ALBUQUERQUE MUSEUM
2000 Mountain Rd. NW
Albuquerque, NM 87104

FACILITY HVAC SYSTEMS - TEMPERATURE AND HUMIDITY CONTROL ASSESSMENT AND ANALYSIS REPORT with SPECIAL EMPHASIS ON THE WEST GALLERY

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April 29, 2022

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1.0 EXECUTIVE SUMMARY

A. The Albuquerque Museum, is a public art and history museum in Albuquerque, New Mexico. The museum is located at 2000 Mountain Rd., NW, in the Old Town area.

The Albuquerque Museum is dedicated to preserving the art of the American Southwest and the history of Albuquerque and the Middle Rio Grande Valley of New Mexico. The museum features art of the Southwest and its global influences, as well as 400 years of Albuquerque history with permanent installations and special exhibitions of national and international origin.

B. The Albuquerque Museum is requesting an assessment and analysis of the existing HVAC Temperature and Humidity (T&H) Systems and Controls which serve the West Gallery in the existing building. The existing HVAC system serving the West Gallery space is not able to maintain the Museum required T&H setpoint conditions.

In addition, the Albuquerque Museum is also requesting an assessment and analysis of the existing HVAC Systems for the entire facility.

C. The purpose of this assessment / analysis is to confirm if existing HVAC systems can meet required T&H criteria and demands, specifically for the West Gallery, but also in other Galleries / Spaces that also have specific T&H setpoint criteria.

Using the information assembled in the assessment / analysis report, provide recommendations that can be used to upgrade, and enhance, the performance of the HVAC Systems serving the T&H critical areas.

D. This Assessment / Analysis Report Document is used to:
   1. Identify and quantify specific environmental Temperature and Humidity conditions within the West Gallery, (*specifically*).
   2. Identify and analyze other Galleries and Spaces that may be affected by upgrades and changes to the existing HVAC T&H systems serving the facility.
   3. Describe Mechanical HVAC systems recommendations for equipment and systems which can be specified and installed in the individual rooms to maintain the T&H environmental conditions.

2.0 DESCRIPTION OF ASSESSMENT / ANALYSIS REPORT; SOURCES OF INFORMATION

A. *ASSESSMENT / ANALYSIS REPORT - OVERVIEW DESCRIPTION:*

1. The Albuquerque Museum requires an Assessment and Analysis of existing HVAC Temperature and Humidity (T&H) Systems and Controls, which serve the West Gallery in the existing building.
    a. The existing HVAC system serving the West Gallery space is currently not able to maintain the Museum required T&H setpoint conditions.

2. In addition, the Albuquerque Museum requires an Assessment and Analysis of the existing HVAC Temperature and Humidity (T&H) Systems and Controls for the *Entire Facility*.

3. The *PRIMARY PURPOSE(S)* of the Assessment / Analysis Report are described as follows:
    a. Identify, analyze, and quantify required environmental T&H setpoint conditions *specifically* within the West Gallery.
    b. Identify, analyze, and quantify *all other* Galleries and Spaces required environmental T&H setpoint conditions within the *entire* facility
    c. Verify and quantify if existing HVAC T&H Systems and Controls can meet required T&H setpoint criteria and demands, *specifically* for the West Gallery.
    d. Verify and quantify if existing HVAC T&H Systems and Controls can meet required T&H setpoint criteria and demands for all *other* Galleries and Spaces in the *entire* facility.

4. Using the information collected and described in the Assessment / Analysis Report:
    a. Provide and describe *RECOMMENDATIONS* that may be used to upgrade, and enhance, the performance of the HVAC Temperature and Humidity Systems and Controls serving the T&H critical areas.

B. *SOURCES OF INFORMATION*:

1. This Assessment / Analysis Report uses information provided by the Albuquerque Museum, and visits to the Facility.

2. Drawings provided from the Museum consist of three (3)-sets of Construction Documents – Record Drawings, (*a.k.a. As-Built Drawings*). The Record Drawings are dated as follows:
    a. 1977 – *Architect: Antoine Predock*
    b. 2002 – *Architect: RMKM Architecture*
    c. 2011 – *Architect: RMKM Architecture*

3. Environmental Systems Assessment Report – Prepared by Innovative Construction & Design Solutions, LLC, (ICDS), Report dated April 2013.

3.0 ENVIRONMENTAL CRITERIA FOR INDIVIDUAL SPACE CONDITIONS

A. TEMPERATURE AND HUMIDITY CRITERIA:

1. The Environmental Systems Assessment Report-2013 (ESAR-2013) describes consultation with Albuquerque Museum personnel. The Museum outlines a "target" environmental range for Temperature and Humidity control setpoints, as follows:
   a. Temperature Setpoints: **68º F to 72 º F, + / - 5º F**
   b. Humidity Setpoints: **30% to 40% RH, + / - 5% RH**
   c. Maximum-Period-of-Time for which the temperature and humidity fluctuations are allowed to be "out-of-spec". **2-hour period**

B. OBSERVATIONS OF TEMPERATURE AND HUMIDITY CRITERIA:

1. The stated Temperature and Humidity Criteria setpoints can be satisfied with using traditional HVAC equipment, provided the equipment is configured with appropriate humidification and dehumidification capabilities.
2. The Dew Point (temperature) is the temperature at which water-entrained in the air will condense.
   a. For an HVAC de-humidification application, when the cooling-coil temperature is lower than the air-stream Dew Point temperature, the cooling-coil will de-humidify the air stream to the space.
   b. When the cooling-coil temperature is higher than the air-stream Dew Point temperature, only some of water entrained in the air-stream will be removed.
3. Plotting the following target environment setpoints on a Psychrometric Chart, the corresponding Dew Points for the setpoints are available:
   a. 72º F and 40% RH, the Dew Point is 46.4º F (DP) (or 57.0 gr/lb.).
   b. 72º F and 35% RH, the Dew Point is 42.8º F (DP) (or 49.8 gr/lb.).
   c. 72º F and 30% RH, the Dew Point is 38.9º F (DP) (or 42.6 gr/lb.).

1. stpt 72f 35%rh

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (gr/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
7,200	72.000	54.601	35.0	49.8	16.471	25.071	42.880	0.0611	0.2770	3.021

