



**Goal 2: Commercial Quality Installation SFDS Working Group
Wednesday December 29, 2015 Meeting Draft Notes**

Call to Order

The meeting was called to order at 8:17 pm PST by Pete Jacobs, BuildingMetrics Inc. and Chair. Meetings are normally scheduled for up to 2 hours.

Roll Call

Quorum for voting organizations = 13 of 24. 12 of 23 voting members, 2 non-voting members and 2 guest/staff attended this meeting. A total of 16 members and guests were in attendance.

P = present at meeting

A = absent voting member; if proxy has been assigned it will be noted below.

WHPA Goal 2: CQI SFDS Working Group VOTING Members				Roll Call
ACCA (Air Conditioning Contractors of America)	Donald	Prather	Contractor Association	
Aire Rite AC & Refrigeration	Larry	Smith	Contractor (Nonresidential)	P
BMI (BuildingMetrics Inc.)	Pete	Jacobs	Energy Efficiency Program Consultant	P
Carrier Corporation	Dick	Lord	HVAC Manufacturer	
CDH (CDH Energy Corporation)	Hugh	Henderson	Energy Efficiency Organization	P
Clean Energy Horizons, LLC	Norm	Stone	Energy Efficiency Program Consultant	P
Cooper Oates AC	Gary	Storck	Contractor (Nonresidential)	
Daiken Applied	Skip	Ernst	HVAC Manufacturer	P
DEG (Davis Energy Group)	Dave	Springer	Energy Efficiency Organization	P
DNV-GL (formerly KEMA)	Jarred	Metoyer	Energy Efficiency Program Consultant	
Energy Analysis Technologies	Chris	Ganimian	Consultant	
Energy Solutions**	Jim	Hannah+	NR	P
FDSI (Field Diagnostic Services Inc.)	Dale	Rossi	Third Party Quality Assurance Providers	P
Galawish Consulting & Associates	Elsia	Galawish	Energy Efficiency Program Consultant	P
HSGS (Honeywell Smart Grid Solutions)	Shayne	Holderby	Energy Efficiency Program Consultant	
IC Refrigeration	Richard	Imfeld	Contractor (Nonresidential)	
JCI (York Unitary)	Bryan	Rocky	HVAC Manufacturer	
Marina Mechanical	Denny	Mann	Contractor (Nonresidential)	
NCI (National Comfort Institute)	Ben	Lipscomb	Educator, Trainer	P
PG&E (Pacific Gas and Electric)	Adam	Scheer	California IOU	P
SCE (Southern California Edison)	Steve	Clinton	California IOU	P
University of Nebraska (Lincoln)	David	Yuill	Educator, Trainer	
XCSpec	Jan	Peterson	Controls (Manufacturer or Distributor)	
WHPA Goal 2: CQI SFDS Working Group Non-VOTING Members				Roll Call
ACCA (Air Conditioning Contractors of America)	Wes	Davis	Contractor Association	
ACCA (Air Conditioning Contractors of America)	Glenn	Hourahan	Contractor Association	
Aire Rite AC & Refrigeration	Don	Langston	Contractor (Nonresidential)	
NCI (National Comfort Institute)	Rob	Falke	Educator, Trainer	P
PG&E (Pacific Gas and Electric)	Leif	Magnuson	California IOU	
PG&E (Pacific Gas and Electric)	Robert	Davis	California IOU	
SCE (Southern California Edison)	Lori	Atwater	California IOU	P
SCE (Southern California Edison)	Andres	Fergadiotti	California IOU	



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SCE (Southern California Edison)	Sean	Gouw	California IOU	
XCSpec	Jeff	Aalfs	Controls (Manufacturer or Distributor)	
WHPA Goal 2: CQI Committee Invited Guests and Staff				Roll Call
STAFF				
BBI (Better Buildings Inc.)	Dale	Gustavson	WHPA Executive Advisor	
BNB Consulting/WHPA Staff, host, admin. support & scribe	Bob	Sundberg	WHPA Staff	P
Empowered LLC	Shea	Dibble	WHPA Co-Director	
John Hill **	John	Hill +	(CPUC/ED Ex Ante Consultant)	
Mechanical Systems Design & Consulting	Jeff	Henning	Educator, Trainer	P

