Code Compliance and Standards

- Mechanical and Electrical Systems shall be designed per the current 9th edition of the Massachusetts State Building Code based on IBC 2015, IMC 2015, and ASHRAE 90.1- 2013 including related Massachusetts State Amendments
- Massachusetts State Stretch Energy Code
- Requirements of the Massachusetts DPH to comply with DON criteria (i.e. LEED certifiable)
- Massachusetts State Plumbing Codes
- Massachusetts State Electrical Codes
- Massachusetts State Fire Prevention Code (based on NFPA 1)
- Massachusetts Elevator Regulations
- Massachusetts DEP Requirements
- Massachusetts Environmental Air Quality Protection Agency
- Cape Cod Commission regulations that are applicable
- Local Ordinances, Regulations of the Local Building Department and Fire Department
- Massachusetts Board of Pharmacy Recommendations
- USP 797 – Pharmaceutical Compounding – Sterile Preparations
- USP 800 – Hazardous Drugs - Handling in Healthcare Settings
- NFPA 13 – Standard for the Installation of Sprinkler Systems
- NFPA 37 – Standard for the Installation and Use of Stationary Combustion Engines & Gas Turbines
- NFPA 70 - National Electric Code
- NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems
- NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
- NFPA 99 - Health Care Facilities Code
- NFPA 101 - Life Safety Code
- NFPA 110 – Standard for Emergency and Standby Power Systems
- Other Relevant NFPA Standards
- AIA Healthcare Facilities Design Guidelines, 2018 edition and referenced ASHRAE Standard 170, Ventilation for Healthcare Facilities
- IES Lighting Handbook 10th Edition
- ANSI/IES RP-29-06 - Lighting for Hospitals and Healthcare Facilities
- ANSI/ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality
- ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration
- ANSI/ASHRAE 55 - Thermal Environmental Conditions for Human Occupancy

ASHRAE 90.1-2013

- This Project shall comply per the current 9th edition Massachusetts State Building Code based on ASHRAE 90.1-2013 with any relevant Massachusetts State Amendments
  - The Mechanical HVAC design shall comply with ASHRAE 90.1-2013, Section 6.4, which relates to the minimum code required energy efficient design for new mechanical equipment. The new mechanical equipment referenced in this section shall meet or exceed the minimum energy efficiency requirements referenced in this section.
  - The Mechanical Plumbing design shall comply with ASHRAE 90.1-2013, Section 7.4, which relates to the mandatory provisions for service water heating, (i.e. piping insulation, controls, outlet temperature controls, circulating pumps).
  - The Lighting and Lighting Controls design shall comply with ASHRAE 90.1-2013, Section 9.4 which relates to lighting and controls incorporated in an appropriate approach for a healthcare inpatient facility. The Lighting and Lighting Controls design shall also comply with the AIA Healthcare Facilities Guideline 2018 edition.

Intent of Cape Cod Regional Policy Plan and Cape Cod Commission Energy 2019 Bulletin:

- To minimize energy consumption through planning and design by incorporating energy efficiency and conservation measures
- To promote resiliency of energy generation and delivery
- To promote sustainable energy efficient design to minimize impact of greenhouse gas emissions through design and construction practices that promote energy efficiency
- The overall intent of this project is to have a high quality of construction consistent with low energy consumption and low long-term life cycle costs. Mechanical equipment shall be of the highest quality requiring a minimum of maintenance. All Mechanical, Electrical, Plumbing (MEP) equipment functions shall be monitored by a central energy management system (EMS), which shall be accessible via the internet.
- There is an intent to have an energy-use reduction goal, which shall be achieved through the use of energy efficient building envelope that utilizes superior building insulation and glazing, energy efficient equipment that either meets or exceeds current energy code requirements, reduced lighting power consumption, and using less energy to minimize the impact of the Cape Cod Healthcare's facility's greenhouse emissions from the construction of this new Tower Building.
- The following energy efficiency strategies shall be employed to reduce energy consumption:
  - Reduced Lighting Density
  - Lighting Daylight Sensors
  - Lighting Occupancy Sensors
  - Enhanced Building Glazing
  - Efficient HVAC and Plumbing Equipment
  - Optimized HVAC Controls
- To ensure efficient operations, commissioning of the HVAC systems, domestic water heating systems and lighting control systems shall be included as part of this new Tower Project.

