Facilities Management Design & Construction Standards

For all Construction & Renovation Projects

January 2019

Division 00: Introduction

The standards contained within this document shall be considered contract requirements for every project unless otherwise stated in writing from the assigned NKU project manager. In the event of conflicting language between a specification issued for a particular project and these standards, this building standard document shall govern.

All specifications created and issued for new building and renovation projects at Northern Kentucky University shall be organized using the 2004 MasterFormat Edition.

Division 01: General Requirements

Northern Kentucky University's construction activity is reviewed by the Commonwealth of Kentucky Department for Housing, Buildings, & Construction with regards to all building code enforcement, building plan review/approval during design, and building inspections during construction. Local building permits are not required and university property is exempt from compliance with local zoning regulations. During construction, the assigned state building inspector is considered the fire marshal until the Certificate of Occupancy is issued. At that time, the building is then referred to the state fire marshal's control.

Other agencies that require notification, permits, registrations, and coordination for the project are:

- Sanitary District No. 1 (SD1)
- Northern Kentucky Water District
- Duke Energy
- Central Campbell County Fire District
- Northern Kentucky Health Department
- Kentucky Transportation Cabinet

Whenever a campus project is located on the fringe of university property and/or the project will affect surrounding property owners and public utilities, these agencies are more actively involved in the planning, design, and review process. In addition, SD1 does require NKU to apply for their typical series of permits, as they always need to monitor NKU's resulting storm water and sanitary sewer outflows on their systems downstream. The NKU project manager will help coordinate the exact involvement of these agencies based on the specific scope and requirements for each particular project.

Contractors shall obtain all permits, and licenses, necessary for any or all parts of the work from the authorities governing such work. Evidence that such permits have been issued shall be furnished to the project manager before beginning work and during ongoing work as applicable. All contractors are responsible for paying all required inspection fee costs associated with their scope of work, and they shall include these inspection fee costs in their bid price.

Scheduled Campus Utility Outages and/or Building Shutdowns:

All necessary utility shutdowns necessary for existing NKU buildings to complete project construction work shall be at the convenience of NKU. The actual times of utility shutdowns could need to happen on third shift and/or weekends to avoid disruption of campus schedules. A minimum of a 48 hour notice is required.

Utility Consumption Meters:

All new building projects shall include consumption meters for all incoming utilities serving that particular building. All meters shall be IP addressable and shall all be connected via TC/IP to the central campus BMS system at the Central Plant. Coordinate with the NKU project manager on any direct connection/integration desired with the Intelligent Building System. Coordinate level of expectation and acceptable quality/brands of meters with NKU project manager.

Attic Stock & Replacement Parts:

For all project materials and systems, attic stock quantities consistent with accepted industry standards for college campuses shall be included in the project specifications. Replacement parts necessary from contractors/vendors shall either be in stock or available within 24 hours.

The following minimum level of attic stock quantities shall be included in the project specifications:

- (1) complete replacement cycle of filters for all HVAC equipment
- (1) replacement belt for each device or piece of HVAC equipment
- 5% ballasts/lamps
- 5% plumbing parts
- 3% floor base
- 3% floor tiles
- 3% ceiling tiles

NKU General Safety Requirements:
Also included in this section are also some general safety requirements every member of the design and construction team must follow when visiting/working on NKU's campus.

NKU CAD and Mapping Standards & Building Information Modeling (BIM):
This section includes the requirements for all CAD file deliverables created and provided to NKU for new projects. In addition to this collection of CAD standards for traditional 2D drawings, NKU also requires the use of Building Information Modeling (BIM) to drive and leverage the coordination process starting during design and continuing through construction. The entire design and construction management team is required to use BIM technology during the design and construction phases of this project. NKU requires the use of Revit for the Building Information Modeling process.

The selected design team will be responsible for developing a complete BIM implementation plan for the project in conjunction with NKU. This strategy shall include developing, defining, and documenting: the collective project goals and specific project uses regarding BIM, the BIM process for all project parties (both consultants and contractors), the BIM model elements and level of detail required to implement and exchange information between all parties and protocols, the Owner of the model at each project phase, the electronic/coordination communication procedures (e.g., file naming conventions, file structures, and file permissions), the hardware/software/network infrastructure required, and finally the BIM process quality control procedures to ensure all project participants follow the rules and meet all defined requirements.

The BIM model developed by the consultants during the design phase will be used by the Construction Manager to fully coordinate the work of subcontractors during construction. The Construction Manager will be responsible for organizing, arranging, and developing the BIM coordination among all the subcontractors during construction. At the conclusion of the project, the final BIM model shall be delivered to NKU as part of the record documents submittal.

NKU General Safety Requirements

The University strives to continuously maintain both a safe and secure work environment for its students, employees, and the employees of all Contractors assigned to our campus. Therefore, it is essential the following criteria be met by all Contractors (and all their subcontractors) working at NKU.

BACKGROUND CHECKS:
The Contractor shall furnish the University with written documentation that verifies each of their employees working on the property of the University has cleared a background check, has no felony convictions, is not a sex offender, and has the legal right to work in the United States.

DRUG-FREE WORKPLACE:
Northern Kentucky University is a drug-free and alcohol-free workplace, and all employees of Contractors and subcontractors are subject to this policy while working on University property. If there is verifiable suspicion or probable cause that an employee of the contractor or subcontractor is under the influence of drugs or alcohol, the University reserves the right to require the Contractor to have the employee tested immediately at no expense to the University. If the test results are positive the

employee will be prohibited from working on University property for a period of one (1) year from the positive test, or the duration of the project, whichever is longer. The banned employee of the Contractor must pass a drug and alcohol test before working again on university property.

CONTRACTOR PRESENCE ON CAMPUS:
All persons working for (or on behalf of) the Contractor whose duties bring them on campus shall obey the rules and regulations that are established by the University and shall comply with the reasonable directions of the University representatives. Contractor's employees shall never enter or use existing areas of campus where they are not required to be performing work. Contractors and subcontractors are always responsible for providing and maintaining portable restroom facilities for all their workers working on the project.

Contractor shall be responsible for the acts of his employees and agents while on campus. Accordingly, Contractor agrees to take all necessary measures to prevent injury and loss to persons or property located on campus. Contractor shall be responsible for all damages to persons or property caused by Contractor or any of his agents or employees. Contractor shall promptly repair any damage that he, or his employees or agent may cause to the campus or to the University equipment.

Contractor agrees that in event of an accident or incident of any kind on university property, Contractor will immediately notify the University's Department of Public Safety (859-572-5500), who will prepare and furnish a full written report of the accident or incident.

All Contractor employees and subcontractors shall present a neat and clean appearance while on University property, and be able to present proper individual and company identification upon request.

PROJECT WORK SITE SAFETY & SECURITY:
The University does not, and will not, assume any responsibility for any tools, materials, equipment, or property belonging to the Contractor, his employees or agents, which may be lost or stolen from University property. All contractors and subcontractors are solely responsible for properly securing and protecting their tools and equipment.

When working within or on top of an existing building, the Contractor shall work with the assigned University project manager in developing a strategy for securing the project work site and protecting the campus staff and community from the project work site. When working in an open area on campus, the Contractor shall provide securable barricades/fencing around the project site to protect the campus community from the dangers within the project work site. The Contractor shall maintain this project work site protection 24hours a day, 7 days a week for the duration of the project.

GENERAL PROJECT COORDINATION:
All work and information requests by the Contractor shall be coordinated through the assigned NKU Project Manager. Any direction provided by the campus Operations & Maintenance Staff and/or the project user group shall **NOT** be considered official direction from the University unless authorized in writing from the assigned NKU Project Manager. Contractor will **NOT** be compensated for work performed without written authorization from the assigned NKU Project Manager or NKU-hired Architect of Record. Contractors must utilize the NKU Construction Change Authorization form to initiate any work changes that have schedule or cost impacts.

As a general rule, utilities required by the Contractor to perform their work can be obtained from the University. However, the University reserves the right to require the Contractor to furnish a meter to record the usage of each provided utility for the duration of the project. For projects requiring utility metering, a deduct change order will be issued at the end of the Project to reimburse the

University for the Contractor utility usage. The Contractor is responsible for determining and coordinating the procurement of any utility where the University cannot reasonably provide.

Unless noted otherwise for a specific project, at least seven (7) calendar day notice is required for any campus utility shutdowns and/or any road/parking lot closures necessary for the Contractor to perform their work. All utility shutdowns and closures shall be coordinated with the assigned NKU Project Manager, and the University reserves the right to schedule these shutdowns and closures at night and/or on weekends to minimize disruptions to the campus community.

The NKU project manager will research and provide whatever information is available and known for the existing utilities in the area of concern. However, NKU generally prefers the contractor hire an outside utility locating service for marking the location of all existing utilities. Outside utility locating services will be required for locating all public utilities (when applicable), and most of the underground utilities on campus are private "house" lines owned & maintained of NKU. All requests for assistance shall be submitted to KY811. In projects with costs exceeding $50,000, the contractor shall be responsible for all utility marking. For any project which will have digging, excavations, trenching etc, the contractor shall place an 811 ticket and include the NKU Project Number for reference by NKU Utility Locating.

General Guidelines

CAD System Requirements & Translation Issues

All CAD files turned over to NKU shall be openable in the latest version of AutoCAD.

Electronic File Categories

Buildings
An electronic drawing for a building shall contain all the appropriate information (architectural, electrical, interior design, mechanical, plumbing, etc.) in plan view for related its floor or level. The absolute final drawing submitted to NKU shall contain "As-Built" information of the completed project, which will be used for maintenance of daily operations and/or as a basis for future projects. The user coordinate systems will be identical between levels, such that, each related level inserted on another shall be aligned appropriately from drawing to drawing. The default scale for text and symbology will be: 1/8"=1' with a linetype scale of 96. North shall always be the top or right side of the drawing area. The lowest southeastern corner of the drawing shall be located at 0, 0.

Exterior Utilities and Site Plans
All exterior utilities and site plans shall be created in model space. New construction projects that involve undisturbed geography may create these elements in a new drawing. New construction projects that require disturbance of existing utilized geographic locations shall begin their basis from existing NKU data, which will require field verification of said data. Both projects types will be required to integrate their final "As- Built" utility and site plan data into NKU's existing campus base plan. All drawings shall reference the same coordinate system. All drawings shall be in accordance with NCS guidelines.

Drawing Requirements

Prototypes & Blocks
Prototype drawings and a block library are available from A & C to further aid in streamlining project processes.

NKU has established the following guidelines to be used in the development of all electronic drawings:

- All CAD elements must be drawn to the most accurate dimensions available
- Every layer must be uniquely named and its use based according to NCS guidelines.
- All entities, layers and linetypes must be defined as "BYLAYER".
- All blocks shall be created on layer "0". No nested blocks will be allowed.
- The font shall be ARIAL.shx for all applications. Alternate fonts may be used at the approval of NKU A & C, however, special fonts which are not packaged with AutoCAD are not allowed.
- Dimensioning styles shall be consistent and associative. This will allow AutoCAD to automatically reflect changes to the entity it is associated to and will therefore allow for greater accuracy. Under certain circumstances it may be necessary to override AutoCAD's dimension, this shall be completed as follows: explode the dimension blocks or disable the AutoCAD dimension variable (Dimaso) for associative dimensioning.
- All bound layers shall be renamed to the original layer name and must adhere to NCS guidelines.

- All drawings and drawing extents shall not contain any objects outside the drawing limits. All drawings shall be submitted such that the extents are in full view upon opening the electronic file.
- All unreferenced layers, linetypes and blocks shall be deleted prior to submittal using the purge command.

No electronic CAD drawing submitted to NKU will be accepted if it contains references to external source drawings (Xrefs). All externally referenced data used during drawing production shall be inserted and bound, resulting in a fully self-contained drawing file.

- Each final plotted drawing sheet must correlate to its separate electronic drawing file mate.
- Every final drawing sheet shall have a unique name and shall be in accordance with NCS naming conventions.
- **Each sheet is to be clearly marked whether it is an As-Built or a Record Drawing.**

Model Space vs. Paper Space

AutoCAD operates between two different drawing environments known as: model space and paper space layout). All drawings are to be produced in Model space. This includes all physical components of the project, such as, walls, topography, pipes, trees, doors, windows, columns, beams, outlets, ducts, etc., or any component(s) necessary for construction. Paper space is for plotting various views and scale. Each sheet shall represent one plotted drawing - plotted at full scale (1=1). All drawings submitted to NKU shall be produced with the following approaches for using model space and paper space:

Model Space

The primary drawing or model shall be created in model space. This includes all base plan elements, which must be drawn to full scale. Any additional items required to define the model or clarify model data, such as, dimensions, elevations, notes, room numbers and names, schedules, sections and/or details, etc., shall be drawn to full scale within model space. Elements shall be consistently relative to their correlating layer assignments.

Paper Space

All subsequent drawing elements, such as, title blocks, legends, key plans, plan titles, riser diagrams and schematic diagrams, along with sheet-specific notes shall be created in Paper Space. All model space features will be represented here at an appropriate scale to fit on the plotted sheet.

As-Built Data

Methods & Implementation

The Contractor is responsible for the following at their expense for the reproduction of (1) full size blueline print of each contract sheet within the project's entire complete drawing package. This original reproduction shall be marked accordingly to reflect all deviations incurred during the actual construction phase of the project, which differs from the contract drawings. All marks shall be made and must be permanent. The color green shall be used to indicate all additions and red to indicate all deletions. The re-marked data must indicate all deviations without exception, which include the following required data.

- All utility locations, such as electric transmission lines, gas lines, etc., along with related description of said elements.
- All existing components of any kind or description must be noted to exist within the project's construction boundaries. The data shall include position relative to permanent features by using appropriate dimension guidelines.
- The locations and dimension of any Changes to the building or structure, which includes changes to: dimension or location shall be included.
- All underground utilities and/or facilities shall be accurately located, which includes dimensions relative to permanent structural features.
- Any changes to topography, drainage grade, elevations, structures, utilities, roads, road alignment

or any other physical feature, which deviate from the contract plans. This includes all additions and deletions, along with any change that may affect drainage patterns due to the projects scope.

- Any deviations, additions or deletions to any project design detail, which includes any information related to working drawings specified to be provided by and/or furnished by the Contractor.
- All information related to the Contractor's furnishment and/or provision of: fabrication, erection, installation, and placing details along with size specifics, (i.e., such as pipes, insulation material, etc.),
- All changes and/or modifications which differ from the original design intent or from final inspection.
- Indication of option used in construction where contract documents and drawings allow for options.
- All options not used for construction shall be deleted.
- All deviations shall be indicated consistently and in accordance as the general detail and information utilized in the contract drawings. Continuous effort shall be made consistently without fail during construction to keep all "As-Built" marks up to date through and until the completion of work has been exercised. All data sheets are to be marked as "As-Built Field Marks" and shall not be used for purposes. This information shall be available at all times for review by the University's designated representative as identified in the project contract. NKU will require a joint review of all marks as defined in the project contract. Failure to maintain current marks is considered sufficient justification to withhold a monetary retainage from the monthly pay applications until marks are brought current to date.

All "As-Built Field Marks" drawings will be returned for correction, if upon review the University deems them to be in error and/or exists with omissions. Deficiencies, error and/or omissions must be corrected immediately. The drawings must be returned to NKU's designated representative within 10 calendar days upon receipt of returned drawings noting all said corrections. Production of all record drawings shall include joint efforts between the Project Architect/Engineer and Contractor. The Architect/Engineer is responsible for review and verification of said documents and must note any necessary revision to reflect "as-built" conditions based upon observations of the project work. The Contractor shall be responsible for incorporating all comments made by the Architect/Engineer. The Contractor may opt to contract the project Architect/Engineer to produce the project's As-Built CAD files. The Contractor must coordinate with NKU's designated representative to determine how to achieve this task for all projects designed in- house by the University.

Submittal Requirements

The As-Built data is to be submitted to the University Architect or designated NKU representative for review, as identified in contract documents. Substantial Completion will not be granted until these items are received and approved in writing by Northern Kentucky University.

- Electronic set of scanned files for each drawing sheet from the related original "As-Built Field Marks" sheet. PDF or tiff are preferred. Files shall be scanned at the highest resolution available.
- Set of hardcopy drawings from CAD as-Builts.
- Electronic set of PDF files created for each sheet of the CAD as-Builts.
- Electronic set of all CAD drawings each sheet. Also required is 1 set of building floorplans with lines as polylines to allow for integration with NorseGIS.

All electronic copies shall be placed on a USB drive, an external hard drive or other suitable media. A minimum of 3 electronic filesets shall be turned over.

A minimum of 1 hardcopy of drawings shall be turned over.

Division 02: NKU Master Plan Guidelines & LEED

In Spring 2009, the university adopted the latest version of the NKU Master Plan, completing a process started in the fall 2007 with Campus Studio. A major focus of the Master Plan, in addition to anticipating and planning for future growth, is a conscious attempt to "green" the campus, both in terms of landscape architecture as well as sustainability efforts.
The Master Plan contains both a full report and an executive summary. It can be viewed at https://inside.nku.edu/campusplanning/masterplan.html

LEED Certification & High Performance Building Standards:
Pursuant to KRS 56.770-784 and 200 KAR 6:070 High Performance Building Standards, construction and major renovation projects under the ownership of the Commonwealth of Kentucky must adhere to this new sustainable design criteria. In addition, NKU signed and adopted the American College and University Presidents Climate Commitment in December of 2007.
http://www.lrc.ky.gov/kar/200/006/070.htm
NKU is committed to achieve some level of LEED certification on all applicable new building and/or renovation projects. The specific level of LEED certification (and applicable version to follow) will vary depending on budgeted project size:

1. All new construction and major renovation building projects in the amount of $25 million or more in budget shall be designed, built and submitted for certification to achieve LEED Silver level or higher.
2. All new construction and major renovation building projects between $5 million and $25 million in budget shall be designed; built and submitted for certification to achieve LEED Certified level or higher.
3. All new construction and major renovation building projects greater than $5 million in budget shall additionally achieve a minimum of 7 points for new and for existing buildings under the LEED Energy and Atmosphere Credit 1, Optimize Energy Performance.
4. All new construction and major renovation building projects between $600,000 and $5 million in budget shall be designed and built using the LEED Rating System as guidance.

Final determination for each new project shall be coordinated with the NKU Project manager. In all cases however, the university will always strive to maximize energy efficiency for all new and renovated/retrofitted building systems. For renovation projects where the budget exceeds half the **replacement** value of the building being renovated, such projects are to be considered "major renovation."

Life Cycle costing:
Designer shall perform a life cycle cost analysis of selected HVAC and other building systems to demonstrate that the most cost effective systems are being selected for major renovations and new construction.

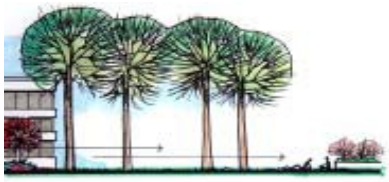
Design Guidelines
As a relatively young institution, Northern Kentucky University is striving to build a sustainable tradition of educational excellence expressed throughout the whole of the campus environment and architecture. The overall goal is to create buildings and a campus landscape that are timeless; are respectful of, in

context with, and build upon the university's unique design history; contribute to the quality of the campus as a place; and, help create a memorable environment with engaging, vibrant places for interaction and socialization, contributing to the collegiality of the campus. Campus Design Guidelines, which are based upon the Master Plan Principles, will be fundamental to creating an exemplary campus setting, reflective of university priorities and a commitment to students, faculty and staff. The following guidelines, which should be interpreted in concert with the university's Design and Construction Standards document, provide for an integrated implementation program to guide the growth and transformation of the campus including: architectural layout; open space and pedestrian circulation; transportation and parking; and, utility improvements.

Potential Site Treatments

- Open Space
    - Where possible, buildings should be clustered around a major open space with connecting pedestrian pathways placed in a manner that maximizes green space and encourages social interaction.
    - Primary open spaces should preferably be 2 acres but not less than 1 1/2 acres in size.
    - Spaces should reflect the scale of the buildings which define them. The width of a major space should be equal to or greater than 1/2 the height of the tallest contiguous building.
    - All buildings should have a primary entrance fronting on a major open space.
    - Buildings should include secondary entrances where necessary to accommodate open space and building-to-building pedestrian patterns. These entrances could be at grade and/or at an upper or lower level; where feasible, these entrances are to be accessible to the disabled.
    - Open spaces should foster a sense of campus and community: they should be memorable and comfortable.
    - Most buildings in the Plan should be sited to support the creation of outdoor rooms. Other buildings are focal points for long vistas or serve as the terminus of an outdoor space.
- **Landscaping**
    - Create a sustainable campus

    - Site improvements are to be a part of all building projects and budgets
    - Use landscaping to increase sense of place, to assist wayfinding, and to create comfortable, yet safe, outdoor spaces
    - Landscapes should result in bold color patterns, creating large patterns of color
    - Use hardy, low-maintenance and proven native plant species capable of withstanding the ph, soils, exposure, and climactic conditions of Northern Kentucky and, more specifically, the microclimate and exposure of surrounding buildings.



