23 00 00 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTIONS INCLUDED:

23 00 00 – HVAC GENERAL

- Facilities Management will provide information regarding preferred locations for tie-ins to existing utilities.

- Primary source of heat for most buildings will be the central High Temperature Hot Water (HTHW) system. The HTHW system is also used in conjunction with absorption chillers for air conditioning systems in most larger buildings. New construction will probably not utilize absorption chillers. The HTHW system is installed in a two pipe loop throughout campus, and is generally located in a tunnel system. HTHW is to be used for heating and production of domestic hot water for most buildings. Verify prior to start of design. HTHW is available 24 hours per day, 7 days per week.

- All projects are required to incorporate State of Colorado Energy Conservation Code, Energy Star and L.E.E.D. recommendations as appropriate to the individual project based upon life cycle cost analysis. This is in accordance with a Governors Executive Order.

- Utility outages will generally need to be scheduled after normal working hours and will often include weekends and holidays. Specifications will need to include this requirement at no additional cost to the Owner.

- Specify meters for all mechanical systems. Water, gas, HTHW, irrigation. All meters are to be capable of providing an output to the building automation system. BACnet IP or BACnet MSTP preferred.

- Coordinate Training / O&Ms / Close-out with Section 01 70 00

- Refer to the drawings in the appendix for UNC preferences on HTHW piping installation, converter piping, valving, pump piping and valving, water treatment and chiller piping and controls.

- Generally all HVAC equipment shall have excess capacity for future expansion. However, if the excess capacity requires an unusual equipment selection and /or the incremental cost appears excessive, then the designer should advise the University.
  - Chillers should be designed with 10 percent excess capacity.
  - Boilers and primary heating equipment shall have 20 percent excess capacity.
  - Air supply and exhaust fans shall have 10 percent excess capacity.
  - HTHW to HW heat exchangers and building heating water pumps require redundant equipment. Each heat exchanger or pump shall be sized to meet full demand load.

- Provide appropriate, year round, cooling systems for phone and data rooms, elevator equipment rooms and similar spaces. Main chilled water system is not available in the winter months.

- All mechanical designs shall meet the requirements of ASHRAE 90.1-1999 regarding ventilation and indoor air quality.

- All systems shall included appropriate connections to the building automation system. Specify that the manufacturers and contractors are to provide all required licensing (JACE, etc.) One extra cat-6 data drop per controller cabinet required for connection to BAS system.

- Provide training for all systems.

MECHANICAL ROOM LOCATION AND DESIGN

- Mechanical rooms must be large enough to allow adequate safe working space. Space must be provided for coil and tube bundle removal, without requiring disassembly of adjacent equipment. Include space for future equipment additions if possible.

- Provide hoist rails for large motor and equipment maintenance access.

- An outside entrance with an oversized door is preferred. All mechanical rooms must be accessible without disturbing building occupants or normal functions of the building. Access shall be limited to authorized maintenance personnel only.

- Provide roof access to at least one roof level, with roof ladders to all other levels. Walkout access is preferred.

- An areaway or doorway large enough to accommodate the largest component in the mechanical room shall be provided. If knock-out panels are provided, coordinate location with outside utilities.

- Equipment rooms shall be arranged and located such that heat and sound will not transmit to other parts of the building.

- Mechanical rooms must have adequate ventilation. This is especially critical with the increase use of electronic controls and other components.

- Provide floor drains. When located above an occupied area, surround the area with a 6" high curb, and waterproof the floor. Provide sleeves for pipe penetrations through mechanical room floors. Sleeve height to be 6” above floor.

- Provide an tempered emergency eye wash unit in each primary mechanical room.

- Provide roof ladders to all upper level roofs for equipment access, unless walkout access is provided.

- Provide adequate lighting and electrical receptacles in all mechanical spaces. Lighting layout must not be finalized until after equipment and ductwork installation.

- Provide adequate access openings in pipe and duct chases for service and maintenance. Access doors shall be sized to allow adequate access to equipment located within. Coordinate access door type and size with Architect for consistency. Allow for specialty doors such as in shower rooms and other areas as needed.

- Provide ventilation for elevator equipment (air conditioning if required) to meet elevator manufacturers requirements.

- Coordinate final location of all field equipment with adjacent walls, lighting, piping, etc. to ensure adequate access for maintenance. Some installations may require a mock-up.

23 05 00 – COMMON WORK RESULTS FOR HVAC

VALVES

- Provide valves to isolate logical segments of the building. Floors, wings etc.

