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 January 18, 2021

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

DATE OF MEETING January 18, 2021 LOCATION Virtual

Note: These aft minutes have not been approved and not the official, approved record until approved by the TC.

MEMBERS PRESENT	MEMBERS ABSENT	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
VOTING MEMBERS	Lex Coors	Rafi Aharoni
Gerardo Alfonso	Ecton English	Matt Wegner
John H Bean, Jr	Terry L Rodgers	
Donald L Beaty		
Dustin Demetriou		
John M Gross, III		
David F Kelley		
Matt Koukl		
Vali Sorell		
Dave Meadows		
David L Moss		
John Groenewold		
Roger R Schmidt		
CORRESPONDING MEMBERS		
Jason Matteson	Jack Glass	
Henry Amistadi	Ahmed Abdel Salam	
Shlomo Novotny	Raymond Abraham	
Rick Pavlak	Antonio Aguayo	
Mark Steinke	Robert Akkerman	
David Grant	Stuart Aldridge	
Aaron Wemhoff	Sajad Alimohammadi	
Eric Yang	Husam Alissa	
Jim VanGilder	Mohammad Alkiswani	
Robert Tozer	Shawn Andrews	

Michael Miller	Matthew Archibald	
Benjamin Petschke	Serpil Ari	
Paul Artman	Jakki Artus	
Mark Seymour	Sean Ashburn	
Mark FIsher	George Augustini	
Fabio Clavijo	Robert Bader	
Daniel Donahoe	William Bahnfleth	
Nick Casale	Andrew Baxter	
Bryce Cox	William Beck	
David Tootle	Chad Beery	
Gwenn Ivester	Adenilson Belizario	
Robert McFarlane	Paul Bemis	
Sang Lee	Satyam Bendapudi	
JOSEPH GANGEMI (Nick)	Ng Kai Beng	
Hugh Hudson	James Benville	
	James Betts	
	Michael Bishop	
	Byron Blackmore	
	Alonzo Blalock	
	James Bogart	
	Holly Brink	
	Rolf Brink	
	Douglas Brown	
	Jerrod Buterbaugh	
	Wim Buters	
	Aldo Calvi	
	Noe Casalino	
	John Castelvecchi	
	Neil Chauhan	
	David Chialastri	
	Dale Cibene	
	Alan Claassen	
	Brad Cochran	
	Benjamin Coe	
	Michael Collarin	
	Dan Comperchio	
	Howard Cooper	
	James Coyle	
	Bryan Coyne	
	Craig Crader	
	Greg Crumpton	
	Bob Culver	
	Christopher Daniel	
	Steve David	
	Thomas Davidson	
	George Degroft	
	Cuong Dinh	
	Bob Doherty	
	Benedict Dolcich	

	DAVID DONGES	
	Robert Druga	
	Aaron Duda	
	John Dumler	
	Andrew Dunn	
	Dan Dyer	
	Jacqueline Eaton	
	David Edenburn	
	Michael Edie	
	Dennis Eisenbarth	
	Michael Ellsworth	
	Frank Erceg	
	Hamza Erden	
	Maxwell Evans	
	Jeffrey Ewin	
	Huang Feng	
	Paul Finch	
	Jon Fitch	
	Sophia Flucker	
	Clayton Foster	
	Kamran Fouladi	
	David Franczak	
	Michael Frank	
	Terry Frantzis	
	Charles Freda	
	F French	
	Paul Galloway	
	Hongwen Gao	
	Kevin Gebke	
	Rajat Ghosh	
	John Gideon	
	Arthur Giesler	
	Robin Gilbert	
	Kenneth Gill	
	Troy Goldschmidt	
	Nigel Gore	
	Scott Graf	
	Shaun Green	
	Steve Greenberg	
	Charles Gulledge	
	Dinesh Gupta	
	Edward Gutowski	
	Kamel Haddad	
	Stephen Halsted	
	John Haney	
	Andrew Harrison	
	Kyle Hasenkox	
	Scot Heath	
	Dennis Hellmer	
	Magnus Herrlin	

	Mathias Hery	
	Robert Hewitt	
	Ted Hight	
	Elly Hiu	
	Chris Hsieh	
	Kevin Hughes	
	Steven Hyde	
	Ming-Ren I	
	J C Ierschot	
	Hifumi Iguchi	
	Madhusudan Iyengar	
	Charles Johnson	
	Rhonda Johnson	
	Gary Johnson, Jr	
	Roger Jones	
	Alex Juncker	
	Alekhya Kaianathbhatta	
	George Kaler	
	Rajendera Kapoor	
	Md Masud Karim	
	Kailash Karki	
	Kanchan Kelkar	
	Daniel Kennedy	
	Gordon Keogh	
	Michael Kester	
	Rehan Khalid	
	Kishor Khankari	
	Richard Killian	
	William Kingrey	
	Marvin Kirshenbaum	
	Timothy Kittila	
	Erhard Klotz	
	Paul Knight	
	Srinivas Kodea	
	Michael Koerner	
	Devdatta Kulkarni	
	Jayavant Kumar	
	Pardeep Kumar	
	Sushil Kumar	
	Yuichi Kurihashi	
	Christopher Kurkjian	
	Osmo Kuusisto	
	Yiu Wa Kwan	
	Stephen Lahti	
	Colin Laisure-Pool	
	Yuk Kuen Lam	
	David Landsberg	
	Federico Lang	
	Elizabeth Langer	
	John Lanni	

	Jon Larry	
	Geoff Lawler	
	Matt Lawrence	
	Christian Le	
	Allan Lee	
	Bret Lehman	
	Frank Lembo	
	Guillermo Leon Orellana	
	Hsing-Sheng Liang	
	Mike Licitra	
	Nemat Lotfi	
	Francis Allen Lumabas	
	William Mak	
	Mark Malkin	
	William Maltz	
	Alessandro Mandelli	
	Noreshvarman Manisagar	
	Eugene Maritz	
	Lawrence Markel	
	Ted Marwitz	
	Caroline Mason	
	Carl Massey	
	Guillermo Massucco	
	James McAleer	
	Timothy McCann	
	Christopher McDermott	
	Jaakko McEvoy	
	Michael McKenna	
	Douglas McLellan	
	Michael McRee	
	Godwyn Mendes	
	Francis Mills	
	Richie Mittal	
	Michael Monahan	
	Mark Monroe	
	Chad Moore	
	Stephen Mowrer	
	Christopher Muller	
	John Murgida	
	Ram Narayanamurthy	
	Philip Naughton	
	C.D Nayak	
	Ian Nelson	
	David Nesheiwat	
	John Neubauer	
	Salah Nezar	
	Michael Nicolai	
	Zuokui Ning	
	Budy Notohardjono	
	John O'Brien	

	Mark Ogilvie	
	Michael Ohadi	
	Sean OHern	
	Lawrence Ollice	
	Shelley Ophir	
	Leslye Paniagua	
	Farid Parsaei	
	Chandrakant Patel	
	Mark Pavol	
	Andrew Pearson	
	Thomas Peddle	
	Tim Persoons	
	Craig Petersen	
	John Peterson	
	FLORIN POPA	
	Mani Prakash	
	Joseph Prisco	
	Justin Prosser	
	Honore'du Puy	
	Suhasini Pyarasani	
	David Quirk	
	Prakash Rapolu	
	David Redford	
	Stuart Redshaw	
	Charles Rego	
	William Reynolds	
	Steven Rosenstock	
	Joel Rutledge	
	Jeffrey Rutt	
	Hitoshi Sakamoto	
	Anders Saksager	
	Nestor Salinas	
	Michael Salvatore	
	Peter Samain	
	Angela Sampaio	
	Michael Schwarz	
	Michael Schwedler	
	Clifford Scofield	
	Justin Seter	
	Darshit Shah	
	Jimil Shah	
	Anthony Sharp	
	Timothy Shedd	
	Saurabh Shrivastava	
	Matt Shumway	
	Ruben Sidranski	
	Thursten Simonsen	
	Mark Simpson	
	Shelby Sims	
	Satwinder Singh	