** Organization is Not a Member of the WHPA; + Individual is NOT Registered with the WHPA;
(P) after last name = Member/Registrant is Pending Approval from the WHPA Executive Committee

AGENDA		
Topic	Discussion Leader	Desired Outcome
Welcome, roll call, approve past meeting minutes, review ACTION items and agenda	Pete Jacobs and Bob Sundberg	Record meeting attendees, finalize past meeting minutes, review status of meeting action items.
Welcome new members & guests	Pete Jacobs	New members and invited guests welcomed.
Review feedback from Dec. 15 meeting	Pete Jacobs	All feedback shared with working group.
Scope of remaining WG effort	Pete Jacobs	Understand the focus for the limited remaining WG time.
Review rev. 6 Spec. spreadsheet. Discuss further revisions to rev. 6 Spec. spreadsheet.	Pete Jacobs	Understand current rev. 6 spec. spreadsheet changes.
Finalize phase 1 data specification	Pete Jacobs	Finalized data specification for commercial installation. Decide on next steps for future phases to address 1) residential installation and commercial maintenance and 2) CQI C. efforts to use specification to develop performance evaluation protocol & methods.
Vote on data specification approval and to elevate work product to CQI Committee for their consideration, probably via email vote.	Pete Jacobs	Finalize vote on approval of data specification and elevation to CQI Committee for consideration.



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Summarize meeting, assignments/ACTION items, sunset WG & adjourn	Pete Jacobs and Bob Sundberg	Completion of WG phase 1 effort to finalize spec. Pete Jacobs & staff will need to .
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Approve Minutes of Previous Meeting

The December 15 meeting draft notes were distributed December 20. No suggested revisions were received. Meeting notes were approved as distributed. Final minutes would be posted to the working group's location within the WHPA/CQI Committee website.

Review Status of Action Items from Previous Meeting

Dec. 15 ACTION: Pete Jacobs would contact chairs and/or key committee members to discuss how best to proceed with cross-cutting efforts toward additional data specifications relevant to residential installation, commercial maintenance and the Energy Savings and DEER Committee. Pending.

Dec. 29 Update: Rob Falke met with Don Langston the previous week. Don said he was very much in favor of what this WG was attempting. Don wanted to meet with Pete, Dale Rossi and Rob early in January to discuss how they could proceed most effectively. Rob had also contacted Chris Ganimian and they'd agreed to also meet in January to align their efforts and discuss how they should proceed regarding residential installation WG work in 2016. Dale Rossi suggested Pete and Don and Rob meet in person at the ASHRAE meetings Friday January 22.

KEY UNDERSTANDING: Field measurement comparisons would make use of equipment manufacturer's extended performance tables with ratings at different combinations of conditions, not a simply comparison against a single maximum rated EER.

Dec. 4 ACTION: Rob Falke and Larry Smith would work together over the next couple of weeks to identify recent jobs where full before/after evaluation data was collection for Standard 180 program customer units. Rob offered to pull the data and share the data and analysis with this group to demonstrate the impact of Standard 180 based maintenance and their approach to data collection and analysis. Pending.

Dec. 4 ACTION: Dale Rossi volunteered to send out his specification which defined evaluating condenser coils and provided guidelines for under what conditions he'd determined that a coil needed to be cleaned. Received and distributed to entire WG 12/29. Dale Rossi explained that EI referred to efficiency index and CI referred to capacity index. Both were outputs of the FDSI HVAC Service Assistant instrument. They were measures of current efficiency/capacity vs. design efficiency/capacity under current conditions. Completed.

Dec. 4 ACTION: Rob Falke and Dale Rossi volunteered to meet off-line and work on revisions and definitions for columns C, E & F to offer a better way to capture initial assessment, ongoing assessment and measurements which needed to be taken during deeper diagnostic investigation, typically on service/repair calls, not as part of scheduled maintenance. Pending.

November 13 ACTION: Dick Lord, Carrier, offered to provide the group with a copy of the white paper he'd authored related to test parameters and procedures. Pending.

Welcome New Members and Guests

None.



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New Business - Pete Jacobs

None.