- Utilize plant materials to enhance and define spaces, provide shade, and control views.

- Use a variety of evergreen, deciduous, and flowering plant materials. Employ grasses and perennials in areas requiring additional interest. Species selection shall be done such that attention is given to incorporate year-round visual interest.

- For security purposes, design campus landscapes to maintain a sense of personal safety. This includes providing open lines of sight near pedestrian pathways, building entrances and bike racks.

- To balance an abundance of existing concrete, hardscape design should include color wherever possible.

- Concrete walls should be carefully designed to minimize their visual impact on the campus environment and should be avoided when possible.

- **Building Consistency**
  - Buildings should be sited to create exterior public spaces

  - There should be consistency of building form, architectural style and materials throughout campus

  - New buildings and building additions should be sympathetic in color and materials to existing buildings, while being expressive of current architectural styles.

  - New buildings should be designed with qualities of permanence, welcome-ness and vibrancy, creating places of energy and interest.

  - Building projects, regardless of size, should be constructed of quality, enduring materials that are easy to maintain.
  - Designs should be responsive to the needs of a building's specific users, but also to the needs and requirements of the university as a whole, and in addition, the design must be adaptable over time to changes in the function and operation of the building.

  - Design decisions should be based upon the best long-term value; generally, this implies that the least expensive solution is not always the best solution.

  - Energy efficient systems and building components are a priority. Designs should

consider all aspects of environmental impact, both on campus and in terms of from where materials are acquired.

- **Site Efficiency**
  - New buildings should average 4 or more stories above grade.
  - Loading zones; short term and handicapped parking; and, drop- off drives should be sited to serve multiple buildings.
- **Site Grading**
  - Use grading to enhance or disguise views.
  - Minimize grading disturbance in areas with existing vegetation.
  - Gently grade areas and avoid the use of steps when possible.
  - Concrete walls should be carefully designed to minimize their impact on the campus environment; avoid using concrete walls unless needed to resolve grading problems or other functional reasons.
- **Safety and Lighting**

- Install lighting at all building entrances, pedestrian routes and parking lots.
- Light areas beyond sidewalks for safety
- Dense vegetation, walls, and other obstructions inhibiting visibility must be no closer than 15' from pedestrian pathways and building entrances.
- Carefully locate light fixtures to allow for even distribution and consistency of lighting. Avoid creation of dark areas and hot spots.
- Select high quality pedestrian-scaled fixtures.
- Light fixtures should be appropriate for their intended use and aesthetically pleasing.
- Strive for a pedestrian-safe campus by maintaining vehicular traffic on the edge of campus.

- **Wayfinding**
  - Establish intuitive wayfinding with consistency of signage, materials, lighting, and site furnishings.
  - Include critical information along pedestrian routes and building entries in Braille.
  - The university's signage standards should govern all signage installations.
- **Universal Access**
  - Adopt a "universal access" strategy.

- Provide equal access into buildings from major vehicular and pedestrian routes; use noticeable pavement changes at cross walks, steps, and building entries.

- **Bicycles**
  - Encourage bicycle use by providing bike racks; locate racks an appropriate distance from building entries.
  - Provide screening around bicycle racks.
  - Clearly designate bike paths with signage and striping.
  - Where possible, separate bicycle traffic from pedestrians by providing separate paved paths.
  - When combined paths for bicycles and pedestrians cannot be avoided, dedicated (striped) bike lanes should be delineated and the combined path should be 10' or more in width.
  - Restrict bicycles in highly-used pedestrian areas such as the Central Plaza. It is proposed that the Central Plaza and other areas where large numbers of students gather be identified as "walk only areas".

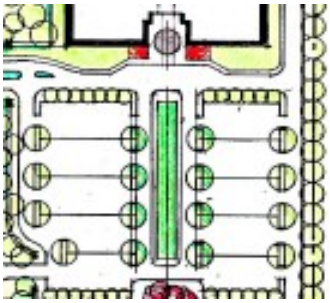
- **Pedestrian Connectivity**
  - Develop a comprehensive pedestrian corridor system linking all campus destinations.

  - Create nodes at pedestrian intersections to encourage social interaction.
  - When transitioning grade levels, avoid designs that require stairs.
  - Consider elevated walkways to ensure pedestrian safety at busy intersections and roadways and to overcome elevation challenges between buildings.
  - Provide strong pedestrian connections between the campus and nearby services, transportation and commercial destinations.
  - Consider tree-lined pedestrian corridors to provide shade, scale and campus continuity.

- **Campus Housing**

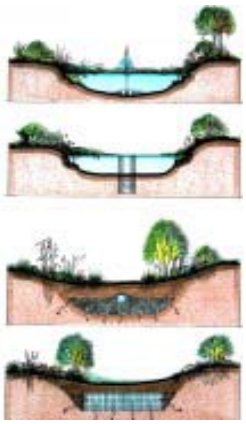
- Work with developers and the community to increase housing opportunities
- Select sites that provide a variety of open spaces for gathering and recreational uses.
- Provide safe pedestrian connections to campus.
- Planting in the residential areas should reinforce a sense of community while creating a more intimate scale.

- **Athletic Facilities**
  - Locate athletic facilities in areas that are within walking distance of student housing.
  - Choose sites that are accessible for community use.
  - Facilities with large anticipated spectator attendance should be within easy access to and from major campus vehicular access routes.
  - Design athletic facilities to minimize traffic impact on neighboring residential land uses.
  - Mitigate lighting spillover to adjacent residential neighborhoods.
  - Provide buffers along residential edges.
- **Parking Lots and Garages**
  - Locate parking facilities within a 10-minute walk to major campus destinations.
  - Construct large, remote parking lots and begin a shuttle system to the center of campus.
  - Provide connections to a minimum of 2 access roads in order to distribute traffic.
  - Incorporate safe crosswalks.
  - Create parking lot pods with a maximum capacity of 250 vehicles. Separate parking pods with 20' wide landscaped areas.
  - Include parking for car-poolers, as well as alternative fuel re- fueling station for low-emission/fuel efficient vehicles.

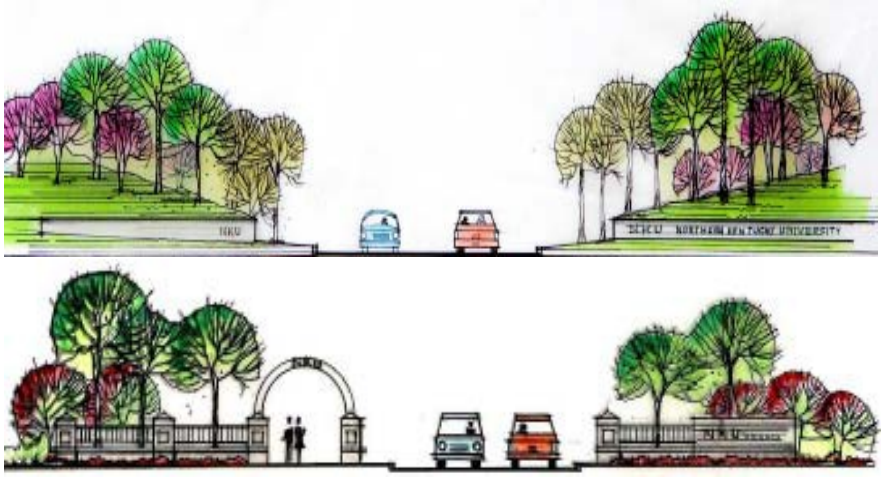


  - Provide visitor parking within a 5-minute walk of major destinations.
  - Design parking garages to blend with surrounding buildings.
  - Maximize natural ventilation in garages by locating in sloped areas.
  - Encourage efforts that reduce on-campus parking demand, and provide convenient drop-off areas for mass transit.

- **Stewardship and Sustainability**
  - All new buildings shall be LEED certifiable.
  - All construction projects, including renovations, shall incorporate sustainable practices.
  - Preserve natural vegetation on building sites, where possible
  - Consider less destructive options such as terracing, and reducing building footprint.
  - Utilize Best Management Practices (BMP's) to reduce storm water runoff by incorporating green roofs, rain gardens and bio-swales into construction projects to reduce use of potable water for irrigation by harvesting roof water.
  - Incorporate permeable pavement technologies in future hard surface areas, both vehicular and pedestrian.
  - Efforts should be made to avoid light pollution (over-lighting).
  - Select energy-efficient fixtures.



- **Neighborhood Gateways/Campus Portals**
  - Provide a hierarchy of campus entrance/gateways designed to promote a strong campus identity, creating a sense of welcome for students and visitors.



- **Public Art**
  - Find opportunities to thoughtfully integrate art into the university's living and learning environment.
  - Select pieces which are visually appealing as well as artistically appropriate.

Division 08: Openings & Building Envelope

The following guidelines represent preferences typically requested by NKU for various building components constituting the interior and exterior of new buildings. These should be considered basic requirements, as there are always situations and conditions warranting exceptions or slight deviations away from these guidelines. However, any deviation from the following guidelines shall be coordinated with and approved by the NKU project manager.

Exterior Building Envelope:

- NKU requires thermal testing for the finished building envelope prior to final acceptance.
- Design teams shall incorporate an appropriate mixture of exposed concrete, glazing, and metal panels on the exterior envelope to remain consistent with the surrounding architecture. Depending on the project location, an appropriate and acceptable proportion of each material will likely vary, and shall be coordinated with the NKU project manager.
- All exterior glass should be treated to reflect ultraviolet radiation and should be as energy efficient as feasible. Provide sun screens or otherwise shade glazing, particularly on the west and south facades.
- In several existing campus buildings, the exterior windows are higher in elevation relative to the office/classroom floor level, and while these windows do allow light to enter, they do not provide views to the exterior for office/classroom occupants. Whenever possible and appropriate, windows should be sized and located to provide both the combined benefit of day lighting and views to the exterior.
- All building entrances should be designed with an airlock for energy conservation. To make the airlock most effective, provide enough distance between sets of doors to allow the user to open one door while the other door is still closed.
- All exterior doors should be recessed. In several locations on campus, strong prevailing winds interfere with proper door operation. This will be particularly true on the west side of the building.
- Exterior doors should be out-swinging and should be equipped with continuous or butt hinges (non-ferrous). Center pivots and Adams Rite type locking devices are not acceptable (all panic devices should be of the push pad type; cross bar devices should not be used). Storefront systems should be of medium stile design.
- All building entrances located on ADA accessible routes must be equipped with an automatic push button door opener to facilitate access for people with disabilities. Automatic door openers are also required for any doors leading to common lobbies, passageways, etc. along an ADA accessible route.
- Roofing systems are NOT required to meet any special Factory Mutual requirements. NKU's insurance carrier simply requires the roofing construction conforms to all current/applicable building codes.
- For roof drains, NKU prefers a roof drain with no-hub-type clamp for attaching the pipe to the roof drain fixture, and not slip into the roof drain fixture.
- All new buildings shall be equipped with a Knox Box located on the exterior of the building near a building entry coordinated with the NKU Project Manager and the Central Campbell County Fire District.
-

Exterior & Interior Glazing:

Provide ample exterior and interior glazing to provide a sense of openness in the building. It is desirable to always see forms of activity as one walks through campus buildings. The more public an area, the more a sense of energy can be achieved through judicious use of exterior and interior glazing. For all interior glass doors/walls, coordinate with NKU project manager on how to implement manual/motorized blinds, as well as blinds potentially integrally sandwiched in glass. With long interior corridors, place exterior glazing at the end of the corridor to diminish perceived length.

Interior Doors:

- All doors should be either hollow metal with welded seams filled and ground smooth or high quality wood doors. All doors should be a minimum of 36" in width.
- Wherever possible, restrooms should be designed with offset walls at entrances to preclude the need for doors. When restroom doors are necessary, at least one set of toilet rooms per floor shall be equipped with automatic push button door openers to facilitate access for people with disabilities.
- All interior doors to offices, classrooms, labs and lounges shall have a small vision window of clear glass (either in the door panel or as a side light) to provide personal security for all room and/or office occupants and visitors. This glass shall be a minimum of 100 in^2. A common size for this is 4" x 25".
- For ADA accessibility and general maintenance, all double doors should be provided without center posts. At double door locations, install a concealed vertical rod in the inactive leaf and equip the active leaf with mortise panic device. If a wide, single door (42" wide, for example) would serve the same purpose as a double door, provide the single wider door.
- Doors providing access to rooms which will receive significant cart traffic, or where items are likely to be moved in and out, should be designed and equipped with ample plate protection for at least half the height of the door.
- Provide an attractive, durable coat hook where noted in the program. Place door stop away from wall a sufficient distance to prevent coat hook damage to door. Provide floor mounted doorstops for all doors not equipped with overhead controls.
- After-set door frames are preferred instead of pre-fabricated welded frames.
- The following are NOT acceptable door manufacturers: Am-weld, Kewanee, and Pioneer.
- NKU prefers Steelcraft doors.

Door Hardware:

Attached at the end of this section is a collection of NKU door hardware standards. The following provides a brief summary, as well as additional requirements:

- For the automatic push button door openers, the pushbuttons should be mounted a minimum of ~3-4' from the door, and 26" above finish floor (26" is the preferred height, but a height up to 36" is also acceptable). Mounting of buttons on rails is not an acceptable solution, and every effort should be considered to achieve wall-mounting of push button door operators. LCN Senior Swing model is recommended, and the push-and-go feature is preferred.
- Refer to Division 28 for details on NKU's standards for controlled access card systems for interior and exterior doors. Provide a key bypass integrated for all doors outfitted with card readers.
- For doors involving card readers, provide both position switches and request to exit switches:
    - Position Switch: Recessed Honeywell 947-75TWH
    - Request to Exit: Honeywell Intellisense IS-310
- All locks should be mortise locks except where panic devices are required.
- Mortise locks should be heavy duty; Best, Sargent, or Schlage are the preferred manufacturers. Cylindrical locksets are not acceptable.
- All cylinders for locksets should be Small Format Interchangeable Core. NKU currently uses Best Peaks Patented with a propriety Best Peak Patented keyway. In general, the contractor will purchase the cores and NKU will pin the cores.
- Contractor shall furnish (3) key blanks per lock/cylinder to NKU.
- All lock trim should be of lever handle design that meets all ADA and fire code requirements. Mechanical rooms and other hazardous areas should have knurled handles or some other warning surface (per ADA requirement) for those with sight -impairments.
- Aluminum (US28) finish on hardware or aluminum hardware is not acceptable. A durable finish should be specified. Finish on all locks (exterior and interior) should be US26D (polished chrome) for durability.
- All panic devices shall be touch pad type. NKU's preference for panic device application is as follows, in order of preference:

  For Pairs of Doors:

1. Two surface mounted concealed vertical cables.
2. If there is a mullion, then use rim devices.
3. If there is an inactive door, use a flush bolt on the inactive side.
4. Exceptions/Other:
    - For interior hollow metal or wood pairs, provide two surface vertical rod devices (with the less bottom rod option).
    - For exterior hollow metal pairs, provide a mullion and two rim devices.
    - For exterior aluminum storefront pairs, provide a concealed vertical cable device with top and bottom latching.

- NKU's preference for panic device manufacturers are as follows, in order of preference:

1. Von Duprin 99
2. Sargent 80 Series

- Provide door closers only when required by the building code, and in-floor (recessed) closers shall never be specified.
- When door closers are required, they must be LCN 4040XP.
- Select Heavy Duty continuous hinges are preferred; offset hinges are not acceptable. Storefront doors should be equipped with continuous or butt hinges.
- Weather stripping should be a brush type. Basis for reference is National Guard Products 601A or DkB or DkB, 602A or DkB, etc.
- Bronze thresholds are preferred in all entrance doors; with specific approval of the project manager, an aluminum threshold may be used.
- All door stops shall be installed on the floor. The preferred stop is Ives FS434.

DOOR HARDWARE

SPECIFICATION GUIDELINE

Door and frame prep

Before hardware installation, verify that all doors and frames are properly prepared to receive the specified hardware. Hollow metal frames shall be prepared for ANSI strike plates per A115.1-2 (4-7/8" high), hinge preps will be mortised and reinforced with a minimum of 10 gauge reinforcement material; minimum of 14 gauge reinforcement material for closer. Hollow metal doors shall be properly prepared and reinforced with a minimum of 16 gauge material for either mortised or cylindrical locks as specified. It is preferred that all hollow metal doors receiving door closers have 14-gauge reinforcement. If this is not possible, the use of sex bolts is mandatory. Wood doors shall be factory prepared to receive the scheduled hardware.

Hardware installation

The manufacturer's representative for the locking devices and closing devices must inspect and approve, in writing, the installation of their products at the expense of the contractor. Hardware installed incorrectly must be reported to the architect prior to the architect's final punch list.

Description	Manufacturer	Model / Series	Finish
Hanging Devices			
Mortise Hinge	Stanley	FBB199 Drs over 36" as required (Ext high use doors)	US32D
		FBB191 Drs up to 36" (Ext low use doors)	US32D
		FBB168 Interior Drs over 36" (Int high use doors)	US26D
		FBB179 Interior Drs up to 36" (Int low use doors)	US26D
		*NRP (Non Removable Pin) at Reverse bevel locked Doors	
Alternate	Hager		
Alternate	Bommer		
Continuous Hinge	Select	SL 11HD (Hvy Duty)	AL
		SL 24HD (Hvy Duty)	AL
		*Continuous Hinge use at selected or Alum Doors	
Alternate	No Substitution		
Securing Devices			
Mortise Lock Set	Schlage	L9000	626
	Lock Function	**Lock Type**	
	AB	Entrance Lock or Office	
	R	Classroom Function	
	INL, IND	Intruder Function	
	D	Storeroom Function	
	N	Passage	
	L	Privacy	
		*Provide lock functions as required for project as appropriate	
Alternate	Best 45h x 15h		
Alternate	Sargent		
Mortise Deadbolt	Sargent		626
Alternate	Best 48H Series		

Description	Manufacturer	Model / Series	Finish
Electrified Lock	Schlage		626
	Lock Function	Lock Type	
	DEU	Electrically unlocked (Fail Secure)	
	DEL	Electrically locked (Fail Safe)	
Alternate	Best	45W x 15H	
Alternate	Sargent		
Cylinders	Best	Mortise 1E74 x RP3 x cam required	626
		Rim 1E72 x RP	626
		*Provide as necessary to operate locking hardware	
Alternate	No Substitution		
Key System	Best	Removable/Interchangeable Core	626
		7-pin Best "Peaks" Existing key system	
		3 keys per lockset	
		All Cylinder and cores must be manufactured by BEST	
		All locks and cylinders must be supplied with permanent cores, with two keys each	
Alternate	No Substitution		
Exit Device	Von Duprin	99 series	626
		996L lever trim where applicable	
Flush Bolts	Ives	FB458 (Manual) (metal doors)	626
		FB358 (Manual) (wood doors)	626
		FB31P (Automatic) (metal doors)	626
		FB41P (Automatic) (wood doors)	626
		*Use automatic flush bolts where required by fire code or IBC	
		*Provide coordinator and brackets as required to meet fire door requirements	
		*Dust Proof strike as required	
Alternate	Trimco		

SPECIFICATION GUIDELINE
Manufacturers and Products
Northern Kentucky University
Substitutions or Alternates not permitted unless noted below.
Edit Date: June 2007
Revision Date: May 2012
DOOR HARDWARE

Description	Manufacturer	Model / Series	Finish
Coordinator	Ives	COR Series Mounting brackets as required	600
Alternate	Trimco		
Alternate	Rockwood		
Closing Device			
Closer	LCN	4040 XP Series *Provide standard duty Parellel arms interior/low traffic *Provide heavy duty S-CUSH or EDA Parallel arms at exterior and high traffic *All door frames to be reinforced *"SNB" Sex Nuts and Bolts at label doors as required	689
Alternate	No Substitution		
Automatic Operators			
Automatic Operator	Von Duprin	Senior Swing with digital control box *Provide at ADA required locations	680
Actuation	BEA	10 PBR1	
Alternate	No Substitution		
Stops & Holders			
Door Stop	Ives	FS438 floor stop (use only as required) WS406CCV (Concave) / WS406CVX (Convex) wall stop *Allow for maximum swing of doors	626 630
Overhead Stops	ABH	9000 Series	630
Alternate	Rockwood		

Description	Manufacturer	Model / Series	Finish
Accessories			
Offset Pull	Ives	8190-0 10" CTC *At Exterior doors	630
Alternate	Trimco		
Alternate	Rockwood		
Straight Pull	Ives	8103-0 10" CTC *Where no hindrance to operation of cylinder	630
Alternate	Trimco		
Alternate	Rockwood		
Push Plate	Ives	8200 4" x 16"	630
Alternate	Trimco		
Alternate	Rockwood		
Kick Plate	Ives	8400 10" x 2" LDW x B4E (Single doors) 8400 10" x 1" LDW x B4E (Pair doors)	630 630
Alternate	Trimco		
Alternate	Rockwood		
Armor Plates	Ives	8400 32" High x 2" LDW x B4E	630
Alternate	Trimco		
Alternate	Rockwood		
Mop Plates	Ives	8400 4" High x 1" LDW x B4E	630
Alternate	Trimco		
Alternate	Rockwood		
Threshold	Pemko	171A (1/2" x 5" Saddle threshold) *Furnished as detailed on drawings, if shown	
Alternate	Reese		
Door Sweep	Pemko	18100 CNB (interior) 345 ANB (exterior)	

