



MEETING MINUTES

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

2025 Winter Meeting

February 9 & 10, 2025

Orlando, Florida



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 February 9, 2025

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

DATE OF MEETING Sunday February 9, 2025 LOCATION Hilton Orlando Room: Lake Highland AB (lobby level)

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

CORRESPONDING MEMBERS PRESENT	PROVISIONAL MEMBERS PRESENT
John Gross	Santosh Shekar Mudunur
Ed Eaton	Matthew Kaufeler
Mohammad Alkisiwani	Amir Ibraheem
Andrew Jenkins	Alireza Behfar
Wangda Zuo	Thomas Kolpasky
Jonell Watson	Eric Self
Brad Cochran	Sankar Padhmanabhan
Chris Campbell	Roger Huggins
Alexandre Kontoyanis	Alkesh Solanki
Vali Sorell	Stephen Mathai
Don Besty	Gregory Alexander
David McGlocklin	Will Martin
Michael McKenna	Russell Tipton
Pardeep Shahi	Alan Neely
Ecton English	Nitin Karwa
Timothy Startt	Joe Furman

Jerrod Buterbaugh	CJ Tang
Carlos Lisboa	Donovan Aguirre
Jim VanGilder	
Shlomo Novotny	
Dustin Demetriou	
Ashwin Siddarth	
Gerardo Alfonso	
Ben Dolcich	
John Groenewold	

GUESTS PRESENT	
Jie Cai	Ashley August
Daud Nosham	Justin Todd
Chris Newton	Dan Holley
Krista Hubbs	Anke Beyer-Lout
Georges Saade	Eric Peterson
Viswanathan Ganesh	Inderjit Singh Bahadur Singh
Donghun Kim	Pooya Navid

ATTENDANCE RECORD	
In Person	52
Virtual	11

PUBLISHED AGENDA

Sunday, February 9, 2025

TC 9.9 Programs, Research, and Handbook

6:00 PM – 8:00 PM EST

Location: Hilton Orlando Room: Lake Highland AB (Lobby Level)

Microsoft Teams Meeting

<https://www.microsoft.com/microsoft-teams/join-a-meeting>

Meeting ID: 252 046 633 687

Passcode: D5Hw6aM9

Attendance

<https://forms.gle/HR88B7MSv2fTHHk37>

Topic		Time	Presenter	In-Person or Virtual
Introduction	Welcome and Introductions	10	Matt Koukl	IP
Programs	2025 Orlando & 2025 Summer Phoenix	20	Eric Yang	IP
Handbook	Handbook Update	15	Robert McFarlane/ Jonell Watson	IP
Research	Research Committee Update	30	Brad Cochran	V
Research	Research Workshop - Topics Working Session	10	Brad Cochran	V
Total Time:		75	Minutes	

CALL TO ORDER: 02/09/2025 6:01pm EST – Matt Koukl

INTRODUCTION – Matt Koukl

- Welcome
- Meeting Housekeeping
 - Virtual meeting etiquette
- Attendance Form
- Housekeeping
 - Virtual Host: Mark Steinke, Vice-Chair
 - Virtual Co-Host: John Gross, Secretary
- Reviewed Agenda (see topic summaries above)

PROGRAMS – Eric Yang

- Orlando Conference
 - Only one (1) seminar this time (co-sponsored)
 - Seminar 52, Wednesday 8-9:30am
 - Five (5) sessions were submitted, but none accepted
 - Very low acceptance rate of debates and forums as well
- Phoenix
 - Plan to resubmit the following for Phoenix
 - DOE COOLERCHIPS update
 - Liquid Cooling Filtration and Water Quality
 - Liquid Cooling TES Resiliency
 - Tracks and Ideas
 - Fundamentals and Applications
 - Liquid Cooling Water Quality and Filtration Requirements
 - A2L – IN Progress (Mukul)
 - HVAC&R Systems and Equipment
 - Modular Electrical Room Design in Data Centers
 - Single- and Two-Phase Immersion Design for Ultra High Density Deployments
 - TCS/FWS Chilled Water Loop Requirements
 - Debate (90.1 scope requirements for TCS Loop: whether or not it should be exempted)
 - Research Summit
 - DOE COOLERCHIPS
 - Onsite Energy Storage
 - Thermal Storage Requirement for Liquid Cooled Data Centers
 - Critical Dates
 - February 26 – Debate, Panel, Seminar, Forum, Workshop, and Debate Proposals
 - March 5 – Conference Papers and Extended Abstracts due
 - Program Options
 - Technical Papers
 - Conference Papers
 - Not required to be approved by TCs
 - Organized either by CEC or TC into sessions

