

Meeting Notes



2022 California Energy Code (Title 24, Part 6)

Agenda for the Utility-Sponsored Stakeholder Meeting for:

Covered Processes Part 1: Refrigeration System Opportunities

Posted March 30, 2020

Meeting Information

Meeting Date: April 2, 2020

Meeting Time: 8:30am – 11:00am PST

Location: Adobe Connect webinar (sign-up at title24stakeholders.com/events)

Meeting Host: California Statewide Utility Codes and Standards Team

Meeting Agenda

Start Time	Topic	Presenter
10 minutes prior to call	Live Attendee Poll	
8:30 am	Meeting Guidelines	Statewide CASE Team
8:35 am	Opening Remarks from the California Energy Commission	Energy Commission Staff
8:40 am	Overview and Welcome	Statewide Utility Codes and Standards Representative
8:45 am	CASE Presentation I: Refrigeration System Opportunities <ul style="list-style-type: none">• Design and Control Requirements for Transcritical CO2 Systems• Design and Control Requirements for Large Packaged Systems• Evaporator Specific Efficiency for RWH• Automatic Door Closers• Acceptance Testing for Commercial Refrigeration Measures	Trevor Bellon (VaCom Technologies)
10:45 am	Wrap Up & Closing	Statewide CASE Team



Meeting Attendees

Statewide Utility Codes and Standards Team – Utility Staff:

First Name	Last Name	Email	Affiliation
Jim	Kemper	James.Kemper@ladwp.com	Los Angeles Department of Water and Power
Kelly	Cunningham	KACV@pge.com	Pacific Gas & Electric
Mark	Alatorre	M6AC@pge.com	Pacific Gas & Electric
Yung	Lin	yung.lin@sce.com	Southern California Edison
Bach	Tsan	Bach.tsan@sce.com	Southern California Edison

Codes and Standards Enhancement (CASE) Team Members:

First Name	Last Name	Email	Affiliation
Alanna	Torres	atorres@energy-solution.com	Energy Solutions
Marisa	Lee	mlee@energy-solution.com	Energy Solutions
Marissa	Lerner	mlerner@energy-solution.com	Energy Solutions
Benny	Zank	bzank@energy-solution.com	Energy Solutions
Heidi	Werner	hwerner@energy-solution.com	Energy Solutions
Zyg	Kunczynski	zkunczynski@energy-solution.com	Energy Solutions
Alamelu	Brooks	abrooks@energy-solution.com	Energy Solutions
Trevor	Bellon	tbellon@vacomtech.com	VaCom Technologies
Pranav	Godbole	pgodbole@vacomtech.com	VaCom Technologies
Kyle	Larson	klarson@vacomtech.com	VaCom Technologies
Jon	McHugh	jon@mchughenergy.com	McHugh Energy

California Energy Commission:

First Name	Last Name	Email
Kelly	Morairty	kelly.morairty@energy.ca.gov
Adrian	Ownby	adrian.ownby@energy.ca.gov
Matthew	Haro	matthew.haro@energy.ca.gov
Armando	Ramirez	Armando.Ramirez@energy.ca.gov
Kevin	Mouayang	kevin.mouayang@energy.ca.gov
Payam	Bozorgchami	Payam.Bozorgchami@energy.ca.gov
Ronald	Balneg	ronald.balneg@energy.ca.gov
Javier	Perez	jperez@energy.ca.gov
Cheng	Moua	cheng.moua@energy.ca.gov
Haile	Bucaneg	haile.bucaneg@energy.ca.gov

Stakeholder Attendees:

