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to Title 24 - 2022 September 23 Pre-Rulemaking Meeting

Additional submitted attachment is included below.

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October 7, 2020

California Energy Commission
Docket Unit, MS-4
Re: Docket No. 17-BSTD-01
1516 Ninth Street
Sacramento, California 95814-5512

Re: AHRI Comments to Title 24-2022 September 23 Pre-Rulemaking Meeting – Data Center Efficiency – Non-residential – Docket 19-BSTD-03

Dear CEC Staff:

This letter is submitted in response to the September 23 California Energy Commission (CEC) Staff Workshop on proposed updates to computer room efficiencies, pipe sizing and leak testing for compressed air systems, and refrigeration systems operations sections of the 2022 Energy Code, specifically regarding computer room efficiencies, and on Codes and Standards Enhancement (CASE) Initiative 2022 California Energy Code report, "Nonresidential Computer Room Efficiency."

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 has some concerns with the CASE report and proposed regulatory text. As expressed during the meeting, AHRI's concerns are in three main areas: (1) Computer rooms are mission critical spaces – essential for business operation – that must be simply and redundantly designed, (2) Efficiency requirements on components of federally regulated equipment is preempted, and (3) Proposed economizer temperatures unfairly limit technology options for California data center owners and should be revised.

Mission critical spaces

Data centers are essential to public and private business operations and are considered to be mission critical. The facilities must operate around the clock for the entire year, without disruption. Reliability, redundancy, and simple design are key design principles for the architecture and mechanical systems services these spaces. Due to the high intensity and constant energy use, data centers are prime-candidates for energy-efficient design measures that can save money and reduce electricity consumption. Energy reduction measure proposals must acknowledge and adhere to the key design principles of reliability, redundancy, and simple design.

Preservation of economizing options supports CEC's goal of reducing energy consumption, while also allowing building owners options to design and operate mission critical spaces throughout the state. Mechanical systems designers need a full range of economizing technologies to select from to optimize design. Some parts of California grapple with water availability and some with air quality issues that can last for many months out of the year. For example, recent wildfires have expelled significant quantities of ash into the air, preventing introduction of outside air with high particulate matter concentration during temperatures normally conducive to airside economizing. Equipment in mission critical spaces is highly sensitive and would need to be protected from air with particulate matter. Any analysis comparing annual energy consumption should account for these realities and properly account for constraints on equipment operation limited by climatic conditions. Data center operators bypass outdoor air during times of poor air quality to mitigate the impact of both smoke and ash. Even if the bulk of "fire season" is during the summer, data centers operate 24/7 and would not see the benefit from air-economizing during cooler night hours. This should be accounted for in the analysis.

ASHRAE research project RP-1755 (Feb 2020) warns about risk of corrosion to sensitive electronic parts related to air pollution, humidity levels and temperatures in data centers. Recommendations include special filtration, maintaining humidity levels and regular checks on corrosion levels. The concerns and costs need to be included in the economic analysis which makes exclusive for some outside air temperature ranges. Some data center owners will not want to take the risk of using outside air and require alternative technologies to cool data centers reliably.

While the proposed heat recovery requirement in Section 140.9(a)4.a makes sense in theory, in reality it stands to add unnecessary complexity to a mission critical space. This requirement is structured around a large computer room adjacent to, within 50 feet of, a small office. While it is certainly feasible to use an air-side economizer to pull 90 °F to 100 °F air from the data center to heat other spaces, warm air from these spaces should be returned to the computer room to temper cold outside air. This requires extensive duct work and dampers to work correctly and introduces many failure points. Mission critical spaces require simple and reliable designs to offer reliable services.

Another proposal that stands to complicate data center design, is the proposal to expand the air containment threshold from 175kW per room to 10kW per room ITE design load. AHRI questions if requirements appropriate for rooms requiring approximately 50 tons of cooling would all be economically justified for electronic closets requiring 3.5 tons of cooling. CEC should revisit this proposal.

