

**AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS, INC.**

**1791 Tullie Circle, N.E./Atlanta, GA 30329
404-636-8400**

TC/TG/MTG/TRG MINUTES COVER SHEET

(Minutes of all Meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/MTG/TRG No. TC 9.9 DATE 2/21/2016

TC/TG/MTG/TRG TITLE Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

DATE OF MEETING 1/25/2016 (1/24/2016 for Subcommittee Report Meeting LOCATION Orlando

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Andrew R Baxter	2014			See attached list below
Thomas A Davidson	2014	Dr. Mukesh K Khattar	2015	
Dr. Dustin Demetriou	2015	Jeffrey P Rutt	2014	
Paul R. Finch	2014	Edward Ka Cheung Tsui	2014	
Jon Fitch	2015			
Jack V. Glass	2014			
John C Groenewold	2014			
Gregory R Jeffers	2014			
David F Kelley	2014			
Jason Matteson	2015			
Richard Pavlak	2014			
Robin A Steinbrecher	2015			

DISTRIBUTION

All Members of TC/TG/MTG/TRG plus the following:

TAC Section Head:	Krishnan Gowri
TAC Chair:	
All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters:	
Manager Of Standards	Stephanie Reiniche
Manager Of Research & Technical Services	Mike Vaughn

ASHRAE

TC/TG/TRG NO: TC 9.9 Date: Jan 25, 2016 Location: Orlando, FL USA
General Meeting/ Subcommittee and Liaison Report

TC/TG/TRG TITLE: Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

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<i>All Members of TC/TG/MTG/TRG plus the following:</i>	
TAC Section Head:	
TAC Chair:	
All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters:	
Manager Of Standards	Stephanie Reiniche
Manager Of Research & Technical Services	Mike Vaughn

Committee Positions	
Name	Position
Robin Steinbrecher	Chair
Jason Matteson	Vice-Chair
Roger Schmidt	IT Subcommittee Chair
Don Beaty	Publications & International Liason
Nick Gangemi	Programs Subcommittee Chair
Robert McFarlane	Handbook Subcommittee Chair
Richard Pavlak	Standards Subcommittee Chair
David Quirk	Research Subcommittee Chair & 90.4 Liason
Jack Glass	Membership Subcommittee Chair
Ecton English	Webmaster
John Groenewold	Secretary

Sunday, January 24th (note attendance lists only apply for Monday's meeting)

5:00 p.m.

The following items were covered:

- 1) General Items – Robin Steinbrecher
 - Jason Matteson was introduced as the Vice Chair
 - The new TC 9.9 website was introduced:
 - i. It is now common with all TC websites.
 - ii. Working with Ecton English to update. Somewhat delayed transition as we work through the issues.

- iii. New ASHRAE interface which is different from old website which was completely managed by Ecton. This has a simpler editing process but has less flexibility for customization.

2) Programs – Nick Gangemi

- Winter conference guide page 30 lists the five session types along with descriptions.
- No dedicated data center/mission critical track at this conference.
- Small quantity of seminars and technical paper presentations focused on TC 9.9 related subjects.
- Provided a handout detailing those related seminars and technical paper presentations.
- Handout also included track information on upcoming 2016 summer conference in St. Louis. No data center/ mission critical track. (Go to ashrae.org/stlouis for more information.)
- Handout included program statistics for past Atlanta conference. Approximately 50% of seminars get accepted.
- Seminar, for, workshop submissions had to be in by February 8.
- Seminars need to have two to three presentations and presentations should be submitted together to increase probability of approval.
- Appeals were made to the group to keep Nick informed of their efforts in this area so he could coordinate and improve probability of approval.

3) Handbook – Bob McFarlane

- New chapter (chp. 19 – DATA CENTERS AND TELECOMMUNICATION FACILITIES) in the latest 2015 HVAC Applications Handbook needs to be updated with the latest environmental envelope as published in the 4th Edition of the Thermal Guidelines book.
- Changes/updates can be submitted in the March/April timeframe.
- Accepted changes will be immediately reflected in the electronic/online versions of the handbook.
- It was suggested by Don Beaty that all the chapters in all the handbooks be reviewed to see what Data Center / Mission Critical topical content could be added.

4) Research – David Quirk

- David reviewed the ASHRAE Strategic Plan and those goals that related to our sponsored research efforts.
- 1755-TRP – Impact of High Humidity and Gaseous Contamination on the Reliable Operation of Information Technology Equipment in Data Centers
 - i. Bids received and being reviewed by PES.
 - ii. TC 9.9 voting members will vote on approving the PES recommended bidder award at an executive meeting on Monday night after the main TC meeting.
- 1675-TRP – Guidance for CFD Modeling of Data Centers Co-sponsored supporting TC 4.10)
 - i. Bids received and being reviewed by PES.

- ii. TC 9.9 voting members will vote on approving the PES recommended bidder award at an executive meeting on Monday night after the main TC meeting.
- 1739-WS – DC Energy Modeling
 - i. Henry Amistadi held a meeting with parties interested in assisting with the work statement earlier in the day. Henry is a member of TC 4.7 (Energy Calculations) which is a co-sponsor of this research.
 - ii. Three white papers are planned to be produced: (1) Loads and Equipment Sizing, (2) Data Center specific equipment monitoring, & (3) Data Center systems interaction modeling in order to move this process along.
 - iii. Strategy will be to produce smaller work statements when the white papers are finished.
 - iv. Henry and team will be meeting with AHRI to partner in developing performance algorithms from empirical data for CRAHs, CRACs and other pieces of equipment.
 - v. Data Center energy modeling will eventually be used to support calculations required by 90.4.

