# RCx 101

## A Technical Introduction to Existing Building Commissioning

## Central Plant Support

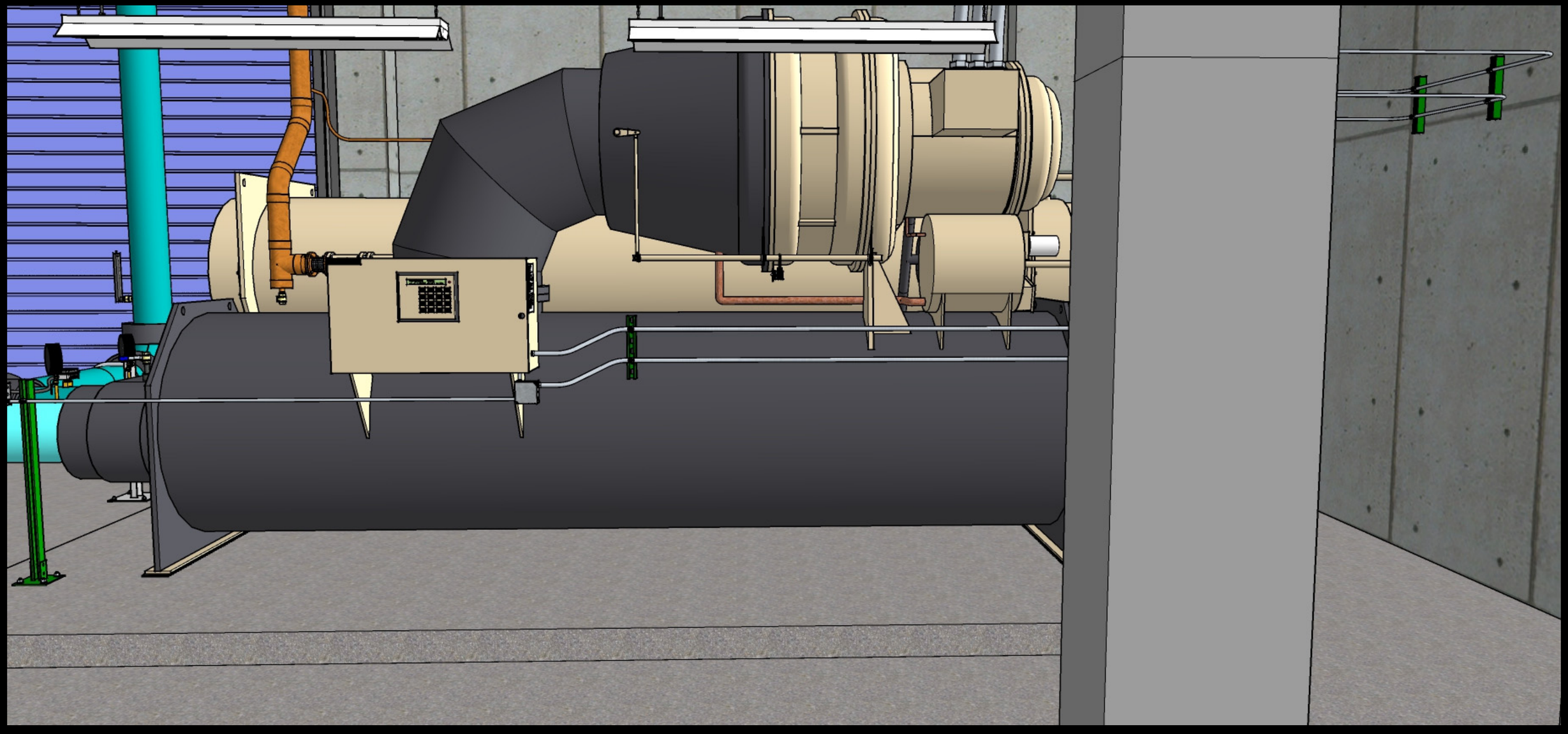
**Instructor:**

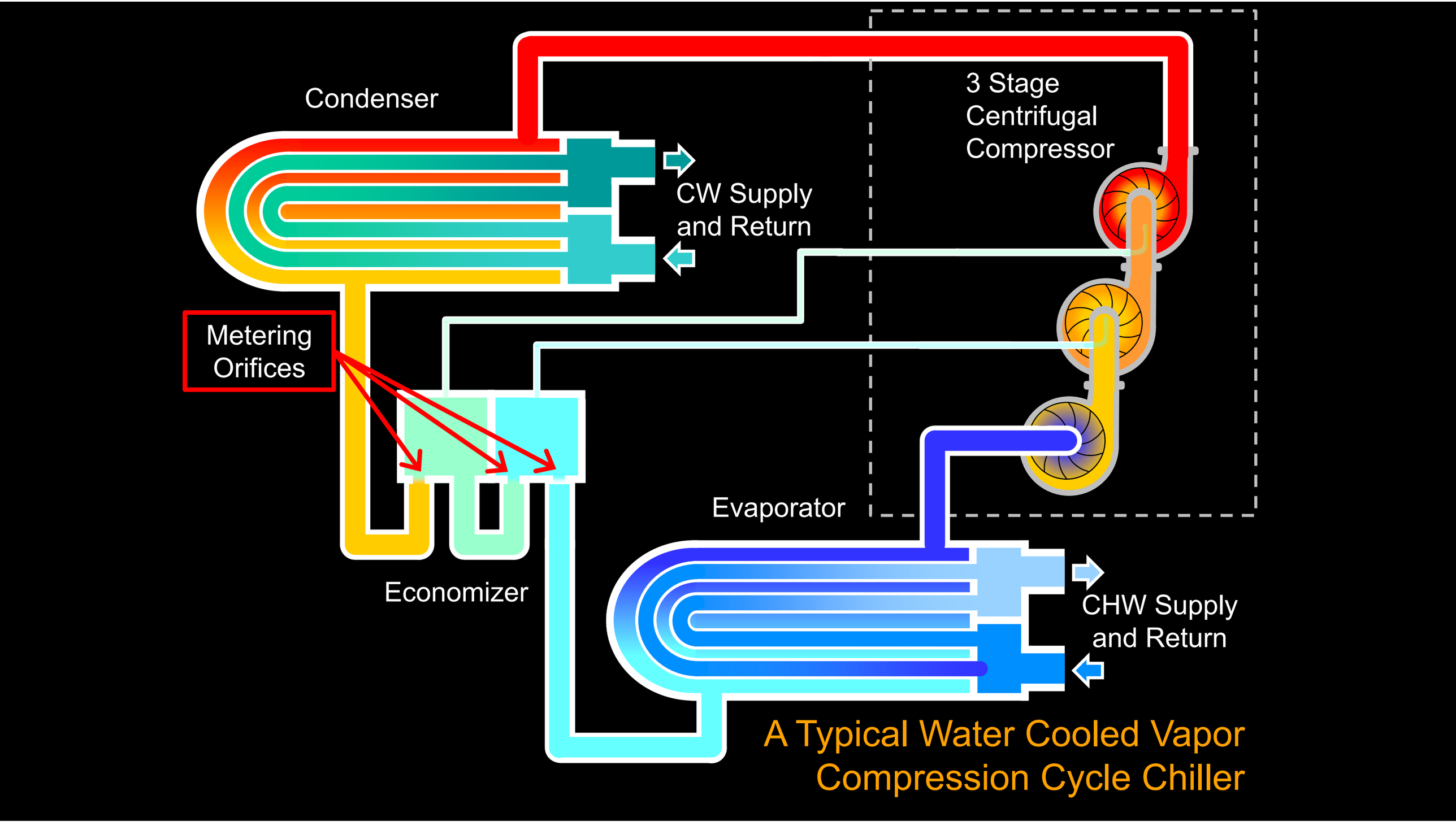
David Sellers

Senior Engineer

Facility Dynamics Engineering

# Taking A Closer Look at a Chiller




Condenser
3 Stage
Centrifugal
Compressor
CW Supply
and Return
Metering
Orifices
Economizer
Evaporator
CHW Supply
and Return
A Typical Water Cooled Vapor
Compression Cycle Chiller

DuPont Fluorochemicals

# HCFC-123

Pressure-Enthalpy Diagram
(English Units)

Pressure, psia

Enthalpy, Btu/lb

c.p.

saturated liquid

saturated vapor

quality = 0.4

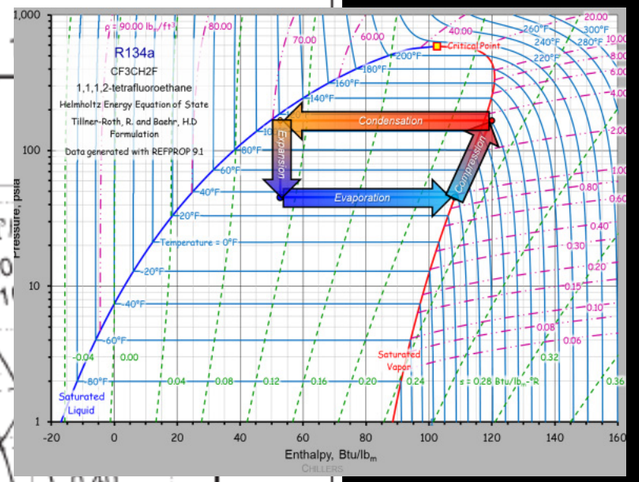
volume = 0.060 ft³/lb

temperature = 80 °F

temperature = 120 °F

temperature = 400 °F

entropy = 0.28 BTU/lb-°F




Compression

Expansion

Condensation

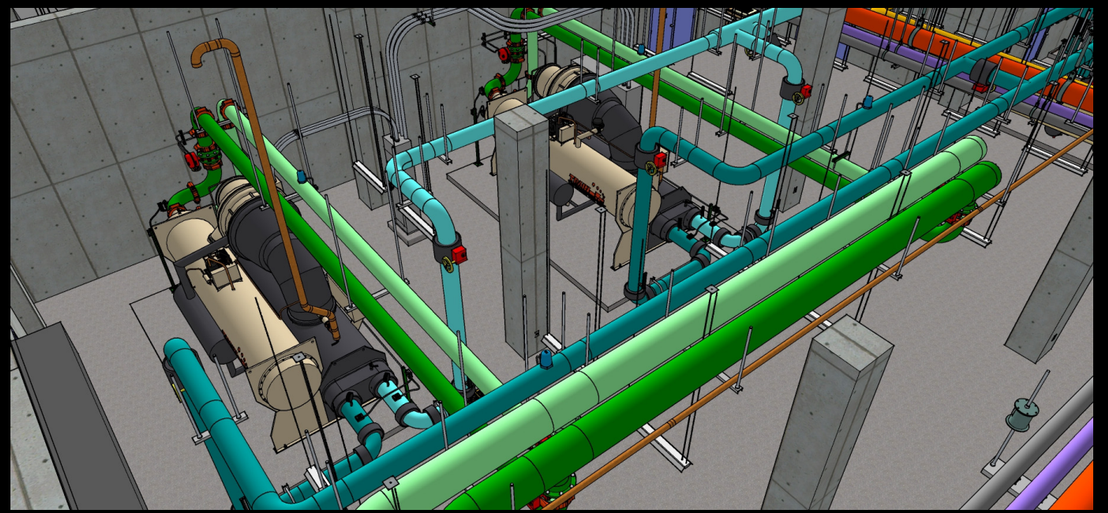
Evaporation

# Break and an Exercise

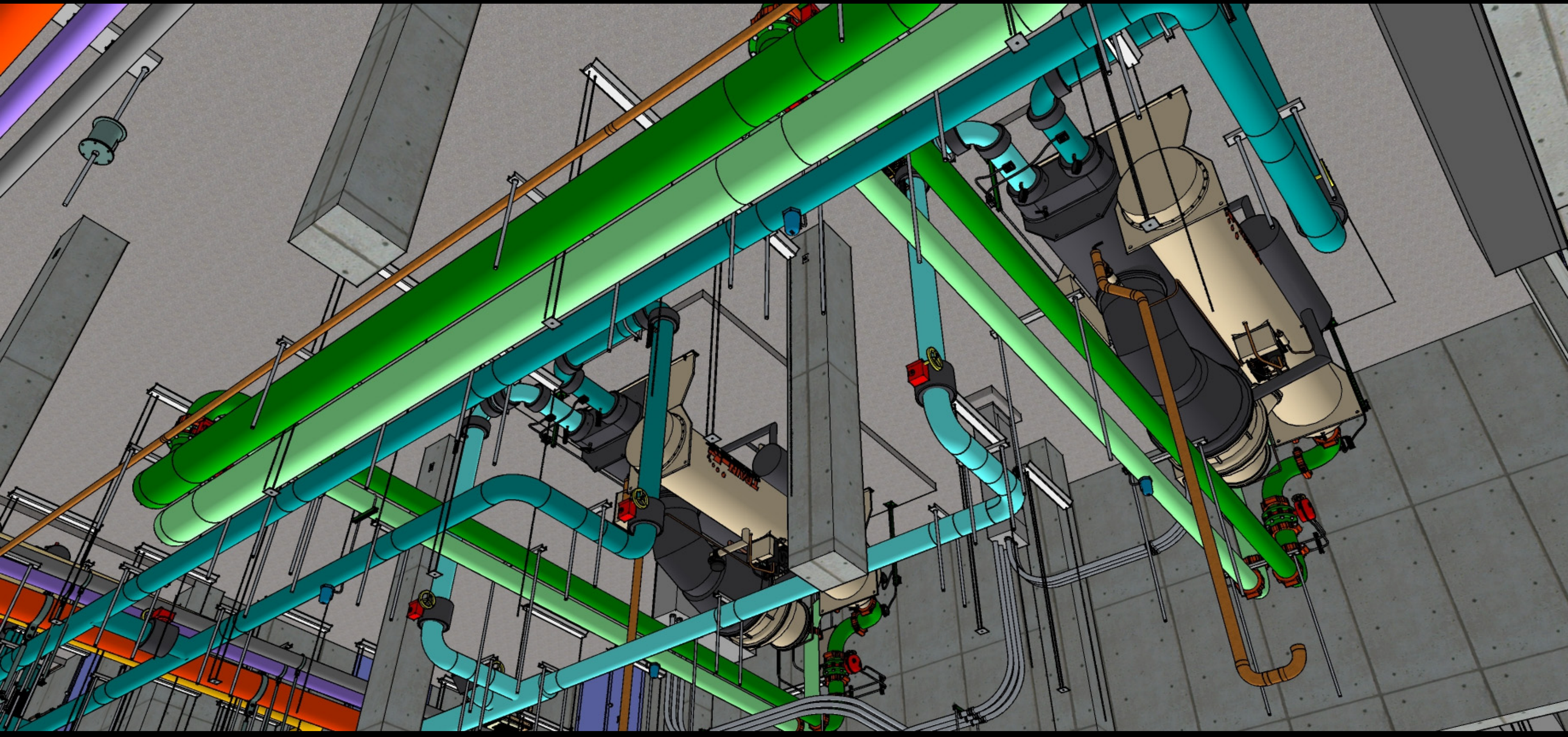
We have looked at Chiller 1 (left)

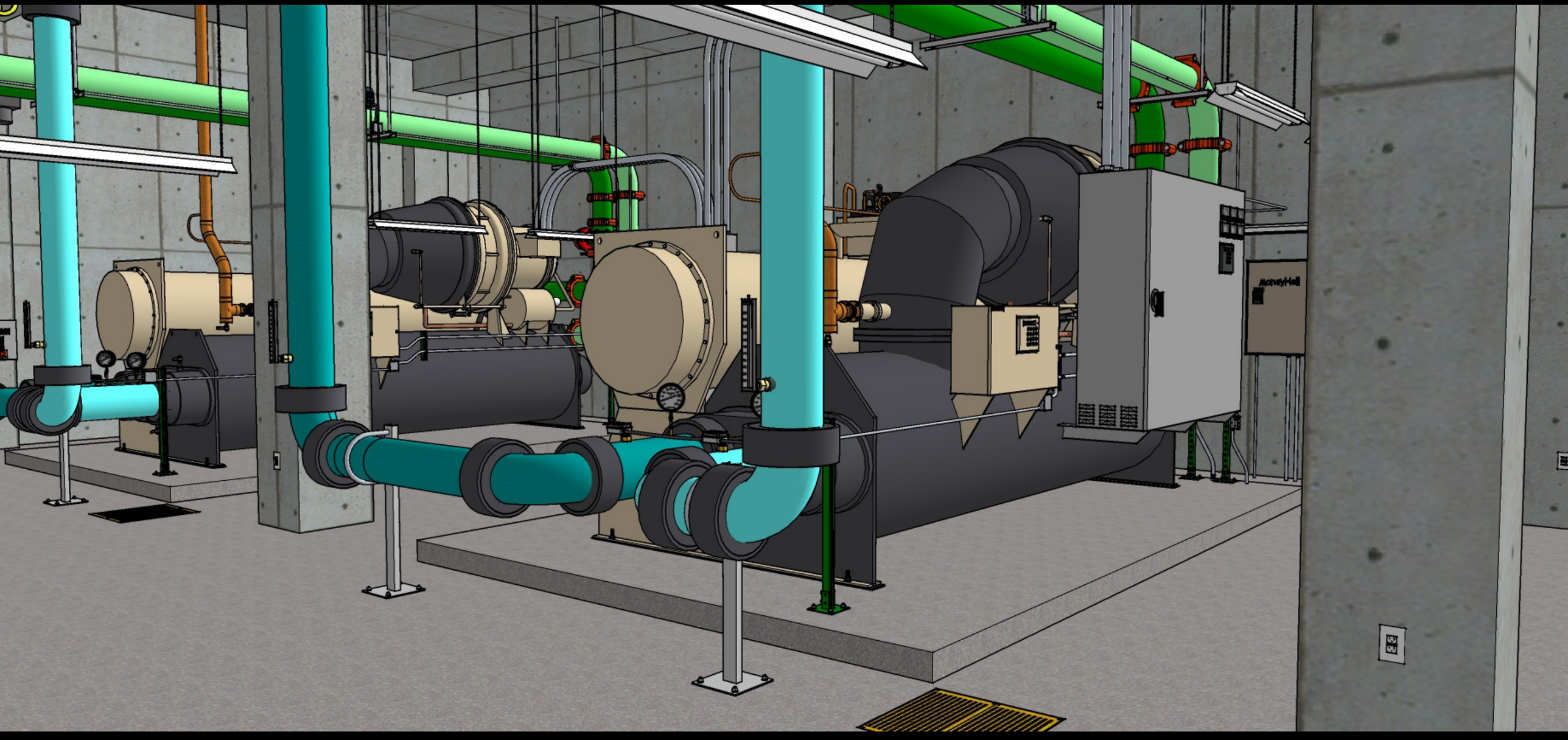
Is Chiller 2 identical?

