



## **Utilization of Modular Chillers & UV in Low Temp Critical Environments at Healthcare Facilities**

*FHEA Expo & Training Camp; St. Petersburg Hilton Bayfront, November 8-11, 2025*

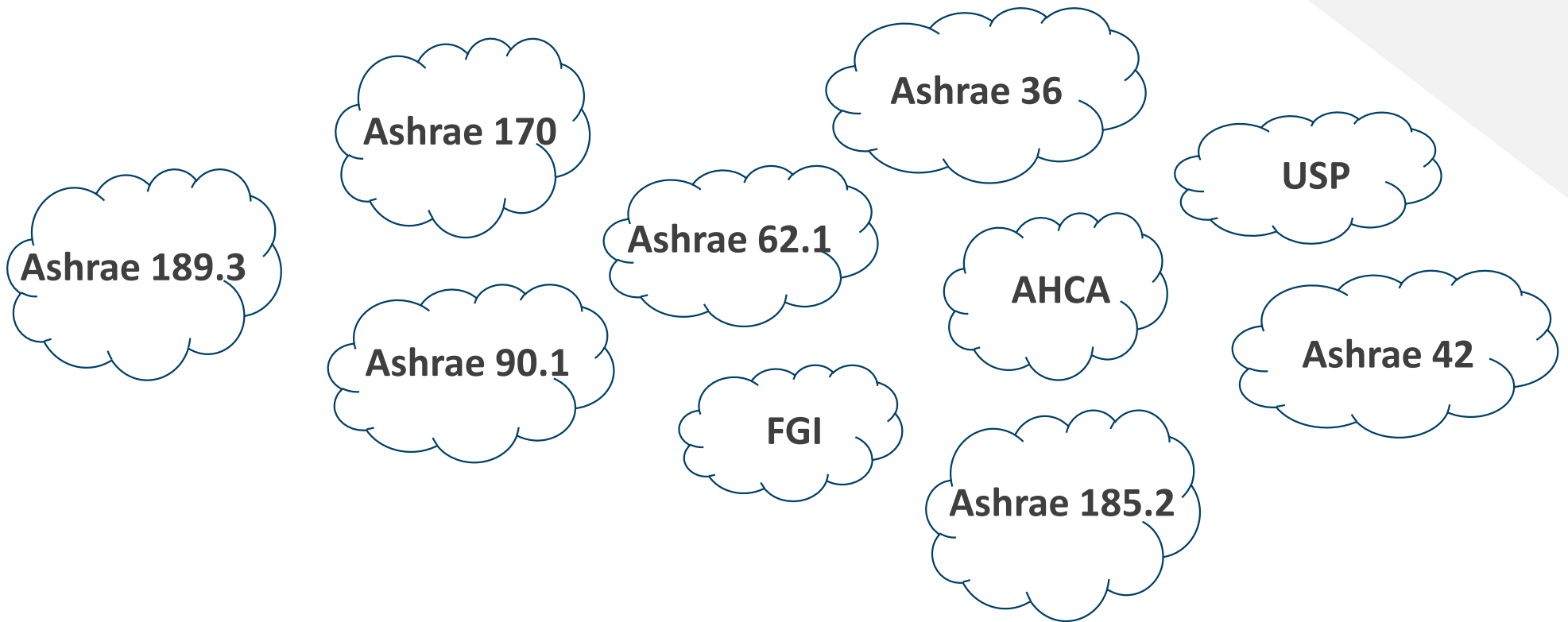


## Outline

- Introduction
- Design Conditions for Critical Environments
- The Role of the modular chiller
- Integration into low temp systems
- UV in low temp applications
- Case Study



# Standards, Guidelines & Codes





**Pharmacies**

**68 F / 50%**  
48.70 F DP  
51.04 GR/LB  
24.28 BTU/LB

**65 F / 50%**  
45.94 F DP  
45.95 GR/LB  
22.76 BTU/LB

**62 F / 50%**  
43.18 F DP  
41.32 GR/LB  
21.31 BTU/LB

**60 F / 50%**  
41.34 F DP  
38.46 GR/LB  
20.38 BTU/LB

**55 F / 50%**  
36.73 F DP  
32.08 GR/LB  
18.18 BTU/LB



## Operating Rooms



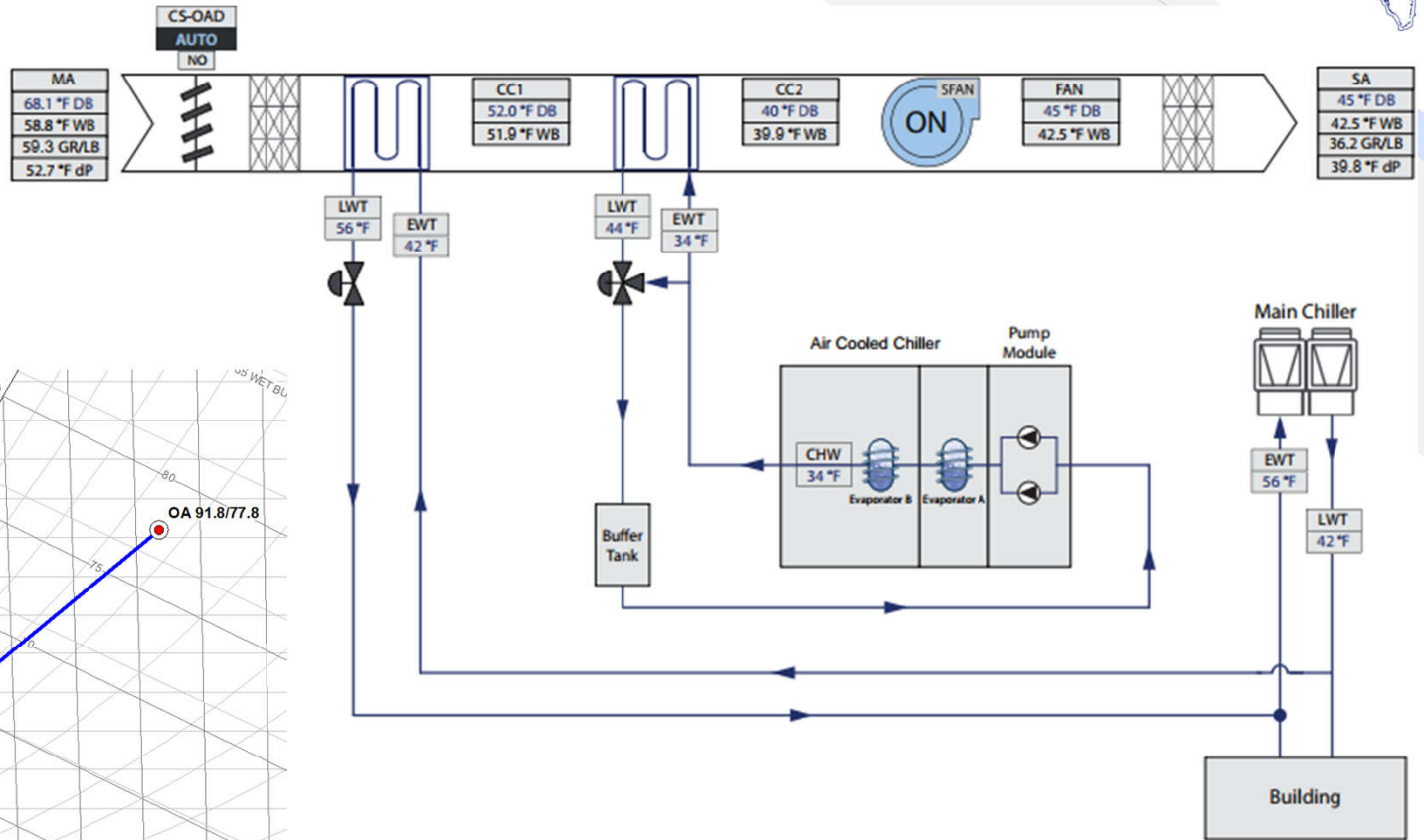
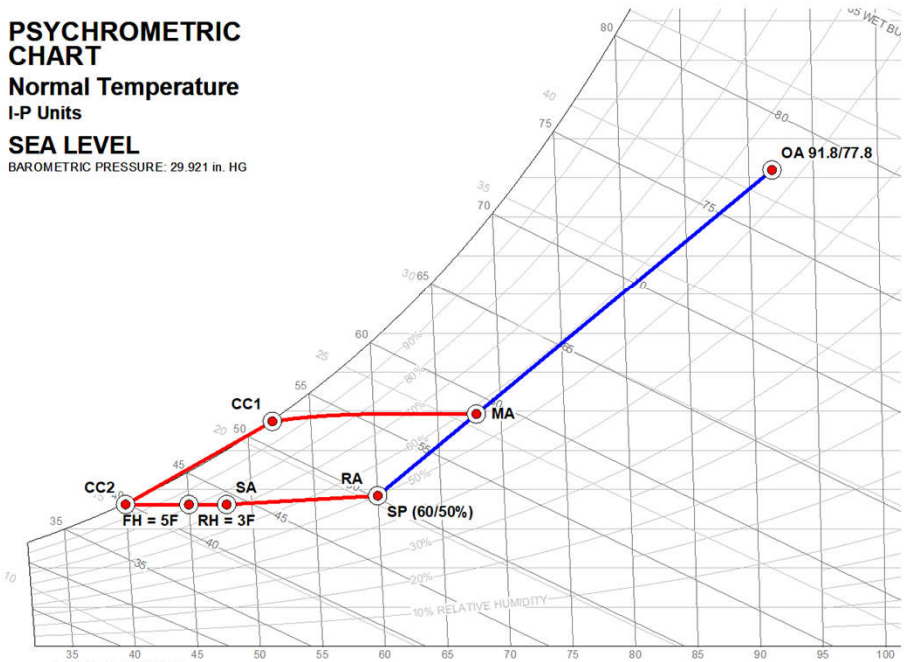
### What or Who determines design conditions...?

