

Appendix 4- Infrastructure



Mechanical / Electrical / Plumbing / Fire Protection
Basis of Design Narrative
Emergency Department Renovation / Expansion

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Prepared by:

Fitzmeyer & Tocci Associates, Inc.
300 Unicorn Park Drive, 5th Floor
Woburn, MA 01801
781.481.0210 | 781.481.0203



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1. Mechanical / Electrical Systems Executive Summary

1.1. Fire Protection

The addition and proposed renovation scope shall be fully sprinklered via the extension of the existing sprinkler system serving the emergency department. The system extension shall be designed and installed in accordance with applicable codes and standards as well as requirements of the insurance underwriter (Factory Mutual Global). The existing water service and sprinkler zoning shall remain to the extent practical. The existing sprinkler and standpipe fire department connections will require relocation. A new 4" main will be extended from the existing 4" sprinkler main to serve new sprinklers and branch piping within the renovation space. The existing antifreeze loop serving the ambulance bay will be demolished and a new dry sprinkler system with nitrogen generator will be provided to serve the new ambulance bay and new exterior overhang. There are no proposed modifications to the fire standpipe systems.

1.2. Plumbing

Complete domestic water, sanitary drainage and venting and storm drainage systems shall be provided for the additions. The domestic water system, supported by an existing site cold water service from municipal water supply, shall consist of cold, hot and circulation piping systems. Domestic hot water shall be provided via existing steam-fired instantaneous water heating equipment. Sanitary and storm drainage shall discharge to existing site drainage services or existing mains, depending on location. Centralized medical air, oxygen, and medical vacuum gas systems shall be provided for the additions on a case by case basis, with associated local and area alarms and zone boxes. The systems shall be tied back into the existing master alarm panel. All systems shall be designed to fully comply with the requirements of NFPA 99 & NFPA 55 and with the 2018 FGI Guidelines for Healthcare Design and Construction, the Vermont State Department of Health and applicable local and state codes and regulations. Plumbing fixtures shall be provided that meet current Energy Policy Act water conservation requirements and are consistent with facility standards.

1.3. HVAC

Complete new heating, ventilation, air-conditioning, and exhaust systems shall be provided for the addition. Primary heating shall be provided by an extension of the existing steam and condensate piping system, with the addition of new heat exchangers and pumps, and will support air handler preheat coils, variable air volume reheat coils and other miscellaneous heating coils. Primary cooling shall be provided by an expansion of the existing chilled water plant by replacing an existing chiller with a new water-cooled chiller connected to the existing cooling towers. As an add alternate, if it is determined the existing chiller is adequate, it may be re-used. Cooling, ventilation, and ventilation air pre-heating shall be provided by a roof mounted variable air volume air handling unit. Air distribution shall be variable air volume with terminal box hot water re-heat coils. Exhaust systems shall be provided for toilet, general, and specialized exhausts. Automatic control systems shall be supported by a new direct digital control-based building automation system.

Renovated spaces within the existing ED area and surrounding support spaces such as registration, blood draw, existing lobby, radiology waiting and coffee shop shall be provided with a reconfiguration of the existing mechanical systems, including variable air volume boxes with reheat coils, steam and hot water piping, and chilled water piping. Existing air handling equipment is expected to remain and be re-used.

All areas within the building shall be provided with systems designed to comply with the 2018 FGI Guidelines for Healthcare Design and Construction, the Vermont State Department of Health and applicable local and state codes and regulations.

1.4. Electrical

New panelboards shall be provided to serve the addition and renovation areas. Normal power shall be provided from the existing West Area Switchboard. Standby power shall be provided via existing North West Area essential distribution equipment. New lighting systems shall be energy efficient LED type fixtures; with automatic relay control and/or occupancy sensing controls. Low voltage systems requiring extension and reconfiguration to align with the new program shall include fire alarm. Low voltage systems requiring raceway support shall include security/access control, nurse call systems, and data & telephone.

All areas within the building shall be provided with systems designed to comply with the 2018 FGI Guidelines for Healthcare Design and Construction, NEC (National Electric Code), specifically article 517 for Health Care Systems, and the Vermont State Department of Health and applicable local and state codes and regulations.

2. Project Description

The scope of this narrative is intended to indicate the basis of design systems for the renovation and expansion of the Emergency Department and main entrance for the Southwestern Vermont Medical Center Hospital. The project consists of approximately xx,000 SF of new construction addition, and approximately xx,000 SF of renovation within the existing building.

