

Call to Order

Mark Lowry (BBI CEO) called the meeting to order at 12:07 p.m. PST.

Agenda

Topic	Facilitator
Roll Call	Bonnie Gustavson
Approve Minutes of November 15, 2017, EC Meeting	Mark Lowry
Announcements	Mark Lowry
CQI FDS WG Work Product (#1): “ <i>HVAC System Performance Assessment Calculation Procedures</i> ” White Paper	Pete Jacobs
CQI FDS WG Work Product (#2): “ <i>Test Protocols and Procedures to Support HVAC System Performance Assessment</i> ” White Paper	Pete Jacobs
HSES and Chartering Committees: Overview of the Scoping Outputs for the Proposed WHPA Articles of Incorporation and Bylaws	Mark Lowry
New Business and Adjourn	Mark Lowry

Roll Call – Attendance

A quorum (eight or more) of the Executive Committee (EC) was present or represented by proxy.
To avoid repetition, the abbreviation for the name of the member organization will be used in the body of the minutes.

Organization	First Name	Last Name	WHPA Category	P=Present
Executive Committee				
ACCA (Air Conditioning Contractors of America)	Don	Langston	Contractor Association	P-has proxy for NCI
AHRI (Air-Conditioning, Heating, and Refrigeration Institute)	Garrett	McGuire	HVAC Manufacturer Association	P-has proxy for ASHRAE
ASHRAE	Ron	Jarnagin (Co-Chair)	Engineering Society	proxy assigned to AHRI
CEC (California Energy Commission)	Lea	Haro	Government (Other than CPUC)	P
CPUC (California Public Utilities Commission)	unassigned		CPUC	
HARDI (Heating, Airconditioning & Refrigeration Distributors International)	Talbot	Gee	Distributor Association	
IHACI (Institute of Heating and Air Conditioning Industries)	Bob	Wiseman	Contractor Association	P
JCEEP (Joint Committee on Energy and Environmental Policy) Western States Council	Dave	Dias	Organized Labor	proxy assigned to UA
NCI (National Comfort Institute)	Dominick	Guarino	Educator, Trainer	proxy assigned to ACCA
PG&E (Pacific Gas and Electric Company)	Christian	Weber	California IOU	P
SCE (Southern California Edison)	Scott	Higa	California IOU	P
SDG&E (San Diego Gas & Electric)	Paul	Thomas (Co-Chair)	California IOU	P
SoCalGas (Southern California Gas Company)	Harvey	Bringas	California IOU	P
UA (United Association)	Don	Tanaka	Organized Labor	P-has proxy for JCEEP

Organization	First Name	Last Name	WHPA Category	P=Present
Guests				
ACCA (Air Conditioning Contractors of America)	Louis	Fuentes	Contractor Association	P
BMI (BuildingMetrics Inc.)	Pete	Jacobs	Energy Efficiency Program Consultant	P
NCI (National Comfort Institute)	Rob	Falke	Educator, Trainer	P
PG&E (Pacific Gas and Electric Company)	Mark	Salavitch	California IOU	P
Staff				
BBI (Better Buildings, Inc. CEO) (Facilitator)	Mark	Lowry	Energy Efficiency Program Consultant	P
BJGustavson Consulting (WebEx)	Bonnie	Gustavson	Other Stakeholder	P
Galawish Consulting Associates (CQI Staff Support)	Elsia	Galawish	Energy Efficiency Program Consultant	P
Key SEO/Key Marketing Group (Scribe)	Judy	Johnson	Other Stakeholder	P

Approve Minutes of November 15, 2017, Meeting – posted on WHPA website

MOTION made by Don Tanaka (UA) and Paul Thomas (SDG&E) to approve the EC Meeting Minutes of November 15, 2017. All EC members present or represented by proxy voted in favor of passing the motion. Motion **CARRIED**.

Announcements

ANNOUNCEMENT by Mark Lowry (BBI CEO) – The Executive Committee was reminded that there will be an additional Executive Committee on December 20 to review documents for the non-profit incorporation. (NOTE – The December 20 meeting was subsequently rescheduled to January 17, 2018.)