- Extended Abstracts
 - Available at Annual Conferences
- Seminars and Workshops
 - Organized by TCs
 - Require Learning Objectives
- Panels, Debates, and Forums
 - Organized by TCs
 - Do Not Require Learning Objectives
- Seminar and Workshop Chair Responsibilities
 - Develop detailed program abstract and identify speakers
 - Upload the required speaker and program information to Conference Website
 - Preview presentations to ensure they comply with ASHRAE guidelines
 - Ensure presentations are uploaded to website prior to conference
 - Coordinate presentations
 - Introduce and monitor sessions at Conference
 - Assist presenters in identifying learning objectives and directing Q&A
- Next Steps – Contact Eric Yang (ericyangcem@gmail.com)

HANDBOOK UPDATE – Bob McFarlane & Jonell Watson

- Handbook written by TCs
 - TC9.9 is Chapter 20 of the Applications Handbook
- Purpose as a reference guide for engineers, manufacturers, etc
 - Tutorial for new engineers
 - Reference for experienced engineers
 - Design Guideline for those new to data centers
 - To alert “what you don’t know” and encourage to engage SMEs
 - Push manufacturers to standardization
- Is the “premier publication” by ASHRAE
 - Can be used as an exhibit in lawsuits
- Timeline
 - Published on a 4-year cycle. Next published 2027.
 - Notify ASHRAE of extent of revisions April 2025
 - Initial draft complete due Nov 15, 2025
 - Draft revisions must be submitted April 1, 2026
 - Final submission July 19, 2026
- 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 – **Current Focus**
 - Subject Matter Experts
 - 2-10 hours per topic
- Secondary Reviewers - **Later**
 - 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 2025 summer meeting presentations and information"
- Topics identified by number
- Email Bob or Jonell if desired
 - rmcfarlane@smwllc.com
 - Jonell.watson@accenture.com
 - Make them "Trusted Senders"
- Next steps
 - Determine extent of revisions
 - Access ASHRAE Authoring Portal
 - All work must use "Tracked Changes"
 - New or Revised Illustrations require written permission, preferably in perpetuity
- There have been issues with some volunteers never receiving emails. This needs to be researched.

RESEARCH COMMITTEE – Brad Cochran

- BC has taken over a Research Chair for Mark Seymour
- Connor Murray is now Section 9 Liaison
- Roland Charneux is now RPS Chair tasked with RTAR reviews
 - Currently no RTARs being reviewed for any TCs in front of RAC
- TRP-1913 – Study of the Corrosion Impact of Information Technology Equipment in Data Centers Located in Coastal Regions with High Sea Salt Concentration
 - Accepted as a work statement
 - Currently out for bid
 - Update on bid review process – Vali Sorell
 - Have received a few RFIs from contractors but being careful not to provide advantageous information.
 - Some new bids have come in
 - Details on research included in slide deck for reference
- WS-1972 – Data Center Direct-to-Chip Liquid Cooling Resiliency
 - WS updated and resubmitted in December
 - Update from Tom Davidson
 - Minor changes to accommodate TC's
 - Submitted to MORTS (RAC)
 - WS returned from MORTS w/ comments
 - December: WS Resubmitted with changes
 - Increased budget from \$300k-350k
 - Total estimated corporate support (cash + in-kind) \$51k
 - Up to three more potential sponsors
 - IBM
 - J M Gross Engineering
 - Vantage Data Centers