- Provide valves on all branch lines, fixtures and on both sides of all equipment, located for easy access. Locate valves at equipment to allow isolation of control valves and strainers without draining coils.

- Valves over 8 ft AFF shall be equipped with chain operators.

- All valves must be shown on the drawings. Do not rely on general notes in the drawings or specifications.

- Ball valves are preferred for domestic hot and cold water, heating water, chilled water, and similar systems where appropriate, for pipe sizes 1/4" through 2 1/2". Provide for isolation of equipment as well as for isolating segments of the building. No three (3) piece body style ball valves allowed. All valves are to have metallic handles.

- Provide ball valves at all gauges in lieu of gauge cocks on low temperature and pressure systems.

- High Temperature Hot Water System (HTHW). Within buildings provide Keystone K-lok Model 372 lug style high performance butterfly valves, RTFE seats w/gear operator for piping over 2", Class 300, carbon steel with stainless steel internals or equivalent by Crane. Valves to be uni-directional for dead end service. For smaller pipe sizes (2" and smaller) provide socket welded, class 300 carbon steel ball valves. Building main and tunnel HTHW valves to have by-pass loops with valves.

- Carbon steel globe valves may be used for balancing.

- High Temperature hot Water valves for use in the central plant, tunnel system or other critical areas, 2 ½" and larger, shall be Butterfly valves, gear operated, triple offset, bi directional by Vanessa or Zwick Tri-con. Valves for these installations shall be welded.

- Provide needle valves for gauges, high point vents, etc. on the HTHW system.

THERMOMETERS, GUAGES, TEMPERATURE & PRESSURE TEST PLUGS

- Provide thermometers with wells on each inlet and outlet pipe of each piece of heat generating water equipment such as hydronic heat exchangers, chillers etc. Install to be relatively upright and readable from the floor.

- Thermometers to be solar powered, digital display by Trend or approved equivalent.

- Gauges to be selected so that normal operating conditions read near the midpoint of the scale. Install upright and readable from the floor. Gauges for pumps and other equipment subject to vibration shall be liquid filled.

- T&P test plugs shall be installed on the inlet and outlet of each piece of heat transfer and pumping equipment. (except HTHW equipment)

HANGERS AND SUPPORTS

- Hangars for HTHW piping shall be roller type.

- Design adequate expansion loops, guides and anchors for the HTHW system. Do not specify mechanical expansion joints.

- Piping shall not be hung from other piping or equipment. Provide attachments to the building structure only.

MISC

- Dielectric nipples with steel unions shall be provided between dissimilar metals in all piping systems. Do not specify dielectric unions.

- Strainers are to be provided upstream of pressure reducing valves, back flow preventers, pumps, all modulating control valves and elsewhere as needed. Strainers shall have a ball type blow off valve with a threaded and capped hose type connection.

- All drains at equipment and other locations to have valve with hose threads and caps.

- Unions (or flanges) are to be provided on the inlet and outlet of each piece of equipment and at each port to automatic control valves, pressure regulating valves, solenoid valves, etc. Provide flanged connections on all larger equipment such as heat exchangers, pumps, large coils, etc. Ground joint type.

- Welding shall be performed by welders certified in the last six months to AWS or ASME standards.

- Piping shall not be routed through telephone rooms, electrical rooms elevator equipment rooms or elevator shafts. The only exception is fire sprinkler piping serving these rooms.

IDENTIFICATION

- Provide engraved nameplates (black plastic with white engraved letters), metal tags, pressure sensitive markers, semi-rigid markers, on all equipment as follows:

- Piping - pressure sensitive or semi-rigid markers on all piping accessible for maintenance, at all wall penetrations, within pipe chases and at all valves (including direction of flow).

- Provide labeled tape above direct buried piping.

- Controls - engraved nameplates on all connecting or controlled equipment. Include automatic controls, control panels, zone valves, relays, PE or EP switches and starters.

- Pumps - stencils or engraved nameplates - service and zone served.

- Heat Exchangers, fans, AC equipment - plan code number and area or zone served.

- Access doors - engraved nameplates to identify equipment within.

- Lift out ceilings – Specify color coded self adhesive dots to be installed on suspended ceiling system grids identifying access points to mechanical and electrical components located above the ceiling. Paint? Marker?

- Color code as follows:
  - Water valves Blue
  - Ventilation system components Purple
  - Heating and Cooling system Yellow
  - Fire dampers or alarm components Red
  - Electrical transformers & equipment Orange

TESTING

- Notify Facilities Management at least one week prior to all scheduled testing.

