**Construction Design Narrative**

# Design Back-Up Cooling System for Critical Care Areas

PROJECT NO.: 593-15-106

*Las Vegas, Nevada*

**June 9, 2017**

## PURPOSE

The VA Southern Nevada Healthcare System (VASNHS) requires a Back-up Cooling System for Critical Care Areas in the hospital. The Back-up Cooling System must be designed to support the full demand of the critical areas.

## GENERAL

Through Market Research and multiple Requests for Information (RFI), the design team shall provide a design that will provide a new Chilled Water System to the VA identified Critical Care Areas. This new Chilled Water System shall provide primary chilled water for Radiology, Operating Rooms and Catheterization Lab.

## MECHANICAL SYSTEMS

### Equipment on new Chilled Water Loop

The equipment identified as being critical and requiring this new chilled water service is as follows:

Radiology

(2) Siemens – Somatom Definition Flash CT – 4.5 GPM @ 48.0 º F EWT / 73.8 º F LWT

(1) Siemens – Biograph PET CT – 11.2 GPM @ 48.0 º F EWT / 58.4 º F LWT

(1) Siemens – Magnetron MRI – 29.1 GPM @ 48.0 º F EWT / 73.8 º F LWT

Operating Rooms

AHU-DT-5A – 208.8 GPM @ 42.0 º F EWT / 58.0 º F LWT

AHU-DT-5B – 208.8 GPM @ 42.0 º F EWT / 58.0 º F LWT

Catheterization Lab

AHU-DT-4 – 61.5 GPM @ 42 º F EWT / 58.0 º F LWT

### Design Criteria

Climate Conditions

| | |
|---|---|
| Summer (0.4%): | 109.2º F DB, 67.4º F WB<br>h = 32.66 BTU/LBDA |
| Dehumidification (0.4%): | 80.8º F DB, 65.8º F DP<br>h = 35.38 BTU/LBDA |
| Winter (99.6%): | 27.7º F DB, 0% RH |
| Elevation: | 1867 FT ASL |

Chilled Water Pipe Sizing

| | |
|---|---|
| 2 inches and below | Max Velocity - 6.0 fps<br>Max Pressure Drop - 2.0 ft WG/100 ft |
| Above 2 inches | Max Velocity - 10.0 fps<br>Max Pressure Drop - 2.0 ft WG/100 ft |

**Chilled Water Cooling System**

This system is to provide the primary cooling for the equipment noted previously. The existing house chilled water system shall provide the redundancy for all equipment. This redundancy can be activated via control valves to the particular piece of equipment. Refer to Chiller Load Summary at end of narrative; a high diversity has been factored into the calculations to account for the possibility of nearly all the operating rooms and cath Lab, along with all radiology equipment in full operation on a peak design day.

The chilled water system will consist of (1) chiller having (5) 85 nominal ton chiller modules with (5) remote air cooled condensers, primary, secondary and tertiary circulation pumps, water treatment systems, air elimination, expansion compensation and distribution systems. The chilled water distribution system will consist of a primary loop, a decoupled variable flow secondary distribution system and a decoupled variable flow medium temperature tertiary distribution system.

The chillers, primary pumps and secondary pumps will be located in the Mechanical Equipment Room – 4D208. The remote air cooled condensers serving the chiller will be located on the roof directly above. The tertiary circulation pumps and heat exchanger will be located next to the chiller.
Refrigerant piping shall be routed from the (5) chiller modules, up through the north exterior wall cavities of Break Room 5D224 and Airborne Infectious Isolation Room 6D232, up to roof and routed to the (5) air cooled condensers.

A variable flow secondary chilled water loop with dedicated redundant distribution pumps (2 @ 100%) will be used to circulate chilled water to cooling coils in the OR Suite air handing units, Cath Lab air handling unit and a plate and frame heat exchanger which will serve the radiology equipment. The new chilled water loop will tie into the respective existing takeoffs for all connections. Control valves shall be provided at the connection points to the air handling units and radiology equipment to allow the BMCS to switch the chilled water service from the new to the existing should it become necessary.

