



PennState Health
Milton S. Hershey Medical Center



PennState
College of Medicine

**MECHANICAL AND ELECTRICAL
DESIGN AND CONSTRUCTION STANDARDS
FOR NEW CONSTRUCTION & RENOVATION
WORK**

Issued: January 2020

TABLE OF CONTENTS

The HMC “Design and Construction Standards” are to be considered guidelines.

This is a “living” document that will be continuously updated as best practices evolve, manufacturers develop new products, and building codes change.

This document is not intended to stifle innovation.

Deviations from these guidelines are acceptable if concurrence is obtained from the Owner.

MECHANICAL

- Section 15010 – Mechanical General Provisions
- Section 15050 – Plumbing Basic Materials
- Section 15055 – Plumbing Pipe and Pipe Fittings
- Section 15060 – Plumbing Valves
- Section 15065 – Plumbing Pipe Specialties
- Section 15070 – Plumbing Supports and Anchors
- Section 15080 – Plumbing Pumps
- Section 15090 – Plumbing Insulation
- Section 15200 – Plumbing Specialties
- Section 15250 – Water Heaters
- Section 15300 – Sanitary Drainage
- Section 15350 – Storm Drainage
- Section 15400 – Plumbing Fixtures
- Section 15430 – Medical Gas and Vacuum Systems
- Section 15450 – Fire Protection
- Section 15500 – HVAC System Design Criteria
- Section 15550 – HVAC Basic Materials
- Section 15555 – HVAC Pipe and Pipe Fittings
- Section 15560 – HVAC Valves
- Section 15565 – HVAC Piping Specialties
- Section 15570 – HVAC Supports and Anchors
- Section 15575 – HVAC Vibration Isolation
- Section 15580 – HVAC Pumps
- Section 15590 – HVAC Insulation

MECHANICAL

- Section 15600 – Central Heating Equipment
- Section 15650 – Central Cooling Equipment
- Section 15660 – Variable Frequency Drives
- Section 15700 – Heat Transfer
- Section 15705 – Humidity Control Equipment
- Section 15710 – Terminal Heating Units
- Section 15720 – Unitary Equipment
- Section 15800 – Air Handling Equipment
- Section 15840 – Air Filtration
- Section 15850 – Air Distribution
- Section 15870 – Variable Air Volume Systems
- Section 15900 – Building Automation System
- Section 15950 – Testing and Balancing of Mechanical Systems

ELECTRICAL

- Section 16010 – Electrical General Provisions
- Section 16050 – Basic Materials and Methods
- Section 16110 – Raceways and Fittings
- Section 16120 – Wire and Cable 600 Volts and Below
- Section 16125 – Wire and Cable Above 600 Volts
- Section 16130 – Boxes
- Section 16140 – Wiring Devices
- Section 16145 – Disconnect Switches
- Section 16170 – Overcurrent Protective Devices
- Section 16180 – Grounding Systems
- Section 16200 – Power Generation
- Section 16250 – Automatic Transfer Switches
- Section 16400 – Electric Service
- Section 16420 – Sub-Stations
- Section 16430 – Panelboards

ELECTRICAL

Section 16440 – Dry Type Transformers

Section 16445 – Liquid Filled Transformers

Section 16500 – Lighting

Section 16715 – Telecommunication (Telephone and Data) System

Section 16720 – Fire Alarm System

Section 16725 – Area of Refuge Communication System

Section 16750 – Sound/Paging System

Section 16765 – Nurse Call System, Audible-Visual-Tone

Section 16790 – Cable TV System

Section 16800 – Security/Access Control System

Section 16900 – Controls and Instrumentation

SECTION 15010 – MECHANICAL GENERAL PROVISIONS

A. CODES AND STANDARDS

1. The following codes and standards requirements shall be identified in the project specifications:
 - i. Mechanical Work shall meet requirements of the National Fire Protection Association, the Pennsylvania Uniform Construction Code, and all other federal, state, and municipal authority's laws, rules, and regulations applicable to the Work.
 - ii. Boilers, hot water heater(s), heating equipment and pressure vessels shall be constructed and tested in accordance with recommendations of the National Fire Protection Association, Pennsylvania Department of Labor and Industry - Boiler Inspection Division, and ASME Code. Boilers, hot water heaters and unfired pressure vessels shall be stamped with the ASME symbol and National Board number and shall be inspected during construction by an inspector who has been commissioned by the Pennsylvania Department of Labor and Industry to perform such service. Boilers, hot water heaters and unfired pressure vessels shall be prepared for initial inspection in accordance with Pennsylvania Department of Labor and Industry regulations.
 - iii. Plumbing Work shall be approved as the project progresses by the local plumbing inspector having jurisdiction. Contractor shall certify domestic water systems for compliance with Pennsylvania Plumbing System Lead Ban & Notification Act (No. 33-1989). Nothing in the specifications shall be construed to permit deviation from requirements of governing code(s).
 - iv. Installation of all gas piping and gas burning equipment shall conform to recommendations of the American Gas Association, the owner's Insurance Underwriter and the local utility.
 - v. The handling and use of CFC and HCFC refrigerants, whether leaking, venting, recovering, etc., shall be in accordance with US Environmental Protection Agency regulations CFR 58 FR 28660, ASHRAE 15 Safety Code for Mechanical Refrigeration, and ANSI/ASHRAE 34 Number Designation and Safety Classification of Refrigerants.
 - vi. Electrical Work shall meet requirements of the National Electrical Code and all federal, state, and municipal authority's laws, rules and regulations applicable to the Work. Refer to section 16010

-
- vii. Where applicable, materials and equipment shall bear the label of approval of Underwriters Laboratories, Inc.
 2. Except where a requirement in this specification is more stringent, the mechanical work shall be designed and installed to meet the following codes, standards, and guidelines:

The most recent approved version is to be followed

Pennsylvania State University's Office of Physical Plant (OPP) Standards included as an appendix to these standards and available at the following link. HMC reserves the right to modify OPP standards as necessary to meet specific project needs.

http://www.opp.psu.edu/construction/standards/design_standards.cfm

AIA Guidelines for Design and Construction of Hospital and Health Care Facilities (2014 Edition)

Pennsylvania Uniform Construction Code, including:

- International Building Code
- ICC Electrical Code (references National Electric Code NFPA 70-05)
- International Energy Conservation Code
- International Existing Building Code
- International Fire Code
- International Fuel Gas Code
- International Mechanical Code
- International Plumbing code

3. EXCAVATION AND BACKFILL
 - A. Perform excavation and backfill required for Work of this Division, inside and outside building. Work shall include cutting and patching of curbs, walks, concrete, repaving, and reseeding of all areas disturbed by excavation.
 - B. Banks and excavations shall be retained by means of shoring and braces to avoid cave-ins. Shoring shall be in accordance with Pennsylvania Department of Labor and Industry requirements. Shoring shall be maintained until installation, tests and inspections are complete.
 - C. Pumping equipment shall be provided and maintained to pump water from excavations.
 - D. Comply with Pennsylvania Underground Utility Line Protection Act (No.

172-1986) before commencing any excavation work. Telephone number for Pennsylvania One-Call Systems, Inc. is 1-800-242-1776.

E. All underground conduit runs shall be marked with metal-embossed utility marking tape to be run above the duct bank along its full length. Locate marking tape 12 inches minimum above the top of the duct bank.

F. Underground conduits installed horizontally using augers shall also have metal-embossed utility marking tape installed within the conduits.

G. Abandoned underground conduits and pipes shall be removed in their entirety or left in place and filled with suitable material with owner approval.

B. COORDINATION

1. Equipment not related to the support of Telecommunication Rooms such as piping, ductwork, and distribution of building power must not be located in, or pass through, the Telecommunication room.
2. Any equipment requiring periodic or emergency maintenance shall be located in the corridor outside of patient and critical use rooms.
3. Roof mounted equipment curbs shall be approved by owner and installed in accordance with the owner's roofing representative.

C. PAINTING

1. Equipment furnished under this Division that is pre-painted or pre-finished by manufacturer shall have all rust spots cleaned, primed, and refinished prior to final acceptance by HMC. Equipment labels and or tags shall not be painted over or defaced.
2. Rooftop equipment shall be painted Duron 5431W, "Silver Wing".

D. RECORD DOCUMENTS

1. The Contractor shall be required to maintain a set of Contract Documents, i.e., Specifications, Drawings, Addenda, Modifications and approved submittals at the site, in good order and annotated to show all changes made during construction process. At the time of substantial completion of the Work, deliver to the Engineer the complete set of as-built drawings. The Engineer will, within 30 days after receipt from the Contractor, transpose all changes recorded by the Contractor onto a full set of reproducible drawings, and CADD electronic media, compatible

with the HMC's CADD system, which shall become the record drawings for the Project, and shall forward same to the HMC. These record documents shall be delivered to HMC in electronic form. Electronic format for printed documents shall be Adobe Acrobat PDF. Electronic format for drawings shall be AutoCAD. In each case, provide the software version required by HMC.

E. OPERATION AND MAINTENANCE INSTRUCTIONS

1. The Contractor shall be required to furnish an instructor/operator at completion of system(s) installation, who shall operate all systems and provide documentation. The instructor/ operator(s) shall provide instruction to thoroughly train HMC personnel in the operation and maintenance of all equipment. The amount of time required for training shall be determined by HMC for each project. The owner reserves the right to audio and visually record all contractor training.
2. The Contractor shall be required to provide a minimum of 1 printed sets and 1 electronic set of instructions covering operation and maintenance of each item of equipment and shall be submitted to the owner during this operating period. Required instructions from manufacturer's representatives shall be submitted at this time. Instructions and charts shall be submitted in print and electronic form. Electronic format shall be Adobe Acrobat PDF.

F. TEMPORARY UTILITIES

1. Shall be provided as required by the owner.

G. MATERIALS

1. Materials shall be new, without imperfections or blemishes, and shall be protected from the elements prior to installation.

H. VIBRATION ANALYSIS

1. A vibration analysis shall be performed prior to the start of warranty for all fans and pumps rated 15HP and above.
2. The vibration levels at frequencies associated with the major machine components (i.e. motor and fan shafts, bearings, belts, and impeller) shall be measured and compared to applicable vibration severity levels.
3. A report identifying findings shall be provided to HMC and included in the operation and maintenance manuals.

I. MECHANICAL ROOM CONSTRUCTION

1. Mechanical room wall construction will be as required to accommodate the storage of materials and the function of the mechanical equipment, as determined by the Architect and owner.

END OF SECTION

SECTION 15050 - PLUMBING BASIC MATERIALS

- A. Furnish and install access panels in ceilings and walls for service and repair access to concealed equipment. Minimum size shall be 18 inches by 18 inches. Where restrictions will not permit minimum size, verify access panel size with HMC. Access panel construction shall be compatible with ceiling and wall materials and fire rating.
- B. Furnish and install fire stop sealing system for piping and conduits passing through walls and floors with smoke or fire rating in accordance with HMC's Above Ceiling Compliance Policy A-96 HAM.
- C. Complete and submit HMC's Equipment Data Acquisition form for central plumbing equipment. Coordinate equipment designations with HMC and submit a complete itemized listing of nameplate equipment designations for approval.

END OF SECTION

SECTION 15055 - PLUMBING PIPE AND PIPE FITTINGS

- A. Interior domestic water piping shall be Type L copper type, with solder joints. Mechanical joints with any non-metal components shall be prohibited.
- B. Sanitary vent piping shall be service weight cast iron soil pipe with no-hub.
- C. Interior sanitary piping shall be service weight cast iron pipe. Exterior sanitary piping shall be service weight cast iron soil pipe. Piping serving acid waste systems shall be Schedule 40, Type II acid resistant polypropylene compound or Schedule 40, fire retardant, acid resistant polyethylene, lab waste pipe (CPVC with glued joints). Mechanical joints on acid waste piping is not acceptable.
- D. All storm piping shall be service weight cast iron pipe.
- E. Piping located within MRI room shielding shall be non-ferrous.
- F. Interior and above grade natural gas piping shall be Schedule 40 black steel.
- G. Underground natural gas piping shall be polyethylene plastic with trace line meeting local utility's requirements.
- H. Dead legs in domestic piping distribution systems shall not be permitted larger than 3X the pipe diameter. All branch piping should be removed to mains and capped. Abandoned in place piping shall be tagged/identified at each end of the pipe.

END OF SECTION

SECTION 15060 - PLUMBING VALVES

- A. All branch lines on both cold and hot water systems shall be furnished with shut-off valves.
- B. Ball valves shall be used on all domestic water piping 4 inches and smaller. Ball valves shall be full port, one-piece style, and certified lead free, with stainless steel ball.
 - 1. Up to 2 inch: Apollo, model 77FLF or approved equal.
 - 2. 2 -1/2 to 4 inch: Full stainless steel, flanged. SQM Tru-Flo EA Series or approved equal.
- C. Three-piece ball valves shall be used on all medical gas piping and rated for the application.
- D. Butterfly valves shall be used on all domestic water piping over 4 inches. Double offset, full stainless steel, with hand actuator. Manufacturer: Apollo or Jamesbury.
- E. Domestic water check valves: In-line, spring assisted disc type, full stainless steel. DFT model SCV Series or approved equal.