Current Program Intent is as follows:

Facility / Bldg	GSF	Key Program Elements	Comments
Main Entrance	2,700		
Emergency Department	6,700		
Interior Renovations	13,600		
Total Additions and Renovations	23,000		

3. Fire Protection Systems

3.1. Existing Sprinkler Water Service

The existing building sprinkler system is served by a dedicated 6" fire protection service which enters the building in the Crawl Space area. After entering the building, a 6" reduced pressure backflow preventer assembly with supervised butterfly isolation valves is provided. Downstream of the backflow preventer assembly, the service splits into two (2) 6" lines. One line serves the proposed renovation / addition and the other valve is labeled "Medical Office Building". The 6" line serving the proposed renovation / addition further splits into two system risers:

1. 6" Standpipe System: The standpipe system consists of a 6" check valve and 6" OS&Y isolation valve with tamper switch. Downstream of the isolation valve, 6" horizontal standpipe interconnecting mains are routed on the Ground Floor to serve stairwells at columns M6 and E11. The stairwell at column F1 is provided with a standpipe riser that serves the second floor only. A fire department connection dedicated to the standpipe system and fire pump test header (associated with the previously decommissioned fire pump) are provided on the standpipe interconnection main.
2. 4" Sprinkler System: The sprinkler system consists of a 4" alarm valve, OS&Y isolation valve with tamper switch and pressure regulating valve. The sprinkler system is zoned as follows:

- a. Ground Level: A 4" interconnecting sprinkler main serves 4" sprinkler risers in stairwells at columns M6 and E11. A 4" flow control assembly (OS&Y isolation valve with tamper switch and flow switch) located in the crawl space area near column D8. A fire department connection dedicated to the sprinkler system is provided at the main entrance and is connected to the system downstream of the main alarm valve.
- b. First Floor: A 4" flow control assembly located in the stairwell at column E11 serves the portion of floor east of gridline G. There is an auxiliary anti-freeze loop installed on this zone to feed the ambulance bay. A 4" flow control assembly located in the stairwell at column M6 serves the portion of the floor west of gridline G.
- c. Second Floor: A 2-1/2" flow control assembly located in the stairwell at gridline E11 serves the penthouse. A 4" flow control assembly located in the stairwell at column M6 serves the second floor.

The system pressure was observed to be approximately 90 PSI at the entrance. Field observations noted that the existing main drain was routed to a floor drain, which is atypical due to waterflow requirements. Discussion with facilities staff confirmed that the drain arrangement is not problematic during system testing.

3.2. Sprinkler Water Service and Zoning Modifications

The design intent is to utilize the existing 6" water service and sprinkler zoning. The proposed addition will require the following modifications:

1. The existing sprinkler fire department connection and standpipe fire department connection will require relocation. The existing connections will be demolished and new piping shall be extended to the new south wall of the emergency department where new connections will be installed. The fire pump test header is intended to be demolished within this scope of work, as the pump is no longer installed and the standpipes can be used to test the full backflow preventer system flow.
2. The existing auxiliary anti-freeze loop serving the ambulance bay shall be demolished. There are currently no listed anti-freeze solutions available and new anti-freeze systems are not permitted. A dry sprinkler system will serve the new canopy and ambulance bay, as discussed below.
3. The existing first-floor east sprinkler zone will be extended to serve the new addition. A new sprinkler zone is not required because the existing zone is adequately sized to serve both the existing-to-remain and the proposed areas, and the maximum system protection area will not be exceeded.
4. The existing ground-level east sprinkler zone will be extended to serve the crawl space below the new addition. A new sprinkler zone is not required because the existing zone is adequately sized to serve both the existing-to-remain and the proposed areas, and the maximum system protection area will not be exceeded.

3.3. Standpipe Systems

There are no new stairwells proposed to be added within the scope of the project. Therefore, modifications to the standpipe system are not anticipated.

3.4. Sprinkler Systems

While the main piping and sprinkler infrastructure serving the space will be maintained, the sprinklers and piping throughout the proposed renovation will be demolished. Reuse of the existing piping within the renovation space is not proposed due to the following: components approaching the end of design life, reconfiguration to accommodate the new program, and main sizing to support the proposed expansion. On the first floor, a new 4" sprinkler main will be extended from the existing 4" sprinkler main that is located between Gridline 8 and 9. This main will supply all sprinklers in the renovation area and addition from the existing first-floor east sprinkler zone, including the double-

height atrium space. On the lower level / crawl space, a new 4" sprinkler main will be extended from the existing 4" sprinkler main that is located between Gridline 8 and 9. This main will supply all sprinklers in the renovation area and addition from the existing ground-floor east sprinkler zone.

3.5. Special Sprinkler Systems

The new ambulance bay and exterior overhang shall be protected with a dry system. The dry valve will be of the low differential pressure type and is intended to be located in the crawl space below the emergency department. The system will be provided with a nitrogen generator in lieu of an air compressor to allow for the use of black steel pipe in place of galvanized and to prolong the system's useable life. A 4" dry valve is anticipated.

3.6. Sprinklers

Sprinklers shall be installed in all areas, except where omission is permitted by both NFPA 13 and applicable insurer's requirements. All sprinklers shall be UL listed as quick response and both UL Listed and FM Approved for their end use. Generally, the sprinkler characteristics shall be as noted in Table F-1, except where otherwise required by applicable regulations and / or listings. Listed protective guards will be provided in areas where sprinklers are susceptible to physical damage to protect against accidental damage.