	Annelise Smith	
	Grant Smith	
	Stuart Smith	
	John Song	
	Marc Soucy	
	Ronald Spangler	
	Jonathan Spreeman	
	Mark Sprenger	
	Jeffrey Stein	
	Robin Steinbrecher	
	Morgan Stevens	
	Charles Stewart	
	Michael Streich	
	Robert Sullivan	
	Kaiyu Sun	
	David Sundin	
	Jacob Svenkeson	
	Micah Sweeney	
	Inn Tang	
	SOON TATT	
	Edwin Teoh	
	Jeff Tepler	
	Ronald Thomas	
	Russell Tipton	
	Sengul Topuz	
	Chad Tramonte	
	Jeff Trower	
	William Tschudi	
	Edward Tsui	
	Saahil Tumber	
	Marianna Vallejo	
	James Vallort	
	Richard Velten	
	Herb Villa	
	David Vranish	
	Darrin Watson	
	Ralph Webb	
	Andrew Wengerd	
	Kurt Wetzel	
	Malcolm White	
	Katherine Whitenack	
	Robert Wichert	
	Casey Winkel	
	Larry Wong	
	Stephen Woollard	
	Stephen Wren	
	Lixia Wu	
	Yang Zou	
	Wangda Zuo	

PROVISIONAL CORRESPONDING MEMBERS		
Kapil Mehrotra	Mina Abiedallah	
Ameya Soparkar	Sama Aghniaey	
kamal mostafavi	Rafael Aharoni	
Michael Hathorne	Hassan Ali Younes	
Gaurav Soni	Ramanathan Arumugasamy	
Timothy Startt	Tozer Bandorawalla	
Michael Geraghty	Kenneth Beach	
Balakrishnan P Panicker	Adenilson Belizario	
Philip Yu	Kyle Bergeron	
David McGlocklin	Rakesh Bhatia	
Ryan Reimer	Erich Binder	
	Norman Bourassa	
	Matthew Brazil	
	Dustin Bremner	
	Glenn Brenneke	
	CILLIAN BROWN	
	Julia Call	
	Jian Wen Chan	
	Vijayakumar Chithambaram	
	Byron Coetser	
	Kevin Connor	
	Florin Corcoz	
	Anthony Cosenze	
	Robert Curtis	
	Biswajit De	
	Brian Derby	
	Charuchandra Dewasthale	
	Shivraj Dhaka	
	Jon Elfi	
	Adam Fleming	
	Terry Fletcher	
	PIETRO FUMAGALLI	
	Michael Gibbons	
	Mike Gilkerson	
	Kenneth Goodman	
	Michael Hallstrom	
	John Han	
	Xu Han	
	Mohamed Hegazy	
	Ali Heydari	
	Ali Akber Kazmi	
	Peter Koneck-Wilwerding	
	Alexandre Kontoyanis	
	Steve Krupka	
	Cheng-Xian Lin	
	Christopher Malone	

	M.R. Mannex	
	DONALD Mitchell	
	Giuliano Molon	
	Lucas Moreira	
	Ramesh Navaratnam	
	Pooya Navid	
	Oscar Rueda	
	Carine Saliba	
	Francisco Sanchez	
	Mohit Shrivastava	
	Thomas Sin	
	Jeremy Smith	
	Antonio Tan III	
	Russell Taylor	
	Sharon Thomas	
	ERIC TUNKS	
	William Ung	
	Alfred Uzokwe	
	Jonell Watson	
	Christopher Wilson	
	Bruno Winge	
	David Yancosky	
	Jon Zubiaurre	

Published Agenda

Topic		Time	Presenter
Introduction	Welcome and Introductions	10	Dustin Demetriou
Programs	2021 Winter Virtual and 2021 Summer Phoenix	15	Nick Gangemi
Handbook	Chapter 20	10	Bob McFarlane
Research	1675-RP: Guidance for CFD Modeling of Data Centers	15	Mark Seymour
	Sea Salt Filtration RTAR and WS	15	Roger Schmidt
	Wetted Materials Research	10	Mark Steinke
	Open Discussion on Research Topics	15	All

Total Time 90 minutes

Call to Order: 1/18/21 10:00 AM EST Dustin Demetriou

- Procedural Items for Virtual Meeting
  - Zoom meeting overview
  - Use of meeting attendance form.
    - A few additional questions to capture info about members.
- Introductions and Welcome
  - Dustin Demetriou Current Chair, John Groenewold- Vice Chair
  - Agenda for Sunday and Monday meetings is posted on TC 9.9 website.
  - Overview of Meeting Agenda
- Programs –Nick Gangemi
  - Reviewed ASHRAE Virtual Winter Conference Feb. 9-11 2021.
    - Reviewed the various conference tracks.
    - Wednesday Feb. 10, 10:30 AM - 11:30 AM- what you need to Know about ANSI/ASHRAE Standard 90.4 The energy Standard for Data Centers (Live)
    - Thursday Feb 11, 3-4 PM Climate control solutions for what is next, moving from Hyperscale to the Edge (Live)
    - On Demand- Smart Indoor Environmental Models for Data Centers.
  - Upcoming Summer Conference
    - Phoenix, AZ l June 26-30, 2021
    - Review of tracks
      - Track 1: Fundamentals of Applications
      - Track 2: HVAC & R Systems and Equipment
      - Track 3: Research Summit
      - Track 4: Professional Development
      - Track 5: Design, Control, and Operation of Critical Environments

- Track 6: HVAC&R For Indoor Plants
- Track 7: Future proofing – Renewable, Regenerative, and Resilient
- Track 8: Hot, Hot, Hot
- Track 9: To be Announced

- **Track 5 is our most applicable to TC 9.9 and is the main focus.**
- Important Dates for Phoenix:
  - Wednesday Jan. 13, 2021: Revised Conference Papers/ Final Technical Papers Due
  - Monday February 15, 2021 : Extended Abstracts Due
  - Thursday February 18, 2021: Conference and Technical Paper Final Accept/ Reject notifications
  - Monday February 22, 2021: Program Submission Due
  - Friday March 19, 2021: Extended abstract Accept/ Reject Notifications
  - Friday April 2, 2021: Program Submissions Accept/Reject Notifications.

- Different Types of Presentations at ASHRAE
  - Each Track has a Chair
  - If no data center track, Conference Chair will help make decisions on where the presentation will occur when no data center track.
  - Program Types
    - Technical Papers
      - Submitted for review and be technically accurate and clearly written.
      - Undergo a double-blind review and must be approved by three-reviewers
      - Can be up to 30 double-spaced manuscript pages in length and include tables, charts, and a max. of 12 figures.
      - Accepted papers are available as hard-copy reprints at the bookstore during the conference.
      - Must be presented at the conference to be published in *ASHRAE Transactions*
      - Typically, will include major industry updates

- Conference Papers
    - Updates on research on going
    - Shorter than Technical Papers, undergo a less stringent review and can be prepared closer to a conference.
    - Abstracts are submitted first for review
    - Once the abstract is accepted, they undergo a single-blind review and must be approved by two reviewers.
    - Once approved, papers are presented at the conference.
    - No more than 8 single-spaced pages in total length including text, tables, figures, etc.
- Workshops
    - ASHRAE Technical Committee provides a series of short presentations on a topic requiring specific expertise.
    - Goal is to engage the audience for active participation and training in a specific set of skills.
- Seminars
    - Presentation on a subject of current interest
    - Papers are not available
- Panels, Debates, Forums
    - Broad range of subjects and explore different perspectives
    - No papers
    - Promote a free exchange of ideas
    - Can be about a “hot-button” issue
- Seminar and Conference paper will have title, abstract and presentation. Abstract is important to the submission to get it accepted and into the correct track.

- TC members are encouraged to work through Nick when working on ASHRAE presentation activities to help with acceptance success rate.
- Contact Nick Gangemi, Program Chair I 585-721-8795 I nick.gangemi@bureauveritas.com
- Comments:
    - Jim Van Guilder- looking for TC 9.9 to Co-Sponsor presentation.