CQI Field Data Specification Working Group Work Product #1: “HVAC System Performance Assessment Calculation Procedures” White Paper – Work Product and PPT Presentation posted on WHPA website

PRESENTATION by Pete Jacobs (BMI and Chair of the CQI FDS Working Group) – The CQI Field Data Spec Working Group (CQI FDS WG), which reports to the Commercial Quality Installation Committee, is presenting two related Work Products to the Executive Committee at this meeting for adoption. The first Work Product is “*HVAC System Performance Assessment Calculation Procedures*.” Rob Falke (NCI), Chair of the CQI Committee, will also add comments during the two presentations.

The CQI FDS WG was formed several years ago to work on data specs, and in 2016 we submitted a Work Product that was adopted by the Executive Committee.

The two Work Products presented today provide:

- 1) Documentation of a calculation methodology for conducting HVAC system performance assessment and
- 2) A series of test protocols and procedures to support those calculations and best practices for obtaining those measurements in the field.

To create these Work Products, we held a series of meetings to talk through both the engineering algorithms and the field feasibility of collecting the data called out in the algorithm, which were later addressed in the best practices document.

We had a good group of SMEs and I learned a ton from working with them—contractors, manufactures, utility folks, and evaluators. Several things that I was really curious about were revealed in our conversations across a broad representation around the HVAC industry.

The first Work Product is a system performance calculation procedure. The goal was to provide standardized methods for calculating installed system performance from field measurements. These were developed in conjunction with the ASHRAE SPC 221 Committee, which is addressing similar issues. They are drafting a new standard, ASHRAE Standard 221. Standardization of

calculation procedures provides a consistent and comparable set of results across all entities conducting field measurements of system performance.

COMMENT by Rob Falke (NCI) – What this test method does is measure and quantify the deterioration in efficiency once a piece of equipment is taken out of the laboratory and attached to a distribution system in the field and the effects of the building that take their toll on the system. It documents how much the efficiency of the equipment is deteriorated, and then it scores the system in the field as it operates in the field.

COMMENT by Pete Jacobs (BMI) – The benefit of this Work Product is standardization. Once those procedures are adopted, then it gives us a basis to compare results.

The work focuses on four performance metrics:

1. Equipment Capacity
2. Equipment Efficiency
3. System Delivered Capacity
4. System Delivered Efficiency

The work presents a set of calculations based on engineering first principles, which are primarily equations. We focused on measurements that can be done in the field.

The Working Group came up with an algorithm (see Slide 5 in the PPT presentation posted on the WHPA website) that characterizes both loads as part of the delivery capacity of the equipment. To do the calculation in the algorithm requires a set of Equipment Capacity and Efficiency Measurements.

- Two Air Flow Measurements – Outdoor Air (OA) Entering and Supply Air Flow Rate
- Three Sets of Air Temperature and Humidity Measurements – Supply, OA, and Return.
- Input Power

Separately the Work Product addresses system level calculation (see Slide 6). The outside air conditioning temperature remains the same as it happens inside the unit, but the system delivered calculation is different.

System Level Calculation Measurements:

- Outdoor Air and Supply Air Flow Rate Delivered to Zone
- Supply and Return Air DB and WB Measured at Zone
- Outdoor Air and Return Air DB and WB Measured at Unit
- Input Power at the Unit

QUESTION by Louis Fuentes (ACCA) – Are any additional tools required beyond what a technician would normally carry for testing procedures?

ANSWER by Pete Jacobs (BMI) – No; it is the opinion of the Working Group that it is not a huge stretch for most technicians to assemble the required tools.

COMMENT by Rob Falke (NCI) – A lot of the air flow tools won't be carried by a clean-and-check technician. It is a fairly advanced technician who would need to be trained to do some of these measurements. If this becomes part of what a technician does, he will need each of those instruments. Bottom line—when we add power to the calculation, we are able to measure the installed system EERs in the field. Where we assume 12 EER is typical for a current system, we are seeing a lot of 6 or 7 EER in the field-measured systems, which is a significant deterioration. The good news is that once that system has been tested, diagnosed, and repaired, we can get that system much closer to what it was intended to be.