Description	Manufacturer	Model / Series	Finish
Alternate	Reese		
Smoke Seal	Pemko	S88 (verify color)	
Alternate	Reese		
Sound Seal	Pemko	*Use double row of S88 for Sound Seal at Music Rooms	
Alternate	Reese		
Light Seal	Pemko	379 CS (at head and jambs) Door bottom and threshold as required *Used at Dark Rooms	
Alternate	Reese		
Weather Seal	Pemko	18041 CNB (at head and jambs)	
Alternate	Reese		
Miscellaneous			
Key Control Software	Best	Match existing in use on campus.	
Pad Lock	Best	21B722L	
Alternate	No Substitution		
Fire Dept Lock Box	Knox Box	3200 - As required	
Access Control			
Access Control:		Refer to Division 28 Specifications/Standards	

Division 09: Interior Finishes

- **Walls**: Walls shall meet ANSI standards for Sound Transmission Class (STC) ratings. Generally, painted gypsum board is acceptable. High traffic areas shall have impact resistant drywall. Use ceramic tile on all restroom walls Stud walls should be 16" center, 3 5/8" x 20 ga metal studs minimum. Install corner guards on wall corners likely to receive abuse.
- **Paint**: All paint is to be water-based. Concrete surfaces should not be painted unless approved by NKU Project Manager. The campus standard is Sherwin Williams Harmony for gypsum board and Sherwin Wiliams Metal Latex for metal surfaces. The design team should also consider the use of the Sherwin Williams "ProGreen 200 Low VOC" product line as well.
- **Paint Colors**: All paint colors should be approved by NKU and efforts should be made to use colors from the existing NKU color palette. The Sherwin Williams retail location in Southgate, KY has NKU's campus color palette on file, and they will be able to provide the corresponding Sherwin Williams color to match these legacy colors. .All ceilings and soffits shall receive a flat white ceiling paint.
- **Floors**: Carpets chosen and installed shall be closely coordinated with NKU for proper product selection. All flooring shall be of commercial grade for heavy use environments. All flooring systems shall be installed such that they maintain the manufacturer warranty. All materials shall be as environmentally friendly as possible (refer to Division X for LEED Guidance).
- . New exposed concrete flooring surfaces shall be colored throughout or have colorant added at time of placement rather than using a topically applied stain or paint after curing. Public areas shall have high quality hard surface flooring in high use public areas.
- **Ceilings**: All lay-in ceilings should be on a 2' X 2' grid using reveal edge ceiling tile. All ACT ceiling grid shall be white in color. Acceptable manufacturers for standard ACT ceilings are Armstrong and USG. Any specialty ceilings shall be approved by NKU project manufacturer.
- **Building Entrance/Walk-off Mats**: Waterhog by Andersen shall be used.
- **Window Treatments & Curtains**: Motorized/powered window treatments and theater curtains shall be included in the base construction contract scope of work to ensure proper coordination of the electrical requirements. When installed, classrooms and meeting spaces shall have electrically operated shades with controls integrated into the classroom Crestron system and office shades shall be manually operated. The current campus standard for window treatments is "MechoShades" (1300 Series/5% openness factor) with a clear anodized fascia and a shade fabric color of 1010 light grey. However, different fabric colors, styles, and openness factors shall be verified with the NKU project manager.
- **Specialty Finishes:** All proposed specialty finishes including, but not limited to, writing surfaces, wall coverings, and specialty paints and floors shall be closely coordinated with, and approved by, the NKU project manager.
- **Guard Railings:** Guardrails installed shall not be glass.
- **Decorative Glass:** Any decorative glass installations must be tempered glass. It shall be laminated or have film installed to prevent falling glass in the event of breakage. Common methods of this protection include lamination or installation of face-applied film (3M Ultra S600).
- **Wall Base:** Wall base shall be 4" black brown cove base installed in straight sections.

Division 10: Toilet Rooms and Accessories

Accessory	Provided & Installed by NKU	Provided & Installed by Contractor	Surface Mount or Built-in	Comments
Roll paper towel dispenser	X		SM	Approximately 18"W x 24"H
Trash receptacle	X			Freestanding
Soap dispenser	X		SM	
Sanitary napkin dispenser	X		SM	
Toilet Tissue dispenser	X		SM	
Mirrors		X	SM	Provide individual mirrors to allow soap dispensers to be mounted proximate to sinks.
Shelf		X	SM	For books and personal items. Laminate covered
Baby changing shelf		X	SM	

Any other spaces needing paper towel and/or soap dispensers besides toilet rooms will be furnished and installed by NKU. The following represents a listing of the current accessories furnished and installed by NKU Custodial Services:

- Toilet Paper
- Paper Towels
- Dual Napkin/Tampon Dispenser
- Feminine Napkin Disposal Unit

Whenever possible, design restrooms with wall offsets so entry doors are not necessary. If restroom entry doors are necessary, provide an automatic door opener (push-button type) on the door to each men's and women's restroom to facilitate access by the disabled (refer to Division 08 for info on automatic door opener buttons).

All new toilet rooms shall be equipped with (2) electric hand dryers. The current campus standard model is Xlerator by Excel Dryer, Inc. (Model #XL-B, XL-BW or XL-SB), but other acceptable manufacturers/models can be listed as American Specialties Turbo-Dri (Model #0197) and the Dyson Airblade (Model #AB02). The design team shall review the wall offset, open entries described above coupled with the desire for electric hand dryers and implement any necessary acoustic provisions to preclude excessive sound transmission into adjacent spaces.

Each new building shall include at least one Family Restroom that shall serve as both a 'family' restroom and also as a gender-inclusive restroom. This restroom shall include a baby-changing station. This room shall be identified with signage as follows: "Gender Inclusive Family Restroom".

Each new building shall include a small room designed for lactation. This room shall be equipped with a small sink with a gooseneck faucet, mirror, one or two lockers and shall be equipped with user-operated deadbolt. The door for this space shall not have glass or sidelights installed.

Other Toilet Room Accessory Preferences:

- Drop-in sinks with a durable countertop are preferred. Specify energy efficient faucets, urinals and toilets.
- Provide sufficient space between mirrors to mount soap dispensers.
- Toilet partitions should be floor mounted with overhead head rail bracing. Toilet partitions should be solid composite partitions whenever possible, but other durable type partitions will be

considered.

- The Rockwood #102 handle, in a bright or brushed chrome finish is suggested. Stall doors shall have a continuous hinge with extra heavy duty coat hook installed inside the stall.
- Provide a 62" spacing between the front edge of the toilet and the stall door in the accessible stalls to allow sufficient room to maneuver a wheelchair in the stall. These dimensions exceed code requirements.
- All new restrooms shall be equipped with a shelf for occupant use outside of the stalls. The shelf shall be laminate or solid surface to match the countertops.

Division 11: Service Loading Areas & Custodial

All buildings need some type of service delivery access for NKU Operations and Maintenance personnel, as well as for deliveries from outside vendors. A trash collection point (dumpster & compactor) is typically preferred, but some building locations and orientations cause some difficulty in achieving this goal. Refer to each project program for more direction on the specific service area and trash collection requirements for each individual project.

Service Docks:

If the new building is planned to connect into the existing tunnel system (see Division 33), and the new tunnel connection provided adequate accommodation for a cushman cart or a tow motor, then a new service dock is not required at the new building. In this case, garbage and deliveries can pass to/from the building through the new tunnel connection. However, some consideration and coordination should occur with the NKU project manager to ensure adequate trash collection space is included within the building program when a dedicated service dock area is not required.

If a new tunnel connection is not possible, a new building service dock is normally the only alternative. In this case, the dock service area should be wide enough to accommodate a delivery from a 24-foot box truck, and provide the standard dock height necessary for a tractor trailer. Provide the follow minimum level of utilities at all service dock areas:

- Convenience exterior power outlet receptacles
- Convenience exterior domestic water hook-up

Depending on the nature of the building served, some service docks might require the design team to accommodate the the following:

- Space to house an (8) yard, trash compactor (closed top).
- 208V 3 phase electrical service for the trash compactor.
- When food service is provided, determine and provide adequate space allocation and access at dock areas for grease containers/removal.

Custodial Closets:

Locate custodial closets within the building in close proximity to the restrooms on each floor. Slop sinks shall be provided in the custodial closet on each floor, and custodial closets shall have FRP board put on the wall surrounding the sink at least 3-4 feet high. Always include a main custodial closet in the program at the lowest building level at the tunnel connection level or near the service dock. This main custodial closet will serve as the primary storage location for a two week stock of custodial supplies, all tools, equipment, and special floor care equipment necessary for that building. This main custodial closet shall also include a slop sink, and all custodial closets shall be designed with sufficient ventilation.

Vending Machines:

At all programmed vending machine locations, provide 1 power duplex and “1D” (1 data jack) per vending machine unit. The standard vending machine provided is 72” high x 37” wide x 34” deep, and each unit draws approximately 3 amps of power. Coordinate exact vending machine dimensions and requirements for each project with NKU project manager.

Division 12: Building Signage & Room Numbering

Building Signage:

All NKU projects require the interior building signage to conform to a set of campus standards developed by the NKU Interior Designer (coordinate with NKU project manager). Code required Interior building signage shall be provided as part of the base building package, while all other Interior directional and way finding signage is typically coordinated and procured directly by NKU as part of the project FFE budget. For ADA accessibility, all corridor/pathway material should include possible tactile clues for clear paths of accessible travel, both inside and outside the building.

Room Numbering Guidelines:

Room Numbering for projects shall be completed by the office of Campus and Space Planning. A copy of the floor plan shall be provided to this office and a copy will be returned with room numbers.

Division 14: Stairs & Elevators

Stairs:

As a general rule, design vertical circulation in new buildings to encourage the use of stairs as much as possible by making stairs open, inviting and accessible. Stairs should be located convenient to a building's predominant traffic pattern and should be sufficiently wide enough to allow users to comfortably pass each other when traveling in opposite directions. In terms of use, the design team should assume building occupants can routinely walk up or down one flight of stairs when interpreting loose programmed adjacencies. The finish for standard egress stairways can be painted or exposed/sealed concrete. Look for ways to make a bigger stairwell to allow for materials transport. Where possible, egress stairwells shall not incorporate the use of horizontal sliding fire doors. Reference interior finished design for tread finishes. No glass railings shall be included. Glass shall be installed in stairwell doors. Minimum size for stairs and landings?

Elevators:

Provide passenger and freight elevator(s) as required in the building code and to support the specific project program. Locate passenger elevators carefully, as they should be secondary in location compared to stairs, but they still must be considered convenient for building occupants. Unless approved in writing by the NKU project manager, all buildings must provide at least (2) passenger elevators; however, the design team need not locate these elevators side by side. INCLUDE FREIGHT ELEVATOR IN EVERY BUILDING

Passenger elevator finishes should be attractive and durable, including the floor which should be hard surface. There is a preference for 1 piece elevator flooring. Finishes shall be user serviceable to allow for future tightening or replacement of panels and full stainless steel interiors should be avoided. Elevators should be wide enough to provide sufficient space in them for normal, everyday maintenance/custodial activities, as well as adequate space for people using wheelchairs. Project specifications shall include provisions for the contractor to provide protective blankets and floor mats when elevators need to be used during construction, renovation, and/or move-in activities.

The need for a special service/freight elevator will be defined in the project program, along with the required size and capacity. When required, service/freight elevators shall be designed as key-operated (using SFIC Cores) only. The interior finishes in the service/freight elevator can be utilitarian, but the finish materials used must be durable and easily cleaned.

The emergency phones provided with all elevators need to involve special coordination between the elevator contractor, the NKU project manager, and the NKU telecommunications department. All emergency buttons in existing campus elevators direct dial NKU's Department of Public Safety when the alarm button is pressed. When answering the trouble call, the DPS dispatcher immediately sees the NKU building code and specific elevator number, and the dispatcher can also immediately converse with the elevator occupant making the call. All pre- programmed elevator distress messages must be disabled.

For the hydraulic cylinders, provide factory applied polyvinyl chloride shields sealed at the bottom and sealed to jack unit at the top. PVC casing and seals shall be watertight. Two small, elbowed tube openings shall be provided into PVC casing. These shall be accessible from the elevator pit. At time of installation, PVC casing shall be filled with oil to level of top seal, thus creating watertight oil barrier around jack unit. Once installed, two small tubes shall be capped.

Controls for elevators must be non-proprietary. Elevator lighting shall be LED. Elevator equipment rooms shall have a stand-alone cooling. Elevator equipment rooms shall transmit as little noise as possible and

shall have a minimum rating of STC-60.

MRL-type elevators are not permitted.

Elevators should be keyed to match an existing elevator key in use on campus (most on campus are Dover). All key switches utilized for restricting/permitting elevator access to certain levels, such as the attic, penthouses, mechanical levels, and other restricted areas shall keyed using SFIC hardware.

NKU does not permit the installation of escalators on campus.

For elevators in new Parking Garages, the initial design shall specify an extra length for the hydraulic pistons to accommodate potential, future vertical expansion of the parking levels. Typically, NKU requires the initial structural design for new Parking Structure to assume 1-2 future level additions. Obviously, individual project budgets always will ultimately decide how much expansion NKU can plan for during the initial design and construction, and the specific future expansion details shall be coordinated with the NKU Project Manager.

To promote better accessibility for people with disabilities, NKU generally prefers to provide/install digital voice annunciators at elevators.

Elevator Maintenance:

NKU generally prefers hydraulic elevators, but for future NKU maintenance purposes, ALL elevator equipment must be NON-proprietary. Any elevator equipment installed shall not require any special tools, software programs, or equipment for routine and/or repair maintenance. The university has a campus-wide contract for elevator maintenance and service with a local elevator company, and when the service provider changes after a periodic re-bid, the new company must be able to service the operational software for ALL elevators on campus.

In the project specifications, the initial, 12 month elevator maintenance period shall be included in the project base bid, coinciding with the standard, 1-year construction warranty. After the first 12 months, the university will roll the maintenance of the new elevator(s) into the blanket, campus-wide elevator maintenance contract.

Division 21: Fire Suppression

- Install sprinkler system inside building for fire safety. Avoid dry-type system, except where required. Equip the sprinkler system with tamper switches and provide at least one shut-off per floor so each floor can be drained independently of the others. These shut-offs and all fire lines shall be easily accessible. If valves are located above ceiling, the ceiling shall be marked to indicate valve location. Each floor should be equipped with a drain that flows to the outside (preferable) or to a floor drain or mop sink.
- NKU prefers quick response sprinkler heads in order to minimize the required amount of portable extinguishers/cabinets.
- All new buildings shall be equipped with a Knox Box located on the exterior of the building near a building entry coordinated with the NKU Project Manager and the Central Campbell County Fire District.
- Elevator shafts shall not have sprinkler heads installed at the top of the hoistways and machine room where allowed to be omitted by code or applicable exemption. This shall be coordinated with the Fire Alarm design.
- Where portable extinguishers are necessary in public spaces, provide them in a surface mounted cabinet. Any extinguishers required in mechanical/maintenance spaces do not need a cabinet. Fire extinguisher locations shall be the minimum allowed by code.
- All sprinkler valves located in exterior water pits shall have submersible, plug type tamper switches installed. All raceways, conduits and junction boxes to exterior water pits shall be outdoor/weather rated. (example: Potter PTS-C)
- All sprinkler valves shall visually indicate the open/close status.
- Water motor gongs or other audible alarms separate from the fire alarm system shall not be included as part of any water based suppression system.
- For all hose cabinet/riser connections, Old Cincinnati thread style is the campus standard.
- The fire department connection shall be a single 5" locking stortz connection. The bottom of the connection shall be between 36"-42" off finished grade.
- The Fire Department Connection shall be marked to indicate the building it supplies.
- The fire department connection shall be located within 50' of the nearest hydrant.
- All new NKU campus fire hydrants shall adhere to the following criteria from the Central Campbell County Fire District
    1. All hydrants shall have (2) – 2½-inch hose nozzles with Old Cincinnati Thread and (1) steamer or pumper connection. Steamer/pumper nozzle shall be 4½" with adapter to a 5" locking Storz connection. The operating nut and the nuts of the nozzle caps shall be square, measuring one (1) inch from side to side.
    2. Hydrant body shall be painted yellow.
    3. All hydrants shall be right hand open, clockwise, and shall have a direction arrow of operation cast into the dome of the hydrant.
    4. Acceptable fire hydrant models/brands:
        a) Dresser M&H Style 129 (4-1/2" – 5-1/2")
        b) Mueller D1 Centurion (4-1/2" – 5-1/4")
        c) Kennedy K11 (5").
- All fire suppression systems installed shall be tested per NFPA 13 code requirements, and per the direction of the Commonwealth of Kentucky state fire marshal's office.
- Once a preliminary building design is developed, the design team will be expected to meet with the local fire department (Central Campbell County Fire District) and NKU Safety & Emergency Management to review the systems and obtain an overall general knowledge of the systems. Potential items for discussion include, but are not limited to, hydrant locations, fire truck access, building fire panel location, sprinkler valve location, etc.
- All compressors for dry pipe fire suppression systems shall be of the tank variety. They shall have an automatic condensation release device installed on the tank and the compressor shall have vibration

isolation pads at each bolt. Compressors shall have the air storage pressure set to a minimum of 20 psi higher than the dry pipe air pressure. The air compressor shall also be located in a mechanical area of the building, preferably the fire pump room if equipped. In buildings with multiple dry pipe systems, efforts should be made to include only 1 compressor.

Division 22: Plumbing

Campus Infrastructure for Domestic Water:

Primary domestic water service from the Northern Kentucky Water District is fed into the campus water loop at the following (3) supply locations:

- 8" line located at Johns Hill & Kenton Drive
- 8" line located at Campbell near the maintenance building
- 12" line located down the hill southeast of the Central Plant. The water line is an NKYWD main through NKU's campus, and this line was relocated along the east side of University Drive to the Roundabout, across University Drive, and then along the south side of Nunn Drive towards Steely Library.

Consistent with the plumbing code, NKU requires backflow preventers on each building feed, as well as lines feeding irrigation systems. Previous engineering analysis indicates the following pressure drop summary:

- 77 psi = Theoretical static pressure available at elevation 830 (12" city main)
- 55 psi = Pressure available from 10" campus main flow test
- -10 psi = loss through water meter at building
- -15 psi = loss through back flow preventor at building
- - 5 psi = friction loss in building piping
- 25 psi = available pressure in building without booster pump

Campus Infrastructure for Natural Gas:

Natural gas service to campus is provided by Duke Energy, and there are (2) primary feeds provided to campus:

1. The Central Plant is fed with a plastic 40 lb line originating from a buried regulator station at the southeast corner of the Nunn Drive/University Drive intersection Roundabout near the Bank of Kentucky Center. Duke's feed for this buried regulator station comes from the east along the north side of Nunn Drive and crosses below Nunn Drive before the buried regulator station. NKU's 40lb "house" line extends from the buried regulator station and proceeds underneath University Drive up towards Steely Library along the south side of Nunn Drive. The line then wraps around the western and southern portion of the parking lot (Lot D in 2012) back towards the Central Plant. The arena is fed with a 5lb line originating from the same buried regulator station at the Nunn Drive/University Drive intersection Roundabout.

2. The remaining buildings on campus are fed by a separate 5lb, 6" line that originates at the Duke Energy meter/regulator caged area located between the Student Union and the Albright Health Center. Duke's feed for this station comes from the south along the east side of Kenton Drive.

The campus standard is to install all new gas lines with new plastic line, per Duke Energy standards.

All gas piping after the meter is considered "house" piping (customer owned piping), but NKU requires all contractors to follow all requirements of the current Duke Energy Gas Installer's Manual, which can downloaded from Duke Energy's website. All gas pipe installation inspections and pressure tests shall be scheduled through Duke Energy by calling (513) 651-0444.

General Plumbing Preferences:

- Every effort should be made to install water service lines outside of paved areas and at a normal depth of 4 to 5 feet.
- All new domestic water service installation must have a RPZ back-flow device (Watts 957) plus gallon type readable meter installed at a proper height and location for service. The back-flow device must

be tested and a copy of all test reports will be sent to NKWD and NKU before water is turned on for service.