        - Bob McFarlane- Thanks to Nick Gangemi for supporting presentation on 90.4 Presentation.
        - Last Mission Critical track was 3 years ago.
- Handbook Revision Update – Bob McFarlane
    - (4) volumes published (1) issued each year
    - Chapters are written by TC's
    - TC 9.9 is included in the Applications Handbook
    - We are in chapter 20, in 2019 it was moved from 19 to 20
    - 2023 "Applications" Handbook
    - Revision due Date: June 2022 Summer Meeting
        - Revision need to be complete by March 1, 2022
        - Revisions have been proposed
        - (3) reviewers have provided comments.
        - Need additional reviewers to provide a review of the chapter and offer updates.
    - Handbook wants Major topic lists for 2023
        - Specific review forms are being requested for the 2023 submission.
    - Please send suggested changes to Handbook to Bob McFarlane
        - rmcfarlane@smwllc.com
        - Requesting Assistance in Reviewing suggestions
            - Subject matter experts on specific suggestions
            - Two Board Members to Expedite Board Approval
            - Don Beaty for "Relevance" Review.
    - Comments
        - John Gross- noting he will review the chapter and provide comments. He also noted he would be willing to be a board member to provide comments as a TC board member.
        - Chapter Review Form has not changed. Bob is willing to complete form and update. Each Suggested change requires a new form to be completed.
        - Roger Schmidt. Thermal guideline book will be updated and released by summer. To be included in the new chapter.
        - Chair encourages all to provide a review and send comments ASAP.
- **Research Subcommittee – Mark Seymour**
    - Agenda
        - General ASHRAE Research Situation
        - 1675-RP: Guidance for Computational Fluid Dynamic (CFD)

Modeling of Data Centers.
    - Sea Salt
    - Wetted Materials Research
    - Open Discussion on Research Topics.
- General ASHRAE Research Situation
    - Less revenue and funding for research.
    - Only 3 projects got approved during the last review. Not that many projects have been submitted.
    - (1) project has been submitted, (2) are proposals at this time.
    - General TC 9 has not meet yet and will be discussed Feb. 9-11.
- **1675-RP: Guidance for CFD Modeling of Data Centers.**
    - Reviewed principal investigators performing work.
    - Reviewed Project Objectives and set-up parameters of the model including construction of the room, configuration of the room, equipment, and systems.
        - Reviewed configuration variations.
        - Reviewed the parameter variations.
    - Project Timeline
        - Behind schedule
        - Lab measurements started in October 2019
        - Lab measurements completed December 2020
        - CFD comparisons – ongoing
        - Sensitivity study completion and guidance production intended March 2021.
        - Requested a 6 month extension
    - Recent Progress
        - Server simulators evaluations and verifications
        - CFD work has been on going
        - Moving into report generation
    - Plans for the Next few Months
        - Compete all the data analysis and guideline development
        - Will submit once complete.
    - Experiment Overview
        - Recent progress
            - Sensors set-up required changes
            - Reviewed the layout of sensors in the room.

- Flow rate measurement
    - Used sensors (anemometers)
- Performed repeatability testing.
    - Testing has shown 1.5°C of uncertainty.
- Blockage Selection
    - Changed the flow.

- CFD Results
    - Recent Progress
        - Perforated tiles were calibrated.
        - CFD results were validated.
        - University had to develop a model of a tile.
        - Repeatability tests vs. time were investigated.
        - Blockage locations were tested.
        - CFD simulations and experiments were finished for each scenario.
        - Results are in progress.
    - Tile Pressure Loss Calibration
        - needed to adjust for the tile loss coefficient.
    - Case Studies
        - Had different flow rates, etc.
    - Temperature Comparisons.

- Comments
    - Bob McFarlane- noted that this will be good for the various CFD companies.
        - What type of guidelines will be provided?
            - Develop guidance on simulation of tile models
            - Guidance on floor leakage
            - Guidance on blockages.
            - Further sensitivity testing is going to need additional work.
            - Guidance on items to questions of the model, and guidance on system modeling.
        - Is the variability in temperature due to unsteady flow (vorticity)?
            - Yes possibly.
        - Brad Cochran- Any Plans to include some LES

(Large Eddy Simulations) simulations
        - No plans. More work than the project could afford.
        - Likely would see some unsteady states in the model.
        - LES is an alternative computational technique compared to RANS CFD.
    - Bob McFarlane- Will any of this research translate to in-row or non-raised floor designs?
        - Yes. Looking at the systems will be generally similar. Again, this is to reflect the methods of modeling vs. the specific types.
    - Henry Amistadi- was blockage across entire height of the plenum?
        - Yes.
- **ASHRAE Sea Salt RTAR and WS – Roger Schmidt.**
    - Work Statement
        - Study of the Corrosion Impact on Information Technology Equipment in Data Center Located in Coastal Regions with High Sea Salt Concentrations and the Level of Filtration Required to Maintain Reliable Operation of this Equipment
    - No investigations have focused on the filtration required of sea salts such that corrosion or degradation of electronic equipment located in these coastal regions can be minimized.
    - No investigation on the corrosion in marine environments of materials used in constructing IT equipment, principally copper, silver, and PCB's (printed circuit boards).
    - Research goal is to provide guidance for the required filtration and to verify the current environmental guidelines for information technology equipment (ITE) in marine environments to maintain or expand the opportunity for increased free cooling hours and improve data center energy efficiency globally.
    - Draft Work Statement Submitted December 15th, 2020.
        - Sponsor TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
        - Coordinated with TC 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment
    - Significant amounts of studies on Sodium Chloride particle -induced corrosion, no investigations have focused on the filtration required

of sea salts such that corrosion or degradation of electronic equipment located in these coastal regions can be minimized.

- A Challenge of the study will be in addressing is the 'environment scenario'.
    - The transient nature of the coastal conditions – changing temperature, relative humidity, atmospheric conditions and contaminant are all important and without a well-defined boundary on the environment scenario there will be challenges in accepting the corrosion results.
    - The objectives are to determine where air side economization is acceptable for reliable operation of any electronic equipment including those inside a data center where the data center is susceptible to the marine environmental conditions.
    - Mimicking the scenarios will be more complex in the lab.
- Project Deliverables include:
    - Literature Review
    - Description of experimental methods and associated justification of the experiment design.
    - Results showing the effects of moisture (dew point) combined with varying levels of sea salts in airborne forms of corrosion of copper, silver and PCBs used in electronic equipment in data centers.
    - Results of the effect on corrosion of electronic equipment from the sea salts by applying filtering prior to the sea salt contaminated air entering the data center.
    - Development of new guidelines for operating data centers in marine environments.
    - Technical paper summarizing the results of the research including new guidelines for operating data centers reliably and in the most efficient manner world-wide. This will inform the basis for a new standard.
- Comments:
    - Mark Seymour- It is worth adding for the record that we also asked for co-sponsorship from TC 2.4. They submitted a vote a little late, but we hope that it will also be accepted. In any case, the proposed PMS includes members from TC 2.3 and TC 2.4 as well as TC 9.9 so the broad expertise is included.
    - John Gross- It is worth noting that petrochemical plants along the coast have a lot of issues with corrosion in their PLC

hardware distributed throughout the plant. Admittedly some of it is from the airborne contaminants related to the processes.
        - Dan Donahoe- did mention salt in a top level article: “Canary in a Coal Mine: Issues in Efficient Cooling of Data Centers”, IEEE-USA SusTech Conference 2014, July 2014, pp 86-89.
            - Roger Schmidt requested a copy of the article.