Review of WG progress, focus and goals - Pete Jacobs

Standardized Field Measurement Data Specification Related to Commercial Installation - Pete Jacobs

Slide 2 - Focus for Dec. 29 Meeting

Pete Jacobs suggested the group focus their efforts on commercial installation to try and complete one of the applications. The entire project was broad in scope and he thought they really needed to take each application sequentially. To defer residential installation and commercial maintenance as phase 2 and 3 efforts for 2016.

Pete proposed the try to resolve some of the remaining questions about the specification at this meeting. He would then revise the specification and have it sent out to the working group (WG) one last time for comments. Pete would incorporate comments into a final spec. revision and prepare a phase 1 commercial installation specification work product for a member vote.

Pete advised the group that until the WHPA approved additional staff support for meetings, they could proceed with holding meetings early in 2016 until the Alliance re-ups support for the WG. But, the WG would need to follow the same process, use the same documents to produce meeting records, record meetings as Bob Sundberg had described at the previous meeting. Procedures and document templates are provided at the WHPA website at the following link. He proposed saving the rest of that discussion until the end of this meeting. He wanted to spend most of the meeting time addressing the questions which had been raised which would also apply to residential applications and probably commercial maintenance.

<http://www.performancealliance.org/Committees/ToolsandTemplatesforChairs/tabid/384/Default.aspx>

Dale Rossi, FDSI, indicated he'd reviewed the version 6 specification document and concluded that they'd not done the work necessary to put it to a vote. Specifically, the objectives statement hadn't really been discussed or agreed upon. He would also have started with the performance assessment needs of capacity and efficiency to begin to list out the data requirements. He did not think that starting with what data needed to be collected and then later determining how it would be used, what calculations would be necessary to determine capacity and efficiency, that didn't seem to be the right approach to him. He'd noted that equipment reliability was a critical measure that wasn't being considered.

Pete Jacobs responded that, perhaps, to lay out the analysis approach first and then determine the data flow was better and had been considered. He'd anticipated that starting with the analysis methods first approach would be pretty involved. Part of their decision to tackle data collection first was related to program evaluation activities going on in the field at the present time. It was their hope to bring some discipline and consistency to those data collection activities. He did anticipate providing a text introduction to the spreadsheet work product. He was reluctant to get into deep discussions on all the possible evaluation methods and different calculations which was intended for a CQI Committee goal #4 activity.

Rob Falke, NCI and CQI Committee Chair, clarified that the effort of this working group was step one in a sequence of CQI Committee objectives originally proposed to the Executive Committee. For analysis, they needed data collection from the air side, refrigeration side and for combustion. Doing analysis on all three didn't seem practical for utility programs. To complete even one was a major accomplishment. Once the data elements were

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identified by this group, the plan was for a follow-on working group to work on defining those methods for performance evaluation like capacity and efficiency which would lead towards determining energy savings. That would include efforts to determine test methods drawn from different industry standards including the correct way to gather this data in the field. He understood what Dale had proposed. Rob wondered whether they could include clear enough goal statements in this first step to keep the ball rolling.

Dale Rossi responded that there was nothing presently in the goals about energy savings. He thought they needed to work on the objectives. The recorded goals didn't match this conversation. But, he'd had opportunity to give his input. The chair and other WG members would need to decide how they wanted to proceed.

Lori Atwater, SCE, offered her IOU perspective. A direct link between performance improvement and energy savings would be of great interest to them. She also thought it would be very valuable for the contractor to be aware when collecting the data that the reason was to provide an ability to determine energy savings and the impact of their work on the customer and their energy bill. That would be optimal. It was especially important for residential installation which was her area of focus.

Ben Lipscomb, NCI, tended to agree with Dale that they weren't ready for a vote yet. Maybe to shift back to the objectives and start considering data elements from the top-down rather than continue from the bottom-up. He wasn't sure what they would find they actually need until they'd decided and clarified how data points would be used. He wasn't sure how valuable a list of data points would be without first determining how they would be used.

Pete Jacobs supported the idea of putting more work on the front end for objectives. He asked all members to send him their ideas about objectives and he'd include it in the introductory material. He also mentioned they'd always considered this specification as a living document. When they got to the methods and calculations, as Ben suggested, they could expect to iterate back and forth with refinements to the data points in the spec. Different data or more or less data. Revisions could and should occur as this process proceeded. He then suggested they hold further "next steps" for the end of the meeting.