- Faucets, toilets, urinals, and water closets shall be energy efficient models with a preference for automatic/ sensor-actuated operation.
- Instantaneous hot water heaters shall not be used for building restrooms.
- Within each new building, provide only the minimum amount of water fountains required by code.
- For all water fountain locations, specify local chillers. Remote chiller locations just lead to more piping to maintain with no real benefit.
- Provide (1) water bottle filling station at each bi-level set of water fountains. NKU's preference is to specify the Elkay EXH20 System (model #LZS8WS/LZSTL(R)8WS series) similar to Griffin Hall. However, NKU is open to entertaining alternate manufacturers and styles.
- All flush valves must be a diaphragm type, auto flush, must flush with the handle, be battery operated, and must be designed for low water consumption.
- All plastic underground water service of any type must have tracer wire installed on pipe. (mains and laterals)
- Ceramic disc fixtures (not rubber seals) shall be used on all manually operated bathroom faucets.
- Roof drains shall be of the no-hub variety.
- Domestic water booster pumps shall be Grundfos
- All restrooms, labs, janitor closets, mechanical rooms, kitchens, break areas, outside hose bibs or any areas that require water fixtures must have individual isolation valves per water line per room.
- Floor drains are required in all toilet rooms, and any other rooms with a better than average potential for flooding.
- Plumbing for toilets and sinks must be accessible for repairs; either situate restrooms back-to-back with an accessible, walk-in plumbing chase separating them, or provide strategically placed access panels. Panels must be at least 24" by 24".
- At a minimum, provide one valve to shut off hot water and one valve to shut off cold water to the sinks for each restroom, as well as valves for each sink individually. Also, provide a separate shut valve to turn off water to the urinals and toilets for each toilet room. These shutoff valves need to be easily & quickly accessible in the event of a major leak, and they can be installed in the ceilings or in the hallway in front of the restrooms.
- For all areas with limited space for a walk-in chase, stop the interior drywall just above the hung ceiling and provide access to the high piping.
- All drain clean outs must be accessible for serviceability. All sinks shall have a sink drain above flood level rim.
- All domestic water valves must be full port type ball valves.
- All acid piping installed for any building shall be designed for and suitable for that purpose.
- The quantity of handicap fixtures and stalls for restrooms shall be per the Kentucky Plumbing Code.
- All water heaters installed will be energy efficient and carry a minimum warranty of (6) years on the tank and (1) year on parts and labor. AO Smith Commercial Natural gas water heaters are preferred, but the design team shall always consider and determine the applicable payback for implementing solar powered heaters whenever feasible. Water heater will include a low water pressure cut off device and a properly sized expansion tank. All water heaters shall be connected and wired to the building automation system to allow remote reading at the Central Plant.
- All domestic water piping will be properly tagged for direction of water flow, and hot water piping must be insulated with 1" insulation.
- Generally, drop-in sinks with a durable countertop are preferred.
- Do not specify any type of external mechanical trap on urinals.
- Provide a minimum of (1) exterior wall hydrant/hose bib at the building load dock area, as well as (1) wall hydrant/hose bib location along each building face as well as 1 on the roof where feasible.
- For any wall hydrants/hose bibs provided along the building exterior, provide an isolation shut off valve somewhere nearby within the building so NKU can isolate and drain the exterior system as necessary.

Acceptable Plumbing Fixture Manufacturers:
(Substitutions are not permitted unless authorized in writing from NKU project manager)

Urinals and Water Closets:

1. Zurn "Nano Pint" 1/8 GPF (Model #Z5708)
2. American Standard
3. Kohler

Sinks: (shall have 4" faucet spread)

1. American Standard
2. Eljer
3. Elkay
4. Kohler
5. Gerber

Mop Basins: (with solid brass Drain Body)

1. Mustee
2. Crane/Fiat Products

Water Coolers:

1. Elkay
2. Halsey Taylor

Toilet Seats: Shall be open front commercial plastic

Flush Valves: (closet 1.6 gpf) (urinal 1.0 gpf)

1. Sloan Valve Co. (royle and regal only, **NOT** GEM 2)
2. Zurn Industries

Faucets: (0.5 gpm aerators included on faucet)

1. American Standard
2. Delta
3. Chicago
4. Kohler
5. T&S
6. Symmons

Domestic Water Booster Pumps:

1. Grundfos Pump MFG.

Division 23: Heating, Ventilation, & Air Conditioning

Campus Infrastructure for HVAC:

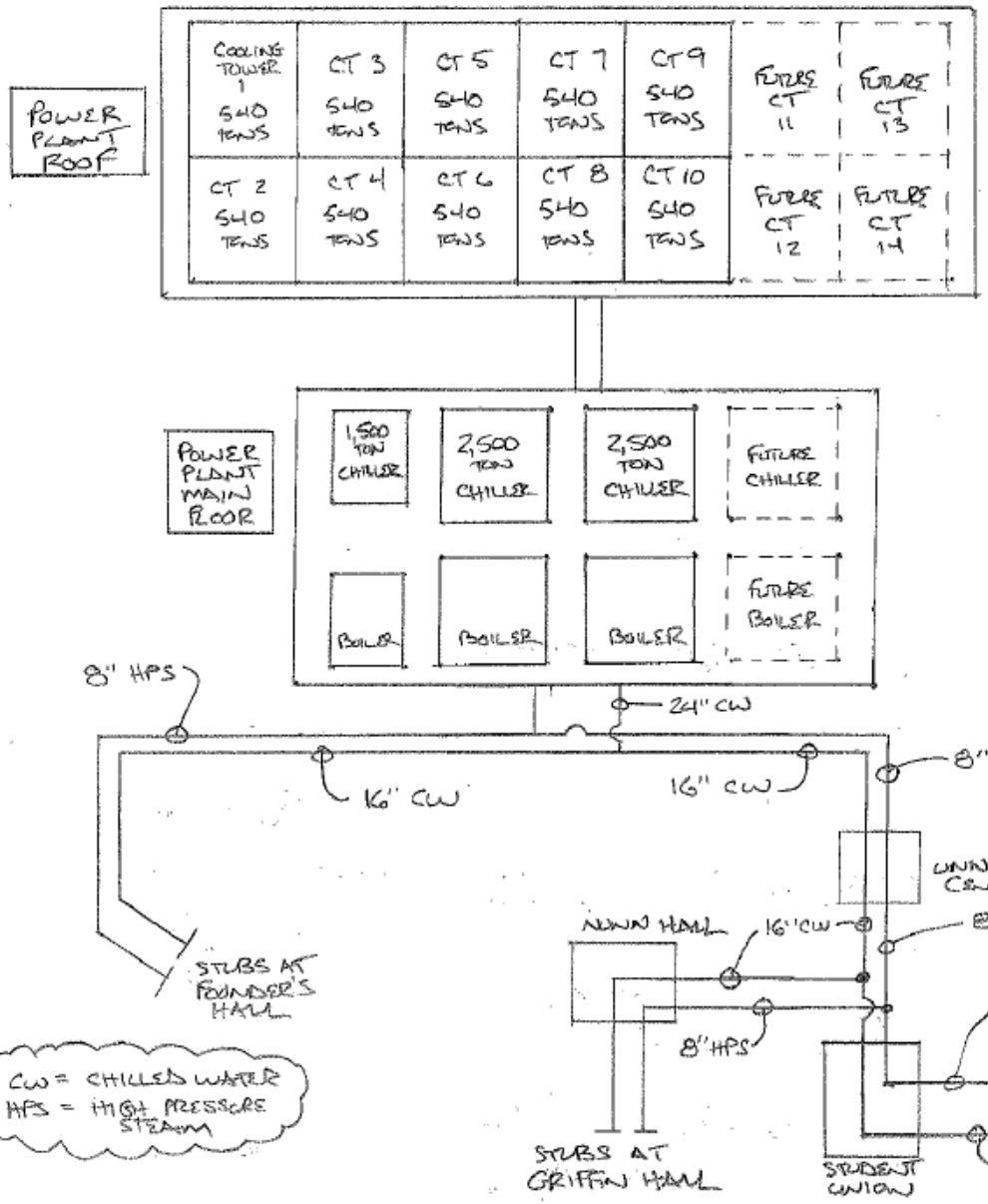
A network of underground utility tunnels (see Division 33 for an overall campus tunnel layout) typically distribute steam and chilled water throughout campus, and connecting/expanding into the existing tunnel system for distribution towards new buildings is always the preferred option. When a full size tunnel is not feasible, other options, such as an accessible trench, should be investigated. All piping and systems must be sized in consideration of all planned future growth and potential extensions of the system.

General HVAC preferences:

- Building air intakes must be located to ensure building/equipment exhaust air (or vehicle exhaust from loading/parking areas) is not inadvertently pulled back into a building. Building exhausts shall be designed such that they do not interfere with intake air from other buildings, also.
- Aside from University Housing, buildings should be connected into the existing campus steam and chilled water systems whenever possible. These 2 systems shall have building level meters installed to monitor usage.
- Existing external air intake louvres on buildings which will be affected by construction dust and debris, shall be protected with filter rolls which are refreshed as needed. These shall be removed at the completion of the project or when exterior work has completed.
- While it is the University's preference that the permanent HVAC system not be used during construction, if it is used, the contractor will be held accountable for cleaning air handlers, ducts, etc. prior to Substantial Completion. When the permanent system is utilized prior to substantial completion, the warranty still shall not begin until the date of substantial completion.
- Chilled water and steam usage meters must be installed for each building, and provisions shall be included in the design for connecting these meters into the campus building automation system. Other meters to be included are electric, domestic cold water, geothermal makeup water, and natural gas. These shall all be integrated into the building automation system to allow for remote meter reading from the central plant.
- The mechanical systems in all rooms, but especially in any sound sensitive rooms such as classrooms and conference rooms, should be quiet. A noise coefficient rating of NC 25 is required.
- Air handling units or other equipment must be located on isolated slabs. Vibration isolation devices shall also be installed on AHUs. Similarly, mechanical rooms housing air handling units within the building must be designed to ensure no noise transfer to adjacent spaces. STC Rating for these rooms shall be STC-60.
- HVAC and ventilation design for storage rooms should mimic design levels for offices.
- When designing zones for HVAC systems, NKU shall review and approve the zone design **prior to bidding**. No zone shall have more than 3 offices. Each classroom shall also be an individual zone.
- Areas with high heat load, such as computer labs, shall be designed such that cooling can still be provided year-round, even when campus chillers are not running.
- Adjustable thermostats should be specified where appropriate to give occupants the ability to modestly modulate local temperature settings. Specify a thermostat with a “cooler-warmer” slide.
- In foodservice areas, redundant supply fans shall be installed. All valves shall be located to provide adequate maintenance access. When valves are located higher than 8’-0” above finish floor in mechanical/service areas, specify chain wheels for operating the valves from the ground. Specify Babbitt adjustable sprockets (#2.5), which should fit valve wheels measuring 9.25"-12.5".
- At the building steam pressure reducing station, provide cast iron steam safety relief valves.
- All new campus buildings shall include braided flex piping/connections for hot/cold water distribution

to VAV boxes.

- At all new steam line valve locations, a small bypass shall be installed from one side of the valve to the other to facilitate “line warm up” for whenever a valve needs to be reopened after an extended closed period.
- All freeze stats shall be hard-wired to the AHU associated supply and return fan VFD’s. They shall only be able to be reset manually and shall not require entrance into the unit to reset.
- All safeties shall be hard-wired into the fan starter circuit such that the safety shall function whether the start selector switch is in the hand or automatic position. In other words, all safeties shall be hard-wired to their devices and shall not rely on DDC system software for operation.
- NKU has a preference for welded fittings on steam, hot water and chilled water lines. Victaulic fittings shall not be permitted on these systems.
- All VFDs shall be ABB and be located outside of equipment.
- For new filter sizing, attempts shall be made to match existing filter sizes on campus.
- Steam, chilled water and condensate lines shall have valves installed to allow building level isolation.
- All air bleeders and bleeder valves shall be piped to a drain and shall be equipped with isolation valves to allow for replacement.
- In buildings with multiple floors, chilled water and hot water lines shall have isolation valves installed at each floor (at a minimum).
- If humidifiers are installed, they shall be coupled with softeners.
- Static pressure switch locations shall be indicated on the BAS graphics.
- Rooms with critical equipment and independent heating/cooling such as IDF/MDFs and Electrical Switchgear shall be equipped with backup air supply from the main building system(s) to allow for heating/cooling in emergent situations. This can be accomplished through the use of a VAV or through manual dampers that can be open/closed when needed.
- Pump packages shall include the ability to be fully controlled by, and integrated into, the BAS.



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Division 25: Building Automation System

The following section describes the requirements for properly integrating with our existing campus building automation and monitoring systems. Any deviation from the following guidelines shall be coordinated with the NKU project manager.

SECTION 250400 - CONTROL - DIRECT DIGITAL

PART 1 – GENERAL:

1.1 The bid for Temperature Controls for this project shall include an allowance. Refer to bid documents for allowance. Schneider Electric shall fully integrate the new temperature controls system for this project into the existing Schneider SmartStruxure server/front-end system in the Physical Plant. It is the responsibility of the contractor to coordinate with the temperature control contractor schedules and scope of work. The Allowance for Schneider and the TCC shall be a subcontractor to the mechanical contractor. Refer to Part 2 for scope details for the Allowance.

1.2 The temperature controls for this project shall fully integrate and seamlessly interface to the existing the SmartStruxure front end system in the Physical Plant via BACnet IP protocol. NKU has an on-going service contract with Schneider Electric. Interface and graphics generation on the university's DDC system server is included in this project and shall be consistent with the existing. Windowing between different computers/systems, or loading separate building energy management system software on the existing Operator Workstations for interface to the existing Building Energy Management system will NOT be permitted or accepted.

1.3 All application specific controllers on all network controllers shall be configurable, commissionable and downloadable through the Server or Network Controller IP connection.

1.4 All unitary and field controllers shall be commissioned, uploadable and downloadable from the university SmartStruxure server. BACnet IP objects descriptions that are a jumble of letter/numbers are not acceptable. The TCC shall provide a list of points, object descriptions and coordinate with Schneider Electric.

1.5 All unitary and field controllers shall be commissioned, up-loadable and downloadable from the university host network automation engine. LON/BACnet/MODBUD object descriptions that are a jumble of letter/numbers are not acceptable.

1.6 The controls system for this project shall be a web-based digital controls system. All controllers, control interface hardware, services, installation, warranty, training, etc., shall be included as hereinafter specified. The system shall utilize a network controller and unitary" type controllers. Including such minor details not specifically mentioned or shown, as may be necessary for the complete operation of the system.

1.7 A pre-programming meeting shall be held with the TCC, Engineer, Owner and Schneider Electric to discuss program variable names, room name scheme LON and system structure.

1.8 The Temperature Control Contractor (TCC) shall furnish all labor, materials, equipment, and service necessary for a complete and operating Building Automation System (BAS), utilizing Web Based Direct Digital Controls. All labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits

and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned shall be included for the complete, fully functional and commissioned temperature controls system.

1.9 The TCC shall provide all items, articles, materials, devices, operations or methods listed, mentioned or scheduled on the drawings including all labor, materials, equipment and incidentals necessary and required for their completion to provide a complete and operating temperature control system. This will include connecting to any mechanical equipment furnished with a control interface device and contacting the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished.

1.10 These apparatus' shall consist of, but not limited to, all necessary thermostats, sensing devices, valves, automatic dampers, damper motors, actuators, (except automatic dampers, valves, and damper motors furnished with HVAC equipment), and with the necessary accessories for the complete control of all equipment hereinafter specified.

1.11 Control sequences are specified at the end of this section. Provide all control equipment required to perform sequences described. Coordinate all dampers with the sheet metal contractor and equipment provider. It is the responsibility of the control contractor to ensure all required dampers in the sequence of operations are provided.

1.12 Coordinate wells, flow meters, valves with mechanical contractor.

1.13 Include all power wiring and cabling for the operation of the controls system. Refer to Electrical Division Specifications for additional requirements.

1.14 Manufacturer's: Schneider, Johnson Controls factory Branch Office, and Siemens Factory Branch Office. These TCCs/manufacturers have prior approval with the Owner and Engineer and are the only allowed suppliers and/or installing TCCs.

1.15 The TCC shall have an established working relationship with the control manufacturer of not less than five years and shall have prior approval from the Owner and Engineer and are the only allowed suppliers and/or installing contractors. The TCC shall have a local office within 50 miles of the project site and provide service and/or replacement parts within a 24 hour notification of a control failure. The Building Management System contractor shall be staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The contractor's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.

1.16 A mandatory pre-installation meeting shall occur prior to the TCC beginning any work on site. This meeting shall be attended minimally the prime contractor, mechanical contractor superintendent, TCC superintendent, Engineer, Owner and Architect. The purpose of the meeting is to have the controls installer communicate their understanding of the system design and how the system is intended operate to the Engineer and get the Engineer's input and agreement. The agreement between the TCC and the mechanical engineer is to be thoroughly documented by the TCC for later reference.

1.17 The installation shall comply with the Local Authorities and State Fire Marshal code requirements, including normal operating and smoke mode functions (where applicable). The installation shall comply with the requirements of the NEC, NFPA, UL and the Building Codes, including referenced mechanical, electrical, energy codes, etc.

1.18 Abbreviations
- TCC – Temperature Control Contractor
- BAS – Building Automation System

1.19 The TCC shall list the following cost breakdowns, material and labor, on the official project schedule of values:
- Controls shop drawings
- Controls materials and labor
- Controls startup, commissioning, testing, documentation (2.5% of controls contract value)
- Controls training and Owner acceptance (2.5% of controls contract value)

PART 2 – ALLOWANCE:

1.20 Northern Kentucky University has elected to utilize Schneider Electric as their System Integrator to connect controls provided under this contract with the existing Schneider Electric SmartStruxure Facility Management System front-end platform. The successful Building Automation contractor must utilize, contract and coordinate all system integration functions listed within this specification.

1.21 The BAS allowance shall provide control, alarm detection, scheduling, reporting and information management for the entire facility.

1.22 It will be the responsibility of Schneider Electric to implement this project onto the SmartStruxure server with no damage to the existing projects.

1.23 Allowance shall include mapping all the BACnet IP objects from the temperature control network controller and the power monitor to the SmartStruxure server/front-end system in the Physical Plant.

1.24 If TCC needs to update or revise any of the existing software, to allow their software to operate seamlessly with the owners existing server, it will be completed by Schneider Electric as a part of this allowance.

1.25 If the existing building head end software needs to be updated or revised to communicate with TCC's software it is to be completed Schneider Electric as part of the allowance.

1.26 All new software, graphics, terminology, operation, trending, scheduling etc. is match any existing systems and any changes needed to accomplish this will be the responsibility of the TCC.

1.27 Allowance shall include Graphics

1.28 The TCC shall provide all CAT6A cabling network cabling for power meter MODbus TCP/IP connection. This shall include cabling to the Owner's data drop. The main system data drop will be provided by others.

1.29 The BAS shall include trend logging screens accessible from tabs on the home page for building utilities usage.

PART 3 - GENERAL SYSTEM REQUIREMENTS:

3.1 All labeling for this system shall utilize actual final room names and numbers. The room names and numbers on the Contract Documents may not be the Owner's exact requirements. Coordinate with the Owner to insure compliance.

3.2 Include in the bid for the Controls Contractor to perform additional 40 on-site hours of on-site programming, adjustments, modifications, etc. as requested by the Engineer during the warranty period after the date of substantial completion for the project.

3.3 All points of user interface shall be on standard PCs that do not require the purchase of any special software from the control's manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

3.4 The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system integrated utilizing ANSI/ASHRAE Standard 135-2001 BACnet, LONWorks technology, OBIX TCP/IP, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

3.5 The TCC shall connect to any mechanical and electrical (power monitoring) equipment furnished with a control interface device. The TCC shall contact the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished. All points not provided with the equipment control interface are the responsibility of the TCC.

3.6 The operating system shall be based on a distributed control system in accordance with specifications. All building controllers, application controllers and all input/output devices shall communicate LonMark/LonTalk communication protocol. Network controller shall communicate via BACnet over Ethernet (IP). BACnet MS/TP is NOT an approved communication protocol.

3.7 The TCC contractor shall provide access to the system from a location determined by the Owner and from the Consulting Engineer's office. This shall include remote access requirements, set-up, passwords and any software necessary to access the BAS system.

3.8 The TCC shall all have access to various types of WEB browsers (i.e. Netscape, IE, etc.), which shall be included for access to the Direct Digital Control (DDC) system via the Owner's Wide Area Network (WAN) and/or Local Area Network (LAN).

3.9 The TCC shall be responsible for coordination with the Owner's IT staff to ensure that their system will perform in the Owner's environment without disruption to any of the other activities taking place on that WAN/LAN.

3.10 On Static pressure safeties during smoke purge, fireman override's etc., the Fire Alarm contractor shall be responsible for providing contacts and wiring to override applicable safety controls.

PART 4 – SUBMITTALS:

4.1 The TCC shall not start the project installation until the shop drawing submittals have been reviewed by the Engineer.

4.2 Submittals shall include hardware, end devices, ancillary control components, a written operating sequence, unitary control wiring, building floor plans showing communication cabling and labels as well as logic flow diagrams. All submittals shall be provided on paper and electronically in PDF format.