- **Proposed Research (RTAR) on Wetted Materials – Mark Steinke**
    - Background
        - Liquid cooling Guidelines book contains a listing of wetted materials for the Facility Water Supply (FWS) and Technology Cooling System (TCS) loops.
        - Latest water-cooling white paper “Water-Cooled Servers – Common Designs, components, and processes” identified the growing list of wetted materials being used by ITE manufacturers.
            - Just an acknowledgement that the list is growing.
            - More liquid cooled solutions coming to the market
            - Heavily debated topic of the white paper.
        - Every ITE manufacturer should be investigating.
        - Every customer should be asking
    - Purpose
        - Every ITE manufacturer should be performing own studies and results are typically proprietary to that company.
        - Begin work on an RTAR to study wetted materials in liquid cooled systems.
        - Provide validation of a basic set of wetted materials for use.
        - Develop testing roadmap to validate other or emerging wetted materials.
        - Provide a common set of recommended wetted materials that can be expanded over time using this process.
    - Action
        - Form small group interested in research topic
        - Begin RTAR work statement
        - Goal of having RTAR work statement ready by summer meeting
        - Contact if interested in participating
            - Mark Steinke

        - Dustin Demetriou
        - Roger Schmidt
        - Mark Seymour

    - Comments
        - John Gross- Consider simplifying this a bit by addressing what materials are compatible with facility cooling systems. Whatever isn't should be behind a CDU.
            - Need to consider the FWS and TCS and consider reducing scope of the work
        - Mark Seymour- What parameters do you imagine assessing for compatibility? Given the channel sizes of some devices, should this include fluid and material compatibility e.g. resistance to fouling?
            - Evaluate scope of specific materials as part of this research topic.
        - David McGlocklin: Dale Sartor @ Lawrence Berkeley National Laboratory is working on an open standard around this topic, I talked to him earlier in the week on this topic. Would like to be part of this working group.

- **Open Forum on Research Topics.**
    - Michael Garrity- Louvers in cold climates.
    - Bob McFarlane- UPS sizing

- **Closing Comments**
    - Review and provide feedback on Handbooks
    - Recapped phoenix conference for topics on presentations
    - Provide research topics to Mark Seymour.
    - Next Meeting Jan. 19, 2021 10 - 2PM EST

12:02 PM EST Meeting Concluded

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 January 19, 2021

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

DATE OF MEETING January 19, 2021 LOCATION Virtual

MEMBERS PRESENT	MEMBERS ABSENT	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
VOTING MEMBERS	Lex Coors	William J Stewart
Gerardo Alfonso	John H Bean, Jr	Raven Jones
Donald L Beaty	Matt Koukl	Jim Marsh
Dustin Demetriou		Clifford Federspiel
John M Gross, III		Nathan Parkison
David F Kelley		Larry Smith
Vali Sorell		Rick Eiland
Dave Meadows		Hannah Hoffmann
David L Moss		Mina Aziz
John Groenewold		Ben Sy
Roger R Schmidt		Brett Cecere
Ecton English		CRAIG ADAMS
Terry L Rodgers		Kyle Bergeron
CORRESPONDING MEMBERS		
Jason Matteson	Paul Artman	
Henry Amistadi	Fabio Clavijo	
Shlomo Novotny	Daniel Donahoe	
Rick Pavlak	Bryce Cox	
Mark Steinke	David Tootle	
David Grant	Hugh Hudson	
Aaron Wemhoff	Jack Glass	
Eric Yang	Raymond Abraham	
Jim VanGilder	Antonio Aguayo	
Robert Tozer	Robert Akkerman	
Michael Miller	Stuart Aldridge	
Benjamin Petschke	Sajad Alimohammadi	
Mark Seymour	Husam Alissa	
Mark FIsher	Mohammad Alkiswani	
Nick Casale	Shawn Andrews	
Gwenn Ivester	Serpil Ari	
Robert McFarlane	Jakki Artus	
Sang Lee	Sean Ashburn	

JOSEPH GANGEMI (Nick)	George Augustini	
Steve Greenberg	Robert Bader	
Sean OHern	William Bahnfleth	
Jon Fitch	Andrew Baxter	
Stuart Smith	William Beck	
Brad Cochran	Chad Beery	
Charles Freda	Adenilson Belizario	
John Dumler	Paul Bemis	
Thomas Davidson	Satyam Bendapudi	
Nigel Gore	Ng Kai Beng	
Gordon Keogh	James Benville	
Ahmed Abdel Salam	James Betts	
Mark Malkin	Michael Bishop	
Paul Finch	Byron Blackmore	
Micah Sweeney	Alonzo Blalock	
Mark Pavol	James Bogart	
David Quirk	Holly Brink	
Matthew Archibald	Rolf Brink	
Eugene Maritz	Douglas Brown	
	Jerrod Buterbaugh	
	Wim Buters	
	Aldo Calvi	
	Noe Casalino	
	John Castelvecchi	
	Neil Chauhan	
	David Chialastri	
	Dale Cibene	
	Alan Claassen	
	Benjamin Coe	
	Michael Collarin	
	Dan Comperchio	
	Howard Cooper	
	James Coyle	
	Bryan Coyne	
	Craig Crader	
	Greg Crumpton	
	Bob Culver	
	Christopher Daniel	
	Steve David	
	George Degroft	
	Cuong Dinh	
	Bob Doherty	
	Benedict Dolcich	
	DAVID DONGES	
	Robert Druga	
	Aaron Duda	
	Andrew Dunn	
	Dan Dyer	
	Jacqueline Eaton	
	David Edenburn	

	Michael Edie	
	Dennis Eisenbarth	
	Michael Ellsworth	
	Frank Erceg	
	Hamza Erden	
	Maxwell Evans	
	Jeffrey Ewin	
	Huang Feng	
	Sophia Flucker	
	Clayton Foster	
	Kamran Fouladi	
	David Franczak	
	Michael Frank	
	Terry Frantzis	
	F French	
	Paul Galloway	
	Hongwen Gao	
	Kevin Gebke	
	Rajat Ghosh	
	John Gideon	
	Arthur Giesler	
	Robin Gilbert	
	Kenneth Gill	
	Troy Goldschmidt	
	Scott Graf	
	Shaun Green	
	Charles Gulledge	
	Dinesh Gupta	
	Edward Gutowski	
	Kamel Haddad	
	Stephen Halsted	
	John Haney	
	Andrew Harrison	
	Kyle Hasenkox	
	Scot Heath	
	Dennis Hellmer	
	Magnus Herrlin	
	Mathias Hery	
	Robert Hewitt	
	Ted Hight	
	Elly Hiu	
	Chris Hsieh	
	Kevin Hughes	
	Steven Hyde	
	Ming-Ren I	
	J C Ierschot	
	Hifumi Iguchi	
	Madhusudan Iyengar	
	Charles Johnson	
	Rhonda Johnson	

	Gary Johnson, Jr	
	Roger Jones	
	Alex Juncker	
	Alekhya Kaianathbhatta	
	George Kaler	
	Rajendera Kapoor	
	Md Masud Karim	
	Kailash Karki	
	Kanchan Kelkar	
	Daniel Kennedy	
	Michael Kester	
	Rehan Khalid	
	Kishor Khankari	
	Richard Killian	
	William Kingrey	
	Marvin Kirshenbaum	
	Timothy Kittila	
	Erhard Klotz	
	Paul Knight	
	Srinivas Kodea	
	Michael Koerner	
	Devdatta Kulkarni	
	Jayavant Kumar	
	Pardeep Kumar	
	Sushil Kumar	
	Yuichi Kurihashi	
	Christopher Kurkjian	
	Osmo Kuusisto	
	Yiu Wa Kwan	
	Stephen Lahti	
	Colin Laisure-Pool	
	Yuk Kuen Lam	
	David Landsberg	
	Federico Lang	
	Elizabeth Langer	
	John Lanni	
	Jon Larry	
	Geoff Lawler	
	Matt Lawrence	
	Christian Le	
	Allan Lee	
	Bret Lehman	
	Frank Lembo	
	Guillermo Leon Orellana	
	Hsing-Sheng Liang	
	Mike Licitra	
	Nemat Lotfi	
	Francis Allen Lumabas	
	William Mak	
	William Maltz	