First Name	Last Name	Affiliation
John	Bade	2050 Partners
Jennifer	Kane	AHRI
Joe	Fulton	ALTA Refrigeration
Patrick	Cocagne	APCCO
Kris	Crosby	Arkema
Akane	Karasawa	ASK energy
Caleb	Nelson	Azane, Inc.
Philip	Hollander	Baltimore Aircoil
Jerry	Lozano	Baltimore Aircoil Company
Frank	Morrison	Baltimore Aircoil Company
Jon	Kwok	C&L Refrigeration Corp.
Russ	King	CalCERTS, Inc.
David	Choo	CalCERTS, Inc.
Jeanne	Fricot	Center for Sustainable Energy
Dave	Snyder	Chemours
Stephen	Spletzer	Chemours
Jeff	Warther	Chemours
Bruce	Nelson	Colmac Coil Manufacturing Inc.
Tom	Paine	ConSol
Pete	Kalambakas	Coolsys
Henry	Ernst	daikin
Chris	Miles	Daikin America, Inc.
Tom	Wolgamot	DC Engineering
Jeremy	Huhn	Delfield
Farhang	Beik	DNV GL Energy Services USA, Inc.
Scott	Martin	Dover Food Retail
Armin	Hauer	ebm-papst. Inc.
Brian	Buynacek	Emerson
George	Nesbitt	Environmental Design / Build
Gordon	Struder	Evapco
Brian	Russ	Evapco
Don	Hamilton	Evapco
Kurt	Liebendorfer	Evapco
Patrick	Strine	Evapco Inc.
Trevor	Hegg	EVAPCO, Inc.
Greg	Derosier	Evapco, Inc.
Steve	Combs	Everidge
Robert	Glass	Goodman Mfg. Company
Michael	Pennington	Heatcraft

Augusto	Zimmermann	Heatcraft WWR
Mike	Straub	HTPG
Buzz	Schaeffer	Hussmann
Wilson	Mwaura	Hussmann Corporation
Ronald	Shebik	Hussmann Corporation
Ignacio	Chaparro	Kysor Warren
David	Winningham	Lennox International
John	Miranda	M&M Refrigeration LLC
Jon	Mchugh	MEC
Soph	Davenberry	National Energy Management Institute Committee
Rahul	Athalye	NORESKO
Erica	Dilello	Noresko
Jay	Kindle	RAE Corporation
Kyle	Bowling	RAE Corporation
Richard	Norman	Refrigeration Equipment Specialist Co. Inc.
Tom	Nau	RESCO
Nik	Wybaczynsky	RESCO
Mike	Nau	RESCO
Joe	Boros	Rheem
John	Papastavrou	SGS
Fawaz	Gazanfar	SubZero Constructors
Larry	Gilliland	SubZero Constructors, Inc.
Jason	Harris	Target
Ted	Tiffany	Ted M. Tiffany
Minjin	Kim	The Chemours Company
Jill	Hootman	trane technologies
Cathy	Chappell	TRC
Bruce	Hierlmeier	Zero Zone

Meeting Resources

1. [Agenda](#)
2. [Presentation](#)
3. [Submeasure Summary - Covered Processes: Refrigeration](#)

