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October 7, 2020

California Energy Commission
Docket Unit, MS-4
Re: Docket No. 19-BSTD-03
1516 Ninth Street
Sacramento, California 95814-5512

Re: AHRI Refrigeration System Opportunities Comments to 2022 Energy Code Pre-Rulemaking - Proposed 2022 Energy Code Computer Rooms, Compressed Air Systems, and Refrigeration Staff Workshop

Dear CEC Staff,

This letter is submitted in response to the September 23 California Energy Commission (CEC) Staff Workshop on proposed updates to refrigeration equipment in the "Refrigeration System Opportunities" report developed by the California Statewide Codes and Standards Enhancement (CASE) Team.

AHRI represents over 315 air-conditioning, heating, and refrigeration equipment manufacturers. In North America, the annual output of the HVACR and water heating industry is worth more than $44 billion. In the United States, the industry supports 1.3 million jobs and $256 billion in economic activity annually.

AHRI is concerned that energy efficiency compliance pathways in the Refrigeration System Opportunities report are overly prescriptive and limit technology options for manufacturers and end-users. AHRI urges CEC to include more refrigeration technology options in its plans for the 2022 proposed energy code and establish a process for adding new options in the future. AHRI's comments specifically focus on the 'Design and Control Requirements for Transcritical CO_2 systems.'

Refrigeration System Opportunities Proposal for 2022 Nonresidential Covered Processes

AHRI appreciates the presentation on two measure proposals for new mandatory requirements for refrigeration systems and has additional comments regarding the 'Design and Control Requirements for Transcritical CO_2 Systems.' AHRI understands that CEC and the CASE Team determined that additional technologies should not be included in Table 4 of the CASE Refrigeration System Opportunities report because other technology options were not feasible, would not result in widescale adoptions, and/or did not have a high enough B/C ratio.

The current approach to this transcritical CO_2 technology will unnecessarily limit design options and will not promote energy efficiency. AHRI's July 17, 2020 letter recommended that

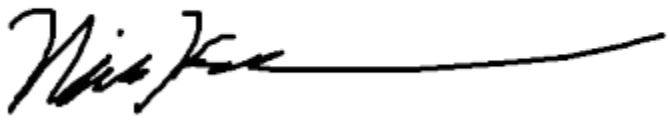
the CASE team include other technology options for improving energy efficiency like parallel compression and ejectors and mechanical subcooling in the Refrigeration System Opportunities technology listings. (Exhibit 1) The CEC should not prescriptively limit appropriate system choices that provide important energy efficiency improvements. These business-level decisions are made on a case-by-case basis, and the CEC should not exclude energy efficiency-improving technologies because earlier analysis or research may have excluded a technology option from its scope.

This technology listing approach is based on current knowledge and understanding, but is not forward looking, and would discourage or disallow improvements in known and unknown technologies that might benefit from further innovation. For this reason, the CEC and CASE Team should develop a performance threshold standard that would be technology agnostic and push manufacturers to compete in the open marketplace. The basis of achieving a performance threshold is generally a best approach where there are not specific reasons to eliminate or limit specific or new technologies. AHRI is concerned that the current report recommendations and language will cause energy efficiency in California to stagnate as future transcritical CO_2 energy efficiency-improving technologies become mature.

AHRI is encouraged by the CASE Team's acknowledgement of technology measure packages that could achieve equivalent energy performance in its September 10, 2020 Response to July 17, 2020 AHRI Letter. (Exhibit 2) The CEC should establish these 'equivalent energy performance' levels that serve as a threshold standard for manufacturers to meet the 2022 proposed energy code requirements. AHRI is happy to work with the CEC to set appropriate thresholds and looks forward to the development of efficacious and enduring energy code requirements.

If you have any questions regarding this submission, please do not hesitate to contact me.

Sincerely,



Nicholas Harbeck
Industry Analyst
Direct: (703) 293-4880
Email: nharbeck@ahrinet.org

Exhibits:

1. AHRI Comments to Title 24-2022 Refrigeration System Opportunities Draft Report
2. CASE Team Response to July 17, 2020 AHRI Letter

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July 17, 2020

CASE Author
Trevor Bellon and Doug Scott (VaCom Technologies)
(Submitted via email to info@title24stakeholders.com)

Re: AHRI Comments to Title 24-2022 Refrigeration System Opportunities Draft Report

Dear Mr. Bellon and Mr. Scott,

This letter is submitted in response to the California Statewide Codes and Standards Enhancement (CASE) Team's Stakeholder draft report on Refrigeration System Opportunities[1].

