MEETING MINUTES

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

2024 Annual Meeting

June 23 & 24, 2024

Indianapolis, Indiana

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. T.C. 9.9 DATE June 23, 2024

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

DATE OF MEETING Sunday June 23, 2024 LOCATION Indianapolis Marriott, Indiana ABC, Indianapolis, IN

VOTING MEMBERS PRESENT	VOTING MEMBERS ABSENT
Matt Koukl	Jason Matteson
Mark Steinke	Mark Monroe
John Groenewold	Joe Prisco
Rick Pavlak	Lixia Wu
Mark Seymour	David Quirk
Bob McFarlane	
Paul Finch	

CORRESPONDING MEMBERS PRESENT	PROVISIONAL MEMBERS PRESENT
John Gross	Marelle Paas-O'Brock
Chris Muller	Vimaldoss Jesudhas
Alexandre Kontoyanis	CJ Tang
Matt Archibald	Alex Hubbard
Dustin Demetriou	Esteban Baccini
Jonell Watson	Nicolas Estefanell
Chris Campbell	Marelle Paas-O'Brock
Justin Seter	Mohammad Alkiswani
Wangda Zuo	Nachiket Patwardhan
Vali Sorell	Sankar Padhmanabhan
Ericy Yang	Russell Tipton
Benjamin Petschke	Gregory Alexander
Brad Cochran	Abraham Lee
Mukul Anand	William Martin
Jeshwanth Kundem	
Jim VanGilder	

Michael McKenna	
David McGlocklin	
Guillermo Massucco	
Gerardo Alfonso	
Dan Donahoe	
Ashwin Siddarth	
Ecton English	
David Moss	

GUESTS PRESENT	
Keith Dunnavant	Sugun Tej Inampudi
Franco Datri	Bruno Yuji Kimura de Carvalho
Yaman Manaserh	Michael Donahue
Matthew Kaufeler	Eleazar Rivera
Marcus Hassen	Joshua Martens
Joshua Martens	

ATTENDANCE COUNT	
In Person	52
Virtual	8

PUBLISHED AGENDA

Sunday, June 23, 2024
TC 9.9 Programs, Research, and Handbook
6:00 PM – 8:00 PM EDT
Location: Indianapolis Marriott, Indiana ABC (1)

Microsoft Teams Meeting
https://www.microsoft.com/microsoft-teams/join-a-meeting
Meeting ID: 282 351 545 380
Passcode: h7fwVb

Attendance
https://forms.gle/tD3sKPS83kAZpgwAA

Topic		Time	Presenter	In-Person or Virtual
Introduction	Welcome and Introductions	10	Matt Koukl	IP
Programs	2024 Summer Indianapolis & 2025 Orlando	10	Eric Yang	IP
Handbook	Handbook Update	20	Robert McFarlane/ Jonell Watson	IP
Research	Research Committee Update	30	Mark Seymour	IP
Publications	Publications Update	10	Don Beaty	IP
Programs	Working session on Program Topics	10	Eric Yang/ Matt Koukl	IP
Research	Research Workshop - Topics Working Session	10	Mark Seymour	IP
Liaison Reports	Standard 90.4	5	Marcus Hassen	IP
	Total Time:	105	Minutes	

CALL TO ORDER: 06/23/2024 6:07pm CDT – Matt Koukl

INTRODUCTION – Matt Koukl

- Welcome
- Meeting Housekeeping
    - Hybrid meetings being recorded for purpose of taking Minutes
    - Teams for Sunday & Monday meetings
    - Virtual Host: Vice Chair – Mark Steinke
    - Virtual Co-Host: Secretary John Gross
    - The projector is sharing content in the room
- Attendance Form
    - Both in person and virtual attendees to click and fill out the attendance form
    - You must fill out for each meeting (Sunday/Monday)
        - Same link both days
- Reviewed Agenda

PROGRAMS – Eric Yang

- Conference has 1 panel and 1 seminar
    - Panel was this afternoon
    - Seminar is on Tuesday
- Program types
    - Technical papers
    - Conference papers
    - Extended Abstracts
    - Seminars, Workshops
    - Panels, Debates, Forums
    - 130 total proposals for the conference, with 74 accepted
        - High rate of acceptance
        - Workshop success rate is highest
- Technical papers
    - Requires 9 months of submission and review time
- Conference paper is easier pathway to approval
    - Requires 4 months of submission and review time
- Extended Abstract
    - Intended to be preliminary research
- Upcoming Conferences
    - Submission deadlines for Orlando
        - August 2
        - October 4
    - Tracks related to TC 9.9
        - Fundamentals and Applications
        - HVAC&R Systems and Equipment
        - Refrigeration and Refrigerant
        - Energy Storage and Grid Resiliency
        - Pathways to Building Carbonization
        - Artificial Intelligence
        - Industrialized Construction: Opportunities and Challenges.
- Program Ideas

