

9:45 AM – 10:45 AM
Seminar 24 (Intermediate)

As Cool as it Sounds: Strategies to Mitigate the Acoustic Challenges of Radiantly-Cooled Environments
Room: 103AB
Sponsor: 6.5 Radiant Heating and Cooling
Chair: Devin Abellon, P.E., Member, Uponor, Apple Valley, MN

1. Effect of Acoustical Coverage and Air Movement on the Cooling Capacity of a Radiant Chilled Ceiling
   Caroline Karmann, Student Member, UC Berkeley, Berkeley, CA

2. Effects of Horizontal and Vertical Sound Absorbers on the Cooling Capacity of Thermally Activated Building Systems (TABS)
   Marcos Dominguez, Student Member, Technical University of Denmark, Lyngby, Denmark
Monday, June 26

9:45 AM – 10:45 AM

Seminar 25 (Intermediate)

ASHRAE’s Residential Energy Performance Standards for New and Existing Buildings
Room: 202AB
Sponsor: 7.6 Building Energy Performance, SSPC 100, SSPC 90.2, Residential Building Committee
Chair: Michael Deru, Ph.D., Member, National Renewable Energy Laboratory, Golden, CO
1. Standard 90.2: The Path to Performance
   Theresa A. Weston, Ph.D., Member, DuPont Building Innovations, Richmond, VA
2. Standard 100 Residential Applications and Options
   Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL

9:45 AM – 10:45 AM

Seminar 26 (Advanced)

Evolution of Underfloor Design and its Application for Millennial Office Spaces
Room: 201A
Sponsor: 5.3 Room Air Distribution
Chair: Matt Bhumbra, Member, Price Industries, Suwanee, GA
1. Underfloor System Design Evolution
   Dan Nall, AIA, Fellow ASHRAE
   Syska Hennessy, New York, NY
2. Top Five Application Considerations for Successful UFAD Systems
   Jim Megerson, P.E., Member, Design Mechanical Inc., Kansas City, KS

9:45 AM – 10:45 AM

Forum 2 (Basic)

Great Minds Don’t Always Think Alike: What Is Needed for a “Good” Project Specification?
Room: 201B
Sponsor: 9.8 Large Building Air-Conditioning Systems
Moderator: Heather Schopplein, Member, P.E., Haldeman Inc., San Diego, CA

11:00 AM – 12:00 PM

Technical Paper Session 2 (Intermediate)

Cooling Systems Design, Operation and Commissioning
Room: 102AB
Chair: Sonya Pouncy, Member, Walker-Miller Energy Services, Detroit, MI
1. Performance Monitoring of a Chilled Water Distribution System
   HVAC-Cx (LB-17-004)
   Natascha Milesi Ferretti, P.E., Member1, Mike Galler, Member1 and Steven Bushby1, (1) National Institute of Standards and Technology, Gaithersburg, MD
2. Optimizing the Design of Chilled Water Plants for Commercial Building Energy Systems (LB-17-005)
   Nabil Nassif, Nihal AlRaeed1 and Fouad AlRifaie1, (1) North Carolina A&T University, Greensboro, NC
3. Low-Cost Control System Built Upon Consumer-Based Electronics for Supervisory Control of a Gas-Operated Heat Pump (LB-17-006)

Ahmad Abu-Heiba¹, Randall Wetherington¹, Isaac Mahderekal, Ph.D., Member² and Edward A. Vineyard, Fellow ASHRAE³, (1) Oak Ridge National Laboratory, Oak Ridge, TN, (2) Energy Studies and Services Group, Henderson, NV, (3) Texas A&M University, College Station, TX

11:00 AM – 12:00 PM

Conference Paper Session 9 (Intermediate)

Residential High Efficiency

Room: 203AB

Chair: Mini Malhotra, Member, Oak Ridge National Laboratory, Oak Ridge, TN

1. Residential Hybrid-Ground Source Heat Pump – Phase I (LB-17-C029)

Nelson Fumo, Ph.D., Associate Member¹ and Vicente Bortone, P.E.², (1) University of Texas at Tyler, Tyler, TX, (2) Johnson Controls, Inc., Lenexa, KS


Yeshpal Gupta, Ph.D.¹ and Patrick Phelan¹, (1) Lincus, Inc., Tempe, AZ


Charles R Upshaw, Ph.D., Associate Member¹, Joshua Rhodes, Ph.D., Student Member and Michael Webber, Ph.D., Member, University of Texas, Austin, TX

11:00 AM – 12:00 PM

Seminar 27 (Intermediate)

Best Practices for Employing VRF Systems

Room: 201A

Sponsor: 8.7 Variable Refrigerant Flow, 7.9 Building Commissioning

Chair: Lee Riback, Member, McKinstry, Dallas, TX

1. Best Practices and Quality Control Considerations for VRF Projects

Bill Artis, Member, Daikin, New York, NY

2. Lessons Learned through Commissioning

Thomas Conn, Horizon Engineering Associates, New York, NY

11:00 AM – 12:00 PM

Seminar 28 (Advanced)

Commercial Kitchen Ventilation: Insights into Energy and Water Efficiency!

Room: 101B

Sponsor: 5.10 Kitchen Ventilation

Chair: Donald Fisher, P.Eng., Life Member, Fisher Consultants, Danville, CA

1. The Potential for Exhaust Air Heat Recovery in Commercial Kitchen Ventilation

Rich Swierczyna, Associate Member, Fisher-Nickel, San Ramon, CA

2. Field Test Results of an Air-to-Water Heat Exchanger in a Commercial Kitchen

Michael Watz Jr., P.E., Member, Accurex a Greenheck Company, Schofield, WI
Monday, June 26

3. Clean in Place Hoods, the Labor and Water Resource Trade Off
Russell Robinson, Member, Gaylord Industries, Tualatin, OR

4. Modeling Demand Controlled Kitchen Ventilation Systems
Vernon Smith, P.E., Life Member, Smith Energy Engineers, LLC, Niwot, CO

11:00 AM – 12:00 PM

Seminar 29 (Basic)

Urban-Scale Building Energy Modeling, Part 5
Room: 101A
Sponsor: 1.5 Computer Applications, 4.7 Energy Calculations
Chair: Bass Abushakra, Ph.D., Member, United States Military Academy, West Point, NY
1. Automatic Building Energy Model Creation (AutoBEM)
Joshua New, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN
2. Simplified Estimation of Energy Use Intensity Based on Building Façade Features
Joon-Ho Choi, Ph.D., Associate Member, University of Southern California, Los Angeles, CA
3. Retrofitting District-Scale Buildings to Cut Energy Use By 50%: A Case Study
Yixing Chen, Ph.D., Associate Member and Tianzhen Hong, Ph.D., Member, (1) Lawrence Berkeley National Laboratory, Berkeley, CA

11:00 AM – 12:00 PM
Forum 3 (Basic)

Accreditation of HVAC&R Engineering Programs: Who Cares?
Room: 202AB
Sponsor: Student Activities Committee
Moderator: Michael Brandemuehl, Fellow Member, University of Colorado, Boulder, CO

11:00 AM – 12:00 PM
Forum 4 (Intermediate)

What the FPT Is Commissioning for Design Build Projects?
Room: 103AB
Sponsor: 7.9 Building Commissioning, 7.2 HVAC&R Construction & Design Build Technologies
Moderator: Will Mak, P.E., Member, Cyclone Energy Group, Chicago, IL

11:00 AM – 12:00 PM
Workshop 8 (Basic)

Opaque OPRs Produce Obscure Objectives
Room: 201B
Sponsor: 7.3 Operation and Maintenance Management, 1.7 Business, Management & General Legal Education
Chair: E. Mitchell Swann, P.E., Member, Virtual Construction/ BIM Manager, Paoli, PA
1. Owner’s Perspective of an OPR
Wayne Webster, Member, Princess Towers, Inc., Kingston, ON, Canada
2. Cx Provider’s Perspective of an OPR
Mina Agarabi, P.E., CPMP, Member, Agarabi Engineering PLLC, New York, NY
Your Ethics Tool Box: Building a Framework for Ethical Decision-Making With Case Studies
Room: 103AB

Sponsor: 1.7 Business, Management & General Legal Education
Chair: James Arnold, P.E., Member, Haslett Heating and Cooling, Columbus, OH

1. Your Ethics Tool Box: Building a Framework for Ethical Decision-Making
Kathleen Lacey, J.D., Ukleja Center for Ethical Leadership at California State University, Long Beach, Long Beach, CA

2. Case Studies in Engineering Ethics Part 1
Kristin Schaefer, P.E., Member, Schaefer Engineering, Katy, TX

3. Case Studies in Engineering Ethics Part 2
Mike Bilderbeck, P.E., Fellow ASHRAE, Pickering, Inc., Memphis, TN

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Using Occupancy and Actual Short-Term/Long-Term Energy Data to Develop More Accurate Modeling Tools
Room: 101A

Chair: Alamelu Brooks, Member, ICF International, Columbia, MD

Hidemitsu Koyanagi, Ph.D.1 and Alan Meier, Ph.D.2, (1) TAISEI Corporation, Yokohama, Japan, (2) Lawrence Berkeley National Lab, Berkeley, CA

2. Improving the Accuracy of Building Energy Simulation Using Real-Time Occupancy Schedule and Metered Electricity Consumption Data (LB-17-C033)
Chandra Sekhar, Ph.D., Fellow ASHRAE1, Junjing Yang, Ph.D., Associate Member1, Prashant Anand, Student Member1, David Cheong, Ph.D., Member1 and, (1) National University of Singapore, Singapore, Singapore

3. Half-Hourly Regional Electricity Price Modelling for Commercial End Users in the UK (LB-17-C034)
Salvador Acha, Ph.D., Aitor Soler, Gonzalo Bustos, P.Eng. and Nilah Shah, Ph.D., Imperial College London, London, United Kingdom

4. A Systematic Feature Selection Procedure for Data-driven Building Energy Forecasting Model Development (LB-17-C035)
Liang Zhang, Student Member1 and Jin Wen, Ph.D., Member1, (1) Drexel University, Philadelphia, PA
Tuesday, June 27

8:00 AM – 9:30 AM

Seminar 31 (Intermediate)

Feedback: The Essential Ingredient for High Performance Green Homes
Room: 201A
Sponsor: 2.8 Building Environmental Impacts and Sustainability, 4.4 Building Materials and Building Envelope Performance, Residential Building Committee
Chair: Audrey Dupuis, Member, Pageau Morel, Montreal, QC, Canada

1. Feedback Tools for Designing and Implementing Comfortable Efficient Homes
   Dan Perunko, Balance Point Home Performance, Nevada City, CA
2. Which Should Come First in Housing, Energy Efficiency or Thermal Comfort?
   Robert Bean, Member, Indoor Climate Consultants Inc., Calgary, AB, Canada
3. The Energy and Environmental Benefits of Design Choices that Provide Excellent Comfort
   Jim Larsen, Cardinal Glass Industries, Eden Prairie, MN

8:00 AM – 9:30 AM

Seminar 32 (Intermediate)

Ejector Systems in Transport Refrigeration
Room: 201B
Sponsor: 10.6 Transport Refrigeration
Chair: Robert Chopko, Member, Carrier Transicold, Syracuse, NY

1. Modeling, Design and Efficiency of Two-Phase Ejectors to Increase Cop of Transport Refrigeration Systems
   Stefan Elbel, Ph.D., University of Illinois at Urbana-Champaign, Urbana, IL
2. Application of Natural Refrigerant CO2 in Container Transport Refrigeration Systems and Potential Benefits and Impacts with CO2 Ejector Cycle
   Keonwoo Lee, Member, Carrier Transicold, Syracuse, NY
3. Manufacturing Considerations for Ejector Systems
   David Lee, Member, Mueller Refrigeration, Hartsville, TN

8:00 AM – 9:30 AM

Seminar 33 (Basic)

Flooding, Superstorm Sandy: Lessons Learned and Strategies Implemented
Room: 202AB
Sponsor: 2.5 Global Climate Change, 2.8 Building Environmental Impacts and Sustainability, 4.2 Climatic Information
Chair: Scott Sherwood, Member, Eco Care Corporation, Bronx, NY

1. Superstorm Sandy: Lessons Learned
   Chris Colasanti, P.E., Member, Jaros Baum & Bolles, New York, NY
2. Superstorm Sandy: New Codes and Design Considerations
   Illya Azaroff, AIA, +LAB Architect PLLC, New York, NY
3. Life Safety Issues That Occurred at NYU Medical during and in the Aftermath of Superstorm Sandy
   Richard Cohen, NYU Langone Medical Center, New York, NY
4. Climatic Information: History and Current Data & Trending
   Scott Sherwood, Member, Eco Care Corporation, Bronx, NY
Tuesday, June 27

8:00 AM – 9:30 AM
Seminar 34 (Intermediate)
Not-in-Kind HVAC Technologies, Part 1
Room: 101B
Sponsor: Publication and Education Council
Chair: Pradeep Bansal, Ph.D., Fellow ASHRAE, ASHRAE STBE Editorial Board, Atlanta, GA
1. Compressor Driven Metal Hydride Heat Pumps Using Adsorptive Slurry and Isothermal Compression
Nelson James, Student Member, James Braun, Ph.D., Fellow ASHRAE, Eckhard Groll, Dr.Ing., Fellow ASHRAE and Travis Horton, Ph.D., Member, (1)Purdue University, West Lafayette, IN
2. Design of a Hydraulically Driven Compressive Elastocaloric Cooling System
Yunho Hwang, Ph.D., Member, Suxin Qian, Ph.D., Member, Yunlong Geng, Ph.D., Member, Yi Yang, Ph.D., Member, Jan Muehlbauer, Member, Jiachen Ling, Ph.D., Member, Reinhard Radermacher, Ph.D., Fellow ASHRAE and Ichiro Takeuchi, Ph.D., (1)University of Maryland, College Park, MD, (2)Xi’an Jiaotong University, Xi’an, China
3. Design and Performance of a Novel Magnetocaloric Heat Pump
Michael Benedict, Ph.D., Member, S.a. Sherif, Ph.D., Member, Michael Schroeder, Member and David Beers, Member, (1)General Electric, Louisville, KY, (2)University of Florida, Gainesville, FL

8:00 AM – 9:30 AM
Seminar 35 (Intermediate)
Advancing Standard 90.1 to Net Zero Energy Buildings
Room: 103AB
Sponsor: 7.6 Building Energy Performance, SSPC 90.1
Chair: Bing Liu, P.E., Member, Pacific Northwest National Laboratory, Portland, OR
1. Advancing Standard 90.1 Envelope Requirements
Leonard Sciarra, AIA, Member, Gentler, Chicago, IL
2. Advancing Standard 90.1 Lighting and Power Requirements
Eric Richman, Member, Pacific Northwest National Laboratory, Richland, WA
3. Advancing Standard 90.1 Mechanical Requirements
Richard Lord, Fellow ASHRAE, United Technologies Carrier Corp, Marfrestesboro, TN
4. Advancing Standard 90.1 Performance-Based Path to Achieving Net Zero Energy Buildings
Michael Rosenberg, Fellow ASHRAE, Pacific Northwest National Laboratory, Richland, WA

8:00 AM – 9:30 AM
Seminar 36 (Basic)
Using Nature, Keeping Control
Room: 102AB
Sponsor: 1.4 Control Theory and Application, 4.5 Fenestration, MTG OBB
Chair: James Coogan, P.E., Associate Member, Siemens Industry, Inc., Buffalo Grove, IL
1. Engaging Users in Natural Ventilation in Mixed Mode Buildings
Glenn Friedman, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

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Tuesday, June 27

2. Reducing Uncertainty When Controlling Natural Ventilation  
Stephen Ray, Ph.D., P.E., Associate Member, North Park University, Chicago, IL

3. Integrated Room Control for HVAC, Lighting and Daylighting  
Klaus Jank, Siemens BT, Buffalo Grove, IL

8:00 AM – 9:30 AM  
Seminar 37 (Basic)

Water Treatment: The Overlooked Aspect of Commissioning Hydronic Systems  
Room: 203AB

Sponsor: 3.6 Water Treatment, 8.6 Cooling Towers and Evaporative Condensers  
Chair: Helen Cerra, Member, ChemTreat, Inc., Glen Allen, VA

1. Commissioning of Your Steam System’s Water Treatment Program  
Todd Cornwell, Member, AFCO, Raleigh, NC

2. Proper Commissioning of Your Cooling System’s Water Treatment Program  
Dan Weimar, Member, Chem-Aqua, Inc., Irving, TX

3. Potable Water and Other Indoor Aerosolizing Systems  
Tim Keane, Member, Legionella Risk Management Inc., Chalfont, PA

9:45 AM – 10:45 AM  
Technical Paper Session 3 (Intermediate)

Research in HVAC Fundamentals  
Room: 102AB

Chair: Daniel Pettway, Member, Hobbs & Associates, Norfolk, VA

1. Updating the ASHRAE Climate Design Data for 2017 (RP-1699)  
(LB-17-007)

Michael Roth, Ph.D., Klimaat, Guelph, ON, Canada

2. Effects of Air Leakage on Buildings’ Overall Thermal Resistances Based on U.S. Climate Zones (LB-17-008)

Simon Fullin, Ph.D., Associate Member1, Michaela Stockdale2, Phillip Boudreaux, Ph.D.1 and Elizabeth Buechler2, (1)ORNL, Oak Ridge, TN, (2)Tennessee Technological University, Cookeville, TN; (3)Tufts University, Medford, MA


Reece Kiriu, P.E., Member1 and Steven Taylor, P.E., Fellow ASHRAE1, (1) Taylor Engineering LLC, Alameda, CA

9:45 AM – 10:45 AM  
Conference Paper Session 11 (Intermediate)

CFD for Smoke Management  
Room: 101B

Sponsor: 5.6 Control of Fire and Smoke  
Chair: Paul Turnbull, Member, Siemens Building Technologies, Inc., Buffalo Grove, IL

1. Tenability Analysis and Atrium Smoke Control (LB-17-C036)

John Klote, P.E., Fellow Life Member, John Klote Fire and Smoke Consulting, Leesburg, VA

2. CFD Modeling of Full-Size Highrise Fire Smoke Spread and Control (LB-17-C037)

Liangzhu Wang, Ph.D., P.E., Member1, Dahai Qi, Student Member1, Shamim Mashayekh1 and Malek Soubra1, (1) Concordia University, Montreal, QC, Canada
3. CFD Analysis of Smoke Protected Seating (LB-17-C038)
Jennifer L. Wiley, P.E.\(^1\) and Michael J. Ferreira, P.E.\(^1\), (1) Jensen Hughes Inc., Baltimore, MD

9:45 AM – 10:45 AM
Conference Paper Session 12 (Intermediate)

Highly Efficient HVAC System Components

Room: 101A
Chair: Stephanie Kunkel, Member, JMT, Sparks, MD

1. Application of TPRTs (Thermal Performance/Response Tests) in a Saturated Porous Formation (LB-17-C039)
Wonjun Choi, Ph.D., Member\(^1\) and Yaszuki Nakamura, Ph.D.\(^2\), (1)University of Tokyo, Tokyo, Japan

Takao Katsura, Ph.D.\(^1\), Katsunori Nagano, Ph.D.\(^1\) and Yasushi Nakamura, Ph.D.\(^2\), (1)Hokkaido University, Sapporo, Japan, (2)Nippon Steel & Sumikin Engineering, Tokyo, Japan

Letícia De Oliveira Neves, Ph.D., Member\(^1\), Bruno Scalent, P.E.\(^3\), Fernando Alves\(^4\), Tâssia Marques\(^5\) and Edson Kuotas\(^6\), (1)University of Campinas, Campinas, Brazil, (2)CTE, São Paulo, Brazil

9:45 AM – 10:45 AM
Seminar 38 (Intermediate)

Not-in-Kind HVAC Technologies, Part 2

Room: 103AB
Sponsor: Publication and Education Council
Chair: Pradeep Bansal, Ph.D., ASHRAE STBE Editorial Board, Atlanta, GA

1. Elastocaloric Cooling: From Fundamental Thermodynamics to Solid State Air Conditioning
Marvin Schmidt, Member\(^1\), Susanne-Marie Kirsch, Member\(^1\), Stefan Seelecke, Dr.Ing., Member\(^1\) and Andreas Schütte, Dr.Ing., Member\(^1\), (1)Saarland University, Saarbrücken, Germany

Paulo Trevizoli, Ph.D., Member\(^1\), Theodor Christiaanse, Student Member\(^1\), Premakumara Govindappa, Student Member\(^1\), Iman Niknia, Student Member\(^1\), Reed Teyber, Student Member\(^1\), Jader Barbosa\(^1\) and Andrew Rowe, Ph.D., Member\(^1\), (1)University of Victoria, Victoria, BC, Canada

9:45 AM – 10:45 AM
Seminar 39 (Basic)

Chiller Retrofit Case Study: From Evaluating Options to Optimizing Operation

Room: 203AB
Sponsor: 7.6 Building Energy Performance
Chair: Annie Smith, Member, Ross & Baruzzini, St. Louis, MO

1. Case Study: Critically Evaluating Replacement Chiller Options beyond Lifecycle Cost Analysis
Edmund Wong, P.E., Associate Member, Arup, Los Angeles, CA

2. Post Chiller Retrofit: Ongoing Optimization Strategies for Continuous Improvement
Jeff Landreth, P.E., BEAP and CPMP, Associate Member, tk1sc, Los Angeles, CA
Tuesday, June 27

9:45 AM – 10:45 AM

**Seminar 40 (Advanced)**

Delivering a Successful Critical Facility/Data Center Project by Fostering a Healthy Relationship between the Owner, Engineer and Commissioning Agent

*Room: 201A*

*Sponsor: 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment, 7.9 Building Commissioning*

*Chair: Nick Gangemi, Life Member, Northern Air Systems, Rochester, NY*

1. The EOR’s Perspective on Delivering a Successful Critical Facility/Data Center Project By Fostering a Healthy Relationship with the Owner and Commissioning Agent
   *Vali Sorell, P.E., Member, Sorell Engineering, Charlotte, NC*

2. The CxA’s Perspective on Delivering a Successful Critical Facility/Data Center Project by Fostering a Healthy Relationship with the Owner and Engineer
   *Terry Rodgers, Member, Primary Integration Solutions Inc., Charlotte, NC*

9:45 AM – 10:45 AM

**Forum 5 (Basic)**

Future Smart Buildings: What Data Do We Need to Collect and How?

