CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Notes from 2019 Title 24 Part 6 Code Development Cycle Utility-Sponsored Stakeholder Meeting for Laboratory Topics

Posted June 27, 2017

Meeting Information

Meeting Date: March 15, 2017

Meeting Time: 9:00am – 12:00pm

Meeting Host: California Statewide Utility Codes and Standards Team

Attendees

First Name	Last Name	Contact	Organization
Statewide Utility Codes and Standards Team			
Utility Staff			
John	Barbour	JBarbour@semprautilities.com	SoCal Gas
Kelly	Cunningham	KACV@pge.com	Pacific Gas & Electric
Daniela	Garcia	dgarcia3@semprautilities.com	SoCal Gas
Jim	Kemper	James.Kemper@ladwp.com	Los Angeles Department of Water and Power
Chris	Kuch	christopher.kuch@sce.com	Southern California Edison
Dave	Roland	David.Roland@smud.org	Sacramento Municipal Utility District
Chris	Roman	croman@semprautilities.com	SoCal Gas
Neha	Arora	Neha.Arora@sce.com	Southern California Edison
Kevin	Chan	kevin.chan@sce.com	Southern California Edison
Sean	Gouw	sean.gouw@sce.com	Southern California Edison
Marshall	Hunt	mbh9@pge.com	Pacific Gas & Electric
Jay	Madden	jay.madden@sce.com	Southern California Edison
Codes and Standards Enhancement (CASE) Team Members			
John	Arent	jarent@noresco.com	NORESCO
Farhad	Farahmand	ffarahmand@trcsolutions.com	TRC Energy Services
Marian	Goebes	mgoebes@trcsolutions.com	TRC Energy Services
Stefan	Gracik	sgracik@integralgroup.com	Integral Group
Heidi	Hauenstein	hhauenstein@energy-solution.com	Energy Solutions
Erin	Linney	elinney@energy-solution.com	Energy Solutions
Jon	McHugh	jon@mchughenergy.com	McHugh Energy
Gwelen	Paliaga	gpaliaga@trcsolutions.com	
Kyra	Weinkle	kweinkle@noresco.com	
Catherine	Chappell		TRC Energy Services
California Energy Commission Participants			
Payam	Bozorgchami	Payam.Bozorgchami@energy.ca.gov	California Energy Commission
Adrian	Ownby	adrian.ownby@energy.ca.gov	California Energy Commission
Mazi	Shirakh	Maziar.Shirakh@energy.ca.gov	California Energy Commission
Joe	Loyer	joe.loyer@energy.ca.gov	California Energy Commission
Kelly	Morairty	kelly.morairty@energy.ca.gov	California Energy Commission
Adrian	Ownby	adrian.ownby@energy.ca.gov	California Energy Commission

Javier	Perez	jperez@energy.ca.gov	California Energy Commission
Alex	Pineda	alex.pineda@energy.ca.gov	California Energy Commission
Peter	Strait	Peter.Strait@energy.ca.gov	California Energy Commission
Other Participants			
John	Bade		Johnson Controls
Martin	Bond		Community Energy Services Corporation (CESC)
Beth	Braddy		Trane
Chris	Bradt		BKi/BayREN
Bill	Bray		Honeywell
Hwakong	Cheng		Taylor Engineering
Ben	Cohen		Baltimore Aircoil Company
Gregory	Collins		Zero Envy
Robert	Davis		Pacific Gas and Electric
Ruth Ann	Davis		Williams
Darryl	DeAngelis		BELIMO Americas
Dave	Dias		Sheet Metal Worker's Local 104
Skip	Ernst		Daikin
Jayda	Freibert		Kelvion Inc.
Darrell	Garrison		International Training Institute
Kristin	Heinemeier		UC Davis, Energy Efficiency Center
Alex	Hillbrand		NRDC
Eli	Howard		Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
Tim	Hreha		Brummitt Energy Associates (BEA)
Andrew	Jenkins		Trane
Caleb	Joiner		Trane
Benjamin	Kelderman		Ezenics
Soodabeh	Khalifeh		Khalifeh & Associates, Inc.
Kyle	Landis		Disneyland Resort
Vincent	Lee		Mitsubishi Electric
Guanjing	Lin		Lawrence Berkeley National Lab
PAUL	Lindahl		SPX Cooling Technologies
Mark	Lyles		New Buildings Institute (NBI)
Arthur	Miller		Refrigeration Service Engineers Society (RSES)
George	Nesbitt		Environmental Design / Build
Gregory	Partch		CA State Pipe Trades
Laura	Petrillo-Groh		Air Conditioning, Heating, and Refrigeration Institute (AHRI)
Mark	Pfeifer		SPX Cooling Technologies
Mike	Pouchak		Honeywell
Danny	Quezada		UA Local 250 Training Center
Gina	Rodda		Gabel Energy
Aniruddh	Roy		Goodman
Amber	Ryman		ACCO
Glenn	Savage		LG Electronics (HVAC)
Andy	Smith		tk1sc
Adrienne	Stoinoff		Baltimore Aircoil Company