Slide 3 - Questions for Group Discussion - 1

1. Is it necessary to hook up gauges to a newly installed rooftop system? A new system right from the factory.

Discussion:

- Dale Rossi. How would the next tech fare following an installation if benchmark refrigeration readings were not recorded and he finds a serious problem? Like really low subcooling not caught at the initial installation. It would put the tech in a very bad situation.
- Rob Falke. Agreed for a need for new installation commissioning or near the installation.
- Pete Jacobs. If you hook up gauges to a new system, you always run the risk of contamination and loss of charge. He was curious for input from contractors and implementers for how big a risk they perceived gauge measurements involved on newly installed systems .
- Dale Rossi added that this was more of an issue for smaller equipment, less of an issue for larger equipment. Three tons was the breakpoint. Below 3T you would not measure. Above 3T you would put on the gauges and take readings.
- Larry Smith, Aire Rite AC & Refrigeration. Putting gauges on a system would be the last thing you want to do just to confirm charge on a new system. Overkill. He trusted that manufacturers tested performance of the unit. You could use the airflow/temperature data to confirm an expected air temperature change. If you matched the unit output to the manufacturer's criteria, there would be no

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reason to go further with refrigeration measurements or temperature ones within the unit. If they suspected an issue outside of the unit, they'd begin looking for duct leakage and other sources.

- Skip Ernst, Daiken. He was most familiar with 20T and up sized equipment. Following the manufacturer start up procedures was important. On larger equipment, that meant confirming refrigerant temperatures/pressures by taking gauge readings. Their start up procedures directed installers to confirm superheat which they knew couldn't be determined under a single factory set of conditions. They also suggested the installer to check subcooling which they considered to be the best test for correct charge in the field. Factory testing was quite rigorous but was tested at factory conditions and wide open airflow. They used a mass flow meter to establish charge at the factory.
- Rob Falke added that considering Lori Atwater's interest in residential installations, the length of the split system lines had a pretty big impact on charge in the lines. Putting on gauges was pretty much required. But, after installation, as Ben indicated earlier, you could get an indication of charge deviation from the air side. If needed, you could always tap into the refrigerant circuit.
- Dale Rossi commented that most new equipment, from his experience, was set on the curb, powered up, rotation of the fan was confirmed and then they walked away.
- Ben Lipscomb added that with lower cost, less featured equipment there was a need to confirm proper operation and most of those manufacturers made that recommendation. With more expensive, featured equipment, there was often some operation diagnostics onboard that would catch issues and faults.

2. When are combustion benchmarking tests needed? What were the issues around the combustion side?

- Dale Rossi. The heat content of gas varied depending on your location. Checking the incoming gas pressure was important to insure the unit was getting the correct gas supply. Manifold pressure was about the only adjustment available after the regulator. Flue gas analysis was then necessary to make any further adjustments but was difficult.
- Rob Falke differed in his opinion. He believed that trained technicians with the right instruments could take reasonably accurate readings and make combustion adjustments.
- Skip Ernst. They asked installing technicians to check inlet gas pressures and confirm manifold pressure and to do combustion tests. They sold mostly modulating furnaces which were more demanding. They had to check CO₂ and CO at several different firing rates. This was more likely to be checked out properly by people in colder climates.
- Norm Stone, Clean Energy Horizons. Besides direct combustion tests, you also had to take delivery system temperature readings to confirm that the heat being produced was being delivered properly to the space.
- Ben Lipscomb agreed with Norm. The spreadsheet should probably call out all those important airside measurements separately from cooling data collection.

3. What defines "steady state" operation and what are acceptable rates of change of indoor and outdoor conditions during a single test? Jumpering a system into full cooling or full heating was inherently problematic. All on and then off. How would you take all the required "near instantaneous" measurements?

