

1 General

.1 Life Cycle Costs Analysis (New projects and major Renovations)

- .a Refer to the Wake County Energy Design and Management Guidelines. Forms in the Guidelines to be submitted for review in each design phase.
- .b Schematic Design Phase:
 - 1. Consider site, building, orientation, and renewables.
 - 2. Identify energy conserving design alternatives.
 - 3. Compile a high-level project presentation for presentation to the Wake County Energy Advisory Commission. Presentation to include sustainable and energy efficient features planned, and design alternatives considered.
- .c Design Development Stage:
 - 1. A 30-year life-cycle cost analysis (LCCA) shall be provided and submitted with final recommendation of type HVAC system to be used.
 - 2. Confirm design alternatives based on LCCA.
 - 3. Compile a project presentation to the Energy Advisory Commission (EAC). Presentation to include energy performance, and renewable energy considerations.
- .d LCCA analysis shall include at least three (3) alternates along with integrated studies of the following:
 - 1. Building construction material.
 - 2. Building orientation.
 - 3. Usage schedules.
 - 4. Lighting.
 - 5. HVAC Equipment.
 - 6. Maintenance Costs.
 - 7. Fuels.
 - 8. Solar PV systems
 - 9. Other factors relating to initial capital costs
- .e The life cycle costs study shall include (but not limited) to the following for each alternate study:
 - 1. The initial cost of the mechanical system, including electrical work, and miscellaneous building costs and payback related to sustainable elements, energy savings features, and mechanical systems.
 - 2. First year utility costs for Heating Energy, Cooling Energy, Interior Building Lighting, Domestic Hot Water, and all other Energy Sources.

.2 System Requirements

- .a Where future expansion is planned in the initial design of a facility the Engineer shall provide adequate additional capacity and connection points in the mechanical design. The additional capacity shall be clearly noted in the equipment schedules.
- .b All points for future connections shall be clearly shown and labeled on the drawings with the capacity (GPM, Tons, Kw, etc.) that is available at each connection point.
- .c Access to mezzanine mechanical room shall be stairwell, (not ships ladder) leading up to the mezzanine mechanical room with a minimum width of 4'-0" and minimum size to remove equipment.
- .d Design insulated walls around all mechanical rooms. Provide adequate ventilation.
- .e Provide floor drains and hose bibbs in mechanical rooms. Provide hose bibbs in chiller yards and roof locations where condensing units are located.

- .f Locate noisy equipment (i.e. chillers, cooling towers, pumps, etc.) in locations so as not to disturb user groups or neighbors.
- .g All water piping shall be located a minimum of 10 ft. from electrical Switchboards and panel boards.
- .h The electrical contractor shall provide all power wiring to each piece of mechanical equipment. The electrical contractor shall furnish all starters and disconnects. Mechanical contractor provides the VFD's and is to make final connection to each piece of mechanical equipment.
- .i Avoid the use of roof mounted exhaust fans on steep-sloped roofs.
- .j Roof mounted air handlers, exhaust fans, equipment, or hoods should be avoided. Any exceptions require owner approval.
- .k Roof mounted exhaust fans when approved shall be secured to the roof curb with minimum of 2 stainless steel fasteners and more as required by manufacturer, and EPDM washers for each side of the roof curb.
- .l Air side economizers shall be used where possible. **Provide preheat coils where air side economizers are used with hydronic cooling systems.**
- .m Critical facilities shall have redundancy in equipment to provide heating and cooling.
- .n Low-leakage type outdoor air dampers shall be used to minimize air infiltration with a maximum leakage rate of ½ of 1% at 4 in. WG.
- .o Specify plug fans. Vane axial fans are acceptable only in low static conditions.
- .p Design the HVAC system so as to provide building relative humidity levels less than 60% at all times. Reheat may be utilized as required to limit humidity maximum of 60%.
- .q Label all shut off valves on ceiling grid or access door with Valve Number, System & Area Served. See Grid and Access/Labeling/Fire Alarm Labelling Convention (Exhibit A)
- .r Label all VAV boxes on ceiling grid or access door with BAS VAV point number. Associated thermostats shall be labeled with BAS VAV point number. See Grid and Access/Labeling/Fire Alarm Labelling Convention (Exhibit A)
- .s All piping systems shall be identified by color and labelling as indicated on the Wake County Pipe Label & Identification Chart. (Exhibit B)
- .t Proprietary Systems shall not be designed or specified without prior approval by the owner.
- .u Variable refrigerant systems shall not be considered without preauthorization by Wake County.
- .v All exterior equipment supports shall be galvanized or hot dipped galvanized prior to assembly.
- .w Exterior equipment such as pumps, tanks, should be avoided.
- .x All equipment suspended from ceiling must be supported by building structure.
- .y Wall mounted unit heaters shall be installed in each mechanical room, and sprinkler riser room. Unit heaters in electrical rooms shall be provided as needed. Unit heaters shall be hot water except electric may be used in electrical rooms, or where heating hot water is not available. Recessed cabinet type hot water unit heaters shall be installed at the bottom of each stairwell.
- .z Refer to Division 25 for the Building Management (BMS) specifications. These specifications are provided to the designer to be revised and edited as required for each individual project.
- .aa Sub-meter hot water, chilled water, gas supply, equipment, lighting, and plug load electrical panels where interconnecting systems serve multiple buildings and fuel oil/natural gas supplying boilers. Utilize BACnet and connect to BMS. Designers to coordinate with all trades.
- .bb Concrete floors are preferred for Mechanical courtyards. Provide means to drain stormwater and prevent vegetative growth.
- .cc Where gas boilers are provided for year-round heating all unit heaters shall be hot water type.
- .dd All screen walls around chillers must be coordinated to provide proper airflow per manufacturers recommendation. This includes screen wall height, composition, and chiller clearance. **The screen wall shall not be higher than the top of the air-cooled chiller.**
- .ee No mechanical or refrigerant piping shall be installed underground. If required, specialty piping as approved by the owner must be provided.