Efficiency requirements on components of federally regulated equipment is preempted

Section 140.9(a)1 Exception 4, contains a preempted requirement for federally covered CRACs. Under the Energy Policy and Conservation Act (EPCA), California Energy Commission (CEC) is explicitly preempted from establishing standards on federally regulated equipment. Under EPCA's preemption provision, state regulations "concerning" the "energy efficiency" or "energy use" of covered commercial and industrial equipment are no longer effective when a Federal standard becomes effective for those covered equipment.[1] Courts have interpreted this preemption provision to be expansive, finding that the term "concerning" suggests Congress intended the provision to have a "broad preemptive purpose."[2] The following are all federally regulated by DOE—the air-cooled, glycol-cooled, and water-cooled computer room air conditioners with a net sensible cooling capacity of between 65,000 and 760,000 Btu/h, the total fan power limit, the supply and return air dry-bulb temperature differential. As a result, the proposed efficiency requirements for the air-cooled, glycol-cooled, and water-cooled computer room air conditioners with a net sensible cooling capacity of between 65,000 and 760,000 Btu/h, neither the total fan power limit, nor the supply and return air dry-bulb temperature differential requirement can apply.

Federal energy conservation standards generally preempt state laws or regulation concerning energy conservation testing, labeling, and standards. Through EPCA, Congress has granted authority to the 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. The fans and blowers embedded CRACs are covered by EPCA and thus subject to the energy efficiency standards established by EPCA. A requirement to select equipment above the federal minimum efficiency, as proposed in Section 140.9(a)1 Exception 4, is also expressly preempted. AHRI recommends CEC eliminate the fan and temperature differential requirements in Exception 4 to Section 140.9(a)1. AHRI also questions the justification, or lack thereof, of the 20-percent improvement above minimum efficiency. Appendix G does not cite efficiency tables for CRACs, only referencing chillers. The 20-percent efficiency increase threshold is arbitrary, and the pathway, as written, would not allow for compliance for systems other than chilled water designs. No additional justification has been provided to support the improvement in computer room equipment operation. If there is to be an efficiency level improvement of the CRAC that supports excluding an integrated economizer, CEC needs to analyze and support this proposal more effectively.

CEC should also remove existing language in Section 140.9(a)2. Power Consumption of Fans. Requiring the total fan power at design conditions of each fan system serving a computer room to not exceed 27 W/kBtuh of net sensible cooling capacity is expressly preempted as

[1] *See* 42 U.S.C. § 6297(c) (2016). Note that the statutory "crosswalk" at 42 U.S.C. § 6316(a)(10) that applies to covered equipment described in § 6311(1)(L), including commercial fans and blowers, incorporates § 6297(c).

[2] *See id.*; *see also Metro. Life Ins. Co. v. Massachusetts*, 471 U.S. 724, 739 (1985); *Nat'l Elec. Mfrs. Ass'n*, 2017 WL 6558134 at *5; but *see Air Conditioning & Refrigeration Inst. v. Energy Res. Conservation & Dev. Comm'n*, 410 F.3d 492 (9th Cir. 2005) (finding that the "legislative history of [EPCA] supports a narrow interpretation of the preemption provision" with respect to preempting state regulations requiring the submission of data to state government agencies.).

discussed thoroughly, above. This language should have been removed after the first DOE standard went into effect in October 2012.

Proposed clarification suggestions on regulatory text

In addition to the refinements suggestion above to Section 140.9(a)1, Section 5.7.3.2. Supply Fans – ACM describes how the compliance software needs to work to implement the equipment control requirements. AHRI appreciates the clarification that space temperature should be return air temperature. The software should be revised to better model data centers. AHRI appreciates the opportunity to review additional tables for the ACM as they are developed.

Section 140.9(a) 1 proposes to require economizing between 64.4°F and 80.6°F. It is technically impossible to achieve 64.4°F Supply Air with 65°F Economizer Temperature Threshold. The lowest this requirement could be set to, with 65°F Economizer Temperature Threshold, is 65°F.

Fully permit the use of refrigerant and glycol economizers

Title 24-2019 recognizes there are different requirements for air-side and water-side economizers. Using economizers is a very energy efficient approach to cooling data centers and the effectiveness increases when return air temperature increases. AHRI understands that water cost and water availability concerns are accelerating the use of air-cooled chillers, water-cooled chillers with dry coolers, and air-cooled refrigerant economizers in data center applications. Air economizers are sometimes the most efficient, but some data centers have building constraints that inhibit the application of air economizers, or humidity control and electro-static discharge issues necessitating fluid economizer choices. There are several design strategies to consider.

One common design strategy is to implement water economizer coils as part of the air-cooled chiller (commonly called “free cooling”) to minimize the use of mechanical cooling at lower ambient temperatures. Since most new data centers are typically designed for 65°F to 70°F chilled water temperatures, the available hours for “free cooling” are much greater than a typical comfort cooling HVAC system requiring a 44°F chilled water temperature.