- a. Codes
- b. Standards
- c. Procedure
- d. Surgeon
- e. Pharmacist
- f. Facility Administrator/Manager
- g. Design Professional
- h. AHJ
- i. All of the above

# LTCH Piping Schematic "1"



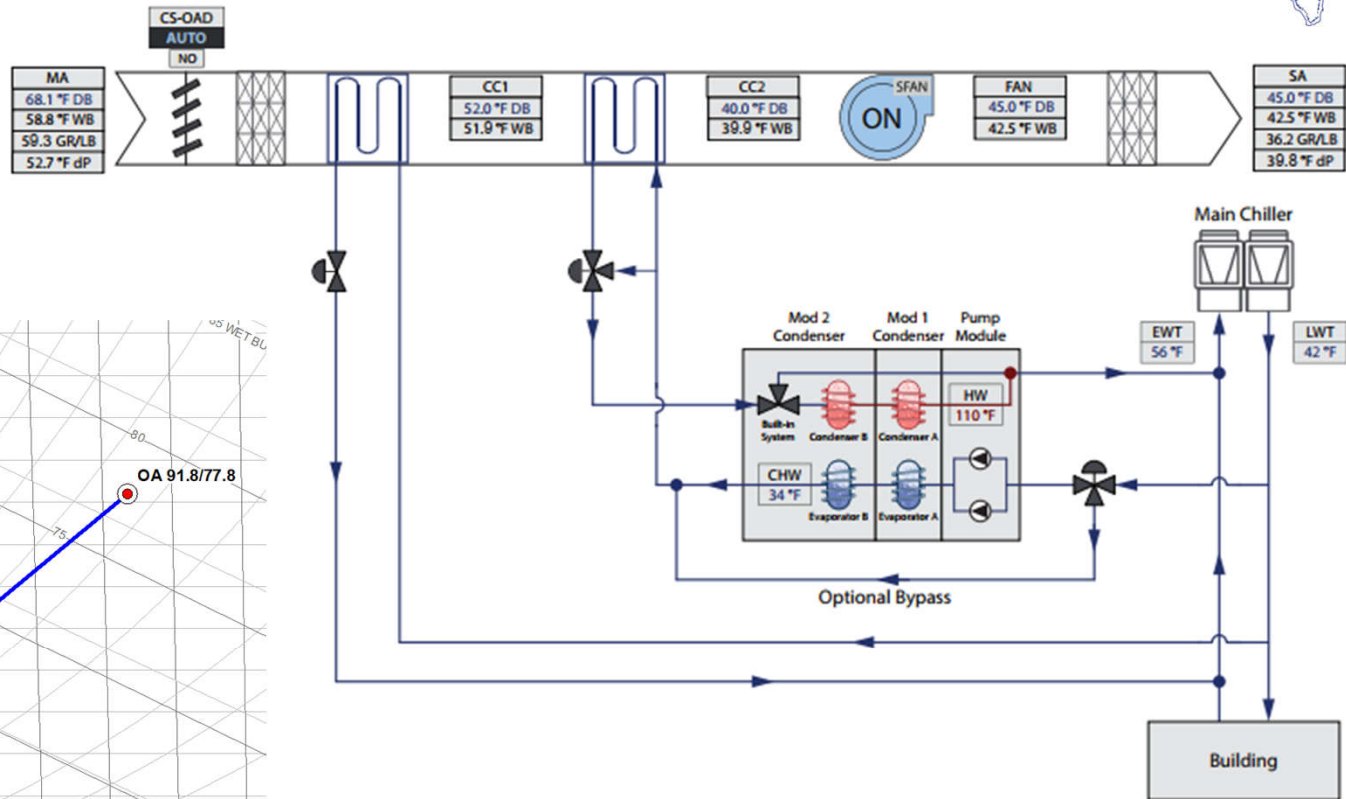
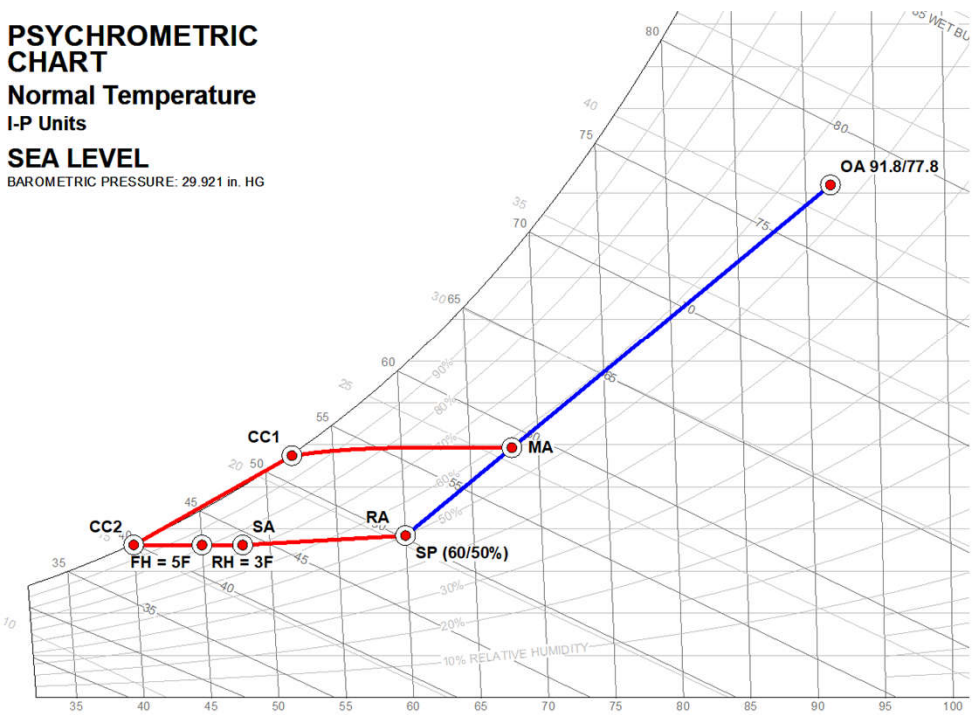
**PSYCHROMETRIC CHART**  
 Normal Temperature  
 I-P Units  
**SEA LEVEL**  
 BAROMETRIC PRESSURE: 29.921 in. HG



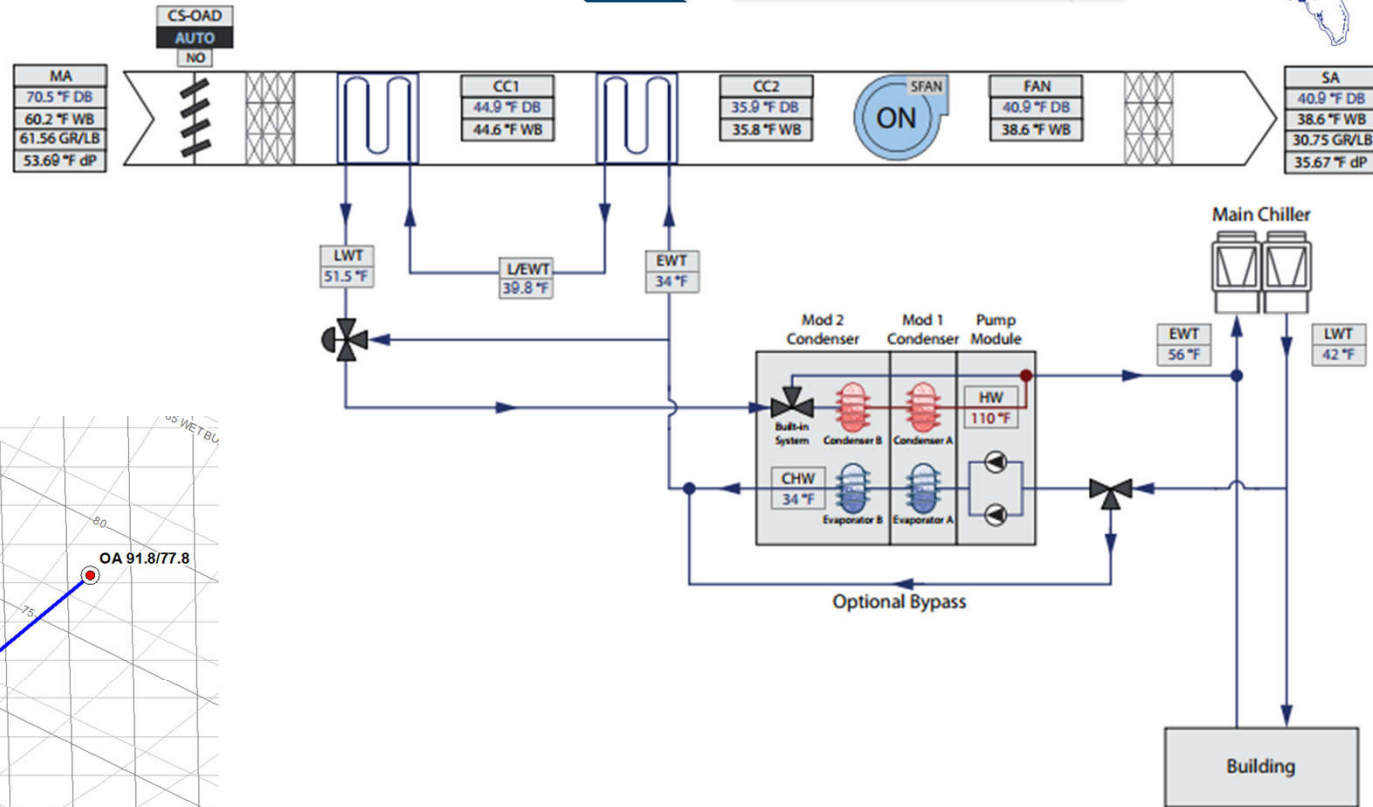
# LTCH Piping Schematic "2"



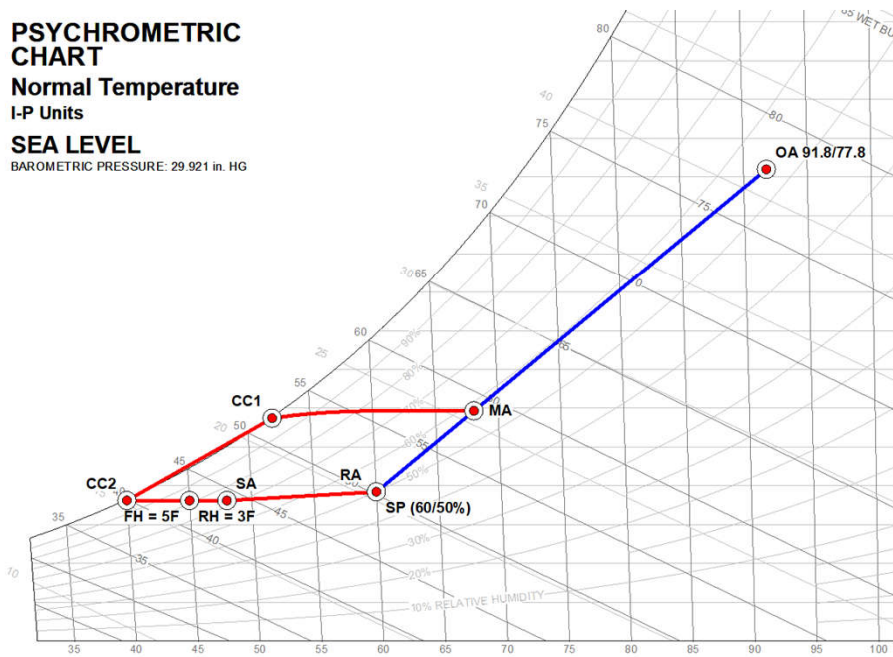
**PSYCHROMETRIC CHART**  
 Normal Temperature  
 I-P Units  
**SEA LEVEL**  
 BAROMETRIC PRESSURE: 29.921 in. HG