Meeting Notes

1.1 CASE Presentation I: Refrigeration System Opportunities (Trevor Bellon – VaCom Technologies)

1.1.1 Design and Control Requirements for Transcritical CO₂ Systems (TCCO₂)

1. Gordon Struder (Evapco): You have a minimum saturating condensing temperature of 60 degrees. What is your temperature difference (TD) between your dry bulb and cooling temperature?
 - a. Trevor Bellon (VaCom Technologies): This is simply a setpoint, we assumed a 10 degree difference. There may be some adjustment for each climate zone.
 - b. Gordon Struder (Evapco): Which is different from the 8 degree TD for gas cooled?
 - c. Trevor Bellon (VaCom Technologies): One is to optimize the system and one is a true setpoint.
2. Larry Gilliland (SubZero Constructors, Inc.): Most TCCO₂ applications we've looked at are 10 degree TD and minimum of 65-70 degree TD for sizing the gas cooler (knowing floating lower is possible depending on climate).
 - a. Trevor Bellon (VaCom Technologies): I think that make sense in terms of setting the saturation closer to 70 degrees. To our knowledge, most compressors used on these systems can go lower so at this point it would simply be a setpoint change without requiring any change in technology.
3. Jerry Lozano (Baltimore Aircoil Company): Variable speed compressors, is that for all compressors in a rack? Or just a variable frequency drive (VFD) present in at least one?
 - a. Trevor Bellon (VaCom Technologies): Just one per suction group, not each one on the rack.
4. Caleb Nelson (Azane, Inc.): You are showing air cooled gas coolers as the baseline, would adiabatic be a requirement above the baseline?
 - a. Trevor Bellon (VaCom Technologies): We looked at gas cooled and adiabatic for each climate zone, we can discuss it on those slides.
5. Bruce Nelson (Colmac Coil Manufacturing Inc.): Trevor, not allowing parallel compression or ejectors will allow very energy inefficient TCCO₂ systems to be installed.
 - a. Trevor Bellon (VaCom Technologies): We are definitely not limiting people's ability to use parallel compressors (PC) or ejectors.
 - b. Scott Martin (Dover Food Retail): Bruce, I don't believe he is not saying they are not allowed, just not required.
 - c. Bruce Nelson (Colmac Coil Manufacturing Inc.): My point was by allowing TCCO₂ systems that do not include PC or GI you will be allowing lower cost, very energy inefficient products to be installed.
 - d. Scott Martin (Dover Food Retail): Bruce, it depends on the ambient conditions. A location with low wet bulb temperatures and adiabatic gas coolers is quite efficient vs. standard systems without PC or GI.
 - e. Ignacio Chaparro (Kysor Warren): Bruce, there are other technologies available that also improve system efficiency. It could be gas subcooling or flooding evaporators and adiabatic gas coolers.

6. Wilson Mwaura (Husmann Corporation): For the TD on the gas cooler, is the 8 degrees for gas cooler operation or condensing?
 - a. Trevor Bellon (VaCom Technologies): That is for gas coolers, a sizing requirement based on conditions. Whenever you are operating in the super critical state.
7. Larry Gilliland (SubZero Constructors, Inc.): There needs to be a balance to create demand for TCCO2 as a low GWP solution vs. less expensive system types (split systems and freon rack).
 - a. Trevor Bellon (VaCom Technologies): Our intention here is we are not looking to put any undue burden on CO2 systems that would make them not cost effective, we are only looking at incremental improvements.
8. Buzz Schaeffer (Husmann Corporation): capacity compressors rather than variable speed - acceptable?
 - a. Trevor Bellon (VaCom Technologies): I believe currently we are not mandating how you achieve variable capacity; it is an unloader versus a VFD. We are not making a distinction and requiring one over the other.
 - b. Armando Ramirez (California Energy Commission): That might depend on type of compressor.
9. Caleb Nelson (Azane, Inc.): About adiabatic, is there a requirement for performance when water is not flowing?
 - a. Trevor Bellon (VaCom Technologies): In other words, what is the performance requirement in dry mode. The way we modelled it was assuming dry mode operation, which essentially sets the performance requirements for adiabatic in dry mode.
10. Jerry Lozano (Baltimore Aircoil Company): I think definitely more than one manufacturer should be considered to building this table.
 - a. Trevor Bellon (VaCom Technologies): If you do have relevant data it would be great to connect with you.
11. Augusto Zimmermann (Heatcraft WWR): 75Btuh/W for efficiency of gas coolers doesn't mean a lot without the sizing conditions since it seem to be incomplete. What is the ambient?
 - a. Trevor Bellon (VaCom Technologies): When we have our efficiency, it is paired with the sizing conditions of 8 degree TD and the ambient is going to be dependent on the climate zone dry bulb temperature.
12. Gordon Struder (Evapco): My question was, I think there was some confusion on the 75 Btu/Watt around the 10 and 8 degree temperature difference. Can you state the difference?
 - a. Trevor Bellon (VaCom Technologies): The 10 degrees is simply the rating condition so that we can properly compare different models at the same rating condition. It is a little arbitrary but allows us to compare models. It is not the actual sizing requirement itself, that is the 8 degree difference.
13. Bruce Nelson (Colmac Coil Manufacturing Inc.): Trevor, sorry I have a question about the definition of the TD being discussed. That is the approach temperature difference, right? Leaving gas temperature and ambient temperature? A more appropriate term may be approach temperature difference or approach temperature.
 - a. Trevor Bellon (VaCom Technologies): I appreciate the comment, thanks Bruce.
14. Caleb Nelson (Azane, Inc.): If adiabatic becomes a requirement, have you considered the risk of efficiency loss over time as pads become dirty? Have you thought about minimum water flow rates? What about regionally, considering locations which will run dry for many hours with pads inducing a fan power penalty? Sorry for playing devil's advocate.