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) represents over 315 air-conditioning, heating, and refrigeration equipment manufacturers. In North America, the annual output of the HVACR and water heating industry is worth more than $44 billion. In the United States, the industry supports 1.3 million jobs and $256 billion in economic activity annually.

AHRI appreciates the opportunity to comment on the draft report for refrigeration system opportunities. In discussion with our membership, AHRI received suggestions to improve the draft report and approach that the CASE team is making. AHRI's comments reflect the industry's need for certainty and consistency with existing Department of Energy (DOE) regulations. As such, we request that any efficiency protocols identified in the draft report be harmonized with the test methods and requirements from DOE for regulated refrigeration equipment. New efficiency levels, test methods, and regulations, in general, offer no producer or consumer benefits and significantly increase the burden on manufacturer's ability to bring necessary equipment to market. Any required modifications to efficiency levels, test methods, or other regulations should be driven by, or in concert with, DOE.

California is Subject to Federal Preemption under EPCA

Federal energy conservation standards generally preempt state laws or regulation concerning energy conservation testing, labeling, and standards. Through the Energy Policy and Conservation Act of 1975 (EPCA), Congress has granted authority to the Department of Energy (DOE) to establish federal appliance and equipment standards. In addition, DOE implements minimum efficiency standards for a wide range of appliances and equipment used in commercial and residential buildings. Some refrigeration equipment technologies, such as walk-in coolers and freezers serving a total chilled storage area of less than 3,000 square feet, listed in this draft

[1] CASE Team. (June 2020) Codes and Standards Enhancement (CASE) Initiative 2022 California Energy Code, Refrigeration Systems ("Draft Case Report"). Retrieved from https://title24stakeholders.com/wp-content/uploads/2020/06/NR_Refrig-System-Opps_Draft-CASE-Report.pdf.

report are covered by EPCA and thus subject to the energy efficiency standards established by EPCA. Any potential energy efficiency savings that would result from the proposed efficiency savings for federally regulated equipment are covered by EPCA.

Any state regulation that purports to impose energy efficiency minimums on the components of regulated products inhibits innovation, are contrary to EPCA's double-regulation prohibition, and are expressly preempted by federal law.

In instances where products are not regulated by DOE, such as walk-in coolers and freezers serving a total chilled storage area of greater than 3,000 square feet, any test procedures and regulatory requirements should still align with the DOE processes. This is to ensure valid and consistent comparison across product offerings and to reduce regulatory burdens on manufacturers.

The below comments are in response to the CASE team's request for feedback on the following areas in its June 2020 Initiative 2022 California Energy Code Refrigeration System Opportunities Draft CASE Report:

- Transcritical CO_2 gas cooler performance modeling
- Transcritical CO_2 gas cooler cost data (both air-cooled and adiabatic)
- Evaporator specific efficiency thresholds

Transcritical CO_2 gas cooler performance modeling

AHRI understands that the CASE team seeks feedback on the provisions and changes in the Refrigeration System Opportunities Draft Report related to transcritical CO_2 gas cooler performance modeling and cost data. AHRI and its members find that the current language is overly prescriptive and does not allow manufacturers to develop technologies that would meet consumer and environmental needs.

AHRI is concerned that the draft report did not consider the combination of parallel compression and ejectors or mechanical subcooling in areas where the adiabatic gas cooler provided a B/C ratio marginally above 1. The restriction should not be prescriptive. An efficiency-based value for the whole system should be specified to allow parallel compression and ejector (gas and liquid) systems or mechanical subcooling to be used with air-cooled gas coolers, therefore allowing designers the freedom to innovate in pursuing the best balance between initial and operational cost[2].

AHRI recommends that the proposal include more cost-effective solutions that provide similar energy efficiency to other technology options. The CASE team should include parallel compression and ejectors and mechanical subcooling in its listing of technology options found in Table 4.[3]

[2] Please see Appendix 1 for a list of peer-reviewed research supporting the need for the CASE team to include parallel compression and ejector systems and mechanical subcooling in its listing of transcritical CO_2 gas cooler technology listings.
[3] Draft Case Report at page 1.