- After testing has been completed, prior to permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters replaced, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured, lubrication checked and replenished if required.

23 07 00 – INSULATION

- Piping shall be provided with insulation shields and calcium silicate inserts at each support locations, or use pre-manufactured high density inserts. Calcium silicate inserts are not required on HTHW systems when supported with metal insulation pipe support saddles.

- Insulation shields on all piping systems shall be secured to piping at all support locations.

- Stop and seal insulation at unions and other fittings that are to be accessible.

- All interior insulation shall include premolded PVC fitting covers.

– Exterior insulation shall be metal jacketed.

23 08 00 – COMMISSIONING OF HVAC

COMMISSIONING

The level of commissioning will vary with each project. Some projects will require full 3rd party commissioning. At a minimum, all projects will require the following:

* Specify General Contractor led commissioning of all mechanical, plumbing, controls and electrical systems to verify operational and functional performance and compliance with “design intent”.

    * Coordinate commissioning requirements with other divisions as needed.

    * All system tests and inspections are to be full documented.

    * Complete commissioning of mechanical and electrical systems during initial start-up

    * Provide advance notice to UNC Facilities Management prior to all commissioning activities.

    * Contractor to submit for review, an outline of the organizational plan, commissioning schedule, documentation process and commissioning plan specific to the project.

    * Establish the requirements and plan for the commissioning process throughout the construction phase of the project.

    * Commissioning shall begin after equipment and systems are complete. Include:

        * Review and verification of TAB readings
        * Verify calibration of thermostats and related controls
        * Verify readings of remote data and control systems
        * Verify operation of system modes
        * Verify that total system is performing to provide conditions as outlined in the contract documents.

START-UP PROCEDURES

– Please emphasize start up requirements in the project specifications and in pre-construction meeting requirements. This is a critical issue.

- Notify Facilities Management at least two weeks prior to scheduled start-up date of all mechanical equipment and systems.

- Prior to start-up, all piping systems shall be cleaned and flushed. Notify Facilities Management prior to cleaning and flushing operation. Hot water heating and chilled water systems including pumps, converters, coils, etc. shall be flushed with an alkaline material containing dispersants, detergent and organic corrosion inhibitors. Preferred product is Rocky Mountain Aquatech (RMA) 6100 or equivalent. For effective cleaning, system is properly dosed with chemical, circulated for 24 hours and, if possible, heated to 140 – 180 deg. F. Following circulation, drain, flush, fill and circulate 30 minutes and flush system until the water is clear and TDS is +/- 50 ohms that of city water. Once system has been flushed, add closed loop inhibitor (nitrate based) to boost chilled water system to 375 – 500 PPM NO2 and heating water systems to 500 – 750 PPM. Preferred inhibitor is RMA 5338..

- Coordinate all start-up and testing operations with the work of other trades. Include manufacturers representatives and all sub-contractors in the start-up planning.

- Provide a written start-up plan which includes a listing of all start-up tasks, prerequisite tasks by other trades and proposed schedule.

- Before start-up, each piece of equipment shall be checked for proper lubrication, rotation, belt tension, alignment, control sequence, visually checked for debris or other possible conditions which could cause equipment damage or endanger personnel.

- Control systems shall be fully operational in automatic mode

- Fully comply with OSHA lock-out tag-out procedures before, during and after start-up.

- Factory personnel shall be notified as appropriate to start up equipment requiring their services.

23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

- Please consult with UNC Facilities Management on final specifications for tie into building automation as each project may be slightly different.

- UNC utilities BACnet MSTP, BACnet IP and Niagara Protocols.

- Acceptable Manufacturers:

    - Schneider Niagara by Dynamic Controls

  - Honeywell installed by Honeywell
  - Lynxpring by Dynamic Controls

- Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

- AHU controllers and terminal unit controllers will be same brand as BAS. Chiller controllers will come with the chillers and have a BACnet I/P or BACnet MSTP interface. Boilers controls can be done either way (by boiler manufacturer of BAS supplier). Chiller and Boiler management will be performed by the BAS. VFD's will have a BACnet interface to directly communicate with the BAS as any other controller

- All equipment interfacing directly to JACE's are preferred to be BACnet IP or MSTP.