A separate variable flow tertiary chilled water loop (to be set 48 degree F. (adjustable) with dedicated redundant distribution pumps (2 @ 100%) and plate and frame heat exchanger shall serve the Radiology equipment.

Chilled water piping shall be fully welded, schedule 40, black steel or type L copper with soldered wrought copper fittings and threaded joints, insulated with fiberglass insulation and sealed vapor barrier. Refrigerant piping shall be Copper, dehydrated, with high-temperature soldered joints and wrought copper fittings, insulated with Armaflex pipe insulation and PVC jacketing.

### Instrumentation and Controls

All new devices and instrumentation will tie into the existing Building Management Control System (BMCS). It may be necessary to expand the existing BMCS to accommodate the new control points. All actuation shall be electric.

The BMCS will control the chiller and pumps. The chiller control panel will monitor its safeties, proof of flow and provide capacity modulation. The BMCS will provide input to the chiller controls to indicate need for operation and provide the supply temperature setpoint. The BMCS will also monitor all chiller control function including remote condensers, chilled water flow, chilled water temperatures, kW demand and kWh usage. The BMCS will monitor the secondary chilled water pressure differential at two points and use low select logic for the secondary pump speed control. The BMCS shall monitor and control the tertiary chilled water temperature and pressure differential at two points and use low select logic for tertiary pump speed control.

## STRUCTURAL SYSTEMS

The structural work for the project is limited to verification of the existing floor and roof system to carry the new equipment loading as well as supplemental support of the floor system where multiple cores are being placed for pipe penetrations. New equipment on the fourth floor will be placed on the existing concrete pad thus eliminating the need to augment the floating slab. New equipment on the roof will be mounted to concrete curbs doweled directly to the concrete roof structure. Anchorage of the equipment to the pads and curbs is deferred to the contractor.

### Codes

A. International Building Code – IBC 2015.

### Standards

A. Code Prescribed Standards:

1) Loads: ASCE 7-10 Minimum Design Loads for Buildings and Other Structures including Supplement No. 1 and excluding Chapter 14 and Appendix 11A.

2) Steel: AISC 360-10 Specification for Structural Steel Buildings.

3) Concrete: ACI 318-14 Building Code Requirements for Reinforced Concrete.

### Design Criteria

A. Occupancy:

1) Use Group: I

2) Risk Category: IV(Table 1604.5)

B. Existing Construction Conditions:

1) Original construction drawings Titled New VA Medical Center Phase IV, dated May 2009 and prepared by Degenkolb Engineers was used as the basis of design.

2) Existing Construction Description: The existing building is a steel framed structure with composite concrete on metal deck floors designed to the 2003 IBC. Design Live loads for the Roof and Floor are 20 PSF (unreducible) and 100 PSF (reducible) respectively.

C. Earthquake (Seismic)

1) Design Parameters:

a. Spectral Acceleration for Short Period (Ss): 0.513g

b. Spectral Acceleration for 1-Second Period ($S_1$): 0.169 g

c. Site Class: C

d. Site Coefficient (Fa): 1.195

e. Site Coefficient (Fv): 1.631

f. Spectral Response Coeff. for Short Period ($S_{DS}$): 0.409 g

g. Spectral Response Coeff. for 1-Second Period ($S_{D1}$): 0.184 g

h. Seismic Design Category: D

i. Importance Factor Ip: 1.5

## ELECTRICAL SYSTEMS

### Existing Electrical System

The location of the new water cooled chiller is in the vicinity of the existing fourth floor Electrical Room 4D410. This room contains a normally powered 2000kVA-277/480V, 3PH, 4W unit substation US-F which will be used to provide power to the new chiller and associated pumps.

The location of the air condenser units is the seventh floor (roof). The units are located too far away from the existing roof mounted panelboard for practical use. A new panelboard will be installed and located in the vicinity of new condensers.

