

**2011 ASHRAE WINTER CONFERENCE  
LAS VEGAS, NEVADA  
JANUARY 29 – FEBRUARY 2, 2011**



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*First-time meeting attendees, see Seminar 4 description on page 29.*

*\*Designated with colored tabs on the edge of the program.*

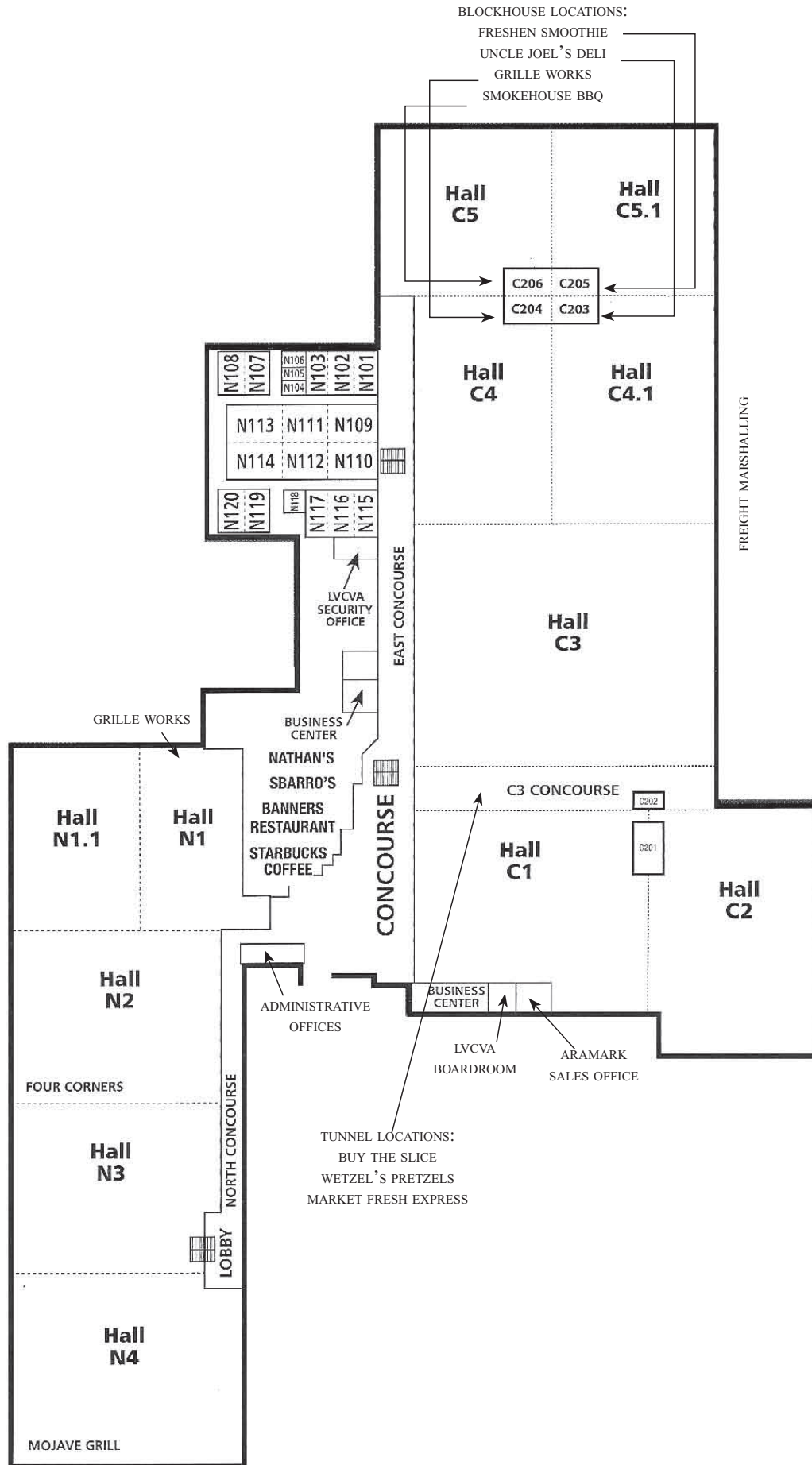
**Personal Program**—Plan your own meeting schedule!

FRIDAY, JANUARY 28	SATURDAY, JANUARY 29	SUNDAY, JANUARY 30
8:00 am–9:30 am	7:30 am–9:00 am	8:00 am–9:30 am
9:45 am–11:00 pm	9:00 am–11:00 pm	9:45 am–10:45 am
11:00 am–12:30 pm	11:00 am–1:00 pm	11:00 am–12:30 pm
12:30 pm–2:00 pm	1:00 pm–3:00 pm	1:30 pm–3:00 pm
2:00 pm–3:30 pm	3:00 pm–5:00 pm	3:00 pm–5:00 pm

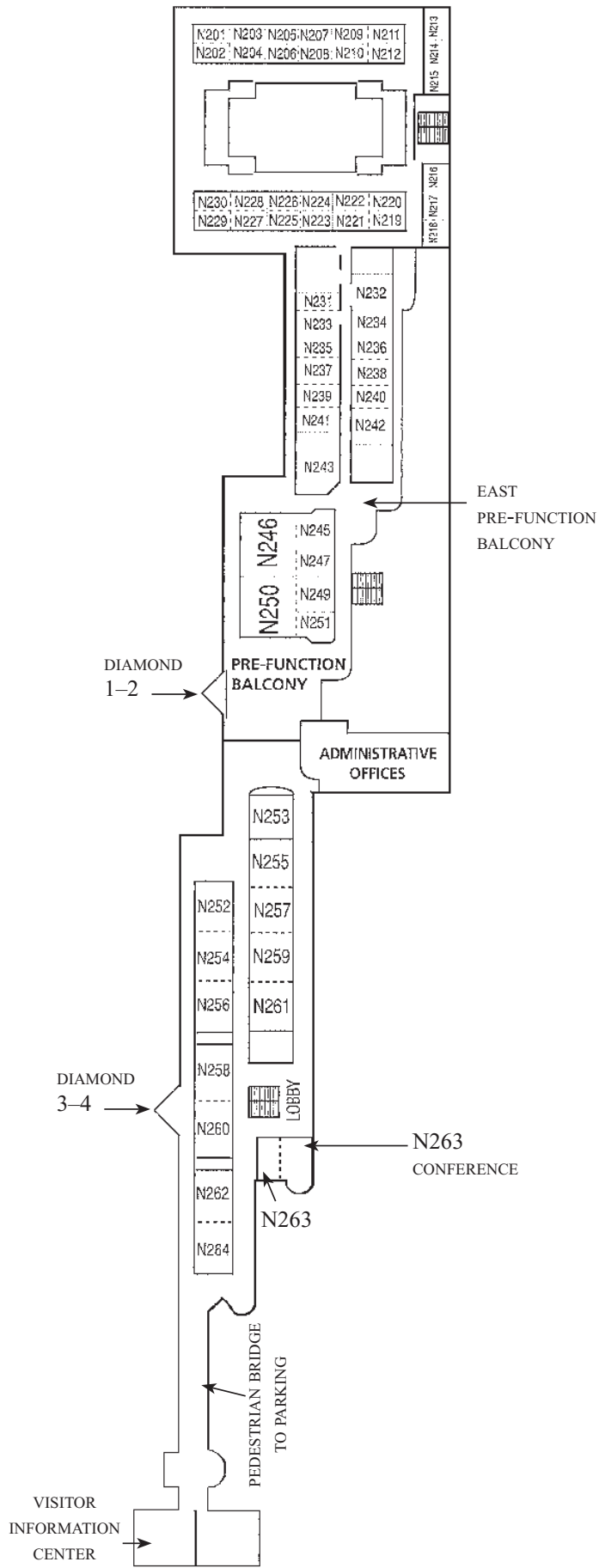
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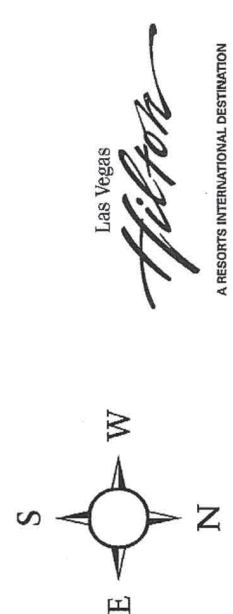
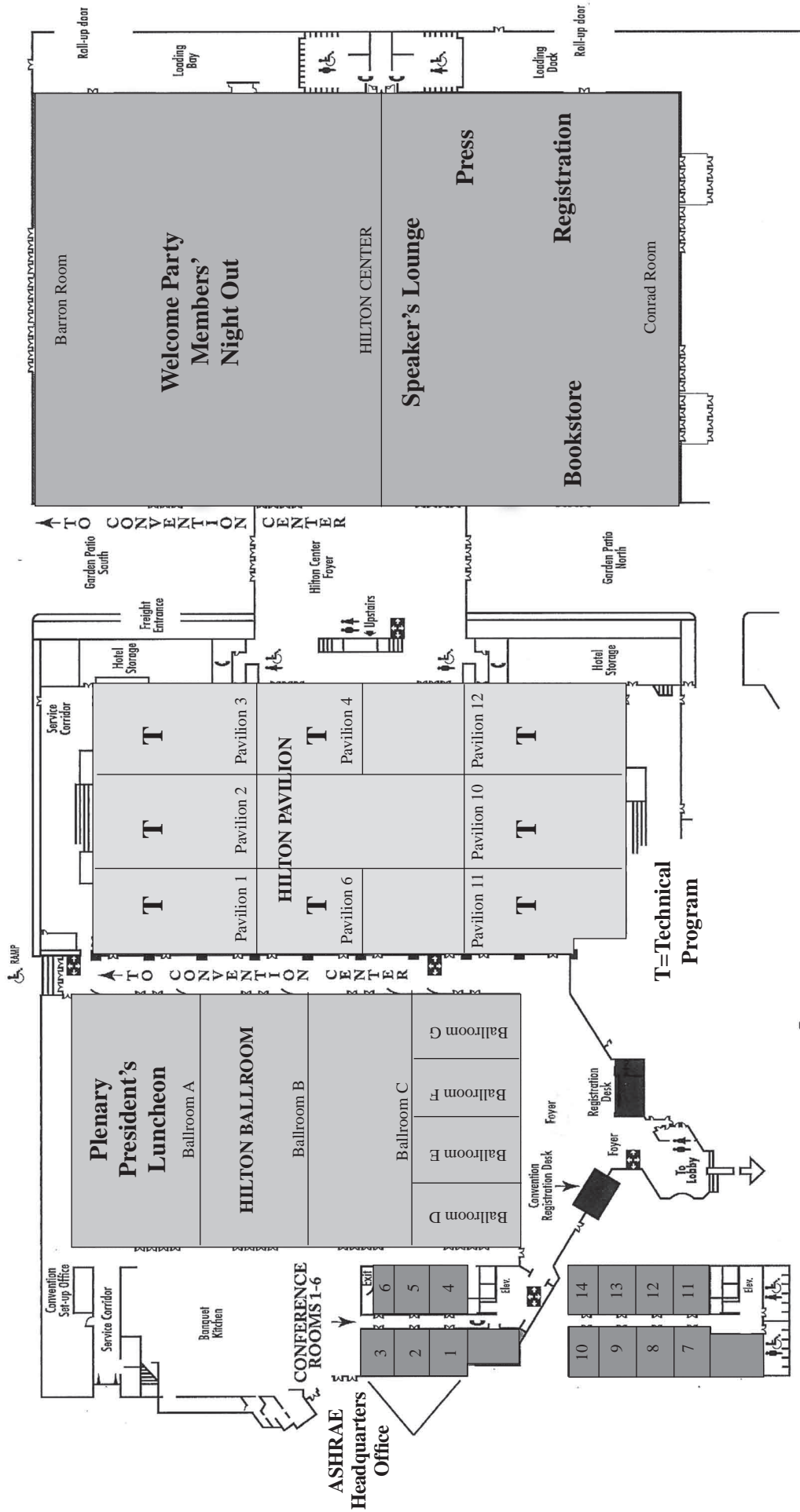
MONDAY, JANUARY 31	TUESDAY, FEBRUARY 1	WEDNESDAY, FEBRUARY 2
8:00 am–9:30 am	8:00 am–9:30 am	8:00 am–9:30 am
9:45 am–10:45 am	9:45 am–10:45 am	9:45 am–10:45 am
11:00 am–12:00 noon	11:00 am–12:30 pm	11:00 am–12:30 pm
2:00 pm–4:00 pm	1:00 pm–3:00 pm	
4:00 pm–6:00 pm	3:00 pm–5:00 pm	

# Las Vegas Convention Center North Hall – Level One



# Las Vegas Convention Center North Hall – Level Two





CONFERENCE ROOM 7-14 LOCATED ON SECOND FLOOR ABOVE CONFERENCE ROOMS 1-6

A RESORTS INTERNATIONAL DESTINATION

## CHAPTER AND SOCIETY OFFICIALS

*A special thanks to all the members in the Southern Nevada chapter who helped make the meeting a success!*

### Southern Nevada Chapter Officers

James M. Boyd, *President*  
 Bryan Y. Im, *President-Elect*  
 Thomas J. Tetting, *Treasurer*  
 Matt J. Lisiewski, *Secretary*

### Las Vegas Host Committee

General Chair Leon Shapiro

Vice Chair Manny Galvez

Hospitality Jason Cavizo, Chair  
 Dave Fagotti, Co-Chair

Entertainment Mark Speros, Chair  
 Pedro Quiroz, Co-Chair

Sessions Mike Aslanides, Chair  
 Mike Hallenbeck, Co-Chair

Tours Jonathan Leitch, Chair  
 Matt Lisiewski, Co-Chair

Information Lance Robinson, Chair  
 Gary Lovewell, Co-Chair

### ASHRAE Officers

Lynn G. Bellenger, P.E., President  
 Ronald Jarnagin, President-Elect  
 Thomas Watson, P.E., Treasurer  
 William Bahnfleth, Ph.D., P.E., Vice President  
 Sheila J. Hayter, P.E., Vice President  
 Ross D. Montgomery, P.E., Vice President  
 T. David Underwood, Vice President  
 Jeff H. Littleton, Executive Vice President

### Conferences and Expositions Committee

William E. Dietrich, Chair	Ben A. Leppard
Dennis J. Wessel, Vice Chair	Dustan L. Macauley III
Pamela L. Androff	Sarah E. Maston
Bryan R. Becker	Michael J. McDermott
Wade H. Conlan	Keith C. Newcomer
Kelley P. Cramm	Robert B. Risley
K. William Dean	Larry Sun
Charles E. Henck	Monte G. Troutman
Mohammad H. Hosni	David L. Zimmerman
Julia A. Keen	A. Damon Gowan
William K. Klock	

## CONFERENCE SPONSORS

*ASHRAE thanks the following sponsors for their support of the 2011 Winter Conference.*



## GENERAL INFORMATION

### BADGES MUST BE WORN FOR ADMISSION TO SESSIONS

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

### HOTEL ADDRESS, TELEPHONE

Las Vegas Hilton  
3000 Paradise Road  
Las Vegas, NV 89109  
702-732-5111

### 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. All meeting rooms in the North Hall, Level Two at the Las Vegas Convention Center will have wi-fi access.

### NOTICE

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

### CELL PHONES/PAGERS

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

### COMPANY-SPONSORED HOSPITALITY SUITE POLICY

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

### SALE OF MERCHANDISE

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

### SIGNS/DISPLAY OF AFFILIATE MEETING INFORMATION

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

### PHOTO RELEASE

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


### WHAT TO WEAR

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

### INVITATION TO ALL NEW MEMBERS, FIRST-TIME ATTENDEES AND NON MEMBERS 2:45-3:45, Hilton Ballroom D, Sunday, January 30

If you've never attended an ASHRAE meeting before, join us and meet some of your fellow first timers. New Member, non-members and first time meeting attendees are invited, and feel free to bring your family members. The event is sponsored and hosted by the ASHRAE Membership Promotion Committee. As a first time attendee plan to attend Seminar 4, Make the Most of Your ASHRAE Experience, scheduled at 8:00 a.m. Sunday morning. This session will offer insights to all the opportunities available at an ASHRAE 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. In order to report your attendance at the session, please sign the PDH and AIA sign-in sheets in the session room.

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

### NEW!

A new process for providing you information on the sessions you attend will begin at this conference. Your badge will be scanned as you enter the session and a summary of sessions attended will be emailed to you upon conclusion of the conference. The new scanning process may take a little longer to get into the room so have patience. Please keep track of the sessions that you attend at the conference.



## MEETING PAPERS

Abstracts of all poster papers and sessions are included in this program. During the conference, papers presented at the poster session and technical paper and conference paper sessions can be purchased in the ASHRAE Bookstore. After the conference, papers will be posted in the online ASHRAE Bookstore. Papers are not available for seminars or forums. Poster and technical paper session papers will be published with discussion in ASHRAE Transactions. Conference papers will be published in ASHRAE Transactions without discussion. Other meeting papers can be purchased in the online Bookstore at [www.ASHRAE.org](http://www.ASHRAE.org) or searched online in Abstract Center. The Abstract Center is a searchable database of abstracts on everything ASHRAE has published since 1980. This service is free to ASHRAE members, but a subscription fee will be charged to nonmembers. For ordering information, contact ASHRAE Customer Service at 1-800-527-4723.

## VIRTUAL CONFERENCE

### *Free for Paid Conference Registrants*

ASHRAE is offering a virtual conference option so you won't miss the state-of-the-art concepts and latest design techniques presented in the Society's technical program. The Las Vegas Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board. All conference attendees paying the full registration fee should have received via email their password and link prior to arriving in Las Vegas. If you do not have your password and link Go to [www.ashrae.org/lasvegasvirtual](http://www.ashrae.org/lasvegasvirtual) and click on the link to access the Virtual Conference and put in your email address to request your password.

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations
- Access to all seminar presentations
- Access to selected transactions session paper presentations
- Access to posters presented in the poster session
- Ability to post questions or answers for selected sessions through Friday, Feb. 18. Presentations available online for 18 months.

A full slate of technical programs will be posted beginning Monday, Jan. 31, of the sessions that were presented the previous day, with additional content posted through Wednesday, Feb. 2

On-site registration is available for those who would like to purchase the Virtual Conference. To sign up, go to ASHRAE Registration, Hilton, Conrad Room, \$299 ASHRAE member; \$464 non member.

Fully-paid conference attendees registering on-site receive a temporary password at registration.

## SOME COMMON SENSE SAFETY TIPS

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

**Hotel Safety.** Some general guest safety tips include:

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

## EMERGENCY SITUATIONS

Hotel emergencies should be directed to the hotel operator; for police and fire department emergencies dial 911. Hotel security is trained in emergency response and can get to the scene of an emergency quickly if medical assistance is needed. In case of an emergency, Sunrise Hospital is located at 3186 S. Maryland Parkway. Phone is 702-731-8000.

## Fire Emergency... Preparedness in Hotels

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

## ROOMS/HOURS

### FINDING THE ASSIGNED MEETING ROOM

To assist you in finding your meeting room at the Winter Conference, please refer to the floor plans located in the front of this program. Meetings are scheduled in both the Las Vegas Hilton and Las Vegas Convention Center which is adjacent to the Hilton and within easy walking distance. ALI Short Courses are scheduled in the Las Vegas Convention Center. Meeting room names are listed in this program followed by parentheses indicating the number of the floor the room is located on.

### CONFERENCE REGISTRATION Las Vegas Hilton, Conrad

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

Friday, January 28	11:00 a.m.–4:00 p.m.
Saturday, January 29	7:15 a.m.–6:00 p.m.
Sunday, January 30	7:00 a.m.–5:00 p.m.
Monday, January 31	7:00 a.m.–4:00 p.m.
Tuesday, February 1	7:30 a.m.–4:00 p.m.
Wednesday, February 2	7:30 a.m.–10:00 a.m.

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

### ASHRAE BOOKSTORE Las Vegas Hilton, Conrad

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

Friday, January 28	11:00 a.m.–5:00 p.m.
Saturday, January 29	7:15 a.m.–6:00 p.m.
Sunday, January 30	7:00 a.m.–5:00 p.m.
Monday, January 31	7:00 a.m.–4:00 p.m.
Tuesday, February 1	7:30 a.m.–4:00 p.m.
Wednesday, February 2	7:30 a.m.–1:00 p.m.

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

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

*Make the bookstore your meeting place!!*

### AHR EXPO® Las Vegas Convention Center 3150 Paradise Road

#### Hours:

Monday, January 31	10:00 a.m.–6:00 p.m.
Tuesday, February 1	10:00 a.m.–6:00 p.m.
Wednesday, February 2	10:00 a.m.–4:00 p.m.

If you have registered for the ASHRAE Conference, your conference badge is your admission into the exposition. Easy access to the Las Vegas Convention Center is available from the Hilton Center Foyer. Go across the street and up the escalator to the skywalk which will take you directly to the North Hall meeting rooms.

If you are attending the exposition only and you did not register in advance, the fee for admission is \$20.00 and can be paid at the Las Vegas Convention Center. **Registration for the AHR Expo® will be open from Noon to 5:00 p.m. on Sunday, January 30. Starting Monday, you can register one hour before the doors open.**

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

#### AHR BAR CODES

Exhibitors will scan your badge if you have interest in receiving product information from an exhibitor. This is another step toward greening our events. Contact information provided on the bar code may be distributed to all AHR exhibitors.

### ASHRAE LOUNGE Las Vegas Hilton, Ballroom G

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

This room will be open during the following hours:

Saturday, January 29	7:30 a.m.–3:00 p.m.
Sunday, January 30	7:30 a.m.–4:00 p.m.
Monday, January 31	7:30 a.m.–4:00 p.m.
Tuesday, February 1	7:30 a.m.–4:00 p.m.
Wednesday, February 2	7:30 a.m.–1:00 p.m.

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

#### TOURS

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

**SPEAKERS' LOUNGE****Las Vegas Hilton, Conrad**

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

Saturday, January 29	1:00 p.m.–3:00 p.m.
Sunday, January 30	7:00 a.m.–3:30 p.m.
Monday, January 31	7:00 a.m.–12:15 p.m.
Tuesday, February 1	7:00 a.m.–1:00 p.m.
Wednesday, February 2	7:00 a.m.–1:00 p.m.

**PRESS ROOM****Las Vegas Hilton, Conrad**

The Press Room will be open during the following hours:

Saturday, January 29	8:00 a.m.–2:30 p.m.
Sunday, January 30	8:00 a.m.–5:00 p.m.
Monday, January 31	10:00 a.m.–4:00 p.m.
Tuesday, February 1	8:00 a.m.–4:00 p.m.
Wednesday, February 2	8:00 a.m.–10:00 a.m.

**HEADQUARTERS OFFICE****Las Vegas Hilton, Conference Room 1-3**

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

Friday, January 22	Noon–5:00 p.m.
Saturday, January 29	8:00 a.m.–5:00 p.m.
Sunday, January 30	8:00 a.m.–5:00 p.m.
Monday, January 31	8:00 a.m.–5:00 p.m.
Tuesday, February 1	8:00 a.m.–5:00 p.m.
Wednesday, February 2	8:00 a.m.–1:00 p.m.

**MEMBERSHIP INFORMATION DESK**

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

**INVITATION TO ALL NEW MEMBERS,  
FIRST TIME ATTENDEES AND NON-MEMBERS**  
**Las Vegas Hilton, Ballroom D**

*Sunday, January 30, 2:45 p.m. to 3:45 p.m.*

If you've never attended an ASHRAE meeting before, join us and meet some of your fellow first timers. New members, non-members, and first time meeting attendees are invited, and feel free to bring your family members. The event is sponsored and hosted by the ASHRAE Membership Promotion Committee. You should also plan on attending the session titled Make the Most of Your ASHRAE Experience scheduled from 8:00 – 9:30 a.m. on Sunday morning in Pavilion 3.

**YOUNG ENGINEERS IN ASHRAE (YEA)  
HOSPITALITY ROOM**

**Las Vegas Hilton, Suite 2935, Central Tower**

Attention members age 35 and younger! You are invited to visit the Young Engineers in ASHRAE (YEA) Hospitality room to be held on Sunday, January 30, from 4:00 p.m.–7:00 p.m. The hospitality event offers social and networking opportunities as well as planned activities including meeting tips, leadership development, and more! Light refreshments will be available.

**STUDENT ACTIVITIES****Las Vegas Hilton, Ballroom A**

The Student Breakfast & Program will be held in Ballroom A at the Las Vegas Hilton on Sunday, January 30 from 7:30 a.m.–2:00 p.m. Take advantage of this opportunity to learn more about ASHRAE while becoming acquainted with your fellow students and ASHRAE members. There will be a speaker, design competition and grant award presentations, and a career panel. Don't miss the free student items and the raffle for your chance to win cool prizes! Activities for students are a unique feature of the ASHRAE Winter Conference—a foundation on which to build your network of resources for your future in the HVAC&R industry.

**Student Tour of the City Center Complex.****Sunday, January 30 – Two tours are scheduled.**

\*Buses leave promptly from the East Tower exit at 2:30 and again at 4:30.

\*\*Tour tickets are \$15 and can be purchased at meeting registration

**LAS VEGAS HOST COMMITTEE INFORMATION DESK**  
**Las Vegas Hilton, Conrad**

The Host Committee will have an information desk located at the ASHRAE registration area. General information about the sights of the city will be available, and a host committee member will be present to answer questions about Las Vegas. Information Desk hours will be Saturday and Sunday from 8:00 a.m.–2:00 p.m. and Monday and Tuesday from 8:00 a.m.–Noon. Please take a few minutes to stop by and discover some of the activities available to you in Las Vegas.

**MONTREAL CONFERENCE INFORMATION**  
**Las Vegas Hilton, Conrad**

Information on the upcoming Annual Conference scheduled for June 25-29, 2011, in Montreal, Quebec, Canada will be available in the registration area.

**NEW at this Meeting**

Badges are required for attendance at any of the technical sessions. For the first time scanners will be used to capture the information located on your badge. Upon conclusion of the conference you will be able to get a complete record of all the sessions you attended. Please be patient if the line to get into the room is a little longer – try to get to the sessions you really want to attend early to ensure a seat.

## PROJECT GREEN TEAM

At the Las Vegas Hilton, we take being "Green" seriously. Our Project Green Team has accomplished a lot since 2009 and we look forward to many more green initiatives in the years to come.

### FOOD & BEVERAGE

- Cooking oil recovery and recycling saving F&B approx. \$180,000/yr. (Savings of \$13,000 - \$15,000/mo.)
- Food recycling (leftover food given to pig farm) and recovery of hotel property 'unintended throwaways' using COMBS Bros. approx. annual savings \$156K (Savings of \$10,000 - \$12,000/mo.)
- COMBS Bros. sorts and recycles plastic, glass, cardboard and aluminum (reduces dumpster pulls around \$3,000/mo.)
- 20 reverse osmosis water stations installed. This will eliminate use of bottled water. Styrofoam has been removed from some areas and several departments have stopped using Styrofoam and instead use reusable water and coffee cups. Reusable water bottle distribution to approximately 700 employees.

### MAIL SERVICES

- In the first month of adding recycle bins 3,129 lbs. of recycled paper was gathered. Opportunity Village reduced our paper shredding price per lb. from \$.095 to \$.04 per lb. because we added non-shred paper recycle bins.
- PAPER - As of December 2008 - 34 recycle paper bins are in 22 locations, 42 shred bins in 34 locations.
- Opportunity Village - Projecting triple the volume of 243,114 lbs. in 2008 by adding non-shredded paper, thus saving 2067 trees by recycling paper.
- Provided recycle bins to 2 conventions upon request.
- Placed PGT logo on all bins.
- Currently recycling in house material distribution and convention material distribution. Recycled all guest room phone books for the 1st time.
- Toner cartridges recycled.
- Package management and record retention maintenance system is paperless. Receipt, delivery and storage is all performed with wireless palm pilots, signature capture and downloading information directly to PC.
- Mail Services reuses packing and shipping materials, office supplies and record storage boxes, powers off all computers and equipment at closing.

### PURCHASING

- Installed Energy Star Canon copiers property wide. Scanning, emailing, making 2 sided copies, and faxing from these machines saved paper and mailing costs.
- 34% decrease in paper usage for a six month period, property wide.
- 69% decrease in toner cartridges ordered for a six month period, property wide.

### I.T.

- Educating departments to utilize their department share drive to pass on information instead of printing.
- Provides storage environment for scanning and emailing instead of printing.

### I.T./PAYROLL

- New time and attendance system installed which reduces printing of some reports.

### HOTEL

- Signature Capture (electronic paperless check-in/check-out) at the front desk.
- Lights are being turned off in rooms not utilized, such as convention area, theater, guest rooms, storage areas, etc.

### HOUSEKEEPING

- Hand sanitizers have been placed throughout the property and hand blowers are an option in restrooms instead of paper towels.
- Towel and linen re-use placards in each room (NEW CARDS are now used for each room, a program called the "Opt Out" where a guest may decline housekeeping services, allowing less water and energy consumption and guests are rewarded with a \$5 voucher (\$10 during summer) to use in select outlets.)
- New hepa bags used in vacuums
- Eco-friendly, non-toxic cleaning products for septic and drain are being used with new products being introduced continually.

### EVS

- 'TNT Mold Guard' (totally non-toxic) used by Environmental Services.

### FACILITIES

- Tower renovations complete. Light change out complete in all towers. Fluorescent lights use 50% less energy. Outdoor cold cathodes in place.
- Faucet aerators, low flow toilets, and oxygenic shower heads installed to conserve on water consumption in guest rooms.
- Xeriscaped property grounds for water/cost conservation. Rebate around \$150,000.
- LVH reduced electricity usage in first 9 mos. of 2008 by 11.4% from the prior year. Nevada Power awarded LVH a \$65,000 rebate for installing cost effective measures on cooling towers, chillers and boilers and light reduction program.
- LED lighting is now in Tempo Lounge, Shimmer Cabaret and office areas with more and more areas being transitioned to LED lighting as the year progresses.

### RETAIL

- Merchandise made locally from organic, natural and recycled materials is highlighted and expanded in retail. Some examples of the many eco-friendly and vegan-friendly items we permanently carry are: purses made from recycled rice bags, seatbelts, plastic bottles and coffee bean bags. Trays/ placemats made from recycled paper, journals, jewelry and table top accessories made from recycled items such as computer keyboards, cassette tapes, soda cans, rice sacks and more. Staple free staplers, vegan cookbooks, books focusing on the eco-movement such as "Gorgeously Green", vegan food items such as candy bars and cookies, Locally made and 100% natural skin care line exclusive to LVH. Vegan lip balms, organic locally made teas and T-shirts made from Bamboo and/or recycled materials created for LVH.

### RESTAURANTS

- Benihana is using non-toxic grease cutter
- The Buffet posts a sign; 'water provided upon request'.
- Vegan items available upon request
- Soymilk available upon request

### MARKETING

- PGT logo created to place on business cards of PGT members.

### SPA

- Installation of new software eliminates 4 different paper types: 1 being 2-part and approx. 9,000 sheets a year.

### HUMAN RESOURCES

- Weekly and quarterly newsletter, Club Ride employee incentives to carpool, ride bike or take the bus to and from work.
- Department does not use Styrofoam, but reuses own cups/mugs.

### SECURITY

- Toyota Highlander hybrid vehicle leased for usage in place of Dodge Caravan for gas savings, less environmental impact.

## SCHEDULE

### LOCATION OF MEETINGS

To assist you in finding your meeting room at the Winter Conference, please refer to the floor plans located in the front of this program. All meetings are scheduled in either the Las Vegas Hilton or the Las Vegas Convention Center. All space in the Hilton is located in the Hilton Conference Center and all space in the Las Vegas Convention Center is in the North hall.

### MEETING SCHEDULE

#### FRIDAY, JANUARY 28

- 8:00 am–5:00 pm **Committee Meetings**  
*See listing on pages 59–78.*
- 11:00 am–4:00 pm **Registration**, Las Vegas Hilton, Conrad Room
- 11:00 am–5:00 pm **ASHRAE Bookstore**, Las Vegas Hilton, Conrad Room

#### SATURDAY, JANUARY 29

- 7:30 am–3:00 pm **ASHRAE Lounge**, Las Vegas Hilton, Ballroom G
- 7:15 am–6:00 pm **Registration, ASHRAE Bookstore**  
Las Vegas Hilton, Conrad Room
- 8:00 am–2:30 pm **Press Room**, Las Vegas Hilton, Conrad Room
- 8:00 am–5:00 pm **Committee Meetings**  
*See listing on pages 59–78.*
- 1:00 pm–3:00 pm **Speakers' Lounge**, Las Vegas Hilton, Conrad Room

#### Special Event

- 3:15 pm–5:00 pm **Meeting of the Members, Plenary Session**, Las Vegas Hilton, Ballroom A
- Opening and Welcoming Remarks by ASHRAE President Lynn G. Bellenger
  - Welcome by Director and Chair, Region X, Jack H. Zarour
  - Secretary's Report by Executive Vice President Jeff H. Littleton
  - Awards Presentation  
*See page 17 for details.*
  - Keynote Speaker, Jack Bacon  
*See page 14 for details.*

#### Special Event

- 6:30 pm–8:30 pm Welcome Party, Las Vegas Hilton, Barron Room  
*See page 18 for details.*
- Note:* \$47 ticket per person required. Tickets may be purchased/picked up at the ASHRAE Registration Desk; advance-purchase tickets may be picked up at the door if after registration hours.

#### SUNDAY, JANUARY 30

- 7:00 am–3:30 pm **Speakers' Lounge**, Las Vegas Hilton, Conrad Room
- 7:00 am–5:00 pm **Registration, ASHRAE Bookstore**, Las Vegas Hilton, Conrad Room
- 7:30 am–4:00 pm **ASHRAE Lounge**, Las Vegas Hilton, Ballroom G
- 7:30 am–8:30 am **Student Breakfast**, Las Vegas Hilton, Ballroom A
- 8:00 am–9:30 am **Seminar 4**  
(Open Session—no badge required), Las Vegas Hilton, Pavilion 3
- Make the Most of Your ASHRAE Experience**  
*See Seminar 4 on page 29 for more details.*
- 8:00 am–3:30 pm **Technical Sessions**  
*See Technical Program on pages 28–58.*
- 8:00 am–5:00 pm **Press Room**, Las Vegas Hilton, Conrad Room
- 8:00 am–5:00 pm **Committee Meetings**  
*See listing on pages 59–78.*
- 8:30 am–2:00 pm **Student Program**, Las Vegas Hilton, Ballroom A
- 9:00 am–3:00 pm **Tour: Hoover Dam**  
*See description on page 19.*
- 9:45 am–10:45 am **Technical Plenary Session**, Standard 189.1: Sustainability Beyond Energy Conservation, Las Vegas Hilton, Pavilion 1, *Conference badge required.*  
*See page 29 for details.*
- 12:00–1:30 pm **Lunch concession available for quick lunch option in Hilton Center Foyer**
- 2:30 pm–4:30 pm **Student Tour to Las Vegas City Center Complex**  
*See description on page 21.*
- 2:45 pm–3:45 pm **First Time Attendee**, New Member Reception, Las Vegas Hilton, Ballroom D
- 3:15 pm–4:15 pm **ASHRAE Foundation Seminar – Gambling on the Future – Charitable Giving Opportunities & Challenges**, (Open Session-no badge required), Las Vegas Hilton, Pavilion 3
- 4:30 pm–6:30 pm **Student Tour** to Las Vegas City Center Complex  
*See description on page 21.*

## Schedule

4:00 pm–7:00 pm Young Engineers in ASHRAE (YEA)  
Hospitality Suite,  
Las Vegas Hilton, Suite # 2935,  
Central Tower

**Attention members age 35  
and younger—**

*you are invited to visit the YEA  
Hospitality suite, offering social  
and networking opportunities  
including meeting tips, leadership  
development, and more. Light  
refreshments will be available.  
See page 11 for more details.*

### MONDAY, JANUARY 31

7:00 am–12:15 pm **Speakers' Lounge**, Las Vegas Hilton,  
Conrad Room

7:00 am–4:00 pm **Registration, ASHRAE Bookstore**,  
Las Vegas Hilton, Conrad Room

7:30 am– 4:00 pm **ASHRAE Lounge**, Las Vegas Hilton,  
Ballroom G

8:00 am–12:00 pm **Technical Sessions**  
*See Technical Program on pages 26–58.*

10:00 am–4:00 pm **Press Room**, Las Vegas Hilton,  
Conrad Room

## KEYNOTE SPEAKER – JACK BACON

### ASHRAE Plenary Session

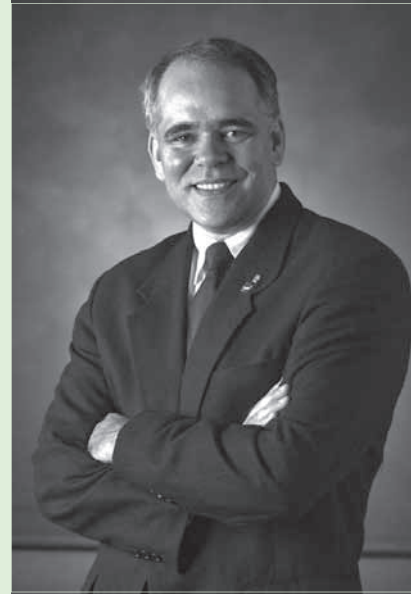
Saturday, January 29

3:15 – 5:30 p.m.

Las Vegas Hilton, Ballroom A

#### Killer Apps for the Green Global Village

The world is going back to green lifestyles that had been practiced for centuries before the industrial revolution. However, our modern productivity and lifestyle are the result of several centuries of automation, communications, and power that had no precedent in societies that serve as our model of “green.” As we struggle to achieve an ecological balance, much of the modern world will need complete and revolutionary reinvention. The spreadsheet was a “killer application” that redefined computing. What are the “killer Apps” that will redefine the green societies of yesteryear? Futurist and technological historian Dr. Jack Bacon will take us on a guided tour of such “killer apps”, and forecast what they mean to those of us shaping the world’s future.



Jack Bacon has often been called “A New Carl Sagan.” He is an internationally-known motivational speaker, a distinguished lecturer (emeritus) of the American Institute of Aeronautics and Astronautics (AIAA), and one of the most requested speakers in the world for topics concerning technology and the factors that shape human society. A noted futurist and a technological historian, he has written three popular books entitled “My Grandfathers’ Clock,” “My Stepdaughter’s Watch,” and “The Parallel Bang,” with many thousands of copies sold of each. A fourth: “Killer Apps for the Green Global Village” is in the works. His lectures have captivated tens of thousands of all ages in thirty-eight countries on six continents, and he has appeared on numerous radio and television broadcasts.

A graduate of Caltech (B.S. ‘76) and the University of Rochester (Ph.D. ‘84) his extensive career includes roles in the development of many cutting edge topics, including controlled thermonuclear fusion, the development of the electronic office, factory automation, the human conquest of space, third world agricultural enhancements, and the globalization of business. He pioneered the deployment of several artificial intelligence systems, learning his craft at the famed Xerox Palo Alto Research Center. Jack is a fellow of the Explorer’s Club, a member of the AIAA, the National Speakers Association, the International Federation of Professional Speakers, Engineers Without Borders, and Rotary International. He was a founding member of the board of directors of the Science National Honor Society, and is a recipient of the US Government’s Exceptional Achievement Medal. He routinely advises numerous academic programs and institutions, and he is a champion of education throughout the world.