2. 72f 40%rh

STATE POINT DATA

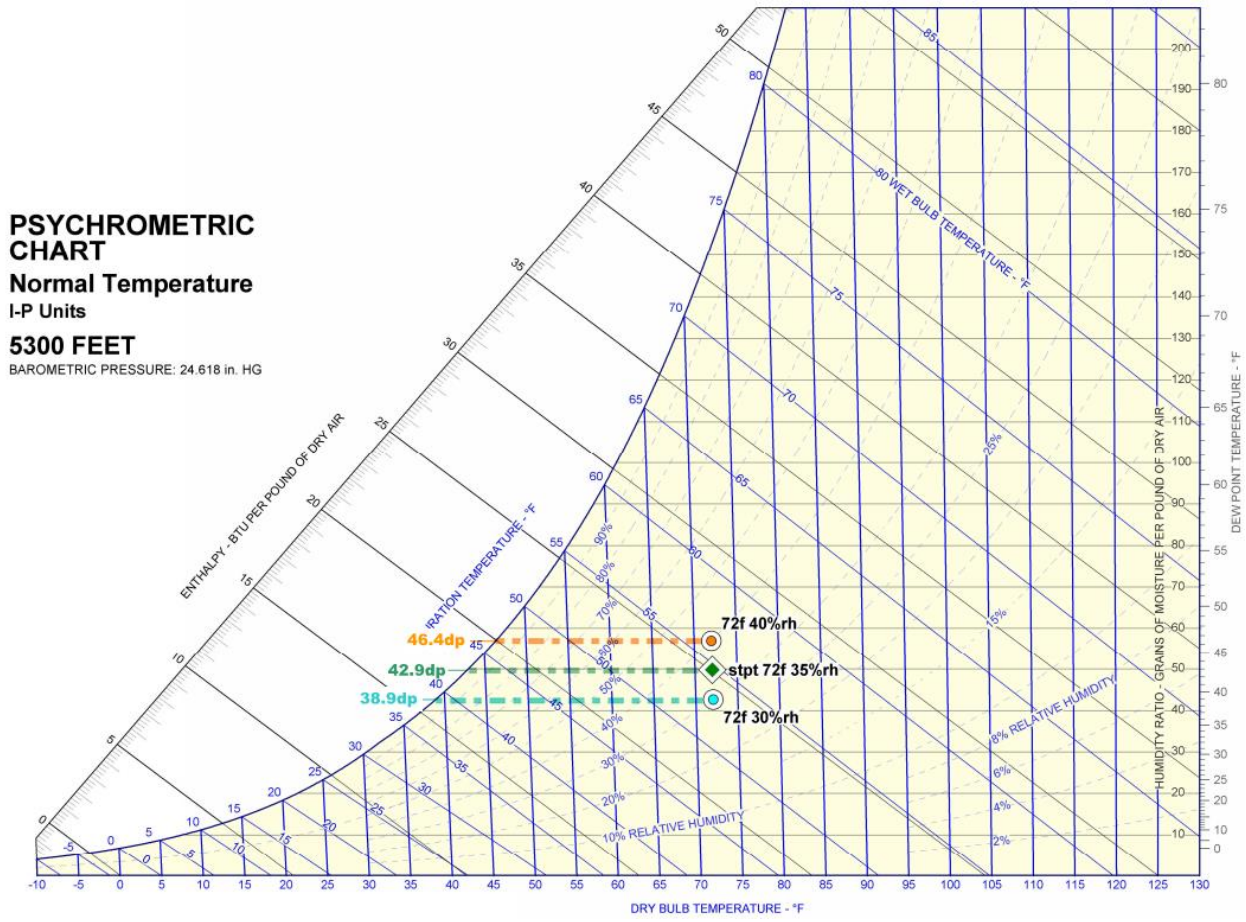
Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (gr/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
7,200	72.000	56.195	40.0	57.0	16.498	26.196	46.390	0.0611	0.3167	3.453

3. 72f 30%rh

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (gr/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
7,200	72.000	52.953	30.0	42.6	16.444	23.950	38.910	0.0612	0.2375	2.590

3.0 ENVIRONMENTAL CRITERIA FOR INDIVIDUAL SPACE CONDITIONS



C. OPTIONS FOR DE-HUMIDIFICATION

1. The ESAR-2013 has a discussion regarding “traditional” HVAC systems, and how de-humidification can be achieved. The description primarily focuses on when the outside ambient humidity is higher than “normal”. For the Albuquerque area, this condition occurs during “monsoon season”.
    a. The ESAR-2013 offers consideration for the “relatively short weather periods” when ambient humidity is high.
    b. The ESAR-2013 proposes that maintaining a constant relative humidity is the most critical parameter, and as such, proposes for the temperature to be allowed to rise up to 75 ^{o} F, while maintaining the relative humidity at 40%.

        75^{o} F and 40% RH, the Dew Point is 49.1^{o} F (DP) (or 63.1 gr/lb.).

2. A Dew Point of 49.1^{o}F, is far easier match for a “typical” HVAC system, as opposed to trying to match a 42.9^{o}F Dew Point.

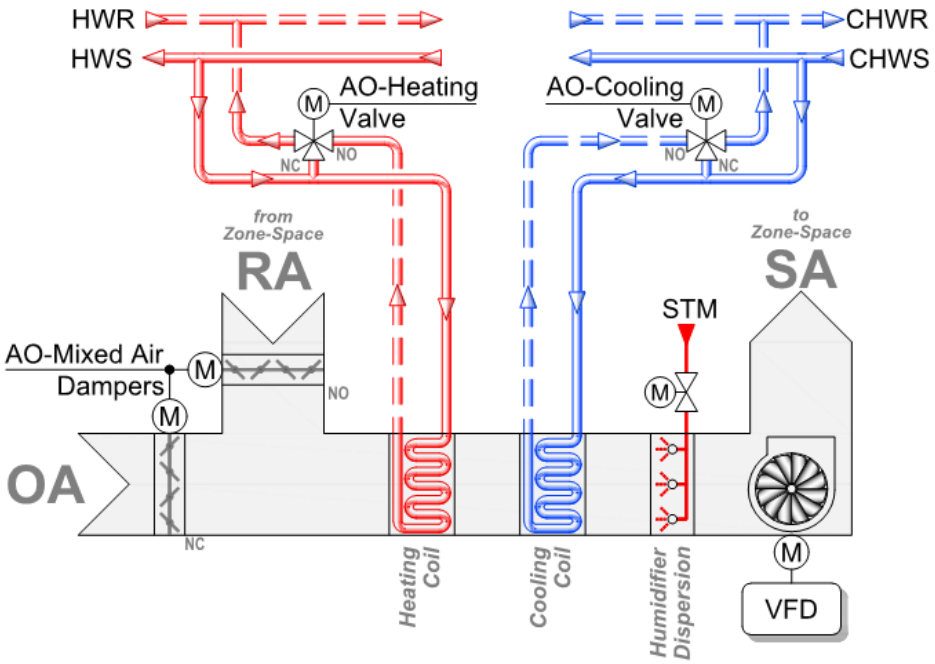
4.0 EXISTING HVAC EQUIPMENT SYSTEMS

A. *GENERAL DESCRIPTIONS OF HVAC EQUIPMENT SYSTEMS - FACILITY*

1. In general, the HVAC systems serving the Albuquerque Museum is achieved using a wide assortment of:
    a. Air Handling Units, (AHU's), Fan-Coil Units (FCU's),
    b. Chilled Water systems, both water-cooled and air-cooled – with associated Chilled Water Pumps.
    c. Heating Water Boilers, natural gas-fired – with associated Heating Water Pumps.
2. The assortment(s) of HVAC systems were installed during various Addition and Remodel Projects for the Museum Facility over the years.
    a. These Projects are identified as:
        - 1977 – *Architect: Antoine Predock, (original construction)*
        - 2002 – *Architect: RMKM Architecture*
        - 2011 – *Architect: RMKM Architecture*

B. *AIR-SIDE HVAC EQUIPMENT – AIR HANDLING UNITS / FAN COIL UNITS*

1. At a minimum, every HVAC machine, AHU or FCU has:
    a. Supply Air Fan
    b. Chilled Water-Cooling Coil
    c. Hot Water-Heating Coil
2. AHU's serving Temperature and Humidity controlled spaces have additional equipment installed:
    a. Return Fan
    b. Humidifier – Steam



Schematic Description of Typical Air Handling Unit

4.0 EXISTING HVAC EQUIPMENT SYSTEMS

C. 2002-DOCUMENTS

The 2002- documents show:

1. A *NEW* Mechanical Room was constructed.
    a. The new 2002-Mechanical Room is located at lower level, northeast side of Building.
    b. The new 2002-Mechanical Room shows four (4)-AHU's and two (2)-FCU's are installed. The AHU's and FCU's installed are as follows:
        - AHU1-2002: Serves the Grand Hall and Museum Café, (*main level*).
        - AHU2-2002: Serves the Special Events Room, (*main level*).
        - AHU3-2002: Serves the Museum Shop, (*main level*).
        - AHU4-2002: Serves the Changing Exhibit Gallery, (*main level*).
        - FCU4-2002: Serves Video Viewing, (*main level*).
        - FCU10-2002: Serves Electrical Room, (*lower level-inside mech room*).

D. 2011-DOCUMENTS

The 2011-documents show:

1. A *NEW* Mechanical Room was constructed.
    a. The new 2011-Mechanical Room is located at lower level, and was carved out of the existing Vault Storage Room.
    b. The new 2011-Mechanical Room shows five (5)-AHU's are installed. The AHU's installed are as follows
        - AHU1-2011: Serves the Existing Vault History, (lower level).
        - AHU2-2011: Serves the Vault Storage, (lower level).
        - AHU3-2011: Serves the Existing Art Vault, (lower level).
        - AHU5-2011: Serves the History Gallery, (main level).
        - AHU6-2011: Serves the East Gallery, (main level).