In is not anticipated that any electrical demolition work will be required.

### New Electrical Work

The design intent is to install new distribution panelboards dedicated to providing power to the new water cooled chillers, air condensers and associated pumps. The new panelboards will be fed from the existing unit substation US-F. New 1200A and 225A draw-out style circuit breakers will be installed within the existing substation space to support the feeders required for the new panelboards.

It is the design intent to support the new air condenser units on the seventh floor (roof) from a new 225A- 277/480V, 3PH, 3W panelboard located near the proposed condenser units.

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The new chilled water system is the primary cooling source for areas it will serve. It is backed up mechanically by the central plant's chilled water system which is supported by an emergency generator source. Therefore, the new chilled water system will not be supported by an emergency power source.

The addition of new light fixtures does not appear to be a requirement at this time as the areas of work already contain sufficient lighting.

| | | | |
|---|---|---|---|
| Project: | VA Southern Nevada - Backup Cooling | Computed: JDW | Date: 04/15/16 |
| Subject: | Chiller Load Summary | Updated: | Date: |
| Task: | | Page: | of: |
| Job No: | | No: | |

| | | |
|---|---|---|
| CHWS Temp: | 42 | F |
| CHWR Temp: | 58 | F |
| CHW Flow: | 528.3 | GPM |
| Minimum Equipment Pressure Difference: | 15.1 | PSI |
| | 34.9 | FTWG |
| Total Cooling Load: | 4226.4 | Mbh |
| Chiller Tonnage: | 352.2 | Tons |
| Diversity: | 92.5% | |
| Realized Load: | 325.8 | Tons |

**EQUIPMENT DEMAND**

**Siemens - Somatom Definition Flash CT**

| | | |
|---|---|---|
| Acceptable CHW Range | 39.2 - 60.8 | F |
| Acceptable Pressure Range | 29.0 - 87.0 | PSI |
| Flow required at 48F | 4.5 | GPM |
| Pressure drop at flow | 3.27 | PSI |
| Load to Water | 58045 | Btuh |
| LWT | 73.8 | F |

**Siemens - Somatom Definition Flash CT**

| | | |
|---|---|---|
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| Load to Water | 58045 | Btuh |
| LWT | 73.8 | F |

**Siemens - Biograph PET CT**

| | | |
|---|---|---|
| Acceptable CHW Range | 39.2 - 53.6 | F |
| Flow required at 48F | 11.2 | GPM |
| Pressure drop at flow | 15.1 | PSI |
| Load to Water | 58045 | Btuh |
| LWT | 58.4 | F |

**Siemens - Magneton MRI**

| | | |
|---|---|---|
| Acceptable CHW Range | 42.8 - 53.6 | F |
| Flow required at 48F | 29.1 | GPM |
| Pressure drop at flow | 14.5 | PSI |
| Load to Water | 204729 | Btuh |
| LWT | 62.1 | F |

***48F For Radiology Equipment through HX***

**AHU-DT-4**

| | | |
|---|---|---|
| Design CHW Range | 42.0 - 58.0 | F |
| Minimum Capacity | 492 | Mbtuh |
| Fow at design CHW | 61.5 | |
| Pressure drop at flow | 4.1 | PSI |
| Tonnage | 41 | Tons |

**AHU-DT-5A**

| | | |
|---|---|---|
| Design CHW Range | 42.0 - 58.0 | F |
| Minimum Capacity | 1670 | Mbtuh |
| Fow at design CHW | 208.8 | |
| Pressure drop at flow | 5.2 | PSI |
| Tonnage | 139.2 | Tons |

**AHU-DT-5B**

| | | |
|---|---|---|
| Design CHW Range | 42.0 - 58.0 | F |
| Minimum Capacity | 1670 | Mbtuh |
| Fow at design CHW | 208.8 | |
| Pressure drop at flow | 5.2 | PSI |
| Tonnage | 139.2 | Tons |