- DLB Associates
 - Strategic Thermal Labs
 - Details on research included in slide deck for reference
- WS-1956 – Compact CFD Modeling Guidance for Thin Flow Resistances
 - WS returned but not yet resubmitted
 - Update from Jim Vanwilder
 - Comments from RAC indicated they may not “get” the proposal
 - May be too concise and specific
 - Should set up coordination call with Research Liaison
- New RTAR – Data Center Direct to Chip Liquid Cooling Resiliency – Failure Modes and IT Throttling Impacts
 - RTAR to be voted on during main meeting Feb 10, 2025
 - Slide deck is showing wrong authors
- Volume Calculations for ITE Cooling Appliances Using ATLs
 - Rick Pavlak
 - Standard 15-2022 has UL method for calculating refrigerant concentration. This is not believed to be applicable to data centers due to differences between Process and Comfort Cooling, and airflow velocities
 - Believe this is a CFD dispersion modeling effort
 - Believe the RTAR is ready to go to voting members and send to RAC
 - More details in the slide deck
- Guidelines for External CFD Modeling
 - BC and Mark Seymour
 - Has been stagnant
 - Guidance on how to set up models, what is the expected accuracy of the resultant model, etc
- Flow Velocity Limits for Erosion Control
 - Mark Steinke leading
 - Guidance on velocities in ASHRAE documentation is both obsolete and not applicable to our use case
 - Target to have an RTAR and SoW by Phoenix conference
 - This part of a discussion around whether the TCS is part of a process system and should be exempted from 90.1.
 - This issue is very hot due to industry movement
- Looking for additional ideas for research. Opportunity to get involved in TC 9.9
 - Digital Twin for Data Center Environments, Integrating Liquid and Air Cooling in a Single Model/Tool – Ali Heydari

IT SUBCOMMITTEE – Dustin Demetriou

- Will meet tomorrow morning (9am-11:30am), Hilton Orlando, Key Largo B

MEETING ADJOURNED: 02/09/25 7:20 pm EST – Matt Koukl



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TC/TG/MTG/TRG MINUTES COVER SHEET

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TC/TG/MTG/TRG No. T.C. 9.9 DATE February 10, 2025

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

DATE OF MEETING Monday February 10, 2025 LOCATION Hilton Orlando, Room Orange D

VOTING MEMBERS PRESENT	VOTING MEMBERS ABSENT
Matt Koukl	Lixia Wu
Jason Matteson	Nick Gangemi
Paul Finch	Mark Seymour
Joseph Prisco	
Robert McFarlane	
Rick Pavlak	
Mark Steinke	
David Quirk	

CORRESPONDING MEMBERS PRESENT	
Don Beaty	Sengul Topuz
Roger Jones	Naveen Kannan
Michael Miller	Sang Lee
Chris Muller	Carlos Lisboa
Timothy Startt	Vali Sorell
Mohammad Alkiswani	shlomo novotny
Chris Campbell	Mark Pavol
Dustin Demetriou	Jerrold Buterbaugh
Mark Fisher	Tim Shedd
John Dumler	Dave Meadows
Alexandre Kontoyanis	John Gross
Pardeep Shahi	Jeff Ewin
Melissa Olson	David Moss
Michael McKenna	Kaiyu Sun
Glenn Brenneke	Gwenn Ivester
Jonell Watson	Ben Dolcich

CORRESPONDING MEMBERS PRESENT (cont.)

Brad Cochran	Guillermo Massucco
Charles Freda	Mark Malkin
David Grant	Nicolas Estefanell
John Peterson	Edward Gutowski
Justin Seter	Gerardo Alfonso
Eric Yang	Kamal Mostafavi
Jonell Watson	Norman Bourassa
Ashwin Siddarth	Ashwin Siddarth
Ali Heydari	Edward Tsui
Benjamin Petschke	Brad Chen

PROVISIONAL CORRESPONDING MEMBERS PRESENT

Vimaldoss Jesudhas	CJ Tang
Alkesh Solanki	David McGlocklin
Roger Huggins	Gregory Alexander
Stephen Mathai	Davide Ziviani
Santosh Shekar Mudunur	Nitin Karwa
amir ibraheem	Santosh Shekar Mudunur
Thomas Kolpasky	Donovan Aguirre
Vimaldoss Jesudhas	Tejeshkumar Bagul
Elizabeth Langer	Ian Mills
Matthew Kaufeler	Nathaniel Cook
Will Martin	Michael Anderson
Andrew Jenkins	Caleb Feldbusch
Ken Duncan	Roger Schmidt
Phillip Diffley	Jake Yu
Roger Huggins	Eric Self
TJ Lyle	Ed Eaton
Matt Hatley	

GUESTS PRESENT

Bahadur Singh	Shirin Niroomand
Jeff King	Jose Maya
Peter De Bock	Nicolas Ventura
Pooya Navid	Scott Milburn
Ashley August	Ok Kim
Chris Newton	Georges Saade
Dustin Meredith	Tom Daenzer
Lukas Guillien	Gerardo Sanchez
Dan Holley	Christina DiGiacomo
Matthew McIntosh	Alexis Barnett
Kenny Kober	Keith Dunnavant
Donghun Kim	Yaoyu Li
Sean Sivapalan	Jie Cai
Krista Hubbs	Marcus Hassen