DRAFT

Monday, January 25th

- A. Opening and Introductions – Robin Steinbrecher
 - Jason Matteson was introduced as new Vice Chair and John Groenewold as new Secretary.
 - David Quirk as past Chair and Greg Jeffers as past Secretary were thanked for their TC 9.9 service.
 - Robin introduced sub committee chairs and provided an overview of the Sunday Programs/Handbook/Research meeting.
 -
 - Approval of prior meeting minutes by Voting Members – Not done.
 - Introductions of all present at the meeting.
- B. Website – Robin Steinbrecher substituting for Ecton English (not present due to the North East storm)
 - New website format as dictated by ASHRAE which takes on a common look with the other TC's <http://tc0909.ashraetcs.org/index.php>
 - Under “Membership” tab there is a new button “Join TC 9.9” to request TC 9.9 provisional corresponding membership.
 - Nobody is required to be an ASHRAE member to join a technical committee.
 - Ecton English will continue as TC 9.9's webmaster.
 - The website still has an active link to the datacom books in the ASHRAE bookstore.
 - Members are encouraged to update their contact information through the ASHRAE website as nobody on the TC 9.9 committee can update individuals' ASHRAE information including email address, title or company.
 - An effort will be made to delete those from the membership roles who are deemed to be unreachable.
- C. TC9.9 Overview Presentation – Roger Schmidt
 - The website had a previous TC 9.9 overview presentation. An updated version will be placed on the new website as soon as the presentation is finished. The draft was presented by Roger. Comments on the presentation are welcome.
 - The new presentation covers an organizational overview –
 - Tech councils - TAC, RAC, etc.
 - Member councils – 178 chapters (56 outside US)
 - Publications – handbook, Journal, etc.
 - Strategic plan with 11 goals (with extension to 2018)
 - Handbooks/publications addressed by TC 9.9
 - Applications – Chapter 19 – Data Centers
 - Datacom Series Books and CD's – 12 books with more on the way
 - About TC9.9 Presentation

- Presentation's title needs to be updated to include "Data Centers".
- Group organized in 2002 and TC 9.9 was formed in 2004. Most activities are handled by volunteers.
- Membership
 - Over 300 listed
 - Producers, users, general interest, academic
- Activities
 - Conduit to electronic equipment manufacturers, end users, and designers
 - Books – establish baselines such as thermal guidelines, forecasted power trends, define best practices and key metrics. The 4th edition of the Thermal Guidelines book has been released.
- Roger reviewed the timeline for our work products and efforts since 2004 to current day including training courses, publications and their translation to other languages.
- Environmental envelopes
 - Presentation needs to be updated to reflect the new envelope as in 4th Ed. of Thermal Guidelines book
 - Inlet conditions matter = air temperature, humidity, particulate contamination and gaseous contamination
 - Envelope definitions
 - Recommended – NOT required, but highest reliability
 - Allowable – limits to which the ITE will function
 - 4th edition of thermal guideline book published
 - Lower humidity line has dropped significantly due to ASHRAE research on ESD. ESD NOT as much of a concern anymore – recommended and A1/A2 allowable range expanded downward for energy savings
- Liquid Cooling was covered including definitions and supply water reference
- Server Performance (Book 12) reviews performance benchmark requirements. It's the only reference that enables comparison of benchmarks in a cohesive book.
- Current activities
 - Standard 90.4
 - Title needs to be changed to remove "Telecommunications" from standard title.
 - Standard 127
 - Server power trend book update
 - IT impact on data center solutions (Datacom Series book 13)
 - Power equipment thermal guidelines whitepaper
 - DCIM whitepaper – starting 1/2016
 - Liquid cooling common components within the data center and ITE
 - Research on IT equipment corrosion at high humidity and gaseous pollutants
- Help is needed in all areas – standards, handbook, publications and research.

Contact and of the officers to determine how best to contribute

D. Handbook Update – Bob McFarlane

- New chapter (chp. 19 – Data Centers and Telecommunication Facilities) in the latest 2015 HVAC Applications Handbook needs to be updated with the latest environmental envelope as published in the 4th Edition of the Thermal Guidelines book.
- Changes/updates can be submitted in the March/April timeframe.
- Accepted changes will be immediately reflected in the electronic/online versions of the handbook.
- All the chapters in all the handbooks be reviewed to see what Data Center / Mission Critical topical content could be added.

E. TC9.9 Definitions – David Quirk

- Proposed a definition for data center related terms to be adopted by the TC in order to better define TC 9.9's domain of impact.
 - A room or building, or portions thereof, with one or more ITE enclosures greater than 2 kW.
- Noted that Codes and Standards are defined around occupancy. In data centers, the occupancy is the IT.
- Existing Definitions (from current edition of 90.4P)
 - Information technology equipment (“ITE”): IT Equipment includes computers, data storage, servers and network/communication equipment.
 - ITE enclosure: A rack, cabinet, or chassis that is designed to mount and enable appropriate ventilation of ITE.
- Definition would be included in the next version of the Handbook.

F. Standards Updates

- 90.1 update – Richard Pavlak
 - 90.1 is a 40+ year old standard with a standing committee that interfaces with an international code council.
 - Its scope changed to include computer rooms in 2007 and covered all data centers/computer rooms greater than 20 W/ft².
 - 90.1 scope – computer rooms: A room whose primary function is to house equipment for the processing and storage of electronic data and that has a design electronic data equipment power demand that is less than or equal to 10 kW or power density that is less than or equal to 20 W/ft² (215 Watts/m²) of conditioned floor area.
 - 90.4 scope – data centers: A room or building or portions thereof, including computer rooms being served by the data center systems, serving a total information technology equipment load greater than 10kW and 20 W/ft² (215 Watts/m²) of conditioned floor area.
- 90.4 update – David Quirk
 - Dave described the progress on 90.4. Development is following the ANSI process which can be somewhat slow and confusing.
 - The 3rd publication public review period will open on January 29, 2016. Supportive comments are encouraged.
 - 90.1-2013 addendum CZ would remove data centers from the 90.1 scope

publication for public review at the same time. Addendum CZ will remove all exceptions for data centers as well. This review only allows comment on changes but ¾ of the proposed standard changed.