.3 Codes & Standards

- .a Comply with applicable provisions of the most recent “North Carolina Building Code: Mechanical Code”.
- .b Comply with the most recent ASHRAE 90.1 “Energy Standards for Buildings,” ASHRAE 62.1 “Standards for Ventilation and Indoor Air Quality,” and ASHRAE 55 “Thermal Environmental Conditions for Human Occupancy”.
- .c Comply with the 2022 or latest edition of the Wake County “Energy Design and Management Guidelines”.
- .d Comply with NFPA Codes and Standards.
- .e Pressure vessels shall be ASME labelled and installed in accordance with the “ASME Boiler and Pressure Code”
- .f Comply with all applicable ANSI standards.
- .g Apply ASHRAE 189.1 “Standard for High Performance Green Buildings” where applicable.
- .h All products specified and installed shall bear the label of UL or other North Carolina recognized third party testing agency.
- .i Design and installation shall be compliant with the requirements of the “local authority having jurisdiction.”
- .j Comply with USGBC LEED requirements where applicable.
- .k Design of HVAC system and selection of equipment shall be based on life cycle cost considerations appropriate to the size and type of facility.

2 Products

.1 Equipment Selection

- .a The selection of all HVAC systems shall be approved by Wake County at the schematic design phase.
- .b **Motors**
 1. All motors shall be high efficiency type.
 2. Any motors 1 HP and above shall not be (Electrically Commutated Motor) ECM type. Any ECM motors shall be provided with 20% attic stock and a minimum of two of each size.
 3. Motors greater than or equal to 5HP shall be TEFC motors, less than 5 HP shall be ODP unless use requires greater environmental protection.
 4. A motor used with VFD shall be inverter rated.
 5. Where appropriate, air handling unit supply and return fan motors, secondary chilled water pump motors, and heating hot water pump motors will be provided with variable frequency drives **and independent manual line voltage 3 contactor by-pass controls**.
 6. VFD Motors shall have shaft grounding rings, be inverter rated with a minimum service factor of 1.15.
- .c **Vibration Isolation**
 1. Each base mounted pump and each fan shall be installed with appropriate vibration isolation. Refer to ASHRAE vibration isolation standards.
 2. Provide 4” thick concrete pad 6” larger than the pump base for base mounted pumps. The pump shall be isolated from the pipe with stainless flexible connectors. Base mounted pumps located in mechanical rooms above an or adjacent to occupied space shall be mounted on an inertia base and the pump shall be isolated from the pipe with stainless flexible connectors.
 3. In-line pumps shall be isolated from the pipe with stainless flexible connectors and shall be supported independently of the pipe.