    - Fundamentals and Applications
        - Liquid Cooling Design Consideration and Challenges in Data Centers
        - Liquid Cooling Water Quality and Filtration Requirements (in progress)
        - Case Study of Recent Life Cycle Assessment in Data Centers (in progress)
    - HVAC&R Systems and Equipment
        - Modular Electrical Room Design in Data Centers
        - Thermal Storage Requirement for Liquid Cooled Data Centers
        - Single-phase and Two-phase Immersion Design for Ultra High-Density Deployment
    - Artificial Intelligence
        - Data Center Design Challenges
    - Industrialized Construction: Opportunities and Challenges
        - Prefabricated Construction in Data Centers
    - LCDC – continuation of Indy presentation
    - TCS and FWS requirements
- Review of Seminar and Workshop chair responsibilities
    - Develop a detailed program abstract and identify speakers
    - Upload the required information on the session and speakers to the conference website preview speaker presentations to check that they meet the ASHRAE conference presentation policy
    - Make sure the speaker presentations are uploaded prior to the conference coordinate presentations to minimize overlap and make sure the timing is correct introduce and monitor session at the conference assist authors in identifying learning objectives and completing Q&A
- TC 9.9 program chair can help coordinate co-sponsorship by additional TCs

HANDBOOK – Bob McFarlane & Jonell Watson

- Background
    - Chapter 20
    - Physical copy of handbook will still be available, but ASHRAE is switching to PDF or online version as part of the standard membership
    - Everything in the PDF will be in the online version
        - ***Only the PDF and print version are considered Legal Documents in the event of litigation.***
- General
    - One of four publications
    - We are in Applications
    - Published on a 4-year cycles
    - All revisions are on a volunteer basis
- Purpose
    - Tutorial for New Engineers
    - Reference for Experience Engineers
    - Design Guideline for those new to data centers
    - To alert people to “what they don’t know”
    - To push manufacturers to standardization
- Current Status
    - Last published in 2023
    - Revision cycle has already started
    - Draft revisions due April 1, 2026 to prep for 2027 edition

    - Must advise ASHRAE by Jan 2025 on scope of intended revisions
- Today's Priorities
    - CH 20 Cross check – mandated by ASHRAE
        - What is covered in other handbook volumes or chapters?
        - Due to massive increase in content in handbooks under last revision cycle
    - If similar, who should cover?
        - Bob and Jonell will coordinate with other TCs once we identify where there is overlap
        - Just need TC members to identify book and chapter that covers overlapping information
- Need primary reviewers for all CH 20 topics, but can wait until Jan 2025
    - 32 current volunteers, but some are trying to cover too many
        - Trying to spread to keep it 5-8 topics per person
    - Need industry experts
    - New participants
    - People willing to review
- Why Volunteer?
    - Contribute to the society and support your industry
    - Be a role model for mentees and junior engineers
    - Experience developing industry text
    - Bragging rights
    - Major contributors receive a personalized handbook and published recognition for new material or significant revisions
- Primary Reviewers
    - Subject Matter Experts
    - 2-10 hours per topic
- Secondary Reviewers
    - Support to primary
    - 2nd & 3rd set of eyes
    - Review of clarity
    - Smooth writing
    - 5-10 hours per topic
- Signup spreadsheet will be passed around in the room
- Signup spreadsheet is on the website, but you have to scroll down
    - Also accessible via http://tc0909/ashraetcs.org "TC 9.9 2024 summer meeting presentations and information"
- Topics identified by number
- Email Bob or Jonell if desired
- Sign-up Sheet #1
    - Cross-check process
    - Sample sign-up sheet displayed
- Won't be looking for
- Everything done on the authoring portal
    - Tracked changes automatically enabled
    - All comments visible to all
    - Revised illustrations require permission
- Contact Bob or Jonell with questions
    - rmcfarlane@smwllc.com
    - Jonell.watson@accenture.com

