



1791 Tullie Circle, N.E./Atlanta, GA 30329

404-636-8400

**DRAFT**

### 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-1.4 DATE 2/4/2020

TC/TG/MTG/TRG TITLE Control Theory and Application

DATE OF MEETING February 4, 2020 LOCATION Orlando, FL

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
James Del Monaco	2019	Jin Wen	2017	Corresponding – 17
Chariti Young	2019			Provisional – 12
Mark Hydeman	2017			Guests – 25
Brandon Gill	2018			
Larry Fisher	2018			
Chris Benson	2019			
Lotfi Nemat	2019			
Amanda Pertzborn	2019			
<b>DISTRIBUTION: All Members of TC/TG/MTG/TRG plus the following:</b>				
TAC Section Head: Jennifer Leach, PE			<a href="mailto:SH1@ashrae.net">SH1@ashrae.net</a>	
All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters (Research, Standards, ALI, etc.)			<a href="mailto:jkohler9@comcast.net">jkohler9@comcast.net</a> ; <a href="mailto:ahmed.kashef@nrc-cnrc.gc.ca">ahmed.kashef@nrc-cnrc.gc.ca</a> ; <a href="mailto:jatkisson@aeieng.com">jatkisson@aeieng.com</a> ; <a href="mailto:pharmeng@shaw.ca">pharmeng@shaw.ca</a> ; <a href="mailto:shammerling@ashrae.org">shammerling@ashrae.org</a>	
Steve Hammerling, Manager Of Research & Technical Services			<a href="mailto:MORTS@ashrae.net">MORTS@ashrae.net</a>	

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



# ASHRAE Technical Committee 1.4

## Meeting Agenda

TC 1.4 Control Theory and Application

<http://tc14.ashraetcs.org/>

Tuesday, February 4, 2020 1:00 – 3:30 pm LL Orange G, Hilton Orlando, FL

*“Commitment to the ASHRAE Code of Ethics – In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, integrity and respect for others, and we shall avoid all real or perceived conflicts of interests. (See full Code of Ethics: <https://www.ashrae.org/about-ashrae/ashrae-code-of-ethics>.)”*

TC 1.4 Control Theory and Application	Tuesday 1:00 PM	Orange G	Hilton Orlando
TC 1.4 YEA/Education	Sunday 2:00 PM	Lake Monroe A	Hilton Orlando
TC 1.4 Control Components and Applications	Sunday 3:00 PM	Lake Monroe A	Hilton Orlando
TC 1.4 Programs	Sunday 4:00 PM	Lake Monroe A	Hilton Orlando
TC 1.4 Research	Monday 2:00 PM	Lake Down B	Hilton Orlando
TC 1.4 Handbook	Monday 4:00 PM	Lake Down B	Hilton Orlando
TC 1.4 Executive	Tuesday 8:30 AM	Key Largo B	Hilton Orlando
TC 1.4 RP-1711 SOO's for Hydronic Systems	Tuesday 9:30 AM	Key Largo B	Hilton Orlando

Seminar 4	Moving BAS for Hospitals into the Future	Sunday 8:00	Orange F	Hilton Orlando
Forum 1	Cybersecurity, Artificial Intelligence and HVAC	Monday 9:45	Orange B	Hilton Orlando
Seminar 34	Control of District Energy Systems	Monday 11:00	Orange C	Hilton Orlando
Seminar 37	Show Me the Money! Cost-Based Control of Supply Air Temperature	Monday 11:00	Orlando VI	Hilton Orlando
Seminar 45	BACnet Secure Connect: What You Need to Know!	Tuesday 9:45	Orange E	Hilton Orlando
Seminar 60	Control for Grid Interactive Buildings: A Look Toward the Future	Wednesday	Orange E	Hilton Orlando
Seminar 74	Smart Is as Smart Does: Case Studies from Intelligent Florida Buildings, Campuses and Cities	Wednesday 11:00	Orange F	Hilton Orlando

### 1) Call to Order

### 2) Introduce Members, Guests, and Liaisons

### 3) Roll Call (Quorum)

X	James Del Monaco, 6/30/21
X	Christopher Benson, 6/30/23
	Jin Wen, 6/30/21
X	Larry Fisher, 6/30/22
X	Brandon Gill, 6/30/22

	Mark Hydeman, 6/30/21
X	Chariti Young, 6/30/21
X	Nemat Lotfi, 6/30/23
X	Amanda Pertzborn, 6/30/23

### 4) TC 1.4 Scope

- a) ASHRAE Technical Committee 1.4 is concerned with control theory, systems, and components (excluding refrigerant flow controls) for heating, ventilating, air conditioning, and refrigeration uses.

### 5) Approve minutes from previous meeting (posted on website)

- a) Chariti Young motions to approve. Larry Fischer seconds. Approved 7-0-0

### 6) Approve agenda

- a) Chariti Young motions to approve. Larry Fischer seconds. Approved 7-0-0

### 7) Group Discussion point

- a) **New Clause in ASHRAE Guideline 13- Specifying BAS Systems**
  - i) Short presentation by Ron to introduce concepts to be covered in the next update.
    - (1) Updates are planned to be incorporated by the next Winter conference. Updates will include new section on cybersecurity and security architecture.
    - (2) Ron is asking for assistance from the TC to help author the new sections.
- b) **Review of Dampers and Airflow Controls**
  - i) [https://www.techstreet.com/ashrae/standards/dampers-and-airflow-control?product\\_id=1703570](https://www.techstreet.com/ashrae/standards/dampers-and-airflow-control?product_id=1703570)
  - ii) ASHRAE has requested feedback if the TC feels this book is still relevant given the recent publication of Guideline 36.
    - (1) Larry asked if there is data on the sales numbers of the books. The Publications committee looks at this to judge whether a book should continue to be offered.
    - (2) Steve Taylor volunteered to review the book's coordination with Guideline 36 to ensure the overlap is aligned, if he can be provided an electronic copy.
- c) **Certification Course in Building Automation Systems**
  - i) Larry Fischer : he had 62 people in attendance in the course. Only 30 were pre-registered prior to the conference.
  - ii) There is renewed interest in a controls installer certification, particularly in developing countries. This was previously proposed to ASHRAE and rejected. Dave Kahn has the previous documentation. This would be a certification, not a certificate, and would therefore have an exam.
  - iii) Chariti moves for committee to revise and resubmit the previous application
    - (1) Votes to approved 7-0-0
    - (2) Chariti Young, Ron Benstein, Greg with EcoSystems, Larry Fisher, and Dave Morrow volunteered to help update