*Room: 202AB*

*Sponsor: 7.5 Smart Building Systems*

*Moderator: Kristen Cetin, Ph.D., P.E., Member, Iowa State University, Ames, IA*

9:45 AM – 10:45 AM

**Forum 6 (Basic)**

Best Practices for Low Energy Residential Buildings Across the Globe

*Room: 201B*

*Sponsor: 2.8 Building Environmental Impacts and Sustainability, AASA, MTG.HCDG Hot Climate Design Guide*

*Moderator: Ashish Rakheja, P.E., Member, AEON Integrated Building Design Consultants LLP, Noida, India*

11:00 AM – 12:30 PM

**Conference Paper Session 13 (Intermediate)**

Design, Commissioning and Fault Detection Considerations for New and Existing Buildings

*Room: 101B*

*Chair: Xiufeng Pang, Lawrence Berkeley National Laboratory, Berkeley, CA*

1. Design-Build Commissioning: How to Enforce When the Contractor Is the Designer (LB-17-C042)
   *Michael Flemming, P.E., Associate Member* and *Bishara Mogannam*,
   (1) Interface Engineering, San Francisco, CA, (2) CTC Design, Santa Clara, CA
Tuesday, June 27

2. IED and LCA in Design Processes for Refurbishment (LB-17-C043)
Mathilde Landgren, Ph.D.1 and Lotte M.B. Jensen, Ph.D.1
(1) Technical University of Denmark, Kgs. Lyngby, Denmark

3. Using Pattern Matching and Principal Component Analysis Method for Whole Building Fault Detection (LB-17-C044)
Yimin Chen, Student Member1, Adam Reigner1 and Jin Wen, Ph.D.
Member1, (1) Drexel University, Philadelphia, PA

4. Codes and Standards Options for Existing Buildings in BC (LB-17-C045)
James Montgomery, Ph.D., Member1, Andrew Pape-Salmon, P.Eng., Member2 and Toby Lau, P.E., Member1, (1)RDH Building Science Inc., Vancouver, BC, Canada, (2)BC Government, Building and Safety Standards Branch, Victoria, BC, Canada, (3)BC Hydro, Vancouver, BC, Canada

11:00 AM – 12:30 PM
Conference Paper Session 14 (Intermediate)
Low GWP Refrigerants: Is There a Tradeoff in Performance and Safety?
Room: 101A
Chair: Vikrant Aute, Ph.D., Member, University of Maryland, College Park, MD

1. Application of Safety Factors When Setting Charges Limits for A2L Flammable Refrigerants (LB-17-C046)
William Hansen, P.E., Member1 and Stephen Kujak, Member1, (1) Trane, Ingersoll Rand, La Crosse, WI

2. Impact of Next Generation Low GWP Refrigerants on Building Sustainability (LB-17-C047)
Stephen Kujak, Member1, Tina Li Juan Hong, Ph.D.1, Xiawei Yin2 and Ted Xueyuan Yang2, (1) Trane, Ingersoll Rand, La Crosse, WI, (2)Ingersoll Rand, Tyler, TX, (3)Ingersoll Rand, Shanghai, China

Jordan Morrow, Student Member1, Melanie Derby, Ph.D., Member1 and Xi Chen1, (1) Kansas State University, Manhattan, KS

4. Performance of an Air-Cooled Chiller with R410A Alternatives R452B and R32 (LB-17-C049)
Kenneth Schultz, Ph.D., Member1 and Gurudath Nayak, Ph.D.2, (1) Ingersoll Rand, La Crosse, WI, (2) Ingersoll Rand, Bangalore, India

11:00 AM – 12:30 PM
Seminar 41 (Intermediate)
Designs and Policies for Affordable Zero Net Energy Homes and Sustainable Communities
Room: 201B
Sponsor: 2.8 Building Environmental Impacts and Sustainability, Residential Building Committee
Chair: Larry Brand, Member, Gas Technology Institute, Davis, CA

1. Affordable Zero Net Energy Home Design Strategies
George Koertzen, Habitat for Humanity of San Joaquin County, Inc., Stockton, CA

2. Challenges and Opportunities in the Design of Sustainable Communities
Judi Schweitzer, Schweitzer and Associates, Lake Forest, CA

Sue Kristjansson, Southern California Gas Co., Los Angeles, CA
Tuesday, June 27

11:00 AM – 12:30 PM

Seminar 42 (Intermediate)

Integrate Your Body: Human Physiological Response as a Potential Driving Factor in IEQ Controls
Room: 102AB
Sponsor: 2.1 Physiology and Human Environment, 1.5 Computer Applications
Chair: Mark Jackson, Ph.D., McCree Consulting, Grand Prairie, TX
1. Thermal Comfort in Health Care: The Need for Physiological Feedback
   Rodrigo Mora, Ph.D., Associate Member, British Columbia Institute of Technology, Burnaby, BC, Canada
2. Using Occupants’ Control Behavior with Internet-Connected Personal Comfort System to Predict Individuals’ Thermal Preference
   Joyce Kim, Student Member, University of California, Berkeley, CA
3. Bio-Sensing Environmental Control: Data-Driven Thermal Sensation Prediction as a Function of Local Body Skin Temperature
   Joon-Ho Choi, Ph.D., Associate Member, University of Southern California, Los Angeles, CA

11:00 AM – 12:30 PM

Seminar 43 (Intermediate)

Making Displacement and Natural Ventilation Work in High Heat Gain Applications
Room: 103AB
Sponsor: 4.10 Indoor Environmental Modeling
Chair: Wangda Zuo, Ph.D., Member, University of Miami, Coral Gables, FL
1. CFD Ventilation Study of an Aluminum Foundry
   Duncan Phyfe, Associate Member¹ and Marty Kozlak¹, (1) ARL, Alden, MA
2. Natural Ventilation Modeling of High Heat Gain Auditoria
   Malcolm Cook, Member¹, Faisal Durrani, Ph.D.¹ and James J. McGuirk, Ph.D.¹, (1) Loughborough University, Loughborough, United Kingdom
3. Push It to the Limit: Using Displacement Ventilation for High Heat Gain Applications
   Mike Koupriyanov, P.E., Associate Member, Price Industries Limited, Winnipeg, MB, Canada
   Leon Wang, Ph.D., P.E., Member¹, Jun Cheng, Student Member¹ and Ali Katal¹, (1) Concordia University, Montréal, QC, Canada

11:00 AM – 12:30 PM

Seminar 44 (Intermediate)

Optimization of Existing Buildings Is Much More than Retro Commissioning
Room: 202AB
Sponsor: 7.9 Building Commissioning, 7.6 Building Energy Performance
Chair: Wade H. Conlan, P.E., Member, Hanson Professional Services, Orlando, FL
Tuesday, June 27

1. Campus Energy Management: You Need a Plan  
   Nathaniel Boyd, P.E., CPMP, Member, Hanson Professional Services, Orlando, FL

2. How to RetroCommission a 30,000 Ton Chiller Plant  
   Joshua Harwood, P.E., McKinstry, Denver, CO

3. Taking the “Retro” out of Retro-Commissioning  
   Benjamin Skelton, P.E., CPMP and BEMP, Member, Cyclone Energy Group, Chicago, IL

11:00 AM – 12:30 PM  
Seminar 45 (Intermediate)

The Use of Pollution Control Units and Technologies to Control Grease, Smoke and Odor from Commercial Kitchens  
Room: 201A  
Sponsor: 5.10 Kitchen Ventilation, 5.4 Industrial Process Air Cleaning (Air Pollution Control)  
Chair: Derek Schrock, Member, Halton Company, Scottsville, KY

1. Safety Requirements of Pollution Control Units: The Timely Release of New UL8782  
   Dwayne Sloan, UL LLC, Research Triangle Park, NC

2. Pollution Control Technologies: Rising to the Challenge  
   Chris Lowell, Member, Air Scrubbers, Sanford, NC

3. Electrostatic Pollution Controls: Performance and Maintenance Considerations  
   Russ Robison, Member, Gaylord Industries, Tualatin, OR

4. The Use of Ozone Generators in CKV Exhaust  
   Mark Tilles, Associate Member, AirMaid/Interzon, Stockholm, Sweden

11:00 AM – 12:30 PM  
Seminar 46 (Intermediate)

Updates in the Air Distribution Systems Design Procedure: Expansion of Air Diffusion Performance Index Method  
Room: 203AB  
Sponsor: 5.3 Room Air Distribution  
Chair: David John, P.E., Member, Stan Weaver & Co., Tampa, FL

1. Updates in Air Diffusion Performance Index Diffuser for Cooling Operation  
   Atila Novoselac, Ph.D., Member, University of Texas at Austin, Austin, TX

2. A New Air Diffusion Performance Index for Heating Operation  
   Shichao Liu, Ph.D., Associate Member, Center for Built Environment at UC Berkeley, Berkeley, CA

3. Connection between Air Diffusion Performance Index and Ventilation Effectiveness (EV): Effects of Diffuser Adjustment and Return Air Placement  
   Hideyuki Amai, University of Texas at Austin, Austin, TX

4. The History of Air Diffusion Performance Index and the Results of Research Project RP 1546 Expansion and Updating of the ADPI Method  
   David John, P.E., Member, Stan Weaver & Co., Tampa, FL
Tuesday, June 27

1:30 PM – 3:00 PM

**Debate 3 (Intermediate)**

**Fellow’s Debate: There is No Purpose in a Code of Ethics**

**Room:** 203AB

**Sponsor:** College of Fellows, 1.7 Business, Management & General Legal Education

**Moderator:** Larry Spielvogel, P.E., Fellow Life Member; Consulting Engineer, Bala Cynwyd, PA

1. Don Beaty, P.E., Fellow Life ASHRAE, DLB Associates, Eatontown, NJ
2. Kathleen Lacey, J.D., Ukleja Center for Ethical Leadership at California State University, Long Beach, Long Beach, CA
3. Richard Rooley, FREng, OPMP, Presidential Fellow ASHRAE, Project Management Partnership, Stoke Poges, United Kingdom
4. E. Mitchell Swann, P.E., Member, Virtual Construction/BIM Manager, Paoli, PA
5. Samir Traboulsi, Dr.Ing., P.Eng., Fellow Life Member, Thermotrade/Ranec, Beirut, Lebanon
6. Victor Goldschmidt, Ph.D., Fellow Life Member, Purdue University, Northport, MI
7. Larry Spielvogel, P.E., Fellow Life Member, Consulting Engineer, Bala Cynwyd, PA

3:15 PM – 4:45 PM

**Seminar 47 (Intermediate)**

**Zero Energy Healthcare Buildings: Current Status and Future Efforts**

**Room:** 203AB

**Sponsor:** 9.6 Healthcare Facilities, 2.8 Building Environmental Impacts and Sustainability, TC 7.6

**Chair:** David Eldridge Jr., P.E., Member; Grumman/Butkus Associates, Evanston, IL

1. Toward NZE Hospitals in North America
   **Heather Burpee**, University of Washington Integrated Design Lab, Seattle, WA
2. Owner Perspective on Potential for NZE Healthcare Facilities
   **Travis English, P.E., Member**, Kaiser Permanente, Anaheim, CA
3. European Research Study into NZE Hospitals
   **Wim Maassen**, Royal Haskoning DHV, Rotterdam, Netherlands
4. Strategies for NZE Hospitals in the UK
   **Francis Mills, CEng, Life Member**, Frank Mills Consulting, Leyland, United Kingdom

5:00 PM – 6:00 PM

**Seminar TC (Basic)**

**Seminar Ductless Car Park Ventilation: Global Trends and Design Practices**

**Room:** Renaissance, Bixby 3

**Sponsor:** 5.9 Enclosed Vehicular Facilities

**Chair:** Yoon Ko, Ph.D., Member; National Research Council Canada, Ottawa, ON, Canada

1. Ductless Car Park Ventilation: Global Trends and Design Practices
   **Troy Goldschmidt, Member**, Greenheck, Schofield, WI

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Wednesday, June 28

8:00 AM – 9:30 AM

Technical Paper Session 4 (Basic)

Advances in Domestic Water Heating

Room: 103AB
Chair: Ratnesh Tiwari, Ph.D., University of Maryland, College Park, MD

1. The Dependence of Water Heater Energy Factor on Deviations from Nominal Test Conditions (LB-17-010)
   William Healy, Member, National Institute of Standards and Technology, Gaithersburg, MD

2. Tankless Electric Water Heater Diversified Electrical Demand in Residential Applications (LB-17-011)
   Carl C. Hiller, Ph.D., P.E., Fellow ASHRAE, Applied Energy Technology, Davis, CA

3. Hot Water Use in Hotels, Results of ASHRAE Research Project 1544, Part 4 of 6: Comparison of Travel and Business Hotel Hot Water System Monitoring Results (RP-1544) (LB-17-012)
   Russell Johnson, Member and Carl C. Hiller, Ph.D., P.E., Fellow ASHRAE, (1) Johnson Research LLC, Pueblo West, CO, (2) Applied Energy Technology, Davis, CA

   Carl C. Hiller, Ph.D., P.E., Fellow ASHRAE and Russell Johnson, Member, (1) Applied Energy Technology, Davis, CA, (2) Johnson Research LLC, Pueblo West, CO

8:00 AM – 9:30 AM

Conference Paper Session 15 (Intermediate)

Building Energy and Consumption

Room: 101A
Chair: Rachel Romero, P.E., Member, National Renewable Energy Laboratory, Golden, CO

1. Quantification of the Potential for Advanced Thermal Control Strategy over a Range of Buildings Characteristics (LB-17-C050)
   Solène Gay, Student Member, François Maréchal and Donal Finn, (1)University College Dublin, Energy Institute, Dublin, Ireland, (2)Ecole Polytechnique Fédérale de Lausanne, Industrial Process and Energy Systems Engineering (IPESE), Lausanne, Switzerland

2. The Impact of Chiller Plant Retrofit on Energy Consumption for Commercial Buildings in Singapore (LB-17-C051)
   Siew Eang Lee, Ph.D., Chirag Deb and Junjing Yang, Ph.D., Associate Member, (1) National University of Singapore, Singapore, Singapore

3. Unsupervised Non-Intrusive Building Energy Disaggregation (LB-17-C052)
   Mohammad A. Hossain, Student Member, Ethan M. Pickering, Jack Mousseau, Arash Khalilnejad, Rachel A. Swanson, Roger H. French and Alexis R. Abramson, (1) Case Western Reserve University, Cleveland, OH

4. Analysis of Energy Consumption in Office Buildings Based on the National Building Energy Database in Korea (LB-17-C053)
   Haeng Pil Jo, Hye Gi Kim and Sun Sook Kim, Ph.D., Member, (1) Ajou University, Suwon, Korea, Republic of (South)
Wednesday, June 28

8:00 AM – 9:30 AM
Conference Paper Session 16 (Intermediate)

Dynamic HVAC Controls
Room: 101B
Chair: Geoff Bares, P.E., Member, CB&I, Plainfield, IL

Zhiang Zhang, Student Member and Khee Poh Lam, Ph.D., (1) Carnegie Mellon University, Pittsburgh, PA

2. Dynamic Scheduling of HVAC Systems' Occupied Period using Access Control Data (LB-17-C055)
Bianca Howard, Ph.D., Salvador Acha, Ph.D., Nilay Shah, Ph.D., and John Polak, Ph.D., (1) Imperial College London, London, United Kingdom

Andrew Windham, Ph.D., Associate Member, Appalachian State University, Boone, NC

4. Field Performance of a MPC Coordinating Multiple Rooftop Units (LB-17-C057)
Donghun Kim, Ph.D., and James E. Braun, (1) Purdue University, West Lafayette, IN

8:00 AM – 9:30 AM
Seminar 48 (Intermediate)
Achieving Net Zero: Design Strategies and Modeling Techniques
Room: 102AB
Sponsor: 7.1 Integrated Building Design, 1.5 Computer Applications
Chair: Krishnan Gowri, Ph.D., Fellow ASHRAE, Autodesk, Bothell, WA

1. Trending Towards Net Zero: Codes, Standards and Voluntary Programs
Krishnan Gowri, Ph.D., Fellow ASHRAE, Autodesk, Bothell, WA

2. Scenario Analysis for ZNE Modeling
Charles Eley, P.E., BEMP, Member, Eley Consulting, San Francisco, CA

3. The Technical Feasibility of Zero Net Energy Buildings in California
Wyatt Kennedy, P.E., Arup, San Francisco, CA

4. Aiming for Zero-Net-Energy at an Existing Supermarket
Elizabeth Joyce, P.E., BEAP, Associate Member, Arup, San Francisco, CA

8:00 AM – 9:30 AM
Seminar 49 (Intermediate)
Direct Expansion Ground Source Heat Pump: Reviewing Issues, Advancements and Advantages
Room: 203AB
Sponsor: 6.8 Geothermal Heat Pump and Energy Recovery Applications
Chair: Xiaobing Liu, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN
1. Natural Refrigerant, Geothermal DX Heat Pump System
   *Marc Portnoff, Oak Ridge National Laboratory, Oak Ridge, TN*

2. Performance and Reliability of Direct-Expansion Ground-Coupled Heat Pumps
   *Demba Ndiaye, Ph.D., P.E., BEMP, Member, University of North Carolina at Charlotte, Charlotte, NC*

3. Status and Trends in DX Bore Field Dimensioning
   *Louis Lamarche, Ph.D., Ecole de Technologie Superieure, Montreal, QC, Canada*

4. Debunking the Myths Surrounding Direct Geoexchange Heat Pumps
   *Joe Parsons Jr., Member, EarthLinked Technologies, Inc., Lakeland, FL*

5. Direct Expansion Ground Source Heat Pump Using Carbon Dioxide as Refrigerant
   *Parham Eslami Nejad, Ph.D., Natural Resources Canada, Varennes, QC, Canada*