4.3 Submittals shall contain one control drawing per specified system and equipment.

Drawing shall include point descriptors (DI, DO, AI, AO), addressing, and point names. Each point names shall be unique (within a system and between systems). For example, the point named for the mixed air temperature for AHU #1, AHU #2, and AHU #3 shall not be MAT but should be named AHU#1MAT, AHU#2MAT, and AHU#3MAT. The point names should be logical and consistent between systems and AHU's. The abbreviation or short hand notation (e.g., MAT) shall be clearly defined in writing by the TCC.

4.4 Control diagrams shall identify: System being controlled (attach abbreviated control logic text, all digital points, analog points, virtual points, all functions (logic, math, and control) within control loop, legend for graphical icons or symbols, definition of variables or point names and detailed electric connections to all control devices and sensors.

4.5 Points list shall include all physical input/output. Points list shall be provided in both hard copy and in electronic format and shall include: Name, address, engineering units, high and low alarm values and alarm differentials for return to normal condition, default value to be used when the normal controlling value is not reporting, message and alarm reporting as specified, identification of all adjustable points and description of all points.

4.6 Submittals shall contain floor plans depicting DDC control devices (control units, network devices, LAN interface devices, and power transformers as well as static pressure sensor in duct and temperature sensors in rooms) in relation to mechanical rooms, HVAC equipment, and building footprint.

4.7 Submittals shall contain DDC system architecture diagram indicating schematic location of all control units, LAN Interface devices, etc. Indicate address and type for each control unit, Indicate protocol, baud rate, and type of LAN per control unit.

4.8 Electrical wiring diagrams shall include motor start, control, and safety circuits and detailed digital interface panel control point termination diagrams with all wire numbers and terminal block numbers identified. Indicate all required electrical wiring. Provide panel termination drawings on separate drawings. Clearly differentiate between portions of wiring that are existing, factory-installed and portions to be field-installed.

4.9 Show all electric connections of the controls system to equipment furnished by others complete to terminal points identified with manufacturer's terminal recommendations.

4.10 TCC shall provide one complete drawing that shows the control-wiring interface with equipment provided by others.

4.11 Submittals shall include project specific graphic screens for each system including a picture of the screen with a list of the variables to be placed on the screen. (ALLOWANCE)

4.12 Submittals shall include TCC's hardware checkout sheets and test reports.

4.13 Submittals shall include the agenda for approval by the engineer and owner of the specified training periods.

4.14 Provide complete panel drawings that are:

- Clearly labeled and schematic or drawn to scale.
- Show the internal and external component arrangement so that the operators can identify the components by their position if the labels come off.
- Wiring access routes shall also be identified so that Class 1 wiring is separated from Class 2 and 3 and so high voltage wiring is segregated from low voltage wiring.

- Complete identification of all control devices (manufacturer's type, number, and function).
- Provide details for labeling all wiring, control devices, and controllers.
- Material and equipment descriptive material such as catalog cuts, diagrams, performance curves, and other data to demonstrate conformance with specifications shall be provided.

4.15 Include room schedule including a separate line for each terminal unit, heat pump, etc. indicating location and address.

4.16 Include control valve schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: code number, configuration, fail position, pipe size, valve size, body configuration, close-off pressure, capacity, valve Cv, design pressure, and actuator type.

4.17 Include control damper schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: code number, fail position, damper type, damper operator, duct size, damper size, mounting, and actuator type.

PART 5 – O&M MANUALS AND CLOSEOUT DOCUMENTS:

5.1 Refer to Mechanical Specification Section – REQUIRED SHOP DRAWINGS, ETC. for additional requirements.

5.2 Operating instructions, maintenance procedures, parts and repair manuals shall be supplied. Repair manuals shall include detailed instructions in the setup, calibration, repair and maintenance of all equipment furnished. Also supplied with these manuals will be a complete parts listing of all devices supplied which is to include part numbers and model numbers of all parts and component parts along with exploded views of devices.

5.3 All as built drawings (wiring diagrams, flowcharts, floor plans, etc.) shall also be supplied to the owner electronically in PDF format.

5.4 System specific wiring, control diagrams, sequence of operation and points lists shall be as installed in each control panel. This means as-built drawings, not design (submittal) drawings.

5.5 Supply all software necessary for configuration of, modification, editing or communicating to any of the unitary devices. Software shall be capable of uploading and down-loading the entire unitary data base or any part of the automated system for backup or archiving.

5.6 Supply one copy of the software programming manual (hard copy and PDF format). The manual shall describe all furnished software. The manual shall be oriented to programmers and shall describe calling requirements, data exchange requirements, data file requirements, and other information necessary to enable proper integration, loading, testing, and program execution.

5.7 Provide a Bill of Materials with each schematic drawing. List all devices/equipment and match to schematic and actual field labeling. Provide quantity, manufacturer, actual product ordering number, description, size, accuracy, operating ranges (voltage, temperature, pressure, etc.), input/output parameters, etc.

5.8 Maintenance manual shall include copies of signed-off acceptance test forms, commissioning reports, start-up reports, etc.

5.9 The TCC shall turn over to owner two (2) sets of computerized back-ups of the complete temperature control system.

PART 6 – WARRANTY & SOFTWARE LICENSES:

6.1 Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after substantial completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.

6.2 The TCC shall respond to the Owner's request for warranty service within 24 hours during normal business hours. The TCC shall respond to the Owner's request for Emergency service (defined as life-threatening or creating the potential to cause property damage) during the warranty period within 4 hours.

6.3 The TCC shall provide technical phone support to the owner during the warranty period for warranty related issues and for two years after the warranty period. If the technical support location of the TCC is outside of the toll free calling area for the customer, the TCC shall have a toll free number or accept collect calls for the purpose of providing technical support.

6.4 During the warranty period, standard parts for the DDC system shall arrive at the facility within 48 hours of placing an order. Non-standard parts (requiring re-manufacturing or ordering from another supplier) shall be shipped within 96 hours.

6.5 Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the TCC shall be provided and correctly installed at no charge during the warranty period.

6.6 Provide licensed electronic copies of all software for each workstation, laptop, and server. This includes, but is not limited to: project graphic images (editing/modifying/creating), project database, trouble-shooting and debugging programs, project-specific programming code and all other software required to operate and modify the programming code (including software at system level, primary control units, secondary control units, and all communication software). Any hardware devices (cables, protection devices) required to operate the software/hardware shall also be provided.

6.7 All additional licensing needed for this project shall be supplied by TCC. Software license shall not expire or utilize any sort of protection hardware device for its use. In any case owner shall be free to direct the modification of any software license, regardless of supplier to allow open access to all controllers. Owner shall hold the software and firmware licensing. Software license shall not expire or utilize any sort of protection hardware device for its use.

6.8 System software shall be the latest version available with upgrades provided at the end of the warranty period, and shall be fully licensed to the Owner for the entire system. Supply all software necessary for configuration of, modification, editing or communicating to any of the unitary devices. Software shall be capable of uploading and down-loading the entire unitary data base or any part of the automated system for backup or archiving.

Software shall be "IBM compatible".

PART 7 – TRAINING:

7.1 FACTORY TRAINING -- Provide training at a Manufacturer's Factory Training Center on the operation of the system for two NKU staff members. Minimum 4 days of training. Control Contractor shall pay travel (air fare if training center is greater than 400 miles from project site or vehicle mileage at $0.45/mile), lodging, and registration fees. Coordinate with NKU on itinerary to avoid travel that will require extended travel time other than regular NKU working hours. Coordinate with NKU as to which Manufacturer training they will receive training from, and which course. Provide close-out documentation for training and warranty obligations.

7.2 A formal on-site "Hands On" training session shall be conducted for the owner's maintenance personnel. This session shall be a minimum of one (1) eight (8) hour days to train the staff on setup, operation, and maintenance of all system(s) and/or devices. This will be at a time and location selected by the owner. One (1) additional eight (8) hour session shall be provided as "opposite season" training – generally 6 months into the warranty period. One (1) additional eight (8) hour session shall be provided at a later date. (This may be requested any time during the warranty period.) All training materials and books shall be provided. Both sessions shall be given by the manufacturers "factory" technical representative. (This is defined as someone other than the installing contractor's representative.) All expenses are to be provided by the TCC. All training sessions shall be scheduled at owner's request.

7.3 Training shall be a mix of, test exercises, and actual keyboard entry and screen viewing at the operator's terminal. A curriculum shall be discussed and implemented based on the level of expertise of the employees. Hands-on experience and problem solving shall be emphasized.

7.4 If during any training session, the trainer/owner finds more than three (3) items that need repair, the training session will be immediately terminated. The session will be rescheduled for another date. The re-scheduled training session will be carried out at no additional cost to the Owner.

7.5 Additionally, the training shall include:

- System start-up, shutdowns, power outage and restart routines, alarms, security levels, changing setpoints, changing schedules and other parameters, overrides, freeze protection, manual operation, return to automatic operation, and resetting equipment.
- All screens shall be discussed, allowing time for questions.
- Information specifically focused on showing the owner methods of troubleshooting the mechanical systems using the DDC.
- Use of laptop and hand-held operator interface device, if applicable.
- Creating, modifying, viewing, downloading, and reloading, trend logs.
- Remote access to the system.
- The other training sessions shall be oriented toward answering specific questions from Owner's staff.
- The trainer must be well grounded in both DDC system operation and in mechanical systems service and shall be the programmer.

7.6 This documentation and process shall be complete, approved and accepted by Engineer and Owner prior to acceptance. This information shall be documented as completed. A

copy shall be delivered to the Engineer and Owner and included in the O&M manuals.

7.7 Coordinate training schedule with the project commissioning agent.

PART 8 – COMMISSIONING & VERIFICATION, FUNCTIONAL PERFORMANCE TESTING & CHECKLISTS:

8.1 100% compliance with the requirements of this section is a condition of the Owner's acceptance and start of the warranty period.

8.2 The TCC shall be responsible for completion of (1) their hardware checkout sheets and test reports, (2) Point- by-point confirmations of ALL points – this includes visual inspection of installed components, and (3) sequence of operation confirmation.

8.3 This documentation and process shall be complete, approved and accepted by Engineer and Owner prior to acceptance. This information shall be documented as completed. A copy shall be delivered to the Engineer and Owner and included in the O&M manuals. Each subcontractor shall be responsible for completion of their own System Verification Checklists/Manufacturer's Checklists. Sample checklists shall be submitted to the Engineer and Testing Agent for approval.

8.4 Provide the Commissioning, configuration and diagnostic tool (CCDT), color display personnel computer, software, and interfaces to provide uploading/downloading of High Point Count Controllers (AAC), Unitary Equipment Controllers (UEC) and VAV controllers (VAVDDC) monitoring all objects, monitoring overrides of all controller physical input/output points, and editing of controller resident time schedules.

8.5 Air and water balancing shall be completed (and discrepancies resolved) before the TCC's final system check and before the acceptance test to be conducted in the presence of the Engineer.

8.6 Refer to Mechanical Specification Section – GENERAL PROVISIONS for additional information and requirements.

PART 9 – WIRE MANAGEMENT, ELECTRICAL POWER, ETC:

9.1 Refer to CABLING section of this specification for additional requirements.

9.2 Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.

9.3 All wiring and cabling in mechanical and electrical rooms shall be in conduit. No wiring or conduit can be exposed to view in any other area. Conceal all wiring and cabling in conduit in wall from thermostats or other controls devices to above ceiling. Install conduit in wall from wall thermostats to above ceiling for cabling. Route wiring directly to cable tray from control points above the ceiling. Rough-in for control devices shall be in compliance with the requirements of the ELECTRICAL SPECIFICATIONS.

9.4 Any power for controls shall be fed from dedicated circuits in emergency electrical panels, when provided for a project, and shall not be obtained from receptacles, lighting, or equipment circuits. Unitary control power may be obtained from the equipment served. If power is obtained from the equipment served, the power may not be interrupted to the electronics if the equipment is off for any reason.

9.5 Electrical trade to provide all necessary 120vac emergency/normal circuits required for BAS control panel power in each mechanical room where BAS panels are located. BAS controls contractor to extend the 120vac circuits from central location in mechanical room to each BAS control panel.

9.6 The TCC shall be responsible for the power source to any control panels, unitary controllers, etc. on any controlled equipment and all other control power requirements. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.

9.7 Prior to installation, insure through coordination with all trades, that appropriate clearances (36" minimum) as required by the N.E.C. are maintained at all control panels, including unitary controllers for VAV terminals, heat pumps, etc.

9.8 The TCC shall provide all CAT6A cabling network cabling for a complete system. This shall include cabling to the Owner's data drop. The main system data drop will be provided by others.

9.9 All control circuits within the electrical panels shall be marked to indicate equipment served.

9.10 The TCC shall perform all temperature control interlock wiring. This shall include control valves, dampers, thermostats, indoor/outdoor HVAC systems, etc. Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.

9.11 The TCC shall be responsible for any power required for the unitary controls or control panels. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.

9.12 Provide one duplex outlet mounted inside the control panel and separately fused with a non-time delay fuse at 15 A at any panel location containing electronic control components. This receptacle may be served from the control panel 120 VAC power source.

9.13 All wiring shall be continuous runs. Any junctions must be made in metal enclosure.

9.14 Grounding terminals shall be color coded green and yellow and shall be compatible with the other specialty terminals specified above and shall mount on the same DIN rail system. Units shall be arranged so that the wiring connected to them is grounded to the enclosure via the mounting rail. These terminals shall be provided for grounding cable shields at the points where the cables enter a control panel and terminate on the control panel terminal strip. Terminals shall be Entrelec M 4/5.3A.PI or equivalent by Weidmuller, Phoenix, or Allen Bradley.

9.15 The Department of Housing, Building and Construction's Electrical Division requires that all new lighting control panels, new Building Automation Systems control panels, and new conventional HVAC control panels be certified as being constructed and wired in accordance with NFPA 70 110.3 (a) (1) and article 409.

9.16 Contractor shall insure control panels have an identification label stating the "Certification Agency" such as UL, CSA, CE, etc. or a label of certification for each control panel by a Professional Engineer (P.E.) registered in the State of Kentucky, stating that the design of

the control panel was under their direct supervisory control. Include with shop drawings.

9.17 The Electrical Advisory Council for the State of Kentucky requires that only an electrical contractor licensed by the State of Kentucky with a licensed Master Electrician and a licensed on-site electrician can install the electrical wiring for lighting controls systems or Building Automation Systems (BAS).

PART 10 – CABLING:

10.1 Refer to WIRE MANAGEMENT section of this specification for additional requirements.

10.2 ALL CONTROL WIRING SHALL BE INSTALLED IN A WIRE MANAGEMENT SYSTEM TO INCLUDE CABLE TRAYS, BRIDLE RINGS, & CONDUITS. NO EXCEPTIONS! COORDINATE WITH ELECTRICAL CONTRACTOR TO INSURE A COMPLETE WIRE MANGEMENT SYSTEM.

10.3 Acceptable cable manufacturers are Belden, West Penn or Alpha.

10.4 A complete cabling system shall be furnished and installed, which shall adhere to the highest workmanlike standard of quality and appearance. Cabling shall be installed square with building lines and contained within a wire management system.

10.5 All sizing of cabling shall be according to manufacturer's recommendations, but shall be a minimum of 18 AWG.

10.6 Furnish a floor plan of the building indicating communication cable labeling and routing as well as addresses and branch wiring from the unitary devices. All cabling shall be labeled on both ends. The type, size and label of all cabling shall be indicated on submittal floor plan drawings.

10.7 Wall space temperature sensor cabling (from the sensor to the unitary controller) shall have a minimum of four (4) conductors.

10.8 All cabling shall be stranded. "NO" solid conductors will be accepted. All cabling shall be 100% shielded with appropriate drain wire and insulation.

10.9 All cable connections shall be continuous run (including shield). Any junctions must be made in a metal enclosure, connections must be soldered, taped and the metal enclosure must be mechanically attached to the nearest ground. No wire nuts or crimped connections will be accepted. Note location of junction boxes on the as built floor plans. All cabling networking unitary controllers, and other networked equipment, shall be in soldered.

10.10 All shields must be terminated as per manufacturer's recommendation. Shield termination requirements by the manufacturer must be provided with submittals.

10.11 Wireless controllers are not approved.

PART 11 – SYSTEM SOFTWARE:

11.1 System software will be the latest version available with upgrades provided for full warranty period, and shall be fully licensed to the owner for all network controllers and servers. Refer to WARRANTY section of this specification for additional requirements.

11.2 System software shall, at a minimum, provide:

- Monitor and supervise all control points.
- Add new points and edit system database.
- Change control setpoints, timing parameters and loop tuning of PID coefficients in all control loops in all control units.
- Enter programmed start/stop schedules.
- Modify existing control logic (or sequence of operation) in all control units.
- Upload/Download programs, databases, control parameters, etc.
- Modify graphic screens.

11.3 Sequence of operation programming methodology - The application software shall be user programmable. Application programming shall be (1) Line type programming that uses text programming in a language similar to BASIC or FORTRAN, or (2) graphical block programming - The method of programming shall be by manipulation of graphic icon "blocks." Each block represents a subroutine containing the programming necessary to execute the function of the device that the block represents.

11.4 Unitary Control Unit Database Archiving - The host software shall provide capability to upload sequence of operation, database, and other control parameters from each controller. Uploaded programs shall be retained on hard disk for system backup. Programs may be modified using Editor-functions, and downloaded to individual controllers as desired. Downloading of databases shall not interrupt other multi-tasked functions that are ongoing.

11.5 Third Party Software Packages - The host software shall provide the capacity to run third party software packages for word processing, spreadsheets, or database management programs. Use of third party software shall not suspend operation of background tasks of multi-tasking operating system, such as alarm logging, and report generation.

PART 12 – COLOR GRAPHIC DISPLAYS (ALLOWANCE):

12.1 Scheduling provided by the allowance.

12.2 The color graphics shall reside on the Schneider SmartStruxture server and are included in the allowance. All graphics shall be consistence with NKU graphic standards.

12.3 All graphics screens shall be submitted for review by Engineer. Provide the following animated, color graphics screens minimally:

12.4 Entire floor plan home screen with OAT, Time and Date displays.
- Floor plan showing major zones,
- Graphics shall include a floor plan with zone temperature and a matrix view for each floor showing room number: VAV Zone Number, Room Number, CFM, Space Temperature, Discharge Air Temperature, Damper Position and Reheat % at a minimum. Heat Pump Zone Number, Room Number, Space Temperature, Discharge Air Temperature, Heating / Cooling mode.
- Click major zone displays enlarged floor plan of the zone showing individual heat pump zones & numbers.
- Include link to respective mechanical room.
- Click individual zone shows heat pump graphic. Display all data points from points list, occ/unocc schedule and setpoints, VAV cfm and setpoint, OAT, Time and Date.

12.5 Color Graphic Screens to match existing shall be designed the Dashboard in the Steam Plant and shall include the following:

- Electric power metering demand and consumption
- Steam metering demand and consumption
- Gas meters demand and consumption
- Chilled water demand and consumption
- Domestic water demand and consumption
-

12.6 Color Graphic Screens shall be designed for all mechanical systems and shall include the following:

- A graphic shall be the starting page with the building graphically indicated. Break up the floor plan into zones to match Contract Documents. The building shall be the point of reference to enter into the respective building control system.
- All heat pump units including pumps, filters, associated VAV boxes, etc.
- All terminal equipment including but not limited to VAV boxes, reheat coils, zone dampers, etc.
- All AHU and OA units.
- Domestic hot water heaters and pumps.
- Pool Dehumidification Unit
- The summation of all supply OA for each unit shall be displayed on the AHU graphic pages.

12.7 Graphics to include floor plans with room numbers (as-built room numbers) and thermostat locations, links to flow diagrams for heat pumps, zone dampers, hydronic loop systems, outside air systems, domestic hot water and lighting controls.

12.8 All new graphics shall match the existing system graphics, unless noted otherwise.

12.9 The graphical programming software shall allow for interactive mouse-driven placement of block icons on the graphic screen and connection of block inputs to block outputs by means of drawing lines to form a graphic logic diagram. The user shall not have to manually input text to assign block input/output interconnections. Blocks shall allow entry of adjustable settings and parameters via pop-up windows.

12.10 Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.

12.11 All data fields must indicate a unit of measure; DegF, %, ppm, etc.

12.12 The clarity of sequence shall be such that the user has the ability to verify that the system programming meets the specs without having to learn or interpret a manufacturer's unique programming language. Provide a means for testing and/or debugging the control programs off-line (not communicating with control units) using operator entered values for physical inputs and time. Provide a means for testing and/or debugging the control programs on-line (communicating with control units), showing actual physical inputs land all block outputs in real time.

12.13 Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time output values.

- Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.

12.14 All graphic software shall be in the html web browser format and support multiple

simultaneous screens to be opened and resizable in a "Windows" type environment. All functions, except text entry, shall be executable with a mouse. Graphic software shall provide for multitasking such that third party programs can be used while the Operator Workstation Software is on-line. Provide the ability to alarm graphically even when operator is in another software package. The software shall allow for Owner to create user defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics.

12.15 The contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, coils, filters, dampers, etc.), mechanical system components (e.g., pumps, heat pumps, etc.), complete mechanical systems (e.g. VAV, etc.) and electrical symbols. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.