END OF SECTION

SECTION 15065 - PLUMBING PIPE SPECIALTIES

- A. Furnish and install dielectric nipples whenever dissimilar metals are used in a piping system. Dielectric unions shall not be permitted.
- B. If determined necessary by the Owner, furnish and install valve tags for all shutoff valves. Coordinate with HMC for number sequencing. Valve tags for valves to be replaced shall be removed and re-installed on the new valves. Valve tags for valves to be removed shall be turned over to HMC.
- C. All piping shall be identified by legend and flow arrows. Identification system shall conform to ANSI A-13.1, Scheme For Identification of Piping Systems, using standard background colors. Compressed air and vacuum piping serving laboratories shall be labeled "LAB AIR" and "LAB VACUUM".

END OF SECTION

SECTION 15070 - PLUMBING SUPPORTS AND ANCHORS

- A. The requirements of the applicable sections of ANSI B31, pressure piping shall be considered as minimum requirements governing fabrication, installation and support of piping systems.

END OF SECTION

SECTION 15080 - PLUMBING PUMPS

- A. Furnish and install a fractional horsepower inline circulator pump for the domestic hot water circulation system. Pump shall be bronze and shall be rated for use in potable hot water systems. The circulator pump shall be furnished with isolation valves, pressure gage(s) (indicating inlet and outlet pressure) and thermometer. The pump should be manufactured by Bell & Gossett or TACO.

Other Pumps:

1. Sump Pumps: Submersible type, Duplex. Preferred: Zoeller Inc.
2. Booster Pumps: B&G, TACO and Grundfos
3. Sewer Pumps: Zoeller
4. Condensate Return Pumps: Spirax Sarco. Steam powered pumps shall only be considered if electrical power is not readily available and shall be approved by owner.

END OF SECTION

SECTION 15090 - PLUMBING INSULATION

- A. Domestic cold water piping, valves, and appropriate piping system specialties shall be insulated with fiberglass or foamed plastic insulation. Insulation shall be minimum 1/2 inch thick for all pipe sizes.
- B. Domestic hot water piping, valves, and appropriate piping system specialties shall be insulated with fiberglass or foamed plastic insulation. For water temperature less than 170 degrees F, insulation shall be minimum 1 inch thick for pipe sizes up to 2 inches and 1-1/2 inch thick for pipe sizes 2-1/2 inches and larger.
- C. Vertical drop from roof drains within five feet of roof drain connection and horizontal rain water conductors shall be insulated. Insulation shall be fiberglass or foamed plastic, 1/2 inch thick minimum.

END OF SECTION

SECTION 15200 - PLUMBING SPECIALTIES

- A. Water supply shall be extended from the local municipal water system and distributed to all fixtures and equipment requiring same. Water service shall be protected by a double check valve backflow preventer with isolation valves and valved bypass where required by the local water authority. Water meter shall be installed in accordance with local municipality requirements.

- B. Wall hydrants with locking covers shall be provided on the exterior building walls in quantities and locations as directed by the owner. Zurn or approved equal.

END OF SECTION

SECTION 15250 - WATER HEATERS

- A. Where plant steam is available, furnish and install instantaneous-type water heaters with electronic modulating steam control. The water heaters shall be manufactured by Patterson-Kelly.
- B. For stand-alone buildings, furnish and install two gas-fired storage water heaters and associated vent piping. Each water heater shall be sized for 2/3 of the building demand. Vent terminations shall be as required by equipment manufacturer. The water heaters shall be manufactured by PVI, Bradford White or A.O. Smith.
- C. Hot water shall be generated at 140 degrees F and distributed through a temperature limiting device (thermostatic mixing valve) that limits the tempered water to a maximum 110 degrees F to lavatories. Hot water used for culinary purposes, cleansing, glassware washing or building maintenance purposes may be delivered up to 140 degrees.
- D. A domestic water circulation system shall be designed to return to the water heaters at a temperature loss of 5 degrees Fahrenheit. Provide balancing valves with isolation valves as required. Circulation pumps shall be of bronze construction be manufactured by Bell & Gossett, or TACO.

END OF SECTION

SECTION 15300 - SANITARY DRAINAGE

- A. Sanitary drainage shall be collected from all fixtures and equipment requiring same and connected to the municipal sewer system.
- B. Sanitary and vent piping below floors, above ceilings and inside walls shall be minimum 2 inch ID.
- C. Furnish and install floor drains (minimum 2 inch) in each toilet room, patient toilet room with a shower, and mechanical room and where required by code for equipment drains. Floor drains shall be furnished with integral trap guards to prevent trap evaporation and sewer gas emissions. Trap guards similar to Proset (Trap Guard).
- D. Traps for grease, barium or plaster shall be constructed of cast iron or stainless steel. Porcelain covered carbon steel will not be permitted.
- E. Active sanitary piping should not be left open during construction. Piping shall be plugged with approved temporary plugs at the end of each work day. Any piping proposed to be abandoned in place must be approved by owner.
- F. Abandoned sanitary piping shall be removed. All piping to be removed shall be removed back to the remaining active stack or branch and capped. If abandoned sanitary piping is not accessible, backfilling with cement slurry is acceptable as approved by owner.
- G. Connections to existing sanitary piping shall be achieved by cutting the pipe and installing a fitting. Drain tappings shall not be permitted. Field verify locations and sizes of existing sanitary and vent piping. Abandoned inverted sanitary wyes on vertical stacks shall be capped or plugged with a close thread nipple with a cap or a no-hub coupling with a no-hub cap.
- H. Roof openings from vents through roofs to be removed shall be properly patched, by **owner** approved roofing contractor following industry and OEM guidelines.

END OF SECTION

SECTION 15350 - STORM DRAINAGE

- A. Storm drainage shall be collected within the building via roof drains and on the site via catch basins and extended to the municipal storm drainage system.

END OF SECTION

SECTION 15400 - PLUMBING FIXTURES

- A. Furnish and install plumbing fixtures in locations and arrangements required by building program. Fixtures shall meet ADA requirements where required and be installed with stop valves and all associated trim and piping. In general, plumbing fixtures shall meet the following characteristics:
1. Water Closets: Flush valve, floor mounts with rear discharge for installation against finished walls, siphon jet action, ADA compliant with hinged seat, 1000 lb. minimum load rating white vitreous china elongated bowl and open toilet seat. Tank type will not be permitted. Provide with bedpan lugs and bedpan washing wand on flush valves in patient toilet rooms. Water closets shall be Kohler, Steward Model K-4352, or approved equal.
 2. Urinals: Wall hung vitreous china, without strainers. Urinals shall be Kohler, Steward Model K-5244-ET, or approved equal.
 3. Flush valves for water closets and urinals in public and staff areas shall be automatic style manufactured by Toto, no substitutions. Toto toilet: TETIGNC-32, Toto urinal: TEU1UN12. Flush valves in patient areas shall be manual manufactured by Sloan, no substitutions.
 4. Lavatories: floor mounted fixtures shall be vitreous china material, manufactured by American Standard or Kohler. In public and patient care areas with countertop sinks, the sinks shall be integral molded bowls as part of the solid surface material countertop.
 5. Sinks: Stainless steel, self-rimming. Compartment quantity and size as required for function. Sinks shall be manufactured by Elkay or Just.
 6. Faucets for lavatories and sinks in staff and patient care areas where approved shall be swivel-base gooseneck style with wrist blade handles on 4 and 8 inch centers manufactured by Chicago. (Faucet: TELGG100 #CP, TN78-10V510; Chicago: 4" 895-317XKABCP, 8" 786-E3XKABCP)
 7. Faucets for lavatories in public toilet areas shall be automatic style (self-generating hydropower with back-up battery) manufactured by Toto Model TEL151, no substitutions.
 8. Faucets for sinks in laboratories shall be furnished with vacuum breakers. Coordinate spout configuration with size of sink.

-
9. Showers: One-piece acrylic with, fold-up seat, top and dome light. ADA shower stalls shall be provided with threshold strips to contain water. Showers shall be manufactured by Acryline or Aquaglass. Hand-held shower heads are not permitted in showers unless required by code or functional program. Shower valves shall be pressure-balancing type with check stops manufactured by Powers. All shower strainers shall be stainless steel.
 10. Mop Receptors: One piece precast terrazzo with faucet. Mop receptors shall be manufactured by Fiat, or equal. Acrovyn or stainless steel surrounds at mop receptors shall be installed.
 11. Electric Water Coolers: (with or without bottle fillers) Wall mounted, ADA compliant with hand-operated (valve-type) bubblers. Touch pads with solenoid valves shall not be permitted. Electric water coolers shall be manufactured by Oasis, Elkay or Halsey Taylor. Bottle filler units shall have integral water filtration.
 12. Emergency Eyewash: Drench hose type for installation on countertop with 8 feet long hose, squeeze handle operation and ABS plastic eye/face wash head with integral flip top dust cover. Provide with thermostatic mixing valve with high temperature limit valve and built-in shutoff in the event of hot or cold water supply failure. Eyewash and thermostatic mixing valve shall be manufactured by Guardian (Models G5022 and G3600), no substitutions. Spring loaded check valves shall be installed up-stream of the tempering valve.
- B. Ball valves shall be provided for each group of plumbing fixtures and remote plumbing fixtures above the ceiling in addition to square-keyed shut-offs (loose key) below the fixture.
- C. Exposed piping below plumbing fixtures shall be chrome plated. ADA compliant accessible fixtures shall be installed with appropriate (offset) P-traps and insulated jacket.
- D. Hot and cold water piping to shower valves shall be installed with spring-loaded check valves and stop & waste valves. An access panel to permit maintenance of the valves shall be provided behind the shower. Copper sweat unions shall be installed downstream of the stop & waste valves to facilitate maintenance.

END OF SECTION

SECTION 15430 – MEDICAL GAS AND VACUUM SYSTEMS

- A. Medical gas and vacuum systems shall be designed, installed and tested in accordance with NFPA 99 and manufacturer’s recommendations. Coordinate outlet locations and quantities with HMC.
- B. The current loading and capacity of existing medical gas and vacuum systems shall be reviewed when extending or adding to existing systems. Any capacity or operational deficiencies or upgrade requirements shall be identified to HMC.
- C. Oxygen piping shall be extended from the existing central system or oxygen cylinders and manifold supply and distributed to patient outlets and equipment requiring same.
- D. Medical air piping shall be extended from the existing central system or medical air cylinders and manifold supply and distributed to patient outlets and equipment requiring same.
- E. Medical vacuum piping shall be extended from the existing central system or vacuum pumps and receiver system and distributed to patient outlets and equipment requiring same.
- F. Medical gas/vacuum piping service valves, patient outlets, zone valve box assemblies, line pressure monitoring gages shall be manufactured by Allied Healthcare, no substitutions. Medical gas outlets shall be series B latch key NGC/Chemetron style. Medical gas area alarm panels shall be Amico Alert 3 LCD.
- G. Medical gas supply manifolds shall be manufactured by Allied Healthcare, Amico, or Beacon Medical Products and shall be approved by the Owner.
- H. Vacuum pump assembly shall be liquid ring style with cooling water recirculating system. Vacuum pump shall be manufactured by Beacon Medical Products (Nash).
- I. Medical air compressors shall be oil-less scroll type. Air compressors shall be manufactured by Beacon Medical Products.
- J. Source equipment shall be furnished with transducers or contacts as required to permit remote monitoring of alarm points by the Building Management System in addition to monitoring required by NFPA 99.
- K. Brazed fittings shall be used on all medical gas fittings. All medical gas piping when installed shall be purged each time a joint is brazed. Piping shall be purged with nitrogen to prevent carbonizing.
- L. Any compound that has an oil base shall not be used on medical gas system installations.

- M. Medical gas and vacuum systems, including all source equipment, valving, alarms and use point outlets shall be evaluated and certified for mechanical and therapeutic function as defined in the NFPA 99. Testing shall be performed by an agency independent of the facility, installer or suppliers. Testing agency shall specialize in medical facilities and shall be able to demonstrate experience and expertise in medical gas installations. Medical gas verification shall be performed by one of the following companies:

Sherman Engineering Company (610-340-5300)

Medical Engineering Services, Inc. (703-779-8442)

Patient Instrumentation Corporation (610-799-4436)

MedGAS, Inc. (570-759-9319)

Medpipe Maintenance, Inc. (724-745-1854)

END OF SECTION

SECTION 15450 - FIRE PROTECTION

- A. The entire fire protection system shall conform to the latest requirements of the National Fire Protection Association (NFPA 13), state and local authorities, and HMC's Fire Insurance Underwriters (FM Global).
- B. All areas of the building shall be fully sprinklered by a wet pipe sprinkler system. The sprinkler systems shall be zoned as approved by HMC.
- C. Canopies, attics and freeze-potential areas shall be protected by a dry-pipe system.
- D. The wet pipe sprinkler system shall be hydraulically designed and shall be based upon "Ordinary Harzards"; 0.20 GPM per sq. ft. over the most remote 1500 sq. ft. area with sprinkler heads spaced at a maximum of 225 sq. ft. per head.
- E. Sprinkler contractor shall furnish and install all required flow switches and valve supervisory switches. Electrical contractor shall furnish and install all conduit and wiring from all flow switches and supervisory switches to fire alarm panel. Electrical contractor shall make final connections at the switches and at the panels. All sprinkler control valves except drain valves shall be electronically supervised and equipped with supervisory switches, chained and locked. (HMC provided lock)
- F. Unless noted otherwise, sprinkler heads in finished ceilings shall be 1/2 inch, quick response application, adjustable, fully concealed with white cover plate, with a temperature rating of 155 degrees F. All sprinkler heads installed in finished ceilings shall be centered in the ceiling tiles. Fully concealed sprinkler heads shall be Viking VK462 Horizon Mirage, with Model B-2 sprinkler spray pattern, with an FM stamp.
- G. For areas where ceilings are not installed, sprinkler heads shall be 1/2 inch, quick response application, brass, and of appropriate orientation (upright, pendent, or sidewall) with a temperature rating of 155 degrees F. Exposed sprinkler heads shall be chrome plated. Sidewall heads shall be installed with recessed escutcheons. Exposed sprinkler heads shall be manufactured by Viking with an FM stamp, no substitutions.
- H. Sprinkler heads installed in refrigerated rooms shall be 1/2 inch, Reliable G3FR Dry Pendent with a 135 degree F temperature rating.
- I. Sprinkler heads in steam reduction rooms shall have a 286 degree F temperature rating.