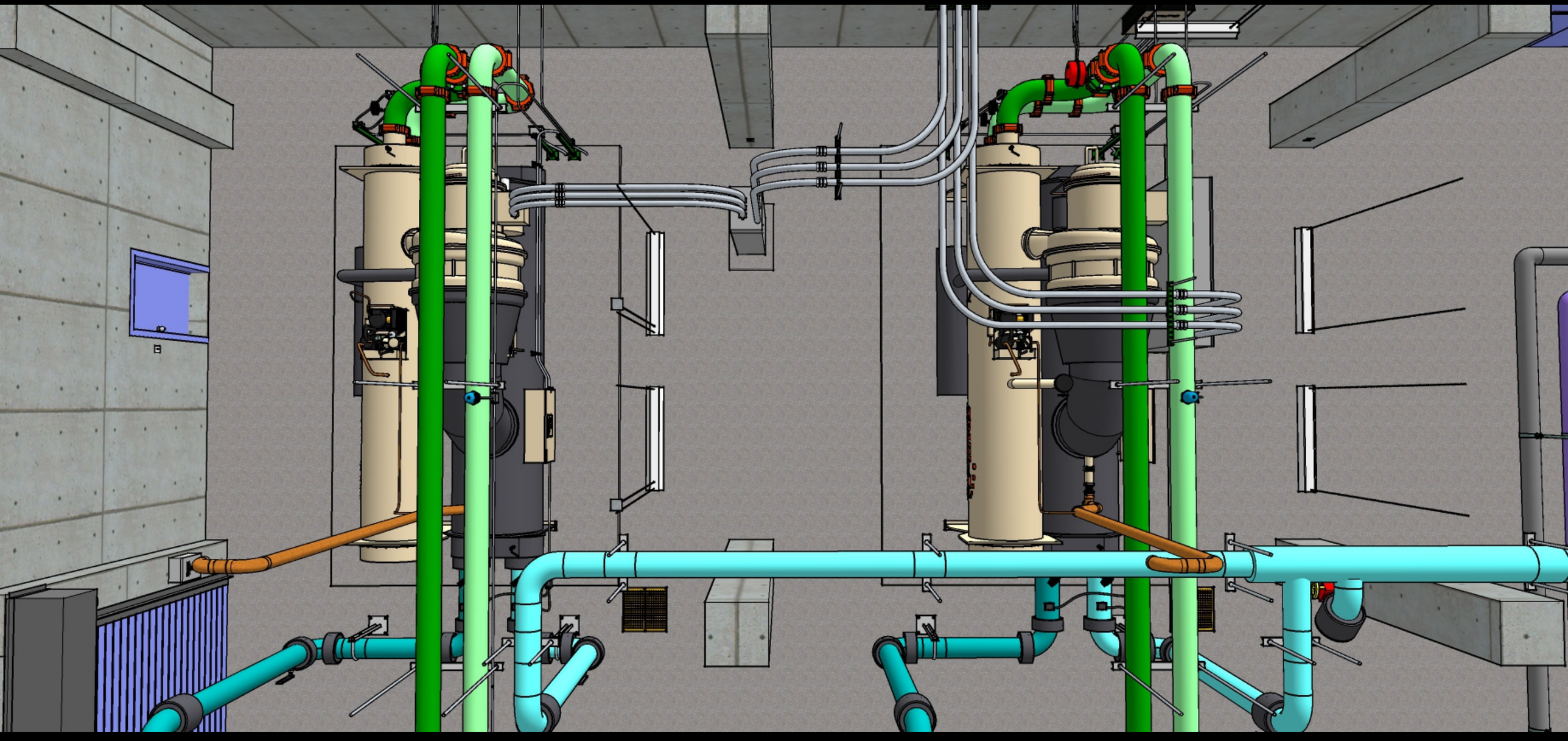
If not, what are the differences?