RESEARCH COMMITTEE – Mark Seymour

- 1913 – Study of the Corrosion Impact on Information Technology Equipment in Data Centers Located in Coastal Regions with High Sea Salt Concentration
  - RAC requested changes to the work statement
  - Changes were made and are awaiting approval to send out to bid
    - Expecting updating at RAC meeting
  - Motivation is to learn the impact of sea salt corrosion
  - Tasks And Deliverables
    - Task 1: perform and document a detailed literature review
      - Deliverable: a report that summarizes the literature review
    - Task 2. Develop a test facility capable of monitoring and controlling dry bulb temperature, dew point, air flow velocity, sea salt concentration, and time of exposure that mimics the environmental conditions of data centers in marine environments
      - Deliverable: a report that summarizes the test facility design and method to vary the various test parameters over the range of environmental parameters exhibited by data centers in coastal regions
    - Task 3. Experimentally characterized copper and silver corrosion of the test coupon samples using conditions appropriate to cover the ASHRAE thermal guidelines
      - Deliverable: a report that summarizes corrosion test results over the range of environmental parameters experienced in coastal data centers highlight those parameters or group of parameters having the most destructive effect on it equipment reliability include the effect of makeup air in your comments regarding the test results
    - Task 4. Understand and perform experiments to elucidate the relationship between the rate the change of humidity on the corrosion rates of copper and silver for direct air side economizer these changes can occur in minutes or hours depending on the weather patterns of the data center location and would impact the it equipment housed within the data center
      - Deliverable: a report on the effect that rate of change of humidity (wet/dry cycles) has on the corrosion of the it materials
    - Task 5. Develop an updated set of thermal guidelines for coastal locations of data centers and specific guidelines that may focus on those data centers where resiliency may be the primary operational goal and not energy efficiency
      - Deliverable: a report of the thermal guidelines for coastal data centers with those environmental conditions providing the highest reliability for it equipment in addition a set of guidelines for coastal data centers where resiliency is the primary operational goal should also be reported
    - Task 6. Provide guidance on what tools to use for quantifying corrosion in coastal data centers in addition provide recommendations on where those measurements should be made
      - Deliverable: a report summarizing the tools for measuring corrosion in data centers and the optimum location for those measurements
  - Project Monitoring Subcommittee
    - Chris Muller, Chair – AAF International, member TC2.4
    - Rui Zhang – ORNL, member of TC9.9
    - Kyung-Ju Choi, PhD – LMS Technologies, ASHRAE TC2.3 Program Subcommittee Chair

        - Vali Sorell – Oracle, member of TC9.9
        - Michael Corbat – Rensa Filtration, TC2.3 Voting Member
- 1972 – Data Center Direct-to-Chip Liquid Cooling Resiliency – Failure Modes and IT Throttling Impacts
    - At the RTAR stage – Accepted May 13, 2024 (received unanimous support from all related TCs
    - Objectives
        - Research failure system design for air/liquid hybrid and liquid cooled equipment using computer models and empirical data
        - Examine ITE power and thermal capacitance impact on rate of rise and IT throttling time
        - Look at impact of liquid cooling S classes on IT throttling time
        - Look at impact of secondary loop delta T on IT throttling time
        - Look at impact of liquid cooling percentage on IT throttling time
        - Look at impact of percentage of secondary loop failure on IT throttling time
        - Conduct a comprehensive analysis modeling and testing of 30 plus combinations look at energy impact of specific liquid cooling systems and S classes versus air cooled baseline metrics to include: MLC, LLC, PUE, and TUE
    - Proposed Timeline
        - Now to June 28: continue review at author/TC research subcommittee level
        - July 1 to 3: updates to WS
        - July 5 to 19: review by TC 9.9 RAC research liaison
        - July 22 to 25: further updates to WS
        - July 26 to August 9th: review and votes by TC 9.9, TC 4.10, TC 7.6
        - Aug 10 to 14: minor changes as needed to accommodate TC'S
        - Aug 15: submit to MORTS (RAC)
    - Intention to get back to RAC with a Work Statement by August 15
        - Need to help solicit and demonstrate industry co-sponsorship
    - Estimated cost of research is $300k (large by ASHRAE standards)
        - Can be financial, equipment, field data support, etc
- Volume Calculations for ITE Cooling Appliances Using A2Ls
    - ASHRAE 15-2022 and UL/CSA are not intended for data center use
    - UL/CSA 60335-2-40 uses 4' above ceiling
        - 4' must be used in the calculation for dispersal volume
        - No one knows where this comes from
    - Objectives
        - Build a CFD geometric model based on the parameters in U101.DVN.8.1
        - Evaluate the effectiveness of the dilution of the refrigerant charge specified in ASHRAE standard 15-2022, the air flow pattern into the return air, comparing these results to the safety metrics established in standard 15-2022
        - If the base model identifies the effective volume as well mixed at the prescribed 4 foot limit, raise the height
        - If the base model shows a dead airspace below 4 foot limit lower the height to determine and verify whether there is a height with all acceptable circulation
        - The expectation is that the four foot limit is too low and that increasing the height limit above the return air opening is viable thus the objective is to run successive models increasing the height limit until the total volume does not mix and a boundary layer of room air appears in the CFD model
    - Proposed Authors
        - Rick Pavlak
        - Ben Dolcich