2. An *EXISTING* Mechanical Room was *RENOVATED*.
    a. The renovated 2011-Mechanical Room is located at main level, south of History Gallery, and east of West Gallery [230].
    b. The renovated 2011-Mechanical Room shows two (2)-AHUs are installed. The AHU's installed are as follows:
        - AHU4-2011: Serves the West Gallery [230], (*main level*).
        - AHU7-2001: Serves Connection Hallway [247], Changing History Gallery [204], and Restrooms-Men / Women [216] [217], (*main level*).

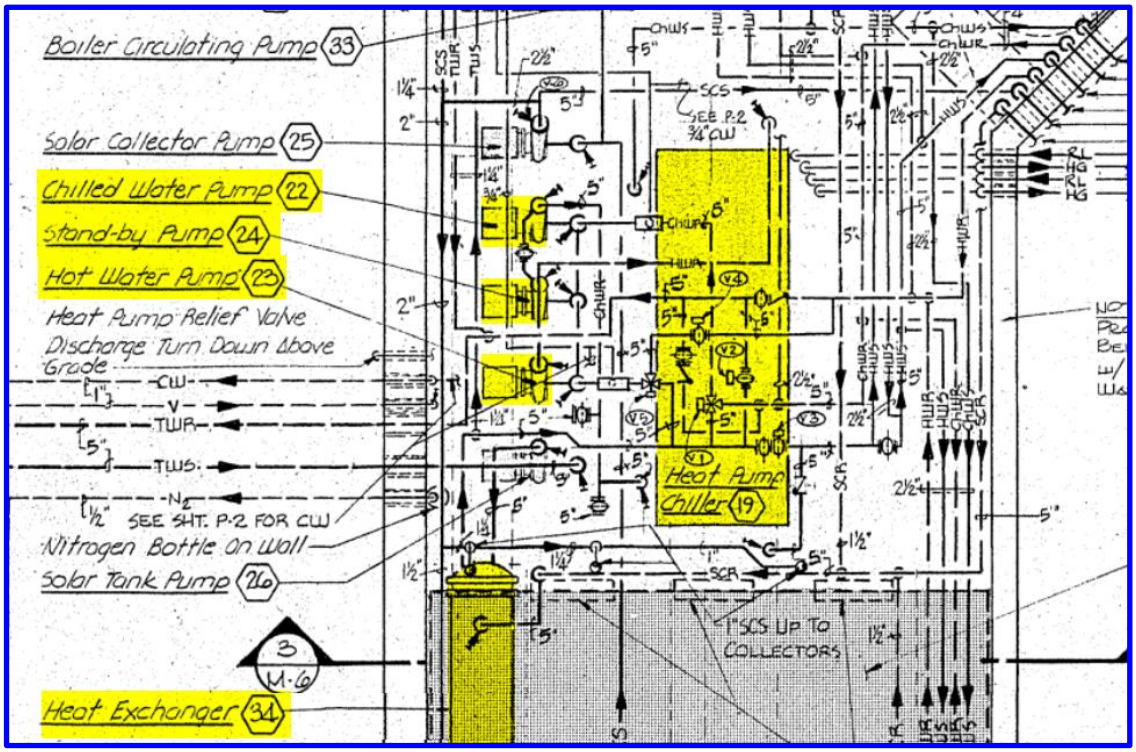
E. *CHILLED WATER SYSTEMS*

AIR-COOLED CHILLERS –

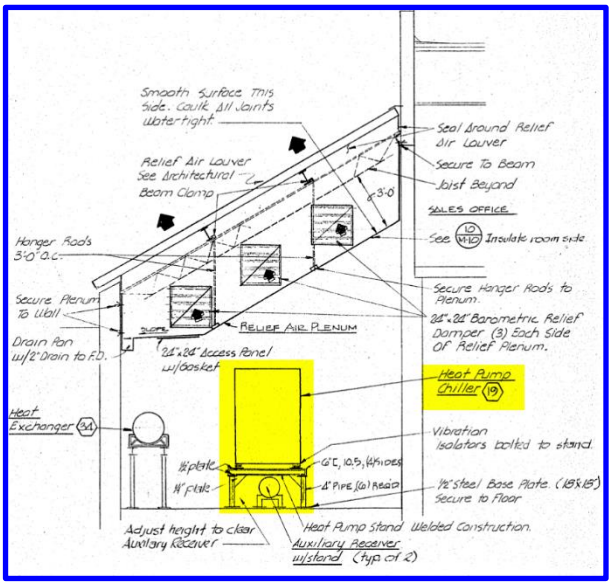
1. At the time this Assessment / Analysis Report was developed, there are two (2)-Air-Cooled Water Chillers installed at roof-level of Building, at south end of Building.
    a. Existing two (2)-Air-Cooled Chillers installed at the roof-level are 64.5-ton capacity, each; 130-ton total capacity.

4.0 EXISTING HVAC EQUIPMENT SYSTEMS

2. 1977-Documents show one (1)-Heat-Pump Chiller, with Remote, Air-Cooled Condenser Units were installed.
    a. The Heat-Pump Chiller was installed in Mechanical Room, lower level, at very far south end of Building.
    b. Remote, Air-Cooled Condenser Units were installed on roof of Building.

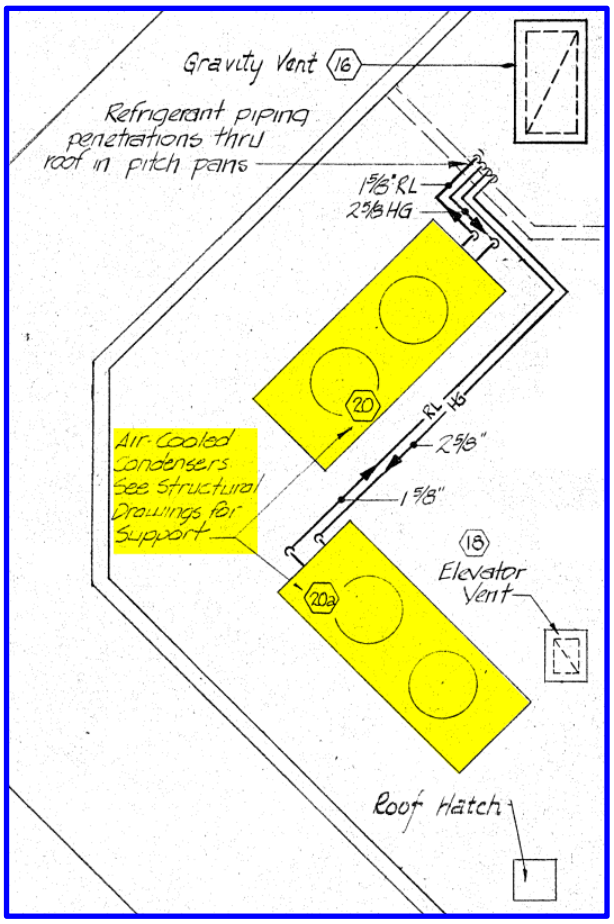


1977 Documents: Mechanical Room Floor Plan – Lower Level



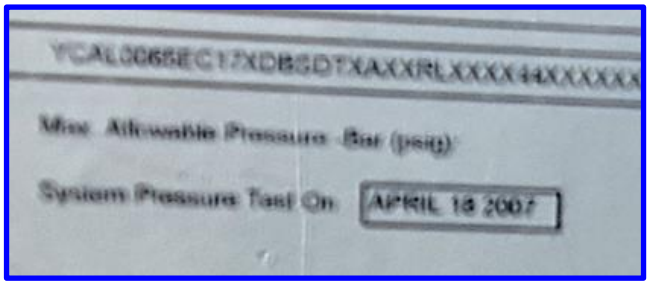
1977 Documents: Mechanical Room Section View – Lower Level