8:00 am – 11:30 am **Tour: Springs Preserve**  
*See description on page 20.*

8:00 am–5:00 pm Committee Meetings  
*See listing on pages 59–78.*

10:00 am–6:00 pm **AHR Expo®**, Las Vegas Convention Center, 3150 Paradise Road  
*If you are registered for the ASHRAE Conference, your conference badge is admission into the exposition; if attending exposition only and not registered in advance, admission is \$20.00 at the exposition.*  
**Note:** You must be 16 years or older to be admitted to the show floor. Ages 16 and 17 will be admitted only if accompanied by an adult. The Las Vegas Convention Center is located next door to the Hilton – an easy walk.

10:15 am–11:45 am **Student Congress**, Las Vegas Hilton, Ballroom E

12:00-1:30 pm **Lunch concession available for quick lunch option in Hilton Center Foyer**

**SPECIAL EVENT**

12:15 pm–2:00 pm **President’s Luncheon (doors open at noon)**, Las Vegas Hilton, Ballroom A  
*President Lynn G. Bellenger will speak on the State of the Society and the Golden Circle Awards will be presented “in honor of contributors who have consistently and significantly supported ASHRAE research.” Spouses and guests are cordially invited to attend.*  
**Note:** Ticket required.

2:15 pm-3:45 pm **Public Session I**, Las Vegas Convention Center, North Hall, Room N256  
**A Practical Guide for Reducing Air Leakage in HVAC Air Systems**  
*See description on page 41.*

2:15 pm–5:00 pm **Technical Tours:** Planet Hollywood Central Plant and Springs Preserve  
*See description on page 21.*

2:15 pm-6:00 pm **Tour:** Las Vegas Strip  
*See description on page 20.*

**Regional Dinners**  
*Sign up in ASHRAE registration area.*

**TUESDAY, FEBRUARY 1**

7:00 am–1:00 pm **Speakers’ Lounge**, Las Vegas Hilton, Conrad Room

7:30 am-4:00 pm **Registration, ASHRAE Bookstore**, Las Vegas Hilton, Conrad Room

7:30 am–4:00 pm **ASHRAE Lounge**, Las Vegas Hilton, Ballroom G

8:00 am–12:30 pm **Technical Sessions**  
*See Technical Program on pages 26–58.*

8:00 am–4:00 pm **Press Room**, Las Vegas Hilton, Conrad Room

8:00 am–5:00 pm **Committee Meetings**  
*See listing on pages 59–78.*

9:00 am-1:00 pm **Tour:** Bodies and Titanic Exhibit  
*See description on page 20.*

10:00 am-6:00 pm **AHR Expo®**, Las Vegas Convention Center, 3150 Paradise Road  
*If you are registered for the ASHRAE Conference, your conference badge is admission into the exposition; if attending exposition only and not registered in advance, admission is \$20.00 at the exposition.*  
**Note:** You must be 16 years or older to be admitted to the show floor. Ages 16 and 17 will be admitted only if accompanied by an adult. The Las Vegas Convention Center is located next door to the Hilton – an easy walk.

11:30 am-2:00 pm **Life Members’ Luncheon**, Las Vegas Hilton, Conference Rooms 11/12  
**Note:** Ticket required.

12:00-1:30 pm **Lunch concession available for quick lunch option in Hilton Center Foyer**

1:30 am-5:00 pm **Tour:** Venetian Canal Shoppes  
*See description on page 20.*

1:30 am–5:30 pm **Technical Tour:** MGM City Center and Central Plant  
*See description on page 21.*

2:15 pm-3:45 pm **Public Session 2**, Las Vegas Convention Center North Hall, Room N256  
**Highlights of ASHRAE/IES 90.1-2010**  
*See description on page 51.*

**SPECIAL EVENT**

6:15 pm–7:00 pm **Reception**, Las Vegas Hilton, Hilton Center Foyer

7:00 pm–10:30 pm **Members’ Night Out**, Las Vegas Hilton, Barron Room  
*See page 18 for details.*  
**Note:** Ticket required.

## Schedule

### WEDNESDAY, FEBRUARY 2

- 7:30 am–10:00 am **Registration**, Las Vegas Hilton, Conrad Room
- 7:30 am–1:00 pm **ASHRAE Bookstore**, Las Vegas Hilton, Conrad Room
- 7:30 am–1:00 pm **ASHRAE Lounge**, Las Vegas Hilton, Ballroom G
- 7:00 am–1:00 pm **Speakers' Lounge**, Las Vegas Hilton, Conrad Room
- 8:00 am–10:00 am **Press Room**, Las Vegas Hilton, Conrad Room
- 8:00 am–5:00 pm **Committee Meetings**  
*See listing on pages 59–78.*
- 8:00 am–12:30 pm **Technical Sessions**  
*See Technical Program on pages 26–58.*
- 10:00 am–4:00 pm **AHR Expo®**, Las Vegas Convention Center, 3150 Paradise Road

*If you are registered for the ASHRAE Conference, your conference badge is admission into the exposition; if attending exposition only and not registered in advance, admission is \$20.00 at the exposition.*

**Note:** You must be 16 years or older to be admitted to the show floor. Ages 16 and 17 will be admitted only if accompanied by an adult. The Las Vegas Convention Center is located next door to the Hilton – an easy walk.

## notes



## AWARDS PRESENTATION

Saturday, January 29, 3:15-5:30 p.m.  
Plenary Session, Las Vegas Hilton  
Ballroom A

### STUDENT DESIGN PROJECT COMPETITION

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

#### HVAC System Selection

**First Place:** Zachary Buckmiller, Matthew Kolins,  
Todd Kuno, Jared Palan, Nicole Vogt,  
Joel Wheeler, Kansas State University

#### HVAC System Design

**First Place:** Michael Angell, Nathaniel Boyd,  
Edward Gillett, Trong Nguyen, Justin Wiese,  
University of Central Florida

#### Integrated Sustainable Building Design

**First Place:** Amy Rose Keyzer, Carolyn Lamb,  
Ryland Phelps, Lawrence Technological  
University

### TECHNOLOGY AWARDS

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

#### First Place

##### Category I – Commercial Buildings – New

**Peter H. Rumsey, P.E.** for *The David Brower Center*,  
Berkeley, CA  
Owner, Equity Community Builders

##### Category II – Institutional Buildings – New

**Amit Khanna** for *Jerry Yang and Akiko Yamazaki  
Environment and Energy Building*, Stanford  
University, Palo Alto, CA  
Owner, Stanford University

##### Category III – Healthcare Facilities – Existing

**Gilles Desmarais** for *Pierre-Boucher Hospital*,  
Longueuil, QC  
Owner, CSSS Pierre-Boucher

##### Category IV – Public Assembly- New

**Charles P. Eggert** and **Yury Y. Lui** for *the Jewish  
Reconstructionist Congregation*, Evanston, IL  
Owner, The Jewish Reconstructionist Congregation

### JOHN F. JAMES INTERNATIONAL AWARD

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

**Yuan-wei Wu, Beijing, China**

### DISTINGUISHED 50-YEAR MEMBER AWARD

*Given in recognition of fifty years of membership and distinction in the arts and sciences of heating, refrigeration, air conditioning and ventilation.*

**J. Richard Wright, P.E., Algood, TN**

### ASHRAE FELLOWS

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

**Walid Chakroun, Ph.D., Safat, Kuwait**

**James B. Cummings, Cocoa, FL**

**J. Eduardo Donoso, Guayas, Ecuador**

**Chad B. Dorgan, Ph.D., P.E., Newport Beach, CA**

Presidential Member **A. Damon Gowan, Galveston, TX**

**Gershon Grossman, Sc.D., Haifa, Israel**

**Jaap J. Hogeling, Lienden, Netherlands**

**Russell M. Keeler, P.E., Golden, CO**

**Ravindra S. Kulkarni Sr., Pune, India**

**Cesar Luis D. L. Lim, P.M.E. Paranaque, Philippines**

**Apichit Lumlertpongpana, Ph.D., Bangkok, Thailand**

**Hugh D. McMillan III, Cypress, TX**

**Farooq Mehboob, Karachi, Pakistan**

### E.K. CAMPBELL AWARD OF MERIT

*presented by the Life Members' Club*

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

**William Ryan, Ph.D., P.E.**

University of Illinois at Chicago, Chicago, IL

### F. PAUL ANDERSON AWARD

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

Presidential Member **Richard P. Perry, P. Eng.**

Vancouver, BC, Canada

## 2011 ASHRAE WINTER CONFERENCE WELCOME PARTY

Saturday, January 29

6:30-8:30 p.m.

Las Vegas Hilton, Barron Room

People come from all over the world to visit Las Vegas, but you don't have to go any farther than the Welcome Party to have the world come to you. Watch 'Vegas grow through the ages, from its vintage roots to its breath-taking future. Enjoy an exciting twist on the traditional, all-you-can-eat Vegas buffet featuring destination-oriented food from across the USA, Italy, Asia and Mexico. Don't forget to stop by the premium, Vegas-Style martini station!

**Two drink tickets included**

**Dress:** Casual

**Note:** \$47 ticket per person required. Tickets may be purchased/picked-up at the ASHRAE registration desk; advance purchase tickets may be picked up at the door after registration has closed.

## MEMBERS' NIGHT OUT

Tuesday, February 1

6:15 p.m.-7:00 p.m. (Reception – cash bar)

Hilton Center Foyer

7:00-10:30 p.m. (Dinner and Entertainment)

Barron Room

Las Vegas Hilton

**MEMBERS' NIGHT OUT –  
So You Think You Can Dance?**

You may be in Las Vegas, but Members' Night Out will take you back to the exotic and glamorous gambling destination of the 1940s and 1950s—Old Havana. Relax, and enjoy succulent Cuban cuisine, foot tappin' music and take in a captivating performance featuring the well known dances of the Latin world--tango, cha-cha and salsa. For those who "feel the rhythm of the music," join the performers afterwards for dance lessons. The non-dancers in the crowd are encouraged to stay and enjoy the show. Reception takes place at 6:15 p.m. followed by dinner and entertainment at 7 p.m., in the Hilton

### Menu:

Petite greens  
Grilled Cuban Filet of Beef  
Black Beans and Rice garnished  
with Fired Plantain Chips  
Caribbean vegetables  
Caramel flan with seasonal fruit  
Coffee, Tea  
Wine with dinner

If you have purchased a ticket for this event, you will receive an exchange coupon. Take this coupon to the Member's Night Out desk located in ASHRAE Registration and exchange it for a reserved seat ticket by 2:00 p.m. Monday, January 31. Each table seats ten. A seating chart is available to help in deciding table preference. Seats are available on a first-come, first-served basis. When reserving your seat, please advise us of any special dietary requirements to ensure that we are able to accommodate your requests during the evening.

**Dress:** Sport coat and sport shirt (tie optional) for men; coordinates for ladies

**Note:** \$47 ticket per person required.

ASHRAE thanks the following companies for their support of the Welcome Party and Members Night Out



The Expansion Joint  
and  
Check Valve People



## SPOUSE/GUEST GUIDE

**SATURDAY, JANUARY 29**

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

**ASHRAE Lounge – Join Us and Relax  
Las Vegas Hilton, Ballroom G**

The ASHRAE Lounge is open daily for all individuals who are registered for the meeting. Refreshments are available from 7:30 to 9:30 a.m. each day and beverages are available all afternoon. Members of the Las Vegas Host Committee will be present to answer questions about local activities. Detailed information on the city including brochures and maps can be found at the Host Committee Desk located in the ASHRAE Registration area in the Conrad Room in the Hilton.

**SUNDAY, JANUARY 30**

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

**ASHRAE Lounge  
Las Vegas Hilton, Ballroom G**

**MONDAY, JANUARY 31**

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

**ASHRAE Lounge  
Las Vegas Hilton, Ballroom G**

**MONDAY, JANUARY 31**

**9:30 a.m.-11:00 a.m.**

**ASHRAE Lounge  
Las Vegas Hilton, Ballroom G**

## ASHRAE Meet and Greet – If I Had a Hammer

ASHRAE's "First Dude" Neil Bellenger hosts this year's Meet and Greet, which is focused on Habitat for Humanity, a nonprofit, ecumenical Christian housing organization building simple, decent, affordable housing in partnership with people in need. Neil, who began working with Habitat for Humanity in Rochester, N.Y., after he retired, is a regular volunteer and a member of what the local affiliate calls the "hammer and saw crew" consisting of about 80 individuals, Neil devotes every Friday he is in town to Habitat and works with the group every week, summer and winter. The program will highlight on the programs and goals of what Habitat does.

A special guest speaker is Guy Amato, president and CEO for Habitat for Humanity Las Vegas. He will make a brief presentation on their mission and provide an overview on Habitat International and describe their own building program in Clark county including their ReStore operation.

**TUESDAY, FEBRUARY 1**

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

**ASHRAE Lounge  
Las Vegas Hilton, Ballroom G**

**WEDNESDAY, FEBRUARY 2**

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

**ASHRAE Lounge  
Las Vegas Hilton, Ballroom G**

## TOURS

*All tours depart from the East Tower entrance of the Las Vegas Hilton.*

**Tour tickets may be purchased at the ASHRAE Registration desk in the Hilton, Conrad Room.**

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

### HOOVER DAM EXPERIENCE

**SUNDAY, JAN. 30**

**9 A.M.-3 P.M.**

Travel by a luxury bus through fabulous Las Vegas toward Boulder City, Nev. As you leave Boulder City, enroute to the magnificent Hoover Dam, you see the spectacular shoreline of Lake Mead in the distance. Lake Mead is one of the largest and most beautiful manmade lakes in the United States. This

official dam discovery tour allows you to travel farther and deeper into the dam than others typically see. Experience the excitement of this top ten man-made wonders of the modern world with unsurpassed views that will create memories of a lifetime.

### Tour Highlights

- Guided narrated tour with oversized windows for your viewing pleasure
- Spectacular views of the beautiful manmade Lake Mead
- Official Dam Discovery Tour
- Photo opportunities and time for souvenir shopping

### Security:

All visitors to the Visitor Center are required to enter the facility through a security checkpoint. Cameras, purses, small-size backpacks, and camera tripods are permitted. Knives and weapons are not allowed in the Visitor Center. All carry-in possessions will be scanned.

**Cost:** \$40

### SPRINGS PRESERVE EXPERIENCE MONDAY, JAN. 31 8-11:30 A.M.

The Springs Preserve is a 180-acre cultural institution designed to commemorate Las Vegas' dynamic history and to provide a vision for a sustainable future. The Preserve features museums, galleries, outdoor concerts and events, colorful botanical gardens and an interpretive trail system that meanders through a scenic wetland habitat. The Preserve, owned and operated by the Las Vegas Valley Water District, is built around the original water source for Las Vegas Valley originally called the Las Vegas Springs. The Preserve shows people how to live in the desert environment and how to take advantage of what is available. Springs Preserve was the first LEED Platinum certified project in the Las Vegas area.

*Two guided tours are offered:*

#### Springs Preserve Overview Tour

Covering more than 180 acres, the Springs Preserve can be daunting to many visitors, making the Springs Preserve Overview Tour the ideal way to get started. Experienced tour guides presents the many highlights of the Springs Preserve including its galleries, exhibits, facilities and venues.

#### Archaeology/History Tour

Many visitors to Las Vegas find it hard to see past the glitz and glamour of the world-famous Strip, but the Archaeology Tour opens you up to a more compelling side of Sin City. Explore more than 5,000 years of history in Southern Nevada through exhibits and galleries at the Springs Preserve, as well as a visit to the ORIGEN Experience and a short tour of the trails.

**Cost:** \$30

### LAS VEGAS STRIP TOUR MONDAY, JAN. 31 2:15-6 P.M.

Sit back and take a first-hand look at the glitz and glamour of the world-famous Las Vegas Strip. Your tour begins with a drive down the Las Vegas Strip past amazing hotels and landmarks that define Las Vegas. You will continue on with a historical stop in Old Downtown, the "original" Las Vegas Strip.

#### Tour Highlights

- The Bellagio conservatory and fountain show
- Rio's Masquerade Show in the Sky
- The Fremont Street Experience light show
- Madame Tussauds at the Venetian
- The Mirage Volcano
- Landmark hotels and Casinos

**Cost:** \$22

### VENETIAN GRAND CANAL SHOPPES TUESDAY, FEBRUARY 1 1:30-5 P.M.

Whether it's a stroll along a cobblestone walkway, or a relaxing ride in an authentic Italian gondola, The Grand Canal Shoppes offers a shopping experience like no other. Enjoy world class dining, shopping and elegance in an atmosphere of sophistication and refinement. Talented performers serenade shoppers as they stroll along the Grand Canal. Performances are held at various times throughout the day, seven days a week. The Venetian Living Statues perform daily in St. Mark's Square. Transportation will be provided to the Venetian and you'll have the afternoon to indulge yourself in the uniqueness of The Grand Canal Shoppes. Benvenuto!

**Cost:** \$12

### BODIES AND TITANIC EXHIBIT TUESDAY, FEB. 1 9 A.M.-1 P.M.

#### Titanic Exhibit

If you loved the 1997 movie "Titanic," then the Titanic exhibit at the Luxor will blow you away. Featuring more than 300 artifacts, as well as breathtaking replicas from the famous ship, the Titanic exhibit brings history to life. One of the most heartfelt elements of the exhibit is the personal stories of the passengers. During the tour, the exhibit's staff shares personal tales from the passengers. Some stories have a tragic, yet romantic ending. At the beginning of the exhibit, patrons receive a boarding pass of an actual passenger on Titanic, featuring their age and itinerary. At the end of the tour, patrons find out if he or she survived the Titanic by finding the name on the wall memorial.

#### Bodies Exhibition

Perhaps one of the most impressive works of science you may ever see. To understand the human anatomy you must see it up close and in person. This exhibition introduces you to the human body through actual human specimens in a display of science marvel.

The Exhibition showcases 13 whole-body specimens and more than 260 organs and partial body specimens. These real human bodies have been meticulously dissected, preserved through an innovative process. The bodies are respectfully presented, giving visitors the opportunity to view the beauty and complexity of their own organs and systems. The Exhibition provides an up-close look inside our skeletal, muscular, respiratory, and circulatory systems. Authentic human specimens illustrate the damage caused to organs by over-eating and lack of exercise encouraging healthy lifestyle choices. Although this exhibit is definitely not for everyone, anyone interested in medicine, biology or just curious about seeing how the human body works and what's going on inside their own, will be fascinated by it.

**Cost:** \$52

## TECHNICAL TOURS

All tours depart from the East Tower entrance of the Las Vegas Hilton.

**Tour tickets may be purchased at the ASHRAE Registration desk in the Hilton, Conrad Room.**

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

### PLANET HOLLYWOOD CENTRAL PLANT MONDAY, JAN. 31 2:15-5 P.M.

Step inside the Planet Hollywood Casino Resort, formerly known as The Aladdin, located on the Las Vegas Strip. Planet Hollywood features an expanded casino/hotel, a condo tower, new restaurants, nightclubs and retail space. Take a guided in-depth tour from a chief engineer who can answer your technical questions. Once the tour is complete, you can tour the various accommodations such as the new Miracle Mile Shops or the casino. The property features a three-acre casino floor with traditional gambling machines. The Miracle Mile is a 475,000 ft<sup>2</sup> (44,129 m<sup>2</sup>), 1.5-mile (2.4 km) long, enclosed shopping mall with more than 140 stores and 15 restaurants.

**Cost: \$17**

### SPRINGS PRESERVE MONDAY, JAN. 31 2:15-5 P.M.

The Springs Preserve is a 180-acre cultural institution designed to commemorate Las Vegas' dynamic history and to provide a vision for a sustainable future. The Preserve features museums, galleries, outdoor concerts and events, colorful botanical gardens and an interpretive trail system that meanders through a scenic wetland habitat. Owned and operated by the Las Vegas Valley Water District, it is built around the original water source for Las Vegas Valley originally called the Las Vegas Springs. The Preserve shows people how to live in the desert environment and how to take advantage of what is available. Springs Preserve was the first LEED Platinum development in the Las Vegas area. Part of this project showcases green building efforts through a dual use concept. For example, the parking area is actually the roof of the reservoir and the shade structures in various areas are photovoltaic cells used to generate power for the site. The HVAC includes an indirect/direct evaporative cooling system that is both energy and water efficient. The gardens also use a fleet of hydrogen powered utility vehicles. The vehicles are refueled on site by a solar powered hydrogen fueling station.

Your visit to Springs Preserve includes the Sustainability Tour, exploring building materials used to construct the Dester

Living Center, the constructed wetland that treats water waste, solar panels in the parking lot and the Sustainability Gallery.

**Cost: \$25**

### MGM CITYCENTER AND CENTRAL PLANT TUESDAY, FEB. 1 1:30-5:30 P.M.

MGM CityCenter is a 16,797,000 ft<sup>2</sup> (1,560,492 m<sup>2</sup>) mixed-use, massive urban complex on 76 acres located on the Strip. With a total cost of approximately \$11 billion, it is the largest privately funded construction project in the history of the United States. The mixed-use development is composed of a "skyline" of two 400-room boutique hotels; one 4,000-room hotel and casino; four towers of 2,500 residential units; and 550,000 ft<sup>2</sup> (51,096 m<sup>2</sup>) of high-end retail, dining and entertainment space. The multi-use project makes extensive use of green technologies, such as using reclaimed water and an on-site power plant. Highlights of the tour include a guided technical tour through the 11-story, 51,155 ft<sup>2</sup> (4,752 m<sup>2</sup>) central plant.

#### Central Plant Highlights

- 1,450 ft<sup>2</sup> (134 m<sup>2</sup>) fire command center and engineering dispatch center
- Six dual compressor chillers, 5,740 tons each
- Six fiberglass cooling tower cells, 10,900 gallons per minute (688 litres per second) each
- Three gas-fired 1,000 (981 kW) boiler horsepower water tube, boilers high pressure gas
- Two cogeneration 4.6 MW gas turbines with unfired 400 boiler (298kW) horsepower waste heat recovery
- Three emergency generators 2.4 MW diesel fired 3,600 brake horsepower (2.7 MW) each
- A 15,000 gallon (56,781 liters), double wall, underground fiberglass diesel storage tank
- A 3,400 pound (1,530 kilogram) capacity hydraulic elevator
- Underground 75,000 gallon (283,905 liters) fire protection storage tank
- Maximum plant cooling capacity- 34,400 tons (120 MW)
- Maximum plant heating capacity- 3,800 BHP (37.3 MW)

**Cost: \$17**

### STUDENT TOUR – CITY CENTER COMPLEX SUNDAY, JANUARY 30

A student technical tour of the Las Vegas City Center Complex, a 76 acre mixed-use, urban complex located on the Las Vegas Strip, will be offered on Sunday. Learn about how HVAC systems undergird the largest, privately-funded construction project in United States history.

**2:30 pm and 4:30 pm**

**Cost: \$15 – attendance is limited to students**



## ASHRAE 2011 WINTER CONFERENCE COURSES

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

All ASHRAE Learning Institute (ALI) courses will be held at either the Las Vegas Hilton or Las Vegas Convention Center. Courses will carry Continuing Education Units (CEUs) and/or Professional Development Hours (PDHs), which can be applied toward maintaining your P.E. licensure. Registration for the full-day seminars and half-day courses will be in the Las Vegas Hilton, Conrad Room.

### FULL-DAY PROFESSIONAL DEVELOPMENT SEMINARS

**Registration fees:** \$485 per course;  
\$395 for ASHRAE members

Completion of the course earns 6 PDHs/AIA LUs or .6 CEUs (check with your state for their continuing education credit requirements)

**Saturday, January 29, 2011**

#### The Commissioning Process in New and Existing Buildings

*8:00 am – 3:00 pm, Las Vegas Hilton, Pavilion 11*

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

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

#### Implementing Energy Management in New and Existing Buildings: A Sustainable Activity

*8:00 am – 3:00 pm, Las Vegas Hilton, Ballroom D*

This hands-on seminar prepares participants to apply energy management principles to their own facilities. The seminar discusses several energy management examples, allows additional time for questions, and includes 14 hands-on exercises. The examples include: a healthcare organization; a Chicago high-rise building; a Wisconsin insurance company; a Wisconsin convention center; and a Chicago elementary school. The 14 exercises reinforce the concepts and terminology presented in the seminar's lecture portion. The exercises include: energy management assessment; EUI and ECI questions; monthly electric and gas profiles; using motor logger data; evaluating impact of lighting changes; and weather normalization. The final exercise asks participants to outline what actions they can take immediately to improve the state of energy management in buildings under their care.

**Instructors:** Richard J. Pearson, P.E., Fellow/Life Member ASHRAE; and Kevin Little, Ph.D., Member ASHRAE

#### Healthcare Facilities Best Practice Design & Applications

*8:00 am – 3:00 pm, Las Vegas Hilton, Ballroom E*

A must-attend for HVAC designers and engineers in the healthcare field, this seminar introduces the unique design criteria and constraints for healthcare spaces and HVAC systems used in healthcare facilities, including infection control, life safety, pressurization and emergency preparedness requirements. Also discussed are various methods for making healthcare HVAC systems more energy efficient. The course provides best practice air distribution and air handling system design practices for spaces as operating suites, various radiology spaces, patient rooms, isolation rooms, pharmacies and emergency departments. Finally, healthcare cooling and heating plants as well as commissioning, operations and maintenance are discussed. This course is based on ASHRAE's publication *HVAC Design Manual for Hospitals and Clinics*.

**Instructors:** Robert Cox, P.E., Member ASHRAE; Daniel Koenigshofer, P.E., Member ASHRAE, HFDP; and Michael Sheerin, P.E., Member ASHRAE

#### Integrated Building Design

*8:00 am – 3:00 pm, Las Vegas Hilton, Ballroom F*

This seminar provides a working knowledge of the integrated building design process, explaining the basic concepts involved and outlining the fundamental application of this approach. Course content explains the advantages and benefits of integrated building design, and how this process differs from conventional design practice. The seminar structure identifies the necessary sequencing and scope of activities that should be implemented to support development of collaborative solutions. In addition to design related

philosophy, the seminar explores the critical elements of TEAM activity and management of collaborative teams. This seminar benefits any person who has a role in the planning, design, construction and operation of a built solution. Attendees are able to strategically position themselves in the marketplace by understanding the value of project fundamentals and the importance of holistic interdependencies. Emphasis is placed on transitioning traditional processes that aggregate isolated silos of knowledge into collaborative thought and shared outcome.

**Instructors:** Charles Gullledge, P.E., Member ASHRAE, HFDP; and Lisa Rosenow, Member ASHRAE

### Complying With the Requirements of ASHRAE/IES Standard 90.1-2010

*8:00 am – 3:00 pm, Las Vegas Hilton, Pavilion 1*

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

**Instructors:** Joseph Deringer, AIA, Member ASHRAE; and Mack Wallace, P.E., Member ASHRAE

### Tuesday, February 1, 2011

#### Energy Modeling Best Practices and Applications (Parts 1 and 2) NEW!

*9:00 am – 12:00 pm, 2:00 pm – 5:00 pm,  
Las Vegas Convention Center, Room N258*

This seminar focuses on topics critical to the effective delivery of energy modeling services, including modeling fundamentals, ASHRAE Standard 90.1 Performance Rating Method, modeling best practices, modeling to inform design, and measurement and verification. With an objective to improve building energy modeling quality and consistency, this seminar combines methods with examples, case studies, tools and online resources that relate concepts to applications. The seminar objective is to improve building energy modeling quality and consistency.

**Instructors:** Ellen Franconi, Ph.D., Member ASHRAE; Kendra Tupper, P.E., Associate Member ASHRAE; and Gail Hampsmire, P.E.

### HALF-DAY SHORT COURSES

**Registration fees:** \$159 per course;  
\$119 for ASHRAE members

Completion of the course earns 3 PDHs/AIA LUs or .3 CEUs (check with your state for their continuing education credit requirements)

### Saturday, January 29, 2011

#### Fundamental Requirements of ASHRAE Standard 62.1-2010 NEW!

*8:00 am – 11:00 am, Las Vegas Hilton, Pavilion 2*

Focusing on the basic requirements of *ASHRAE Standard 62.1-2010 Ventilation for Acceptable Indoor Air Quality*, this course covers the scope, application and multiple compliance paths available in the standard including the ventilation rate procedure, indoor air quality procedure, and natural ventilation procedure. Many of the standard's general requirements apply regardless of the procedure used. In the 2010 version, the IAQ procedure is rewritten and the natural ventilation procedure is new. The different application conditions for the ventilation rate procedure are also described. This course is highly recommended for all HVAC designers and engineers.

**Instructor:** Hoy Bohanon, P.E., Member ASHRAE

#### Application of ASHRAE Standard 62.1-2010: Multiple Spaces Equations & Spreadsheet Calculations NEW!

*12:00 pm – 3:00 pm, Las Vegas Hilton, Pavilion 2*

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

**Instructor:** Hoy Bohanon, P.E., Member ASHRAE

### Sunday, January 30, 2011

#### Understanding Air-to-Air Energy Recovery Technologies and Applications

*2:00 pm – 5:00 pm, Las Vegas Convention Center,  
Room N258*

## ASHRAE Learning Institute Courses

As we move towards net-zero energy buildings, air-to-air energy recovery provides one of the most cost-effective and efficient ways to recycle waste energy and create superior indoor environments. Unfortunately, these technologies remain underutilized and misunderstood. This course examines current and proposed standards, codes and guidelines, reviews commercially available technologies and explores how they can be employed in various configurations and applications to meet today's stringent energy and indoor environmental quality requirements.

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

### Chilled Beam Technology for Excellent Indoor Climate in an Energy Efficient Manner

2:00 pm – 5:00 pm, Las Vegas Convention Center, Room N259

Chilled beam technology and products are relatively well known in Europe. Now the ASHRAE Learning Institute is helping to bring understanding of this technology to the US. Individuals who complete this course will learn the general principles of chilled beam technology and products, able to use chilled beam technology taking into account the specific climate conditions and building requirements, and design a chilled beam system to achieve excellent indoor climate conditions. This course provides the designer and operator with one more option to meet energy and comfort requirements in terms of building type, quality and the outdoor climate. The course highlights the benefits of chilled beam systems in terms of indoor climate quality, energy efficiency and life cycle costs.

**Instructor:** Maija Virta, M. SC-Eng., Member ASHRAE

### Using Standard 90.1 to Meet LEED® Requirements

2:00 pm – 5:00 pm, Las Vegas Convention Center, Room N260

Appendix G, an informative appendix in Standard 90.1 added in 2004, is the focus of this course. Targeted toward design professionals and building owners, it provides specific guidance on the rules and procedures to simulate building energy use when the objective is to substantially exceed the requirements of 90.1. Appendix G is especially useful for energy simulations connected with LEED credits and U.S. energy tax credits. This course presents an overview of Appendix G and explains its use through several examples using eQUEST.

**Instructors:** Joseph Deringer, AIA, Member ASHRAE; and Mack Wallace, P.E., Member ASHRAE

**Monday, January 31, 2011**

### The Commissioning Process & Guideline 0 (co-sponsored with BCA, IES, NEBB)

2:30 pm – 5:30 pm, Las Vegas Convention Center, Room N260

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

**Instructor:** Walter Grondzik, P.E., Fellow ASHRAE

### Determining Energy Savings from Performance Contracting and LEED Projects

2:30 pm – 5:30 pm, Las Vegas Convention Center, Room N259

An overview of measurement and verification (M&V) procedures for determining energy and cost savings is shared in this course. Intended for energy consultants, LEED professionals and facility managers, participants learn principles of baseline definition and baseline adjustments, M&V plan development, IPMVP and Guideline 14 adherence, application to energy-efficiency upgrades and performance contracting projects, and application to LEED-NC and LEED-EB for EA-5.

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

### Understanding Standard 189.1-2009 for High Performance Green Buildings

2:30 pm – 5:30 pm, Las Vegas Convention Center, Room N258

Based on *Standard 189.1-2009, Standard for the Design of High-Performance Green Buildings*, this course provides the minimum requirements for the design, construction and plans for operation of high-performance green buildings, including new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings. Water use efficiency, indoor environmental quality, energy efficiency, site sustainability and a building's impact on the atmosphere are covered. The course presents the goals of establishing mandatory criteria in all topical areas, providing simple compliance options, and the complement of green building rating programs for Standard 189.1.

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

**Tuesday, January 31, 2011**

### Understanding & Designing Dedicated Outdoor Air Systems (DOAS)

9:00 am – 12:00 pm, Las Vegas Convention Center, Room N259

This course presents some of the issues that emphasize the advantages of separate dedicated outdoor air systems



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

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

### **Low Temperature Radiant Heating & High Temperature Radiant Cooling Systems (co-sponsored with REHVA)**

*9:00 am – 12:00 pm, Las Vegas Convention Center, Room N260*

This course describes different concepts of high temperature radiant cooling and low temperature radiant heating of buildings and how these systems can be applied in residential, commercial and industrial buildings. The course includes the basic concepts of water-based radiant heating and cooling systems and focuses on the use of these systems combined with the use of renewable energy sources. Attendees receive a discount toward the purchase of *Low Temperature Heating and High Temperature Cooling*.

**Instructor:** Bjarne Olesen, Ph.D., Fellow ASHRAE

### **Successful Solar Applications**

*9:00 am – 12:00 pm, Las Vegas Convention Center, Room N261*

This course is designed to introduce the HVAC community (including engineers, architects, building owners and managers) to sustainable design principles and provide the knowledge necessary to evaluate and implement cost-effective solar applications for commercial and industrial (C&I) facilities. The purpose is to provide attendees with the knowledge and skills required for the development, evaluation, procurement and installation of commercial and industrial solar projects. The technical focus is on cost-effective solar water heating and photovoltaic applications for C&I facilities. However, a wide variety of solar applications, including site-built process water and air heating, is discussed.

**Instructor:** Henry Healey, P.E., Life Member ASHRAE

### **Avoiding IAQ Problems: Using ASHRAE's New IAQ Guide**

*2:00 pm – 5:00 pm, Las Vegas Convention Center, Room N259*

Based on ASHRAE's *IAQ Guide, Best Practices for Design, Construction and Commissioning*, this course provides a systematic overview of the key objectives that must be met to achieve good indoor air quality. A review of the most common

causes of IAQ problems in buildings, as well as the process management strategies that owners and design teams can use during design, construction and turnover to help avoid IAQ problems are discussed. The course discusses the state-of-the-art strategies to prevent IAQ problems related to moisture and mold in building assemblies, outdoor contaminants, moisture and dirt in air handling systems, material emissions, outdoor air monitoring and control and more. Case studies and examples are provided to help make the *IAQ Guide* easy to use on your next project.

**Instructor:** Martha Hewett, Member ASHRAE

### **District Cooling & Heating Systems: Central Plants (co-sponsored with BCA, IES, NEBB)**

*2:00 pm – 5:00 pm, Las Vegas Convention Center, Room N260*

Design principles for an efficient, reliable district cooling/heating plant that serves multi-building facilities are described and demonstrated. The course addresses each component of equipment and the relationship with other equipment within the plant. Types of equipment and the choices available within a type such as chillers will be reviewed and the criteria for selection will be a part of the course. Included is a short discussion of special applications, such as thermal storage, combined heat and power, and deep lake water cooling.

**Instructors:** Donald Bahnfleth, P.E., Presidential/Fellow/Life Member ASHRAE; and William Bahnfleth, Ph.D., P.E., Member AHSRAE

### **Designing Toward Net-Zero Energy Commercial Buildings**

*2:00 pm – 5:00 pm, Las Vegas Convention Center, Room N261*

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

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

## ASHRAE WINTER CONFERENCE TECHNICAL PROGRAM Las Vegas —January 2011

Earn Professional Development Hour (PDH) credits by attending sessions listed in the Technical Program. Each hour attended in a session equals one PDH. For forums and other one-hour sessions, you must be present for the entire 50-minute program to earn a PDH. Sign-in sheets will be available in all session rooms for attendees to complete. New York State PDHs and AIA LUs will be awarded for select sessions. A new process for providing you information on the sessions you attend with begin at this conference. Your badge will be scanned as you enter the session and a summary of sessions attended will be emailed to you upon conclusion of the conference. The new scanning process may take a little longer to get into the room so have patience. Please keep track of the sessions that you attend at the conference.

**Technical sessions are in the Las Vegas Hilton .**

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

## ASHRAE'S CONFERENCES AND EXPOSITIONS COMMITTEE WELCOMES YOU TO THE 2011 WINTER CONFERENCE

**Four types of sessions are presented:**

**Technical Paper Sessions.** These sessions present papers on current applications or procedures, as well as papers resulting from research on fundamental concepts and basic theory. Papers presented in these sessions have successfully completed a rigorous peer review. You are invited to comment on these papers. Forms for written comment are available at each session, and if received by July 16, 2010, comments will be sent to respective authors for reply and publication in ASHRAE Transactions. Preprints of papers and a Meeting Preprints CD are available for purchase in the ASHRAE Bookstore.

**Conference Paper Sessions.** These sessions present papers on current applications or procedures, as well as papers reporting on research in process. These papers differ from technical papers in that they are shorter in length and undergo a much less stringent peer review. Preprints of conference papers and a Meeting Preprints CD are available for purchase in the ASHRAE Bookstore. Conference papers will be published in ASHRAE Transactions but without comments.

**Seminars.** Seminars feature presentations on subjects of current interest. Papers are not available from the Society; however, seminar PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Access is free for attendees who purchase a conference registration. Additional Virtual Conference registrations can be purchased in the ASHRAE Registration.

**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 forums.

### VIRTUAL CONFERENCE

*Free for Paid Conference Registrants*

ASHRAE has added a virtual conference option so you won't miss the state-of-the-art concepts and latest design techniques presented in the Society's technical program. The Las Vegas Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board. All conference attendees paying the full registration fee should have received via email their password and link prior to arriving in Las Vegas. If you do not have your password and link Go to [www.ashrae.org/lasvegasvirtual](http://www.ashrae.org/lasvegasvirtual) and click on the link to access the Virtual Conference and put in your email address to request your password. If you register on-site at the full registration fee you will receive your password at that time.

**Virtual Conference registration includes:**

- Synced audio and PowerPoint presentations
- Access to all seminar presentations
- Access to selected transactions session paper presentations
- Access to posters presented in the poster session
- Ability to post questions or answers for selected sessions through Friday, February 18. Presentations available online for 18 months.

A full slate of technical programs will be posted beginning Monday, January 31, of the sessions that were presented the previous day, with additional content posted through Wednesday, February 2.

Access to the Las Vegas Virtual Conference is free with your paid conference registration. To register only for the Virtual Conference, go to ASHRAE Registration, Las Vegas Hilton, Conrad Room, \$299 ASHRAE member; \$464 non member.

Tech Program



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

Technical Paper, Conference Paper and Poster Session papers as presented at this Conference  
\$98 (includes five FREE hard copies of preprint papers)

Available at the Conference Bookstore



**Conference Seminar Recordings (DVD)**

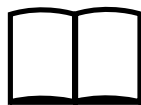
57 Seminars (PowerPoint files synced with speakers' audio)  
\$109 (ships March 2011)



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

Technical Paper, Conference Paper and Poster Session papers as presented at this Conference  
\$6 each

Available at the Conference Bookstore



**ASHRAE Transactions (Print Volume)**

Technical Paper and Poster Session papers with discussion questions and answers for papers in bound, library-quality form. Includes Conference Papers without discussion.  
\$119 (ships May 2011)



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

**Packages**

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

Get five FREE hard copies of preprint papers when you purchase this package  
\$159 – Available at the Conference Bookstore

2. Winter Conference CD and Seminar DVD  
\$159 – Purchase in the Conference Bookstore

3. Complete Winter Conference Package  
(Seminar DVD, Conference CD and ASHRAE Transactions)  
\$199 – Purchase in the Conference Bookstore

All prices are special conference-only member prices.