        - Bill Kinas
    - Data Center implementation of A2L has been deferred to 2027, thus majority of deployment effort has been focused on residential and commercial as it must be done in 2025
- Guidelines for Data Center External Airflow CFD Modeling
    - With increased size and power density of data centers more external CFD modeling is needed
    - Need to account for Terrain
        - Digital mapping tools can provide 3D representation of the terrain
        - May need to replace buildings with simulation objects
    - Challenges
        - Multiple wind directions, and which to run?
        - Variable external environment
        - Turbulence
            - Currently being done usually with Time-Averaged (RANS) model
            - Does not account for large eddy currents
            - Need to understand effects on accuracy
    - Modeling Details, such as effect of fans to create swirl, impact of wind on plumes, etc
    - Modeling Humidity
    - Will check with other TCs such as 4.7 and 4.10 but do not believe there is overlap

- 1956-WS Compact CFD Modeling Guidance for Thin Flow Resistances (w/ TC 4.10)
    - Follow up to previous ASHRAE RP
    - Focused on modeling perforated tiles, perforated doors, and louvers
        - Intent is to make a simplified representation of commonly used complex geometries
    - Returned with comments from RAC
        - Believe it's too detailed for reviewers of WS on RAC
        - Did not believe it was very much money for the level of effort anticipated
        - Will revisit with RAC
- Flow Velocity Limits for Erosion Control
    - Reviewing rationale for 1.5 m/s vs 3.0 m/s
        - Energy vs Erosion over a time domain
        - Reference for 1.5 m/s in TC9.9 documentation has been removed
    - Will continue discussion in IT Subcommittee
- IT Subcommittee meeting tomorrow
    - Open attendance from 9-11:10am

PUBLICATIONS – Don Beaty

- Encyclopedia has gone live
- Working on transition of content from books to online
- Will discuss process for updating in tomorrow's meeting in much more detail
    - We will break up into groups and have tasks during the meeting
- Working session and tasks from Chicago meeting were very beneficial helping to formulate the foundation for the online version work.

PROGRAM TOPICS WORKING SESSION – Eric Yang

- Ideas

- Russ Tipton
  - PFAS and Application to HFOs
  - A2Ls – Insurance and Building Codes
  - RCLs on refrigerants
  - Are all PG25's created equally? (Research Topic)
  - Monitoring the health of the TCS fluid
  - How much flushing and water consumption
- Sankar Padhmanabhan
  - Wetted Materials List updates
  - There is an RTAR already started on this, run by Tim Shedd
- Dave McGlocklin
  - Tier Redundancy in Liquid Cooling
  - Regulatory landscape of Liquid Cooling Deployments
  - GTIC (Global technical interaction committee) interacts with international bodies
- Unknown
  - Airflow management in DC (workshop)
- Bruno de Carvahlo
  - Heat Recovery in data centers
- Paul Finch
  - Best Practices around aisle containment
- Mark Seymour
  - Heat rejection on high density data centers (seminar)
  - Use of 2-phase materials for creating a buffer for LC equipment for ride-through
- Matt Archibald
  - Reference designs and S-classes
- Matt Koukl
  - Forum to look at "what's in and what's out" on liquid cooling
  - Details of FWS and TCS design, fluid and materials opportunities and challenges

LIAISON REPORT

- 90.4 – Marcus Hassen
  - Will be adding 5 new members in July
  - Voting member increase from 21 to 22
  - Has been a focus on proposed TPS Change
    - Intent to include decarbonization due to ASHRAE efforts
    - Coming out of public review period
    - Working on a draft response to 13 substantive comments
  - 90.4 will support WS-1732
  - Industry Trends – want to interface with IT Subcommittee on including ITE efficiency gains
  - CEBD (Center of Excellence for Building Decarbonization) has been influential in recent activities
    - Looking for carbon reporting to be included
    - ASHRAE 240 and 242 – new standards for GHG emissions (Operations and Life Cycle)
  - Marketing Working Group
    - Presented at Uptime Institute Spring Member Network Conference – Raleigh May 15th.
    - Biggest topics
      - How to account for increased power densities