Mechanical HVAC Energy Efficiency

- New water-cooled and air-cooled chillers shall be installed under this new Tower Building Project to create a stand alone remote chiller plant in the penthouse mechanical room of the new Tower Building. The new chiller plant systemsshall exceed current Massachusetts State Energy Code requirements. All new chillers shall also comply with the LEED refrigerant pre-requisite requirements. The new chillers shall be selected to be considered for an electric utility incentive for energy efficient operation.
- The new cooling towers shall comply with the ANSI/ASHRAE 90.1-2013 energy efficiency requirements. The cooling tower fans shall be inverter duty ready and shall be controlled with variable speed drives to modulate tower fan operation to efficiently control the condenser water supply temperature. The new cooling tower make-up water service shall be metered to monitor tower water make-up usage per LEED requirements. A new sidestream sand filter shall be integrated into the design to ensure optimized cooling tower operation by regularly removing particulates. A diligent chemical treatment program shall be incorporated into the cooling tower operation to optimize tower heat rejection capability and maintain cooling tower water quality for optimal pump and chiller operation.
- All new chiller plant condenser water and chilled water pumps shall have premium efficient motors rated for inverter duty operation. All condenser water and chilled water pumps shall be controlled by variable frequency drives to allow the pumps to operate at actual system load requirements and deliver the required flow and system head in lieu of operating at constant volume design duty during non-design load conditions.
- Existing Chiller Plant
  - There shall be cross connect piping to enable the existing central chiller plant to provide back-up cooling to the new Tower Building chiller plant and vice versa. The new Tower Building chiller plant shall also be designed to provide 'back-up' cooling capacity to the existing chiller plant as a resiliency feature.
- New Hot Water Boiler Plant
  - A new high efficiency (gas-fired) hot water condensing boiler plant shall be installed to provide dedicated heating hot water to the new Tower Building
  - New hot water pumps shall be specified with premium efficient motors rated for inverter duty operation. All hot water pumps shall be controlled by variable frequency drives to allow the pumps to operate at actual system load requirements in lieu of operating at constant volume design duty during non-design load conditions.
- Existing Boiler Plant
  - The existing CCH steam boiler plant shall serve a back-up source of heating to the new Tower Building heating plant. New steam to hot water shell/tube heat exchangers shall convert steam from the existing boiler plant to hot water for use in the new Tower Building heating systems.
  - Design provisions have also been made for the installation of a Combined Heating and Power (CHP) Plant in the future. Steam shall be derived from the CHP plant to provide an energy efficient first stage of heating for the new Tower Building heating plant. Incorporating a heating system design via the future CHP pant shall also provide increased resiliency for the new Tower Building heating systems.
  - The existing CCH boiler plant currently includes one (1) boiler that is equipped with a dual fuel burner (gas and No. 2 fuel oil) for resiliency.

- Custom Air Handling Units
  - Conditioned air to serve the occupied spaces of the new Tower Building shall be derived from new custom air handling units (AHUs). The new AHUs shall be specified with aluminum insulated double wall construction. Wall construction shall be fabricated with thermal insulation that ensures energy efficient operation of the air handling units and tight air leakage requirements.
  - The new custom AHUs shall be designed and fabricated for low velocity through components (i.e. pre-filters, final filters and coils) to minimize and achieve energy efficient operation.
  - All filters in the new custom AHUs shall comply with the current AIA Healthcare Facilities Guidelines
  - All new custom AHUs shall be designed for variable airflow operation to provide the required amount of conditioned air based on the actual load of the spaces served for energy efficient operation (in lieu of operating at design airflow continuously).
- Fans
  - All new exhaust fans shall be specified with premium efficiency inverter duty motors. All new exhaust fans shall be controlled by variable frequency drives to efficiently to deliver the required airflow based on actual conditions.
- Ductwork
  - All new ductwork shall be designed to comply with SMACNA duct standards and sized for energy efficient operation.
- Terminal Air Distribution
  - All new supply air systems shall include variable air volume terminal boxes, which shall modulate to satisfy space load by varying airflow from a maximum design airflow to a minimum design airflow.
- Fan Coil Units
  - All fan coils units shall be specified with EC motors for true variable airflow operation.
- Piping
  - All new chilled water and hot water piping systems shall be sized per ANSI/ASHRAE 90.1-2013 recommended piping requirements.
- Insulation for Ductwork and Piping
  - Insulation for new ductwork and piping systems shall comply with ANSI/ASHRAE 90.1-2013 requirements for required R-values.