# Sunday, January 30

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

**TECHNICAL PAPER SESSION 1 (BASIC)**

**Residential Water Heaters and Hot Water Use: The Real Story**

Track: Low Energy Design

**Room: Pavilion 10**

**Sponsor:** 06.06 Service Water Heating

**Chair:** Lance DeLaura, Member, Sempra Energy, San Diego, CA

Every person that wants to take a hot shower needs some kind of water heaters. Most of these heaters have a rating and an assumed performance. But how are these water heaters really performing and how does the behavior of the users affect this performance? Will high efficiency water heaters really get us to zero energy design? Without field studies and detailed laboratory work these questions are difficult to answer. This session highlights information gained from recent field studies and lab work looking at hot water usage and water heater performance for both standard and high efficiency equipment.

**1. Actual Savings and Performance of Gas Tankless Water Heaters (LV-11-001)**

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

**2. A New Study of Hot Water Use In Canada (LV-11-002)**

*Martin Thomas, Member, CANMET Energy Technology Centre, Ottawa, ON, Canada*

**3. Application of a Linear Input/Output Model to Instantaneous Water Heaters (LV-11-003)**

*Thomas Butcher, Ph.D., Member, Brookhaven National Laboratory, Upton, NY*

**CONFERENCE PAPER SESSION 1 (INTERMEDIATE)**

**Heat Pump Applications**

Track: HVAC Systems and Equipment

**Room: Pavilion 11**

**Chair:** William Murphy, Ph.D., Fellow ASHRAE, University of Kentucky, Lexington, KY

Ground source heat pumps (GSHP) are being used in more and more mainstream applications due to their inherently

superior efficiency in many situations that require both heating and cooling. The optimization of every GSHP system depends on how well the ground heat exchanger performance matches the heating and cooling requirements of the load. This session addresses new methods to assist in this optimization process. In addition, high temperature geothermal energy (<100°C) can be used in a Kalina power cycle to generate electricity from energy that would normally be considered not suitable for useful power production.

**1. New Analytical and Numerical Solutions for the Short-term Analysis of Vertical Ground Heat Exchangers (LV-11-C001)**

*Saqib Javed, P.E., Student Member, Chalmers University of Technology, Gothenberg, Sweden*

**2. An Experimental Investigation of the Accuracy of Thermal Response Tests Used to Measure Ground Thermal Properties (LV-11-C002)**

*Saqib Javed, P.E., Student Member<sup>1</sup>, Jeffrey Spitler, Ph.D., P.E.<sup>2</sup> and Per Fahlen<sup>3</sup>, (1)Chalmers University of Technology, Gothenberg, Sweden, (2)Oklahoma State University, Stillwater, OK, (3)University of Technology in Gothenburg, Sweden, Gothenburg, Sweden*

**3. Parametric Analysis and Thermodynamic Limits of Solar Assisted Geothermal Co- and Tri-Generation Systems (LV-11-C003)**

*Marija S. Todorovic, Ph.D., P.E., Member<sup>1</sup> and Dusan Licina<sup>1</sup>, (1)University of Belgrade, Belgrade, Serbia and Montenegro*

**CONFERENCE PAPER SESSION 2 (INTERMEDIATE)**

**Temperature and Capacity Control**    

Track: HVAC Fundamentals and Applications

**Room: Pavilion 2**

*Chair: Sarah Maston, P.E., Member, Advanced Building Performance, Andover, MA*

This session presents papers addressing a variety of control topics.

**1. Rehab of DDC at Corporate National Training Center- Three Years of Therapy (LV-11-C004)**

*Alonzo Blalock, P.E., Member, Jacobs, Fort Worth, TX*

**2. Capacity Control of Air Coils for Heating and Cooling: Transfer Functions, Drive Power and System Design (LV-11-C005)**

*Per Fahlen, Member<sup>1</sup> and Caroline Markusson<sup>1</sup>, (1) Chalmers University of Technology, Gothenburg, Sweden*

**3. Proportional-Integral-Plus (PIP) Control System for Individual Thermal Zones in a Small Ventilated Space (LV-11-C006)**

*Ali Youssef<sup>1</sup>, Vasileios Exadaktylos<sup>1</sup>, Sezin Ozcan<sup>1</sup> and Daniel Berckmans<sup>1</sup>, (1)University of Leuven, Leuven, Belgium*

**SEMINAR 1 (INTERMEDIATE)**  

**Building Development: High Performance Teamwork for High Performance Buildings**

Track: Integrated Design

**Room: Pavilion 4**

*Sponsor: 07.01 Integrated Building Design*

*Chair: David S. Allen, P.E., Member, Allen Consulting, LLC, Chelmsford, MA*

Buildings consume 40% of the world’s energy resources. Revolutionary change is coming to the building industry: high performance buildings. Creating these buildings will require those of us who conceive, design, build and operate them to work much differently. This workshop style seminar introduces two proven product development practices that are beginning to be effectively used in the building industry. Specifically, it will focus on two best practices: breaking down the functional silos between architecture, engineering, and construction and accomplishing more with less through cross-functional teams. The other best practice is how teams learn what “High Performance” means to customers, the people who will work in and pay for the building.

**1. What Can the Building Design, Construction and Operation Community Learn From the New Product Development World?**

*Rick Norman, Strategyn, Wilmington, NC*

**2. Building Development: High Performance Teamwork for High Performance Buildings**

*Robert Pennisi, Strategyn, Boca Raton, FL*

**SEMINAR 2 (INTERMEDIATE)**  

**HVAC Security - Less We Forget**

Track: HVAC Systems and Equipment

**Room: Pavilion 9**

*Sponsor: 09.01 Large Building Air-Conditioning Systems, TG2 - Security*

*Chair: Howard J. McKew, Member, RDK Engineers, Andover, MA*

This seminar introduces the revised 2011 ASHRAE Handbook Chapter 58 HVAC Security that will be published this coming year. The chapter has had significant changes to its content as well as a change to its chapter name. This seminar assists the design engineer in addressing the issues and concerns in sync with designing the HVAC systems for the specific building application. It is also a discussion on the importance of HVAC security design based on the experience of the three speakers relative to design and operation of HVAC systems in buildings.

**1. HVAC Security: Overview of ASHRAE Handbook Chapter**

*Kevin Cogley, P.E., Associate Member, Joint Program Executive Office for Chemical and Biological Defense, Dahlgren, VA*

Tech Program

**2. The New ASHRAE Guideline 29 and Secure HVAC Design**

*Gregory Dobbs, Ph.D., Member, United Technologies Research Center, East Hartford, CT*

**3. Checklist Approaches to HVAC Security**

*Scott D. Campbell, Ph.D., P.E., Str-Analysis, AL*

**SEMINAR 3 (ADVANCED)  **

**Low GWP Refrigerant Options for Unitary Equipment**

Track: Refrigeration Update

**Room: Pavilion 6**

**Sponsor:** 08.11 Unitary and Room Air Conditioners and Heat Pumps

**Chair:** Don A. Schuster, P.E., Member, UTC Carrier Corp., Tyler, TX

The use of hydrochlorofluorocarbon (HCFC) type refrigerants ended and transitioned to non-chlorinated refrigerants in new OEM equipment. Concern now mounts over the replacements due to global warming issues. This seminar examines the drivers, current low global warming potential (LGWP) candidates, their application and safety issues.

**1. Potential Low Global Warming Refrigerants for Unitary Air Conditioning Systems**

*Mark Spatz, P.E., Member, Honeywell Inc., Buffalo, NY*

**2. Low GWP Refrigerant Options for Air Conditioning**

*Thomas J. Leck, Ph.D., Member, Du Pont Refrigerants, Wilmington, DE*

**3. Low GWP Refrigerants and Their Performance Potentials**

*J. Steven Brown, Ph.D., P.E., The Catholic University of America, Washington, DC*

**4. Developments and Opportunities Using Hydrocarbon Refrigerant Blends**

*Nicholas Cox, Earthcare Products Limited, Ware, Herts, United Kingdom*

**SEMINAR 4 (BASIC)**

**Make the Most of Your ASHRAE Experience**

Track: Professional Skills

**Room: Pavilion 3**

**Sponsor:** Conferences and Expositions Committee

**Chair:** Monte G. Troutman, P.E., Member, B.C. Engineering, Inc., Evansville, IN

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

answers all your questions and offers insight to all the opportunities that ASHRAE has to offer.

**1. ASHRAE 101: Learning the Basics**

*Monte G. Troutman, P.E., Member, B.C. Engineering, Inc., Evansville, IN*

**2. How to Get the Most out of ASHRAE Conferences**

*Alan C. Veeck, Member, MVA Inc., Virginia Beach, VA*

**SEMINAR 5 (INTERMEDIATE)  **

**Smart Grid and Net Zero Buildings: Where Are We Now?**

Track: Net Zero Energy

**Room: Pavilion 1**

**Sponsor:** 07.05 Smart Building Systems

**Chair:** Rich Hackner, P.E., Member, GDS Associates, Madison, WI

Designing and operating building system technologies to achieve comfort and efficiency provide challenges under normal conditions. And adding electrical grid interactions with various utility pricing options, including real time pricing, and it raises the level of complexity. Critical path elements such as standards development, new technologies, and new approaches to building operation can help speed the integration of smart grid technology and development of net-zero buildings.

**1. Overview of Smart Grid Standards Development Efforts**

*David Holmberg, NIST, Gaithersburg, MD*

**2. Critical Path Elements of Smart Grid Implementation**

*Ken Sinclair, Member, Automated Buildings.COM, Sidney, BC, Canada*

**3. Developing An Energy Management Plan In a Smart Grid Future**

*Michael Chimack, P.E., Member, GDS Associates, Chicago, IL*

**9:45 AM-10:45 AM**

**TECHNICAL PLENARY (BASIC) **

**Standard 189.1: Sustainability Beyond Energy Conservation**

Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 1**

**Sponsor:** Conferences and Expositions Committee

**Chair:** William Dietrich, Member, Baltimore Aircoil Co., Baltimore, MD

**Technical Plenary Speaker:** Kent Peterson, P.E., Presidential/Fellow Member, P2S Engineering, Inc., Cypress, CA

With Standard 189.1 working its way into the building community, its impact is being felt by engineers, architects and building owners as they seek to apply the standard's

requirements on sustainable sites, water efficiency, indoor environmental quality and the building's impact on the atmosphere. The standard has been built on many ASHRAE standards and guidelines including 90.1, 62.1, 55, 180, Guideline 0. This session focuses on how Standard 189.1 pulls all these requirements together for high-performance green buildings.

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

**TECHNICAL PAPER SESSION 2 (BASIC)**    

**Hot Off the Griddle: New Developments in Commercial Kitchen Ventilation Research**

Track: HVAC Systems and Equipment

Room: Pavilion 11

Sponsor: 05.10 Kitchen Ventilation

Chair: Derek Schrock, Halton Co., Scottsville, KY

The theme of this session is to provide updates on the latest ASHRAE research in kitchen ventilation. The topics presented include the results of ASHRAE research to measure the exhaust airflows in the field in kitchen hoods (RP-1376) and means of optimizing the performance of island hood systems (RP-1480).

**1. Performance Evaluation of Hand Held Airflow Instruments Applied to Commercial Kitchen Exhaust Systems (LV-11-004)**

Thomas Kuehn, Ph.D., Fellow ASHRAE, University of Minnesota, Minneapolis, MN

**2. Capture and Containment Ventilation Rates for Double-Island Canopy Hoods Measured During (RP-1480) (LV-11-005)**

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

**3. Capture and Containment Ventilation Rates for Single-Island Canopy Hoods (LV-11-006)**

Paul Sobiski, Member<sup>1</sup> and Don R. Fisher<sup>2</sup>, (1), Boulder, CO, (2)Fisher-Nickel, San Ramon, CA

**CONFERENCE PAPER SESSION 3 (INTERMEDIATE)**

**Radiant Heating and Cooling**    

Track: Low Energy Design

Room: Pavilion 4

Chair: Gary Hayden, P.E., Member, GBH Engineering, Norfolk, VA

The session addresses exergy in radiant heating and cooling, solar thermal hot water heating and solar-assisted radiant floor heating in a residential building.

**1. Over Thirty Years of Experience with Solar Thermal Hot Water Heating (LV-11-C007)**

Stanley Mumma, Ph.D., P.E., Fellow ASHRAE, Penn State University, University Park, PA

**2. Exergy Metrication of Radiant Heating and Cooling (LV-11-C008)**

Birol Kilkis, Ph.D., Fellow ASHRAE, Baskent University, Ankara, Turkey

**3. Solar-Assisted Radiant Heating and DHW for a Net Zero Energy House (LV-11-C009)**

José A. Candanedo, Student Member<sup>1</sup>, Amelie Allard, Student Member<sup>1</sup> and Andreas K. Athienitis, Ph.D., P.E., Member<sup>1</sup>, (1)Building, Civil and Environmental Engineering, Concordia University, Montréal, QC, Canada

**4. Solar Energy Utilization of a Residential Radiant Floor Heating System (LV-11-C010)**

Kamel Haddad, Ph.D., Member, Natural Resources Canada, Ottawa, ON, Canada

**CONFERENCE PAPER SESSION 4 (INTERMEDIATE)**

**Residential Applications**    

Track: HVAC Systems and Equipment

Room: Pavilion 9

Chair: Marcus Bianchi, Ph.D., Associate Member, National Renewable Energy Laboratory, Golden, CO

This session provides an overview of ways to use energy efficient methods in residential applications.

**1. Prediction of Air Mixing from High Sidewall Diffusers in Cooling Mode (LV-11-C011)**

El Hassan Ridouane, Ph.D., Member<sup>1</sup> and Keith Gawlik, Ph.D., Member<sup>1</sup>, (1)National Renewable Energy Laboratory, Golden, CO

**2. Simulation and Experimental Investigation of Condensation in Residential Venting (LV-11-C012)**

Paul Glanville, P.E., Associate Member<sup>1</sup>, Larry Brand, Member<sup>1</sup> and Shawn Scott<sup>1</sup>, (1)Gas Technology Institute, Des Plaines, IL

**3. Energy Efficiency Design Options for Residential Water Heaters: Economic Impacts on Consumers (LV-11-C013)**

Alex Lekov, Ph.D., Member<sup>1</sup>, Victor Franco<sup>1</sup>, Steve Meyers<sup>1</sup>, Lisa Thompson<sup>1</sup> and Virginie Letschert<sup>1</sup>, (1)Lawrence Berkeley National Laboratory, Berkeley, CA

**SEMINAR 6 (INTERMEDIATE)**  

**Building a Sustainable Future by Removing Barriers for Low GWP Refrigerants**

Track: Refrigeration Update

Room: Pavilion 6

Sponsor: 03.01 Refrigerants and Secondary Coolants

Chair: Barbara Minor, Member, DuPont, Wilmington, DE

With increasing concern about climate change and the potential long term impact of high global warming HFC refrigerant use, the potential to use low GWP refrigerant options is increasing

in importance. To achieve low GWP, tradeoffs in flammability, pressure, toxicity and other characteristics need to be considered to understand which options have the best potential in specific applications. Also, improved property data is required for low GWP refrigerants to assist with system design from a performance and safety standpoint. Safety codes and standards also need to be assessed and potentially upgraded to include a new class of low flammability refrigerants.

**1. A Primer on HFOs**

*Brett Van Horn, Member, Arkema, Philadelphia, PA*

**2. Property Data for Low-GWP Refrigerants: What Do We Know and What Don't We Know?**

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

**3. Burning Velocity Measurement of Low Flammability 2L Refrigerants**

*Kenji Takizawa, National Institute of Advanced Industrial Science and Technology (AIST), Ibaraki, Japan*

**4. Review of Regulations and Standards for the Use of Refrigerants with GWP Values Less Than 20 In HVACR Applications**

*William Goetzler, Navigant Consulting, Burlington, MA*

**SEMINAR 7 (INTERMEDIATE)** 

**Building Energy Simulation 102**

Track: HVAC Fundamentals and Applications

**Room: Pavilion 2**

*Sponsor: 04.07 Energy Calculations*

*Chair: Keith R. Cockerham, P.E., Member, DLB Associates, Eatontown, NJ*

Energy modeling is presented in three parts: modeling best practices and quality control, modeling during predesign, and modeling for energy conservation measure (ECM) identification and analysis. As an advanced modeling session, the first presentation outlines best practice procedures to incorporate into modeling to support consistency in methods, reduction in input errors, and generation of reasonable results. The second presentation discusses opportunities for energy modelers to influence goal setting, building programming, design criteria, and design alternative decisions to create energy efficient buildings. The final presentation outlines modeling procedures and ECM's resulting from a utility based carbon abatement program.

**1. Modeling Best Practices and Quality Control**

*Ellen Franconi, Ph.D., Rocky Mountain Institute, Boulder, CO*

**2. Modeling During Predesign**

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

**3. Modeling for Energy Conservation Measure (ECM) Identification and Analysis**

*Thomas A. Davidson, P.E., Member, DLB Associates, Eatontown, NJ*

**SEMINAR 8 (INTERMEDIATE)** 

**Controls for Central Chiller Plant Optimization**

Track: Low Energy Design

**Room: Pavilion 10**

*Sponsor: 01.04 Control Theory and Application, TC 9.1, TC 9.8, TC 10.8, 01.05 Computer Applications*

*Chair: Frank Shadpour, P.E., Fellow ASHRAE, Shadpour Consulting Engineers, Inc., San Diego, CA*

This seminar addresses how optimization techniques can be used to improve the energy efficiency and performance of central chiller plants. Growing trends on energy conservation has placed a spotlight on the optimization of central plants. Control strategies and proper sequence of operation has significant effect on the operation and efficiency of the central plants. The presentations cover the unique challenges, lessons learned and critical do's and don'ts associated with optimization of central chiller plants.

**1. Optimized Control Sequences for An All-Variable Speed Chilled Water Plant**

*Steven Taylor, P.E., Taylor Engineering LLC, Alameda, CA*  
*Fundamentals of Design & Control of Central Chilled Water Plants*

**2. Achieving Ultra-Efficient Chiller Plants with Relational Control**

*Thomas Hartman, P.E., The Hartman Company, Georgetown, TX*

**3. Managing a Complex Central Plant Designed for the Life of a Facility**

*Tim Jacoby, Rady Children's Hospital, San Diego, CA*

**SEMINAR 9 (INTERMEDIATE)** 

**Fault Detection and Diagnostics, But What about Correction?**

Track: HVAC Fundamentals and Applications

**Room: Pavilion 3**

*Sponsor: 07.05 Smart Building Systems*

*Chair: Srinivas Katipamula, Ph.D., Fellow ASHRAE, Pacific Northwest National Laboratory, Richland, WA*

Automated fault detection and diagnostic (FDD) technologies for building equipment have been under investigation/development for 15 to 20 years. Some of these techniques are beginning to appear in commercial equipment and controls. A next logical contribution of technology is for it to automatically correct common faults that are amenable to such correction. The presentations in this seminar report on an exploratory investigation of self-correcting and adaptive controls can minimize the impact of faults on equipment operations.

**1. Self-Correcting Air-Handler Controls: Results From Early Development and Testing**

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

**2. Building System Life-Cycle Diagnosis Starting From Design: Experiences and Benefits In a Super-High-Rise Building In Hong Kong**

*Shengwei Wang, Ph.D., Member, Hong Kong Polytechnic University, Kowloon, Hong Kong, Hong Kong*

**3. Soft-Repair of Faults In HVAC Systems**

*Haorong Li, Ph.D., Member, University of Nebraska-Lincoln, Omaha, NE*

**SEMINAR 9-2 (INTERMEDIATE)**  

**Energy and Comfort Performance of Active Chilled Beam Systems**

Track: Low Energy Design

Room: Pavilion 1

Sponsor: 05.03 Room Air Distribution

Chair: Fred S. Bauman, P.E., Member, University of California, Berkeley, Berkeley, CA

Chilled beam systems have been attracting increased attention in recent years as an energy-reducing alternative to conventional overhead mixing systems. In this seminar, we report on energy and comfort performance of active chilled beams from both modeling studies and case studies of installed systems.

**1.Active Chilled Beams: A Case Study Comparing Modeled Performance to Actual Performance**

*Christopher Conley, P.Eng., Member, Daniels Wingerak Engineering Ltd., Saskatoon, SK, Canada*

**2.Do Active Beams Save Energy and Provide Thermal Comfort?**

*Peter Simmonds, Ph.D., Fellow ASHRAE, IBE Consulting Engineers, Sherman Oaks, CA*

**3.Effects of Chilled Beams on Chilled Water Plant Efficiency**

*Mike Filler, Member, Trane Company, Pueblo, CO*

**1:30 PM-3:00 PM**

**TECHNICAL PAPER SESSION 3 (INTERMEDIATE)**

**Hot Water Distribution Systems: New Design Information**



Track: Low Energy Design

Room: Pavilion 4

Sponsor: 06.06 Service Water Heating

Chair: Russell K. Johnson, Member, Johnson Research LLC, Pueblo West, CO

Distribution piping is responsible for as much as 95% of water heating system energy use in poorly designed and implemented potable hot water systems, and is rarely responsible for less than 15% even in the best designed systems. This technical paper session presents new laboratory and field test information that quantifies hot water distribution

system time, water, and energy waste, and discusses improved system designs.

**1. Hot Water Distribution System Piping Heat Loss Factors – Phase III Test Results (LV-11-007)**

*Carl C. Hiller, Ph.D., P.E., Fellow ASHRAE, Applied Energy Technology Co., Davis, CA*

**2. Hot Water Distribution System Piping Time, Water, and Energy Waste – Phase III Test Results (LV-11-008)**

*Carl C. Hiller, Ph.D., P.E., Fellow ASHRAE, Applied Energy Technology Co., Davis, CA*

**3. Pilot Phase of a Field Study to Determine Waste of Water and Energy In Residential Hot Water Distribution Systems (LV-11-009)**

*James Lutz, Member, Lawrence Berkeley National Laboratory, Berkeley, CA*

**CONFERENCE PAPER SESSION 5 (INTERMEDIATE)**

**Evaporative Cooling**



Track: HVAC Systems and Equipment

Room: Pavilion 9

Chair: Dennis Knight, The Sustainability Institute, Charleston, SC

This session provides information and details ways to increase the efficiency of evaporative cooling in commercial applications.

**1. Dew Point Evaporative Cooling: Technology Review and Fundamentals (LV-11-C014)**

*Paul Glanville, P.E., Associate Member<sup>1</sup>, Aleksandr Kozlov, Ph.D.<sup>1</sup> and Valeriy Maisotsenko, Ph.D., Member<sup>2</sup>, (1)Gas Technology Institute, Des Plaines, IL, (2)Coolerado Corp., Denver, CO*

**2. Myths and Realities of Indirect Evaporative Cooling Thermodynamic Performance (LV-11-C015)**

*Nicholas Des Champs, Ph.D., P.E., Fellow Life Member, Munters, Buena Vista, VA*

**3. Energy Simulation Results for Indirect Evaporative Assisted DX Cooling Systems (LV-11-C016)**

*James V. Dirkes II, P.E., Member<sup>1</sup> and Ryan Hoffman<sup>1</sup>, (1) The Building Performance Team, Grand Rapids, MI*

**SEMINAR 10 (BASIC)**  

**Boiler Water Treatment: How to Do It Right**

Track: HVAC Fundamentals and Applications

Room: Pavilion 2

Sponsor: 03.06 Water Treatment, SPC 191

Chair: Leon Shapiro, J.D., VRTX Technologies, Las Vegas, NV

This is a great seminar for anyone wishing to learn both the basics and state of the art of boiler water treatment. Basic water chemistry, objectives of a good boiler treatment, and an update on the latest in new technologies and approaches are presented. Designers, owner and operators will be delighted



with the value of the information to be obtained at this seminar. The emphasis is on maximizing energy efficiency through good practices and equipment.

**1. Basics of Steam Boiler Pretreatment Equipment**

*Jon J. Cohen, Member, H-O-H Water Technology, Palatine, IL*

**2. Internal Boiler Water Treatment — In the 21st Century**

*Bill Pearson II, Associate Member, Southeastern Laboratories, Raleigh, NC*

**3. Meeting Today’s Challenges in Hospitals**

*Brian Jenkins, Affiliate, Nalco, Naperville, IL*

**SEMINAR 11 (INTERMEDIATE)  Cradle to Grave Refrigerant Management**

Track: Refrigeration Update

**Room: Pavilion 6**

**Sponsor:** 03.08 Refrigerant Containment, ASHRAE Associate Society Alliance, 03.01 Refrigerants and Secondary Coolants

**Chair:** Robert Yost, Member, National Refrigerants, Inc., Bridgeton, NJ

Sustainable use of refrigerants involves proper management of the refrigerant charge during the entire life cycle of the equipment. This seminar presents different strategies and techniques for ensuring refrigerant emissions to the environment are minimized. These techniques may form the basis for a regulatory framework for refrigerant management.

**1. Refrigerant Management System for Mitigating Global Warming**

*Momoki Katakura, JSRAE, Tokyo, Japan*

**2. European Strategies for Refrigerant Management**


*Denis Clodic, Ph.D., Member, Armines Cep., Paris, France*

**3. RMC: The Canadian Industry Response to Extended Producer Responsibility Regulations**

*Warren Heeley, Heating, Refrigeration and Air Conditioning Institute of Canada, Mississauga, ON, Canada*

**4. U.S. Strategies for Managing Refrigerant Use and Emissions**

*David Godwin, P.E., Member, US EPA, Washington, DC*

**SEMINAR 12 (INTERMEDIATE)  Designing for Improved Air Quality in Casinos with ETS**

Track: HVAC Fundamentals and Applications

**Room: Pavilion 3**

**Sponsor:** 4.3 Ventilation Requirements and Infiltration

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

Casino gaming areas where tobacco smoking is allowed present a challenge to ventilation system designers. This program discusses design options and techniques for improving air quality and reducing exposure to environmental tobacco smoke (ETS) for both customers and employees in casinos.

**1. HVAC Design for IAQ In Casinos with ETS**

*Brian Rock, Ph.D., P.E., Fellow ASHRAE, The University of Kansas, Lawrence, KS*

**2. Design of Air Distribution for Secondary Smoke Mitigation Using Computational Fluid Dynamics**

*Daniel Nall, P.E., Member, WSP Flack + Kurtz, New York, NY*

**3. Building Ventilation System Design to Improve Containment of Smoking Environments**

*Brad R. Geinzer, P.E., Member, JBA Consulting Engineers, Las Vegas, NV*

**SEMINAR 13 (INTERMEDIATE)  Don't Gamble with your NZEB – Maintain It!**

Track: Net Zero Energy

**Room: Pavilion 1**

**Sponsor:** 07.03 Operation and Maintenance Management, 07.05 Smart Building Systems

**Chair:** Angela Lewis, P.E., Student Member, University of Reading, Alexandria, VA

Moving towards net-zero energy buildings, or even just reducing energy waste, requires knowing how to implement operations and maintenance best practices. This seminar session provides an overview of what is necessary to achieve NZEB during operations and maintenance, as well as two best practices that help illustrate the true costs of moving toward net zero. The first presentation provides an overview of the importance using operations and maintenance best practices for NZEB. The second and third presentations showcase technologies and processes that need to be embraced to reduce building energy consumption, moving toward NZEB. The second presentation discusses how the use of data from building automation systems can be used to detect and reduce energy waste. The final presentation provides practical insight about reducing energy waste during air-handler operation.

**1. NZEB: A Higher Level of O&M**

*Bill McCartney, Member, Isotherm Engineering Ltd, Mississauga, ON, Canada*

**2. Monitoring-Based Commissioning: A Path Toward Proactive Maintenance**

*Vernon Smith, P.E., Associate Member, Architectural Energy Corporation, Boulder, CO*

**3. Watch Both Airflow and Pressure Drop**

*Robert Baker, Fellow ASHRAE, BBJ Environmental LLC, Riverview, FL*

**SEMINAR 14 (INTERMEDIATE)**  

**Energy Modeling of Existing Buildings**

Track: Low Energy Design

**Room: Pavilion 10**

*Sponsor: 04.07 Energy Calculations*

*Chair: Susan Reilly, Member, Enermodal, Inc. Industry, Denver, CO*

This session addresses the process and challenges of creating calibrated energy models of existing buildings. A calibrated energy model of an existing building can assist with the decision process in adopting energy conservation measures; however, the process of modeling an existing, occupied building can be difficult. Challenges include incorporating variations in occupant behavior and building internal loads, modeling the actual and sometimes varying HVAC and lighting controls, and modeling malfunctioning equipment. Utility data can provide some guidance, but often only provides a vague energy profile for the building, and rarely provides information about the individual building energy end-uses.

**1. Case Study: The Role of Energy Modeling In General Services Administration Audits**

*Aleka Pappas, Member, Enermodal Engineering Inc, Denver, CO*

**2. Energy Modeling Software**

*Ron Judkoff, Ph.D., Member, National Renewable Energy Laboratory, Golden, CO*

**3. Development of An Automated Calibration Tool for Code-Compliant Residential Simulation**

*Jeff Haberl, Fellow ASHRAE, Texas A&M University, College Station, TX*

**SEMINAR 15 (INTERMEDIATE)**  

**Going Lower with Solar**

Track: Low Energy Design

**Room: Pavilion 11**

*Sponsor: 06.07 Solar Energy Utilization*

*Chair: Mark A. Hertel, P.E., Member, SunEarth, Inc., Honolulu, HI*

This seminar considers how the utilization of solar energy in building design can lower the utility energy budget of an already low energy building design. The use of various simulation software provides a basis for the feasibility of solar collectors, seasonal storage and flexible end-use components. The applications include an office building in Greece, a performing arts center in Connecticut and a subdivision in Northern Canada. Optimizing system performance with sophisticated control strategies is a key to successful solar integration.

**1. Simulation of the Thermal Performance of a Net-Zero Energy Performing Arts Building: Achieving Net Zero Energy Conditions In Retrofit**

*Dennis J. O'Connor, Student Member<sup>1</sup> and Cenk C. Yavuzturk, Member<sup>2</sup>, (1)University of Hartford, Hartford, CT, (2)University of Hartford, West Hartford, CT*

**2. From Design and Simulations to Case Study of a High Solar Combi-Plus System**

*Constantinos A. Balaras, Ph.D., P.E., Member<sup>1</sup> and Elena G. Dascalaki, Ph.D.<sup>1</sup>, (1)National Observatory of Athens, Athens, Greece*

**3. Solar-Assisted District Heating System In a Sub-Arctic Climate**

*Andrew Chiasson, Ph.D., Member, University of Dayton, Dayton, OH*

**3:15 PM-4:00 PM**

**FORUM (BASIC)**

**Gambling on the Future – Charitable Giving Opportunities & Challenges**

Track: Professional Skills

**Room: Pavilion 3**

*Sponsor: ASHRAE Foundation*

*Chair: Bert Huffman, ASHRAE Foundation, Atlanta, GA*

Join Jeff Lydenberg, a qualified tax attorney, from PG Calc for a forecast of what's to come in charitable giving laws, rules and regulations. Also, feel free to come armed with any questions regarding your own estate plans, and how you can plan for the future in the way most efficient for your family's needs!

**notes**

Tech Program

# Monday, January 31

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

**CONFERENCE PAPER SESSION 6 (INTERMEDIATE)**

**Energy Efficiency and Energy Simulation Applications**   

Track: HVAC Systems and Equipment

**Room: Pavilion 9**

**Chair:** Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

This session presents ideas and information on ways to increase the energy efficiency of buildings by way of case studies and energy modeling software.

**1. Verification of the Energy Efficiency Advancement in District Heating and Cooling Plant by Renovation (LV-11-C017)**

Shinya Nagae<sup>1</sup>, Yoshiyuki Shimoda, Ph.D.<sup>1</sup>, Shiori Takamara<sup>1</sup>, Yoshitaka Uno<sup>1</sup>, Kenichiro Wantanabe<sup>2</sup> and Yutaka Shoji<sup>3</sup>, (1)Osaka University, Osaka, Japan, (2) Sibaura Institute of Technology University, Tokyo, Japan, (3)Energy Advance Co., Ltd., Tokyo, Japan

**2. CFD Simulation of Single Phase Flow in Plate Heat Exchangers (LV-11-C018)**

Steven O'Halloran, Ph.D., Member<sup>1</sup> and Amir Jokar, Ph.D., Member<sup>2</sup>, (1)University of Portland, Portland, OR, (2) ThermoFluids Tech, Vancouver, WA

**3. Environmentally Opportunistic Computing: Computation as Catalyst for Sustainable Design (LV-11-C019)**

Aimee P.C. Buccellato<sup>1</sup>, Paul Brenner, Ph.D., P.E.<sup>1</sup>, David B. Go<sup>1</sup>, Ryan Jansen<sup>1</sup> and Eric M. Ward, Jr.<sup>1</sup>, (1)University of Notre Dame, Notre Dame, IN

**4. ASHRAE Resources for LEED-Existing Buildings Certification (LV-11-C020)**

Barry Abramson, P.E.<sup>1</sup> and Lung-Sing Wong, P.E., Member<sup>1</sup>, (1)Servidyne, Atlanta, GA

**5. Building Professional Accreditation, Construction Quality Control and Better Buildings (LV-11-C021)**

Ellis G. Guiles Jr., TAG Mechanical Systems, Inc., Syracuse, NY

**SEMINAR 16 (INTERMEDIATE)** 

**Climate Change: It's Happening, So Who's Responding?**

Track: HVAC Fundamentals and Applications

**Room: Pavilion 2**

**Sponsor:** 02.05 Global Climate Change, 04.02 Weather Information

**Chair:** David Godwin, P.E., Member, US EPA, Washington, DC

Scientific studies continue to provide data that indicate the Earth's climate is changing due to human activities, and evidence from across the planet, including in the U.S., indicates some early changes are already happening. Although (as of August 2010) debate continues on legislation in the U.S., as well as on international agreements under the UNFCCC and Montreal Protocol, many companies, organizations and governments are taking action now. This seminar provides an overview of some of the indications of climate change, actions being taken under California legislation, and the impact that ASHRAE standards can and are having to reduce greenhouse gas emissions.

**1. Climate Change Indicators in the U.S.**

Donald J. Wuebbles, Ph.D., University of Illinois, Urbana, IL

**2. California Air Resources Board Regulations on Refrigerants**

Glenn Gallagher, California Air Resources Board, Sacramento, CA

**3. Reductions In Greenhouse Gas Emissions Achieved by Standards 90.1-2010 and 189.1-2009**

T.M. Lawrence, Ph.D., Member, University of Georgia, Athens, GA

**4. Climate Change: Scientific Certainties and Political Realities**

James Crawford, Fellow ASHRAE, Trane Co., Tyler, TX

**SEMINAR 17 (INTERMEDIATE)**  

**Codes and Standards that Influence Mission Critical Facilities**

Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 11**

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

**Chair:** Craig A. Crader, P.E., Associate Member, Bick Group, St. Louis, MO

Mission critical facilities, like other facilities, are influenced by various codes and standards. This session takes a look at these codes and standards to help designers and operators understand the parameters to which influences the design of mission critical facilities.

**1. An Overview of the European Union Code of Conduct for Data Centers**

Michael K. Patterson, Ph.D., P.E., Member, Intel, Hillsboro, OR

**2. Energy Codes for Data Centers**

Jeff Stein, P.E., Member, Taylor Engineering, Alameda, CA

**3. Telecommunication Standards for Data Centers**

Rhonda Johnson, Member, Panduit Corp., Tinley Park, IL

Tech Program

**4. U.S. Green Building Council LEED Guidelines and the Impact for Mission Critical Facilities**

*Doug McLellan, P.E., HP Critical Facilities Services, Bethesda, MD*

**SEMINAR 18 (INTERMEDIATE)** 

**Cutting-Edge Japanese Technologies for Zero-Energy Buildings (Part 1)**

Track: Net Zero Energy

Room: Pavilion 1

*Chair: Shin-ichi Tanabe, Ph.D., Fellow ASHRAE, Department of Architecture, Waseda University, Tokyo, Japan*

This session presents new Japanese HVAC technologies employed for ZEBs (Zero-Energy Buildings). The IPCC Fourth Assessment Report suggests that the construction industry has the largest potential for emission reduction; but in reality, emissions from building sector including housing have been increasing. Background in Asia is explained at the beginning of the session. We conducted a case study of an Asian office building with a new multiple split air-conditioning system by performing field measurements. A heat pump and a thermal storage system were installed in a DHC system with the aim of achieving high efficiency with minimum energy consumption and large reduction in greenhouse gas emission.

**1. Carbon Neutral Architecture, Action In Japan**

*Hiroshi Yoshino, Ph.D., Fellow ASHRAE, School of Engineering, Tohoku University, Sendai, Japan*

**2. Performance of K Building with Multiple Split Air-Conditioning System**

*Seiichi Tabuchi, Kajima Corporation, Tokyo, Japan*

**3. Successful Application of Heat Pumps to DHC System In Tokyo Bay Area**

*Keiji Kojima, Tokyo Electric Power Company, Tokyo, Japan*

**SEMINAR 19 (INTERMEDIATE)** 

**District Ground Source Heat Pump Systems, Part 1**

Track: Low Energy Design

Room: Pavilion 10

*Sponsor: 06.08 Geothermal Energy Utilization, 09.04 Applied Heat Pump/Heat Recovery Systems*

*Chair: J. B. Singh, Fellow ASHRAE, J&P Consulting Engineers, Linwood, NJ*

Fueled by stimulus money and tax incentives at both the Federal and State levels, the geothermal industry is enjoying a renewed interest by building owners and developers for district systems. A district GSHP system is not a new idea, but one that is more frequently being explored for large campuses and mixed use application in many locations. The challenge in designing these systems is the management of a

central pump or series of pumps for both energy efficiency and management of the pumping system by the owner. Several projects which apply these ideas are presented as part one of this seminar series.

**1. A Feasibility Study for a District Hybrid Geothermal Heat Pump System in Northern Canada**

*Andrew Chiasson, Ph.D., Member, University of Dayton, Dayton, OH*

**2. District Ground Source Hybrid System Applications for Large Commercial Projects**

*Donald C. Smith, Member, Sound Geothermal Corp., Sandy, UT*

**3. Energy Transfer within a Community Development**

*Ed Lohrenz, Member, Geo-Xergy Systems, Inc., Winnipeg, MB, Canada*

**SEMINAR 20 (BASIC)** 

**Mechanical Engineer's Role in Green Building**

Track: Integrated Design

Room: Pavilion 4

*Sponsor: Student Activities Committee*

*Chair: Chuck Curlin, P.E., Member, Shultz Engineering Group, Charlotte, NC*

Mechanical engineers play a vital role in achieving true sustainability as we move forward in reducing our dependency of fossil fuels for energy. In the advent of low cost energy, building designers and architects lost touch with the linkage between the outdoor and the indoor built environment. With today's focus on energy conservation and the return of the integrated building design process, the mechanical engineer plays a vital role in the overall building design – no longer relegated to fitting an HVAC system into an existing building design. This session explores the impact you can have at any stage of your career.