GUESTS PRESENT (cont.)	
Moises Levy	Bernie Tong
David Sickinger	Felipe de Castro
Anke Beyer-Lout	Jessie Roy
Thomas Steen	Subhrajit Chakraborty
Justin Todd	Jeremy Rice

ATTENDANCE COUNT	
In Person	144
Virtual	76

PUBLISHED AGENDA**Monday, February 10, 2025**

TC 9.9 Main Meeting, IT & Publications Workshops

2:30 PM – 7:00 PM EST

Location: Hilton Orlando Room: Orange D (Lower Level)

Microsoft Teams Meeting<https://www.microsoft.com/microsoft-teams/join-a-meeting>

Meeting ID: 243 052 086 357

Passcode: ff2RX6eT

Attendance

<https://forms.gle/HR88B7MSv2fTHHk37>

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 Groenewold	IP
Handbook	Handbook Update Summary	5	Robert McFarlane/ Jonell Watson	IP
Liaison Reports	Standard 90.1	5	Rick Pavlak	IP
	SPC-127 / AHRI 1360	15	David McGlocklin	IP
	Decarbonization Task Force	5	Lixia Wu	IP
	Standard 90.4	5	Marcus Hassen	IP
	International	5	Don Beaty	IP
	OCP	5	Matt /Mark/John	IP
Partnership	NEMA Data Center RFP	5	Michael Erbesfeld	IP
	ASHRAE Data Center Forum	5	Nicolás E. Estefanell	IP
Webmaster	Website	5	Ecton English	IP
Research	Research Highlights	5	Brad Cochran	V
Program Work session	Abstract Work	15	John Gross	IP
Break		10		
	COOLERCHIPS Update	40	Peter de Bock, Jungho Kim	V/IP
Break		10		
IT Subcommittee	Liquid Server Thermal Template	10	Dustin Demetriou	IP
	S-Class Definition and Addition of S20/25	20	Paul Artman	IP
	Liquid Cooling Resilience Tech Brief	10	Dave Quirk / Dustin Demetriou	IP
	Erosion Flow Velocity	10	Mark Steinke	IP
	CDU/ TCS Considerations	30	Dustin Demetriou/Tim Shedd	IP
Publications	ASHRAE TC 9.9 Datacom Encyclopedia	20	Dustin Demetriou	IP
	Upcoming Tech Briefs	5	John Gross	IP
	Total Time:	270	Minutes	

CALL TO ORDER: 02/10/25 2:44 pm EST – Matt Koukl

WELCOME – Matt Koukl

- Welcome
 - MK reviewed agenda
 - MK reviewed website
- Housekeeping
 - Mark Steinke, Vice Chair – meeting host
 - John Gross, Secretary – meeting co-host
 - MK notified the attendees the meeting is being recorded for the purpose of taking Minutes.
 - MK reviewed virtual attendance etiquette
 - MK reviewed officer roles
 - MK reviewed attendance recording
- Attendance Form
 - Link: <https://forms.gle/HR88B7MSv2fTHHk37>
 - Both in person and virtual attendees to click and fill out the attendance form
 - Must fill out for each meeting (Sunday/Monday)
- Reviewed the TPS for the TC

INTRODUCTIONS – Matt Koukl

- Introduction
 - In-person attendees introduced

RECOGNITION – Matt Koukl

- Roger Schmidt – Past IT Subcommittee Chair
- Mark Seymour – Past Research Chair
- Past Chairs
 - Don Beaty
 - Roger Schmidt
 - Fred Stack
 - Jack Glass
 - Dave Quirk
 - Robin Steinbrecher
 - Jason Matteson
 - Dustin Demetriou
 - John Groenewold
- Voting Members – refer to slide deck

TC ACTIVITY – Matt Koukl

- Voted to Approve: Vote on Liquid Cooling Resiliency Technical Bulletin
- Voted to Approve: Vote on ASHRAE WS-1972 Data Center Direct-To-Chip Liquid Cooling Resiliency

MEMBERSHIP – Matt Koukl

- Need to apply online to become a Provisional Corresponding Member, and will then start process through the membership ladder.
- How to get involved – numerous methods to contribute, with so many efforts in process
 - Handbook
 - Online Encyclopedia
 - Development of a Program
 - Development of a Research Topic
- John Groenewold
 - Overall Membership