	Alessandro Mandelli	
	Noreshvarman Manisagar	
	Lawrence Markel	
	Ted Marwitz	
	Caroline Mason	
	Carl Massey	
	Guillermo Massucco	
	James McAleer	
	Timothy McCann	
	Christopher McDermott	
	Jaakko McEvoy	
	Michael McKenna	
	Douglas McLellan	
	Michael McRee	
	Godwyn Mendes	
	Francis Mills	
	Richie Mittal	
	Michael Monahan	
	Mark Monroe	
	Chad Moore	
	Stephen Mowrer	
	Christopher Muller	
	John Murgida	
	Ram Narayanamurthy	
	Philip Naughton	
	C.D Nayak	
	Ian Nelson	
	David Nesheiwat	
	John Neubauer	
	Salah Nezar	
	Michael Nicolai	
	Zuokui Ning	
	Budy Notohardjono	
	John O'Brien	
	Mark Ogilvie	
	Michael Ohadi	
	Lawrence Ollice	
	Shelley Ophir	
	Leslye Paniagua	
	Farid Parsaei	
	Chandrakant Patel	
	Andrew Pearson	
	Thomas Peddle	
	Tim Persoons	
	Craig Petersen	
	John Peterson	
	FLORIN POPA	
	Mani Prakash	
	Joseph Prisco	
	Justin Prosser	

	Honore'du Puy	
	Suhasini Pyarasani	
	Prakash Rapolu	
	David Redford	
	Stuart Redshaw	
	Charles Rego	
	William Reynolds	
	Steven Rosenstock	
	Joel Rutledge	
	Jeffrey Rutt	
	Hitoshi Sakamoto	
	Anders Saksager	
	Nestor Salinas	
	Michael Salvatore	
	Peter Samain	
	Angela Sampaio	
	Michael Schwarz	
	Michael Schwedler	
	Clifford Scofield	
	Justin Seter	
	Darshit Shah	
	Jimil Shah	
	Anthony Sharp	
	Timothy Shedd	
	Saurabh Shrivastava	
	Matt Shumway	
	Ruben Sidranski	
	Thursten Simonsen	
	Mark Simpson	
	Shelby Sims	
	Satwinder Singh	
	Annelise Smith	
	Grant Smith	
	John Song	
	Marc Soucy	
	Ronald Spangler	
	Jonathan Spreeman	
	Mark Sprenger	
	Jeffrey Stein	
	Robin Steinbrecher	
	Morgan Stevens	
	Charles Stewart	
	Michael Streich	
	Robert Sullivan	
	Kaiyu Sun	
	David Sundin	
	Jacob Svenkeson	
	Inn Tang	
	SOON TATT	
	Edwin Teoh	

	Jeff Tepler	
	Ronald Thomas	
	Russell Tipton	
	Sengul Topuz	
	Chad Tramonte	
	Jeff Trower	
	William Tschudi	
	Edward Tsui	
	Saahil Tumber	
	Marianna Vallejo	
	James Vallort	
	Richard Velten	
	Herb Villa	
	David Vranish	
	Darrin Watson	
	Ralph Webb	
	Andrew Wengerd	
	Kurt Wetzel	
	Malcolm White	
	Katherine Whitenack	
	Robert Wichert	
	Casey Winkel	
	Larry Wong	
	Stephen Woollard	
	Stephen Wren	
	Lixia Wu	
	Yang Zou	
	Wangda Zuo	
PROVISIONAL CORRESPONDING MEMBERS		
Kapil Mehrotra	Mina Abiedallah	
kamal mostafavi	Rafael Aharoni	
Gaurav Soni	Hassan Ali Younes	
Timothy Startt	Ramanathan Arumugasamy	
Michael Geraghty	Tozer Bandorawalla	
Balakrishnan P Panicker	Adenilson Belizario	
Philip Yu	Rakesh Bhatia	
David McGlocklin	Erich Binder	
Ryan Reimer	Norman Bourassa	
Peter Koneck-Wilwerding	Dustin Bremner	
Jeremy Smith	Glenn Brenneke	
ERIC TUNKS	Julia Call	
Robert Curtis	Jian Wen Chan	
Matthew Brazil	Vijayakumar Chithambaram	
Kyle Bergeron	Byron Coetser	
CILLIAN BROWN	Kevin Connor	
Kenneth Beach	Florin Corcoz	
Ali Akber Kazmi	Anthony Cosenze	

Pooya Navid	Biswajit De	
Ali Heydari	Brian Derby	
Alexandre Kontoyanis	Charuchandra Dewasthale	
Sama Aghniaey	Shivraj Dhaka	
	Jon Elfi	
	Adam Fleming	
	Terry Fletcher	
	PIETRO FUMAGALLI	
	Michael Gibbons	
	Mike Gilkerson	
	Kenneth Goodman	
	Michael Hallstrom	
	John Han	
	Xu Han	
	Michael Hathorne	
	Mohamed Hegazy	
	Steve Krupka	
	Cheng-Xian Lin	
	Christopher Malone	
	M.R. Mannex	
	DONALD Mitchell	
	Giuliano Molon	
	Lucas Moreira	
	Ramesh Navaratnam	
	Oscar Rueda	
	Carine Saliba	
	Francisco Sanchez	
	Mohit Shrivastava	
	Thomas Sin	
	Ameya Soparkar	
	Antonio Tan III	
	Russell Taylor	
	Sharon Thomas	
	William Ung	
	Alfred Uzokwe	
	Jonell Watson	
	Christopher Wilson	
	Bruno Winge	
	David Yancosky	
	Jon Zubiaurre	

Published Agenda

Tuesday, January 19, 2021
TC 9.9 Main Meeting
10:00 AM – 2:00 PM EST
Location: Virtual

Topic		Time	Presenter
Introduction	Welcome and Introductions	5	
	What is TC 9.9 Presentation	15	Dustin Demetriou
	TC 9.9 Officers and Membership	10	
Program		5	Nick Gangemi
Webmaster		5	Ecton English
Liaison Reports	Standard 90.1	10	Rick Pavlak
	Standard 90.4	10	Dave Kelley
	SPC-127	10	John Bean
	AHRI 1360	10	Dave Kelley
	SSPC 300, Guideline 1.6	10	Terry Rodgers
	MTG.CYB	10	Ecton English
	COVID-19 Impact on the Data Center Industry	20	John Groenewold
Break		15	
International	International Update	10	Don Beaty
	Dubai Data Center Course	10	Demetriou / Seymour
Industry Engagement	LBNL / DOE	10	Steve Greenberg
	OCP Liquid Cooling Workgroup	10	Nigel Gore
Publications	Edge Technical Bulletin	5	Jon Fitch
	Technical Bulletin Strategy	10	Jon Fitch
	Cold Weather Shipping White Paper	5	Joe Prisco
	Thermal Guidelines 5th Edition	15	R. Schmidt
IT Subcommittee	Hot Aisle Considerations for Human Health	10	John Gross
	Water Cooling White Paper	15	Dave Moss
	IEC Connector Harmonization	5	Roger Schmidt

Call to Order: 01/19/21 10:07 AM EST Dustin Demetriou

1. Introductions
    a. Overview of Meeting Agenda
    b. Noted ASHRAE TC 9.9 website
        i. Noted that presentation will be uploaded to website.
    c. Brad Cochran Section Head for Section 9
        i. Past TC 9.10 Chair.
        ii. Corresponding Member of 9.9
        iii. Has been engaged in performing research and has written papers.
        iv. SH9@ashrae.net for contact
    d. 11 Voting Members in attendance and quorum met.
    e. What is TC 9.9

i. Reviewed TC 9.9 Title, Purpose, and Scope
ii. Reviewed the Contributions of ASHRAE TC 9.9
iii. Reviewed the timeline of ASHRAE TC 9.9 publications.
    1. Typically, white papers result in a Datacom Book
iv. Overview provided of TC 9.9 Datacom Book Series
v. Most current Book, Book 14 DCIM.
    1. Books are available in the Bookstore/ Library.
vi. Reviewed TC 9.9 current work Activities.
vii. Noted LinkedIn page. https://www.linkedin.com/company/18665978

f. Officers and Membership. Went into effect August 1, 2020.
    i. New membership will run through June 30,2021
    ii. Roster updates are in the works.
    iii. Reviewed Roster and Chairs.
    iv. Reviewed Officers (as of August 1, 2020)

Position	Name
Chair	Dustin Demetriou
Vice Chair	John Groenewold
Secretary	Matt Koukl
Program Subcommittee Chair	Nick Gangemi
IT Subcommittee Chair	Roger Schmidt
Handbook Subcommittee Chair	Robert McFarlane
Standards Subcommittee Chair	Richard Pavlak
Membership Subcommittee Chair	Jack Glass
Research Subcommittee Chair	Mark Seymour
Webmaster	Ecton English
Marketing Subcommittee Chair	Paul Finch

    v. TC 9.9 Liaisons
        1. Standard 90.1: Rick Pavlak
        2. Standard 90.4: Dave Kelley
        3. Standard 127: John Bean
        4. Standard 300, Guideline 1.6: Terry Rodgers
        5. International: Don Beaty
        6. MTG.CYB: Ecton English
    vi. Voting Members
        1. 15 are full voting members.
        2. Consists of an average of 12, minimum of 6 and a maximum of 18.