Table F-1: Typical Sprinkler Characteristics

Area	Style	System	T, °F	K-Factor	Notes
Finished Ceilings (Aesthetic Areas)	Concealed	Wet	155	5.6 (Light Hazard)	White cover plate
Finished Ceilings (Gypsum, ACT)	Recessed	Wet	155	5.6 (Light Hazard) 8.0 (Ordinary Hazard)	White cover plate
Open Ceilings (Mechanical / Electrical Rooms)	Upright	Wet	200	8.0	Brass
Open Ceilings (Other)	Upright	Wet	155	5.6	Brass
Open Ceilings (Dry System)	Upright	Dry	200	5.6	White (Corrosion Resistant)

3.7. Fire Suppression Systems

No chemical or gaseous fire suppression systems are anticipated to be required for the project.

3.8. Materials

Piping, above ground:

1. 2 ½" and larger: Schedule 10, black-steel pipe with ends to match joining method (roll-grooved or welded)
2. 2" and smaller: Schedule 40, black-steel pipe with ends to match joining method (grooved or threaded)
3. Flexible Sprinkler Fittings:
 - o FM Approved for 300 PSI and no fewer than three (3), ninety (90) degree bends
 - o Stainless Steel

3.9. Proposed Manufacturers

Sprinklers:	Tyco; Reliable; Victaulic; approved equal.
Valves:	Victaulic; Reliable; approved equal.
Piping:	Allied; Wheatland; Central; approved equal.
Flow and Supervisory:	Potter Roemer; McDonnell; Autocall; approved equal.
Flexible Sprinkler Fittings:	Victaulic; Viking; approved equal.
Automatic Air Vent:	Potter Roemer; approved equal.

All equipment shall be approved by Factory Mutual for the intended use.

4. Plumbing Systems

4.1. Domestic Water Service

The existing water services to the building are intended to remain and be re-used. The existing service has enough capacity to provide for the building expansion. The existing meter and backflow preventer assembly shall remain, and the existing system extended therefrom throughout the building. The building expansion system shall extend from the existing mains within the area of scope. No changes to the domestic water service shall be required as a part of this expansion.

4.2. Domestic Water Heating Systems

The existing domestic hot water system for the buildings shall be utilized to provide hot water for the building expansion. A 1 1/2" domestic hot water main shall extend from the existing main to supply the expansion with hot water. A 3/4" domestic hot water circulation main shall connect a minimum of three hot water circulation branches within the addition. The hot water circulation system shall be balanced using self-regulating lead free thermostatic balancing valves to minimize hot water delay at the furthest fixtures and connect back into the existing hot water circulation main.

Pipe insulation shall be provided for the hot water systems throughout the building. Insulation thicknesses shall comply with current Energy Codes; 1" thick for all domestic hot water systems.

4.3. Domestic Water Distribution Systems

A complete domestic water system shall be provided, extending to all fixtures and equipment requiring hot and / or cold water. There is no water treatment within the building and there is no requirement water treatment is anticipated for the building expansion.

Make-up water for HVAC applications and any other potentially contaminated service shall be provided with a local backflow preventer.

Piping shall be sized based on fixture units and velocity within the pipe. Water velocity shall not exceed 8 feet / second. Cold water piping shall be insulated with 1/2" thick insulation. Hot water and re-circulation piping shall be insulated with 1" insulation, or as required by local energy code.

Domestic pressure within the system is adequate to support the needs of our building expansion. Fixture isolation valves shall be full port, ball type, solder end.

4.4. Sanitary Drainage and Venting Systems

A complete sanitary drainage and venting system is to be provided, extended and connected to all fixtures and equipment as required within the building expansion.

The drainage system is to be connected to the existing sanitary main below grade by gravity. If there is a need to provide a new connection due to invert issues, then a new main shall extend 5'-0" from

the building foundation wall prior to connection to the municipal sanitary sewer. In-direct sanitary drainage connection and cool down shall be provided for any water discharge above 140°F.

Venting will terminate through the roof at multiple locations.

4.5. Storm Water Drainage Systems

A complete storm drainage system is to be provided, extended and connected to all roof drains. The drainage system is to extend 5'-0" from the building foundation wall prior to connection to the municipal storm sewer within the plaza. An above grade overflow drainage system will be provided, extended and connected to overflow roof drains, discharged to a visible location via multiple wall penetrations with flush mounted downspouts. Roof drains or a gutter system shall be provided for any canopies located on the exterior of the building, per architectural coordination.

Horizontal storm drainage piping shall be insulated with 1" thick insulation. Vertical piping risers shall not be insulated.

4.6. Special Drainage and Venting Systems

No requirement for special drainage and venting is anticipated for the building expansion.

4.7. Medical Gas and Vacuum Systems and Distribution

The existing oxygen system shall be utilized to support the needs of the building expansion. The piping system shall be extended and connected to all valve boxes and oxygen outlets from existing mains, per NFPA 99 requirements.

The existing medical air system shall be utilized to support the needs of the building expansion. The piping system shall be extended and connected to all valve boxes and medical air outlets from existing mains, per NFPA 99 requirements.

The existing medical vacuum system shall be utilized to support the needs of the building expansion. The piping system shall be extended and connected to all valve boxes and medical vacuum inlets from existing mains, per NFPA 99 requirements.

Master alarm panels (2) shall be provided for system monitoring. Exact locations shall be coordinated, but at least one panel shall be located at a constantly attended location. Area alarm panels shall be provided with each zone valve box for distribution monitoring.