- Board – 23
- Corresponding – 357 (down)
- Provisional (185) - up
- Total (565) - up
- YEA (69) – up
- Attendance
 - Reviewed the conference attendance from Summer
 - Is used as an indicator to advance members to Corresponding
 - US v International
 - 72% v 28%

HANDBOOK – Robert McFarlane and Jonell Watson

- Quick review of Handbook framework due to time vs agenda
- Chapter 20 of Applications Handbook
- Published on 4 year cycle. Due to publish next in 2027.
 - Need to have all material reviewed and updated by April 2026
 - Calling for volunteers for Primary and eventually Secondary reviewers
- Currently 33 volunteers – some for too many topics. Need to spread the workload
 - Still need some primary reviewers – only have 8 sections remaining needing a Primary Reviewer
 - Hard copy version of the sign up sheet in the room of the meeting
 - Primary reviewers should be experienced with expertise in the section
 - Secondary reviewers are focused on readability, grammar, etc.
- Handbook can be referenced as an exhibit in court
- 2-10 hours total per topic time commitment for Primary Reviewer
- 5-10 hours total per topic time commitment for Secondary Reviewer
- Refer to website for link to sign-up sheet
- Please email Jonell and Bob directly additionally
- Next Steps
 - Ensure all sections have Primary Reviewers
 - Identify scope of required changes
 - Access ASHRAE Authoring Portal (Sharepoint-based site)
 - Can work simultaneously in document for edits
 - New or Revised Illustrations will require written permission, preferably in perpetuity
 - rmcfarlane@smwllc.com
 - Jonell.watson@accenture.com
 - Be sure they are set as “Trusted Senders” and confirm the Read Receipt

LIAISON REPORTS

- Standard 90.1 – Rick Pavlak
 - Have passed and published about 45 addenda since last publication
 - A significant number of addenda are being voted out in Orlando
 - Many affect scope of the standard
 - Bringing energy and resources under the model code of the standard
 - Goal is to publish in Fall of 2025
- SSPC127 / AHRI 1360 – Dave McGlocklin
 - 127
 - Now covers Air and Liquid cooling
 - Switch happening on LC Subcommittee, with John Gross moving to Chair, and Tim Shedd moving to Vice Chair

- Draft is out for review (2.5 weeks out)
 - Will be reviewing comments received to date in meeting tomorrow morning
- 1360
 - Den Dolcich will become chair since Dave Kelly's passing
- 8-noon tomorrow Lake Florence AB
- Decarbonization Task Force – Lixia Wu
- Standard 90.4 – Marcus Hassen
 - Recognition of Ron Jarnagan who passed last month
 - Ron was charter chair of 90.4
 - SSPC 90.4 proposing to add 90.4 User Manual to Online Data Center Encyclopedia
 - Center for Excellence in Decarbonization project which has been approved on Artificial Intelligence
 - See 90.4 and TC 9.9 as critical partners
 - Expect courses and certifications that come out of this
 - Both 9.9 and 90.4 over the last 6 months have been pulled into sessions with Federal and State governments
 - US Department of Commerce – International Trade Association
 - To understand how to enable the supply chain
 - State of VA – Joint Legislative Audit and Review Commission
 - RP1732 Research Project
 - Would be executed jointly with 90.4
 - Waiting on response from RAC
 - Did submit for a TPS change (purpose change)
 - Wanted to better position 90.4 to support decarbonization efforts of ASHRAE and the industry
 - Chief mission is still energy
 - Added Greenhouse Gas Emissions, Water and Renewable Energy
 - Approved and published end of January
 - 2025 is the 3-year for the next edition
 - Addendum b – miscellaneous to clarify definitions, address user requests, enhancements to the informative appendices
 - Potential refinements to the MLC values related to ACCH and LC baseline models
 - Will likely be pushed to an addenda
 - Changes have to be approved by end of next month
 - CEBD
 - ASHRAE 240 and 242 carbon reporting references
 - Not going to be done in time to reference in 90.1 or 90.4
 - Committee is monitoring a number of industry trends
- International – Don Beaty
 - BICSI and TIA are about to publish an update that will reference the thermal guidelines
 - Have been coordinating with the EU to help access to TC 9.9 documentation
- OCP – Matt Koukl, Mark Steinke, John Gross
 - ASHRAE co-presented with Cooling Environments over last summer
 - MOU for collaboration with OCP is under review by ASHRAE right now
 - Practical example this morning in the IT Subcommittee meeting for flow velocities for erosion control
 - Want to leverage OCP's speed with ASHRAE's ability to get information into Guidelines and Standards that can be codified