- The University currently has in place a server and Tridium front end and is based on the N4 format. The Controls Contractor shall provide the new equipment, hardware, software, and licensing to be fully integrated and compatible with the current system. BACnet IP or Niagara protocol for all JACE's on N4

- Refer to appendix 230900 BAS Specification for more detailed information

23 20 00 – HVAC PIPING & PUMPS

HVAC PIPING AND PUMPS

Hot Water Heating Systems

  - The preferred heating system is hydronic using HTHW to hot water converters.

Current HTHW system operating conditions: At Heating Plant

Temperatures
- 350 Deg F Supply
- 225 Deg F Return
- Flow (severe weather) 65,000 GPH (1083 GPM)

Pressure
  - Supply – 235 - 255 PSI
  - Return – 185 -210 PSI

Remote Building Temperatures – Measured at Candelaria and Butler Hancock Halls

Temperatures
- Winter (high load) – 285 Deg F

Original HTHW System Design
- EWT 380 Deg F
- LWT 240 Deg F
- 140 Deg F delta T (large delta T is required to reduce system flow requirements)

HTHW Control Valves

- HTHW control valves for converters shall be located on the return piping. HTHW Control valves for heating water converters shall be interlocked with the heating water circulating pumps(s) to prevent valve opening unless heating water is circulating. All HTHW control valves shall have a full line size bypass with valve. Control valves shall have a strainer located immediately upstream. Control valves on HTHW shall be normally closed, positive shut off type, ANSI Class 4. Use 1 ½" minimum for HTHW control valves. HTHW control valves to be Honeywell or Fisher only. HTHW control valves shall be flanged 300#. Refer to drawings in appendix.

SHELL & TUBE HEAT EXCHANGERS

- Hot water heating system shall include duplex converters for redundancy, each sized for 100% load.

- Converters shall be A.S.M.E. constructed and stamped.

- U tube type with 3/4" OD minimum copper nickel, tube wall = .049 thick, suitable for 400 PSI working Pressure, tube gauge = 18.0 B.W.G. suitable for 400 Deg. Provide steel tube sheet with bronze or brass spacers. Head to be ductile iron.

- Shell: steel pipe with threaded or flanged connections and necessary tappings, suitable for 160 Deg. water in, 200Deg. water out.

- Acceptable Heat Exchanger manufacturers: Bell & Gossett, Taco, Armstrong

- All heat exchangers shall be located and piped to permit removal of tube bundles without interference.

EXPANSION TANKS

- Expansion tanks for glycol systems require EPDM diaphrams.

AIR SEPERATORS (Combination air separator/strainer/dirt filter)

- Acceptable manufacturers: Spirovent Air / Dirt

HEATING AND COOLING PIPING – GENERAL

- High points in piping system shall be fitted with manual air vents. Low points shall be fitted with drain valves. Automatic air vents, where used, must have isolation valve.

- Provide flow balancing stations in the main system and each major branch and at equipment.

- Valves shall be installed at each branch line (each floor and zone).

- Control valves in hydronic systems shall be flanged for valves larger than 1". Valves 1" and smaller shall be installed with unions. Provide isolation valves on all ports to control valves.

- Branch piping coming off the bottom of a main is not acceptable

HEATING AND COOLING PIPING (200 Deg.)

- Steel 2" & smaller ASTM A120, Sched. 40 black buttweld or continuous welded steel - with ASTM A197 150 lb black screwed fittings

- Copper 2" & smaller ASTM B88, Type L, hard drawn with wrought copper fittings

- Steel 2 1/2" & larger ASTM A53, grade A or B, Sched. 40 black seamless steel - with ASTM A234 sched 40 weld fittings

- Gaskets: 1/16" full face - punched Garlock Blueguard or Spiral Wound (minimum 150 LB) or as approved by Facilities Management.

- Bolts: Grade 5 minimum, regular hex head machine bolts with heavy hex nuts

HTHW HEATING WATER PIPING (400 Deg.)

- Steel 2" & smaller ASTM A53, Grade B Schedule 80 black socket weld or continuous welded steel - with ASTM A105, 3000 pound socket weld steel fittings

- Steel 2 1/2" & larger ASTM A53 Grade B, Schedule 40 black seamless steel, butt weld, with ASTM A234 WPB steel fittings.

- Flanges: In general, flanges are not allowed in the Heating Plant, Tunnel system or for building root valves. Where allowed, ASTM A105, 300 pound slip-on or weld neck raised faced.