ATC/EMS Energy Efficiency

- Energy efficient HVAC sequences of operation shall be implemented for control of the major HVAC equipment of the new Tower Building including:
  - Optimized chiller plant control strategies shall include:
    - CHW temperature reset

        - CW temperature reset
        - Automatic mechanical to free cool switchover operation
        - Variable flow pumping
        - Cooling tower fan modulation
    - Optimized custom AHU control strategies shall include:
        - Air economizer operation
        - VAV operation of the major Air Handling Units
        - Static pressure reset and fan tracking strategy
        - Discharge temperature reset strategy based on outside air temperature
    - Optimized heating hot water system control strategies shall include:
        - Variable HW pumping
        - HW reset temperature based on outside air temperature for the HW reheat system
    - VAV terminal boxes:
        - Efficient EMS sequencing of VAV terminal boxes serving patient floors (exterior exposures shall also be served with HW perimeter baseboard)
    - Fan coil units:
        - Variable fan speed control of the fan coil units which shall have true proportional EC motors
    - Unoccupied Setback for appropriate spaces
    - Demand Control Ventilation for appropriate spaces
    - Occupancy sensors where appropriate
- Additionally, the EMS shall monitor and alarm the following systems:
    - Critical rooms such as isolation rooms, compounding rooms, etc.
    - Space temperatures in mechanical and electrical rooms
    - Domestic hot water equipment for alarm monitoring
    - Monitoring of normal electrical power service
- Meters to monitor energy usage for
    - Gas
    - Electricity (with sub-meters for all major distribution systems)
    - Chilled Water usage
    - Boiler steam usage
- Meters to monitor usage for water:
    - Main building usage
    - Usage for cooling tower make up

Normal Power

- Single 25kv Feeder suppling each unit substation air-cooled transformer for normal power (two total).
- Two new Air-Cooled transformers, each transformer capable of sustaining the full load of the building (N+1 system configuration).
- Each transformer serves one end of a new Main-Tie-Main automated switchgear via fully redundant, for normal service.
- Power shall be distributed throughout the facility at 277/480V with localized transformers to provide power at 120/208V to receptacle loads.
- All new transformers shall comply with DOE 2016 efficiency requirements.
- Mechanical systems shall primary be powered from the 480V power distribution system. Large equipment (chillers, pumps, AHU, fans, etc.) shall be served via VFDs to fluctuate operation based on space demand.

Emergency Power

- New emergency generator shall be a diesel fired (selected for No. 2 low sulfur fuel oil) rated for 1 MW at 480/277V. The new emergency generator shall the primary source as back-up the emergency system for the new Tower Building.
- Redundant emergency power shall be provided by the existing N+1 generator plant via an 'electric cross-connect'.
- The Life Safety/Critical Branch and Equipment Branch automated switchgear shall supply backup power to the automatic transfer switches for life safety, critical branch, elevators and mechanical equipment to support the facility under loss of normal power.
- Automated emergency distribution equipment shall switch loads to the redundant generator in the event of failure of the new Tower Building emergency generator.
- Life Safety and Critical Branch loads shall be prioritized through automated general distribution.
- Resiliency shall be achieved by suppling the following equipment served by the new 1 MW Emergency Generator and generator plant:
  - 50% AHU capacity for the new custom AHUs installed
  - New Hot Water Boiler Plant
  - New imaging equipment
  - Out-patient services
  - DHW booster pumps
- Existing Generators
  - The existing emergency generators shall be 'cross connected' electrically to provide back-up resiliency to the new Tower Building 1 MW emergency generator

- The existing CCH Chiller Plant (CH-2 and CH-4) are currently served by the existing emergency generators. Cross-connected CHW piping shall be installed to provide back-up chilled water capacity to the new Tower Building chiller plant.
- The existing CCH Boiler Plant is currently served by the existing emergency generators
- The existing ejector pumps are served by the existing emergency generators. The new Tower Building sanitary and storm water systems shall be designed for gravity drain and will not require ejector pumps.