PARTNERSHIP

- NEMA Data Center RFP – Michael Erbesfled
 - Was also presented in 90.4 this morning
 - Looking collaboration between ASHRAE and NEMA around codes and standards. NEMA is

- looking for feedback
 - Contact Michael at Michael.erbesfeld@nema.org
 - Bob McFarlane expressed a need for better clarification of what is needed.
- ASHRAE Data Center Forum – Nicolas Estefanell (chair, Argentina Chapter)
 - First forum featured 350+ attendees, 14 speakers, and 6+ hours of technical sessions
 - Second forum upcoming – March 27, 2025
 - Artificial Intelligence: A Sustainable Approach for Data Centers

WEBMASTER – Ecton English

- On average site sees 50-100 views each day
- 34,000 site views on the ASHRAE Datacom Landing page when the Encyclopedia was announced

RESEARCH PROGRAM WORKSESSION

- Research Highlights – Brad Cochran
 - BC is new Research Chair
 - Conor Murray is new Section 9 Research Liaison
 - Roland Cherneux is now RPS chair for RTAR reviews
 - No RTARs currently under review
 - 6 work statements currently under review
 - TRP-1913 - Study Of The Corrosion Impact On Information Technology Equipment In Data Centers Located In Coastal Regions With High Sea Salt Concentration
 - Went out for bid last fall
 - Four bids received
 - Setting up a call between PMS and RAC to review bids
 - WS-1972 - Data Center Direct-to-Chip Liquid Cooling Resiliency Failure Modes And IT Throttling Impacts
 - Resubmitted to MORTS with changes
 - Increased budget to \$350k
 - Total estimated corporate support (cash + in-kind) - \$51k
 - Up to three more potential sponsors
 - Added letters of support from
 - IBM
 - J. M. Gross Engineering
 - Vantage Data Centers
 - DLB Associates
 - Strategic Thermal Labs
 - RAC appears to have not received the updated WS. Tom has resubmitted
 - WS-1956 - Compact CFD Modeling Guidance For Thin Flow Resistances
 - WS returned to PES with comments
 - PES concerned RAC did not understand the purpose of the work. May be too narrow and “precise” in scope
 - Setting up a call between PES and RAC to align
 - New RTAR - Volume Calculations For ITE Cooling Appliances Using A2L's
 - RTAR has been reviewed by Research Chair
 - Distributed to Voting Members for Review
 - Starting in 2027 all refrigerants that will be acceptable are A2L
 - Concern around the “arbitrary” determination of 4’ above the CRAC return used for volume calculations
 - This could severely limit the size of CRAC units in the space
 - If the elevation of the “well mixed condition” can be raised it will increase the effective volume of the room for refrigerant calculations
 - Objectives are in the slide deck for review
 - Vote for Approval will be sent via email ballot

- Future RTAR - Guidelines for Data Center External Dispersion Modeling
 - Hope to be able to compare models to measured data from operating data centers to help provide guidance on how to improve the accuracy of the models
 - Provide guidance on modeling techniques and understand their impact on the model speed and accuracy
 - Establish realistic expectations on accuracy for analysis
- Future RTAR - Flow Velocity Limits for Erosion Control
 - Develop a guideline that will replace the existing fluid velocity recommendations
 - Presented in the IT Subcommittee. Wanted to use that forum to help sharpen the content for the RTAR
 - Will discuss more in the IT Subcommittee liaison report
- Other Research Ideas
 - Use of digital twins for liquid cooling and air cooling in an integrated model, possibly through incorporation of AI
- Either place name in chat or email Brad with ideas for Research Topics
 - Looking for individuals to participate in the preparation or review of RTARs