- Norm Stone. You almost needed continuous metering to get a handle on a steady state reading. Getting instantaneous readings to annualize savings would be very difficult.
- Pete Jacobs. Norm had brought up extrapolating instantaneous readings to annual usage which Pete thought was a separate challenge from performance evaluation under one set of conditions. He wanted the group to focus on essentially the one time measurement that could be used to determine a point in time performance metric which Dale Rossi had described earlier.
- Dale Rossi thought two different issues were being combined. For him, steady state referred to no longer being in a transient startup condition. For the refrigeration cycle, they'd found that the

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determining factor was the liquid temperature which was the thing that stopped changing last. When that liquid temperature finally became stable, they considered the system operation in steady state. Modern digital gauges, like the HVAC Service Assistant, took multiple simultaneous readings. Line pressures and temperatures, ambient temperature, RH, all at one time, continuously sampling. The time it takes the liquid line temperature to stay +/- 1 degree F changed with mass/size of the unit. They'd found it took about 7-8 minutes for a 20T unit, about 15-16 minutes for a 5T unit and about 45 minutes for a 1/2T window units.

- Rob Falke. In one sense there was no "steady state" for the system. If you were heating, it was on until it reached set point then turned off. If cooling, same thing. They looked for the equipment output to be stable. Rob Falke stated that in the past, the focus was on the box, the operation of just the equipment. The future focus would be on the system as a whole. He looked forward to seeing a manufacturer step up to include sensing and fault detection on the distribution side of the system.

The group discussed monitoring and use of data loggers and the benefits that might yield annualized energy usage for determining savings. The conclusion was that this was too time-intensive and expensive to become part of normal utility programs given the cost and limited field time that could be charged. Also, that the larger, more expensive/featured systems with variable refrigerant flow control (VRF) had factory installed pressure and temperature transducers that allowed continuous monitoring of system operation and more advanced onboard diagnostics and alarm capability. You could see system measurements from the keypad display so no need for hooking up gauges. For most high volume, lower featured equipment, instantaneous readings was the only current viable option.

- Pete Jacobs asked Skip Ernst whether he could inquire about whether someone could determine refrigerant diagnostics from VRF systems or whether it was so complicated with so many flow conditions that they needed to depend on system diagnostics. He agreed to check and get back to the group.

ACTION: Skip Ernst, Daiken, would look into VRF systems and whether someone could be expected to perform manual diagnostics from the fluctuating flow conditions or if they needed to depend upon onboard condition monitoring/diagnostics.

- Rob Falke was skeptical about current monitoring systems for wet bulb temperature sensing.
- Ben Lipscomb. The only thing currently reasonable was simultaneous temperature sensing of the equipment, not the rest of the delivery system at ducts and grills.
- Adam Scheer, PG&E, from a utility perspective. He referred to earlier discussions about the need for coordinated data collection for the quality maintenance programs. The utilities had very limited budgets to spend on encouraging contractors to spend a little more effort to delivery better maintenance. He encouraged the committee to view data collection with the broader industry in mind, not just for uses related to utility programs. Programs could only directly influence a very small percentage of the larger group of contractors. As Norm had stated earlier, annualized savings was ultimately what the utilities needed to prove the worth of their programs. That was how they were judged. He also was interested to have the group looking into use of AMI data (advanced metering infrastructure), the incremental or 15 minute interval building metered data. How to use that data to understand the influence and impact of their programs on energy usage. That might be done more easily on the maintenance side than for unit installation which included both the variable of the new vs. old unit as well as the selection, design and installation of that new unit. With billing analysis, it was pretty hard to separate those two factors. He suggested coupling the sale of a new high efficiency unit

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with a quality installation then you'd have one program that would measure the savings/impact of both factors combined. Then, the complexities of extrapolating and combining the simulated impact of individual energy efficiency measures would be unnecessary.

- Lori Atwater, SCE, agreed. RQI program would be examining building metered data beginning in Q1 2016. They were looking to see if they could validate benefits of the program using this data. Even though, as Norm and Adam had said, verifying energy savings for programs was a big deal for the IOUs, connecting greater energy savings with a contractor's ability to sell the additional time and cost for a quality installation was critical. Contractor communications about the energy savings was going to get a lot of new emphasis in their program because it rarely occurred in typical system sales which were mostly "first cost" price sensitive.
- Dale Rossi indicated that FDSI had been using AMI data analysis for about a decade with their national account customers. He was happy to share information with others about how they used AMI data. The earlier remark about market transformation reminded him of another void in the marketplace. The need for customer facing reporting. The utility programs he supported really didn't have good reporting and that would be a worthy goal to correct.
- Rob Falke shared that 80% of their work was with contractors outside of utility programs and their incentives. The training and instrumentation requirements meant higher installation costs and charges to customers. Customers needed proof that they were getting value for those greater costs. Deemed savings for individual energy efficiency measures, averaged by location and buildings, didn't really mean anything to customers. And, there was the misunderstanding that a system had been properly selected and installed if it complied with Title 24 requirements which just wasn't a valid assumption. And, few installations were even code approved in California. Their evaluation of Title 24 compliant new residential systems revealed that on average they only delivered about 63% of the equipment rated performance. Commercial systems were slightly lower. He believed that implementation of the specification they were working on would allow older systems to be evaluated and compared to newly installed ones. It would also allow issues with new system installations to be recognized and corrected to deliver the lower energy usage at the meter which AB 802 legislated meter analysis couldn't do alone.