- J. Prior to design of a new fire protection system, a water flow test shall be performed to determine the actual water supply available at the building's fire system inlet. All elevation differences during water flow shall be considered.
- K. Plastic pipe shall not be permitted.
- L. Adjustable drop nipples (maintenance eliminator) shall be permitted for flush fit adjustment of the sprinkler head assembly in acoustical tile ceilings. Adjustable drop nipples above gypsum board or other inaccessible materials shall be prohibited. Adjustable drop nipples shall be merit eliminator, manufactured by Anvill International.
- M. Each sprinkler system zone shall be provided with a combination drain/inspector's test station and piped to grade.
- N. Fire hydrants shall be furnished with two (2) – 2-1/2 inch National Standard Thread side outlets and a 5 inch Storz steamer connection.
- O. Final fire protection system design and layout shall be coordinated with all building trades and shown on drawings generated by the fire protection system designer/engineer.
- P. Coordinate sprinkler piping, equipment, heads, appurtenances, etc. with that of other trades so that sprinkler work will be installed in the most direct manner and so that interference between piping, ducts, equipment, and architectural or structural features will be avoided. Sprinkler piping, equipment, heads, appurtenances, etc. installed in an arbitrary manner without regard for work of other trades will be rejected in any situation where an undesirable condition or an unfair hardship for other trades, or HMC, results.
- Q. Submit insurance company (Factory Mutual) and fire marshal (if required), and Labor & Industries letters of approval and any additional review comments with drawings and calculations to architect. Fire protection shop drawings will not be reviewed unless submitted with approval letters and associated comments from insurance company, fire marshal, and Labor & Industries.
- R. Flexible piping connections from sprinkler branch piping to sprinkler heads shall be prohibited.

END OF SECTION

SECTION 15500 - HVAC SYSTEM DESIGN CRITERIA

- A. The design criteria for determining the heating and cooling loads for the building shall be based on the following:
1. Summer Outdoor Conditions: 95 degrees F DB, 78 degrees F WB
 2. Winter Outdoor Conditions: 0 degrees F DB
 3. Summer Indoor Conditions: 72 degrees F DB, 45-55 percent RH
 4. Winter Indoor Conditions 75 degrees F DB, minimum RH as required by Guidelines or medical or computer equipment manufacturers, typ. 30-55RH, 30-70RH, in AAALAC areas. And as required by staff and equipment manufacturers
 5. Procedure and Equipment Rooms As required by staff and equipment manufacturers
 6. HMC reheat water temperature at the Coils 185 degrees F.
- B. Ventilation systems shall be designed in accordance with latest ASHRAE Ventilation for Acceptable Indoor Air Quality Standard 62 and the AIA Guidelines for Design and Construction of Hospital and Health Care Facilities.
- C. Airborne Infectious Isolation (AII) Rooms shall be designed in accordance with Centers for Disease Control and Prevention (CDC) Guideline for Environmental Infection Control in Healthcare Facilities.

END OF SECTION

SECTION 15550 - HVAC BASIC MATERIALS

- A. Furnish and install access panels in ceilings and walls for service and repair access to concealed equipment. Minimum size shall be 18 inches by 18 inches. Where restrictions will not permit minimum size, verify access panel size with HMC. Access panel construction shall be compatible with ceiling and wall materials and fire rating.
- B. Furnish and install fire stop sealing system for piping and conduits passing through walls and floors with smoke or fire rating in accordance with HMC's Above Ceiling Compliance Policy, A-96 HAM.
- C. Complete and submit HMC's Equipment Data Acquisition form for all installed central HVAC system equipment Coordinate equipment designations with HMC and submit a complete itemized listing of nameplate equipment designations for approval.
- D. Full perimeter roof curbs with sheet metal caps shall be used for installing air handlers on the roof. Individual equipment supports (roof rails) may be used for other mechanical equipment (ie: exhaust fans, condensers, etc.).
- E. Walkway pads or pavers shall be provided on a path to and around roof mounted equipment. Coordinate type of pad/paver with roofing system.
- F. Access catwalks and protective railings shall be installed for all equipment installed on steel dunnage if higher than 36".

END OF SECTION

SECTION 15555 - HVAC PIPE AND PIPE FITTINGS

- A. Low, medium and high pressure steam and condensate piping shall be Schedule 80 black steel with threaded (up to 2 ½ inch) or welded fittings.
- B. The hot water heating system piping shall be Type L hard drawn seamless copper tube with solder joints or standard weight (Schedule 40) black steel with threaded joints. Victaulic fittings will not be permitted on hot water piping.
- C. The chilled water system piping shall be Type L hard drawn seamless copper tube with solder joints, standard weight (Schedule 40) black steel with threaded joints, or Victaulic piping and fittings.
- D. Refrigerant piping shall be Type L hard drawn seamless copper tube with brazed joints.
- E. Cryogen vent piping for MRI magnet venting shall be constructed of non-ferrous materials and installed and insulated in accordance with MRI manufacturer's requirements.
- F. Hydronic piping shall be sized with a maximum friction loss of 3.5 feet of head per 100 feet of pipe.

END OF SECTION

SECTION 15560 - HVAC VALVES

- A. Shut-off valves shall be installed to permit isolation of each piece of equipment and its associated appurtenances (balancing valves, control valves, etc.).
- B. Ball valves shall be used on all heating and chilled water piping 4 inches and smaller. Ball valves shall be full port, one-piece style, with stainless steel ball.
 - 1. Up to 2 inches: Apollo, Model 77FLF, or approved equal.
 - 2. 2-1/2" to 4 inches: Full stainless steel, flanged. QSM TRU-FLO EA Series or approved equal.
- C. Butterfly valves shall be used on all heating and chilled water piping over 4 inches. Double offset, full stainless steel, with hand actuator. Manufacturer: Apollo or Jamesbury.
- D. Heating and chilled water check valves: In-line, spring assisted wafer type, carbon steel body, stainless steel trim. DFT WLC Series or approved equal.
- E. Ball valves shall be installed on each side of steam traps, balancing valves and heating coil assemblies for isolation.

END OF SECTION

SECTION 15565 - HVAC PIPING SPECIALTIES

- A. Furnish and install dielectric nipples whenever dissimilar metals are used in a piping system. Dielectric unions will not be permitted.
- B. If determined necessary by the Owner, furnish and install valve tags for all shutoff valves. Coordinate with HMC for number sequencing. Valve tags for valves to be replaced shall be removed and re-installed on the new valves. Valve tags for valves to be removed shall be turned over to HMC.
- C. All piping shall be identified by legend and flow arrows. Identification system shall conform to ANSI A-13.1, Scheme For Identification of Piping Systems, using standard background colors.

END OF SECTION

SECTION 15570 - HVAC SUPPORTS AND ANCHORS

- A. The requirements of the applicable sections of ANSI B31, Pressure Piping shall be considered as minimum requirements governing fabrication, installation and support of piping systems.

END OF SECTION

SECTION 15575 - HVAC VIBRATION ISOLATION

- A. Furnish and install concrete inertia bases with free-standing isolators for base mounted pumps above 5 horsepower.
- B. Furnish and install spring hangers for suspended air handling units and fans.
- C. Furnish and install restraining spring isolators for packaged air-cooled chiller and process chillers located on the roof.
- D. Furnish and install neoprene or fiberglass isolation pads for boilers, condenser-compressor units and air-cooled condensers.

END OF SECTION

SECTION 15580 - HVAC PUMPS

A. GENERAL

1. For free-standing hot water heating systems, furnish and install two constant or variable volume, base-mounted pumps. One pump shall serve as a lead pump and the other shall serve as a lag pump.
 2. For free-standing chilled water systems, furnish and install two variable volume, base-mounted pumps. One pump shall serve as a lead pump and the other shall serve as a lag pump.
- B. Base-mounted pumps shall be furnished with high efficiency motors, suction diffusers, isolation valves, gages and balancing devices (triple duty valve). Pumps shall be manufactured by Bell & Gossett, Taco and Aurora.
- C. Inline pumps for small heating systems shall be furnished with isolation valves, gages and Tour + Anderson balancing devices (circuit setter). Pumps shall be manufactured by Bell & Gossett or Taco.

END OF SECTION

SECTION 15590 - HVAC INSULATION

- A. Hot water heating piping, valves, and appropriate piping system specialties shall be insulated with fiberglass or foamed plastic insulation. Insulation shall be 1 inch thick for branch runout piping and mains up to 2 inches, 1-1/2 inch thick for piping mains to 2 inches and 2 inch thick for piping mains larger than 2 inches.
- B. Chilled water piping, valves, and appropriate piping system specialties shall be insulated with fiberglass or foamed plastic insulation. Insulation shall be minimum 1 inch thick for branch runout piping up to 2 inches, 1 inch thick for piping mains to 1-1/2 inches and 1-1/2 inch thick for piping mains 2 inches and larger.
- C. Steam and condensate return piping, valves, and appropriate piping system specialties shall be insulated with fiberglass insulation. Insulation thickness shall be as listed below:

Temp Range	Runouts to 2"	Mains to 1"	Mains to 2"	Mains to 4"	Mains 5" & Larger
>306	1-1/2	2-1/2	3	3	3-1/2
<305	1-1/2	2	3	3	3

- D. Refrigerant suction piping and appropriate piping system specialties shall be insulated with fiberglass or foamed plastic insulation. Insulation shall be minimum 1 inch thick for branch runout piping and mains up to 1 inch and 1-1/2 inch thick for piping mains larger than 1 inch.
- E. Condensate drainage piping shall be insulated with 1/2 inch thick fiberglass or foamed plastic insulation.
- F. Cryogen vent piping for MRI magnet venting shall be insulated with fiberglass insulation. Insulation shall be 5 inches thick or as recommended by MRI manufacturer.
- G. For outdoor installations, piping insulation jacket shall be 20 mil PVC, aluminum or stainless steel.
- H. Supply and return air ductwork shall be externally insulated with 1-1/2 inch thick fiberglass duct insulation. Interior duct insulation will not be permitted.
- I. Exposed supply and return ductwork in laboratories shall be double wall construction with minimum of 1 inch insulation in between walls.
- J. Exposed supply and return ductwork in mechanical rooms shall be externally insulated

with 1 inch thick rigid fiberglass insulation with aluminum foil finish. Insulation mounting pins shall be mechanically attached to ductwork.

- K. Backs of lay-in style ceiling diffusers shall be insulated to prevent condensation.
- L. Access doors for servicing equipment shall be double wall insulated. Doors shall be sized large enough to facilitate service and inspections (i.e. fire damper links).

END OF SECTION

SECTION 15600 – CENTRAL HEATING EQUIPMENT

A. GENERAL

1. For hot water heating systems in free-standing buildings, furnish and install two hot water boilers located in a mechanical room to provide hot water for heating equipment used in the various areas of the building. Each boiler shall be sized for 2/3 of the connected building heating load.

B. Coordinate boiler type and selection with Owner.

- C. Boiler flue pipe shall be air insulated, double-wall constructed of stainless steel inner pipe and aluminized steel outer pipe. Flue pipe shall be UL approved and comply with NFPA Standards 37 and 211. Furnish and install required sections and fittings for a complete installation.**

END OF SECTION

SECTION 15650 –CENTRAL COOLING EQUIPMENT

A. GENERAL

1. Coordinate chiller type and selection with owner.
- B.** The chiller shall be completely assembled on a fabricated steel base with all interconnecting refrigerant piping and internal power and control wiring. Unit mounted control panel shall include a interface to the Building Automation System as well as to permit remote chilled water setpoint adjustment and demand limiting by accepting a 4-20mA or 10-20Vdc analog signal. Unit shall be provided with manufacturer's sound attenuation package to reduce compressor and condenser fan noise and 5 year compressor warranty. Chiller shall be manufactured by York International or Carrier.
- C.** Provide a refrigerant leak detection system for each indoor chiller installation. System shall alarm locally and be connected to the Building Management System for remote monitoring.

END OF SECTION

SECTION 15660 - VARIABLE FREQUENCY DRIVES

- A. Furnish and install variable frequency drives on each air handling unit to serve as starter, circuit breaker, motor overload protection, indicator panel, remote signal output and power-factor correction. Drives shall be provided with digital readout monitors and the following protection systems: frequency stall, current limit, overcurrent, short circuit, overvoltage, undervoltage, component burnout. The drive shall also be provided with auto restart, incoming motor circuit protector and thermal overload, AC line reactor, harmonic filter, and manual bypass switch and contactors for interfacing with the Building Automation System. Drives shall be manufactured by ABB, Cutler Hammer, or Allen Bradley or Yaskawa.

