

# Webinar Audio Recording

- ▶ To play the audio recording:
  - ▶ Go to:
    - ▶ <http://www2.teleconferencingcenter.com/moderator/presentation/Playback?id=c4b7c391-c88b-4d0d-8cad-b6de41aa12da.rpm>
    - ▶ Enter your name and email
  - ▶ Select whether to use Real Player or Windows Media Player.

To play the recording, you must have one of these installed on your computer. The Real Player tends to work better.
  - ▶ <http://www.real.com/>
  - ▶ <http://windows.microsoft.com/en-US/windows/downloads/windows-media-player>
- ▶ Click “Listen.”





THE **GREENCHILL** PARTNERSHIP



# *Hybrid and Secondary Loop CO<sub>2</sub> Refrigeration Systems*

August 16, 2012



# Welcome / Webinar Etiquette

- ▶ Webinar is being recorded
- ▶ Recording will be available on GreenChill LinkedIn site and GreenChill website, under “Events and Webinars”: [www.epa.gov/greenchill](http://www.epa.gov/greenchill)
- ▶ Phones are muted (#6 to unmute)

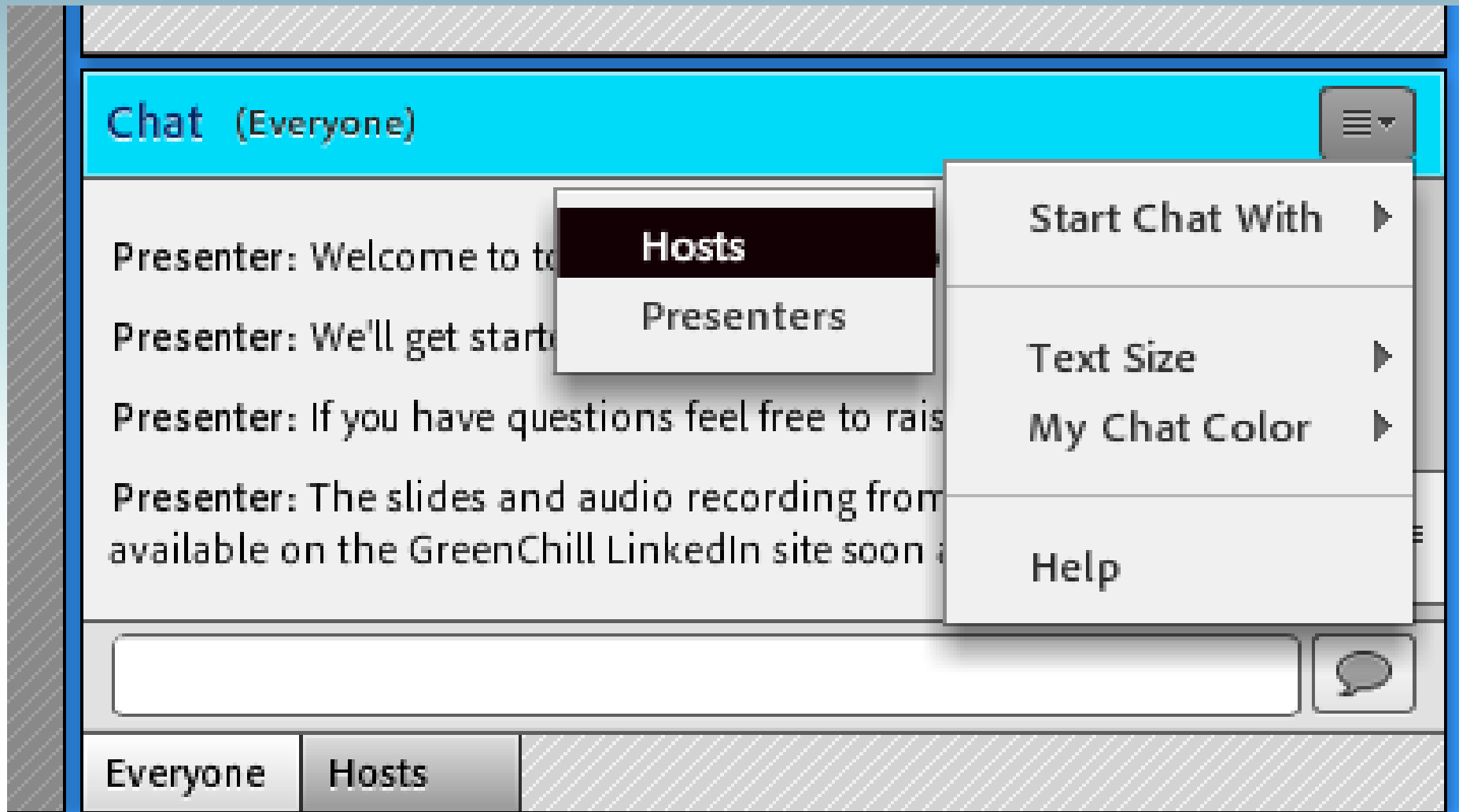


# Q & A

- ▶ Q&A session after presentation
- ▶ Submit your questions using CHAT at anytime; we'll go through them during Q&A
  - ▶ If you'd like to remain anonymous, send your question by CHAT to Keilly Witman instead of to all participants
- ▶ Raise your hand during Q&A (hand button is on the upper right part of the screen)



# Sending Questions via Chat



The image shows a chat window titled "Chat (Everyone)". The chat history contains four messages from a "Presenter":

- Presenter: Welcome to to
- Presenter: We'll get start
- Presenter: If you have questions feel free to rais
- Presenter: The slides and audio recording from

The last message is partially cut off and reads "available on the GreenChill LinkedIn site soon a".

A context menu is open over the chat area, with the following options:

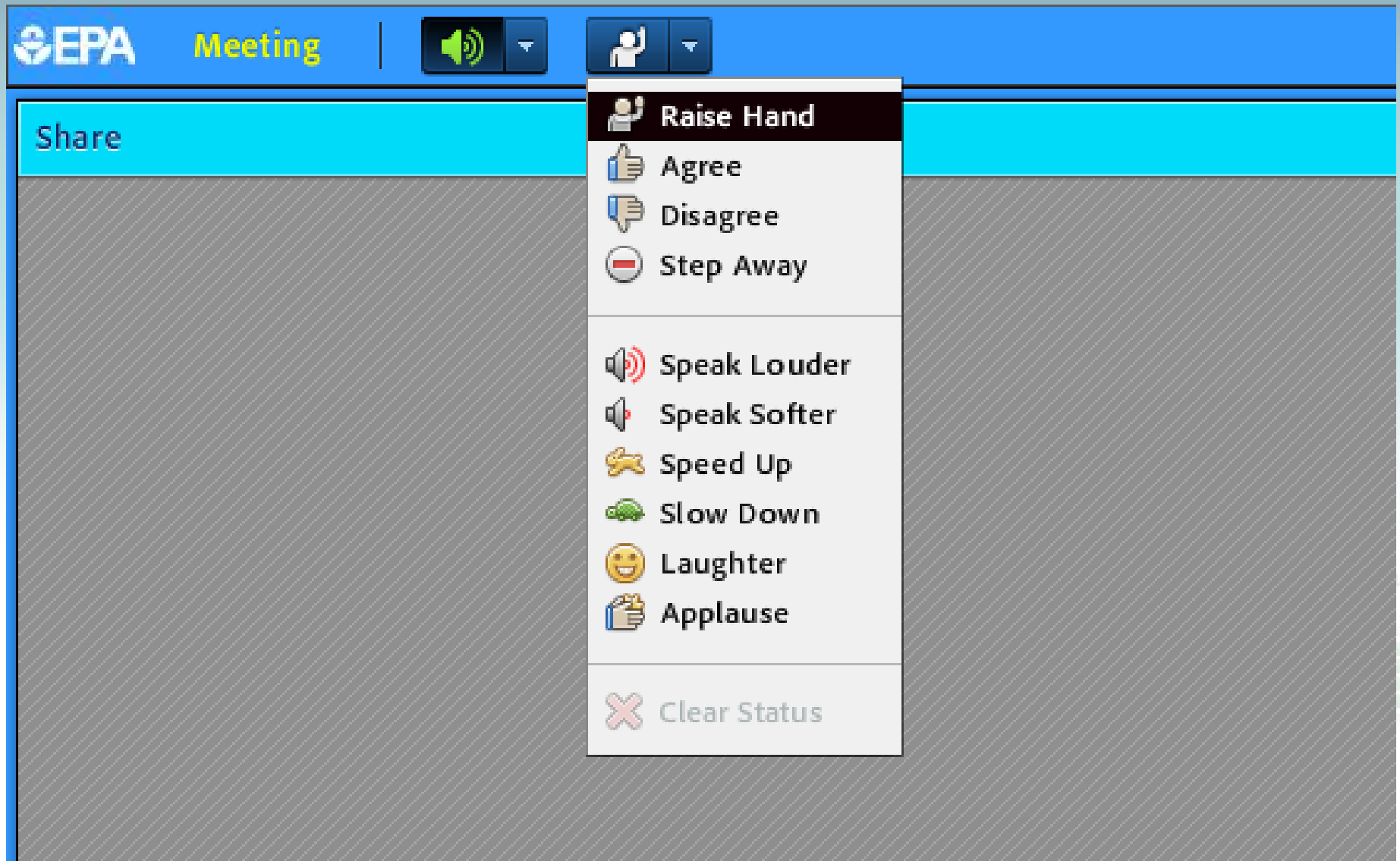
- Start Chat With
- Text Size
- My Chat Color
- Help

The "Hosts" option is highlighted in the menu. Below the chat area is a text input field and a speech bubble icon. At the bottom, there are two tabs: "Everyone" and "Hosts".

# Sending Questions via Chat

The screenshot displays a meeting interface with a blue header bar containing a 'Help' link. Below the header, a cyan bar indicates 'Attendees (3)'. The attendees list is organized into categories: 'Hosts (1)' with a dropdown arrow, 'Presenters (0)' with a right-pointing arrow, and 'Participants (2)' with a right-pointing arrow. The 'Hosts (1)' category is expanded, showing a list item for 'Kelly Witman' with a person icon. A dark grey button with a speech bubble icon and the text 'Start Private Chat' is positioned over the attendees list. At the bottom, a cyan bar indicates 'Chat (Everyone)' with a dropdown arrow. A faint watermark 'AGENCY PARTNERSHIP' is visible on the right side of the image.

# Raising Your Hand



# Please Note!

- ▶ GreenChill and EPA do not endorse products or companies.
- ▶ The information in the webinar is from the presenters. It is not verified by GreenChill or EPA.
- ▶ The opinions of the presenters are their own, and they do not represent GreenChill or EPA.
- ▶ We are not webinar-ing experts.