### 8) New business

- i) TC will be more active in utilizing Basecamp
  - (1) TC leadership will invite all corresponding members in Basecamp

- (2) [3.basecamp.com/3106353/projects/8184907](https://3.basecamp.com/3106353/projects/8184907)
- ii) New Standard on Control Description Language (CDL)
  - (1) Steve Taylor to update the TC.
  - (2) Steve requests that interested parties e-mail him to be added as an interested stakeholder.
  - (3) Steve makes a motion for 1.4 to endorse the creation of new standard.
    - (a) Vote: Vote 7-0-0 to approve the title, purpose, and scope
    - (b) Vote: 7-0-0 to approve Paul Ehrlich as the proposed committee chair.
  - (4) Joe Zhou commented that CDL may play as important a role in streamlining the design of control sequences that BACnet has played in communication protocols.
  - (5) Paul Ehrlich described the efforts to date by a DOE funded project and how the committee efforts will build upon that project.
  - (6) Full specification and paper is available online. [Obc.lbl.gov/specification/index.html](http://Obc.lbl.gov/specification/index.html)
- iii) Update on RP 1711
  - (1) Update by PMS Chair Marcelo Acosta
  - (2) PMS met on Task 5 submitted 1/2/2020. PMS voted to recommend the TC approve the report. Only outstanding task is the white paper presentation, anticipated for Chicago 2021. The PMS voted 3-0-1 to approve the final report,
  - (3) Motion from subcommittee (Kim) to offer a no cost time extension to March; Chariti seconds.
    - (a) Vote: 4-0-3 to approve; Abstentions are due to involvement in the project.
  - (4) Motion from the PMS to vote to approve:
    - (a) Vote: 4-0-3 to approve the final report. Abstentions are due to involvement in the project.
- iv) Update on 1865-WS.
  - (1) Update by Kim Barker and Steve Taylor
    - (a) 10 companies bid on the project; the evaluation subcommittee has make their recommendations.
    - (b) Executive vote to approve the PES RP-1865 recommendations for PI selection.
      - (i) Electronic vote to occur after the Winter Conference Meeting.
- v) Update on RP-1819 Multi Zone...
  - (1) Requesting a no-cost extension through July 1, 2020
  - (2) No cost extension was approved 5-0-1, with final approval at the Annual Conference in Austin.
- vi) Larry Fischer recommends that the committee adds a few more voting members;
  - (1) The number of voting members is up to the chair;
  - (2) In the last 20 years, the number has varied from 9-15 voting members;
  - (3) This will be discussed prior to the annual conference.

## 9) Announcements

### a) **TAC – Technical Activities Committee**

- i) Update on TAC initiative to reduce the number of technical groups
- ii) Goals
  - (1) Increase opportunity for collaboration for programs & research
  - (2) Increase opportunity for workshops for Handbook
  - (3) Increase meeting efficiency and increase effectiveness of members' volunteer time
- iii) Results
  - (1) Expecting (3) TCs to merge in Orlando
  - (2) Ongoing conversations with others

### b) **CEC – Conferences and Expositions Committee**

- i) Larry's 3-hour course about "Best Practices for Installing DDC Control Systems" was approved and the first presentation was scheduled for Orlando.

- (1) <https://www.ashrae.org/professional-development/all-instructor-led-training/instructor-led-training-seminar-and-short-courses/best-practices-for-installing-ddc-control-systems>
- (2) Registration was at a maximum of 30, 62 people attended. Approximately 20 in consulting, 15 owners, 7 contractors, and the rest for PDH's.
- (3) ASHRAE has asked Larry to expand the course from three to six hours for the next conference.
- ii) ASHRAE has requested TC's reach out to members to volunteer to review conference papers.
- iii) Technical Program Statistics for Orlando:
  - Conference Papers and Extended Abstracts
    - 165 conference paper abstracts submitted, 137 approved
    - 73 conference papers presented
    - 25 Conference Paper Sessions
  - Technical Papers
    - 27 Technical papers received
    - 25 Technical papers presented
    - 25 Technical Paper Sessions
  - Seminars
    - 123 submitted
    - 75 presented
  - Panels
    - 2 submitted
    - 2 scheduled
  - Workshops
    - 6 submitted
    - 2 scheduled
  - Forums
    - 5 submitted
    - 1 scheduled
  - Debates
    - 2 submitted
    - 2 scheduled
- iv) Upcoming conferences
  - 2020 Annual – Austin, TX June 27 – July 1, 2020
  - 2021 Winter – Chicago, Illinois, January 23 – 27
  - 2021 Annual – Phoenix, Arizona, June 26 – 30
  - 2022 Winter – Las Vegas, Nevada, Jan. 29 – Feb. 2
  - 2022 Annual – Toronto, ON, June 25-29

**c) RAC – Research Activities Committee**

**10) OLD BUSINESS**

**a) PROJECT COMMITTEE AND ONGOING RESEARCH REPORTS**

- i) SSPC 135 (BACnet) – Michael Osborne / Carol Lomonaco
  - (1) Working on Semantic Tagging (Standard 223P), Secure Connect, and ISO 16484-5 and -6 updates.
  - (2) Will obsolete the current Security scheme due to very low adoption.
  - (3) Researching Semantic Tagging

- (4) Looking for volunteers
  - (a) To help with Integrator's and Developer's Guides
  - (b) Also, security people who understand Bootstrapping.
- (5) Published 3 addenda this year, 3 addenda passed at this conference and are going for public review.
- ii) SGPC 13 (Specifying Building Automation Systems) – Ron Bernstein
  - (1) The public review will go out soon; if anyone from TC 1.4 would like to review prior to public review, reach out to Ron.
- iii) SGPC 36 (High Performance Sequences of Operation for HVAC Systems) – Mark Hydeman / Steve Taylor
  - (1) 5 addendum were previously published since the original publication 18 months ago; 4 more addenda were approved yesterday.
  - (2) Steve is requesting any cool sequences for systems that are currently not covered by the Guideline; they can be incorporated as a CMP (Continuance Maintenance Proposal)
  - (3) Steve Taylor replaces Mark as Chair of SGPC-36
  - (4) ASHRAE copyright on Guideline 36 has been clarified/reviewd. Approval was granted at this conference to pursue issuing Word document with standard.