Medical gas outlets shall be quick-connect type.

4.8. Fuel Gas Systems

No requirement for a fuel gas system is anticipated for the building expansion.

4.9. Reverse-Osmosis (RO) Water Systems

No requirement for a reverse-osmosis water system is anticipated for the building expansion.

4.10. Plumbing Fixtures

Plumbing fixtures shall be provided complete with all trim, accessories and necessary piping connections. Fixture types and operators shall be consistent with FGI Guidelines, local and other applicable codes and facility standards.

In general, fixtures shall be provided as required by the architectural layout:

4. Clinical exam / treatment and support (lab) spaces shall be provided with stainless steel counter sinks with gooseneck faucets and wrist blade operators.

5. Toilet rooms shall be provided with vitreous china wall-mounted water closets (bariatric, as required) and wall-mounted lavatories with gooseneck faucets and wrist blade operators.
6. Soiled utility spaces shall be provided with flushing rim sinks and eyewash stations, the pull-out spray type.
7. Housekeeping spaces shall be provided with floor-mounted or wall-hung mop sinks.
8. Floor drains shall be provided with automatic trap primers.
9. Showers shall be provided with ADA accessible trim and barrier free access. Trim shall include a single water temperature control lever with integral pressure and temperature regulator, standard and wand-connected heads, and diverter valve assembly.
10. Emergency eyewash stations shall be located in areas with hazardous chemicals or biohazards, the pull-out spray type. Typically located within labs, soiled utility rooms, medicine rooms, etc. as required.

4.11. Materials

1. Domestic water: Type L copper, hard drawn, soldered or press-fit fittings. PEX drops to fixtures, in wall only, with brass stops
2. Sanitary waste and venting, 2 1/2" and larger, above grade: Hubless cast-iron.
3. Sanitary waste and venting, 2" and smaller, above grade: Cast-iron or type L copper, threaded or solder fittings.
4. Sanitary waste and venting, below grade: Hub and spigot.
5. Storm drainage, above grade: Service weight hubless cast-iron, four-band (minimum) heavy-duty clamp / gasket mechanical joints.
6. Storm drainage, below grade: Service weight hub and spigot cast-iron, rubber seals.
7. Medical gas: Type L copper, pre-washed and sealed, brazed fittings.
8. Medical vacuum & WAGD: Type L copper, pre-washed and sealed, brazed fittings.

4.12. Proposed Manufacturers

Toilets:	Toto; American Standard; Kohler; approved equal.
Flush Valves:	Toto; Delaney; Sloan; approved equal.
Sinks:	Just; Elkay; Opella; approved equal.
Faucets:	Chicago; Delta; Toto; approved equal.
Eyewash:	Guardian; Haws; Speakman; approved equal.
Floor Drains:	JR Smith; Wade; Mifab; approved equal.
Roof Drains:	Froet; JR Smith; Wade; approved equal.
Valves:	Apollo; Watts; Nibco; approved equal.
Backflow Preventers:	Apollo; Watts; Febco; approved equal.
Water Heaters:	Rinnai; Navien; State; approved equal.
Medical Gas and Vacuum:	Beacon Medaes; Allied; Amico; approved equal.

5. HVAC Systems

5.1. Primary Heating Systems

Primary heating for the addition shall be provided by new steam piping extending from existing steam mains in the existing West Wing ED basement crawl space. A new crawl space shall be provided underneath the ED Addition, and a new pressure reducing station shall be provided to produce low pressure steam from the existing medium pressure steam mains. The new 4" low pressure steam and

2" condensate piping will be routed to two (2) new steam to hot water 480 MBH heat exchangers in the new addition crawl space. New 2" low pressure steam and 1" branch condensate piping will be routed in a shaft leading to the pre-heat coil and humidifier in the new air-handling unit on the roof. One heat exchanger will be the primary and one will be for redundancy.

5.2. Primary Cooling Systems

Primary cooling for the addition will be provided by a new 500 ton centrifugal water-cooled chiller to replace the existing 350 ton centrifugal water cooled chiller located in the existing West Wing chilled water plant mechanical room. The new chiller and existing 500 ton centrifugal chiller will be connected to the recently upgraded two 500 ton cooling towers. Two new primary chiller pumps and two new secondary (one being standby) chilled water pumps, and new chilled water piping shall be provided to replace the existing chilled water system distribution system in the mechanical room. New 10" secondary piping from the mechanical room shall be connected to existing 8" chilled water piping downstream of the new branch take-off to the addition in the existing ED crawl space. Two new condenser water pumps and 12" condenser water piping shall also be provided in the mechanical room to replace the existing condenser water system. The chilled water secondary pumps shall be rated for 1600 gpm at 100 ft of head and sixty (60) HP, and the primary pumps 800 gpm at 50 ft of head and twenty (20) HP. The condenser water pumps shall be rated for 1500 gpm at 50 ft of head and twenty-five (25) HP.

Add Alternate: If it is determined that the existing 350 ton chiller is in good condition, and spare capacity is available, accounting for redundancy, than the existing chiller and mechanical room chilled water piping may be re-used. The existing chilled water distribution pumps and condenser water pumps shall be tested to ensure they are in good working order.