4.0 EXISTING HVAC EQUIPMENT SYSTEMS



1977 Documents: Mechanical Equipment – Roof Level

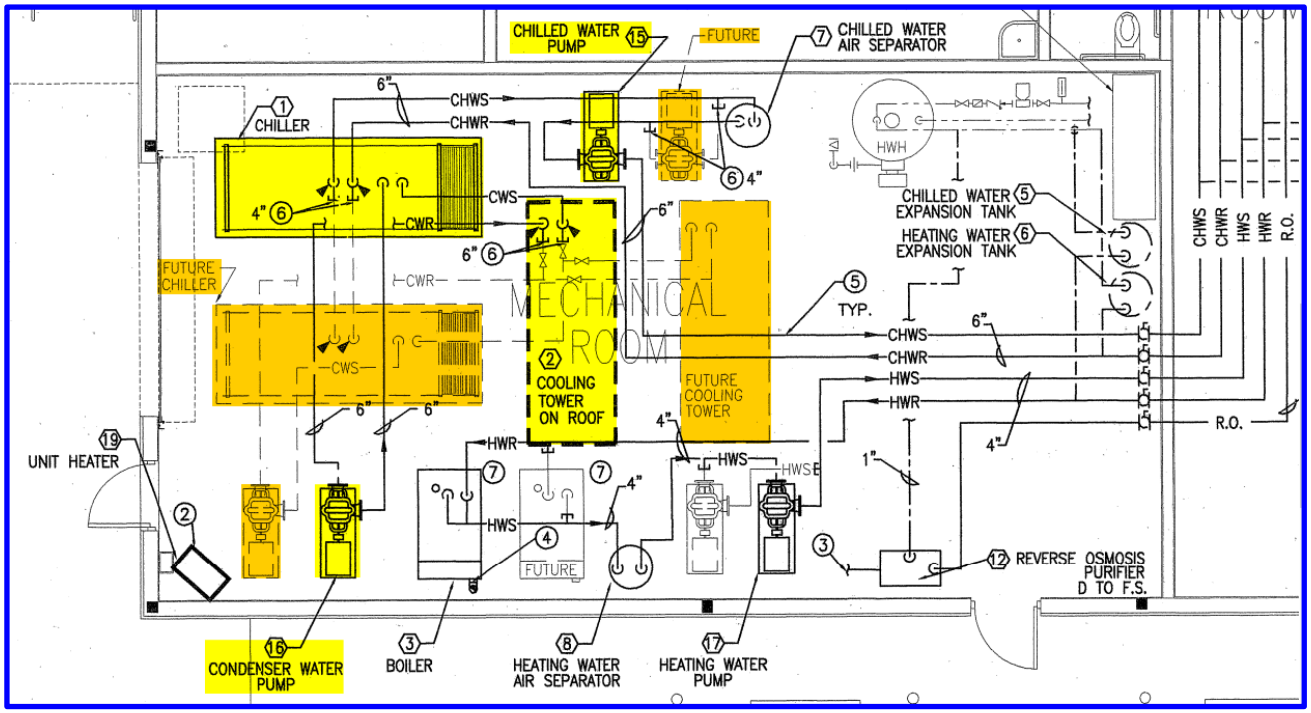
3. The 2002-Documents do not reference the Heat-Pump Chiller / Remote Air-Cooled Condensers, roof mounted.
    a. The 2002-Addition / Remodel Project does not include this area of the Building.
4. The 2011-Documents reference the two (2)-Air-Cooled Chillers as “existing”, and are included in the design to include the additional 130-tons chilled water capacity.
    a. No information is available regarding when the two (2)-Air-Cooled Water Chillers were installed.
    b. Information in this Assessment / Analysis Document is based on data label affixed to existing Air-Cooled Water Chillers.



4.0 EXISTING HVAC EQUIPMENT SYSTEMS

WATER-COOLED CHILLERS -

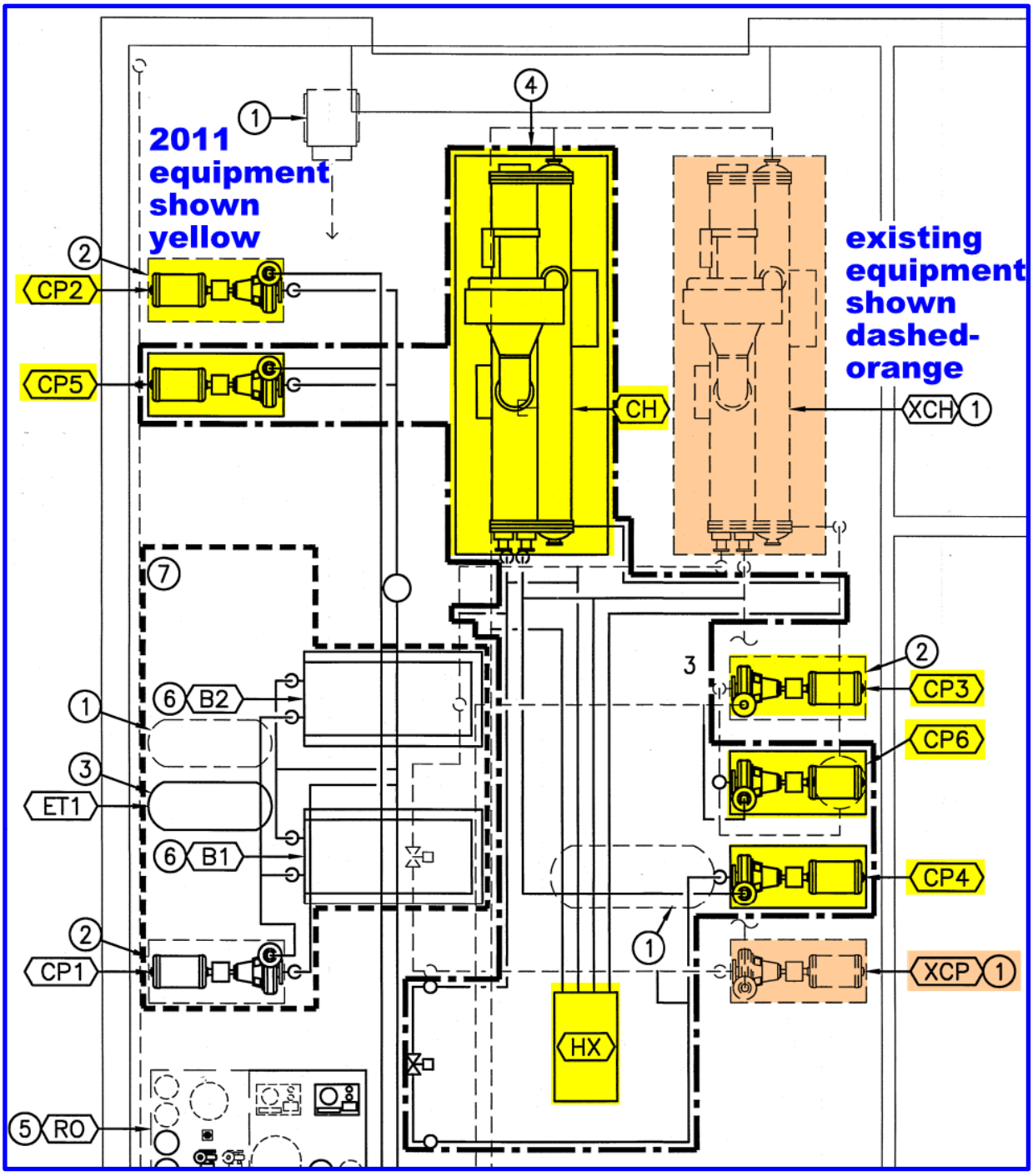
1. 2002-Documents show one (1)-112-ton Water-Chiller to be installed.
    a. CH-2002 is to be installed in the new 2002-Mechanical Room.
        - Associated Cooling Tower, Chilled Water, and Condenser Water Pumps to also be installed in the 2002-Project.



2002 Documents: Mechanical Room Floor Plan – Main Level

4.0 EXISTING HVAC EQUIPMENT SYSTEMS

2. 2011-Documents show one (1)-118-ton Water-Chiller installed.
    a. CH-2011 is to be installed in the existing 2002-Mechanical Room.
        - Associated Cooling Tower, Chilled Water, and Condenser Water Pumps to also be installed in the 2011-Project.