# Today's speakers...



# Rusty Walker – Hill PHOENIX Learning Center

Rusty Walker

Senior Corporate Trainer

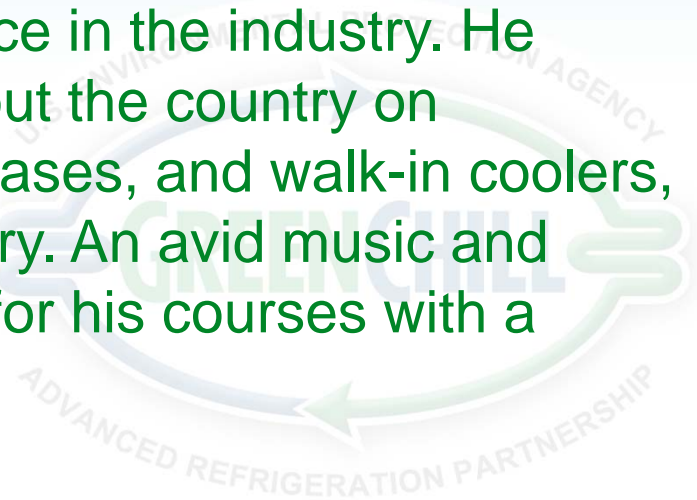
Hill PHOENIX Learning Center

Office: 678-209-1810

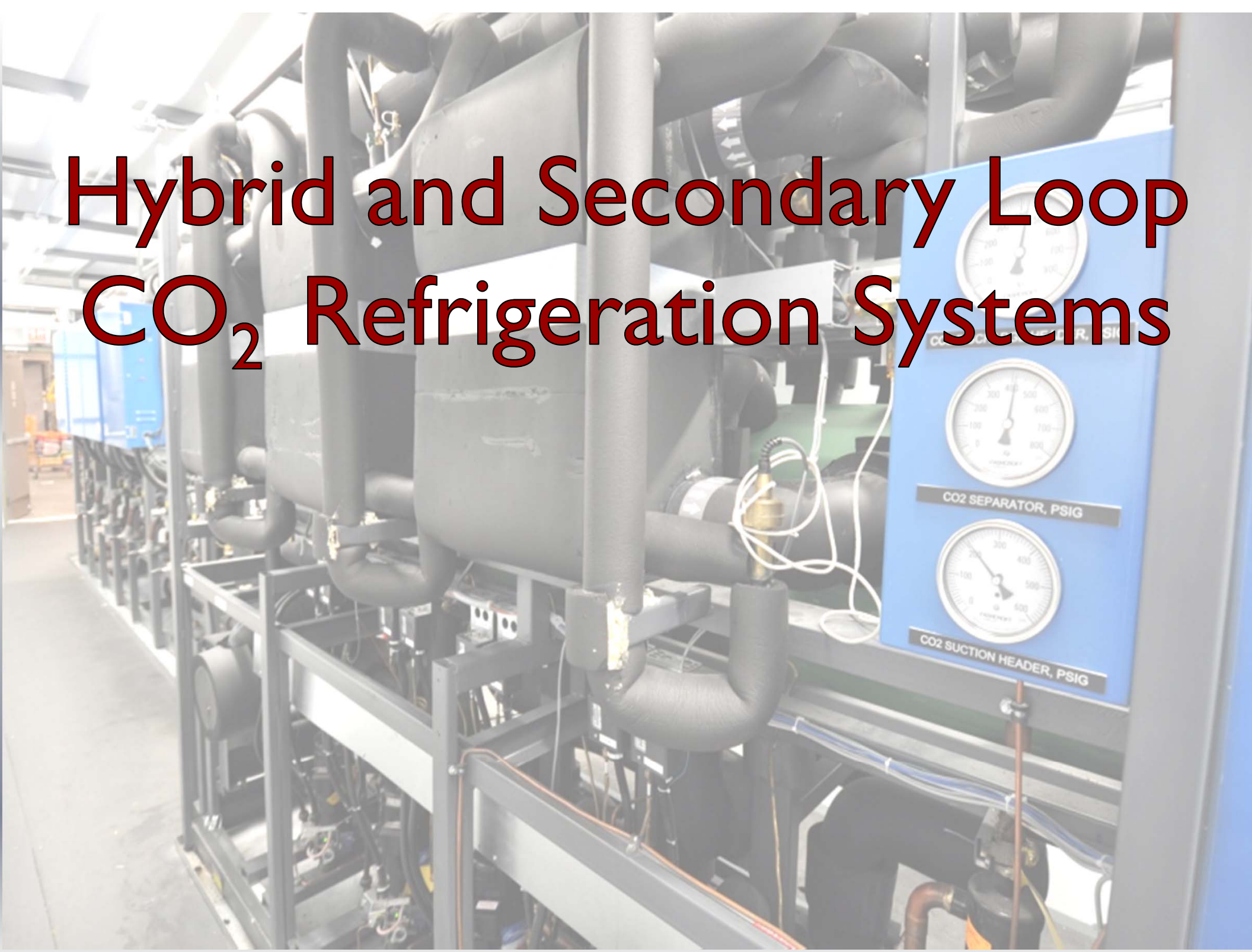
Email: [rusty.walker@hillphoenix.com](mailto:rusty.walker@hillphoenix.com)



**Rusty Walker** is a Senior Corporate Trainer with Hill PHOENIX Learning Center. He has more than 25 years of experience in the industry. He conducts many courses and seminars throughout the country on refrigeration systems, power systems, display cases, and walk-in coolers, and is well versed in most aspects of the industry. An avid music and baseball enthusiast, Rusty often sets the tone for his courses with a lively tune.



# Hybrid and Secondary Loop CO<sub>2</sub> Refrigeration Systems



# Useful Definitions

## Direct Expansion

A refrigeration system that includes a compressor, condenser, evaporator coil, and an expansion device

## Primary Refrigerant

A fluid used to lower the temperature of a secondary coolant (i.e. R-22, R-404a, R-507, R-410A, R-717, etc...)

## Secondary Coolant

(a.k.a Secondary Refrigerant, Secondary Fluid) A fluid used to transfer heat from a heat source (i.e. refrigerated space) to a primary refrigerant.

## Single-Phase Secondary Coolant

(a.k.a Secondary Refrigerant, Secondary Fluid) A fluid used to transfer heat from a heat source (i.e. refrigerated space) to a primary refrigerant.

## Two-Phase Secondary Coolant

a secondary fluid which absorbs heat by means of latent heat transfer resulting in a change in phase (i.e. carbon dioxide, ice-slurries)

# Useful Definitions

## Cascade System

A system having two (or more) refrigerant circuits, each with a compressor, condenser and evaporator, where the evaporator of one circuit cools the condenser of another circuit

## Upper Cascade

The refrigerant circuit in a cascade system that cools the condenser of the lower-cascade and transfers the heat to a heat sink, typically outdoor ambient

## Lower Cascade

The refrigerant circuit in a cascade system that removes heat from a refrigerated load and transfers the heat to the upper-cascade

# Subcritical vs. Transcritical

- **Subcritical** - CO<sub>2</sub> systems where the pressure of the CO<sub>2</sub> is maintained well below the critical pressure of 87<sup>0</sup>F / ~1055 psig
- Operating pressures for subcritical systems are slightly higher than those in conventional direct-expansion systems but are similar to those seen in air-conditioning applications using **R-410A**.
- **Transcritical** - CO<sub>2</sub> systems that are designed to operate at pressures above the critical pressure, above 1055 psig.

# Triple Point vs. Critical Point

- Triple Point
- Liquid CO<sub>2</sub> below 60PSIG changes to Dry Ice



- Critical Point
- 87°F = 1055 psig
- No longer able to distinguish between liquid and vapor.
- An undefined gas.
- Only found in a Transcritical system.

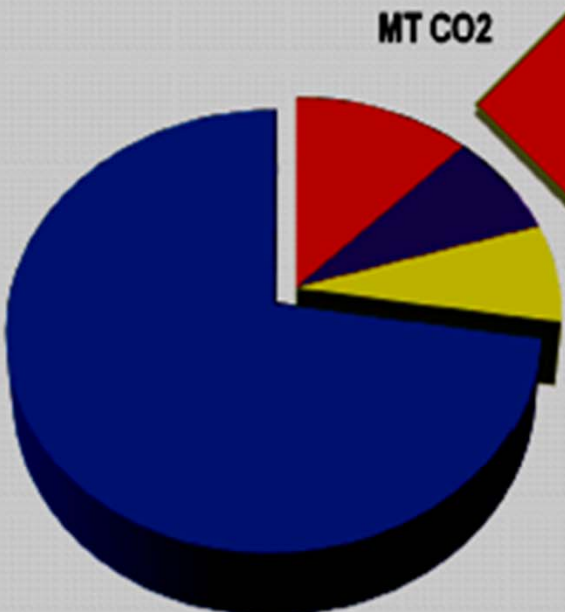
# Refrigerant Choices for Commercial Systems



= 28



One 100 pound cylinder of R-404A leaked to atmosphere equates to the tailpipe emissions of 28 - 4x4 Chevy Suburban's travelling 12,000 miles each!



Refrigerant Leaks are higher than transportation

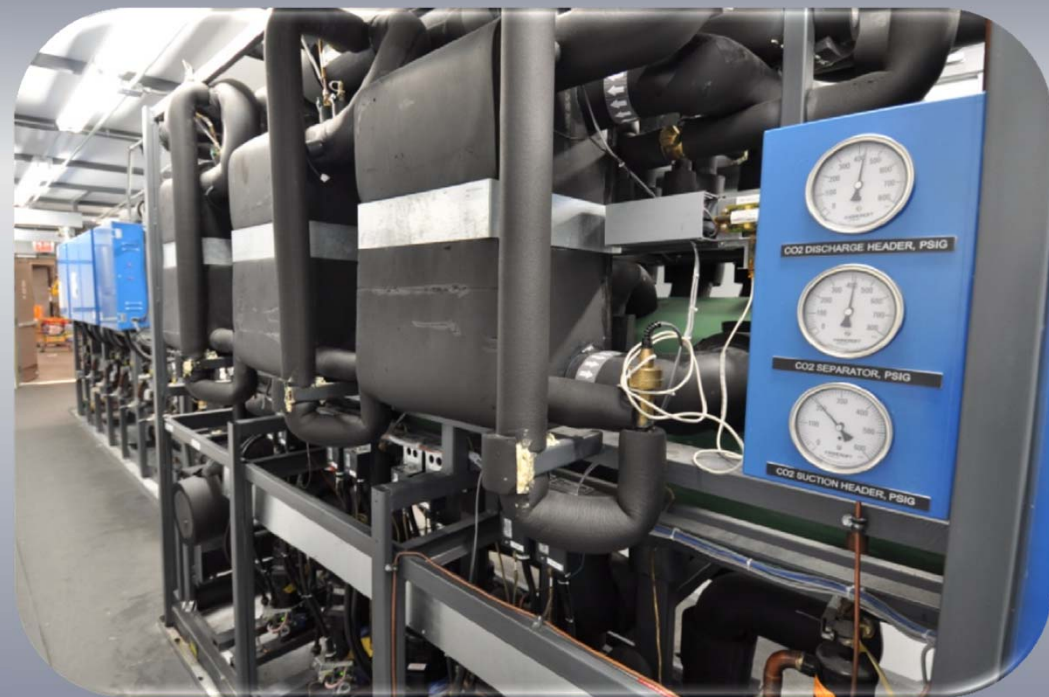
- Refrigerant Leaks
- On Site Combustion
- Transportation (Trucking, Autos, Air)
- Purchased Electric