END OF SECTION

SECTION 15700 - HEAT TRANSFER

- A. Furnish and install all hydronic specialties necessary for a complete system including, but not limited to air purgers, air vents, expansion tanks, relief valves, backflow preventers, pressure reducing valves and test plugs. Furnish and install a ball valve for isolation of each air vent.
- B. Furnish and install calibrated balancing valves on all terminal hot and chilled water equipment. Provide a portable master meter kit for use during testing and balancing and deliver meter kit to HMC at completion of Work. Calibrated balancing valves shall be manufactured by Tour and Anderson.
- C. Furnish and install a complete water treatment program. Feeding, control equipment, and chemicals on the hot water and chilled water loops shall include one 4 quart, one shot feeder and one year supply of chemicals for each system. Chemicals, service and equipment shall be provided by HMC's current water treatment vendor.
- D. Furnish and install electric heating cable on all hot and chilled water piping installed outdoors. The cable shall be controlled and monitored by the Building Automation System.
- E. Steam pressure reducing valves shall be configured for 1/3, 2/3 capacity arrangement with a valved bypass. Steam pressure reducing stations serving building additions shall be located in dedicated, ventilated rooms. Pressure reducing valves and steam traps shall be manufactured by Spirax Sarco.
- F. Condensate return pumps shall be electrically powered. Steam powered condensate pumps will not be permitted unless approved by Owner. Condensate pumps shall be manufactured by Weil Pump Company, Pacific Pumping Company, or Roth.
- G. Steam to hot water heat exchangers shall be U-tube design manufactured by Spirax Sarco, or approved equal. A valved bypass shall be provided around temperature control valves.
- H. 3-way control valves shall be used on constant volume systems. 2-way shall be used on variable volume systems.
- I. All control valves shall be installed with isolation valves and unions to permit replacement.
- J. Reheat coils will be sized assuming reheat water temperature of 185 degrees. F.

END OF SECTION

SECTION 15705 – HUMIDITY CONTROL EQUIPMENT

- A. Humidifiers shall be provided for each procedure and equipment room as required to maintain space conditions specified by the AIA Guidelines and medical equipment manufacturer's requirements. Humidifiers shall be installed downstream of supply fans.
- B. Where plant steam is not available, humidifier shall be steam generating humidifier with electric steam generator and stainless steel duct dispersing manifold or space distribution unit containing a fan. Unit shall be provided with disconnect switch, microprocessor control and remote humidistat. Provide condensate separator where required in steam line between duct dispersing manifold and unit and water filter in make-up water line.
- C. Where plant steam is available, steam humidifiers shall be dispersing manifold type with stainless steel, perforated steam jacket, stainless steel condensate receiver and electrically operated control and jacket valves. Humidifier shall be manufactured by Carel.
- D. Coordinate ductwork material and configuration requirements for duct dispersion tube installation with equipment manufacturer's recommendations.
- E. High limit controls shall be provided for each humidifier.

END OF SECTION

SECTION 15710 - TERMINAL HEATING UNITS

A. GENERAL

1. Cabinet unit heaters shall be provided at each exterior entrance or vestibule.
2. Horizontal unit heaters shall be provided in each mechanical, electrical and service space not served by the central air handling system.
3. Wall heaters shall be provided in any toilet with an exterior wall.

- B. Cabinet unit heaters, horizontal unit heaters and wall heaters shall be controlled by line voltage room thermostats with heat-off-fan settings. Thermostat shall cycle the fan. If the unit heaters are served by the same hot water loop serving the variable air volume boxes, provide a 2-way control on each unit heater to allow water flow only on a call for heat.

END OF SECTION

SECTION 15720 - UNITARY EQUIPMENT

A. GENERAL

1. Furnish and install dedicated computer room style units for each MRI procedure, equipment and control room. Floor-mounted configuration is preferred. Ceiling-recessed or ceiling-concealed configuration is least desirable. If ceiling installation is approved by the Owner, provide adequate access around units for servicing.
2. Furnish and install a remote air-cooled condenser or compressor-condenser unit for each computer room air conditioner. Location of unit shall be approved by HMC.
3. Install an HMC-furnished closed-loop process fluid chiller for each MRI, CT Scanner and linear accelerator.
4. Furnish and install a dedicated ductless split system for each Telecommunication room.

B. Computer room air conditioners shall be air cooled. Units shall be provided with an electric steam-generating humidifier, electric heating coil and microprocessor control system. Associated air-cooled condensers or compressor-condenser units shall be arranged for vertical airflow and furnished with low ambient temperature controls. Computer room air conditioners shall be manufactured by Liebert or Data-Air.

C. Ductless split systems shall be provided with low ambient controls and manufactured by Sanyo or Mitsubishi. These are typically used for IT Hub Closet rooms.

END OF SECTION

SECTION 15800 - AIR HANDLING EQUIPMENT

A. GENERAL

1. Furnish and install air handling units for each building or area of work. Air handling units shall be installed inside mechanical equipment rooms or penthouses whenever possible. Number of units and zoning shall be approved by HMC. Air handling units shall be sized for the total airflow required by the summation of the terminal units. "Block load sizing" will not be permitted.
2. Furnish and install centrifugal roof fans to provide general exhaust for miscellaneous areas.
3. Furnish and install high plume style exhaust fans for laboratory hood exhaust systems. Redundant fans serving a common exhaust plenum shall be provided. Fans should be on normal/emergency power and controlled/monitored by the Building Management System. Redundant fans will operate one month on/one month off. Laboratory hood exhaust fans should be high-plume discharge type manufactured by Strobic Air, or Greenheck Vector. Redundant fans shall be provided as directed by the Owner
4. AHU's and Exhaust fans should provide 20% addition capacity, unless otherwise directed by the Owner.

B. Air handling units shall be double wall construction. Rooftop units shall be designed and built specifically for outdoor installation. The air handling units shall be manufactured by York International/Pace or Carrier. The units shall be configured for economizer operation and building pressure relief. The units shall be furnished with hinged access doors and shall generally consist of the following sections:

1. Discharge section.
2. Sound attenuator section.
3. Bag filter section.
4. Diffuser plate/access section.
5. Supply fan section with high efficiency motor compatible with VFD, fixed sheaves and airflow monitor.
6. Chilled water coil section (maximum 550 fpm face velocity) with 304 stainless steel casing, tracks, coil supports, drain plugs and drain pan.

-
7. Access section with UV lighting. UV Lighting shall be manufactured by Sani-Vox, no substitutions.
 8. Hot water coil section (maximum 700 fpm face velocity) or minimum 2-row steam coil section. Integral face and bypass steam (Wing) coils will not be permitted.
 9. Air blender section.
 10. Filter/mixing box section.
 11. Return fan section with high efficiency motor compatible with VFD, fixed sheaves and airflow monitor.
- C. Coil headers shall be copper or cast iron with red brass connections. Steel pipe headers will are not acceptable.
 - D. A valved bypass shall be installed around all large chilled water control valves and preheat coil valves.
 - E. Steam heating coil control valves serving air handling units shall be arranged for 1/3-2/3 capacity control with a valved bypass. Face and bypass coils shall be prohibited.
 - F. Concrete housekeeping pads or steel rails for support of floor-mounted air handling units shall be of sufficient height for proper condensate drain and steam coil condensate trapping installation.
 - G. Air handling units shall be installed at least 3 feet from any wall.
 - H. Access shall be provided to permit air handling unit coil removal, fan motor, and bearing replacement. Motor removal rails shall be provided in all sections that contain motors 10 hp or larger.
 - I. Centrifugal roof fans shall be provided with motorized dampers, automatic spring loaded belt tightener and insulated roof curb. Roof fans shall be manufactured by Greenheck, Cook, or Penn Ventilator.
 - J. Variable speed pulleys are to be replaced with fixed sheaves immediately following the Testing, Adjusting, Balancing procedure.
 - K. All air handling unit casing sections shall be designed for less than 1% leakage at +/- 8.0 in WG internal casing pressure as tested per AHRI standards

Electric acuation shall be provided for all control valves and dampers, unless otherwise authorized by owner.

END OF SECTION

SECTION 15840 - AIR FILTRATION

- A. 35% efficient (MERV-A 8) pre-filter and 95% efficient (MERV-A 14) final filters for installation in the air handling units shall be manufactured by Tri-Dim. Final filters shall be cartridge type.
- B. HEPA filter used for contaminated exhaust shall be 99.97% efficiency (MERV-A 18) installed in a bag-in, bag-out type stainless steel filter housing with isolation dampers. Filter frame shall be manufactured from particle board (steel frames shall not be permitted). Application and BAS monitoring of filter pressure drop shall be as directed by HMC.
- C. Bag-in, bag-out filter housings shall not be installed above ceilings.
- D. Service platforms shall be installed for stacked housings.

END OF SECTION

SECTION 15850 - AIR DISTRIBUTION

- A. The supply, return and exhaust systems for the building shall be fully ducted using rigid metal ductwork fabricated from galvanized sheet steel or aluminum, constructed in accordance with SMACNA, HVAC Duct Construction Standards and the latest publication of the ASHRAE Equipment Handbook. Round and oval metal ductwork shall be fabricated with spiral lockseam construction. All duct joints shall be sealed to prevent leakage.
- B. Ductwork within each MRI procedure room shall be fabricated from non-ferrous material.
- C. Ductwork shall be sized with a maximum friction loss of 0.1 inch per 100 feet of ductwork with velocities in duct mains not exceeding 2200 fpm.
- D. The duct systems shall be arranged to minimize cross-talk and sound transmission between rooms by use of fittings or sound attenuators.
- E. Joints in ductwork installed outdoors shall be sealed with caulk.
- F. Ductwork installed outdoors, including exhaust ductwork, shall be insulated.
- G. Ductwork installed on roofs shall be installed high enough above the roof to permit re-roofing with the ductwork in place.
- H. Laboratory hood exhaust ductwork shall be labeled "CONTAMINATED". Label shall identify the room or area served.
- I. Take-off fittings for connecting flexible duct shall be pre-fabricated, galvanized steel with dampers. Acoustical flexible ductwork shall be limited to 6 feet in length and be similar to Flexmaster, Type 8M.
- J. Opposed blade volume dampers shall be provided at each branch duct connection and as required for balancing.
- K. Turning vanes shall be installed in all mitered elbows. Turning vanes shall be single wall.
- L. Duct access doors shall be installed in ductwork within working distance of all motor-operated dampers, fire dampers and smoke dampers to permit inspections and adjustments. Access doors shall be minimum 24 inches by 24 inches or full width of duct less 2 inches. Closure method shall be double cam latch to allow complete removal.
- M. Ceiling return and exhaust registers shall be perforated face lay-in style and provided with opposed blade volume dampers and baked white enamel finish, manufactured by Tuttle & Bailey, Titus, or Carnes.

- N. Sidewall exhaust and return registers shall be surface mounted with fixed position horizontal bars at 35 to 45 degree deflection and spaced 3/4 inches on center and provided with opposed blade volume dampers and baked white enamel finish. Registers shall be manufactured by Tuttle & Bailey, Titus, or Carnes.
- O. Sidewall supply registers shall be surface mounted with double deflection air foil shaped bars with adjustable horizontal front bars spaced 3/4 inches on center and provided with opposed blade volume dampers and baked white enamel finish. Registers shall be manufactured by Tuttle & Bailey, Titus, Carnes or equal.
- P. Registers shall be selected and branch ductwork to terminals shall be configured to minimize noise. Ceiling supply diffusers shall be high performance style for variable air volume applications. Diffusers shall be 24 x 24 full face and panel mounted lay-in type frames with removable inner core, adjustable volume damper and baked white enamel finish. Diffusers shall be manufactured by Tuttle & Bailey, Titus, Carnes or equal.
- Q. Supply, return and exhaust terminals shall be selected with a maximum noise rating of NC-25.
- R. Louvers shall be 6 inch deep extruded aluminum construction with drainable stormproof blades, birdscreen and Kynar 500 finish in color selected by the Owner. Louvers shall be manufactured by Louvers and Dampers, American Warming and Ventilating, Ruskin or equal.
- S. Fire dampers shall be dynamic rated with blades stacking out of airstream, constructed and installed in accordance with UL 555 and NFPA 90A.
- T. During construction, open ends of ductwork, either are stored or installed, shall be protected with plastic covering.
- U. All branch volume dampers shall be provided with quadrant locks that are fixed in place upon final balancing and marked with orange paint to permanently indicate final position.

END OF SECTION

SECTION 15870 - VARIABLE AIR VOLUME SYSTEMS

- A. Variable air volume boxes shall be control reheat style. Casing shall be provided with access door and constructed of galvanized steel and lined with minimum 1-1/2 pound density thermal/acoustical foil-faced fiberglass insulation meeting UL 181 and NFPA 90 requirements or double wall construction. The calibrated air damper assembly shall be factory set and field adjustable for minimum and maximum airflows. Unit shall be provided with hot water heating coil, internal regulator to maintain constant airflow independent of inlet static pressure and factory mounted electric actuator for interface with the Building Automation System. The heating coil shall be selected to provide a minimum 35 degree F air temperature rise at 50 percent of design cooling airflow. Variable air volume boxes shall be manufactured by Johnson Controls/York International, Carrier, or Enviro-Tec.
1. All variable air volume boxes serving intensive care unit patient rooms shall be sized to be capable of achieving an 80 degree F room temperature in less than 30 minutes from starting room temperature of 68 degrees F.
- B. A temperature zoning plan shall be submitted to HMC for review and approval prior to preparation of heating-cooling load calculations and ductwork design. No more than 3 rooms of similar function and exposure shall be grouped on a single VAV box.