Fire Alarm:

- New Fire Alarm Command Center shall be installed to service the entire campus
- Upgrade and expand existing Fire Fighter Communication system.

Lighting Intent:

- Energy Efficient systems
- Low maintenance
- Use of LED fixtures
- Use of latest technology to control lighting

Exterior Lighting:

- Exterior site lighting on roadways shall be an LED source with photocells for on/off operation.
- Exterior lighting fixtures shall be specified to comply with Dark Sky requirements.
- Exterior building lighting shall be controlled via lighting control contactor panel with photocell control.

Interior Lighting:

- Interior lighting shall be primarily LED fixtures. Fixtures shall be provided with sensors for occupant and daylight control. Fixtures' output shall be reduced when unoccupied.
- Exit signs shall use LED illumination.

Lighting Controls:

- Exterior building lighting shall be controlled via lighting control contactor panel with photocell control.
- Local lighting controls (manual and/or occupancy switching) shall be provided for interior spaces based on occupant space, task needs and preferences.

- Fixture light levels and control functions can be individually programmed based on occupancy, daylight and space types.
- In public spaces, individual fixture's illumination levels shall be reduced during unoccupied times and ambient day light levels.
- In specific room types, lighting shall be controlled with manual on/automatic off controls.

Water Plumbing Systems

- As a resiliency feature, the new Tower shall have dual city water feed to the new Tower, one shall be from Barnstable and the 2nd city water feed shall be from Yarmouth.
- As a protective device, each new dedicated service shall have a backflow preventer
- There shall also be localized backflow prevention shall be provided at any equipment requiring Non-potable water to protect the domestic water service
- Domestic hot water shall be generated using a set of fully redundant semi-instantaneous steam water heaters. Domestic hot water shall be generated at 140'F and reduced down to 120'F for distribution. The hot water system shall be fully recirculated.
- Potable water shall maintain a minimum of 30 psi at the most remote flushing fixture.
- Low flow water conserving fixtures for all water closets, lavatories, and showers shall be part of the Project Design; these fixtures shall have consumption rates below the plumbing code required minimums.

Medical Systems Plumbing Systems

- The medical air vacuum service for the new Tower is served by an existing triplex pump/compressor assembly with the triplex pump arrangement offering redundancy and resiliency.
- The medical vacuum and medical air systems have built in redundancy per NFPA 99. The oxygen has an emergency oxygen connection that provides redundancy.

Natural Gas Plumbing Service

- As a resiliency feature, there are two (2) natural gas service feeds:
  - Natural gas service for the chiller and boiler plant, which is the primary gas service
  - Natural gas service for the Lab to serve the Hospital's main kitchens

Fire Protection

- As a resiliency feature, fire protection service includes three (3) feeds:
  - One service from the ED
  - One service from Mugar via the Chiller Plant
  - Once service from the Lab

- A new 100-HP fire pump shall be installed in a code compliant 2-hour rated mechanical room within the New Tower Building. The new fire pump shall be powered via emergency feeder with MI feeder and an automatic transfer switch (ATS).
- The new fire pump shall have a code required dual check backflow preventer.

Combined Heat and Power (CHP)

- The new Tower Building Project shall include provisions to install a future 800-kw cogeneration package that will include an internal combustion natural gas engine from Caterpillar. The rich burn engine shall be capable of running with high temperature jacket water for generation of steam in a new 2,800 lb/hr heat recovery boiler.
- The packaged cogeneration unit shall be contained within a new aluminum weatherproof sound attenuated enclosure. Auxiliary equipment shall include lube oil and aftercooler heat exchangers with pumps that HW shall be extracted for use via the HW reheat loop. Other auxiliary equipment shall be urea storage and SCR emissions control to comply with current Massachusetts State DEP requirements.
- The cogeneration unit shall operate continuously year-round and be base loaded to achieve electrical output of 820 kW to offset electric utility usage and a waste heat recovery steam rate of 2,800 Lbs/hour to offset the operation of the CCH steam boiler plant.