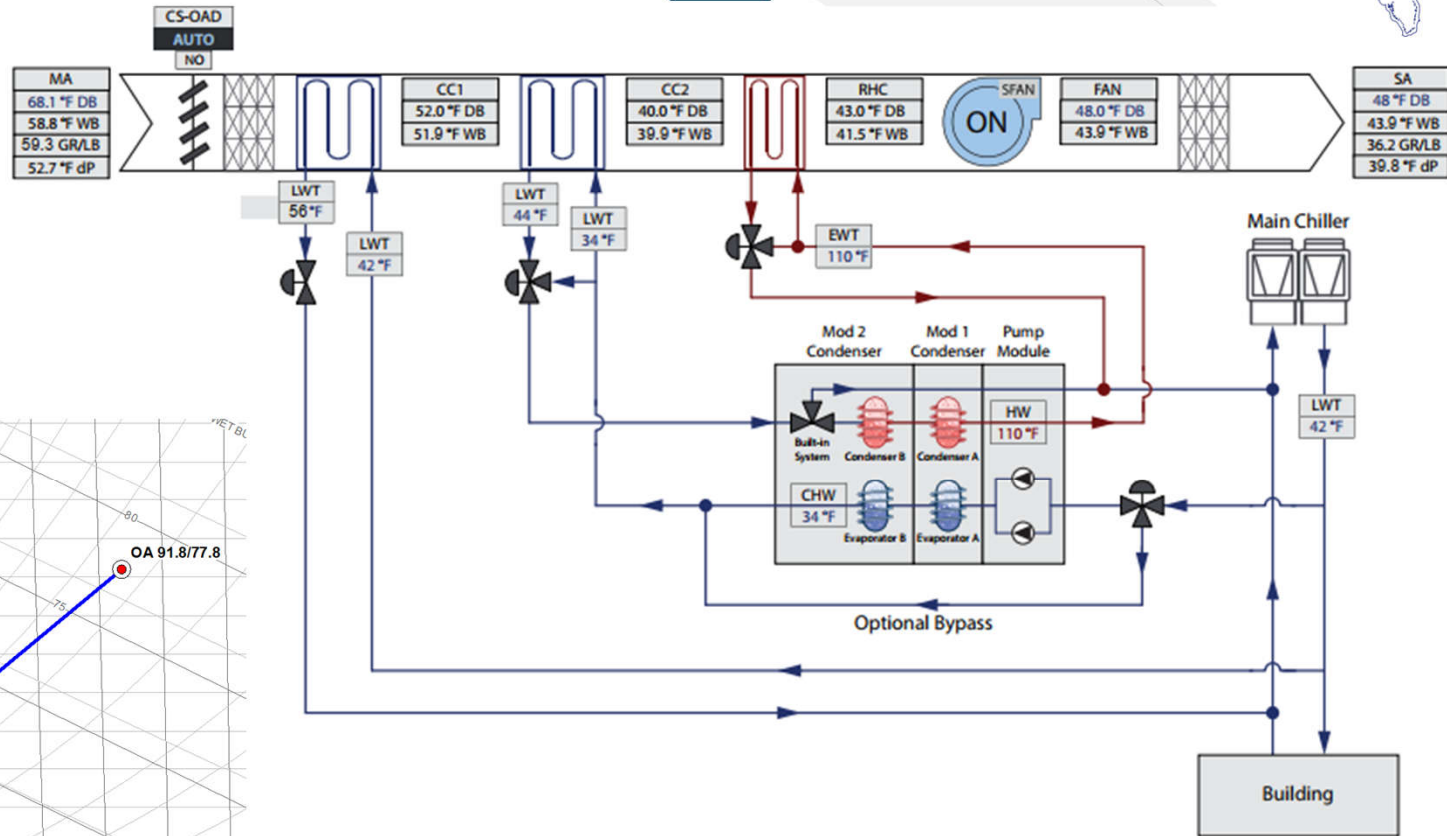
# LTCH Piping Schematic "3"



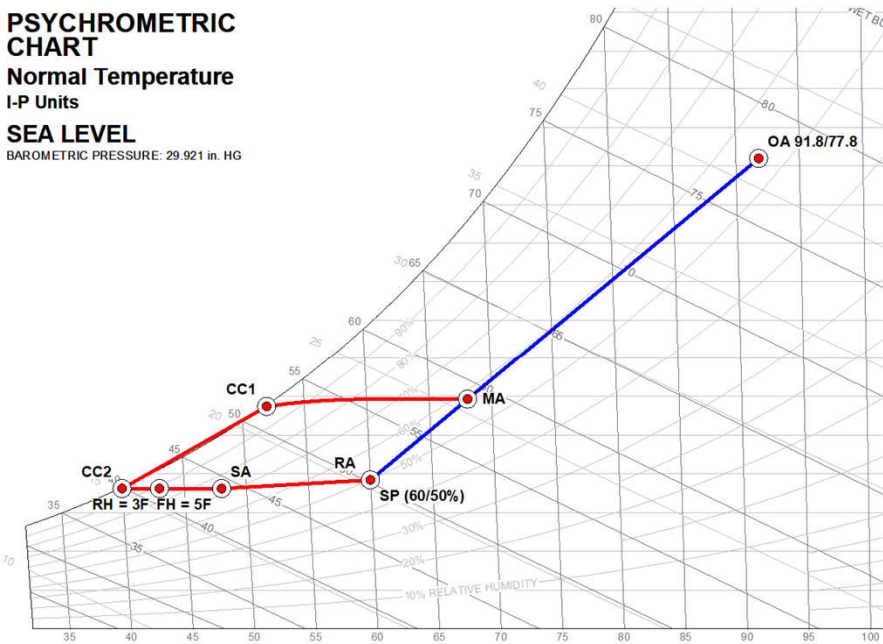
**PSYCHROMETRIC CHART**  
 Normal Temperature  
 I-P Units  
 SEA LEVEL  
 BAROMETRIC PRESSURE: 29.921 in. HG