- Timeline objectives
 - Publish 90.4 this summer
 - Publish addendum CZ to Standard 90.1 – removes computer room requirements from 90.1 (2016 publication) and makes reference to 90.4.
- If both 90.4P and Addendum CZ do not get approved then data centers will continue to be under 90.1.
- SPC127 – John Bean
 - John reviewed the latest updates. The title was changed to remove the limitation to unitary systems.
 - A letter ballot will soon be issued with a tentative public review for Spring 2016.
 - There has been more participation than ever before – between 10-12 people.
- AHRI 1360 update - David Kelley
 - AHRI 1360 covers certification for the HVAC covered under Standard 127 and was originally issued in 2013. New efficiency numbers were updated.
 - Once 127 is updated, then those units will be tested and rated per 1360 in the next update. 90.1 is continuing to hold the rating tables but SPC-127 describes how the test is conducted.
- G. Introduction – Krishnan Gowri, the new Section 9 Head was introduced. He suggested the possible need for a roster subcommittee chair. Matt Koukl volunteered to assist the chair in this effort and will be engaged as needed.
- H. ITE Subcommittee Report
 - Joe Prisco reviewed a paper on transportation in extreme cold conditions and acclimation of information technology equipment prior to installation – ‘Frost Byte’. Joe will be pursuing this further within the ITE subcommittee with respect to more comprehensive guidance for end users. Condensation does not cause failures in non-powered equipment, but full acclimation prior to power on is required. Education for end users is required with possible guidelines to better handle the acclimation process.
 - Dave Moss provided status on the ITE-DC Interactions book.
 - The book is in final editing now and is targeted to be available before the St. Louis meeting.
 - Susan Smith provided an update on the Power Trends Book.
 - She expects to send out a survey to members to see how the book is presently used and how it could be more valuable. The team has considered a number of new factors and possible focus for the new book but wants to better understand its usage first.
 - Roger Schmidt discussed TC 9.9’s involvement in providing input to the IEC on DC connectors in data centers.
 - Many commonly used DC connectors are only rated to 40 C which is too low when considering the exhaust temperatures of ITE. A member of the

IEC representing the US has been briefed on the topic and will be able to communicate the expected environments at the upcoming IEC meeting.

I. International – Don Beaty

- Don described the push by the ASHRAE board to expand international connections and participations.
- Paul Finch has been representing TC 9.9 to the EU commission.

J. Research – David Quirk

- 1739-WS – DC Energy Modeling
 - The project is on hold. Henry Amistadi held a meeting with parties interested in assisting with the work statement earlier in the day. Henry is a member of TC 4.7 (Energy Calculations) and co-sponsor of the WS. Three white papers are planned to be produced: (1) Loads and Equipment Sizing, (2) Data Center specific equipment monitoring, and (3) Data Center systems interaction modeling.
 - The strategy will be to produce smaller work statements when the white papers are finished. Henry and team will be meeting with AHRI to partner in developing performance algorithms from empirical data for CRAHs, CRACs and other pieces of equipment. Data Center energy modeling will eventually be used to support calculations required by 90.4.
 - The team is looking for members with their own data center calculation spreadsheets to assist with the effort. They are interested in talking further with manufacturers to get performance information.
- 1675-TRP – Guidance for CFD Modeling of Data Centers (co-sponsored by TC 9.9 supporting TC 4.10) and 1755-TRP – Impact of High Humidity and Gaseous Contamination on the Reliable Operation of Information Technology Equipment in Data Centers
 - Bids received and a recommended bidder for each TRP were chosen by the respective PESs.
 - TC 9.9 voting members were to vote on approving the PES recommended bidders following the main TC meeting.

6:30 p.m. – 7:30 pm Executive Session (Voting Members Only)

- RP-1675, Guidance for CFD Modeling of Data Centers and RP-1755, Impact of Gaseous Contamination and High Humidity on the Reliable Operation of Information Technology Equipment in Data Centers
 - Presentations were made by the PES for each research topic. In both cases the PES had come up with recommended bidders from the bids received.
 - Voting members present voted to approve the award of the work to the PES recommended bidders.

Votes:

VOTING MEMBERS	Employer	Position	Status Code	Votes (see last item)	
				1675	1755
Andrew R Baxter	Page Southerland Page	Member	Present	For	For
Thomas A Davidson	DLB Associates Consulting	Member	Present	For	For
Dr. Dustin Demetriou	IBM	Member	Present	For	For
Paul R. Finch	Digital Realty Trust	Member	Present	For	For
Jon Fitch	Dell	Member	Present	For	For
Jack V. Glass	Citigroup (Retired)	Member & Sub. Chair	Present	For	For
John C Groenewold	JPMorgan Chase	Member	Present	For	For
Gregory R Jeffers	McKenney's	Member	Present	For	For
David F Kelley	Liebert Corp	Member	Present	For	Not Present
Dr. Mukesh K Khattar	EPRI	Member	Not Present		
Jason Matteson	Lonovo	Vice Chair	Present	For	For
Richard Pavlak	Heapy Engineering	Member & Sub. Chair	Present	For	For
Jeffrey P Rutt	Department of Defense	Member	Not Present		
Robin A Steinbrecher	Intel	Chair	Present	Abstain	Abstain
Edward Ka Cheung Tsui	Intelligent Technologies, Ltd	Member	Not Present		

