

100% DESIGN DEVELOPMENT

Cooling Tower Replacement for VAMC Lebanon, PA

Project No. 595-11-135



Lebanon VA Medical Center
Lebanon, PA

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Building One – 1st Floor
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CHAPTER 1

STRUCTURAL

1. Applicable Codes and Standards

- International Building Code – 2009 Edition
- American Society of Civil Engineers - Minimum Design Loads for Buildings and Other Structures - ASCE 7-05
- Department of Veterans Affairs Seismic Design Requirements H-18-8
- VA Program Guide PG-18-15 Volume C
- VA Structural Design Manual For Hospital Projects - August 2009
- American Concrete Institute - Building Code Requirements for Structural Concrete – ACI 318-08
- American Institute of Steel Construction - Manual of Steel Construction – Thirteenth Edition - AISC 360-05
- American Welding Society - Structural Welding Code for Steel – ASW D1.1
- American Society for Testing and Materials – ASTM Standards

2. Design Loads

1. Dead loads for the purpose of structural design are the actual self-weight of the permanent building construction materials. In addition to the self-weight of the structure, the following additional dead loads are included in the design:

- Closed Circuit Coolers: 105 kips

2. Design live loads to be supported are as follows:

- Mechanical Area 150 PSF

3. Snow Load:

- Ground Snow Load (Pg) 30 PSF
- Snow Importance Factor (Is) 1.2
- Exposure Factor (Ce) 1.0

- Thermal Factor (Ct) 1.2
4. Wind Load:
- Basic Wind Velocity 90 MPH (3-second gust)
 - Exposure Category B
 - Wind Importance Factor (Iw) 1.15
5. Seismic Load:
- Occupancy Category IV
 - Seismic Importance Factor (Ie) 1.5
 - 0.2 Second Spectral Response Acceleration Ss 0.228g
 - 1.0 Second Spectral Response Acceleration S1 0.057g
 - Soil Site Classification C
 - Seismic Design Category C
 - Seismic Force-Resisting System: Cantilevered Column System
 - Analysis Procedure: Equivalent Lateral Force Procedure per ASCE 7
6. All load combinations shall be in conformance with the listed codes and standards.
3. Structural Systems
1. Foundation System: A geotechnical report has been provided for this site by ARM Group, Inc. Based on this report, the cooling towers and pipe supports are supported on a reinforced concrete slab over an existing concrete slab.
 2. Superstructure: The cooler supporting structure consists of structural steel wide flange beams resting on the concrete slab. The pipe support structure consists of structural steel HSS cantilevered columns and wide flange beams.
 3. Lateral Force Resisting System: A structural steel cantilevered column system serves as the primary lateral load resisting system for the pipe support structure. The system is designed to meet the requirements of the 2009 International Building Code/ASCE 7-05 and Department of Veterans Affairs Seismic Design Requirements H-18-8 for wind and seismic loads.

4. Structural System Selection: The structural system was selected as the optimum structural system for the structure configuration.
4. Structural Materials
 1. Concrete
 - Minimum Compressive Strength: $f'_c=4,500$ psi
 - Maximum Water-Cementitious Materials Ratio: 0.45
 - Minimum Cementitious Materials Content: 500 lb/cu. yd.
 - Air Content: 4.5 to 5.5 percent
 - Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
 - Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Maximum Coarse-Aggregate Size: 1 1/2 inch nominal.
 - Air-Entraining Admixture: ASTM C 260.
 - High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 2. Structural Steel
 - Rectangular and Square HSS: ASTM A 500/A 500M, Grade B ($F_y = 46$ ksi).
 - Round HSS: ASTM A500, Grade B ($F_y = 42$ ksi).
 - Channels, Angles, M, S-Shapes: ASTM A 36/A 36M ($F_y=36$ ksi).
 - Plate: ASTM A 36/A 36M ($F_y=36$ ksi).
 - Wide Flange Shapes: ASTM A992 ($F_y = 50$ ksi)
5. Structural Special Inspections
 1. In accordance with Section 1704 of the international building code, and all applicable state and local requirements, an independent approved agency shall make periodic and/or continuous inspections of the construction progress in accordance with the following requirements:

Steel Construction	Section 1704.3, Table 1704.3
Concrete construction	Section 1704.4, Table 1704.4
Soils	Section 1704.7, Table 1704.7

CHAPTER 2

HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

1. GENERAL

1. HVAC design will be done in accordance with, but not limited to the following VA design standards:
 - VHA Program Guide PG-18-3, Topic 1 – Codes, Standards, and Executive Orders
 - DVA HVAC Design Manual
 - ASHRAE Standard 90.1-2007
 - ASHRAE Standard 62.1-2007

2. DESIGN CIRTERIA

1. Outdoor Design Conditions
 - Summer: 92.4°F DB, 73.8°F WB
 - Winter: 8.7°F DB

Source: Table 6.1 Climatic Conditions, HVAC Design Manual

3. SEQUENCE OF OPERATION

1. Cooling Tower Pump Control
 - When the first chiller is enabled the lead cooling tower distribution pump shall start and required isolation valve(s) to the lead tower cell shall be opened.
 - If the lead pump fails for 15 seconds or more, the lag pump shall start and an alarm sent to the BAS.
 - As additional chillers are enabled the appropriate cooling tower distribution pumps and isolation valves shall be enabled.
2. Cooling Tower (Chiller) Bypass Valve Control

- The BAS system shall monitor the leaving-water temperature for each chiller's evaporator and condenser. The BAS system shall use PID based DDC to control the chiller condenser pump VFD or the cooling tower bypass valve to maintain no less than the minimum temperature differential specified by the chiller manufacturer.

3. Cooling Tower Fan Control

The following control sequence is for cooling tower fans with VFD drives.