        - Are you going to cover ITE?
    - Working Group Chair position is Open
- ESG Working Group
    - Main group which liaises with CEBD, working on TPS update
    - Conducting workshops with GBI (Green Building Initiative) looking to reference 90.4 to enhance DC requirements
- Electrical Working Group – focused on decarbonization at this time
- Mechanical Working Group
    - Has been working hard on water regulations
        - Working on tools to evaluate tradeoff of power vs water
- 2025 Publication
    - Drivers are
        - TPS scope change
        - Working group initiatives
        - ASHRAE decarbonization harmonization

MEETING ADJOURNED: 06/23/24 8:08 pm CST – Matt Koukl

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. T.C. 9.9 DATE June 24, 2024

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

DATE OF MEETING Monday June 24, 2024 LOCATION Indianapolis Marriott, Indiana E (1), Indianapolis, IN

VOTING MEMBERS PRESENT	VOTING MEMBERS ABSENT
Matt Koukl	Mark Monroe
Mark Steinke	Lixia Wu
John Groenewold	Jason Matteson
Joe Prisco	
Paul Finch	
Rick Pavlak	
David Quirk	
Robert McFarlane	

CORRESPONDING MEMBERS PRESENT	PROVISIONAL MEMBERS PRESENT
Ben Dolcich	Russell Tipton
Ed Eaton	Tom Ruggierio
Mark Malkin	Rani Doughty
Chris Campbell	Pardeep Shahi
Roger Jones	Brad Cochran
Mark Fisher	Nicolas Estefanell
Mark Pavol	Annette Dwyer
Dustin Demetriou	
justin seter	
John Gross	
Gerardo Alfonso	
Michael McKenna	
Eric Yang	
John Bean	
Sang Lee	
Ben Dolcich	

Madhusudan Iyengar	
Mukul Anand	
Matt Archibald	
Jonell Watson	
Benjamin Petschke	
Don Beaty	
Tom Davidson	
Carlos Lisboa	
Chris Muller	
Michael Ohadi	
Melissa Olson	
Adenilson Belizario	
Brad Chen	
Charles Freda	
Guillermo Massucco	
Joel Rutledge	
Timothy Startt	
Gwenn Ivester	
Ali Heydariz	
Ashwin Siddarth	

GUESTS PRESENT	
Ryan Oddo	Joshua Martens
Galen Gerig	Hanjong Yoo
Panos Fykas	Rohit Dhumane
Ella Moss	Chuck Lehn
Mike Saunders	Marc Sorge
Yaman Manaserh	Tracey Jumper
Timothy Ahn	Steve Harrington

ATTENDANCE RECORD	
In Person	63
Virtual	26

PUBLISHED AGENDA

Monday, June 24, 2024
TC 9.9 Main Meeting, IT & Publications Workshops
2:30 PM – 7:00 PM EDT
Location: Indianapolis Marriott, Indiana E (1)

Microsoft Teams Meeting
https://www.microsoft.com/microsoft-teams/join-a-meeting
Meeting ID: 279 454 711 503
Passcode: DqcYw7

Attendance
https://forms.gle/tD3sKPS83kAZpqwAA

Topic		Time	Presenter(s)	In-Person or Virtual
Welcome	Welcome, Agenda Review, Hybrid Meeting Etiquette	5	Matt Koukl	IP
Introductions	Introductions of All In-Person Attendees, Officers, Voting Members and Subcommittee Chairs	10	Matt Koukl	IP
TC Activity	Status of Voted on Topics	5	Matt Koukl	IP
Membership	Details of TC 9.9 Membership	5	John Groenwold	IP
	Special Topic	5	Matt Koukl/Ben Dolcich	IP
Handbook	Handbook Update	10	Robert McFarlane/ Jonell Watson	IP
Liaison Reports				
	Standard 90.1	5	Rick Pavlak	IP
	SPC-127 / AHRI 1360	5	David McGlocklin	IP
	Decarbonization Task Force	5	Lixia Wu	IP
	International	5	Don Beaty	IP
Webmaster	Website	10	Ecton English	IP
Research	Research Update	10	Mark Seymour	IP
Break		20		
IT Subcommittee	Liquid Server Thermal Template	15	Dustin Demetriou	IP
	S-Class Definition and Addition of S20/25	15	Paul Artman	IP
	Thermal Guidelines Tech Brief	10	Mark Seymour/ Dustin Demetriou	IP
	IT Equipment Power Trends	10	Mark Steinke	IP
	Chip BC for Cold Plate	5	Mark Steinke	IP
Publications	ASHRAE TC 9.9 Data com Encyclopedia	30	Dustin Demetriou	IP
	Encyclopedia Worksession	60	All	IP
	Total Time:	245	Minutes	