4. Vibration isolation pads will be provided for all chillers per manufacturer's instructions.
5. Consideration should be given to provide piping spring isolators for 25 linear feet of pipe from each pump and any vibrating equipment where vibration could be a concern. Engineer of record to design isolation system.
6. Rubber flexible connectors shall not be used. Provide braided stainless flex type connectors only.
7. Heating Hot Water flexible connectors shall not be insulated.
8. Each air handling unit and individual fan shall have flexible duct connectors.
9. Fan powered equipment suspended from above shall be isolated from structure with spring isolators.
10. Air handling units that do not have internal fan isolation shall be mounted on spring isolators. Engineer of record to determine where all spring isolation is located.

.d Piping Insulation

1. Heating hot water and chilled water piping shall be insulated with two (2) inch minimum (or as required by the NCSBC) fiberglass insulation with air service jacket sized for painting and stenciling in concealed spaces except as noted herein. PVC or canvas jacketing shall be provided on piping in mechanical spaces and any location where the piping is exposed. Final selection of jacket type to be determined during design.
2. All condensate pipes shall be insulated with 1 inch minimum elastomeric or fiberglass.
3. Two (2) inch minimum cellular glass insulation with service jacket shall be used on all exposed piping risers up to eight (8) feet of finished floor elevation.
4. Any hydronic piping installed above ground and exposed to weather shall be insulated with cellular glass and have aluminum jacket and heat tracing.
5. Refrigerant piping shall be insulated with elastomeric and where exposed to the weather, a PVC or aluminum jacket shall be applied.
6. Provide rigid insulator blocks at supports and hangers.
7. All bare elastomeric insulation shall have a protective coating applied.

.e Duct Insulation

1. All supply, return, and outdoor air ductwork shall be insulated with minimum 2" fiberglass duct external insulation.
2. Exhaust, and relief air ducts shall not be insulated.
3. All supply, return, and outdoor air ductwork in mechanical rooms will be insulated with minimum 2" **rigid fiberglass board external insulation with canvas jacket** and prepared for painting.
4. The only lined elements allowed in the duct system are prefabricated ~~transfer~~ return air transfer ducts as required for privacy sensitive areas.
5. All concealed duct work shall be insulated externally with fiberglass insulation per the NCSBC.

.f Equipment Insulation

1. Install mineral fiber insulation at heat exchangers, tanks, steam traps, and other equipment as required.
2. Air separators shall be insulated with minimum 2" elastomeric insulation directly adhered to the equipment.
3. Chilled water pumps shall be insulated with a removable galvanized insulated box.
4. All bare elastomeric insulation shall have a protective coating applied.
5. Hot water pumps are not required to be insulated.

6. External Equipment if required shall be insulated internally and certified by manufacturer for external use.
7. Install field applied jackets on all insulation, both factory and field installed.

.g Hydronic Piping

1. All piping to be run parallel and at right angles to walls, ceilings, floors and building structure.
2. Chilled, hot water, condenser and cooling tower hydronic piping will be welded black steel for piping larger than 3" and Type K copper for piping 3" and smaller.
3. Condenser water piping shall be welded black steel.
4. Condensate drain piping shall be copper.
5. Galvanized piping will not be permitted.
6. Designs utilizing underground chilled, hot, and condenser water piping should be avoided. If and where absolutely required underground piping shall be fiberglass reinforced plastic pipe, 150 psi rated with butt fusion joints and factory fittings of the same material.
7. Pipe size >3" provide high performance butterfly or <=3" provide ball type isolation in the main chilled and hot water piping at each mechanical room.
8. Gate valves **shall not** be provided in any piping system. Ball or high-performance butterfly valves are to be provided in lieu of gate valves.
9. All chilled water valves shall be insulated. Hot and condenser water valves insulation is optional.
10. Insulated valves shall have **metal** valve extensions and **metal** handles. Stem shall be insulated.
11. Where combination valves are installed, provide shut off valves on each side of combination valve.
12. Two position control valves need feedback where available.
13. In all buildings with multiple zones or multiple stories install isolation shut off valves for each zone or story near piping risers in a designated stainless valve cabinet or, closet or other accessible location. Height of valves installed shall be at 60" AFF. Coordinate locations with Wake County.
14. Install valve tags on all valves. Provide schedule and mount to wall in mechanical room or in applicable valve cabinet/closet.
15. **Dielectric unions are not to be installed.** Use copper only or where black steel is stubbed out, use a brass flange or bronze unions. Brass unions, valves, and nipples are acceptable.
16. Use of o-rings is not acceptable.
17. Groove and cut joint piping shall not be specified or installed in any facility.
18. Each piece of equipment shall have valves, unions or flanges, for isolation and easy removal.
19. Auto flow valves shall not be installed. Provide circuit setters to facilitate hydronic balancing.
20. All piping to be supported direct from structure.
21. Provide low point drains and high point air vents in Mechanical Rooms.
22. Pipe shall be supported utilizing adjustable clevis hangers, galvanized saddles, and threaded rod. Clevis hangers shall be located external to the pipe insulation.
23. Coordinate with Plumbing to provide drains in all Mechanical Rooms.
24. The majority of the controls valves shall be two-way valves with appropriate number of three-way valves installed in the hydronic piping system to provide minimum flow rates for the associated pumping system.
25. No pressurized piping shall be installed under slab of any building.
26. Split rings are not acceptable for chilled water supports with clevis hangers.