b) SUB-COMMITTEE REPORTS

- i) **Executive** – James Del Monaco
  - (1) Roster Membership Update
    - (a) No change to voting members.
    - (b) Executive meeting to be scheduled at 7 am for next few conferences.
- ii) **Education/YEA** – Michelle Shadpour
  - (1) Great turnout
  - (2) Plans to incorporate pre-main meeting presentations into the Chicago winter conference.
- iii) **Control Components and Applications** – Chad Moore via Ryan Williams
  - (1) New ideas for the TC to work on - research and seminars
  - (2) Chiller plant optimization and RP1711 were a major point of discussion.
  - (3) Applications for implementation of Guideline 36.
  - (4) BAS point naming responsibility
  - (5) BAS installation cost tool request was brought up based on a request by policymakers for incentivization
- iv) **Program** – Frank Shadpour
  - (1) 7 sessions at this conference
  - (2) 14 proposals planned for Austin
- v) **Research** – Kim Barker
  - (1) 1711-RP (Advanced Sequences of Operation for HVAC Systems – Phase II Central Plants and Hydronic Systems) – Marcelo Acosta
    - (a) Task 2 – Final submission approved
    - (b) Task 3 – First submission. Not voted yet
    - (c) Task 4 – Started
  - (2) 1 WS approved and submitted
    - (a) DOAS Supply Temperature Optimization.

- (3) No other RTARs & WSs under development; Kim is planning to set up some Basecamp workspace to encourage development of new RTAR's.

vi) **Handbook** – Charlotte Dean

- (1) Chapter 7 of Fundamentals – Started review. Approval anticipated in Austin at the Annual Conference.
- (2) Call for volunteers to assist in editing the chapter, interested parties should reach out to Charlotte.
- (3) Handbook central:  
<https://www.ashrae.org/technical-resources/ashrae-handbook/ashrae-handbook-central>

vii) **Standards** – Steve Taylor

- (1) Standard 62 has put in some recent additions that may require humidity control in every room of a building.
- (2) 90.1 has put in more stringent exhaust requirements in garages.

viii) **Webmaster** – Joe Kilcoyne

- (1) Elise Backstrom has taken over as the webmaster.
- (2) Website is up-to-date. Basecamp undergoing update.

c) COMMITTEE LIASION REPORTS

- i) TC 1.5 (Computer Applications) – Mike Pouchak.
  - (1) 2 active RPs related to BIM and automation, co-sponsorship with TC1.4, interest in cyber security.
- ii) TC 2.10 HVAC Resiliency and Security – Kim Barker
- iii) TC 5.6 (Control of Fire & Smoke)
- iv) TC 6.1 (Hydronic Systems)
- v) TC 6.7 (Solar Energy Utilization) – Gaylen Atkinson
- vi) TC 7.3 (Operations & Maintenance Management)
- vii) TC 7.5 (Smart Building Systems) – Joe Zhou
  - (1) Smart application guide sold out first day in store, available online.
- viii) TC 7.6 (Systems Energy Utilization)
- ix) TC 7.9 (Building Commissioning) – David Bornside
- x) TC 9.10 (Laboratory Systems) – Jim Coogan
- xi) TC 9.11 (Clean Rooms) – Phil Naughton
- xii) SSPC 62.1 (Ventilation and Acceptable IAQ) – Len Damiano
- xiii) SSPC 90.1 (Energy Efficient Design of New Buildings) – Steve Taylor
- xiv) SSPC 202 (Commissioning Process for Buildings and Systems) – Barry Bridges
- xv) TC 1.6 (Terminology) – David Bornside
- xvi) SGPC 0.2 & 1.2 (The Commissioning Process) – David Bornside
- xvii) SPC134 (Graphic symbols for HVAC systems) – David Bornside
- xviii) SPC 189.1 Design of High Performance Building – Bogi Setty
- xix) MTG Occupant Behavior in Buildings – Kim Barker

d) SOCIETY COMMITTEES

**11) Upcoming Deadlines**

- Austin Annual Conference – June 27 – July 1, 2020
- Seminar and Forum proposals for Austin are due by February 10, 2020
- RTARs & Work Statements TBD (typical deadline around mid-March)

- Conference Website: <https://www.ashrae.org/conferences/2020-annual-conference-austin-texas>
- Conference Chair: Bill Klock
- Program Focus at Austin Annual Conference
  - i. Track 1: Fundamentals and Applications
  - ii. Track 2: HVAC&R Systems and Equipment
  - iii. Track 3: Research Summit
  - iv. Track 4: Professional Development
  - v. Track 5: Grid-Interactive Efficient Built Environment
  - vi. Track 6: Multifamily and Residential Buildings
  - vii. Track 7: Resilient Buildings and Communities
  - viii. Track 8: Zero Energy Buildings and Communities: Opportunities and Challenges
  - ix. Track 9 (Mini-Track): Building Myths

**12) Next Meeting – Austin, TX | June 27 – July 1, 2020**

**13) Adjourn**

- a) Vote to adjourn at 3:15 pm. Approved 5-0-0.



## **TC 1.4 Control Theory and Application**

### **YEA/Education Subcommittee Meeting Agenda**

**Orlando – February 2, 2020**

**2:00-3:00pm**

**Hilton**

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- 1) Introductions
- 2) Young Engineers in ASHRAE (YEA) attendance
- 3) Discussion Topics
  - a) What is a TC?
  - b) What does TC 1.4 do?
    - i) Subcommittees – education, programs, research, handbook, etc.
  - c) How to increase involvement of YEA members and new ideas
    - i) Instagram member spotlight (follow us @millennialengineers)
    - ii) Facebook
    - iii) Seminar Series
      - (1) Submitting workshop on controls 101 for YEA for 2020 Austin conference.
    - iv) Main Committee Meeting Seminar/Workshop: Breakout with YEA & SME.
      - (1) Plan to submit at 2020 Austin conference for following winter conference.
    - v) Email Blasts (2x a year)
    - vi) TC 1. 4 YEA lunch social event
    - vii) Develop a template presentation for local chapters on controls 101



## TC1.4 Control Components & Applications

**Chad E. Moore, P.E., LEED**  
Chair, Control Components &  
Applications Subcommittee

Reply to: **Engineering Resource Group**  
350 Edgewood Terrace Drive  
Jackson, MS 39206-6216  
Tel: 601.362.3552  
Fax: 601.366.6418  
cmoore@ergms.com

### **TC1.4 Control Components & Applications Subcommittee Meeting**

Meeting Date: February 2, 2020, 1500 – 1600

Hilton Orlando, L, Lake Monroe A

**Subcommittee Focus:** Brainstorming Session, “open forum” discussing what is new in Building Automation System control components and applications.