3. Shall be appointed annually by the chair for not more than 4 consecutive one year terms.
4. Number of voting members required to be present to conduct business or a quorum is at least four or more than half of the number of voting members.
5. Currently 15 voting members
    a. Gerardo Alfonso
    b. John Bean
    c. Don Beaty
    d. Lex Coors
    e. David Kelley
    f. Dustin Demetriou
    g. Ecton English
    h. John Groenewald
    i. John Gross
    j. Matt Koukl
    k. David Meadows
    l. David Moss
    m. Terry Rodgers
    n. Roger Schmidt
    o. Vali Sorell
6. June 30,2021

vii. Voting Members Rolling off in 2021
1. Dustin Demetriou- rolling off as chair and voting member.
2. John Groenewald will be the new chair after July 1, 2021
3. Looking to add 1 new person as a voting member.

g. 2020 Votes
i. Reviewed items the Voting members voted on
ii. All votes were approved by the voting members.

h. Membership Information
i. 68 Provisional Corresponding Members as of 1/2021
1. 2 years, Chair make decision to move to a Corresponding member
ii. 342 Corresponding Members as of 1/2021
1. Can be voting members
2. Can be nominated/ elected as an officer
iii. Make sure that you keep your ASHRAE profile updated! (email is used for committee updates)

iv. Can join TC 9.9 via website.

i. Functional Group Evaluation Sheet.
   i. Was discussed from the Chair breakfast meeting.
   ii. Method for ASHRAE to gather info about what's happening within the committee.

j. TC Reorganization Update
   i. TAC has a subcommittee to implement recommendations of TC re-org Ad Hoc Final report.
      1. TC mergers- 3.2 & 3.3, 8.10 & 8.12, 9.4& 9.8, 7.3 & 7.8, and 10.1 & 10.3… more are in the works.
   ii. Likely not something that will have an impact to TC 9.9
   iii. Question B. McFarlane: Is there another TC that would want to merge with TC 9.9… no indications from RAC.

k. Awards
   i. 2021-2022 Hightower Award Nominations by Wednesday, September 1st.
   ii. Recognizes technical leadership in the TC.
   iii. Looks at the activity over 4 years of activity within the TC.
   iv. Reach out to Dustin for the awards.

l. Additional Announcements:
   i. Work with Nick or Dustin on program track thoughts or recommendations.
   ii. Professional Development Committee PDC is seeking ideas for new ASHRAE Leaning Institute (ALI) courses.

2. Program
   a. Reviewed program on 1/18/2021
   b. 2021 ASHRAE Annual Conference Phoenix, AZ Jun 26-30, 2021
   c. Reviewed Phoenix Tracks
      i. Track 3 would be great for those performing research type work
      ii. Track 5 would be the next best track associated for TC 9.9
   d. Reviewed dates that were presented in the meeting on 1/18/2021 for the Phoenix program.
   e. Contact Nick Gangemi 585-721-8795, nick.gangemi@bureauveritas.com
   f. 7.6 is interested in co-sponsor regarding a presentation on energy management in the data center.
3. Webmaster
   a. Reviewed website link.

b. http://tc0909.ashraetcs.org
c. Invites and other documents are stored on the website.
d. Meeting minutes are provided on the website.
e. Document section has current white papers and old presentations.
f. Bob McFarlane Comment- The TC 9. Webpage has become the gold standard for TC websites.

4. Liaison Reports
    a. Standard 90.1 -Rick Pavlak
        i. Continuous maintenance standard for commercial building energy
        ii. 3 year renewing cycle, last update was in 2019.
        iii. States are generally 1-10 years behind from adopting.
        iv. Typically adopted in the international building code.
        v. 14 addenda since 2019 has been issued.
            1. Most of the addendums are related to modeling in Appendix G or Chapter 11.
            2. Minimum renewable energy requirement for new buildings and substantial additions
                a. 250W/sqft.
                b. Many exceptions are noted on why it isn't required.
            3. 90.1-2022 will include heat recovery for the data center and then site renewables are not required.
        vi. New publication will be in 2022.
        vii. New Addendum has been issued for 1st public review and will have either an ISC or 2nd public review on insulating the hot gas lines for refrigerant systems.
            1. Might have an impact on the Data Center.
        viii. 1st full Committee meeting to happen late January and into early February.
        ix. If anything major comes out of the meetings Rick will note to Ecton for issuing on the website.
    b. 90.4 Liaison Report – Dave Kelley
        i. Similar to 90.4 on a 3 year renewing cycle and last issuance was in 2019.
        ii. Published 4 addendums. Published in October 2020.
        iii. On ASHRAE webpage.
            1. Addendum A: Heat recovery in the MLC calculations.
            2. Addendum B: Renewables in the MLC and ELC

calculations.
3. Addendum D: Clarifications on Diesel Rotary UPS and how to perform calculations in ELC calculations, and an update to the example calculations.
4. Addendum E: How to handle shared systems between a 90.1 building and a 90.4 data center.

iv. Working on other activities in the sub committees.
1. Joint meeting next month to verify ELC inefficiencies are incorporated into the MLC calculations.
2. Mechanical group has published the chiller and CRAH example calculations and working on an example for an indirect evaporative system.
    a. These examples are posted on the website and are available to those that have purchased the standard.
3. Seminar presentation on Feb 10th, 2021 on a 90.4 presentation 10:30- 11:30 am. (Live Presentation)
4. Dustin Demetriou- question on if the access is retroactive for purchasing a copy of the 2019 copy and prior to the website.
5. Bob McFarlane - 90.4 was written into 90.1 in 2019 as an alternative compliance path for data centers.

c. SPC 127- Dave Kelley
i. SPC 127 was published in 2020 and should be available on the website.
ii. Will be updated with addendums as industry changes and will not require a major update vs. a complete revision.
iii. The standard will be under continuous maintenance.
iv. SSPC 127 to be operational by late June.
1. 1st order of business will be to resolve open comments from last full public review and craft addendum to address concerns
v. Available in the web bookstore.

d. AHRI 1360 Liaison Report- Dave Kelley
i. Rating standard for cooling systems in data centers.
ii. 127 is the method of test for rating standards in data centers.
iii. Last published date 2017 and started in May 2020 to update the standard.
iv. New version finalized in Jan 2021 and going out for a

committee vote and then publications.

v. What's been done differently…
    1. AHRI in 2018/2019 re-organized the structure of the organization.
    2. Standard has been opened-up to a wider audience than just the manufacturers.
        a. Only AHRI product committee members can vote on the approval of the standard.
        b. Had more representatives from DOE and Intertek testing lab).
    3. Standard now includes rooftop units and external wall mounted units like a telecom shelter.
    4. The external wall mount units are starting to be marketed to data center computer room applications. Manufactures that have marketing literature noting products is used in a data center will it then have to be rated for 1360.
    5. Ties into 2020 version of SPC-127
    6. Also references ASHRAE 37 for method of test.
        a. ASHRAE 37 hasn't been updates since 2009.
    7. ASHRAE 37 update might be published in 2022. Once published there might be a few items removed from 1360.

e. SSPC 300, guideline 1.6 – Terry Rodgers
    i. Proposed guideline for commissioning of datacenters and will fall under SSPC 300
    ii. SSPC 300
        1. Guideline 0 is the best practice
        2. Standard 202 is the minimum for commissioning
        3. Guideline 1.6 is anticipated to occur in alignment with guideline 0 and 202.
        4. Hope is to publish in 2021.
    iii. Contact Terry Rodgers if you would like to help in the development of the product.
    iv. Approached by LBNL and the HPC workgroup with regards to commissioning high performance computing facilities.
f. MTG.CYB – Ecton English
    i. Multidisciplinary Task Group.
    ii. Spin off from TC 1.5 cybersecurity sub-committee.

iii. Group is focused on partnering with other TC's within and outside of ASHRAE
iv. Working on briefings to get work out about cybersecurity related to building HVAC controls.
v. John Groenewold – JPMC is working on connecting their systems to the intranet. Interested in joining the MTG and can join the MTG. Connect with Ecton to join the group.