**1. Mechanical Engineer's Role in Green Building**

*Paul Petrilli, P.E., Member, H.F. Lenz Company, Johnstown, PA*

**SEMINAR 21 (BASIC)** 

**Profitability Killers and How To Avoid Them**

Track: Professional Skills

Room: Pavilion 3

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

*Chair: Michael DeSantiago, P.E., Member, Primera Engineers, Ltd, Chicago, IL, Samuel Reed, P.E., Member, BSA LifeStructures, Indianapolis, IN*

This session addresses issues related to profitability. It describes various profitability “killers” that can occur on a project and provide ideas for the engineer and/or project manager on how

to avoid them. The presentation includes a discussion of lessons learned based on actual case studies in which the bottom-line was severely impacted and how the losses could have been mitigated or avoided. The discussion includes a description of some of the basic metrics of profitability such as the effective multiplier, and a discussion of how the PM can influence these metrics on a project.

**SEMINAR 22 (ADVANCED)** 

**Vapor-Compression Cycles, Systems and Components with Natural Refrigerants**

Track: Refrigeration Update

Room: Pavilion 6

*Sponsor: 03.01 Refrigerants and Secondary Coolants, Refrigeration Committee, 08.01 Positive Displacement Compressors*

*Chair: Georgi S. Kazachki, Ph.D., Fellow ASHRAE, DRS Technologies, Florence, KY*

This seminar presents the outcome from more than a decade of intensive research and development of refrigeration systems with natural refrigerants, which have reached a high level of maturity manifested by the availability of components necessary to design and construct efficient and cost-competitive applications.

**1. A New CO2 Compressor Design to Maximize Energy Efficiency, Optimize Product Industrialization and Reduce Cost**

*Giacomo Pisano, Dr.Eng., Affiliate, Officine Mario Dorin, Compiobbi, Firenze, Italy, Compiobbi, Firenze, Italy*

**2. Applying Natural Refrigerants In Supermarket Refrigeration: Design Considerations and Evaluation**

*Shitong Zha, Ph.D., Member, Hill PHOENIX, Covington, GA*

**3. Laboratory Testing and Evaluation of a Transcritical CO2 Retail Refrigeration System**

*Doron Shapiro, P.E., Member, Ingersoll-Rand Climate Solutions, Bridgeton, MO*

**4. Ammonia – the Natural Refrigerant of the Past, Present and Future**

*Eric M. Smith, P.E., Member, International Institute of Ammonia Refrigeration, Alexandria, VA*

**9:45 AM-10:45 AM**

**CONFERENCE PAPER SESSION 7 (INTERMEDIATE)**

**Heat Transfer, Heat Exchanger Analysis and High Efficiency Compressor** 

Track: Refrigeration Update

Room: Pavilion 6

*Chair: Bo Shen, Oak Ridge National Laboratory, Oak Ridge, TN*

Papers related to fundamental studies on heat transfer and pressure drop characteristics, and heat exchanger analysis are presented.

**1. Experimental Investigation of a Machine Tool Cooler Using Hot-Gas Bypass Valves for Temperature Control (LV-11-C022)**

*Fu-Jen Wang, Ph.D., P.E., Member<sup>1</sup>, Kuei Tsai<sup>1</sup>, Jian-Wei Kao<sup>1</sup> and Hao-Chung Lee<sup>2</sup>, (1)National Chin-Yi University of Technology, Taichung, Taiwan, (2)Industrial Technology Research Institute, Taiwan, China*

**2. In-tube Boiling Heat Transfer of CO2-Lubricant Mixture at Low Temperatures (LV-11-C023)**

*Pradeep Bansal, Ph.D., Fellow ASHRAE, The University of Auckland, Auckland, New Zealand*

**3. High Efficiency Compressor Design for HC-600a Refrigerant Using Energy Saving Household Refrigerators (LV-11-C024)**

*Ichiro Kita<sup>1</sup>, Makoto Katayama<sup>1</sup> and Akiro Nakano<sup>1</sup>, (1)Panasonic Corporation, Shiga, Japan*

**SEMINAR 23 (INTERMEDIATE)** 

**Cutting-Edge Japanese Technologies for Zero-Energy Buildings (Part 2)**

Track: Net Zero Energy

Room: Pavilion 1

*Chair: Shinsuke Kato, Ph.D., Fellow ASHRAE, IIS, University of Tokyo, Tokyo, Japan*

This session presents the new HVAC technologies employed for ZEBs (Zero-Energy Buildings) in Japan. The heat pump and the fuel cell are the key technologies for ZEBs. Directly embedding the adsorbent on the surface of the air-to-refrigerant heat exchanger for direct heating and direct cooling enables this system to regenerate the adsorbent at the condensation temperature of the heat pump (around 40°C). Japanese manufacturers started selling polymer electrolyte fuel cell (PEFC) for CHPs in 2009. The newly developed solid oxide fuel cells (SOFC) for CHPs, which have a power efficiency of over 45%, are also explained.

**1. Humidity and Temperature Individual Control Air-Conditioning System with Highly Effective Compact Desiccant Unit**

*Nobuki Matsui, Daikin Industries LTD, Osaka, Japan*

**2. Fuel Cell Technologies and Their Applications**

*Yoshitaka Kayahara, Osaka Gas CO., LTD., Osaka, Japan*

**SEMINAR 24 (INTERMEDIATE)** 

**Historical Perspectives: Las Vegas Casino Design Past to Present**

Track: HVAC Fundamentals and Applications

Room: Pavilion 3

*Sponsor: Historical Committee*

*Chair: Lee Riback, Member, Southern Nevada ASHRAE Chapter, Las Vegas, NV*

Three noted HVAC design engineers in Las Vegas discuss the history of system designs. Each covers a different topic regarding changes in the designs and demands of the city's biggest industry, casino resorts. There have been substantial changes in the needs of the industry, driven by the demands of clients to improve not only the attractions, but their systems, as well. These needs have pushed HVAC designers to find innovative and creative ways to meet the customer's needs.

**1. Las Vegas HVAC Designs: How It All Started**

*Ralph Joekel, P.E., Member, JBA Consulting Engineers, Las Vegas, NV*

**2. How the Changing Codes and Standards Have Impacted Ventilation Design for Las Vegas Casinos over the Past 25 Years**

*Don Koch, P.E., Member, DG Koch & Associates, Las Vegas, NV*

**3. The Evolution of Energy Efficient Design for Large Las Vegas Resorts**

*Rob Finnegan, P.E., Member, Finnegan Erickson & Associates, Las Vegas, NV*

**SEMINAR 25 (INTERMEDIATE) **  
**Seismic Code Compliance for HVAC Equipment**

Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 11**

*Sponsor: 02.07 Seismic and Wind Restraint Design*

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


The IBC Building Code requires that HVAC equipment be certified for special seismic design and inspections. A discussion of how this certification takes place and what is required is presented.

**1. New AHRI Seismic Qualification Standard**

*James A. Carlson, P.E., Member, Seismic Source International, Springfield, NE*

**2. ICC-ES AC 156 Acceptance Criteria for Seismic Qualification by Shake Table Testing of Non-Structural Components and Systems**

*Greg L. Meeuwssen, Member, Ingersoll Rand-Trane, La Crosse, WI*

**SEMINAR 25-2 (INTERMEDIATE) **  
**Commissioning the World's Largest LEED-Certified Building: The Palazzo**

Track: Integrated Design

**Room: Pavilion 10**

*Sponsor: 07.09 Building Commissioning*

*Chair: Bill McGuire, P.E., Member, X-nth, Inc., Maitland, FL*

At the time of its grand opening the Palazzo was the largest LEED-certified building in the world when it achieved LEED

Silver Certification. The sheer size of the facility created some interesting challenges for the commissioning efforts, and overall construction process and schedule. In addition, the eco-friendly objectives of this facility posed many challenges and lessons learned for engineers, owners and the commissioning authority. Issues such as balancing indoor air quality, scheduling, space pressurization, and demand controlled ventilation, and others are discussed.

**1. Commissioning Large Facilities**

*Bill McGuire, P.E., Member, X-nth, Inc., Maitland, FL*

**2. An Owner's Perspective on Large Hotel Resort Casinos and Their Challenges**

*John Hess, P.E., Las Vegas Sands Corp., Las Vegas, NV*

**FORUM 1 (BASIC)**

**Good Design for GCHP: What Is It and Who Does It?**

Track: HVAC Systems and Equipment

**Room: Pavilion 9**

*Sponsor: 06.08 Geothermal Energy Utilization*

*Chair: Lisa Meline, P.E., Member, Meline Engineering, Sacramento, California*

While most design engineers understand that ground-coupled heat pumps (GCHPs) are one of the best strategies to meet ASHRAE's sustainability and net-zero energy goals, not all design engineers have the training or experience to design the ground heat exchanger. Because of this, it is becoming more common to see the ground heat exchanger as a "design build" component of the plan and specification project. What is required to properly design GCHP systems? What are the minimum requirements to properly describe the installation of a GCHP system? This forum will focus on setting expectations for good GCHP design.

**FORUM 2 (INTERMEDIATE)**

**Should ASHRAE Develop a Certification or Education Programs on CFD?**

Track: HVAC Fundamentals and Applications

**Room: Pavilion 2**

*Sponsor: 04.10 Indoor Environmental Modeling*

*Chair: Amy Musser, Ph.D., P.E., Member, Vandemusser Design, PLLC, Asheville, NC*

Members of TC 4.10 have been struggling for some time about how best to serve the growing ASHRAE CFD user community. This forum will be an open discussion of the need and potential market for publications, educational programs or certification programs. The goal for the forum will be to discuss options that exist within ASHRAE, to assess the size and needs of the user community, and to discuss approaches that the TC might take.

Tech Program

**FORUM 3 (INTERMEDIATE)**

**What Energy Recovery Technologies in Labs Are Being Utilized?**

Track: Low Energy Design

**Room: Pavilion 4**

**Sponsor:** 09.10 Laboratory Systems

**Chair:** Wade Conlan, P.E., Member, X-nth, Maitland, FL

Labs are applying more and more forms of energy recovery as required by ASHRAE Std 90.1, but, also due to the sustainable movement, owners, operators and designers are applying energy recovery to labs as well. There is a huge debate on the type of technologies that should be applied to labs (all varieties) and this session is hoping to shed light on what is being installed and where the bar for “standard of care” is being established. The information will be utilized for the “ASHRAE Lab Design Guide” revision as well as the Standards Sub-Committee to ensure that labs are being incorporated correctly.

**11:00 AM-12:00 PM**

**CONFERENCE PAPER SESSION 8 (INTERMEDIATE)**

**Data Center Studies**



Track: HVAC Fundamentals and Applications

**Room: Pavilion 3**

**Chair:** Ecton English, Department of Defense, Ft. Meade, MD

As high density electronic equipment in mission critical facilities such data centers continue to evolve, better cooling strategies and air management techniques are needed to effectively cool the electronic equipment while maintaining reliability and increasing energy efficiency. Using Computational Fluid Dynamics (CFD) to perform data center thermal modeling can be an effective tool for maximizing cooling effectiveness and can determine the effect of the lack of cooling during a power outage. The papers presented in this session provide valuable information on CFD methods and analysis techniques to analyze and optimize cooling within data centers.

**1. Unique Airflow Visualization Techniques for the Design and Validation of Above-Plenum Data Center CFD Models (LV-11-C025)**

*Michael Lloyd, Member<sup>1</sup> and Leon Glicksman, Ph.D., Fellow ASHRAE<sup>1</sup>, (1)Massachusetts Institute of Technology, Cambridge, MA*

**2. Rate of Heating Analysis of Data Centers During Power Shutdown (LV-11-C026)**

*Kishor Khankari, Ph.D., Member, Syska Hennessy, Ann Arbor, MI*

**CONFERENCE PAPER SESSION 9 (BASIC)**

**Integrated Design**



Track: Integrated Design

**Room: Pavilion 4**

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

The integrated design process is a collaborative building design method focused on optimum building performance and cost effectiveness often utilized in the sustainable design. This is a holistic building design approach in which systems are considered interdependent and independent decision making is minimized.

**1. Building Development High Performance Teamwork for High Performance Buildings (LV-11-C027)**

*David S. Allen, P.E., Member<sup>1</sup>, Rick Norman<sup>2</sup> and Bob Pennisi<sup>2</sup>, (1)Allen Consulting, LLC, Chelmsford, MA, (2) Strategyn, Wilmington, NC*

**2. Implementation of Integrated Design as a Paradigm for the Design of Low Energy Office Buildings (LV-11-C028)**

*Michael Jorgensen, Ph.D.<sup>1</sup>, M. W. Neilsen<sup>1</sup> and J. B. Stromann-Andersen<sup>1</sup>, (1)Technical University of Denmark, Lyngby, Denmark*

**3. High Performance Buildings Using Whole Building Integrated Design Approach (LV-11-C029)**

*Mohamed Abaza, Member, Gilbane Building Company, San Diego, CA*

**CONFERENCE PAPER SESSION 10 (INTERMEDIATE)**

**Recent Research in Acoustics for Healthcare Facilities**



Track: HVAC Fundamentals and Applications

**Room: Pavilion 2**

**Chair:** Chris Papadimos, Member, Papadimos Group, San Rafael, CA


This session presents recent research findings on acoustical conditions in hospitals. The first paper is a case study on how acoustic conditions in hospitals can influence patient health based on noise measurement and patient satisfaction surveys. The second paper presents case studies on how a poor hospital acoustical environment may affect patients and employees and the importance of appropriate methodologies to characterize hospital acoustical conditions.

**1. Hospital Noise and Occupant Response (LV-11-C030)**

*Erica Ryherd, Ph.D., Member<sup>1</sup>, Selen Okcu, Student Member<sup>1</sup>, Timothy Hsu, Student Member<sup>1</sup> and Arun Mahapatra<sup>1</sup>, (1)Georgia Institute of Technology, Atlanta, GA*

**2. Measured Levels and Patient Perception of Hospital Noise Before, During and After Renovation of a Hospital Wing (LV-11-C031)**

*Lily Wang, Ph.D., P.E.<sup>1</sup> and Cassandra H. Wiese, Student Member<sup>1</sup>, (1)University of Nebraska – Lincoln, Lincoln, NE*

**SEMINAR 26 (INTERMEDIATE)**   
**Design, Commissioning and Verification Considerations for Net-Zero Energy Buildings**

Track: Net Zero Energy

**Room: Pavilion 1**

**Sponsor:** 07.09 Building Commissioning

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

Net-zero energy buildings require clear performance goals and clear communication between different parties that have varying levels of involvement from early design through building operation. The design process is critical in putting the elements and specified interactions in place that allow the building to function in a net-zero energy manner. Commissioning is essential in defining functional and performance goals and verifying that they are met during the different project phases and operation. This session defines and details critical elements of both designing and commissioning net-zero energy buildings.

**1. Design and Energy Modeling for Net Zero Energy**

*John Swift Jr., P.E., Member, Cannon Design, Boston, MA*

**2. Commissioning as Quality Assurance for Net-Zero Energy Buildings**

*Manus McDevitt, P.E., Member, Sustainable Engineering Group, Madison, WI*

**SEMINAR 27 (INTERMEDIATE)**   
**District GHP Systems, Part 2: 1500+ Ton Sustainable Utilities**

Track: Low Energy Design

**Room: Pavilion 10**

**Sponsor:** 06.08 Geothermal Energy Utilization, 09.04 Applied Heat Pump/Heat Recovery Systems

**Chair:** Lisa Meline, P.E., Member, Meline Engineering, Sacramento, California

While part 1 of this two-part seminar introduces the idea of district ground source heat pump systems, part 2 presents two different district or campus GHP systems. Are GHP district systems the key to an energy independent future? Is the large campus system (approaching 1500 tons and large) viable as a sustainable utility for the future?

**1. Geothermal District Systems – A Sustainable Utility**

*Kirk T. Mescher, P.E., Member, CM Engineering, Inc., Columbia, MO*

**2. GeoExchange on a Campus Scale**

*Jeff Urlaub, P.E., Member, MEP Associates, Eau Claire, WI*

**SEMINAR 28 (INTERMEDIATE)**   
**Integrating Solar and Hydronic Heating for Residential and Small Commercial Systems**

Track: HVAC Systems and Equipment

**Room: Pavilion 9**

**Chair:** Fredric Milder, Ph.D., SolarLogic, LLC, Santa Fe, NM

Solar heating integrates most easily with hydronic heating systems because solar thermal panels provide hot fluid at temperatures that are compatible with normal heat loads. However, in order to make the best use of the solar heat when it is available and minimize parasitic heat loss and pump (electric) power, a heating system design must treat all heat sources, loads and storage components as an integrated system. This session presents best practices for a simple, optimally efficient system design for residential and small commercial applications that is modular, easily adaptable and scalable.

**1. Advantages of Primary/Secondary Plumbing Design**

*Bristol Stickney, Affiliate, SolarLogic, LLC, Santa Fe, NM*

**2. Advantages of Integrated System Control**

*Fredric Milder, Ph.D., SolarLogic, LLC, Santa Fe, NM*

**SEMINAR 29 (INTERMEDIATE)**   
**Low Energy Design for Casinos: Integrating CHP Systems**

Track: Low Energy Design

**Room: Pavilion 11**

**Sponsor:** 01.10 Cogeneration Systems

**Chair:** Richard Sweetser, Member, Exergy Partners Corp., Herndon, VA

Hotels and casinos represent an excellent but underutilized market for combined heat and power (CHP). According to the U.S. EPA, of the nearly 48,000 hotels in the United States, about 10,000 have the energy characteristics suitable for current CHP technology. More than 1,000 of these sites are likely to meet a simple payback on their investment within five years or less. The Rio was the first Las Vegas hotel and casino to incorporate CHP in 2004 and MGM City Center is the second system commissioned in 2009. These two projects provide important insight into CHP system design, operation and economic which is the subject of this seminar.

**1. The Rio Hotel & Casino Experience: A 4.9 MW CHP System Generating 40% of the Electricity, 60% of the Hot Water and 65% of the Heat for the Hotel**

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

**2. Las Vegas MGM Mirage City Center's CHP Facility Delivers 8 MW of Electricity and 800 BHP of Steam**

*Bruce Hedman, Ph.D., ICF, Arlington, VA*

Tech Program



**FORUM 4 (ADVANCED)**

**The Technical Basis of the Federal Walk-In Efficiency Standard**

Track: Refrigeration Update

**Room: Pavilion 6**

**Sponsor:** 10.05 Refrigerated Distribution and Storage Facilities, 10.07 Commercial Food and Beverage Cooling Display and Storage

**Chair:** Jon McHugh, P.E., Member, McHugh Energy Consultants Inc., Fair Oaks, CA

Prior to the passage of EISA 2007, walk-in refrigeration was unregulated. USDOE is developing performance standards that would be adopted January 2012 and affect all walk-in component manufacturers by 2015. New test standards have been written (AHRI 1250) and DOE has developed a preliminary technical support document. This forum provides the opportunity for experts to discuss the key technical issues associated with developing standards for walk-in refrigeration.

**2:15 PM-3:45 PM**

**PUBLIC SESSION 1 (INTERMEDIATE)** 

**A Practical Guide for Reducing Air Leakage in HVAC Air Systems**

Track: Low Energy Design

**Room: N256**

**Sponsor:** TG3 HVAC Contractors and Design Build Firms

**Chair:** Mike McLaughlin, Associate Member, Southland Industries, Dulles, VA

OPEN SESSION: Excessive air leakage in HVAC Systems is known to be a significant source of energy waste in HVAC Systems. Given this fact, the engineering, contracting manufacturing community has had a common goal of reducing air leakage in HVAC systems to provide a low energy design solution and provide yet another step towards achieving a zero energy design. Over the years, numerous standards, guidelines, project specifications and procedures have been developed that both directly and/or indirectly influence the ability to achieve this goal. In some cases, the combination of these documents impedes the ability to reduce air leakage and/or add significant costs to a project without additional benefit. This seminar reviews the pertinent information necessary for the engineer, contractor and manufacturer to refine these documents and develop a practical guide for reducing air leakage in HVAC Air systems. We identify the current standards, guidelines and project specification that influence air leakage and where conflicts can arise. We provide background information on duct construction and air leakage testing and how these components can contribute to reducing air leakage in a cost effective manner. Finally, we highlight the roles and responsibilities of the engineer, contractor and manufacturer and the interdependent actions that are required to assure we meet our common goal of reducing air leakage in HVAC systems. The

seminar is presented by industry professionals representing the engineering, contracting and trade association community.

**1. A Practical Guide for Reducing Air Leakage In HVAC Air Systems**

Mark Terzigni, Member<sup>1</sup>, Robert Delawder<sup>2</sup> and Mike McLaughlin, Associate Member<sup>2</sup>, (1)SMACNA, Chantilly, VA, (2)Southland Industries, Dulles, VA

**2:15 PM-3:45 PM**

**SEMINAR (INTERMEDIATE)**

**Performance Deficiencies & Strategies for Improving Exhaust Ventilation Systems**

Track: HVAC Systems and Equipment

**Room: Pavilion 10**

**Sponsor:** TC 4.3 Ventilation Requirements and Infiltration

**Chair:** Craig Wray, P.Eng., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

OPEN SESSION: no badge required, no PDHs awarded, presented during the TC's meeting. Exhaust systems are ubiquitous in large buildings, and have many of the same problems that are found in supply and return systems. Specifically, leaks in exhaust ducts and excess airflows mean that fans must draw more air than needed to meet required

**4:00 PM-5:00 PM**

**FORUM (INTERMEDIATE)**

**Failure Mode and Effects Analysis and Risk Management in Data Centers...And Other Important Matters to Consider**

Track: HVAC Fundamentals and Applications

**Room: Pavilion 3**

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

**Chair:** Vali Sorell, Member, Syska Hennessy, Charlotte, NC

OPEN SESSION: no badge required, no PDHs awarded, presented during the TC's meeting. In today's ever-expanding data center environment, owners and operators are becoming more concerned about failures in their facilities causing downtime of their core business operations. Whether the need for continuous uptime is based on governmental regulations, business operational requirements, security, or life safety, it is something that design engineers, contractors, equipment/system manufacturers, and end users now have to address directly. The need for Failure Mode and Effects Analysis (FMEA) studies and the Risk Management that comes from such studies has been increasing with the goal of reducing failures in the systems supporting the critical loads. ASHRAE TC 9.9 wishes to set goals toward defining a methodology to identify failure modes and quantifying risk in order to gain a better understanding of how to approach these studies. Attendees are encouraged to provide input and expertise. Other issues relating to mission critical design will also be entertained. All input relating to the direction for TC9.9, relative to research and programs, is welcome and encouraged.

# Tuesday, February 1

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

**CONFERENCE PAPER SESSION 11 (INTERMEDIATE)**

**Modeling Extreme Events**



Track: HVAC Fundamentals and Applications

**Room: Pavilion 3**

**Chair:** Amy Musser, Ph.D., P.E., Member, Vandemusser Design, PLLC, Asheville, NC

Engineers are often asked to model typical or design conditions in buildings. Much more rarely, the opportunity presents itself to model unusual or extreme conditions. To do so successfully, we are challenged to think about what we do in different ways and to sometimes use modified techniques. This session deals with questions like, how do we define unusual boundary conditions? What are the limits of our usual modeling methods? What are the statistical implications of working with extreme conditions?

**1. Some Building Design Issues Related to Extreme Winds (LV-11-C032)**

David Banks, Ph.D., Member, CPP Wind Engineering and Air Quality Consultants, Ft. Collins, CO

**2. Extreme Events: Examining the Tails of a Distribution (LV-11-C033)**

Eric W. Adams, Ph.D., Member<sup>1</sup> and Samarin Ghosh, Ph.D.<sup>2</sup>, (1)Carrier, Syracuse, NY, (2)Indianapolis, IN

**3. Quantifying Chemical/Biological Event Severity with Vulnerability-Based Performance Metrics (LV-11-C034)**

Jason W. DeGraw, Ph.D., Member<sup>1</sup> and William P. Bahnfleth, PhD, PE, Fellow<sup>2</sup>, (1)Pennsylvania State University, University Park, PA, (2)Penn State University, University Park, PA

**CONFERENCE PAPER SESSION 12 (INTERMEDIATE)**

**Regulatory Efforts for Energy Efficiency in Canada and Europe**



Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 11**

**Chair:** Toby Lau, P.E., Member, BC Hydro, Burnaby, BC, Canada

Energy efficiency regulations are now being developed at many jurisdictional levels. This session discusses some current examples of these regulatory efforts in Canada and Europe.

**1. European Efforts Towards NZEBs and Energy Conservation in Hellenic Buildings (LV-11-C035)**

Constantinos A. Balaras, Ph.D., P.E., Member, National Observatory of Athens, Athens, Greece

**2. British Columbia's Energy Efficient Buildings Strategy (LV-11-C036)**

Andrew Pape-Salmon, P.Eng., Member<sup>1</sup>, Erik Kaye<sup>1</sup> and Katherine Muncaster<sup>1</sup>, (1)BC Ministry of Energy, Mines and Petroleum Resource, Victoria, BC, Canada

**3. Transforming the Window and Glazing Markets in BC through Energy Efficiency Standards and Regulations (LV-11-C037)**

Andrew Pape-Salmon, P.Eng., Member<sup>1</sup> and Warren Knowles, P.Eng.<sup>2</sup>, (1)BC Ministry of Energy, Mines and Petroleum Resource, Victoria, BC, Canada, (2)RDH Building Engineering, Vancouver, BC, Canada

**CONFERENCE PAPER SESSION 13 (INTERMEDIATE)**

**The Real Cost of Zero Energy Buildings: Applications**



Track: Net Zero Energy

**Room: Pavilion 6**

**Chair:** Andrew Price, Stanley Consultants, Muscatine, IA

This session includes papers offering broad applications and utility system integration for net zero buildings.

**1. Finding the “Switching Point”: Cost Optimization for New NZE Commercial Buildings (LV-11-C038)**

Erik Bonnett, Student Member<sup>1</sup>, Michael Bendewald<sup>1</sup> and Victor Olgyay, Member<sup>1</sup>, (1)Rocky Mountain Institute, Boulder, CO

**2. Smart Net Zero Energy Buildings and Their Integration in the Electrical Grid (LV-11-C039)**

Meli Stylianou, CanmetENERGY, Varennes, QC, Canada

**3. Reducing Plug and Process Loads for a Large Scale, Low Energy Office Building: NREL's Research Support Facility (LV-11-C040)**

Chad Lobato, Associate Member<sup>1</sup>, Shanti Pless, Member<sup>1</sup>, Michael Sheppy, Associate Member<sup>1</sup> and Paul Torcellini, Ph.D., Member<sup>1</sup>, (1)National Renewable Energy Laboratory, Golden, CO

**4. Gas Roadmap to Zero Energy Homes (LV-11-C041)**

Ryan Kerr<sup>1</sup> and Doug Kosar, Member<sup>1</sup>, (1)Gas Technology Institute, Des Plaines, IL

**5. Estimating Industrial Building Energy Savings Using Inverse Simulation (LV-11-C042)**

Franc Sever, Student Member<sup>1</sup>, Kelly Kissock, Ph.D., P.E., Member<sup>1</sup>, Dan Brown, P.E., Member<sup>2</sup> and Steve Mulqueen, Associate Member<sup>2</sup>, (1)University of Dayton, Dayton, OH, (2)Cascade Energy Engineering, Portland, OR

Tech Program

**SEMINAR 30 (INTERMEDIATE)** 

**Micro-Combined Heat and Power Systems, Part 1: Applications, Best Practices and Technologies**

Track: Low Energy Design

**Room: Pavilion 10**

**Sponsor:** 09.05 Residential and Small Building Applications, 01.10 Cogeneration Systems

**Chair:** Mark W. Davis, Member, National Institute of Standards and Technology, Gaithersburg, MD

Micro-combined heat and power (micro-CHP) systems generate electricity for residential or small-commercial buildings at the point of use. Overall efficiencies approaching 90% can be achieved by utilizing the system's waste heat for hot water or space heating, which results in significant primary energy and carbon savings when compared to electricity generated at large, central power plants. This first of two seminars discusses the potential applications, best practices and technologies that can be used in micro-CHP systems.

**1. Micro Cogeneration: A Novel Way for Heat and Power Generation In Residential Buildings**

*Evgueniy Entchev, CanmetENERGY Research Centre, Ottawa, ON, Canada*

**2. Best Practices and Applications for Micro-CHP Systems**

*Mike Cocking, Marathon Engine Systems, East Troy, WI*

**3. Domestic Combined Heat and Power Unit Based Upon Fuel Cells**

*Bob Flint, Ceres Power Limited, Crawley, United Kingdom*

**SEMINAR 31 (ADVANCED)** 

**Next Generation Heat Exchangers for Net-Zero Design**

Track: HVAC Systems and Equipment

**Room: Pavilion 9**

**Sponsor:** 08.04 Air-to-Refrigerant Heat Transfer Equipment

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

Striving towards net-zero energy buildings mandates new levels of HVAC&R systems efficiency improvements. Air-to-refrigerant heat exchangers are integral parts of most HVAC&R systems. This seminar highlights the impact of heat exchanger efficiency on the system performance and provides insight on how new designs may affect efficiency regulations. Furthermore, novel heat exchanger designs are presented along with the projected and demonstrated performance improvements.

**1. Experimental Investigations of Ultra-Compact Air-to-Refrigerant Heat Exchanger**

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

**2. Novel Heat Exchangers: Pathways to New Levels of Efficiency**

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

**3. Overview of Energy Efficiency Regulations In Germany for Optimized System Design and Influence on Heat Exchangers**

*Stanislav Perencevic, Member, Güntner AG & Co. KG, Fürstentfeldbruck, Germany*

**4. Air-Side Performance of Finned Tube Heat Exchangers with Small Size Tube Diameter**

*Man-Hoe Kim, Ph.D., Member, Korea Advanced Institute of Science and Technology, Daejeon, South Korea*

**SEMINAR 32 (BASIC)**

**Prescriptive Standards Result in Bad Buildings**

Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 2**

**Sponsor:** College of Fellows

**Chair:** Richard Rooley, Presidential Fellow Life Member, Rooley Consultants, Stoke Poges, Buck, United Kingdom

This is the third in the series of College of Fellows debates. Where ASHRAE is now writing both prescriptive and performance standards is there management guidance to designers on which type of standard will help them to produce buildings which are perceived to be good, efficient and sustainable. There is evidence on both sides of the argument. The speakers from America, England as a typical European country and Pakistan as a typical developing country will debate their opinions. The audience will also contribute argument. The speakers will demonstrate that powerful argument can be presented by the same person on either side.

**Speakers:**

**Gordon Holness, P.E.,** Presidential Fellow Life Member, West Palm Beach, FL; **Kent Peterson, P.E.,** Presidential/Fellow Member, P2S Engineering, Inc., Long Beach, CA; **Farooq Mehboob, P.E.,** Fellow ASHRAE, S Mehboob & Co., Karachi, Pakistan; **David Arnold, Ph.D.,** DBA, Reading, United Kingdom; **Robert Baker,** Fellow ASHRAE, BBJ Environmental LLC, Riverview, FL

**SEMINAR 33 (BASIC)** 

**Want Peak System Efficiency from Your Water-Cooled System? Quit Cooling Dirt!**

Track: HVAC Systems and Equipment

**Room: Pavilion 4**

**Sponsor:** 08.06 Cooling Towers and Evaporative Condensers, SPC 191, 03.06 Water Treatment

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

Airborne dirt and suspended solids produced by the system have to be removed in order to maximize water and energy savings, improve water treatment effectiveness and reduce maintenance of water cooled systems. The presentations provide valuable information including, “Fundamentals of Filtration” and “How Much Filtration Do I Need?”, and the results of a comprehensive study on the effect of filtration on energy efficiency. This seminar is a must for anyone involved with cooling towers.

**1. Rx for Cooling Towers: HVAC Filtration**

*Allyn Troisi, Member, LAKOS, Fresno, CA*

**2. Basin Sweeping for Cooling Tower and Evaporative Condenser Maintenance and Year-Round System Cleanliness**

*Allison Trollier, Associate Member, Mazzie Injector Corporation, Bakersfield, CA*

**3. Best Practices of Filtration In Industrial Cooling Water Treatment**

*Phillip Yu, Associate Member, Nalco, Naperville, IL*

**4. Energy Savings through Filtration: A Comparison of Different Types of Filtration with Respect to Energy Savings**

*George Ornaski, Associate Member, Energy Systems Group, Newburgh, IN*

**4. Net Zero Energy Mediterranean Settlement**

*Marija Todorovic, Dr.Ing., P.Eng., Fellow ASHRAE, University of Belgrade, Belgrade, Yugoslavia*

**9:45 AM-10:45 AM**

**CONFERENCE PAPER SESSION 14 (INTERMEDIATE)**

**Absorption and Alternate Refrigeration Technologies**



Track: Refrigeration Update

**Room: Pavilion 6**

*Chair: Vikas Patnaik, Ph.D., Member, Trane Co., Lacrosse, WI*

As depletion of natural resources and accompanying environmental impact grows with growing population, careful energy consumption from the use of natural resources becomes critical. Towards this end, alternative technologies that are amenable to integration with multiple energy systems for improved overall source energy efficiencies are of growing interest to the HVAC&R practitioner. This session focuses on recent research and development of such technologies.

**1. Experimental Apparatus for Measuring the Performance of a Precooled Mixed Gas Joule Thomson Cryoprobe (LV-11-C043)**

*Harrison Skye, Student Member<sup>1</sup>, Sanford Klein, Ph.D., Member<sup>2</sup> and Greg Nellis, Ph.D., Member<sup>2</sup>, (1)University of Wisconsin-Madison, Madison, WI, (2)University of Wisconsin, Wisconsin*

**2. Absorption Refrigeration Cycle Based on Capillary Force (LV-11-C044)**

*Atsushi Tsujimori<sup>1</sup> and Masakazu Ohnuki<sup>1</sup>, (1)Kanto-gakuin University, Yokohama, Japan*

**SEMINAR 35 (BASIC) NY PDH DVD**

**Coils and Water Don't Mix Well: Avoiding Scale Build Up in Mechanical Plumbing System Design**

Track: HVAC Systems and Equipment

**Room: Pavilion 9**

*Chair: Larry Linkens, American Hometec, Inc., Wilmington, DE*

One of the longest running plumbing design challenges has been a fundamental one; put simply, electrical components and water are an inefficient combination. Even in the best possible system, coils that come in contact with water begin to scale – causing an immediate deterioration in the life of a water heating system and its efficiency. In this session, attendees learn how to minimize scale problems in plumbing design through indirect water heating. By removing the direct contact between coils and water, both engineers and building contractors can extend equipment lifetimes and take energy efficiency to the next level.

**SEMINAR 34 (ADVANCED) NY PDH DVD**

**Zero Energy Buildings Around the World**

Track: Net Zero Energy

**Room: Pavilion 1**

*Sponsor: ASHRAE Associate Society Alliance*

*Chair: Branislav Todorovic, Ph.D., Fellow, University of Belgrade, Belgrade, Serbia, Belgrade, Serbia*

This seminar presents examples of zero energy buildings in different countries around the globe. What is understood with zero energy among engineers and architects in various regions and different climates is presented. Examples of such buildings include China, India, Southeast Europe and USA. How the climate influences such buildings. Energy independent buildings. Zero energy buildings and sustainable settlements concerning water needs. Zero energy houses near the seaside. Management systems as the condition to achieve zero energy buildings. Overview of such buildings that are already built and their attributes.

**1. Toward Net Energy Buildings In India**

*Ashish Rakheja, Ph.D., Member, Spectral Services Consultants, Noida, India*

**2. Zero Energy Residential Buildings for Varying Climates**

*Ursula Eicker Eicker, Ph.D., University of Applied Science, Stuttgart, Germany*

**3. Zero Energy Buildings-a Reality Today**

*Drury Crawley, Member, DOE, Washington, DC*

Tech Program

**1. Coils and Water Don't Mix Well: Avoiding Scale Build up In Mechanical Plumbing System Design**

*Larry Linkens, American Hometec, Inc., Wilmington, DE*

**SEMINAR 36 (INTERMEDIATE)** 

**HVAC Software Applications for Smart Phones and Tablet Computers**

Track: HVAC Fundamentals and Applications

**Room: Pavilion 3**

*Sponsor: 01.05 Computer Applications*

*Chair: Stephen Roth, P.E., Member, Carmel Software, San Rafael, CA*

Smart phones and tablet computers are being used more frequently by HVAC mechanical engineers, technicians and architects to perform analysis in the field or to monitor and control building automation systems. This panel includes speakers from companies that have developed popular applications for the Apple iPhone/iPod touch/iPad and Android that are specifically geared toward HVAC mechanical engineers, technicians and home owners.

**1. Smart Apps for HVAC System and Building Analysis**

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

**2. Smart Apps for Home Building Automation Systems**

*Stuart Lombard, Ecobee, Toronto, ON, Canada*

**SEMINAR 37 (INTERMEDIATE)** 

**Integrated Design Build Delivery: Project Case Studies**

Track: Integrated Design

**Room: Pavilion 4**

*Sponsor: TG3 - Contractors and Design Build Firms*

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

Integrated design build delivery continues to offer significant benefits to the engineer, contractor and owner. This seminar includes several case studies of projects using an integrated design build delivery process and shares the methods for success, the collaboration achieved and the results of the project.

**1. A Campus Central Plant Renovation for Masonic Homes**

*Daniel Kerr, P.E., Member, McClure Company, Harrisburg, PA*

**2. Case Study of Using a Single BIM Model for Engineering and Construction**

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

**SEMINAR 38 (BASIC)** 

**Mentoring Young Technical Employees for Success**

Track: Professional Skills

**Room: Pavilion 2**

*Sponsor: 01.07 Business, Management & General Legal Education, Conferences and Expositions Committee*

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

Many engineering consulting firms struggle to provide the right level of technical support to new hires. This seminar lays out a step-by-step approach to ensuring that new employees feel part of the team, understand their role, see their long-range path within the firm and have a clear personalized program to improve their skills. Additionally, this session speaks directly to the particular nature of employees from the Y-generation: they do not respond to the same incentives and have different needs as employees.

**1. Mentoring Technical Employees for Success**

*Joel Primeau, P.Eng., Member, GENIVAR, Ottawa, ON, Canada*

**2. Mentoring Technical Employees for Success**

*Julia Keen, Member, Kansas State University, Manhattan, KS*

**SEMINAR 39 (ADVANCED)** 

**When Zero Makes You a Hero**

Track: Low Energy Design

**Room: Pavilion 10**

*Sponsor: 07.08 Owning and Operating Costs*

*Chair: Charles Dale-Derks, P.E., Member, McClure Engineering, St. Charles, MO*

Owning and operating costs are much greater than the initial project cost over the life of a building. This seminar provides case studies and information with actual owning and operating cost data for a LEED-EB Platinum campus and how they sustain the high performance. It presents a case study on a Nantucket Block Island project design and cost benefits for an off the grid residence.