Transcritical CO_2 gas cooler cost data

In Section 2.2.2, the rating pressure cannot be specified alone above the critical point. Ambient temperature influences the optimum discharge point and therefore a pressure and temperature combination should be specified. The CASE team appears to list design points for each climate region and products must meet minimum efficiencies specified according to high pressure with no associated temperature. The CASE team should specify both temperature and pressure in this section or list an acceptable curve of optimum pressure that manufacturers can use to create a uniform rating condition.

By not providing this information, engineering and subsequent incremental first costs are likely to increase beyond what CASE has listed in Section 2.4.3. AHRI suggests that the CASE team meet with manufacturers to ascertain the cost of producing uniquely engineered-to-order products for the entire California market, and to gain clarity regarding the difference between design requirements and equipment regulation. The CASE team could then use this data provided by manufacturers which would be helpful for performing a regional analysis and create new requirements that capture these climate variations. Any information collected in this process would be helpful for establishing a single rating condition to accommodate all California climate regions, and possibly all national climate regions.

CEC should encourage and allow manufacturers to use advanced technologies to achieve CEC's efficiency goals. Allowing other technologies could expand the breadth of technology options that can serve California's refrigeration needs and could be accomplished by including transcritical CO_2 gas cooler parallel compression and ejectors and mechanical subcooling in its analysis and update cost data based on manufacturer input.

Evaporator specific efficiency thresholds

AHRI also reviewed the evaporator specific efficiency thresholds and found that the levels in this section should align with DOE test procedures, rating conditions, and minimum efficiency levels. Per federal preemption, equipment meeting minimum Annual Walk-In Energy Factor (AWEF) standards is considered compliant with the requirements in this section.

Under EPCA, efficiency thresholds cannot be more stringent than the requirements defined by DOE. CEC is federally preempted from imposing more stringent requirements on efficiency thresholds. The CASE team should align all test procedures and rating conditions with the federal minimum AWEF values from DOE. Once aligned, Title 24 cannot be more restrictive than DOE minimums. Even if the Title 24 and DOE test methods are different, CEC cannot impose more stringent efficiency requirements for DOE-covered products. In all instances, the CASE team should defer to federal metrics so refrigeration equipment manufacturers are not subject to unnecessary duplicative regulatory schemes.

In section 4.2.2, the CASE team stated[4], "stakeholder feedback from multiple major evaporator manufacturers has indicated that AHRI 420 is more applicable to equipment with

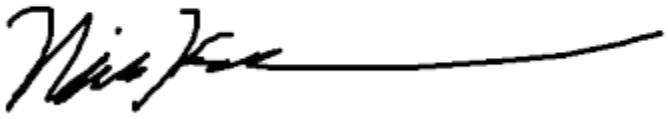
[4] *Id.* at page 95.

comfort cooling applications as opposed to industrial refrigeration applications." AHRI Standard 420[5] applies to unit coolers for refrigeration and does not necessarily apply to just one application. AHRI Standard 410 is then cited[6] as the standard more applicable to industrial refrigeration applications. AHRI Standard 410[7] is more generally written for air heating and cooling coils and is not exclusively applicable to industrial refrigeration applications. AHRI recognizes that the CASE Team is currently not proposing required certified ratings based on AHRI 420 but may be a source for future work. AHRI does not see any issue with the CASE Team proposing required certified ratings based on AHRI 420 but would recommend that the Team follow AHRI Standard 1250[8] for rating conditions and testing.

AHRI also recommends that the CASE Team follow AHRI Standard 1250[9] for rating conditions and testing instead of developing a different methodology that each manufacturer can use, which could be a potential burden on manufacturers and create an uneven playing field, and potentially requisite liability for the CASE Team.

If you have any questions regarding this submission, please do not hesitate to contact me.

Sincerely,



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[5] AHRI, (2016) AHRI Standard 420 *Performance Rating of Forced-circulation Free-delivery Unit Coolers for Refrigeration*. http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_420_I-P_2016.pdf
[6] Draft Case Report at page 96.
[7] AHRI, (2001) AHRI Standard 410 *Forced-Circulation Air-Cooling and Air-Heating Coils*. http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_410-2001_with_Addenda_1_2&3.pdf
[8] AHRI, (2020) AHRI Standard 1250 *Performance Rating of Walk-in Coolers and Freezers*. http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI-1250-(I-P-2020)_Performance_Rating_of_Walk-in_Coolers_and_Freezers.pdf
[9] *Id*.