PROGRAM ABSTRACT WORKSHOP – John Gross

- Done during break
- Submissions have to be in to ASHRAE by February 26th

COOLERCHIPS UPDATE – Peter de Bock

- ARPA-E program
- Goal is to advance technology in high performance processors to enhance US's ability to compete globally
- ARPA-E Goals
 - Reduce Imports
 - Improve Efficiency – *high priority of this effort*
 - Reduce Emissions
- Previous Energy Secretary was champion of investing in data centers
- Have not had the chance to speak with new Secretary yet
- \$42M total funding (\$40M allocated, \$2M in reserves)
- Want to explore opportunities to reduce the thermal resistance so we can maintain coolant temperatures and handle higher heat fluxes
- Below 50 kW/rack air cooling works and the air provides thermal capacitance
- Above 50 kW/rack liquid cooling is required and cooling is now a critical end-to-end path
- A380 uses about 200 MW of power to fly. Cooling systems have to operate for 30 minutes without cooling without failing
 - Considerations for failover systems when liquid cooling fails
- Solution has to be transformative, Cost and Benefit at the system/investor level, Reliability and uptime/availability cannot be compromised
- Program Structure
 - Tech Scope A: TCS
 - Tech Scope B: FWS and TCS Loop
 - Scope C: Tools for modeling of system energy, CO2, reliability and cost
 - Scope D: testing infrastructure
 - Working closely with NREL, Sandia, and Georgia Tech
 - Would like to switch to TUE
- 15 projects included in Tech Scope A
 - Have to demonstrate solution in April 2025
 - Teams that don't succeed will be shut down and remaining funds will be put back in the

- pool
 - Recognition tech is still early stage
 - TC9.9 involvement necessary to help grow to commercial maturity
 - Contact information is in the slide deck
- Michael Ohadi – team presentations
 - IBM – Dustin Demetriou
 - Systems 2-phase cooling
 - Target operation in an ambient of 55C without water use
 - “Reliability and serviceability is king”
 - <1.03 PUE target
 - End-to-end design from cold plate to system
 - Building a full system demonstration unit
 - Currently testing system at different ambient conditions
 - UCDavis – Subhrajit Chakraborty
 - Intended to support containerized (20 ft container) solution supporting 240kW rack
 - Novel Vortex shedding heat sink
 - Novel dry cooler
 - Includes radiant cooling technology
 - Focus on speed of deployment, optimization,
 - Mid-phase demonstration
 - UFlorida
 - Boyd, NREL, TRINA, U Maryland
 - Objective to extract heat at max possible temperature
 - Targeting 70C FWS for drycooler deployment
 - Have built TTVs at 1000W
 - Subambient pressure (40 kPa)
 - 6C approach temperature across TIM
 - Designed to integrate to existing FWS at 10C dT
 - Enables waste heat
 - Expect operational demonstration soon
 - PUE 1.08
 - Omnicool
 - Presented by Ali Heydari
 - Category B Project
 - Ultra Efficient Green Hybrid Cooling Technology
 - Binghamton University, Nvidia, Vertiv, Boyd, Durbin Group, Villanova University
 - 1MW IT container
 - 1.05 PUE or lower
 - 160 kW /rack target
 - 40ft container
 - 40C ambient
 - Refrigerants with GWP <1
 - Pumped 2-phase with cold plate attached to TTVs combined with 1P-immersion
 - Rack-mounted CDU to couple with solution
 - Working to develop digital twin as well
 - Flexnode
 - Prefab modular liquid cooled micro-data center

- U Maryland
- Iceotope
- CALCE/Oresme/Roger Schmidt
- Shop Architects
- ARUP
- Liquid-to-Air at 1.5 MW in ISO 40 container
- PUE ≤ 1.05
- Utilizes dry cooler developed in previous ARPA-E project by UM
- EXTRACT
 - HPe, Purdue University, Vertiv
 - Ribbon Oscillating heat pipes for processor heat extraction, currently being used for avionics electronics
 - Targeted reduction in thermal resistance 3.5x over single phase cold plate
- MOSTCOOL
 - U Maryland, NREL, LBNL, U Arkansas, Trane
 - Software to evaluate thermal, energy, CO2 footprint, availability, reliability from cooler to chip level
 - Modules for EnergyPlus, ARL's Parapower, thermal performance analysis, predictive reliability, metrics
 - Different teams working on different modules, with intent to integrate at the end
- Q&A
 - T Rogers – does research include failure modes?
 - PDeBock – yes, but it is early stage. Right now looking for red flags
 - B McFarlane – has their been any examination of thermo-electric cooling or is the temperature too high?
 - Project is focused on getting the heat off the chips – PD
 - Opportunity to give high risk-high reward solutions a chance to be developed
 - M Koukl – what is the difference between A track and B track?
 - A track is TCS only
 - B track is FWS and TCS, modular data center to accelerate time to market
 - B Cochran – with the elevated temperatures of the projects, what happens when you place 50-60 together?
- Need industry feedback to ensure these are usable solutions - PD