# LTCH Piping Schematic "4"



**PSYCHROMETRIC CHART**  
 Normal Temperature  
 I-P Units  
**SEA LEVEL**  
 BAROMETRIC PRESSURE: 29.921 in. HG







# Hospital Energy by End Use

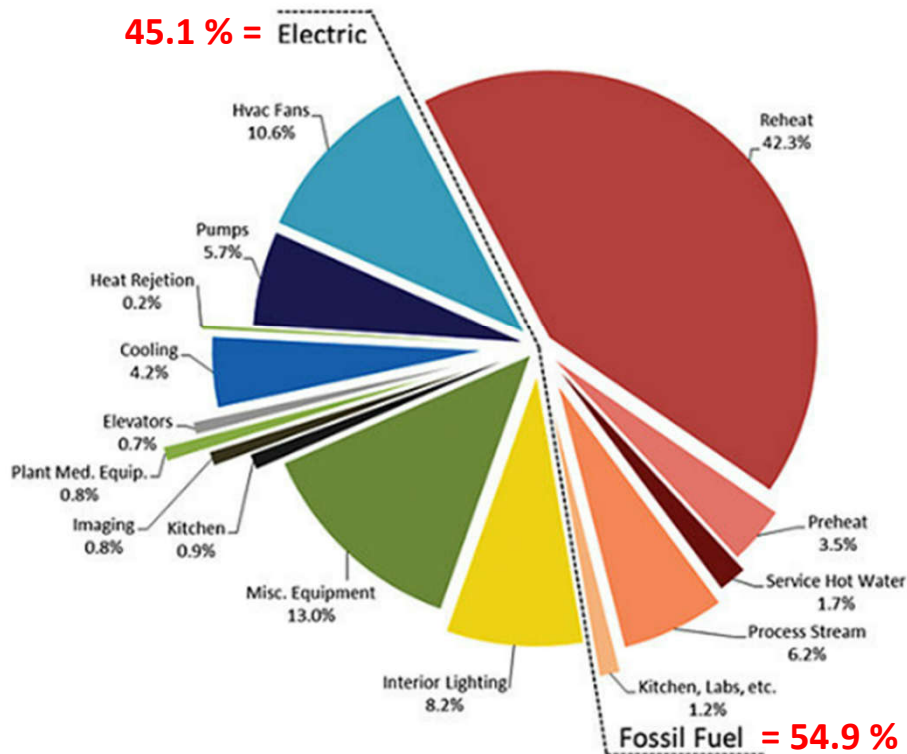


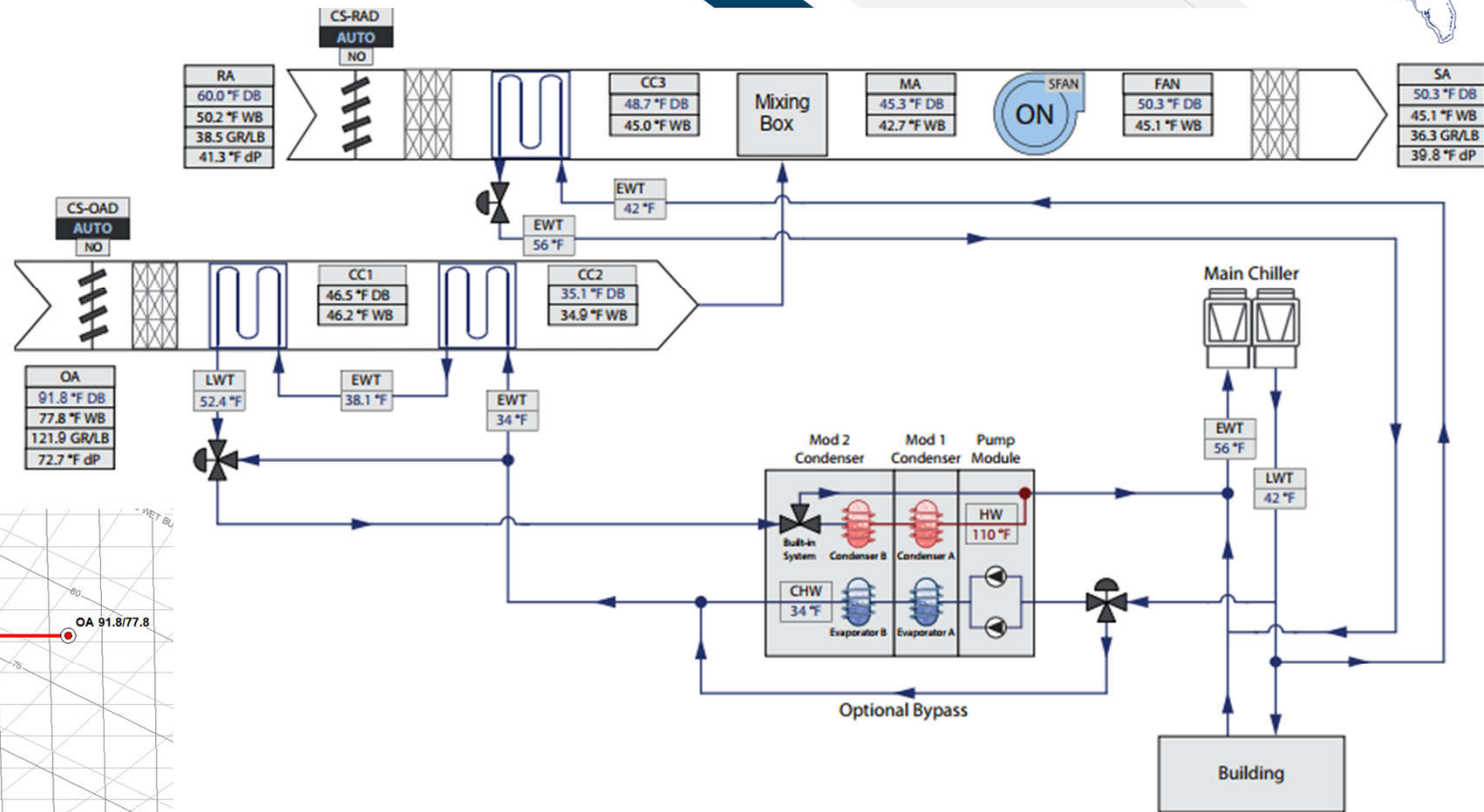
Table 1. Annual Energy Use Summary

| Annual Energy Use Summary                 |                     |              |               |             |                |                   |              |             |
|---|---------------------|--------------|---------------|-------------|----------------|-------------------|--------------|-------------|
| Legacy Salmon Creek Medical Center - 2010 |                     |              |               |             |                |                   |              |             |
| Fuel                                      | End Use             | 2010 EUI     | MMBtu         | %           | Therms         | kWh               | Avg. kW      | Avg. wsf    |
| Natural Gas                               | Reheat              | 90.4         | 42,112        | 42.2%       | 421,115        |                   |              |             |
|   | Preheat             | 7.6          | 3,533         | 3.5%        | 35,334         |                   |              |             |
|   | Service Hot Water   | 3.7          | 1,705         | 1.7%        | 17,053         |                   |              |             |
|   | Process Steam       | 13.3         | 6,187         | 6.2%        | 61,871         |                   |              |             |
|   | Kitchen, Labs, etc. | 2.6          | 1,229         | 1.2%        | 12,291         |                   |              |             |
| Electricity                               | Interior Lighting   | 17.5         | 8,146         | 8.2%        |                | 2,386,815         | 272          | 0.59        |
|   | Misc. Equipment     | 27.9         | 12,981        | 13.0%       |                | 3,803,263         | 434          | 0.93        |
|   | Kitchen             | 1.9          | 891.2         | 0.9%        |                | 261,105           | 30           | 0.06        |
|   | Imaging             | 1.7          | 782.1         | 0.8%        |                | 229,167           | 26           | 0.06        |
|   | Plant Med. Equip.   | 1.8          | 829.2         | 0.8%        |                | 242,958           | 28           | 0.06        |
|   | Elevators           | 1.5          | 706.9         | 0.7%        |                | 207,132           | 24           | 0.05        |
|   | Cooling             | 9.1          | 4,238         | 4.2%        |                | 1,241,746         | 142          | 0.30        |
|   | Heat Rejection      | 0.5          | 228.5         | 0.2%        |                | 66,950            | 8            | 0.02        |
|   | Pumps               | 12.2         | 5,675         | 5.7%        |                | 1,662,877         | 190          | 0.41        |
|   | HVAC Fans           | 22.8         | 10,610        | 10.6%       |                | 3,108,591         | 355          | 0.76        |
| <b>Total</b>                              |                     | <b>214.4</b> | <b>99,854</b> | <b>100%</b> | <b>547,665</b> | <b>13,210,605</b> | <b>1,508</b> | <b>3.24</b> |

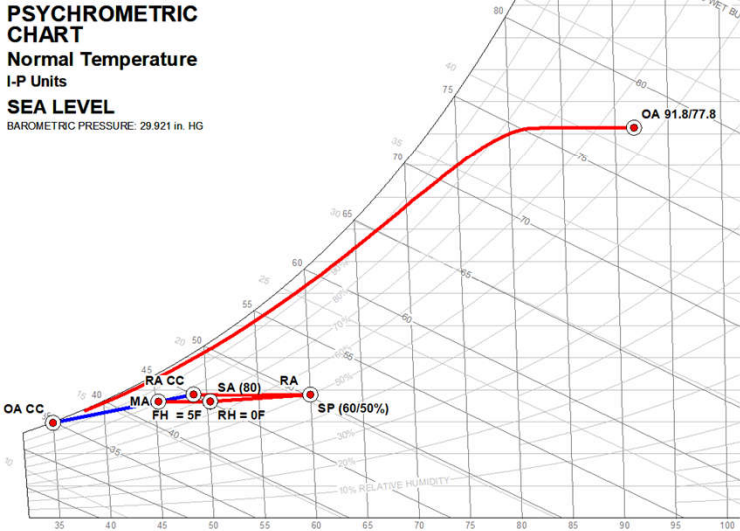
Hatten, M., Van Houten, B., Burpee, H., Loveland, J. "Targeting 100! Energy Use and Model Calibration Study for Legacy Salmon Creek Medical Center." A Section of "Advanced Energy Efficient Building Technologies for High Performance Hospitals." University of Washington, Integrated Design Lab. Funded by Department of Energy and Northwest Energy Efficiency Alliance. July 2011.

Annual energy use for Legacy Salmon Creek Hospital was calculated at an EUI of 214.4 kBtu/sf-yr, based on the utility data provided by the Hospital. The main Hospital Building consists of 465,692 square feet. The energy use breakdown shown in Table 1 was calculated primarily using utility data and adjusted in conjunction with power monitoring system data and calibrated energy model output.

# LTCH Piping Schematic "5"



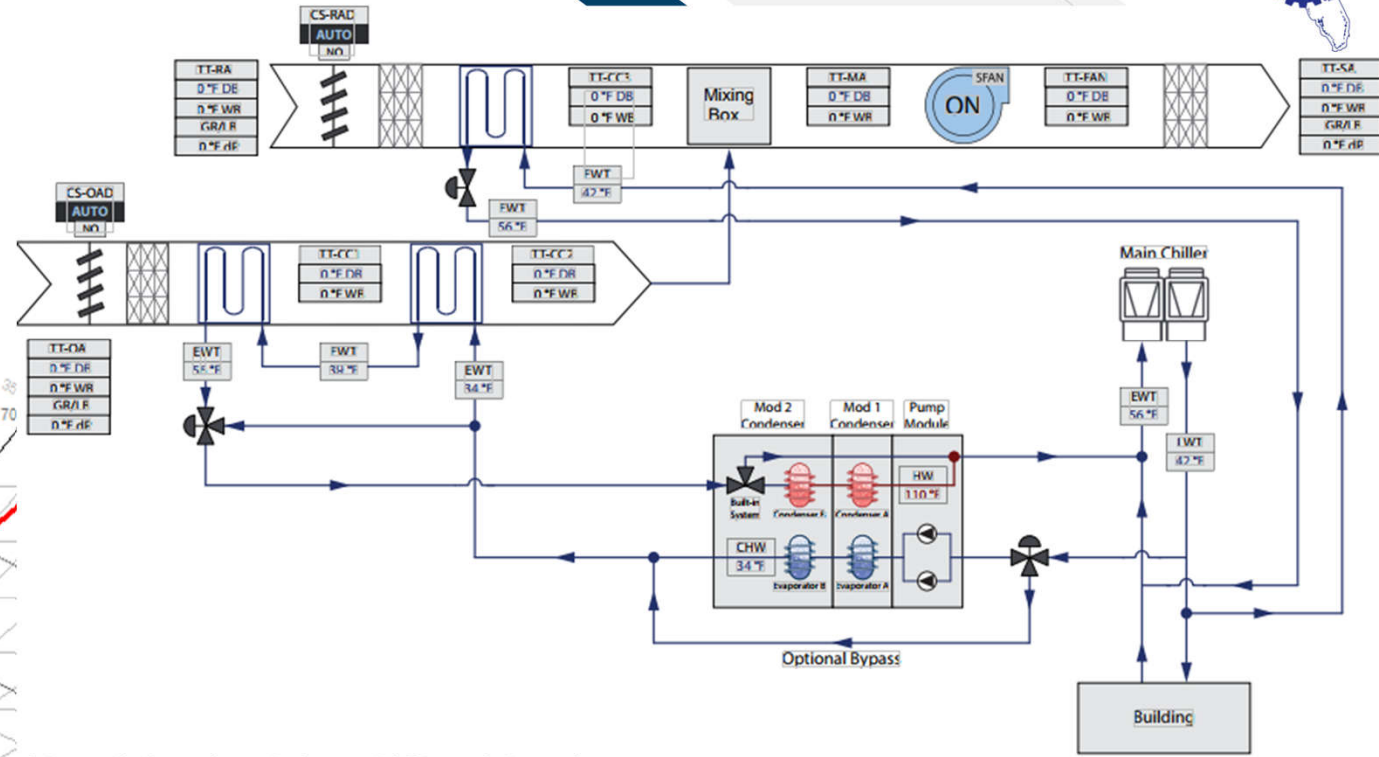
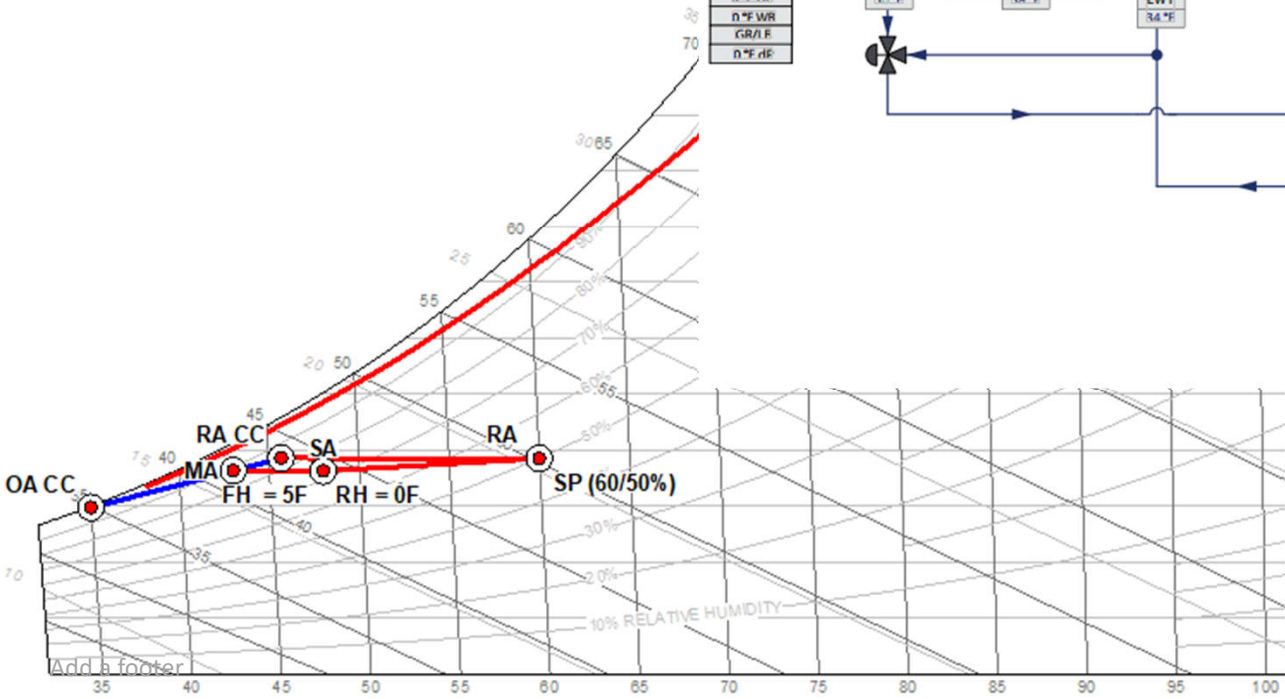
**PSYCHROMETRIC CHART**  
Normal Temperature  
I-P Units  
SEA LEVEL  
BAROMETRIC PRESSURE: 29.921 in. HG