Another common design strategy is the use of refrigerant economization that also minimizes the use of mechanical cooling at lower ambient temperatures. The use of integrated water, glycol, and refrigerant economizers should be permitted beyond where the local water authority does not allow cooling towers, as stated in Exception 3 to Section 140.9(a)1. While the preservation of these technologies is imperative in jurisdictions where cooling towers are not permitted, the proposed requirements should have been analyzed acknowledging limitation on air economizing caused by persistent air quality issues in California, and be revised to fully permit the use of water, glycol, and refrigerant economizers. Since it’s highly unlikely for any dry heat rejection economizer (either a dry cooler or a refrigerant economizer) to provide 70°F supply air temperature (SAT) with 65°F dry bulb temperature, this proposal, as written, prohibits these types of economizers unless water is not available. This should be revised to allow choices for California consumers. AHRI is working with manufacturers of all technologies to suggest an alternative proposal and CEC should also analyze alternate temperature settings.

When using “dry” heat rejection economizer systems, no evaporative cooling is used, and systems are designed to achieve a temperature approach to the dry-bulb ambient design temperature. Where a 10°F approach to the wet bulb temperature may be achievable with an evaporative cooling system, the temperature approach to the dry bulb ambient temperature with a dry cooler is typically 25°F to 30°F. Using a 25°F approach in a system designed to Title 24-2019 as an example, the designer could achieve a chilled water temperature of 65°F with a 40°F ambient dry-bulb temperature. Under the proposed standard change to increase minimum outdoor temperatures for 100-percent economizing to 65°F dry-bulb, practical achievable chilled water temperatures would be about 90°F (using the same 25°F approach) with dry coolers – well above the design chilled water temperature of 65°F to 70°F.

For “wet” economizers, current requirements are for a 25°F differential between the data hall supply air temperature (SAT) (60°F) and the 100% wet economizer switchover wet bulb temperature (35°F). In the proposed change, this has been reduced to a 20°F differential. In the proposed change, the modeling is based on a 7°F approach between the entering coil water temperature (63°F) and the supply air temperature (70°F). Since the differential between the SAT and WB has been reduced by 5°F, AHRI infers that the CRAH coil approach was reduced by 5°F. If so, this would most likely require a much larger (and expensive) CRAH coil and a higher CRAH coil air pressure drop. How were this higher cost and higher pressure drop taken into account in the analysis?

When “evaporative wet” economizers, tied to evaporative heat rejection devices are used, the benefits of wet-bulb depression can be obtained. There are also new products with water-cooled free cooling coils added to the condenser, which are also being used on data centers and computer rooms. Lastly, there is also new water-cooled chillers that make use of refrigerant-side free-cooling coupled to water cooled towers which allows for cooling without running the compressor. The issue has been the requirement to meet 100% of the capacity at 55°F dry-bulb /40°F wet-bulb for air economizers or 40°F dry-bulb /35°F wet-bulb for water economizers. The proposal intends to raise the temperature requirement even higher for air, water, and refrigerant economizers, which will be difficult to accomplish even with a higher supply air temperature as proposed. For economizing, it will be difficult to comply with Section 140.9(a)1 proposed increased outside air temperature requirements of, “65°F dry-bulb and below or [*sic*] 35°F wet-bulb” since data centers often are constant load – these requirements cannot always be met and will be hard to enforce without full building modeling.

These proposed changes would require every data center to have an air-side economizer system or force the use of evaporative cooling systems for water side economizers, with the associated significant water use and chemical treatment costs. Designers may need design options other than air-side economizers to properly address computer rooms in marine climates. ASHRAE TC 9.9 is initiating a research project to investigate the impact of saline air present in costal climates on IT equipment. The hypothesis is that humidity will need to be tightly controlled.

Introducing additional moist, saline air may be detrimental to the necessary humidity control. An analogous study on corrosive elements has been completed and recommended lower humidity introduced through outside air.

While air-side economizers may be able to meet sensible cooling loads at warmer ambient temperatures when compared with dry water-side economizing solutions, they can introduce additional, unwanted latent loads in humid environments that must be removed in a separate process, using mechanical cooling or desiccants, offsetting some of the energy savings. Water-side economizers avoid this pitfall, but either require cooler air temperatures (dry) or require water consumption (evaporative) to do so. Given the variation in local climate conditions, combined with the growing need for responsible and sustainable water usage, and to allow engineers the flexibility to optimize solutions based on the application, it is critical to have flexibility in the prescriptive language to allow for multiple economization solutions based on which solution makes sense for the particular climate.