New 3" Chilled water distribution piping will be provided from the new 10" chilled water mains (or existing 8" mains) in the existing ED crawl space to the new crawl space under the addition, and routed in a shaft to the new air-handler on the roof. Chilled water design temperatures shall be 42-57 deg F.

5.3. Hydronic Distribution Systems

Hot water systems will be distributed throughout the addition by variable primary pumping systems. Hot water will be distributed from the steam to hot water heat exchanger to the heating coils via two (2) base mounted end suction pumps and 2-1/2" hot water piping. The pumps will be rated for 50 GPM at 60 feet of total dynamic head and will have two (2) horsepower motors with variable speed drives. One pump will be primary, and one will be standby. Hot water design temperatures shall be 180 to 160 deg F.

5.4. Humidification Systems and Distribution

Humidification will be provided in the new air-handling unit via the new steam piping provided for the addition. New 1" low pressure steam and 3/4" condensate piping will be routed to a grid type humidifier located downstream of the heating coil within the air-handling unit. The humidifier grid will disperse steam into the supply air. The humidifier will be designed to maintain 30% RH in the spaces.

5.5. Air Handling Systems

Cooling, ventilation, and ventilation air pre-heating shall be provided by one (1) hydronic roof top unit. The roof top unit will have the following characteristics:

- 17,500 CFM Capacity
- 50 Tons of Cooling (actual capacity)
- 466" Long x 99" Wide x 97" Tall (excluding curb)
- 13,700 lbs (excluding curb)

- 36" tall acoustic curb (approx. 2,000 lbs)
- 33% outside air, minimum
- Solid double wall galvanized construction with hinged access doors
- Stainless steel drain pans
- 90% efficient cartridge final filters mounted in stainless steel racks downstream of the supply fan
- 30% efficient pleated pre-filters upstream of cooling coil
- Outdoor air hoods with air measurement and 0-100% economizer
- Steam Pre-heat coil
- Steam Humidifier
- Chilled water cooling coil
- Premium efficiency motors
- Variable speed drives for fans
- Filter bank differential pressure gauges
- Multiple supply and multiple return fans for redundancy and control.
- DDC control
- Variable air volume operation with discharge air temperature control

5.6. General Exhaust Systems

A complete ducted general exhaust air system shall be provided to serve toilet rooms, shower rooms, housekeeping areas and soiled holding as well as areas as required by code and FGI guidelines. A galvanized steel duct system shall run throughout the building and connect from the wall / ceiling or duct-mounted grilles in each space to the exhaust air mains and rooftop exhaust fans. Ductwork serving showers will be aluminum. Exhaust fans shall be a minimum of 25 feet away from fresh air intakes.

It is anticipated that there will be three (3) exhaust fans for bathrooms and environmental services.

5.7. Special Exhaust Systems

Areas performing specialized procedures and as required by the FGI guidelines shall be provided with individual dedicated exhaust systems. Equipment such as pharmacy and lab fume hoods, bio-safety cabinets, and chemical storage cabinets, etc. are expected to require dedicated exhaust systems.

It is anticipated that the ED waiting area and triage are expected to require dedicated exhaust systems.

5.8. Air Distribution Systems

The existing duct systems shall be reconfigured as necessary to meet the requirements of the renovated areas. This may require replacement of VAV boxes, ductwork, registers and diffusers.

New supply air ductwork shall generally be insulated galvanized steel. Stainless steel ductwork shall be used for service to procedure rooms. Medium pressure supply air ductwork between the air handler and the VAV terminal boxes shall be rated for 6" wg pressure class service. Supply air ductwork downstream of VAV terminal boxes (low pressure) shall be rated for 2" wg service.

Relative to the new VAV air handling system and associated duct distribution, pressure independent variable air volume (VAV) terminal boxes with hot water reheat coils shall be provided for air flow, space pressure and temperature control. All VAV boxes shall be single inlet type with hospital grade lining and factory sound attenuators. VAV boxes will be zoned to support similar program areas and exterior exposures.

VAV terminal boxes serving areas such as offices, corridors, lounges and staff areas shall operate in variable volume fashion with airflow modulating in response to the thermal load within the space. Minimum air flow rate shall be defined as the minimum flow required for compliance with building code minimum ventilation air flow.

VAV terminal boxes supporting patient general care areas shall operate in variable volume fashion with airflow modulating in response to the thermal load within the space. Minimum air flow rate shall be defined as the minimum flow required for compliance with ASHRAE 170 criteria. The following are applicable minimum air exchange and ventilation rate requirements for the typical project spaces:

Space Name	Min. Total ACH	Min. Vent. ACH	Pressurization
Exam Room	6	2	Neutral
Medication Room	4	2	Positive
Radiology	6	2	Neutral
Laboratory, general	6	2	Negative
Soiled Utility	10	2	Negative (1)
Toilet Room	10	NA	Negative (1)
Housekeeping	10	NA	Negative (1)
Mechanical	6	2	Neutral
Storage/Closet	NA	NA	Neutral
Office	4	2	Neutral
ED Waiting / Triage	12	2	Negative (1)
Trauma	15	3	Positive
Corridor	4	2	Positive

(1) All air exhausted to outdoors

Space pressure relationships shall be maintained by balancing in all areas.