- a. Trevor Bellon (VaCom Technologies): The way that we tried to incorporate that risk of efficiency loss over time is assume a certain incremental cost for replacing those pads over the 15 year period. We have not put a lot of time into establishing minimum water flow rates. Because we are evaluating each climate zone individually, we will have a different number of hours above that set point, and that is how we are currently addressing water flow.
15. Jerry Lozano (Baltimore Aircoil Company): Can you comment again on how we are going to compare adiabatic options?
- a. Trevor Bellon (VaCom Technologies): In terms of potential efficiency losses and differences in water usage based on climate zone, we do assume an incremental cost of replacing pads. For water usage, there will be a different number of hours where the adiabatic gas cooler will operate in precooling versus dry mode, so we are capturing water usage based on operating time in each mode.
- b. Jerry Lozano (Baltimore Aircoil Company): Dry mode to all and 10 degree or 15 degree TD?
16. Jon McHugh (McHugh Energy): How many replacements occur during 15-year period?
- a. Trevor Bellon (VaCom Technologies): One.
- b. Jon McHugh (McHugh Energy): In year 7?
- c. Trevor Bellon (VaCom Technologies): Yes.
17. Jason Harris (Target): Does the incremental cost for adiabatic gas coolers include water treatment in hard water locations?
- a. Trevor Bellon (VaCom Technologies): It does not include water treatment. Based on our understanding and research there is essentially no water treatment. When it comes to possible degradation of the pads over time, our maintenance assumption bakes that in.
18. Jon McHugh (McHugh Energy): What is the square footage of the warehouse?
- a. Trevor Bellon (VaCom Technologies): 92000 sf.
19. Augusto Zimmermann (Heatcraft WWR): Have you considered the adiabatic initial and operating cost in comparison to an air cooled paired with parallel compression and ejectors as an alternative to prescribing adiabatic?
- a. Trevor Bellon (VaCom Technologies): We have not considered that. If it is something that you think should be addressed, we can talk about it offline.
- b. Augusto Zimmermann (Heatcraft WWR): Definitely, I would be glad to discuss it offline.
20. Tom Wolgamot (DC Engineering): Your incremental cost difference for adiabatic seems a little low based on what we have seen.
- a. Trevor Bellon (VaCom Technologies): If that is the case, we would like to hear from you and see more cost data so that we can review it and factor it in.
21. Jon McHugh (McHugh Energy): Does virtually zero transcritical CO2 projects as part of retrofits seem correct?
- a. Armando Ramirez (California Energy Commission): There is always interest in refrigerant changeout retrofits. Not sure if jumping to CO2 has any appeal there.
22. John Miranda: At higher suction temperatures 60 degree SCT (saturated condensing temperature) is outside the compressor map for some high stage compressors.
- a. Trevor Bellon (VaCom Technologies): I think that is an excellent point and we should consider it. We did think about this in terms of parallel compressors as well. If we see

that there are multiple installations where this 60 degrees will fall outside the compressor map we will consider it and welcome further comments.