.h Refrigerant Piping

1. Refrigerant piping shall be hard drawn copper with brazed joints and installed between the interior air handler and the outdoor heat pump/condensing unit.
2. Piping to be sized per manufacturer's recommendations for the application and length of the refrigerant piping installed.

.i HVAC Pumps

1. Pumps shall be base mounted, end suction type. Motors shall be 1750 or 3500 RPM. Speed control shall be provided via VFD. In-line pumps are allowed when floor space is not available in existing building renovations. In-line pumps shall be mounted in an accessible location below 6'-0". No inline pumps shall be used if the motor/pump assembly exceeds 75lbs.
2. Design hydronic systems with redundant pumps in critical facilities or those in excess of 30,000 sq. ft. One primary, base mounted, end suction pump shall be provided for each chiller and cooling tower.
3. All pumps to be minimum 70% efficiency and have premium motor efficiency listed.
4. Motors greater than 5 HP shall be TEFC. Motors less than 5 HP can be TEFC or ODP in interior applications. All motors exposed to weather shall be TEFC.
5. Provide OSHA coupling guards.

.j Variable Frequency Drives

1. Air handling unit supply and return fan motors, secondary (and primary where variable flow is used), chilled water pump motors, and heating hot water pump motors shall be provided with variable frequency drives.
2. Drives shall be 6 pulse or better with harmonic distortion mitigation of 5% or less.
3. Drives shall have independent manual individual by-pass features with manual reset safeties and three (3) contactor bypass. Preference should be given to circuit breakers in lieu of fuses. If drive is located out of sight of equipment serviced provide intermediate disconnect.
4. FLN interface to DDC controls shall be provided with all variable frequency drives.
5. Provide BACnet connection.
6. Inverter duty rated motors with grounding kit.
7. Exterior drive shall be avoided and if provided must be rated for exterior use.
8. Coordinate locations and requirements with electrical design.

.k Chemical Water Treatment

1. Each separate heating water and chilled water system will be supplied with a shot feeder for chemical treatment.
2. Condenser water treatment shall use injector pumps and appropriate chemical treatment based on water test results.
3. Reclaim water where utilized will be supplied with a shot feeder for chemical treatment.
4. Water treatment shall be provided by Wake County's current water treatment provider:
 - a. Treatrite
 - b. Aqua Trol

.l Boilers

1. The primary heating equipment should be a hot water system. Standard equipment for most facilities will be high efficiency condensing natural gas boilers. Hot water boilers shall be one of the following types depending on the application.
 - a. High Efficiency Condensing Boiler
 - b. Flexible Water-Tube Boiler
 - c. Heat Pump boilers could be considered as products develop further.