8:00 AM – 9:30 AM

**Seminar 50 (Intermediate)**

High Efficiency Commercial Refrigeration Systems with Natural Refrigerants

*Room: 201A*

*Sponsor: 10.7 Commercial Food and Beverage Refrigeration Equipment, Refrigeration Committee, TC8:1 Positive Displacement Compressors; TC3.1 Refrigerants and Secondary Coolants*

*Chair: Georgi Kazachki, Ph.D., Member, Dayton Phoenix Group, Inc., Dayton, OH*

1. Doing It All Efficiently with CO2 Refrigeration Anywhere in the World
   *Klaas Visser, P.E., Affiliate, KAV Consultants Pty Ltd, Kangaroo Flat, Australia*

2. Design and Performance Validation of Ultralow Charge Ammonia Cascade System for Retail Food Environment
   *Masood Ali, Kysor/Warren, Columbus, GA*

3. Opportunities for Utilizing Two-Phase Ejectors to Increase Efficiency of Commercial Refrigeration Systems Using Natural Refrigerants
   *Stefan Elbel, Ph.D., Member, Creative Thermal Solutions and University of Illinois at Urbana-Champaign, Urbana, IL*

4. Packaged Ammonia/CO2 Systems for Refrigeration
   *Scott Mitchell, Associate Member, Southern California Edison, Irwindale, CA*

8:00 AM – 9:30 AM

**Seminar 51 (Intermediate)**

It’s a Breeze! Understanding the Fundamentals of Air Flow around Buildings and Its Effect on Ventilation and Air Quality

*Room: 202AB*

*Sponsor: 4.3 Ventilation Requirements and Infiltration*

*Chair: Martin Stangl, P.Eng., Member, RWDI Consulting Engineers, Guelph, ON, Canada*

1. Air Flow around Buildings and Its Effect on Ventilation and Air Quality
   *Michael Ratcliff, Ph.D., P.E., Member, RWDI, Redlands, CA*
Wednesday, June 28

2. Dispersion Modeling Techniques for Exhaust Stack Design  
_Brad Cochran, P.E., Member, CPP Wind Engineering & Air Quality Consultants, Fort Collins, CO_

3. Engineered Lab Exhaust Design Application  
_Nathan Ho, P.E., Associate Member, P2S Engineering, Inc., Long Beach, CA_

8:00 AM – 9:30 AM  
_Seminar 52 (Basic)_

The New 90.2  
Room: 201B  
_Sponsor: 7.6 Building Energy Performance, SSPC 90.2; Residential Building Committee_  
Chair: Theresa A. Weston, Ph.D., Member, DuPont Building Innovations, Richmond, VA  
1. Standard 90.2 in a Diverse Residential Marketplace  
_Chris Mathis, Member, Mathis Consulting, Montreal, AL_  
2. Standard 90.2 Performance and Flexibility  
_Philip Fairey, Member, Florida Solar Energy Center, Cocoa, FL_  
3. Illuminating the ASHRAE 90.2 Lighting Requirements  
_Michael Jouaneh, Member, Lutron Electronics Co., Inc., Coopersburg, PA_  
9:45 AM – 10:45 AM  
_Technical Paper Session 5 (Intermediate)_

Building System Analysis  
Room: 103AB  
_Chair: Jaya Mukhopadhyay, Ph.D., Member, Montana State University, Bozeman, MT_  
1. Interpreting Occupant-Building Interactions for Improved Office Building Design and Operation (LB-17-014)  
_Sara Gilani, Student Member1 and William O’Brien, Ph.D., Member1, (1) Carleton University, Ottawa, ON, Canada_  
2. Performance Evaluation of an Incorporation of a Compact Liquid Desiccant System into an Evaporative Cooling-Assisted 100% Outdoor Air System (LB-17-015)  
_Ahmed Mohamed, Sohag University - Department of Mechanical Engineering, Sohag Governorate, Egypt_  
9:45 AM – 10:45 AM  
_Conference Paper Session 17 (Intermediate)_

Analyzing, Improving and Innovating Thermal Comfort  
Room: 101B  
_Chair: Peng Yin, Ph.D., Associate Member, University of Louisiana at Lafayette, Lafayette, LA_  
1. Experimental Study of Energy Savings Using a Household Humidifier (LB-17-C058)  
_Kevin Anderson, Ph.D., P.E., Member1 and Patricia Wassem1, (1) California State Polytechnic University at Pomona, Pomona, CA_  
2. Improving Thermal Comfort via Spatially Adaptive HVAC (LB-17-C059)  
_Robert Bailey, Ph.D., P.E., Member1, Matthew Kalensky1 and Charles Wilson1, (1)Loyola University Maryland, Baltimore, MD_  
_Abdullah Karimi, Affiliate1 and Reza Ghas, Ph.D., Member1, (1) Southland Industries, Dulles, VA_
9:45 AM – 10:45 AM

Conference Paper Session 18 (Intermediate)

Room: 101A

Chair: Marija Todorovic, P.Eng., Fellow ASHRAE, University of Belgrade, Belgrade, Serbia

1. Experimental Performance Study on a CO₂ Heat Pump System with Thermal Storage (LB-17-C061)
   Fang LIU, Ph.D., P.E., Member¹, Weiquan Zhu¹ and Yang Cai¹,
   (1) Shanghai University of Electric Power, Shanghai, China

2. Integrated Optimization of PV and Storage Systems for UK Non-Domestic Buildings (LB-17-C062)
   Salvador Acha, Ph.D., Member¹, Arthur Mariaud³, Ned Ekins-Daukes, Ph.D.¹ and Nilay Shah, Ph.D.¹,
   (1) Imperial College London, London, United Kingdom

3. Efficient Interaction between Energy Demand, Surplus HEAT/ Cool and Thermal Storage (LB-17-C063)
   Trond Thorgeir Harsem, P.Eng.¹ and Janne Grindheim, M.D., BEAP and HFDP¹,
   (1) Norconsult AS, Sandvika, Norway

9:45 AM – 10:45 AM

Seminar 53 (Intermediate)

Control System Best Practices: How to Make Your Control System Project a Success, Part 1

Room: 201A

Sponsor: 1.4 Control Theory and Application
Chair: Kris Kinney, Member, Highwoods Properties, Raleigh, NC

1. Effective Design of Building Control Systems
   Frank Shadpour, P.E., HFDP, Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

2. What Owners and Engineers Should Know about Control Systems for Successful Implementation
   Larry Fisher, Life Member, ECT Services (Retired), Louisville, KY

9:45 AM – 10:45 AM

Seminar 54 (Advanced)

Hot Water Distribution Systems in Residential Buildings

Room: 201B

Sponsor: 6.6 Service Water Heating Systems
Chair: James D. Lutz, P.E., Member, Hot Water Research, Oakland, CA

1. Energy and Water Losses in a Residential PEX Home-Run System
   Tania Ullah, Associate Member, National Institute of Standards and Technology, Gaithersburg, MD

2. Pressure Drop and Flow Rates in Residential Water Piping
   Gary Klein, Associate Member, Gary Klein and Associates, Inc., Rancho Cordova, CA
Wednesday, June 28

9:45 AM – 10:45 AM

Seminar 55 (Intermediate)

Research Updates on Radiant Cooling and Heating Systems
Room: 202AB
Sponsor: 6.5 Radiant Heating and Cooling
Chair: Paul Raftery, Ph.D., Center for the Built Environment, Berkeley, CA
1. New Method for the Design of Radiant Floor Cooling Systems with Direct Solar Radiation
Jingjuan Feng, Ph.D., Associate Member, Taylor Engineering, Alameda, CA
2. Design Cooling Load Calculations Comparison between TABS and Air Systems
Eleftherios Bourdakis, Student Member, Technical University of Denmark, Kongens Lyngby, Denmark

9:45 AM – 10:45 AM

Seminar 56 (Basic)

Urban-Scale Building Energy Modeling, Part 6
Room: 102AB
Sponsor: 1.5 Computer Applications, 4.7 Energy Calculations
Chair: Joshua New, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN
1. Agent Based Modeling to Estimate the Adoption of Energy Efficient Building Technologies
Ralph Muehleisen, Ph.D., P.E., Member, Argonne National Laboratory, Lemont, IL
2. Virtual Reality UBEM
Drury Crawley, Ph.D., BEMP, Fellow ASHRAE, Bentley Systems, Inc., Washington, DC

9:45 AM – 10:45 AM

Workshop 9 (Advanced)

How to Design, Construct and Operate Net Zero Hospitals and Save Money
Room: 203AB
Sponsor: 9.6 Healthcare Facilities, 2.8 Building Environmental Impacts and Sustainability, SSPC 170
Chair: Francis Mills, CEng, Member, Frank Mills Consulting, Leyland, United Kingdom
1. How to Achieve Net Zero Energy Hospitals
Hans Besselink, Member, HaskoningDHV Nederland B.V., Rotterdam, Netherlands
2. Strategies to Net Zero Hospitals
Frank Mills, CEng, Member, Frank Mills Consulting, Leyland, United Kingdom
Wednesday, June 28

11:00 AM – 12:30 PM

Technical Paper Session 6 (Intermediate)

Airside HVAC Advances
Room: 103AB
Chair: Ratnesh Tiwari, Ph.D., University of Maryland, College Park, MD

   John Bryant, Ph.D., P.E., Member, Texas A&M University, College Station, TX

2. ASHRAE SSPC 170 Natural Ventilation Task Group: Position Paper on Natural Ventilation in Health Care Facilities (LB-17-017)
   Travis English, P.E., Member1, Paul Ninomura1, Heather Burpee1, Jeremy Fauber, P.E., Member2 and Arash Guilty3, (1)Kaiser Permanente, Anaheim, CA, (2)Indian Health Service, Seattle, WA, (3)University of Washington Integrated Design Lab, Seattle, WA, (4) Heapy Engineering, Dayton, OH, (5)Mazzetti, Denver, CO

3. Redesigning the HVAC System of a University Laboratory Building (LB-17-018)
   James Mathias, Member1, Navya Madineedi1 and Justin Harrell1, (1) Southern Illinois University Carbondale, Carbondale, IL

4. Energy and Control Performance Investigation of Air Handling Units with Return Air Bypass (LB-17-019)
   Gang Wang, Ph.D., P.E., Member1, Xuejing Zheng2, Esber Andiroglu1 and Li Song, Ph.D., P.E., Member1, (1)University of Miami, Coral Gables, FL, (2)Tianjin University, Tianjin, China, (3)University of Oklahoma, Norman, OK

11:00 AM – 12:30 PM

Conference Paper Session 19 (Intermediate)

Ventilation: A Critical Element from Design through Operation
Room: 101B
Chair: Anil Parekh, Member, HBC – CanmetENERGY, Ottawa, ON, Canada

   Niraj Chandra, P.Eng., Member1 and Udit Sapre2, (1)Government of Canada, Gatineau, QC, Canada, (2)Carleton University, Ottawa, ON, Canada

2. Experimental Study on Influence of Overhang of Exhaust Hood on Ventilation Requirements (LB-17-C065)
   Toshiya Iwamatsu, Ph.D., Associate Member1 and Wataru Urabe2, (1)Central Research Institute of Electric Power Industry, Komae, Japan, (2)Central Research Institute of Electric Power Industry, Tokyo, Japan

3. Ventilation and Corresponding CO2 Levels in High School Classrooms (LB-17-C066)
   Leigh Lesnick, Student Member1, Atilla Novoselac, Ph.D., Member1 and Richard Corsi, Ph.D., P.E.1, (1)University of Texas at Austin, Austin, TX

4. The Effects of Temperature and Humidity on the Permeation Properties of Membrane Transport Media Used in Energy Recovery Ventilators (LB-17-C067)
   Steven Rogak, Ph.D., P.E.1, Amin Engarnevis, Student Member1, Sarah Romani1, Alexander Sylvester, Student Member1, Ryan Hutzing, P.Eng.2, and Sheldon Green, Ph.D., P.E.1, (1)University of British Columbia, Vancouver, BC, Canada, (2)dPoint Technologies, Vancouver, BC, Canada
Wednesday, June 28

11:00 AM – 12:30 PM

Conference Paper Session 20 (Intermediate)

District and Central Plant Efficiency

Room: 101A

Chair: Steven Taylor, P.E., Fellow ASHRAE, Taylor Engineering LLC, Alameda, CA

1. Comparison of the Energy Saving Potential between Centralized and Decentralized Pumping Systems under Various Flow Conditions (LB-17-C068)
   Mingzhe Liu, Ryozo Ooka, Ph.D., Member1, Wonjun Choi, Ph.D., Member1 and Shintaro Ikeda1, (1) University of Tokyo, Tokyo, Japan

2. CFD Investigation on Parameters Affecting the Thermal Performance of Mechanical Draft Cooling Towers in District Cooling Plants (LB-17-C069)
   E. M. ElBialy, Ph.D.1 and Essam E. Khalil, Fellow ASHRAE1, (1) Cairo University, Cairo, Egypt

3. Large Campus Loop Performance Improvement, Negative Pressure Issue (LB-17-C070)
   Robert Henry, P.E.1, Hui Chen, P.E., BEAP, BEMP, CPMP, HBDP and OPMP, Member1, Homer Bruner, Member1, Klayment Wittler1, Elijah Crosby1 and James Riley1, (1) Texas A&M University, College Station, TX

4. Evaluating and Improving the Chilled Water System of a Data Center Using Flow Network Modeling (LB-17-C071)

11:00 AM – 12:30 PM

Seminar 57 (Intermediate)

Dampness and Mold in Homes: Update on Health Effects and Environmental Assessments that Are Useful for Physicians

Room: 203AB

Sponsor: 1.12 Moisture Management in Buildings, Environ Health, SSPC 62.1, SSPC 62.2

Chair: Elliott Horner, Ph.D., Member, UL Environment, Marietta, GA

1. Key Elements of Relevant and Useful Home Assessments
   Kevin Kennedy, MPH, CIEC, MS, Associate Member, Children’s Mercy Hospitals and Clinics, Kansas City, MO

2. Finally Getting to the Cause: What Is Damp and Mold Doing to Residents?
   Jay Portnoy, M.D., Children’s Mercy Hospital, Kansas City, MO

3. Residential Dampness Assessment: Elements of a Useful Report
   Elliott Horner, Ph.D., Member, UL Environment, Marietta, GA
Wednesday, June 28

11:00 AM – 12:30 PM

Seminar 58 (Intermediate)

Acoustic Performance Standards for Residential Buildings and When They Fall Short
Room: 201B
Sponsor: 2.6 Sound and Vibration
Chair: Erik Miller-Klein, P.E., Member, A3 Acoustics, LLP, Seattle, WA
1. Status of Acoustical Standards and Codes in the USA for Residential Buildings
   Cathleen Novak, Associate Member, Veneklasen Associates, Santa Monica, CA
2. Where Current Standards and Codes Fall Short: Tones and Unsteady Noise from MEP Systems
   Roman Wowk, Associate Member, Papadimos Group, San Francisco, CA
3. ISO 19488: Acoustic Classification for Residential Buildings
   Jason Swan, Member, Sandy Brown Associates, LLP, London, United Kingdom

11:00 AM – 12:30 PM

Seminar 59 (Intermediate)

Don’t Be Scared: CFD for Everyday Design
Room: 202AB
Sponsor: 4.10 Indoor Environmental Modeling
Chair: James W. VanGilder, P.E., Member, Schneider Electric, Andover, MA
1. Using CFD Modeling for HVAC System Design
   Mike Koupriyanov, P.E., Associate Member, Price Industries Limited, Winnipeg, MB, Canada
2. Practical Applications of CFD for Optimizing Chilled Beam Performance
   Ramin Rezaei, Associate Member, Southland Industries, Dulles, VA
3. Garbage In, Garbage Out: Is Conceptual Data Center CFD Design Any Use?
   Mark Seymour, CEng, Member, Future Facilities Ltd, London, United Kingdom

11:00 AM – 12:30 PM

Seminar 60 (Intermediate)

Power Trends Update: Aligning Future Facility Capability and ITE Power
Room: 102AB
Sponsor: 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
Chair: Nick Gangemi, Life Member, Northern Air Systems, Rochester, NY
1. Datacom Equipment Workloads, Configurations and Applications
   Matt Archibald, Associate Member, Lenovo, NY, NY
2. Datacom Equipment Power Trends
   Susan Smith, Member, Intel Corp, Hillsboro, OR
3. Data Center Solutions and Examples
   Jerrod Buterbaugh, Lenovo, New York, NY
Wednesday, June 28

11:00 AM – 12:30 PM

Seminar 61 (Intermediate)  
Do You Know What You Are Breathing? Indoor Air Contaminants  
Room: 201A  

Sponsor: 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment, 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment  
Chair: Kyung-Ju Choi, Ph.D., Member, Clean & Science, Louisville, KY

1. Fate and Transport of Phthalates in Indoor Environments and the Influence of Temperature: A Case Study  
Chenyang Bi, Associate Member, The University of Texas at Austin, Austin, TX

2. Impact of Residential HVAC Filters on Indoor Air Quality  
John Zhang, Ph.D., Member, 3M Personal Care Division, St. Paul, MN

3. Effectiveness of Residential Air Cleaning Devices in Removal of Particulate and Gaseous Pollutants: A Review  
Thad Ptak, Ph.D., Member, A. O. Smith Corporation, Milwaukee, WI
FINDING YOUR MEETING LOCATION

Society and Technical committee meetings are located in three different venues: Hyatt Regency (H), Renaissance (R) and the Long Beach Convention Center (LBCC). Please see page 2–7 for maps of each venue. All venues are in easy walking distance to one another.

Hyatt Regency (H)
Meeting rooms at the Hyatt will be marked “H” with a “-” indicating the floor number. Meeting rooms are on the 1st (Lower Level) and 4th (Upper Level) floors. From the lobby, take the escalator near The Cove Coffee Bar down to the 1st floor and turn right to access the meeting space on the 1st floor. From the main entrance of the hotel, enter the lobby and take the escalator or stairs on your right to access the 4th floor. The first set of escalators stop on the Mezzanine level which will take you to Convention Center.

Renaissance (R)
Meeting rooms at the Renaissance will be marked “R” with a “-” indicating the floor number. Meeting rooms are on the 1st, 2nd and 3rd floors. From the main entrance, go through the lobby and past the Promenade Café and turn left to access the meeting rooms on the 1st floor. From the main entrance, take the elevators or stairs on your right to the meeting space on the 2nd and 3rd floor.

Long Beach Convention Center (LBCC)
Meeting rooms at the Long Beach Convention Center will be marked “LBCC” with a “-” indicating the floor number. Meeting rooms are on the 1st and 2nd floor. From the first floor, take the elevators or stairs located outside of 103 to the 2nd level. See page 6 for information regarding access to seaside meeting rooms.

From the Hyatt’s main entrance, take the escalators to the Mezzanine level to access the Convention Center South Entrance. You will enter near room 104 (Registration, Bookstore and Speakers Lounge).

From the Renaissance, Westin and Courtyard, enter the Convention Center through the North Entrance. You will enter near room 100.

From the Hyatt Centric, enter the Convention Center through the Main Entrance. You will enter in the main lobby.
Seaside rooms (SS) at the Convention Center require a separate entrance and will be marked “SS.” From the North Entrance of the Convention Center (outside room 100), walk outside and take the stairs on your left down to Seaside Way. Turn right on Seaside way and walk past the loading dock to the Seaside Entrance. Follow the ASHRAE signs to the entrance.

See page 7 for a campus map of the LBCC.

**SOCIETY COMMITTEE MEETINGS**

The venue and floor numbers are indicated in parenthesis in the listing below. Subcommittees are indented. Rooms will be set 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.

**Venue Key:**

(H) = Hyatt with a “-” indicating the floor number.

(R) = Renaissance with a “-” indicating the floor number.

(LBCC) = Long Beach Convention Center with a “-” indicating the floor number.

(LBCC-SS) = Seaside rooms (SS) at LBCC require a separate entrance and will be marked “SS.” See page 6 for more details.