END OF SECTION

SECTION 15900 - BUILDING AUTOMATION SYSTEM

- A. Furnish and install a complete direct digital control (DDC), Building Automation System/Automatic Temperature Control (BAS/ATC) system as manufactured by Johnson Controls. System shall be complete in all respects including all labor, materials, equipment and services necessary, and shall be installed by personnel regularly employed by system manufacturer. Refer to the Division 17 for additional requirements.
- B. For remote buildings, an operator (computer) workstation interface shall be provided for local access and to communicate remotely with the Main Campus' BAS/ATC systems via a dial-up modem or web-based (Internet) access. Capabilities for future communication via a fiber optic data network shall be provided.
- C. All BAS/ATC controllers that serve critical equipment and equipment that is served by emergency power shall be served by normal emergency power and provided with an uninterruptible power supply (UPS).
- D. Room pressure monitors shall be permanently installed at all operating rooms, procedure rooms, airborne infection isolation rooms, protective environment rooms, and as directed by owner. Room pressure monitors shall be Pressura, manufactured by TSI Incorporated, or approved equal manufactured by Johnson Controls.
- E. Sequences of Operation
 - 1. Sequences of operation for mechanical equipment shall be reviewed and approved by HMC and Johnson Controls prior to completion of design. Typical sequences of operation are listed below.

Air Handling Units

General: The BAS/ATC unit controller shall dictate the unit operating mode.

Off Mode: During times of when the unit is de-energized, the unit's hot water coil valve shall be fully open, the unit's chilled water cooling coil valve shall be fully closed, the unit's supply and return fans shall not run, the outdoor air damper shall be in the fully closed position and the return air damper shall be in the fully opened position. If the outside air temperature is below 40 degrees F, the chilled water cooling coil valve shall open to a minimum flow position to prevent freezing.

The unit's associated VAV boxes shall be indexed to 100% open. The VAV boxes' hydronic heating valves shall also be indexed to 100% open.

Unoccupied Mode: During Unoccupied Mode of operation, the unit supply and

return fans shall run and the unit shall produce 105 degree (adjustable) supply air via its hot water heating coil. The heating coil valve shall modulate open (in response to depressed supply air temperatures) and close (in response to elevated supply air temperatures) in order to maintain discharge air temperature set point. The unit's outdoor air damper shall be closed and the unit's return air damper shall be fully open.

As the room temperatures begin to rise, the PID loop associated with the room's respective VAV box(s) shall begin to close the VAV box in order to optimally arrive at the space's setback heating set point. The VAV boxes associated with each room shall be allowed to modulate completely shut during this mode.

When the average room temperatures during the Unoccupied Mode are within 1 degree of the average of the setback set points, the Air Handling Unit system shall index to the Off Mode.

Warm Up Mode: During Warm Up Mode of operation, the unit supply and return fans shall run and the unit shall produce 105 degree (adjustable) supply air via its hot water heating coil. The heating coil valve shall modulate open (in response to depressed supply air temperatures) and close (in response to elevated supply air temperatures) in order to maintain discharge air temperature set point. The unit's outdoor air damper shall be closed and the unit's return air damper shall be fully open.

As the room temperatures begin to rise, the PID loop associated with the room's respective VAV box(s) shall begin to close the VAV box in order to optimally arrive at the space's adjustable heating set point. The VAV boxes associated with each room shall be allowed to modulate completely shut during warm up operations. If at any time during the Warm Up Mode the supply fan VFD's output falls below 30 percent (adjustable), the system shall index its associated VAV boxes to their respective minimum heating positions and the system supply air temperature shall be reset to 70 degrees (adjustable).

The room temperatures associated with a given Air Handling Unit's VAV boxes shall be averaged and the average temperature value shall be used to initiate the occupied mode of operation. When the average room temperatures during the Warm Up Mode are within 1 degree of the average of the occupied set points, the Air Handling Unit system shall index to the Occupied Mode.

Cool Down Mode: During Cool Down Mode of operation, the unit supply and return fans shall run and the unit shall produce 55 degree (adjustable) supply air by utilizing its economizer and/or modulating the chilled water cooling coil control valve. .

As the room temperatures begin to fall, the PID loop associated with the room's respective VAV box(s) shall begin to close the VAV box in order to optimally arrive at the space's adjustable cooling set point. The VAV boxes associated with each room shall be allowed to modulate completely shut during cool down operations. If at any time during the Cool Down Mode the supply fan VFD's output falls below 30 percent (adjustable), the system shall index its associated VAV boxes to their respective minimum cooling positions and the system supply air temperature shall be reset to Occupied Mode temperature required by the Cooling Mode Reset Schedule.

The room temperatures associated with a given Air Handling Unit's VAV boxes shall be averaged and the average temperature value shall be used to initiate the occupied mode of operation. When the average room temperatures during the Cool Down Mode are within 1 degree of the average of the occupied set points, the Air Handling Unit's system shall index to the Occupied Mode.

Occupied Mode: In the occupied mode of operation, the Air Handling Unit shall deliver supply air based on the following reset schedules for Heating and Cooling modes of operation:

Heating Mode Reset Schedule

<u>O.A. Temp.</u>	<u>Supply Air Temp.</u>
0	85
60	65

Cooling Mode Reset Schedule

<u>O.A. Temp.</u>	<u>Supply Air Temp.</u>
60	60
80	55

The change over from the Heating Mode to the Cooling Mode shall occur at 55 degrees (adjustable) outdoor air temperature.

During the Heating Mode, the Air Handling Unit's outside air damper shall open to its minimum airflow position. The system's VAV boxes shall prevent

overheating of their spaces by modulating their respective hot water heating coil valves shut and then modulate their air valves to their Heating Minimums. On a drop in space temperature the reverse shall occur.

During the Cooling Mode, the Air Handling Unit's outside air damper shall be allowed to modulate with the unit's return air damper to provide the required supply air temperature in accordance with the Cooling Mode Supply Air Temperature Reset Schedule as long as the outdoor air temperature is 2 degrees or more below the average space temperature of the system's rooms and the return air humidity is below 60 percent (adjustable) relative humidity as sensed by the Air Handling Unit's return air humidity sensor. The Air Handling Unit's outdoor air damper shall be closed to its minimum airflow position and its return air damper opened and the chilled water cooling coil control valve shall modulate to maintain the supply air temperature in accordance with the Cooling Mode Reset Schedule. If the return air humidity, as sensed by the Air Handling Unit's return air humidity sensor, rises above 60 percent (adjustable) relative humidity, the unit shall be indexed to the Dehumidification Mode of operation. When the return air humidity, as sensed by the Air Handling Unit's return air humidity sensor, drops five percentage points below the adjustable high humidity set point, the unit shall return to its Cooling Mode of operation. The system's VAV boxes shall prevent overcooling of their spaces by first modulating their air valves to their Cooling Minimums and on a continued fall in space temperature their respective hydronic heating coil valves shall modulate open. On a rise in space temperature the reverse shall occur.

During the Dehumidification Mode, the Air Handling Unit's supply air temperature shall be set to 53 degrees (adjustable). In the event that the space temperature of any of the rooms served by the VAV Packaged Unit's system falls below its heating set point, the hot water heating coil control valve shall modulate to warm the supply air stream to within 5 degrees (adjustable) of the average space temperature of the system's rooms while the unit's chilled water coil control valve continues to dehumidify the air stream to five percentage points below the adjustable high humidity set point.

Variable Frequency Drive (VFD) Control: The Air Handling Unit's associated supply fan VFD shall be controlled by a static pressure sensor located two thirds of the way down the system's supply duct main. The VAV system balancer shall determine the required minimum system static pressure necessary for the most remote VAV box to deliver its maximum scheduled cooling air volume. The minimum system static pressure necessary for the most remote VAV box to deliver its maximum scheduled cooling air volume shall be input to the system's the Cooling Mode Reset Schedule's supply static pressure set point (adjustable). The VAV system balancer shall determine the required minimum system static

pressure necessary for the most remote VAV box to deliver its minimum scheduled heating air volume. The minimum system static pressure necessary for the most remote VAV box to deliver its minimum scheduled heating air volume shall be input to the system as the Heating Mode Reset Schedule's supply static pressure set point (adjustable). The system's static pressure shall change as the system changes back and forth from the Heating Mode Reset Schedule to the Cooling Mode Reset Schedule.

The Air Handling Unit's associated return fan VFD shall be controlled to maintain the constant minimum outside airflow indicated on the Drawings as measured at the outside air intake. The minimum outside air volume shall remain constant regardless of system turndown. The unit controller shall modulate the relief air damper to maintain a positive building pressure of 0.10 inches wc (adjustable).

Safeties: The Air Handling Unit's supply and return fans shall turn off, its chilled water cooling control valve stroked 100 percent closed, and its hot water heating coil valve stroked 100 percent open upon activation of the fire alarm system or if the supply air temperature, as sensed by the system's discharge air temperature sensor, drops below 40 degrees (adjustable). The Air Handling Unit's return air damper shall fully open, its outdoor air damper shall be fully closed and an alarm shall be sounded at the operator interface.

The VFD output algorithm shall prevent the system static pressure from exceeding the Heating or Cooling static pressure set point by more than 25 percent. If the system static pressure exceeds the Heating or Cooling static pressure set point by more than 25 percent for more than 10 seconds, the Air Handling Unit's fan shall turn off, its chilled water cooling control valve stroked 100 percent closed, and its hot water heating coil valve stroked 100 percent open. Its return air damper shall fully open, its outdoor air damper shall be fully closed and an alarm shall be sounded at the operator interface.

Computer Room Air Conditioners and Air-Cooled Condensers

Manufacturer supplied controller shall maintain room temperature setpoint of 72 degrees F, 50 percent relative humidity (adjustable). BAS/ATC system shall monitor space temperature and humidity and alarm on abnormal condition or a trouble signal from the manufacturer controls.

Closed Loop Process Chiller

Unit mounted manufacturer's controller shall maintain discharge glycol temperature setpoint. BAS/ATC shall monitor glycol supply and return temperatures and alarm on abnormal supply temperature condition or a trouble signal from the manufacturer

controls.

Cabinet, Unit and Wall Heaters

A line voltage thermostat shall energize the unit fan on a fall in space temperature below 72 degrees F (adjustable) if hot water is proven by an aquastat located on the hot water return branch. On a rise in temperature above setpoint, the unit fan shall be de-energized.

Fans

Ventilation fans shall be energized and associated motor operated damper shall be opened by the BAS/ATC system to operate continuously during occupied hours. The BAS/ATC system shall monitor fan status via a current sensing switch and signal an alarm upon failure.

Thermal relief fans shall be energized upon a rise in space temperature above 85 degrees F (adjustable) as sensed by a space thermostat and the associated motor operated dampers shall open. Fan shall de-energized and associated motor operated damper shall close upon a drop in space temperature below 85 degrees F (adjustable).

Air-Cooled Chiller

The chiller shall be enabled by the BAS/ATC system during occupied hours and anytime the outdoor air temperature is above 50 degrees F (adjustable). The chiller shall maintain its supply temperature at 45 degrees F (adjustable) via its internal controls.

Boilers

The boilers shall be enabled by the BAS/ATC system during occupied hours and anytime the outdoor air temperature is below 55 degrees F (adjustable). The hot water scheduling valve shall mix return hot water and water off of the boiler in order to reset the hot water supply temperature from 180 degrees to 150 degrees with respective outdoor air temperatures of 20 degrees to 80 degrees. The reset function shall be linear. The boiler shall maintain its temperature at 180 degrees F (adjustable) via its internal controls.

Hot Water/Chilled Water Pumps

The BAS/ATC unit controller shall energize pumps in a lead-lag sequence. On a loss in flow as sensed by a differential pressure sensor, the unit controller shall energize the standby pump and signal an alarm. The BAS/ATC system shall automatically reverse the lead and standby positions of the pumps every 30 days.

Electric Heat Trace

The unit controller shall energize the electric heat trace whenever the outside air

temperature drops below 38 degrees F (adjustable) and de-energize the electric heat trace when the outside air temperature rises above 41 degrees F (adjustable). The BAS/ATC system shall monitor the status of each electric heating cable via a current switch and signal an alarm upon failure.

Medical Gas Source Equipment

All NFPA required monitoring and alarm points shall be tied-in to the BAS/ATC system.

Refrigerators/Freezers

Research & Medical freezers with alarms shall be tied-in to the BAS/ATC system or the Amega/MESA System (preferred).

- F. BAS/ATC system input and output points shall be furnished in accordance with the attached Input/Output Summary.
- G. BAS/ATC system input and output points shall be reviewed and approved by HMC and Johnson Controls prior to completion of design. Typical input and output points are listed on the attached Input/Output Summary.

END OF SECTION

SECTION 15950 - TESTING AND BALANCING OF MECHANICAL SYSTEMS

- A. Testing, adjusting, and balancing shall be performed by a fully certified independent agency in complete accordance with standards as published by the Associated Air Balance Council or the National Environmental Balancing Bureau.
- B. Copies of complete test and balance reports shall be submitted for approval in accordance with specified submittal procedures at substantial completion of the project. Test and balance reports shall include a table of contents, air systems schematics including terminal numbers and traverse locations, and hydronic systems schematics including flow station locations.
- C. Filters in air handling equipment shall be replaced immediately prior to testing and balancing of the air systems.