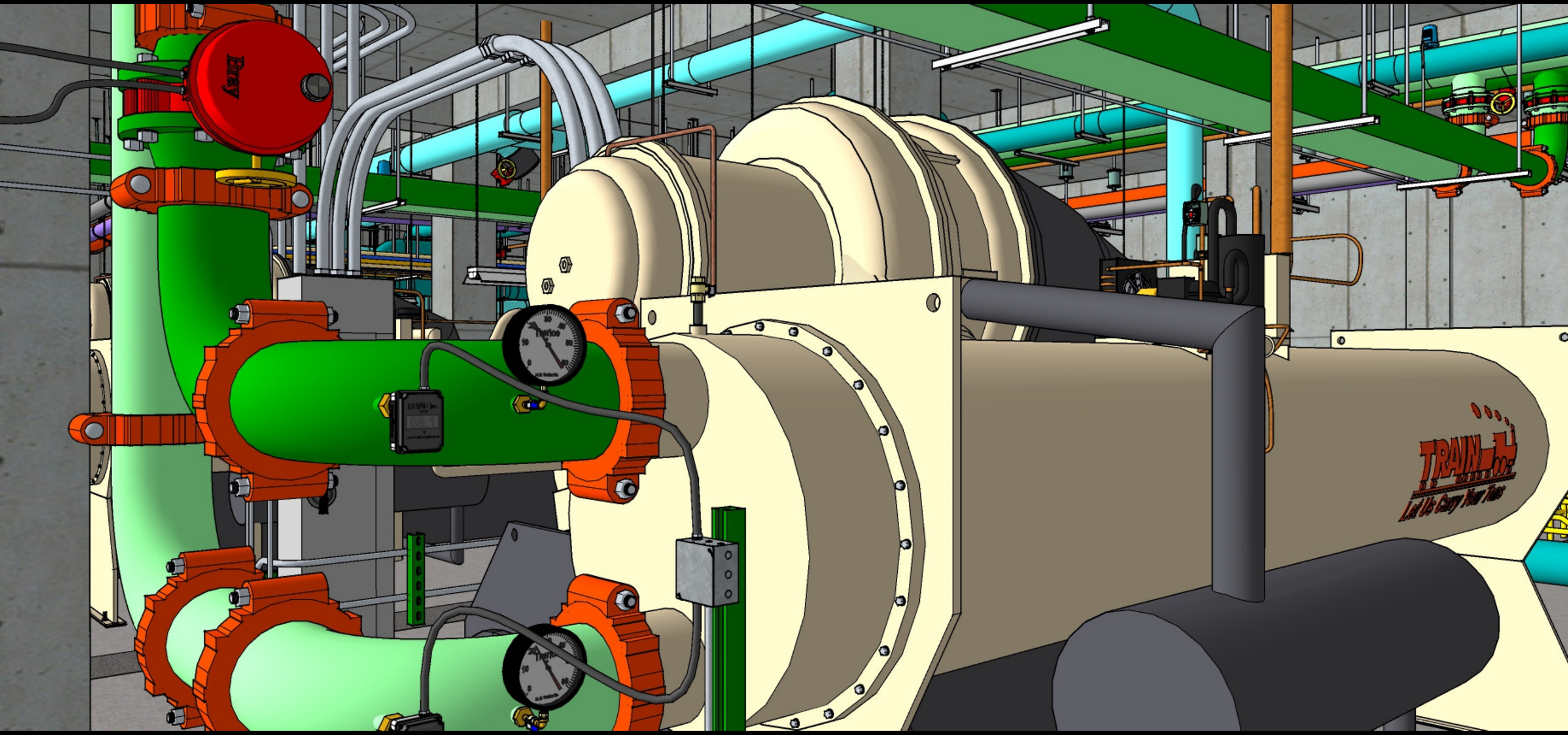
# Chiller Overview

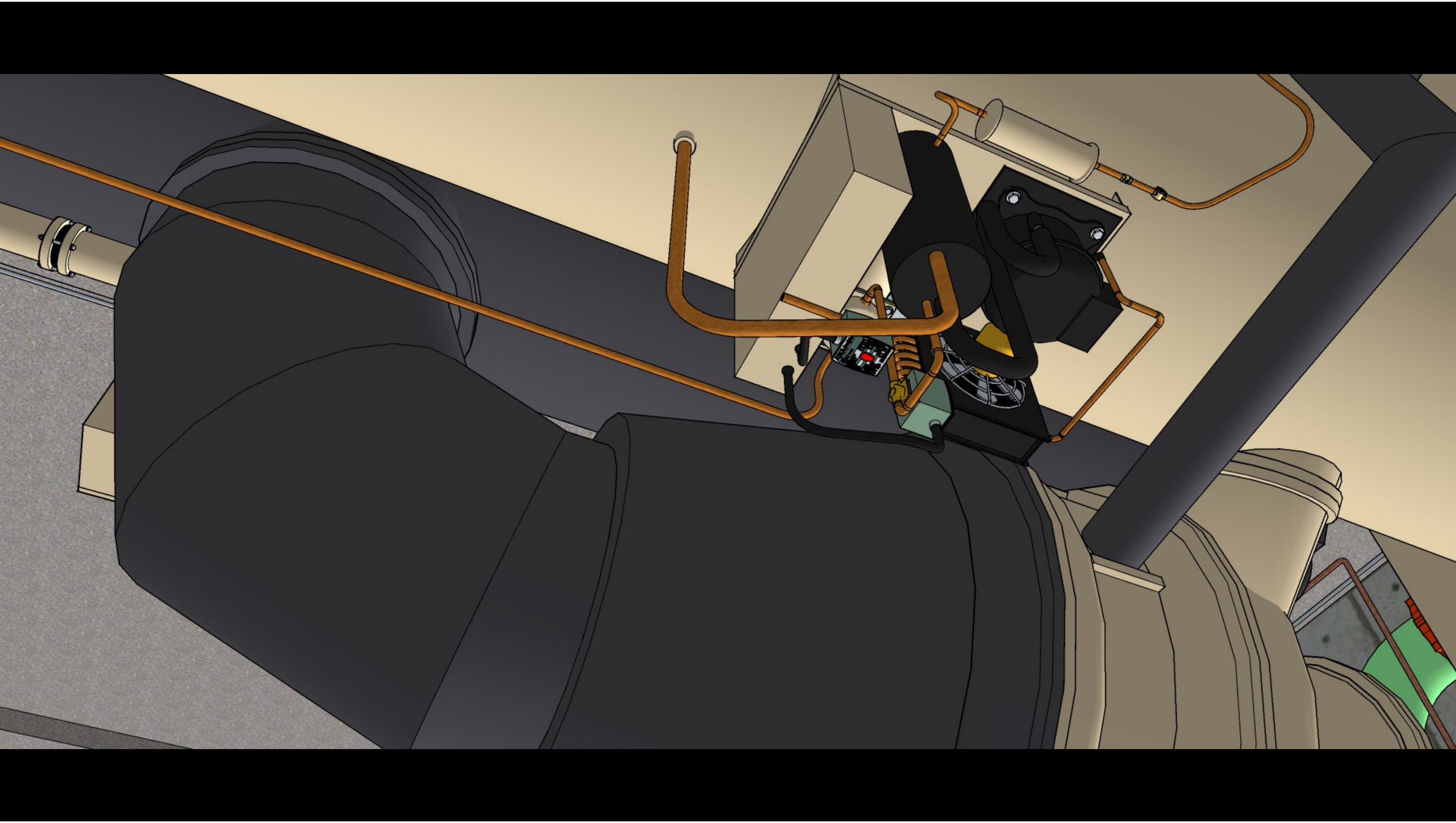


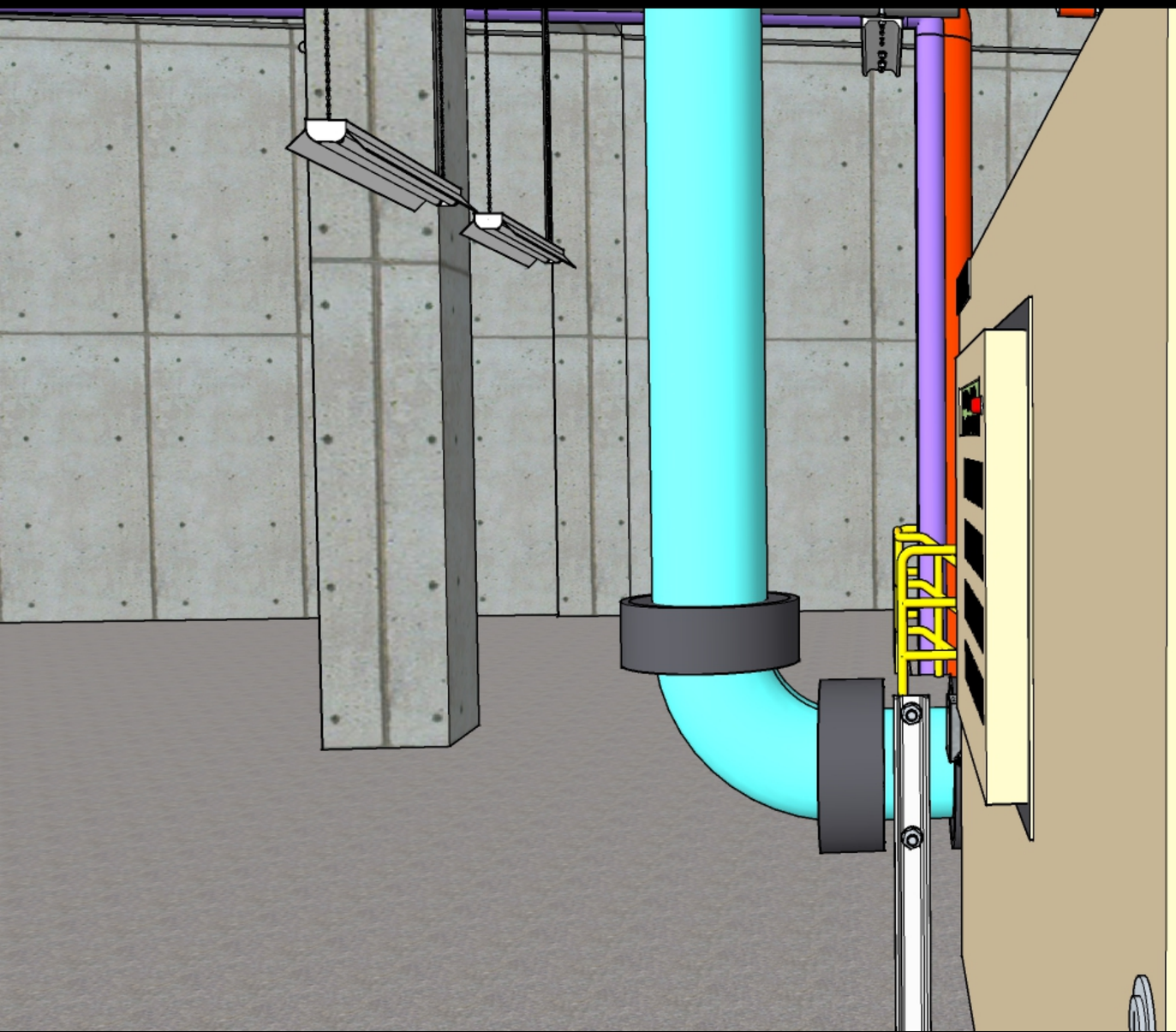

Honeywell



# Chiller 1


TRAIN
Let Us Carry Your Tons





TRAIN
Let Us Carry Your Tons

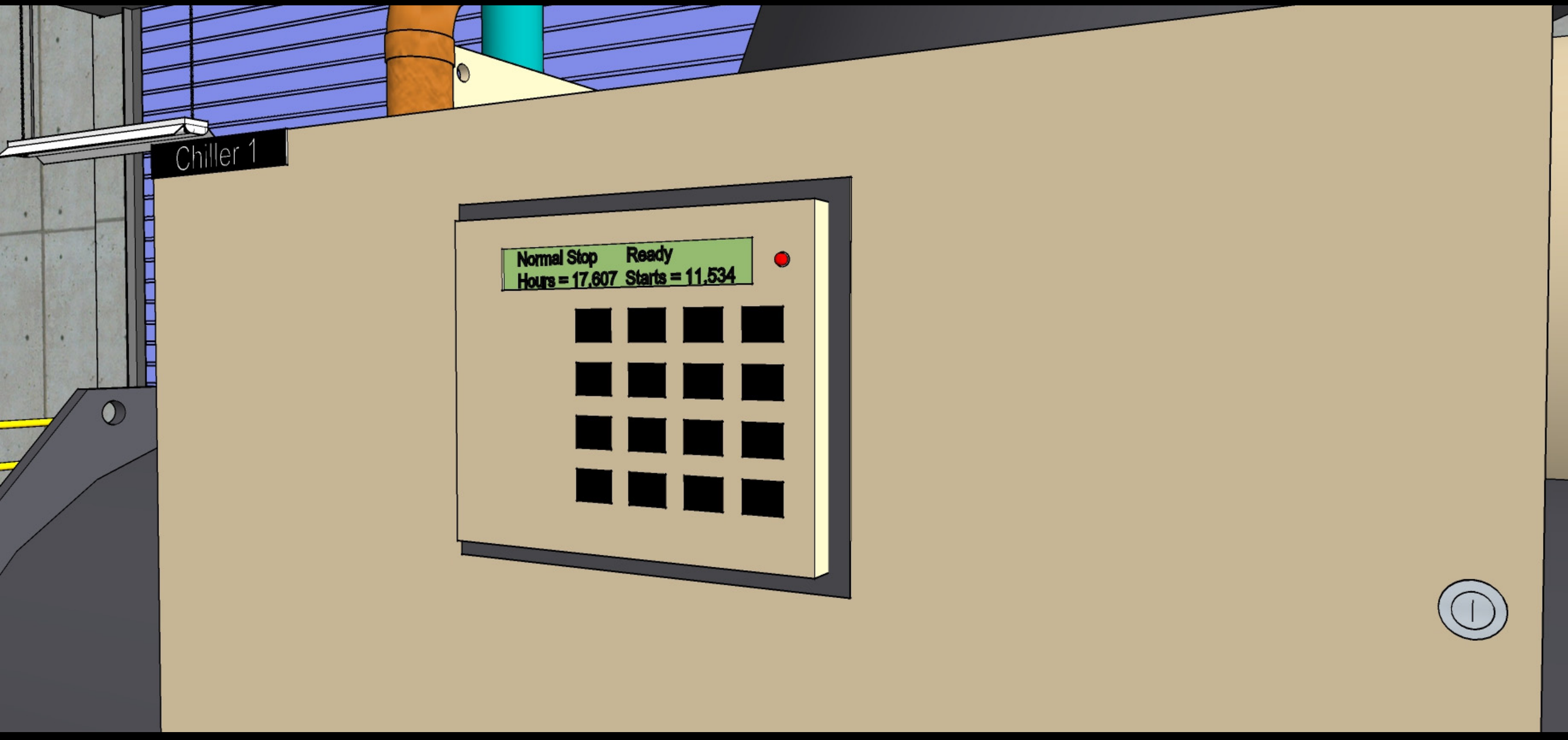
## Model CVHF 570
## Serial Number L07G03609

**Electrical Characteristics**
Rated Voltage: 460 Volts 60 Hz 3 PH
Nameplate NMKW: 286.10
Voltage Utilization Range: 414 - 506 VAC
Minimum Circuit Ampacity: 517 Amps
Maximum Overcurrent Protective Device: 800 Amps
Primary RLA: 376 Amps

**General Characteristics**
Refrigerant system to be field charged with 1050 lb of R-123
Maximum Refrigerant Working Pressure
Hi Side 15 psig Lo Side 15 psig
Factory Test Pressure
Hi Side 45 psig Lo Side 45 psig
Field Leak Test Pressure 8 psig Max.

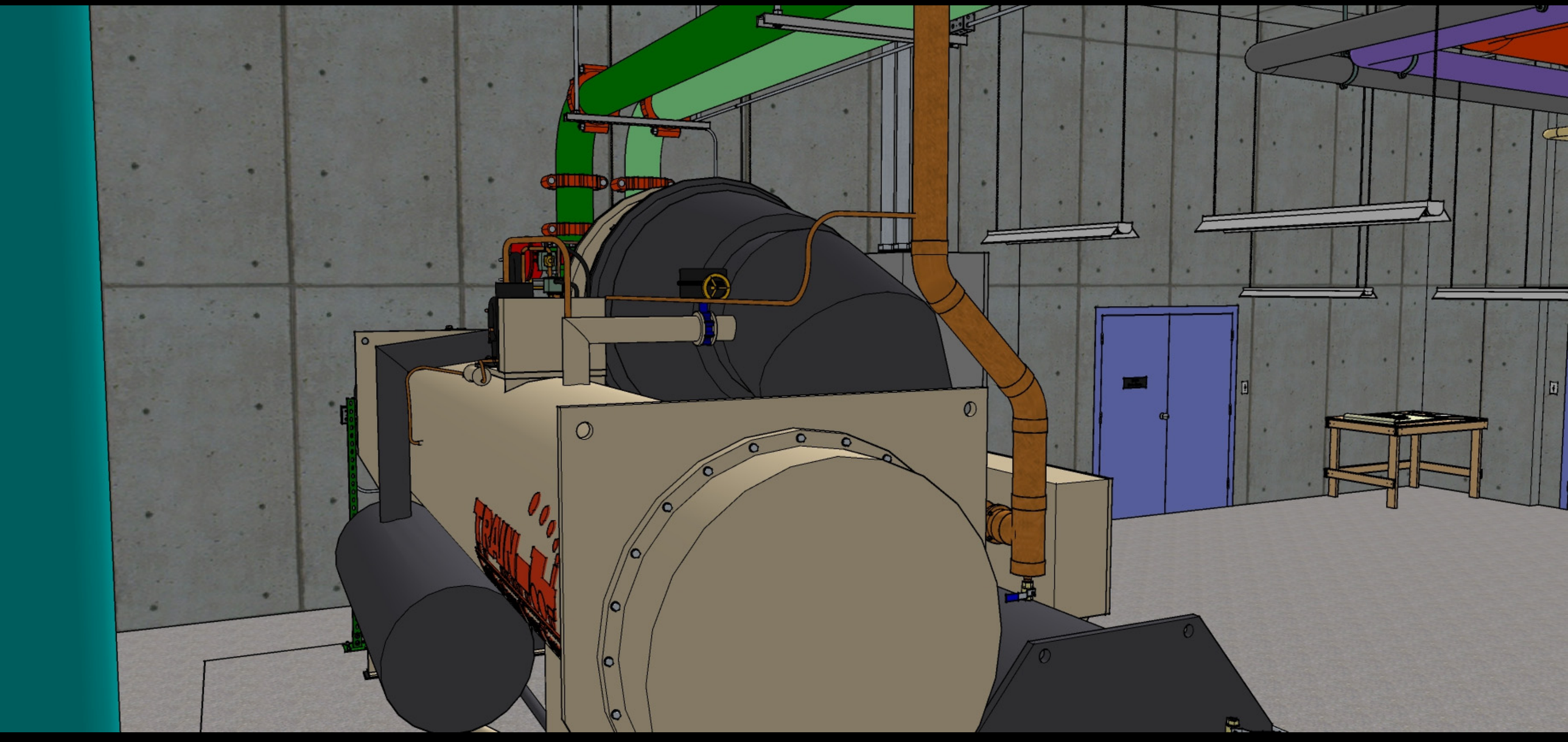
**Product Description**

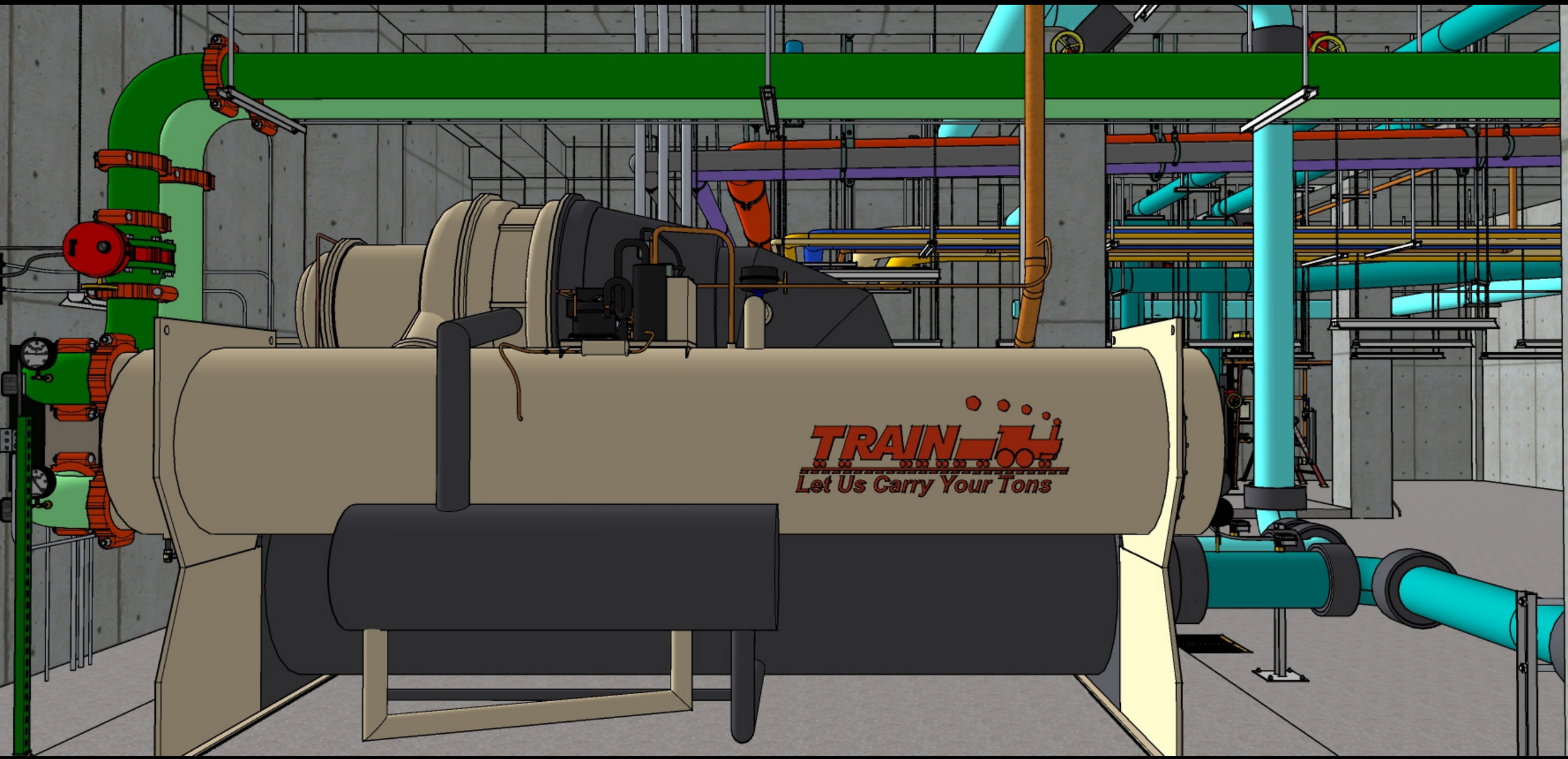
| | | |
|---|---|---|
| FCLT-LAX | EVBS-740 | TSTY-STD |
| MODL-CVHF | EVTM-IM48 | CDFP-TDFS |
| NTO-570 | EVTH-25 | ORSZ-790 |
| CNIF-ADPV | EVVF-NO | TEST-AIR |
| INDP-NO | EVWP-2 | TTOL-AIR |
| IHRZ-60 | EVWN-10 | FTST-YES |
| SRTM-CVSK | EVFP-TDFS | ASTT-NO |
| HRTZ-60 | CDSZ-060L | OPMM-HPLV |
| IVLT-460 | CDBS-800 | INSL-NO |
| ENCL-STD | CDTM-IMCU | GBAS-YES |
| VOLT-460 | CDTH28 | CRFG-R123 |
| CPKW-286 | CDVF-NO | |
| CPIM-273 | CDWP-2 | |
| EVSZ-060L | CDWN-10 | |