### **Minutes:**

#### **1. Introduction of attendees**

#### **2. Discussion Topics**

- What is new in the industry in chiller plant optimization. Caution must be used in maintaining chiller minimum lifts and other operating parameters. ASHRAE Research Project RP1711 – Advanced Sequences of Operation for HVAC Systems – Phase II Central Plants and Hydronic Systems includes chiller plant optimization sequences and Automatic Fault Detection & Diagnostics rules. It is expected that the RP1711 final report will be approved by TC1.4 shortly after the Orlando meeting.
- Discussed where the industry is with incorporated ASHRAE Guideline 36 sequence of operations in actual buildings and where BAS manufacturers are with incorporating Guideline 36 sequences into their controllers. The discussion revealed that the industry is in various stages of implementation. Attendees expressed that they have been utilizing the Guideline 36 sequences with slight modifications. Discussed how the sequences should be specified and incorporated into Construction Documents. Should the sequences be included in the Construction Documents or should they just be referenced and then the BAS contractor is responsible for providing detailed sequences of operation? Opinions varied as to what should be best practice. Suggest this topic be revisited as Guideline 36 sequences are implemented more widely throughout our industry.
- LBNL is working on software, to filter Guideline 36 sequences to output the sequences based on responses to the software’s user interface. The Guideline 36 sequences are detailed and cumbersome to use in project specifications. This tool is intended to filter through the guideline and output sequences that are user friendly and can easily be included in other documents. Attendees agreed this tool is very much needed to better utilize the Guideline 36 sequences.



## TC1.4 Control Components & Applications

- Who is responsible for BAS point naming? Where should it occur? Guideline 13 has section on recommendations on BAS point naming. ASHRAE Standard 135 BACnet includes language on BAS point naming. BAS point naming is highly Owner influenced based on the Owner's unique system layout (single building versus multi-building, multi-campus applications).
- Discussed the need for an industry tool (or database) that can be used for BAS installation cost estimates: Currently there is no industry guideline or database on how to estimate BAS installation costs. Should TC1.4 take on developing a Guideline or sponsor a research project to characterize BAS installation costs? Discussed the variations in cost based on the technology included in the BAS systems and level of integration. Discussed the difficulty in developing and maintaining a BAS cost database. Attendees agreed there is a need in our industry for a BAS cost database.
- Briefly discussed the need for ASHRAE to develop standard symbols and abbreviations for Building Automation Systems and controls.
- Discussed if ASHRAE has any resources or documents that provide guidance on project construction responsibility between Divisions. For example, who is responsible for providing electrical power to smoke dampers (Division 23 or Division 26)?
- Reviewed emerging Department of Defense standards and specifications in BAS and cybersecurity.

### 3. Future CCA Discussion Topics

- Updates to Standard 62.1 minimum VAV zone flow modifications
- GUI's and dashboards – need understanding of the problem to answer, of the data available, and capability to present the data in an effective manner; hard to find a party that can do all three – it's an issue
- What makes for maintainable programming code; organization, comments, meeting design intent?
- Neural networks and machine learning; how can controls components be optimized by these new neural networks that can analyze thousands of points? Google has proven out 40% savings in the CHW systems serving their data centers using "narrow AI" applied to their equipment
- Fault Detection and Diagnostics to keep the built environment efficient; cosponsor a program with 7.9?
- How do you make the unseen seen in building automation systems?
- Occupant centered controls – it changes the paradigm from room sensors; people counters for outside air control; looks at shoulder diameter to find if you are wearing a lot of clothes or are a big/heavy person; thermal comfort is currently rated lowest in all categories of building environment
- New sources of data for integration – medical devices, wearables, etc.
- Allow user requests into the BAS; specifically, into new Guideline 36 sequences
- There was an ASHRAE study which indicated that people with operable windows don't do well with maintaining temperature, but makes themselves much more satisfied with thermal comfort
- ASHRAE classes and certifications on controls



## TC1.4 Control Components & Applications

- How to bridge the gap of under control vs. over control (in terms of point qty)
- Lack of integration in systems; the difference between open protocol and "plug and play"
- Sequencing of HVAC systems based on energy performance of the space and occupant satisfaction; how can they be integrated together for total energy integration
- How to convert from design to installation? Differences in styles in specifiers as well as installers as well as the maintenance staff
- Airflow technologies – pitot tubes vs. thermal dispersion for VAV box airflow sensing, specifically for net zero buildings.
- Cybersecurity updates to Guideline 13 by Ron Bernstein
- API for Guideline 13 by Ron Bernstein;
- Common graphics for Guideline 13 by Ron Bernstein;
- Common data point profiles for equipment and new sensors/actuators for Guideline 13 by Ask Ron Bernstein;
- Occupant behavior; can devices learn to adapt to the occupant needs through AI?

### 4. **Adjourned meeting at 4:05 p.m.**



**TC 1.4 – PROGRAM SUBCOMMITTEE  
ASHRAE WINTER MEETING  
ORLANDO – JANUARY 2020**

The subject meeting was held on Sunday, February 02, 2020 starting at 4:00 PM following the Components and Control Applications Subcommittee meeting. The attendees remained. The sign-in sheet is attached. Special thanks to the active members of TC 1.4.