END OF SECTION

SECTION 16010 – ELECTRICAL GENERAL PROVISIONS

A. CODES AND STANDARDS

1. Electrical Work shall meet requirements of NFPA 70 - National Electrical Code, the Pennsylvania Uniform Construction Code and all other federal, state, and AHJ's laws, rules and regulations applicable to the work.
2. Where applicable, materials and equipment shall bear the label of approval of Underwriters Laboratories, Inc.
3. Except where a requirement in these standards is more stringent, the electrical work shall be designed and installed to meet the following codes, standards, and guidelines (the most recent approved version is to be followed):

Pennsylvania State University's Office of Physical Plant Standards included as an appendix to these standards and available at the following link. HMC reserves the right to modify OPP standards as necessary to meet specific project needs.

http://www.opp.psu.edu/construction/standards/design_standards.cfm

AIA Guidelines for Design and Construction of Hospital and Health Care Facilities

NFPA 13 - Standard for the Installation of Sprinkler Systems

NFPA 72 - National Fire Alarm Code

NFPA 99 - Standard for Health Care Facilities

NFPA 101 - Life Safety Code

NFPA 110 - Standard for Emergency and Standby Power Systems

NFPA 111 - Standard on Stored Electrical Energy Emergency and Standby Power Systems

Pennsylvania Uniform Construction Code, including:

International Building Code

ICC Electrical Code (references National Electric Code NFPA 70-05)

International Energy Conservation Code

International Existing Building Code

International Fire Code

International Fuel Gas Code

International Mechanical Code

International Plumbing Code

B. EXCAVATION AND BACKFILL

1. Perform excavation and backfill required for Work of this Division, inside and outside building. Work shall include cutting and patching of curbs, walks, concrete, repaving, and reseeding of all areas disturbed by excavation.
2. Banks and excavations shall be retained by means of shoring and braces to avoid cave-ins. Shoring shall be in accordance with Pennsylvania Department of Labor and Industry requirements. Shoring shall be maintained until installation, tests and inspections are complete.
3. Pumping equipment shall be provided and maintained to pump water from excavations.
4. Comply with Pennsylvania Underground Utility Line Protection Act (No. 172-1986) before commencing any excavation work. Telephone number for Pennsylvania One-Call Systems, Inc. is 1-800-242-1776.
5. All underground conduit runs shall be marked with metal-embossed utility marking tape to be run above the duct bank along its full length. Locate marking tape 12 inches minimum above the top of the duct bank.
6. Underground conduits installed horizontally using augers shall also have metal-embossed utility marking tape installed within the conduits.
7. Abandoned underground conduits shall and pipes shall be removed in their entirety or left in place and filled with suitable material with approval of Owner.

C. PAINTING

1. Equipment furnished under this Division that is pre-painted or pre-finished by manufacturer shall have all rust spots cleaned, primed, and refinished prior to final acceptance by the Owner
2. Raceways shall be factory colored. Junction boxes shall be galvanized and the cover shall be painted to match the raceway. Color coding shall be as follows:
 - a) Life safety – Red
 - b) Fire Alarm – Orange

- c) ATS – Purple
- d) Critical Branch – Yellow
- e) Equipment Branch – Green
- f) Normal Branch – No color
- g) Conduit Connectors – No color

D. RECORD DOCUMENTS

1. The Contractor shall be required to maintain a set of Contract Documents, i.e., Specifications, Drawings, Addenda, Modifications and approved submittals at the site, in good order and annotated to show all changes made during construction process. At the time of substantial completion of the Work, deliver to the Engineer the complete set of AS-BUILT DRAWINGS. The Engineer will, WITHIN 30 DAYS after receipt from the Contractor, transpose all changes recorded by the Contractor onto a full set of reproducible drawings, and CADD electronic media, compatible with the HMC's CADD system, which shall become the RECORD DRAWINGS for the Project, and shall forward same to the HMC. These record documents shall be delivered to HMC in BOTH PRINT and electronic form (1 copy) within 30 days of substantial completion. Electronic format for printed documents shall be Adobe Acrobat PDF Microsoft Word. Electronic format for drawings shall be AutoCAD. In each case, provide the software version required by HMC.

E. OPERATION AND MAINTENANCE INSTRUCTIONS

1. The Contractor shall be required to furnish an instructor/operator at completion of system(s) installation, who shall operate all systems and provide documentation. The instructor/ operator(s) shall provide instruction to thoroughly train HMC personnel in the operation and maintenance of all equipment. The amount of time required for training shall be determined by HMC for each project.
2. The Contractor shall be required to provide a minimum of 1 printed sets and 1 electronic set of instructions covering operation and maintenance of each item of equipment and valve charts shall be submitted to HMC during this operating period. Required instructions from manufacturer's representatives shall be submitted at this time. Instructions and charts shall be submitted in print and electronic form. Electronic format shall be Adobe Acrobat PDF.

F. TEMPORARY UTILITIES

1. Temporary utilities, (lighting and power) shall be provided as required by the Owner. The source of power shall be as approved by HMC.

G. MATERIALS

1. Materials shall be new, without imperfections or blemishes, and shall be protected from the elements prior to installation.

H. EQUIPMENT DESIGNATIONS

1. Contact the Owner for the designations of all electrical equipment provided as part of the scope of work. Reference Section 16050 for nameplate requirements.

END OF SECTION

SECTION 16050 - BASIC MATERIALS AND METHODS

- A. All materials and equipment shall be new and shall be UL listed, where applicable.
- B. Furnish and install access panels in ceilings and walls for service and repair access to concealed equipment. Minimum size shall be 18 inches by 18 inches. Where restrictions will not permit minimum size, verify access panel size with Architect. Access panel construction shall be compatible with ceiling and wall materials and fire rating.
- C. Hangers and supports shall be suitable for their intended purpose and shall have a galvanized finish, or otherwise protected against corrosion. Hangers and supports for all electrical equipment shall only be secured to and supported from structural steel, or concrete deck.
- D. Where backboards are required the Contractor shall furnish and install a sheet of 3/4 inches fire-treated plywood backboards from finished floor to finished ceiling at each location shown on the drawings. Backboards shall be painted white with a fire retardant paint. The fire rating label shall not be obscured.
- E. Furnish and install fire stop sealing system for conduits passing through walls and floors with smoke or fire rating in accordance with HMC's Above Ceiling Compliance Policy, A-96 HAM.
- F. Complete and submit HMC's Equipment Data Acquisition form for all installed transformers, panelboards, substations, and similar equipment. Submit a complete itemized listing of nameplate equipment designations for approval.
- G. Electrical System Overcurrent Protective Device Coordination Study

This study is typically required when a project installs new or replacement circuit breaker panels and/or transformers. Confirm with the Owner that this study is required.

- 1. Provide for review 2 copies of a detailed over-current protective device coordination study, and short circuit analysis. Analysis shall begin at and include nearest upstream protective device from the electrical equipment items furnished and installed under this contract as indicated on the Drawings. Ground fault shall be included. Study shall end with either main breaker or largest branch breaker in lighting and appliance panelboards. Study will be used to determine settings of protective devices for selective coordination. Equipment will be provided with ampere interrupting current rating and bus bracings equal to or greater than values indicated on Drawings. Where the Drawings indicate short circuit ratings larger than required by the short circuit analysis, the ratings shown

on the Drawings shall not be decreased as a result of short circuit study.

2. All breakers shall be fully rated for short circuit interrupting, series connected ratings will not be approved.
3. The over-current protective device coordination and short circuit analysis shall be submitted prior to submission of power distribution equipment shop drawings.

H. ARC – Flash Study

This study is typically required when a project installs new or replacement circuit breaker panels and/or transformers. Confirm with the Owner that this study is required.

1. Provide for review 2 copies of a detailed arc-flash study.
2. An arc-flash study and analysis shall be performed on the electrical system beginning at and include the nearest upstream transformer. System to include both existing electrical equipment items and electrical equipment items furnished and installed under this contract indicated on the Drawings.
3. The Arc-Flash Hazard Analysis shall be performed with the aid of computer software intended for this purpose in order to calculate ARC Flash incident Energy (AFIE) levels and flash protection boundary distances.
4. The Arc-Flash Hazard Analysis shall be performed in conjunction with the Over-current Protective Device Coordination Study and Short Circuit Analysis.
5. Results of the analysis shall be submitted in tabular form, and shall include, device or, bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
6. The analysis shall be performed under worst-case Arc-flash conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
7. The Arc-Flash Hazard Analysis shall be performed by a professional engineer registered in Pennsylvania.

-
8. The Arc-Flash Hazard Analysis shall be performed in compliance with IEEE standard 15842002, IEEE Guide for Performing Arc-Flash Calculations.
 9. The Arc-Flash Hazard Analysis shall include recommendations for reducing AFIE levels and enhancing worker safety.
 10. The proposed vendor shall demonstrate experience with Arc-Flash Hazard Analysis by submitting names of at least ten actual Arc-Flash Hazard Analysis it has performed in the past year.
 11. The proposed vendor shall demonstrate capabilities in providing equipment, services, and training to reduce Arc-Flash exposure and train workers in accordance with NFPA 70E and other applicable standards.

The proposed vendor shall demonstrate experience in providing equipment labels in compliance with NEC-2002 section 110 and ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment (PPE) classes.

12. Appropriate “Danger Labels”, as specified in Section 16050, Basic Materials, shall be specified to be placed on all items of electrical equipment by the installing contractor. Included in the study. “Danger Label” shall, at a minimum, indicate the word message as specified in Section 16050, for “Danger Labels” and the following:
 - (a.) Maximum voltage of the equipment.
 - (b.) Arc-flash Boundary
 - (c.) Required PPE.
13. Information and data on existing electrical system components and equipment required for completion of the Over-current Protective Device Coordination Study and Short Circuit Analysis and Arc-Flash Analysis shall be collected by the contractor in the field.

- I. Danger labels shall be specified to be furnished and installed on each item of electrical equipment specified to receive the label. Installation to be by the installing contractor. Word message on label shall be: “ARC FLASH AND SHOCK HAZARD. DE-ENERGIZE BEFORE SERVICING”.

END OF SECTION

SECTION 16110 - RACEWAYS AND FITTINGS

- A. Raceways in the building shall be either rigid metal conduit (RMC) or electrical metal tubing (EMT). Flexible metal conduits shall be used for final connections to light fixtures, motors and other items that would require a flexible dry connection. Liquid-tight flexible metal conduits shall be used for final connections to light fixtures, motors and other items that would require a flexible wet-location connection. Conduits under concrete slabs should be PVC schedule 40. The minimum acceptable size shall be 3/4 inch.
- B. All EMT shall utilize compression fittings.
- C. Underground conduits for both power and communications systems shall be concrete encased unless approved otherwise by HMC. Telephone, data cabling may be run in cable tray to be located above finished ceilings. Cable tray should be aluminum ladder types, minimum 12 inches wide and shall have a usable depth of 5 inches. Sides shall be “flanged out.” Furnish and install all support hardware.

END OF SECTION

SECTION 16120 – WIRE AND CABLE 600 VOLTS AND BELOW

The HMC “Design and Construction Standards” are to be considered guidelines, not standards.

This a “living” document, one that will need continuous revisions as best practices evolve, manufactures develop new products; and building codes change.

This document is not a stiffling innovation.

Deviations from these guidelines are acceptable if concurrent is obtained from the Owner.

- A. All wire and cable shall be copper, with heat and moisture resistant thermoplastic insulation, type THHN/THWN, and shall be installed in metallic raceways. Conductors #12A WG and below may be solid, all other conductors shall be stranded.
- B. Minimum size for power wiring shall be #12 AWG.
- C. Minimum size for control wiring shall be #14 AWG, except 24 volt and below. All control wiring shall be stranded.
- D. Shared neutral conductors are not permitted. Each branch circuit phase conductor shall be paired with a dedicated neutral conductor along its entire length, including branch circuits for light fixtures.
- E. Aluminum conductors will not be permitted.
- F. All runs over 100; conductors shall be up sized by one size.
- G. All circuits installed for refrigerators and freezers minimum conductor size shall be #10 AWG.

END OF SECTION

SECTION 16125 – WIRE AND CABLE ABOVE 600 VOLTS

- A. Conductors shall be single-stranded copper conductor, extended semiconducting screen, EPR insulation 15 KV rated 133 percent, extruded semiconducting insulation, copper tape shielding and outer jacket, Type MV-90. Each reel of cable shall be factory-tested in accordance with KEA and UL standards. A certified copy of the factory test shall be furnished to HMC. Specific approval on cable type and size must be obtained for each installation. Cables and terminations for use on 5 KV systems shall be rated for 15KV.
- B. Terminations and Connections
1. High-voltage cable shall be terminated with Elastimold nonloadbreak 650 LR Series 600 amp, KV devices where connections and taps are required. Taps may be made using nonloadbreak 200 amp, 15 KV devices where appropriate.
 2. Permanent splices shall be kept to a minimum but may be authorized for specific applications.
 3. Stress cones shall be of the premanufactured style as manufactured by Adalet, Raychem, Elastimold, or 3M. Handmade stress cones are not acceptable.
- C. Direct Burial Cable
1. Direct burial cable shall not be used.
- D. Identification
1. After installation, all high-voltage cables shall be properly identified by a durable nonmetallic tag in each manhole. Tag shall bear feeder identification number (i.e., EC-4) and be secured by plastic tie wraps.
- E. Testing
1. Reference Pennsylvania State University's Office of Physical Plant (OPP) standards for testing requirements.