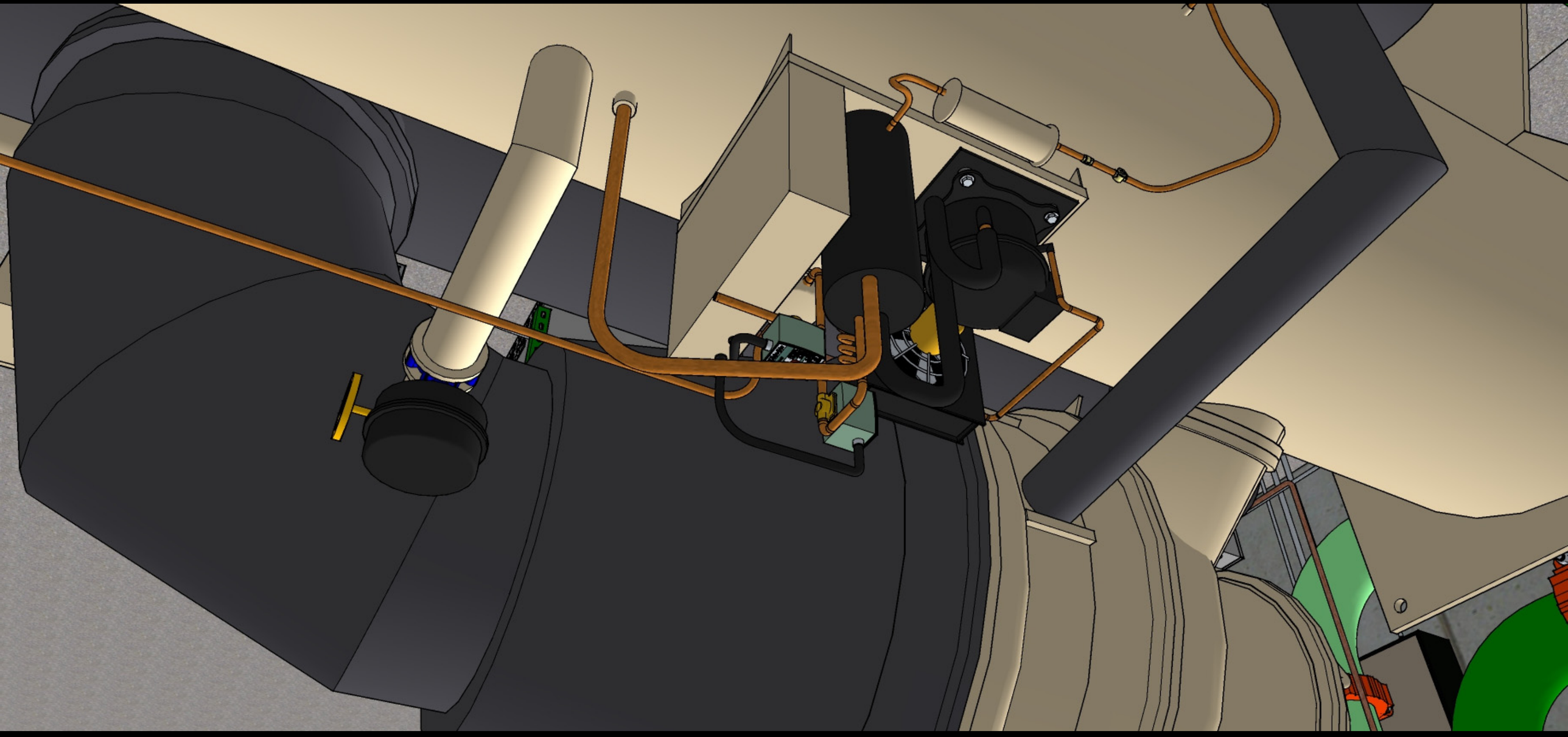

Chiller 1
Normal Stop Ready
Hours = 17,607 Starts = 11,534

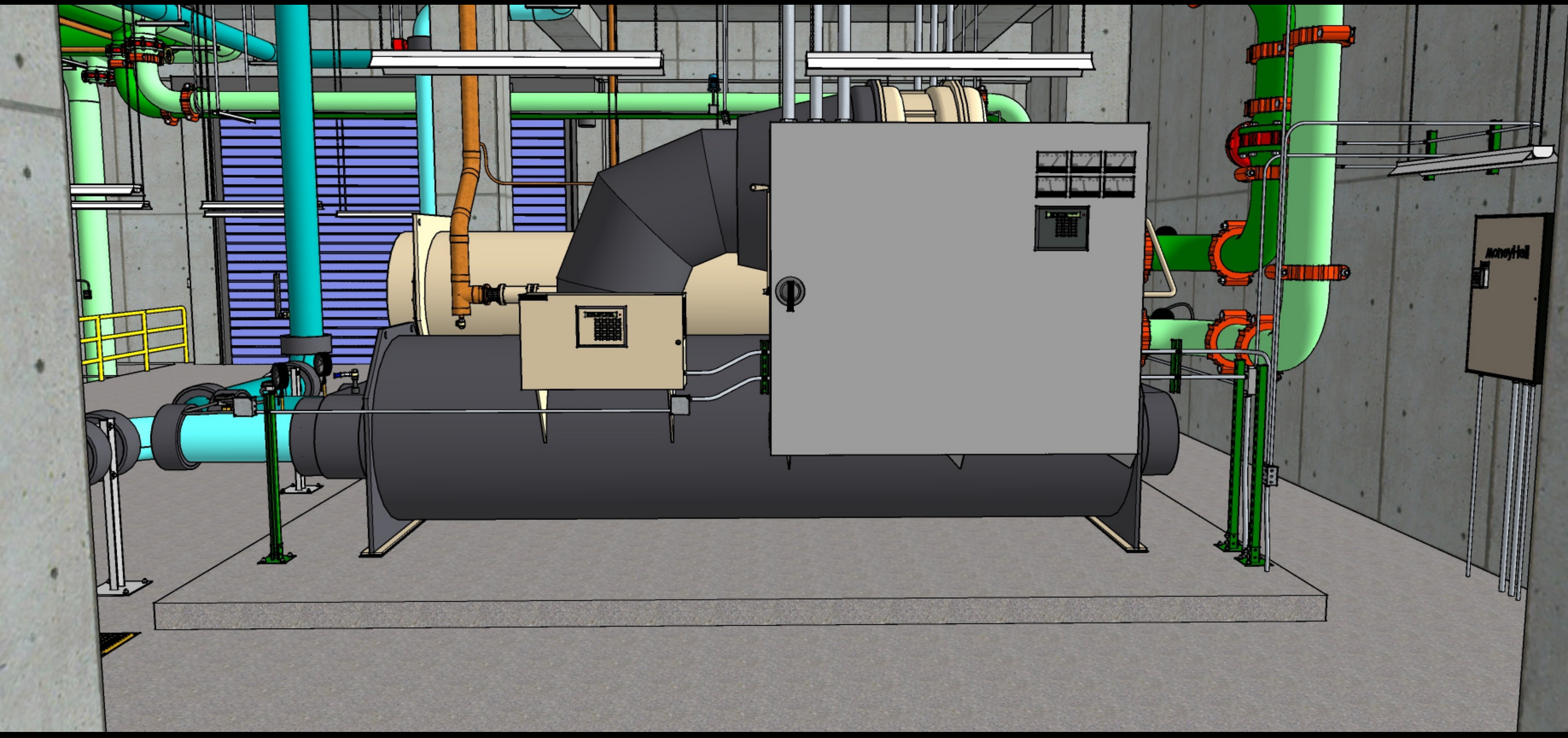
# Chiller 1

# Chiller 2




TRAIN
Let Us Carry Your Tons




Honeywell


0
200
400
600
Main Buss Voltage - 489 vac
Drive Speed - 78%

TRAIN
Let Us Carry Your Tons

**Model CVHF 0570**
**Serial Number L07G03608**

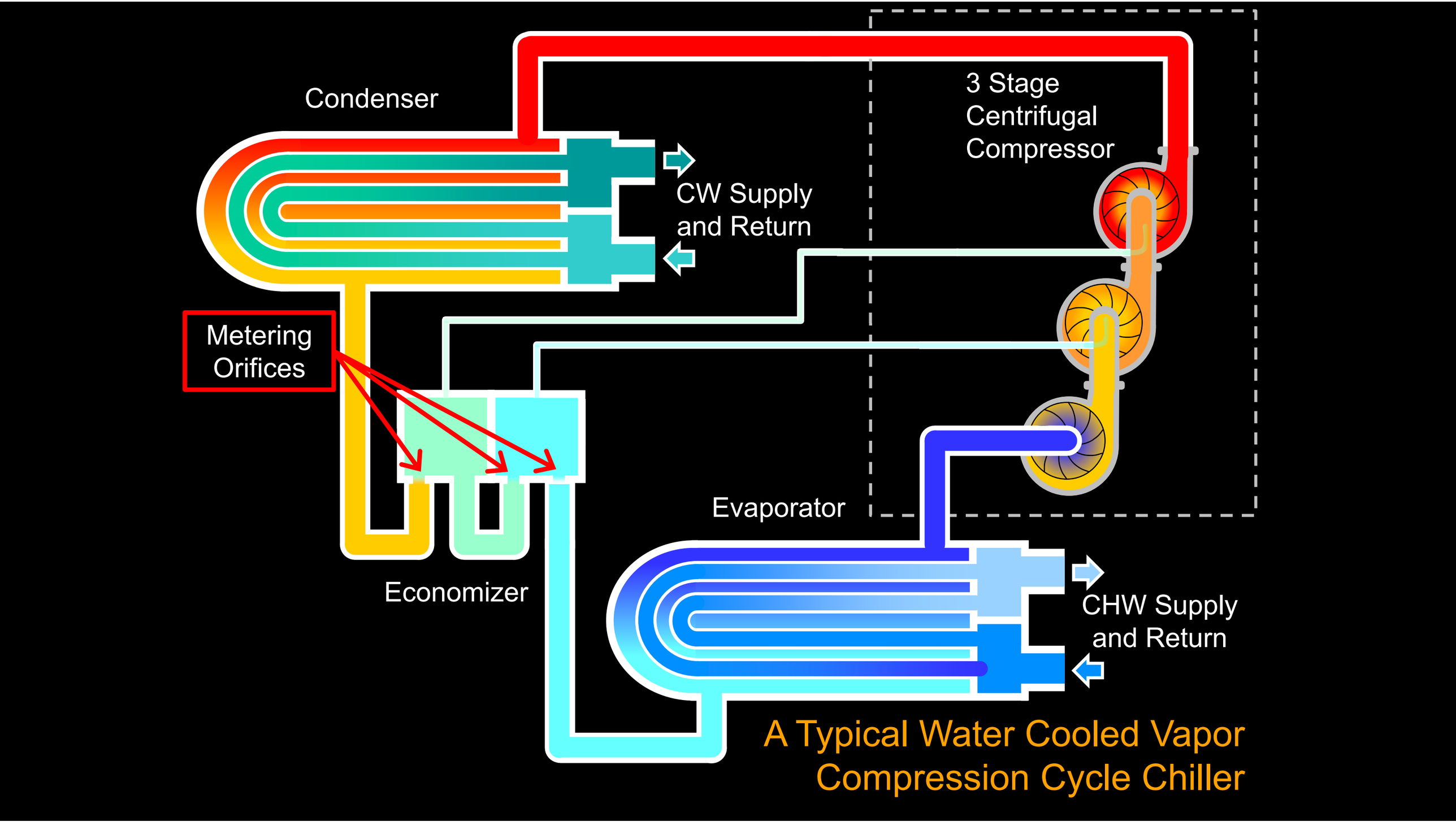
**Electrical Characteristics**
Rated Voltage: 460 Volts 60 Hz 3 PH
Nameplate NMKW: 309.20
Voltage Utilization Range: 414 - 506 VAC
Minimum Circuit Ampacity: 517 Amps
Maximum Overcurrent Protective Device: 800 Amps
Primary RLA: 406 Amps

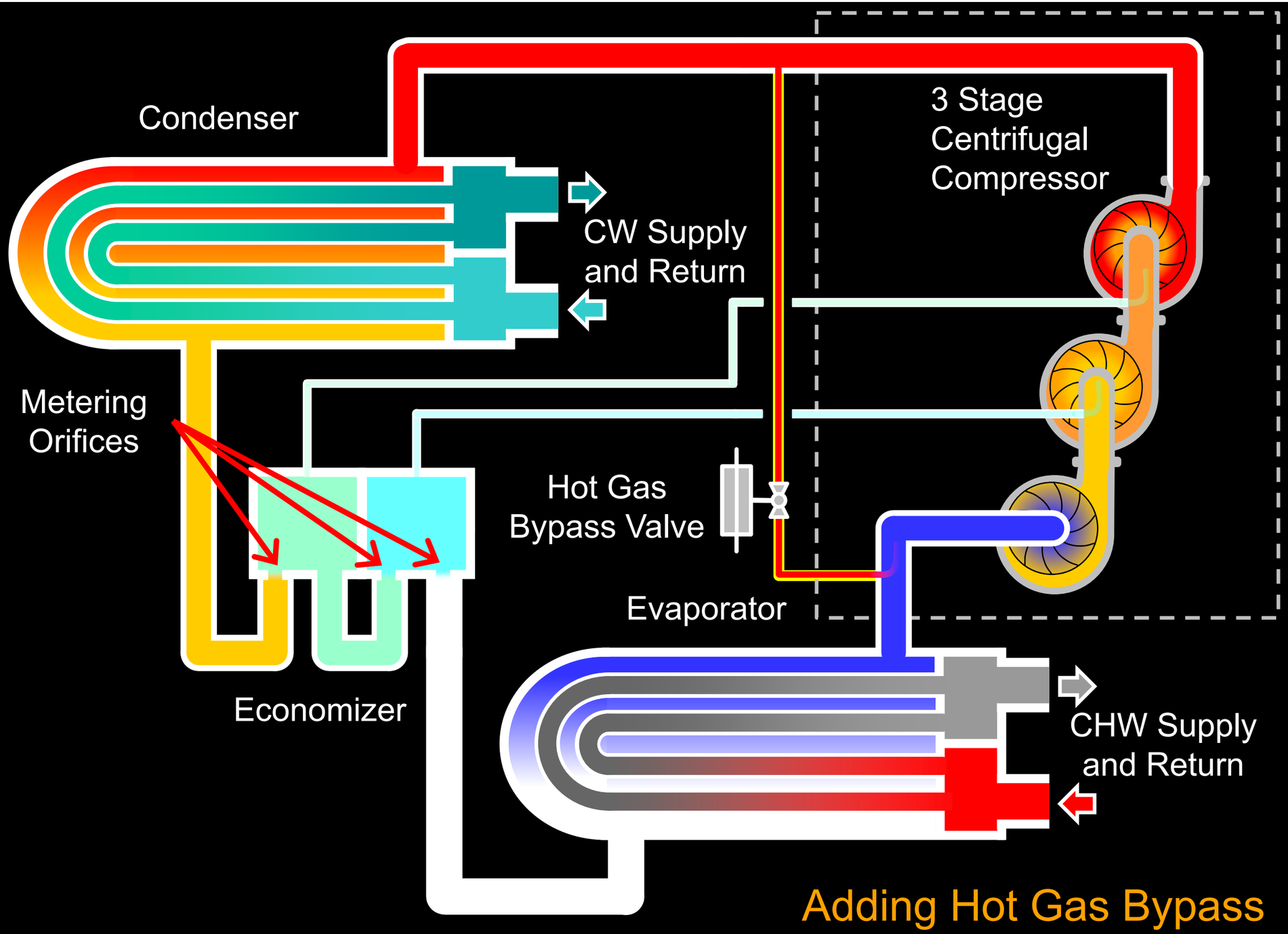
**General Characteristics**
Refrigerant system to be field charged with 1050 lb of R-123
Maximum Refrigerant Working Pressure
Hi Side 15 psig Lo Side 15 psig
Factory Test Pressure
Hi Side 45 psig Lo Side 45 psig
Field Leak Test Pressure 8 psig Max.

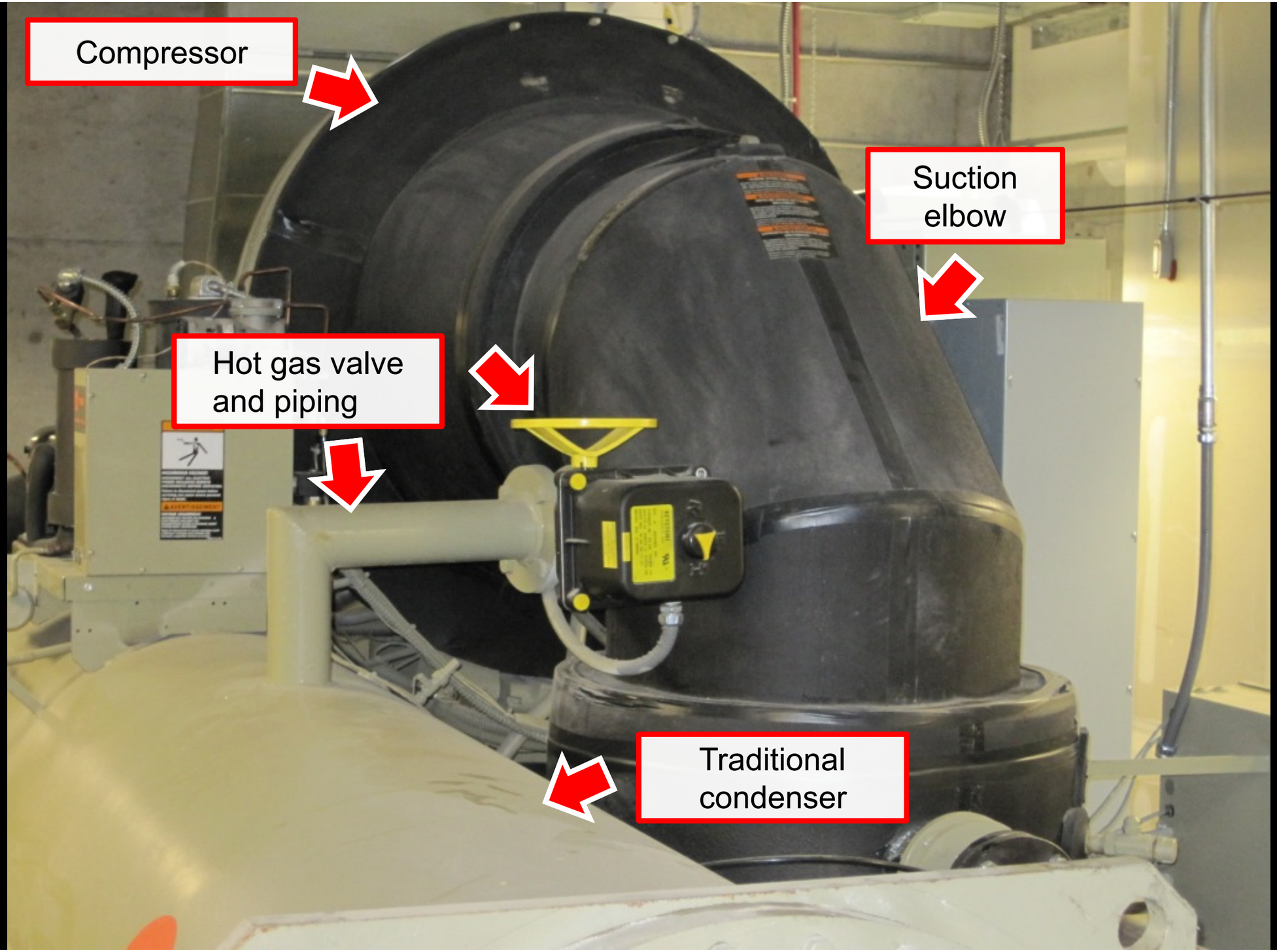
**Product Description**

| | | |
|---|---|---|
| FCLT-LAX | EVBS-740 | TSTY-STD |
| MODL-CVHF | EVTM-IM48 | CDFP-TDFS |
| NTO-570 | EVTH-25 | ORSZ-790 |
| CNIF-ADPV | EVVF-NO | TEST-AIR |
| INDP-NO | EVWP- 2 | TTOL-AIR |
| IHRZ-60 | EVWN- 10 | FTST-YES |
| SRTY-UAFD | EVFP-TDFS | ASTT-NO |
| HRTZ-60 | CDSZ-060L | OPMM-IPLV |
| VLT-480 | CDBS-800 | INSL-NO |
| ENCL-STD | CDTM-IMCU | GBAS-YES |
| VOLT-480 | CDTH28 | CRFG-R123 |
| CPKW-309 | CDVF-NO | |
| CPIM-273 | CDWP-2 | |
| EVSZ-060L | CDWN-10 | |