**AEDG Steering Committee (15/10) Electric**
Monday (6/26)  2:15 pm – 5:00 pm  Shoreline A (H-1)

**Appointments Roadmap (32/0)**
Sunday (6/25)   7:00 am – 8:00 am  Seaview A (H-1)

**ASHRAE Foundation (30/15) Electric**
Monday (6/26)  7:30 am – 9:45 am  Shoreline B (H-1)
ASHRAE Foundation Executive Subcommittee (10/5) Electric
Saturday (6/24)  1:30 pm – 3:00 pm  Harbor C (H-1)

**Associate Society Alliance (35/35) Screen**
Monday (6/26)  4:15 pm – 6:15 pm  Beacon B (H-4)

**Audit Committee (5/3)**
Friday (6/23)   3:30 pm – 5:00 pm  Harbor C (H-1)

**Broadcasting ASHRAE Impact and Key Constituency Leadership Outreach Ad Hoc (30/6) Screen**
Saturday (6/24)  8:00 am – 10:00 am  201B (LBCC-2)

**Board of Directors (41/100) Screen/Electric**
Sunday (6/25)  1:30 pm – 5:30 pm  Regency ABC (H-4)
Wednesday (6/28)  2:00 pm – 6:00 pm  Regency ABC (H-4)

**Building EQ Committee (15/40) Screen/Electric**
Sunday (6/25)  8:30 am – 11:30 am  Seaview A (H-1)

Building EQ Methodology (8/8) Screen/Electric
Saturday (6/24)  11:00 am – 1:00 pm  Harbor B (H-1)

Building EQ Marketing (8/8) Screen/Electric
Saturday (6/24)  1:00 pm – 3:00 pm  Harbor B (H-1)
Building Envelope Committee (30/0)
Monday (6/26) 9:00 am – 12:00 pm 203C (LBCC-2)

Certification (12/12) Screen/Electric
Saturday (6/24) 8:00 am – 12:00 pm Nieto (R-2)

Chapter Technology Transfer Committee (30/15)
Screen/Electric
Friday (6/23) 8:00 am – 12:00 pm 203B (LBCC-2)
Saturday (6/24) 8:00 am – 12:00 pm 202C (LBCC-2)

Chapter Technology Transfer Member Services (11/15) Screen
Friday (6/23) 1:30 pm – 5:00 pm 203A (LBCC-2)

Chapter Technology Transfer Operations (10/5) Screen
Friday (6/23) 1:30 pm – 5:00 pm 203B (LBCC-2)

Chapter Technology Transfer Executive (7/0)
Friday (6/23) 5:00 pm – 6:00 pm 203B (LBCC-2)

Chapter Technology Transfer Committee New Member Orientation
(10/5) Screen/Electric
Saturday (6/24) 1:15 pm – 2:30 pm 202C (LBCC-2)

CLIMA 2019 (12/0)
Saturday (6/24) 12:30 pm – 1:30 pm Harbor C (H-1)

Climate Change Position Document Committee (15/0)
Tuesday (6/27) 8:00 am – 11:00 am Shoreline A (H-1)

College of Fellows (25/10)
Sunday (6/25) 10:00 am – 12:00 pm Shoreline B (H-1)
College of Fellows: Advisory Committee (15/10)
Sunday (6/25) 9:00 am – 10:00 am Shoreline B (H-1)

Conferences and Expositions Committee (30/10)
Screen/Electric
Saturday (6/24) 8:00 am – 3:00 pm 203C (LBCC-2)

Conferences and Expositions Executive (30/5)
Friday (6/23) 1:00 pm – 3:30 pm 203C (LBCC-2)

Conferences and Expositions Annual and Winter Meetings (30/5)
Friday (6/23) 3:30 pm – 6:00 pm 203C (LBCC-2)

Development Committee (25/15) Screen/Electric
Monday (6/26) 10:00 am – 12:00 pm Shoreline A (H-1)

Director and Regional Chairs and Regional Members
Council Representatives (15/20)
Friday (6/23) 11:00 am – 1:00 pm Shoreline B (H-1)
Wednesday (6/28) 12:00 pm – 2:00 pm Shoreline B (H-1)

Directors-At-Large (15/20)
Wednesday (6/28) 12:00 pm – 2:00 pm Shoreline A (H-1)

Electronic Communications Committee (13/10) Screen
Saturday (6/24) 11:00 am – 3:00 pm 101A (LBCC-1)

Electronic Communications Subcommittees (13/10) Screen
Saturday (6/24) 8:00 am – 11:00 am 101A (LBCC-1)

Energy Efficiency in Buildings Position Document Committee (10/0) Screen/Electric
Tuesday (6/27) 3:00 pm – 4:00 pm Harbor A (H-1)

Environmental Health (20/20) Screen/Electric
Monday (6/26) 2:15 pm – 6:15 pm Seaview A (H-1)

Environmental Health Executive (20/20) Screen/Electric
Monday (6/26) 7:00 am – 8:00 am Seaview A (H-1)

Environmental Health Handbook/Policy (20/20) Screen/Electric
Monday (6/26) 8:00 am – 10:00 am Seaview A (H-1)

Environmental Health Program/Research (20/20) Screen/Electric
Monday (6/26) 10:00 am – 12:00 pm Seaview A (H-1)
Executive Committee (12/20) Screen/Electric
Saturday (6/24) 8:30 am – 1:00 pm Seaview A (H-1)
Wednesday (6/28) 7:30 am – 9:00 am Seaview A (H-1)
Thursday (6/29) 7:30 am – 12:00 pm Seaview A (H-1)

Finance Committee (13/10) Electric
Friday (6/23) 8:00 am – 12:00 pm Pacific (H-1)
Finance Investment Subcommittee (4/0)
Thursday (6/22) 5:00 pm – 7:00 pm Harbor B (H-1)
Finance Planning Subcommittee (8/8) Electric
Thursday (6/22) 5:00 pm – 7:00 pm Pacific (H-1)

Grassroots Government Advocacy Committee (30/15) Screen/Electric
Saturday (6/24) 8:00 am – 12:30 pm 202AB (LBCC-2)
GGAC: Member Training (30/15) Screen/Electric
Friday (6/23) 8:00 am – 10:00 am 202AB (LBCC-2)
Grassroots Government Advocacy Executive (15/10) Screen/Electric
Friday (6/23) 10:15 am – 12:00 pm 202AB (LBCC-2)
GGAC: Active Outreach Subcommittee (15/10) Screen/Electric
Friday (6/23) 5:00 pm – 7:00 pm 202AB (LBCC-2)
GGAC: Responsive Engagement Subcommittee (15/10) Screen/Electric
Friday (6/23) 2:45 pm – 4:15 pm 202AB (LBCC-2)
GGAC: Ad Hoc Committee on GGAC Structure (15/10) Screen/Electric
Friday (6/23) 4:30 pm – 6:00 pm 202AB (LBCC-2)

Handbook Committee (30/15) Screen
Sunday (6/25) 10:30 am – 1:00 pm Bixby 1 (R-2)
Handbook Excom (5/5)
Saturday (6/24) 1:00 pm – 2:00 pm Harbor A (H-1)
Handbook Strategic Planning (5/5)
Saturday (6/24) 2:00 pm – 3:00 pm Harbor A (H-1)
Handbook Electronic Media (5/0)
Sunday (6/25) 8:00 am – 9:00 am Bixby 1 (R-2)
Handbook Functional (5/0)
Sunday (6/25) 8:00 am – 9:00 am Bixby 3 (R-2)
Handbook International (5/5)
Sunday (6/25) 8:00 am – 9:00 am Bixby 2 (R-2)
Handbook Training Workshop (50/0) Screen
Sunday (6/25) 8:00 am – 9:00 am Wilmore (R-2)
Handbook 2018 Refrigeration TCs/Volume Subcommittee (25/0)
Sunday (6/25) 9:00 am – 10:00 am Bixby 3 (R-2)
Handbook 2019 HVAC Applications TCs/Volume Subcommittee (25/0)
Sunday (6/25) 9:00 am – 10:00 am Bixby 1 (R-2)
Handbook 2020 HVAC Systems and Equipment TCs/Volume Subcommittee (25/0)
Sunday (6/25) 9:00 am – 10:00 am Bixby 2 (R-2)
Handbook Volume Subcommittees (25/0)
Sunday (6/25) 10:00 am – 10:30 am Bixby 1 (R-2)

Historical Committee (20/5) Screen
Sunday (6/25) 8:30 am – 12:00 pm 203C (LBCC-2)

Honors & Awards (20/0) Screen/Electric
Sunday (6/25) 1:30 pm – 5:00 pm 203C (LBCC-2)
Monday (6/26) 2:15 pm – 5:30 pm 203C (LBCC-2)
Honors & Awards New Member Orientation (5/5) Screen/Electric
Sunday (6/25) 12:30 pm – 1:30 pm 203C (LBCC-2)

IEQ-GA (20/0) Screen/Electric
Tuesday (6/27) 4:00 pm – 5:30 pm Shoreline B (H-1)

Indoor Air Quality Position Document (10/0) Screen/Electric
Tuesday (6/27) 9:00 am – 10:30 am Harbor A (H-1)
Life Member Executive Board Meeting (10/0)
Tuesday (6/27)  9:00 am – 11:00 am  Pacific (H-1)

Members Council (37/40) Screen/Electric
Tuesday (6/27)  8:15 am – 2:00 pm  Beacon B (H-1)
  Members Council Planning Subcommittee (12/10) Electric
  Saturday (6/24)  8:00 am – 12:00 pm  Harbor C (H-1)
  Members Council Region Operations Subcommittee (12/10) Electric
  Sunday (6/25)  8:00 am – 12:00 pm  Pacific (H-1)

Membership Promotion (24/15) Screen/Electric
Saturday (6/24)  8:00 am – 3:00 pm  Shoreline B (H-1)
  Membership Promotion Subcommittees (20/10) Screen/Electric
  Friday (6/23)  8:00 am – 2:00 pm  Seaview A (H-1)

Nominating (48/0) Screen/Electric
Sunday (6/25)  7:30 am – 12:00 pm  Beacon B (H-4)

PEAC (20/20) Screen/Electric
Tuesday (6/27)  12:00 pm – 2:00 pm  Shoreline A (H-1)

Planning (25/25) Screen/Electric
Friday (6/23)  1:00 pm – 6:00 pm  Beacon B (H-4)

Professional Development (15/15)
Monday (6/26)  8:00 am – 12:00 pm  Pacific (H-1)

Publications Committee (15/10) Screen
Sunday (6/25)  8:00 am – 12:00 pm  Broadlind 1 (R-2)
  Publications Planning Subcommittee (5/5)
  Saturday (6/24)  10:00 am – 12:00 pm  Harbor A (H-1)

Publishing and Education Council (35/30) Screen/Electric
Tuesday (6/27)  8:00 am – 12:00 pm  Regency EF (H-4)
  Publishing and Education Council E-Learning (12/0) Screen
  Saturday (6/24)  1:30 pm – 3:00 pm  Seaview A (H-1)
  Publishing and Education Council Research Journal Associate Editor Meeting (12/4) Screen
  Sunday (6/25)  10:00 am – 12:00 pm  Harbor A (H-1)
  Publishing and Education Council Fiscal (25/10) Screen
  Monday (6/26)  2:00 pm – 3:30 pm  Shoreline B (H-1)
  Publishing and Education Council Functional (25/10) Screen
  Monday (6/26)  3:30 pm – 5:00 pm  Shoreline B (H-1)
  Publishing and Education Council Orientation (35/30) Screen/Electric
  Tuesday (6/27)  2:00 pm – 4:00 pm  Regency EF (H-4)

Refrigeration Committee (20/20) Screen/Electric
Sunday (6/25)  8:00 am – 12:00 pm  Shoreline A (H-1)
  Refrigeration Excom (20/20) Screen
  Monday (6/26)  7:00 am – 8:00 am  Shoreline A (H-1)
  Refrigeration PMS for RP-1634 (15/0) Screen
  Monday (6/26)  4:30 pm – 6:30 pm  Harbor C (H-1)

Region-at-Large (40/0) Screen
Monday (6/26)  2:15 pm – 4:15 pm  101A (LBCC-1)

Research Administration Committee (25/20) Screen/Electric
Friday (6/23)  3:00 pm – 7:00 pm  202C (LBCC-2)
  Saturday (6/24)  8:00 am – 3:00 pm  102AB (LBCC-1)
  Wednesday (6/28)  7:00 am – 11:00 am  203C (LBCC-2)
  RAC Excom (6/6) Screen
  Friday (6/23)  1:00 pm – 2:30 pm  202C (LBCC-2)

Research Promotion (25/5)
Saturday (6/24)  7:30 am – 1:00 pm  103AB (LBCC-1)
  Research Promotion Executive (10/0)
  Friday (6/23)  9:30 am – 11:30 am  Beacon A (H-4)
  Research Promotion RVC Training (25/5) Screen
  Friday (6/23)  1:30 pm – 5:00 pm  Beacon A (H-4)
### Research Promotion Subcommittee (10/0)
Saturday (6/24) 2:00 pm – 3:00 pm 103AB (LBCC-1)

### Residential Building Committee (20/15) Screen/Electric

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Building Committee: Conferences Subcommittee</td>
<td>Sunday (6/25)</td>
<td>8:30 am – 9:30 am</td>
<td>Harbor B (H-1)</td>
</tr>
<tr>
<td>Residential Building Committee: Programs Subcommittee</td>
<td>Sunday (6/25)</td>
<td>9:30 am – 10:30 am</td>
<td>Harbor B (H-1)</td>
</tr>
<tr>
<td>Residential Building Committee: Technical Subcommittee</td>
<td>Sunday (6/25)</td>
<td>10:30 am - 11:30 am</td>
<td>Harbor B (H-1)</td>
</tr>
<tr>
<td>Residential Building Committee: Publications Subcommittee</td>
<td>Sunday (6/25)</td>
<td>1:00 pm – 2:00 pm</td>
<td>Harbor B (H-1)</td>
</tr>
<tr>
<td>Residential Building Committee: Stakeholders Subcommittee</td>
<td>Sunday (6/25)</td>
<td>2:00 pm – 3:00 pm</td>
<td>Harbor B (H-1)</td>
</tr>
</tbody>
</table>

### Scholarship Trustees (10/5) Screen/Electric
Tuesday (6/27) 8:00 am – 12:00 pm Harbor B (H-1)

### Society Rules (12/6) Screen/Electric
Tuesday (6/27) 2:00 pm – 6:00 pm Harbor B (H-1)

### Standards Committee (30/20) Screen/Electric

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Standards: Executive Committee (10/10)</td>
<td>Saturday (6/24)</td>
<td>8:00 am – 12:00 pm</td>
<td>Beacon B (H-4)</td>
</tr>
<tr>
<td>Standards: ILS/ISAS (10/3) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>1:00 pm – 4:00 pm</td>
<td>Pacific (H-1)</td>
</tr>
<tr>
<td>Standards: PPIS (6/10) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>2:00 pm – 4:00 pm</td>
<td>Pacific (H-1)</td>
</tr>
<tr>
<td>Standards: SPLS (20/20) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>2:00 pm – 4:00 pm</td>
<td>Pacific (H-1)</td>
</tr>
<tr>
<td>Standards: Code Interaction Subcommittee (CIS) (15/10) Screen/Electric</td>
<td>Tuesday (6/27)</td>
<td>5:00 pm – 6:00 pm</td>
<td>Pacific (H-1)</td>
</tr>
</tbody>
</table>

### Student Activities Committee (22/10) Screen/Electric

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Activities RVC Training (15/5) Screen/Electric</td>
<td>Saturday (6/24)</td>
<td>8:00 am – 3:00 pm</td>
<td>Shoreline A (H-1)</td>
</tr>
<tr>
<td>Student Activities Executive (25/5) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>8:30 am – 9:30 am</td>
<td>Shoreline A (H-1)</td>
</tr>
<tr>
<td>Student Activities K-12/STEM (20/5) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>9:30 am – 11:30 am</td>
<td>Shoreline A (H-1)</td>
</tr>
<tr>
<td>Student Activities ABET (15/5) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>12:00 pm – 2:00 pm</td>
<td>Shoreline A (H-1)</td>
</tr>
<tr>
<td>Student Activities Post High (15/5) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>2:00 pm – 4:00 pm</td>
<td>Shoreline B (H-1)</td>
</tr>
<tr>
<td>Student Activities Design Competition (15/5) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>2:00 pm – 4:00 pm</td>
<td>Shoreline A (H-1)</td>
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<tr>
<td>Student Activities Grants (15/5) Screen/Electric</td>
<td>Friday (6/23)</td>
<td>4:00 pm – 6:00 pm</td>
<td>Shoreline A (H-1)</td>
</tr>
<tr>
<td>TC/TG Chair’s Training Workshop (50/20)</td>
<td>Sunday (6/25)</td>
<td>9:45 am – 10:45 am</td>
<td>101A (LBCC-1)</td>
</tr>
</tbody>
</table>
Technical Activities Committee (25/20) Screen/Electric
Saturday (6/24) 8:00 am – 3:00 pm 101B (LBCC-1)
Wednesday (6/28) 7:00 am – 10:00 am 204 (LBCC-2)

TAC/Standing Committee Executive Interface (25/20) Screen/Electric
Saturday (6/24) 7:00 am – 8:00 am 101B (LBCC-1)

TAC/TC/SSPC 90.1 Interface/Liaison Session (50/0) Screen/Electric
Monday (6/26) 2:15 pm – 4:15 pm 202AB (LBCC-2)

Technology Council (37/20) Screen/Electric
Wednesday (6/28) 9:00 am – 12:00 pm Beacon B (H-4)

Technology Council: Operations Subcommittee (20/10)
Screen/Electric
Tuesday (6/27) 7:30 am – 9:00 am Shoreline B (H-1)

Techology Council: Special Projects Subcommittee (8/5)
Screen/Electric
Tuesday (6/27) 9:00 am – 10:30 am Shoreline B (H-1)

Technology Council: Document Review Subcommittee (10/10)
Screen/Electric
Tuesday (6/27) 10:30 am – 12:00 pm Shoreline B (H-1)

Technology Council Planning (25/10) Screen/Electric
Tuesday (6/27) 2:00 pm – 4:00 pm Shoreline B (H-1)

Young Engineers in ASHRAE Committee (20/15) Electric
Saturday (6/24) 8:00 am – 3:00 pm Pacific (H-1)

YEA Hospitality (125/0)
Sunday (6/25) 4:00 pm – 6:00 pm Regency DEF (H-4)

TC/TG/MTG/GPC/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

The venue and floor numbers are indicated in parenthesis in the listing below. Subcommittees are indented. Rooms will be set 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.

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Venue Key:
See page 87–88 for more information on how to find your meeting location.

(H) = Hyatt with a "-" indicating the floor number.
(R) = Renaissance with a "-" indicating the floor number.
(LBCC) = Long Beach Convention Center with a "-" indicating the floor number.
(LBCC-SS) = Seaside rooms (SS) at LBCC require a separate entrance and will be marked “SS.” See page 6 for more details.

Color Codes: If the meeting has not been listed in color it was NOT confirmed prior to the meeting.