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Title</i>	<i>First Name</i>	<i>Last Name</i>	<i>Attendance Sunday</i>	<i>Attendance Monday</i>	<i>Guest?</i>
<i>Mr</i>	<i>Raymond</i>	<i>Abraham</i>			
<i>Mr</i>	<i>Deepak</i>	<i>Agarwal</i>			
<i>Mr</i>	<i>Robert</i>	<i>Akkerman</i>			
<i>Mr</i>	<i>Stuart</i>	<i>Aldridge</i>			
<i>Mr</i>	<i>Gerardo</i>	<i>Alfonso</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Terral</i>	<i>Altom</i>			
<i>Mr</i>	<i>Henry</i>	<i>Amistadi</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Henry</i>	<i>Amistadi</i>			
<i>Mr</i>	<i>Paul</i>	<i>Artman</i>			
<i>Mr</i>	<i>Rangarajan</i>	<i>Arulselvan</i>			
<i>Mr</i>	<i>K M</i>	<i>Asawa</i>			
<i>Mr</i>	<i>Sean</i>	<i>Ashburn</i>			
<i>Mr</i>	<i>Frank</i>	<i>Atkinson</i>			
<i>Mr</i>	<i>Robert</i>	<i>Bader</i>			
<i>Prof</i>	<i>William</i>	<i>Bahnfleth</i>			
<i>Mr</i>	<i>Farhad</i>	<i>Banisadr</i>			
<i>Mr</i>	<i>Andrew</i>	<i>Baxter</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>John</i>	<i>Bean</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Donald</i>	<i>Beaty</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>William</i>	<i>Beck</i>			
<i>Mr</i>	<i>Bob</i>	<i>Beer</i>			
<i>Mr</i>	<i>Chad</i>	<i>Beery</i>			
<i>Mr</i>	<i>Volkmar</i>	<i>Bender</i>			
<i>Mr</i>	<i>Ng Kai</i>	<i>Beng</i>			
	<i>James</i>	<i>Betts</i>			
	<i>James</i>	<i>Betts</i>			
<i>Dr</i>	<i>Niels</i>	<i>Bidstrup</i>			
<i>Mr</i>	<i>Michael</i>	<i>Bishop</i>			
<i>Mr</i>	<i>Byron</i>	<i>Blackmore</i>			

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Mr</i>	<i>Alonzo</i>	<i>Blalock</i>			
<i>Mr</i>	<i>Bob</i>	<i>Blough</i>			
<i>Mr</i>	<i>Gary</i>	<i>Bowdler</i>			
<i>Mr</i>	<i>Sébastien</i>	<i>Brasseur</i>			
<i>Mr</i>	<i>Matthew</i>	<i>Brown</i>			
<i>Mr</i>	<i>Mark</i>	<i>Burtwell</i>			
	<i>Tahir</i>	<i>Cader</i>		<i>x</i>	
<i>Mr</i>	<i>Aldo</i>	<i>Calvi</i>			
<i>Mr</i>	<i>Don</i>	<i>Carless</i>			
<i>Mr</i>	<i>Eric</i>	<i>Carter</i>			
<i>Mr</i>	<i>Nicholas</i>	<i>Casale</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Noe</i>	<i>Casalino</i>			
<i>Mr</i>	<i>John</i>	<i>Castelvecchi</i>			
<i>Mr</i>	<i>Tsann</i>	<i>Chang</i>			
<i>Mr</i>	<i>Neil</i>	<i>Chauhan</i>			
<i>Dr</i>	<i>Victor</i>	<i>Chiriac</i>			
<i>Mr</i>	<i>Herman</i>	<i>Chu</i>			
<i>Mr</i>	<i>Dale</i>	<i>Cibene</i>			
<i>Mr</i>	<i>Alan</i>	<i>Claassen</i>			
<i>Mr</i>	<i>Fabio</i>	<i>Clavijo</i>			
<i>Mr</i>	<i>Michael</i>	<i>Collarin</i>	<i>x</i>	<i>x</i>	
	<i>Dan</i>	<i>Comperchio</i>			
<i>Mr</i>	<i>Howard</i>	<i>Cooper</i>			
<i>Mr</i>	<i>Lex</i>	<i>Coors</i>			
<i>Mr</i>	<i>David</i>	<i>Copeland</i>		<i>x</i>	
	<i>James</i>	<i>Coyle</i>			
<i>Mr</i>	<i>Craig</i>	<i>Crader</i>			
<i>Mr</i>	<i>Matthew</i>	<i>Cronmiller</i>			
<i>Mr</i>	<i>Bob</i>	<i>Culver</i>			
<i>Mr</i>	<i>Christopher</i>	<i>Daniel</i>			
<i>Mr</i>	<i>Steve</i>	<i>David</i>			
<i>Mr</i>	<i>Thomas</i>	<i>Davidson</i>		<i>x</i>	