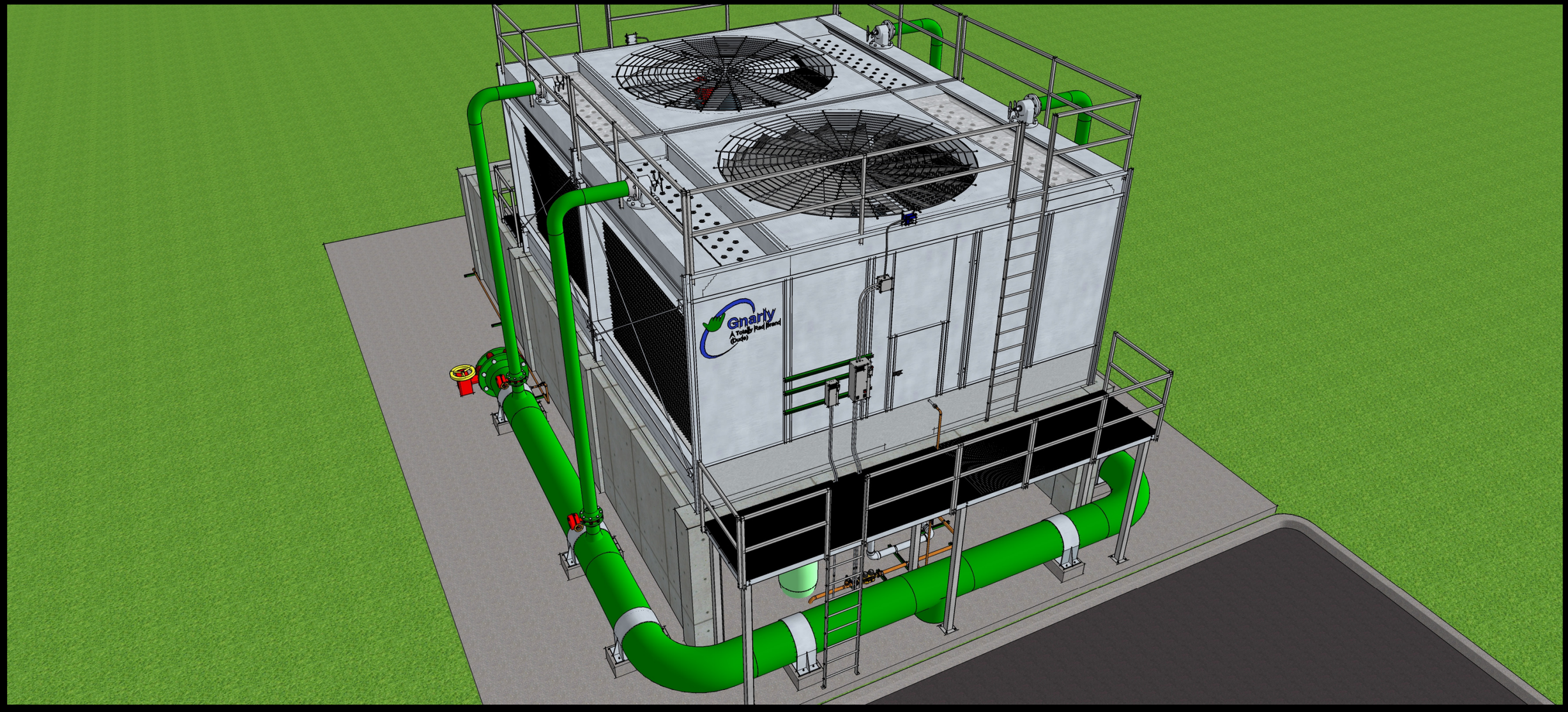

Chiller 2
Run Auto 188 KW 42F LWT
Hours = 19,765 Starts = 1,263


Condenser
3 Stage
Centrifugal
Compressor
CW Supply
and Return
Metering
Orifices
Economizer
Evaporator
CHW Supply
and Return
A Typical Water Cooled Vapor
Compression Cycle Chiller


Condenser
3 Stage
Centrifugal
Compressor
CW Supply
and Return
Metering
Orifices
Hot Gas
Bypass Valve
Evaporator
Economizer
CHW Supply
and Return
Adding Hot Gas Bypass


Compressor
Suction elbow
Hot gas valve and piping
Traditional condenser

# Cooling Towers



# Cooling Towers

Given:

The images to the right

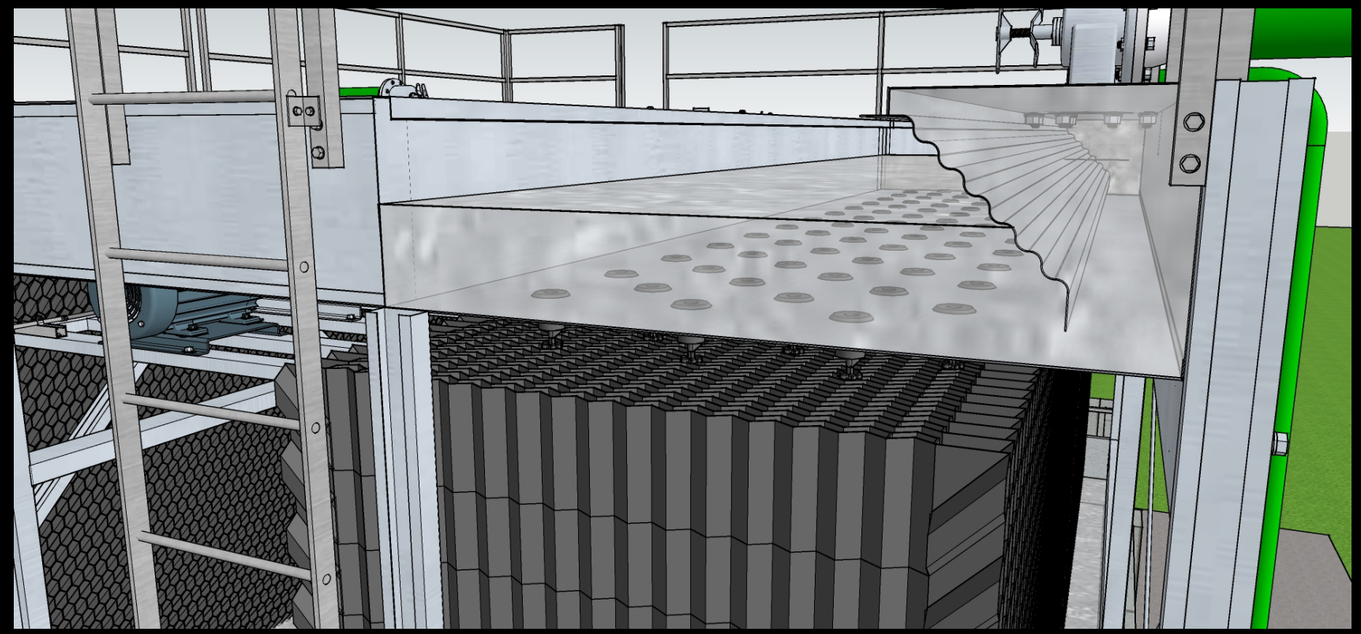
Our discussion

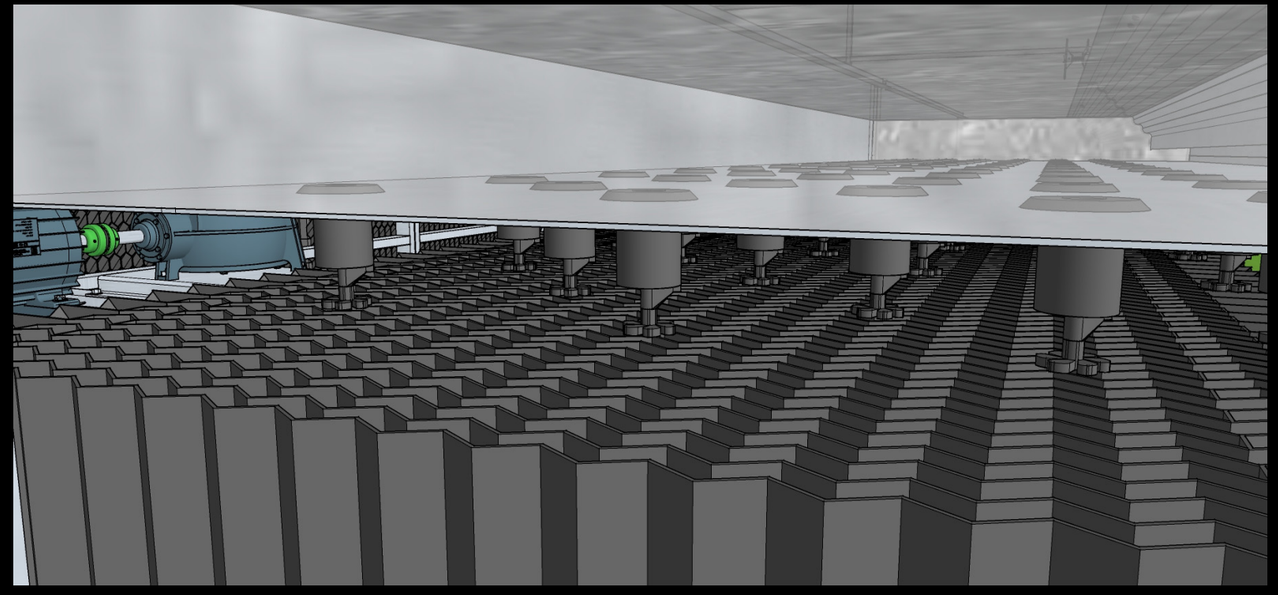
Newtonian physics

Common sense

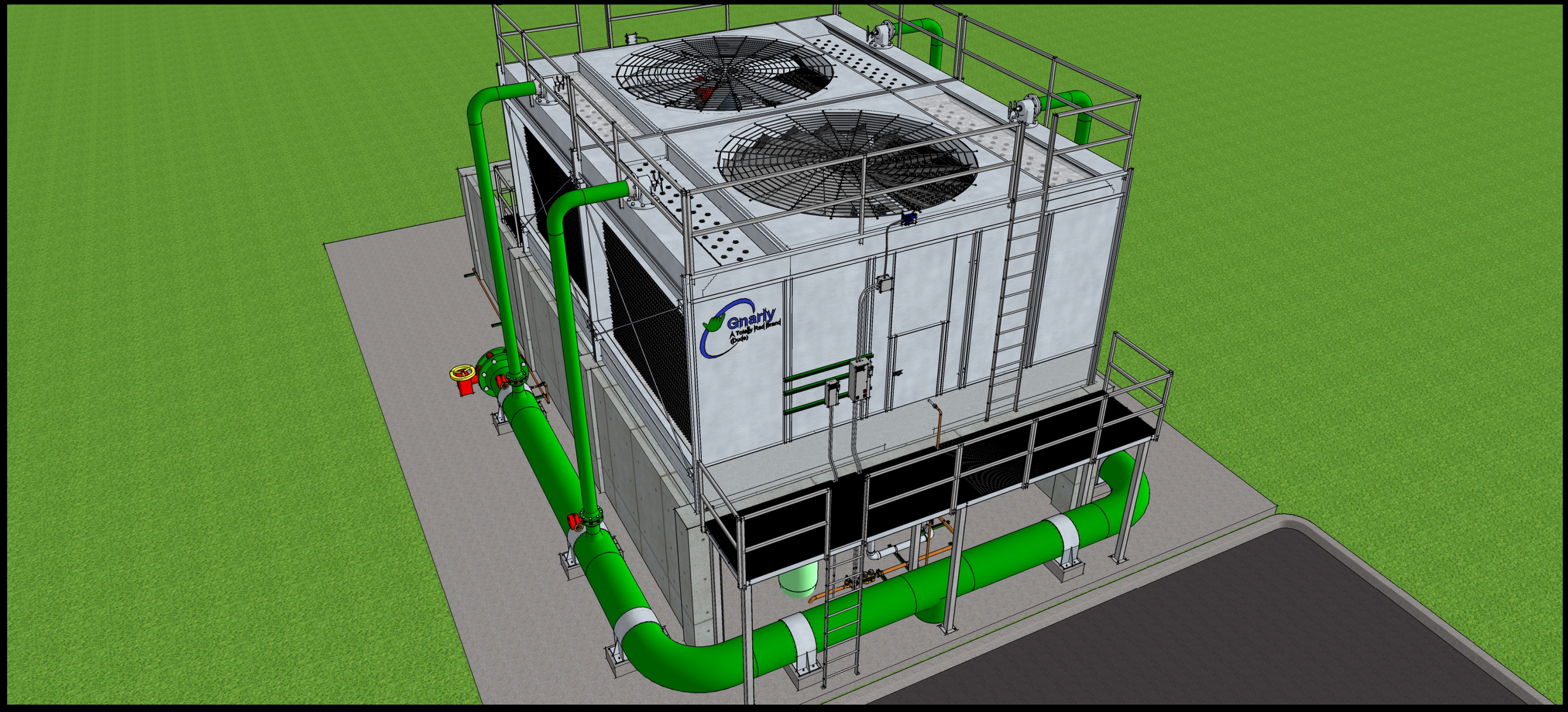
*What factors affect the flow rate through the orifices in the bottom of the hot basin?*

*If the flow rates to all basins where **not** the same, how could you tell that out in the field?*





# Cooling Towers



# Cooling Towers

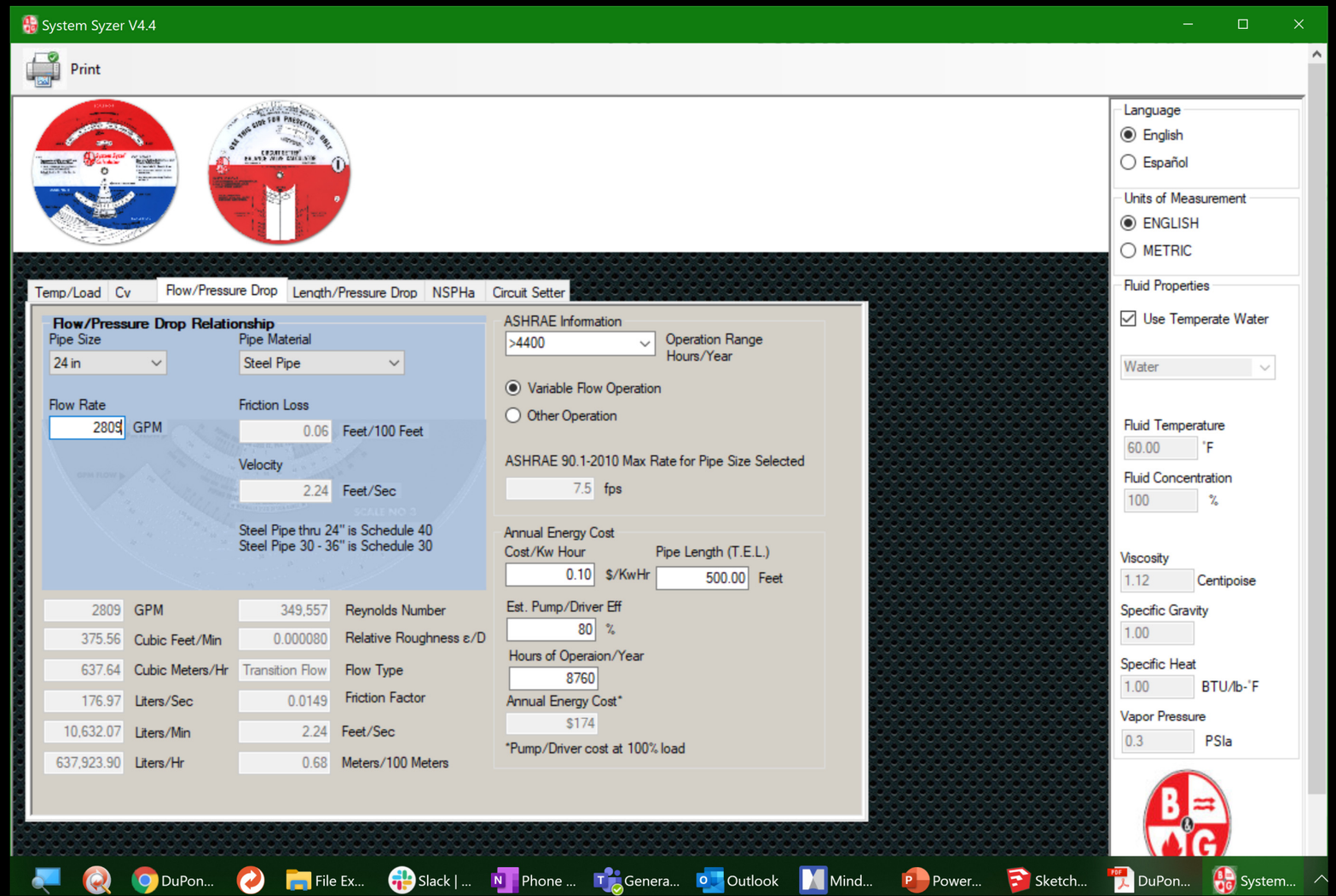
Given:

Return header size – 24”

Design Flow Rate (3 cells) = 2,809 gpm

Distance Between connections = 14 ft

*Is there a meaningful difference in pressure between the connection points where the risers to the hot basin connect to the headers?*



# Cooling Towers

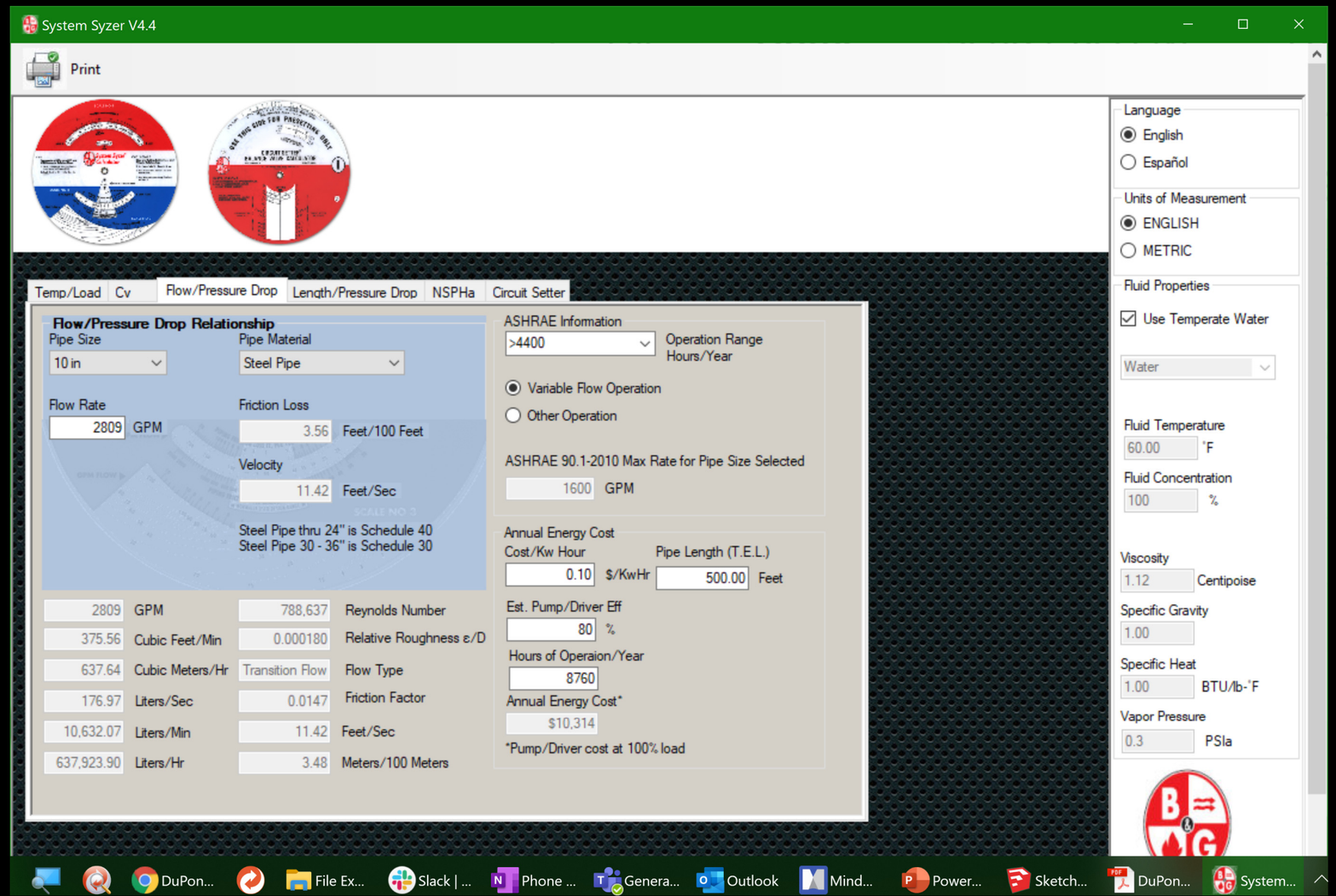
Given:

Return header size – 10”

Design Flow Rate (3 cells) = 2,809 gpm

Distance Between connections = 14 ft

*Is there a meaningful difference in pressure between the connection points where the risers to the hot basin connect to the headers?*



# Cooling Towers

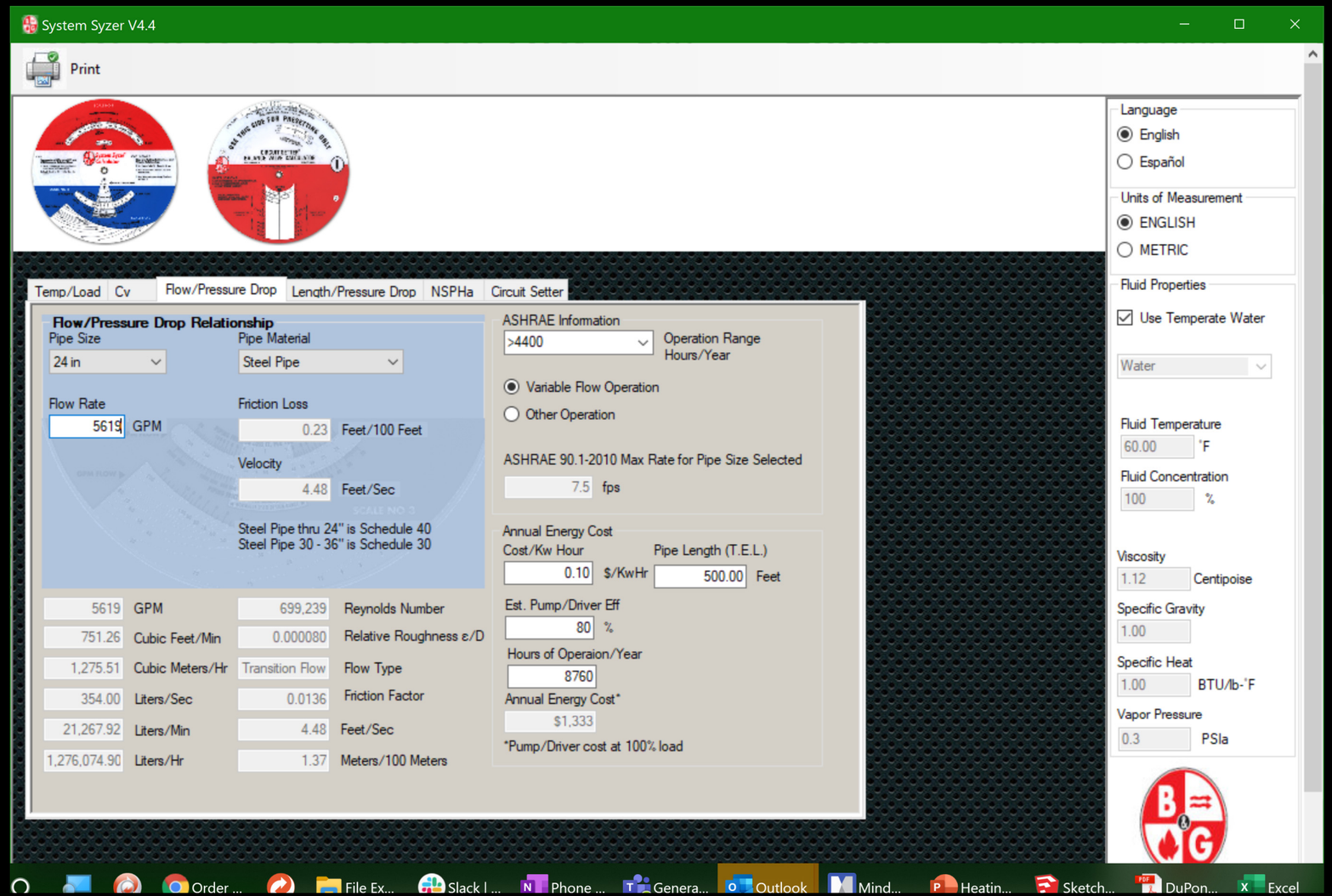
Given:

Supply header size – 24”

Design Flow Rate (3 cells) = 5,619 gpm

Distance Between connections = 14 ft

*Is there a meaningful difference in pressure between the connection points where the risers to the cold basin connect to the headers?*



# Cooling Towers

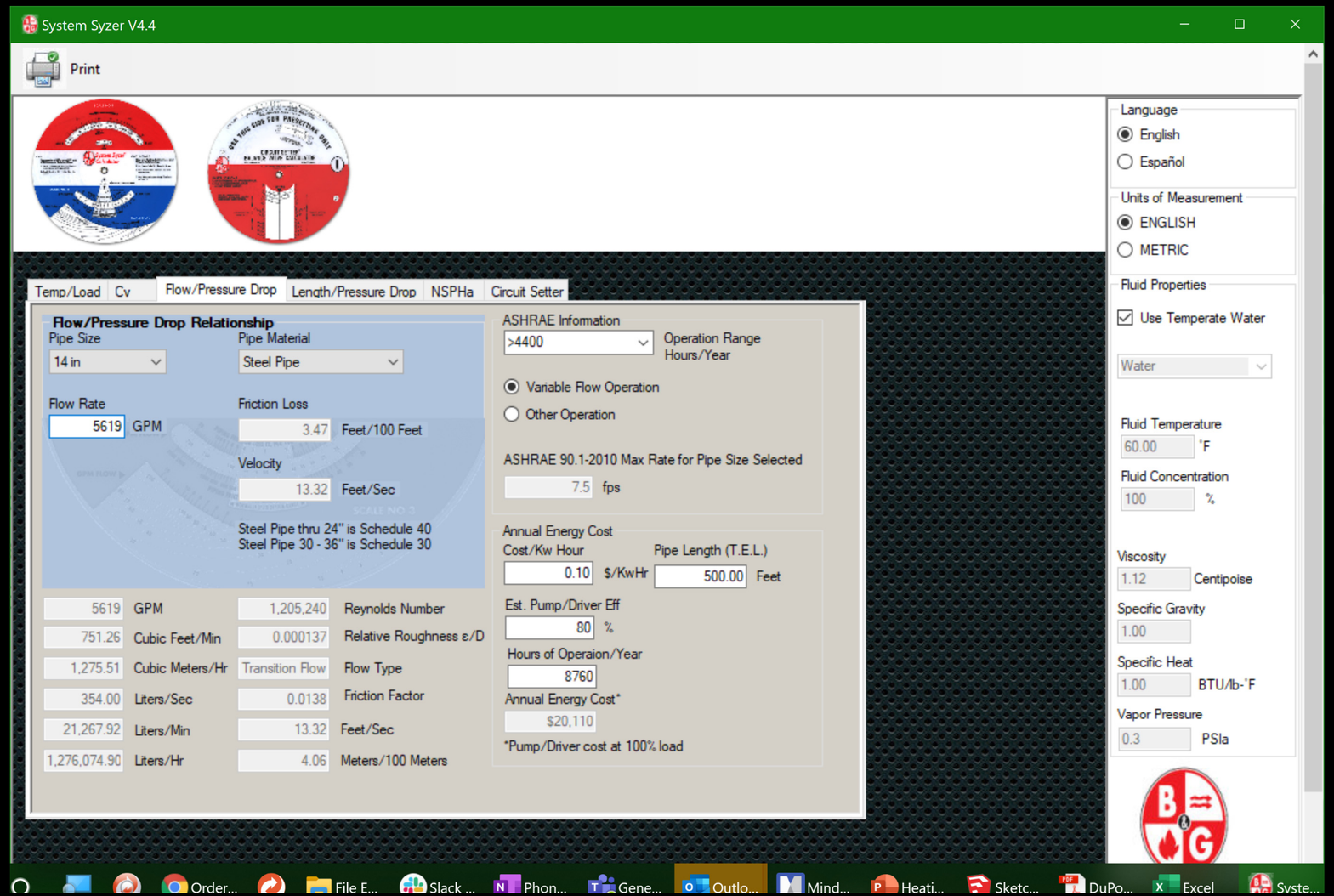
Given:

Supply header size – 14”

Design Flow Rate (3 cells) = 5,619 gpm

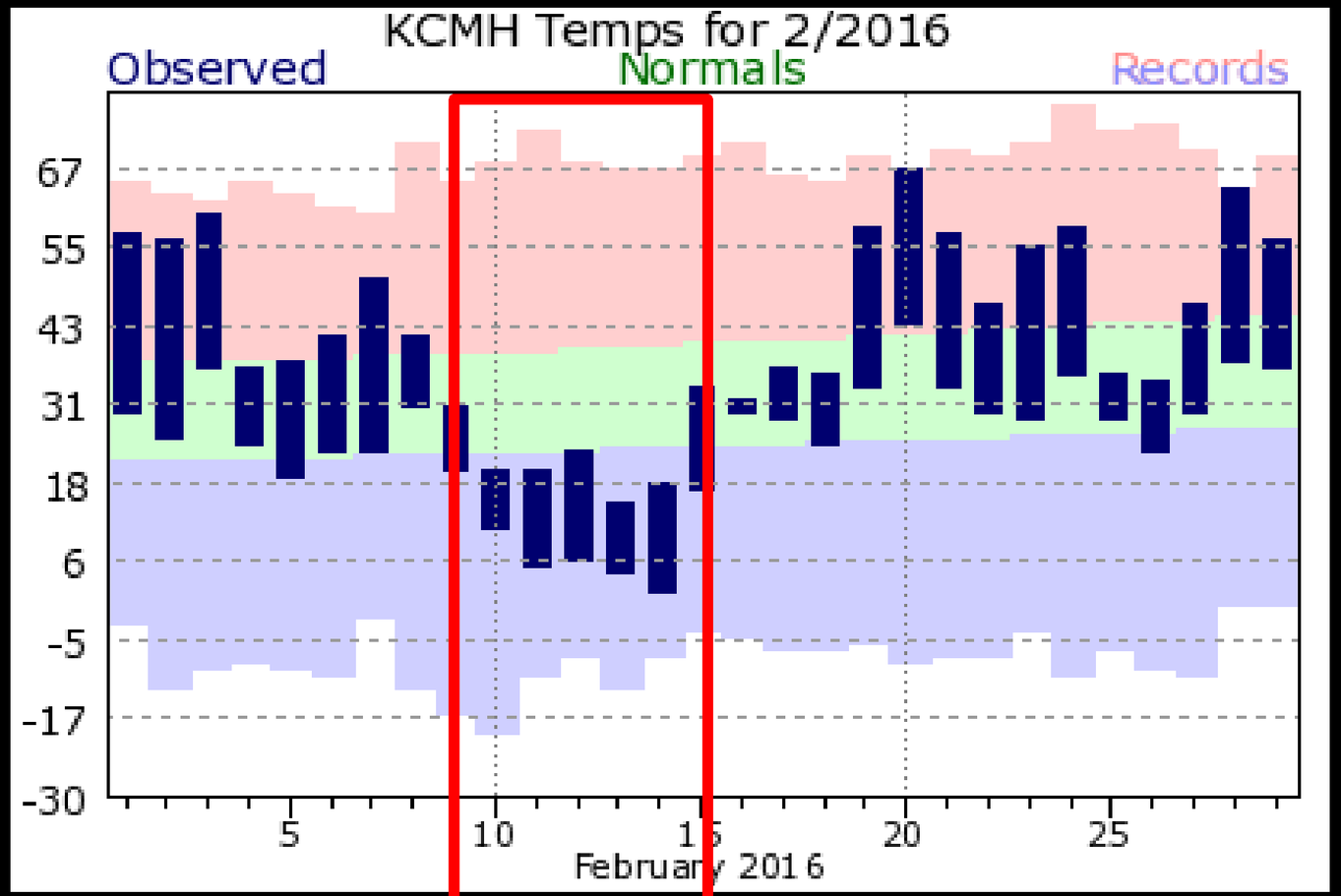
Distance Between connections = 14 ft

*Is there a meaningful difference in pressure between the connection points where the risers to the cold basin connect to the headers?*