Nehemiah	Stone		Stone Energy Associates
Joe	Vadder		Evapco
Chris	Walker		SMACNA (California)
Courtney	Ward		Kitchell
Ryan	Ware		CalCERTS Inc.
Don	Wells		Trane
Mark	Wiese		CalCERTS
Jacob	Wolfe		Kelvion Inc.
Ed	Wuesthoff		Heat Transfer Products Group, LLC

Meeting Agenda

Time	Topic	Presenter
9:00 – 9:15	Introduction	Kelly Cunningham (PG&E)
9:15 – 10:10	Proposal Based on ASHRAE 90.1-2016: Water Side Economize	Stefan Gracik (Integral Group)
10:10 – 11:05	Cooling Tower Minimum Efficiency	Stefan Gracik (Integral Group)
11:05 – 11:55	Fault Detection Diagnostics (FDD) for Built-up Systems	Farhad Farahmand (TRC), Hillary Weitze (Integral Group)
11:55 – 12:00	Review and wrap-up, next steps	Kelly Cunningham (PG&E)

Key Takeaways and Action Items

1. **Overview**
    a. No key takeaways or action items.
2. **Proposal Based on ASHRAE 90.1-2016: Water Side Economizer**
    a. Utility CASE Team will consider the impact of requiring fan-coils to be included in new waterside economizer requirements.
    b. Utility CASE Team will further research the new requirements for sizing of waterside economizers at 49°F Wet-bulb and the coincident dry-bulb.
    c. Utility CASE Team will consider if changes need to be made to current exclusions, including the high-rise residential and hotel building types.
    d. Stefan Gracik will talk to Cooling Technology Institute (CTI) to discuss the feasibility of pre-certification for cooling towers.
    e. CASE Team will further consider what should be required for certification to ensure the towers perform as required by code.
3. **Cooling Tower Minimum Efficiency**
    a. The cost increase percentages will vary based on the size of cooling towers. For example, a 300 ton tower may have a 15 percent cost increase to go from 42.1 gpm/hp to 80 gpm/hp, but a 900 ton tower may have a 20 percent cost increase for the same. Cost analysis has been updated by CASE Team to represent a more thorough cost survey.
    b. The CASE team will look at whether costs for stainless steel towers should be included. Currently only the most affordable 80 gpm/hp towers were considered, which would not be stainless, but if considering code minimum requirements in cost analysis, galvanized would be typical, and adding additional cost for stainless towers, which are rarely

selected adds bias. The CASE team will explore if an exception should be added for certain types of stainless steel towers, which implement other water saving features.

c. Current analysis assumes minimal increases required structurally to support the larger cooling towers based on interviews with structural engineers. Additional outreach can be done by CASE Team to structural engineers to get a wider range of opinion.