In most areas, the ceiling diffusers are anticipated to be 2'x2' and to lay in the acoustic tile ceiling grid. Common spaces such as lobbies, waiting areas and corridors may have specialized diffusers / grilles to meet the requirements of the architecture. Procedure room areas shall be provided with specialized diffuser / grille systems.

A complete ducted return air system shall be provided. A duct system shall run throughout the building and connect from the wall / ceiling or duct-mounted grilles in each space to the return air mains. Return air ductwork will generally be un-insulated except for ductwork serving areas with potentially low space temperatures which will be provided with insulation due to the potential for condensation to form on the ductwork.

5.9. HVAC Zoning

Each temperature control zone will have a separate VAV box based on the following criteria:

- Interior and exterior spaces shall be zoned separately.
- Exterior spaces with multiple exposures shall be zoned separately.
- No more than 1,600 sf per zone for interior spaces.
- No more than 1,000 sf per zone for spaces with exterior exposures.
- Offices shall be zoned separately from Patient Care areas.
- No more than 3 private offices shall be zoned together.
- No more than 4 like patient spaces shall be zoned together.
- All critical care spaces shall be zoned separately.

- Areas shall be zoned by department. Spaces in different departments shall not be zoned together.

5.10. Local Terminal Equipment and Systems

Tel/data rooms shall be provided with mini-split DX systems consisting of an indoor wall mounted fan coil and outdoor air cooled condenser.

Vestibules will be provided with cabinet unit heaters. The type of heater will be coordinated with the architectural design of the vestibule.

Mechanical and electric rooms will be provided with unit heaters for heating and exhaust fans for cooling.

Fin tube radiators will be provided for areas with large amounts of glass such as atriums or main lobbies.

5.11. Automatic Temperature Controls

The entire system shall be controlled by a Direct Digital Control building automation system. The control system shall provide the primary function of temperature control throughout the facility. In addition, the system shall allow for problems to be identified. Alarms, scheduling and troubleshooting may take place at a remote location. Facility staff may monitor, troubleshoot and adjust the HVAC system, solving many problems remotely.

The control system is intended to be an extension of the existing facility system and communicate via BACNet to the existing front end.

5.12. Materials

Piping:

- Piping 2-1/2" and larger: Schedule 40 welded steel, welded steel fittings, iron valves. Grooved piping where exposed in mechanical rooms.
- Piping 2" and smaller: Type L copper, soldered or press-fit fittings, bronze valves.

Ductwork:

- ASTM A525 galvanized steel sheet, lock forming quality, zinc coating of 1.25 oz per sq ft for each side in conformance with ASTM A90.
- ASTM A167 316 Stainless steel sheet, 22 gauge annealed finish.
- Fabricated in accordance with SMACNA pressure class 6 duct standards for medium-pressure supply (AHU to VAV), class 2 for low-pressure supply (VAV to diffuser), class 3 for return and class 2 for exhaust systems.

Insulation:

- Hot Water Piping: 2" fiberglass with all service jacket. Color coded PVC jackets for exposed piping in mechanical rooms.
- Supply Duct: Flexible 2" fiberglass with integral vapor barrier FSK jacket.
- Return Duct: Flexible 1.5" fiberglass with integral vapor barrier FSK jacket.
- Exhaust or fresh air ducts within ten feet of exterior penetration: Flexible 2" fiberglass with integral vapor barrier FSK jacket.

Identification:

- Piping shall be labeled per ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, colors, length of color field and viewing angles of identification devices for piping.

- Ductwork shall be labeled with plastic duct tape markers.
- Equipment will be labeled with engraved plastic markers

5.13. Proposed Manufacturers

Air Handlers:	Haakon; Trane; York; approved equal.
Chillers:	York; Trane; Daikin
Pumps and Accessories:	B&G; Armstrong; Taco; approved equal.
VAV Terminals:	Titus; MetalAire; JCI/Envirotech; approved equal.
Diffusers / Grilles:	Titus; MetalAire; Krueger; approved equal.
Fans:	Greenheck; Cook; Penn; approved equal.
Terminal Heating Units:	Sterling; Airtherm; approved equal.
Controls:	JCI; Honeywell; approved equal.

6. Electrical Systems

6.1. Electrical Service – Normal

A new distribution panelboard shall be provided to serve the ED renovation and addition areas. The new panelboard shall be 600A, 480/277V, 3 phase, 4 wire and fed from the existing West Substation. The renovation areas shall be provided with (2) double tub 120/208V, 225A, 3 phase, 4 wire, branch distribution panelboards to be located in new normal electrical rooms.