**Programs Presented in Orlando:**

**Feb 01 - Feb 05, 2020**

- 1. Seminar 4: Using Analytics and Big Data to Optimize Your HVAC Systems**  
*Chair: Jim Coogan*  
*Track: High Efficiency Design and Operation*  
*Sponsor: 1.4 Control Theory and Application & 9.6 Healthcare Facilities*  
*Track: Optimization in HVAC&R, Room: 2103C, KCCC*  
*Sunday, 8:00 AM – 9:00 AM, Room: Orange F*
- 2. Forum 1: Cybersecurity, Artificial Intelligence and HVAC?**  
*Chair: Frank Shadpour*  
*Track: Cutting Edge Approaches*  
*Sponsor: 1.4 Control Theory and Application*  
*Monday, 9:45 AM - 10:45 AM, Room: Orange B*
- 3. Seminar 34: Control of District Energy and Cogeneration Systems**  
*Chair: Chad Moore*  
*Track: Systems and Equipment*  
*Sponsor: 1.4 Control Theory and Application*  
*Monday, 11:00 AM - 12:00 PM, Room: Orange C*
- 4. Seminar 37: Show Me the Money! Cost-Based Control of Supply Air Temperature**  
*Chair: Taraneh Shoorideh,*  
*Track: Big Data and Smart Controls*  
*Cosponsor Sponsor: 7.5 Smart Building Systems*  
*Monday, 11:00 AM - 12:00 PM, Room: Orlando VI*
- 5. Seminar 45: BACnet Secure Connect: What You Need to Know!**  
*Chair: Carol Lomonaco*  
*Track: Big Data and Smart Controls*  
*Tuesday, 9:45 AM - 10:45 AM, Room: Orange E*  
*Sponsor: 1.4 Control Theory and Application, 7.5 Smart Building Systems SSPC 135*
- 6. Seminar 60: Control for Grid Interactive Buildings: A Look Toward the Future**  
*Chair: Michael Brambley,*  
*Track: Big Data and Smart Controls*  
*Wednesday, 8:00 AM - 9:30 AM, Room: Orange E*  
*Sponsor: 7.5 Smart Building Systems, 1.4 Control Theory and Application*
- 7. Seminar 74: Smart Is as Smart Does: Case Studies from Intelligent Florida Buildings, Campuses and Cities**  
*Chair: Chariti Young*  
*Track: Big Data and Smart Controls*  
*Wednesday, 11:00 AM - 12:30 PM, Room: Orange F*  
*Sponsor: 1.4 Control Theory and Application, 7.5 Smart Building Systems , 7.3, 7.9*



### Anticipated Programs for 2020 Orlando That Did Not Take Place:

1. **Debate: Control Subsystem LEGO®s vs. Custom Solution Sculptures? Which approach yields better results?**  
Chair: Marcelo Acosta
2. **Seminar: Controls in an Evolving Landscape - The Impact of 5G, Blockchain, AI and Other Exciting Technologies**  
Chair: Ron Bernstein (Guideline 13)  
Cosponsor TC 1.5 (Amanda Pertzborn)
3. **Seminar: Minimizing Energy Use with Primary DOAS and Secondary Fan Powered Units in the Occupied Space**  
Chair: Jim Coogan
4. **Seminar: YEA – Cutting-Edge Building Automation Concepts**  
Chair: *Elise Backstrom*
5. **Seminar: Automating Control Sequence Selection and Evaluation**  
Chair: Philip Haves
6. **Seminar: What have you done for me lately? BAS Best Practices for O&M Success**  
Chair: Greg Cmar  
Cosponsor TC7.3



1. **Seminar: Controls in an Evolving Landscape - The Impact of 5G, Blockchain, AI and Other Exciting Technologies**  
Chair: Mike Pouchak  
Possible Cosponsor: TC 1.5 (Amanda Pertzborn)
2. **Seminar: Minimizing Energy Use with Primary DOAS and Secondary Fan Powered Units in the Occupied Space**  
Chair: Jim Coogan
3. **Seminar: YEA – Cutting-Edge Building Automation Symbols & Abbreviation**  
*Chair: Elise Backstrom*  
*Speaker Charlotte Dean*
4. **Seminar: Automating Control Sequence Selection and Evaluation**  
Chair: Chariti Young  
Speaker: Paul Ehrlich, Mike Wetter, Steve Taylor
5. **Seminar: What have you done for me lately? BAS Best Practices for O&M Success**  
Chair: James Del Monaco  
Possible Cosponsor: TC7.3
6. **Seminar: Implementing Guideline 36:**  
*Chair: Ryan Williams*  
May be RP 1711 (Get Permission)
7. **Seminar: Emotional Intelligence & Building Automation**  
Chair: Chad Moore  
Speaker: James Del Monaco,
8. **Debate: Rule-Based Control vs. Model-Predictive Control – Which one is better?**  
Chair: Paul Ehrlich
9. **Seminar: Building Resilient Communities**  
Chair: Joseph Kilcoyne
10. **Workshop: Control Made Simple. A Seminar for YEA. Controls for Non-Control Engineers!**  
Chair: Michelle Shadpour
11. **Seminar: BAS Lockdown: The top 10 things you can do today to secure your BAS**  
Chair: Carol Lomonaco  
Speaker:  
Cosponsor: TC1.5
12. **Seminar: Demystifying Building Automation for the Hospital of the Future: Cybersecurity, Commissioning, and Balancing Implications**  
Chair: Frank Shadpour  
Speaker: Travis English

**13. Seminar: the latest developments in integrated, digital control between lighting and HVAC**

Chair: Scott Hackel

**Program “Pipeline” for Future Meetings:**

1. Should I be Alarmed? Part I: BACnet Alarm Options and When to Use them  
Chair: Carol Lomonaco
2. Should I be Alarmed? Part 2: Building Operations Alarming Best Practices  
Chair: Michelle Shadpour  
TC7.3 Co-sponsor
3. Should I be Alarmed? Part 3: Improving BAS Alarm Specification  
Chair: Chariti Young
4. Seminar: How to Become a Building Automation Engineer?  
Chair: Dave Kahn (YEA)
5. “Be Alarmed at what your BAS is not Telling You: Is no news really good news?”
6. Web-Services. XML, SOAP: How Do I Get Non-Traditional BAS Information and Use It for My Building Automation.
7. Controls for Fuel cells, Cogeneration and Micro-cogeneration, Renewables
8. Data Analytics... What interesting information can be derived from BAS data?
9. Special Sensors: Contaminants and Microbial Sensors
10. Project Control Submittals – What should it include?
11. Designing Command and Control Center for Buildings and large campuses
12. Humidifiers and Humidity Control for Critical Spaces.
13. How to Assess the DDC systems of an Existing Facility?
14. What Is That Most Consulting Engineers Are Doing Poorly? How to Properly design and specify control systems?
15. Seminar: IAQ & Comfort through Building Automation Systems
16. Application of narrow AI in BAS, in the near future – Machine learning!
17. Seminar or Conference Paper by Ron Bernstein: Smart Grid and Smart Buildings





### Proposed Tracks for 2020, Austin, Summer Meeting

Jun 27–Jul 1, 2020

Track 1	Fundamentals and Applications
Track 2	HVAC&R Systems and Equipment
Track 3	Research Summit
Track 4	Professional Development
Track 5	Grid-Interactive Efficient Built Environment
Track 6	Multifamily and Residential Buildings
Track 7	Resilient Buildings and Communities: and communities
Track 8	Zero Energy Buildings and Communities
Track 9	Mini-Track Building Myths

### Deadlines for 2020 Austin, Summer Meeting

Jun 27–Jul 1, 2020

- ✓ Monday, 1/13/20, Website Opens for Seminar, Workshop, Panel, Debate and Forum
- ✓ Monday, 1/13/20, Revised Conference Papers/Final Technical Papers Due
- ✓ **Monday, 2/10/20, Program (Seminar, Forum, Workshop, Debate and Panel) and Extended Abstract Paper**
- ✓ **Tuesday, 2/18/20, Conference and Technical Paper Final Accept/Reject Notifications**
- ✓ **Monday, 3/2/20, Extended Abstracts Accept/Reject Notifications**
- ✓ **Monday, 3/16/20, Debate, Panel, Seminar, Forum, Workshop Accept/Reject Notifications**
- ✓ **Friday, 5/1/20, Upload of presentation open for review**
- ✓ **Monday, 6/1/20, Presentation submissions due**



**Potential Sources Bias Disclosure:** In accordance with the ASHRAE Code of Ethics, speakers have been asked to fill out a potential sources bias disclosure document that will note affiliations/ involvement with any organizations with financial or commercial interest in the subject matter to be discussed.