4. **Fault Detection Diagnostics (FDD) for Built-up Systems**
   a. Acceptance tests are proposed to require pre-certification as well as an acceptance test.
   b. Cost analysis excludes design of FDD sequences, but does account for implementation and testing of FDD sequences for each AHU.
   c. Utility CASE Team to follow-up with stakeholders on feasibility of pre-certifying mechanical designer or third-party FDD vendor FDD sequences, in case mechanical contractor elects to implement them.

Meeting Notes

Introduction

- Kelly Cunningham (Pacific Gas & Electric Company, Utility CASE Team) presented.
- Presentation available here.

Comments and Feedback

1. No comments or questions.

Topic 1: Water-Side Economizer

- Stefan Gracik (Integral Group, Utility CASE Team) presented.
- Presentation available here.

Comments and Feedback

1. John Bade (Johnson Controls): If a hotel has a mix of air handling unit (AHU) and fan coils, the project will have a water-side economizer (WSE), even if they are doing air-side economizing in the AHU's? That goes beyond what is required in ASHRAE 90.1-2016. I'm on the ASHRAE subcommittee. I am just pointing out that this is a larger requirement than ASHRAE 90.1. My interpretation is that ASHRAE 90.1 specifically only applies the new water-side economizer requirement to passive or induction based systems. This excludes fan coil systems from the requirement (given they are less than 54,000 Btu/hr). While I'm not saying that Title 24, Part 6 should do the same, fan coils are often designed for lower temperature water than passive systems, making it much less advantageous to do waterside economizer.
   a. Stefan Gracik (Integral Group, Utility CASE Team): Yes, I noticed ASHRAE 90.1 is targeting chilled water systems using induction or passive radiant chilled beams systems. The current Title 24, Part 6 code requires water-side in spaces that are cooling or induction. Our goal is to match ASHRAE language as closely as possible. Your example about the code would not trigger this requirement. I will look into the ASHRAE proposal and contact the writers of the proposal to make sure Title 24, Part 6 is in alignment as much as possible. This proposal would not apply to hotels, additions or alterations. This

is a prescriptive requirement. From our research, 75 percent of large office buildings will use the performance pathway.

b. Gregory Collins (Zero Envy): If the intent of the proposed 2019 code changes is to align with ASHRAE 90.1-2016 changes, the most straightforward proposal would be to simply align exactly with ASHRAE requirements? Limit the nuanced difference between Title 24, Part 6 and ASHRAE.

c. Hwakong Cheng (Taylor Engineering): A fan coil designed for 45°F chilled water does not necessarily need 45°F water for the entire year, just at the design condition. Economizing, whether air or water, occurs mainly at off design conditions.

d. Tim Hreha (BEA): I suggest a switch to ASHRAE entirely.

e. Gregory Collins (Zero Envy): Great point, Tim!

f. Hwakong Cheng (Taylor Engineering): John, in your hotel example, if you read the proposed code language, the requirement for WSE would be based on a minimum system capacity that excludes the AHUs with airside economizers.

g. John Bade (Johnson Controls): Hwakong, if you have a building with 1,000 tons of AHU cooling and 100 tons of FCU cooling, you would have to use a WSE under this language (hotels excluded). My concern is that the rational user would then drop airside economizing and only use WSE, which may increase energy use.

2. Gina Rodda (Gabel Energy): Will HVAC baseline types match ASHRAE 90.1, and allow for the performance to work in alignment with ASHRAE?

   a. John Arent (NORESCO, Utility CASE Team): Gina, the baseline HVAC could change, but ultimately that decision is made by the Energy Commission. I do not think the WSE will change the baseline for buildings with a central plant.

3. Eli Howard (SMACNA): This would increase the seismic restraint requirements when using larger/heavier towers and heat exchangers, thereby increasing costs.

4. Jay Madden (Southern California Edison, Utility CASE Team): Should the WSE be sized for the cooling load at conditions where wet bulb temperature is less than 49°F? That will probably align with outside air (OSA) dry bulb temperatures below design, so the towers sized for peak load may already be large enough for this economizer condition.

   a. Stefan Gracik (Integral Group, Utility CASE Team): Currently, the code says to design for wet bulb at 49°F and dry bulb at 54°F.