The building electrical service is estimated to be approximately 21 W/sq. ft. Building electrical services is estimated to be as follows:

Area	Square Footage	Kilowatts	Service Size
ED Addition/Renovation	18,800	400 kW	500 A

6.2. Electrical Service – Essential / Standby

New essential branch distribution panelboards shall be provided for the addition and area of renovation. The new panelboards shall be fed from the existing North West area essential distribution including Life Safety, Equipment and Critical. The following panelboards shall be provided to serve the new addition and renovation areas:

- (1) 200A – 480/277V Equipment Panelboard
- (1) 100A – 120/208V Equipment Panelboard
- (1) 200A – 120/208V Critical Panelboard (Double tub)
- (1) 60A – 480/277V Life Safety Panelboard
- (1) 60A – 120/208V Isolation panelboard for new Trauma Rooms (fed from the critical branch)

The new essential panelboards shall be located in a dedicated 2hr emergency closet in the area of renovation.

6.3. Grounding

The new addition shall tie in to the existing building ground loop.

Each feeder and branch circuit will contain an equipment-grounding conductor in addition to phase and neutral conductors.

Ground bars shall be provided in all electrical & tel/data rooms and shall be connected to the building grounding system.

6.4. Wiring Methods

The minimum size wire for standard 120 Volt, 20 ampere circuits shall be #12 AWG. The minimum size wire for any special purpose receptacles shall be #10 AWG. All lighting and power circuits shall be provided with dedicated neutral.

All wiring devices shall be hospital grade, tamper proof type. Receptacles with integral 5mA ground fault protection shall be provided for devices within 6' of sinks, restrooms, roof, and wet locations. Special purpose receptacles shall be provided as required by the program. Dedicated circuits shall be provided where required by the load.

The power distribution infrastructure shall limit voltage drop on feeders to 2 percent and 3 percent on branch circuits. Feeders and branch circuits shall be upsized as required.

Indoor concealed or exposed feeders shall be provided in rigid steel conduit, IMC, or EMT with copper conductors; type THHN-THWN insulation.

Branch circuits shall consist of insulated copper conductors in raceway and shall be provided as follows:

- Concealed – Electrical Metallic Tubing (EMT) with copper conductors; type THWN-2 insulation; minimum size #12AWG conductors. Hospital-grade type AC/MC cable with a full-size green grounding conductor; minimum size #12AWG conductors shall be permissible as follows. If type AC/MC cable is used all homeruns shall be run in EMT from the panelboard to a junction box in the room being served and AC/MC cable run from the junction box to the devices. No horizontal runs of type AC/MC shall be permitted.
- Exposed – Rigid galvanized steel (RGS) with copper conductors; type THWN-2 insulation; minimum size #12AWG conductors.

Branch circuits shall be provided as follows:

- Lighting Branch Circuits – 20Amp 277V 1Ph 2W branch circuits shall serve no more than 3000 Watts of lighting load.
- General Receptacle Branch Circuits – 20Amp 120V 1Ph 2W branch circuits shall serve no more than 1400 Watts of hospital grade receptacle load assuming 200 Watts per hospital grade receptacle.
- Computer Receptacle Branch Circuits – 20Amp 120V 1Ph 2W branch circuits shall serve no more than 1200 Watts of receptacle load assuming 400 Watts per receptacle.

Mechanical control power shall be provided as follows:

- A minimum of one (1) dedicated 20Amp 120V 1Ph 2W branch circuit for every 2,500SF.

Mechanical Equipment – A dedicated branch circuit shall be provided to accommodate the specific power requirements of each mechanical unit.

Power for car charging station shall be provided. Exact requirements to be coordinated further during design.

6.5. Lighting

Lighting shall ultimately be determined via coordinated effort between architects and engineer but the following are some basic lighting concepts:

1. Corridor (Back of House) – Recessed 1'x4', 2'x4', or 2'x2' LED fixtures with 0.125" acrylic prismatic lenses and LED exit signs.
2. Corridor (Public) – Recessed, fully lensed, direct/indirect 1'x4', 2'x4', or 2'x2' LED fixtures, indirect LED lighting, and LED edge lit exit signs.
3. Lobby – Large diameter, pendant-mounted decorative LED fixtures and supplemental LED down lights.
4. Waiting Rooms – LED downlights and LED wall sconces.
5. Toilet Rooms – Recessed LED cove along toilet/urinal wall supplemented by LED down lights.
6. Exam Rooms/Treatment Rooms/Offices/Workrooms – Recessed, fully lensed, direct/indirect 1'x4', 2'x4', or 1'x4' LED fixtures, supplemented by LED recessed downlights. Under cabinet task lighting will be provided on the underside of cabinets.
7. Specialty Rooms – Each will receive LED lighting designed to best aid patient comfort and staff performance.
8. Utility Rooms/Closets – 4 foot LED industrial pendants with 20% up-light and wire guards.
9. Illuminated Exit Signs – LED edge-lit type, except in "back-of house areas" where standard polycarbonate LED exit signs will be used.
10. Psych Rooms – Recessed, fully lensed, direct, 1' x 4' psych safe LED fixtures
11. Exterior/Site – Pole mounted LED fixtures supplemented by LED bollards. Backlit signage lighting at the entrance.

The majority of the lighting fixtures shall be LED, 277 volt. All lamps shall be 3500°K, CRI 90 unless otherwise noted.

Installed lighting and controls shall be in conformance with the lighting power allowance and requirements of the Vermont State Energy Code. The lighting shall be selected to maximize the utility company incentives. The lighting power density for Healthcare occupancy type is 1.2W/ft².