## Program Types

**Technical Paper Session:** These sessions present papers on current applications or procedures, as well as papers resulting from research on fundamental concepts and basic theory. Papers presented in these sessions have successfully completed a rigorous peer review. Forms for written comment are available at each session and sent to respective authors for reply and publication in ASHRAE transactions, if received by a certain date.

**Conference Paper Session:** These sessions present papers on current applications or procedures, as well as papers reporting on research in process. These papers differ from technical papers in that they are shorter in length and undergo a much less stringent peer review.

**Seminar:** These sessions feature presentations on subjects of current interest. There are not papers attached to seminars.

**Workshop:** These sessions enable technical committees and other ASHRAE committees to provide a series of short presentations on a topic requiring specific expertise. These short presentations are provided with an increased emphasis on audience participation and training in a specific set of skills. There are not papers attached to workshops.

**Forum:** The sessions are “off-the-record” discussions held to promote a free exchange of ideas. Reporting of forums is limited to allow individuals to speak confidentially without concern of criticism. There are not papers attached to forums.

**Panel Discussion:**

Panel discussions can feature a broad range of subjects and explore different perspectives on industry related topics. This session format includes a panel of 3-4 speakers each addressing a facet of the session topic, followed by an interactive discussion lead by the session chair. Panel Discussions may be 60 minutes or 90 minutes in length and will be posted online in the Virtual Conference.

**Debate:** Debates highlight hot-button issues commonly faced by our membership. Industry experts, either on teams or as individuals, argue opposing sides of an issue, concluding with position summaries and audience feedback. Debate sessions may be 60 minutes or 90 minutes in length and will be posted online in the Virtual Conference.

## Presentations and Guidelines:

1. *Conference Paper vs. Technical Paper:* Conference paper is limited to eight (8) pages, the timeline is shorter and the review process less rigorous than the technical papers currently presented in the Technical Paper Sessions.
2. *Seminar and Forum Submissions:* For Seminar submissions, they should include six (6) Learning Objectives and ten (10) Questions and Answers for the session.
3. *Seminar Program Submission:* 60 minutes (1-2 speakers) or 90 minutes (3-4 speakers).



### Upcoming Meetings:

Jun 27–Jul 1, 2020     Austin, TX  
Jan 23–27, 2021        Chicago, IL  
Jun 26–30, 2021        Phoenix, AZ  
Jan 29–Feb 2, 2022     Las Vegas, NV

### Reminder:

- *Conference Paper vs. Technical Paper:* Conference paper is limited to eight (8) pages, the timeline is shorter and the review process less rigorous than the technical papers currently presented in the Technical Paper Sessions.
- *Seminar and Forum Submissions:* For Seminar submissions, they should include six (6) Learning Objectives and ten (10) Questions and Answers for the session.
- *Seminar Program Submission:* 60 minutes (1-2 speakers) or 90 minutes (3-4 speakers).
- **ASHRAE Announcement:** Conference, presentations will be REQUIRED to be uploaded before the conference opening onsite. If a presentation is not uploaded, the presenter will be assessed a strike, within our 3 strike program. If a presenter collects three strikes, he/she will not be selected to present at another ASHRAE conference.

These minutes stated herein were approved by TC1.4 program subcommittee.

*Submitted by:* Frank Shadpour, PE  
TC1.4 Program Subcommittee Chair  
[frank@scengineers.net](mailto:frank@scengineers.net)

## TC 1.4 Control Theory and Applications Research Subcommittee (RSC) Activities

Orlando – Feb 02, 2020

### RSC Meeting Minutes:

#### 1. Announcements

- a) Honors & Awards (5)
  - Grant In Aid
  - Service to ASHRAE Research
  - Homer Adams Award
  - Innovative Research Grant (IRG) pre-proposals
  - New Investigator Award
- b) [NEW] PTAR (Publication Topic Acceptance Request) to be rolled out after Kansas City,
- c) Web-based Training Modules for RTAR, WS, PES and PMS.
- d) WS and TRP's must have milestone chart and associated costs for each milestone as a percent of total project cost. Bidders may propose a different milestone chart with associated costs than suggested in the RFP. A questionnaire will be sent to PMS Chair at each milestone level to obtain project status. Payments at each milestone level will be made to the contractor only after approval of each milestone deliverables by the PMS.
- e) Reminder:
  - RTARs and WSs should be reviewed by liaison prior to submission to RAC. TC 1.4 Research Liaison is Ahmed Kashef [RL1@ashrae.net](mailto:RL1@ashrae.net) and Curtis Wilkins [RACvchair@ashrae.net](mailto:RACvchair@ashrae.net)

#### Active Project Status:

Name	Project	PMS	Status
<b>RP-1711</b>	Advanced Sequences of Operation for HVAC Systems – Phase II Central Plants and Hydronic Systems	Barry Bridges Marcelo Acosta Chad Moore Joe Kilcoyne	PMS has draft report. No cost extension was voted upon in Kansas City.
<b>RP-1661 TC 4.7 w/1.4</b>	Development and Validation of Dynamic Models for the Control of Chiller Plants with Water Side Economizer	Michael Wetter Wangda Zuo Jeff Stein	No cost extension requested.
<b>RP-1865</b>	Optimizing Supply Air Temperature Control for Dedicated Outside Air Systems		PES reviewed 10 bids and made recommendation. TC1.4 will vote on PES recommendation.