5. **Compliance Improvement Discussion**

   a. Paul Lindahl (SPX Cooling Technologies): Cooling Technology Institute (CTI) licensed acceptance testing can be done to any design approach, although this would add an additional cost to each project. Certification is pre-testing and uses the 5° approach minimum. The certification would do pre-testing of line.

      i. Ben Cohen (Baltimore Aircoil Company): CTI licenses acceptance testing would require onsite acceptance testing, which would be onerous for all projects required to meet this code proposal.

      ii. John Bade (Johnson Controls): A licensed acceptance tester is adding a large expense to the project.

      iii. Ben Cohen (Baltimore Aircoil Company): Pre-testing to CTI Standards is a more practical and cost-effective approach for customers.

      iv. Gregory Collins (Zero Envy): Could a project submit a CTI certificate using the 5° approach? If actual design is less than 5°, that would be a better result.

v. John Bade (Johnson Controls): Does the licensed testing need to be done onsite or can it be done in the factory? Testing in factory would be less costly.
vi. Paul Lindahl (SPX Cooling Technologies): I disagree, it would be more expensive to test in factory, which would require shipping the model to the lab to test, then shipping to the project.
    1. John Bade (Johnson Controls): Paul, understood. I was referring to chillers.
vii. Joe Loyer (Energy Commission): Can anyone supply the Utility CASE Team with actual acceptance test costs?
    1. Paul Lindahl (SPX Cooling Technologies): Cost is variable depending on site, and complexity of testing. I would guess acceptance test costs range from $5,000 to $15,000 per project.
    2. Joe Loyer (Energy Commission): Thanks, Paul. However, we need real-world cost examples. I have seen too many estimates that ended high or low.

b. Aniruddh Roy (Goodman): If economizers have a declaration statement, a project could bypass the acceptance test if the manufactures have already certified the product.
    i. Stefan Gracik (Integral Group, Utility CASE Team): We will talk to CTI about the feasibility of pre-certification for cooling towers.
c. Kyle Landis (Disneyland Resort): The process for certification under consideration should address site built towers that must be tested in field.
    i. Paul Lindahl (SPX Cooling Technologies): Certification is not available for field erected, they must be acceptance tested.

6. Aniruddh Roy (Goodman): What is currently excluded? Is this included in the draft code language?
    a. Stefan Gracik (Integral Group, Utility CASE Team): I will make a note of what is currently exempted in Title 24, Part 6 Section 140.4 in our draft code language.
    b. Javier Perez (Energy Commission): See Exception 3 to 140.4(e)1.
    c. Nehemiah Stone (Stone Energy Associates): Please clarify possible applications to high-rise multifamily.
        i. Stefan Gracik (Integral Group, Utility CASE Team): We will consider this suggestion.
7. Gregory Collins (Zero Envy): It is important to note that the air-cooled chillers 300 ton limit is a prescriptive requirement.
8. Ben Cohen (Baltimore Aircoil Company): Is VRF limited as well? Any proposal on chilled water systems should be offset for other technologies as well.
    a. Adrian Ownby (Energy Commission): Ben, the limitation is for chiller plants.

Topic 2: Cooling Tower Minimum Efficiency

- Stefan Gracik (Integral Group, Utility CASE Team) presented.
- Presentation available here.