2. Dual fuel-with natural gas as the primary and fuel oil as the secondary fuel shall be provided on critical facilities or as required by the owner.
3. Where natural gas is not available electric boilers should be considered.
4. All critical facilities shall have redundancy.
5. High efficiency condensing boiler systems shall have a high turn down as follows:
 - a. <1000 MBH, minimum 7:1
 - b. >1000 MBH & <3000 MBH, minimum 20:1
 - c. >3000 MBH, minimum 10:1
6. Where large boilers are required, smaller summer boilers may need to be provided where reheat is utilized or low heating load may be expected.
7. Where condensing boilers are utilized design heating system around 120 F to 140 F degrees
8. The heating water system will be set up as a primary/secondary system with the secondary system sized for the building block load heating requirement. The primary pump system shall be constant speed pump and the secondary system pumps shall be variable speed pumps with variable speed drives. If high efficiency boiler is used, the primary pump shall be variable flow with VFD speed being controlled by the boiler.
9. CPVC flues shall be used on condensing boilers as allowed or recommended by the manufacturer. Flex tube or marine boilers should be fitted with stainless steels flues.
10. Condensing boilers shall be fitted with all stainless-steel heat exchangers. **Aluminum Boilers or sections are not acceptable.**
11. Special consideration should be given to the plumbing drain for the boiler condensate. For new facilities, coordinate with plumbing designers to provide CPVC sewer lines to tie into the building sanitary waste pipe to avoid pipe corrosion of the individual mechanical room drain piping.
12. Provide electronic controls and BACnet MS/TP when available.
13. Air permit applications where required must be submitted and final approvals obtained.

.m Air Cooled Water Chillers

1. Air cooled chillers should be scroll type units with integral BACNET capability or Screw type if equipped with sound attenuation package as approved by the owner. Screw type is preferred if available in the appropriate size.
2. Preferred refrigerant depends on current regulatory requirements and should be coordinated and approved by Wake County in selection of all equipment.
3. Consider integral chiller summer heat recovery option where appropriate.
4. Units shall be provided with sound packages where required to comply with the sound ordinance of the local jurisdiction, protective grilles for the compressor sections, and louvers for the air intake of the condenser fans. Maximum decibel level for air cooled chillers cannot exceed local jurisdiction sound ordinance.
5. Single point connection shall be provided.
6. Five (5) year compressor warranty.
7. Provide two (2) year equipment and labor warranty.
8. Coils shall be copper or copper tube with aluminum fin.
9. Provide compressor and coil guards
10. Provide external phase protection, independent of the chiller and is required even if the chiller had factory provided phase protection.
11. All chillers to be visually screened within a secure courtyard with gate or entrance secured by lock. Coordination with equipment clearances and required airflow requirements must be considered. **Screen walls shall not be higher than the top of the chiller.**
12. Provide flange type chilled water piping connections.

.n Water Cooled Chillers

1. Water cooled chillers shall be centrifugal units with integral BACNET capability.
2. Refrigerant monitoring systems shall be provided in each water-cooled plant unless exception granted by owner.
3. Evaporator and condenser tube shall be copper.
4. Preferred refrigerant depends on current regulatory requirements and should be coordinated and approved by Wake County in selection of all equipment.
5. Single point connection shall be provided.
6. Five (5) year warranty.
7. Provide two (2) year equipment and labor warranty.
8. Provide external phase protection, independent of the chiller and is required even if the chiller had factory provided phase protection.
9. Screw chillers are not acceptable.
10. Provide flange type chilled water piping connections.

.o Water Cooling Towers

1. Water cooling towers shall be all stainless steel, factory assembled, and designed for cross flow. Rails, support plat forms, etc. shall be stainless steel.
2. Units shall have integral basin heaters and variable speed motors for the fans.
3. Integral float switch control shall be provided for make-up water.
4. Access must be OSHA compliant, shall be provided from two sides with integral access ladders, walkways and platforms. Ladders, walkways, platforms shall be hot-dipped galvanized steel or stainless steel. Aluminum ladders if provided shall be heavy gauge. Provide lockable ladder side hinged guard.
5. Include internal PVC basin sweeper piping and centrifugal solids separator.
6. Provide cooling tower blow down valves.
7. Fill materials shall be corrugated rot, decay, biological attack resistant PVC type and installed by the manufacturer.
8. Make up water shall be metered and monitored by the BMS.
9. All cooling towers to be reclaimed water certified.

.p Air Handling Units

1. Modular, double wall, variable air volume air handling units shall be installed in mechanical rooms. The units shall be configured to operate with a full outdoor air economizer and will primarily include the following modular sections: a return air fan sections, a relief air mixing box section, an outdoor air mixing box section, and 2" pleated MERV 13, a hot water heating coil section, an access section, a chilled water coil section, and a supply fan section. Unit access shall be provided such that the unit is not considered a permit - required confined space. Prefilters may be considered if space allows.
2. For hydronic semi-custom AHU:
 - a. AHU must include door & section between coils for cleaning and instrumentation.
 - b. Mixing sections should be incorporated. The only exception is in existing facility AHU replacements where existing space may be limited.
3. Appropriate vibration isolation shall be provided for fan sections.
4. Cooling coils shall be selected with a minimum water velocity of 4 fps and a maximum of air velocity 500 fpm.
5. Provide supply fans with current sensors in lieu of DPS for status signal.
6. Provide preheat coils on all units with economizers and outside air intake.
7. Constant volume units shall have a reheat coil.
8. Large and custom-built units shall have two (2) means of egress.