5. COVID-19 Impact on the Data Center Industry – John Groenewold
    a. Discussion around the challenges in reaction to COVID and the operation of the data center.
    b. John O'leary – global head of Data centers, Ed Quinn- head of North American data centers.
    c. Had issues in JPMC owned data centers and also colo facilities.
    d. Procurement of Supplies
        i. Bought cots and 3 months of non-perishable foods. Needed to operate 24X7. Required people to be onsite and bought
        ii. Weekly COVID sampling kits.
        iii. If confirmed case, all members of the team leave, and then a whole new team is brought in as a Tiger team to manager break fixes.
        iv. PPE was deployed to performed only breaker fixes
        v. COVID testing has changed the duration and time for team to be removed offsite.
        vi. Nightly electrostatic machines and sprayed every night and or if the tiger team needs to come in.
        vii. Increase in deferred maintenance. Has noticed more issues on the typical regular maintenance issues than the deferred maintenance.
        viii. Reduction in times/ policies to visit construction areas.
        ix. Reduced travel to no travel to other sites.
        x. Racks and other equipment were quarantined for 5 days before rolled into the white space.
        xi. 3rd party maintenance support was restricted and required a 14 day quarantine before traveling between sites.
        xii. Had 51 occurrences since March.
        xiii. Opened 4 new data centers during this time and required sr. approval.
    e. Questions:
        i. Bob McFarlane- how are you handling spray in the data

center. No spray in the data center. If someone needs to go into the data center, there's a requirement for higher level PPE once there was an issue on side. Bioesque is the product used for electrostatic. Has a Clorox machine. Employees are feeling safer with the method.

ii. John Gross- Crews are compartmentalizing and cleaning before and after crews are coming in and leaving.
    1. JPMC Many projects were put off and delayed work and in other instances social distancing and PPE were followed.
    2. Saw more issues in commercial buildings with data centers. JPMC is not going to have data centers in commercial buildings moving forward. They will either be in Colo's or in stand-alone data centers.

iii. Reducing primary injection on breakers due to the number of failures. Looking at using Manufacturer standards vs. using IEEE standards.

iv. How effective has your process been for COVID and how many positive case:
    1. Globally 51 positive cases. After initial case testing was performed and additional means were put into place. Have not had a secondary case occur.
    2. Tiger teams were meant to be staying at home and not going out. Weekly testing is increasing the reliability of staff.
    3. Thermal scan of people along with an affidavit.
    4. No secondary infections at the same location after initial first case.

v. Remote monitoring: most maintenance is performed inhouse. Trial activity of remote monitoring is occurring. Still staffing 24X7. Working on standing up remote monitoring and figuring out cybersecurity. JPMC has several hundred data centers worldwide. Even with a few sites with remote monitoring there are still issues where onsite staff are needed.
    1. Dark Storm Book.. good book on cybersecurity

vi. Bob McFarlane – wrote an article but not published on the topic of remote access and good Data Center infrastructure Management (DCIM) have proved to be very valuable. This basis was on smaller enterprise data centers. Consensus was

the need to have the DCIM/ remote monitoring was a positive.

vii. There's a need to get more selective on the alarms and information that is being presented. JPMC is looking at using their large amounts of data and performing analytics on their big data warehouse.

6. International – Don Beatty
    a. Publications
        i. Started committee in 2004 and had Steve Comstock as an advocated in publications and marketing. ASHRAE separated the marketing and publications
        ii. Moved to Europe and has helped publications in Europe
        iii. Mark Owen took over.
        iv. Steve has recently retired and has a major impact on publications
        v. White paper/Bulletin on Edge computing was agreed to by Steve
        vi. The publication committee has been engaging with Mark Owen to push forward getting the whitepapers/ bulletins and the publications out to the market.
    b. Designing & Operating Data Centers for the Internet of Everything" Mitigating Risk and Optimizing Performance – Dustin Demetriou, Mark Seymour
        i. Championed by Steve Comstock.
        ii. Course made available through ASHRAE Dubai global training center.
        iii. Course put together by many of the ASHRAE TC 9.9 members
        iv. Given in November 2020 and had about 50 attendees.
        v. Cosponsored by Trane.
        vi. Course built off of other previous courses provided by ASHRAE TC 9.9 members.
            1. Included new items such as DCIM, commissioning of data centers, and facility case study.
            2. Mainly attended by Consulting engineers and contractors due to the needed for CEU's and additional information on the topic.
            3. Highly rated based upon feedback and reviewed feedback provided on the course. Preference would like to have more on the facility focus but need to balance

with a focus on IT

vii. Likely going to continue performing the course due to the positive feedback.

7. Industry Engagement
    a. Center of Expertise for Energy Efficiency in Data Centers (CoE) – Steve Greenberg
        i. Sponsored by FEMP and hosted at LBNL.
        ii. Many webinars have been provided along with recordings
        iii. Tools have been provided to perform assessment tools.
            1. IT equipment tool- New tool to the group and free for all.
        iv. Data Center Energy Practitioner (DCEP)
            1. Not free and is a spin-off
        v. Supporting the Federal Office of Management and Budget Data Center Optimization Initiative
            1. Supporting regular meetings
        vi. Updates to tools for air management, IT equipment, Power chain tool, thermal guidelines, how to build a business case for energy efficiency in data centers.
            1. Open source and open to the public
        vii. Website is undergoing updates as it is a bit outdated.
        viii. Can sign up for newsletters through website.
        ix. Questions can go to segreenberg@lbl.gov or CoE@lbl.gov
        x. CoE Resources, News and Training: datacenters.lbl.gov
        xi. Liquid cooling: datacenters.lbl.gov/technologies/liquid-cooling
        xii. Small data centers: datacenters.lbl.gov/small-data-centers
        xiii. DCEP: datacenters.lbl.gov/DCEP
    b. Open Compute Project Update- Nigel Gore
        i. Industry non-profit focused on establishing an open source-hardware-ecosystem for the Data Center market
        ii. Founded in 2011 by Facebook, Rackspace, Intel and now 200+ members and growing. Member companies now also include Microsoft and Goldman Sachs.
        iii. Community of members contribute specifications and guidelines.
        iv. Two groups with Advanced Cooling Solutions groups are the Rack & Power and Data Center Facility groups.
            1. Rack & Power
                a. Focused on immersion, cold plates, and rear door HX.

2. Data Center Facility
    a. New group
3. Advanced cooling Solutions Charter is mostly focused on the global adoption of liquid cooling for data center equipment.
    a. Project to focus on
        i. Standardization and definition of critical interfaces
        ii. Standardization of operational parameters
        iii. Standardization of environmental conditions
    b. Door HX- Sub-Project Overview
        i. Provides guidance on use with Open rack , physical and Interfaces spec, serviceability, regulations.
        ii. Definition of different solutions (infacility water ready for DC or in Air-ready DC)
    c. Cold Plate Sub- Project Overview
        i. Support the open specification standard and definitions of liquid cooed solutions an interface without preventing innovations.
        ii. Current projects:
            1. Lead detection and mitigation
            2. Blind Mate interfaces group.
            3. Anticipated to have commissioning guidance for these designs.
    d. Immersion Sub-Project Overview
        i. Reviewed Approved contributions.
        ii. Reviewed Current projects:
            1. Material &Liquid compatibility: white paper
            2. Immersion Requirements rev 2: whitepaper
4. Advanced Cooling Facility
    a. Facilities Sub-project collaborates on integration of Advances Cooling Solutions (ACS) into Data Center Facilities via Liquid distribution.
    b. Current projects:
        i. Aligning facility cooling solutions in support of liquid cooled IT technologies over the life

of a data center
    ii. Example deployment strategies that can easily be modified to support a spectrum of liquid cooling solutions.
  c. Will be looking at all applications not just liquid cooling.