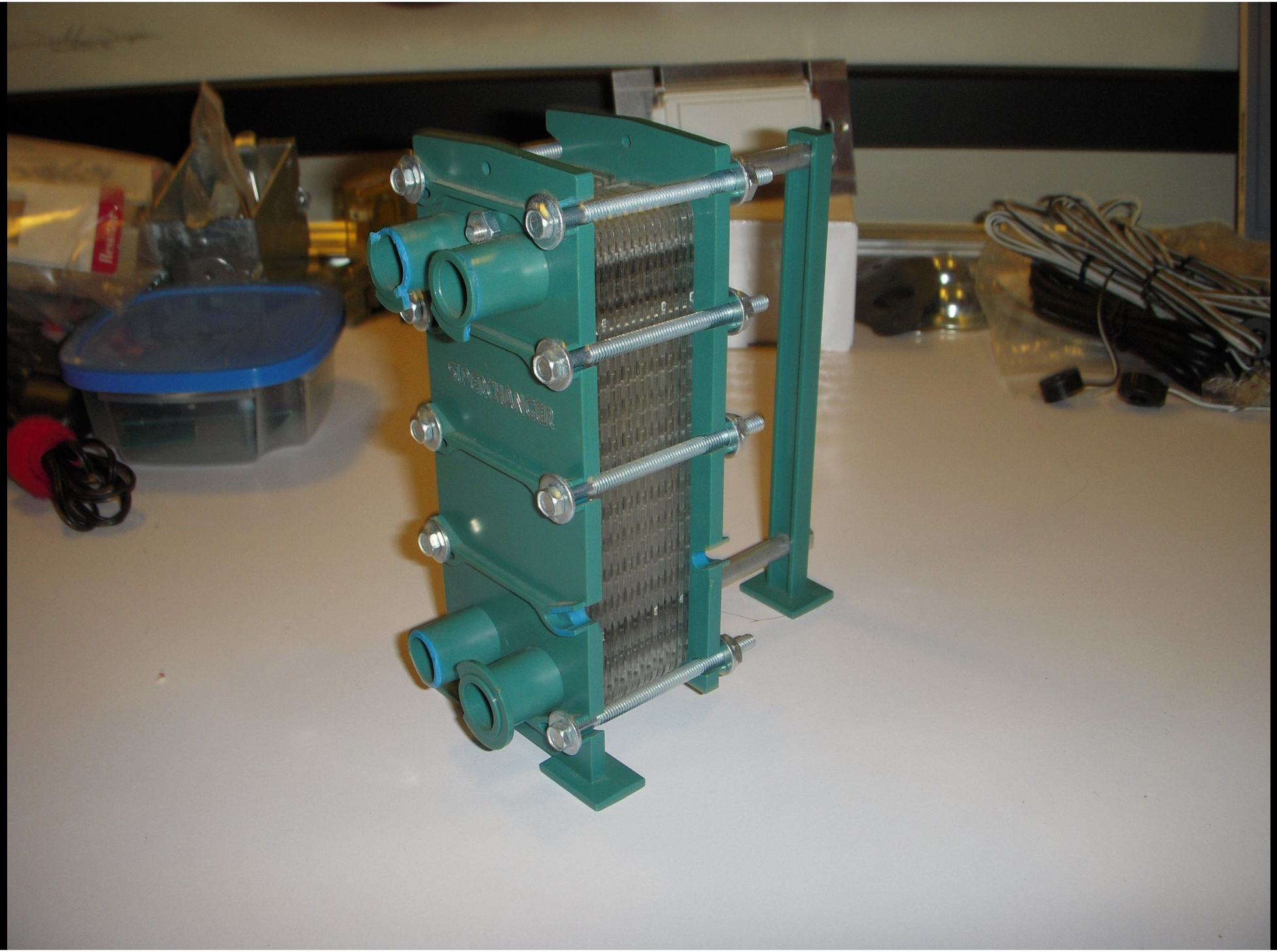


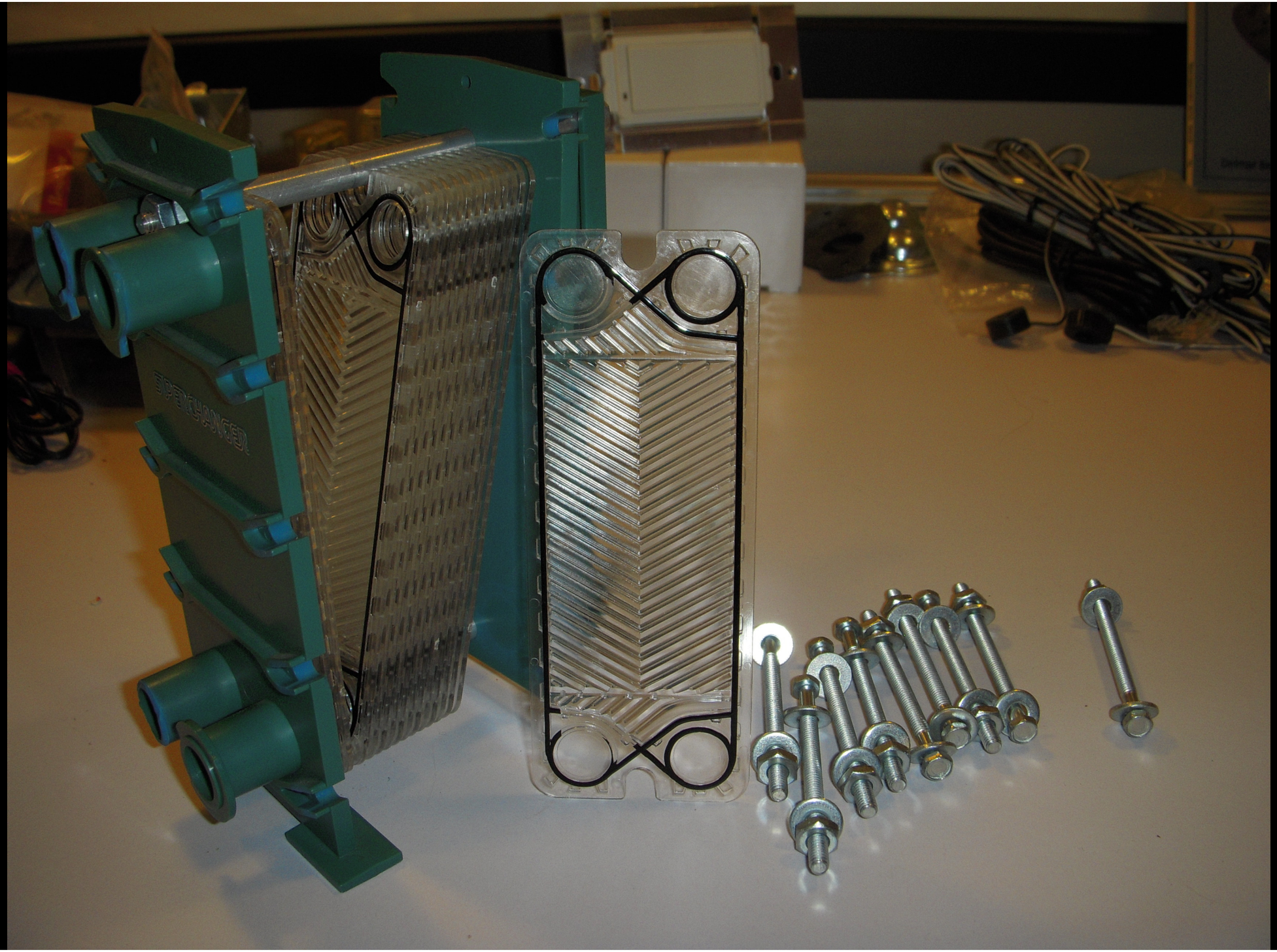
# Bonus – Free Cooling Cycles

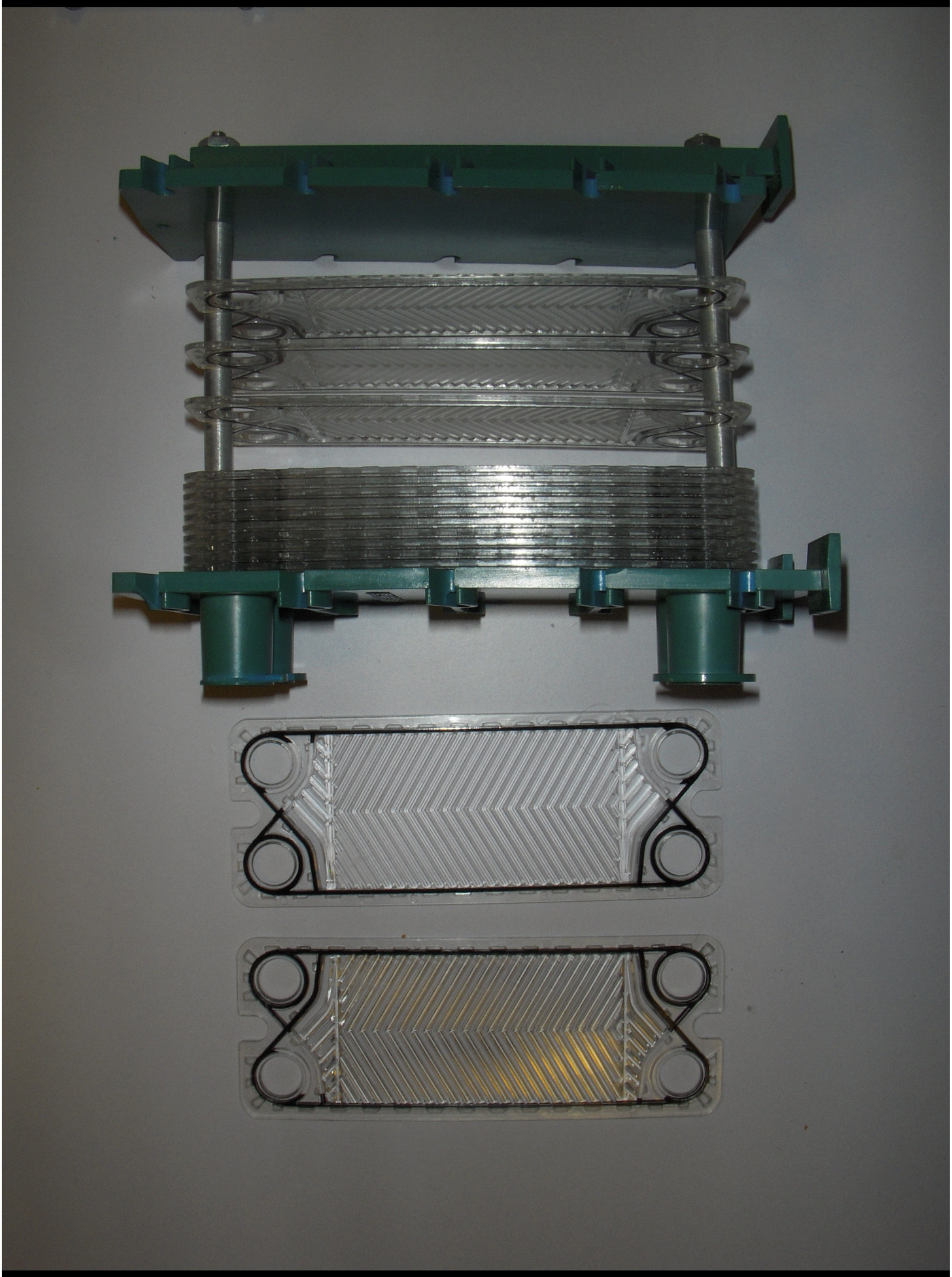
# Just Because It’s Free Doesn’t Mean You Should Use It