END OF SECTION

SECTION 16130 – BOXES

- A. Outlet and junction boxes shall be furnished and installed with plaster rings for plaster areas and masonry boxes in masonry areas.
- B. NEMA 1 boxes shall not be exposed in public areas.

END OF SECTION

SECTION 16140 - WIRING DEVICES

A. General

1. 20 ampere receptacles shall be standard throughout the HMC.
2. Hospital grade receptacles shall be used in hospital Department of Health (DOH) regulated areas. Spec grade receptacles shall be used in all other areas (i.e. College of Medicine).
3. Standard duplex receptacles shall be provided at regular intervals as required by Code for cleaning, maintenance, and general use. Install duplex receptacles with the ground opening in the “up” position. Additional receptacles over Code minimum shall be provided as required. Special receptacles and power supplies shall be installed at locations designated for equipment requiring special power characteristics.
4. Minimally, at least one duplex receptacle shall be provided on each wall of each room. Additional receptacles and data outlets shall be installed for computer stations to minimize the use of the power strips.
5. A minimum of four receptacles will be installed in each office. A double duplex receptacle, data outlet, and phone outlet will be installed at the approximate location of the desk.
6. Ground fault interrupter (GFI) duplex receptacles shall be installed in all operating rooms and at locations required by the National Electrical Code.
7. Faceplates shall be brushed stainless steel. Receptacles faceplates shall be inscribed with panelboard and branch circuit designations.

B. Hub (Data/Telecommunication) Rooms:

1. Furnish and install in each room two dedicated 3-wire 120V AC duplex transient-voltage protected electrical outlets supplied by separate branch circuits rated 20-ampere for telecommunication equipment/racks. Coordinate exact locations for the receptacles with HMC’s I.T. Department in field prior to rough-in. Install one 208 volt 30 Amp, single phase simplex outlet.
2. Furnish and install, in addition to the two branch circuits and receptacles above, 20-ampere, duplex 120V AC convenience outlets located on six foot centers around the rooms perimeter walls. All outlets must be on non-switched circuits

-
3. Furnish and install a dedicated 3 phase panelboard to serve the room in cases where IT equipment loads exceed normal branch circuit capacity. Lighting and ancillary power requirements not associated with the IT equipment should be fed from other building lighting/power panelboards.
 4. Furnish and install a 10 position ground bar in each room. Connect the ground bar to each of the following using a 6 gauge conductor: main electrical service ground, electrical panel in Telecommunications room, main service entrance/telecommunication equipment room, and the non-dedicated local 120/208V panelboard serving the Telecommunications room. All equipment and cable shields shall be properly grounded.
 5. Equipment not related to the support of the Telecommunications room such as piping, ductwork, and distribution of building power must not be located in, or pass through, the room.
 6. Furnish and install lockable breakers for the Telecommunications room at the main panel.
 7. Coordinate Telecommunications room size and electrical layout with HMC's I.T. Department.
- C. General purpose switches shall be manufactured by Hubbell, 1221 Series or Pass & Seymour.
- D. Duplex receptacles shall be manufactured by Hubbell, 5362 Series or Pass & Seymour, except in patient treatment and imaging areas, which shall be Hubbell, 8300 Series or Pass & Seymour.
- E. Ground fault circuit interrupter type receptacles shall be manufactured by Hubbell, GF5362 Series or Pass & Seymour, except in patient treatment and imaging areas, which shall be Hubbell, GF-8300 Series or Pass & Seymour.
- F. Transient voltage surge suppression (TVSS) duplex receptacles shall be manufactured by Hubbell, 5252-S Series or Pass & Seymour.
- G. Unless noted, color of all wiring devices shall be ivory, except red when connected to the emergency or essential electrical system.

END OF SECTION

SECTION 16145 - DISCONNECT SWITCHES

- A. Heavy duty, fusible or non-fusible, disconnects shall be manufactured by Square D, Cutler-Hammer, Siemens, or General Electric.
- B. NEMA 12 enclosure for indoor locations and NEMA 3R enclosure for exterior locations. Furnish 3 spare fuses for each fusible disconnect.

END OF SECTION

SECTION 16170 - OVERCURRENT PROTECTIVE DEVICES

- A. All breakers shall be fully rated for short circuit interrupting, series connected ratings will not be approved.
- B. All circuit breakers shall be the bolt-on type.

END OF SECTION

SECTION 16180 - GROUNDING SYSTEMS

- A. Grounding shall be by separate insulated grounding conductors pulled with phase conductors. Grounding system shall be electrically, and mechanically continuous from all outlet devices, power utilization equipment, and distribution equipment to system main ground point.
- B. Neutral conductors shall be continuous throughout system and shall be grounded only at service neutral.
- C. Ground wires insulated with green covers and shall be installed in all raceway runs.
- D. Furnish and install a ground bar along all of the walls in every main electrical room.

The ground bar shall be solid copper measuring 2 inches wide by 1/4 inch thick. Locate 12 inches above the finished floor using 2 inch stand-off hardware. Connect the ground bar to the building ground electrode system using #4/0 bare copper conductor.

- E. Ground electrode systems shall consist of a copper ground ring, main water service piping, concrete encased electrodes and ground rods all bonded together using #4/0 bare copper conductors. The ground electrode system shall be bonded to the ground buss of the service entrance equipment using #4/0 bare copper conductor.

END OF SECTION

SECTION 16200 - POWER GENERATION

- A. A generator shall be furnished and installed to provide emergency power for emergency egress lighting, exit lights, and selected electrical systems as indicated. The generator shall be sized for the planned connected load. Minimally the generator shall have a spare capacity of 25 percent. Fuel shall be natural gas or diesel.
- B. Furnish and install the generator in an approved exterior weather protected, sound attenuating enclosure, and belly tank. All openings and exhaust openings for enclosure shall be provided with sound attenuation. Overall sound performance shall be 66 dBA at 7 meters, maximum. Sound attenuating enclosure shall have hinged doors.
- C. The generator shall have a run-time meter with time intervals not less than a tenth of an hour.
- D. Emergency power electrical wiring shall be installed in non-flexible metal conduit in accordance with Article 517 - Health Care Facilities of NFPA-70 National Electrical Code.
- E. Emergency power shall be supplied to the following equipment and systems:
 - 1. Egress lighting
 - 2. Building fire alarm system
 - 3. IT/Telephone system
 - 4. Sound/paging system
 - 5. Nurse call/code blue system(s)
 - 6. Other approved uses
- F. The emergency generator shall be manufactured by Caterpillar, Onan-Cummins, Kohler or Volvo.

END OF SECTION

SECTION 16250 - AUTOMATIC TRANSFER SWITCHES

- A. An automatic transfer switch (ATS) shall be installed in compliance with Article 517 Health Care Facility of NFPA-70 National Electrical Code. The transfer switch shall only be used for the connection of life safety branch, critical branch, and equipment branch loads as identified in Article 517 of NFPA-70.
- B. The ATS shall have a programmable delayed transition when transferring loads to and from the emergency source so that the electromagnetic fields associated with motor loads can collapse prior to re-energizing. Each ATS shall be provided with a bypass isolation switch housed in the same enclosure as the ATS.
- C. The automatic transfer switches shall be manufactured by ASCO.
- D. Normal-to-emergency transition shall be in accordance with the National Electrical Code. Emergency-to-normal transition shall be adjustable up to 5 minutes.
- E. All automatic transfer switches shall be configured for open transition unless otherwise approved by the owner.

END OF SECTION

SECTION 16400 - ELECTRIC SERVICE

- A. Contractor shall be responsible for requesting, coordinating, and assisting in the installation of the building's electric service. The contractor is responsible for furnishing and installing all items and accommodations required by the electric company, including the installation of electric company supplied items for installation by the contractor. The electric service shall be installed in accordance with the requirements of the electric utility company and NFPA 70.
- B. The metering facility shall be installed in accordance with the utility company requirements and Penn State OPP standards.
- C. Buildings located remotely from the HMC site shall be served with 277/480 volts, 3 phase, 4 wire by the utility company.
- D. Service entrances conductors shall be installed underground in conduit from a pad mounted transformer to the buildings main service disconnect location. A ground wire shall not be run in the conduits containing the service lateral conductors.
- E. Service entrance equipment of the proper capacity shall be installed adjacent to the metering facilities. Feeders rated at 277/480V, 3 phase shall be extended to power and lighting panels throughout the building. 120/208 volt, 3 phase, 4 wire power for duplex receptacles, incandescent lights, and small motors shall be derived from one or more dry type transformers.
- F. The service entrance equipment shall include a power monitoring device compatible with a Johnson Controls, Metasys Building Management System. Measured parameters shall include: phase amperes, phase-to-phase and phase-to-neutral voltage, kilowatts, kilovars, kilovolts, and power factor. Provide labor and coordination during start-up.

END OF SECTION

SECTION 16420 – SUB-STATIONS

- A. Sub-stations shall be manufactured by Square D, Siemens, Cutler-Hammer or General Electric.
- B. Construction shall be front accessible and completely self-supporting. Over –current devices shall be panel mounted, and each device shall be provided with a nameplate.
- C. Protective devices shall be as listed on Drawings.
- D. Buses
 - 1. Shall be tin or silver plated copper.
 - 2. Shall be arranged for future addition.
- E. Sub-station and all components shall be capable of withstanding the short circuit current indicated on the drawings. All circuit breakers shall be fully rated for interrupting the required short circuit current. Series rated circuit breakers shall not be provided.
- F. Secondary Side Main Over-current device shall be an electronic trip circuit breaker.
- G. Provide a panel mounted system monitoring device. System shall monitor peak and average values of current, voltage, energy, demand and power factor as a minimum.
- H. Transformer section shall be open ventilated, dry type transformers with full capacity primary taps, two 1-1/2 percent taps above voltage and two 2-1/2 percent below rated voltage. Windings shall be copper. Maximum temperature rise shall be 55 degrees C above a 40 degrees C ambient. Insulation: UL 220 degrees C system in accordance with NEMA standards. High voltage leads and connections shall have insulation equal to the voltage class of the winding and shall be properly supported. Basic Impulse Level: 95 KV for 15 KV Class.
- I. Provide ground fault protection system as required by the National Electrical Code – NFPA 70.

END OF SECTION

SECTION 16430 – PANELBOARDS

- A. Panelboards shall be 3 phase and shall be manufactured by Square D, Siemens, Cutler-Hammer or General Electric.
 - 1. Panel boards will have “door in door” configuration. Panel boards in public areas in HMC will have the BEST lock with a captive key core. Panel boards will be assigned an archibus number through the Equipment Data Acquisition Form process.
- B. Transient voltage surge suppression (TVSS) with indicating lights shall be provided for all switchboards and distribution panelboards.
- C. Transient voltage surge suppression (TVSS) shall be provided for all branch circuit panelboards dedicated to supplying computer loads.

END OF SECTION

SECTION 16440 - DRY TYPE TRANSFORMERS

- A. Dry-type transformers shall be manufactured by Square D, Siemens, Cutler-Hammer or General Electric.
- B. Transformer cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability and low eddy current and hysteresis losses. All conductors shall be copper.
- C. Insulating materials shall be per NEMA ST20 standards for 220 degrees C UL recognized insulation system.
- D. Transformers below 15KVA shall be rated for 150 degrees C temperature rise over 40 degrees C ambient. Transformers 15KVA and larger shall be rated for 80 degrees C temperature rise over 40 degrees C ambient.
- E. Transformers 25KVA and larger shall be a minimum of four, 2-1/2 percent full capacity taps on the primary windings.
- F. Sound levels shall not exceed the following:

15 to 50KVA	45dB
51 to 150KVA	50dB
151 to 300KVA	55dB
301 to 500KVA	60dB
501 to 700KVA	62dB
701 to 1000KVA	64dB
- G. Transformer enclosures shall be ventilated and fabricated of heavy gauge sheet steel. Finish with powder coating that is electro-statically applied. Color shall be ANSI 49 gray, or similar. Enclosure shall be rated for NEMA 1 indoor use.
- H. All transformers shall be UL listed.
- I. 151KVA and above: transformer temperature monitor to be connected to the BAS.

END OF SECTION

SECTION 16445 - LIQUID FILLED TRANSFORMERS

- A. Liquid filled transformers shall be manufactured by Square D, Siemens, Cutler-Hammer or General Electric.
- B. Core and coil assemblies shall be designed to minimize operating losses and provide adequate mechanical strength during fault conditions. Core and coil assemblies shall be of the 5-legged design utilizing wound cores. Provide two, 2-1/2 percent above normal taps and two 2-1/2 percent below normal taps on the primary windings. All conductors shall be copper.
- C. Temperature rise shall be 55 degrees C over 40 degrees C ambient when the transformer is being operated at rated KVA output.
- D. The transformer shall be of sealed tank construction of sufficient strength to withstand a pressure of 7 psi without permanent distortion. The cover shall be welded and tamperproof. Provide with lifting lugs. Enclosure shall be rated for outdoor use.
- E. Coolant and insulating fluid shall be inhibited mineral oil.
- F. High and low voltage compartments shall be located side-by-side and separated with a steel barrier. The low voltage compartment shall be on the right when facing the front of the transformer. The high voltage terminations and equipment shall be dead front, and the high voltage compartment shall include current limiting fuses and distribution class lightning arrestors. The low voltage terminations shall be spade terminals having NEMA standard hole spacings arranged for vertical take-off of connecting cables. The low voltage neutral shall be an insulating bushing, grounded to the tank by a removable strap.
- G. Transformers rated 75 – 500KVA shall be provided with fluid drain plugs. Transformers rated above 500KVA shall be provided with fluid drain valves having a sampling device.
- H. Transformers shall be tested in accordance with the applicable portions of ANSI C57.12.
- I. Provide with options and accessories as required by project specific design documents.
- J. Temperature alarms shall be connected to the BAS.