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Mr</i>	<i>George</i>	<i>Degroft</i>		<i>x</i>	
<i>Dr</i>	<i>Dustin</i>	<i>Demetriou</i>		<i>x</i>	
<i>Dr</i>	<i>Dustin</i>	<i>Demetriou</i>			
<i>Mr</i>	<i>George</i>	<i>Demetriou</i>			
<i>Mr</i>	<i>Bob</i>	<i>Doherty</i>			
<i>Mr</i>	<i>Wade</i>	<i>Doll</i>			
<i>Dr</i>	<i>Daniel</i>	<i>Donahoe</i>			
<i>Mr</i>	<i>Robert</i>	<i>Druga</i>			
<i>Mr</i>	<i>John</i>	<i>Duffin</i>			
<i>Mr</i>	<i>John</i>	<i>Dumler</i>			
<i>Mr</i>	<i>Andrew</i>	<i>Dunn</i>			
<i>Mr</i>	<i>Dan</i>	<i>Dyer</i>		<i>x</i>	
<i>Mr</i>	<i>Michael</i>	<i>Edie</i>			
<i>Mr</i>	<i>Dennis</i>	<i>Eisenbarth</i>			
<i>Mr</i>	<i>Michael</i>	<i>Ellsworth</i>			
<i>Mr</i>	<i>Ecton</i>	<i>English</i>			
<i>Mr</i>	<i>Frank</i>	<i>Erceg</i>			
<i>Mr</i>	<i>Jeffrey</i>	<i>Ewin</i>			
<i>Mr</i>	<i>Huang</i>	<i>Feng</i>			
<i>Mr</i>	<i>Gregory</i>	<i>Fennewald</i>			
<i>Mr</i>	<i>Paul</i>	<i>Finch</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Jon</i>	<i>Fitch</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Jon</i>	<i>Fitch</i>			
<i>Mr</i>	<i>Kevin</i>	<i>Fletcher</i>			
<i>Mr</i>	<i>Philip</i>	<i>Flinn</i>			
<i>Mr</i>	<i>Stephen</i>	<i>Fok</i>			
<i>Dr</i>	<i>Kamran</i>	<i>Fouladi</i>			
<i>Mr</i>	<i>Michael</i>	<i>Frank</i>			
<i>Mr</i>	<i>Terry</i>	<i>Frantzis</i>			
<i>Mr</i>	<i>F</i>	<i>French</i>			
<i>Mr</i>	<i>Paul</i>	<i>Galloway</i>			
<i>Mr</i>	<i>Joseph</i>	<i>Gangemi</i>	<i>x</i>	<i>x</i>	

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Mr</i>	<i>Hongwen</i>	<i>Gao</i>			
<i>Mr</i>	<i>Jeff</i>	<i>Gatlin</i>			
<i>Mr</i>	<i>Kevin</i>	<i>Gebke</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Mark</i>	<i>Germagian</i>			
<i>Dr</i>	<i>Rajat</i>	<i>Ghosh</i>			
<i>Mr</i>	<i>John</i>	<i>Gideon</i>			
<i>Mr</i>	<i>Arthur</i>	<i>Giesler</i>			
<i>Mr</i>	<i>Robin</i>	<i>Gilbert</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Kenneth</i>	<i>Gill</i>			
<i>Mr</i>	<i>Jack</i>	<i>Glass</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>John</i>	<i>Golder</i>			
<i>Dr</i>	<i>Evraam</i>	<i>Gorgy</i>	<i>x</i>	<i>x</i>	
<i>Dr</i>	<i>Krishnan</i>	<i>Gowri</i>			
<i>Mr</i>	<i>David</i>	<i>Grant</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>John</i>	<i>Greco</i>			
	<i>Steve</i>	<i>Greenberg</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>John</i>	<i>Groenewold</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Charles</i>	<i>Gulledge</i>			
<i>Mr</i>	<i>Edward</i>	<i>Gutowski</i>			
<i>Dr</i>	<i>Kamel</i>	<i>Haddad</i>			
<i>Mr</i>	<i>Stephen</i>	<i>Halsted</i>			
<i>Mr</i>	<i>John</i>	<i>Haney</i>			
<i>Mr</i>	<i>Andrew</i>	<i>Harrison</i>			
<i>Mr</i>	<i>Kevan</i>	<i>Harrison</i>			
<i>Mr</i>	<i>Kyle</i>	<i>Hasenkox</i>		<i>x</i>	
<i>Mr</i>	<i>Scot</i>	<i>Heath</i>			
<i>Mr</i>	<i>Michael</i>	<i>Heinrich</i>			
<i>Mr</i>	<i>Dennis</i>	<i>Hellmer</i>			
<i>Dr</i>	<i>Magnus</i>	<i>Herrlin</i>			
<i>Mr</i>	<i>Ted</i>	<i>Hight</i>			
<i>Mr</i>	<i>Elly</i>	<i>Hiu</i>			
<i>Dr</i>	<i>Xin</i>	<i>Hu</i>	<i>x</i>	<i>x</i>	