#### 2. Pending Research Project Status:

Status	Project	Champion	Remarks

## 3. Possible Research Project Status:

Status	Other TCs	Project	Champion	Remarks
<b>RTAR</b>	Co-sponsor TC	Common GUI system graphics for BAS Operators Specifying BAS graphics (Data sets, functional objects)	Marcelo Acosta Ron Bernstein Hwakong Cheng Carol Lomonaco	Identify minimal data set required for functional objects. Make graphics that are user-friendly. Number of clicks to navigate, Recommendations, how many bells and whistles get turned off to do your work. RP-1633. GUI for SGPC-36 sequences. GPC-13 can provide, examples.
<b>WS</b>		%kW vs, %CFM and %GPM curves for real systems	Steve Taylor Joe Zhou Jim Coogan Jin Wen	Real variable flow systems do not have ideal parabolic system curves because of closing dampers/valves. DP setpoint reset helps but actual and simulated performance doesn't match.  Keep - Good idea!
<b>WS</b>	Co-sponsor TC 6.1	Selecting Control Valves	Steve Taylor Carol Lomonaco	Work statement under development. Keep
<b>IDEA</b>	Co-sponsor TC7.5	Effectiveness of Night Setback and Optimum Start	<b>Gregory Cmar</b> Reece Kim Barker Joe Zhou	Cold climates impact SSTO. How can we automate when you need to adjust night setback variable? Develop control sequence based on recovery time. Simulation for guidelines for changing reset temperature. Determine seasonal space temperature setpoint reset and/or impact of using rolling weather forecast (next-day, 3-day, 7-day) via internet.
<b>IDEA</b>	7.5 7.3	Alarm Management, Alarm escalation, suppression, alarm flooding, latching etc..	<b>Carol Lomonaco</b> Kim Barker Jin Wen (TC7.5)	Planned forum for Austin will provide more information to support development of RTAR.
<b>IDEA</b>		Coordinating control of hybrid radiant and DOAS for maximum efficiency	Hwakong Cheng	CEC has done past research. Provides recommended research
<b>IDEA</b>		Cloud based MPC to that interacts with on BAS.	Needs champions Kim Barker	How do you simplify MPC to run optimum control sequence on BAS? Send optimization settings from the cloud to BAS.
<b>RTAR</b>	TC 7.9 TC 7.3	Persistence, Cost & Benefits of Commissioned Building Controls	David Underwood Joe Zhou Scott Hackel Ron Bernstein	When does building performance start to degrade? Report done by ComEd (28 bldgs).

Status	Other TCs	Project	Champion	Remarks
IDEA		Retrofit of Adv. RTUs for mitigation of risks.	Chris Benson	Managing of the Adv. RTU conversion/retrofit. What steps need to be added to the process to identify if risk Is any risk to building occupants and equipment life/liability.
IDEA			Chris Benson	What do the adv sequences optimize? Optimization of cost, energy, carbon may impact selection sequences used.
IDEA	7.5		Jayson Bursill	Separate sensor proxy for different type of functions. Cost benefit, function benefits, Define best measurement. Example: occupancy sensor, security. Proxy for other values. May have home in GPC-13

4. Research RTARs and WS Deadlines:

- March 15 for spring meeting
- May 15 for June meeting
- **August 15 for fall meeting**
- December 15 for January meeting

5. Adjourn: 4:00 pm

6. In Attendance: See attached sheet.

## Topic of Discussion

### Building Operations and Equipment Key Performance indicators

**Ian Bonadeo & Gary Powers** – slide presentation & Draft RTAR. How do you find simple KPI? Example Energy Star products (simple number). KPIs follow 80/20 rule. Develop health values for equipment, instead of measuring faults (measuring health or wellness measure). KPI Top-down hierarchy.

Campus->Buildings-> Air System->Plant->Zones. Building <Air System, Plant, Zones>

Utilizes navigation of the graphics and produces single view.

Ahu's > Zones (four categories – Temperature, humidity, pressure, flow, schedule, etc...)

How do you rate value, what does it mean?

Weekly report using KPIs and Boolean checkpoints. Customer does not have time to analyze lots of information.

Issues – What needs KPI? Where do you find KPI library? Usable on older systems (existing systems).

Inputs: BAS Alarms, BAS overrides, (what goes into KPI?), How many alarms are setup for the system (noise, nuisance). How well are does system maintain setpoint?

What types of buildings (campus level, industrial – case studies). Areas of concerns: Built on Tridium, alerts on smart alarms. Nest FDD underneath it, complement it, do you need further investigation.

Faults can be incorporated into the KPI score. Wellness factors (loop, etc..) exist. Start with most common equipment, encompass more equipment with less detail. Rule for exceptions, how do I create KPI for equipment. How well is AHU following it's schedule? Night setback, overrides, etc... Analytic server & Application (KPI's could be built anywhere?). Graphics – dependent on UX – best way to convey information.

Hierarchy management – kpi project dependent, define baseline of 100 (optimal performance). Audience O&M teams, operation for the past 7 days, baseline all the setpoints.

What determined the 4 or 5 things? RP-1633 what should UI look like? Guidebook.

Discussion about whether this should be a RTAR or USRP? Ian will need to consider how he wants to proceed with this idea.

### **Native graphics in BAS can we come up with best practice.**

Range in graphics is an impediment to trouble-shooting. Surveys, List of examples of what's out there.

Where would you go and look? Stakeholder interview, focus groups of operators, list of case studies.

Outcome examples, better understanding

More effective communication between graphics. Tighten up scopes. Impact comprehension. SPC207P – Not testing economizer, testing the fault detection to see if it does what it needs to do?

RTAR – TC7.5, TC7.9(not right home). Draft

### **SPC207P – proposed RTAR (co-sponsor) with TC7.5**

Ron Bernstein, Ed Morris will review RTAR and provide feedback to Dave Shipley. Kim to send draft RTAR to Ron and Ed.

### **Alarm management**

Forum to collect information, Usability, UX, root-cause. Need to identify problem statement for alarm management (potential Austin). Cosmetic or too many of them?

### **VRF optimal control sequences**

Most done by manufacturers. Application of the units (heating, cooling), ASHRAE should put together some type guide, relates to DOAS that serves VRF applies to RP-1711.

### **Cybersecurity – where are things going good system/best practices.**

10 best practices – internal expertise, do we have external practices (MTG to bring others together being pursued by TC1.5). NIST, Industrial world, IT vs OT. DOD require all controls need to go through cybersecurity certification (SME must verify, process in DOD/DOE). Boil this down to small, medium buildings. Impact of costs on business. Other groups looking at this and wait for things that are in the works.