A "Carbon Footprint" is the amount of carbon emitted from burning of fuels + the carbon equivalent (calculation) of refrigerant leaks



**Carbon Dioxide** is used as a secondary coolant or a Direct Expansion Refrigerant

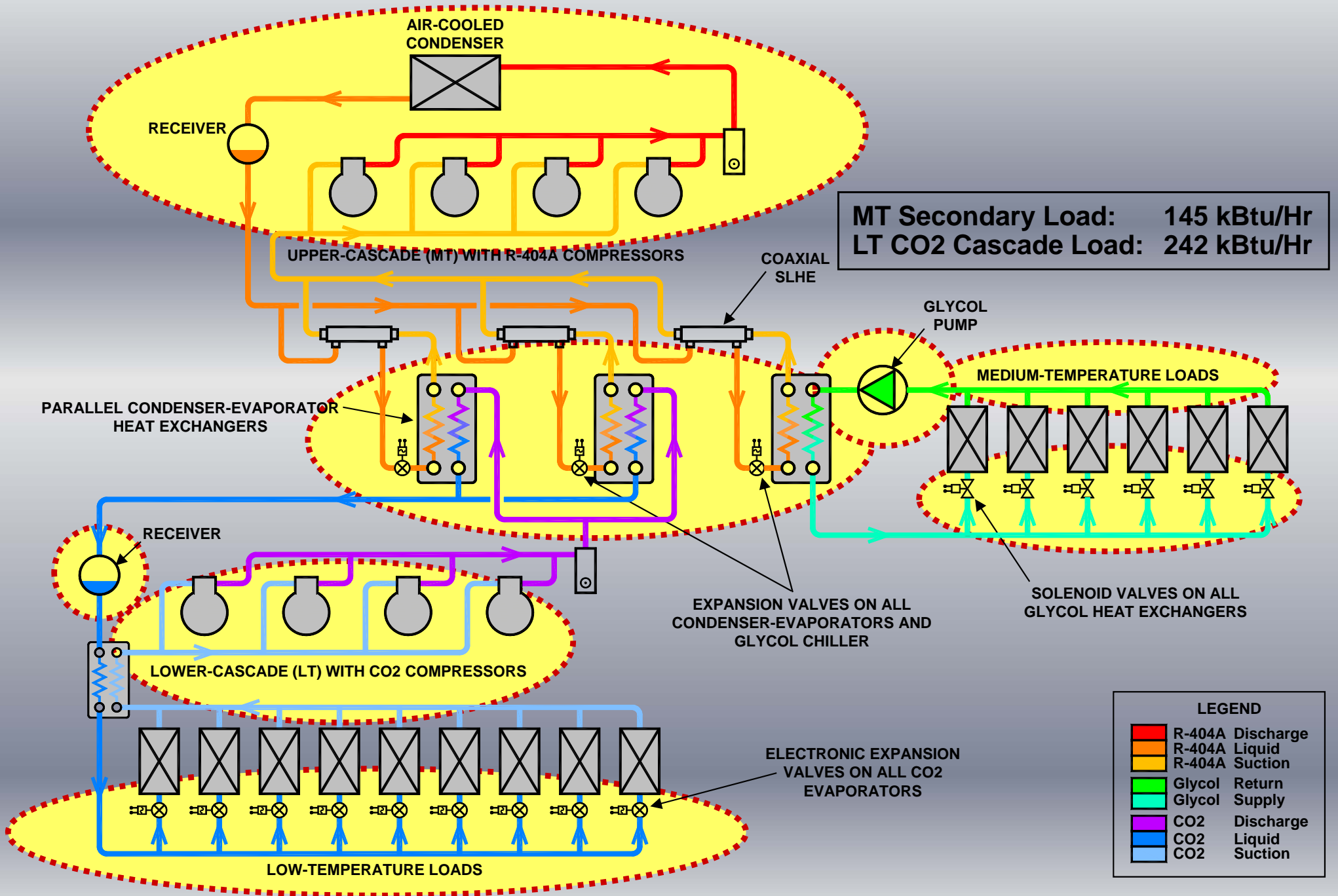
**Carbon Dioxide = CO<sub>2</sub> = R-744**



# Types of CO<sub>2</sub> Systems

- Cascade Low Temp CO<sub>2</sub> & Medium Temp Glycol
- Secondary Low Temp CO<sub>2</sub> & Modular Medium Temp Glycol
- Cascade Low Temp CO<sub>2</sub> & Secondary Medium Temp CO<sub>2</sub>