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Mr</i>	<i>Hugh</i>	<i>Hudson</i>			
<i>Mr</i>	<i>Roger</i>	<i>Huggins</i>			
<i>Mr</i>	<i>Daniel</i>	<i>Hughes</i>			
<i>Mr</i>	<i>Kevin</i>	<i>Hughes</i>			
<i>Mr</i>	<i>Mark</i>	<i>Hydeman</i>			
<i>Mr</i>	<i>Akio</i>	<i>Idei</i>			
<i>Mr</i>	<i>J C</i>	<i>Ierschot</i>			
<i>Mr</i>	<i>Madhusudan</i>	<i>Iyengar</i>			
<i>Mr</i>	<i>Ted</i>	<i>Jagusztyn</i>			
<i>Mr</i>	<i>Gregory</i>	<i>Jeffers</i>	<i>x</i>	<i>x</i>	
<i>Dr</i>	<i>Charles</i>	<i>Johnson</i>			
<i>Mrs</i>	<i>Rhonda</i>	<i>Johnson</i>			
	<i>George</i>	<i>Jones</i>			
<i>Mr</i>	<i>Er Toh Siam Hui</i>	<i>Joseph</i>			
<i>Mr</i>	<i>Alex</i>	<i>Juncker</i>			
<i>Mr</i>	<i>George</i>	<i>Kaler</i>			
<i>Dr</i>	<i>Kailash</i>	<i>Karki</i>			
<i>Mr</i>	<i>Kanchan</i>	<i>Kelkar</i>			
<i>Mr</i>	<i>David</i>	<i>Kelley</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Daniel</i>	<i>Kennedy</i>			
<i>Dr</i>	<i>Michael</i>	<i>Kester</i>			
<i>Dr</i>	<i>Kishor</i>	<i>Khankari</i>	<i>x</i>		
<i>Dr</i>	<i>Mukesh</i>	<i>Khattar</i>			
<i>Mr</i>	<i>Richard</i>	<i>Killian</i>			
<i>Mr</i>	<i>William</i>	<i>Kingrey</i>			
<i>Mr</i>	<i>Marvin</i>	<i>Kirshenbaum</i>			
<i>Mr</i>	<i>Timothy</i>	<i>Kittila</i>			
<i>Mr</i>	<i>Erhard</i>	<i>Klotz</i>			
<i>Mr</i>	<i>Paul</i>	<i>Knight</i>			
<i>Mr</i>	<i>Michael</i>	<i>Koerner</i>			
<i>Mr</i>	<i>Matt</i>	<i>Koukl</i>	<i>x</i>	<i>x</i>	

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Dr</i>	<i>Devdatta</i>	<i>Kulkarni</i>			
<i>Mr</i>	<i>Pardeep</i>	<i>Kumar</i>			
<i>Mr</i>	<i>Sushil</i>	<i>Kumar</i>			
<i>Mr</i>	<i>Christopher</i>	<i>Kurkjian</i>		<i>x</i>	
<i>Mr</i>	<i>Osmo</i>	<i>Kuusisto</i>			
<i>Mr</i>	<i>Alfred</i>	<i>Kwong</i>			
<i>Mr</i>	<i>Cameron</i>	<i>Labunski</i>			
<i>Mr</i>	<i>Stephen</i>	<i>Lahti</i>			
<i>Mr</i>	<i>David</i>	<i>Landsberg</i>			
<i>Mr</i>	<i>John</i>	<i>Lane</i>			
<i>Mr</i>	<i>Federico</i>	<i>Lang</i>			
<i>Mr</i>	<i>John</i>	<i>Lanni</i>			
<i>Mr</i>	<i>Jon</i>	<i>Larry</i>			
<i>Mr</i>	<i>Geoff</i>	<i>Lawler</i>		<i>x</i>	
<i>Mr</i>	<i>Matt</i>	<i>Lawrence</i>			
<i>Mr</i>	<i>Stuart</i>	<i>Lawrence</i>	<i>x</i>	<i>x</i>	
<i>Dr</i>	<i>Thomas</i>	<i>Lawrence</i>			
<i>Mr</i>	<i>Christian</i>	<i>Le</i>			
<i>Mr</i>	<i>Sang</i>	<i>Lee</i>			
<i>Mr</i>	<i>Bret</i>	<i>Lehman</i>			
<i>Mr</i>	<i>Tim</i>	<i>Lehotsky</i>			
<i>Mr</i>	<i>Frank</i>	<i>Lembo</i>		<i>x</i>	
<i>Mr</i>	<i>Guillermo</i>	<i>Leon Orellana</i>			
<i>Ms</i>	<i>Suzanne</i>	<i>LeViseur</i>			
<i>Dr</i>	<i>Hsing-Sheng</i>	<i>Liang</i>			
<i>Mr</i>	<i>Mike</i>	<i>Licitra</i>			
<i>Mr</i>	<i>Michael</i>	<i>Linde</i>			
<i>Dr</i>	<i>Wei</i>	<i>Ling</i>			
<i>Mr</i>	<i>Damion</i>	<i>Lock</i>			
<i>Mr</i>	<i>Nemat</i>	<i>Lotfi</i>			
<i>Mr</i>	<i>Yury</i>	<i>Lui</i>			
<i>Mr</i>	<i>Francis Allen</i>	<i>Lumabas</i>			

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Mr</i>	<i>Lu</i>	<i>Luna</i>			
<i>Mr</i>	<i>Chris</i>	<i>Malanga</i>			
<i>Dr</i>	<i>Christopher</i>	<i>Malone</i>			
	<i>William</i>	<i>Maltz</i>			
<i>Mr</i>	<i>Alessandro</i>	<i>Mandelli</i>			
<i>Mr</i>	<i>Eugene</i>	<i>Maritz</i>			
<i>Mr</i>	<i>Lawrence</i>	<i>Markel</i>			
<i>Mr</i>	<i>Ted</i>	<i>Marwitz</i>			
<i>Miss</i>	<i>Caroline</i>	<i>Mason</i>			
<i>Mr</i>	<i>Guillermo</i>	<i>Massucco</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Jason</i>	<i>Matteson</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Ronald</i>	<i>Mays</i>			
<i>Mr</i>	<i>James</i>	<i>McAleer</i>			
<i>Mr</i>	<i>Timothy</i>	<i>McCann</i>			
<i>Mr</i>	<i>Greg</i>	<i>McDonald</i>			
<i>Mr</i>	<i>Robert</i>	<i>McFarlane</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Michael</i>	<i>McKenna</i>	<i>x</i>		
<i>Mr</i>	<i>Douglas</i>	<i>McLellan</i>			
<i>Mr</i>	<i>David</i>	<i>Meadows</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Godwyn</i>	<i>Mendes</i>			
<i>Mr</i>	<i>Zuheir</i>	<i>Mheir</i>			
<i>Mr</i>	<i>Francis</i>	<i>Mills</i>			
<i>Mr</i>	<i>Richie</i>	<i>Mittal</i>			
<i>Mr</i>	<i>Michael</i>	<i>Monahan</i>			
<i>Mr</i>	<i>Mark</i>	<i>Monroe</i>			
<i>Dr</i>	<i>Stephen</i>	<i>Montgomery</i>			
<i>Mr</i>	<i>David</i>	<i>Moss</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>John</i>	<i>Mouritsen</i>			
<i>Mr</i>	<i>Stephen</i>	<i>Mowrer</i>		<i>x</i>	
<i>Mr</i>	<i>Christopher</i>	<i>Muller</i>		<i>x</i>	
<i>Mr</i>	<i>John</i>	<i>Murgida</i>			
<i>Mr</i>	<i>John</i>	<i>Musilli</i>			