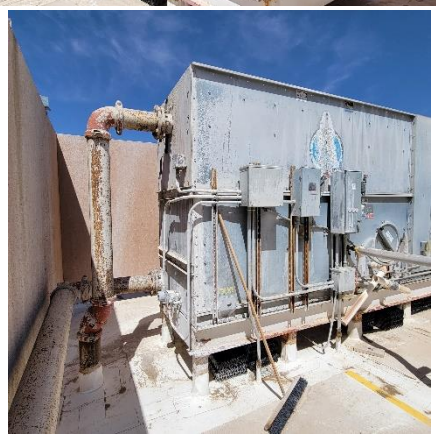


2011 Documents: Mechanical Room Floor Plan – Main Level

4.0 EXISTING HVAC EQUIPMENT SYSTEMS

3. FIELD OBSERVATIONS:
    a. There is only one (1)-Water-Cooled Chiller installed in Mechanical Room – Main Level Northwest corner of building.
        - As described, 2002 documents and 2011 documents each show new Water-Cooled Chiller to be installed.
        - Based on As-Built documents, there should be two (2)-Water-Cooled Chillers installed in Building.
        - It is not clear why only one (1)-Water-Cooled Chiller is installed.
    b. Existing installed Water-Cooled Chiller, and associated Cooling Tower on roof, is the same Chiller and Cooling Tower specified to be installed in the 2011 documents.
        - Chiller, and associated Cooling Tower, (installed on roof), is installed in location as shown in 2002 documents.
        - Existing, installed Cooling Tower installed on roof, is in POOR CONDITION.

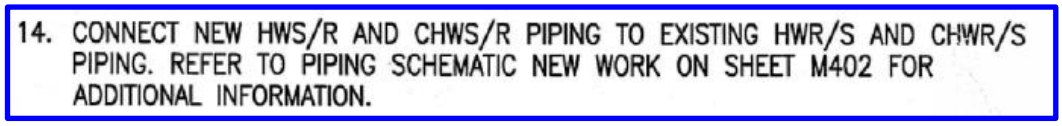





F. *HVAC WATER PIPING SYSTEMS – CHILLED WATER & HEATING WATER (CHW and HW)*
    1. 2002-Documents show all new CHW and HW Piping to be installed.
        a. No connections to existing HVAC Water Piping is shown.
    2. 2011-Documents show new CHW and HW Piping to be installed.
        a. In addition, there is also CHW and HW Piping shown to be connected to existing CHW and HW Piping systems.

4.0 EXISTING HVAC EQUIPMENT SYSTEMS

b. There are notations and descriptions indicated to:
   - Connect *NEW* CHW *Supply* Piping to *EXISTING* CHW *Return* Piping, *and*
   - Connect *NEW* CHW *Return* Piping to *EXISTING* CHW *Supply* Piping.
   - Connect *NEW* HW *Supply* Piping to *EXISTING* HW *Return* Piping, *and*
   - Connect *NEW* HW *Return* Piping to *EXISTING* HW *Supply* Piping.


14. CONNECT NEW HWS/R AND CHWS/R PIPING TO EXISTING HWR/S AND CHWR/S PIPING. REFER TO PIPING SCHEMATIC NEW WORK ON SHEET M402 FOR ADDITIONAL INFORMATION.

4.0 EXISTING HVAC EQUIPMENT SYSTEMS

G. *SUMMARY OF INSTALLED HVAC SYSTEM REQUIREMENTS and CAPACITIES* -

1. See APPENDIX A.0 for detailed information and available Data Sheets of Existing HVAC Systems Equipment – AHUs, FCUs, and Chilled Water Systems.
2. HVAC AIR HANDLING UNIT SYSTEMS - COOLING REQUIREMENTS, (*AHUs and FCUs*):
   a. Total connected loads of installed HVAC Equipment, (AHU's and FCU's), is as follows:
   b. Chilled Water Flow - Required:
      - **645 gpm - Required**
   c. Cooling Load – Required:
      - **266-tons Cooling – Required**

	Water Flow: gpm	Cooling Load: mbh
AHUs & FCUs – 2002:	292	1,421
AHUs & FCUs – 2011:	243	1,216
AHUs – 1977:	110	554
TOTAL:	***645***	***3,191*** *=266-tons (approx)*

3. HVAC CHILLED WATER SYSTEMS COOLING CAPACITIES - INSTALLED:
   a. As described in this section, (*Section 4*), there are two (2)-separate Chilled Water Systems:
      - Water-Cooled Chiller System
      - Air-Cooled Chiller System

	Water Flow: gpm
Water-Cooled Chiller – 2011:	260
TOTAL:	***260***

	Water Flow: gpm
Air-Cooled Chiller#1 – 1977:	156
Air-Cooled Chiller#2 – 1977:	156
TOTAL:	***312***

   b. **Total AVAILABLE Chilled Water Supply / Cooling Capacity = 572 gpm; 247-tons**
   c. The existing, installed Chilled Water-Cooling System **does not have enough capacity** to meet the existing, installed HVAC (*AHU's and FCU's*), Requirements.

5.0 RECOMMENDATIONS TO UPGRADE / ENHANCE HVAC EQUIPMENT SYSTEMS

A. Using the information collected and described in the Assessment / Analysis Report Recommendations to Upgrade / Enhance HVAC Equipment Systems are described as follows:
   1. Install one (1)-Water-Cooled Chiller System.
      a. The *NEW* Water-Chiller would be selected to provide 190-tons Cooling capacity.
      b. The existing functional Water-Chiller is 118-tons capacity.
      c. 190-tons Cooling Capacity is the difference between *REQUIRED* Cooling Capacity (*266-tons*) and Existing Water-Chiller capacity (118-tons), plus 10%.
      d. The *NEW*, 190-ton chiller will be installed in location for the Chiller shown in the 2011 documents.

   2. The *NEW* Chilled Water system would also include the following support Equipment:
      a. One (1)-Cooling Tower
      b. Two (2)-Chilled Water Pumps
      c. Two (2)-Condenser Pumps, (aka: Cooling Water Pumps)
      d. Existing Water-Chiller and Cooling Tower currently have one (1)-each Chiller Pump and Condenser Water Pumps.
      e. There is *NO REDUNDANCY* provided using only one (1)-each pump for chilled water and condenser water systems. If one of the pumps fail, the entire Chilled Water System is non-functional.
      f. The *NEW* Chilled Water and Condenser Water Pump systems will be piped, and configured, to include the existing Chilled Water and Condenser systems.
      g. This configuration provides an n+1 configuration. In other words, if one of the pumps in each system would fail, there will always be a “stand-by pump” available.

   3. Replace *EXISTING* Cooling Tower –
      a. Condition of *EXISTING* Cooling Tower is POOR CONDITION.
      b. If *EXISTING* Cooling Tower fails, the entire Chilled Water System will be non-functional.

   4. Re-Configure the *EXISTING* Air-Cooled Chiller Plant Piping Configuration to be used as “Stand-By” Chiller Plant.
      a. Install two (2)-Chilled Water pumps for the Air-Cooled Chiller Plant System.
      b. Reconfigure Chilled Water Supply and Return Piping, to be connected to *EXISTING* Chilled Water System serving the Building.

   5. CONTROLS DDC –
      a. ADD new Chilled Water System Equipment into EXISTING DDC-CONTROL System.
      b. Configure DDC-Control system to ENABLE-ON the Air-Cooled Stand-By Chiller Plant when one of the main chilled water systems is non-operational due to scheduled maintenance, *OR* failure.
      c. Calibrate Building DDC Controls to align with CABQ Museum DicksonOne Temperature and Humidity System: Settings and Recording.

6.0 OPINION OF PROBABLE COSTS TO UPGRADE / ENHANCE HVAC EQUIPMENT

A. The Opinion of Probable Costs Summary, (OPC), is a Rough-Order-of-Magnitude, (ROM), cost summary. The OPC is generated using generally accepted Cost Estimating methodologies for the local Construction Industry. The OPC uses available data for costs of Equipment / Materials, and Labor Rates, up thru year 2021.

****** DISCLAIMER ******

B. The Author of this OPC cannot, and will not, be held responsible for any cost escalations outside of Author's responsibility. Cost escalations include, but are not limited to, Costs of Equipment/Materials, Labor Rates, Potential Revisions required during actual Design of Systems, etc.