# Plate and Frame Heat Exchangers


SUPERCHARGER


SPECIFIED




Ratchet-end Wrenches
Screwdrivers
Air Tools


1/4" Drive Sockets
Electronics
Analyzer

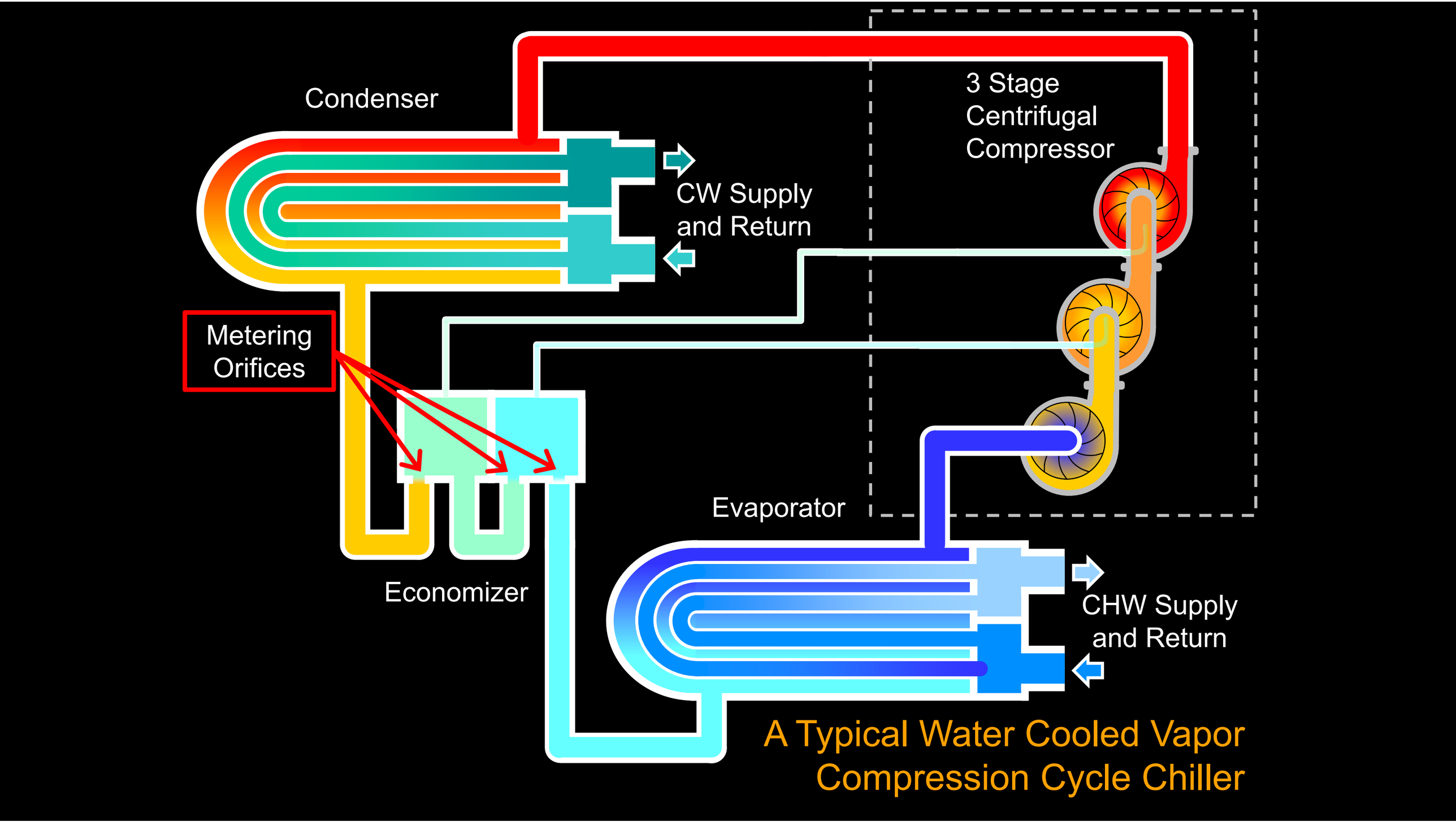
# Plate and Frame vs. Shell and Tube

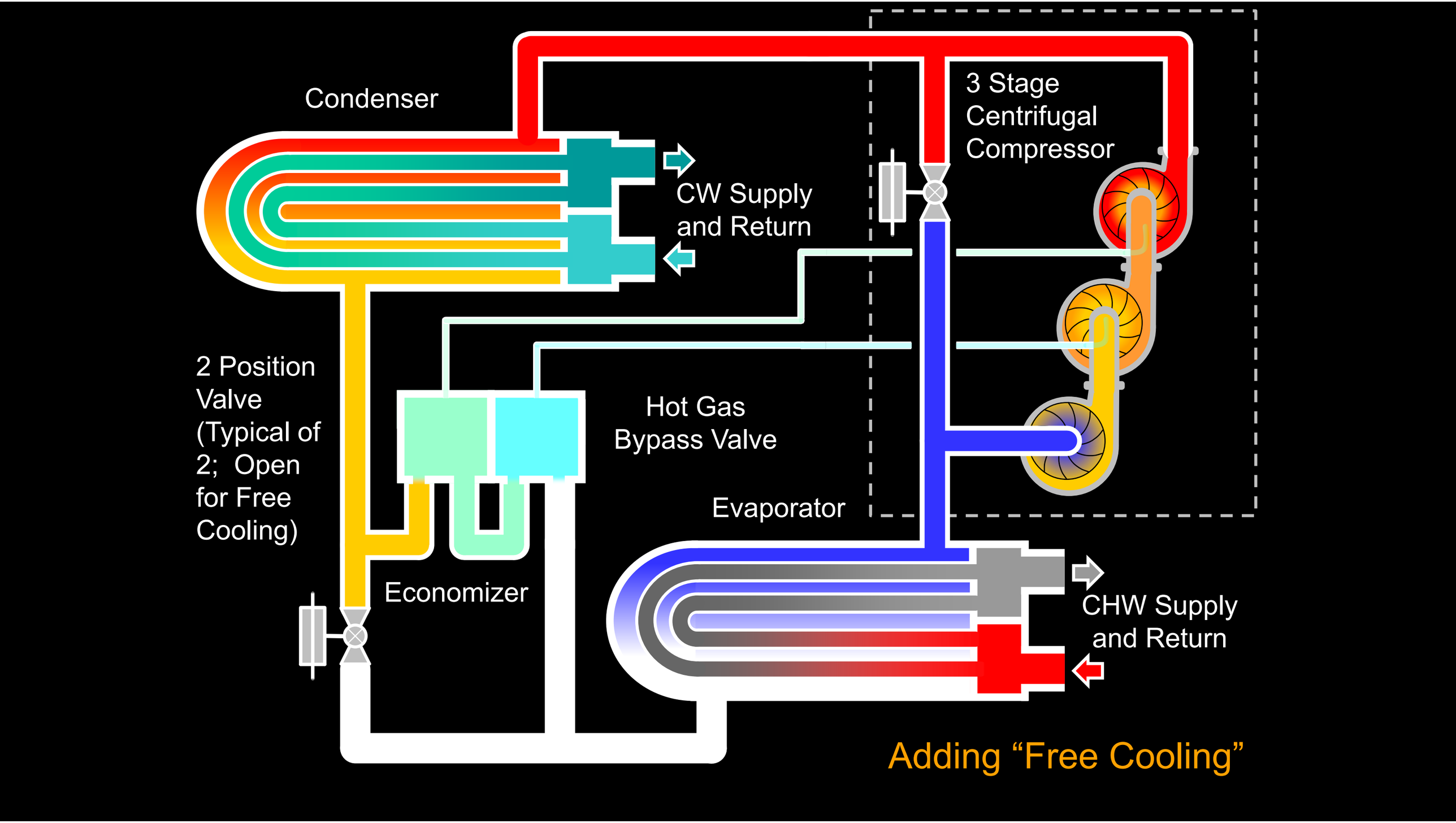
# Plate and Frame vs. Shell and Tube

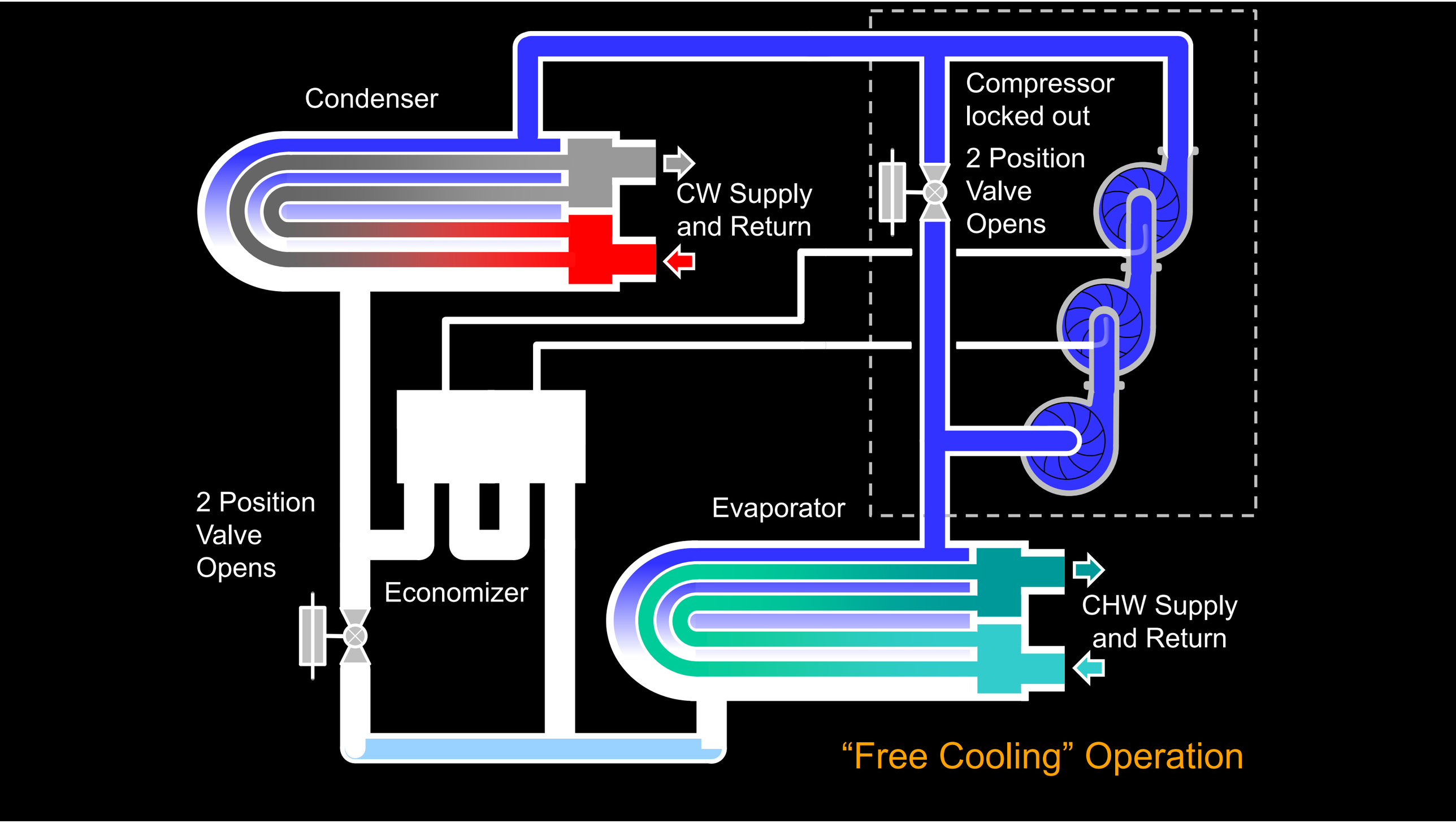
# Plate and Frame vs. Shell and Tube

# Plate and Frame vs. Shell and Tube

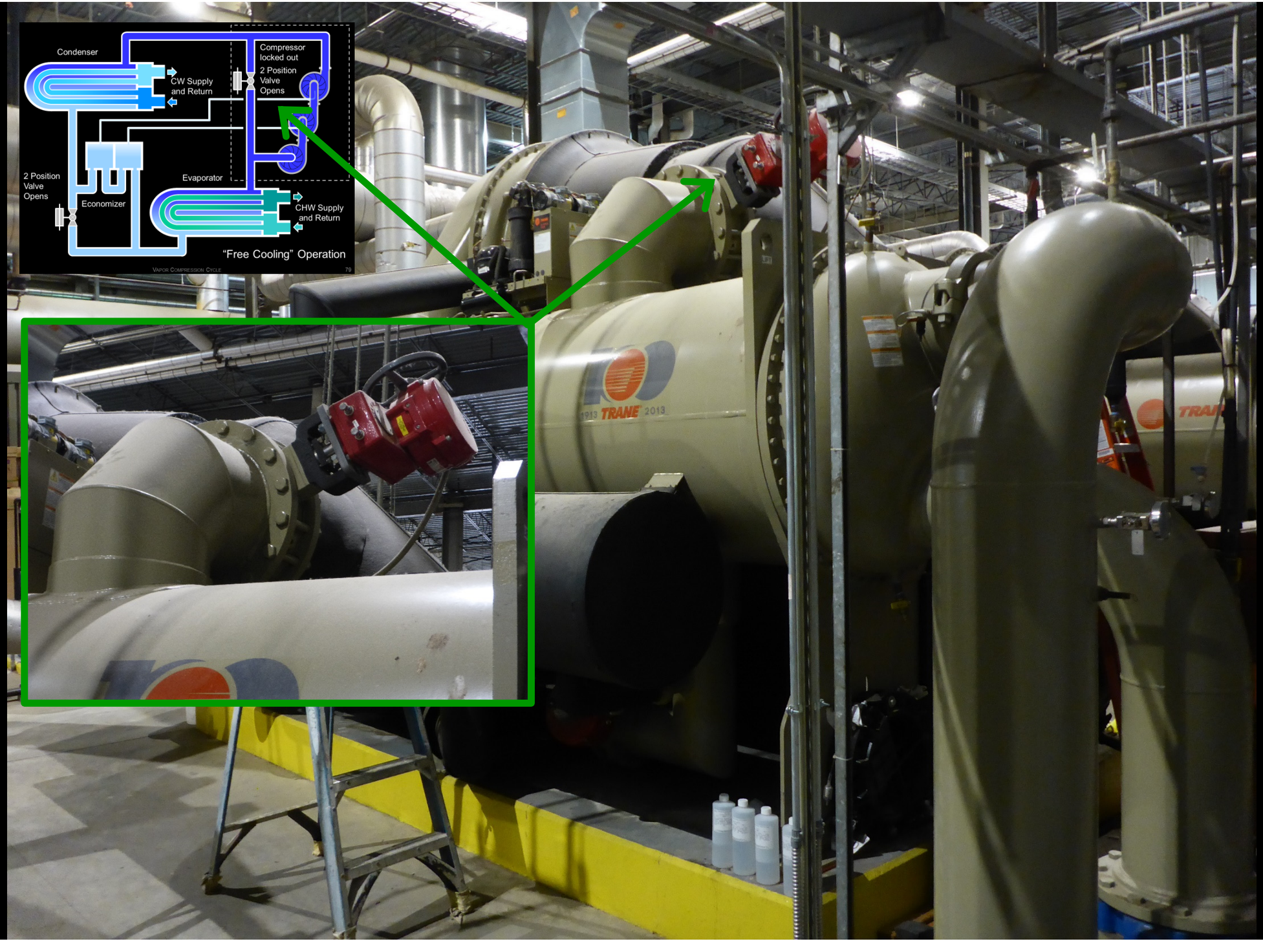
# Chiller Based Free Cooling Cycle

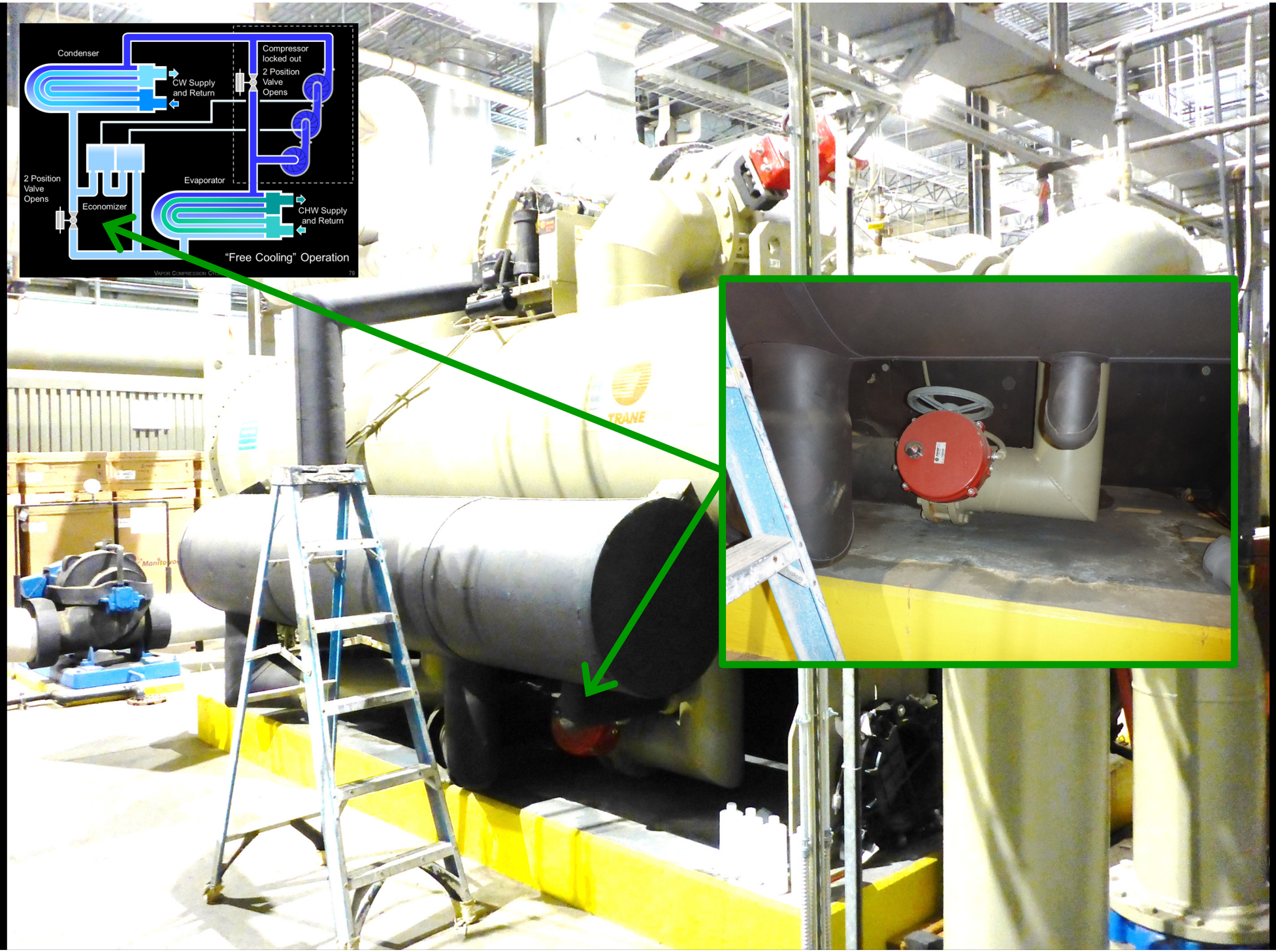

Condenser
3 Stage
Centrifugal
Compressor
CW Supply
and Return
Metering
Orifices
Economizer
Evaporator
CHW Supply
and Return
A Typical Water Cooled Vapor
Compression Cycle Chiller


Condenser
3 Stage
Centrifugal
Compressor
CW Supply
and Return
2 Position
Valve
(Typical of
2; Open
for Free
Cooling)
Hot Gas
Bypass Valve
Evaporator
Economizer
CHW Supply
and Return
Adding “Free Cooling”


Condenser
CW Supply
and Return
Compressor
locked out
2 Position
Valve
Opens
2 Position
Valve
Opens
Economizer
Evaporator
CHW Supply
and Return
“Free Cooling” Operation


Condenser
CW Supply and Return
Compressor locked out
2 Position Valve Opens
2 Position Valve Opens
Economizer
Evaporator
CHW Supply and Return
"Free Cooling" Operation
Vapor Compression Cycle
79
1913 TRANE 2013


Condenser
CW Supply and Return
Compressor locked out
2 Position Valve Opens
2 Position Valve Opens
Economizer
Evaporator
CHW Supply and Return
"Free Cooling" Operation
Vapor Compression Cycle
79


Condenser
CW Supply and Return
Compressor locked out
2 Position Valve Opens
2 Position Valve Opens
Economizer
Evaporator
CHW Supply and Return
"Free Cooling" Operation
TRANE