# LTCH Piping Schematic "5"



**PSYCHROMETRIC CHART**  
 Normal Temperature  
 I-P Units  
**SEA LEVEL**  
 BAROMETRIC PRESSURE: 29.921 in. HG



# ASHRAE 185.2 Testing for Successful UV-C Applications

FEATURE


©ASHRAE www.ashrae.org Used with permission from ASHRAE Journal at www.ashrae.org. This article may not be copied nor distributed in either paper or digital form without ASHRAE's permission. For more information about ASHRAE, visit www.ashrae.org.

## Why ASHRAE Standard 185.2 is Important to the Success of Germicidal Ultraviolet Projects

BY LARRY FLETCHER, ASSOCIATE MEMBER ASHRAE; WALTER ELLIS, MEMBER ASHRAE

UV devices have been incorporated into HVAC systems as part of decarbonization efforts and to maintain coil efficiency. They are also in ASHRAE Standard 241-2023, *Control of Infectious Aerosols*. It is important to understand how the installation environment may affect the performance of a UV-C system. ANSI/ASHRAE Standard 185.2-2020, *Method of Testing Ultraviolet Lamps for Use in HVAC&R Units or Air Ducts to Inactivate Microorganisms on Irradiated Surfaces*, is a test method designed specifically to determine UV device performance when under HVAC-induced windchill conditions based on temperature, humidity and airflow.<sup>1</sup>

Low pressure UV lamps are the most commonly used UV-C source for microbial reductions in air, water and wastewater. UV was originally used for bacterial control by Niels Ryberg Finsen to treat tuberculosis of the skin, for which he received the Nobel Prize in 1903. Commercial production of UV lamps began in the early 1900s. A Cooper Hewitt lamp<sup>2</sup> is shown here.

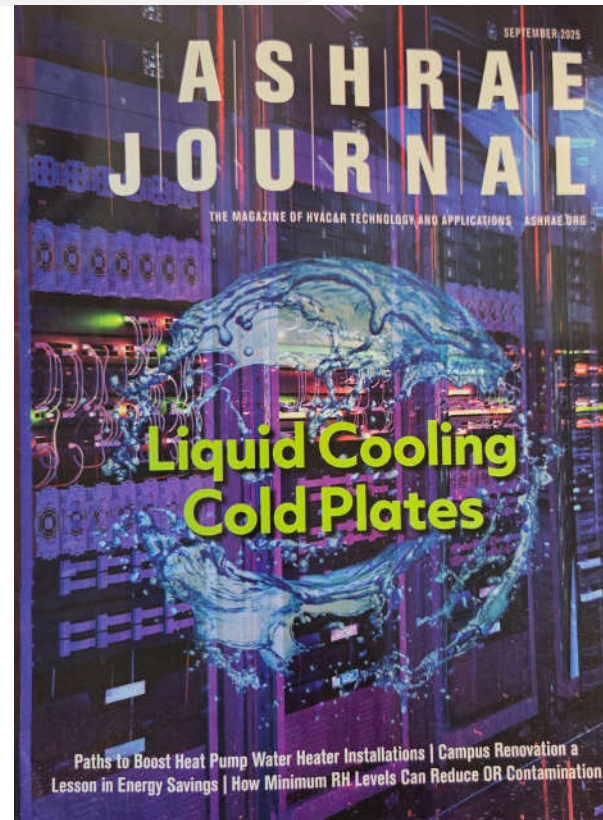


Cooper Hewitt UV Lamp<sup>2</sup>

The performance of early, modern UV-C lamps has been shown to be impacted by the temperature of its surrounding environment, with an ideal operating temperature between 75°F - 80°F (24°C - 27°C).<sup>3,4</sup> These lamps rely on gaseous mercury to produce the UV-C wavelengths and use a combination of temperature and pressure to generate their UV-C output by creating an internal environment for the optimum mercury vapor pressure. When the surrounding environment is colder or hotter than the ideal operating temperature, it will impact the mercury vapor pressure and subsequent lamp performance.

Larry Fletcher is technical director and Walter Ellis is executive vice president at RCF Environmental in Riviera Beach, Fla.

48 ASHRAE JOURNAL ashrae.org SEPTEMBER 2025



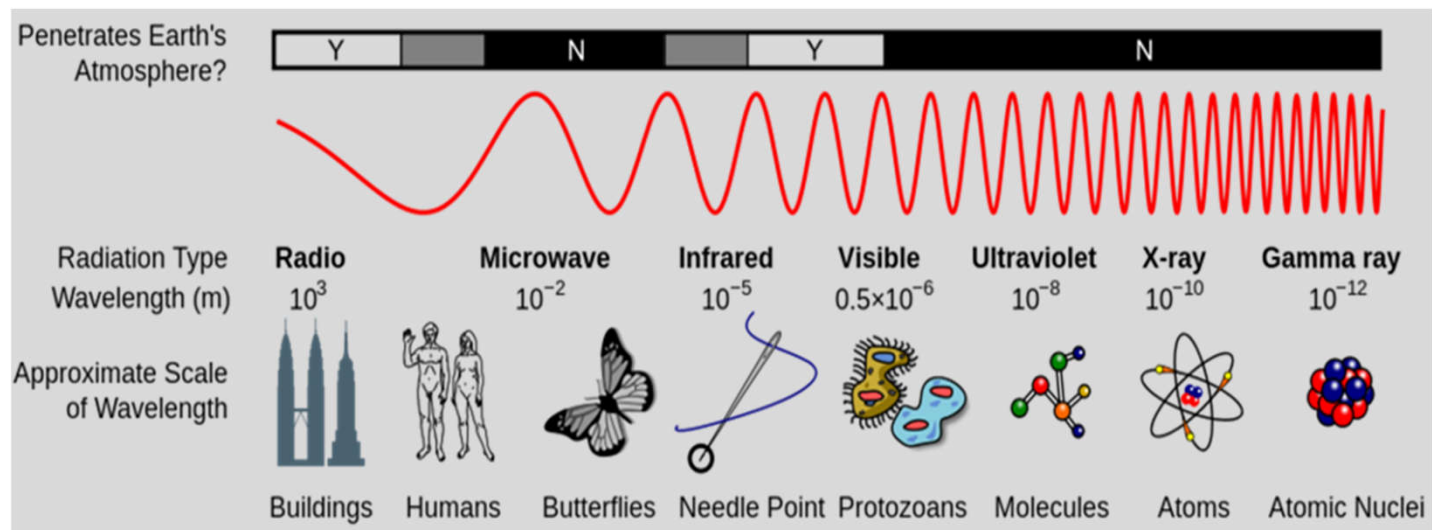
13. ASHRAE. 2020. ANSI/ASHRAE Standard 185.2-2020, Method of Testing Ultraviolet Lamps for Use in HVAC&R Units or Air Ducts to Inactivate Microorganisms on Irradiated Surfaces. Atlanta: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
14. Fletcher, L. 2025. Why ASHRAE Standard 185.2 is Important to the Success of Germicidal Ultraviolet Projects. ASHRAE Journal 67(9).



# What Is UV?

## AI Says:

“...a form of electromagnetic radiation with wavelengths shorter than visible light but longer than X-rays, making it invisible to the human eye. The ultraviolet (UV) wavelength range is from 100 to 400 nanometers (nm). UV radiation is typically divided into three bands: UV-A (315–400 nm), UV-B (280–315 nm), and UV-C (100–280 nm). UV-A has the longest wavelength and least energy, while UV-C has the shortest wavelength and highest energy.”



# So Why Might Installations Fail?

## Common Challenges:

1. Poor Understanding of UV sources.
2. Over Simplification of “System Sizing”.
3. Not Taking Into Account The Environment.

These all assume UV sources are identical and are not impacted by the installation environment!