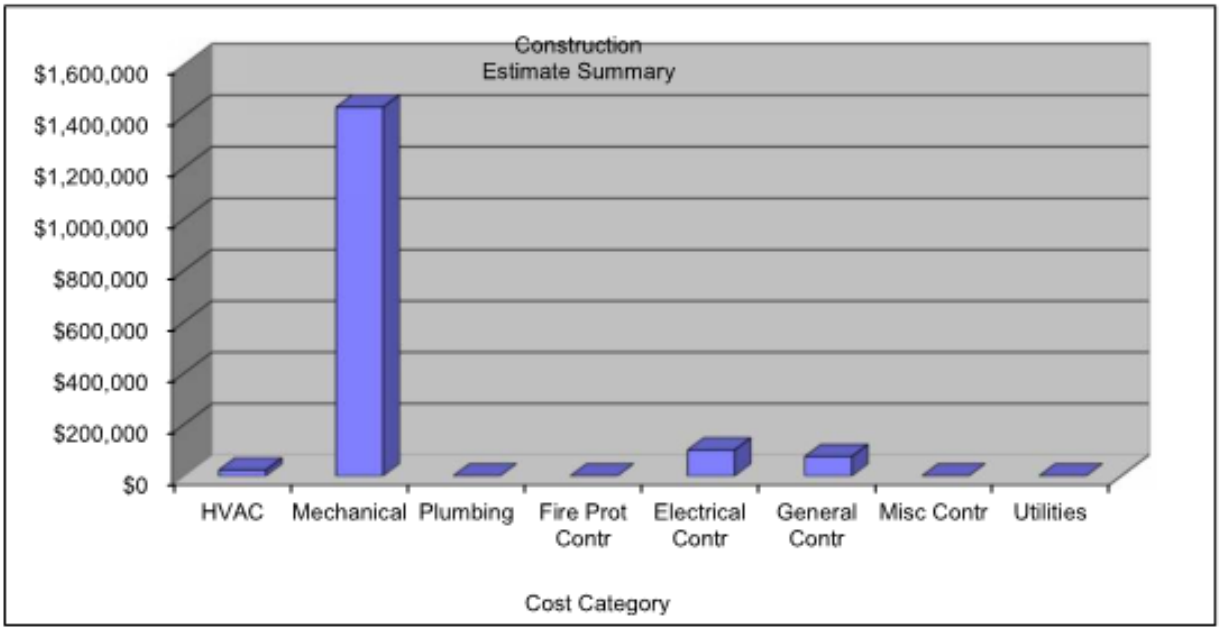
Estimate Summary

Bond Percent $ 0.006

Subtotal Category	Cost	Percent	Check $/SF
HVAC	$22,932	1%	
Mechanical	$1,435,195	88%	
Plumbing	$0	0%	
Fire Prot Contr	$0	0%	
Electrical Contr	$101,200	6%	
General Contr	$75,900	5%	
Misc Contr	$0	0%	
Utilities	$0	0%	
Total Project	$1,635,227	100%	
Bond	$8,994		

Fees	
Mech Engr:	$92,042
Elec Engr:	$6,072
Total	$98,114
Commissining (Y/N)	N
Commissioning	$0

Total Design/Build Cost $1,733,341



April 29, 2022

APPENDIX A.0

EXISTING HVAC EQUIPMENT CAPACITIES / AVAILABLE DATA SHEETS

A. *AIR-SIDE HVAC EQUIPMENT – AIR HANDLING UNITS / FAN COIL UNITS*

1. 2002-Documents:

AHUs - *2002*

TAG	AIR		COOLING COIL		HEATING COILS			
	Supply Flow cfm	Outside Flow cfm	Flow gpm	Capacity mbh	Heating Flow gpm	Heating Capacity mbh	Re-Heat Flow gpm	Re-Heat Capacity mbh
AHU1-*2002*	13,200	1,800	78.0	390	37.9	379	na	na
AHU2-*2002*	5,900	1,600	33.6	168	16.6	166	na	na
AHU3-*2002*	2,800	480	18.0	90	7.7	77	na	na
AHU4-*2002*	14,580	1,600	88.2	441	21.5	215	24	240
			217.8		83.7		24.0	*107.7*

FCUs - *2002*

TAG	AIR		COOLING COIL		HEATING COILS			
	Supply Flow cfm	Outside Flow cfm	Flow gpm	Capacity mbh	Heating Flow gpm	Heating Capacity mbh	Re-Heat Flow gpm	Re-Heat Capacity mbh
FCU1-*2002*	1,905	240	20.4	102.0	15.0	75.0	na	na
FCU2-*2002*	1,965	240	11.7	59.0	12.0	60.0	na	na
FCU3-*2002*	1,350	120	7.2	40.2	9.6	48.0	na	na
FCU4-*2002*	1,340	520	8.0	40.2	5.2	25.8	na	na
FCU5-*2002*	1,400	400	7.2	36.0	4.8	24.0	na	na
FCU6-*2002*	1,800	200	10.0	49.9	12.2	61.1	na	na
FCU7-*2002*	400	40	2.4	1.2	3.6	1.5	na	na
FCU8-*2002*	400	40	2.4	1.2	3.6	1.5	na	na
FCU9-*2002*	400	40	2.4	1.2	3.6	1.5	na	na
FCU10-*2002*	400	na	2.4	1.2	na	na	na	na
			74.1		69.6		0.0	*69.6*

TOTAL WATER FLOW	***292***	*cooling gpm*	***177***	*heating gpm*
TOTAL CAPACITY	***1,421***	*cooling mbh*	***1,375***	*heating mbh*

APPENDIX A.0

EXISTING HVAC EQUIPMENT CAPACITIES / AVAILABLE DATA SHEETS

2. 2011-Documents:

AHUs - *2011*

TAG	AIR		COOLING COIL		HEATING COILS			
					Heating		Re-Heat	
	Supply Flow cfm	Outside Flow cfm	Flow gpm	Capacity mbh	Flow gpm	Capacity mbh	Flow gpm	Capacity mbh
AHU1-*2011*	1,700	na	8.8	45	7.7	75	na	na
AHU2-*2011*	3,000	na	16.5	83	15.1	146	na	na
AHU3-*2011*	1,400	na	7.0	35	6.7	66	na	na
AHU5-*2011*	12,900	3,650	85.5	426	65.5	639	36.2	353
AHU6-*2011*	7,250	2,175	51.4	258	36.3	354	18.7	182
			169.2		123.6		54.9	***178.5***

AHUs - *2011*

TAG	AIR		COOLING COIL		HEATING COILS			
					Pre-Heat		Re-Heat	
	Supply Flow cfm	Outside Flow cfm	Flow gpm	Capacity mbh	Flow gpm	Capacity mbh	Flow gpm	Capacity mbh
AHU4-*2011*	7,200	1,900	47.2	238	35.6	348	17.8	173
AHU7-*2011*	3,250	600	19.2	96	16.4	160	8.3	81
			66.4		52.0		26.1	***78.1***

FCs - *2011*

TAG	AIR		COOLING COIL		HEATING COILS			
					Pre-Heat		Re-Heat	
	Supply Flow cfm	Outside Flow cfm	Flow gpm	Capacity mbh	Flow gpm	Capacity mbh	Flow gpm	Capacity mbh
FCU1-*2011*	1,000	na	4.5	22.5	3.6	35.7	na	na
FCU2-*2011*	675	na	2.5	12.5	2.3	23.1	na	na
			7.0		5.9		0.0	***5.9***

TOTAL WATER FLOW	***243***	*cooling gpm*	***263***	*heating gpm*
TOTAL CAPACITY	***1,216***	*cooling mbh*	***2,636***	*heating mbh*

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APPENDIX A.0

EXISTING HVAC EQUIPMENT CAPACITIES / AVAILABLE DATA SHEETS

3. 1977-Documents:

AHUs - *1977* *(Central Station AHUs)*

TAG	AIR		COOLING COIL		HEATING COILS			
					Heating		Re-Heat	
	Supply Flow cfm	Outside Flow cfm	Flow gpm	Capacity mbh	Flow gpm	Capacity mbh	Flow gpm	Capacity mbh
XCS#1-*1977*	10,000	???	55.0	277	39.0	???	na	na
XCS#2-*1977*	10,000	???	55.0	277	39.0	???	na	na
			110.0		78.0		na	*78.0*

TOTAL WATER FLOW	***110***	*cooling gpm*	***78***	*heating gpm*	
TOTAL CAPACITY	***554***	*cooling mbh*	***???***	*heating mbh*	

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APPENDIX A.0

EXISTING HVAC EQUIPMENT CAPACITIES / AVAILABLE DATA SHEETS

B. *WATER CHILLERS – WATER-COOLED and AIR-COOLED*

chillers - WATER COOLED

TAG	MFGR / MODEL #:	CAPACITY						
		Tons	Evaporator			Condenser			
			Flow gpm	EWT °F	LWT °F	Flow gpm	EWT °F	LWT °F	*Comments:*
CH-*2011*	York / YCWL0118HE46	118.4	260	55	45	400	85	95	Evaporator capacity based on 2.4 gpm CHW / ton @ AHRI. Condenser capacity based on 65 °F wb ambient outside temp.