**1. Off the Grid: High Efficiency Technology at a Nantucket Block Island Residence**

*Klas C. Haglid, P.E., Member, Haglid Engineering & Associates, Inc., Hillsdale, NJ*

**2. Sustaining High Performance on a LEED-EB Campus**

*Ward Komorowski, Johnson Controls, Milwaukee, WI*

**FORUM 5 (INTERMEDIATE)**

**The Commissioning Process ASHRAE Standard: What Should Be Included?**

Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 11**

**Sponsor:** 07.09 Building Commissioning, SGPC 0

**Chair:** Gerald Kettler, P.E., Life Member, Air Engineering and Testing, Dallas, TX

ASHRAE has published Commissioning Process Guidelines for over 20 years. The development of a Commissioning Standard was approved by the Board of Directors as Standard 202, Commissioning Process for Buildings and Systems. This forum discusses the potential contents in the new standard. Also of importance is the application of the Commissioning Process Standard to other standards, documents, programs and the code language variations.

**FORUM 6 (ADVANCED)**

**The Role of Solar and other Renewable Energy Sources on the Strategic Energy Planning**

Track: Net Zero Energy

**Room: Pavilion 1**

**Sponsor:** 06.07 Solar Energy Utilization, 6.8, 1.10, 2.5, AASA, 06.08 Geothermal Energy Utilization

**Chair:** Marija Todorovic, Dr.Eng., P.Eng., Fellow ASHRAE, University of Belgrade, Belgrade, Yugoslavia

Forum questions and search answers: (1) Is the Strategic Energy Planning worldwide appropriate with the reference to the current RES technologies and RES technical potential status, particularly in buildings sectors, or could and should it be more “offensive” (taking in account “threatening” global warming caused events?); (2) Searching especially important answers among the most developed and the most intensively developing countries and regions (US, EU, China, India); (3) Recent EU Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage; and (4) Revisits the UN Environment Conference 1972 closing message “Only One Earth”.

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

**TECHNICAL PAPER SESSION 4 (INTERMEDIATE)**

**Computer Models for Design of Smoke Control Systems**



Track: HVAC Fundamentals and Applications

**Room: Pavilion 9**

**Sponsor:** 05.06 Control of Fire and Smoke

**Chair:** Paul Turnbull, Member, Siemens Industry, Inc., Buffalo Grove, IL

Computer models can be very valuable in helping designers of smoke control systems predict system performance under a variety of design options and fire scenarios. Models in common use today accurately predict smoke movement near the fire, or remote from the fire, but not both. To model smoke movement within an entire building, designers currently use both types of models, manually transferring data obtained from the first model into the second. This session discusses new models that predict smoke movement in both near and far fields at the same time, eliminating the need for designers to transfer data between programs.

**1. Algorithm for Smoke Modeling in Large, Multi-Compartmented Buildings (1328-TRP): Development of a Hybrid Model (LV-11-010)**

Ahmed Kashef, Dr.Eng., P.Eng., Member, National Research Council Canada, Ottawa, ON, Canada, ON, Canada

**2. Algorithm for Smoke Modeling In Large, Multi-Compartmented Buildings (1328-TRP): Implementation of the Hybrid Model (LV-11-011)**

George Hadjisophocleous, Ph.D., Member, Carleton University, Ottawa, ON, Canada

**3. Computer Modeling of Stairwell Pressurization to Control Smoke Movement During a High-Rise Fire (LV-11-012)**

William Black, Ph.D., Member, Georgia Institute of Technology, Atlanta, GA

**CONFERENCE PAPER SESSION 15 (INTERMEDIATE)**

**The Real Cost of Zero Energy Buildings: Modeling and Design**



Track: Net Zero Energy

**Room: Pavilion 4**

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

This session includes papers describing activities in system modeling and performance protocols for buildings approaching net zero energy.

**1. Using an Energy Performance Based Design-Build Process to Procure a Large Scale Replicable Zero Energy Building (LV-11-C045)**

Shanti Pless, Member<sup>1</sup>, Paul Torcellini, Ph.D., Member<sup>1</sup> and Dave Shelton<sup>2</sup>, (1)National Renewable Energy Laboratory, Golden, CO, (2)DesignSense Inc., Olathe, KS

**2. Modeling a Net-Zero Energy Residence: Combining Passive and Active Design Strategies in Six Climates (LV-11-C046)**

Brent Stephens, Student Member, The University of Texas at Austin, Austin, TX

**3. Essential Methods, Models and Metrics for Net Zero Energy Buildings (LV-11-C047)**

Thomas Marseille, P.E., Member, WSP Flack & Kurtz, Seattle, WA

Tech Program

**4. The Role of Modeling when Designing for Absolute Energy Use Intensity Requirements (LV-11-C048)**

*Adam Hirsch, Ph.D., Member<sup>1</sup>, Shanti Pless, Member<sup>1</sup>, David Okada, P.E., Member<sup>2</sup> and Porus Antia, Member<sup>2</sup>, (1) National Renewable Energy Laboratory, Golden, CO, (2) Stantec, San Francisco, CA*

**5. Zero Net Energy Buildings and Title 24 Energy Code (LV-11-C049)**

*Clark C. Bisel, WSP Flack+Kurtz, San Francisco, CA*

**SEMINAR 40 (INTERMEDIATE)** 

**Advancing Energy Efficiency in Commercial Refrigeration**

Track: Refrigeration Update

Room: Pavilion 6

*Sponsor: 10.07 Commercial Food and Beverage Cooling Display and Storage, Refrigeration Committee*

*Chair: Cynthia Gage, Ph.D., Fellow ASHRAE, U.S. Environmental Protection Agency, Durham, NC*

For many building types, significant progress has been made to move towards a “net-zero” energy building. However buildings which have refrigeration systems remain a considerable challenge. Means to calculate LEED energy credits and/or to build refrigeration facilities which consume 50% less energy are still works in progress. This session presents information on advancing the energy efficient operation of commercial refrigeration systems. Presentations include best practices for energy efficiency, options for modeling energy credits, a case study of designs for 50% reduction in energy consumption, and national energy impacts from recent standards imposed on refrigeration equipment.

**1. Best Practices for Commercial Refrigeration**

*Brian Fricke, Ph.D., Member, University of Missouri – Kansas City, Kansas City, MO*

**2. A Proposed Methodology for LEED Baseline Refrigeration Modeling**

*Kristin Field, Associate Member, National Renewable Energy Laboratory, Golden, CO*

**3. Case Study of the Design Process of An Advanced Refrigeration System for a Commercial Supermarket**

*Ian Doebber, Associate Member, National Renewable Energy Laboratory, Golden, CO*

**4. National Energy Savings Impacts of DOE Rulemakings on Commercial Refrigeration Equipment**

*Sriram Somasundaram, Ph.D., Fellow ASHRAE, Navigant Consulting, Richland, WA*

**SEMINAR 41 (INTERMEDIATE)** 

**Codes and Standards Impacting Healthcare Facility Energy Use**

Track: Codes and Standards in the HVAC&R Industry

Room: Pavilion 11

*Sponsor: 09.06 Healthcare Facilities*

*Chair: Ronald L. Westbrook, P.E., Member, State University of New York, Upstate Medical University, Syracuse, NY*

There are numerous codes and standards that have a direct impact on HVAC design and their subsequent energy consumption. Understanding the basis of the newer codes and standards will be key for designers to provide higher performing, more energy efficient HVAC systems serving healthcare facilities.

**1. Standard 189.2 Elements Impacting Energy Use In Health Care Facilities**

*Michael Sheerin, P.E., Member, TLC Engineering for Architecture, Orlando, FL*

**2. Standard 170 Understanding the Basis of Table 7-1 Design Parameters**

*Jeff Boldt, P.E., Member, KJWW Engineering, Monona, WI*

**3. LEED for Health Care Overview**

*Michael Meteyer, P.E., Member, Cogdell Spencer ERDMAN, Madison, WI*

**SEMINAR 42 (INTERMEDIATE)** 

**European Net-Zero Energy Activities and Buildings**

Track: Net Zero Energy

Room: Pavilion 1

*Sponsor: REHVA*

*Chair: Francis Allard, Dr.Ing., Member, REHVA President, Université de La Rochelle, La Rochelle, France Karel Kabele, Dr.Ing., REHVA President-Elect, Czech Technical University in Prague, Praha, Czech Republic*

In 2010, the framework of Energy Performance of Building Directive was recast (2010/31/EU) modifying the original EPBD from 2002 and defining new means of improving the energy performance of buildings – including building energy performance certification and the concept of

**1. Recast of the Directive on Energy Performance of Buildings**

*Karel Kabele, Dr.Ing., REHVA Vice President, Czech Technical University in Prague, Praha, Czech Republic*

**2. Indoor Environment Quality in Low Energy Buildings**

*Michael Schmidt, Dr.Ing., University of Stuttgart, Stuttgart, Germany*

**3. HVAC Technologies for Nearly Zero Energy Buildings**

*Maria Virta, Member, Green Building Council Finland, Helsinki, Finland*

**4. Experience from Operation of a Low-Energy Intelligent Building**

*Frank Hovorka, Service Developpement Durable, Paris, France*

**SEMINAR 43 (INTERMEDIATE)** 

**Micro-Combined Heat and Power Systems, Part 2: Case Studies**

Track: Low Energy Design

Room: Pavilion 10

*Sponsor: 09.05 Residential and Small Building Applications, 01.10 Cogeneration Systems*

*Chair: Mark W. Davis, Member, National Institute of Standards and Technology, Gaithersburg, MD*

Micro-combined heat and power (micro-CHP) systems generate electricity for residential or small-commercial buildings at the point of use. Overall efficiencies approaching 90% can be achieved by utilizing the system's waste heat for hot water or space heating, which results in significant primary energy and carbon savings when compared to electricity generated at large, central power plants. This second of two seminars presents performance data from an installed system and two modeling case studies.

**1. Installed Performance of a Micro-CHP System In a New York State Multifamily Building**

*Dominique Lempereur, Steven Winter Associates, Norwalk, CT*

**2. A Techno-Economic Comparison of Micro-CHP Systems with District Energy Systems**

*Biröl Kilkis, Ph.D., Fellow ASHRAE, Baskent University, Ankara, Turkey*

**3. Using Building Energy Simulations to Predict Energy, Cost and Carbon Savings of Micro-CHP In a Net Zero Energy Home**

*Mark W. Davis, Member, National Institute of Standards and Technology, Gaithersburg, MD*

**SEMINAR 44 (ADVANCED)** 

**Micro/Nano Fluids and Systems in HVAC&R**

Track: HVAC Fundamentals and Applications

Room: Pavilion 3

*Sponsor: 01.03 Heat Transfer and Fluid Flow, 08.05 Liquid-to-Refrigerant Heat Exchangers*

*Chair: Satheesh Kulankara, Member, Johnson Controls, York, PA*

Nano-fluids and micro-systems research are at the edge of thermal/fluid sciences, and there are still many unknowns that need to be investigated. This seminar reviews some of the

new studies in this area with the possible applications in HVAC&R industry. This topic is critical to current and future ASHRAE research, and is along the 2010-2015 strategic plans. Such popular seminars had presented to the ASHRAE community in the past with successful results, and it was rated as one of the best by the audience.

**1. Development of Nanofluids Research for HVAC&R Applications**

*Amir Jokar, Ph.D., Member<sup>1</sup> and Ken Schultz, Member<sup>2</sup>, (1) ThermoFluids Tech, Vancouver, WA, (2)Trane, LaCrosse, WI*

**2. Enhanced Mobility of CO<sub>2</sub> Using Nano Particles**

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

**3. Boiling with Refrigerants and Nanolubricants**

*Mark A. Kedzierski, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD*

**4. Visualization of LiBr/Water Absorption In a Single Micro-Channel**

*Ebrahim Al-Hajri, Ph.D., Member, Petroleum Institute, Abu Dhabi, United Arab Emirates*

**SEMINAR 45 (INTERMEDIATE)** 

**Putting Your Meter – and Submeter – To Work for You**

Track: HVAC Fundamentals and Applications

Room: Pavilion 2

*Sponsor: 01.09 Electrical Systems*

*Chair: Steven Faulkner, Member, Georgia Power Company, Atlanta, GA*

How does a facility manager design and implement the best metering/submetering system to enable effective energy management? To effectively manage energy use in a facility or multi-facility campus, one must monitor energy use of key loads and processes.

**1. Implementing Federal Metering Guidelines: How Many Meters and Where Do They Go?**

*Terry Sharp, P.E., Oak Ridge National Laboratory, Oak Ridge, TN*

**2. Designing Your Metering System to Help You Manage Your Energy Use**

*Jim Plourde, Schneider Electric North America, LaVergne, TN*

**3. Using Metered Data to Enhance Your Measurement and Verification of Energy Savings**

*Bruce B. Lindsay, Member, Johnson Controls, Inc., Madison, WI*

**4. The Utility's Role In the Installation of Smart Meters for a Large Customer**

*Kris Findley, Member, Mississippi Power, Gulfport, MS*



**11:00 AM-1:00 PM**

**POSTER SESSION**

**Room: Ballroom B**

1. A Methodology for the Comprehensive Evaluation of the Indoor Climate Based on Human Body Response: Environment and Man - Theoretical Principles (LV-11-013)

*Miloslav Jokl, Ph.D., Czech Technical University, Prague, Czech Republic*

As part of every design, a comprehensive evaluation of the indoor microclimate should be conducted. The evaluation should be based on two criteria: the physical-physiological that enables the indoor environment to be evaluated from the view point of the physiology of the human organism, and the physical– psychological that makes it possible to evaluate the impact of the environment on the psychological impact of the individual components of the environment. The impetus for this work were difficulties that arose from the application of optimal operative temperatures based on PMV in order to derive credible values for new or revised standards.

2. A Methodology for the Comprehensive Evaluation of the Indoor Climate Based on Human Body Response: Hygrothermal Microclimate Evaluation Based on Human Body Physiology (LV-11-014)

*Miloslav Jokl, Czech Technical University, Prague, Czech Republic*

In this paper a new methodology for the comprehensive evaluation of the thermal condition of environment based on operative temperature thermal levels, so called decitherms, is presented. One of its strengths is that it takes into account the fact that a decrease in operative temperature is perceived the more strongly at lower temperatures. The concept of the decitherm allows a direct numerical comparison with decibels, used for noise evaluation, and with deciodors, used for odour assessment, and additionally the total environment can be assessed by adding the individual levels multiplied by corresponding impact factors.

3. Analysis Tools and Guidance Documents for Evaluating and Reducing Vulnerability of Buildings to Airborne Threats, Part 1: Literature Review (LV-11-015)

*T. Agami Reddy, Ph.D., P.E., Fellow ASHRAE<sup>1</sup>, Steven Snyder, Associate Member<sup>1</sup>, Justin Bem, Associate Member<sup>2</sup> and William P. Bahnfleth, PhD, PE, Fellow<sup>3</sup>, (1)Arizona State University, Tempe, AZ, (2)James Posey Associates Inc, Baltimore, MD, (3)Penn State University, University Park, PA*

This paper classifies and describes analysis methods, tools, and simulation programs that allow prediction of airborne chemical/biological dispersal and transport dynamics in indoor environments subject to different risk scenarios. These methods are distinguished by the level of mathematical and scientific rigor in modeling the phenomena, in the spatial and temporal resolution in solving the modeling equations, and in

the types of boundary conditions and the numerical parameters that appear in the model. The paper also describes various general guidance documents and vulnerability assessment protocols and software available in the open-source literature to assess and reduce vulnerability in buildings.

4. Analysis Tools and Guidance Documents for Evaluating and Reducing Vulnerability of Buildings to Airborne Threats, Part 2: Comparison of Tools (LV-11-016)

*T. Agami Reddy, Ph.D., P.E., Fellow ASHRAE<sup>1</sup>, Steven Snyder, Associate Member<sup>1</sup>, Justin Bem, Associate Member<sup>2</sup> and William P. Bahnfleth, Ph.D., P.E., Fellow ASHRAE<sup>3</sup>, (1) Arizona State University, Tempe, AZ, (2)James Posey Associates Inc, Baltimore, MD, (3)Penn State University, University Park, PA*

Assessing and reducing vulnerability of building occupants to intentional indoor airborne releases of chemical and biological agents has acquired some importance in the past two decades. This paper reports on the evaluation and comparison of a set of available tools (described in the companion paper) which have been developed for practical and pragmatic use by building security professionals, consulting engineers, building owners and maintenance personnel to evaluate vulnerability of a building, and determine the effect of implementing specific countermeasures. These tools have been applied to a few carefully selected buildings so that their responses can be evaluated.

5. Applications of a Simplified Model Calibration Procedure for Commonly Used HVAC Systems (LV-11-017)

*Guopeng Liu, Ph.D., P.E., Member, Pacific Northwest National Laboratory, Richland, WA*

A calibration procedure for simplified building energy simulation models for commonly used HVAC systems has been developed through an ASHRAE sponsored project (ASHRAE 1092-RP). The procedure is applied to five buildings. This paper presents the calibration procedure, summary results of five case studies. A two-level calibration procedure provides a good approach for model calibration. The case studies strongly indicate that the simplified model calibration procedure developed can be used to accurately calculate long-term energy consumption data using short-term field energy measurement data for different types of buildings with different systems.

6. Comparison of Vertical Display Cases: Energy and Productivity Impacts of Glass Doors versus Open Vertical Display Cases (1402-RP) (LV-11-018)

*Brian A. Fricke, Ph.D., Member<sup>1</sup> and Bryan R. Becker, Ph.D., P.E., Fellow ASHRAE<sup>1</sup>, (1)University of Missouri-Kansas City, Kansas City, MO*

The objective of this project was to compare a typical open refrigerated display case line-up to a typical glass-doored refrigerated display case line-up with the aim of quantifying

the difference in overall energy consumption and the difference in food product sales for each case type. For this research project, two supermarkets were identified as test sites: one supermarket received a new open refrigerated display case line-up and the other supermarket received a new doored refrigerated display case line-up. The door opening duration data validates the door opening procedure used in the method of test described in ASHRAE Standard 72 (2005).

8. Determining the Average R-value of Tapered Insulation (LV-11-019)

*Jonathan Ochshorn, Member, Cornell University, Ithaca, NY*

The impact of curved heat flow trajectories on the efficiency of the tapered forms is a function of taper angle or slope, and becomes significant only at slopes much steeper than those found in typical tapered roof insulation applications. Equations are derived, and tables are presented, for the efficiency of tapered insulation considering volumetric forms typically encountered in practice. Examples illustrate how these tools can be used to accurately calculate heat loss through a roof assembly with tapered insulation.

9. Improvements to a Methodology for Estimating Potential Energy Savings from Existing Building-Commissioning/Retrofit Measures (LV-11-020)

*Jingjing Liu, Student Member<sup>1</sup>, Juan-Carlos Baltazar, Ph.D., Member<sup>1</sup> and David E. Claridge, Ph.D., P.E., Fellow ASHRAE<sup>1</sup>, (1)Texas A&M University, College Station, TX*

10. Methods for Estimating Heating and Cooling Degree-Days to any Base Temperature (LV-11-021)

*Didier Thevenard, Ph.D., P.E., Member, Numerical Logics Inc., Waterloo, ON, Canada*

This paper examines several methods for calculating heating and cooling degree-days to any base, by relying on temperature statistics such as the monthly mean temperature and the standard deviation of daily average temperature. It is found that the method developed by Schoenau and Kehrig works best, and is usually able to estimate monthly heating and cooling degree-days to within 3 °C-day or 5.4 °F-day (in a root mean square error sense) of their true value. The paper also presents an extension of the Schoenau and Kehrig method to the case when only monthly mean temperatures are known.

11. Net Zero Energy Air Conditioning Using Smart Thermosiphon Arrays (LV-11-022)

*Bidzina Kekelia, Student Member<sup>1</sup>, Kent S. Udell, Ph.D.<sup>1</sup> and Phil Jankovich, Student Member<sup>1</sup>, (1)University of Utah, Salt Lake City, UT*

Smart thermosiphon arrays (STAs) use standard passive thermosiphon mechanisms to transfer energy out of soil, and controlled rate transfer of energy into the soil using standard machinery. This paper describes how STAs can provide seasonal energy storage to meet all climate control needs. The passive mode of soil freezing and the pump assisted

operation of air conditioning are modeled and the resultant simulations are shown. Compared to conventional vertical borehole exchangers, simulations show the same total heat transfer can be obtained with 40% of the depth using STAs with drilling costs per length of borehole an order of magnitude lower.

12. Numerical Analysis and Measures for the Evaluation of Comfort: Inside Buses Used for Public Transportation (LV-11-023)

*Roberto de lieto Vollaro, Ph.D., University of Roma 3, Rome, Italy*

This work analyses the thermo hygrometric conditions inside buses used for public transportation. The technical solutions found through the analysis of the thermo-hygrometric conditions inside trains, were also set out and extended to buses. This was in order to maximize the conditioning system and the installation of the air distribution terminals. A pattern for the simulation of the thermo fluid dynamics has been researched, in order to evaluate possible improvements in the conditioning system and the installation or in the distribution system.

13. Numerical Modeling of Thermally Enhanced Pipe Performances in Vertical Ground Heat Exchangers (LV-11-024)

*Jasmin Raymond, Student Member<sup>1</sup>, Alexandre Leger, P.E.<sup>2</sup>, Rene Therrien, Ph.D., P.E.<sup>3</sup>, Marc Frenette, P.E.<sup>4</sup> and Eric Magni<sup>5</sup>, (1)Universite Laval, Laval, QC, Canada, (2)IPL Plastics, Saint-Lazare, QC, Canada, (3)Unversite Laval, QC, Canada, (4)Centre Specialise de Technologie Physique du Quebec, QC, Canada, (5)IPL Plastics, Saint-Damien, QC, Canada*

The installation cost of a ground source heat pump system can be minimized by optimizing the length of the ground heat exchanger. For a given system, the length depends, among other factors, on the pipe thermal conductivity, which can be increased by mixing additives to the polymer resin used to extrude the pipe. Two- and three-dimensional numerical simulations were used to evaluate the performance of the thermally enhanced pipe in vertical ground heat exchangers used with ground-coupled heat pumps. The borehole thermal resistance and the water temperature inside the pipes during heat exchange were evaluated numerically.

14. Ongoing Commissioning Approach for a Central Cooling and Heating Plant (LV-11-025)

*Danielle Monfet, Student Member<sup>1</sup> and Radu Zmeureanu, Ph.D., P.E., Member<sup>1</sup>, (1)Concordia University, Verdun, QC, Canada*

This paper presents a new approach for the development and use of benchmarking models in the context of ongoing commissioning. Different techniques are explored to establish the benchmarking models: (1) a static approach, which is based on pre-defined training set size and established different

models for week days and weekend & holidays, or (2) window techniques, which are either augmented or sliding. The performance of each approach is evaluated for two chillers installed in an existing central cooling and heating plant.

Optimal Operation of a Chilled Water Storage System Under a Real Time Pricing Rate Structure (LV-11-026)

Zhiqin Zhang, Ph.D., Student Member<sup>1</sup>, William D. Turner<sup>1</sup> and Song Deng<sup>1</sup>, (1)Texas A&M University, College Station, TX

Under a real-time-pricing rate structure, the focus of operating a chilled water storage system is to determine the optimal starting and ending time of charging and discharging the tank. This paper proposes a simple method to determine the optimal operation.

15. Optimization of the Cooling Tower Condenser Water Leaving Temperature Using a Component-Based Model (LV-11-027)

Zhiqin Zhang, Ph.D., Student Member<sup>1</sup>, Hui Li, Ph.D.<sup>1</sup> and William Turner, Ph.D., P.E.<sup>1</sup>, (1)Texas A&M University, College Station, TX

This study investigates the optimization of the cooling tower condenser water leaving temperature using a component-based model. This model consists of a chiller, a condenser water pump, and two cooling towers. This optimization problem is formulated as that of minimizing the total power of the chiller, pump, and fans by selecting an optimal cooling tower condenser water leaving temperature at given weather conditions, chiller load, chilled water leaving temperature, and condenser water flow rate. The model is applied in an example chiller CW system and a generalized reduced gradient solver is used to search the optimal cooling tower approach setpoint.

16. Parametric Analysis to Support the Integrated Design and Performance Modeling of Net-Zero Energy Houses (LV-11-028)

William T. O'Brien, Ph.D., Student Member<sup>1</sup>, Andreas K. Athienitis, Ph.D., P.E., Member<sup>1</sup> and Ted Kesik, Ph.D., P.E., Member<sup>2</sup>, (1)Concordia University, Montreal, QC, Canada, (2)University of Toronto, Toronto, ON, Canada

This paper is divided into two parts. The first part presents a methodology for identifying the critical parameters and two-way parameter interactions. The second part uses these results to identify the appropriate level of modeling resolution. The methodology is applied to a generic model for net-zero or near net-zero energy houses, which will be used for an early stage design tool. The results show that performance is particularly sensitive to internal gains, window sizes, and temperature setpoints and they indicate the points at which adding insulation to various surfaces has minimal impact on performance.

**2:15 PM-3:45 PM**

**PUBLIC SESSION 2 (INTERMEDIATE)** NY PDH

**What You Need to Know about the Energy Standard for Buildings — ASHRAE/IES Standard 90.1-2010**

Track: Low Energy Design

**Room: N256**

**Sponsor:** 07.06 Systems Energy Utilization, SSPC 90.1

**Chair:** Keith I. Emerson, P.E., Member, Tri-State Generation and Transmission Association, Westminster, CO

The new ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI Approved; IESNA Co-sponsored), has been a benchmark for commercial building energy codes for over 35 years and indispensable for engineers and other professionals involved in the design of buildings and building systems. Now, with well over 100 addenda incorporated since the 2007 edition, Standard 90.1-2010 will significantly change in the way buildings are built as these new modifications find their way into the world's energy codes. This session highlights some of the major changes that you can expect to see in building envelope requirements, mechanical system and lighting requirements. In addition, the results of those changes on building energy efficiency since 2004 will be shown. This session for anyone who wants advanced insight into the new standard's expected impacts on the industry.

**1. Envelope Improvements In 90.1-2010**

Len Sciarra, Member, Gensler, Chicago, IL

**2. Mechanical System Improvements In 90.1-2010**

Drake H. Erbe, Member, Airxchange, Inc., Rockland, MD

**3. Lighting System Improvements In 90.1-2010**

Eric Richman, Member, Pacific Northwest National Laboratory, Richland, WA

**4. Analysis of Energy Savings for 90.1-2010**

Bing Liu, Member, PNNL, Richland, WA

**5:00 PM-6:00 PM**

**FORUM (INTERMEDIATE)**

**Is ASTM G85 Annex 3 (SWAAT) the Correct Corrosion Test for Stationary Applications?**

Track: Codes and Standards in the HVAC&R Industry

**Room: 263**

**Sponsor:** 08.04 Air-to-Refrigerant Heat Transfer Equipment

**Chair:** Mark Johnson, Associate Member, Modine Mfg., Racine, WI, USA, Racine, WI

OPEN SESSION: no badge required, no PDHs awarded, presented during the TC's meeting. This forum is opportunity for the ASHRAE community to discuss corrosion testing of air to refrigerant heat exchangers. Currently there is no standard rating or method of test for corrosion life of stationary heat exchangers. Automotive test specifications.

# Wednesday, February 2

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

**CONFERENCE PAPER SESSION 16 (INTERMEDIATE)**

**Air Quality Studies**



Track: HVAC Fundamentals and Applications

**Room: Pavilion 6**

**Chair:** Richard Fox, Member, Honeywell Aerospace, Tempe, AZ

The U.S. Department of Energy goal to achieve net zero-energy in 50% of U.S. commercial buildings by 2050 poses technical challenges to traditional ventilation technology. The use of controlling air quality through increased ventilation, and monitoring carbon dioxide concentration is no longer a viable approach. This session visits issues related with zero energy removal of ozone in residences, the effect of varying HVAC on volatile organic contaminant (VOC) interactions, the effect of varying HVAC airflow rates on resuspension of primary and secondary layers of dust on indoor surfaces, and VOC removal efficiency using photocatalytic oxidation in conjunction with ozone.

**1. Zero-Energy Removal of Ozone in Residences (LV-11-C050)**

*Elliott Gall, Student Member<sup>1</sup>, Jeffrey Siegel, Ph.D., Member<sup>1</sup> and Richard Corsi, Ph.D., P.E., Member<sup>1</sup>, (1)University of Texas, Austin, TX*

**2. Effects of HVAC Operations on Sorptive Interactions (LV-11-C051)**

*Priscilla Guerrero, Student Member<sup>1</sup> and Richard L. Corsi, Ph.D., P.E., Member<sup>1</sup>, (1)University of Texas, Austin, TX*

**3. Air Cleaning by Photo Catalytic Oxidation: An Experimental Performance Test (LV-11-C052)**

*Ragib Kadribegovic, Student Member, Chalmers University of Technology, Gothenberg, Sweden*

**4. Monolayer and Multilayer Particle Resuspension from Indoor Surfaces (LV-11-C053)**

*Brandon E. Boor, Student Member, University of Texas, Austin, TX*

**CONFERENCE PAPER SESSION 17 (BASIC)**

**Net Zero Energy in Hot Climates**



Track: Low Energy Design

**Room: Pavilion 10**

**Chair:** Renison Tisdale, P.E., Member, Vansant & Gusler, Inc., Norfolk, VA

This session presents a two-part paper on new tools and methods and experimental feedback and another paper on a parametric study for integrated design optimization of low-energy buildings.

**1. A Parametric Study for Integrated Design Optimization of Low-Energy Buildings (LV-11-C054)**

*Siir Kilkis, Student Member<sup>1</sup> and Birol Kilkis, Ph.D., Fellow ASHRAE<sup>2</sup>, (1)KTH, Stockholm, Sweden, (2)Baskent University, Ankara, Turkey*

**2. Towards Net Zero Energy Buildings in Hot Climates: Part 1, New Tools and Methods (LV-11-C055)**

*Francois Garde, Ph.D., P.E., Member<sup>1</sup>, Mathieu David, Ph.D., P.E.<sup>1</sup> and Aurelie Lenoir, Student Member<sup>1</sup>, (1)University of La Reunion, Le Tampon, France*

**3. Towards Net Zero Energy Buildings in Hot Climates: Part 2, Experimental Feedback (LV-11-C056)**

*Aurelie Lenoir, Student Member<sup>1</sup>, Francois Garde, Ph.D., P.E., Member<sup>1</sup> and Francoise Thellier, Ph.D., P.E., Member<sup>2</sup>, (1)University of La Reunion, Le Tampon, France, (2)University of Toulouse, Toulouse, France*

**CONFERENCE PAPER SESSION 18 (INTERMEDIATE)**

**Smoke Control for Tall Buildings**



Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 11**

**Sponsor:** 05.06 Control of Fire and Smoke

**Chair:** Ray Sinclair, Ph.D., RWDI, Guelph, ON, Canada

High performing sustainable buildings are achieved by an integrated design process that seeks to achieve comfort and safety for the building occupants. Fire life safety is an important aspect of these buildings. Tall buildings in particular have special challenges for smoke control. Three presentations in this seminar share current understanding of unique engineering design issues and code requirements for tall and super tall buildings. The audience will gain knowledge and awareness that will be applicable to new projects.

**1. Super Tall Buildings: Special Smoke Control Requirements? (LV-11-C057)**

*William A. Webb, P.E., Fellow ASHRAE, WEBB FIRE Protection Consulting, LLC, Brooksville, FL*

**2. Smoke Control for Tall and Super Tall Buildings – An Integrated Approach (LV-11-C058)**

*Jeffrey Tubbs, P.E., Member, Arup, Cambridge, MA*

**3. Stairwell Smoke Control by Ventilation (LV-11-C059)**

*Dr. John H. Klote, P.E., Member, Fire and Smoke Consulting, Lansdowne, VA*

**SEMINAR 46 (INTERMEDIATE)**



**Achieving Zero Energy Design with Absorption Cooling**

Track: Net Zero Energy

**Room: Pavilion 1**

**Sponsor:** 08.03 Absorption and Heat Operated Machines

**Chair:** Ersin Gercek, P.E., Associate Member, Concord Engineering Group, Voorhees, NJ

This session includes three presentations discussing efforts towards sustainability in absorption cooling technologies through renewable energy sources and advanced working fluids. Two of the presentations review applications and key design considerations involved in engineering solar hot water fired absorption systems. Third session reviews design challenges regarding advanced working fluids and presents findings from an experimental investigations on crystallization behavior.

**1. Design Considerations of a Solar-Fired Chiller System**

*Isaac Mahderekal, Ph.D., P.E., Associate Member, IntelliChoice Energy, Las Vegas, NV*

**2. 30-Ton Absorption Chiller Installation on Vacuum Solar Collector**

*Piyush V. Patel, Associate Member, Thermax Ltd., Northville, MI*

**3. Water-LiBr Enabling Technologies Using Chemical Additives**

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

**SEMINAR 47 (INTERMEDIATE)** 

**Building Envelopes for Mechanical Engineers: It's All in the Handbooks!**

Track: Professional Skills

**Room: Pavilion 4**

*Sponsor: 04.04 Building Materials and Building Envelope Performance*

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

The complexity of modern building envelopes makes it increasingly difficult for mechanical designers to accurately calculate heating, cooling, and moisture loads. Fortunately, the ASHRAE Handbooks contain a wealth of information on modern building envelopes, including details and constructions, material properties, and calculation methods. This presentation covers the basics of building envelopes in the Handbooks, calculation methods and analytical techniques, and typical details and systems as they pertain to the mechanical engineering practice.

**1. Reaching Dew Point: A Brief History of Building Envelopes In ASHRAE Handbooks**

*William B. Rose, Member, University of Illinois Building Research Council, Champaign, IL*

**2. Hygrothermal Loads and Performance Assessment – Fundamentals Chapters 25-26**

*Hartwig Kuenzel, Member, Fraunhofer-Institut Bauphysik, Holzkirchen, Germany*

**3. Effective Moisture Control and the Building Envelope – Applications Chapter 43**

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

**SEMINAR 48 (INTERMEDIATE)** 

**Cool New Tools for Finding and Fixing Problems in Buildings and HVAC Systems**

Track: HVAC Systems and Equipment

**Room: Pavilion 9**

*Sponsor: 01.12 Moisture Management in Buildings*

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

Sooner or later every contractor, engineer, architect and building owner has problems that he or she must investigate and solve. The problems of air leakage and moisture accumulation have been more important lately, and the traditional problems of poor temperature and humidity control always seem to be with us. In recent years, building investigators have found (or invented) innovative, practical and economical tools and techniques for locating and diagnosing problems. This seminar focuses on new hardware and innovative techniques for building investigations.

**1. What's Hot and What's Not: The Secret Guide to Using Thermal Cameras for Effective Building Investigations**

*Holly Bailey, P.E., Member, Bailey Engineering Corp., Jupiter, FL*

**2. Long Ago and Far Away: Cool Tools for Web-Based Long-Term Remote Monitoring and Diagnosis of Problems In Buildings**

*Lew Harriman, Member, Mason-Grant Consulting, Portsmouth, NH*

**3. Huffing and Puffing: Cool Tools and Techniques for Locating and Quantifying Air Leaks In Green Buildings**

*Terry Brennan, Member, Camroden Associates Inc., Westmoreland, NY*

**SEMINAR 49 (INTERMEDIATE)** 

**Recent Research Developments in HVAC Energy Reduction in Cleanrooms, Labs and Critical Spaces**

Track: HVAC Fundamentals and Applications

**Room: Pavilion 3**

*Sponsor: 09.11 Clean Space, 09.10 Laboratory Systems*

*Chair: Peter Gardner, P.E., Member, Torcon, Inc., Red Bank, NJ*

Energy consumption and significant reduction is a hot topic in cleanrooms, labs and healthcare critical spaces which use much more energy than general offices and they are also performance-critical. Recent research has identified new approaches to improve cleanroom/lab particle contamination control and de-contamination performance while reducing energy. These presentations will illustrate not only theoretical modeling and computer simulations, but also demonstrate lab or field testing to validate the findings and recommendations. For decades cleanroom airflow rate determination was not

through software calculation, but through selecting a rate from an over-simplified table disregarding site specific information.

**1. Air Change Rate and De-Contamination Performance In Airlocks/Anterooms for Cleanrooms, Labs and Healthcare Critical Spaces**

*Wei Sun, P.E., Member, Engsysco Inc., Ann Arbor, MI*

**2. Development of Theoretical Airflow Rate Model for Mixed Type Cleanroom and Energy Conservation Strategies**

*Chung-Chieh Lee, Ph.D., Member, National Taipei University of Technology, Taipei, Taiwan*

**3. Effect of Air Change Rate and Perforated Floor Panel on Room Particle Concentration and Energy Consumption In Cleanrooms**

*Shih-Cheng Hu, Ph.D., Member, National Taipei University of Technology, Taipei, Taiwan*

**SEMINAR 50 (INTERMEDIATE)** 

**Residential Power Factor and EMI (FCC) Requirements for VSDs**

Track: HVAC Fundamentals and Applications

Room: Pavilion 2

Sponsor: 01.11 Electric Motors and Motor Control

Chair: *Derrick Vigil, Member, Baldor Electric Company, Greenville, SC*

Variable speed motor usage is on the rise in residential systems. This presents some increasing challenges for single phase power systems in the areas of power factor and electromagnetic interference. This seminar aims to explain the cause, compare different motor type/control topologies, present possible solutions and understand FCC regulatory compliance.

**1. Green Power Factor for Residential Systems?**

*Robert W. Helt, Member, Helt Engineering, Portland, ME*

**2. Variable Speed Drives and Residential Power Factor/EMI Requirements**

*Daemon Heckman, LCR Electronics, Inc., Norristown, PA*

**3. Simple and Cost Effective EMI Characterization of Variable Speed Drive Systems for Determining EMI Compliance**

*Jason Anderson, Professional Testing (EMI), Inc., Round Rock, TX*

**9:45 AM-10:45 AM**

**TECHNICAL PAPER SESSION 5 (INTERMEDIATE)**

**Displaced Carbon Emissions Methodology for Onsite Combined Heat and Power Systems**

Track: HVAC Systems and Equipment 

Room: Pavilion 3

Sponsor: 01.10 Cogeneration Systems

Chair: *Timothy Wagner, Member, UTC Power Program Office at United Technologies Research Center, Hartford, CT*

According to the U.S. EPA the average efficiency of fossil-fueled power plants in the U.S. is 33 percent and has remained unchanged for 40 years. Combined heat and power (CHP) systems offer significant cost-effective emissions reduction potential by increasing efficient electric and thermal energy supply. Providing a reliable means of calculating carbon, SO<sub>2</sub> and NO<sub>x</sub> emissions of conventional systems (separate heat and power) for comparison to CHP system emissions is essential. These two papers explore a protocol approach where the net emissions are calculated from three primary components: 1. Onsite emissions from the CHP system. 2. Displaced emissions from onsite thermal production (i.e., steam). 3. Displaced emissions from offsite generation of electricity, including transmission losses and cooling if the CHP system has a cooling component.

**1. Fuel and CO<sub>2</sub> Emissions Savings Calculation Methodology for Combined Heat and Power (CHP) Systems (LV-11-029)**

*Bruce Hedman, Ph.D., ICF, Arlington, VA*

**2. Applying a Fuel and CO<sub>2</sub> Emissions Savings Calculation Protocol to a Combined Heat and Power (CHP) Project Design (LV-11-030)**

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

**CONFERENCE PAPER SESSION 19 (INTERMEDIATE)**

**HVAC Design Considerations for Justice Facilities** 

Track: HVAC Fundamentals and Applications

Room: Pavilion 2

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

This program provides the owner, design engineer, contractors, and local authorities with information regarding some design considerations for various types of justice facilities.