# Med Temp Glycol /CO2 Low Temp Cascade

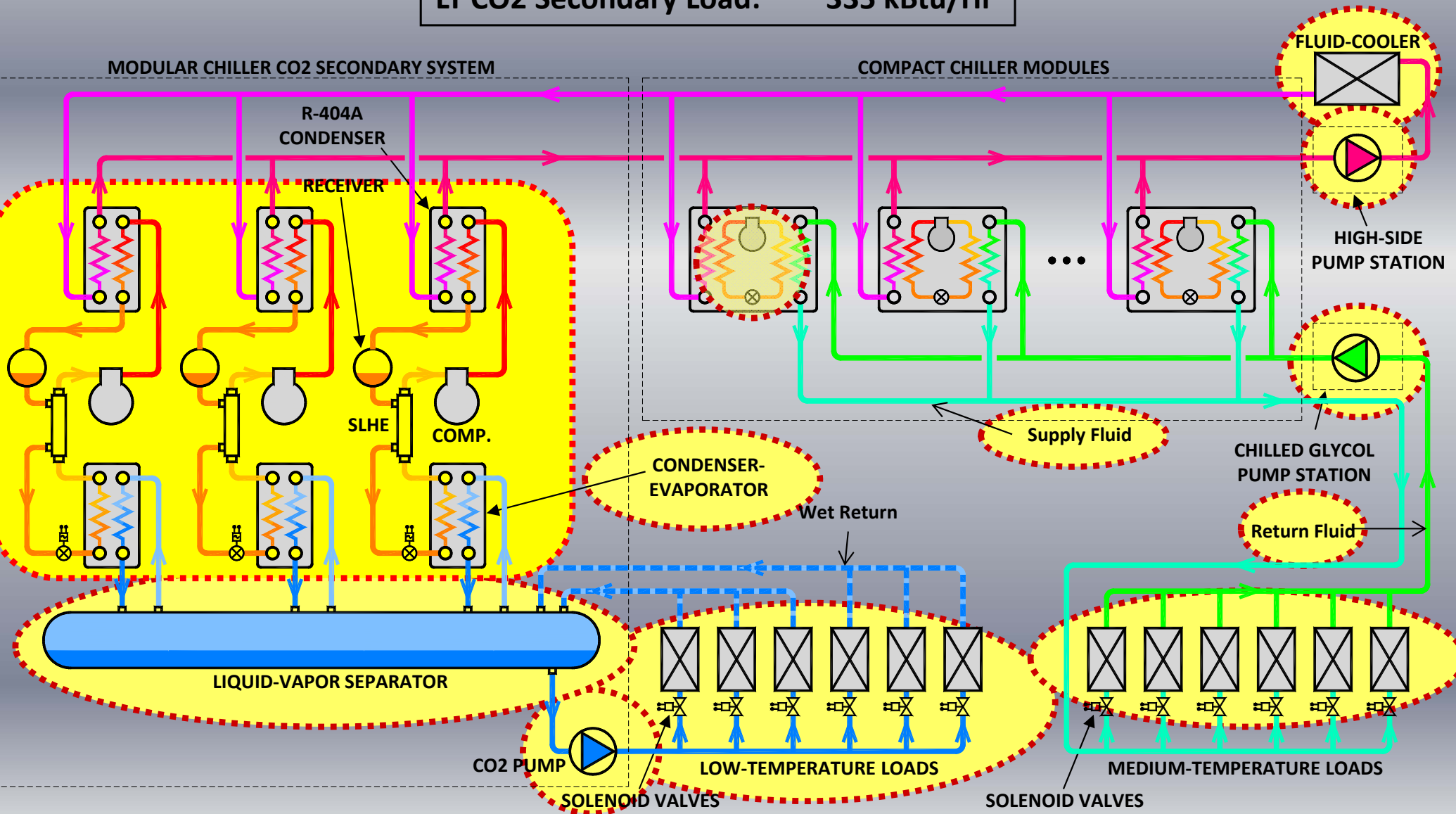


# Combined Medium Temperature Modular Glycol Secondary Low Temperature CO2

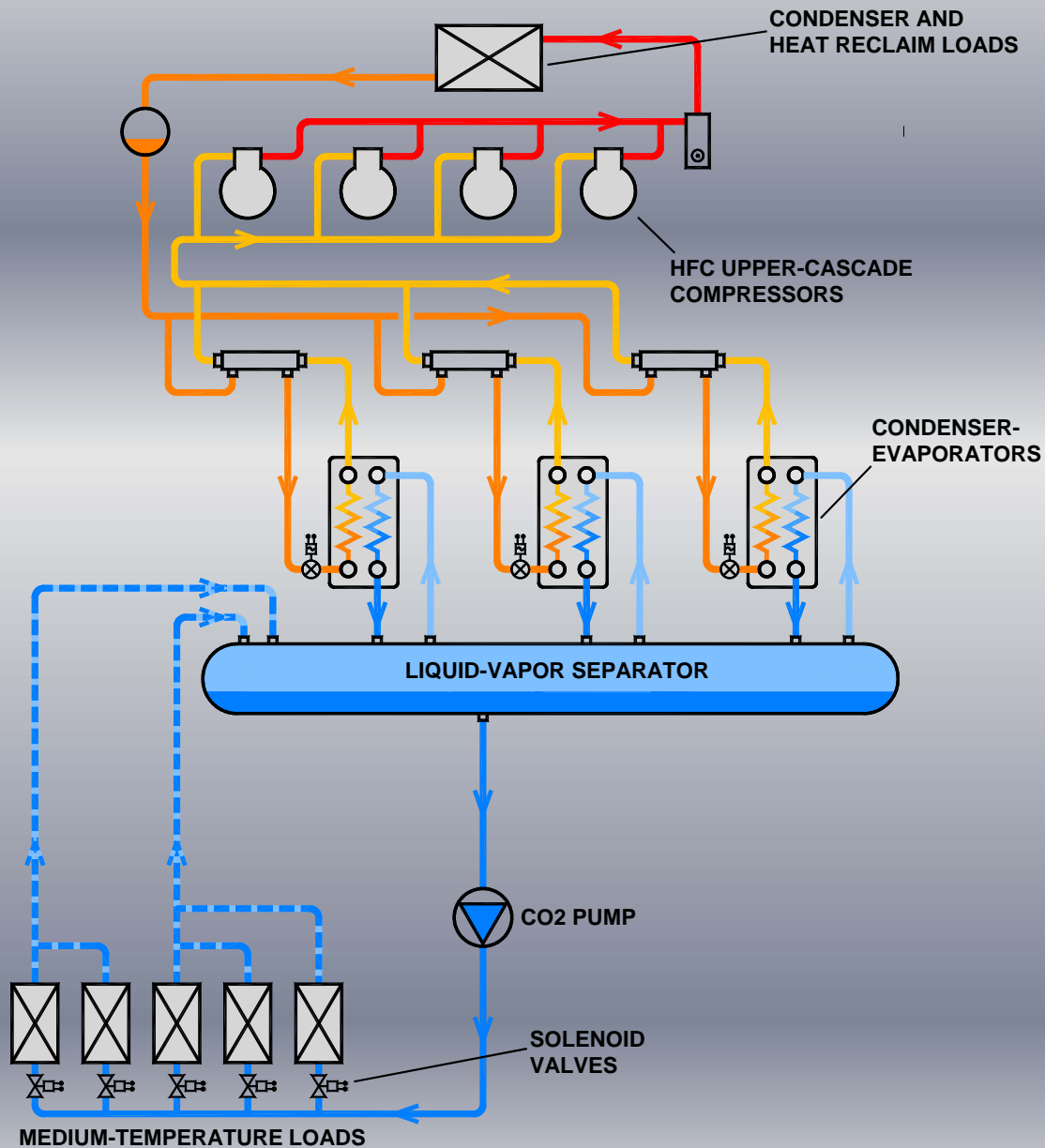
MT Glycol Secondary Load: 860 kBtu/Hr  
LT CO2 Secondary Load: 335 kBtu/Hr