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Appendix 1

Peer-reviewed research studying the effects of parallel compression and ejectors systems and mechanical subcooling on transcritical CO_2 gas cooler efficiency.

1. Catalán-Gil, J., Nebot-Andrés, L., Sánchez, D., Llopis, R., Cabello, R., Calleja-Anta, D. (2020). Improvements in CO2 Booster Architectures with Different Economizer Arrangements. DOI: 10.3390/en13051271.

2. Haida, Michal, Banasiak, Krzysztof, Smolka, Jacek, Hafner, Armin, Madsen, Kenneth Bank. (2016). EXPERIMENTAL ANALYSIS OF THE R744 VAPOUR COMPRESSION RACK EQUIPPED WITH THE MULTI-EJECTOR EXPANSION WORK RECOVERY MODULE. DOI: 10.18462/iir.gl.2016.1079.

3. Hafner, Armin, Banasiak, Krzysztof, Herdlitschka, Timo, Fredslund, Kristian, Girotto, Sergio, Haida, Michal, Smolka, Jacek. (2016). R744 EJECTOR SYSTEM CASE: ITALIAN SUPERMARKET, Spiazzo. DOI: 10.18462/iir.gl.2016.1078.

4. Llopis Doménech, R.; Cabello, R.; Sanchez, D.; Torrella Alcaraz, E. (2015). Energy improvements of CO2 transcritical refrigeration cycles using dedicated mechanical subcooling. International Journal of Refrigeration. 55:129-141. DOI: 10.1016/j.ijrefrig.2015.03.016

5. Pisano, Giacomo. (2018). The use of ejectors technology: how to boost efficiency in warm climates – a real example from Italy. DOI: 10.18462/iir.gl.2018.1363.

6. Sánchez, D., Catalán-Gil, J., Llopis, R., Nebot-Andrés, L., Cabello, R. (2016). Improvements in a CO2 transcritical plant working with two different subcooling systems. DOI: 10.18462/iir.gl.2016.1170.

7. Zha, Shitong. (2018). ALTERNATIVE SUCTION GROUPS CONFIGURATION TO IMPROVE EFFICIENCY OF ADVANCED CO2 COMMERCIAL REFRIGERATION SYSTEMS. DOI: 10.18462/iir.gl.2018.1384.

CALIFORNIA ENERGY CODES & STANDARDS
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MEMO

To: **Air-Conditioning, Heating, and Refrigeration Institute (AHRI)**

From: George Chapman
Senior Project Manager
Energy Solutions
gchapman@energy-solution.com

Date: September 10, 2020

Subject: **Response to July 17, 2020 AHRI Letter**

Dear Mr. Harbeck,

Thank you for your comments to the Statewide CASE Team's proposed code changes for refrigeration systems. We appreciate you taking the time to share your input. We have reviewed those comments and provide our responses below.

1. Transcritical CO2 Gas Cooler Performance Modeling

AHRI Recommendation

From the last paragraph on page 2*: AHRI recommends that the proposal include more cost-effective solutions that provide similar energy efficiency to other technology options. The CASE team should include parallel compression and ejectors and mechanical subcooling in its listing of technology options.*

Statewide CASE Team Response

The Statewide CASE Team encourages technology innovation and understands the desire for design flexibility. Alternative pathways to compliance must result in approximately equivalent energy savings as the primary compliance pathway. AHRI suggested allowing parallel compression and gas ejectors and mechanical subcooling as alternatives to the proposed air-cooled gas cooler restriction that would apply in Climate Zones 9 through 15. Although these technologies result in energy savings, the savings are not equivalent to the proposed requirement. For example, the Statewide CASE Team modeled parallel compression in Climate Zone 10, where the benefits-to-cost ratio for the air-cooled gas cooler restriction measure is relatively modest. The results of the analysis showed that parallel compression saved only 23 percent of the energy saved by the proposed measure (modeled with an adiabatic gas cooler.) Parallel compression would therefore not be a viable alternative to the proposed measure in Climate Zone 10. The Statewide CASE Team did not run other cases for parallel compression or for gas ejectors and mechanical subcooling because it is not expected that these technologies would achieve equivalent energy savings.