IT SUBCOMMITTEE

- Liquid Server Thermal Template - Dustin Demetriou
 - Intro – Roger Schmidt
 - Dustin is now the IT Subcommittee Chair
 - Lots of activity
 - Thank you to Roger for years of service pushing the industry and TC forward
 - A lot of the work is grassroots by small teams identifying issues and drafting content
 - Cooling Resiliency Tech Brief is a good example
 - Won't be spending 3-4 months putting major documents together
 - Focus is on Tech Briefs which can be approved through committee in a few weeks
 - 1-week ITS review
 - 1-week TC review and vote
 - Updates only made to the encyclopedia version of the content
 - Tech Briefs mapped to datacom topics

- Liquid Cooling Thermal Template – Dustin Demetriou
 - Have long had a thermal template in the guidelines to identify for manufacturers the information that must be provided for infrastructure planning
 - Published to encyclopedia November 7, 2024
 - Manufacturers should be generating it and end users/specifiers should be requesting it
 - Need to consider adding rate of rise to template
- Liquid Cooling resiliency Tech Brief – Dave Quirk, Dustin Demetriou
 - Provides content informing what needs to be done at the infrastructure level to handle interruptions to service, rapid changes in workload, etc
 - Download is in slide deck
 - Can be downloaded from TC Website
- Erosion Flow Velocity – Mark Steinke
 - Can impact FWS and TCS
 - Barrier to deployment of even higher densities
 - Actions/Considerations:
 - What does this mean relative to 90.1/90.4
 - Develop what we think will be the guideline and risks
 - Develop the fundamental research to develop the guidance – feeds the RTAR
 - Will likely keep this as a small team but reach out if interested
- CDU/TCS Consideration Tech Alert – Tim Shedd, Dustin Demetriou
 - Has been through ITS review and will be sent to TC voting members in the next 1-2 days for vote
 - Intent is to identify key drivers for CDU deployment that is digestible by senior management
 - Concern about deploying large capacity CDUs with multiple ITE manufacturers in the same loop, which can cause significant issues with current state of standardization
 - Also concern around isolation and blast radius on large capacity systems
 - Vendor isolation, as every vendors' solution is different
 - Platform requirements, CapEx, contamination, etc
 - This does not discuss approach temperatures. Document is focused on considerations for scale of a given TCS loop
- Dave Quirk makes a motion to have TC9.9 take a position to not focus on regulating energy efficiency on TCS loops until such time as the TC has resolved reliability and resiliency concerns
 - MK – not sure if we have a quorum, but second the motion
 - RM – not sure this would be a good thing to publish to the World

PUBLICATIONS – Dustin Demetriou

- Challenge about speed to market relating to publication updates
- Decision to move to Online Encyclopedia - \$24/year for ASHRAE members
 - The following have been added
 - Thermal Guidelines
 - Liquid Cooling Design Guidelines
 - Updates to “Book 3”
 - PDF version of all other publications via subscription
- Access encyclopedia via ASHRAE TC9.9 Website
- Content Update Structure
 - Will no longer be a collection of books, but rather be topical
 - To do this we need to have responsible parties for topics, including manager and teams of editors and developers
 - Roles
 - Site Management
 - Dustin and Ecton

- Update the content on the Sharepoint site once it's been developed and approved
 - Topic Management
 - Content Manager
 - Content Editor
 - Content Developers
 - Update steps
 - Voting members vote on the updates, not the overall content
 - Highlight the changes, what's been added or changed
 - Publication book is extracted and annotated, edits are made, changes are voted out, Dustin and Ecton upload the changes
 - Need for version control
 - Page version is now in the upper right corner of page
 - Version summary table on the bottom of page
 - Can click on summary of changes to access extract of changes
- What's New table at the bottom of the welcome page
- Goal is quarterly updates
- Status
 - Migrating from Datacom Books to Topical Encyclopedia
 - Goal to get first chunk done from the first three books by summer meeting
 - Will be reviewing content to relevance
 - Snapshot of work performed to date in slide deck
 - Focus has been on environmental guidelines
 - Has not been published yet
 - Example of Air-Cooling Thermal Guidelines shown for reference
 - Direct links to figures and images
 - Supplemental information for subtopics linked
 - Need to identify Topic Owners to drive development by June 2025
 - Need to remove references to chapters, among other things to enable the document to flow like an encyclopedia
 - Goal to get updates done by end of year

CALL TO CLOSE: 02/10/25 6:44 pm EST – Matt Koukl