In fact, under the CASE proposal manufacturers of water-side and refrigerant economizers would have to substantially reconfigure their products to satisfy outside temperature thresholds which have increased by 25°F dry-bulb, while air-economizer manufacturers need only ensure their products are capable of satisfying an increase in outside temperatures of 10°F dry-bulb. The CEC should either lower the proposed temperature thresholds for water and refrigerant economizers to recognize these technological differences between air, water, and refrigerant economizers or lower the temperature thresholds from 65°F for all three technologies. Again, AHRI urges CEC to analyze different temperature settings to preserve the use of all economizing technologies.

ASHRAE 90.1-2019, section 6.5.1.2.1 has some exceptions for computer rooms and defines the requirements as a function of climate zone. The climate zones referenced in ASHRAE 90.1-2019 are the U.S. climate zones, which are different than in Title 24. The climate zones are converted into many other metrics. AHRI recommends the CASE team review Section 6.5.1.2.1 and consider implementing similar measures.

During the September 23rd public workshop, AHRI noted that no justification was provided in the CASE report to substantiate limiting refrigerant economizers to specific climate zones in Section 141.1(a)1.C. During the public workshop, CEC staff suggested that this limitation exists in the current edition of Title 24. It does not. Section 140.9(a) of 2019 edition of Title 24 has no climate zone-dependent requirements. AHRI recommends removing climate zone limitations in proposed Section 141.1(a)1.C.

Also as noted above, all instances of water economizer should be revised to be fluid economizer to clearly include glycol and refrigerant economizers.

AHRI questions the fairness of comparing the baseline of a CRAH with water economizing with a dry cooler to an evaporative cooling tower. This comparison, as shown in Table 20 of the CASE Report, burdens the base dry cooler system with operating with a 60°F SAT while the evaporative cooling tower economizer is permitted to operate at a much more favorable 70°F supply air temperature. CEC should also consider the efficiency of a chilled water system using a dry cooler also operating at 70°F SAT as a viable system to compare against the base system. AHRI suggest that CEC conduct an additional analysis using a more appropriate baseline technology for comparison.

Lastly, both Title 24 and ASHRAE 90.1 still require modeling to determine the load at reduced ambient. AHRI recommends using a performance approach rather than a prescriptive approach, similar to ASHRAE 90.4-2019. A designer needs options including fluid, air-cooled free cooling, refrigerant-based free cooling or higher efficiency equipment to design for a full range of data centers and computer rooms. Additionally, manufacturers would like to retain the ability to apply new technologies to increase the efficiency of equipment within a system. Constraints imposed by the proposal eliminate all technologies except air economizers. California customers deserve options to address building constraints and computer room humidity control, and to specify innovative technologies.

Humidification options and reheat should be preserved in the prescriptive path

Section 120.6(i) proposes to make certain prescriptive measures mandatory. Would prohibiting reheat, as written in Section 120.6(1)1, eliminate options for variable air volume (VAV) systems with reheat to be used in conjunction with water-cooled servers or building that use heat recovery chillers that transfer heat between chilled water cooling[3] and hydronic heating systems[4]? Both options have been cited in the CASE report as energy saving techniques. While the test in Section 120.6(i)1 cites reheating air streams, it is an example rather than the requirement. No substantiation has been provided to mandatorily prohibit reheat by waste hot water or heat recovery chillers. Likewise, no substitution has been provided to support mandatorily banning nonadiabatic humidification. While adiabatic humidification may generally be more energy efficient, there may be cases where a nonadiabatic system may be preferred and use of the prescriptive pathway should be permitted.

Clarifying question from the CASE Report

AHRI notes that Figure 2 in the CASE Report shows the chiller supplying 63°F water but Table 35 says the chiller supply temperature is 60°F. Which condition was used in the analysis?

[3] "Water-cooled servers can operate with 130°F entering water temperature and 140°F leaving water temperature. This 140°F water can be used directly by most mechanical systems (e.g., variable air volume with reheat, radiant, etc.) without any need to boost the temperature higher. If the computer room load exceeds the demand for heat then the excess heat can be rejected with a simple dry-cooler or evaporative cooling tower." CASE Report, p. 81

[4] "A building that uses chilled water cooling and hydronic heating (e.g., VAV reheat, radiant floors, hot water fan coils, etc.) can use a heat recovery chiller to transfer heat from the chilled water loads (e.g., chilled water computer room air handlers) to the hot water loads (e.g., hot water reheat boxes, radiant panels, etc.)." CASE Report, p. 85

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

Sincerely,

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