CALL TO ORDER: 06/24/2024 2:33pm CDT – Matt Koukl

INTRODUCTION – Matt Koukl

- Welcome
  - MK reviewed agenda
  - MK reviewed website
- Housekeeping
  - MK notified the attendees the meeting is being recorded for the purpose of taking Minutes.
  - MK reviewed virtual attendance etiquette
  - MK reviewed attendance recording
- Attendance Form
  - Link: https://forms.gle/wjboSPgW6yQecKsW8
  - Both in person and virtual attendees to click and fill out the attendance form
  - Must fill out for each meeting (Sunday/Monday)
- Webpage
  - MK reviewed webpage (http://tc0909.ashraetcs.org)
- MK read TC 9.9 Overview
- Introduction
  - In-person attendees introduced
- MK reviewed recent board votes
  - RTAR for Liquid Cooling Resiliency – Approved
  - RP-1956: Compact CFD Modeling Guidance for Thin Flow Resistances - Approved

Membership – John Groenewold

- MK reviewed membership links on TC9.9 website (http://tc0909.ashraetcs.org/membership.php)
  - Discussed the process from Provisional to Corresponding membership
- John Groenewold (JG) reviewed membership process, from submission to provisional corresponding member, to corresponding member.
- Board & Chairs – 12 currently. Looking to add a few more. Contact MK
  - Corresponding Members: 365
  - Provisional Corresponding Members: 139
  - YEA: 67
  - Total: 518
- Remembrance of Dave Kelley

HANDBOOK - Bob McFarlane

- ASHRAE Handbook has been used in college texts and as a reference in litigation
- Published on a 4-year cycle
- Contributions on a volunteer basis
- Advise ASHRAE on scope of changes by April 2025
- Sign-up Sheet #1 (First task – cross check CH20 content with other chapters) o ASHRAE wants to reduce book size and duplication of content from other chapters o BM and JW will coordinate with other TC's on the identified cross-referenced content • Sign-up Sheet #2 (Second task – Primary Reviewers for topics)
    - Grayed out rows have sufficient coverage
    - Figures, tables, references must be reviewed
    - Goal to identify if extensive revisions are needed
- Sign-up sheets will be available on website
    - Can also email Bob or Jonell directly
        - Bob McFarlane: mcfarlane@smwllc.com
        - Jonell Watson: jonell.watson@accenture.com
    - Prefer people only volunteer for between 1-5 topics

LIAISON REPORTS - Rick Pavlak

- Reviewed Energy.Gov summary of adopted energy codes
    - States shown in white are "home rule" states so the adopted code is by municipality
    - Energy Code indicates the adopted code and the equivalent.
        - Ohio used as an example where amendments make the energy equivalent in performance to 90.1-2016 despite 90.1-2019 being adopted.
- 90.1 - Rick Pavlak
    - Voted out TPS update to include Decarbonization
    - There is contention around keeping 90.1 focused on energy and not morphing to another metric
- SSPC 127 – Dave McGlocklin
    - Air Cooled and Liquid Cooled subcommittees
    - Focus is on Liquid Cooling activities
    - Meeting tomorrow from 8-12
    - Should have a Liquid to Liquid CDU MoT out for public comment before Orlando
- AHRI 1360 – Dave McGlocklin
    - Working with 127 to harmonize with 1360 on rating requirements
    - Closely aligned with air cooling efforts
- Decarbonization Task Force – Lexia Wu
    - Not present

RESEARCH – Mark Seymour

- WS-1913: Study of the Corrosion Impact on Information Technology Equipment in Data Centers Located in Coastal Regions with High Sea Salt Concentration
    - RAC asked for relationship to HVAC industry. We responded with information about the Edge Industry
    - Confirmed this morning it is approved to be sent out for bid. Believe there will be budget to go out to bid this fall
- RTAR-1972/WS-1972: Data Center Direct-to-Chip Liquid Cooling Resiliency – Failure Modes and IT Throttling Impacts – Tom Davidson