QUESTION by Mark Lowry (BBI CEO) – Can you explain the basic difference between the calculations on Slides 5 and 6 to describe the difference between the equipment-level calculations and the system-level measurements?

ANSWER by Pete Jacobs (BMI) – Box efficiency basically draws a boundary around the equipment itself, whereas the system level calculation considers the inefficiencies associated with the distribution system, such as uninsulated duct work. The difference between those two numbers is what is lost in the distribution system.

COMMENT by Rob Falke (NCI) – A 2016 Work Product of this Working Group was the definition of an efficiency installation and titled “CQI Standardized Field Data Specification for Commercial HVAC Installation” (2016). It is a significant shift to what we have assumed that efficiency was in the past.

MOTION made by Christian Weber (PG&E) and seconded by Scott Higa (SCE) to adopt the CQI FDS WG Work Product “*HVAC System Performance Assessment Calculation Procedures.*” All EC members present or represented by proxy voted in favor of passing the motion. Motion **CARRIED.**

CQI Field Data Specification Working Group Work Product #2: “*Test Protocols and Procedures to Support HVAC System Performance Assessment*” White Paper – Work Product and PPT Presentation posted on WHPA website

PRESENTATION by Pete Jacobs (BMI and Chair of the CQI FDS Working Group) – This is the second of two related Work Products developed by the CQI Field Data Spec Working Group (CQI FDS WG), which reports to the Commercial Quality Installation Committee. It is titled “*Test Protocols and Procedures to Support HVAC System Performance Assessment.*” This is basically a compilation of recommended instrumentation, recommended specifications for that instrumentation, and best practices in how to accurately use that instrumentation to drive the calculations in the first Work Product.

Uncertainty was a big deal in our Working Group. We had broad representation, including someone who works in the lab of a manufacturer, and they work with uncertainty on a day-to-day basis.

Recognizing that all measurements have uncertainty, uncertainty can be propagated through a calculation. Once someone understands the uncertainty in the final number and then compares two numbers such as test-in and test-out calculations of capacity and efficiency, you can know if those comparisons are statistically significant.

We focused on the following five measurements required to take the calculations:

1. Temperature
2. Humidity
3. Air Flow
4. Static Pressure—which can be a component of air flow measurements
5. Electric Power

Our goal was to recommend best practices to minimize the error in each of these measurements, then to quantify the measurement error, and then to follow that through to the final calculations.

These are some of a longer list of best practices for temperature and humidity measurements that are described in the document:

- Basic Instrument Specifications
- Measurement Timing
- Probe Placement

Measurement timing is important, because when you lock the system into cooling, you know that over time everything is going to change. The space will cool off, the outside temp will change, and the return air will change. It is not a steady-state calculation; it is near-steady state. For example, if you are making a measurement and you are on a ladder and you are running all over with the same instrument making measurements, by the time you are up on the roof, the zone has changed. So, we had a really good discussion on how to get a snapshot as close as possible to the same time.

We talked a lot about available tools. There are many tools coming onto the market that are WI-FI-enabled so that from a hand-held device, you can simultaneously take multiple measurements. Tools that are available to make nearly simultaneous measurements in diverse locations are included in the report.

COMMENT by Rob Falke (NCI) – When we began this Working Group, instruments that could simultaneously take multiple measurements at once did not exist. The accuracy of the measurements has greatly increased as the tools have become available. It is interesting to watch technology keep up with where the industry is going. The instrument manufacturers have really responded well to requirements.

COMMENT by Don Langston (ACCA) – Great job on the report.

COMMENT by Pete Jacobs (BMI) – We talked about Best Practices for Static Pressure Measurements.