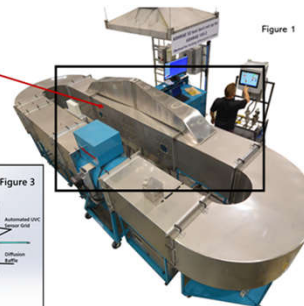
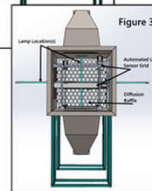
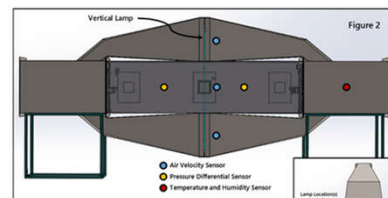
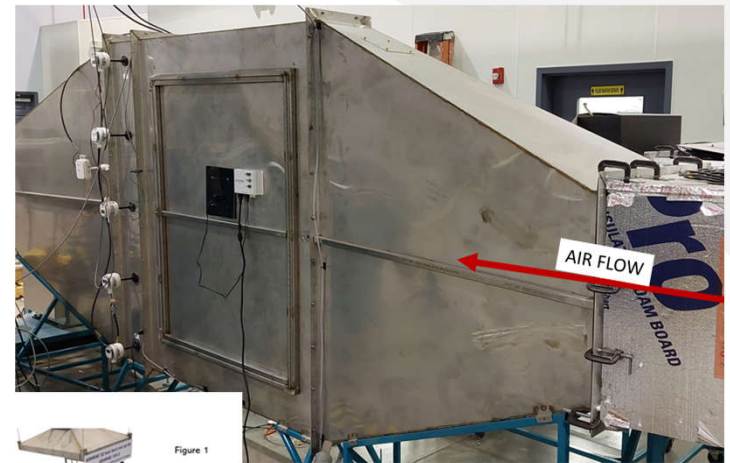




# ASHRAE 185.2 – Provides *Windchill* Data

## Basic Test Parameters:

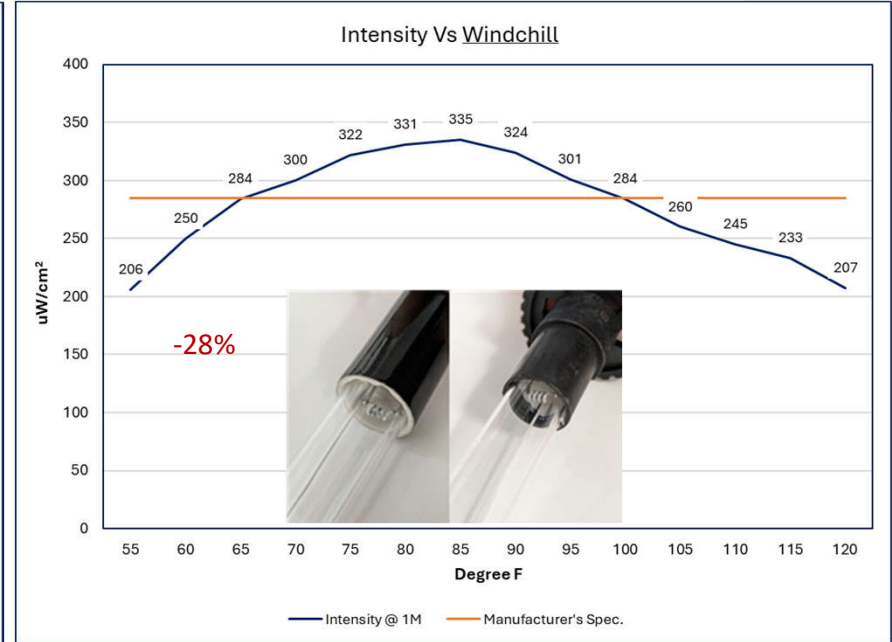
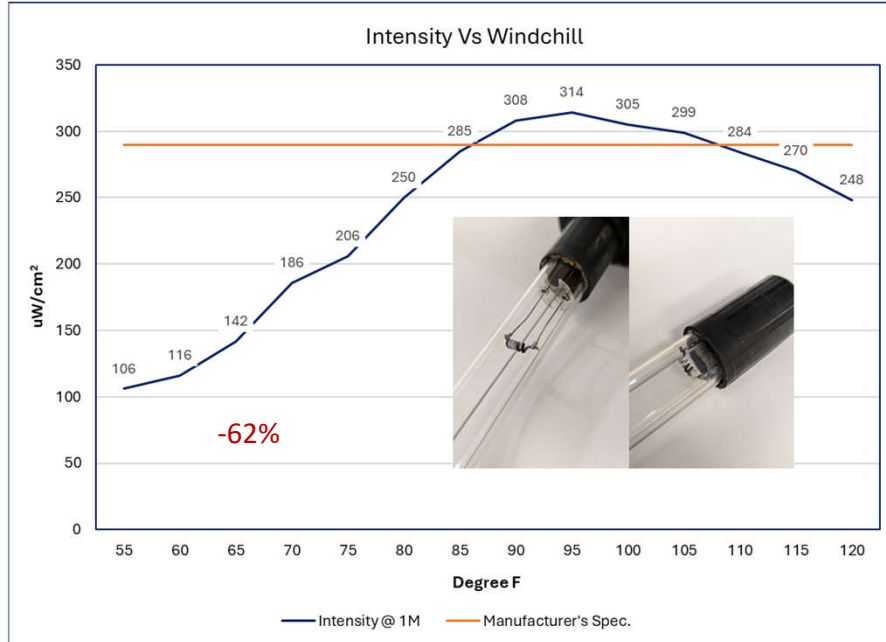
1. 50% RH (+/- 10%)
2. Air Flow 500 fpm (8.33 fps)
3. Measure intensity at 1 meter at 55, 75, and 120 F





# What We Learned... 2 Different 42" HO Bulbs

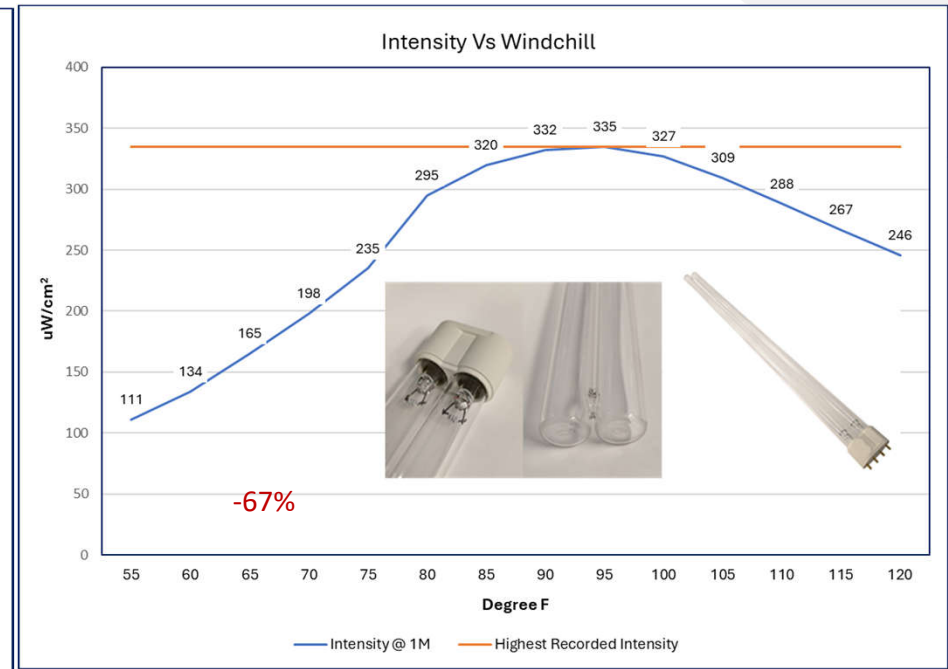
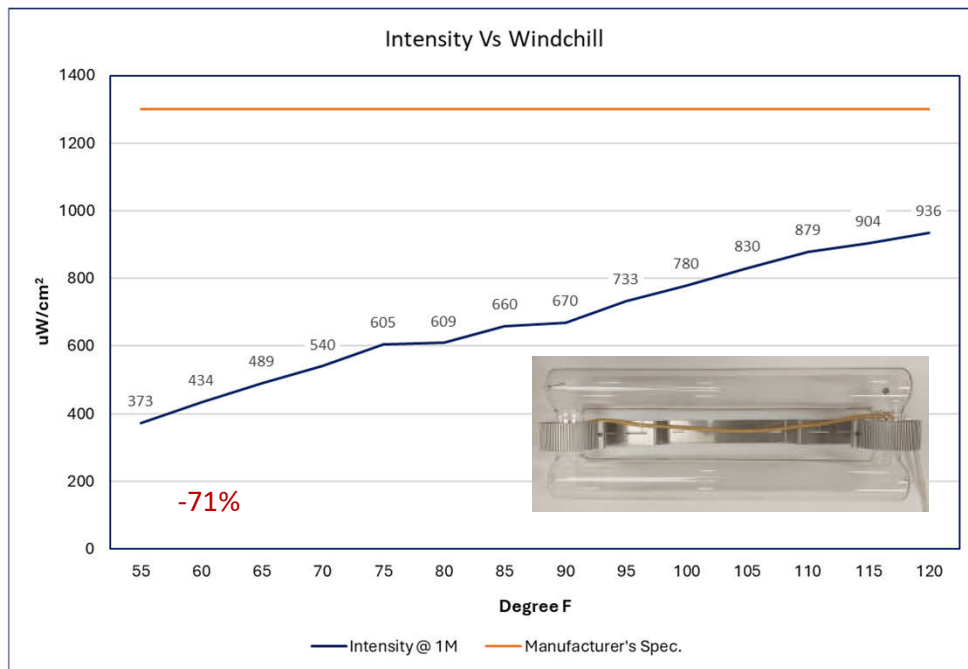
| Description                                     | Mfg. Spec @ 1 M<br>( $\mu\text{W}/\text{cm}^2$ ) | Lamp<br>Wattage |
|---|--|-----------------|
| 42 inch T5 HO stick lamp with "short filaments" | 290  | 100             |
| 42 inch T5 HO lamp with "long filaments"        | 285  | 105             |