9. Provide manual reset on freezestat. BMS to monitor status and shut down unit.

.q Split Systems & Mini Split Systems

1. Steel, finished with baked enamel, removable panels for access, weep holes, and mounting holes in base.
2. Copper coils are preferred on both indoor and outdoor units with aluminum fins where available. Aluminum tubing should be avoided.
3. Brass service valves, fittings, and gage ports.
4. Hermetically sealed scroll, two-speed compressor motor where available.
5. Preferred refrigerant depends on current regulatory requirements and should be coordinated and approved by Wake County in selection of all equipment.
6. Low ambient kit.
7. Variable refrigerant flow systems shall not be installed.
8. Automatic reset kit.
9. Five (5) year warranty compressor warranty.
10. Two (2) year equipment and labor warranty.

.r Gas Furnace

1. Heavy gauge steel reinforced insulated cabinet with baked enamel finish.
2. Stainless steel primary and secondary heat exchanger.
3. Variable speed blower.
4. Minimum 96% AFLUE

.s Computer Room Air Conditioning Units (CRAC)

1. IT Rooms for non-critical facilities should be cooled using the following:
 - a. Cooling only VAV box and
 - b. Mini-split AC Unit (Wall mounted units in telco or data rooms must have drip pans installed to extend beyond the entire bottom of the unit and associated condensate pump). Preferable installation above entrance door where feasible. Gravity drains are preferred. Pumps shall be considered as last resort
2. IT rooms for more critical use or facilities should be cooled as follows:
 - a. Cooling only VAV Box and
 - b. Dedicated CRAC unit:
 - i. Steel, finished with baked enamel, removable panels for access, and mounting holes in base.
 - ii. Both indoor and outdoor units are preferred to have copper coils with aluminum fins.
 - iii. Brass service valves, fittings, and gage ports.
 - iv. Hermetically sealed scroll, two-speed compressor motor.
 - v. Preferred refrigerant depends on current regulatory requirements and should be coordinated and approved by Wake County.
 - vi. Five (5) year warranty compressor warranty.
 - vii. Two (2) year equipment and labor warranty.
3. Less temperature sensitive rooms such as electrical rooms with transformers should consider the use of fans to circulate air through the room in lieu of active cooling.

.t Power Ventilators

1. Toilet and general exhaust fans shall be rooftop exhaust fans or inline fans located in the ceilings in appropriate spaces.
2. Each fan located in the ceiling shall be located so as to be readily accessible through ceiling tiles or access doors in hard ceilings.
3. Direct drive fans are preferred.

4. Each direct drive fan shall have an integral speed controller.
5. An electrical disconnect shall be provided at the fan.

.u Ductwork & Duct Accessories

1. Ductwork between the air handling units and terminal units shall be medium pressure.
2. All other ductwork shall be low pressure.
3. All exposed ductwork in occupied spaces shall be double wall insulated spiral type.
4. Maximum length of 5'-0" flexible duct shall be used for final connections to individual air distribution devices.
5. Lined ductwork is allowed only in return air transfer sound trap ducts.
6. Designer shall specify allowable means of attachment. All ducts shall be suspended direct from building structure and not from piping, conduits, or other systems.
7. Ductwork connected to large capacity air handlers shall be double wall insulated from the air handler to a distance of 50 feet.
8. Flex connections shall be used at air handlers and fans.
9. Manual dampers shall be provided at branch duct serving each air distribution device.
10. Minimum thickness and pressure ratings shall be per current SMACNA standards.
11. Control dampers shall be opposed blade dampers.
12. Actuators shall be provided with duct accessories and are to have integral calibrated end switches, electronic protection from over torquing, and 3-point, tri-state, floating control inputs for both clockwise and counterclockwise movement. Coordinate with Wake County preferred actuator type.
13. Air flow Stations should be thermal dispersion type and detailed with access panel for cleaning.