**TECHNICAL COMMITTEES (TC)**

<table>
<thead>
<tr>
<th>TC/TG Chair’s Breakfast Section</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>TC/TG Chair’s Breakfast Section 1 (32/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Bixby 1 (R-2)</td>
</tr>
<tr>
<td>TC/TG Chair’s Breakfast Section 2 (26/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Bixby 2 (R-2)</td>
</tr>
<tr>
<td>TC/TG Chair’s Breakfast Section 3 (17/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Dawson (R-3)</td>
</tr>
<tr>
<td>TC/TG Chair’s Breakfast Section 4 (19/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Broadlind 1 (R-2)</td>
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<tr>
<td>TC/TG Chair’s Breakfast Section 5 (31/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Pike 3 (R-1)</td>
</tr>
<tr>
<td>TC/TG Chair’s Breakfast Section 6 (23/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Bixby 3 (R-2)</td>
</tr>
<tr>
<td>TC/TG Chair’s Breakfast Section 7 (23/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Broadlind 2 (R-2)</td>
</tr>
<tr>
<td>TC/TG Chair’s Breakfast Section 8 (34/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Pike 2 (R-1)</td>
</tr>
<tr>
<td>TC/TG Chair’s Breakfast Section 9 (24/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Pike 1 (R-1)</td>
</tr>
<tr>
<td>TC/TG Chair’s Breakfast Section 10 (18/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Nieto (R-2)</td>
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</table>

<table>
<thead>
<tr>
<th>MTG Chairs’ Section Breakfast</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>MTG Chairs’ Section Breakfast (11/4)</td>
<td>Sunday (6/25)</td>
<td>6:30 am – 8:00 am</td>
<td>Tichenor (R-2)</td>
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</table>

<table>
<thead>
<tr>
<th>TC/TG Chair’s Training Workshop (50/20)</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>TC/TG Chair’s Training Workshop (50/20)</td>
<td>Sunday (6/25)</td>
<td>9:45 am – 10:45 am</td>
<td>101A (LBCC-1)</td>
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<table>
<thead>
<tr>
<th>TC Program Subcommittee Training (30/0) Screen</th>
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<th>Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>TC Program Subcommittee Training (30/0) Screen</td>
<td>Tuesday (6/27)</td>
<td>11:15 am – 12:00 pm</td>
<td>202C (LBCC-2)</td>
</tr>
</tbody>
</table>
Research Subcommittee Chairs (137/0) Screen
Monday (6/26) 6:30 am – 9:30 am Regency (H-4)

TC 1.1 Thermodynamics and Psychrometrics (10/15)
Monday (6/26) 2:15 pm – 4:15 pm 204 (LBCC-2)

TC 1.2 Instruments and Measurements (15/0)
Tuesday (6/27) 1:00 pm – 3:30 pm Seaside 6 (LBCC-SS)
TC 1.2 Research, Program, Handbook (8/2)
Sunday (6/25) 5:00 pm – 7:00 pm Seaside 2 (LBCC-SS)

TC 1.3 Heat Transfer and Fluid Flow (25/25)
Tuesday (6/27) 1:00 pm – 3:30 pm Bixby 2 (R-2)
TC 1.3/8.5 Research Subcommittee Meeting and Project Review (20/30) Screen/Electric
Sunday (6/25) 3:00 pm – 7:00 pm 102AB (LBCC-1)

TC 1.4 Control Theory and Application (20/80) Screen
Tuesday (6/27) 1:00 pm – 3:30 pm 102AB (LBCC-1)
TC 1.4 YEA/Education (20/10) Screen/Electric
Sunday (6/25) 2:00 pm – 3:00 pm Nieto (R-2)
TC 1.4 Control Components and Applications (20/10) Screen/Electric
Sunday (6/25) 3:00 pm – 4:00 pm Nieto (R-2)
TC 1.4 Programs (20/10) Screen/Electric
Sunday (6/25) 4:00 pm – 5:30 pm Nieto (R-2)
TC 1.4 Research (20/10) Screen/Electric
Monday (6/26) 2:30 pm – 4:30 pm Seaside 4B (LBCC-SS)
TC 1.4 Handbook (10/5) Screen/Electric
Monday (6/26) 4:00 pm – 6:00 pm Seaside 4B (LBCC-SS)
TC 1.4 RP-1746 PMS (7/5) Screen/Electric
Monday (6/26) 6:00 pm – 8:00 pm Seaside 4B (LBCC-SS)
TC 1.4 Executive (10/3) Screen/Electric
Tuesday (6/27) 7:00 am – 8:00 am Seaside 3B (LBCC-SS)

TC 1.5 Computer Applications (25/25) Screen/Electric
Monday (6/26) 6:30 pm – 9:00 pm Pike 1 (R-1)
TC 1.5 DBOSS (20/10)
Sunday (6/25) 3:00 pm – 4:00 pm Pike 2 (R-1)
TC 1.5 Cyber Security (20/10)
Sunday (6/25) 4:00 pm – 5:00 pm Pike 2 (R-1)
TC 1.5 Emerging Applications (20/15)
Sunday (6/25) 5:00 pm – 6:00 pm Pike 2 (R-1)
TC 1.5 Research (20/15)
Sunday (6/25) 6:00 pm – 7:00 pm Pike 2 (R-1)
TC 1.5 Program (20/15)
Sunday (6/25) 7:00 pm – 8:00 pm Pike 2 (R-1)
TC 1.5 Handbook (20/10)
Monday (6/26) 6:00 pm – 6:30 pm Pike 1 (R-1)

TC 1.6 Terminology (10/5) Screen/Electric
Monday (6/26) 4:30 pm – 6:00 pm Seaside 6 (LBCC-SS)
TC 1.6 Working Group Subcommittee (10/3) Screen/Electric
Monday (6/26) 8:00 am – 11:30 am Seaside 6 (LBCC-SS)

TC 1.7 Business, Management and General Legal Education (20/5)
Monday (6/26) 10:15 am – 12:00 pm Nieto (R-2)
TC 1.8 Mechanical Systems Insulation (6/6) Screen
Monday (6/26) 4:15 pm – 6:30 pm Seaside 2 (LBCC-SS)
   TC 1.8 Handbook (15/3)
   Sunday (6/25) 8:00 am – 10:30 am Tichenor (R-2)
   TC 1.8 Program (15/3)
   Sunday (6/25) 10:30 am – 11:00 am Tichenor (R-2)
   TC 1.8 Research (15/3)
   Sunday (6/25) 11:00 am – 12:00 pm Tichenor (R-2)

TC 1.9 Electrical Systems (8/4)
Tuesday (6/27) 3:30 pm – 6:00 pm Seaside 3B (LBCC-SS)

TC 1.10 Cogeneration Systems (20/8) Electric
Tuesday (6/27) 2:30 pm – 4:00 pm Seaside 5A (LBCC-SS)
   TC1.10 Handbook, Program, Research, CTIC, Membership Subcommittee (15/10) Electric
   Tuesday (6/27) 1:00 pm – 2:30 pm Seaside 5A (LBCC-SS)

TC 1.11 Electric Motors and Motor Control (13/7) Screen
Tuesday (6/27) 1:00 pm – 3:30 pm Seaside 3B (LBCC-SS)

TC 1.12 Moisture Management in Buildings (20/20) Screen/Electric
Saturday (6/24) 1:00 pm – 3:00 pm Bixby 1 (R-2)
   TC 1.12 Research, Program, Handbook, Standards (20/20) Screen/Electric
   Saturday (6/24) 8:00 am – 12:00 pm Bixby 1 (R-2)

TC 1.13 Optimization (20/5)
Sunday (6/25) 1:00 pm – 3:00 pm 202C (LBCC-2)

TC 2.1 Physiology and Human Environment (25/30) Electric
Tuesday (6/27) 1:00 pm – 5:00 pm Seaside 1 (LBCC-SS)
   TC 2.1 Research/Programs/Handbook Follow-Up Meeting (10/5) Electric
   Sunday (6/25) 1:30 pm – 3:30 pm Seaside 3B (LBCC-SS)

TC 2.2 Plant and Animal Environment (10/5) Screen/Electric
Monday (6/26) 4:15 pm – 6:30 pm Harbor B (H-1)

TC 2.3 Gaseous Air Contaminants /Removal Equip. (30/30) Screen/Electric
Tuesday (6/27) 1:00 pm – 3:30 pm 101B (LBCC-1)
   TC 2.3 Research (20/10) Screen/Electric
   Sunday (6/25) 5:00 pm – 7:00 pm 202 AB (LBCC-2)
   TC 2.3 Standards (20/10) Screen/Electric
   Monday (6/26) 2:15 pm – 3:15 pm Nieto (R-2)
   TC 2.3 Publications (combined with TC 2.4 Publications) (20/10) Screen/Electric
   Monday (6/26) 3:15 pm – 4:15 pm Nieto (R-2)
   TC 2.3 Handbook (5/5) Screen/Electric
   Monday (6/26) 4:15 pm – 6:30 pm Nieto (R-2)
   TC 2.3 Planning (15/5) Screen/Electric
   Tuesday (6/27) 6:30 am – 8:00 am 202C (LBCC-2)

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**TC 2.3 Programs (20/10) Screen/Electric**
Tuesday (6/27) 12:00 pm – 12:45 pm  202C (LBCC-2)

**TC 2.4 Particulate Air Contaminants / Removal Equipment (20/40) Screen**
Tuesday (6/27) 3:30 pm – 6:00 pm  101B (LBCC-1)

**TC 2.4 Handbook (10/15) Screen/Electric**
Saturday (6/24) 1:00 pm – 2:30 pm  201B (LBCC-2)
**TC 2.4 1649-RP PMS (5/20) Screen/Electric**
Saturday (6/24) 1:30 pm – 2:30 pm  202AB (LBCC-2)

**TC 2.4 Research (20/30) Screen/Electric**
Sunday (6/25) 3:00 pm – 5:00 pm  202AB (LBCC-2)
**TC 2.4 Publications (combined with TC 2.3 Publications) (20/10) Screen/Electric**
Monday (6/26) 3:15 pm – 4:15 pm  Nieto (R-2)
**TC 2.4 Standards (20/20) Screen/Electric**
Monday (6/26) 4:15 pm – 5:15 pm  Wilmore (R-2)

**TC 2.4 Planning (20/10) Screen/Electric**
Tuesday (6/27) 8:00 am – 10:00 am  202C (LBCC-2)
**TC 2.4 Program (20/10) Screen/Electric**
Tuesday (6/27) 10:00 am – 11:00 am  202C (LBCC-2)

**TC 2.5 Global Climate Change (20/10) Screen**
Tuesday (6/27) 1:30 pm – 3:30 pm  Broadlind 2 (R-2)

**TC 2.5 Research, Programs (10/15) Screen/Electric**
Monday (6/26) 2:15 pm – 4:15 pm  Seaside 6 (LBCC-SS)

**TC 2.6 Sound and Vibration (20/30) Screen/Electric**
Monday (6/26) 2:15 pm – 4:15 pm  202C (LBCC-2)
**TC 2.6 Vibration Isolation (20/30) Screen/Electric**
Sunday (6/25) 9:00 am – 10:00 am  202C (LBCC-2)
**TC 2.6 RP 1408 (20/30) Screen/Electric**
Sunday (6/25) 10:00 am – 11:00 am  202C (LBCC-2)
**TC 2.6 Hot Topic 1 – Mech Equipment Vibrations and Structural Interaction (20/30) Screen/Electric**
Sunday (6/25) 11:00 am – 12:00 pm  202C (LBCC-2)
**TC 2.6 Programs (20/30) Screen/Electric**
Sunday (6/25) 3:00 pm – 4:00 pm  202C (LBCC-2)
**TC 2.6 Hot Topic 2 (20/30) Screen/Electric**
Sunday (6/25) 4:00 pm – 5:00 pm  202C (LBCC-2)
**TC 2.6 Executive Committee (20/30) Screen/Electric**
Sunday (6/25) 5:00 pm – 6:00 pm  202C (LBCC-2)
**TC 2.6 Publications (20/30) Screen/Electric**
Monday (6/26) 9:00 am – 10:00 am  202C (LBCC-2)
**TC 2.6 Research (20/30) Screen/Electric**
Monday (6/26) 10:00 am – 11:00 am  202C (LBCC-2)
**TC 2.6 Standards/Criteria (20/30) Screen/Electric**
Monday (6/26) 11:00 am – 12:00 pm  202C (LBCC-2)

**TC 2.7 Seismic and Wind Restraint Design (17/24) Screen**
Tuesday (6/27) 3:30 pm – 6:00 pm  Wilmore (R-2)
**TC 2.7 Programs, Publications, Research, Long Range Planning (15/10) Screen/Electric**
Tuesday (6/27) 1:00 pm – 3:30 pm  Alford (R-2)
TC 2.8 Building Environmental Impacts and Sustainability (20/50)
Sunday (6/25)  5:30 pm – 7:00 pm  Seaside 7 (LBCC-SS)
   TC 2.8 Green Guide (8/10) Screen/Electric
   TC 2.8 Existing & Future Building Challenges (6/10) Screen/Electric
   TC 2.8 Water-Energy Nexus (6/10) Screen/Electric
   TC 2.8 International (4/10) Screen/Electric
   TC 2.8 Research (4/6) Screen/Electric
   TC 2.8 Handbook (6/6) Screen/Electric
   TC 2.8 Programs (8/8) Screen/Electric

TC 2.9 Ultraviolet Air and Surface Treatment (10/20)
Screen
Monday (6/26)  10:00 am – 12:00 pm  Wilmore (R-2)
   TC 2.9 Programs (8/5)
   TC 2.9 Handbook (5/5)
   TC 2.9 Standards (6/6)
   TC 2.9 Research (10/8)

TC 3.1 Refrigerants and Secondary Coolants (10/30)
Screen/Electric
Monday (6/26)  4:15 pm – 6:30 pm  Pike 3 (R-1)
   TC 3.1 Research (combined with 3.2, 3.3, 3.4 and 3.8 Research) (15/40) Screen/Electric
   TC 3.1 Program (Combined with 3.2, 3.3, 3.4 and 3.8 Program) (15/40) Screen/Electric

TC 3.2 Refrigerant System Chemistry (12/40)
Screen/Electric
Monday (6/26)  2:15 pm – 4:15 pm  Seaside Ballroom B (LBCC-SS)
   TC 3.2 Research (combined with 3.1, 3.3, 3.4, 3.8 Research) (15/40) Screen/Electric
   TC 3.2 Program (Combined with 3.1, 3.3, 3.4 and 3.8 Program) (15/40) Screen/Electric

TC 3.3 Refrigerant Contaminant Control (14/25) Screen
Tuesday (6/27)  3:30 pm – 6:00 pm  Seaside 3A (LBCC-SS)
TC 3.3 Research (combined with 3.1, 3.2, 3.4, 3.8 Research) (15/40) Screen/Electric
Sunday (6/25) 3:00 pm – 6:00 pm 203AB (LBCC-2)
TC 3.3 Program (Combined with 3.1, 3.2, 3.4 and 3.8 Program) (15/40) Screen/Electric
Monday (6/26) 10:30 am – 12:00 pm Seaside Ballroom B (LBCC-SS)

TC 3.4 Lubrication (20/40) Screen
Tuesday (6/27) 1:30 pm – 3:30 pm Bixby 4 (R-2)
TC 3.4 Research (combined with 3.1, 3.2, 3.3, 3.8 Research) (15/40) Screen/Electric
Sunday (6/25) 3:00 pm – 6:00 pm 203AB (LBCC-2)
TC 3.4 Program (Combined with 3.1, 3.2, 3.3 and 3.4 Program) (15/40) Screen/Electric
Monday (6/26) 10:30 am – 12:00 pm Seaside Ballroom B (LBCC-SS)

TC 3.6 Water Treatment (18/10) Screen
Tuesday (6/27) 1:00 pm – 3:30 pm Seaside 3A (LBCC-SS)
TC 3.6 Handbook/Program/Research (15/10) Electric
Sunday (6/25) 4:00 pm – 6:00 pm Pike 1 (R-1)

TC 3.8 Refrigerant Containment (9/5) Screen
Monday (6/26) 4:15 pm – 6:30 pm Tichenor (R-2)
TC 3.8 Research (combined with 3.1, 3.2, 3.3, 3.4 Research) (15/40) Screen/Electric
Sunday (6/25) 3:00 pm – 6:00 pm 203AB (LBCC-2)
TC 3.8 Program (Combined with 3.1, 3.2, 3.3 and 3.4 Program) (15/40) Screen/Electric
Monday (6/26) 10:30 am – 12:00 pm Seaside Ballroom B (LBCC-SS)

TC 4.1 Load Calculation Data and Procedures (20/10) Screen
Monday (6/26) 2:15 pm – 4:15 pm Wilmore (R-2)
TC 4.1 RP-1729 PMS (8/5) Screen
Sunday (6/25) 8:00 am – 9:00 am Alford (R-2)
TC 4.1 RP-1681 PMS (15/10)
Sunday (6/25) 2:00 pm – 3:00 pm Seaside 6 (LBCC-SS)
TC 4.1 Handbook (15/10)
Sunday (6/25) 3:00 pm – 4:00 pm Bixby 2 (R-2)
TC 4.1 Research (15/10)
Sunday (6/25) 4:00 pm – 5:00 pm Bixby 2 (R-2)
TC 4.1 Programs and Standards (15/10)
Sunday (6/25) 5:00 pm – 6:00 pm Bixby 2 (R-2)
TC 4.1 RP-1742 PMS (8/5) Screen
Sunday (6/25) 6:00 pm – 7:00 pm Bixby 2 (R-2)
TC 4.1/4.3 PMS for RP1747 Implementation of DCV for Multiple Zone Systems (12/0)
Tuesday (6/27) 9:00 am – 10:00 am Suite 334 (R-3)

TC 4.2 Climatic Information (20/10) Screen
Tuesday (6/27) 1:00 pm – 3:30 pm Delker (R-3)
TC 4.2 Handbook (7/7) Screen/Electric
Sunday (6/25) 2:30 pm – 3:30 pm Harbor A (H-1)
TC 4.2 Program (7/7) Screen/Electric
Sunday (6/25) 3:30 pm – 4:30 pm Harbor A (H-1)
**TC 4.2 Research (7/12) Screen/Electric**  
Monday (6/26) 4:15 pm – 6:00 pm Pacific (H-1)

**TC 4.3 Ventilation Requirements and Infiltration (10/20)**  
Monday (6/26) 4:15 pm – 6:30 pm 101B (LBCC-1)  
TC 4.1/4.3 PMS for RP1747 Implementation of DCV for Multiple Zone Systems (12/0)  
Tuesday (6/27) 9:00 am – 10:00 am Suite 334 (R-3)

**TC 4.4 Building Materials and Building Envelope Performance (40/10) Screen**  
Monday (6/26) 2:15 pm – 4:15 pm Seaside 7 (LBCC-SS)  
TC 4.4 Program (30/15) Screen/Electric  
Sunday (6/25) 11:00 am – 12:30 pm Seaside 4B (LBCC-SS)  
TC 4.4 Handbook (30/15) Screen/Electric  
Sunday (6/25) 4:15 pm – 5:30 pm Seaside 4B (LBCC-SS)  
TC 4.4 Research (30/15) Screen/Electric  
Sunday (6/25) 5:30 pm – 6:00 pm Seaside 4B (LBCC-SS)  
TC 4.4 Standards (30/15) Screen/Electric  
Sunday (6/25) 6:00 pm – 7:00 pm Seaside 4B (LBCC-SS)

**TC 4.5 Fenestration (10/8)**  
Tuesday (6/27) 2:00 pm – 4:00 pm Suite 334 (R-3)  
TC 4.5 Program (10/10)  
Monday (6/26) 2:15 pm – 3:15 pm Seaside 5B (LBCC-SS)  
TC 4.5 Handbook (10/10)  
Monday (6/26) 3:15 pm – 4:15 pm Seaside 5B (LBCC-SS)  
TC 4.5 Calculation Methods (10/10)  
Tuesday (6/27) 1:00 pm – 2:00 pm Suite 334 (R-3)

**TC 4.7 Energy Calculations (25/50) Screen**  
Tuesday (6/27) 6:00 pm – 8:30 pm 101A (LBCC-1)  
TC 4.7 Simulation and Component Models (20/20) Screen/Electric  
Monday (6/26) 6:00 pm – 7:30 pm Dawson (R-3)  
TC 4.7 Data-Driven Models (20/20) Screen/Electric  
Monday (6/26) 7:30 pm – 9:00 pm Dawson (R-3)  
TC 4.7 Calculation Methods (20/10) Screen/Electric  
Tuesday (6/27) 3:30 pm – 5:00 pm 101A (LBCC-1)  
TC 4.7 Handbook (20/10) Screen/Electric  
Tuesday (6/27) 5:00 pm – 6:00 pm 101A (LBCC-1)