- Gaskets: 1/16" ring gaskets - Garlock Graphonic flexible graphite facing w/ 304 SS corrugated core, dimensions per ANSI B16.21, or spiral wound or as approved by Facilities Management.

- Bolts: Grade 8 bolts or Grade B7 studs with 2H nuts. Bolt length selection must allow for a full nut plus a maximum of ½" of thread. Studs are not allowed unless approved by UNC Facilities Management. All bolts are to be torqued to manufacturer's specifications.

HYDRONIC PUMPS

- Refer to the standard pump and accessory piping detail in the appendix.

- Provide a minimum of two pumps for main building heating pumps. One primary pump and one stand-by for full redundancy in a lead lag configuration.

- End-suction centrifugal, flexible coupled. Provide standard single mechanical seal with carbon seal ring and ceramic seat. Replaceable shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal. Use of in-line pumps shall be limited to coil circulation. Specify stainless braided steel bellows connector expansion joint.

- Pumps shall be end suction, vertical split case design, cast iron with bronze fitted construction. Pump internals shall be capable of being serviced without disturbing piping connections or motors.

- Maximum pump speed shall be 1800 RPM. Mechanical seals shall be selected for intended temperature service.

- Pump and motor shall be base mounted on common base plate. Grout base plate in accordance with manufacturers instructions. Laser align all pumps after final piping connections and grouting of base plate.

- Provide suction diffuser with in stream magnet, start-up strainer and adjustable foot support.

- Acceptable manufacturers: Bell & Gossett, Taco, Armstrong, A-C Pumps (ITT), Aurora, Gould, Grundfos.

MOTORS

- Motors to be high quality, long life, general purpose, continuous duty, design “B” except “C” where required for high starting torque. Premium Efficiency (91% – 94%)

- Motors 3/4 HP and larger to be 3 phase. All motors rated greater than 1000 watts shall have a power factor not less than 85% under rated load conditions. Service factor for three phase motors 1.15, single phase motors 1.35. Three phase motors shall have under voltage, phase failure and phase reversal protection on all legs.

- Bearings to be L-10, 100,000 hour rated or better. Re-greasable except where motor is in-accessible for regular maintenance.

- Provide “quiet” rating on motors. 80 DB or less at full speed and power.

- Motors to have an expected useful of life 17 years.

- Specify Invertor rated for use with Variable Frequency Drives.

- Motors to be manufactured by Baldor, US, Reliance, WEG or GE.

VARIABLE FREQUENCY DRIVES

- Drive shall be manufactured by Danfoss ,Graham,Toshiba, Mitsubishi, ABB

- Specify extended warranty – 3 year minimum

- Provide manual bypass

- Provide VFD’s on all chilled, condenser and heating water pumps. Also provide them on all Air handlers and cooling tower fans.

23 25 00 – WATER TREATMENT

- Heating and cooling systems shall be freeze protected with inhibited propylene glycol Dowfrost or approved equal. System concentration as defined by Facilities Management. Approx. 30-35% concentration provides –4 deg F freeze and –40 deg F burst protection. Verify with Facilities Management.

- Provide boiler drain connection for chemical addition on suction side of pump.

- Automatic make-up water systems are prohibited on glycol filled systems

- Condenser water chemical treatment systems shall be automated to feed corrosion inhibitor and biocides. System components shall include Advantage Controls Inc.

Megatron MGCF3E-H11 controllers with Stenner #45MPHP22 pumps as defined by Facilities Management.

- Provide CAT-6 data drop for BAS connection

- Refer to the water treatment drawing in the appendix.

23 30 00 – HVAC AIR DISTRIBUTION

DUCTWORK

- No fiberglass ductwork shall be used.

- Duct systems shall be designed to allow balancing of air quantities. Main duct runs must be dampered to permit proper division of air quantities in the duct system. Each supply and exhaust branch must have a damper control. Do not provide manual damper control on medium/high pressure duct branches. Dampers which are integral parts of supply or exhaust grilles may be uses for air balancing only with prior approval from Facilities Management. No OBD's on grilles where they can be accessed from within the room are allowed.

- Duct liner may be used for sound control within 20’ of supply air fan discharge, Return air ductwork and inside exposed round ductwork. If used, liner shall be installed per manufacturers instructions to assure no air entrapment of fibers at less than or equal to 3000 fpm.

- DUCTWORK TO BE COVERED AND ALL OPENINGS PROTECTED AT ALL TIMES DURING CONSTRUCTION.