TOTAL WATER FLOW **260** *cooling gpm*

chillers - AIR COOLED

TAG	MFGR / MODEL #:	CAPACITY				
		Tons	Evaporator			
			Flow gpm	EWT °F	LWT °F	*Comments:*
CH-1 *AC*	York / YCAL0065EC	64.5	156	55	45	Capacity based on 2.4 gpm CHW / ton @ AHRI, 100 °F db ambient outside temp.
CH-2 *AC*	York / YCAL0065EC	64.5	156	55	45	

TOTAL WATER FLOW **312** *cooling gpm*

TOTAL AVAILABLE CAPACITY

WATER FLOW: **572** *cooling gpm*

TONS: **247**

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APPENDIX A.0

EXISTING HVAC EQUIPMENT CAPACITIES / AVAILABLE DATA SHEETS

C. *WATER CHILLERS – WATER-COOLED and AIR-COOLED: DATA SHEETS*

specified: 2002

YORK®
BY JOHNSON CONTROLS

York YCWS Water Cooled Screw Chillers
Style B

1 CHILLER: ELECTRONICALLY CONTROLLED WATER COOLED LIQUID CHILLER, HELICAL ROTOR COMPRESSOR, OPERATING OIL CHARGE, STANDARD SHELL. COMPLETE WITH ALL EQUIPMENT NECESSARY FOR COMPLIANCE WITH A.S.H.R.A.E. STANDARD 15. CAPABLE OF COOLING 260 GPM WATER FROM 55 TO 45 DEG. F. WITH 400 GPM OF CONDENSER AT 85 DEG. F. INCLUDE ALL STANDARD EQUIPMENT/ACCESSORIES PLUS INSULATION ON LOW TEMPERATURE SURFACES. MODEL "YORK". ELEC: 480V/3PH/60HZ.

SYM	MODEL	CHW GPM	COND. GPM	ELECTRICAL MCA	RLA	LRA
1	YCWS0120SC	260	400	77	61	174

2 COOLING TOWER: LOWE PROFILE, WET COOLING TOWER, CAPACITY TO COOL 400 GPM FROM 95 DEG F TO 85 DEG F AT 96 DEG DB AND 65 DEG WB, AND FAN MOTOR. PROVIDE WITH FLOW CONTROL VALVES, AIR INLET SCREENS, CONT. DUTY, FAN GUARD, AND SAFETY FAN VIBRATION CUT–OFF SWITCH. (CAPACITY AT 5500 FT ASL). COMPLETE WITH SOUND ATTENUATORS. WEIGHTS IN LBS. MODEL "MARLEY". ELEC: 480V/3PH/60HZ

SYM	MODEL	GPM	CFM	HP	BASIN HTR.	OP. WT.
2	VTL 103–K	400	24,990	15	5.0 KW	4750

chiller was *NOT* installed

Nomenclature

YC W S 0140 S C 50 Y B

- YC= York Chiller
- W= Water cooled
- S= Screw Compressor
- Nominal Capacity in kW
- S= Standard Efficiency
- Refrigerant C = R-22
- Voltage Code: 17 = 200-3-60, 28 = 230-3-60, 40 = 380-3-60, 46 = 460-3-60, 58 = 575-3-60
- Type Start: Y = Star-Delta
- Design Series: B

CH-2002	2002	York / YCWS0120SC

Ratings English (R-22)

MODEL: YCWS0120SC — IPLV= 18.2

LCWT (°F)	LEAVING CONDENSER WATER TEMPERATURE (°F) 85.0 TONS	KW	MBH	EER	95.0 TONS	KW	MBH	EER	105.0 TONS	KW	MBH	EER
40.0	108.0	75.6	1554.0	17.1	101.7	85.6	1513.0	14.3	95.3	96.7	1473.0	11.8
42.0	112.4	75.8	1607.0	17.8	106.0	85.9	1564.0	14.8	99.4	96.9	1523.0	12.3
44.0	116.9	76.0	1662.0	18.5	110.3	86.2	1618.0	15.4	103.5	97.2	1574.0	12.8
45.0	119.2	76.0	1689.0	18.8	112.5	86.3	1645.0	15.6	105.7	97.3	1600.0	13.0
46.0	121.5	76.0	1717.0	19.2	114.8	86.5	1672.0	15.9	107.8	97.5	1626.0	13.3
48.0	126.3	76.0	1775.0	19.9	119.4	86.7	1728.0	16.5	112.2	97.8	1680.0	13.8
50.0	131.2	75.9	1833.0	20.7	124.1	86.9	1785.0	17.1	116.8	98.1	1736.0	14.3

NOTES:
1. **Tons** = Unit Cooling Capacity Output
2. **KW** = Compressor Input Power
3. **MBH** = Condenser Heat Rejection
4. **EER** = Chiller Energy Efficiency Ratio
5. **LCWT** = Leaving Chilled Water Temperature
6. Ratings based on 2.4 GPM cooler water per ton.

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APPENDIX A.0

EXISTING HVAC EQUIPMENT CAPACITIES / AVAILABLE DATA SHEETS

specified: 2011

YORK®

MODEL YCWL
WATER-COOLED SCROLL LIQUID CHILLER
STYLE A

ALTERNATE #3
MECHANICAL EQUIPMENT SCHEDULE:

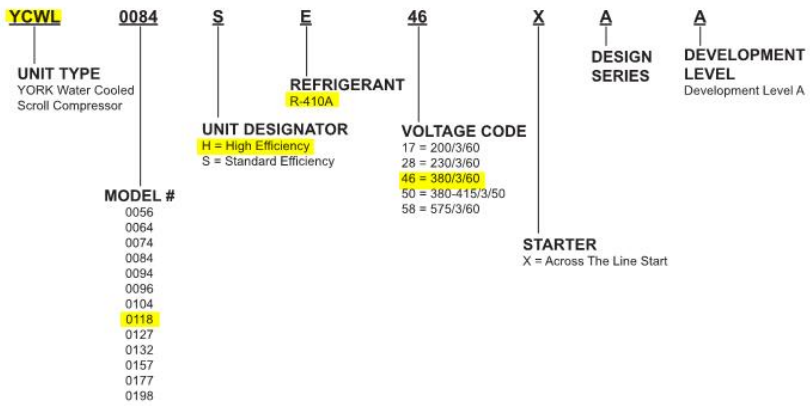
CH ELECTRONICALLY CONTROLLED WATER COOLED LIQUID CHILLER, RECIPROCATING SERVICEABLE SCROLL SEMI-HERMETIC COMPRESSOR, R410A REFRIGERANT, AUTOMATICALLY REVERSIBLE OIL PUMP, OPERATING OIL CHARGE, SUCTION ANO OISCHARGE SHUTOFF VALVES, OIL SIGHT GLASS, REFRIGERANT SUCTION GAS COOLED MOTOR, CRANKCASE HEATER, MUFFLER, SUCTION CUTOFF UNLOADER, OIRECT EXPANSION COOLER, SINGLE-PASS ANSI TYPE 316 STAINLESS STEEL BRAZED PLATE CONSTRUCTION, GROOVED-END-TYPE WATER CONNECTIONS, CONDENSER LIQUID LINE SHUT-OFF VALVE, START/STOP SWITCH, ELECTRONIC CHILLED WATER STEP CONTROLLER, SAFETIES SHALL INCLUDE: OVER PRESSURE, LOSS OF CHARGE, LOW WATER TEMPERATURE, COMPRESSOR OVER CURRENT, AND LOCK-OUT ALARM LIGHTS. NON-FUSED DISCONNECT, CAPACITY REOUCTION, PROOF OF FLOW SWITCH, GROUNO CURRENT SENSING, OIL SAFETY SWITCH, HEAVY-GAGE GALVANIZED STEEL MEMBERS, AND BAKED ENAMEL FINISH. CHILLER CAPABLE OF COOLING WATER FLOW OF 260 GPM FROM 55 TO 45 DEG. F.
"YORK" MODEL YCWL0118HE46.
ELEC.: 480V/3PH/60HZ.