**TC 4.10 Indoor Environmental Modeling (20/20) Screen**  
Monday (6/26) 2:15 pm – 4:15 pm Pike 2 (R-1)  
TC 4.10 Program (10/10) Screen/Electric  
Sunday (6/25) 2:00 pm – 3:00 pm Seaside 5A (LBCC-SS)  
TC 4.10 Handbook (14/10) Screen/Electric  
Sunday (6/25) 3:00 pm – 4:00 pm Seaside 5A (LBCC-SS)  
TC 4.10 Research (14/10) Screen/Electric  
Sunday (6/25) 4:00 pm – 5:00 pm Seaside 5A (LBCC-SS)  
TC 4.10 PMS 1696-RP (20/10) Screen/Electric  
Sunday (6/25) 5:00 pm – 6:00 pm Seaside 5A (LBCC-SS)
TC 5.1 Fans (20/20) Screen
Monday (6/26)  4:15 pm – 6:30 pm  201A (LBCC-2)
   TC 5.1 Handbook (12/12) Screen/Electric
   Sunday (6/25)  2:00 pm – 3:00 pm  Seaside 5B (LBCC-SS)
   TC 5.1 Research (10/10) Screen
   Sunday (6/25)  3:00 pm – 4:00 pm  Seaside 5B (LBCC-SS)
   TC 5.1 Program (10/10) Screen
   Sunday (6/25)  4:00 pm – 4:30 pm  Seaside 5B (LBCC-SS)
   TC 5.1 Hot Topics (15/15) Screen
   Sunday (6/25)  4:30 pm – 6:00 pm  Seaside 5B (LBCC-SS)

TC 5.2 Duct Design (12/20) Screen
Tuesday (6/27)  3:30 pm – 6:00 pm  Seaside 4B (LBCC-SS)
   TC 5.2 Duct Design Guide (30/20) Screen/Electric
   Monday (6/26)  8:00 am – 12:00 pm  Seaside Ballroom A (LBCC-SS)

TC 5.3 Room Air Distribution (30/30) Screen/Electric
Tuesday (6/27)  1:00 pm – 3:30 pm  101A (LBCC-1)
   TC 5.3 Handbook (20/10) Screen/Electric
   Friday (6/23)  12:00 pm – 5:00 pm  Bixby 4 (R-2)
   TC 5.3 Handbook (20/10) Screen/Electric
   Saturday (6/24)  8:00 am – 3:00 pm  Dawson (R-3)
   TC 5.3 Fan Coils (20/10) Screen/Electric
   Sunday (6/25)  8:00 am – 9:00 am  Pike 2 (R-1)
   TC 5.3 Chilled Beams (20/10) Screen/Electric
   Sunday (6/25)  9:00 am – 10:00 am  Pike 2 (R-1)
   TC 5.3 Air Curtains (20/10) Screen/Electric
   Sunday (6/25)  10:00 am – 10:45 am  Pike 2 (R-1)
   TC 5.3 1629-TRP Testing and Modeling Energy Performance of Active Chilled Beams systems (6/10) Screen/Electric
   Sunday (6/25)  10:00 am – 11:00 am  Alford (R-2)
   TC 5.3 Underfloor Air Distribution (20/10) Screen/Electric
   Sunday (6/25)  10:45 am – 11:45 am  Pike 2 (R-1)
   TC 5.3 Research, Programs (25/10) Screen/Electric
   Sunday (6/25)  12:30 pm – 2:30 pm  Pike 2 (R-1)

TC 5.4 Industrial Process Air Cleaning (Air Pollution Control) (11/6)
Monday (6/26)  2:15 pm – 4:15 pm  Seaside 2 (LBCC-SS)

TC 5.5 Air-to-Air Energy Recovery (30/10) Screen
Tuesday (6/27)  3:30 pm – 6:00 pm  Bixby 2 (R-2)
   TC 5.5 Handbook, Program, Research (15/5) Screen/Electric
   Tuesday (6/27)  1:00 pm – 3:30 pm  Tichenor (R-2)

TC 5.6 Control of Fire and Smoke (23/30) Screen
Monday (6/26)  4:15 pm – 6:30 pm  Pike 2 (R-1)
   TC 5.6 Program/Research/Handbook (13/20)
   Sunday (6/25)  3:00 pm – 6:30 pm  Bixby 1 (R-2)

TC 5.7 Evaporative Cooling (20/10)
Monday (6/26)  4:15 pm – 6:30 pm  Bixby 3 (R-2)

TC 5.8 Industrial Ventilation (Combined with TC 9.2 Main) (45/15) Screen/Electric
Tuesday (6/27)  1:00 pm – 3:30 pm  Bixby 5 (R-2)
TC 5.8 Industrial Ventilation Systems (30/15) Screen/Electric
Monday (6/26) 4:15 pm – 6:30 pm Seaside 7 (LBCC-SS)

TC 5.9 Enclosed Vehicular Facilities (30/10) Screen
Tuesday (6/27) 3:30 pm – 6:00 pm Bixby 3 (R-2)
TC 5.9 Program, Standards, Handbook, Research (30/10)
Screen/Electric
Tuesday (6/27) 1:00 pm – 3:30 pm Bixby 3 (R-2)

TC 5.10 Kitchen Ventilation (20/15) Screen
Monday (6/26) 6:30 pm – 7:30 pm Broadlind 1(R-2)
TC 5.10 Handbook (20/15) Screen/Electric
Monday (6/26) 2:00 pm – 3:30 pm Broadlind 1 (R-2)
TC 5.10 Program (20/15) Screen/Electric
Monday (6/26) 3:30 pm – 4:30 pm Broadlind 1 (R-2)
TC 5.10 Research (20/15) Screen/Electric
Monday (6/26) 4:30 pm – 6:30 pm Broadlind 1 (R-2)

TC 5.11 Humidifying Equipment (10/5) Screen/Electric
Monday (6/26) 2:15 pm – 4:15 pm Seaside 4A (LBCC-SS)
TC 5.11 Research (6/4) Screen/Electric
Sunday (6/25) 3:00 pm – 5:00 pm Seaside 3A (LBCC-SS)

TC 6.1 Hydronic and Steam Equipment and Systems (20/25) Screen
Tuesday (6/27) 1:00 pm – 3:30 pm Bixby 1 (R-2)
TC 6.1 Handbook (12/8) Screen/Electric
Sunday (6/25) 5:00 pm – 6:00 pm Alford (R-2)
TC 6.1 Chilled Water Plant (12/8) Screen/Electric
Sunday (6/25) 6:00 pm – 7:00 pm Alford (R-2)
TC 6.1 Program (12/8) Screen/Electric
Monday (6/26) 2:15 pm – 3:15 pm Tichenor (R-2)
TC 6.1 Research (12/8) Screen/Electric
Monday (6/26) 3:15 pm – 4:15 pm Tichenor (R-2)

TC 6.2 District Energy (20/10)
Sunday (6/25) 3:00 pm – 5:00 pm Shoreline B (H-1)
TC 6.2 Programs, Research, Handbook (20/10)
Screen/Electric
Sunday (6/25) 1:00 pm – 3:00 pm Shoreline B (H-1)

TC 6.3 Central Forced Air Heating and Cooling Systems (20/12) Screen
Tuesday (6/27) 1:00 pm – 3:30 pm Wilmore (R-2)
TC 6.3 Research, Standards and Program (10/10) Electric
Monday (6/26) 2:15 pm – 4:15 pm Harbor A (H-1)

TC 6.5 Radiant Heating and Cooling (30/10)
Screen/Electric
Monday (6/26) 2:15 pm – 4:15 pm Seaside Ballroom A (LBCC-SS)
TC 6.5 RP-1766 PMS (15/20) Screen/Electric
Sunday (6/25) 2:00 pm – 3:00 pm Seaside 4A (LBCC-SS)
TC 6.5 Research (15/20) Screen/Electric
Sunday (6/25) 3:00 pm – 4:00 pm Seaside 4A (LBCC-SS)
TC 6.5 Program (15/20) Screen/Electric
Sunday (6/25) 4:00 pm – 5:00 pm Seaside 4A (LBCC-SS)
TC 6.5 Handbook (15/20) Screen/Electric
Sunday (6/25) 5:00 pm – 6:00 pm Seaside 4A (LBCC-SS)

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<table>
<thead>
<tr>
<th>TC 6.6 Service Water Heating Systems (20/10) Screen</th>
<th>Monday (6/26) 4:15 pm – 6:30 pm Bixby 5 (R-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 6.6 Research, Handbook, and Program (20/10) Screen/Electric</td>
<td>Monday (6/26) 2:15 pm – 4:15 pm Bixby 5 (R-2)</td>
</tr>
</tbody>
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<thead>
<tr>
<th>TC 6.7 Solar Energy Utilization (20/55) Screen</th>
<th>Tuesday (6/27) 1:00 pm – 3:30 pm 201A (LBCC-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 6.7 Research, Standards, Programs and Handbook (15/10) Screen/Electric</td>
<td>Monday (6/26) 4:15 pm – 8:15 pm Broadlind 2 (R-2)</td>
</tr>
</tbody>
</table>

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<tr>
<th>TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25) Screen/Electric</th>
<th>Tuesday (6/27) 3:30 pm – 6:00 pm 102AB (LBCC-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 6.8 Handbook: Geothermal Energy (10/10) Screen/Electric</td>
<td>Sunday (6/25) 3:00 pm – 5:00 pm Tichenor (R-2)</td>
</tr>
<tr>
<td>TC 6.8 Research, Programs, Standards (15/10) Screen/Electric</td>
<td>Sunday (6/25) 5:00 pm – 7:00 pm Tichenor (R-2)</td>
</tr>
</tbody>
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<tr>
<th>TC 6.9 Thermal Storage (14/25) Screen/Electric</th>
<th>Monday (6/26) 4:30 pm – 6:00 pm Seaside 1 (LBCC-SS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 6.9 Standards, Programs, Handbook, Research &amp; LRP (11/20) Electric</td>
<td>Monday (6/26) 2:15 pm – 4:15 pm Seaside 1 (LBCC-SS)</td>
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</tbody>
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<tr>
<th>TC 6.10 Fuels and Combustion (20/10) Screen</th>
<th>Tuesday (6/27) 3:30 pm – 6:15 pm 202C (LBCC-2)</th>
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</thead>
<tbody>
<tr>
<td>TC 6.10 Handbook</td>
<td>Monday (6/26) 4:15 pm – 6:00 pm 101A (LBCC-1)</td>
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<thead>
<tr>
<th>TC 7.1 Integrated Building Design (25/10)</th>
<th>Monday (6/26) 8:15 am – 10:30 am Seaside Ballroom B (LBCC-SS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 7.1 Research, Program, Handbook</td>
<td>Met prior to Long Beach Conference via web meeting</td>
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</table>

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<tr>
<th>TC 7.2 HVAC&amp;R Construction and Design Build Technologies (10/5)</th>
<th>Sunday (6/25) 10:00 am – 12:00 pm Seaside 4A (LBCC-SS)</th>
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</thead>
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<tr>
<th>TC 7.3 Operations &amp; Maintenance Management (25/7) Electric</th>
<th>Tuesday (6/27) 1:00 pm – 3:30 pm Seaside 4B (LBCC-SS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 7.3 Standards, Programs (15/10) Electric</td>
<td>Monday (6/26) 2:15 pm – 4:15 pm Seaside 3A (LBCC-SS)</td>
</tr>
<tr>
<td>TC 7.3 Research, Handbook (15/10) Electric</td>
<td>Monday (6/24) 4:15 pm – 6:30 pm Seaside 3A (LBCC-SS)</td>
</tr>
<tr>
<td>TC 7.3 RP-1650 PMS (6/0)</td>
<td>Tuesday (6/27) 8:00 am – 9:00 am Seaside 2 (LBCC-SS)</td>
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</tbody>
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| TC 7.4 Exergy Analysis for Sustainable Buildings (14/8) | Sunday (6/25) 8:00 am – 10:00 am Seaside 4A (LBCC-SS) |
TC 7.5 Smart Building Systems (11/50) Screen
Tuesday (6/27)  3:30 pm – 6:00 pm  204 (LBCC-2)
   TC 7.5 Fault Detection & Diagnosis (11/50) Electric
   Sunday (6/25)  2:30 pm – 3:15 pm  204 (LBCC-2)
   TC 7.5 Enabling Technologies (11/50) Electric
   Sunday (6/25)  3:15 pm – 4:00 pm  204 (LBCC-2)
   TC 7.5 Smart Grid (11/50) Electric
   Sunday (6/25)  4:00 pm – 4:45 pm  204 (LBCC-2)
   TC 7.5 Handbook (11/50) Electric
   Sunday (6/25)  4:45 pm – 5:30 pm  204 (LBCC-2)
   TC 7.5 Program (11/50) Electric
   Sunday (6/25)  5:30 pm – 6:00 pm  204 (LBCC-2)
   TC 7.5 Buildings Operations Dynamics (11/50) Electric
   Monday (6/26)  4:30 pm – 5:15 pm  202 AB (LBCC-2)
   TC 7.5 Research (11/50) Electric
   Monday (6/26)  5:15 pm – 6:00 pm  202 AB (LBCC-2)

TC 7.6 Building Energy Performance (10/30)
Tuesday (6/27)  1:00 pm – 3:30 pm  202 AB (LBCC-2)
   TC 7.6 Federal Buildings (25/25) Electric
   Saturday (6/24)  9:00 am – 3:00 pm  Bixby 3 (R-2)
   TC 7.6 Federal Buildings (25/25) Electric
   Sunday (6/25)  9:00 am – 12:00 pm  Pike 3 (R-1)
   TC 7.6 Project Monitoring Committee for 1702-RP (8/0)
   Electric
   Sunday (6/25)  11:30 am – 1:00 pm  Alford (R-2)
   TC 7.6 Research (10/10) Electric
   Sunday (6/25)  1:00 pm – 2:00 pm  Alford (R-2)
   TC 7.6 Commercial Building Energy Audit (10/10) Electric
   Sunday (6/25)  2:00 pm – 3:00 pm  Alford (R-2)
   TC 7.6 Handbook (10/10)
   Sunday (6/25)  3:00 pm – 4:00 pm  Alford (R-2)
   TC 7.6 Monitoring and Energy Performance (10/30)
   Monday (6/26)  2:15 pm – 4:15 pm  Bixby 4 (R-2)
   TC 7.6 Energy Management (10/15) Electric
   Monday (6/26)  4:15 pm – 5:15 pm  Bixby 4 (R-2)
   TC 7.6 Standards and Programs (10/10) Electric
   Monday (6/26)  5:15 pm – 6:15 pm  Bixby 4 (R-2)
   TC 7.6 Executive (10/0) Electric
   Monday (6/26)  6:15 pm – 7:00 pm  Bixby 4 (R-2)

TC 7.7 Testing and Balancing (20/30)
Monday (6/26)  2:15 pm – 4:15 pm  201A (LBCC-2)
   TC 7.7 Program, Handbook, Research (5/3) Electric
   Sunday (6/25)  5:00 pm–7:00 pm  Delker (R-3)

TC 7.8 Owning and Operating Costs (20/5)
Monday (6/26)  2:15 pm – 4:15 pm  101B (LBCC-1)
   TC 7.8 Handbook, Program, Research
   Met prior to the Long Beach Conference via web meeting

TC 7.9 Building Commissioning (40/20) Screen/Electric
Sunday (6/25)  3:00 pm – 5:00 pm  101A (LBCC-1)
   TC 7.9 Handbook, Programs, Research (15/10) Electric
   Saturday (6/24)  7:00 am – 10:00 am  203AB (LBCC-2)
TC 8.1 Positive Displacement Compressors (12/14)
Screen
Tuesday (6/27) 3:30 pm – 6:00 pm Delker (R-3)
TC 8.1 Research and Programs (8/4) Electric
Sunday (6/25) 4:00 pm – 5:00 pm Alford (R-2)

TC 8.2 Centrifugal Machines (20/8)
Monday (6/26) 2:15 pm – 4:15 pm Broadlind 2 (R-2)
TC 8.2 Programs, Research and Handbook (17/8) Screen/Electric
Sunday (6/25) 5:00 pm – 7:00 pm 201A (LBCC-2)

TC 8.3 Absorption and Heat Operated Machines (20/10) Screen
Monday (6/26) 3:30 pm – 6:00 pm Dawson (R-3)
TC 8.3 Research/Handbook (8/5) Electric
Monday (6/26) 2:15 pm – 3:30 pm Dawson (R-3)

TC 8.4 Air-to-Refrigerant Heat Transfer Equipment (20/10) Screen
Tuesday (6/27) 3:30 pm – 6:00 pm Broadlind 2 (R-2)
TC 8.4 Research, Standards, Handbook (15/30) Screen/Electric
Monday (6/26) 6:00 pm – 9:00 pm Bixby 1 (R-2)

TC 8.5 Liquid-to-Refrigerant Heat Exchangers (47/18) Screen
Monday (6/26) 4:15 pm – 6:30 pm Seaside Ballroom A (LBCC-SS)
TC 8.5/1.3 Research Subcommittee Meeting and Project Review (20/30) Screen/Electric
Sunday (6/25) 3:00 pm – 7:00 pm 102AB (LBCC-1)

TC 8.6 Cooling Towers and Evaporative Condensers (20/5)
Monday (6/26) 2:15 pm – 4:15 pm 203AB (LBCC-2)
TC 8.6 Handbook/Program/Research (8/0)
Monday (6/26) 9:00 am – 10:00 am Harbor A (H-1)

TC 8.7 Variable Refrigerant Flow (VRF) (20/30)
Monday (6/26) 4:15 pm – 6:30 pm 203AB (LBCC-2)

TC 8.8 Refrigerant System Controls and Accessories (10/10) Screen/Electric
Tuesday (6/27) 1:00 pm – 3:30 pm 204 (LBCC-2)
TC 8.8 Research, Program, Handbook (5/5)
Sunday (6/25) 6:30 pm – 7:30 pm Harbor B (H-1)

TC 8.9 Residential Refrigerators and Food Freezers (6/10)
Monday (6/26) 2:15 pm – 4:15 pm Harbor B (H-1)

TC 8.10 Mechanical Dehumidification and Heat Pipes (16/10)
Tuesday (6/27) 3:30 pm – 5:00 pm Regency D (H-4)
TC 8.10 Program/Handbook/Research/Standards (20/10) Electric
Tuesday (6/27) 1:00 pm – 3:30 pm Regency D (H-4)
TC 8.11 Unitary and Room Air Conditioners and Heat Pumps (20/40)
Monday (6/26)  4:15 pm – 6:30 pm     202C (LBCC-2)
TC 8.11 Handbook, Program, Research (12/20) Electric
Sunday (6/25)  3:00 pm – 5:00 pm     201A (LBCC-2)

TC 8.12 Desiccant Dehumidification Equipment and Components (15/15)
Monday (6/26)  2:15 pm – 4:15 pm     Pacific (H-1)

TC 9.1 Large Building Air-Conditioning Systems (14/10) Screen/Electric
Tuesday (6/27)  1:00 pm – 3:30 pm     Ebell (R-3)
TC 9.1 Program and Handbook (10/2) Screen/Electric
Tuesday (6/27)  12:00 pm – 1:00 pm     Ebell (R-3)

TC 9.2 Industrial Air-Conditioning (Combined with TC 5.8 Main) (45/15) Screen/Electric
Tuesday (6/27)  1:00 pm – 3:30 pm     Bixby 5 (R-2)
TC 9.2 Programs/Research/Handbook (10/5) Electric
Sunday (6/25)  4:00 pm – 6:00 pm     Seaside 3B (LBCC-SS)

TC 9.3 Transportation Air-Conditioning (14/20) Screen/Electric
Monday (6/26)  3:00 pm – 5:00 pm     Bixby 1 (R-2)
TC 9.3 Rail/Mass Transit Subcommittee (14/20)
Monday (6/26)  10:00 am – 12:00 pm    Bixby 1 (R-2)
TC 9.3 Handbook Subcommittee (14/20)
Monday (6/26)  2:15 pm – 3:00 pm     Bixby 1 (R-2)

TC 9.4 Justice Facilities (20/5) Electric
Sunday (6/25)  3:00 pm – 5:00 pm     101B (LBCC-1)
TC 9.4 Justice Facilities Design Guide (8/6) Electric
Sunday (6/25)  5:00 pm – 7:00 pm     101B (LBCC-1)