- Manometer Specifications
- Probe Selection
- Test Ports
- Probe Placement

We devoted almost an entire Working Group session to air flow; this is everyone’s favorite topic. There are three sets of airflow measurements that need to be made with different techniques required for each measurement:

1. Outdoor Air
2. Supply Air at Unit
3. Supply Air at Zone

These measurements do not always work, especially when it is windy. We talked through different ways to measure air flow at the unit, the strengths and weaknesses, and what to use when. It was a good discussion. I was gratified that the more lab-oriented folks in the Working Group were in line and that it squared with their experience.

QUESTION by Christian Weber (PG&E) – We are potentially interested in continuous monitoring of the energy efficiency ratio. We would evaluate embedded controls and monitoring in HVAC and package units. In terms of air flow measurements, you probably need to use fan RPM and brake horsepower, or maybe brake horsepower and static pressure with a fan look-up table eventually. How would you rate the feasibility of using that in determining airflow?

ANSWER by Pete Jacobs (BMI) – With the deadline to get the work product out, the Working Group did not have time to take that to a conclusion, although I did a side study on that. The results are inconclusive at this point, but here’s a quick snippet of what we did find out—the CPUC funded a study to put a bunch of commercial rooftops in a lab with 500 individual tests (flat file HVAC 5). The results were all over the place. The fan tables are computer generated, but the fan laws are fairly predictable, expected them to be off but not widely scattered. I would be glad to discuss further.

COMMENT by Rob Falke (NCI) – There are several comments in this Work Product that allude to the field reality—that often a single measurement is inadequate—and often it takes a series of different kinds of measurements to fully determine what is happening with that system at that time. The old standby is ASHRAE 111 using an air flow traverse. When you get the full information, it harmonizes if the readings are right but doesn’t if the readings are wrong. It is rarely a single reading that gets the accuracy and repeatability; it is often using several readings together. As we look forward to ASHRAE 221, there is much interest in building control systems that can refer to the manual test-in and then monitor changes in the system. We are excited to see where this goes. It is based on the principles that we discussed today.

COMMENT by Pete Jacobs (BMI) – This work is focused on one-time tests. Christian Weber’s (PG&E) application for continuous monitoring is not something that we took on, but we have information that we can provide.

COMMENT by Christian Weber (PG&E) – This is excellent work and is a precursor to any next step.

QUESTION by Scott Higa (SCE) – Was there any assessment on the minimum number of measurements or was it considering just the single measurement at a time?

ANSWER by Pete Jacobs (BMI) – We did not make any prescriptions on the number of measurements to take and average together; however, we do have criteria on rate of change to avoid systems that are dramatically not steady state. The document just identifies that multiple measurements are required to get repeatable numbers. A lot depends on the expertise and training of the technician.

COMMENT by Pete Jacobs (BMI) – The Work Paper covers best practices for power measurements, specifically:

1. Instrument Type
2. Specifications
3. Reading Timing

Often, especially when measuring three-phase equipment, people will measure each of the three legs individually and add them up. However, it takes time to hook it up to take all three legs, and in that time the environment can change. So as a group, we talked through the availability of true three-phase power meters with instantaneous readings for all three legs.

- ▶ Of all the measurements, getting a good electric power measurement is probably the easiest.
- ▶ We did talk specifications for instruments that are good quality but nevertheless both affordable and rugged enough to be used in the field.
- ▶ The consensus was that the trickiest measurement, even with good quality instrumentation, is the air flow, the outdoor air entering the unit.

We compiled information to help drive the uncertainty calculation. Once you understand the uncertainty, there is a mathematical technique to propagate the error into the final answers; it is called “propagation of error technique.” Errors that are randomly

distributed (equally likely to be high or low) tend to cancel out. The main takeaway is that the uncertainty in the final answer is generally less than the accumulated uncertainty of the individual measurements.

The final part of the Best Practices document is that *“Uncertainty should be considered in all measurements, and the uncertainty in the measured quantities should be determined from the individual measurement uncertainty using a propagation of error calculation.”*

Within the document, we provided examples of the propagation of error analysis. We used Monte Carlo simulations with Excel, which is pretty easy.