### **Cost of Controls**

(Gwelen Paliaga)– Schedule meeting with Michael Bobker (NYC colleges). Owners risks, works for large buildings, great opportunities for small buildings.

From TC1.4 – incentives program – cost of implementing control systems. What's it going to cost me?

What does it depend on? What determines the cost of BAS implementation?

Implied benefit that you will save energy. Impact of different building types? What are you replacing?

No incentive plans for full-implementation, incentive programs use retro-commissioning programs. Breakout of custom model. Value to full retrofit, how could we provide full levers to describe.

Incentive models for full BAS retrofits (barriers to new models)

## TC 1.4 Control Theory and Applications

### Handbook Subcommittee

February 3, 2020 / 4:00 – 6:00

Hilton Orlando – Lake Down B

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#### 1. CALL TO ORDER

#### 2. REPORT FROM FUNDAMENTALS HANDBOOK LIAISON (Jason Atkisson)

- 2.1. TC approval for 2021 Fundamentals, Chapter 7 “Fundamentals of Control” is due on July 5, 2020.

#### 3. NEW BUSINESS

- 3.1. The subcommittee is in the process of editing Fundamentals, Chapter 7.
- 3.2. Edits to the Chapter will be done using the ASHRAE Authoring Portal (AAP). The link to the portal is as follows: [www.portal.ashrae.org](http://www.portal.ashrae.org). Internet Explorer is the only compatible browser. Anyone who's associated with TC1.4 can access the Chapters associated with this TC. Further guidance on the AAP can be found at the following link: <https://www.ashrae.org/technical-resources/ashrae-handbook/ashrae-handbook-central>
- 3.3. Jason Atkisson (TC6.1 Valves Liaison) requested TC1.4 members review the Valves Chapter. He'll send us the submitted chapter for review.
- 3.4. Joe Zhou (TC7.5) requested TC1.4 members assist in the review of Chapter 42 *Supervisory Control Strategies and Optimization* and Chapter 61 *Smart Building Systems* of the HVAC Applications handbook.
- 3.5. Chapter 7 of the Fundamental Review for TC1.4 has been split up into several sections.
  - 3.5.1. Charlotte will do a General Review as well as focus on CxA and Tuning Sections.
  - 3.5.2. Terry and Chris will review the Control Devices sections.
  - 3.5.3. Dave will do a General Review as well as focus on the Bibliography Section.
  - 3.5.4. Ron and Chariti will review the Networks and Specifying Building Automation Systems sections.
  - 3.5.5. Elise and Greg for general review or as needed, Chris Battisti for Networking and Specifying Building Automation Systems
  - 3.5.6. Chris Benson will help update graphics within the chapter (color, higher res) and if they need further explanation (symbols).
  - 3.5.7. Tara will help review the 6.1 valves section.
  - 3.5.8. New chapter 65 of Applications, occupant-centric sensing and control, should be reviewed by TC1.4 Which TC wrote that chapter? MTG.OBB (find out the chair).
  - 3.5.9. We will schedule webex meetings (at least two) before Austin.
  - 3.5.10. Kashif Nawaz is our Applications Handbook Liaison for Chapter 47 in 2023. We will start to work on this chapter after Fundamentals gets approved in Austin.

#### 4. NEXT MEETING AND SCHEDULE

- 4.1. 4: 00-6:00 Monday June 29, 2020 Summer Meeting in Austin, TX.



## 5. Adjourn

Adjourn at 6:00

### TC 1.4 Handbook Subcommittee Attendance List

Present	Name	
X	James Del Monaco	
X	Chariti Young	
X	Charlotte Dean	
X	Chris Miller	
X	Taraneh Shoorideh	
X	Terry Schroeder	
X	Ron Bernstein	
X	Christopher Benson	
X	Christopher Battisti	
x	Elise Backstrom	
X	Richard Farmer	
X	Greg Tayco	
X	Pratik Deokas	Guest
X	Tyler Bradburn	Guest
X	Irene Andsage	Guest
X	Rob Delaney	Guest
X	Patric Doyle	Guest
<b>Liaisons</b>		
	Kashif Nawaz	Applications 2023 Handbook Liaison
X	Jason Atkisson	Liaison from TC 6.1 Valves
X	Jason Atkisson	Fundamentals 2021 Handbook Liaison

## James Del Monaco

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**From:** Acosta, Marcelo [SAA] <macosta@armstrongfluidtechnology.com>  
**Sent:** Tuesday, February 4, 2020 7:56 AM  
**To:** James Del Monaco  
**Cc:** joseph@scengineers.net; Chad Moore; Barry Bridges; Chariti.Young (Chariti.Young@automatedlogic.com); Backstrom, Elise  
**Subject:** PMS 1711 Meeting Minutes

RP-1711 – Meeting Minutes

Feb 4, 2020

### Attendance

For the PI	For the PMS
Steve Taylor	Marcelo Acosta
Brandon Gill	Chad Moore
Reece Kiriou	Joseph Kilcoyne
	Mark Hegberg
	Barry Bridges (remote)
	(1 absent member)

### Guests: 16

1. The PI presented the project status
  - a. Tasks 3 to 5 have been completed over last semester
  - b. Report for Task 5 was submitted to the PMS on Jan 2<sup>nd</sup>
  - c. Pending a white paper conference session, expected for Chicago 2021
2. The PMS recommended adding notes when incorporating the sequences into Guideline 36 about assumptions of the system design philosophy (high deltaT and little dehumidification were specifically mentioned) which in some cases may affect efficiency but can be improved with minor tweaks.
3. The PMS noted “navigation” could be improved, pointing to some specific sections and addenda.
4. The PMS enquired about the status of a parallel project, outside the scope of this RP, to produce a software which will receive the specific configuration of a plant and automatically select the applicable portions of the sequences. The project is being done by Lawrence Berkeley National Laboratory and doesn’t require support from ASHRAE.
5. Despite the minor comments above, Barry Bridges and Marcelo Acosta commended the PI for the quality and value of the work.
6. Marcelo Acosta motioned to approve the Task 5 report, Joseph Kilcoyne seconded
7. **The PMS voted to recommend TC-1.4 to approve the Task 5 report 4-0-1**  
(Mark Hegberg abstained. He had missed the last 2 meetings and hadn’t received access to review the report)

Regards,  
**Marcelo Acosta**  
Armstrong Fluid Technology

23 Bertrand Ave, Toronto, Ontario, M1L 2P3, Canada  
T : +1(647)794-4306 | M : +1(647) 622-1531  
F : +1(416)759-9101

<http://www.armstrongfluidtechnology.com>



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