Although parallel compression and gas ejectors and mechanical subcooling cannot achieve similar energy performance alone, there is precedent to create packages that couple alternative technologies with other measures that, when evaluated together, achieve equivalent energy performance. If AHRI can demonstrate a package of measures that could achieve equivalent savings, the Energy Commission might consider that package as an alternative compliance pathway to the proposed mandatory requirement.

2. Transcritical CO2 Gas Cooler Cost Data

AHRI Recommendation

From the first paragraph on page 3: *The CASE team should specify both temperature and pressure in [Section 2.2 of the CASE Report] or list an acceptable curve of optimum pressure that manufacturers can use to create a uniform rating condition.*

Statewide CASE Team Response

This recommendation from AHRI may stem from a misunderstanding. The Statewide CASE Team does provide both pressure and temperature for the specific efficiency rating conditions, presented in Table 120.6-H of the proposed code language (1400psig for air cooled gas coolers, 1100 psig for adiabatic gas coolers, 100°F leaving gas temperature/90°F dry bulb temperature). The specified pressure for each condenser type is an approximate average design pressure. The rating conditions are similar to those used for condenser specific efficiency rating conditions (100°F saturated condensing temperature /95°F dry bulb temperature) as well as those used for remote mechanical draft air-cooled refrigerant condensers in AHRI Standard 460 (125°F saturated condensing temperature/ 95°F dry bulb temperature). The proposed rating conditions do not correspond to any particular climate zone but act as points of comparison. The Statewide CASE Team utilized performance data from manufacturers at those rating conditions to determine reasonable and cost-effective minimum efficiency values.

The designer would still be able to specify design pressure when sizing the gas cooler. The mandated maximum difference between ambient air and outlet gas cooler temperature was modeled with a proxy optimum design pressure for each climate zone derived from established optimization formulas used in other modeling software. This allows the design engineer to select from a range or pressures while still ensuring the gas cooler has enough surface area to achieve cost effective savings, driving down the average head pressure and reducing the number of supercritical operating hours.

3. Evaporator Specific Efficiency Thresholds

AHRI Recommendation

From the first paragraph addressing this on page 3: *AHRI also reviewed the evaporator specific efficiency thresholds and found that the levels in this section should align with DOE test procedures, rating conditions, and minimum efficiency levels. Per federal preemption, equipment meeting minimum Annual Walk-In Energy Factor (AWEF) standards is considered compliant with the requirements in this section.*

From the last paragraph on page 4: *AHRI also recommends that the CASE Team follow AHRI Standard 1250 for rating conditions and testing instead of developing a different methodology that each manufacturer can use.*

Statewide CASE Team Response

The proposed code changes are intended to be applied to equipment covered under Section 120.6(a). We will add clarifying language to the final report for your review.

The Statewide CASE Team is proposing its own methodology instead of AHRI Standard 1250 for the following reasons: First, it would provide an easier compliance path for manufacturers and end users in California than AHRI 1250 because the calculation is more straightforward and applicable to all evaporators used in refrigerated warehouses. Second, this approach creates a representative annual efficiency metric, so that manufactures do not have to perform additional calculations to do so. The specific efficiency values in the Statewide CASE Team's approach were derived using the savings results from whole building energy modeling software with specific prototypes representative of refrigerated warehouses. The analysis used relevant factors including weather, infiltration, envelope loads, internal heat gain from fan motors, and typical refrigerated warehouse forklift and people traffic. Third, it considered the distribution of efficiencies in the refrigerated warehouse evaporator market and what was cost effective using the Title 24 lifecycle analysis method.

The Statewide CASE Team would also like to note the similarity between the evaporator rating conditions specified in AHRI 420 *Performance Rating of Forced-circulation Free-delivery Unit Coolers for Refrigeration* and what is proposed in the Final CASE Report. Both rating conditions utilize the same temperature difference between saturated suction temperature (SST) and inlet air temperature for both coolers and freezers (35F dry bulb temperature / 25F SST and –10F dry bulb temperature / -20F SST respectively). Additionally, an earlier AHRI letter recommended to rate evaporators with glide refrigerants at the refrigerant dewpoint temperature instead of the midpoint between the bubble point and dewpoint temperatures. The Statewide CASE Team agreed with this recommendation and modified its proposal so that for glide refrigerants, the rated saturated evaporating temperature is defined as the dewpoint temperature.