MODULAR CHILLER CO2 SECONDARY SYSTEM

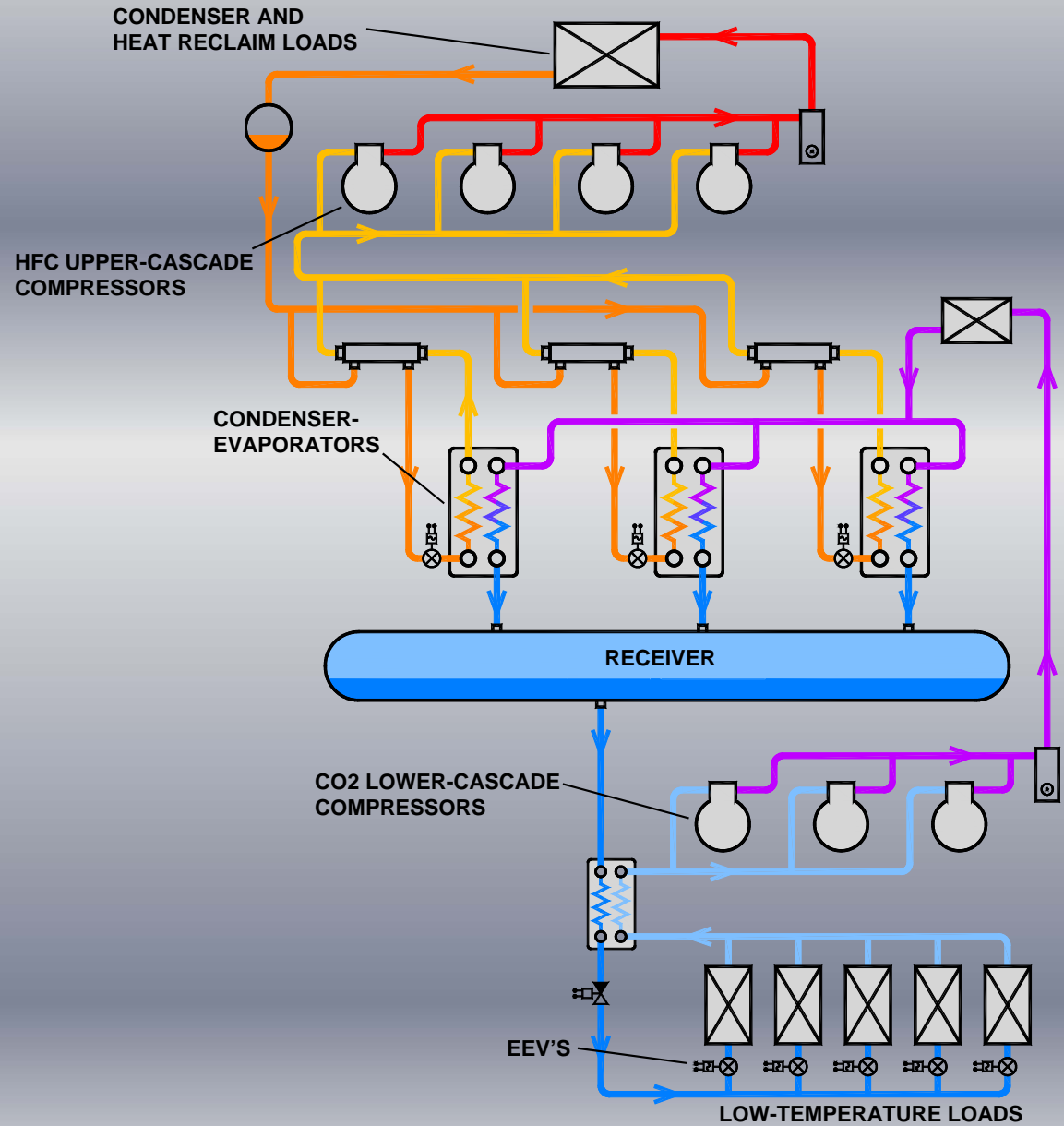
COMPACT CHILLER MODULES



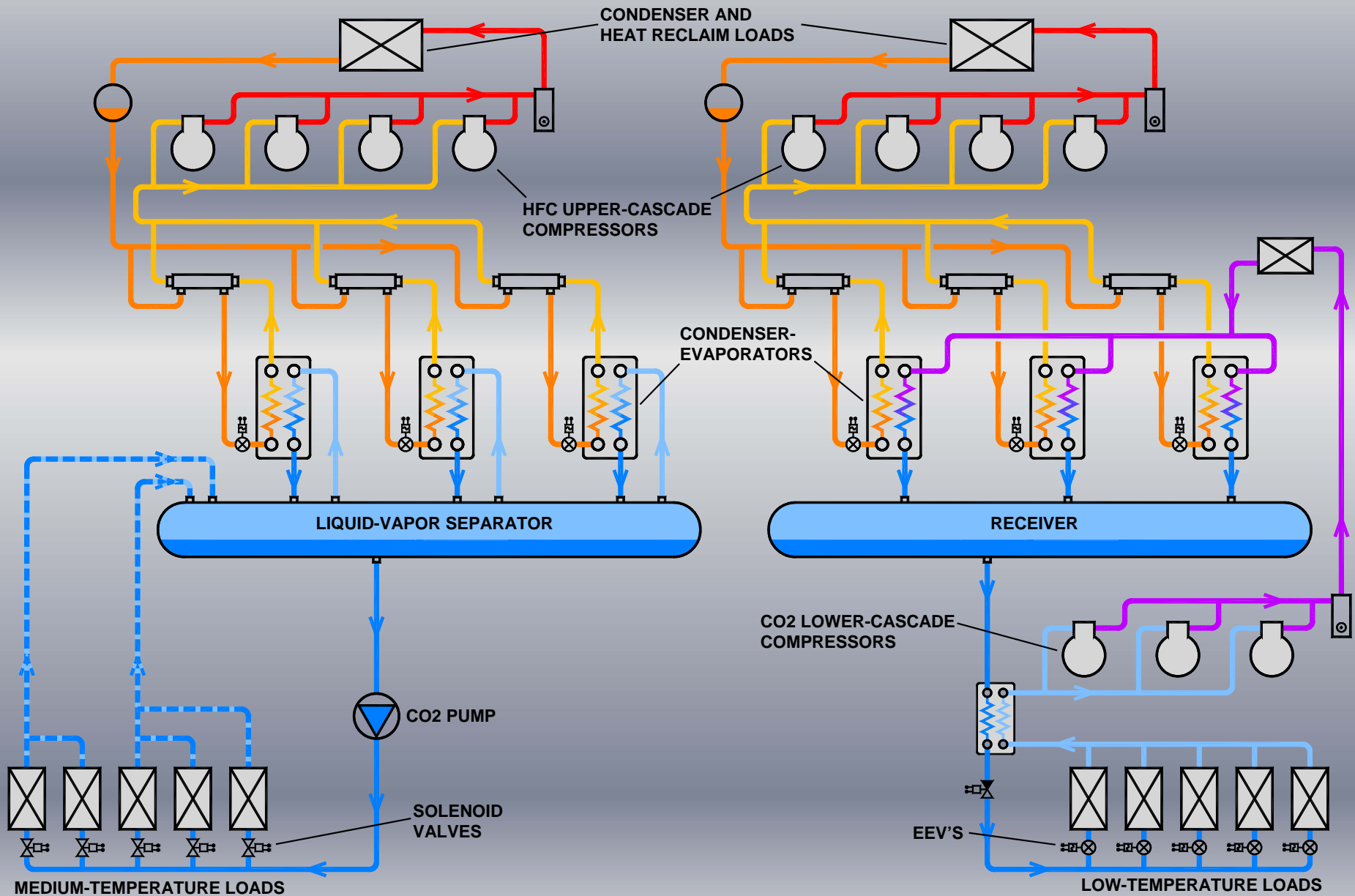
# Secondary Medium Temperature CO2



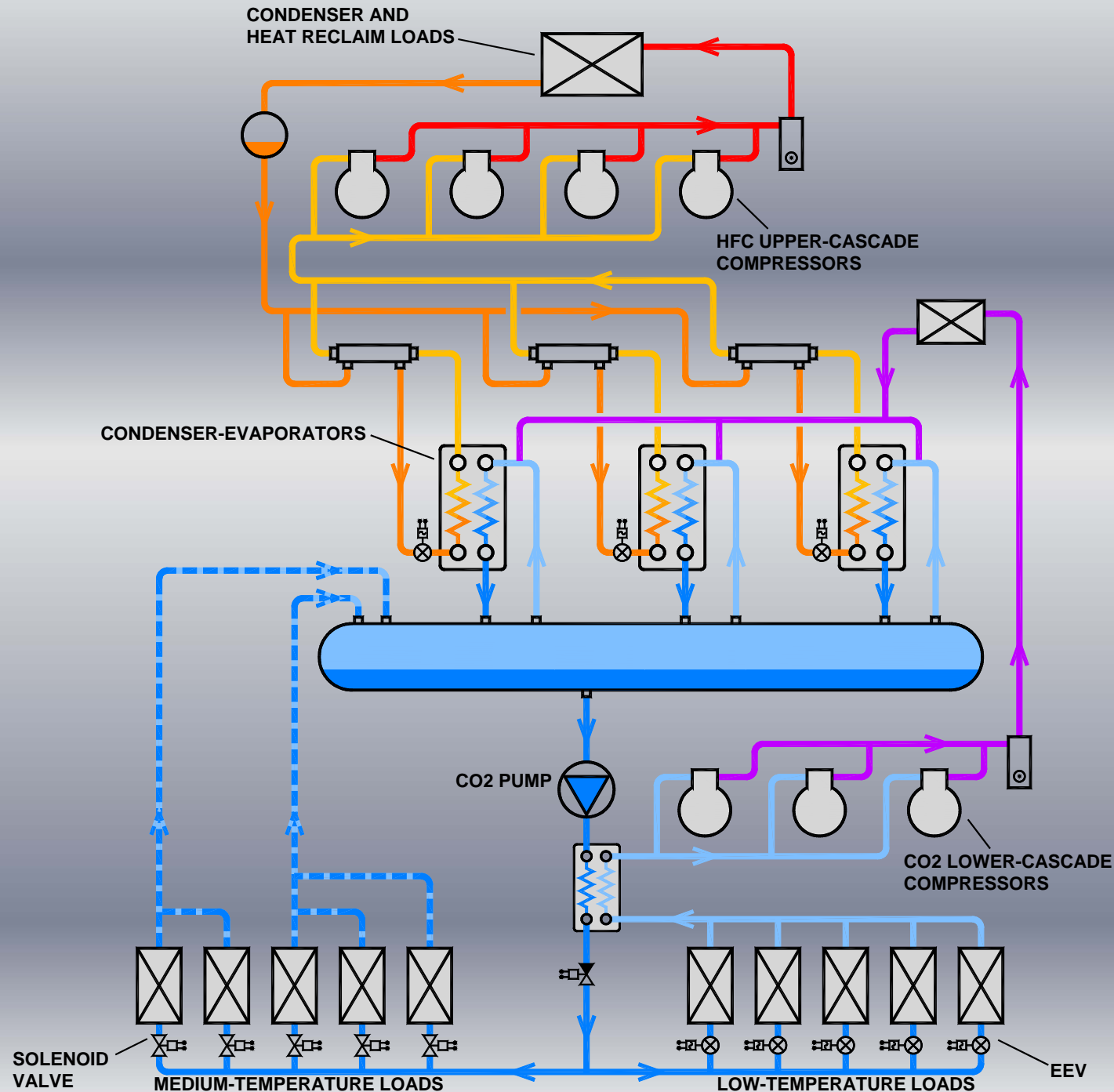
# Cascade Low Temperature CO2



# Cascade Low Temperature CO2 Secondary Medium Temperature CO2

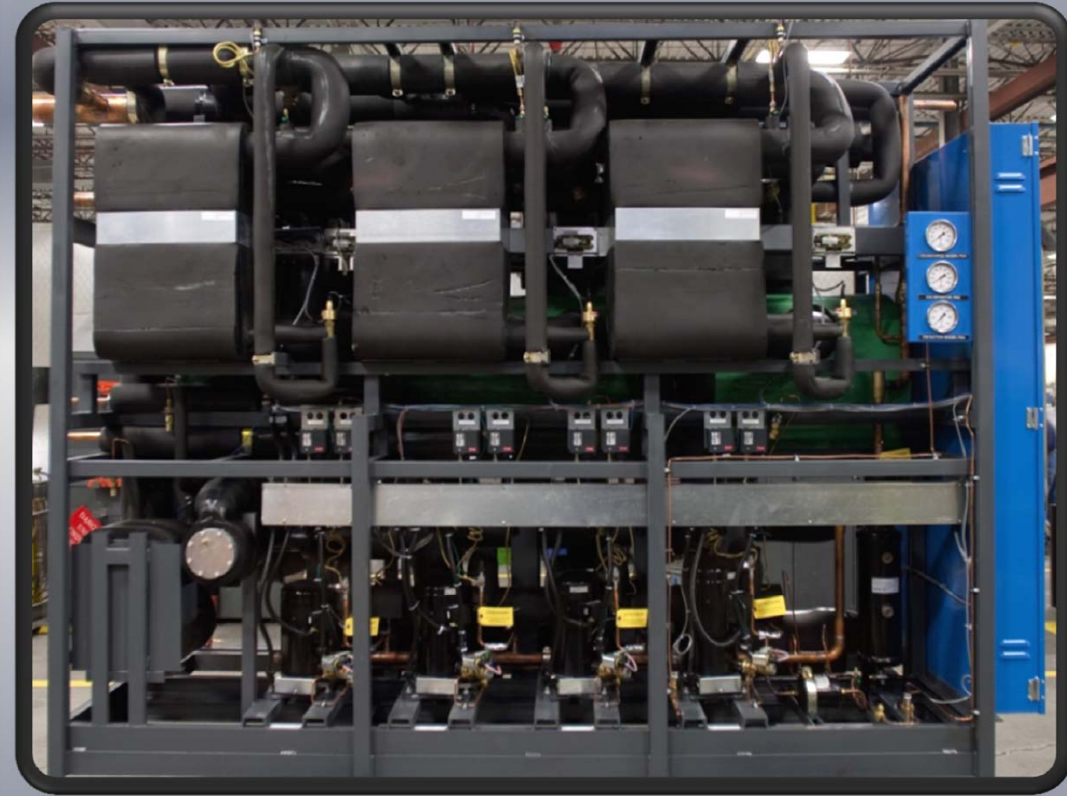


# Combined System Low and Medium Temp CO2





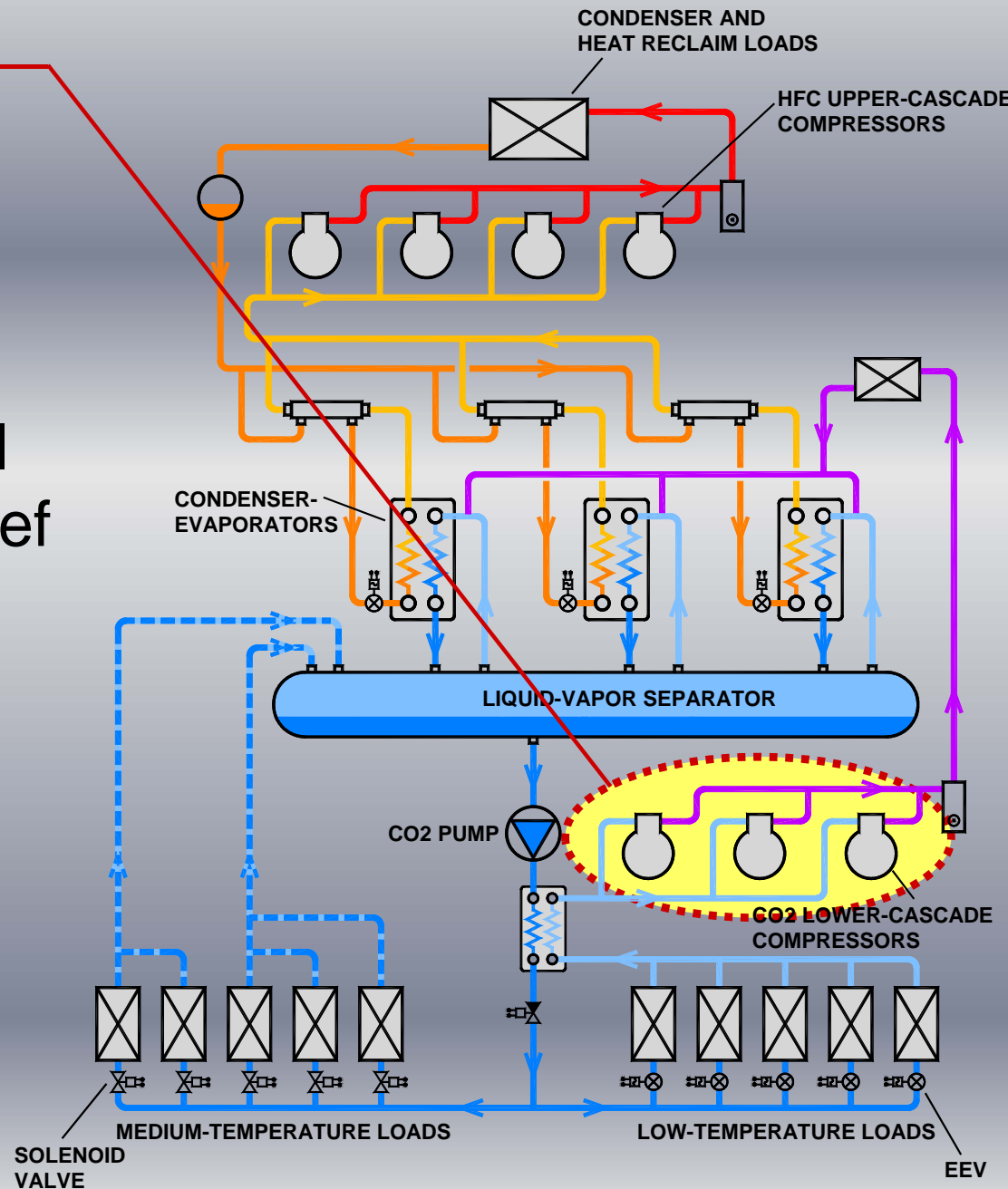
# Combined System Low and Medium Temp CO2