- When a chiller is operating and the cooling tower basin temperature rises to two (2) degrees F above the current tower leaving water leaving water setpoint the cooling tower lead tower fan shall be turned on at minimum speed and the DDC control loop enabled.
- When the operating fan(s) are operating at 50 percent speed an additional fan shall be enabled and controlled at the same speed as the operating fans until all active cooling tower cell fans are enabled.
- When operating fans are running at minimum speed and the tower supply water temperature is five (5) degrees below the current tower leaving water leaving water setpoint the most lag tower fan shall be turned off.
- Cooling tower fans shall have five (5) minute minimum on an off delays.
- Cooling tower fan sequence shall be rotated on a 7-day basis to equalize fan run time.

4. Cooling Tower Leaving Water Setpoint Optimization

- The controls provider shall provide controls that calculate the optimal tower setpoint at any chiller(s) load and ambient wet bulb. The optimization program shall provide as an output a leaving tower water temperature setpoint.
- Optimal performance is defined as the lowest total kW input consumed by both chiller(s) plus cooling tower(s) while maintaining chilled water setpoint.
- As part of the BMS/ATC Contractor's letter of specification compliance (to be submitted 10 days prior to the scheduled bid date), provide optimal setpoint and estimated chiller + tower power (kW) for the following load and ambient conditions:

- Chiller Load Wet Bulb Tower Setpt. Twr + Chlr KW

100 %	64
75 %	61
50 %	64
50 %	59
25 %	64
- A Chiller-Cooling Tower Optimization Program shall be provided by the controls contractor. As a minimum, the following chiller and tower characteristics shall be used in the optimization routine.
 - Chiller type (per chiller)
 - Chiller full load efficiency (kW/ton)
 - Chiller part load performance (kW/ton) (efficiencies from 100-10% in 10% increments)
 - Chiller evaporator water flow rate
 - Chiller cond. Water flow rate
 - Tower type (per tower)
 - Tower approach temperature
 - Total tower fan(s) hp
 - Tower range
 - Actual instantaneous chiller tons
- The Chiller-Tower Optimization program shall scan every 5 minutes (adj.) the chiller(s) load and ambient WB temperature. Using these inputs and both the chiller and cooling tower characteristics noted above, the program shall provide optimal chiller plus tower performance.

CHAPTER 3

ELECTRICAL

1. GENERAL

- .1 This project will design three cooling towers and add three variable frequency drives to three condenser pumps all located in Building 10 at the Lebanon VA Medical Center.

2. SCOPE OF WORK – ELECTRICAL

- .1 Provide a complete electrical design for three new cooling towers outside of Building 10 at the Lebanon VA Medical Center.
 - The new cooling towers will be located in the parking lot to the south east of Building 10. The new cooling tower electrical design will use the existing electrical distribution and communication system available in Building 10.
- .2 Provide a complete electrical design for three new variable frequency drives (VFDs) to be added to three existing condenser pumps inside of Building 10 at the Lebanon VA Medical Center.
 - The new VFDs will be located inside the chiller room of Building 10. The new VFD electrical design will use the existing electrical distribution and communication system available in Building 10.
- .3 The electrical design will be done in accordance with, but not limited to the following VA design standard:
 - Electrical Design Manual for New Hospitals, Replacement Hospitals, Ambulatory Care, Clinical Additions, Energy Centers, Outpatient Clinics, Animal Research Facilities, and Laboratory Buildings.
 - NFPA 70 (NEC) and NFPA 870 (Lightning Protection)
- .4 The design will consider future requirements, as directed by the VA, in all electrical design.

3. EXISTING CONDITIONS

- .1 There is an existing 480 VAC distribution system that serves the Building 10 existing Chiller plant. The Chiller plant power comes into the North West corner of the Chiller Room to a 4000 amp switchboard.

4. DESIGN APPROACH

.1 ELECTRICAL DISTRIBUTION SYSTEM

- The existing 480 VAC distribution system will be utilized to provide power to the new cooling tower.. An existing 600 amp circuit breaker (in the existing 4000 amp switchboard) shall be used to provide power to a new main distribution panelboard (MDP).
- Electrical power shall be distributed from the MDP to all required electrical equipment (cooling tower control panels, motors, heaters, etc).
- A step down 15 kVA transformer shall provide power to a 40 amp power panel. The power panel shall provide power to maintenance receptacles and lights on the cooling tower skids.

.2 LIGHTING

- In general, the lighting fixture selection shall follow the Department of Veterans Affairs June 2011 Community Living Centers Design Guide. Careful selections shall be made to provide residential style lighting fixtures with high efficiency. Table 3-6, Lighting Schedule, of the design guide shall be adhered to for fixture selections.
- Exterior emergency lighting shall be provided for egress. It will be powered from by battery backup lights.
- All outdoor lighting shall be controlled thru a photo sensor on each light fixture.

.3 SYSTEMS

- Communication with the existing chiller system shall be provided from variable frequency drives in the field thru CAT 6E cables to the central chiller plant monitoring station in the maintenance office.
- Communication for the three new cooling towers shall be incorporated into the existing central chiller plant monitoring system in maintenance office 102. CAT 6E cables shall distribute from each V.F.D. on the cooling towers.

.4 LIGHTNING PROTECTION SYSTEMS

- Lightning protection on the existing roof shall modified to take into account upgraded conditions.

- Lightning protection shall be expanded to incorporate the new cooling towers being added.
- Lightning protection standard NFPA 780 and the local AHJ shall be followed.

.5 GROUNDING SYSTEMS

- NFPA 70 and the AHJ shall be adhered to for grounding.
- Existing grounding systems (or loops) shall be expanded to incorporate the new cooling towers being added.
- Grounding protection on the roof shall be modified to accommodate the modified conditions on the roof.