TC 9.6 Healthcare Facilities (18/50) Screen/Electric
Sunday (6/25)  5:00 pm – 7:00 pm     101A (LBCC-1)
TC 9.6 Infectious Diseases (30/15) Electric
Sunday (6/25)  8:30 am – 10:30 am     Pike 1 (R-1)
TC 9.6 Handbook (15/15) Electric
Sunday (6/25)  10:30 am – 11:30 am    Pike 1 (R-1)
TC 9.6 Leadership (20/15) Electric
Sunday (6/25)  12:00 pm – 1:00 pm     Pike 1 (R-1)
TC 9.6 Water, Energy (20/15) Electric
Sunday (6/25)  1:00 pm – 2:00 pm     Pike 1 (R-1)
TC 9.6 Research (15/15) Electric
Sunday (6/25)  2:00 pm – 3:00 pm     Pike 1 (R-1)
TC 9.6 Program (15/15) Electric
Sunday (6/25)  3:00 pm – 3:30 pm     Pike 1 (R-1)

TC 9.7 Educational Facilities (13/10)
Sunday (6/25)  1:00 pm – 3:00 pm     Tichenor (R-2)

TC 9.8 Large Building Air-Conditioning Applications (20/10)
Monday (6/26)  2:15 pm – 4:15 pm     Bixby 3 (R-2)
TC 9.8 Handbook (10/5) Screen/Electric
Monday (6/26)  9:00 am – 10:00 am     Ebell (R-3)

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TC 9.8 Programs (10/5) Screen/Electric
Monday (6/26) 10:00 am – 11:00 am  Ebell (R-3)
TC 9.8 International and Membership (10/5) Screen/Electric
Monday (6/26) 11:00 am – 12:00 pm  Ebell (R-3)

TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment (25/75) Screen
Monday (6/26)  2:15 pm – 6:30 pm  201B (LBCC-2)
TC 9.9 Programs, Handbook and Research (15/55) Screen/Electric
Monday (6/26)  7:30 am – 9:00 am  Tichenor (R-2)

TC 9.10 Laboratory Systems (20/40) Screen/Electric
Tuesday (6/27)  3:30 pm – 5:30 pm  201B (LBCC-2)
TC 9.10 RP-1573 PMS Monitoring Subcommittee (10/2) Electric
Sunday (6/25)  1:00 pm – 3:30 pm  Seaview A (H-1)
TC 9.10 Standards (20/5) Screen/Electric
Sunday (6/25)  3:00 pm – 3:30 pm  Seaview A (H-1)
TC 9.10 Research (25/5) Screen/Electric
Sunday (6/25)  3:30 pm – 4:15 pm  Seaview A (H-1)
TC 9.10 Program (25/5) Screen/Electric
Sunday (6/25)  4:15 pm – 4:45 pm  Seaview A (H-1)
TC 9.10 Handbook (20/5) Screen/Electric
Tuesday (6/27)  1:00 pm – 1:45 pm  201B (LBCC-2)
TC 9.10 Lab Classifications (25/5) Screen/Electric
Tuesday (6/27)  1:45 pm – 2:30 pm  201B (LBCC-2)
TC 9.10 Labs Energy Efficiency (25/5) Screen/Electric
Tuesday (6/27)  2:30 pm – 3:00 pm  201B (LBCC-2)

TC 9.11 Clean Spaces (30/45) Screen
Monday (6/26)  3:00 pm – 4:15 pm  102AB (LBCC-1)
TC 9.11 Research (12/6) Screen/Electric
Monday (6/26)  2:15 pm – 3:00 pm  102AB (LBCC-1)
TC 9.11 Energy Efficiency (12/6) Screen/Electric
Monday (6/26)  4:30 pm – 5:00 pm  102AB (LBCC-1)
TC 9.11 Handbook (12/6) Screen/Electric
Monday (6/26)  5:00 pm – 5:30 pm  102AB (LBCC-1)
TC 9.11 Design Guide (12/6) Screen/Electric
Monday (6/26)  5:30 pm – 6:00 pm  102AB (LBCC-1)

TC 9.12 Tall Buildings (12/8)
Tuesday (6/27)  3:30 pm – 6:00 pm  Nieto (R-2)

TC 10.1 Custom Engineered Refrigeration Systems (30/10) Screen
Monday (6/26)  2:00 pm – 4:00 pm  Beacon B (H-4)

TC 10.2 Automatic Ice Making Plants and Skating Rinks (12/3) Screen/Electric
Monday (6/26)  4:30 pm – 6:30 pm  Ebell (R-3)
**TC 10.3 Refrigerant Piping, Controls and Accessories (20/10) Screen**
Tuesday (6/27) 1:00 pm – 3:30 pm Nieto (R-2)
TC 10.3 RP-1569 PMS (15/0)
Tuesday (6/26) 8:00 am – 10:00 am Bixby 1 (R-2)

**TC 10.5 Refrigerated Processing and Storage (15/10)**
Tuesday (6/27) 3:30 pm – 6:00 pm Bixby 1 (R-2)

**TC 10.6 Transport Refrigeration (8/10) Screen/Electric**
Monday (6/26) 4:45 pm – 7:00 pm Seaside 3B (LBCC-SS)
TC 10.6 Handbook (5/5) Electric
Monday (6/26) 2:15 pm – 4:15 pm Seaside 3B (LBCC-SS)

**TC 10.7 Commercial Food and Beverage Refrigeration Equipment (30/40) Screen**
Monday (6/26) 2:15 pm – 4:15 pm Pike 3 (R-1)
TC 10.7 Program (10/4)
Sunday (6/25) 5:00 pm – 5:30 pm Broadlind 2 (R-2)
TC 10.7 Research (10/4)
Sunday (6/25) 6:00 pm – 6:30 pm Broadlind 2 (R-2)
TC 10.7 Handbook (10/4)
Sunday (6/25) 6:30 pm – 7:30 pm Broadlind 2 (R-2)

**TC 10.8 Refrigeration Load Calculations (10/10)**
Sunday (6/25) 3:00 pm – 5:00 pm Seaside 2 (LBCC-SS)

**TASK GROUPS (TG), TECHNICAL RESOURCE GROUPS (TRG), AND MULTIDISCIPLINARY TASK GROUPS (MTG)**

**TG2 HVAC Security (10/5) Screen/Electric**
Tuesday (6/27) 9:00 am – 12:00 pm Seaside 4A (LBCC-SS)

**TRG4.IAQP–Indoor Air Quality Procedure (12/8)**
Screen/Electric
Sunday (6/25) 10:30 am – 12:00 pm Bixby 2 (R-2)

**TRG9 Cold Climate Building Design Guide (20/0)**
Screen/Electric
Wednesday (6/28) 9:00 am – 11:00 am Pacific (H-1)
TRG9 Cold Climate Building Design Guide 2018 Working Session (12/0)
Monday (6/26) 8:00 am – 12:00 pm Harbor C (H-1)

**MTG.BIM – Building Information Modeling (20/0)**
Screen
Monday (6/26) 10:15 am – 12:00 pm Broadlind 2 (R-2)

**MTG.ET–Energy Targets (10/10)**
Tuesday (6/27) 12:00 pm – 3:00 pm Harbor A (H-1)

**MTG.HCDG – Hot Climate Design Guide (20/0)**
Sunday (6/25) 8:00 am – 9:00 am Pike 3 (R-1)
MTG.IAST – Impact of ASHRAE Standards and Technology on Energy Savings/Performance (15/10) Electric
Saturday (6/24)  1:00 pm – 2:30 pm     Delker (R-3)

MTG.LowGWP – Lower Global Warming Potential Alternative Refrigerants (25/36) Screen
Sunday (6/25)  5:00 pm – 6:00 pm     203C (LBCC-2)
Wednesday (6/28) 10:00 am – 12:00 pm  204 (LBCC-2)
MTG.LowGWP Research Subcommittee (20/20) Screen/Electric
Sunday (6/25) 12:00 pm – 2:00 pm     204 (LBCC-2)
MTG.LowGWP Codes & Standards (20/15) Screen/Electric
Tuesday (6/27)  1:00 pm – 3:30 pm     202C (LBCC-2)

MTG.OBB – Occupant Behavior in Buildings (30/10) Screen
Monday (6/26)  8:00 am – 10:00 am     Bixby 1 (R-2)

Sunday (6/25)  7:30 am – 8:15 am     Bixby 4/5 (R-2)

STANDARD PROJECT COMMITTEES (SPC) AND STANDING STANDARD PROJECT COMMITTEES (SSPC)

PC Chairs Training Breakfast (100/0) Screen
Sunday (6/25)  7:30 am – 9:00 am     Regency DEF (H-4)

SSPC 15 Safety Standards for Refrigeration Systems (20/40) Screen/Electric
Sunday (6/25)  1:00 pm – 5:00 pm     Seaside 1 (LBCC-SS)
SSPC 15 Safety Standards for Refrigeration Systems Rewrite (20/40) Screen/Electric
Saturday (6/24) 1:00 pm – 4:00 pm     Beacon B (H-4)
SSPC 15 Safety Standards for Refrigeration Systems Ad Hoc and Rewrite (20/40) Screen/Electric
Sunday (6/25)  9:00 am – 12:00 pm     Seaside 1 (LBCC-SS)
SSPC 15 Subcommittee 15.2 Safety Standard for Refrigeration Systems in Residential Applications (15/15) Screen/Electric
Tuesday (6/27)  8:00 am – 12:00 pm     Bixby 2 (R-2)

Sunday (6/25)  12:00 pm – 2:00 pm     Seaside 5A (LBCC-SS)

SPC 24 Methods of Testing for Rating Liquid Coolers (6/10) Screen/Electric
Tuesday (6/27)  8:00 am – 12:00 pm     Dawson (R-3)

SPC 25 Methods of Testing Forced-Circulation Free-Delivery Unit Coolers for Refrigeration (5/3)
Monday (6/26)  7:30 pm – 9:30 pm     Alford (R-2)
SPC 26 Mechanical Refrigeration & Air-Conditioning Installation Aboard Ship (4/4) Screen /Electric
Tuesday (6/27)  8:00 am – 12:00 pm  Seaside 4B (LBCC-SS)

SPC 28 MOT Flow Capacity of Refrigerant Capillary Tubes (5/5) Electric
Sunday (6/25)  5:00 pm – 7:00 pm  Seaside 3A (LBCC-SS)

SPC 30 Method of Testing Liquid-Chilling Packages (7/5) Screen/Electric
Monday (6/26)  8:00 am – 11:00 am  Seaside 4A (LBCC-SS)

SPC 32.2 MOT for Rating Pre-Mix and Post-Mix Beverage Dispensing Equipment (5/3) Screen
Tuesday (6/27)  8:00 am – 12:00 pm  Seaside 5B (LBCC-SS)

SSPC 34 Designation and Safety Classification of Refrigerants (18/55) Screen /Electric
Monday (6/26)  6:30 pm – 10:00 pm  Pike 3 (R-1)
   SSPC 34 Designation and Nomenclature Subcommittee (13/45) Screen/Electric
   Saturday (6/24) 7:00 am – 10:00 am  201A (LBCC-2)
   SSPC 34 Flammability Subcommittee (15/51) Screen/Electric
   Saturday (6/24) 10:00 am – 3:00 pm  201A (LBCC-2)
   SSPC 34 Toxicity Subcommittee (10/26) Screen/Electric
   Sunday (6/25)  6:30 pm – 10:00 pm  Bixby 1 (R-2)

SPC 37 MOT for Rating Electrically Driven Unitary Air-Conditioners and Heat Pump Equipment (20/30) Screen/Electric
Wednesday (6/28)10:00 am – 12:00 pm  202C (LBCC-2)

SSPC 41 Standard Methods for Measurement (18/10) Electric
Sunday (6/25)  1:00 pm – 3:00 pm  Broadlind 2 (R-2)
   41.3 Subcommittee, Standard Methods for Pressure Measurement (10/5) Screen/Electric
   Sunday (6/25) 10:00 am – 12:00 pm  Broadlind 2 (R-2)
   SSPC 41 Uncertainty Ad Hoc Committee (18/10) Electric
   Sunday (6/25)  3:00 pm – 4:00 pm  Broadlind 2 (R-2)
   41.6 Subcommittee, Standard Methods for Humidity Measurement (10/5) Screen/Electric
   Monday (6/26) 10:00 am – 12:00 pm  Alford (R-2)
   41.11 Subcommittee, Standard Methods for Power Measurement (10/5) Screen/Electric
   Monday (6/26)  2:15 pm – 4:15 pm  Alford (R-2)
   41.4 Subcommittee, Standard Methods for Proportion of Lubricant in Liquid Refrigerant Measurement (10/5)
   Screen/Electric
   Monday (6/26)  4:15 pm – 6:15 pm  Alford (R-2)
   Tuesday (6/27)  8:00 am – 10:00 am  Alford (R-2)
   41.1 Subcommittee, Standard Methods for Temperature Measurement (10/5) Screen/Electric
   Tuesday (6/27) 10:00 am – 12:00 pm  Alford (R-2)
SSPC 52.2 Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size (16/45) Screen/Electric
Saturday (6/24) 8:00 am – 12:00 pm Broadlind 1 (R-2)

SSPC 55 Thermal Env. Cond. for Human Occupancy (15/5) Screen/Electric
Saturday (6/24) 8:00 am – 3:00 pm Tichenor (R-2)
Sunday (6/25) 9:00 am – 12:00 pm Seaside 7 (LBCC-SS)

SSPC 62.1 Ventilation for Acceptable Indoor Air Quality (30/30) Screen/Electric
Saturday (6/24) 8:00 am – 12:00 pm Pike 3 (R-1)
Sunday (6/25) 1:00 pm – 7:00 pm Pike 3 (R-1)
  SSPC 62.1 IAQ Guideline Subcommittee (15/15) Screen/Electric
  Friday (6/23) 8:00 am – 12:00 pm Pike 2 (R-1)
  SSPC 62.1 Administration Subcommittee (15/15) Screen/Electric
  Friday (6/23) 1:00 pm – 3:00 pm Pike 1 (R-1)
  Saturday (6/24) 1:00 pm – 3:00 pm Alford (R-2)
  SSPC 62.1 Research and Education Subcommittee (15/15) Screen/Electric
  Friday (6/23) 1:00 pm – 3:00 pm Pike 2 (R-1)
  Saturday (6/24) 1:00 pm – 3:00 pm Broadlind 2 (R-2)
  SSPC 62.1 Buildings, Systems and Equipment (15/15) Screen/Electric
  Friday (6/23) 3:00 pm – 5:00 pm Pike 1 (R-1)
  Saturday (6/24) 1:00 pm – 3:00 pm Pike 3 (R-1)
  SSPC 62.1 Ventilation Subcommittee (15/15) Screen/Electric
  Friday (6/23) 3:00 pm – 5:00 pm Pike 2 (R-1)
  Saturday (6/24) 1:00 pm – 3:00 pm Nieto (R-2)
  SSPC 62.1 Natural Ventilation Working Group (15/30) Screen/Electric
  Monday (6/26) 8:00 am – 12:00 pm Pike 2 (R-1)

SSPC 62.2 Ventilation and Acceptable IAQ in Residential Buildings (30/20) Screen/Electric
Friday (6/23) 9:00 am – 2:30 pm Pike 3 (R-1)
Saturday (6/24) 8:00 am – 3:00 pm Pike 1 (R-1)
  SSPC 62.2 Envelope Subcommittee (20/20) Screen/Electric
  Friday (6/23) 2:30 pm – 5:00 pm Pike 3 (R-1)
  SSPC 62.2 IAQ Subcommittee (12/20) Screen/Electric
  Friday (6/23) 2:30 pm – 5:00 pm Bixby 1 (R-2)
  SSPC 62.2 System Subcommittee (12/20) Screen/Electric
  Friday (6/23) 2:30 pm – 5:00 pm Nieto (R-2)

SPC 63.1 Method of Testing Liquid-Line Refrigerant Driers (5/6)
Sunday (6/25) 6:00 pm – 8:00 pm Harbor C (H-1)

SPC 63.2 Method of Testing Liquid-Line Filter Drier Filtration Capability (9/3) Screen/Electric
Sunday (6/25) 2:00 pm – 3:00 pm Harbor C (H-1)
SPC 64 Methods of Lab Testing Remote Mechanical Draft Evaporative Refrigerant Condensers (6/5)
Monday (6/26) 10:00 am – 11:00 am Suite 334 (R-3)

SPC 70 Method of Testing for Rating the Performance of Air Outlets and Air Inlets (15/10) Screen/Electric
Monday (6/26) 10:00 am – 12:00 pm Shoreline B (H-1)

SSPC 72 Method of Testing Open and Closed Commercial Refrigerators and Freezers (16/14) Electric
Sunday (6/25) 1:00 pm – 5:00 pm Shoreline A (H-1)

SPC 78 Method of Testing Flow Capacity of Suction Line Filters and Filter-Driers (6/6)
Sunday (6/25) 3:00 pm – 4:00 pm Harbor C (H-1)

SPC 84 Method of Testing Air-to-Air Heat/Energy Exchangers (8/12) Screen/Electric
Monday (6/26) 4:15 pm – 6:30 pm Seaside Ballroom B (LBCC-SS)

SSPC 90.1 Energy Eff. Design of New Bldg. (50/60) Screen/Electric
Saturday (6/24) 8:00 am–12:00 pm Bixby 4/5 (R-2)
Sunday (6/25) 9:00 am–12:00 pm Bixby 4/5 (R-2)
Monday (6/26) 8:00 am–12:00 pm Bixby 4/5 (R-2)

SSPC 90.1 Envelope Subcommittee (15/30) Screen/Electric
Friday (6/23) 9:00 am – 10:00 pm Bixby 3 (R-2)
Saturday (6/24) 1:00 pm – 8:00 pm Bixby 2 (R-2)
Sunday (6/25) 1:00 pm – 8:00 pm Bixby 3 (R-2)

SSPC 90.1 Envelope Subcommittee Working Group (15/30) Screen/Electric
Friday (6/23) 9:00 am – 10:00 pm Broadlind 2 (R-2)
Saturday (6/24) 1:00 pm – 7:00 pm Broadlind 1 (R-2)
Sunday (6/25) 1:00 pm – 8:00 pm Broadlind 1 (R-2)

SSPC 90.1 Mechanical Subcommittee (25/25) Screen/Electric
Friday (6/23) 9:00 am – 10:00 pm Bixby 2 (R-2)
Saturday (6/24) 1:00 pm – 7:00 pm Bixby 4/5 (R-2)
Sunday (6/25) 1:00 pm – 8:00 pm Bixby 4/5 (R-2)

SSPC 90.1 ECB Subcommittee (12/18) Screen/Electric
Friday (6/23) 3:00 pm – 8:00 pm Wilmore (R-2)
Saturday (6/24) 1:00 pm – 5:00 pm Wilmore (R-2)
Sunday (6/25) 1:00 pm – 4:00 pm Wilmore (R-2)

SSPC 90.1 Format & Compliance Subcommittee (6/6) Electric
Friday (6/23) 5:00 pm – 10:00 pm Tichenor (R-2)
Saturday (6/24) 1:00 pm – 5:00 pm Ebell (R-3)
Sunday (6/25) 4:00 pm – 7:00 pm Wilmore (R-2)

SSPC 90.2 Energy-Efficient Design of Low-Rise Residential Buildings (20/15) Screen/Electric
Monday (6/26) 2:15 pm – 6:15 pm Bixby 2 (R-2)
Tuesday (6/27) 1:00 pm – 5:00 pm Broadlind 1 (R-2)
SSPC 90.2 Envelope (10/10) Screen/Electric
Monday (6/26) 6:30 pm – 9:30 pm  Bixby 2 (R-2)
Tuesday (6/27) 8:00 am – 12:00 pm  Broadlind 1 (R-2)

SSPC 90.2 Lighting (3/5) Electric
Monday (6/26) 6:30 pm – 9:30 pm  Tichenor (R-2)
Tuesday (6/27) 8:00 am – 12:00 pm  Tichenor (R-2)

SSPC 90.2 Mechanical (5/10) Screen/Electric
Monday (6/26) 6:30 pm – 9:30 pm  Nieto (R-2)
Tuesday (6/27) 8:00 am – 12:00 pm  Nieto (R-2)

SSPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings (17/20) Screen
Saturday (6/24) 9:00 am – 1:00 pm  Bixby 2 (R-2)
Monday (6/26) 7:30 am – 11:30 am  Dawson (R-3)