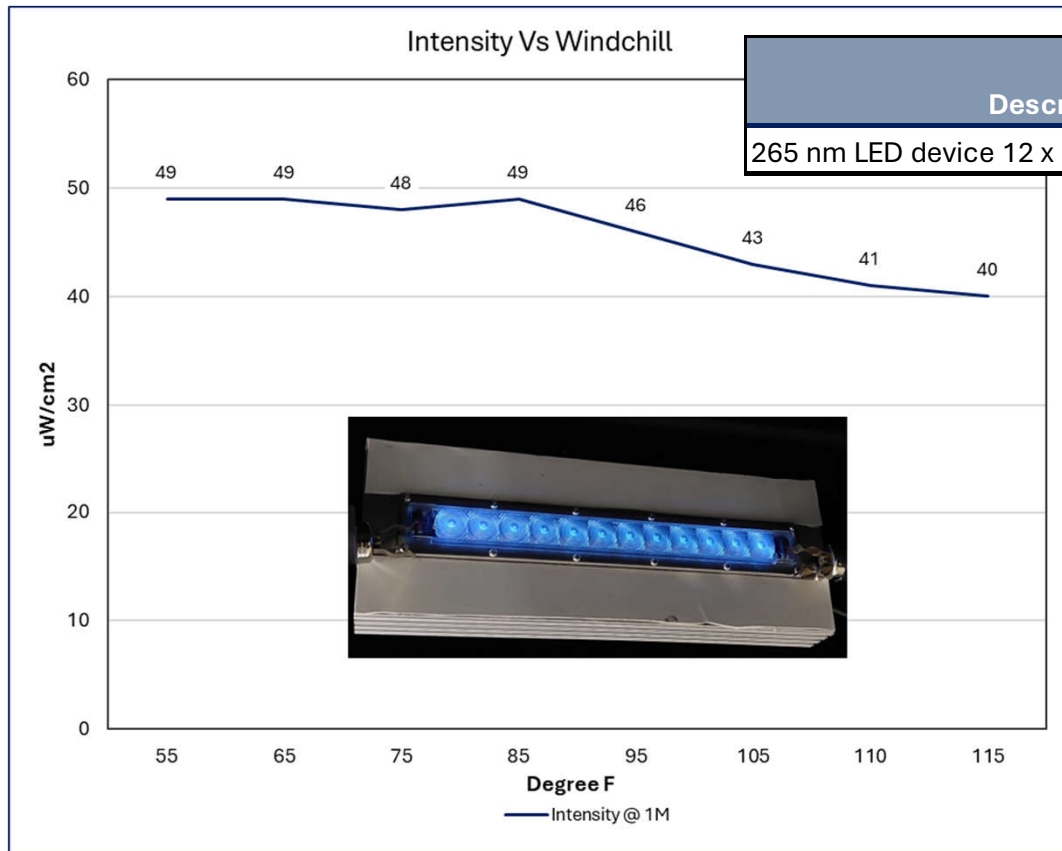
# What We Learned... Induction and PLL Bulbs

| Description               | Mfg. Spec @ 1 M<br>( $\mu\text{W}/\text{cm}^2$ ) | Lamp<br>Wattage |
|---------------------------|--|-----------------|
| Induction lamp (Figure 3) | 1300   | 300             |
| 95 Watt PLL (Figure 4)    | NA   | 95              |





# What We Learned...LED

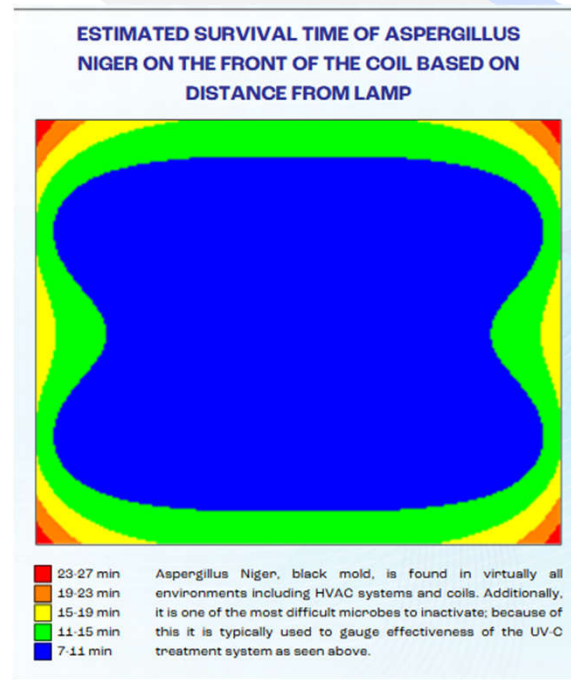
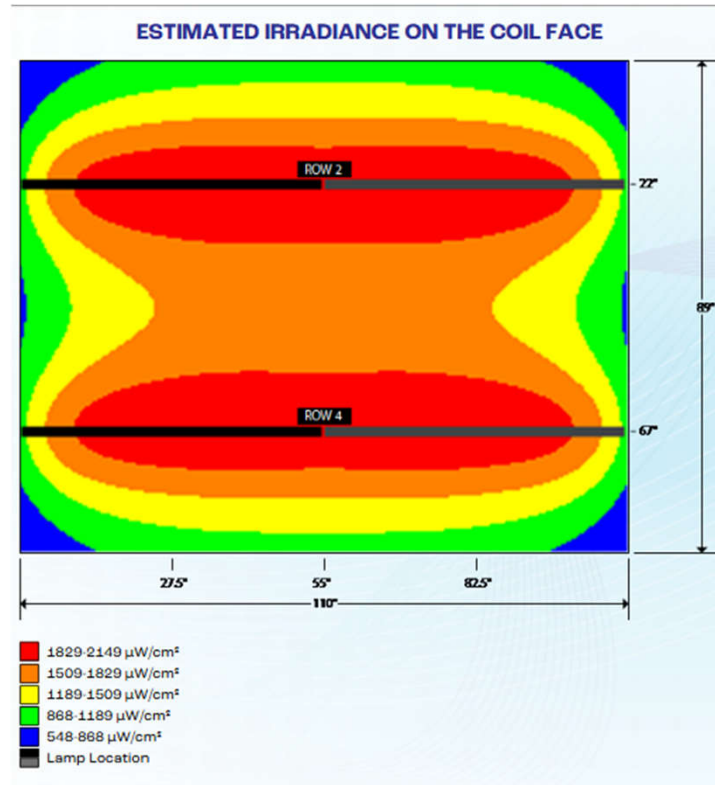


| Description                            | Mfg. Spec @ 1 M (μW/cm <sup>2</sup> ) | Lamp Wattage |
|--|---------------------------------------|--------------|
| 265 nm LED device 12 x 30mW (Figure 5) | 360,000 (360mW)*                      | NA           |

# UV Modeling



| CUV - UV-C ENERGY CALCULATIONS & EVAPORATOR COIL SIZING            |                                |
|--|--------------------------------|
| CUSTOMER PROJECT   | ASHRAE                         |
| AIR HANDLER ID   | ASH-1                          |
| HEIGHT   | 89"                            |
| WIDTH  | 110"                           |
| FRONT OF COIL AVERAGE UV-C DOSAGE                                  | 1566 $\mu\text{W}/\text{cm}^2$ |
| FRONT OF COIL MAXIMUM UV-C DOSAGE                                  | 2149 $\mu\text{W}/\text{cm}^2$ |
| FRONT OF COIL MAXIMUM ESTIMATED SURVIVAL TIME OF ASPERGILLUS NIGER | 27 min                         |
| UV LAMP DISTANCE TO COIL   | 12"                            |
| NUMBER OF UV LAMP PER ROW  | 2                              |
| NUMBER OF ROWS   | 2                              |
| TOTAL NUMBER OF UV LAMPS   | 4                              |
| UV LAMP SIZE   | 54 inch                        |
| DISTANCE OF ROW #2 FROM THE TOP OF THE COIL                        | 22"                            |
| DISTANCE OF ROW #4 FROM THE TOP OF THE COIL                        | 67"                            |





# Make it Simple...

## PLAN FOR SUCCESS!

1. If you don't have access to a model stop!
2. Do they have 185.2 intensity curves?
3. Is the installation environment fully defined? (air velocity, temperature, etc.)

## TAKE-AWAYS!

1. No two applications are the same!
2. No two UVC sources are the same!
3. Semi-custom or custom AHUs are rarely the same (if ever)!
4. Don't think of UVC as a commodity product!
5. Read Ashrae Journal article regarding Standard 185.2!



# Case Study

# Burns

Inspire. Create. Deliver.

## Case Study – Low Temperature Chiller serving OR's

November 11, 2025

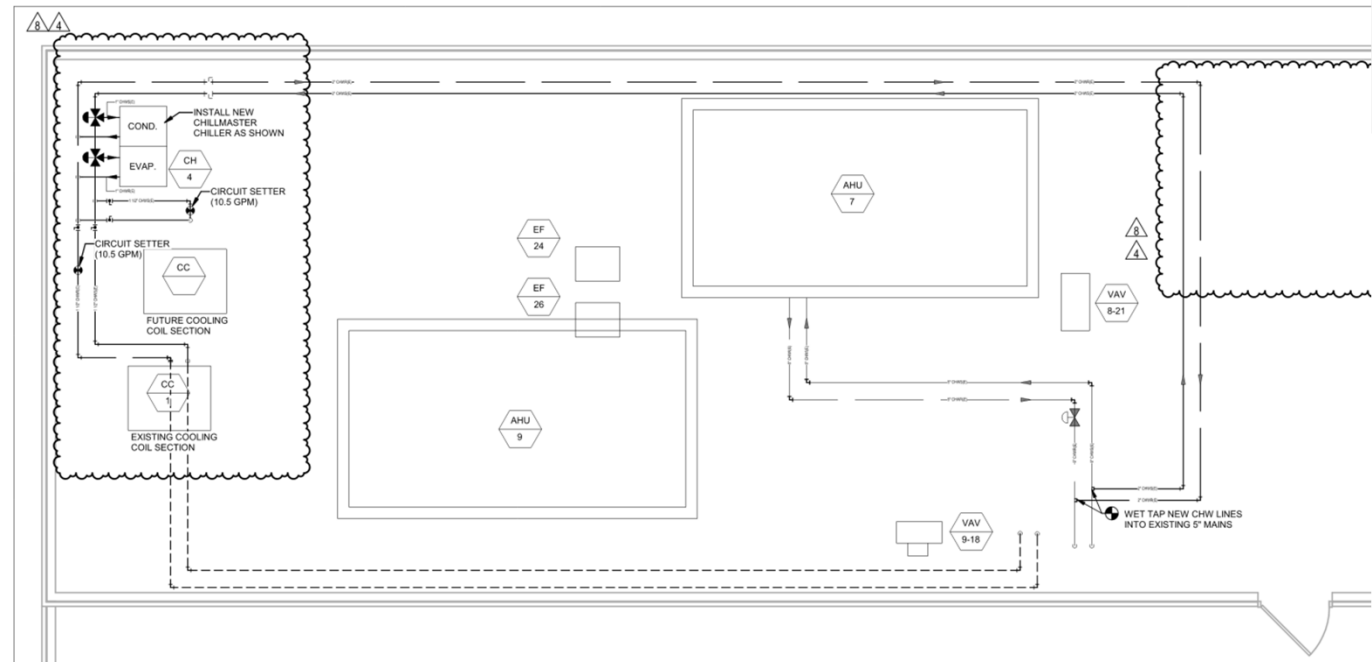
PRESENTED BY

Nelson Long PE



# Project Description

- AHU-9 Serves a C-Section OR on the floor below.
- Disconnected CC-1 from Level 2 glycol system.
- Installed water cooled chiller to feed CC-1.
- System sized for future CC-2.