.v Air Terminal Units

1. Temperature control to all zones shall be regulated by single duct, variable air volume, terminal units with hot water heating coils controlled by wall mounted temperature sensors.
2. Electric reheat shall not be installed.
3. Provide reheat on all boxes except those serving telecom and electrical rooms.
4. Insulation for terminal units should be double walled or foiled faced fiberglass. Mineral insulation is not allowed.
5. Access panels on each side of the reheat coil.

.w Air Distribution

1. All aluminum 24"x 24", louver faced, or slot diffusers shall be installed in suspended ceilings.
2. Slot diffusers shall be installed in ceilings above window and building entrances.
3. Manual dampers shall be installed at all branch connections from main ducts.
4. Installation of opposed blade dampers shall be avoided in air distribution devices.
5. Exterior architectural louvers should be detailed so as to avoid water penetration. An envelope consultant shall be consulted to ensure incidental water has a path to drain. Coordinate louver detail and specification with the architect.

.x Sound Attenuation

1. Where air velocities exceed 500 fpm in noise sensitive areas, sound attenuation should be included. Sound attenuation to be accomplished through the use of double wall duct or where not possible sound attenuators are permitted to be used and sized appropriately so as not to adversely impact the available static pressure.

.y LP Tanks

1. Tank to be located a minimum of 75' from building and screened.

2. If tank is underground, it must be installed in a vault.

3 Execution

.1 Design Requirements

- .a Pipe Labels and Identification shall be provided as noted in the Pipe Label & Identification Chart in Division 23 – Exhibit B.
- .b All exposed piping shall be painted in accordance with the Pipe Label & Identification Chart in Division 23 – Exhibit B.
- .c Engraved phenolic laminated labels shall be provided on **all** equipment.
- .d Equipment name plates (preferably metal) with raised or depressed images for permanent attachment shall list the following:
 1. Manufacturer, product name, model number, and serial number.
 2. Capacity, operating and power characteristics, and essential data
 3. Labels of tested compliances.
- .e All belt driven equipment shall be provided with a new belt at final completion and a new spare belt shall be turned over as attic stock.
- .f All filters shall be replaced at final completion and a spare set of filters shall be turned over as attic stock.
- .g All warranties shall commence for the date of Substantial Completion, not the start-up date of the equipment.
- .h Any building systems started and operated to provide conditioned air during construction shall be evaluated, serviced, and cleaned so that all equipment is like new at substantial completion.
- .i Label the grid or access panels at all concealed equipment in accordance to the “Grid/Access Panel Labeling Convention” in Division 23 – Exhibit A.

.2 System Testing and Operations Manual Review

- .a Each piece of equipment and each specific operation of the Heating, Ventilating, and Air Conditioning system shall be tested, adjusted, and balanced to meet design requirements.
- .b Certified Test and Balance documentation shall be provided by a NEBB or AABC certified agency and submitted to the designer and Wake County.
- .c Contractor shall submit a copy of each O&M Manual to designer prior to 80% billing.
- .d All close-out documentation, including as built drawings, shall be submitted within no more than 60 days of substantial completion.
- .e An integrated system test shall be completed by the contractor to confirm sequence of operations functions as intended.

Exhibit A: Grid / Access Panel Labeling Convention and Exhibit B: Pipe Label & Piping Identification Chart are included in this document below.

Exhibit A**Grid / Access Panel Labeling Convention*****Electrical*****Outlets**

Each outlet to have a label showing: Panel and Circuit Number.

Switch

Each switch to have a label showing: Panel and Circuit Number.

HVAC**VAV Boxes**

A label shall be placed on grid or access panel door showing: Building automation number (VAV point number).

Thermostat

A label shall be placed on grid or access panel door showing: Building automation number (Associated VAV point number).

Shut off valves

A label shall be placed on grid or access panel door showing: Valve #, System & Area Served.

Plumbing**Shut off valves**

A label shall be placed on grid or access panel door showing: Valve #, System & Area Served.

Concealed Equipment

A label shall be placed on grid or access panel door showing: The equipment tag from the design drawings.

Fire Alarm System

Manual Fire Damper

Label on grid or access panel door showing: Fire Damper Number.

Automated smoke or fire damper

Label on grid or access panel door showing: Building automation number (associated point number).

Fire Devices, Below Ceiling

Label on device showing: Fire system point number.

Fire Devices, Above Ceiling

Label (white vinyl label with black print) on grid or access panel showing: Fire system point number.