- Air intakes and louvered openings must be arranged to exclude all types of moisture. Screens shall have 1/2" minimum openings. Provide bird screening on exterior side to prevent entry of birds or debris.

EXHAUST FANS

- Direct drive preferred

- Provide back draft dampers on all fans

- Provide factory wired, non-fused disconnect switch on each unit.

- Provide 1/4" mesh screen installed securely in place.

- Acceptable manufacturers: Engineer shall define the minimum component specifications. Prefer Cook, Greenheck or approved equivalent.

23 60 00 – CENTRAL COOLING EQUIPMENT

REFRIGERATION

- Air Conditioning Equipment - Electrical

CHILLERS

- Review chiller type options with Facilities Management. Life cycle cost analysis will be reviewed before selection.

- Water flow switches shall be wired into control circuit so that chiller will not operate unless water flows are proven and maintained.

- Provide two pumps each for chilled and condenser water systems. One primary and one stand-by for full redundancy in a lead lag configuration.

- Sequence of operations – Chiller systems shall be activated by the Building Automation System based on time of day, outdoor air temperature or load depending on the building or system function. (NOTE: BAS shall be provided with only the points listed in the controls and Instrumentation section. Complete “open protocol” interface with the chiller control panel is required.)

- All functions initiated from the chiller control panel start / stop command from BAS. Start / Stop command initiates chilled water pump, proof of flow initiates condenser water pump, proof of condenser flow initiates chiller functions.

- Provide the services of a factory trained mechanic employed by the chiller manufacturer to provide test and start-up services, and field training for maintenance personnel.

- Provide Harmonic filter for chiller power. Coordinate with electrical engineer

- Compressor driven equipment to have 5 year extended warranty (Compressor only)

- Chillers shall be eddy current tested at commissioning for warranty and baseline purposes.

- Acceptable manufacturers: Trane, Carrier, or Smardt. Others as approved by Facilities Management

COOLING TOWERS

- Cooling towers to be supplied with drain outlet in bottom of sump. Drain line to be piped to nearest roof drain.

- All towers to have access ladders, full height and platforms to service hot decks and motors.

- Tower by-pass valve to be full size to completely bypass tower in low ambient conditions.

- Acceptable manufacturers: Marley, BAC. Others as approved by Facilities Management

- Construction material – stainless steel hot and cold decks.

23 70 00 – CENTRAL HVAC EQUIPMENT

GENERAL

- All connections between fans and ductwork shall be with flexible connections.

- All fan wheels shall be statically and dynamically balanced after installation.

- Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, fan has been test run, and approval has been received from Facilities Management.

AIR-HANDLING UNITS

- All major air handling equipment shall be installed in a mechanical room accessible from inside the building. Roof top air handling units may be considered. If specified, piping and valves for rooftop units must be installed within the unit or an approved enclosure.

- Avoid ground level air intakes. Outside air intakes must be oriented so that they are protected from the North and West prevailing winds.

- Systems should be designed for economy cycle that automatically allows the quantity of outside air supplied to the building to be varied.

- No humidity control shall be provided unless specifically required by the program plan. When humidity control is necessary, steam is the preferred method. Dri-steam or approved equal.

- Units shall be provided with external bearings only. Shafts 3/4" and larger shall have spherical roller bearings. All bearings shall be accessible for lubrication and maintenance. Bearings to be greaseable, L20, 200,000 rated.

- Specify VFD for AHU motor.

- Acceptable manufacturers: Trane, Carrier, Engineered Air, York, M+I, Pace

COILS

- Coils shall be drainable and have manual relief vent located at high point.

- Allow access to both coil faces for cleaning. Provide space for removing and repairing.

- Coils longer than 10’ shall be split to allow for future removal.

- Cooling coils to have drain from condensate pans piped to the nearest floor drain. Drain line shall be copper, with trap and union at connection to pan. Trap to be sized per manufacturers recommendations. Condensate pans to be stainless steel or galvanized coated with approved coating.

FILTERS / BELTS

- Provide throwaway pleated media filters, 2" thick non woven cotton fabric, 25-35 % efficiency. Some buildings may require washable type filters or bag type filters in addition to the throwaway filters as determined by Facilities Management.

- Provide a start-up set of filters for all air handling units. Remove and replace with clean filters at substantial completion, and sooner if necessary. Provide an additional set of spare filters for use by the owner.

- Most air handlers over 10 HP should be specified with synchronous drive belts, Goodyear Eagle PD or approved equivalent.

- Provide one spare set of belts for each belt driven air handling unit.