SSPC 97 Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use Within Refrigerant Systems (8/4) Screen/Electric
Tuesday (6/27) 9:30 am – 11:00 am  Seaside 2 (LBCC-SS)

SSPC 100 Energy Efficiency in Existing Buildings (20/10) Screen/Electric
Tuesday (6/27) 8:00 am – 12:00 pm  204 (LBCC-2)
SSPC 100 Alternative to EUI (WG5) (16/10) Screen/Electric
Sunday (6/25) 12:00 pm – 2:00 pm  Seaside 6 (LBCC-SS)

SSPC 100 International Target Table and Climate Zones (WG4) (4/5) Screen/Electric
Sunday (6/25) 4:00 pm – 6:00 pm  Seaside 6 (LBCC-SS)

Tuesday (6/27) 8:00 am – 12:00 pm  Regency D (H-4)

SPC 113 Method of Testing for Room Air Diffusion (10/10) Screen/Electric
Tuesday (6/27) 3:30 pm – 5:00 pm  Seaside 6 (LBCC-SS)

SPC 118.1 Method of Testing for Rating Commercial Gas, Electric and Oil Service Water Heating Equipment (15/20) Screen/Electric
Sunday (6/25) 9:00 am – 11:00 am  Seaside 4B (LBCC-SS)

SPC 118.2 Method of Testing for Rating Residential Water Heaters (15/15)
Tuesday (6/27) 1:00 pm – 5:00 pm  Seaside 5B (LBCC-SS)

SPC 124 MOT/Rating Combinations Space-Heating and Water Heating Appliances (13/7) Electric
Tuesday (6/27) 9:00 am – 12:00 pm  Delker (R-3)

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 (6/27) 8:00 am – 12:00 pm  Seaside 5A (LBCC-SS)
SPC 128 Method of Rating Portable Air Conditioners
(10/0)
Tuesday (6/27) 11:00 am – 12:00 pm Seaside 2 (LBCC-SS)

SPC 130 MOT/for Rating Ducted Air Terminal Units
(15/20)
Sunday (6/25) 2:00 pm – 6:00 pm Pacific (H-1)

SSPC 135 BACnet (40/10) Electric
Friday (6/23) 8:00 am – 5:00 pm Delker (R-3)
Saturday (6/24) 8:00 am – 3:30 pm Pike 2 (R-1)
Monday (6/26) 8:00 am – 12:00 pm Pike 3 (R-1)
SSPC 135 BACnet Working Groups (20/5) Electric
Thursday (6/22) 8:00 am – 5:00 pm Dawson (R-3)
Friday (6/23) 8:00 am – 5:00 pm Dawson (R-3)
Sunday (6/25) 8:00 am – 5:00 pm Dawson (R-3)
Sunday (6/25) 8:00 am – 5:00 pm Delker (R-3)

SSPC 140 Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs
(15/12) Screen/Electric
Monday (6/26) 2:15 pm – 6:15 pm Delker (R-3)

SSPC 145 Test Method for Assessing the Performance of Gas Phase Air Cleaning Equipment (10/15)
Screen/Electric
Sunday (6/25) 12:00 pm – 3:00 pm Bixby 2 (R-2)

SSPC 146 Method of Testing and Rating Pool Heaters
(7/5) Electric
Tuesday (6/27) 8:00 am – 12:00 pm Suite 332 (R-3)

SSPC 147 Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Systems
(5/5) Screen/Electric
Tuesday (6/27) 8:00 am – 12:00 pm Broadlind 2 (R-2)

Sunday (6/25) 5:00 pm – 6:00 pm Dawson (R-3)

SSPC 154 Ventilation for Commercial Cooking Operations (15/10) Screen/Electric
Sunday (6/25) 8:00 am – 12:00 pm Seaside 5A (LBCC-SS)

Sunday (6/25) 8:00 am – 12:00 pm Seaside 3A (LBCC-SS)

SPC 158.1 MOT Capacity of Refrigerant Solenoid Valves (5/5) Electric
Sunday (6/25) 5:00 pm – 7:00 pm Seaside 3A (LBCC-SS)

SPC 158.2 MOT Capacity of Refrigerant Pressure Regulators (7/5) Electric
Sunday (6/25) 5:00 pm – 7:00 pm Seaside 3A (LBCC-SS)
SSPC 160 Criteria for Moisture Control Design Analysis in Buildings (20/5) Screen/Electric
Tuesday (6/27)  8:00 am – 12:00 pm    Wilmore (R-2)

SSPC 161P Air Quality Within Commercial Aircraft
Met prior to Long Beach Conference via web meeting (June 19, 11:30-2:30 p.m. ET)

SPC 164 MOT for Humidifiers (6/4) Screen/Electric
Monday (6/26)  9:00 am – 11:00 am    Seaside 2 (LBCC-SS)

SSPC 169 Climatic Data for Building Design Standards (10/5) Screen
Monday (6/26)  10:00 am – 12:00 pm    Broadlind 1 (R-2)

SSPC 170 Ventilation of Healthcare Facilities (18/30) Screen/Electric
Monday (6/26)  4:00 pm – 6:00 pm    Pike 1 (R-1)
Tuesday (6/27)  8:00 am – 1:00 pm    Pike 1 (R-1)

SSPC 170 Ventilation of Healthcare Facilities, Natural Ventilation Work Group (15/0) Screen/Electric
Monday (6/26)  2:00 pm – 4:00 pm    Pike 1 (R-1)

SSPC 174P Method of Test for Rating Desiccant Based Dehumidification Equipment (5/2)
Monday (6/26)  10:00 am – 12:00 pm   Seaside 5A (LBCC-SS)

SPC 180 Standard Practice for Inspection and Maintenance of HVAC Systems (20/10) Screen/Electric
Friday (6/23)  2:00 pm – 6:00 pm    Bixby 5 (R-2)

SPC 182 Method of Test for Absorption Chillers (5/5) Electric
Monday (6/26)  11:00 am – 12:00 pm   Suite 334 (R-3)

SPC 184 Method of Test for Field Performance of Liquid-Chilling Systems (10/6) Screen
Tuesday (6/27)  8:00 am – 10:00 am    Seaside 3B (LBCC-SS)

SSPC 185 Methods of Test to Inactivate Microorganisms in HVAC Systems with UV-C Lights (6/6)
Saturday (6/24)  8:00 am – 9:00 am     Ebell (R-3)

SPC 188 Legionellosis: Risk Management for Building Water Systems (50/15) Screen/Electric
Tuesday (6/27)  8:00 am – 12:00 pm    Bixby 5 (R-2)
Tuesday (6/27)  3:30 pm – 5:30 pm    Bixby 5 (R-2)
Wednesday (6/28)  8:00 am – 12:00 pm  102C (LBCC-1)

SSPC 189.1 ASHRAE/USGBC/IES Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (45/50) Screen/Electric
Tuesday (6/27)  8:00 am – 10:00 am    Pike 3 (R-1)
Wednesday (6/28)  8:00 am – 12:00 pm  Pike 3 (R-1)

SSPC 189.1 Working Group 6 (Water Use) (20/20) Screen/Electric
Tuesday (6/27)  10:00 am – 12:30 pm    Pike 2 (R-1)
SSPC 189.1 Working Group 7 (Energy Efficiency) (30/30)
Screen/Electric
Tuesday (6/27) 10:00 am – 1:00 pm Pike 3 (R-1)
SSPC 189.1 Working Group 9 (Materials and Resources)
(20/20) Screen/Electric
Tuesday (6/27) 1:00 pm – 3:00 pm Pike 2 (R-1)
SSPC 189.1 Working Group 8 (IEQ) (30/30) Screen/Electric
Tuesday (6/27) 1:00 pm – 4:00 pm Pike 1 (R-1)
SSPC 189.1 Working Group 7.5 (30/30) Screen/Electric
Tuesday (6/27) 1:30 pm – 4:30 pm Pike 3 (R-1)
SSPC 189.1 Working Group 5 (Site Sustainability) (20/20)
Screen/Electric
Tuesday (6/27) 4:00 pm – 6:00 pm Pike 1 (R-1)
SSPC 189.1 Working Group 10 (20/20) Screen/Electric
Tuesday (6/27) 5:00 pm – 7:00 pm Pike 2 (R-1)

SPC 189.3P Design, Construction and Operation of
Sustainable High Performance Health Care Facilities
(18/12)Screen/Electric
Monday (6/26) 8:00 am – 12:00 pm Seaside 7 (LBCC-SS)

SPC 191 Standard for the Efficient Use of Water in
Building and Mechanical Systems (12/6)Screen/Electric
Tuesday (6/27) 10:00 am – 12:00 pm Bixby 1 (R-2)

SPC 194 MOT/Direct-Expansion Ground Source Heat
Pumps (5/10)
Sunday (6/25) 1:00 pm – 3:00 pm Seaside 3A (LBCC-SS)

SPC 195 Method of Test for Rating Air Terminal Unit
Controls (8/4) Electric
Tuesday (6/27) 10:00 am – 12:00 pm Seaside 6 (LBCC-SS)

SPC 196 Method of Test for Measuring Refrigerant
Leak Rates (10/10) Screen/Electric
Sunday (6/25) 6:00 pm – 10:00 pm Pike 1 (R-1)

SPC 198 Method of Test for Rating DX-Dedicated
Outdoor Air Systems for Moisture Removal Capacity
and Moisture Removal Efficiency (16/10)
Tuesday (6/27) 5:00 pm – 6:00 pm Regency D (H-4)

SPC 199P Method of Testing the Performance of
Industrial Pulse Cleaned Dust Collectors (10/10)
Sunday (6/25) 8:00 am – 12:00 pm Seaside 3B (LBCC-SS)

SPC 200 MOT Chilled Beams (15/10) Electric
Monday (6/26) 8:00 am – 10:00 am Broadlind 2 (R-2)

SSPC 202 Commissioning Process for Buildings and
Systems (15/15) Screen/Electric
Monday (6/26) 8:00 am – 12:00 pm Bixby 2 (R-2)

SSPC 202 Guideline 0 subcommittee, The Commissioning
Process (15/10) Screen/Electric
Saturday (6/24) 10:00 am – 11:30 am 203AB (LBCC-2)

SSPC 202 Guideline 1.1 subcommittee, The HVAC
Commissioning Process (12/6) Screen/Electric
Saturday (6/24) 12:00 pm – 1:30 pm 203AB (LBCC-2)
Saturday (6/24) 1:30 pm – 3:00 pm     203AB (LBCC-2)
SSPC 202 GPC 1.4 subcommittee meeting, Systems Manual (10/6) Screen/Electric
Sunday (6/25)     10:00 am – 12:00 pm     Seaside 5B (LBCC-SS)

<table>
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<tr>
<th>Event Description</th>
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<tr>
<td>SPC 204 Method of Test for Rating Micro Combined Heat and Power Devices (15/10) Electric</td>
<td>Monday (6/26)</td>
<td>6:30 pm – 9:30 pm</td>
<td>Seaside 5A (LBCC-SS)</td>
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<td>SPC 205 Standard Representation of Performance Simulation Data for HVAC&amp;R and Other Facility Equipment (20/20) Screen/Electric</td>
<td>Tuesday (6/27)</td>
<td>8:00 am – 12:00 pm</td>
<td>Bixby 4 (R-2)</td>
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<tr>
<td>SPC 205 Standard Representation of Performance Simulation Data for HVAC&amp;R and Other Facility Equipment -- Working Groups (20/10) Screen/Electric</td>
<td>Sunday (6/25)</td>
<td>9:00 am – 12:00 pm</td>
<td>Nieto (R-2)</td>
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<tr>
<td>SPC 207P Laboratory Method of Test of Fault Detection and Diagnostics Applied Commercial Air-Cooled Packaged Systems (20/30) Screen</td>
<td>Monday (6/26)</td>
<td>8:00 am – 10:00 am</td>
<td>204 (LBCC-2)</td>
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<td>SPC 207 Scope, Usability, and Verification (20/0) Screen</td>
<td>Monday (6/26)</td>
<td>10:00 am – 12:00 pm</td>
<td>204 (LBCC-2)</td>
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<td>SPC 207 Draft Development (20/0) Screen</td>
<td>Monday (6/26)</td>
<td>4:30 pm – 6:30 pm</td>
<td>204 (LBCC-2)</td>
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<td>SPC 207 Refrigeration and Airflow (20/0) Screen</td>
<td>Monday (6/26)</td>
<td>6:30 pm – 8:30 pm</td>
<td>204 (LBCC-2)</td>
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<td>SPC 210 Method of Testing for Rating Commercial Walk-in Cooler and Freezer Equipment (15/15) Screen/Electric</td>
<td>Monday (6/26)</td>
<td>8:00 am – 12:00 pm</td>
<td>Seaside 3A (LBCC-SS)</td>
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<td>SPC 211 Commercial Building Energy Audits (19/15) Screen/Electric</td>
<td>Monday (6/26)</td>
<td>8:00 am – 12:00 pm</td>
<td>Seaside 4B (LBCC-SS)</td>
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<tr>
<td>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</td>
<td>Tuesday (6/27)</td>
<td>1:00 pm – 5:00 pm</td>
<td>Seaside 4A (LBCC-SS)</td>
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<tr>
<td>SPC 213P Method of Calculating Moist Air Thermodynamics (8/5)</td>
<td>Tuesday (6/27)</td>
<td>8:00 am – 12:00 pm</td>
<td>Ebell (R-3)</td>
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<tr>
<td>SPC 215P Method of Test to Determine Leakage of Operating HVAC Air-Distribution Systems (15/15) Screen/Electric</td>
<td>Monday (6/26)</td>
<td>2:15 pm – 6:15 pm</td>
<td>Seaside 5A (LBCC-SS)</td>
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<tr>
<td>SPC 216 MOT for Determining Application Data of Overhead Circulator Fans (12/12) Screen/Electric</td>
<td>Monday (6/26)</td>
<td>2:15 pm – 5:15 pm</td>
<td>Suite 334 (R-3)</td>
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</table>
SPC 217 Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities (12/5) Screen/Electric
Tuesday (6/27) 7:30 am – 12:00 pm Seaside 3A (LBCC-SS)

SPC 218P–MOT for Lubricant and Refrigerant Miscibility Determination (9/4) Screen/Electric
Monday (6/26) 8:00 am – 10:00 am Suite 334 (R-3)

SPC 219 Method of Testing the Ability of Liquid Line Filter Driers or Absorbents to Remove Organic Acid (5/3) Screen/Electric
Wednesday (6/28) 8:00 am – 12:00 pm 103C (LBCC-1)

SPC 220 Method of Testing for Rating Small Commercial Blast Chillers, Blast Chiller-Freezers, and Blast Freezers (12/10) Electric
Monday (6/26) 5:00 pm – 6:30 pm Seaside 4A (LBCC-SS)

SPC 221 Test Method to Measure and Score the Operating Performance of an Installed Constant Volume Unitary HVAC System (12/10) Screen/Electric
Monday (6/26) 8:00 am – 12:00 pm Pike 1 (R-1)

SPC 222P Standard Method of Test for Electrical Power Drive Systems (5/5) Screen/Electric
Sunday (6/25) 8:00 am – 12:00 pm Seaside 6 (LBCC-SS)

GUIDELINE PROJECT COMMITTEE (GPC), (SPC) AND (SGPC)

GPC 1.2 The Commissioning Process for Existing HVAC&R Systems (18/10) Screen/Electric
Friday (6/23) 8:00 am – 12:00 pm Nieto (R-2)

GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process (8/2) Electric
Tuesday (6/27) 1:00 pm – 5:00 pm Seaside 2 (LBCC-SS)

GPC 4-2008R Preparation of Operating and Maintenance Documentation for HVAC&R Systems (6/2)
Sunday (6/25) 8:00 am – 12:00 pm Seaside 2 (LBCC-SS)

GPC 11 Field Testing of HVAC Controls Components (8/4) Screen/Electric
Saturday (6/24) 9:00 am – 12:00 pm Alford (R-2)

GPC 14 Measurement of Energy, Demand and Water Savings (6/6) Electric
Sunday (6/25) 6:00 pm – 10:00 pm Dawson (R-3)

GPC 21 Guideline for the Ventilation and Thermal Management of Batteries for Stationary Applications (5/5)
Tuesday (6/27) 10:00 am – 12:00 pm Seaside 3B (LBCC-SS)

GPC 22 Instrumentation for Monitoring Central Chilled Water Plants (5/3)
Tuesday (6/27) 10:00 am – 12:00 pm Suite 334 (R-3)
GPC 27P Measurement Procedures for Gaseous Contaminants in Indoor Environments (7/4) Electric
Sunday (6/25) 3:00 pm – 5:00 pm 201B (LBCC-2)

GPC 29 Guideline for Risk Management (8/2)
Sunday (6/25) 1:00 pm – 3:00 pm Seaside 2 (LBCC-SS)

GPC 32 Sustainable, High Performance Operations & Maintenance (7/2) Electric
Saturday (6/24) 12:00 pm – 2:00 pm Suite 334 (R-3)

GPC 35 Method for Determining the Energy Consumption Caused By Air-Cleaning and Filtration Devices (12/40) Screen/Electric
Monday (6/26) 8:00 am – 12:00 pm Bixby 3 (R-2)

Monday (6/26) 8:00 am – 12:00 PM Seaside 1 (LBCC-SS)

GPC 37 Upper Room Ultraviolet Germicidal (UV-C) Devices to Control the Transmission of Airborne Pathogens (6/6)
Saturday (6/24) 9:00 am – 12:00 pm Suite Ebell (R-3)

GPC 38 Guideline for Using Pressure Metal Vessels to Test Materials Used in Refrigeration Systems (7/5)
Monday (6/26) 4:15 pm – 6:15 pm Harbor A (H-1)

Tuesday (6/27) 8:00 am–12:00 pm Seaside 1 (LBCC-SS)

SGPC 10 Interaction Affecting the Achievement of Acceptable Indoor Environments (10/10) Electric
Sunday (6/25) 9:00 am – 12:00 pm 204 (LBCC-2)

SGPC 13 Specifying Building Automation Systems (10/15) Screen/Electric
Saturday (6/24) 8:00 am–12:00 pm Delker (R-3)

US TAG to ISO/TC 86 (20/10) Screen/Electric
Monday (6/26) 8:00 am – 10:00 am Nieto (R-2)

US TAG to ISO/TC 142 Cleaning Equipment for Air and other Gases (30/30) Screen/Electric
Saturday (6/24) 2:30 pm – 3:15 pm 202C (LBCC-2)

US TAG to ISO/TC 163 Thermal Performance and Energy in a Building Environment (18/11) Screen/Electric
Tuesday (6/27) 3:00 pm – 4:30 pm Dawson (R-3)

JWG ISO/TC 163/WG4 and ISO/TC 205 (18/11) Screen/Electric
Tuesday (6/27) 2:30 pm – 3:00 pm Dawson (R-3)
US Tag to ISO/TC 205 (22/12) Screen/Electric
Tuesday (6/27)  1:00 pm – 2:30 pm  Dawson (R-3)

ISO 817 MA (23/11) Screen/Electric
Tuesday (6/27)  8:00 am – 12:00 pm  Bixby 3 (R-2)
ISO 817 MA-Flammability (15/10) Screen/Electric
Monday (6/26)  8:00 am – 9:00 am  Broadlind 1 (R-2)
ISO 817 MA-Toxicity (15/10) Screen/Electric
Monday (6/26)  8:00 am – 10:00 am  Alford (R-2)
ISO 817 MA – Design and Nomenclature (15/10) Screen/Electric
Monday (6/26)  9:00 am – 10:00 am  Broadlind 1 (R-2)

ISO 17584 (15/10) Screen
Wednesday (6/28)  7:00 am – 9:00 am  202C (LBCC-2)

OTHER

gbXML (10/0)
Monday (6/26)  2:00 pm – 3:00 pm  Harbor C (H-1)

USNC/IIR (20/20)
Tuesday (6/27)  2:00 pm – 4:00 pm  Shoreline A (H-1)

USNT/IEA (20/10)
Tuesday (6/27)  4:00 pm – 6:00 pm  Shoreline A (H-1)