AHRI Standards 240 and 340 say that if you go into the lab and measure a quantity that is within 10% of the claim quantity by the manufacturer, that is close enough in terms of claiming a rating value. I don’t personally believe that. We have done some propagation of error calculations using the lab-grade instrumentation specs, and my recollection is that it is closer to +/- 3% (it is in the HVAC 5 Report).

MOTION made by Christian Weber (PG&E) and seconded by Don Tanaka (UA) to adopt the CQI Field Data Specification Working Group Work Product *“Test Protocols and Procedures to Support HVAC System Performance Assessment.”* All EC members present or represented by proxy voted in favor of passing the motion. Motion **CARRIED**.

HSES and Chartering Committees: Overview of the Scoping Outputs for the Proposed WHPA Articles of Incorporation and Bylaws – Presentation posted on the website

PRESENTATION by Mark Lowry (BBI CEO) – The HVAC Stakeholder Engagement Strategy (HSES) Committee and the Chartering Committee were put in place to move forward the process of the WHPA becoming a legal entity with non-profit status. On behalf of these two committees, I am describing where this process is. At next week’s EC meeting, we will have documents ready for the EC to review, discuss, and approve.

The HSES Committee recommendation led us to pursue incorporation of non-profit status. The Chartering Committee is a smaller, more focused group working on actual language and document creation for the incorporation filing and the IRS application for tax-exempt status. Those two committees have been working together—a number of members sit on both committees.

We have used the current Charter within the context of the WHPA’s history and where the stakeholders see it in the future, and then we captured that information into the documents required for legal entity filing and the bylaws required for the IRS application.

We reviewed a set of scoping questions and got stakeholder buy-in from the HSES Committee members on where people see the WHPA in the future. The good news is that the consensus has been to retain the spirit of the WHPA. The WHPA has a unique status for all of the stakeholders—a safe place to discuss all kinds of issues and activities.

Scoping Discussions and Recommendations from HSES and/or Chartering Committee:

- **Name:** Remain Western HVAC Performance Alliance (WHPA)
- **Scope/Focus:**
 - Remain California-focused for now, perhaps expand geographically in the future.
 - Remain HVAC for now, perhaps encompass the Refrigeration sector in the future.
- **What kind of non-profit entity should the WHPA be?**
 - Explored two main options – 501c3, and 501c6
 - The two committees settled on 501c3, which can be educational/scientific.
 - The consensus is that the many disparate stakeholders in the WHPA are committed to improving HVAC energy efficiency *for the good of the public (consumers and end users)*.
- **State of Incorporation**
 - California, Illinois, other?
 - We need to resolve this soon. We started with the assumption of incorporating in the state of California; but from an incorporation efficiency perspective, Illinois state laws are written very favorably for non-profit corporations.
 - This is an overarching question for the Executive Committee to discuss at the December 20 meeting.

COMMENT by Paul Thomas (SDG&E) – Mark Lowry (BBI CEO) organized a call with a law firm and me and Bob Wiseman (IHACI), the two Co-Chairs of the HSES Committee. I encourage members of the Executive Committee to evaluate if they have concerns about this State of Incorporation issue.

PRESENTATION continued by Mark Lowry (BBI CEO) with Scoping Discussions and Recommendations from HSES and/or Chartering Committee:

- **Scoping Question Regarding LOBBYING?**
 - No.
 - This was very unanimous by the two committees.
 - The 501c3 is explicitly not a lobbying structure.

The Chartering Committee went through the current Charter’s Vision/Mission/Goals. There has been some refinement in the wording of the Vision and Mission, but in general it reflects what we currently do as the WHPA. Wording has been modified to capture what the WHPA is trying to do in the future. The Mission/Vision discussion led to the “Specific Purpose” which is for the bylaws required by the IRS. The text approved by the Chartering Committee for review by the Executive Committee is below:

- **VISION (for Charter)**

“The Western HVAC Performance Alliance (WHPA) is an organization that will serve as a credible, reliable, influential, and effective resource for a broad-based community of HVAC stakeholders who have joined forces to transform the marketplace focused on the energy efficiency, environmental quality, and sustainability goals of California. Through stakeholder collaboration, a united HVAC industry has the power to impact the present and the future.”
- **MISSION (for Charter)**

“The WHPA will work as a guiding light for California stakeholders to educate and support present and future HVAC energy efficiency initiatives to benefit consumers. The organization will facilitate communication and action among a wide set of market actors through workforce education & training, emerging technologies, and industry-vetted HVAC programs and activities.”