6.6. Lighting Controls

In general, lighting shall be controlled by lighting relay panel(s) and local switches. Lighting in specific areas shall be controlled as follows:

1. Examination and Treatment Areas – Light fixtures shall be controlled by local wall dimmer switches to allow for various levels of lighting for the patient and staff.
2. Multi-purpose/Conference Room – A lighting control system with multi-scene preset LED dimming control.
3. Corridor/Lobby/Waiting Rooms – Corridor/lobby/waiting fixtures will be run through a lighting control panel and utilize an internal time clock to turn OFF and On all the common area lighting at a pre-determined time. The lighting control panels shall be daisy-chained together and utilize a low-voltage master light switch at each floor and a single master switch at the main entrance for security.
4. Toilet Rooms – Light fixtures shall be controlled by local wall switch with an integral occupancy sensor.
5. Nurse Station – Light fixtures shall be dimmable to allow for lower lighting levels during off hour operation. The two switches shall be located at the station.
6. Exam Rooms/Offices/Workrooms – Light fixtures in these types of rooms shall be controlled via line-voltage switches and ceiling or wall-mounted occupancy sensors. Each room shall include dimmer switches to allow for manipulation of light levels for various tasks and occupancies. In the event the light fixtures are left ON the occupancy sensors shall shut the room down after a predetermined time period and turn ON the light fixtures when the room is re-occupied.
7. Utility Rooms / Closets – Light fixtures shall be controlled by local wall switch with an integral occupancy sensor.

8. Ambulance Bay Lighting: Light fixtures shall have integral occupancy sensors to dim lighting when ambulance bay is not in use.
9. Exterior / Site Lighting – Light fixtures shall be controlled via the lighting control panel, lighting contactors, and photocell.

6.7. Fire Alarm System

The existing fire alarm system is an analog addressable system that was recently upgraded. The fire alarm system shall be reconfigured / extended within the proposed renovation scope to meet the following objectives:

- Meet requirements of applicable codes and standards including NFPA 72 and building code.
- Provide early detection of a fire in elevator lobbies, IT rooms, and electrical rooms.

The system shall be wired in a Class A configuration with fault isolator modules installed between every twenty (25) devices.

Initiating devices shall include the following:

- Manual pull stations at each exterior exit discharge and exit enclosures on each floor.
- Photoelectric smoke detectors in all elevator lobbies, IT areas, and electrical rooms.
- Heat and Photoelectric smoke detectors in elevator machine room.
- Heat detectors in elevator shafts
- CO detectors installed in close proximity to fuel-fired equipment.
- Sprinkler tamper and flow switches.
- Any devices that are installed in concealed spaces shall have remote indicator lights and test switches installed.

Notification shall be accomplished as follows:

- ADA approved speaker / strobe (adjustable 15 / 30 / 60 / 75 / 110 candela) units shall be provided throughout the space in accordance with the state building code and NFPA 72. Strobe only units shall be provided in public and semi-private bathrooms. Strobes shall be synchronized throughout. All fire alarm devices shall be red with white lettering.
- A red external strobe shall illuminate with any alarm activation.

A Knox Box shall be installed at the main building entrance.

The final constructed building shall comply with the requirements of the building code for emergency responder coverage. The basis of design shall include:

- Preparation for installing an emergency responder bidirectional amplifier, including construction of required 2-hour rated chase and run of conduit.
- After substantial construction is completed, the fire department should be notified, and the contractor shall contract a certified third-party testing agency to perform a radio signal survey of the building. Acceptable limits are -95dBm receivable within and -100 dBm received at the agency's radios system when transmitted from within the building.

The contractor shall provide add-alternate pricing for full installation of a bidirectional amplifier at the completion of construction. This system shall be required only if the acceptable signal strength cannot be met in 95% of all areas on each floor as determined by the radio signal survey.

6.8. Raceway Support System

The contractor shall be responsible for providing the infrastructure required for distribution of the following low voltage systems:

1. Nurse Call
2. AV / Video
3. Security / Access Control
4. Telephone / Data

The infrastructure system includes empty conduits, sleeved floor penetration between stack spaces, wireways, pull strings, and back boxes. Provisions for device locations shall consist of a backbox at each location and a minimum 1" conduit run to within 6" of the cable tray/J-hooks. Tel/data and security wiring shall be performed by the owner.

6.9. Proposed Manufacturers

Electrical Distribution:	Square D; Cutler Hammer; GE; approved equal.
Conductors:	Southwire; Southwire; Carol Cable; American Insulated Wire Corp.; Okonite; AFC; Allflex; approved equal.
Wiring Devices:	Hubbell; Leviton; Legrand-Pass & Seymour; Cooper; approved equal.
Device Wall Plates:	Hubbell; Leviton; Legrand-Pass & Seymour; approved equal.
Fire Alarm:	Notifier, Honeywell Corp.; Simplex; Edwards EST; approved equal.
Nurse Call / E-Call:	Rauland; Simplex, Jeron; approved equal.
Lighting:	Cooper; Axis; Lithonia; approved equal.
Cable Tray:	Cooper B-Line; Wiremold; approved equal.

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