12.16 All applicable control points must have “Forced by Operator” or “Manual Mode” properties that are clearly displayed on individual graphic pages for each point accessible from the graphic page. This is displayed by a “M” in the data field.

12.17 The graphic development package shall use a mouse or similar pointing device to allow the user to perform the following:

- Define symbols
- Position items on graphic screens
- Attach physical or virtual points to a graphic
- Define background screens
- Define connecting lines and curves
- Locate, orient and size descriptive text
- Define and display colors for all elements
- Establish correlation between symbols or text and associated system points or other displays.
- Create hot spots or link triggers to other graphic displays or other functions in the software

12.18 The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.

12.19 A matrix view for all Heat Pump’s and VAV’s must be provided in addition to individualized Heat Pump and VAV pages. VAV Graphics must:

- Have an individual graphic page along with a floor/building matrix page
- Provide linking between individualized Heat Pump/ VAV pages to the floor plan and the conceding matrix page. Linking must also be established to previous and succeeding Heat Pump/ VAV boxes through the use of up/down arrows.
- All Heat Pump fans, pumps, heating and cooling controls need to be force-able at the operators discretion from the graphic pages
- All VAV dampers, valves and airflow controls need to be force-able at the operators discretion from the graphic pages.
- “Global” HP setpoints to multiple HP’s shall be performed from a single location on the graphics page.
- “Global” VAV setpoints to multiple VAV’s shall be performed from a single location on the graphics page.
- Each graphic page must be individualized; a “Master” may not be used as a template

for similar zones/controllers so that zone or area specific instructions/notes can be added to each graphic.

PART 13 – ALARMS AND TRENDS (ALLOWANCE)

13.1 Scheduling provided by the allowance

13.2 The alarms and trends shall reside on the Schneider Smartstructure server or the Schneider I/NET server and are included in the allowance. All alarms and trends shall be consistence with NKU standards.

13.3 All alarms must be displayed in the alarm queue and also on the coinciding graphic page with a red flashing alarm indication in the data field and/or similar graphic presentation.

13.4 Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another. Start/Stop and Status points must indicate a graphical and color change in state, (green to black) or similar presentation using the same color scheme.

13.5 All temperature sensors must have a High & Low Level Alarm Limit Set. These alarms limits shall be discussed with NKU prior to implementation of programming of resident I/O's

13.6 Trending of control points must be available on all control & monitoring points and accessible through graphic pages. Ability to add and delete trending data shall also be made available through graphical displays.

13.7 The TCC shall including programming of 25 point trends as directed by the Engineer. These can be requested at any time during the project including the warranty period. Trend "change of state" for digital inputs. Trend analog points in 30 minute increments. Maintain trend history for 30 days. Include the following:

- Outside air temperature
- OA unit leaving air temperatures for each unit
- Summation of all VAV boxes connected to a unit
- VFD speeds (OA & EA)
- Geothermal wellfield main supply and return temperatures
- Geothermal wellfield main flow rate
- Water to water unit main supply and return temperatures (load side)
- Critical room space temperatures
- Domestic hot water supply temperatures
- Makeup water flow rate
- Electrical power kW and kWh
- Others as directed in the field

PART 14 – SYSTEM ARCHITECTURE

14.1 The Building Automation System (BAS) shall consist of Network Controllers and a family of Standalone Digital Control Units.

14.1.1 The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP.. A sub- network of Standalone Digital Unitary Controller using the LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

14.1.2 All Network Controllers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with **no required gateways**. Furthermore, the Network Controller shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.

14.1.3 Gateway's are not approved on this project.

PART 15 – NETWORK CONTROLLER

15.1 The University's existing enterprise level control system between buildings shall maintain TCP/IP for communications of building data with the server-based graphical user interface and enterprise information system. Coordinate with the university's IT department on locations for Ethernet communication cabling and TCP/IP addresses. It is intended to minimize control system traffic over the University's shared Ethernet network. IT is intended that only one Network "Building Level" Controller and its associated TCP/IP address be used per building. Each building shall have its own subnet and Broadcast Management Device (BBMD). The University shall provide the Ethernet switch and port. No other IP switches shall be permitted. The TCC shall provide raceway for the University provided cabling between the switch and the Network "Building Level" Controller. Control systems shall not rely on University Ethernet communications for control sequences.

15.2 The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connection to the campus WAN shall be used for the Network Controller that connects to the WAN.

15.3 Install the Network Controller in a surface mounted panel, NEMA type 12 enclosures, with a removable hinged door. Provide a flush mounted key lock. All control panels must be painted the same color and identified. The boxes are to be made from 16 gauge material. Panels should not be provided with knockouts.

15.4 For each panel, provide a UPS power supply to help with brief power outages and power surges

15.5 Web-based operation shall be supported directly by the Network Controller and require no additional software, other than a Java supported network browser.

15.6 Control panels shall be constructed by a UL approved panel manufacturer. The standard used shall be UL508A. All proper labels are to be attached. Panel shall meet the requirements of UL512 and be arc flash compliant panels.

15.7 The Network Controller shall be web-based and communicate BACnet IP. It shall issue all time schedules, summer/winter commands, customized trending, holiday scheduling, alarm handling, clock or other shared commands to all unitary controllers within the building network. If for any reason communications between the unitary(s) and the Network Controller is lost, the unitary(s) shall operate in a stand-alone manner (in day operation) until communications is restored. It shall also operate in the "summer" or "winter" mode as last commanded.

15.8 The Network Controller shall be integrated and interoperable with the facility infrastructure

and include user access to all system data locally over the Local Area Network (LAN) / Wide Area Network (WAN) within the building and remotely by a standard Web Browser over the Internet. Any computer connected to the network, utilizing a web browser and having the proper password.

15.9 The Network Controller shall be a fully user-programmable, supervisory controller. It shall monitor the network of distributed unitary controllers, provide global strategy and direction, and communicate on a peer-to- peer basis with other Network Controllers. The Network Controller shall have UPS back-up to allow a minimum of seven days of operation. The Network Controller shall be composed of one or more independent, stand-alone, microprocessor to manage the network strategies described in Application software section. The network controller shall have ample memory to support its operating system, database and programming requirements. The operating system of the Network Controller shall manage the input and output communications signals to allow distributed unitary controllers to share real and virtual point information and allow central monitoring and alarms. The database and custom programming routines of the Network Controller shall be editable from a single operator station.

15.10 The Network Controller shall be remotely monitored via the internet. Additionally, it shall include automatic emailing and texting out alarms, gathering alarms, reports and logs, programming and downloading database.

15.11 The Network Controller shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:

- Assume a predetermined failure mode.
- Emit an alarm.
- Display card failure identification.

15.12 Under no circumstance shall more than 75% of the total number of sensor and control points be connected through a single Network Controller. Each DDC system component shall provide for the future addition of at least 20% of each type of the number of sensor and control points connected to that component including a minimum of one universal input and one universal output.

PART 16 – UNITARY CONTROLLER

16.1 Unless otherwise specified, each piece of equipment shall have its own Unitary Controller (i.e., heat pump, AHU, terminal unit, etc.). The Unitary Controller for each piece of equipment shall be mounted on the side of the unit. The Unitary Controller for all other equipment shall be mounted in a panel and properly labeled.

16.2 Panels in mechanical rooms subject to water damage from above shall be installed in a surface mounted panel, NEMA type 12 enclosures, with a removable hinged door. Provide a flush mounted key lock. All control panels must be painted the same color and identified. The boxes are to be made from 16 gauge material. Panels should not be provided with knockouts. NEMA 1 panels are acceptable in remaining locations.

16.3 Each Central Station Air Handler and/or Outside Air Unit shall have its own Unitary Controller mounted where shown on the drawings. If an installation location is not clear, the Contractor shall notify the Engineer for clarification prior to installation.

16.4 Unitary Controllers used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 degrees F to 120 degrees F. All Unitary Controllers

shall have an RJ-11 or similar type connection for monitoring or programming access by room or local equipment level with access to any unitary within the network without modification.

16.5 Control panels shall be constructed by a UL approved panel manufacturer. The standard used shall be UL508A. All proper labels are to be attached. Panel shall meet the requirements of UL512 and be arc flash compliant panels.

16.6 Unitary Controllers utilized in the network shall have full stand-alone capability including time of day and holiday scheduling as well as all energy management functions such as optimal start/stop, duty cycling, etc. The terminal unit Unitary Controllers may be pre-programmed with the project specific sequence of operation as specified for the application. Any re-programming of the electronics shall be performed on location using a portable personal computer with appropriate software or through the Network Controller. The entire unitary data base shall have the capability of being backed up and or downloaded locally.

16.7 All points to have a unique digital input to the BAS system. The use of digital point count expanders is not an acceptable replacement to digital inputs to the unitary controller. The conversion of a single universal input channel to accept up to multiple voltage free contacts such as relay contacts, auxiliary starter contacts, differential pressure switches, etc. IS NOT ACCEPTABLE.

16.7.1 The Fieldbus layer shall be support all of the following types of Standalone Digital Unitary Controller's:

16.7.2 LonWorks Standalone Digital Unitary Controller requirements: The system shall consist of one or more LonWorks FTT-10A field buses managed by the Network Controller. Minimum speed shall be 76.8kbps. The field bus layer shall use peer-to-peer, event-driven communication for operation of HVAC and lighting equipment.

16.7.3 Modbus Standalone Digital Unitary Controller requirements: The system shall consist of one or more Modbus RTU (RS-485 or RS-232) field buses managed by the Network Controller.

16.8 All Unitary Controllers shall be fully application programmable. All control sequences within or programmed into the unitary controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery shall be retained.

16.9 Unitary Controllers shall have a 10% spare point capacity to be provided for all applications.

16.10 The Unitary Controller for each VAV box shall be mounted on the side of the unit. The unitary controller for all other equipment shall be mounted in a panel and properly labeled. Prior to installation, insure through coordination with all trades, that appropriate clearances (36" minimum) as required by the N.E.C. are maintained at all control panels, including unitary controllers for VAV terminals, etc.

16.11 After a power failure, the Unitary Controller shall operate the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.

PART 17 – SENSORS AND MISCELLANEOUS DEVICES:

17.1 WEATHER STATION HOUSING: Provide Kele Model A21 Outdoor Aspirated

Humidity/Temperature housing. NEMA 3R enclosure is painted white to reduce the effect of radiation, and the enclosure has a lockable latch for security. The outdoor air sensor will be installed on the north wall in the shade as not to be effected by sunlight, building ventilation or weather. This location shall be indicated on the control drawings. Installation in outside air ductwork or louvers is not acceptable. If not installed to provide "accurate" temperature readings, it shall be relocated (at the TCC's expense) until a suitable location is found.

17.2 SENSOR RESOLUTION: All temperature sensors shall have a minimum resolution of 1/10th of 1 degree F. (0.1 degree F.) Sensor stability shall be 0.24 degrees over a year period. Space sensors shall be tested and accurate to within 0.75 degrees F. Outside air, water and duct sensors shall be tested and accurate to within 2.0 degrees F.

17.3 SPACE SENSORS AND THERMOSTATS:

- Refer to the drawings for proper type and location.
- All room temperature sensors shall be typical to those used currently throughout the campus. Room Temperature sensors must have blank covers with no LCD display.
- Programmed set-point shall be locally adjustable limited to 2 degrees above set-point and 2 degrees below set-point for supervised areas.
- Unsupervised areas shall have non-adjustable set-point.
- Generally, thermostats/sensors shall be installed 5'-0" above the finished floor.
- Where thermostats/sensors are to be mounted next to a light switch, install at the same height as the light switch.
- Sensors in hallways, vestibules, Gymnasiums, open fitness areas, stairways, restrooms and locker rooms shall utilize a stainless steel surface mount temperature sensor installed on an interior wall or partition (2"x4" blank plate). Care must be taken in the installation of these sensors to ensure proper insulation from the wall temperatures in order to properly sense space temperature.
- If there is a question consult engineer prior to rough-in.

17.4 WATER SENSORS: Temperature sensors for water lines are to be the well type. Wells are to be threaded brass (same manufacturer as the temperature sensor) with the sensor coated with a heat transfer compound. Strap on sensors will not be acceptable.

17.5 MIXED AIR SENSORS: These sensors shall be bendable averaging, type made of copper or aluminum elements. In unit ventilators, these sensors shall be at least five (5) feet in length and installed in the discharge air of the unit. For Air Handling Units, Outside Air Units, etc. the sensors shall be at least 20 feet in length.

17.6 DISCHARGE AIR AND DUCT ROOM RETURN AIR SENSORS: Shall be rigid insertion type. In all applications, care shall be taken to insure that the sensors are securely mounted as not to allow any vibration and installed in such a manner as to indicate the truest possible temperature.

17.7 FREEZE/LOW-LIMIT THERMOSTAT: Provide a freeze/low-limit thermostat in each Air Handling Unit, Outside Air Unit, etc with a water coil for freeze protection. These devices shall be the manual reset, DPDT type. . All Low Limits shall be hard-wired to AHU associated supply and return fan VFD's or starters. An alarm shall also be provided as status to the Schneider Electric front-end Control System. This device shall be wired by using a normally closed contact in series with the motor starting circuit and a normally open set of contacts as an input to the unitary controller. The element shall be constructed of copper and be at least 20 feet in length. It shall be installed serpentined across the air entering the coil. In some cases it may require being installed after the coil. Each application should be

closely evaluated before installation. The device shall sense the lowest temperature by any one foot section of its element.

17.8 HUMIDITY SENSORS: These devices shall be 100% solid state, linear and temperature compensated with scaling 0-100% RH range with LED or LCD Display. Accuracy at 25°C from 10-80% RH* ±2%, operating Humidity Range 0 to 100% RH (non-condensing), Stability ±1% @ 20°C (68°F) annually, for two years, Hysteresis 1.5% typical, Temperature Effect ±0.1% RH/°C above or below 25°C (typical), 1% accuracy between 0% - 90% RH, Operating Temperature Range -40° to 50°C (-40° to 122°F) +/- 1%.-Do not submit products that do not meet this range. The output of the device shall utilize an analog output 4-20 mA, 2-wire, polarity insensitive, (clipped and capped), The device shall use a power supply of 24 VAC or VDC. Duct mounted sensors shall have at least 4" insertion probe with a 16 gauge steel enclosure. NIST traceable certification shall be provided to the Engineer as part of the shop drawings. For wall mounted sensors the enclosure shall be polystyrene plastic mounted next to and at the same height as the temperature sensor in that area. Both shall have the same appearance. Provide protective cages in fitness and common areas.

17.9 COMBINATION TEMPERATURE/HUMIDITY SENSORS: All temperature sensors shall have a minimum resolution of 1/10th of 1 degree F. (0.1 degree F.) Sensor stability shall be 0.24 degrees over a year period. Space sensors shall be tested and accurate to within 0.75 degrees F. The humidity sensing device shall be 100% solid state, linear and temperature compensated with a 0-100% RH range. The response time shall be a minimum of 30 seconds for a 60% change. They shall have a minimum of 2% accuracy minimum accuracy of +/-2% RH minimum rangeability 5 to95% RH non-condensing and maximum hysteresis +/_1.5% RH.– Do not submit products that do not meet this range. The output of the device must utilize a 0-10 VDC or 4-20mA signal as required. The device must use a power supply of 24 VAC or VDC. Duct mounted sensors shall have at least 4" insertion probe with a 16 gauge steel enclosure. NIST traceable certification shall be provided to the Engineer as part of the shop drawings. For wall mounted sensors the enclosure shall be polystyrene plastic mounted next to and at the same height as the temperature sensor in that area. Both shall have the same appearance. Provide protective cages in fitness and common areas.

17.10 LOW PRESSURE TRANSDUCERS: These devises shall be 100% solid state, linear and temperature compensated. Accuracy shall be no less than plus or minus 1% of its full range. Linearity, repeatability and hysteresis shall be no less that plus or minus 0.1%. All pressure sensors shall utilize output averaging/output clipping to adjust and stabilize any fluctuations in the output. The output of the device shall utilize a 0 - 10 VDC signal. The device shall use a power supply of 24 VAC or VDC. The enclosure 16 gauge steel. For sensing internal static pressure of air handling ducts utilize sensors with a rage of 0 to 5 inches water column. For sensing building static pressures (building compared to atmospheric) utilize a sensor with a range of -0.25 to +0.25 inches water column.

17.11 RELAYS: Relays for starting and stopping fractional horsepower motors shall be rated as follows:

- 1/4 horsepower motors or less use 15 ampere rated relays,
- 1/3 horsepower motors use 20 ampere rated relays,
- 1/2 horsepower motors use 30 ampere rated relays,
- Relays used for pilot duty service shall be rated at a minimum of 10 amperes.
- Provide auxiliary pilot duty relays on motor starters as required for control function.
- Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

17.12 CENTRAL STATION AIR HANDLERS: All Central Station Air Handlers, Outside Air Units, etc shall be provided with a D.A.P. (differential air pressure) switch across each the supply fan to provide fan status for each air handler.

17.13 SMOKE SHUTDOWN: All AHUs, OA units, Heat Pump Units, etc with fans of greater than 2,000 CFM are required to have smoke shutdown safeties as required by the Building Code. The Fire Alarm Systems shall NOT provide outputs to notify the BMS of fire alarms. Those signals shall stay within the FA System. All units must be provided with a current sensor to provide fan status for each air handler and heat pump. Coordinate with the Fire Alarm Contractor to insure a complete, code compliant installation.

17.14 CURRENT SENSING DEVICES: Veris Industries model Hx08 Series and H701 or equal. All current sensors shall be capable of alarming to the BAS for belt losses, pump coupling shear or other mechanical failure on loads.

17.15 STEAM FLOW METER: Onicon Model F-2500 series vortex Meter. Accuracy +/-1% volumetric and +/- 1.5% mass; Install flow meter with sufficient pipe diameters as recommended by manufacturer. Provide factory authorized start-up verification of operation and calibration. Provide with remote display where indicated.

17.16 NATURAL GAS METER: Sage Integral Prime In-line style with NPT end connections Model Number SIP-___-DC24-NG. Coordinate Flow body sizing with manufacturer.

17.17 SINGLE DIRECTION WATER FLOW METER: Onicon Model F-1200 series dual turbine insertion flow meter. 50:1 turn down with 2% accuracy with 0.4 to 20 fps range. Install flow meter with sufficient pipe diameters as recommended by manufacturer. Provide factory authorized start-up verification of operation and calibration. Provide with remote display where indicated.

17.18 BI-DIRECTIONAL WATER FLOW METER: Onicon Model FB-1200 series dual turbine insertion flow meter. 50:1 turn down with 2% accuracy with 0.4 to 20 fps range. Install flow meter with sufficient pipe diameters as recommended by manufacturer. Provide factory authorized start-up verification of operation and calibration. Provide with remote display where indicated.

17.19 POTABLE WATER FLOW METER: Onicon Model F-1330/F-1130 series dual turbine insertion flow meter suitable for potable water applications. 50:1 turn down with 2% accuracy with 0.4 to 20 fps range. Install flow meter with sufficient pipe diameters as recommended by manufacturer. Provide factory authorized start-up verification of operation and calibration. Provide with remote display where indicated.

17.20 BTU METER: Provide and install ONICON System -10 MTU Meter system, including F-1200 dual turbine insertion flow meter, supply and return temperature sensors and wells and control panel. The entire system shall be factory calibrated and programmed for particular system where installed (geothermal system and 2-pipe system) and shall be re-programmable at the control panel keypad. Furnish a certificate of calibration for each BTU meter. Interface the control panel into the DDC controls system to obtain energy totals, flow rates, temperatures (supply and return) for trending. Install flow meter with sufficient pipe diameters as recommended by manufacturer. Provide factory authorized start-up verification of operation and calibration. Provide with remote display where indicated.

17.21 DIFFERENTIAL PRESSURE TRANSMITTERS: Provide Rosemount (ITT Bell & Gossett ST-

102R) or Johnson Controls Setra DPT 2302-050-V field mounted differential pressure sensor transmitters as indicated on the plans. Range shall be 0-25 psig. Accuracy shall be .025% full span.

17.22 CARBON DIOXIDE SENSORS: This sensor shall have a range of 0-2000/ 500 ppm programmable. Accuracy ±30 ppm ±2% of measured value*, Repeatability ±20 ppm ±1% of measured value, Response Time <60 seconds for 90% step change, Input Power 20 to 30VDC/24VAC; 100mA max., Analog Output 4-20mA, (clipped & capped)/0-5VDC/0-10VDC (selectable), Operating Temperature Range 0° to 50°C (32° to 122°F), 5-year calibration, Low ambient sensitivity, Power shall be 24VAC. Sensor shall not be provided with a LED or LCD display. Vulcain 90DM4SM-C-2000 or equal. Provide protective cages in fitness, gymnasiums and common areas.