Comments and Feedback

1. Paul Lindahl (SPX Cooling Technologies): ASHRAE-90.1 does not include 52 gpm/hp for WSE, where is this number from?

   a. Stefan Gracik (Integral Group, Utility CASE Team): Thank you, the ASHRAE committed has not yet voted on this new standard.
2. Mark Pfeifer (SPX Cooling Technologies): Space constraints are common even on ground mounted towers.
   a. Stefan Gracik (Integral Group, Utility CASE Team): Mark, the towers can be made taller instead when dealing with limited footprints.
   b. Kyle Landis (Disneyland Resort): Cities have limits on how high the towers can be.
   c. Stefan Gracik (Integral Group, Utility CASE Team): We will consider the impact of local regulations in the code change proposal, but local city regulations should not be dictating state energy code.
3. Gina Rodda (Gabel Energy): The performance method is not as flexible as in the past, and cannot always be the "alternative" for all projects.
4. Gregory Collins (Zero Envy): The draft code language document only addresses the standards. How do the code change proposals translate to the ACM (i.e., how do we know how changes will impact the Standard model in performance approach scenario)? This is important if a majority of large projects use this approach.
5. Paul Lindahl (SPX Cooling Technologies): Approximately 50 percent of cooling tower models will become unavailable if this code change proposal takes effect.
   a. Stefan Gracik (Integral Group, Utility CASE Team): 50 percent will not be suitable for new construction prescriptive compliance. Performance compliance and building-mounted alterations will still allow the other towers to be sold in California. Does anyone see any issues with performance compliance models?
   b. Gina Rodda (Gabel Energy): The performance method will be harder and harder to trade TDV as other areas become more stringent (lighting, etc.).
   c. Stefan Gracik (Integral Group, Utility CASE Team): We are trying to make buildings more efficient to align with the ZNE goals. I do not think the other HVAC CASE Reports will make the performance model more difficult.
   d. Gina Rodda (Gabel Energy): I suggest you review the lighting and other envelope features. Other code changes must be considered regarding "trade-off" abilities before the performance method can be a viable option.
   e. John Arent (NORESCO, Utility CASE Team): There should be products available from more than one manufacturer for the different product lines.
   f. Tim Hreha (BEA): There is also the question of whether or not the software will even be able to model this equipment.
   g. Kevin Chan (Southern California Edison, Utility CASE Team): Those models can still be used for performance compliance.
6. Ben Cohen (Baltimore Aircoil Company): The jump to 80 gpm/hp is very large. Nearly 100 percent increase from the current 42.1 gpm/hp requirement
   a. Stefan Gracik (Integral Group, Utility CASE Team): Please send me comments if you disagree with our cost-effectiveness analysis.
7. John Bade (Johnson Controls): Can somebody get around this new requirement of requiring higher efficiency cooling towers for condenser loops greater than 900 gpm by splitting loops larger than 900 gpm? For example, if I had two chillers at 250 tons each, they would normally be on one loop. If I gave them independent loops does that allow me to use a lower efficiency tower?
   a. Stefan Gracik (Integral Group, Utility CASE Team): I will look at how the Title 24, Part 6 language is worded, specifically in regards to the “total plant chilled water capacity.”

The code language says the total capacity for 300 tons, using multiple chillers is not a way to get around this requirement. The code references the total chiller capacity for the building, rather than individual chillers. We will edit the language to be more clear that we are referring to the total design flowrate of all condenser water loops for the building.