8. Publications
  a. Edge Technical Bulletin on Edge Computing- Jon Fitch
    i. Big success for TC 9.9
    ii. Carried by many of the main IT media outlets.
    iii. Reviewed the multiple people that contributed and media outlets.
    iv. Technical Bulletin
      1. Make Tech Bulletins different than whitepapers
      2. Short, quick-read format for busy professionals, 8 to 10 pages.
      3. Fast time to market
      4. Actionable information
      5. Give TC 9.9 more visibility to the industry
    v. The Edge technical Bulletin was well received but formatting was too resource intensive.
    vi. Should we continue publishing Technical Bulletins?
      1. Who is our target audience and are the TB's effective at reaching them?
      2. Can we simplify the formatting?
        a. No formal feedback
        b. Publications loved it. More smart device friendly.
      3. Re-use one simple cover page, keep same loose bulletized format?
        a. General is yes.. need to evaluate the depth and level of content.
        b. Could follow the document up with a whitepaper if needed.
      4. Why was the format intensive… condensing content down and long sentences took a bit of time.
      5. The technical bulletin could continue but would need the following to occur
        a. Cover to be the same but adjust the title
        b. Text will need to be the same font

c. Content to fall within a specific format and guidelines.
d. Not getting much support from ASHRAE from post processing.

6. Possible topics
   a. Cold shipping
   b. Liquid cooling
   c. CFD Modeling
7. Authors need to really consider the content and information on front page to grab the reader.

vii. Consider developing guidelines for the writing of the technical Bulletin. Possibly use the existing technical content.
viii. Consider reviewing proposed topics at future meetings.

b. Cold Weather Shipping Whitepaper - Joe Prisco
   i. Voted to proceed with the whitepaper and had just a few minor comments based upon initial proof.
   ii. Anticipation is ready to issue in the next month.
c. Thermal Guidelines for Data Processing Environments, 5th Edition – Roger Schmidt
   i. Primary reason for the update is due to ASHRAE funded research project (1755-RP) on effects of high relative humidity (RH) and gaseous pollutants on corrosion of IT equipment.
   ii. Copper and silver coupon testing strongly recommended twice yearly. Environmental conditions to be adjusted based upon testing of coupons.
   iii. Push in processor powers, and adding in H1 for high density air-cooled class (H1). Recommended upper temp limit of 22°C
   iv. Renaming water cooling classes
   v. Removing duplication between books.
   vi. Several review and updates have been completed; voting members have approved.
   vii. Comments on Proof of book will be completed and sent back to ASHRAE for publication
   viii. Plan is for book to be in the bookstore by summer conference.
   ix. Question: Why the new upper recommended range
      1. How was 22°C derived.
      2. If a cooling failure going from 22°C recommended to 25°C allowable provides a very limited time to ride through a failure with high density equipment. Mainly an

operational consideration.
3. Consider adding a footnote about the guidance provided.

x. What is the definition of High density… generally leaving up to the manufacturer to define.
1. The product is likely not going to fit the typical A2 environment.
2. There is some wording in the text about the considerations for H1.

xi. Bob McFarlane- what is happening with Book 3.
1. A number of reviews have occurred. There's many additional items to be addressed. Individuals have limited amounts of time. Reach out to Dustin to pick-up book 3 as there are multiple items to be updated before the books is ready to go to the voting members.

d. Liquid Cooling Updates – Dave Moss

i. Updates to revised Water Class Changes
1. Whitepaper is intended to update the water class changes.
2. IT equipment must be compliant over the full range to claim compliance. It was originally written as compliant within the range.
3. Range was using the EEHPC group to implement a set of conditions.
4. Change of class to call out the upper range of the liquid temperatures.

ii. White Paper title: Emergence and Expansion of Liquid Cooling in Mainstream data Centers
1. Why move to liquid
2. Approximate When
3. Not a deep discussion on *what* liquid is or *how* to do it optimally.

iii. Reviewed Table of Contents
1. Need to optimize the Thermal interface. Result is that the case temp has to go down.
2. Chip power is increasing
3. Going to be harder and harder for IT equipment vendors to accommodate air temperatures.
4. Lowering of server inlet temps to accommodate the

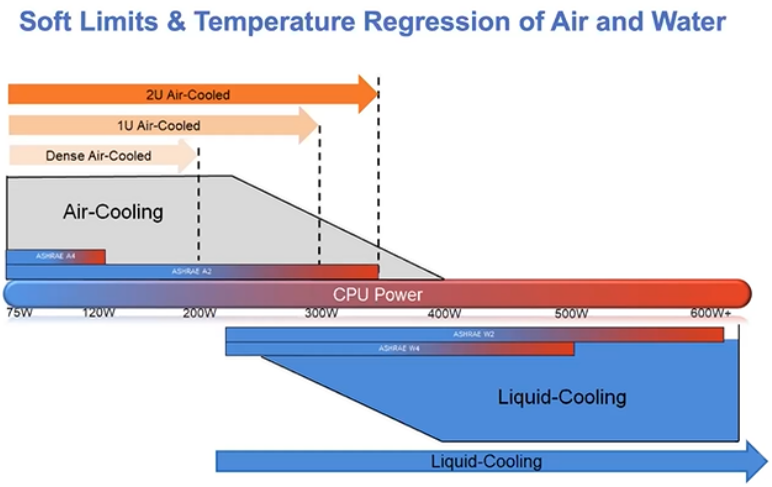
higher chip temperatures/ wattage.

5. Likely to decrease economization with higher wattage temperatures.

iv. Thermal resistance= (case temp minus fluid temp)/ watts handy metric to accommodate higher wattage chips.

v. Inverse metric - “Difficulty to Cool” and moved to a logarithmic graph

vi. In the Power War trend. 2018-2025. Data based upon anticipated products.



e. Hot Aisle Temperature Conditions- John Gross

i. Concern: continued to drive for increased inlet ai temperatures has many owners now asking about occupant safety in hot aisles.

ii. Reference: Thermal Guidelines have long had reference to OSHA Heat Stress Guidelines in the Appendix

1. How many people read the Appendices
2. Most online content references outdoor conditions

iii. Argonne Wet Bulb Globe temperature calculator which is referenced by OSHA guideline for heat stress.

1. Reviewed the conditions encountered in hot aisles
2. Globe temp is a 6” black globe around a temperature sensor.
    a. Rest vs. work break down… nothing in our references as to what constitutes the different types of work based upon the AGCH guidelines.

iv. Are Hot Aisle temps really a problem per OSHA.

1. Reviewed psych chat based upon server and entering air conditions.

2. Competing conditions of environmental operating conditions vs. operating at an elevated temperature.

v. Possibly have a bulleting or other type of publication to review and address the conditions.

f. ASHRAE/IEC/NEMA Collaboration- Roger Schmidt

i. ASHRAE environmental envelopes appear to be in conflict with operating environments with more basic safety standards used to define cables, connectors, appliance couplers, receptacles, etc.

ii. IEC/UL/CSA/NEMA standards for plugs, connectors, wiring, cabling need to be consistent with requirements of maximum environmental conditions of IT Equipment deployed in Data Centers.

iii. New standards in process

1. NEMA Standards Publication WD-10 – High ambient Test Procedure of Wiring Devices – has been approved and is in the process of being published
2. “The test environment shall be specified at 50°C minimum with higher ambient temperature environments starting at 50°C with increments at 5°C intervals (as example 60°C, 65°C, 90°C, etc.) The results of the testing my indicate a need for appropriate construction.”

9. IT Subcommittee

a. Included in the Publications discussion.

Closing Comments

Meeting Ended 2:00PM EST