**1. Special Design Considerations for Institutional and Correctional Facilities (LV-11-C060)**

*Richard Vehlou, P.E., Member, New York State Office of General Services, Albany, NY*

**2. Application Issues for Chilled Beam Technologies (LV-11-C061)**

*Boggarm Setty, P.E., Fellow ASHRAE, Setty and Associates, Fairfax, VA*

**CONFERENCE PAPER SESSION 20 (INTERMEDIATE)**

**Ventilation** 

Track: HVAC Systems and Equipment

Room: Pavilion 9

Chair: *Rick Peters, P.E., TBS Engineering, Inc., Bainbridge Island, WA*

This session discusses the importance of correct ventilation the sizing and placement of systems.

Tech Program

**1. Demand Control Ventilation: Lessons from the Field: How to Avoid Common Problems (LV-11-C062)**

*Brad Acker<sup>1</sup> and Kevin van den Wymelenberg<sup>1</sup>, (1)University of Idaho, Boise, ID*

**2. Reducing Sidewall Vent Plumes and Increasing Equipment Installation Flexibility in Low Energy Design (LV-11-C063)**

*Larry Brand, Member<sup>1</sup>, Paul Glanville, P.E., Associate Member<sup>1</sup> and Yanjie Yang<sup>1</sup>, (1)Gas Technology Institute, Des Plaines, IL*

**3. Unitary HVAC Premium Ventilation Upgrade (LV-11-C064)**

*Reid Hart, Member<sup>1</sup>, Jack Callahan, P.E., Associate Member<sup>2</sup>, Kenneth Anderson, Associate Member<sup>1</sup> and Patrick Johanning, Associate Member<sup>1</sup>, (1)PECI, Portland, OR, (2)Bonneville Power Administration, Portland, OR*

**SEMINAR 51 (BASIC)  **

**Acoustics Codes, Standards, and Design Guidelines: A Primer**

Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 11**

**Sponsor:** 02.06 Sound and Vibration Control

**Chair:** *Ralph Muehleisen, Ph.D., P.E., Member, Illinois Institute of Technology, Chicago, Illinois*

Acoustics is an important consideration in the sustainable design of HVAC systems because of the impact of acoustics on indoor environmental quality. While long neglected, acoustics has, in the last few years, become a larger part of some building codes, design guidelines, design standards and building rating systems. This seminar provides a primer of acoustic measurement standards and criteria and reviews recent changes to acoustics in codes, standards, guidelines, and rating systems including changes to ASHRAE, ANSI, ASTM, ISO, USGBC and ICC codes and standards.

**1. Addressing Building IEQ – Acoustics Needs – through Standards, Guidelines and Rating Systems**

*Kenneth P. Roy, Ph.D., Member, Armstrong World Industries, Lancaster, PA*

**2. Changing Criteria for Design Noise Levels**

*Neil Moiseev, Member, Shen Milsom & Wilke, LLC, New York, NY*

**SEMINAR 52 (BASIC) **

**How to Claim and Document Government Sponsored Tax Credits and Incentives Available for Engineering Firms**

Track: Professional Skills

**Room: Pavilion 10**

**Chair:** *Lynda Cruise, Alliantgroup, Irvine, CA*

This seminar addresses research and development tax credits. The legal and technical description based on the law that was finalized by Congress in 2004. The law was part of the 2001 Jobs Creation Act to encourage companies to use their United States labor force and not outsource. This session explains how the law applies to engineering, design build contractors, and ALL manufacturing companies. Four-Part Test -- Activity must pass these four parts: 1. New (to just the company)... Any New or Improved Business Component. 2. Technological in Nature. 3. Uncertainty of outcome. 4. Testing. Also, this seminar addresses export tax incentives -- costs related to engineering design labor performed in the United States for projects to be built outside of the of the United States.

**1. R&D Tax Credits**

*Lynda Cruise, Alliantgroup, Irvine, CA*

**SEMINAR 53 (ADVANCED)  **

**Windows for Net-Zero Energy Homes**

Track: Net Zero Energy

**Room: Pavilion 1**

**Sponsor:** 04.05 Fenestration

**Chair:** *Brian Crooks, Member, Cardinal Glass Industries, Inc., Eden Prairie, MN*

Windows and skylights are an important component of net-zero energy homes. Windows can provide heat, light, an insulated boundary, and a means to ventilate buildings. The proper application of window technology depends on the climate in which the building is located. The following presentations explore the role of windows in net-zero energy homes.

**1. Net-Zero Energy Windows: From Energy Losers to Energy Gainers**

*Christian Kohler, Member, LBNL, Berkeley, CA*

**2. Climate Impact in Window Design and Performance**

*Bipin Shah, Member, Winbuild, Fairfax, VA*

**FORUM 7 (INTERMEDIATE)**

**Energy Conservation and Circulator Fans**

Track: HVAC Systems and Equipment

**Room: Pavilion 4**

**Sponsor:** 05.01 Fans

**Chair:** *Christian Taber, Member, Big Ass Fan Company, Lexington, KY*

With the current efforts to move toward net-zero buildings, finding low energy means of increasing occupant comfort are vital. Recent changes to ASHRAE Standard 55 and the ASHRAE Thermal Comfort Tool allow for more accurate quantification of the effects of elevated air speed on building occupants. The goal of this forum is to define the necessary criteria to develop a standard method of test for circulator fans in comfort cooling and destratification applications.

**FORUM 8 (BASIC)**

**Right Sizing: What Does It Mean**

Track: Professional Skills

**Room: Pavilion 6**

*Sponsor: 07.01 Integrated Building Design*

*Chair: Dennis Knight, P.E., Member, Liollo Architecture, Charleston, SC*

A new buzz word has crept into our HVAC vocabulary called “Right Sizing”. This forum discusses what right sizing may mean and what are its implications with respect to load calculations, equipment selection, operation and maintenance in the near-zero energy future. Is there room for safety factors, general assumptions, and guesswork in HVAC design anymore? How might a design engineer prepare for potential claims of over or under design and still provide systems that are energy efficient and also readily adaptable to future uses?

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

**CONFERENCE PAPER SESSION 21 (INTERMEDIATE)**

**Applying Rooftop Units and Using Life Cycle Costing**



Track: Low Energy Design

**Room: Pavilion 4**

*Chair: Anne Wagner, Member, Pacific Northwest National Laboratory, Richland, WA*

This session examines if life-cycle cost analysis is worth the effort, measures for maintaining low energy use in commercial buildings over their life cycle, oversizing of rooftop HVAC systems and hybrid rooftop packaged air conditioners.

**1. Measures for Maintaining Low Energy Use in Commercial Buildings Over Their Life-Cycle (LV-11-C065)**

*Om Taneja, Ph.D., P.E., Manhattan Service Center, Manhattan, NY*

**2. Advancing Development of Hybrid Rooftop Packaged Air Conditioners: Test Protocol and Performance Criteria for the Western Cooling Challenge (LV-11-C066)**

*Jonathan Woolley, Member<sup>1</sup> and Mark Modera, Member<sup>2</sup>, (1)University of California, Davis, CA, (2)University of California, Davis, Davis, CA*

**3. Life Cycle Cost Analysis: Is it Worth the Effort? (LV-11-C067)**

*Kendra Tupper, P.E.<sup>1</sup>, Aaron Buys, Affiliate<sup>1</sup> and Michael Bendewald, Affiliate<sup>1</sup>, (1)Rocky Mountain Institute, Boulder, CO*

**CONFERENCE PAPER SESSION 22 (INTERMEDIATE)**

**Performance Modeling**



Track: HVAC Fundamentals and Applications

**Room: Pavilion 3**

*Chair: Gregory Dobbs, Member, United Technologies Research Center, East Hartford, CT*

This session covers three papers on energy conservation optimization and indoor performance evaluation.

**1. Adaptive Optimization Method for Energy Conservation in HVAC Systems (LV-11-C068)**

*Junya Nishiguchi<sup>1</sup>, Tomohiro Konda<sup>1</sup> and Ryota Dazai<sup>1</sup>, (1)Yamatake Corp., Kanagawa, Japan*

**2. Performance Evaluation of Indoor Environment Parameters for an Unoccupied Operating Room (LV-11-C069)**

*Fu-Jen Wang, Member<sup>1</sup>, Chi-Mang Lai, Ph.D., P.E., Member<sup>2</sup>, Tsung-Jung Cheng, Ph.D., P.E.<sup>3</sup> and Zhuan-Yu Liu, Student Member<sup>4</sup>, (1)National Chin-Yi University of Technology, Taichung, Taiwan, (2)National Cheng-Kung University, Taiwan, (3)Feng Chia University, Taiwan, (4) National Chin-Yi University of Technology, Taiwan*

**3. Designing HVAC Systems Using Particle Swarm Optimization (LV-11-C070)**

*Ramiro Bravo, Ph.D., Member<sup>1</sup> and Forrest W. Flocker, Ph.D.<sup>1</sup>, (1)University of the Permian Basin, Odessa, TX*

**CONFERENCE PAPER SESSION 23 (INTERMEDIATE)**

**The Real Cost of Zero Energy Buildings: Equipment**



Track: Net Zero Energy

**Room: Pavilion 1**

*Chair: Wangda Zuo, Lawrence Berkeley National Laboratory, Berkeley, CA*

This session includes papers that offer equipment applications designed to contribute to the potential for a net-zero energy building.

**1. Study of Unglazed Transpired Solar Collector Installations in the Twin Cities Minnesota Climate (LV-11-C071)**

*Patrick A. Tebbe, P.E., Member<sup>1</sup>, Saeed Moaveni, P.E., Member<sup>2</sup>, Louis Schwartzkopf<sup>1</sup>, Joseph Dobmeier<sup>1</sup>, Joseph Gehrke<sup>2</sup>, Matthew Simones<sup>1</sup> and Adam Himmer<sup>1</sup>, (1)Minnesota State University, Mankato, MN, (2)Norwich University, Northfield, VT*

**2. Energy Farming in the USA (LV-11-C072)**

*Brian Warwicker, Member<sup>1</sup> and Dan Cash, Affiliate<sup>2</sup>, (1)Nottingham University, Nottingham, United Kingdom, (2)Buro Happold Building Services, Nottingham, United Kingdom*

Tech Program



**3. Role of Radiant Panel Heating and Cooling in Net-Zero Energy Buildings (LV-11-C073)**

*Birol Kilkis, Ph.D., Fellow ASHRAE, Baskent University, Ankara, Turkey*

**4. Energy Use Intensity and Its Influence on the Integrated Daylighting Design of a Large Net-Zero Energy Building (LV-11-C074)**

*Robert Guglielmetti<sup>1</sup>, Jennifer Scheib<sup>1</sup>, Shanti Pless, Member<sup>1</sup>, Paul Torcellini, Ph.D., Member<sup>1</sup> and Rachel Petro<sup>2</sup>, (1)National Renewable Energy Laboratory, Golden, CO, (2)RNL Design, Denver, CO*

**5. CFD Simulation of Cross-Ventilation Using Fluctuating Pressure Boundary Conditions (LV-11-C075)**

*James Lo, Student Member<sup>1</sup> and Atila Novoselac, Member<sup>1</sup>, (1)University of Texas at Austin, Austin, TX*

**CONFERENCE PAPER SESSION 24 (INTERMEDIATE)**

**Tunnel Design Considerations**   

Track: HVAC Fundamentals and Applications

**Room: Pavilion 2**

*Chair: Kai Kang, P.E., Member, Jacobs, New York, NY*

This session addresses advanced analysis techniques in the design of longitudinal tunnel ventilation system using jet fans, impact of fire heat release rate on rail and road tunnels ventilation systems and fixed fire suppression systems.

**1. Impact of Tunnel Ventilation on Tunnel Fixed Fire Suppression System (LV-11-C076)**

*Igor Maevski, Ph.D., P.E., Member<sup>1</sup> and Raymond C. Klein, P.E., Member<sup>1</sup>, (1)Jacobs Engineering, New York, NY*

**2. Advanced Analysis Techniques in the Design of Longitudinal Tunnel Ventilation System Using Jet Fans (LV-11-C077)**

*Nader Shahcheraghi, Dr.Ing., Member, AECOM, Oakland, CA*

**3. Assessing the Impact Fire Heat Release Rate has on Infrastructure Design and Constructability of Rail and Road Tunnels Ventilation Systems (LV-11-C078)**

*Greg Sanchez, MTA-New York Transit, New York, NY*

**SEMINAR 54 (BASIC)**  

**Don't Roll the Dice with Energy Recovery Ventilation**

Track: HVAC Systems and Equipment

**Room: Pavilion 9**

*Sponsor: 05.05 Air-to-Air Energy Recovery*

*Chair: Carol Marriott, P.Eng., Member, Carol Marriott Consulting, Maple Grove, MN*

Energy recovery should be considered as a part of building ventilation strategy, here's how to do it and comply with Standard 62.1, and when you must do it to comply with

Standards 90.1 and 189.1. Learn about the importance of AHRI 1060 certification and what it means to your designs and specifications. Tips and tricks to design and specify energy recovery devices to cost effectively introduce outdoor air into a building. Case studies cover the theory and practice of using energy recovery to save energy and improve ventilation.

**1. ERV Requirements In the Latest ASHRAE and AHRI Standards**

*Paul Pieper, Member, Venmar CES, St-Leonard-d'Aston, QC, Canada*

**2. Casino Ventilation In Theory and Practice**

*Boyd Erickson, Member, FEA Consulting Engineers, Las Vegas, NV*

**3. A Case Study of ERV Application In Religious/ Institutional Facilities**

*Matthew Friedlander, Member, RenewAire LLC, Madison, WI*

**SEMINAR 55 (INTERMEDIATE)**  

**Energy Saving Goes Hand in Hand with Comfortable Humidification by Evaporative Cooling in Hot and Dry Climates**

Track: Low Energy Design

**Room: Pavilion 10**

*Sponsor: 05.11 Humidifying Equipment, 05.07 Evaporative Cooling*

*Chair: Raul Simonetti, Member, CAREL INDUSTRIES S.r.l., Brugine, Italy*

All the resources of our world should be efficiently used in order to reduce their quick depletion. Among them, energy is currently one of the most important; water is going to be the next. An efficient use implies that we ought to exploit them as less as possible yet guaranteeing our well being. Water can be wisely utilized for reducing the electrical energy required for mechanical cooling thanks to evaporative cooling; at the same time, its evaporation gives comfortable and convenient living conditions especially in hot and dry climates.

**1. Need for Humidifiers In Energy Efficient Homes**

*Eric Brodsky, P.E., Member, Research Products Corporation, Madison, WI*

**2. The Real Health and Comfort Aspects of Humidity Control for a Sustainable Indoor Environment**

*L. Gary Berlin, Member, Nortec, Ottawa, ON, Canada*

**3. Casino VAV with IAQ and ENERGY Savings Too**

*Vijayanand Periannan, Member, Munters Corporation (Deschamps Products Group), Buena Vista, VA*

**4. Energy Saving by Direct Evaporative Cooling: Real Application In Metro Station and Simulated Application for Offices In Madrid**

*Raul Simonetti, Member, CAREL INDUSTRIES S.r.l., Brugine, Italy*

**SEMINAR 56 (BASIC)** 

**Low Energy Load Calculations**

Track: Low Energy Design

**Room: Pavilion 6**

**Sponsor:** 04.01 Load Calculation Data and Procedures

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

Low energy buildings have the same loads as normal buildings; weather data, envelop loads, solar loads, ventilation loads and internal gains. How do energy design targets minimizing these loads? This seminar discusses how low load assumptions can be for low energy load calculations and what happens if the assumptions are too aggressive.

**1. Weather Data for Evaporative Cooling Load Calculations**

*Rolando Legarreta, P.E., Member, Alegro Engineering, El Paso, TX*

**2. Internal Gain Assumptions for Low Energy Design**

*Chris Wilkins, P.E., Member, Hallam-ICS, South Burlington, VT*

**3. What Are the Consequences of Wrong Load Assumptions?**

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

**SEMINAR 57 (INTERMEDIATE)** 

**Thermal Comfort Evaluation and Standards: International Developments**

Track: Codes and Standards in the HVAC&R Industry

**Room: Pavilion 11**

**Sponsor:** 02.01 Physiology and Human Environment

**Chair:** Dennis L. Loveday, Ph.D., Member, Loughborough University, Loughborough, United Kingdom

Designing for acceptable thermal comfort conditions lies at the heart of the building construction process, and is a key determinant of building energy consumption. This seminar provides an update on developments and applications of thermal comfort standards in several regions across the world – China, India, Europe and USA. This international perspective is particularly important in view of the rates of construction in the growing economies of China and India, and will be an opportunity to hear about developments around thermal comfort standards in these parts of the world.

**1. The New Chinese Thermal Comfort Standard**

*Baizhan Li, Ph.D., Member, Chongqing University, Chongqing, China*

**2. Developments, Evaluation and Application of Thermal Comfort Standards In India**

*Madhavi Indraganti, Ph.D., Member, NIFT, Hyderabad, India*

**3. Recent Work of the International Standards Committee on Thermal Comfort: The European Perspective**

*Kenneth C. Parsons, Ph.D., Member, Loughborough University, Department of Human Sciences, Loughborough, United Kingdom*

**4. Thermal Comfort Standards: U.S. Developments**

*Peter Simmonds, Ph.D., Fellow ASHRAE, IBE Consulting Engineers, Sherman Oaks, CA*

## notes

## SOCIETY COMMITTEE MEETINGS

(Subcommittees are indented)

Meetings are scheduled in either the Las Vegas Hilton or Convention Center. The number in parenthesis following the room name indicates location within the hotel. (H) is Hilton, (LVCC) is Las Vegas Convention Center. The N before the number means North Hall. The North Hall meeting space is directly across the street from the Hilton.

### ALPHABETICAL LISTING

#### ABEL-bEQ Ad Hoc,

Sun., 1/30, 8:30 a.m.-11:30 a.m., (LVCC) N238

#### Advocacy,

Sun., 1/30, 6:30 a.m.-8:30 a.m., (H) Executive Boardroom (2)

#### AEDG Steering Committee,

Mon., 1/31, 2:15 p.m.-5:00 p.m., (H) Ballroom E

#### ASHRAE/AHRI Joint Expo,

Sun., 1/30, 9:00 a.m.-11:00 a.m., (LVCC) N233

#### ASHRAE Foundation,

Mon., 1/31, 8:00 -10:00 a.m., (LVCC) N233

##### Executive Subcommittee,

Sat., 1/29, 1:30 -3:00 p.m., (H) Conference Room 4

#### ASHRAE Research Canada,

Sun., 1/30, 7:00 -8:30 a.m., (H) Conference Room 14 (2)

#### Associate Society Alliance,

Sun., 1/30, 1:30 p.m.-4:30 p.m., (H) Ballroom E

Mon., 1/31, 4:15-6:00 p.m., (H) Ballroom D

#### Board of Directors,

Sun., 1/30, 1:30 p.m.-5:30 p.m., (H) Ballroom C

Wed., 2/2, 2:00 -6:00 p.m., (H) Ballroom D

#### Certification,

Sat., 1/29, 8:00 a.m.-Noon, (H) Conference Room 4

#### Chapter Technology Transfer,

Fri., 1/28, 8:00 a.m.-Noon, (LVCC) N257

Sat., 1/29, 8:00 a.m.-Noon, (LVCC) N241

##### Member Services,

Fri., 1/28, 1:30 p.m.-5:00 p.m., (LVCC) N221

##### Operations,

Fri., 1:30 p.m.-5:00 p.m., (LVCC) N257

##### Executive,

Fri., 5:00 p.m.-6:00 p.m., (LVCC) N257

#### CIBSE/ASHRAE Liaison,

Wed., 2/2, 9:30 a.m.-Noon, (H) Conference Room 11 (2)

#### CLIMA,

Sat., 1/29, 12:00-1:30 p.m., (H) Conference Room 12 (2)

#### College of Fellows Board/Advisory,

Sun., 1/30, 8:00 -10:00 a.m., (LCVV) N234

#### College of Fellows,

Sun., 1/30, 10:00 a.m. -Noon, (LVCC) N234

#### Conferences and Expositions Committee,

Sat., 1/29, 8:00 a.m.-1:00 p.m., (H) Pavilion 4

##### Executive,

Fri., 1/28, 1:00 p.m.-3:00 p.m., (H) Pavilion 4

##### TAC/CEC Executive,

Sat., 1/29, 7:00 a.m.-8:00 a.m., (H) Pavilion 9

##### Annual and Winter Meetings,

Fri., 1/28, 3:00 p.m.-6:00 p.m., (H) Pavilion 4

##### Specialty Conferences,

Friday, 1/28, 4:00 p.m.-6:00 p.m., (H) Conference Room 4

#### Electronic Communication,

Sat., 1/29, 11:00 a.m.-3:00 p.m., (LVCC) N212

#### Energy Targets Implementation Ad Hoc,

Sat., 1/29, 1:00 p.m.- 3:00 p.m., (H) Conference Room 13 (2)

#### Environmental Health,

Mon., 1/31, 2:15 p.m. -6:15 p.m., (H) Ballroom F

##### Executive,

Mon., 1/31, 7:00 a.m.-8:00 a.m., (H) Ballroom F

##### Education/Research,

Mon., 1/31, 8:00 a.m.-10:00 a.m., (H) Ballroom F

##### Handbook/Program,

Mon., 1/29, 10:00 a.m.-Noon, (H) Ballroom F

#### Engineers Week,

Mon., 1/31, 4:15 p.m.-6:15 p.m., (H) Conference Room 11 (2)

#### Executive,

Sat., 1/29, 8:30 a.m.-1:00 p.m., (H) Conference Room 11 (2)

Wed., 2/2, 7:30 a.m.-9:00 a.m., (H) Conference Room 11 (2)

Thurs., 2/3, 7:30 a.m.-11:00 a.m., (H) Conference Room 5

#### Finance,

Fri., 1/28, 8:00 a.m.-1:00 p.m., (H) Pavilion 4

##### Investment Subcommittee,

Thursday, 1/27, 7:00 p.m.-9:00 p.m., (H) Conference Room 8

##### Planning Subcommittee,

Thursday, 1/27, 7:00 p.m.-9:00 p.m., (H) Conference Room 7

#### Handbook,

Sun., 1/30, 10:30 a.m.-1:00 p.m., (LVCC) N241

##### Electronic Media

Sun., 8:00 a.m.-9:00a.m., (LVCC) N230

##### Functional

Sun., 8:00 a.m.-9:00 a.m., (LVCC) N225

##### Publicity

Sun., 8:00 a.m.-9:00 a.m., (LVCC) N228

##### Practical Applications

Sun., 8:00 a.m.-9:00 a.m., (LVCC) N241

##### Program

Sun., 8:00 a.m.-9:00 a.m., (LVCC) N237

## Society Committee Meetings

### **Handbook 2012 HVAC Systems and Equipment TCs/Volume Subcommittee**

Sun., 9:00 a.m.-10:00 a.m., (LVCC) N241

### **Handbook 2013 Fundamentals TCs/Volume Subcommittee**

Sun., 9:00 a.m.-10:00 a.m., (LVCC) N237

### **Handbook 2014 Refrigeration TCs/Volume Subcommittee**

Sun., 9:00 a.m.-10:00 a.m., (LVCC) N239

### **Volume Subcommittees,**

Sun., 1/30, 10:00 a.m.-10:30 a.m., (LVCC) N241

### **SPO/Excom,**

Sat., 1/29, Noon-3:00 p.m., (H) Conference Room 6

### **Handbook Training for TC Handbook Chairs,**

Sun., 1/30, 8:00 -9:00 a.m., (LVCC) N260

### **Historical,**

Sun., 1/30, 8:30 a.m.- Noon, (LVCC) N236

### **Honors & Awards,**

Sun., 1/30, 1:00-5:00 p.m., (LVCC) N227

Mon., 1/31, 2:15 p.m.- 5:30 p.m., (H) Conference Room 13 (2)

### **IAQ 2010 Steering Committee,**

Sun., 1/30, 6:30 p.m.-8:30 p.m., (H) Conference Room 12 (2)

### **Life Members' Executive Board,**

Tues., 2/1, 8:00 a.m.-11:30 a.m., (H) Conference Room 5

### **Logo Ad Hoc,**

Sun., 1/30, 6:30 a.m.-8:00 a.m., (H) Conference Room 5

### **Members Council,**

Mon., 1/31, 8:00 a.m. – Noon, (H) Ballroom D

Tues., 2/1, 8:00 a.m. – Noon, (H) Ballroom D

### **Region Operation,**

Sat., 1/29, 8:00 a.m.- 12:30 p.m., (H) Executive Boardroom (2)

### **Planning,**

Sun., 1/30, 8:00 a.m.- Noon, (H) Ballroom E

### **PAOE,**

Mon., 1/31, 2:30 p.m.-4:00 p.m., (H) Conference Room 12 (2)

### **Membership Promotion,**

Sat., 1/29, 8:00 a.m.-3:00 p.m., (H) Pavilion 6

### **Membership Promotion Subcommittees,**

Fri., 1/28, 8:00 a.m.- 6:30 p.m., (H) Pavilion 1

### **Nominating,**

Sun., 1/30, 7:30a-3:00 p.m., (H) Ballroom B

### **PEAC,**

Tues., 2/1, Noon-2:00 p.m., (H) Executive Boardroom (2)

### **Planning,**

Fri., 1/28, 1:00 p.m.-6:00 p.m., (H) Pavilion 3

### **Professional Development,**

Mon., 1/31, 8:00 a.m.- Noon, (H) Executive Boardroom (2)

### **Planning, & Operations,**

Sun., 1/30, 8:00 a.m.-10:00 a.m., (LVCC) N221

### **Publications Committee,**

Sun., 1/30, 8:00 a.m.-Noon, (LVCC) N229

### **Planning Subcommittee,**

Sat., 1/29, 10:00 a.m.-Noon, (H) Conference Room 6

### **Publishing and Education Council,**

Tues., 2/1, 8:00a- Noon, (H) Ballroom E

### **E-Learning**

Sat., 1/29. 1:30 pm.-3:00 p.m., (H) Conference Room 12 (2)

### **Advertising Sales Subcommittee,**

Sun., 1/30, 7:00 a.m.-8:30 a.m., (LVCC) N216

### **Research Journal,**

Mon., 1/31, 11:00 a.m.- Noon, (H) Conference Room 11 (2)

### **Fiscal,**

Mon., 1/31, 2:00 p.m. -3:30 p.m., (H) Conference Room 14 (2)

### **Functional,**

Mon., 1/31, 3:30 p.m.- 5:00 p.m., (H) Conference Room 14 (2)

### **Refrigeration,**

Sun., 1/30, 8:00 a.m.-Noon, (LVCC) N254

### **Special Session**

DOE Next-Generation Ultra-Low GWP Refrigerant Roadmap Discussion

Tues., 2/1, 8:00-9:30 a.m., (LVCC) N256

### **Refrigerants PD Ad Hoc,**

Tues., 2/1, 3:15 p.m.-4:45 p.m., (H) Conference Room 13 (2)

### **Region-at-Large Planning,**

Mon., 1/31, 2:15 p.m.-4:15 p.m., (H) Ballroom D

### **Research Administration,**

Sat., 1/29, 8:00 a.m.-3:00 p.m., (H) Pavilion 10

Wed., 2/2, 7:00 a.m.-11:00 a.m., (LVCC) N252

### **Excom,**

Fri., 1/28, 1:00 p.m.-2:30 p.m., (H) Pavilion 10

### **RAS/RPS,**

Fri., 1/28, 3:00 p.m.-7:00 p.m., (H) Pavilion 10

### **Research Subcommittee Chairs,**

Mon., 1/31, 6:30 a.m.-9:00 a.m., (H) Ballroom A

### **Special Session**

DOE Next-Generation Ultra-Low GWP Refrigerant Roadmap Discussion

Tuesday, 2/1,8-9:30 a.m. (LVCC) N256

### **Research Promotion,**

Sat., 1/29, 8:00 a.m.-Noon, (LVCC) N237

Sun., 1/30, 8:15 a.m.-Noon, (LVCC) N261

### **Executive Subcommittee,**

Fri., 1/28, 2:00 p.m.-6:00 p.m., (LVCC) N216

**Scholarship Trustees,**

Tues., 2/1, 8:00 a.m.- Noon, (H) Conference Room 13 (2)

**Society Rules,**

Tues., 2/1, 2:00 p.m.-5:00 p.m., (H) Conference Room 5

**Solar Decathlon Ad Hoc,**

Sun., 4:00-6:00 p.m., (H) Conference Room 14 (2)

**Standards,**

Sat., 1/29, 8:00 a.m.-3:00 p.m., (H) Pavilion 3

Wed., 2/2, 8:00 -10:00 a.m., (H) Ballroom D

**Executive,**

Fri., 1/28, 8:00 a.m.-11:00 a.m., (LVCC) N217

**TCLS,**

Fri., 1/28, 11:00 a.m.- Noon, (LVCC) N217

Tues., 2/1, 5:00 p.m.-5:30 p.m., (H) Executive Boardroom (2)

**PPIS,**

Fri., 1/28, 2:00 p.m.-5:00 p.m., (LVCC) N217

Tues, 2/1, 11:00 a.m.-1:00 p.m., (LVCC) N239

**ILS/ISAS**

Fri., 1/28, 1:00 p.m.-4:00 p.m., (H) Conference Room 4

**SPLS,**

Fri., 1/28, 2:00 p.m.-5:00 p.m., (H) Pavilion 6

Tues., 2/1, 2:00 p.m.-3:00 p.m., (LVCC) N239

**SRS,**

Tues., 2/1, 5:30 p.m.-6:00 p.m., (H) Executive Boardroom (2)

**Code Interaction,**

Sun., 1/30, 7:00 p.m.-10:00 p.m., (H) Pavilion 6

**PC Chair Breakfast,**

Sun., 1/30, 7:00 -9:00 a.m., (H) Ballroom F

**Student Activities,**

Sat., 1/29, 8:00 a.m.-3:00 p.m., (LVCC) N234

**Executive,**

Fri., 1/28, 10:00 a.m.-Noon, (H) Conference Room 5

**K-12/STEM,**

Fri., Noon-2:00 p.m. (H) Conference Room 5

**Post High/ABET,**

Fri., 2:00 p.m.-4:00 p.m., (H) Conference Room 5

**Design Competition,**

Fri., 4:00 p.m.-6:00 p.m., (H) Conference Room 5

**Grants,**

Fri., 4:00-6:00 p.m., (H) Conference Room 6

**Student Program,**

Sun., 1/30, 7:30 a.m.-2:00 p.m., (H) Ballroom A

**Student Congress,**

Mon., 1/31, 10:00 a.m.-Noon, (H) Ballroom E

**Technical Activities,**

Sat., 1/29, 8:00 a.m.-3:00 p.m., (H) Pavilion 9

Wed., 2/2, 7:00 a.m.-10:00 a.m., (LVCC) N254

**TAC/CEC Executive,**

Sat., 1/29, 7:00 a.m.-8:00 a.m., (H) Pavilion 9

**TC/TG Chair's Training Workshop,**

Sun., 1/30, 9:45-10:45 a.m., (H) Pavilion 6

**TAC: TC/TG Section Meetings**

Sun., 6:30 a.m.-8:00 a.m.

**Section 1,** (LVCC) N239

**Section 2,** (LVCC) N231

**Section 3,** (LVCC) N225

**Section 4,** (LVCC) N224

**Section 5,** (LVCC) N230

**Section 6,** (LVCC) N227

**Section 7,** (LVCC) N235

**Section 8,** (LVCC) N228

**Section 9,** (LVCC) N213

**Section 10,** (LVCC) N218

**Technology Council,**

Tues., 2/1, 8:00 a.m.-Noon, (H) Ballroom F

Wed., 2/2, 9:00a.m.-11:00 a.m., (H) Ballroom F

**Building Information Modeling Steering Committee,**

Sat., 1/29, 1:00 p.m.-3:00 p.m., (LVCC) N241

**Building Performance Metrics Steering Committee,**

Sun., 1/30, 1:00 p.m.-4:00 p.m., (LVCC) N218

**Operations,**

Mon., 1/31, 9:00 a.m.-10:30 a.m., (H) Conference Room 5

**Special Projects,**

Mon., 1/31, 8:00 a.m.-10:00 a.m., (H) Conference Room 4

**Planning,**

Mon., 1/31, 10:30 a.m.-Noon, (H) Conference Room 5

**YEA,**

Sun., 1/30, 8:00 a.m.-Noon, (H) Conference Room 13 (2)

Mon., 1/31, 8:00 a.m.- Noon, (H) Conference Room 13 (2)

**CHRONOLOGICAL**

**THURSDAY, January 27**

**Finance Investment Subcommittee,**

Thurs., 7:00 p.m.-9:00 p.m., (H) Conference Room 8

**Finance Planning Subcommittee,**

Thurs., 7:00 p.m.-9:00 p.m., (H) Conference Room 7

**FRIDAY, January 28**

**Standards Executive,**

Fri., 8:00 a.m.-11:00 a.m., (LVCC) N217

**Chapter Technology Transfer,**

Fri., 8:00 a.m.-Noon, (LVCC) N257

**Finance,**

Fri., 8:00 a.m.-1:00 p.m., (H) Pavilion 4

## Society Committee Meetings

### Membership Promotion Subcommittees,

Fri., 8:00 a.m.- 6:30 p.m., (H) Pavilion 1

#### Student Activities Executive,

Fri., 10:00 a.m.-Noon, (H) Conference Room 5

#### Standards TCLS,

Fri., 11:00 a.m.- Noon, (LVCC) N217

#### Student Activities K-12/STEM,

Fri., Noon-2:00 p.m. (H) Conference Room 5

#### Research Administration Excom,

Fri., 1:00 p.m.-2:30 p.m., (H) Pavilion 10

#### Conferences and Expositions Committee Executive,

Fri., 1:00 p.m.-3:00 p.m., (H) Pavilion 4

#### Standards ILS/ISAS,

Fri., 1:00 p.m.-4:00 p.m., (H) Conference Room 4

### Planning,

Fri., 1:00 p.m.-6:00 p.m., (H) Pavilion 3

#### Chapter Technology Transfer Member Services,

Fri., 1:30 p.m.-5:00 p.m., (LVCC) N221

#### Chapter Technology Transfer Operations,

Fri., 1:30 p.m.-5:00 p.m., (LVCC) N257

#### Student Activities Post High/ABET,

Fri., 2:00 p.m.-4:00 p.m., (H) Conference Room 5

#### Standards PPIS,

Fri., 2:00 p.m.-5:00 p.m., (LVCC) N217

#### Standards SPLS,

Fri., 2:00 p.m.-6:00 p.m., (H) Pavilion 6

#### Research Promotion Executive Subcommittee,

Fri., 2:00 p.m.-6:00 p.m., (LVCC) N216

#### Conferences and Expositions Committee Annual and Winter Meetings,

Fri., 3:00 p.m.-6:00 p.m., (H) Pavilion 4

#### Conferences and Expositions Committee Specialty Conferences,

Friday, 4:00 p.m.-6:00 p.m., (H) Conference Room 4

#### Research Administration RAS/RPS,

Fri., 3:00 p.m.-7:00 p.m., (H) Pavilion 10

#### Student Activities Design Competition,

Fri., 4:00 p.m.-6:00 p.m., (H) Conference Room 5

#### Student Activities Grants,

Fri., 4:00-6:00 p.m., (H) Conference Room 6

#### Chapter Technology Transfer Executive,

Fri., 5:00 p.m.-6:00 p.m., (LVCC) N257

### SATURDAY, January 29

#### TAC/CEC Executive,

Sat., 7:00 a.m.-8:00 a.m., (H) Pavilion 9

#### Certification,

Sat., 8:00 a.m.-Noon, (H) Conference Room 4

#### Chapter Technology Transfer,

Sat., 8:00 a.m.-Noon, (LVCC) N241

### Research Promotion,

Sat., 8:00 a.m.-Noon, (LVCC) N237

#### Members Council Region Operation,

Sat., 8:00 a.m.- 12:30 p.m., (H) Executive Boardroom (2)

### Conferences and Expositions Committee,

Sat., 8:00 a.m.-1:00 p.m., (H) Pavilion 4

### Membership Promotion,

Sat., 8:00 a.m.-3:00 p.m., (H) Pavilion 6

### Research Administration,

Sat., 8:00 a.m.-3:00 p.m., (H) Pavilion 10

### Standards,

Sat., 8:00 a.m.-3:00 p.m., (H) Pavilion 3

### Student Activities,

Sat., 8:00 a.m.-3:00 p.m., (LVCC) N234

### Technical Activities,

Sat., 8:00 a.m.-3:00 p.m., (H) Pavilion 9

### Executive,

Sat., 8:30 a.m.-1:00 p.m., (H) Conference Room 11 (2)

#### Publications Committee Planning Subcommittee,

Sat., 10:00 a.m.-Noon, (H) Conference Room 6

### Electronic Communication,

Sat., 11:00 a.m.-3:00 p.m., (LVCC) N212

### CLIMA,

Sat., 12:00-1:30 p.m., (H) Conference Room 12 (2)

#### Handbook SPO/Excom,

Sat., Noon-3:00 p.m., (H) Conference Room 6

### Energy Targets Implementation Ad Hoc,

Sat., 1:00 p.m.- 3:00 p.m., (H) Conference Room 13 (2)

#### Technology Council Building Information Modeling

### Steering Committee,

Sat., 1:00 p.m.-3:00 p.m., (LVCC) N241

#### Foundation Executive Subcommittee,

Sat., 1:30 -3:00 p.m., (H) Conference Room 4

#### Publishing and Education Council E-Learning

Sat.. 1:30 pm.-3:00 p.m., (H) Conference Room 12 (2)

### SUNDAY, January 30

#### TAC: TC/TG Section Meetings

Sun., 6:30 a.m.-8:00 a.m.