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

Mr	Sanjeev	Nangia			
Mr	Ram	Narayanamurthy			
Mr	Philip	Naughton			
Mr	C.D	Nayak			
Mr	David	Nesheiwat			
Mr	John	Neubauer			
Mr	Michael	Nicolai			
Prof	George	Nnanna			
Mr	Budy	Notohardjono			
Mr	Shlomo	Novotny	x	x	
Mr	John	O'Brien			
Mr	Rodney	Oehlers			
Mr	Mark	Ogilvie			
Prof	Michael	Ohadi			
Mr	Zarko	Palavra			
	Jason	Palmer			
Mr	Sanjay	Panchbhaya			
Mr	Steven	Parris			
Mr	Chandrakant	Patel			
Dr	Michael	Patterson			
Mr	Gregory	Pautsch			
Mr	Richard	Pavlak	x	x	
	Mark	Pavol		x	
	Mark	Pavol			
Dr	Andrew	Pearson			
Mr	Kenneth	Peet			
Mr	Craig	Petersen			
Mr	John	Peterson			
Mr	Long	Phan			
Mr	Rahul	Phansalkar			
Mr	William	Pienta			
Mr	Andrew	Prandoni			

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Mr</i>	<i>Joseph</i>	<i>Prisco</i>		<i>x</i>	
<i>Mr</i>	<i>Vidyasagar</i>	<i>Puthran</i>			
<i>Mr</i>	<i>Honore'du</i>	<i>Puy</i>			
<i>Mr</i>	<i>David</i>	<i>Quirk</i>		<i>x</i>	
<i>Mr</i>	<i>David</i>	<i>Redford</i>			
<i>Mr</i>	<i>Mark</i>	<i>Reed</i>		<i>x</i>	
<i>Mr</i>	<i>Mark</i>	<i>Reed</i>			
<i>Dr</i>	<i>Gamal</i>	<i>Refai-Ahmed</i>			
<i>Mr</i>	<i>Charles</i>	<i>Rego</i>			
<i>Mr</i>	<i>William</i>	<i>Reynolds</i>			
<i>Mr</i>	<i>Terry</i>	<i>Rodgers</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Steven</i>	<i>Rosenstock</i>			
<i>Mr</i>	<i>Joel</i>	<i>Rutledge</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Jeffrey</i>	<i>Rutt</i>			
<i>Mr</i>	<i>Nestor</i>	<i>Salinas</i>			
<i>Mr</i>	<i>Michael</i>	<i>Salvatore</i>			
<i>Mr</i>	<i>Peter</i>	<i>Samain</i>			
<i>Dr</i>	<i>Roger</i>	<i>Schmidt</i>			
<i>Mr</i>	<i>Michael</i>	<i>Schwarz</i>			
<i>Mr</i>	<i>Michael</i>	<i>Schwedler</i>		<i>x</i>	
<i>Mr</i>	<i>Clifford</i>	<i>Scofield</i>			
<i>Mr</i>	<i>Ian</i>	<i>Seaton</i>			
<i>Mr</i>	<i>Justin</i>	<i>Seter</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Mark</i>	<i>Seymour</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Darshit</i>	<i>Shah</i>			
<i>Mr</i>	<i>Anthony</i>	<i>Sharp</i>			
<i>Prof</i>	<i>Timothy</i>	<i>Shedd</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Saurabh</i>	<i>Shrivastava</i>			
<i>Mr</i>	<i>Thursten</i>	<i>Simonsen</i>			
<i>Mr</i>	<i>Mark</i>	<i>Simpson</i>			
<i>Ms</i>	<i>Shelby</i>	<i>Sims</i>			
<i>Mr</i>	<i>Satwinder</i>	<i>Singh</i>			