8. Stefan Gracik (Integral Group, Utility CASE Team): Is there any feedback if stakeholders prefer to use "tons" or "gpm" in the code language? The cooling tower requirements tend to be in gpm while the air-cooled chiller limitation is written in terms of the tons of the chilled water plant.
    a. Ben Cohen (Baltimore Aircoil Company): I recommend using gpm due to wet bulb differences.
    b. Kyle Landis (Disneyland Resort): I suggest you stay with gpm/hp since a CT ton is not a fixed number, since it depends on chiller heat rejection.
9. Kyle Landis (Disneyland Resort): In terms of prescriptive standard verses performance tradeoffs, consider central plants serving a campus or district energy environment, where performance tradeoffs may not be as available.
10. Eli Howard (SMACNA): Construction using larger equipment will increase costs.
11. Paul Lindahl (SPX Cooling Technologies): What if a manufacturer is unware the product will be installed in California, and complies with ASHRAE 90.1?
    a. Stefan Gracik (Integral Group, Utility CASE Team): It is the responsibility of the mechanical designer on the project to spec the appropriate equipment, not the manufacturer. Code outreach is important to ensure engineers are aware of the changing requirements.
12. Kyle Landis (Disneyland Resort): For maintenance cost increase, I suggest you consider that larger towers will have more fill. The costs to clean fill or replace fill over equipment lifecycle will increase.
    a. Stefan Gracik (Integral Group, Utility CASE Team): Please email us if you have any feedback on specific maintenance costs.
13. Paul Lindahl (SPX Cooling Technologies): Was the cost increase that would be expected to change from the smallest to the largest considered? The cost increase to go from low end to 80 gpm/hp is going to be significantly different for a 300 ton tower to a 1,100 ton tower, as a percentage. In the case of a largest and tallest tower, there is a significant difference in the material cost for higher weight and height. I am unclear how you did the cost-effectiveness analysis, as there may be more variables.
    a. Stefan Gracik (Integral Group, Utility CASE Team): We incorporated the cost of the cooling tower based on the climate zone separately, since it varies by climate zone. We used a constant dollar per ton for all towers. We will update our analysis to include costs premiums based on the actual tower size used for the analysis in each climate zone. For each climate zone there is a different size cooling tower. We will look at the cooling tower prototypes we have, then use the manufacture selection software to determine the percentage increase based on climate zone. We will determine the percentage increase for climate zones that require a large tower and those that require a small tower.
14. Mark Pfeifer (SPX Cooling Technologies): As mentioned earlier, please ensure stainless steel is considered for the increase costs, as it will be less incremental for a galvanized steel tower. I cannot speak for other manufactures, but I believe you can do this with the tools provided to you.
    a. Ben Cohen (Baltimore Aircoil Company): I ran two selections, one at a lower gpm and one at a higher gpm. At the lower gpm, it was approximately a 15 percent increase to go from a 40 to an 80 gpm. At 1,500 gpm, it was approximately a 25 percent increase, which

is significant. The materials costs need to be considered, and this information is may not be readily available.

   b. John Arent (NORESCO, Utility CASE Team): Is the incremental cost per ton fixed for different tower sizes when going from 42.1 to 80 gpm/hp?
   c. Stefan: Thank you for the feedback. We will revise our analysis and publish the new numbers in the draft CASE Report. When the towers get larger, the cost will increase, however the energy savings will also increase. The climate zones where the larger towers will be located already have a good benefit-to-cost ratio.

15. Chris Walker (SMACNA): Given the larger size and weight of these towers, it is hard to believe the structural work to support would be negligible. Are you certain that this is the case?
   a. Kyle Landis (Disneyland Resort): Chris, especially when you consider seismic/overturning and not just gravity loads.
   b. Chris Walker (SMACNA): This is a good point, especially in California.
   c. Stefan Gracik (Integral Group, Utility CASE Team): A structural engineer had given his opinion that the size of roof support systems are hardly ever determined by the size of cooling tower weight increases, and that even a doubling of weight (which we don't expect) would have a pretty small impact. We can contact additional structural engineers.
16. Joe Vadder (Evapco): How expensive is the chiller COP increase?
   a. Stefan Gracik (Integral Group, Utility CASE Team): I did not run that analysis as it is out of scope for this code change proposal, because the performance compliance method allows you to run any combination of energy efficiency measures to meet compliance (i.e., lighting).
17. Joe Loyer (Energy Commission): Given some of the comments, I think running the coefficient of performance (COP) with cost increases is a reasonable request.
18. John Arent (NORESCO, Utility CASE Team): The chiller COP tradeoff is just an example and may vary by project.

Topic 3: Fault Detection Diagnostics (FDD) for Built-up Systems

- Farhad Farahmand (TRC, Utility CASE Team) presented.
- Presentation available here.

