DOCKETED	
Docket Number:	19-BSTD-03
Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	235095
Document Title:	Munters Data Centers Comments - September 23rd Staff Presentation on proposed 2022 Energy Code - Response to Q1
Description:	N/A
Filer:	System
Organization:	Munters Data Centers
Submitter Role:	Public
Submission Date:	10/6/2020 2:21:12 PM
Docketed Date:	10/6/2020

Comment Received From: Munters Data Centers
Submitted On: 10/6/2020
Docket Number: 19-BSTD-03

September 23rd Staff Presentation on proposed 2022 Energy Code - Response to Q1

Additional submitted attachment is included below.

10/06/20

In Regards To -
Docket Number: 19-BSTD-03
Project Title: 2022 Energy Code Pre-Rulemaking
TN #: 234890
Document Title: *September 23rd Staff Presentation on proposed 2022 Energy Code*
Submission Date: 9/24/20

To: Haile Bucaneg, California Energy Commission
From: Jim Marsh, Munters Data Centers

Response to Staff Questions

Increased temperature thresholds for economizers:

- Q1: can various economizer technologies work under revised thresholds?

Yes, referencing the economizer definitions Munters previously submitted, the following (not crossed out) economizer technologies can be expected to apply based on 75°F SAT / 95°F RAT, 20°F Delta T as the current industry standard give or take 5°F on both SAT & Delta T.

Air Economizer

- Direct Economizer – This type of air economizer brings cooling outdoor air directly into the computer room without the use of a heat exchanger and requires relief air from the space served to avoid over pressurization. Direct economizers do not have temperature losses related to heat exchange but must provide for treatment of undesirable ambient conditions including humidity level, particular and gaseous contaminants. It can be applied to both packaged and split air handling:

    - Direct Air Economizer (see 9/11 Final CASE Report Figure 2., left diagram) – This type of direct economizer allows the introduction of cooling outdoor air to the computer room typically requiring additional full load electro-mechanical cooling for extreme summer ambient design conditions*.

    - Direct Evaporative Economizer– This type of direct economizer uses water for adiabatic cooling of the outdoor airstream in order to reduce or eliminate the need for additional electro-mechanical cooling.

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- Indirect Economizer – This type of economizer applies intermediate air-to-air heat exchange to separate the heat rejection cooling outdoor air, a.k.a. scavenger air, from the process cooling air recirculated through the computer room and cooling equipment. Indirect economizers have temperature losses related to heat exchange expressed as ambient temperature approach delta to supply air temperature:
    - Packaged Indirect Economizer – This type of indirect economizer includes all components required for the management of recirculating process cooling air heat exchange with scavenger air in a single housed air handling and heat rejection unit. Typical application locations are rooftop or perimeter mount:

        - ~~Packaged Indirect Air Economizer – This type of packaged indirect air economizer typically utilizes a dry aluminum plate heat exchanger and additional full load electro-mechanical cooling for extreme summer ambient design conditions*.~~

        - Packaged Indirect Evaporative Economizer – This type of packaged indirect air economizer typically utilizes water distributed over to a polymer tube or metallic heat exchanger for adiabatic cooling of the scavenger air in order to reduce or eliminate the need for additional electro-mechanical cooling.

Refrigerant Economizer

- Split Refrigerant Economizer - This type of refrigerant economizer has separate system sections for the management of recirculating process cooling air and the scavenger air. The heat exchange sections are decoupled and connected via fluid piping. The medium for the piped heat exchange is typically a refrigerant that changes phase from a liquid to a gas, i.e. evaporation, and back to a liquid, i.e. condensation, through the application of moving air streams with different temperatures, a.k.a. Delta T, and typically requires additional full load electro-mechanical cooling*:

        - Integrated Thermosyphon Refrigerant Economizer – This type of split refrigerant economizer uses the liquid-gas phase change of the refrigerant itself to move the fluid through a passive circuit akin to a circuited heat pipe, with the evaporator below the condenser, without the use of pumping or bypass control valves. Additional electro-mechanical cooling is applied either in parallel or in series to the passive thermosiphon circuit and has discrete fluid piping.

        - ~~Integrated Pumped Refrigerant Economizer – This type of split refrigerant economizer combines the functionality, refrigerant, and piping of a traditional split system indoor full load electro-mechanical DX Computer Room Air Conditioner (CRAC) and matched outdoor condenser with the economization of non-DX refrigerant phase change. Control valves are used to bypass the compressors and refrigerant pumping is applied to move the fluid through the common piping system.~~

- Packaged Refrigerant Economizer – This type of refrigerant economizer includes all components required for the management of recirculating process cooling air heat exchange with scavenger air in a single housed air handling and heat rejection unit. Typical application locations are rooftop or perimeter mount.

    - Integrated Thermosyphon Refrigerant Economizer – This type of packaged refrigerant economizer uses the liquid-gas phase change of the refrigerant itself to move the fluid through a passive circuit akin to a circuited heat pipe, with the evaporator below the condenser, without the use of pumping or bypass control valves. Additional electro-mechanical cooling is applied either in parallel or in series to the passive thermosiphon circuit and has discrete fluid piping.

    - ~~Integrated Pumped Refrigerant Economizer – This type of packaged refrigerant economizer combines the functionality, refrigerant, and piping of a traditional packaged system full load electro-mechanical DX Computer Room Air Conditioner (CRAC) with matched condenser with the economization of non-DX refrigerant phase change. Control valves are used to bypass the compressors and refrigerant pumping is applied to move the fluid through the common piping system.~~

Water Economizer

A water economizer passes ambient outdoor air across an air-to-water heat exchanger, a.k.a. fluid cooler, and pumps that cooled water back to a water-to-air heat exchanger, a.k.a. chilled water coil. A glycol solution may be required for freeze protection. Typically requires additional full load electro-mechanical cooling for extreme summer ambient design conditions*:

- ~~Water Cooled DX Computer Room Air Conditioner (CRAC) Economizer – This type of water economizer diverts DX heat rejection water from an internal refrigerant-to-water heat exchange condenser to an integral economizer chilled water coil.~~

- Air Cooled Chiller with Remote Evaporative Tower (see 9/11 Final CASE Report Figure 2., right diagram) – This type of water economizer diverts warm return chilled water to a water-to-water heat exchanger, which couples to a remote evaporative cooling tower.

- Free Cooling Air-Cooled Chillers with Adiabatic Assist – This type of water economizer diverts DX heat rejection water from internal refrigerant-to-water heat exchange condenser to an economizer fluid cooler, either direct or remote mounted, when ambient outdoor air conditions at the fluid cooler allows for economization with an added Adiabatic Assist step applying an evaporative media to the air inlet side of the fluid cooler to increase the economizer effectiveness.

*Note: Electro-mechanical cooling can be reduced or eliminated through elevated process cooling design supply/return temperatures, Delta T, and/or adiabatic assist processes.

Water Cooled Chiller with Water Economizing

Water cooled chillers utilize remote evaporative cooling towers to cool refrigerant process condenser water. Economizer strategies for water cooled chillers are equivalent to air cooled chillers, e.g. the evaporative cooling tower can be used as an economizer with bypass and heat exchange.