**Section 1,** (LVCC) N239

**Section 2,** (LVCC) N231

**Section 3,** (LVCC) N225

**Section 4,** (LVCC) N224

**Section 5,** (LVCC) N230

**Section 6,** (LVCC) N227

**Section 7,** (LVCC) N235

**Section 8,** (LVCC) N228

**Section 9,** (LVCC) N213

**Section 10,** (LVCC) N218

**Logo Ad Hoc,**

Sun., 6:30 a.m.-8:00 a.m., (H) Conference Room 5

**Advocacy,**

Sun., 6:30 a.m.-8:30 a.m., (H) Executive Boardroom (2)

**ASHRAE Research Canada,**

Sun., 7:00 -8:30 a.m., (H) Conference Room 14 (2)

**Publishing and Education Council Advertising Sales Subcommittee,**

Sun., 7:00 a.m.-8:30 a.m., (LVCC) N216

**Standards PC Chair Breakfast,**

Sun., 7:00 -9:00 a.m., (H) Ballroom F

**Student Program,**

Sun., 7:30 a.m.-2:00 p.m., (H) Ballroom A

**Nominating,**

Sun., 7:30a-3:00 p.m., (H) Ballroom B

**Handbook Electronic Media,**

Sun., 8:00 a.m.-9:00a.m., (LVCC) N230

**Handbook Functional,**

Sun., 8:00 a.m.-9:00 a.m., (LVCC) N225

**Handbook Publicity,**

Sun., 8:00 a.m.-9:00 a.m., (LVCC) N228

**Handbook Practical Applications,**

Sun., 8:00 a.m.-9:00 a.m., (LVCC) N241

**Handbook Program,**

Sun., 8:00 a.m.-9:00 a.m., (LVCC) N237

**Handbook Training for TC Handbook Chairs,**

Sun., 8:00 -9:00 a.m., (LVCC) N260

**College of Fellows Board/Advisory,**

Sun., 8:00 -10:00 a.m., (LCVV) N234

**Professional Development Planning, & Operations,**

Sun., 8:00 a.m.-10:00 a.m., (LVCC) N221

**Members Council Planning,**

Sun., 8:00 a.m.- Noon, (H) Ballroom E

**Publications Committee,**

Sun., 8:00 a.m.-Noon, (LVCC) N229

**Refrigeration,**

Sun., 8:00 a.m.-Noon, (LVCC) N254

**YEA,**

Sun., 8:00 a.m.-Noon, (H) Conference Room 13 (2)

**Research Promotion,**

Sun., 8:15 a.m.-Noon, (LVCC) N261

**ABEL-bEQ Ad Hoc,**

Sun., 8:30 a.m.-11:30 a.m., (LVCC) N238

**Historical,**

Sun., 8:30 a.m.- Noon, (LVCC) N236

**Handbook 2012 HVAC Systems and Equipment TCs/Volume Subcommittee**

Sun., 9:00 a.m.-10:00 a.m., (LVCC) N241

**Handbook 2013 Fundamentals TCs/ Volume Subcommittee**

Sun., 9:00 a.m.-10:00 a.m., (LVCC) N237

**Handbook 2014 Refrigeration TCs/ Volume Subcommittee**

Sun., 9:00 a.m.-10:00 a.m., (LVCC) N239

**ASHRAE/AHRI Joint Expo,**

Sun., 9:00 a.m.-11:00 a.m., (LVCC) N233

**TC/TG Chair's Training Workshop,**

Sun., 9:45-10:45 a.m., (H) Pavilion 6

**Handbook Volume Subcommittees,**

Sun., 10:00 a.m.-10:30 a.m., (LVCC) N241

**College of Fellows,**

Sun., 10:00 a.m. -Noon, (LVCC) N234

**Handbook,**

Sun., 10:30 a.m.-1:00 p.m., (LVCC) N241

**Technology Council Building Performance Metrics Steering Committee,**

Sun., 1:00 p.m.-4:00 p.m., (LVCC) N218

**Honors & Awards,**

Sun., 1:00-5:00 p.m., (LVCC) N227

**Associate Society Alliance,**

Sun., 1:30 p.m.-4:30 p.m.,(H) Ballroom E

**Board of Directors,**

Sun., 1:30 p.m.-5:30 p.m., (H) Ballroom C

**Solar Decathlon Ad Hoc,**

Sun., 4:00-6:00 p.m., (H) Conference Room 14 (2)

**IAQ 2010 Steering Committee,**

Sun., 6:30 p.m.-8:30 p.m., (H) Conference Room 12 (2)

**Standards Code Interaction,**

Sun., 7:00 p.m.-10:00 p.m., (H) Pavilion 6

**MONDAY, January 31**

**Research Administration Research Subcommittee Chairs,**

Mon., 6:30 a.m.-9:00 a.m., (H) Ballroom A

**Environmental Health Executive,**

Mon., 7:00 a.m.-8:00 a.m., (H) Ballroom F

**ASHRAE Foundation,**

Mon., 8:00 -10:00 a.m., (LVCC) N233

**Environmental Health Education/Research,**

Mon., 8:00 a.m.-10:00 a.m., (H) Ballroom F

**Technology Council Special Projects,**

Mon., 8:00 a.m.-10:00 a.m., (H) Conference Room 4

**Members Council,**

Mon., 8:00 a.m. - Noon, (H) Ballroom D

**Professional Development,**

Mon., 8:00 a.m.- Noon, (H) Executive Boardroom (2)

## Society Committee Meetings

### **YEA,**

Mon., 8:00 a.m.- Noon, (H) Conference Room 13 (2)

### **Technology Council Operations,**

Mon., 9:00 a.m.-10:30 a.m., (H) Conference Room 5

### **Environmental Health Handbook/Program,**

Mon., 1/29, 10:00 a.m.-Noon, (H) Ballroom F

### **Student Congress,**

Mon., 10:00 a.m.-Noon, (H) Ballroom E

### **Technology Council Planning,**

Mon., 10:30 a.m.-Noon, (H) Conference Room 5

### **Publishing and Education Council Research Journal,**

Mon., 11:00 a.m.- Noon, (H) Conference Room 11 (2)

### **Publishing and Education Council Fiscal,**

Mon., 2:00 p.m. -3:30 p.m., (H) Conference Room 14 (2)

### **Region-at-Large Planning,**

Mon., 2:15 p.m.-4:15 p.m., (H) Ballroom D

### **AEDG Steering Committee,**

Mon. , 2:15 p.m.-5:00 p.m., (H) Ballroom E

### **Honors & Awards,**

Mon., 2:15 p.m.- 5:30 p.m., (H) Conference Room 13 (2)

### **Environmental Health,**

Mon., 2:15 p.m. -6:15 p.m., (H) Ballroom F

### **Members Council PAOE,**

Mon., 2:30 p.m.-4:00 p.m., (H) Conference Room 12 (2)

### **Publishing and Education Council Functional,**

Mon., 3:30 p.m.- 5:00 p.m., (H) Conference Room 14 (2)

### **Associate Society Alliance,**

Mon., 4:15-6:00 p.m., (H) Ballroom D

### **Engineers Week,**

Mon., 4:15 p.m.-6:15 p.m., (H) Conference Room 11 (2)

### **TUESDAY, February 1**

#### **Life Members' Executive Board,**

Tues., 8:00 a.m.-11:30 a.m., (H) Conference Room 5

#### **Members Council,**

Tues., 8:00 a.m. – Noon, (H) Ballroom D

#### **Publishing and Education Council,**

Tues., 8:00a- Noon, (H) Ballroom E

#### **Scholarship Trustees,**

Tues., 8:00 a.m.- Noon, (H) Conference Room 13 (2)

### **Technology Council,**

Tues., 8:00 a.m.-Noon, (H) Ballroom F

### **Standards PPIS,**

Tues. , 11:00 a.m.-1:00 p.m., (LVCC) N239

### **PEAC,**

Tues., Noon-2:00 p.m., (H) Executive Boardroom (2)

### **Standards SPLS,**

Tues., 2:00 p.m.-3:00 p.m., (LVCC) N239

### **Society Rules,**

Tues., 2:00 p.m.-5:00 p.m., (H) Conference Room 5

### **Refrigerants PD Ad Hoc,**

Tues., 3;15 p.m.-4:45 p.m., (H) Conference Room 13 (2)

### **Standards TCLS,**

Tues., 5:00 p.m.-5:30 p.m., (H) Executive Boardroom (2)

### **Standards SRS,**

Tues., 5:30 p.m.-6:00 p.m., (H) Executive Boardroom (2)

### **WEDNESDAY, February 2**

#### **Technical Activities,**

Wed., 7:00 a.m.-10:00 a.m., (LVCC) N254

#### **Research Administration,**

Wed., 7:00 a.m.-11:00 a.m., (LVCC) N252

#### **Executive,**

Wed., 7:30 a.m.-9:00 a.m., (H) Conference Room 11

#### **Standards,**

Wed., 8:00 -10:00 a.m., (H) Ballroom D

#### **CIBSE/ASHRAE Liaison,**

Wed., 9:30 a.m.-Noon, (H) Conference Room 11 (2)

#### **Technology Council,**

Wed., 9:00a.m.-11:00 a.m., (H) Ballroom F

#### **Board of Directors,**

Wed., 2:00 -6:00 p.m., (H) Ballroom D

### **THURSDAY, February 3**

#### **Executive,**

Thurs., 7:30 a.m.-11:00 a.m., (H) Conference Room 5



## TC/TG/SPC MEETINGS

The ASHRAE Technical Committees, Task Groups and Technical Resource Groups listed below usually meet at each Society Winter and Annual Conference. Attendance at these meetings is open to all society members, to all registered guests at scheduled Society Conferences, and to those invited by the chairman at the request of a member. You are encouraged to attend any of these meetings in which you have a technical interest.

### Policy for Scheduling TC/TG/SPC Meetings

TC and TG meetings will be automatically scheduled on the same day and time based upon the previous meeting schedule. Any changes to the time slot must be made in writing. All TC/TG subcommittees must be scheduled for each meeting. All SPC meetings must be confirmed prior to scheduling.

Audiovisual equipment and electric for laptops must be ordered for each meeting and only advance orders will be guaranteed. LCD projectors are not available.

NOTE: The parenthesis beside each committee represent the number of people expected to attend the meeting and any audiovisual equipment ordered. We encourage you to order audiovisual equipment in advance, as we are unable to guarantee that equipment will be available on-site. Every effort is made to accommodate room size versus number of committee members. If you have not supplied the Conferences Department with the number of members on your committee or subcommittee, we have no basis for room assignments.

### Finding the Assigned Meeting Room

**Codes for meeting locations: (H) = Las Vegas Hilton; (LVCC) Las Vegas Convention Center**

**\*\*\*\*\*ALL MEETING ROOMS IN THE LVCC WILL HAVE WI-FI ACCESS \*\*\*\*\***

### Description of Abbreviations

GPC	=	Guideline Project Committee
RP	=	Research Project
SPC	=	Standard Project Committee
SSPC	=	Standing Standard Project Committee
TC	=	Technical Committee
TG	=	Task Group
TRG	=	Technical Resource Group

PLEASE NOTE; If the committee meeting day/time/location is not printed in green it has not been confirmed. The committee may still be planning to meet but confirmation was not received.

## Format of Listings

### Committee Number and Title

**Day Time Location**  
*Session(s) the committee is sponsoring*

### TCs

#### TC/TG Chair's Breakfast

<b>Sunday</b>	<b>6:30–8:00 a.m.</b>	
		Section 1, (29), (LVCC) 239
		Section 2, (21), (LVCC) 231
		Section 3, (15), (LVCC) 225
		Section 4, (17), (LVCC) 224
		Section 5, (29), (LVCC) 230
		Section 6, (25), (LVCC) 227
		Section 7, (23), (LVCC) 235
		Section 8, (23), (VLCC) 228
		Section 9, (25), (LVCC) 213
		Section 10, (25), (LVCC) 218

#### TC/TG Chair's Training Workshop

**Sunday 9:45–10:45a (H) Pavilion 6**

#### Research Subcommittee Breakfast

**Monday 6:30–8:00a (H) Ballroom A**

#### TC 1.1 Thermodynamics & Psychrometrics (15)

**Monday 2:15–4:15p (LVCC) N224**

#### TC 1.2 Instruments & Measurements (15)

**Tuesday 1:00–3:30p (LVCC) N215**

TC 1.2 Standards/Handbook (5)

**Monday 4:15–6:30p (LVCC) N239**

#### TC 1.3 Heat Transfer & Fluid Flow (25/15)

**Tuesday 1:00–3:30p (LVCC) N263C**

*Sponsoring: Seminar 44: Micro/Nano Fluids and Systems in HVAC&R*

TC 1.3 Handbook

**Sunday 1:00–3:00p (H) Conference Room 4**

TC 8.5/1.3 Research (20/15) (screen)

**Sunday 3:00–7:00p (H) Pavilion 1**

#### TC 1.4 Control Theory & Application (40) (Screen)

**Tuesday 1:00–3:30p (LVCC) N254**

*Sponsoring: Seminar 8: Controls for Central Chiller Plant Optimization*

TC 1.4 Control Components and Applications /Green Buildings

**Sunday 3:00–4:45p (H) Pavilion 9**

TC 1.4 Program (30) (screen)

**Sunday 4:45–5:30p (H) Pavilion 9**

TC 1.4 Reference Applications (10)

## TC/TG/SPC Meetings

**Sunday 5:30–6:30p (H) Pavilion 9**

TC 1.4 Research (20)(Screen)

**Monday 2:15–4:15p (LVCC) N229**

TC 1.4 Handbook (15)

**Monday 4:15–5:15p (LVCC) N229**

TC 1.4 Executive (15)

**Tuesday 7:00–8:00a (LVCC) N214**

### TC 1.5 Computer Applications (25/25)(Screen)

**Monday 6:30–9:00p (LVCC) N262**

*Sponsoring: Seminar 36: HVAC Software Applications for Smart Phones and Tablet Computers*

TC 1.5 Emerging Applications (6/10)

**Sunday 5:00–6:00p (H) Pavilion 2**

TC 1.5 Research (15)

**Sunday 6:00–7:00p (H) Pavilion 2**

TC 1.5 Program (15)

**Sunday 7:00–8:00p (H) Pavilion 2**

TC 1.5 PMS 1468

**Monday 4:15–6:00p (LVCC) N262**

TC 1.5 Handbook (15)

**Monday 6:00–6:30p (LVCC) N262**

### TC 1.6 Terminology (8/6) (Screen/E)

**Monday 4:15–6:30p (LVCC) N215**

### TC 1.7 Business, Management & General Legal Education (20/5)

**Monday 10:15a–Noon (LVCC) N252**

*Sponsoring: Seminar 21: Profitability Killers and How To Avoid Them and Seminar 38: Mentoring Young Technical Employees for Success*

### TC 1.8 Mechanical Systems Insulation (20)

**Monday 4:15–6:30p (LVCC) N236**

TC 1.8 RP–1356 PMS (8)

**Sunday 8:00–9:30a (LVCC) N226**

TC 1.8 Research (10)

**Sunday 9:30–10:30a (LVCC) N226**

TC 1.8 Handbook (10)

**Sunday 10:30–11:00a (LVCC) N226**

### TC 1.9 Electrical Systems (8/4)

**Tuesday 3:30–6:00p (LVCC) N211**

*Sponsoring: Seminar 45: Putting Your Meter – and Submeter – To Work for You*

### TC 1.10 Cogeneration Systems (20/10)

**Tuesday 3:00–5:00p (H) Pavilion 9**

*Sponsoring: Seminar 29: Low Energy Design for Casinos: Integrating CHP Systems and Technical Paper Session 5: Displaced Carbon Emissions Methodology for Onsite Combined Heat and Power Systems*

TC 1.10 Program/Research/Membership (15/10)

**Tuesday 1:00–3:00p (H) Pavilion 9**

TC 1.10 CTIC (8/4)

**Monday 4:15–6:30p (LVCC) N218**

### TC 1.11 Electric Motors and Motor Control (20)

**Tuesday 1:00–3:30p (LVCC) N211**

*Sponsoring: Seminar 50: Residential Power Factor and EMI (FCC) Requirements for VSDs*

TC 1.11 Handbook/Research (5)

**Sunday 10a–Noon (LVCC) N212**

### TC 1.12 Moisture Management in Buildings (15/25) (Screen)

**Saturday 1:00–3:00p (LVCC) N239**

*Sponsoring: Seminar 48: Cool New Tools for Finding and Fixing Problems in Buildings and HVAC Systems*

TC 1.12 Programs/Handbook/Research (10)

**Saturday 8:00a–Noon (LVCC) N239**

### TC 2.1 Physiology & Human Environment (12/18) (Screen)

**Tuesday 1:00–3:30p (LVCC) N241**

*Sponsoring: Seminar 57: Thermal Comfort Evaluation and Standards: International Developments*

TC 2.1 Research (13/7) (Screen)

**Sunday 1:00–3:00p (LVCC) N241**

TC 2.1 Programs (5/5)

**Sunday 3:00–4:00p (LVCC) N241**

TC 2.1 Handbook

**Sunday 4:00–5:00p (LVCC) N241**

### TC 2.2 Plant and Animal Environment (10/5)

**Monday 4:15–6:30p (LVCC) N227**

### TC 2.3 Gaseous Air Contaminants /Removal Equip. (18/30)

**Tuesday 1:00–3:30p (LVCC) N255**

TC 2.3 Research (20/20)

**Sunday 5:00–7:00p (H) Pavilion 4**

TC 2.3 Publications (10/10)

**Monday 3:00–4:00p (LVCC) N211**

TC 2.3 Handbook (10/10)(Flipchart/Screen)

**Monday 4:15–6:00p (LVCC) N223**

TC 2.3 Standards (15/10)

**Monday 6:00–8:00p (LVCC) N211**

TC 2.3 Planning (15) (Flipchart)

**Tuesday 6:30–8:00a (H) Conference Room 14**

TC 2.3 Program (10/10)(Screen/flipchart)

**Tuesday 11:30a–1:00p (LVCC) N255**

### TC 2.4 Particulate Air Contaminants /Removal Equip. (18/30)

**Tuesday 3:30–6:00p (LVCC) N255**

TC 2.4 Handbook (10/10)

**Saturday 1:00–2:30p (LVCC) N225**

TC 2.4 Research (20/20) (Flipchart/Screen)  
**Sunday 3:00–5:00p (H) Pavilion 4**

TC 2.4 Publications (10/10) (Flipchart)  
**Monday 3:00–4:00p (LVCC) N211**

TC 2.4 PMS 1360 –RP  
**Sunday 11:00–Noon (LVCC) N237**

TC 2.4 PMS 1466–RP  
**Sunday Noon–1:00p (LVCC) N237**

TC 2.4 Standards (20/10)  
**Monday 4:15–6:00p (LVCC) N211**

TC 2.4 Program (20/40)  
**Tuesday 11:30a–1:00p (LVCC) N255**

### TC 2.5 Global Climate Change (20/10)

**Tuesday 1:00–3:30p (LVCC) N231**

*Sponsoring: Seminar 16: Climate Change: It's Happening, So Who's Responding?*

### TC 2.6 Sound & Vibration Control (18/30) (Screen)

**Monday 2:15–4:15p (LVCC) N252**

*Sponsoring: Seminar 51: Acoustics Codes, Standards, and Design Guidelines: A Primer*

### TC 2.6 RP 1408 PMS (Lined Duct) (15) (Screen)

**Sunday 11:00a–Noon (LVCC) N228**

TC 2.6 Publications (20)  
**Sunday 1:30–2:30p (LVCC) N228**

TC 2.6 RP 1322 (15)  
**Sunday 2:30–3:00p (LVCC) N228**

TC 2.6 Criteria (20)  
**Sunday 3:00–3:30p (LVCC) N228**

TC 2.6 Programs (25)  
**Sunday 3:30–4:30p (LVCC) N228**

TC 2.6 Hot Topic –Occupancy Surveys (20)  
**Sunday 4:30–5:00p (LVCC) N228**

TC 2.6 Excom (10)  
**Sunday 5:00–5:30p (LVCC) N228**

TC 2.6 Research (25) (Screen)  
**Monday 9:00–10:00a (LVCC) N212**

TC 2.6 Vibration (20)  
**Monday 10:00–10:30a (LVCC) N212**

### TC 2.7 Seismic and Wind Restraint Design (24/6) (Screen)

**Tuesday 3:30–6:00p (LVCC) N227**

*Sponsoring: Seminar 25: Seismic Code Compliance for HVAC Equipment*

TC 2.7 Seismic & Wind Restraint Design (20)(Screen)  
**Tuesday 1:00–3:30p (LVCC) N227**

### TC 2.8 Building Environmental Impacts and Sustainability (75)

**Sunday 5:00–7:00p (LVCC) N255**

TC 2.8 International (25)  
**Sunday 12:00–12:45p (LVCC) N239**

TC 2.8 Green Guide (25)  
**Sunday 12:45–1:30p (LVCC) N239**

TC 2.8 Research  
**Sunday 1:30–3:00p (LVCC) N239**

TC 2.8 Handbook (25)  
**Sunday 3:00–4:00p (LVCC) N239**

TC 2.8 Program (25)  
**Sunday 4:00–4:30p (LVCC) N239**

TC 2.8 Existing Buildings  
**Sunday 4:30–4:50p (LVCC) N239**

### TC 2.9 Ultraviolet Air and Surface Treatment (30)

**Monday 10:00a–Noon (LVCC) N211**

TC 2.9 Program, Handbook, Standards  
**Sunday 8:00–Noon (LVCC) N252**

TC 2.9 Research (Flipchart)  
**Monday 8:00–10:00a (LVCC) N211**

### TC 3.1 Refrigerants & Secondary Coolants (20/10) (Screen/E)

**Monday 4:15–6:30p (LVCC) N255**

*Sponsoring: Seminar 6: Building a Sustainable Future By Removing Barriers for Low GWP Refrigerants and Seminar 22: Vapor-Compression Cycles, Systems and Components with Natural Refrigerants*

TC 3.1 Research (5/5) (screen)  
**Monday 11:00a–Noon (LVCC) N255**

TC 3.1 Program and Handbook (6/4)  
**Monday 2:15–3:45p (LVCC) N255**

### Special Session

#### DOE Next-Generation Ultra-Low GWP Refrigerant Roadmap Discussion

**Tuesday, 2/1, 8:00–9:30 a.m.(LVCC) N256**

### TC 3.2 Refrigerant System Chemistry (12/40) (Screen/E)

**Monday 2:15–4:15p (H) Pavilion 9**

TC 3.2 Research (10/8)  
**Sunday 4:00–5:00p (LVCC) N215**

### TC 3.3 Refrigerant Contaminant Control (50) (Screen/E)

**Tuesday 3:30–6:00p (H) Pavilion 1**

TC 3.3 Research (10/8)  
**Sunday 5:00–5:30p (LVCC) N215**

### TC 3.4 Lubrication (60) (Screen/E)

**Tuesday 1:30–3:30p (H) Pavilion 1**

## TC/TG/SPC Meetings

TC 3.4 Research (10/8)

**Sunday 5:30–6:00 (LVCC) N215**

### TC 3.6 Water Treatment (18/10)

**Tuesday 1:00–3:30p (LVCC) N262**

*Sponsoring: Seminar 10: Boiler Water Treatment: How to Do It Right*

TC 3.6 Handbook/Program/Research (8/6)

**Sunday 3:00–5:00p (LVCC) N237**

### TC 3.8 Refrigerant Containment (9/5)

**Monday 4:15–6:30p (LVCC) N261**

*Sponsoring: Seminar 11: Cradle to Grave Refrigerant Management*

### TC 4.1 Load Calculation Data and Procedures (20/10)

**Monday 2:15–4:15p (LVCC) N254**

*Sponsoring: Seminar 56: Low Energy Load Calculations*

TC 4.1 Handbook

**Sunday 3:00–4:00p (H) Pavilion 10**

TC 4.1 Research (10/5)

**Sunday 4:00–5:00p (H) Pavilion 10**

TC 4.1 Programs & Standards (10/5)

**Sunday 5:00–6:00p (H) Pavilion 10**

### TC 4.2 Climatic Information (20) (Screen/Flip)

**Tuesday 1:00–3:30p (LVCC) N225**

TC 4.2 PMS 1477–RP (6/8) (screen/flip)

**Sunday 1:00–2:00p (LVCC) N215**

TC 4.2 Program (6/8) (flip)

**Sunday 2:00–2:30p (LVCC) N215**

TC 4.2 1613–TRP PES (6/8) (Flip)

**Sunday 2:30–3:00p (LVCC) N215**

TC 4.2 Handbook (6/8)

**Sunday 3:00–4:00p (LVCC) N215**

SSPC 169 (10/8) (screen/flip)

**Monday 10a–Noon (LVCC) N227**

TC 4.2 Research (6/8)(Screen/flip)

**Monday 4:15–6:00p (LVCC) N240**

### TC 4.3 Ventilation Requirements & Infiltration (14/20)

**Monday 4:15–6:30p (H) Pavilion 10**

*Sponsoring: Seminar 12: Designing for Improved Air Quality in Casinos with ETS and Seminar: Performance Deficiencies & Strategies for Improving Exhaust Ventilation Systems*

TC 4.3 1596 RP (SP98) PMS (10)

**Sunday, 7:00–9:00p (H) Conference Room 5**

TC 4.3 Seminar: Performance Deficiencies and Strategies for Improving Exhaust Ventilation System

**Monday 2:15–3:15p (H) Pavilion 10**

TC 4.3 PMS for RP–1478

**Tuesday 8:00–10:00a (H) Executive Boardroom**

### TC 4.4 Bldg. Materials and Bldg. Envelope Performance (20/20)(Screen)

**Monday 2:15–4:15p (LVCC) N262**

*Sponsoring: Seminar 47: Building Envelopes for Mechanical Engineers: It's All in the Handbooks!*

TC 4.4 RP 1365 (20) (screen)

**Sunday 10:00–11:00a (LVCC) N262**

TC 4.4 Research (30/10)

**Sunday 1:00–3:00p (LVCC) N262**

TC 4.4 Handbook (30/10)

**Sunday 3:00–4:30p (LVCC) N262**

TC 4.4 Program (20/5)

**Sunday 4:30–5:00p (LVCC) N262**

TC 4.4 Standards (20/5)

**Sunday 5:00–5:30p (LVCC) N262**

### TC 4.5 Fenestration (10/10)

**Monday 2:15–4:15p (H) Pavilion 2**

*Sponsoring: Seminar 53: Windows for Net-Zero Energy Homes*

TC 4.5 Research & Long Range Planning (8/4)

**Sunday 3:15–4:00p (LVCC) N213**

TC 4.5 Program (8/4)

**Sunday 4:00–5:00p (LVCC) N213**

TC 4.5 Handbook (8/4)

**Sunday 5:00–6:30p (LVCC) N213**

TC 4.5 1415–RP PMS )

**Monday 9:00–10:00a (H) Conference Room 11**

### TC 4.7 Energy Calculations (75) (screen)

**Tuesday 6:00–8:30p (H) Pavilion 3**

*Sponsoring: Seminar 7: Building Energy Simulation 102 and Seminar 14: Energy Modeling of Existing Buildings*

TC 4.7 PMSC RP–1404 (10)

**Sunday 1:00–3:00p (LVCC) N252**

TC 4.7 PMSC RP–1416 (10)

**Monday 8:00–10:00a (LVCC) N221**

TC 4.7 Simulation and Component Models (20/20)

**Monday 6:00–7:30p (H) Pavilion 4**

TC 4.7 Data-Driven Models (25)

**Monday 7:30–9:00p (H) Pavilion 4**

TC 4.7 Applications (40)

**Tuesday 3:30–5:00p (H) Pavilion 3**

TC 4.7 Handbook

**Tuesday 5:00–6:00p (H) Pavilion 3**

### TC 4.10 Indoor Environmental Modeling (40)

**Monday 2:15–4:15p (LVCC) N261**

*Sponsoring: Forum 2: Should ASHRAE Develop a Certification or Education Programs on CFD?*

TC 4.10 RP 1418 PMS (15) (Screen)

**Sunday 12:30–1:30p (LVCC) N238**

TC 4.10 RP 1487 PMS  
**Sunday 1:30–2:30p (LVCC) N238**

TC 4.10 RP 1512 PMS  
**Sunday 2:30–3:30p (LVCC) N238**

TC 4.10 Program  
**Sunday 3:30–4:30p (LVCC) N238**

TC 4.10 Handbook  
**Sunday 4:30–5:00p (LVCC) N238**

TC 4.10 Research (30)  
**Sunday 5:00–6:30p (LVCC) N238**

#### **TC 5.1 Fans (25) (Screen)**

**Monday 4:15–6:15p (LVCC) N237**

*Sponsoring: Forum 7: Energy Conservation and Circulator Fans*

TC 5.1 Handbook (10/10) (screen)  
**Sunday 2:00–3:00p (LVCC) N214**

TC 5.1 Research, Program (10/10)  
**Sunday 3:00–5:00p (LVCC) N214**

TC 5.1 PMS 1216 (8/12)  
**Monday 10:00–11:00 (LVCC) N229**

TC 5.1 1420 PMS (5/10) (Screen)  
**Monday 11:00–Noon (LVCC) N229**

#### **TC 5.2 Duct Design (12/20)**

**Tuesday 3:30–6:00p (LVCC) N232**

TC 5.2 Duct Leakage (10)  
**Sunday 12:30–1:00p (LVCC) N226**

TC 5.2 Duct Fitting Database (10)  
**Sunday 1:00–1:30p (LVCC) N226**

TC 5.2 Research (10)  
**Sunday 1:30–2:30p (LVCC) N226**

TC 5.2 Handbook (20)  
**Sunday 2:30–3:30p (LVCC) N226**

TC 5.2 Programs (20)  
**Sunday 3:30–4:00p (LVCC) N226**

TC 5.2 CFD Shootout Project (10)  
**Sunday 4:00–5:00p (LVCC) N226**

TC 5.2 1180 Design Guide for Duct Design (20)  
**Monday 8:00a–Noon (LVCC) N214**

#### **TC 5.3 Room Air Distribution (25/15)**

**Tuesday 1:00–3:30p (LVCC) N232**

*Sponsoring: Seminar 9: Energy and Comfort Performance of Active Chilled Beam Systems*

TC 5.3 Handbook (15/10)(screen/E)  
**Friday 8:00–10:30a (LVCC) N223**

TC 5.3 Handbook (30/10)(screen/E)  
**Friday 8:00–10:30a (LVCC) N224**

TC 5.3 Handbook (20)(screen/E)  
**Friday 8:00–10:30a (LVCC) N225**

TC 5.3 Handbook (20) (screen/E)  
**Saturday 8:00–3:00p (LVCC) N240**

TC 5.3 ASHRAE and REHVA Chilled Beam Guide (20) (Screen)  
**Saturday 1:00–3:00p (LVCC) N221**

TC 5.3 PMS RP–1335 (15)(screen/E)  
**Sunday 7:30–8:30a (LVCC) N264**

TC 5.3 PMS RP–1522 (15)  
**Sunday 8:30–9:30a (LVCC) N264**

TC 5.3 Fan Coils  
**Sunday 9:30–11:30a (LVCC) N264**

TC 5.3 Chilled Beams (30)  
**Sunday 12–1:30p (LVCC) N264**

TC 5.3 Handbook/Programs/Research (40)  
**Sunday 1:30–3:00p (LVCC) N264**

TC 5.3 ASHRAE and REHVA Chilled Beam Guide (20) (Screen)  
**Wednesday 1:00–8:00p (LVCC) N238**

#### **TC 5.4 Industrial Process Air Cleaning (30)**

**Monday 2:15–4:15p (LVCC) N237**

TC 5.4 PMS–1284 (10)  
**Sunday 10:00–Noon (LVCC) N230**

TC 5.4 Research  
**Sunday 11:00–Noon (LVCC) N230**

#### **TC 5.5 Air-to-Air Energy Recovery (22/4)**

**Tuesday 3:30–6:00p (LVCC) N262**

*Sponsoring: Seminar 54: Don't Roll the Dice with Energy Recovery Ventilation*

TC 5.5 Handbook, Program, Research (14/15)  
**Monday 4:15–6:30p (LVCC) N230**

#### **TC 5.6 Control of Fire & Smoke (23/35)**

**Monday 4:15–6:30p (LVCC) N263C**

*Sponsoring: Technical Paper Session 4: Computer Models for Design of Smoke Control Systems and Conference Paper Session 18: Smoke Control for Tall Buildings*

TC 5.6 Program (30)  
**Sunday 3:00–4:00p (LVCC) N254**

TC 5.6 Research  
**Sunday 4:00–5:30p (LVCC) N254**

TC 5.6 Handbook  
**Sunday 5:30–6:00p (LVCC) N254**

TC 5.6 Guideline 5 Subcommittee  
**Monday 2:15–4:15p (LVCC) N263C**

#### **TC 5.7 Evaporative Cooling (30)**

**Monday 4:15–6:30p (LVCC) N264**

TC 5.7 Research and Handbook (10/5)  
**Sunday 2:00–3:00p (H) Conference Room 13**

## TC/TG/SPC Meetings

TC 5.7 Programs and Standards (10/5)  
**Sunday 3:00–4:00p (H) Conference Room 13**

### TC 5.8 Industrial Ventilation Systems (20/5)

**Monday 4:15–6:30p (H) Pavilion 9**

TC 5.8 Ventilation of Hazardous Spaces (5/5)  
**Sunday 7:00–9:00p (H) Conference Room 6**

### TC 5.9 Enclosed Vehicular Facilities (30/10)

**Tuesday 3:30–6:00p (H) Ballroom D**

TC 5.9 Program, Handbook, Research (25)  
**Tuesday 1:00–3:30p (H) Ballroom D**

### TC 5.10 Kitchen Ventilation (30/15) (screen)

**Sunday 3:00–4:30p (LVCC) N255**

*Sponsoring: Technical Paper Session 2: Hot Off the Griddle: New Developments in Commercial Kitchen Ventilation Research*

TC 5.10 Research  
**Sunday 8:00–9:00a (LVCC) N255**

TC 5.10 Handbook  
**Sunday 9:00–10:00a (LVCC) N255**

TC 5.10 Program  
**Sunday 1:00–2:00p (LVCC) N255**

TC 5.10 Codes & Standards  
**Sunday 2:00–3:00p (LVCC) N255**

TC 5.10 PMS 1469  
**Monday 10:30–Noon (LVCC) N236**

### TC 5.11 Humidifying Equipment (10/3)

**Monday 2:15–4:15p (LVCC) N216**

*Sponsoring: Seminar 55: Energy Saving Goes Hand in Hand with Comfortable Humidification by Evaporative Cooling in Hot and Dry Climates*

TC 5.11 Handbook /Program (9/5)  
**Sunday 10:00–Noon (LVCC) N227**

### TC 6.1 Hydronic & Steam Htg. Equip & Sys (35/15)

**Tuesday 1:00–3:30p (LVCC) N263**

TC 6.1 Program (10/10)  
**Monday 2:15–3:15p (H) Pavilion 11**

TC 6.1 Research (10/10)  
**Monday 3:15–4:15p (H) Pavilion 11**

TC 6.1 Handbook  
**Sunday 5:00–6:00p (LVCC) N223**

TC 6.1 Chilled Water Plant (10/10)  
**Sunday 6:00–7:00p (LVCC) N223**

### TC 6.2 District Energy (20/10)

**Sunday 3:00–5:00p (LVCC) N261**

TC 6.2 PMS 1267 RP (9/10)  
**Sunday 1:00–2:00p (LVCC) N261**

TC 6.2 Programs, Research, Handbook, Planning, (14)

**Sunday 2:00–3:00p (LVCC) N261**

### TC 6.3 Central Forced Air Htg. & Cooling Sys (30)

**Tuesday 1:00–3:30p (LVCC) N236**

TC 6.3 RP–1449 (8) (Screen)  
**Sunday 11:30a–1:00p (H) Conference Room 14**

TC 6.3 Research (10/12)(Screen)  
**Monday 2:15–4:15p (LVCC) N217**

TC 6.3 Program (10/10)  
**Monday 4:15–6:30p (LVCC) N217**

TC 6.3 Handbook and Standards (8/8)  
**Monday 6:30–9:00p (LVCC) N217**

### TC 6.5 Radiant Heating and Cooling (17/10)

**Monday 2:15–4:15p (LVCC) N227**

TC 6.5 Research, Spec Pubs, Journal, Program, Handbook, Snowmelt (6/8)

**Sunday 3:00–5:00p (LVCC) N216**

TC 6.5 1383–RP  
**Monday 8:00–10:00a (LVCC) N231**

### TC 6.6 Service Water Heating Systems (18/15)

**Monday 4:15–6:30p (LVCC) N232**

*Sponsoring: Technical Paper Session 1: Residential Water Heaters and Hot Water Use: The Real Story and Technical Paper Session 3: Hot Water Distribution Systems: New Design Information*

TC 6.6 Research/Handbook/Program (18/15)  
**Monday 2:15–4:15p (LVCC) N232**

### TC 6.7 Solar Energy Utilization (20/20)

**Tuesday 1:00–3:30p (LVCC) N221**

*Sponsoring: Seminar 15: Going Lower with Solar and Forum 6: The Role of Solar and other Renewable Energy Sources on the Strategic Energy Planning*

TC 6.7 Handbook (6/10)  
**Monday 4:15–5:15p (LVCC) N214**

TC 6.7 Program (20/5)  
**Monday 5:15–6:30p (LVCC) N214**

TC 6.7 Research (20)  
**Monday 6:30–7:30p (LVCC) N214**

### TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25)

**Tuesday 3:30–6:00p (H) Ballroom F**

*Sponsoring: Seminar 19: District Ground Source Heat Pump Systems, Part 1; Forum 1: Good Design for GCHP: What Is It and Who Does It? And Seminar 27: District GHP Systems, Part 2: 1500+ Ton Sustainable Utilities*

TC 6.8 Research, Program, Handbook (15/15) (screen)  
**Sunday 5:00–7:00p (LVCC) N240**

TC 6.8 Heat Pump (12)  
**Tuesday 1:00–3:30p (H) Ballroom F**

**TC 6.9 Thermal Storage (25/5)**

**Monday 2:15–4:15p (H) Pavilion 6**

TC 6.9 Standards (20)  
**Sunday 1:00–1:30p (LVCC) N225**

TC 6.9 Program  
**Sunday 1:30–2:30p (LVCC) N225**

TC 6.9 Research  
**Sunday 2:30–3:30p (LVCC) N225**

TC 6.9 Handbook,  
**Sunday 3:30–4:30p (LVCC) N225**

TC 6.9 LRP  
**Sunday 4:30–5:00p (LVCC) N225**

TC 6.9 Research RP 1387 PMS (10)  
**Monday 7:00–8:00a (LVCC) N215**

**TC 6.10 Fuels & Combustion (30)**

**Tuesday 3:30–6:00p (LVCC) N236**

TC 6.10 Handbook (4/4)  
**Monday 2:15–4:15p (H) Conference Room 4**

**TC 7.1 Integrated Building Design (25/10)**

**Monday 8:15–10:30a (LVCC) N232**

*Sponsoring: Seminar 1: Building Development: High Performance Teamwork for High Performance Buildings And Forum 8: Right Sizing: What Does It Mean*

TC 7.1 Subcommittees (15)  
**Sunday 5:00–7:00p (LVCC) N212**

**TC 7.2 HVAC Contractors and Design Build Firms (10)**

**Sunday 10:30–12N (H) Conference Room 12**

*Sponsoring: Seminar 37 Integrated Design Build Delivery: Project Case Studies and Public Session 1: A Practical Guide for Reducing Air Leakage in HVAC Air Systems*

**TC 7.3 Operations & Maintenance Management (25/7)**

**Tuesday 1:00–3:30p (H) Ballroom E**

*Sponsoring: Seminar 13: Don't Gamble with your NZEB – Maintain It!*

TC 7.3 Standards/Program (7/3)  
**Monday 2:15–4:15p (LVCC) N225**

TC 7.3 Research/Handbook (7/3)  
**Monday 4:15–6:30p (LVCC) N225**

**TC 7.5 Smart Building Systems (16/24)**

**Tuesday 3:30–6:00p (H) Ballroom E**

*Sponsoring: Seminar 5: Smart Grid and Net Zero Buildings: Where Are We Now? And Seminar 9: Fault Detection and Diagnostics, But What about Correction?*