ASHRAE TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Ms</i>	<i>Susan</i>	<i>Smith</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Grant</i>	<i>Smith</i>			
<i>Mr</i>	<i>John</i>	<i>Song</i>			
<i>Mr</i>	<i>Vali</i>	<i>Sorell</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Marc</i>	<i>Soucy</i>			
<i>Mr</i>	<i>Ronald</i>	<i>Spangler</i>			
<i>Mr</i>	<i>Ronald</i>	<i>Spangler</i>			
<i>Mr</i>	<i>Jonathan</i>	<i>Spreeman</i>			
<i>Mr</i>	<i>J</i>	<i>Stack</i>			
<i>Mr</i>	<i>Jeffrey</i>	<i>Stein</i>			
<i>Mr</i>	<i>Benjamin</i>	<i>Steinberg</i>			
<i>Mr</i>	<i>Robin</i>	<i>Steinbrecher</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Morgan</i>	<i>Stevens</i>			
<i>Mr</i>	<i>Charles</i>	<i>Stewart</i>			
<i>Mr</i>	<i>Jeremiah</i>	<i>Stikeleather</i>			
<i>Mr</i>	<i>Robert</i>	<i>Sty</i>			
<i>Dr</i>	<i>Robert</i>	<i>Sullivan</i>			
<i>Mr</i>	<i>Abhishek</i>	<i>Sundaram</i>			
<i>Dr</i>	<i>David</i>	<i>Sundin</i>			
	<i>Jacob</i>	<i>Svenkeson</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Inn</i>	<i>Tang</i>			
<i>Mr</i>	<i>Edwin</i>	<i>Teoh</i>			
<i>Mr</i>	<i>Jeff</i>	<i>Tepler</i>			
<i>Mr</i>	<i>Ronald</i>	<i>Thomas</i>			
<i>Mr</i>	<i>Russell</i>	<i>Tipton</i>	<i>x</i>	<i>X</i>	
<i>Mr</i>	<i>David</i>	<i>Tootle</i>		<i>x</i>	
<i>Mrs</i>	<i>Sengul</i>	<i>Topuz</i>			
<i>Dr</i>	<i>Robert</i>	<i>Tozer</i>	<i>x</i>	<i>x</i>	
<i>Mr</i>	<i>Chad</i>	<i>Tramonte</i>			
<i>Mr</i>	<i>Sean</i>	<i>Treweek</i>			
<i>Mr</i>	<i>Jeff</i>	<i>Trower</i>			
<i>Mr</i>	<i>William</i>	<i>Tschudi</i>			

ASHRAE TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

<i>Mr</i>	<i>Edward</i>	<i>Tsui</i>			
<i>Mr</i>	<i>Edward</i>	<i>Tsui</i>			
<i>Mr</i>	<i>Saahil</i>	<i>Tumber</i>			
<i>Miss</i>	<i>Marianna</i>	<i>Vallejo</i>			
<i>Mr</i>	<i>James</i>	<i>VanGilder</i>			
<i>Mr</i>	<i>Michael</i>	<i>Vaughn</i>			
<i>Mr</i>	<i>Richard</i>	<i>Velten</i>			
<i>Mr</i>	<i>Herb</i>	<i>Villa</i>			
<i>Mr</i>	<i>Marlin</i>	<i>Vogel</i>			
<i>Dr</i>	<i>Aleksandar</i>	<i>Vukovic</i>			
<i>Mr</i>	<i>Henk</i>	<i>Waardenburg</i>			
<i>Mr</i>	<i>David</i>	<i>Wang</i>			
<i>Dr</i>	<i>Ralph</i>	<i>Webb</i>			
<i>Mr</i>	<i>Andrew</i>	<i>Wengerd</i>			
<i>Mr</i>	<i>Kurt</i>	<i>Wetzel</i>			
<i>Ms</i>	<i>Katherine</i>	<i>Whitenack</i>			
<i>Mr</i>	<i>Robert</i>	<i>Wichert</i>			
<i>Mr</i>	<i>Jan</i>	<i>Wiersma</i>			
<i>Mr</i>	<i>Scott</i>	<i>Wilson</i>		<i>x</i>	
<i>Mr</i>	<i>Scott</i>	<i>Wilson</i>			
<i>Mr</i>	<i>Martin</i>	<i>Wilson</i>			
<i>Mr</i>	<i>Nick</i>	<i>Wold</i>			
<i>Mr</i>	<i>Jackson</i>	<i>Wong</i>			
<i>Mr</i>	<i>Larry</i>	<i>Wong</i>			
<i>Mr</i>	<i>Tony S F</i>	<i>Wong</i>			
<i>Mr</i>	<i>Stephen</i>	<i>Woollard</i>			
<i>Mr</i>	<i>Lang</i>	<i>Yuan</i>			
<i>Miss</i>	<i>Brook</i>	<i>Zion</i>			
<i>Dr</i>	<i>Wangda</i>	<i>Zuo</i>			
	<i>Olu</i>	<i>Soluade</i>	<i>X</i>		
	<i>Douglas</i>	<i>Sick</i>	<i>X</i>	<i>X</i>	
	<i>Benedict</i>	<i>Dolcich</i>	<i>X</i>		

ASHRAE TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Attendance:

	<i>Matt</i>	<i>Brown</i>	<i>X</i>		
	<i>Rajendera</i>	<i>Kapoor</i>	<i>X</i>	<i>X</i>	
	<i>Harold</i>	<i>Simmons</i>		<i>X</i>	
	<i>Mahmoud</i>	<i>Ibrahim</i>		<i>X</i>	
	<i>Byron</i>	<i>Horak</i>		<i>X</i>	<i>Guest</i>
	<i>Long</i>	<i>Phan</i>		<i>X</i>	<i>Guest</i>
	<i>Mark</i>	<i>Long</i>		<i>X</i>	<i>Guest</i>
	<i>William</i>	<i>Mak</i>		<i>X</i>	<i>Guest</i>
	<i>Ming</i>	<i>Zhang</i>		<i>X</i>	<i>Guest</i>
	<i>Marc</i>	<i>Solge</i>		<i>X</i>	<i>Guest</i>
	<i>Brad</i>	<i>Stanley</i>		<i>X</i>	<i>Guest</i>
	<i>Lori</i>	<i>Polukoshko</i>		<i>X</i>	<i>Guest</i>
	<i>Richard</i>	<i>Burr</i>		<i>X</i>	<i>Guest</i>
	<i>Dong</i>	<i>He</i>		<i>X</i>	<i>Guest</i>
	<i>Sen</i>	<i>Huang</i>		<i>X</i>	<i>Guest</i>
	<i>Suresh</i>	<i>Pichai</i>		<i>X</i>	<i>Guest</i>
	<i>Itzhak</i>	<i>Maor</i>		<i>X</i>	<i>Guest</i>