Comments and Feedback

1. John Bade (Johnson Controls): I am generally supportive of the FDD proposal. Is an onsite acceptance test a current requirement for rooftop units?
   a. Farhad Farahmand (TRC, Utility CASE Team): Yes, there is a current requirement for package systems. I will discuss compliance and enforcement later in the presentation.
   b. John Bade (Johnson Controls): Is there a definition for built-up AHU in the draft language? If not, I suggest you create one to clarify what this proposal applies to.
   c. Farhad Farahmand (TRC, Utility CASE Team): The code change proposal would say "all air handlers" rather than specifying different types.
   d. John Bade (Johnson Controls): You mentioned the unit must be certified through the Energy Commission, who is responsible for certifying? Do air handler companies (distributors) certify or the responsibility of the manufacturers?
   e. Farhad Farahmand (TRC, Utility CASE Team): I will discuss the certification and acceptance testing later in the presentations. In short, for packaged systems, the

certification is usually done by the controls manufacture. The certification could be done by anyone who makes a widget that does FDD. For the built-up systems controlled by direct digital control (DDC), certification would be completed by anyone who designs sequences of operations (SOO).

2. Bill Bray (Honeywell): Do you intend DDC systems to be pre-certified with CEC? This would be difficult with programmable DDC systems.
    a. Farhad Farahmand (TRC, Utility CASE Team): That is the current intention, similar to how L&H Airco pre-certified the Alerton product.
3. Chris Walker (SMACNA): What is the anticipated cost to achieve CEC certification? Is this per unit?
    a. Kelly Cunningham (Pacific Gas & Electric Company, Utility CASE Team): Chris, are you asking if there is a fee to certify to the Energy Commission?
    b. Farhad Farahmand (TRC, Utility CASE Team): We did not pursue identifying those costs, because the cost-effectiveness methodology required by the Energy Commission does not include initial design costs.
4. Farhad Farahmand (TRC, Utility CASE Team): A poll response to the compliance improvement solution suggests that the proposed language appears to be focused on a black box solution, and does not accurately handle site-wide systems with non-canned SOOs. If I interpret this correctly, then I'd like to reiterate the L&H AirCo example where the DDC controller representative, not the manufacturer directly, can go through the certification process.
5. Farhad Farahmand (TRC, Utility CASE Team): A response from the poll stated that it is not clear the role certification plays if it is primarily a software product add-on; acceptance testing is required in either case. Is there a "hard cost" for this software programming?
    a. I agree that we're not completely clear if and how a third party FDD vendor may be able to certify their FDD sequences. Whoever left this comment, please contact me via email and we can continue this discussion.
    b. Yes, there is a hard cost for programming the DDC system to have FDD, as well as implementation and testing. The CEC LCC methodology typically does not include this type of design cost – the program can be replicated and refined across projects, so it is not a recurring cost. Implementation and testing of the FDD sequences will be necessary at each AHU, however, and we have included these costs.
6. Arthur Miller (RSES): What's the reason for the new form NRCC-MCH-13-B? Is the NRCC-MCH-13-A not sufficient?
    a. Farhad Farahmand (TRC, Utility CASE Team): NRCC-MCH-13-A will cover the FDD at the economizer and still be mandatory, while NRCC-MCH-13-B would cover FDD at the valves and zone terminal units and be a compliance credit form.
7. Hwakong Cheng (Taylor Engineering): Do you have anecdotal cost feedback from the L&H Airco example? If it's a one-off basis for programmable DDC systems, then that cost would surely be passed on to each project and need to be included in cost-effectiveness analysis.
    a. Farhad Farahmand (TRC, Utility CASE Team): We do not think it's a one-off basis. The design of the FDD system would be designed by, for example, L&H Airco, and be replicated across all projects. However, the cost of implementing FDD sequence (time to put in sequence and test sequence on the air handler) is included in the cost analysis.
    b. Hwakong Cheng (Taylor Engineering): If you have custom SOO from the mechanical designer, which gets implemented at a specific project, would it need to be certified by the controls dealer? If a stand-alone product from OEM or third party, then certification is not a challenge. I am not sure I understand fully the process if the FDD logic is based

on customized sequences from the mechanical designer and implemented in programmable FDD.

c. Farhad Farahmand (TRC, Utility CASE Team): If I understand your question correctly, if a mechanical designer writes a sequence and the contractor implements it, is that subject to CEC certification requirements? This is a great question and I will look into the answer.