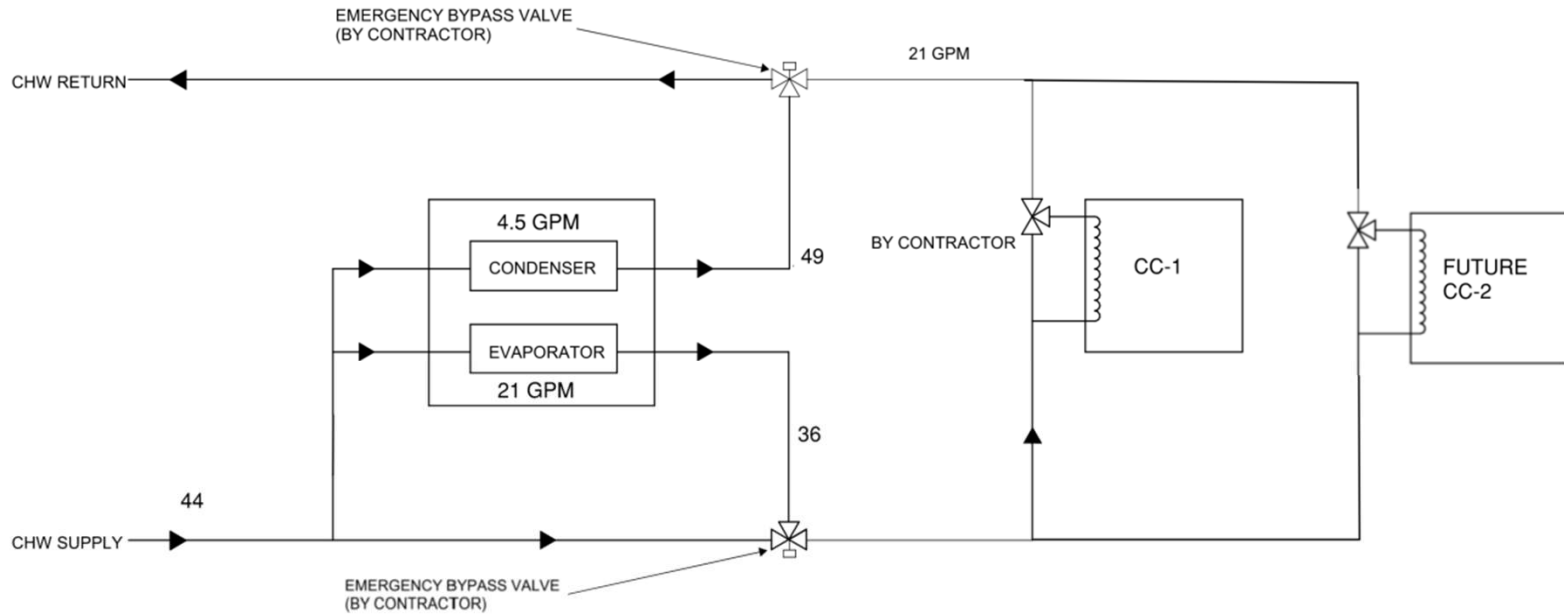


① MECHANICAL PENTHOUSE PIPING PLAN - 4TH FLOOR  
1/4" = 1'-0"

# Cooling Coil-1



# Piping Diagram



1

## MECHANICAL PIPING DETAIL

Scale: NOT TO SCALE

# Chiller Schedule

| EQUIPMENT SPECIFICATIONS |                                 |
|--------------------------|---------------------------------|
| [REDACTED]               | Quote Number: CM05192103 rev3   |
|                          | Date: 10/1/2021                 |
|                          | Job Name: Oviedo Medical Center |
|                          | Job Location: Oviedo, FL        |

| Model Number: CMMC4104NWBMPSA    |                      |  |
|----------------------------------|----------------------|--|
| Quantity: 1                      |                      |  |
| GENERAL DATA                     | INDIVIDUAL MODULE(S) | TOTAL SYSTEM<br>(including pumps and controls) |
| Nominal Tonnage                  | 10 tons              | 10 tons  |
| Design Evaporator Output @ 52hz  | 7 tons               | 7 tons   |
| Minimum Evaporator Output @ 35hz | 4.6 tons             | 4.6 tons                                       |
| Design Condenser Output @ 52hz   | 115.6 MBH            | 115.6 MBH                                      |
| Refrigerant Type                 | R410a                | R410a  |
| Number of Refrigerant Circuits   | 1                    | 1  |
| Number of Compressors            | 1                    | 1  |
| Main Electrical Supply           | 460V/3ph/60Hz        | 460V/3ph/60Hz                                  |
| Estimated kW Consumption         | 7.3 kW               | 7.3 kW   |
| Cooling Efficiency (kW/ton)      | 1.043 kW/ton         | 1.043 kW/ton                                   |
| RLA                              | 25.6 A               | 28 A   |
| MCA                              | 32 A                 | 34 A   |
| MOP                              | 55 A                 | 57 A   |
| Weights                          | 916 lbs              | 1016 lbs                                       |
| Dimensions                       | W 33 " L 61 " H 74 " | W 33 " L 61 " H 74 "                           |

| TOTAL SYSTEM WATER DATA                     | EVAPORATOR  | CONDENSER    |
|---|-------------|--------------|
| Design Entering Temperature (°F)            | 44 °F       | 48.7 °F      |
| Design Leaving Temperature (°F)             | 36 °F       | 100 °F       |
| Design Flow Rate                            | 21.0 gpm    | 4.5 gpm      |
| Design Pressure Drop                        | 5 ft        | 5 ft         |
| Fluid Max Pressure (psig)                   | 650 psi     | 650 psi      |
| Fluid Type (%)                              | H2O         | H2O          |
| Fouling Factor (ft <sup>2</sup> •0F•hr/BTU) | 0.0001      | 0.0001       |
| Type of Heat Exchanger                      | Low-Temp    | Brazed Plate |
| Connection Size and Type                    | 1.5" Flange | 1.5" Groove  |

| PUMP DATA               | EVAPORATOR                     | CONDENSER |
|-------------------------|--------------------------------|-----------|
| Pump Type               | Built-in, In-line, Centrifugal |           |
| Redundant Pumps         | No                             |           |
| Design Flow Rate        | 21gpm                          |           |
| Design Head             | 30ft                           |           |
| Pump HP                 | 1hp                            |           |
| VFD                     | Yes                            |           |
| Pump RLA                | 2                              |           |
| Built-in pump weight    | 100                            |           |
| Pump Package Dimensions |                                |           |

Notes:  
 Single point electrical  
 Single circuit 10 ton variable speed chiller with built-in VFD evaporator pump  
 Unit shall be rated for 65 kAIC through ETL listing

# Benefits

The benefits we found with using this system are:

- Unit is indoors protected from weather, NOA is not required. Maintenance is indoors.
- Unit can produce chilled water down to 34 degrees without glycol. Separate glycol loop, pumps, expansion tank, buffer tank are not required.
- Unit rejects heat to chilled water return raising temperature slightly helping low DT and allowing the chiller to run more efficiently.



## **Bibliography**

1. Hands Down Software, 2001 – 2011. HDPsyChart 7.9.6, [www.handsdownsoftware.com](http://www.handsdownsoftware.com).
2. Rishel, J., Kincaid, B., 2007. Reducing Energy Costs With Condensing Boilers & Heat Recovery Chiller. ASHRAE Journal 49(3).
3. ASHRAE. 2009. Advanced Energy Design Guide for Small Hospitals and Healthcare Facilities Achieving 30% Energy Savings Toward a Net Zero Energy Building. Atlanta: American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.
4. Hatten, M., Van Houten, B., Burpee, H., Loveland, J., July 2011. Targeting 100! Energy Use and Model Calibration Study for Legacy Salmon Creek Medical Center.” A section of “Advanced Energy Efficient Building Technologies for High Performance Hospitals” University of Washington Integrated Design Lab. Funded by Department of Energy and Northwest Energy Efficiency Alliance.
5. ASHRAE. 2019. ANSI/ASHRAE/IES Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings. Atlanta: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
6. Peterson, K. 2019. Heat Recovery Chillers In Campus Chilled Water Distribution Systems. ASHRAE Journal 61(11).
7. Hobbs, B. 2020. Modular Heat-Recovery Chiller Drives College Laboratory Saving. ASHRAE Journal 62(12).
8. ASHRAE. 2021. ANSI/ASHRAE/ASHE Standard 170-2021, Ventilation of Healthcare Facilities. Atlanta: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
9. ASHRAE. 2021. ANSI/ASHRAE/ASHE Standard 189.3-2021, Design, Construction, and Operation of Sustainable High-Performance Health Care Facilities. Atlanta: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
10. ASHRAE. 2021. ASHRAE Guideline 36-2021, High-Performance Sequences of Operation for HVAC Systems. Atlanta: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
11. ASHRAE. 2022. ANSI/ASHRAE Standard 62.1-2022, Ventilation and Acceptable Indoor Air Quality. Atlanta: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
12. ASHRAE. 2023. ASHRAE Guideline 42-2023, Enhanced Indoor Air Quality in Commercial and Institutional Buildings. Atlanta: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
13. ASHRAE. 2020. ANSI/ASHRAE Standard 185.2-2020, Method of Testing Ultraviolet Lamps for Use in HVAC&R Units or Air Ducts to Inactivate Microorganisms on Irradiated Surfaces. Atlanta: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
14. Fletcher, L. 2025. Why ASHRAE Standard 185.2 is Important to the Success of Germicidal Ultraviolet Projects. ASHRAE Journal 67(9).



Thank-you !

&

Questions