# Major Components and Functions

## CO2 Compressors:

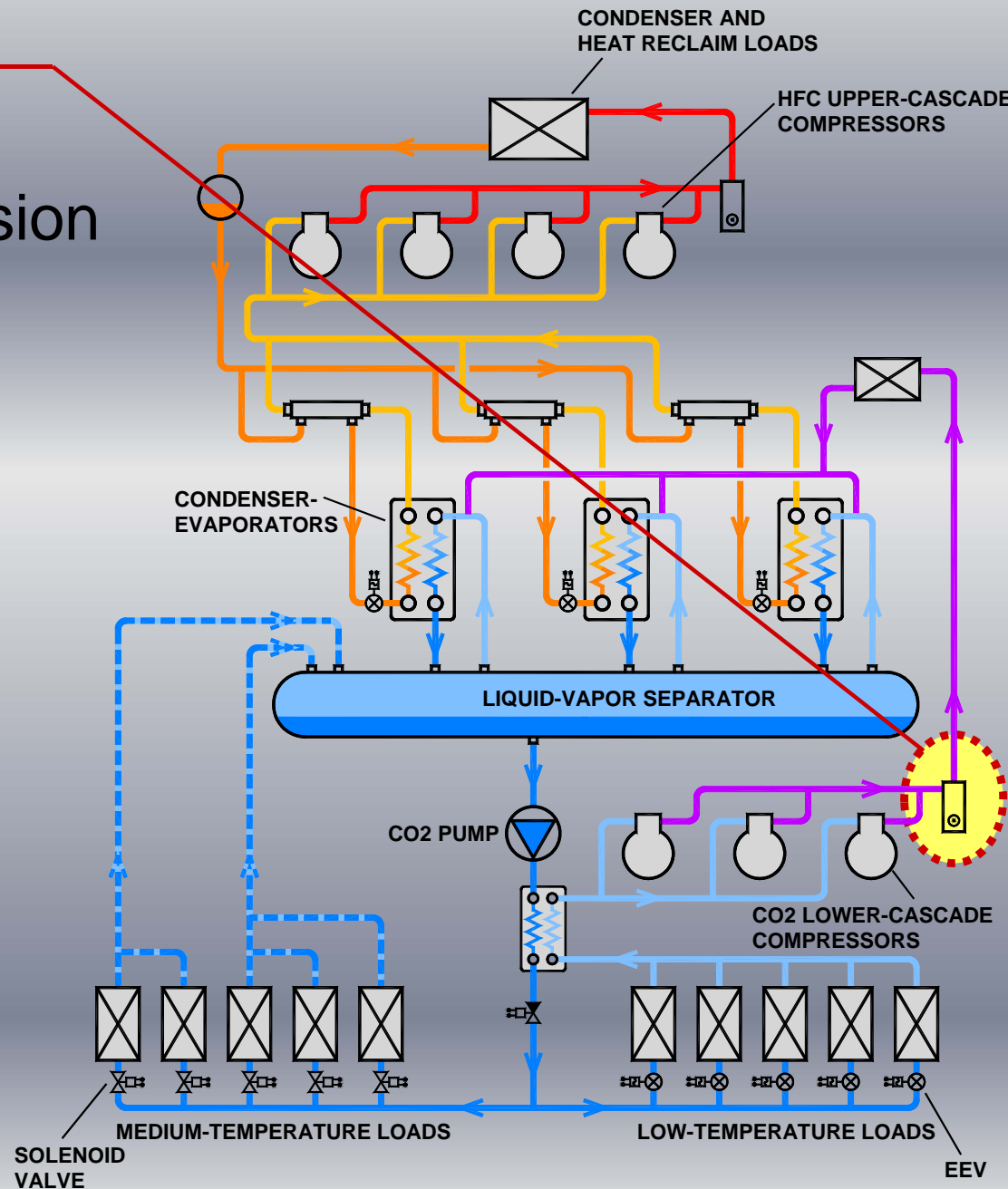
- Typical 3-5 Units in Parallel
- Types Available:
  - Reciprocating
  - Scroll
- Contain High-to-Low Internal Relief and External Low Relief
- Work with POE Oil
- Accessories:
  - Electronic Oil Float
  - High Pressure Switch
  - Low Pressure Switch
- Capacity Control:
  - VS on Reciprocating (no unloading available)
  - Digital Scroll in future



# Major Components and Functions

## Oil Separator:

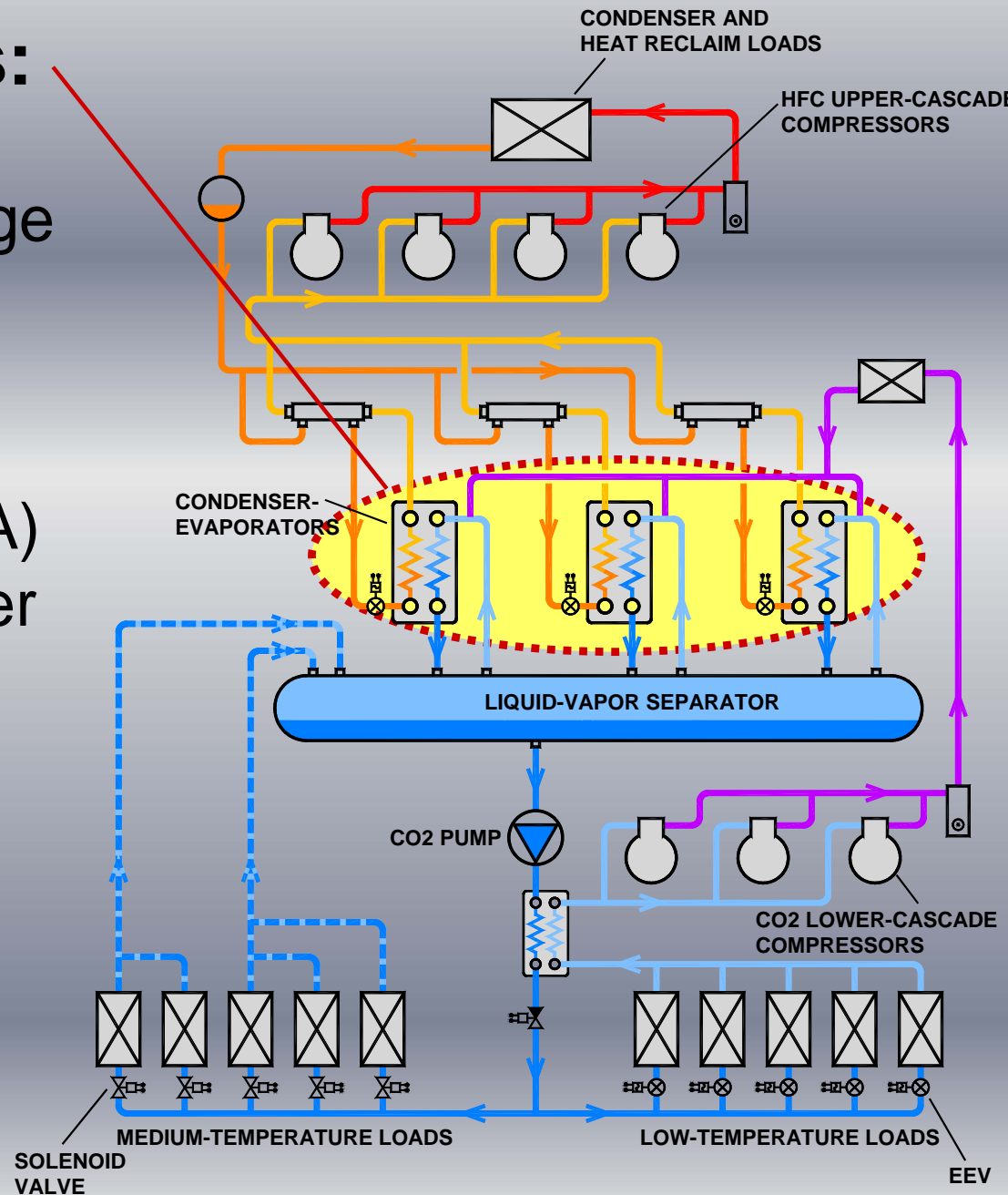
- Removes Most of the Oil Carried Over from Compression
- Accessories:
  - Oil Filter
  - Sight Glass



# Major Components and Functions

## Condenser-Evaporators:

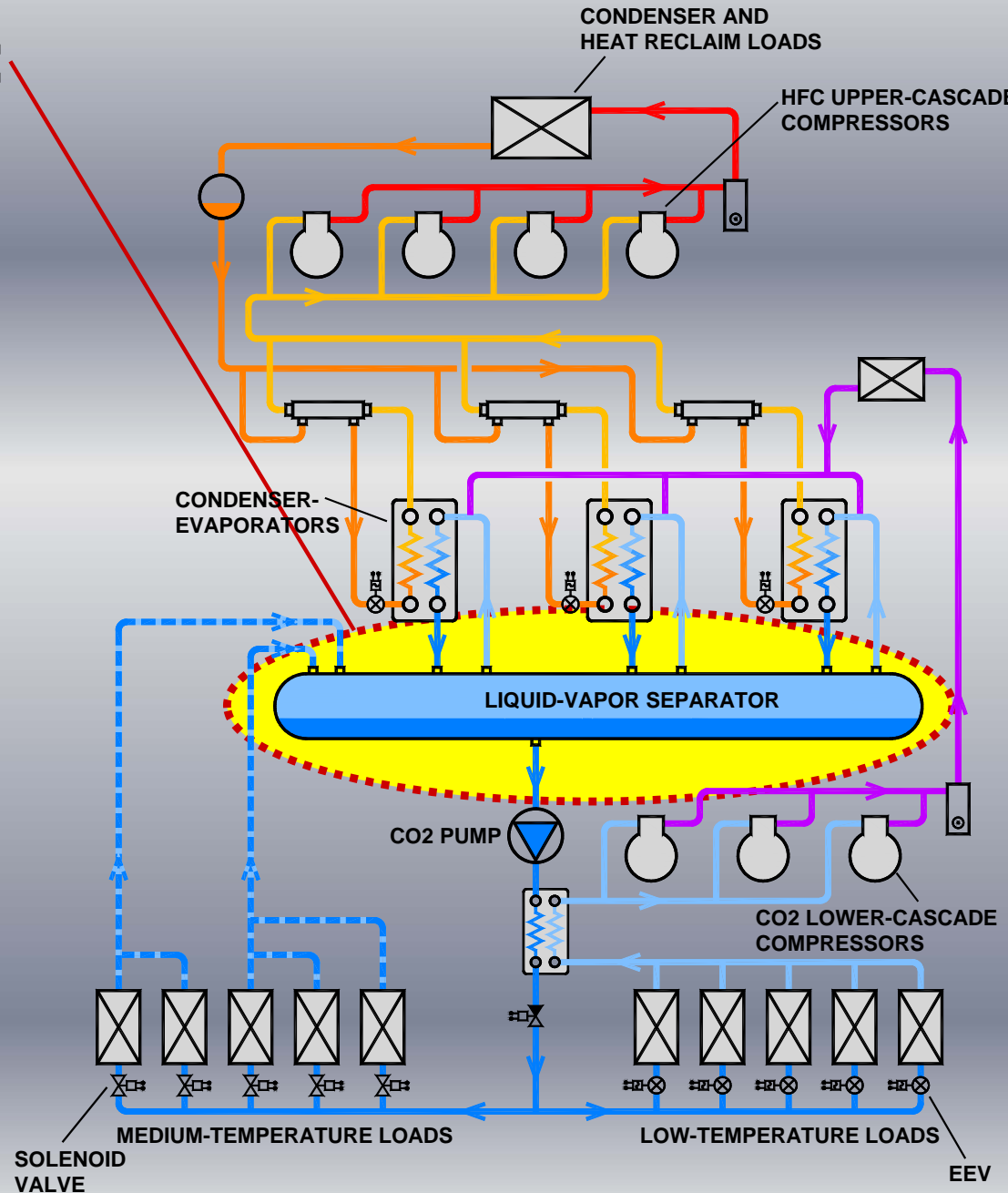
- Condense Vapor from Separator and CO2 Discharge Gas from Compressors into Liquid
- Evaporates Primary HFC Refrigerant (R-404A, R-407A)
- Brazen Plate Heat Exchanger