  - TC4.10 and TC7.6 Co-Sponsored research
  - Submitted to RAC after unanimous support from all related TCs
  - Approved in May to proceed to work statement
  - Working on the work statement to submit by August
  - Objectives
    - Research failure system design for air/liquid hybrid and liquid cooled equipment using computer models and empirical data
    - Examine ITE power and thermal capacitance impact on rate of rise and IT throttling time
    - Look at impact of liquid cooling S classes on IT throttling time
    - Look at impact of secondary loop delta T on IT throttling time
    - Look at impact of liquid cooling percentage on IT throttling time
    - Look at impact of percentage of secondary loop failure on IT throttling time
    - Conduct a comprehensive analysis modeling and testing of 30 plus combinations look at energy impact of specific liquid cooling systems and S classes versus air cooled
    - Baseline metrics to include: MLC, LLC, PUE, and TUE
  - Have to anchor to energy per ASHRAE 5-year plan. Coordinating with 90.4
- Development Options – Mark Seymour
  - Volume calculations for ITE Cooling Appliances using A2Ls
    - Not sure of the source of the 4' plenum height in the current UL/CSA standard
  - Proposing CFD modeling to validate what the height should be
    - Looking for industry sponsors
  - Guidance for External CFD Airflow Modeling
    - Working on writing the RTAR
    - Proposing that ASHRAE should be providing guidance on the creation of CFD models for external airflows
    - Contact Mark Seymour if interested in participating
- TC 4.10 CFD Modeling Guidance for Flow Resistance
  - Determine best practices for modeling flow outlets such as perforated panels and similar devices (ie not limited to floor panels) with Compact CFD modeling tools
- Flow Velocity Limits for Erosion Control
  - Need to evaluate source of velocity references for smaller diameter piping
  - Focus is to understand what is appropriate for this service considering materials, required cleanliness of fluid, and other factors
- Contact Mark Seymour (mseymour@cadence.com) to get involved with any of the above efforts

WEBSITE – Ecton English
- Reviewed data from website activity
  - Seem to have user access to the website aligning with TC membership

INTERNATIONAL – Don Beatty
- BICSI and TIA working on updates to documents
  - BICSI-002 Data Center Design and Implementation Best Practices
  - TIA-942
    - Recommending use of ASHRAE Recommended Range for temp and humidity
    - Recommended adoption of Immersion Cooling Guidelines
  - Additional information will be posted on website

BREAK - 3:37pm, reconvene at 4:00pm

IT SUBCOMMITTEE AND PUBLICATIONS – Dustin Demetriou

- Numerous topics covered this morning in the subcommittee meeting, but will only summarize three here
    - Liquid Cooling Resiliency Research - Dave Quirk
        - Hugely impactful and important research
        - Looking at a variety of system disruptions/transient conditions
        - FWS side
        - TCS side
        - Thermal energy storage
        - CDU failures/failovers
        - What are the server responses to these upsets?
        - What are the reliability impacts from these upsets?
    - Idea is to develop an X-factor for liquid cooling
    - Lack of guidance is resulting in a wide range of solutions
    - Liquid Cooling Server Thermal Template – Dustin Demetriou
        - Intent of template is to provide a simple, comprehensive reporting format for thermal information for facility planning
        - Intent is to be flexible for appliances or servers
        - Desire getting it to the voting members within a week
    - Expanding S-Classes – Paul Artman
        - Review of the existing S-classes from the Liquid Cooling Design Guidelines
            - S50 – telco, edge, heat recovery
            - S40/45 – legacy
            - S30/35 – the new need based on accelerated computing
        - Proposed adding S20/25
        - Consensus for future proofing is this is a good decision
        - Debate about adding S10/15

ENCYCLOPEDIA UPDATE – Dustin Demetriou

- Plan to move away from books and more to a Wiki-style approach to providing content
- Subscription sign up is still small
    - $24 for members, $33 for non-members
    - Link to subscribe has been added to Teams chat
- TC acknowledges it is currently not easy to find and is working with ASHRAE to correct the issue
- Reviewed the current encyclopedia site
    - Three current publications have been converted to the site
    - Full-size graphics
    - Multiple navigation methods
- Steps
    - Get the material online
    - Goal is NOT to put each book online, but rather to transfer the information into an aggregation of content without similar content covered in multiple locations/publications
    - In the Winter Meeting we used a working session to take the existing content and cross reference where we categorized the content in all books