COMMENT by Mark Lowry (BBI CEO) – In addition to Heating, Ventilation, and Air Conditioning, we included “refrigeration” in the bylaws even though the WHPA does not currently address refrigeration. Including “refrigeration” provides breadth in the bylaws for the future without needing to submit a modification to the bylaws.

- **Specific Purpose (for Bylaws – IRS app pkg.)**

“The specific purpose of the Corporation shall include, without limitation, to serve as a credible, reliable, influential, and effective resource for a broad-based community of stakeholders who have joined forces to transform the Heating, Ventilation, Air Conditioning, and Refrigeration marketplace focused on energy efficiency, environmental quality, and sustainability goals and outcomes.”

COMMENT by Mark Lowry (BBI CEO) – Regarding membership, the Chartering Committee with input from the HSES Committee reduced the current 26 categories in the WHPA Charter to five categories: four voting member categories and one non-voting member category. Additionally, they are recommending some new member descriptions that are not currently in the WHPA, including Regional SE/Energy Network, Community Choice Aggregators, Students, and End Users.

- **Voting Member Categories:**
 1. Direct Supply Chain/Market Actor/End User
 2. Industry/Consumer/Educational Organization
 3. Local/State/Federal Government Agency
 4. Energy Providers
- **Non-Voting Member Category:**
 5. Associate

COMMENT by Mark Lowry (BBI CEO) – The two committees further recommend:

- Current members of the Executive Committee should be the initial (interim) Board of Directors.
- In the proposed organization, the Directors are drawn from each voting member category. This is a significant departure from the current WHPA structure. Currently, an individual entity, such as an individual manufacturer or contractor, is not eligible to be part of the WHPA Council of Advisors (COA), the candidate source for the Executive Committee (EC). The proposal for the new entity is that individual organizations are also eligible.

- Additionally, it is proposed that there be a minimum of two members on the Board from each voting category.
- The number of Directors (Board members) is not fixed to a single number but is a range of 11 to 17 members so that the Board can grow over time.
- For the initial Board, the members would be appointed for 1-, 2-, or 3-year terms. In the future, each Board member would serve a 3-year term with $\frac{1}{3}$ of the Board positions rotating each year.
- It is proposed that:
 - The Board select the Nominating Committee from the initial Board members to develop the slate of candidates for election and
 - The vote be by general membership.

COMMENT by Mark Lowry (BBI CEO) – The non-profit status requires officers. The Committee recommendations are:

- **Officers**
 - Chair
 - Vice-Chair
 - Secretary
 - Treasurer
- **2-Year Terms**
- **Drawn/Elected from Board**

COMMENT by Paul Thomas (SDG&E and IOU Co-Chair of HSES Committee) – I have co-chaired the HSES Committee with Bob Wiseman (IHACI), and Mark Lowry (BBI CEO) has been involved as well. The activity is well organized. We are moving fast and getting things done. I am so impressed with the level and quality of work and most importantly the volunteer time and effort being put into this. I wanted to share that with my fellow EC members.

ACTION – Each EC member should decide if he/she is willing to serve on the Board of Directors of the proposed non-profit corporation. Each of you will be asked shortly if you want to participate. We have to submit the name of each Board member and all identifying information as part of the submission process.

New Business and Adjourn

No other new business was presented.

The next Executive Committee Meeting is by conference call on Wednesday, December 20, 2017, at noon Pacific Time (NOTE – The December 20 meeting was subsequently rescheduled to January 17, 2018, 12 noon Pacific Time.)

The meeting adjourned at 1:32 p.m. PST.

Notes by Judy Key Johnson, WHPA Staff
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