# Major Components and Functions

## Liquid-Vapor Separator:

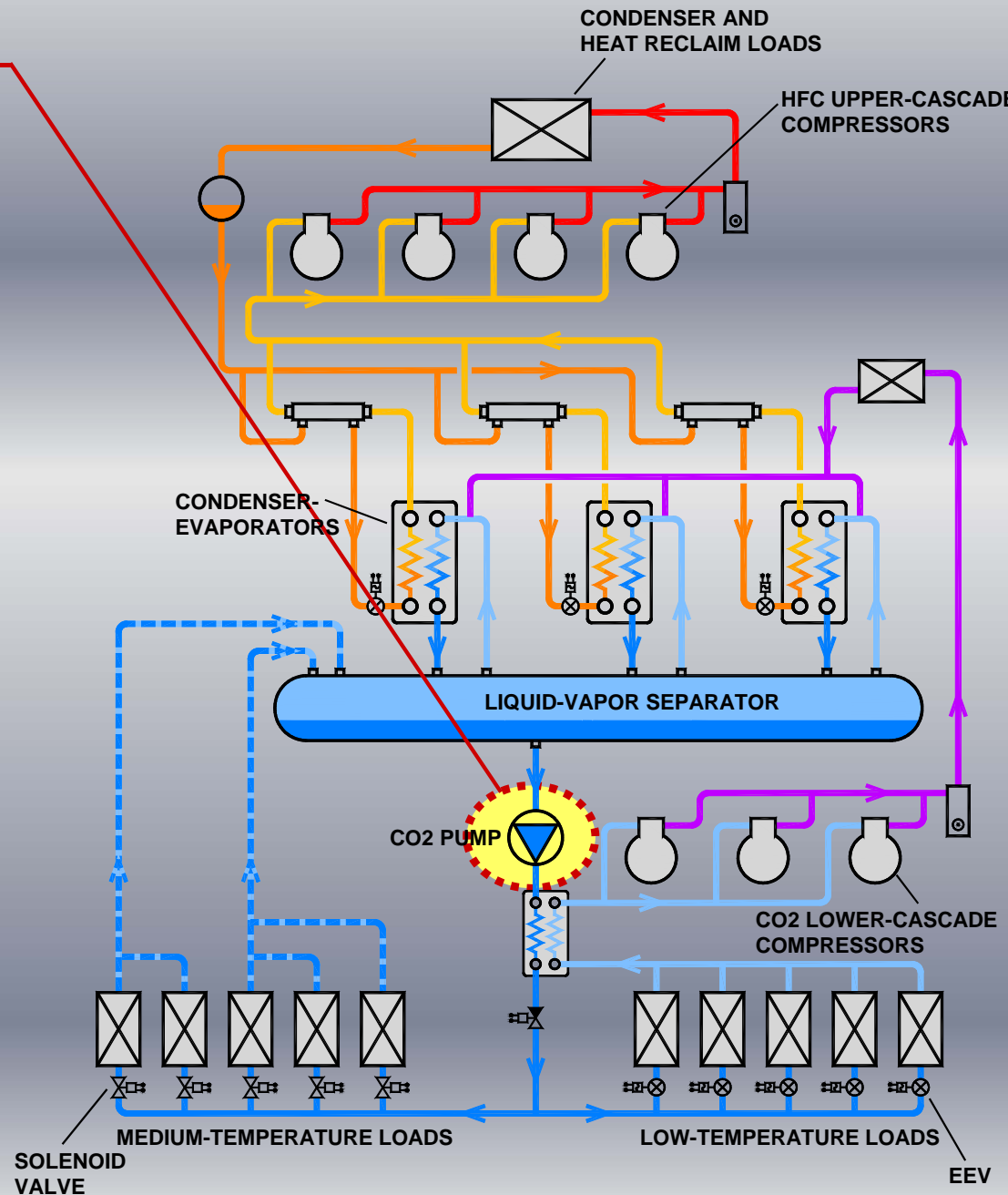
- Holds CO2 Charge
- Compensates for Level Fluctuations during Defrost
- ASME approved Vessel



# Major Components and Functions

## CO2 Pumps:

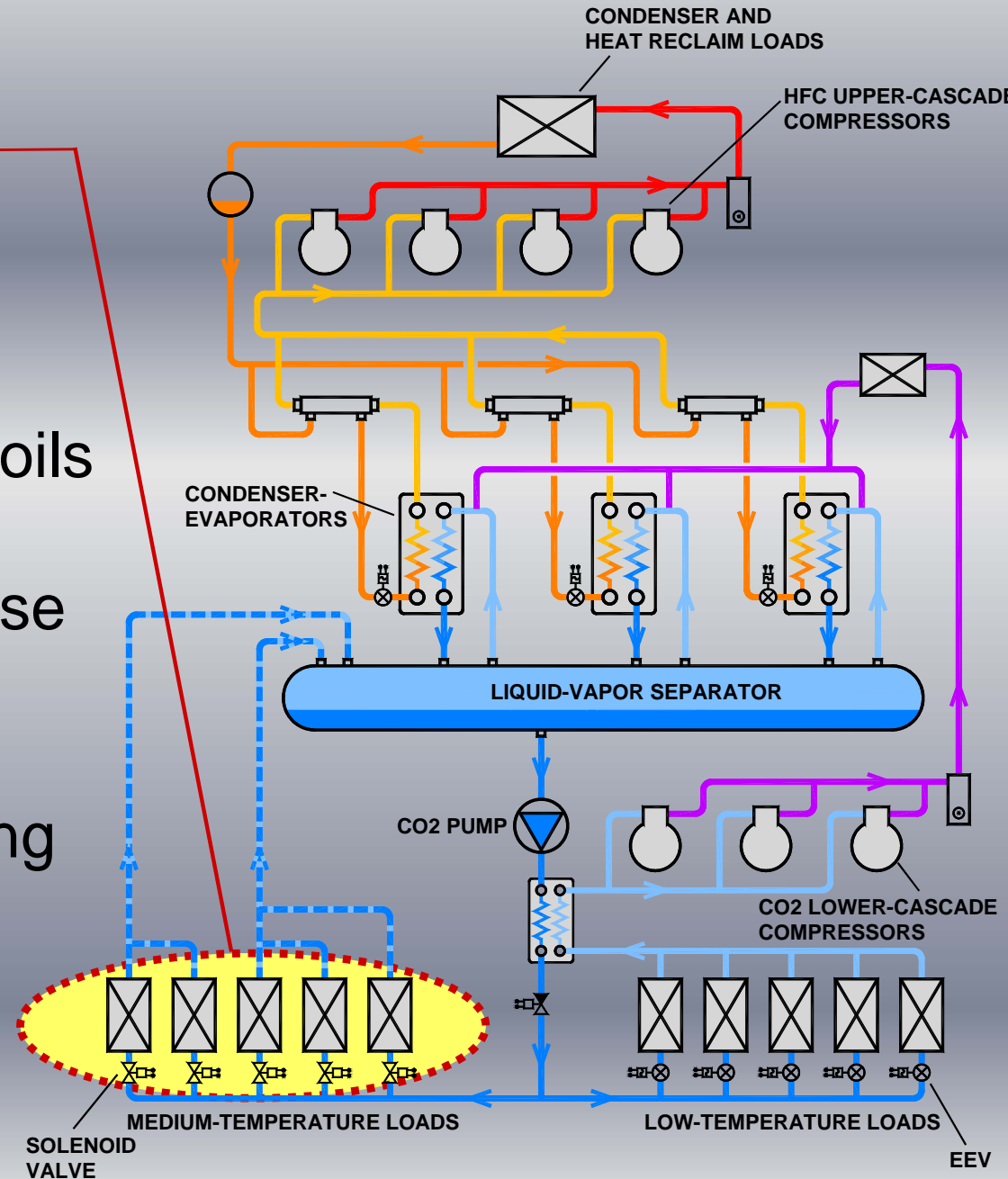
- Pressurize Liquid CO2 for delivery to MT and LT evaporators
- Primary and Backup
- Hermetic, multi-stage centrifugal pump with liquid-cooled motor