17.23 MINIMUM OUTSIDE AIR – AIR FLOW MEASURING STATION: Ebtron Model P+ GTC116, airflow measurement: Accuracy: ±2% of reading, Calibrated range: 0 to 5,000 fpm, NIST traceable calibration; Temperature measurement Accuracy: ±0.15 deg F, Calibrated range: 20 to 160 deg F, NIST traceable calibration. Coordinate cable length with manufacturer. Two isolated analog output signals (field selectable/scalable 0-5/0-10 VDC or 4-20mA.

PART 18 - VALVES, DAMPERS AND ACTUATORS:

18.1 Unless otherwise specified, valves shall be furnished and sized by the TCC. The valves are to provide the required capacity and the close off rating shall be in excess of the system pressures encountered (minimum 40 psi differential). Proportioning-type valve bodies shall be packed type with throttling type inner valve (quick close plug shall not be acceptable). Proportional type valves to be rated at 125 psi static pressure. Modulating control valves shall be selected within a 3-5 psig pressure drop range. Two position control valves (open/close) shall be line size.

18.2 Dampers for various units requiring field mounting shall be tight closing, "ultra low leakage", opposed blade with side and edge seals. They shall be sized and furnished under this section. Installation of dampers shall be by the sheet metal contractor, coordinated by the TCC. Frames shall be no less than 16 gauge galvanized steel and furnished with mounting holes for duct mounting. Damper blades shall be no less than 14 gauge galvanized steel with maximum blade width of 8 inches. Blades shall be secured to 1/2 inch zinc plated axles and hardware with nylon bearings. Provide thrust bearings at the end of each blade. **All dampers shall have end switches to positively prove damper position. <u>No Exceptions!</u>**

18.3 All damper and valve actuators shall be fail safe spring return type with sufficient force to operate the dampers or valves under all normal operating conditions. They shall return to the normally open position upon a loss of power. Exceptions to the spring return applications are (1) face and bypass actuators, (2) boiler 3-way loop mixing valves, (2) boiler room seasonal changeover valves. Actuators for fan coil units, terminal units, etc. shall fail in the last position.

18.4 "ALL" Actuators shall be of the same manufacturer and have internal feedback circuitry to provide a positive action to insure proper positioning of the damper or valve through the entire sequence. Actuators shall have an adjustable starting point to accurately set the range of travel to the output of the controller. All actuators shall also utilize the same input signal (6-9 VDC, 0-010V, 2-10 VDC, 4-20 MA) in order to maintain some consistency in the control application. Analog actuation is 6-9 VDC, 0-010V, 2-10 VDC or 4-20 MA, floating point

control with 2 digital outputs is NOT approved as analog actuation.

18.5 Actuators may be factory installed. If not factory installed they shall be installed as per instructions by the terminal equipment manufacturer.

18.6 Locations mounted above ceiling shall be marked on ceiling grid.

18.7 Install damper motors on the outside of the duct in warm areas where possible, not in air stream or locations exposed to outdoor conditions.

PART 19 - VARIABLE FREQUENCY DRIVES (VFDs):

19.1 The work includes all labor, materials, and related items to completely furnish and install, start up and test, and place into service the Variable Frequency Drives (VFDs) indicated and scheduled on the Drawings and described in the Specifications.

19.2 VFDs shall be as manufactured by ABB or approved equal. This is the only acceptable manufacturers. All VFDs for the project shall be by the same manufacturer (no exceptions).

19.3 VFDs shall be consist of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

19.4 The VFD shall be capable of operation form AC voltage in two rages 208–240 VAC ± 10%, or 380–480 VAC ± 10%. 50/60 HZ operation, ± 2 hertz.

19.5 The VFD enclosure shall be rated UL type 1 and shall be UL listed as a plenum rated, suitable operating conditions: $0 – 40^0$ C continuous. Drives that have thermal cut out circuits, or that cannot operate continuously at 40^0 C shall not be acceptable. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing.

19.6 The VFD shall produce an adjustable AC voltage/frequency output for step less motor speed control utilizing sine wave coded Pulse Width Modulation (PWM) The Drive shall provide automatic power factor correction and a .98 displacement power factor by incorporating a full wave diode bridge rectifier. The VFD shall have an overload rating of 110% of nominal rated current for 1 minute out of every 10 minutes of operation, which is an acceptable overload for centrifugal loads.

19.7 The VFD shall include a built-in first environment RFI/EMI filter and be CE and UL labeled. It shall also meet the CE requirement of EN61800-3 which provides an actual test procedure that shows that the VFD is immune from RFI/EMI interference and at the same time does not emit RFI/EMI noise that would interfere with other sensitive equipment near the VFD.

19.8 The VFD shall include as a minimum a 5% dual DC link or AC line reactor for a clean harmonic signature, which aides in complying with IEEE-519-1992 recommended levels. The VFD manufacturer and representative shall assist in ensuring that the VFD's applied meet IEEE-519-1992 by completing a computer aided Harmonic Analysis of the complete system.

19.9 The VFD shall include as a standard a built in digital keypad/display panel. This panel shall provide "Hand" off "Auto" selection, and a manual speed adjustment via up and down arrows. All faults and warnings shall be provided in "Plain English" for operation without a manual. The drive shall have a complete manual stored in memory that can be accessed with a single keystroke. This display shall be password protected and allow all setup

parameters to be adjusted only by authorized personnel.

19.10 The VFD shall include built in Startup, Diagnostic, and Maintenance assistants, which allow for step-by-step startup procedures, troubleshooting, and the ability to indicate when the VFD and the system it is applied to needs preventive maintenance performed.

19.11 The VFD shall include a real time clock with a day/date stamp for troubleshooting purposes. In addition with the use of this clock the drive shall be capable of stand-alone operation and act as a unitary controller.

19.12 The VFD shall include (2) Analog inputs either 4–20 madc or 0-10 vdc, (6) programmable Digital Inputs, (2) Programmable analog Outputs, (3) Form C Relay output rated 2 amps continuous minimum, and (2) PID Process controllers.

19.13 The VFD keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words.

19.14 BYPASS – As scheduled on the drawings, the drive shall be provided with an integral Bypass circuit which includes a pair of 115V electrically interlocked contactors for drive and bypass operation. The drive shall include a main input circuit breaker, drive input service/isolation switch, and motor overload protection adjustable for either Class 10, 20 or 30 operation. The bypass shall include a built in status display which shows via colored LED's the system operational status including safeties and run permissives for ease of operation. The Bypass shall have its own interactive, programmable keypad. The Bypass shall provide single- phase protection for the motor while operating in bypass. Bypass that does not protect the motor from single- phase operation shall not be acceptable.

19.15 The drive and bypass system shall have embedded serial communication capabilities that allow direct connection to Modbus, Johnson Controls, Siemens and BACnet automation systems as part of the drives software suite without the need for extra hardware cards or gateways. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). In addition, the drive shall be capable of interfacing with Lonworks with the addition of a communication module.

19.16 All VFDs shall be provided and installed in strict accordance with the manufacturer's recommendations.

19.17 The VFDs serving RF-2 and RF-3shall be provided with auxiliary contact interlock

19.18 Factory-authorized startup for each drive is mandatory. Provide a written record of the startup of each unit. Start up and programming by a factory-authorized technician. At startup, lockout any speed with the VFD that does not meet the vibration allowanced of the equipment manufacturers.

19.19 A parts and labor warranty of **3 years from startup and 2 years from the date of substantial completion** shall be included. Warranty shall include travel time and expenses.

PART 20 - TIME SCHEDULES (ALL TIMES SHALL BE USER ADJUSTABLE) (**ALLOWANCE**):

20.1 Scheduling provided by the allowance.

20.2 During construction, the time schedule (for all equipment except OA unit) will be Occupied at 5:00 AM, Unoccupied at 10:30 PM. seven (7) days a week.

20.3 When the system is fully tested and operational and after the Owner's staff have been fully instructed as to the operation of the system the schedule shall be as follows unless otherwise instructed:

PART 21 - OUTSIDE AIR HANDLING UNIT:

21.1 The system shall operate under the control of a local, stand-alone, microprocessor based DDC controller. The DDC controller shall be provided by the TCC.

21.2 Each system shall be placed into the occupied/unoccupied mode based upon the user adjustable schedule at the Network Control Panel. These systems shall be in the occupied mode during regular business hours only. The unit shall be off when scheduled as unoccupied and warm-up.

21.3 If communication is lost between the Network Control Panel and the Outside Air System Controller, then the Outside Air System shall be placed into the occupied mode until communication is restored.

21.4 In the unoccupied mode the supply/exhaust fan and energy recovery wheel shall be OFF and the outside/ exhaust air damper shall be fully closed. Chilled and hot water valves shall be closed.

21.5 When placed into the occupied mode, the following shall occur in sequential order:

21.6 The energy recovery wheel shall be turned on, outside air damper and exhaust air damper shall fully open and be proved via end switch.

21.7 Exhaust Fan Control: The TCC shall provide the VFD for the exhaust fan. The exhaust fan VFD shall provide a soft start. Coordinate VFD setting with test and balance contractor. VFD setting shall NOT be adjustable. . The exhaust fan shall start and operation shall be proved via current sensor. Provide a 3 minute (adj.) time delay prior to starting the supply fan.

21.8 Supply Fan Control: The TCC shall provide the VFD for the supply fan. The supply fan VFD shall provide a soft start. Coordinate VFD setting with test and balance contractor. VFD setting shall NOT be adjustable. The supply fan shall start and operation shall be proved via current sensor or status contacts on the VFD. Engineer or commissioning agent shall be present for final balancing

21.9 Each system will be placed into a Mode of Operation based upon the following adjustable temperature schedule:

Outside Air Temperature	Mode of Operation
65 deg F or greater (adj.)	Cooling Mode
Between 55 deg F and 65 deg F (adj.)	Economizer Mode
55 deg F or less (adj.)	Heating Mode

Note: if exhaust air dew point rises above 57 deg F, unit shall enter dehumidification

mode

21.10 In cooling mode:

21.10.1 In the cooling mode 2-way, modulating chilled water control valve shall modulate to maintain 55 degrees off the cooling coil and the face and bypass dampers shall modulate to maintain discharge air temperature setpoint.

21.10.2 If the exhaust air dew point exceeds 57 deg F the unit shall enter dehumidification mode.

21.11 In the economizer mode:

21.11.1 If the outside air temperature is between 55 deg F (adj.) and 65 deg F (adj.), the chilled water and hot water valves shall be closed. The discharge air temperature shall float until the system is placed in another mode of operation.

21.11.2 If the exhaust air dew point exceeds 57 deg F the unit shall enter dehumidification mode.

21.12 In the heating mode:

21.12.1 In the heating mode 2-way, modulating hot water control valve shall modulate to maintain 95 degrees (adj.) off the hot water coil and the face and bypass dampers shall modulate to maintain discharge air temperature setpoint.

21.13 The discharge temperature in the heating mode shall vary linearly. When the outside air temperature is 55 deg F (adj.) the discharge temperature shall be 65 deg F (adj.). When the outside air temperature is 0 deg F (adj.) the discharge temperature shall be 68 deg F (adj.).

21.14 Dehumidification Control:

21.14.1 In the dehumidification mode, the face and bypass dampers shall be full to the face of the coil, the 2-way modulating chilled water control valve shall modulate to maintain 55 degrees off the cooling coil. The heating modulating hot water control valve shall modulate to maintain discharge air temperature setpoint.

21.15 The system shall not start if any one component does not prove operation.

21.16 A differential air pressure sensor shall be installed across each filter bank on the outside air units. When the differential pressure exceeds 0.8"wg (adjustable), then an alarm shall be generated indicating filter changing is necessary. Set exact alarm setting per the filter manufacturer's recommendations.

21.17 A manual reset low limit installed downstream of the heating coil shall stop the operation of the system if the discharge temperature falls below 38 deg F.

21.18 Unit safeties shall include low limit located prior to the cooling coil, high outside air duct static pressure and low exhaust duct static pressure. If the alarm is detected the system shall shut off and the outside air and exhaust air dampers shall close.

21.19 A smoke detector shall be located in each air stream. If smoke is detected, then the system shall shutoff and an audio/visual alarm shall activate. Upon correction of the problem, the system shall be reset and shall return to normal operation. Coordinate with Fire Alarm System.

PART 25 - OUTSIDE AIR VARIABLE AIR VOLUME (VAV) BOX:

25.1 Zones indicated are to be provided with a CO2 sensor and variable air volume (VAV) terminal box to control the amount OA introduced into the zone. Each VAV box has minimum and maximum set points. The outdoor air to the space is varied linearly between the minimum and maximum set points based on the space CO2 level. Refer to plans for minimum and maximum set points.

25.2 The CO2 algorithm shall be triggered on when the CO2 differential between indoors and outdoors reaches 700 ppm or greater.

25.3 The CO2 algorithm shall be triggered off when the CO2 differential between indoors and outdoors falls to 600 ppm or less.

25.4 When the CO2 algorithm is triggered on, the corresponding VAV box shall allowed to modulate open to its maximum position based on the following formula:

25.5 The corresponding motorized damper at the heat pump return air shall modulate with the VAV box position. When the CO2 algorithm is trigger off, the return air damper shall be 100% open. When the CO2 algorithm is triggered on, the return air damper shall modulate towards closed in conjunction with the VAV box position.

25.6 The above algorithm is based on CO2-based Demand-Controlled Ventilation Utilizing ASHRAE 62: Optimizing Energy Use and Ventilation by Schnell, Turner, Shim (TO-98-21-1).

25.7 CO2 sensor shall wire to the OA VAV unitary controller serving the area.

PART 26 – AIR HANDLING UNIT (AHU-1, 2A/ 2B, 3A and 3B) – VARIABLE AIR VOLUME:

26.1 Supply Fan Control: The TCC shall provide the VFD for the supply fan. The supply fan VFD shall be controlled to maintain an initial 1” duct static pressure setpoint. Refer to plans for duct static pressure sensor location. The supply fan shall start and operation shall be proved via current sensor or status contacts on the VFD. DDC system determines VAV box with greatest damper open position once every ten minutes. Unit's supply air static pressure setpoint decreased by 0.1" WC if VAV box with greatest damper open position 65% or less; increased by 0.1" we if it's greater than 95%. Setpoint is reset between minimum and maximum setpoint of 0.5" and 1.5”.

26.2 Relief Fan Control: The TCC shall provide the VFD for the relief fan. The relief damper shall open the the relief fan VFD shall be controlled to maintain slightly positive building pressure. Initially this shall control to 0.01” (adj). Relief fan points shall be wired to the controller for the associated air handling unit.

26.3 Occupied ventilation mode:

26.3.1 The minimum outside air damper shall open only when scheduled occupied in the

ventilation schedule.

26.3.2 The return air damper shall modulate to maintain design minimum outside setpoint as indicated at the Ebtron airflow measuring station. The return air damper shall have a field calibrated minimum position determined when all the VAV terminal units are at minimum position, the return damper shall be limited to the minimum position to insure the minimum outside air is maintained.

26.4 Unoccupied ventilation mode:

26.4.1 The minimum outside air damper shall closed and return air damper open.

26.5 Supply Air Temperature Controls: A duct mounted, discharge air temperature sensor shall control the unit's 2- way chilled water valve (AHU-1, AHU-2A/ AHU-2B, AHU-3A) and 3-way chilled water valve (AHU-3B), 2- way hot water valve(AHU-1, AHU-2A/ AHU-2B, AHU-3A) and 3-way hot water valve (AHU-3B), return and relief dampers and outside air economizer damper.

26.6 When cooling is required, and the outdoor air temperature is below 65 degrees F (adj.), economizer outside air damper, and return air damper shall modulate as required to maintain 55 degrees F (adj.) supply air temperature. The minimum outside air damper is open. Normally under this condition, the chilled water 2-way or 3-way control valve shall be closed, however, if further cooling is required, the 2-way or 3-way chilled water control valve shall modulate as required.

26.7 When heating is required to maintain the supply air temperature at 55 degrees F (adj.), then the 2-way hot water control valve shall modulate as required to maintain 55 degrees F (adj.) supply air temperature. The relief air damper and economizer damper shall be closed, the minimum outside air damper shall be open and return air damper shall be modulate to maintain minimum outside air CFM.

26.8 Discharge Air Reset: When the outside air temperature is below 55 degrees. The discharge air temperature is reset to from 55 degree to a 60 degrees (adj) . If any zone is unable to satisfy the cooling set-point within 2 degrees (adj) the discharge air will be reset to 55 degrees until the space is satisfied.

26.9 Mixed Air Temperature Control: Modulate the minimum outside air damper to maintain a minimum mixed air temperature of 45 degrees (adj.).

26.10 Freeze Protection: A low limit temperature sensor shall be located on the upstream side of the chilled water coil. If a temperature of 40 degrees F (adjustable) or less is detected, then the outside air and relief air dampers shall fully close and the return air damper shall fully open, and an audio/visual alarm shall activate. Upon correction of the problem, the system shall be reset and shall return to normal operation. The freeze protection wire shall be serpentine across the entire face of the coil every six inches on center.

26.11 Smoke Shutdown: A smoke detector shall be located in the supply and return air stream. If smoke is detected, the supply and return fans shall de-activate and an audio/visual alarm shall activate. Upon correction of the problem, the system shall be reset and unit shall return to normal operation.

26.12 Over Pressurization Control: A static pressure sensor shall be located at the AHU supply air outlet and return air inlet, before any fire dampers. The return air sensor shall be located in the return air duct. If the pressure in the supply duct exceeds 3.5" W.G. (adj.)

in the supply air duct or -2.0" W.G. (adj.) in the return air duct, the fan shall be de-activated. Upon correction of the problem, the system shall be reset and unit shall return to normal operation.

26.13 Filters: A differential air pressure sensor shall be installed across the filter bank. When the differential pressure exceeds 0.7"wg (adjustable), then an alarm shall be generated at the front-end PC indicating filter changing is necessary. Set exact alarm setting per the filter manufacturer's recommendations.

PART 27 - VARIABLE AIR VOLUME (VAV) BOX:

27.1 The box shall have a pressure independent control system.

27.2 A wall mounted thermostat shall control the VAV box.

27.3 When cooling is required, the variable air inlet damper shall modulate between the minimum cooling and maximum cooling air flow rates to maintain room air temperature setpoint. The 2-way hot water control valve shall be closed.

27.4 When heating is required, the variable air inlet damper shall be in the minimum heating air flow rate position and the 2-way hot water control valve modulated to maintain room setpoint.

27.5 Primary air CFM shall be monitored by the DDC control system.

27.6 All VAV boxes with reheat shall be provided with discharge air temperature sensor.

27.7 During the occupied mode, all VAV boxes serving a single zone shall have occupancy sensor control, if the occupancy sensor detects no occupancy in the rooms supplied by the VAV box, the unit shall operate in a standby mode. The cooling mode the temperature will be allowed to rise to 3 deg F (adj.) and in the heating mode the temperature will, be allowed to fall to 3 degrees F (adj.). Occupancy sensor to be provided by electrical contractor with 2 sets of contacts for BAS monitoring.

27.8 Standby Mode / Demand Control Ventilation:

27.8.1 During the occupied mode, the space is unoccupied per the occupancy sensor; the VAV shall close and reset space temperature setpoint to standby mode. Standby mode setpoint shall be 3 deg F (adj.) above occupied cooling and 3 deg (adj.) below occupied heating temperature setpoint. When the space reachs the standby temperature the box shall modulate open to maintain the standby temperature setpoint

PART 28 - GEOTHERMAL HEAT PUMPS SEQUENCE OF OPERATION:

28.1 Each unit shall operate under the control of a local, stand-alone, microprocessor based DDC controller field installed adjacent to unit.

28.2 Each unit shall be placed into the occupied/unoccupied mode based upon the BAS Time Schedule.

28.3 If communication is lost between the Global Time Schedule and the Heat Pump Controller, then the Heat Pump Controller shall be placed into the occupied mode until communication

is restored.

28.4 A smoke detector shall be located in the return air stream of units greater than 2,000 cfm (5 tons and larger). If smoke is detected, then the system shall shutoff and an audio/visual alarm shall activate. Upon correction of the problem, the system shall be reset and shall return to normal operation. Coordinate with Fire Alarm System.

28.5 Space occupancy sensors are installed by others, however, wiring shall be installed by the TCC from the sensor to a DDC controller provided by the TCC. See plans for zones requiring occupancy sensor control.

28.6 Multiple sensors are to be implemented when a heat pump serves multiple or large spaces, such that not more than two spaces are represented per one sensor. Thus a heat pump serving 3 spaces shall have 2 room sensors. Programming shall be selectable between using the high, low or average value for controlling the heat pump serving multiple spaces.

28.7 During the unoccupied mode, the heat pump shall not operate unless the space temperature falls outside unoccupied set points.

28.7.1 During the occupied mode, the space is unoccupied per the occupancy sensor, reset space temperature setpoint to temporary unoccupied mode. Occupancy sensor unoccupied mode setpoint shall be 3 deg F (adj.) above occupied cooling and 3 deg (adj.) below occupied heating temperature setpoint. After the space is unoccupied for 2 hours the setpoint shall automatically reset to the unoccupied heating and cooling set points.