	EVAPORATOR		CONDENSER		OUTPUT	WEIGHT
SYM MCA	GPM	PO FT.	GPM	PD FT.	TONS	LBS
CH 140.1	260	12.3	400	11.0	118.4	5500

CT COOLING TOWER: LOW PROFILE, HEAVY GAUGE HOT-DIP GALVANIZED STEEL CONSTRUCTION WITH INWARD SWINGING DOORS ON EACH END WALL, CAPACITY TO COOL WATER, FROM 94.5 DEG F TO 85 DEG F AT 65 DEG WB, NON-CLOG NOZZLES, STRAINER, COLD WATER BASIN TO BE CONSTRUCTED OF HEAVY-GAUGE GALVANIZED STEEL, PROVIDE WITH FLOW CONTROL VALVES, SLOPED COLD WATER BASIN WITH BASIN HEATER, SOLID PANEL SOUND ATTENUATING AIR INLET PANELS, PREMIUM EFFICIENT VFD DUTY MOTOR WITH VFD, PREMIUM QUALITY SOLID-BACKED MULTI-GROOVE BELT, CORROSION RESISTANT CAST ALUMINUM SHEAVES, HEAVY-DUTY BEARINGS L10 40,ODD HOURS, CENTRIFUGAL FANS OF CORROSION RESISTANT ALUMINUM, FAN GUARD, PVC FILL WITH INTEGRAL DRIFT ELIMINATORS, BACnet CAPABLE CONTROLS, ANO SAFETY FAN VIBRATION CUT-OFF SWITCH. PROVIDE DISCONNECT ANO ALL EQUIPMENT FOR COMPLETE OPERATION. PROVIDE NECESSARY EQUIPMENT FOR INSTALLATION ON EXISTING CURB WITH DIMENSIONS OF 4 FT X 15 FT. CAPACITY AT 5500 FT ASL. CONOITIONS ARE FOR 94.5 DEG F ENTERING FLUID, 85 DEG F LEAVING FLUID, AND 65 DEG F WB.
ELEC: 460V/3PH/60 HZ
MANUFACTURER - "BALTIMORE AIRCOIL".

SYM	MODEL	GPM	FAN HP	HEAT LOSS	BASIN HTR	OPER. WGHT
FC	VTL-082-HM	400	15	1900 MBH	5 kW	3810 LBS

Nomenclature



Ratings - High Efficiency

MODEL:YCWL0118HE									IPLV= 24.9			
	ENTERING CONDENSER WATER TEMPERATURE (°F)											
LCWT	75.0				85.0				95.0			
(°F)	TONS	KW	MBH	EER	TONS	KW	MBH	EER	TONS	KW	MBH	EER
40.0	115.7	71.3	1631.0	19.5	109.5	82.7	1596.0	15.9	102.8	96.0	1561.0	12.8
42.0	119.8	71.0	1679.0	20.2	113.4	82.4	1642.0	16.5	106.6	95.6	1606.0	13.4
44.0	124.0	70.8	1729.0	21.0	117.5	82.0	1689.0	17.2	110.5	95.2	1651.0	13.9
46.0	128.3	70.5	1780.0	21.8	121.6	81.7	1738.0	17.9	114.5	94.8	1697.0	14.5
48.0	132.8	70.3	1833.0	22.7	125.9	81.4	1788.0	18.6	118.5	94.4	1745.0	15.1
50.0	137.4	70.1	1887.0	23.5	130.2	81.1	1839.0	19.3	122.7	94.1	1793.0	15.7

NOTES:
1. Tons = Unit Cooling Capacity Output
2. KW = Compressor Input Power
3. MBH = Condenser Heat Rejection
4. EER = Chiller Energy Efficiency Ratio
5. LCWT = Leaving Chilled Water Temperature

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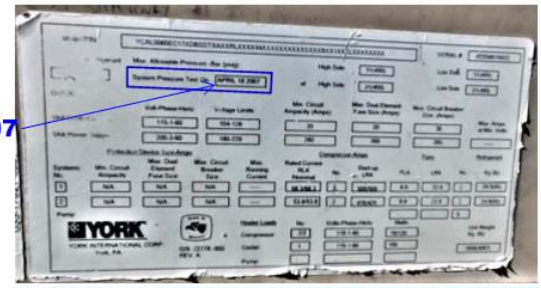
APPENDIX A.0

EXISTING HVAC EQUIPMENT CAPACITIES / AVAILABLE DATA SHEETS

installed: ...???

YORK®
BY JOHNSON CONTROLS

MODEL YCAL AIR-COOLED SCROLL COMPRESSOR LIQUID CHILLERS STYLE D



Nomenclature

YC A L 0045 E C 46 X D

- YC — YORK Chiller
- A — Air-Cooled
- L — Compressor Type: L = Scroll
- 0045 — Nominal Capacity
- E — E= High Efficiency Unit
- C — Refrigerant: C= R-22
- 46 — Voltage Code: 17= 200-3-60; 28= 230-3-60; 40= 380-3-60; 46= 460-3-60; 58= 575-3-60
- X — Type Start: X= Across-the-Line
- D — Design Series

Ratings - R-22 (60Hz - English Units)

MODEL: YCAL0065EC — IPLV=14.5

AIR TEMPERATURE ON - CONDENSER (°F)

LCWT	75.0			80.0			85.0			90.0			95.0			100.0		
(°F)	TONS	KW	EER	TONS	KW	EER	TONS	KW	EER	TONS	KW	EER	TONS	KW	EER	TONS	KW	EER
40.0	&	&	&	&	&	&	59.9	61.4	10.6	58.5	64.8	9.8	57.2	68.4	9.1	55.8	72.2	8.5
42.0	64.5	55.7	12.4	63.2	58.7	11.6	61.8	61.9	10.8	60.5	65.3	10.1	59.1	68.9	9.4	57.6	72.8	8.7
44.0	66.5	56.2	12.7	65.2	59.2	11.9	63.9	62.5	11.1	62.5	65.9	10.3	61.0	69.5	9.6	59.6	73.4	8.9
45.0	67.6	56.5	12.8	66.3	59.5	12.0	64.9	62.7	11.2	63.5	66.2	10.4	62.0	69.8	9.7	60.5	73.7	9.0
46.0	68.7	56.8	13.0	67.3	59.8	12.1	65.9	63.0	11.3	64.5	66.5	10.6	63.0	70.1	9.8	61.5	74.0	9.1
48.0	70.8	57.3	13.3	69.5	60.4	12.4	68.0	63.6	11.6	66.5	67.1	10.8	65.0	70.8	10.1	63.5	74.7	9.4
50.0	73.1	57.9	13.6	71.6	61.0	12.7	70.2	64.2	11.9	68.7	67.7	11.1	67.1	71.4	10.3	65.5	75.3	9.6

NOTES:
1. kW = Compressor Input Power
2. EER = Chiller EER (includes power from compressors, fans, and the control panels 0.8 kW)
3. LCWT = Leaving Chilled Water Temperature
4. Ratings are based upon 2.4 GPM cooler water per ton and 0.0001 fouling factor
5. Rated in accordance with ARI Standard 550/590-98