# Major Components and Functions

## Medium-Temperature Evaporators:

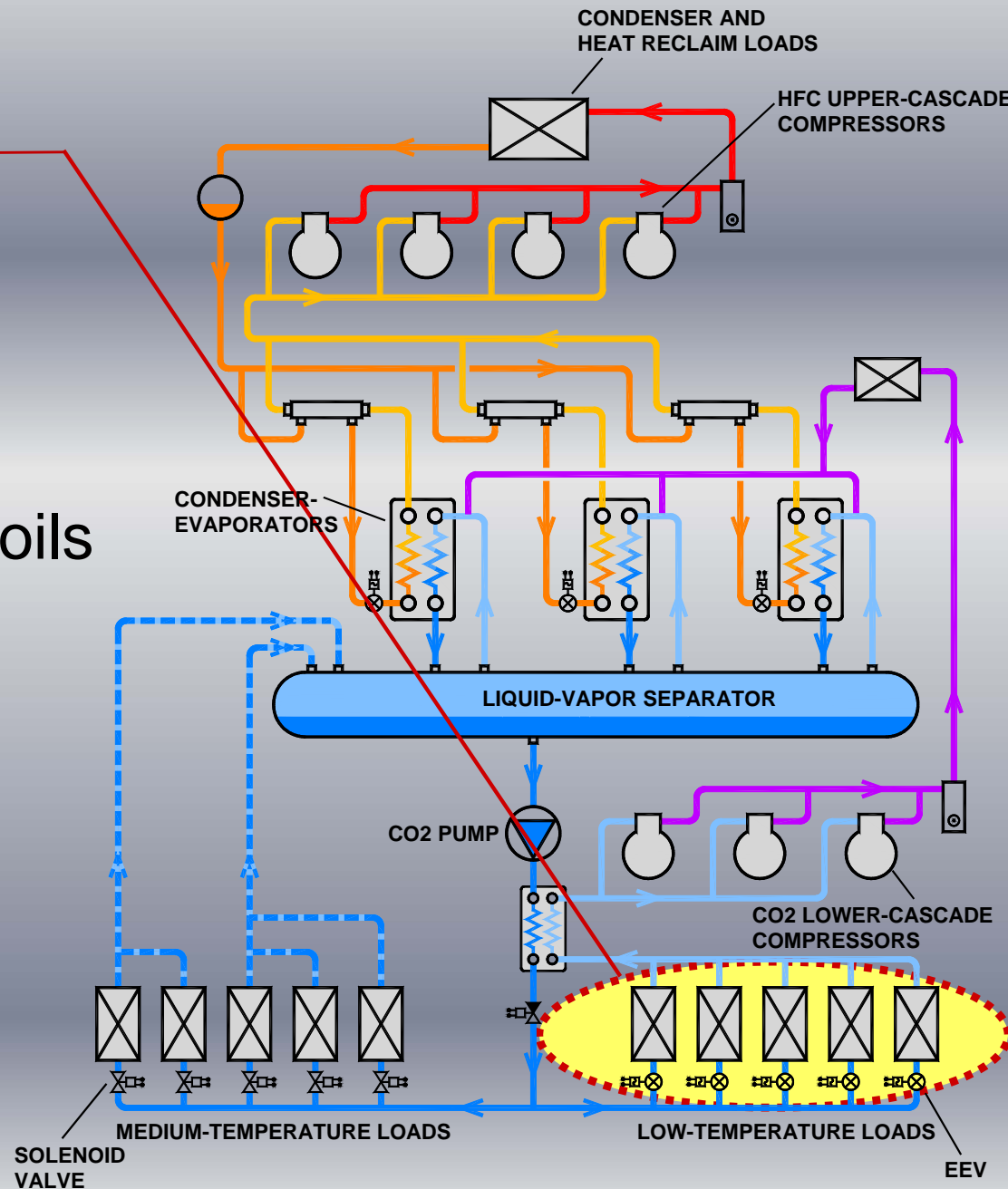
- Specially designed for CO<sub>2</sub>
- Liquid enters coils and is partially evaporated
- Two-phase mixture leaves coils
- Solenoid valve control
- Individual control of each case
- Off-Time Defrost
- Isolation/Balance Valve if needed during commissioning



# Major Components and Functions

## Low-Temperature Evaporators:

- Specially designed for CO<sub>2</sub>
- Liquid enters Electronic Expansion Valve at coil inlet
- CO<sub>2</sub> is fully evaporated with superheated vapor leaving coils
- Dual-Temp Control on some cases
- Electric Defrost with Coil Temperature Probe for Termination

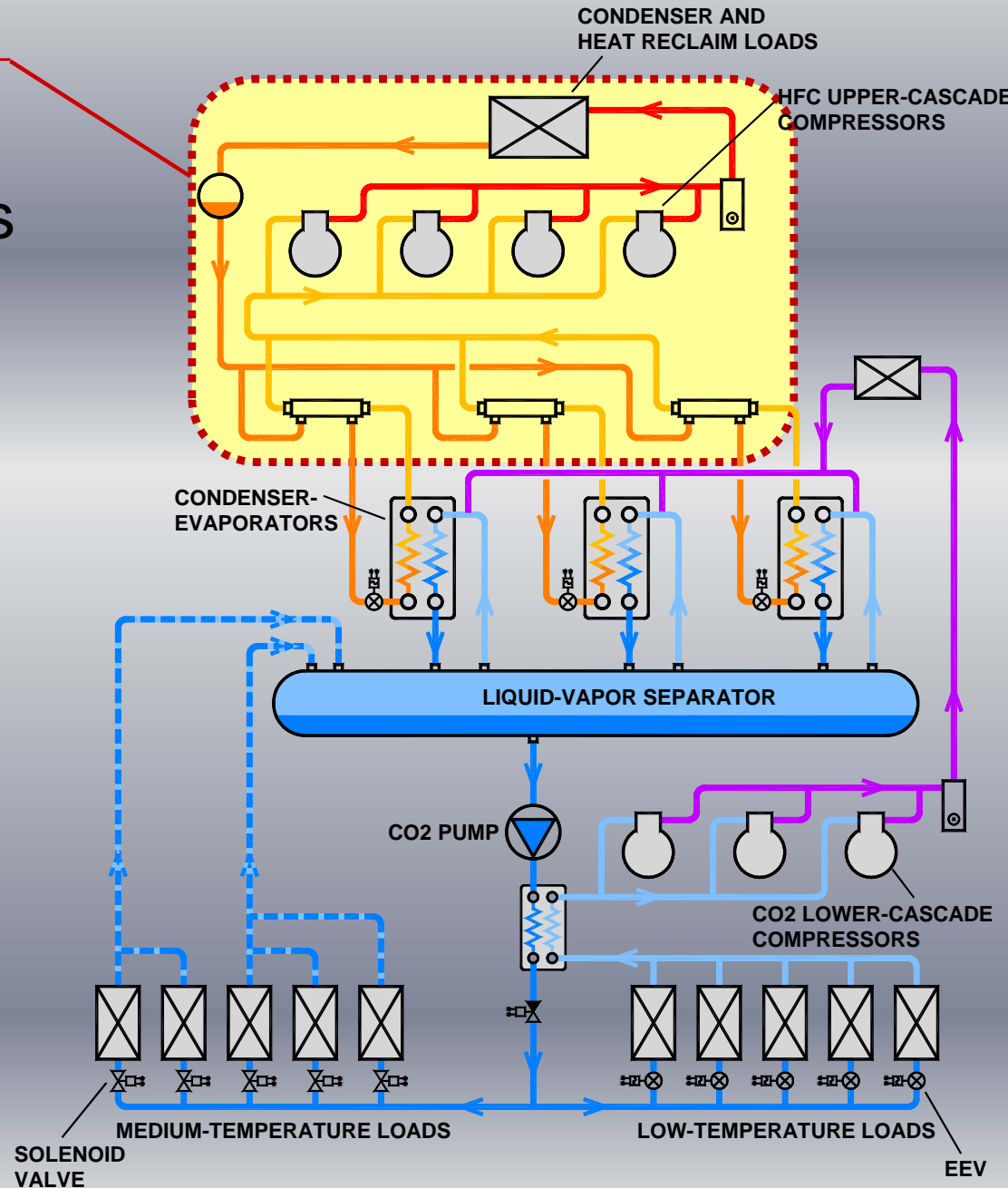


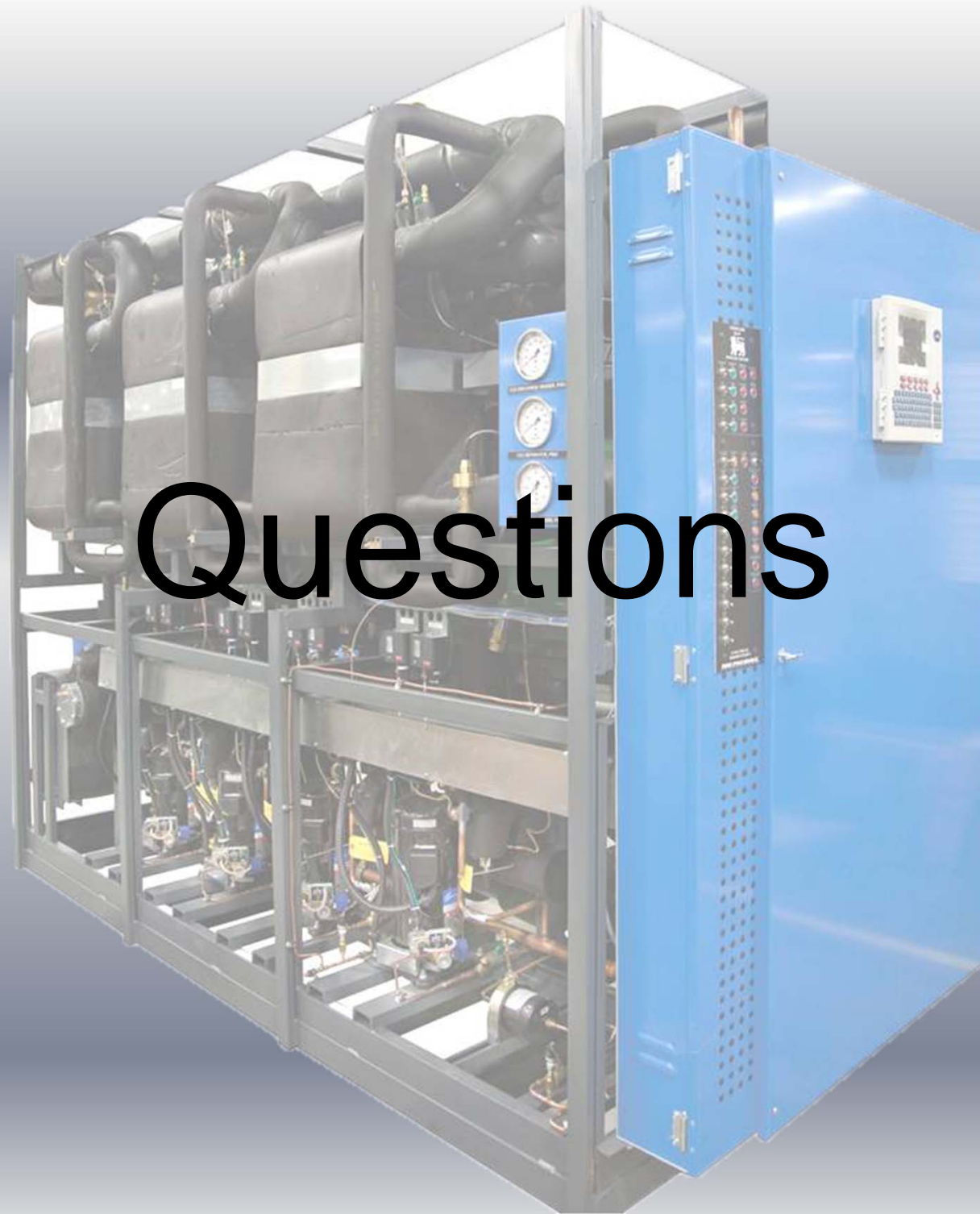


# Major Components and Functions

## Upper-Cascade:

- Refrigerates Condenser-Evaporator Heat Exchangers
- Transfers heat to Ambient
- Typical HFC System





Questions