23. Larry Gilliland (SubZero Constructors, Inc.): Where do refrigerated delivery fulfillment centers fit in? Commercial or RWH, because they look more like RWH but provide a service similar to supermarkets.
 - a. Trevor Bellon (VaCom Technologies): I will have to think about this. If you have examples of these centers we can take a look at it based on what is in the code.
 - b. John Bade (2050 Partners): Larry - definition in T24: REFRIGERATED WAREHOUSE is a building or a space greater than or equal to 3,000 square feet constructed for storage or handling of products, where mechanical refrigeration is used to maintain the space temperature at 55°F or less.
24. Augusto Zimmermann (Heatcraft WWR): What is the timing of developing the code language and the process to make comments and engage in discussions?
 - a. Trevor Bellon (VaCom Technologies): We are driving towards a draft CASE report to be published between now and May for public review and then a final version in July. You can submit your comments right now, send them to me directly, or during that period.
25. Larry Gilliland (SubZero Constructors, Inc.): How are processing components attached to RWH fit in if they aren't providing quick chill or quick freeze capabilities?
26. George Nesbitt (Environmental Design / Build): I have seen consumer concern about refrigerant rules and propane, so there may be a case for safety reasons.

1.1.2 Design and Control Requirements for Large Packaged Systems

1. Kurt Liebendorfer (Evapco): The threshold should be 200 horse power (HP) due to larger sizes of units than traditional freon units. Also the current requirement that compressors above 150 HP be variable VI - this should be changed to above 200HP
2. Bruce Nelson (Colmac Coil Manufacturing Inc.): "Reduced fan motors" means "reduced fan speed"?

1.1.3 Evaporator Specific Efficiency for RWH

1. Trevor Hegg: Was any consideration made for thermally certified capacity?
2. Kurt Liebendorfer (Evapco): Does it need to be a 3rd party certification?
 - a. Trevor Bellon (VaCom Technologies): We have not determined that yet.
3. Gordon Struder (Evapco): Any consideration for static pressure limitation and thermal efficiency?
 - a. Trevor Bellon (VaCom Technologies): We have it capped at 0.5 in. wg.
4. Mike Straub (HTPG): Considering pending CARB regulation why isn't CO2 included in the analysis?
 - a. George Nesbitt (Environmental Design / Build): In residential there is one heat pump water heater the is CO2, Sanden. Not aware of anything else yet.
5. Mike Nau (RESCO): Currently and in the future are the condenser FPI and efficiencies requirements exempt for condensing units less then 100HP?

1.1.4 Automatic Door Closers

1. Bruce Nelson (Colmac Coil Manufacturing Inc.): Trevor, your modeling seems aimed at interior doors between refrigerated spaces. The big issue is infiltration and operation of the dock doors.

- a. Trevor Bellon (VaCom Technologies): This is not in scope for this measure, but I will make a note of it.
2. Bruce Nelson (Colmac Coil Manufacturing Inc.): I suggest you examine dock door technology, leakage rates, and h/day open times. Would be happy to discuss offline.
3. Benny Zank (Energy Solutions): I am surprised to see such a different result for climate zone 16, why is that?
 - a. Armando Ramirez (California Energy Commission): The slide said that this was because of lower infiltration load.
 - b. Benny Zank (Energy Solutions): Armando thanks, but what is it about that climate zone that cause a lower infiltration load?
 - c. Trevor Bellon (VaCom Technologies): Benny, I will need to double check, but I believe it is both reduced air temperature and lower wind factors
 - d. Armando Ramirez (California Energy Commission): Higher elevations, cooler climate, in 16.

1.1.5 Acceptance Testing for Commercial Refrigeration Measures

1. Gordon Struder (Evapco): Code language prohibited air cooled condensers in several climate zones. What is available if water is not available as well?
 - a. Trevor Bellon (VaCom Technologies): Let's connect offline.