Label Practices:

Label Type

Labels shall be produced by a label printer (Dymo, Brother, etc.). Labels shall be white vinyl or plastic label with black print. Labels shall be no smaller than 12mm or ½” and no larger than 20mm or ¾”. Font type shall be plain, font size shall be maximum available for label size and legible from 5’ 0” above finished floor.

Label Placement

Labels shall be placed so that the tile “above” the text is the best ceiling tile to remove for access to the equipment marked by the label. Labels shall be placed on the ceiling grid, centered on the tile they mark for removal. Labels shall be oriented so that they can be read from the most likely point of access (oriented so that they could be read by someone entering the room in it primary entrance). In the case of a corridor, all labels shall be placed in a uniform orientation allowing the maintenance staff to read all labels in a single path down the hall. For access panels the label shall be placed below the access panel.

EXHIBIT B

| PIPE LABEL & PIPING IDENTIFICATION CHART | | | | |
|--|---------------------------|-----------------|------------------|---------------------|
| Service | Marker Wording | Lettering Color | Background Color | Pipe/Covering Color |
| < 30 psig Steam | LOW-PRESSURE STEAM | Black | Yellow | Orange |
| Steam condensate | CONDENSATE RETURN | Black | Yellow | Orange |
| | PUMPED CONDENSATE | Black | Yellow | Orange |
| Hot water systems | HEATING WATER RETURN | Black | Yellow | Lt. Red |
| | HEATING WATER SUPPLY | Black | Yellow | Lt. Red |
| Chilled water systems | CHILLED WATER RETURN | White | Green | Blue |
| | CHILLED WATER SUPPLY | White | Green | Blue |
| Two pipe hot/chilled water systems | HOT/CHILLED WATER RETURN | Black | Yellow | Orange |
| | HOT/CHILLED WATER SUPPLY | Black | Yellow | Orange |
| Heat recovery loops | GLYCOL | Black | Yellow | Orange |
| Cooling tower water | CONDENSER WATER RETURN | White | Green | Lt. Blue |
| | CONDENSER WATER SUPPLY | White | Green | Lt. Blue |
| Nitrogen | NITROGEN | White | Black | * |
| Vacuum | VACUUM | White | Yellow | * |
| Compressed air | COMPRESSED AIR | White | Blue | * |
| Fire Protection | SPRINKLER-FIRE | White | Red | Red |
| Propane gas | PROPANE GAS | Black | Yellow | Yellow |
| Natural Gas | NATURAL GAS | Black | Yellow | Yellow |
| Diesel & #2 fuel oil | FUEL OIL | Black | Yellow | Yellow |
| DI water | DEIONIZED WATER | White | Green | Lt. Green |
| Domestic cold water | DOMESTIC COLD WATER | White | Green | Blue |
| Domestic hot water | DOMESTIC HOT WATER | Black | Yellow | Lt. Red |
| Domestic hot water recirculating | DOMESTIC HOT WATER RETURN | Black | Yellow | Orange |
| Domestic make-up water | MAKE-UP WATER | White | Green | Blue |
| Make-up water non-potable | NON-POTABLE MAKE-UP WATER | Black | Yellow | Purple |
| Tempered water | TEMPERED WATER | White | Green | Lt. Blue |
| Sanitary drain | SANITARY DRAIN | White | Green | * |
| Storm drain, incl. roof drains | STORM DRAIN | White | Green | * |
| Plumbing vent | VENT | White | Green | * |
| Condensate drain | DRAIN | White | Green | * |

*Pipe not painted unless exposed

| Color | Sherwin Williams Industrial & Marine Coatings Paint Number | Sherwin Williams All Surface Enamel Paint Number |
|-------------|--|--|
| Yellow | Safety Yellow SW 4084 | Safety Yellow 502 |
| Orange | Safety Orange SW 4083 | N/A |
| Green | Cedar Green SW 4072 | Hunter Green 510 |
| Light Green | Safety Green SW 4085 | Safety Green 506 |
| Blue | N/A | Navy Blue 509 |
| Light Blue | Safety Blue SW 4086 | Safety Blue 505 |
| Red | N/A | Apple Red 511 |
| Light Red | Safety Red SW 4081 | Safety Red 507 |
| White | Ultra White SW 4087 | Extreme White 500 |
| Black | Black SW 4090 | Black 501 |
| Purple | Plum SW 4080 | N/A |