END OF SECTION

SECTION 16500 – LIGHTING

- A. Where applicable, the latest recommended IES levels of illumination shall be used as a guideline for the lighting design. The quantity and location of all light fixtures shall be coordinated with casework and furniture layouts.
- B. Emergency lighting shall be provided in locations required by the International Building Code and NFPA 101 - Life Safety Code. Switching schemes for each area shall be in accordance with the International Energy Code. Where used, occupancy sensors shall utilize infra-red / ultrasonic, dual technologies for detecting motion.
- C. Egress paths shall be furnished and installed with internally illuminated exit lights with directional arrows where required. Exit signs shall be LED illuminated and consume less than 1.5 watts. Where emergency power is provided using an emergency generator, exit signs shall not have integral batteries.
- D. Lighting fixtures throughout the building shall be illuminated primarily with LED or if necessary with fluorescent lamps utilizing electronic ballasts.
- E. Fluorescent lamps shall have a correlated color temperature of 3500K with a color rendering index of 82. Electronic ballasts shall operate at an input frequency of 60 Hz rated for 108-132 volts (120V circuit) or 249-305 volts (277V circuit). Electronic ballasts shall operate the lamps at a frequency of 20 to 35 KHz and have no detectable flicker. All ballasts shall be of the high power factor type of 90 percent or higher, sound rated A, or better, contain no PCBs and be listed by UL. Electronic ballasts shall comply with FCC and NEMA limits as to EMI or RFI and to minimize interference with the operation of other normal electrical equipment.
- F. Fluorescent fixtures with energy saving T8 low mercury, environmental lamps and multi-volt, instant-start or programmed rapid-start electronic ballasts shall be utilized in all rooms. 2' x 2' or 2' x 4', 2, 3, or 4-lamp fluorescent prismatic lensed fixtures shall be installed in all finished rooms unless noted otherwise; utilitarian spaces without finished ceilings shall be provided with industrial style fixtures. Incandescent lighting shall be used for special applications only as directed by Architect, Engineer or Owner.
- G. Lamps shall be selected from the following list. Any other lamp or ballast types must be approved by HMC prior to specification.
 - 1. 48 inches, T8 fluorescent, 25 watt, low mercury.
 - 2. 24 inches, T8 fluorescent, SP35, 17 watt, low mercury.
 - 3. Low mercury compact fluorescent lamps:
 - a. 26 watt quad

-
- b. 32 watt triple
 - c. 28 watt quad, cold start
 - d. 13 watt, cold start
- H. Conference/education rooms, office and work rooms/areas likely to have computers or audio/visual equipment should be provided with parabolic light fixtures or direct/indirect lenses. Large cell parabolic fixtures shall not contain louvers less than 3-inches deep. 2' x 4' fixtures with three lamps should have 18 cells, and 2' x 2' fixtures should have 9 cells.
- I. Research laboratories should not be provided with night lights, and all fixtures shall be controlled using occupancy sensors.
- J. The switching scheme in all rooms and areas shall conform to the International Building Code. Multi-level/dual-switched fluorescent light fixtures should consist of inside and out side lamp/lamp pairs controlled by separate light switches. Fixtures in public areas shall be controlled by occupancy sensors. LED step dimming is acceptable.
- K. If generator power is not provided, furnish and install emergency battery units to provide adequate egress lighting levels, and to provide power to exit signs in the immediate and adjoining areas. Exit signs shall not be provided with integral batteries. On the exterior of egress doors and where fluorescent fixtures are not installed in an area, remote emergency light fixtures shall be furnished and installed. The remote emergency light fixtures shall be supplied by an emergency battery unit located nearby. If generator power is available emergency lighting may be provided by the normal lights, supplied via an emergency shunt relay.
- L. Furnish and install a complete exterior lighting system for all parking areas, walkways, and flags. Pole heights shall conform to Derry Township height limitations and fixture types shall conform to Derry Township light pollution requirements. Fixtures shall have LED bulbs.
- M. Provide 4 branch circuits for fixtures in parking areas. Parking area fixtures shall be connected to branch circuits to form an alternating "checkerboard" pattern. Provide 2 branch circuits for building mounted lights, and 1 branch circuit for walkway lights. Provide 5 lighting contactors for control of exterior lights via the building management system. All contactors shall have 120 VAC coils. Each pole shall be fused independently.

END OF SECTION

SECTION 16715 - TELECOMMUNICATION (TELEPHONE AND DATA) SYSTEM

- A. Telecommunications system shall conform to HMC Information Technology's "Minimum Standards for Telecommunications Facilities and Cabling" and the requirements of the Pennsylvania State University's "Minimum Standards for Telecommunications Facilities" available at <http://www.tns.its.psu.edu/projects/mintelecomstandards.pdf>
- B. Contractor shall coordinate the installation of telephone service to the facility with the local telephone company/access provider. As a minimum the contractor shall furnish and install four 4 inches PVC conduits, concrete-encased from building to the local telephone company/access provider point of presence onto the property. Coordinate and confirm the actual location with the local telephone company/access provider and HMC prior to installation.
- C. HMC will provide, under separate contract, all data and communication equipment to be located in the telecommunications room. Contractor shall coordinate installation schedule with HMC Information Technology Department.
- D. The contractor shall furnish and install all conduit and cabling for telephone and data networking. Conduits shall be installed from telecommunication outlet box locations to above an accessible ceiling. Additionally, conduit path shall be installed above inaccessible ceilings for HMC furnished and installed telecommunication cabling. From each outlet furnish and install 2 or 4 runs of category 6 cable back to the nearest telecommunications room. All cable shall be plenum rated.
- E. The contractor shall furnish and install a pull cord rated for 200 pound tension in each telecommunication conduit.

All walls within telecommunications closets and rooms shall be furnished with fire treated plywood backboards. Refer to Section 16050.

- F. Telecommunication outlets shall be installed in the following locations and quantities.
 - 1. Each telecommunication outlet shall consist of a double gang outlet box with a single gang faceplate cover, and a 3/4 inch minimum conduit riser in the wall and stubbed out of the wall to above an accessible ceiling. In patient, exam, and treatment rooms etc., extend 3/4 inch conduit from each outlet to above the accessible ceiling in the adjoining corridor. Use 3/4 inch flexible conduit in rooms where inaccessible ceilings exist and new telecommunications outlets are required. Non-terminated telecommunication conduit ends shall be provided with a plastic bushing. Coordinate exact telecommunication outlet locations in field with HMC prior to rough-in.

2. Each office or other room likely to have a desk and/or computer shall be provided with at least two telecommunication outlet locations. Desk/computer locations other than locations in individual offices shall be provided with one telecommunication outlet location.
 3. Each exam or treatment room should be provided with a wall telephone outlet location and a telecommunication outlet location.
 4. Each nurse's station shall be provided with a minimum of two telecommunication outlet locations.
 5. Each work, file, and copy room shall be provided with minimally two telecommunication outlet locations. Other similar type areas shall be provided with one telecommunication outlet location.
- G. Furnish and install a minimum 1inch conduit sleeve through the corridor wall of any room with walls extending to the underside of the ceiling deck. The conduit sleeves shall be extended in each direction to above accessible ceiling areas.
- H. Telephone and data outlets shall be installed in all offices, conference rooms, and other areas where use of a telephone or computer will be required.
- I. Where provided, all telephone and data cable shall be routed within cable tray.

END OF SECTION

SECTION 16720 - FIRE ALARM SYSTEM

- A. The fire alarm system shall be an addressable type, zone annunciated. The fire alarm system shall be listed as required by the International Building Code (IBC) and shall be designed in accordance with IBC regulations.
- B. Pull stations and horns shall be semi-flush mounted.
- C. The fire alarm control panel shall be flush mounted if installed in a finished area.
- D. A remote annunciator panel shall be installed in a main entrance into the building at a location approved by the local fire marshal.
- E. Visual indicating devices shall be installed per ADA requirements and in accordance with NFPA 72 , National Fire Code
- F. Smoke/heat detectors shall be installed as required by the IBC. Where fire alarm devices are installed, the devices shall be installed in accordance with NFPA 72, National Fire Alarm Code
- G. Fire alarm system shall include necessary facilities to tie-in to an off site central monitoring system.
- H. Include all electronics, hardware, wiring, and conduit to tie the fire alarm system with the elevator recall panel.
- I. The fire alarm system shall manufactured by Notifier, no substitutions. The existing site fire alarm system is operated from a Noti-Fire Network and site control is via a Notifier Network Control Station at the Building Operations Center.

END OF SECTION

SECTION 16725 – AREA OF REFUGE COMMUNICATION SYSTEM

- A. System shall be a complete vandal-resistant ADA rescue assistance communications system.
- B. Master control panel and area stations shall not protrude from the wall more than 4 inches as per ADA code.
- C. Construction of all area stations and main control panel is to be heavy-duty stainless steel with tamper-proof mounting screws. Materials and accessible control elements are to be heavy duty and vandal-resistant.
- D. In case of power failure during operation of system, alarms shall not be reset by temporary interruption of power or transfer to battery backup.
- E. Area station shall be engraved operating instructions in a type size and style conforming to ADA requirements for legibility and accompanied with grade 2 Braille. Heavy duty, 15 gage stainless steel cover plate enclosure. Unit shall be powered from the master with separate power sources for the amplifier.
- F. Each area station is to have instructional signage for its use in a stainless steel frame. Text is to conform with ADA requirements for text size and style.
- G. Each area station is to have high-brightness LED indicators and a pulsing audible signal. One red LED for Help Requested and one red LED for Help Coming.

END OF SECTION

SECTION 16750 – SOUND/PAGING SYSTEM

- A. Equipment shall include flush ceiling speakers, back boxes, volume controls, channel selector switches, wall plates, mixer(s), amplifier(s), and program source equipment all housed in a free standing sound system rack.
- B. Contractor shall furnish and install a two-gang outlet box for each combination volume control/selector switch shown on the drawing.
- C. Furnish and install interface with building telephone equipment to allow pages from telephone handset. Paging zones shall be provided as specified by HMC.
- D. Contractor shall furnish and install sound system cable. Size, quantity, and type of cable to be directed by sound system equipment supplier.

END OF SECTION

SECTION 16765 - NURSE CALL SYSTEM, AUDIBLE-VISUAL-TONE

- A. Furnish and install audible-visual-tone type nurse call systems where required by the AIA Guidelines for Design and Construction of Hospital and Health Care Facilities.
- B. New nurse call systems shall be Rauland, “Responder”, no substitutions. Minor modifications to the existing Executone EZ Care system shall be reviewed with the HMC Project Manager. System model shall be verified/approved by HMC Facilities and HMC Clinical Engineering.

END OF SECTION

SECTION 16790 – CABLE TV SYSTEM

- A. Electrical Contractor shall furnish and install a complete, fully functional, CATV system that includes all distribution amplifiers, power supplies, splitters, couplers, taps, cable, jacks and all other required components including the following:
 - 1. Underground conduit for CATV service and conduit and conduit accessories at pole, as directed by CATV Company.
 - 2. All service, backbone and horizontal pathways, surface raceways, conduits, cable tray, backboards, outlet boxes, and grounding.
- B. RG-6U type coaxial cable for all drop cables. RG-11/U type coaxial cable for trunk line cables. Plenum rated - CATVP markings. Acceptable Manufacturers are West Penn, Belden, and Commscope.
- C. HMC will pay all costs directly to the CATV Company for work and services performed by cable company.
- D. Install CATV system in accordance with system manufacturer's instructions. Provide all equipment necessary for a complete and operable system. Final connections between equipment and the wiring system, testing and placing system in operation, shall be completed under direct supervision of a representative of the manufacturer. Submit manufacturer's printed installation instructions with operation and maintenance data at completion of Work.

END OF SECTION

SECTION 16800 - SECURITY/ACCESS CONTROL SYSTEM

- A. Furnish and install outlet boxes, conduit, and wiring for door/window contacts being installed at all grade level windows and exterior doors.
- B. Furnish and install outlet boxes, conduit, and wiring for card readers, cameras, and electric strikes. Card readers shall be by Lenel.
- C. Coordinate exact location and sizes of security and access control items with the security/access control contractor in field prior to rough-in.
- D. Include provisions for security system monitoring by the HMC Security Dispatcher from the Emergency Department Command Post.
- E. Design of security and access control system shall be coordinated with and approved by per HMC Security and HMC I.T. coordinator for access control.

END OF SECTION

SECTION 16900 - CONTROLS AND INSTRUMENTATION

- A. Starters, disconnect switches and wiring shall be provided for mechanical equipment and equipment requiring power that is furnished under the general portions of the contract.
- B. Controls and instrumentation equipment shall be manufactured by Square D, Siemens, Cutler-Hammer, or General Electric.

END OF SECTION