TC 7.5 Fault Detection & Diagnosis (40)  
**Sunday 3:00–3:45 p (LVCC) N264**

TC 7.5 Wireless Applications (40)  
**Sunday 3:45–4:30p (LVCC) N264**

TC 7.5 Smart Grid  
**Sunday 4:30–5:15p (LVCC) N264**

TC 7.5 Handbook  
**Sunday 5:15–6:00p (LVCC) N264**

TC 7.5 1390–RP  
**Monday 3:00–4:00p (LVCC) N241**

TC 7.5 Buildings Operations Dynamics  
**Monday 4:00–5:30p (LVCC) N241**

TC 7.5 Research  
**Monday 5:30–6:30p (LVCC) N241**

TC 7.5 1312–RP PMS  
**Tuesday 8:00–9:30a (LVCC) N211**

**TC 7.6 Building Energy Performance (30)**

**Tuesday 1:00–3:30p (LVCC) N264**

*Sponsoring: Public Session 2: What You Need to Know about the Energy Standard for Buildings – ASHRAE/IES Standard 90.1–2010*

TC 7.6 Working Subcommittee–Annex 46 (10/6)  
**Saturday 1:00–3:00p (LVCC) N214**

TC 7.6 Research (12)  
**Sunday 12:00–2:00p (LVCC) N236**

TC 7.6 Commercial Building Energy Audit  
**Sunday 2:00–3:00p (LVCC) N236**

TC 7.6 Handbook (12)  
**Sunday 3:00–4:00p (LVCC) N236**

TC 7.6 Monitoring & Energy Performance  
**Monday 2:15–4:15p (H) Conference Room 6**

TC 7.6 Energy Management (12)  
**Monday 4:15–5:15p (H) Conference Room 6**

TC 7.6 Standards (12)  
**Monday 5:15–6:30p (H) Conference Room 6**

TC 7.6 Executive (12)  
**Monday 6:30–7:00p (H) Conference Room 6**

**TC 7.7 Testing & Balancing (20/30)**

**Monday 2:15–4:15p (LVCC) N264**

TC 7.7 Program/Handbook (5/5)(screen)  
**Saturday 8:00–10:30a (LVCC) N224**

**TC 7.8 Owning & Operating Costs (25)**

**Monday 2:15–4:15p (LVCC) N240**

*Sponsoring: Seminar 39: When Zero Makes You a Hero*

TC 7.8 Research, Handbook, Programs (8/4)  
**Sunday 3:15–5:15p (H) Conference Room 4**

**TC 7.9 Building Commissioning (25)**

**Sunday 3:00–5:00p (LVCC) N212**

## TC/TG/SPC Meetings

*Sponsoring: Seminar 25: Commissioning the World's Largest LEED-Certified Building: The Palazzo; Seminar 26: Design, Commissioning and Verification Considerations for Net-Zero Energy Buildings and Forum 5: The Commissioning Process ASHRAE Standard: What Should Be Included?*

TC 7.9 Research (5)  
**Saturday 8:00–9:00a (H) Conference Room 14**

TC 7.9 Handbook (5)  
**Saturday 9:00–10:30a (H) Conference Room 14**

TC 7.9 Programs (5)  
**Saturday 1:00–2:00p (H) Conference Room 14**

TC 7.9 Long Range Planning  
**Saturday 2:00–3:00p (H) Conference Room 14**

**TC 8.1 Positive Displacement Compressors (12/14)**  
**Tuesday 3:30–6:00p (LVCC) N231**

TC 8.1 Handbook (10/5)  
**Monday 2:15–3:15p (LVCC) N215**

**TC 8.2 Centrifugal Machines (20/8)**  
**Monday 2:15–4:15p (LVCC) N236**

**TC 8.3 Absorption and Heat Operated Machines (30)**  
**Monday 3:30–6:00p (LVCC) N231**

*Sponsoring: Seminar 46: Achieving Zero Energy Design with Absorption Cooling*

TC 8.3 Research/Handbook (8/4)  
**Monday 2:00–3:30p (LVCC) N231**

**TC 8.4 Air-to-Refrigerant Heat Transfer Equip (20/10)**  
**Tuesday 3:30–5:00p (LVCC) N263**

*Sponsoring: Seminar 31: Next Generation Heat Exchangers for Net-Zero Design and Forum: Is ASTM G85 Annex 3 (SWAAT) the Correct Corrosion Test for Stationary Applications?*

TC 8.4 Research (10/10)  
**Monday 6:30–7:30p (H) Pavilion 10**

**TC 8.5 Liquid to Refrigerant Heat Transfer (25)**  
**Monday 4:15–6:30p (LVCC) N263**

TC 8.5/1.3 Research (20/15) (screen)  
**Sunday 3:00–7:00p (H) Pavilion 1**

**TC 8.6 Cooling Towers and Evaporative Condensers (20)**  
**Monday 2:15–4:15p (LVCC) N221**

*Sponsoring: Seminar 33: Want Peak System Efficiency from Your Water-Cooled System? Quit Cooling Dirt!*

TC 8.6 Handbook/Program/Research (10)  
**Monday 9:00–11:00a (LVCC) N217**

**TC 8.7 Variable Refrigerant Flow( 20/30)**  
**Tuesday 3:30–6:00p (H) Pavilion 4**

TC 8.7 Handbook (10/10)  
**Tuesday 1:30–3:00p (H) Pavilion 4**

**TC 8.8 Refrigerant System Controls & Accessories (10/10)**  
**Tuesday 1:00–3:30p (LVCC) N217**

TC 8.8 Program, Research, Handbook (10/5)  
**Monday 2:15–4:15p (LVCC) N226**

**TC 8.9 Residential Refrigerators and Food Freezers (12/10)**  
**Monday 2:15–4:15p (LVCC) N223**

TC 8.9 Research (6)  
**Sunday 3:00–5:00p (LVCC) N229**

**TC 8.10 Mechanical Dehumidifiers & Heat Pipes (12/4)**  
**Tuesday 3:30–6:00p (LVCC) N230**

TC 8.10 Handbook/Program/Standards (9/10) (screen/E)  
**Tuesday 2:00–3:30p (LVCC) N230**

**TC 8.11 Unitary and Room Air Conditioners & Heat Pumps (20/30)**  
**Monday 4:15–6:30p (H) Pavilion 6**

*Sponsoring: Seminar 3: Low GWP Refrigerant Options for Unitary Equipment*

TC 8.11 Handbook/Program/Research (5/5)  
**Sunday 2:00–4:00p (H) Conference Room 14**

**TC 8.12 Desiccant Dehumidification Equipment and Components (30)**  
**Monday 2:15–4:15p (LVCC) N234**

**TC 9.1 Large Building Air-Conditioning Systems (18/15)**  
**Tuesday 1:00–3:30p (LVCC) N237**

*Sponsoring: Seminar 2: HVAC Security – Less We Forget*

TC 9.1 Research /Program/Handbook/Standards (18/15)  
**Tuesday 12:00–1:00p (LVCC) N237**

**TC 9.2 Industrial Air Conditioning (40)**  
**Tuesday 1:00–3:30p (H) Pavilion 3**

TC 9.2 Nuclear (9/8)  
**Monday 2:15–4:15p (LVCC) N214**

**TC 9.3 Transportation Air Conditioning (25/20)**  
**Monday 3:30–6:00p (LVCC) N235**

TC 9.3 Handbook (4/4)  
**Sunday 9:00–10:00a (LVCC) N256**

TC 9.3 Aviation (20/10) (screen)  
**Sunday 10:00–Noon (LVCC) N256**

TC 9.3 Automotive (6/10)  
**Sunday 5:00–7:00p (LVCC) N239**



TC 9.3 Research (25/25) (Screen)

**Monday 2:15–3:30p (LVCC) N235**

**TC 9.4 Applied Heat Pump/Heat Recovery Systems (13/25)**

**Merged with TC 6.8**

**TC 9.5 Residential and Small Bldg. Applications (20/10)**

**Tuesday 3:30–6:00p (LVCC) N235**

*Sponsoring: Seminar 30: Micro-Combined Heat and Power Systems, Part 1: Applications, Best Practices and Technologies and Seminar 43: Micro-Combined Heat and Power Systems, Part 2: Case Studies*

**TC 9.6 Health Care Facilities (30/30)**

**Sunday 5:00–7:00p (LVCC) N261**

*Sponsoring: Seminar 41: Codes and Standards Impacting Healthcare Facility Energy Use*

TC 9.6 SP 91.2 (20)

**Sunday 8:00a–Noon (LVCC) N217**

TC 9.6 Infectious Diseases (20)

**Sunday 12:30–1:30p (LVCC) N217**

TC 9.6 Research (15)

**Sunday 1:30–2:30p (LVCC) N217**

TC 9.6 Program (10)

**Sunday 2:30–3:00p (LVCC) N217**

TC 9.6 Energy (20)

**Sunday 1:00–2:00p (LVCC) N221**

TC 9.6 Handbook (10)

**Sunday 2:00–3:00p (LVCC) N221**

**TC 9.7 Educational Facilities (13/10)**

**Sunday 1:00–3:00p (LVCC) N213**

**TC 9.8 Large Building Air-Conditioning Applications (30)**

**Monday 2:15–4:15p (H) Pavilion 1**

TC 9.8 Handbook/ Research/ Program (12/5)

**Monday 10:00a–Noon (LVCC) N215**

**TC 9.9 Mission Critical Facilities (25/50)(screen)**

**Monday 2:15–9:30p (H) Pavilion 3**

*Sponsoring: Seminar 17: Codes and Standards that Influence Mission Critical Facilities and Forum: Failure Mode and Effects Analysis and Risk Management in Data Centers...And Other Important Matters to Consider*

TC 9.9 Program/ Handbook/ Research (30/10)

(screen)

**Sunday 5:00–7:00p (LVCC) N252**

TC 9.9 Long-Term Planning Workshop (10/25)

(screen)

**Tuesday 1:00–5:00p (H) Pavilion 6**

**TC 9.10 Laboratory Systems (75)(Screen)**

**Tuesday 3:30–6:00p (H) Pavilion 2**

*Sponsoring: Forum 3: What Energy Recovery Technologies in Labs Are Being Utilized?*

TC 9.10 Standards, Research (10/20)(screen)

**Sunday 3:00–5:00p (LVCC) N211**

TC 9.10 Program, Lab Classifications (10/20)

**Sunday 5:00–7:00p (LVCC) N211**

TC 9.10 Handbook, Design Guide (10/20)(screen)

**Tuesday 1:00–3:30p (H) Pavilion 2**

**TC 9.11 Clean Spaces (30/45)(Screen/E)**

**Monday 2:15–4:00p (H) Pavilion 4**

*Sponsoring: Seminar 49: Recent Research Developments in HVAC Energy Reduction in Cleanrooms, Labs and Critical Spaces*

TC 9.11 RP–1431 PMS (10) (Screen/E)

**Sunday 3:30–4:15p (LVCC) N217**

TC 9.11 RP–1344 PMS (10) (Screen/E)

**Sunday 4:15–5:00p (LVCC) N217**

TC 9.11 Handbook (10)

**Monday 4:00–4:30p (H) Pavilion 4**

TC 9.11 Design Guide(20)

**Monday 4:30–5:30p (H) Pavilion 4**

TC 9.11 Short Course (10)

**Monday 5:30–6:00p (H) Pavilion 4**

**TC 9.12 Tall Buildings (12/5)**

**Tuesday 3:30–6:00p (LVCC) N223**

**TC 10.1 Custom Engineered Refrig Systems (30)**

**Monday 2:15–4:15p (LVCC) N239**

TC 10.1 Research/Handbook, (10)

**Sunday 5:00–7:00p (LVCC) N217**

TC 10.1 Standards/ Program (10)

**Sunday 5:00–7:00p (LVCC) N218**

**TC 10.2 Automatic Ice Making Plants/Skating Rinks (15)**

**Monday 4:15–6:30p (LVCC) N252**

**TC 10.3 Refrigerant Piping, Controls and Accessories (30)**

**Tuesday 1:00–3:30p (LVCC) N238**

TC 10.3 PMS RP–1327

**Sunday 8:00–10:00a (LVCC) N215**

**TC 10.4 Ultra-Low Temp Refrigeration & Cryogenics (15)**

**Monday 4:15–6:30p (LVCC) N224**

TC 10.4 Research (15/4)

**Monday 6:30–8:00p (LVCC) N224**

**TC 10.5 Refrigeration Distrib and Storage Facilities (15/10)**

**Tuesday 3:30–6:00p (LVCC) N221**

*Sponsoring: Forum 4: The Technical Basis of the Federal Walk-In Efficiency Standard*

## TC/TG/SPC Meetings

### TC 10.6 Transport Refrigeration (20)

**Monday 4:15–6:30p (LVCC) N228**

### TC 10.7 Commercial Food, Beverage Display & Storage (25/25)

**Monday 2:15–4:15p (LVCC) N263**

*Sponsoring: Seminar 40: Advancing Energy Efficiency in Commercial Refrigeration*

#### TC 10.7 Program

**Sunday 5:15–6:00p (LVCC) N241**

#### TC 10.7 Research (30)

**Sunday 6:00–6:45p (LVCC) N241**

#### TC 10.7 Handbook

**Sunday 6:45–7:30p (LVCC) N241**

### TC 10.8 Refrigeration Load Calculations (10/10)

**Sunday 3:00–5:00p (LVCC) N252**

### TC 10.9 Refrigeration Applications for Foods & Beverages (15/10)

**Monday 4:15–6:30p (LVCC) N254**

#### TC 10.9 Handbook (10/5)

**Monday 6:30–7:30p (LVCC) N254**

### TC 10.10 Management of Lubricant in Circulation (20)

**Sunday 1:00–3:00p (LVCC) N254**

## TGs/TRGs

### TG1.Exergy Analysis for Sustainable Buildings (14/8)

**Sunday 8:00–10:00a (H) Conference Room 12**

### TG1.Optimatization (15)

**Sunday 1:00–3:00p (LVCC) N211**

### TG2.HVAC Security (20/6)

**Tuesday 9:00–12N (LVCC) N230**

### TRG4 Sustainable Building Guidance & Metrics (17/10)

**Saturday 1:00–300p (LVCC) N228**

### TRG7–Under Floor Air Distribution (Screen) (40)

**Wednesday 8:00–Noon (LVCC) N241**

### TG9.JF Justice Facilities (20/5)

**Sunday 8:00–10:00a (LVCC) N232**

## STANDARDS—GPCs/SPCs

### SPC Chair Training Breakfast

**Sunday 7:00–9:00a (H) Ballroom F**

### SSPC 15 Safety Code Mech. Refrig. (22/25) (screen)

**Sunday 1:00–5:00p (LVCC) N263**

SSPC 15 Ad Hoc 2L Classification Working Group (11/20)

**Sunday, 10:00a–Noon (LVCC) N263**

SSPC 15 ISO 5149 Ad Hoc (10/20)

**Sunday Noon–1:00p (LVCC) N263**

### SPC 16/58 MOT/Rating Room Air Conditioners and PTAC/PTHP (5/10)

**Tuesday 8:00–Noon (LVCC) N217**

### SPC 20 MOT/Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers

**Monday 7:30–8:00p (H) Pavilion 10**

### SPC 23.2 MOT/Rating Positive Displacement Compressors that Operate at Supercritical Temperatures of the Refrigerant (8/2)

**Tuesday 1:00–3:00p (H) Conference Room 4**

### SPC 25 MOT/Forced Convection and Natural Convection Air Coolers for Refrigeration

**Monday 8:00–8:30p (H) Pavilion 10**

### SPC 32.1 MOT/ Beverage Vending Machines (10/10)

**Sunday 10:30a–1:00p (LVCC) N214**

### SPC 33 MOT/Forced Circulation Air Cooling and Air Heating Coils

**Monday 8:30–9:00p (H) Pavilion 10**

### SSPC 34 Designation & Safety Class. of Refrig. (25/25) (Screen/E)

**Monday 6:30–10:00p (LVCC) N255**

SSPC 34 Designation Nomenclature (10/10) (screen/E)

**Saturday 7:00–10:00a (LVCC) N238**

SSPC 34 Flammability (15/20)(screen/E)

**Saturday 10:00–3:00p (LVCC) N238**

SSPC 34 Toxicity (10/20) (screen/E)

**Sunday 6:30–10:00p (H) Pavilion 9**

### SPC 40 MOT/Rating Heat Operated Unitary Air-Conditioning and Heat-Pump Equipment

**Monday 10:00–11:30 a (LVCC) N239**

### SSPC 41 Standard Methods for Measurement (10/10)

**Sunday 1:00–4:00p (LVCC) N224**

SPC 41 RP–1460

**Sunday 10:00a–Noon (LVCC) N224**

41.1 Temperature-Standard Method for Temperature Measurement (10/5)

**Monday 8:00–10:00a (LVCC) N225**

41.2 Laboratory Airflow-Standard Method for Laboratory Airflow Measurement (10/5)

**Monday 10a–Noon (LVCC) N225**

41.3 Pressure-Standard Method for Pressure Measurement (6/4)

**Sunday 4:00-6:00p (LVCC) N224**

41.4 Lubricant Content-Standard Method for Measurement of Proportion of Lubricant in Liquid Refrigerant (6/4)

**Monday 10:00-Noon (LVCC) N226**

41.6 Humidity-Standard Methods for Measurement of Moist Air Properties (9/3)

**Sunday 6:00-8:00p (LVCC) N224**

41.7 Standard Methods for Gas Flow Measurement (10/4)

**Tuesday 8:00 - 10:00a (LVCC) N213**

41.8 Standard Methods for Liquid Flow Measurement (10/4)

**Tuesday 10:00-Noon (LVCC) N213**

41.9 Calorimeter Test Methods for Mass Flow Measurements of Volatile Refrigerants (10/4)

**Monday 2:15-4:15 (H) Conference Room 11**

41.11 Power-Standard Methods for Power Measurement (12/6)

**Monday 8:00a-10:00a (LVCC) N226**

**SSPC 52.2P MOT/Part Size Eff. Proc. for Testing Air Cleaning Devices (13/40) (Screen)**

**Saturday 8:00-Noon (LVCC) N225**

**SSPC 55 Thermal Env Cond. for Human Occupancy (12/20)(screen/E)**

**Saturday 8:00a-3:00p (LVCC) N231**

**SSPC 55 Thermal Env. Cond. for Human Occupancy (12/12)(screen/E)**

**Sunday 9:00a-12p (LVCC) N240**

**SSPC 62.1 Ventilation and Acceptable IAQ in Commercial, Institutional and High-Rise Residential Buildings (30/30) (E/Screen)**

**Saturday 1:30-3:00p (LVCC) N232**

**Sunday 1:00-7:00p (LVCC) N257**

SSPC 62.1 Education (20/20) (screen)

**Friday 1:00-5:00p (H) Pavilion 9**

**Saturday 8:00a-12:30p (LVCC) N232**

SSPC 62.1 Administration (15/25)(screen)

**Friday 1:00-5:00p (H) Ballroom D**

**Saturday 8:00a-12:30p (LVCC) N233**

**SSPC 62.2 Ventilation and Acceptable IAQ in Low-Rise Residential Buildings (28/13)(Screen/Electric)**

**Friday 1:00-2:30p (LVCC) N252**

**Saturday 8:30-3:00p (LVCC) N235**

SSPC 62.2 IAQ Subcommittee (12)

**Friday 2:30-5:00p (LVCC) N225**

SSPC 62.2 System Subcommittee (12)

**Friday 2:30-5:00p (LVCC) N224**

SSPC 62.2 Envelope Subcommittee (20)

**Friday 2:30-5:00p (LVCC) N252**

Standard 136 subcommittee

**Friday 9:00-Noon (LVCC) N252**

**SPC 64 Methods of Laboratory Testing Remote Mechanical Draft Evaporate Refrigerant Condensation (6/4)**

**Monday 4:15-6:15p (LVCC) N221**

**SPC 72 MOT/Commercial Refrigerators and Freezers (12/12)**

**Sunday 1:00-5:00p (LVCC) N234**

**SPC 79 MOT/for Rating Fan-Coil Conditioners (15/15) (Screen/E)**

**Saturday 8:00a-Noon (LVCC) N211**

**SPC 84-2008 MOT/Air-to-Air Heat/Energy Exchangers (9/4)**

**Monday 2:15-4:15p (LVCC) N230**

**SSPC 90.1 Energy Eff. Design of New Bldg. (Screen/E) (50/60)**

**Saturday 8:00a-12p (LVCC) N257**

**Sunday 9:00a-12p (LVCC) N257**

**Monday 8:00a-12p (LVCC) N257**

Format & Compliance Subcommittee (4/6)(E)

**Friday 5:00-10:00p (H) Pavilion 2**

**Saturday 1:00-5:00p (LVCC) N224**

**Sunday 4:00-7:00p (LVCC) N231**

Mechanical Subcommittee (25/25)(screen/E)

**Friday 9:00a-10p (H) Ballroom F**

**Saturday 1:00-7:00p (LVCC) N257**

**Sunday 1:00-8:00p (LVCC) N232**

Lighting Subcommittee (12/10)(screen/E)

**Friday 9:00a-10p (H) Ballroom E**

**Saturday 1:00-7:00p (LVCC) N227**

**Sunday 1:00-8:00p (LVCC) N230**

ECB Subcommittee (8/10) (Screen/E)

**Friday 5:00-10:00p (H) Pavilion 9**

**Saturday 1:00-5:00p (LVCC) N229**

**Sunday 1:00-4:00p (LVCC) N231**

Envelope Subcommittee (screen/E)(15/30)

**Friday 9:00a-10:00p (H) Ballroom G**

**Saturday 1:00-7:00p (LVCC) N237**

**Sunday 1:00-7:00p (LVCC) N233**

**SSPC 90.2 Energy Eff. Design of New Low Rise Res. Bldg. (14/22)(screen/E)**

**Monday 2:15-6:15p (LVCC) N233**

**Tuesday 1:00-5:00p (LVCC) N233**

SSPC 90.2 HVAC (6/6) (Screen/E)

**Monday 6:15-9:15p (LVCC) N228**

**Tuesday 8:00-Noon (LVCC) N233**

## TC/TG/SPC Meetings

SSPC 90.2 Envelope (8/15) (Screen/E)  
**Monday 6:15–9:15 (LVCC) N233**  
**Tuesday 8:00–Noon (LVCC) N234**

**SSPC Standard 100 Revision (20)**  
**Tuesday 8:00–12:30p (LVCC) N264**

Section 5 & 6 Working Groups (15)  
**Sunday 8:00–10:00 (LVCC) N262**

Section 4 & 7 Working Groups (15)  
**Monday 2:15–4:15p (LVCC) N212**

Lighting Subcommittee (5)  
**Monday 4:15–6:15p (LVCC) N212**

Section 8 & 9 Working Groups (15)  
**Monday 6:15–8:15p (LVCC) N212**

**SPC 105 Standard Methods of Measuring and Expressing Building Energy Performance (14/6)**  
**Sunday 9:00 a.m.–Noon (LVCC) N218**

**SPC 110 Fume Hood Testing (15)**  
**Saturday 8:00–10:30a (LVCC) N212**

**SPC 118.1 MOT/Commercial Water Heaters (6/6)**  
**Sunday 9:00–11:00a (H) Executive Boardroom**

**SPC 118.2R MOT/Rating Residential Water Heaters (20/10)**  
**Tuesday 1:00–4:00p (LVCC) N228**

**SPC 119 Air Leakage Performance for Detached Single-Family Residential Buildings (7/7)**  
**Sunday 6:00–10:00p (H) Executive Boardroom**

**SPC 124 MOT/Rating Combination Space-Heating and Water Heating Appliances (10)(Screen)**  
**Wednesday 8:00–Noon (LVCC) N238**

**SPC 127 MOT/Rating Computer and Data Processing Room Unitary Air-Conditioners (10/15)(Screen/E)**  
**Sunday 3:00–5:00p (H) Pavilion 6**

**SPC 128 MOT Spot Air Conditioners (6/4)**  
**Monday 2:15–4:15p (H) Executive Boardroom**

**SPC 129 Measuring Air Change Effectiveness (8)**  
**Sunday 5:00–7:00p (H) Conference Room 13**

**SSPC 134 Graphic Symbols (6/6)**  
**Sunday 1:00–2:00p (LVCC) N212**

**SSPC 135 BACnet (45/15)**  
**Saturday 8:00–3:00p (LVCC) N252**  
**Monday 8:00a–Noon (LVCC) N261**

SSPC 135 (25)  
**Thursday (1/27) 8:00a–5:00p (LVCC) N211**

SSPC 135 (25)  
**Thursday (1/27) 8:00a–5:00p (LVCC) N212**

SSPC 135 Working Group (25)  
**Friday 8:00a–5:00p (LVCC) N227**

SSPC 135 Working Group (25)  
**Friday 8:00a–5:00p (LVCC) N229**

SSPC 135 BACnet Working Group (25)  
**Sunday 8:30a–5:00p (LVCC) N235**

SSPC 135 BACnet (25)  
**Sunday 8:00a–5:00p (LVCC) N263C**

**SSPC 140 Standard MOT for Evaluation of Bldg. Energy Analysis Computer Program (14/8) (screen)**  
**Monday 2:15–6:15p (LVCC) N213**

SSPC 140 Data Format Subcommittee (10) (screen)  
**Sunday 7:30–9:30p (H) Pavilion 4**

**SPC 145P Test Methods for Assessing Performance of Gas Phase Air Clean. Equip. (15/15)(Screen/ E)**  
**Sunday 8:00–5:00p (LVCC) N223**

**SPC 147 Minimizing the Release of Refrigerants (15/5) (screen)**  
**Sunday 6:00–10:00p (H) Pavilion 10**

**SPC 147 Working Session (15)**  
**Saturday 9:00a–3:00p (LVCC) N213**

**SPC 150 MOT/Performance of Cool Storage Systems (6/2)**  
**Sunday 5:30–6:30p (LVCC) N225**

**SPC 151 MOT/Shipboard Balancing (6/4)**  
**Saturday 1:00–3:00p (LVCC) N215**

**SPC 152R MOT/Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems (8/6)**  
**Sunday 8:15–Noon (LVCC) N231**

**SPC 154 Ventilation for Commercial Cooking Operations (8/15) (Screen)**  
**Monday 2:15–6:00p (LVCC) N238**

**SPC 155P MOT/Rating Commercial Space Heating Boiler Systems (12/5)**  
**Sunday 1:00–5:00p (H) Executive Boardroom**

**SPC 158.1 MOT/Capacity of Refrigerant Solenoid Valves (6/4)**

**SPC 158.2 MOT/Capacity for Refrigerant Pressure Regulators**  
**Sunday 5:00–7:00p (LVCC) N229**

**SSPC 160 Criteria for Moisture Control Design Analysis (13/10)**  
**Tuesday 8:00a–Noon (LVCC) N223**

**SPC 161P Air Quality Within Commercial Aircraft (25/15)(Screen)**  
**Sunday 1:00–6:00p (LVCC) N256**  
**Monday 8:00a–Noon (LVCC) N254**

**SPC 164.2 MOT/Self-Contained Residential Humidifiers (10/3) (screen)**  
**Monday 8:30–10:00a (LVCC) N223**

**SPC 164.3 MOT/Commercial and Industrial Humidifiers (8/4)**

**Monday 10:00–11:30a (LVCC) N223**

**SPC 166P Heating, Vent, A/C and Refrig Terminology (6/4) (screen)**

**Monday 8:00a–Noon (LVCC) N234**

**SSPC 169 Weather Data for Building Design Standards (screen/flip) (12/8)**

**Monday 10a–Noon (LVCC) N227**

**SSPC 170 Ventilation of Healthcare Facilities (20/10) (screen)**

**Tuesday 8:00–2:00p (LVCC) N240**

**SSPC 170 Clinical Subcommittee**

**Monday 4:15–6:30p (LVCC) N234**

**SPC 172P MOT/Insoluble Materials in Synthetic Lubricants And HFC Refrigerant Systems (8/2)**

**Monday 8:00–Noon (LVCC) N216**

**SPC 173 MOT/Determine the Performance of Halocarbon Refrigerant Leak Detectors (9/4)**

**Monday 6:30–10:00p (H) Conference Room 14**

**SPC 174 MOT/Rating Packaged, Desiccant Based Dehumidifier Sys.(10)**

**Monday 10a–Noon (LVCC) N241**

**SPC 175 Metal Pressure Vessel Testing (5/5)**

**Monday 4:15–6:30p (LVCC) N226**

**SPC 177P MOT/Fractionation Measurement of Refrigerant Blends (6/8)(Screen)**

**Monday 8:00–10:00a (LVCC) N224**

**SPC 179P MOT/Life Testing Positive Displaced Compressors (6/10)**

**Sunday 1:00–5:00p (LVCC) N240**

**SSPC 180 Standard Practice for Inspection & Maintenance of HVAC Systems (24/6) (Screen)**

**Friday 1:00a–5:00p (LVCC) N228**

**SPC 181 MOT/Liquid-to-Liquid Heat Exchangers (6/4) (Screen)**

**Monday 2:15–4:00p (H) Conference Room 5**

**SPC 184 MOT/Field Test of Liquid Package Chillers (14/5) (screen)**

**Tuesday 8:00–Noon (LVCC) N241**

**SPC 185 MOT/UVC Lights for Use in Air Handling Units or Air Ducts to Inactivate Airborne Microorganisms (15/15)(screen)**

**Saturday 8:00a–3:00p (LVCC) N230**

**SPC 188 Minimizing the Risk of Legionellosis Associated with Building Water Systems (32/10) (screen)**

**Tuesday 9:00–Noon (LVCC) N254**

**Tuesday 3:30–6:00p (LVCC) N254**

**SPC 189.1 ASHRAE/USGBC/IESNA Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (40/40) (E/screen)**

**Tuesday 4:30–6:30p (LVCC) N257**

**Wednesday 8a–Noon (LVCC) N257**

Working Group 9 (Materials and Resources) (10/10)E/Screen)

**Tuesday 8:00–10:00a (LVCC) N235**

Working Group 6 (Water Use)(30/20)(E/Screen)

**Tuesday 8:00–9:30a (LVCC) N257**

Working Group 8 (IEQ)

**Tuesday 9:30–Noon (LVCC) N257**

Working Group 5 (Site Sustainability)(10/10)

**Tuesday 10:00–Noon (LVCC) N235**

Working Group 7 (Energy Efficiency)

**Tuesday 12:30–2:30p (LVCC) N257**

Working Group 75 (Energy Performance)

**Tuesday 2:30–4:30p (LVCC) N257**

**SPC 189.2 Design, Construction and Operation of High-Performance Green Healthcare Facilities (20/10) (screen)**

**Monday 8a–Noon (LVCC) N218**

**Monday 2:00–3:00p (LVCC) N218**

**SPC 190 MOT/Rating Indoor Pool Dehumidifiers for Moisture Removal Capacity and Moisture Removal Efficiency (6/6)**

**Tuesday 1:00–2:00p (LVCC) N230**

**SPC 191 Water Conservation (15/10) (screen)**

**Sunday 8:00–Noon (LVCC) N211**

**SPC 193 MOT/Determining the Air-Leakage Rate of HVAC Equipment (25)**

**Sunday 3:00–5:00p (H) Pavilion 2**

**SPC 194 MOT/Direct-Expansion Ground Source Heat Pumps (15)**

**Sunday 3:00–5:00p (LVCC) N221**

**SPC 195P MOT/Rating Air Terminal Unit Controls (6/5) (screen)**

**Tuesday 8:00–Noon (LVCC) N212**

**SPC 196P MOT/ Measuring Refrigerant Leak Rates**

**Sunday 6:30–10:00p (H) Conference Room 4**

**SPC 197 MOT/Attenuation Characteristics of Vibration Isolators (8/4) (screen)**

**Monday 4:15–6:30p (LVCC) N216**

**SPC 198 MOT/Rating DX Dedicated Outdoor-Air Systems (6/6)**

**Tuesday Noon–1:00 p (LVCC) N230**

**SPC 199 MOT/Rating the Performance of Industrial Pulse Cleaned Dust Collectors (6/2)**

**Sunday 1:00–3:00p (LVCC) N223**

## TC/TG/SPC Meetings

**SPC 200 MOT/Chilled Beams (12/12)(screen/E)**  
**Monday 8:00–Noon (LVCC) N240**

**SPC 201P: Facility Smart Grid Information Model (42/15)**

**Monday 2:15–6:30p (LVCC) N257**

**Tuesday 8:00a–Noon (LVCC) N263**

**SPC 202 Commissioning Process Standard (20/20) (E/Screen)**

**Monday 8:00–Noon (LVCC) N263**

**SSPC 203 MOT/Determining Heat Gain of Office Equipment Used in Buildings**

**Tuesday 1:00–3:30 (LVCC) N234**

**SPC 204P MOT/Rating Micro Combined Heat and Power Devices (11/9)**

**Tuesday 1:00–3:00p (H) Pavilion 10**

**SPC 205 Data Exchange Protocols for Energy Simulation of HVAC&R Equipment Performance (20)(Screen/E)**

**Tuesday 8:00–10:00a (LVCC) N236**

**SGPC 0–General Commissioning Process (11/10)**

**Saturday 8:00–Noon (LVCC) N218**

**GPC 1.2 Commissioning Process for Existing HVAC&R Systems (26/10) (E/Screen)**

**Friday 8:00a–5:00p (H) Pavilion 2**

**Saturday 8:00a–3:00p (LVCC) N236**

**GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process (12)**

**Tuesday 1:00–5:00p (LVCC) N226**

**GPC 1.4 Systems Manuals for Commissioning (10)**

**Saturday 1:00–3:00p (LVCC) N218**

**GPC 1.5 Commissioning Smoke Control Systems (11/10) (screen/E)**

**Monday 2:15–4:15 (LVCC) N263C**

**GPC–10P Achieving Acceptable Indoor Environment (10/10)**

**Sunday 10:00a–Noon (LVCC) N213**

**SGPC 13 Guideline for Specifying Direct Digital Control (15) (screen)**

**Saturday 8:00–Noon (LVCC) N214**

**GPC 14 Measurement of Energy Demand Savings (8/10) (Screen)**

**Sunday 6:00–10:00p (H) Pavilion 11**

**GPC 20 Documenting HVAC&R Work Processes and Data Exchange Requirements (12/12)(Screen/E)**

**Monday 10:15a–12:15p (LVCC) N221**

**GPC 23 Guideline for the Design/Application of HVAC Equip. for Rail Passenger Vehicles (15/10) (screen)**

**Monday 8:00–Noon (LVCC) N228**

**Tuesday 8:00–Noon (LVCC) N218**

**Tuesday 1:00–5:00p (LVCC) N218**

**GPC 25 MOM/Solar-Optical Properties of Materials (5/5)**

**Sunday 8:00–9:00p (H) Pavilion 3**

**GPC 27P Procedures for Measurement of Gases in Indoor Environments (6/6) (flipchart)**

**Sunday 3:00–5:00p (H) Conference Room 12**

**GPC 32 Sustainable, High Performance Operations & Maintenance**

**Sunday 1:00–3:00p (LVCC) N229**

**GPC 33P Guideline for Documenting Indoor Airflow and Contaminant Transport (6)**

**Tuesday 11:00–Noon (LVCC) N221**

### OTHER

**Thermal Performance of the Exterior Envelopes of Whole Buildings XI**

**Monday 9:00a–Noon (LVCC) N235**

**USNC/IIR (20/30)**

**Tuesday 2:00–4:00p (LVCC) N252**

**USNT/IEA (20/30)**

**Tuesday 4:00–6:00p (LVCC) N252**

**ISO/TC 86/SC 1/WG 1 (15) (Screen)**

**Wednesday (1/26) 9:00a–5:00p (LVCC) N221**

**Thursday (1/27) 9:00a–5:00p (LVCC) N218**

**Friday (1/28) 9:00a–1:00p (LVCC) N226**

**ISO/TC 86/SC 6 (25) (Screen)**

**Thursday (1/27) 2:00p–5:00p (LVCC) 221**

**US TAG to ISO/TC 142 (30/10) (Screen)**

**Saturday 2:30–3:00p (LVCC) N225**

**ISO/TC 142/WG 2**

**Wednesday (2/2) 11:00a–3:00p (LVCC) N252**

**US TAG ISO/TC 205/WG 4 (20) (Screen)**

**Wednesday 11:00a–6:00p (LVCC) N236**

**US TAG to ISO/TC 205 (20) (Screen)**

**Tuesday (2/1) 1:00p–3:00p (LVCC) N229**

**ISO/TC 142/WG4 (10) (Screen)**

**Friday (1/28) 4:00p–6:00p (LVCC) N223**

**Accounting**

Annmarie Wilhoit, Manager  
 Marie Ingram, Supervisor  
 Phil Mendoza  
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**Information Technology**

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 Brian Unrein  
 Roxanne Jackson  
 Buyi Kalala  
 Kristi Baer  
 Amy Lin  
 Tom Cahill

**Journal**

Fred Turner, Editor, ASHRAE Journal  
 Sarah Foster  
 Rebecca Matyasovski  
 Christopher Weems  
 Jeri Eader  
 Charlotte Tubbs

**Mailroom**

Lamont Jackson

**Member Services**

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 Kim Fulcher

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and Customer Service**

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 Colleen Knight, Assistant Mgr., Membership  
 Jackie Roessler, Assistant Mgr. Customer Service  
 Linda Allen-Meriweather  
 Ruth Caldwell  
 Tracee Dowdell  
 Camiel Schroeter  
 Pacia Wright

**Professional Development**

Karen Murray, Manager  
 Marty Kraft  
 Vickie Warren

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### Technology

Claire Ramspeck, Director  
 Cassandra Craig  
 Lilas Pratt, Manager Special Projects  
 Bert Etheredge, Asst. Mgr., Special Projects

Winter	Date	Annual
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### FUTURE ASHRAE CONFERENCES

	2011	Montreal June 25–29
Chicago	2012 January 21–January 25	San Antonio June 23–28
Dallas	2013 January 26-30	Denver June 22-26

### PAST ASHRAE CONFERENCES

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



**SPEAKERS LIST**

**A**

Abaza, Mohamed, Conference Paper Session 9  
 Abdelaziz, Omar, Seminar 31 and Seminar 46  
 Abramson, Barry, Conference Paper Session 6  
 Acker, Brad, Conference Paper Session 20  
 Adams, Eric W., Conference Paper Session 11  
 Adams, Peter, Seminar 47  
 Al-Hajri, Ebrahim, Seminar 44  
 Allard, Francis, Seminar 42  
 Allen, David S., Seminar 1 and Conference Paper Session 9  
 Anderson, Jason, Seminar 50  
 Arnold, David, Seminar 32

**B**

Bailey, Holly, Seminar 48  
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 Bravo, Ramiro, Conference Paper Session 22  
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 Brenner, Paul, Conference Paper Session 6  
 Brodsky, Eric, Seminar 55  
 Brown, J. Steven, Seminar 3  
 Butcher, Thomas, Technical Paper Session 1

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 Candanedo, José A., Conference Paper Session 3  
 Carlson, James A., Seminar 25  
 Chen, Chien-Chih, Poster Paper  
 Chiasson, Andrew, Seminar 15 and Seminar 19  
 Chimack, Michael, Seminar 5  
 Clodic, Denis, Seminar 11  
 Cockerham, Keith R., Seminar 7

Cocking, Mike, Seminar 30  
 Cogley, Kevin, Seminar 2  
 Cohen, Jon J., Seminar 10  
 Conlan, Wade, Forum 3  
 Conley, Christopher, Seminar 9  
 Cox, Nicholas, Seminar 3  
 Crader, Craig A., Seminar 17  
 Crawford, James, Seminar 16  
 Crawley, Drury, Seminar 34  
 Crooks, Brian, Seminar 53  
 Cruise, Lynda, Seminar 52  
 Curlin, Chuck, Seminar 20

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