Pete Jacobs thought this had been a great discussion which should be continued in the future or they should determine which venue would be best for its continuation.

4. What is an acceptable elapsed time between a set of measurements comprising a single calculated value

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Slide 4 - Questions for Group Discussion - 2

1. Air flow reporting – how much intermediate data based on air flow method should be included?
 - Ben Lipscomb. Too burdensome for utility programs to require recording/reporting all the intermediary readings. Often times those intermediary readings are direct inputs to an instrument that calculates the final airflow.
 - Bob Sundberg, WHPA staff, mentioned that no one from the CPUC/ED ex ante team was involved in these discussions. They might have specific data requirements and verification which had to be used for IOUs in their claimed savings proposals.
 - Pete Jacobs responded that John Hill of that ex ante team had agreed to review and provide feedback on the WG work product.

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- Lori Atwater, SCE, seconded the comments made earlier about the importance of reporting. IOUs needed to be able to justify the expenses for their programs back to the CPUC and information collected which made that possible was critically important.
2. Use flow weighted average supply/return air temperatures? If there was large volume difference between the volume of air delivered out of certain ducts, would you give a weighted value based on volume? How do you handle those situations?
- Rob Falke said their protocol didn't get that detailed. They typically selected representative ones for sampling. There was a lengthy protocol for where you took those measurements. They rarely measured all the grills. They would normally ignore grills with very low airflow.
3. Need for separate outdoor air/ambient air and condenser entering temperatures?
- Skip Ernst, Daiken. Depending on the location of the condenser, the condenser entering air could be substantially different from the ambient air temperature.
 - Dale Rossi, FDSI. What their firm referred to as ambient air was really the condenser entering air temperature.
 - Ben Lipscomb, NCI, recommended that for refrigeration measurements, condenser entering air temperature was more important. For airside measurements the ambient OA temperature was most important.
4. Duct leakage using fan pressurization (duct blasters common for residential evaluations) was omitted from commercial buildings. Is this technique used in any of the current programs?
- Rob Falke indicated that in commercial it was common to take the fan airflow minus the supply register airflow. He also described a SMACNA pressurization testing method that was sometimes used.
5. Duct leakage testing – how much intermediate data based on duct leakage test protocol should be included?
No comments collected.

Closing Comments/Adjournment

Pete Jacobs asked everyone to send him whatever they thought needed to be added to help revise the goals and objectives.

1. He planned to get with Bob Sundberg to determine a final date by which all comments needed to be sent in before scheduling another meeting. Look for an email soliciting comments from Bob.
2. They would be able to plan and schedule another meeting, independently if needed, during early January.
3. He would then meet with Rob to decide whether they had sufficient revisions to send the to the designated reviewers for their input.
4. Follow getting and incorporating that input, he and Rob would decide whether the narrative and specification would be sent out for a voting member vote. All voting members needed to be WHPA registered and only one person from each registered organization could vote.

Pete suggested the CQI Committee meeting be postponed until January 29 to allow the parties who planned to meet at the ASHRAE meetings January 22 and to collect WG comments.

Pete thanked everyone for their input, participation and attendance.

The meeting was adjourned at 10:24 am PST.



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Summary of Pending and New Action Items and Key Decisions or Understandings

December ACTION: Skip Ernst, Daiken, would look into VRF systems and whether someone could be expected to perform manual diagnostics from the fluctuating flow conditions or if they needed to depend upon onboard condition monitoring/diagnostics.

DRAFT