    - Result is 6 topics for the encyclopedia
    - 214 chapters across 3 books has been mapped to 31 categories and we will continue mapping in the meeting tonight
    - Focus is to simplify the access to content
- "ASHRAE Datacom PDF Series" has copies of all 14 books in PDF form as view-only
- Extensive testing on multiple platforms
- We understand there is language translation, but we have not tested
- Intent will be quarterly updates reviewed and approved by TC9.9
- There will be version control as part of the process, as TC9.9 recognizes the content of the books is referenced in legal documents and contracts
- Recognition some of the publication content is out of date and not worth aggregating to the online platform
- Plan to push out the S-class updates and the Thermal Template this year, as well as get content aggregation online
- TC will be issuing position papers and whitepapers separately through the website for free, though all content will end up in the encyclopedia
- Approach going forward
    - Roles
        - Lead Site Manager/Editor – Dustin Demetriou
        - Support Site Manager/Editor – Ecton English
        - Site is focused on the Sharepoint management
    - Topic Management
        - Content Manager
            - Change Control Documentation Manager
            - Will notify the site manager of changes
            - Subject matter expert in the Topic
                - Responsible for getting Content Editors and Developers
        - Content Editor
            - Integrates information into the topic
        - Content Developers
            - Content creation
            - Integration of books
        - Editors and Editors can be fluid positions, but Content Manager is intended to be a longer-term role.
    - Contact Matt Koukl with availability to support the effort
- Content Managers
    - Facility Design Considerations – John Groenewold
    - ITE Design Considerations – Mark Steinke
    - Environmental Guidelines - TBD
    - Cooling Technologies – John Gross
    - Energy Efficiency – Don Beatty
    - Everything Else – Matt Koukl
- Breakout Session
    - Group based on Topic in the room
    - Regroup the material in the documents to align content
    - Do not create new content or edit content, simply regroup and structure the document into a cohesive order

PRESENTATIONS – John Gross & Paul Artman

- Design Considerations and Challenges on Liquid Cooling Applications of Data Centers - John Gross
- Advancements in Liquid Cooling Applications for Data Centers - Paul Artman
    - Drivers for liquid cooling and temperatures for S-class
    - Currently the floor is set to S30
    - Heat Reuse challenge is managing the workload and the processor loading as it is currently very transient
    - What is appetite for flow control and dT management - difficult to adopt due to adoption at scale, interoperability, and control loop challenges
    - Trend to do liquid to air due to supply chain and readiness issues, but is challenging to get to lower S temps

IT SUBCOMMITTEE – Dustin Demetriou

- IT Hardware Energy Efficiency - Tim Shedd
    - Want to try to characterize the energy efficiency of a server
    - Have been efforts for 20 years (ITUE, for example) to do this, but with less than satisfactory results
    - Significant number of factors affecting energy efficiency and percentage used for compute, making it difficult to characterize
    - Does increase in power actually yield higher efficiency?
    - Efficiency of processor (FLOPS/W) is rapidly improving
    - Software lack of evolution partially negates the gains from the hardware
    - Utilization rate of server impacts efficiency
    - Disaggregated power supplies (rack-level power supplies rather than chassis-level) is showing gains in efficiency, but with tradeoffs
    - Server fan efficiency gains over the last few generations
    - Need to review the solution holistically to determine if the entire end-to-end solution is actually more efficient
    - There is a lot of work going on around adaptive cooling and active power management
    - Server customers care intensely about power consumption/efficiency
- Liquid Cooling Book
    - Book approved by committee and sent to ASHRAE for publication
    - Converted to online format for publication via SharePoint
        - Going through mechanics to get it running
    - Over 200 comments addressed
    - Mostly new graphics
    - Seminar 63 - revealing the book
    - Overview of the key new content
- • S-Class
    - Refer to above under Presentations by Paul Artman
- Liquid Cooling Redundancy RTAR
    - Refer to above under Research by Dave Quirk
- Wetted Materials RTAR
    - Refer to above under Research
- Silicon Boundary Conditions/Power Trends - Mark Steinke
    - Overview of the disruption of silicon power/thermal trends
    - Need to update roadmaps
    - Add information around workload impacts
    - Update rack-level trends

    - Update Power Trends Book
    - Produce the Thermal Reporting Template for the Boundary Conditions
    - Need to execute quickly, probably going straight into the Online Format
- Sea Salt Corrosion Research - Roger Schmidt
    - Finally approved after 4 years
    - Putting out bids in the next 3 months (6 potential bidders)
    - Probably a 2-3 year project
    - Co-sponsored by TC 2.3 (Gaseous Air Contaminants), TC2.4 (Particulate Contaminants)
    - No specific content by ASHRAE on Marine Environments in general, despite 50% of human population living in Marine Environments.
        - RAC have recognized the lack of information on Marine Environments and feel this will be more widely applied.

CALL TO CLOSE: 06/24/24 6:15 pm CDT – Matt Koukl