28.8 During the occupied mode, the space is occupied based on room occupancy sensor, and the ventilation is ducted directly to the space. The valve shall be open and the associated heat pump compressor and fan shall cycle as required to satisfy space thermostat/ sensor set point. The units shall automatically change from heating to cooling. For two stage units, the fan/compressor shall cycle between high/low/off based on space demand. To prevent short cycling a minimum of 5 minute delay when transitioning between heat and cool modes. Current sensor to monitor fan status.

28.8.1 During the occupied mode, the space is occupied based on room occupancy sensor, and the ventilation is ducted to the heat pump return. The valve shall be open and the associated heat pump compressor shall cycle as required to satisfy space thermostat/ sensor setpoint. The fan shall run continuous. The units shall automatically change from heating to cooling. For two stage units, the fan/compressor shall cycle between high/low/off based on space demand to prevent short cycling a minimum of 5 minute delay when transitioning between heat and cool modes. Current sensor to monitor fan status.

28.9 If the heat pump is unable to maintain space setpoint the supplemental SCR electric duct heater shall modulate to maintain space temperate setpoint.

28.9.1 Heat pumps VHP-120 and VHP-180 are provided with VFD supply fans. Coordinate with the manufacture and TAB for low and high speed fan settings based on heat pump compressor staging.

28.9.2 The heat pump fan in the MAC shall run continuously to monitor temperature and return humidity.

28.9.3 The heat pump fan in the racquetball shall run continuously to monitor temperature. The unit shall be off when it is not activated by the building control panel or the occupancy sensor indicates both courts are unoccupied.

28.10 The dedicated valve shall be open and prove prior to starting the compressor. It is the responsibility of the control contractor to field wire the valve to the heat pump controller digital output and wiring for valve status. Valve shall be proven prior to compressor.

28.11 The TCC shall provide a wall thermostat or temperature sensor as noted on the drawings.

28.12 Dehumidification mode: Refer to plans for heat pumps provided with hot gas reheat. Upon zone humidity reaching maximum set point of 60% (adj.) the heat pump shall enter cooling mode with both stages/ compressors and the hot gas reheat shall maintain space temperature. When the humidity is 5% (adj.) below the maximum zone humidity set point then the heat pump will return to normal operation. Heat pumps without a zone humidity sensor shall be controlled based on return air humidity.

28.13 The heat pump fan shall run continuously for all heat pumps with the ventilation VAV terminal dampers to the heat pump return. Compressors shall cycle to maintain space temperature.

28.14 Console heat pumps shall operate on return air temperature control if thermostat is not indicated on plans.

33.1 Electric heaters enabled/ disabled from the BAS. They shall be schedule enabled when the outside air is below 50 deg F (adj.).

PART 34 – GEOTHERMAL HEAT PUMP WATER LOOP CONTROL:

34.1 The Geothermal Heat Pump Water Loop System consists of circulating pumps (P-7, P-8, P-9) associated pump VFD's. Controller for P-7 shall be on emergency power.

34.2 HEAT PUMP LOOP WATER DISTRIBUTION: The heat pump water distribution is accomplished by pumps P-7, P-8 and P-9. Generally two pumps are required to satisfy the building load; the third pump is for reserve. All three pumps shall operate on a lead/lag/ reserve basis. Lead/lag/ reserve operation shall rotate on a weekly (adjustable) basis. The lead/lag pumps shall be capable of operating if required by the demand. The pumps are to be variable flow and a variable speed pump controller unit (VFD) is provided by the the TCC contractor to control the speed of the pumps.

34.3 Two differential pressure sensors are located on the drawings to measure water differential pressure. This contractor shall provide all control wiring necessary for proper system operation. The differential pressure sensor shall be monitored by the unitary controller for the distribution pumps.

34.4 The heat pump controller shall continuously survey the two differential pressure sensors with independent setpoints. The differential pressure shall be set at 12 p.s.i. (adj.) for each differential pressure sensor. If the pump controller senses that if either differential pressure is below the pressure setpoint, the speed of the lead pump shall increase. If one pump rises above 80% (adj.), then two pumps are required to operate. The lag pump shall ramp-up and the lead pump shall ramp down to the same speed to meet the pressure setpoint. The pumps must operate at the same speed and their speed shall be increased/ decreased in tandem to maintain differential pressure setpoint. If both pumps are

operating at 35% (adj.) or less and differential pressure setpoint is satisfied, then the lag pump shall shut-off and the lead pump shall increase speed to maintain differential pressure setpoint.

34.5 If no water flow is sensed by a pumps current sensor, then an alarm signal shall be generated and the lag pump shall be engaged. A thirty second time delay relay shall be provided for the pumps to prevent false alarms. After the cause of the alarm has been eliminated, the system shall be capable of resetting and re-establishing the lead pump.

34.6 If all circulating pumps are commanded on and fail, a signal shall be sent to disable all the heat pumps and alarm at the BAS.

PART 35 – GEOTHERMAL LOOP ENERGY MONITORING:

35.1 Install temperature sensors on the supply and return of the geothermal loop to the building to be trended at the BAS.

35.2 Install temperature sensors on the supply and return of the geothermal loop to the MOB to be trended at the BAS.

35.3 Install flow meters in the returns of the geothermal loop from the building to be trended at the BAS. Coordinate pipe diameters required before and after the flow meter with manufacturer.

35.4 Provide and install a packaged BTUH meter system for the geothermal loop serving the building. The BAS shall measure and record gpm, “peek” gpm with time and date, BTUs, instantaneous BTUH, “peek” BTUH with time and date & OA temperature.

PART 36 – GEOTHERMAL FLOW METER ALARM AND EMERGENCY SHUTDOWN FOR MAKE-UP WATER:

36.1 On the make-up water line, a two-way, two-position, normally open valve shall close if (after a time delay of 2 minutes) the make-up water continues flowing at a rate of 3 gallons per minute while the system switch is in the normal operating position. An alarm shall be sent to through the DDC system. An audible alarm mounted on the control panel (mounted very near the make-up network) shall sound and an indicator light will provide visual indication of a problem. A momentary push button on the panel shall be used to silence/acknowledge the alarm and reset system for normal operation after any necessary repairs are made. A switch mounted on the panel shall be used to shut down the alarm while normal system fill operations are performed. This switch and all panel mounted devices are to be appropriately labeled. Provide and coordinate installation by mechanical contractor the valve and ONICON Model F-1310 Inline Turbine Flow meter. Flow meter to be 1 inch union body, scaled 0-10 GPM range is 0-10 volt output.

PART 37 – CHILLED WATER SYSTEM (EXISTING PUMPS P-5/P-6):

37.1 Chilled water is provided by the Central Chilled Water Plant. Local pumping is accomplished through 2 existing Lead-Standby pumps. Building shall utilize existing chilled water pumps with VFD’s. The BAS shall provide start, stop, status and speed control for the existing pumps.

37.2 Install the packaged BTU meter system including supply and return water temperature sensors and water flow meter. Install per manufacturer’s recommendations and maintain

minimum pipe diameters before and after flow meter.

37.3 Set up for the DDC system to provide monthly chilled water energy consumption is "KBTUH" format.

PART 44 - DOMESTIC WATER BOOSTER PUMP

44.1 The DDC System shall monitor BP-1 status, domestic hot water inlet and outlet pressure.

PART 45 – SUMP PUMPS

45.1 The DDC System shall monitor elevator and pool foundation drainage status and alarm.

PART 46 - THE ELECTRICAL SWITCHGEAR/POWER INTERFACE:

46.1 The electrical switchgear shall be monitored through the DDC system via Modbus communication protocol.

Refer to M5.3

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Current Phase A					×			×		×
Current Phase B					×			×		×
Current Phase C					×			×		×
Current Neutral					×			×		×
Voltage A-B					×			×		×
Voltage B-C					×			×		×
Voltage C-A					×			×		×
Voltage A-N					×			×		×
Voltage B-N					×			×		×
Voltage C-N					×			×		×
Real Power - kW					×			×		×
Apparent Power -					×			×		×
Power Factor					×			×		×
Frequency					×			×		×
Real Energy - kWh					×			×		×

PART 47- BUILDING CONTROL PANEL

47.1 The TCC shall provide recessed stainless steel panel with ON-OFF AUTO switches for building control. The building control panel shall provide an override for the items indicated. The panel is to be located at check-in. Coordinate final location with architect and owner. Shop drawing must include the letter font, colors, and switch cut sheets. LED indicator lights for

engineering and owner approval. Refer to mechanical details for panel layout. The switches shall include the following:

47.1.1 Each court HVLV fan or fans with ON-OFF-AUTO switch. Coordinate court naming with owner.
- ON-override ON
- OFF- override OFF
- AUTO-The fan will run when called for by the BAS sequences

47.1.2 Lighting ON-OFF-AUTO
- ON-override ON
- OFF- override OFF
- AUTO-The fan will run when called for by the Occupancy Sensor

PART 48 – EMERGENCY GENERATOR:

48.1 The generator shall be provided with a Modbus Interface. The BAS shall monitor the attached points through the BAS.

48.2 Provide gas meter and monitor gas consumption from the emergency generator at the BAS.

PART 49 – UTILITY METERS:

49.1 Provide gas meter and monitor gas building usage and totalize consumption at the BAS.

49.2 Provide chilled water meter and monitor chilled water usage and totalize consumption.

49.3 Provide domestic water meter and monitor water usage and totalize consumption.

PART 50 – LIGHTING CONTROLS SYSTEMS:

50.1 The TCC will be responsible for a LON communication trunk to three (3) lighting control panels. Verify communication protocol with electrical contractor.

50.2 There are 3 lighting control relay panels with a maximum 16 lighting relays. The TCC shall map the control of the lighting circuits to the BAS.

50.3 Provide a full graphic page of the building and site lighting zones, indicating the different zones that can be scheduled. A graphic “light bulb” located in the specific area shall indicate whether lights are on or off. The each zones shall be independently scheduled. Refer to electrical plans E6.4 and E6.5.

Division 26: Electrical

Campus Infrastructure for Electrical:

NKU receives Duke Energy's primary power feed at a single campus substation, which is located at the corner of Kenton and Campbell Drives. At this substation, Duke has the capability to provide (2) separate primary feeds for NKU, and Duke Energy's names for these primary feeds are "KY University 41" and "Marshall 41". The "KY University 41" feeder serves as the primary with "Marshall 41" serving as the backup. However, NKU does not currently have the ability to automatically switch over to the backup feed, as there is no "reserved capacity" agreement in place with Duke Energy (as of Spring 2009). NKU must receive permission from Duke Energy prior to switching over to the backup feed.

The main campus 15KV switchgear is located just outside of Duke's substation fence (towards the south) and receives a primary feed from the Duke Energy substation for distributing power through a network of underground manholes for the most of the campus buildings. Refer to Division 33 for an overall campus view of this underground power infrastructure system. The Bank of Kentucky Center, Callahan Hall, and a collection of other small buildings/houses on the fringe of campus receive independent power feeds directly from Duke Energy.

At the main campus switchgear, NKU receive pulses from Duke's (2) main meters to monitor our overall campus load. These are tied into our Central Plant BMS system, but only to monitor peak campus load and NKU does not use info for any energy management function. Each door on the switchgear has a meter too, but we currently only use the meter monitoring the "Dorms" loop. This specific meter is slightly different than the rest, and NKU uses this meter to record the monthly consumption of this loop feeding the Dorms. All of the switchgear door meters have the capability to be tied into a computer system, but they are not networked into any other system yet.

The main campus distribution switchgear was completely replaced in the Spring of 2009, and a significant portion of the main underground cables were replaced in Summer 2009. The design team shall request a current copy of the campus riser from the NKU project manager. All campus buildings except the Central Plant, Ceramics and the Dorms are connected within a (2) loop design configuration (named "A" & "B"). This allows NKU to manipulate switch positions at various locations within the campus electrical infrastructure network in order to minimize outage durations when portions of campus need to undergo maintenance. The Central Plant, Ceramics, and the Dorms are all on independent "radial feeds", but a few changes were made during the switchgear replacement project of Spring of 2009 to help improve this situation. Namely, a 4- way switch was installed next to the first manhole to help manipulate the Ceramics and Dorm radial feeds when necessary for future maintenance activities. Also, one set of feeders running to the Central Plant was moved to the other side of the main switch within the main Central Plant electrical room. These changes, coupled with the design configuration of the new Switchgear, will hopefully help minimize outage durations for future maintenance activities.

The main campus loop voltages are 12,470 volts. Within the campus, underground power infrastructure system, each primary building service to the main switchgear is (3) separate #4/0 wires with a separate #2 ground wire (4 total wires, and NOT 3 triplex-style wires with a ground integrated with each wire).
The following represents instantaneous meter readings observed for all of the loops served by the main campus distribution switchgear on November 24, 2009. These readings were taken prior to the construction of Griffin Hall.

The format is:

- Switch/Feeder Name
- #/#/# (A/B/C) phases (units are in amps)
- First row of values is maximum amps

- Second row of values is DMD amps

C-2 Ceramics 21/19/20
15/12/13

Loop A 70/69/69
54/55/53

Loop B 62/62/63
50/48/48

P-1 Powerplant (400A Fuse) 299/264/323
47/48/50

P-2 Powerplant 49/46/56
15/16/15

Loop A 44/45/48
36/34/38

Loop B 64/62/65
51/48/51
Dorm 22/25/24
19/21/21

Special Electrical Requirements (per KY State Electrical Inspector):

Need to get inspection on books before work begins.

- Electrical Contractors shall supply a copy of all electrical inspections to the Construction Manager/General Contractor and NKU Project Manager within 2 days of each inspection. Electrical Contractor must also identify any non-electrical violations from that inspection to the Construction Manager/General Contractor within this same 2 day period.
- All data/voice installations shall be completed and ready for inspection at the time of any Above Ceiling, In Wall, In Ground and Electrical Final Inspections.
- Certified lightning protection installers shall perform all work requiring or affecting lightning protection. Certification/Recertification documentation of lightning protections systems shall be provided to the electrical inspector and owner at the time of the Electrical Final Inspection. All lightning protection shall achieve a 3rd party verification of UL compliance.
- All installed electrical equipment/devices shall be UL listed individually and large electrical equipment containing such listed devices shall be listed as an assembly by an independent certified testing laboratory.
- No electrical equipment/devices/raceways/wiring shall be abandoned and left in place unless approved by the NKU Project Manager for future use and then such shall be clearly tagged “For Future Use”.
- All electrical circuits shall have a “wire” green grounding conductor pulled with them. No raceway shall be accepted as a grounding conductor. This includes any work using existing circuits, in which case a wire-grounding conductor (if not available) will be installed back to the applicable electrical panel and terminated on the grounding bar. If no grounding bar exists, one shall be installed.
- MC or FMC raceways shall NOT be installed in new walls being constructed. Only EMT or Rigid will be accepted within walls. EMT and Rigid raceways shall be a minimum size of ¾ inch. Metal clad (MC) cable is acceptable for use in suspended ceilings as long as it is only a pigtail from a

junction box to a lighting fixture.
- Any Electrical Panel ledgers affected by construction/renovation shall be replaced with newly typed updated ledgers.

Electrical Raceway Requirements:

- All electrical outlet and switch receptacle cover plates shall be stainless steel. Plastic is NOT acceptable.
- All electrical panels shall be clearly labeled to identify the specific circuit, electrical outlet, and/or room each breaker location feeds. Also, label each device as to the panel from which they are fed. Install mechanical identification to properly identify every system and its components.
- All power receptacles and switch cover plates shall be clearly labeled with the source panel identification & circuit number on the face of the cover plates.
- Exposed raceway in finished areas shall be in 750 or larger wire mold.
- All new floor boxes for above grade floor levels shall be Wiremold Evolution (6 AT or 8 AT) Series Poke-Thru, unless directed otherwise by NKU project manager. Specific floor boxes for installation within a slab on grade situation shall be coordinated with NKU project manager.
- Electrical contractor shall furnish and install all grounding/bonding required for all data/communications pathways (conduits & wire way/cable tray).
- Surface Metal Raceway shall be two-piece type, base mounted with snap-on cover as manufactured by Wiremold or equal. Raceway installation shall be in accordance with manufacturer's instructions using adapters and fittings specifically designed and manufactured for the raceway used.
- Except in mechanical/electrical rooms and data/communication closets, all conduits shall be concealed unless otherwise specified and approved in writing by the NKU Project Manager. Conduits not concealed must be surface mounted metal raceway unless otherwise noted in the written exception.
- Liquid tight flexible metallic conduit shall be light gray in color (if left unpainted). It shall have seal tight fittings and shall be equal to American Brass "Sealtite" Type UA.
- Plastic conduit shall be high impact, high grade, self-extinguishing polyvinyl chloride (PVC) schedule 40, 90 deg. C, U.L. rated. Conduit fitting and elbows shall have the same requirements as the conduit.

Electrical Distribution Requirements:

- All 15kv splicing shall only use the heat shrink polymeric splicing kit. The use of any pre- molded, cold shrink rubber splicing kits is unacceptable.
- Whenever possible, electrical rooms/closets should be stacked vertically, and all electrical panels shall be located inside the rooms/closets with no accessibility to the general campus community.
- At a minimum, provide a duplex power outlet (unless more power is specified) near every data drop location specified on the drawings. When 3 or more data jacks are provided at a data outlet location, provide an adjacent quad power outlet. This general rule of thumb applies to wall outlets as well as floor box locations.
- Provide (1) GFCI duplex outlet every 30' on center in all new sections of underground tunnel.
- Provide a minimum of (1) exterior duplex power outlet at the building load dock area, as well as (1) exterior duplex power outlet along each building face. At each building entrance, provide a minimum of (1) exterior quad power outlet and (1) empty duplex rough-in box with empty conduit for future data or Audiovisual wiring.
- Corridor outlets shall be provided at a maximum spacing of 25 feet and each 120 volt receptacle shall be individually protected by a 20 amp breaker and GFI receptacle. In common areas with lounge/student seating and informal gathering space potential, more frequent outlets should be provided to facilitate the use of laptops and other portable electronic equipment. Design for 60% loading.
- Each Multifunction Printer/Copier location shall have 120v 20A dedicated outlet on its own circuit.
- All Fire Alarm, Security Alarm, Communications Equipment, Elevator Controllers (minimum of 1 elevator per building), Life Safety (including emergency lights, exit lights and combination

emergency\exit lights), Fire pump, Handicap Access, Mechanical and Electrical Room lights and receptacles, and other similar systems shall be supplied by emergency generator distribution panels. Note: Due to battery maintenance cost, do not specify battery backup emergency/exit lighting unless the University specifically requests this strategy in writing. Any room housing live animals shall also have all power, lighting, HVAC and controls supplied by emergency generator distribution panels.

- All wiring shall be 98% conductivity copper. All buss and buss duct conductors shall be 98% conductivity tin plated copper. Aluminum or aluminum alloy connectors shall not be used on copper.
- Wire size, #12 AWG minimum for power circuits. All wiring shall have THHN insulation minimum for installation in conduit.
- Conductors #16 and larger, as well as all branch circuits, shall be stranded copper.
- Driven ground rods shall be 5/8" X 8'-0" copper weld.
- All panel boards shall have both neutral and ground bus separate. All panel boards shall use bolt-on breakers only. Square D is the panel manufacturer most preferred by NKU.
- At all vending machine locations, provide 1 power duplex and "2D" (2 data jacks) per vending machine unit.
- Standard mounting height of devices:
    - o

Electrical Interior Lighting & Lighting Control Requirements:

- For interior lighting systems, explore the following options and coordinate final decisions for each project with the project manager:
    - Lighting controls systems installed shall be Lutron Quantum. Lutron Lighting Control System shall be tied into the BMS and communicate to the NKU Central Plant.
    - Where appropriate, design interior lighting systems with a programmed on/off schedule equipped with an override switch capability at main entry areas to allow occupants to operate the lights (as necessary) during programmed "off" times.
    - When appropriate, implement occupancy/motion detector type light activation devices.
    - All new lighting installed shall be LED including exit and emergency lighting.
- For classroom/lab/meeting/conference rooms, The lighting controls shall be also tied into the Crestron system.
- For lighting within new tunnel sections, provide lighting circuitry so that only every third light fixture is a constantly lit emergency fixture. . Design the circuitry so the other lights will be activated by occupancy sensors when someone enters the tunnel from either end.
- Lighting fixtures shall not be daisy chained between fixtures.
- Under no circumstances shall any non-emergency light in the building be left on 24/7/365 without controllability.
- All mechanical, electrical, custodial, and data closets should have a manual light switch for normal light operation. In addition, an occupancy sensor.
- All light locations shall be carefully considered during design to allow easy access for future maintenance.
- If a room has more than one entrance, there shall be lighting control at each entrance.

Electrical Exterior Lighting Requirements:

- Ample exterior lighting is required to ensure safety of all pedestrian traffic, especially when walking through garages. There should be no dark spots in areas where students will need to walk.
- All new road and parking lot light fixtures shall be Autobahn Series ATB2 LED fixtures, 5000K with Shorting Caps. Light poles shall be Holophane Lighting Solutions aluminum alloy, 30', Powder Paint RAL 7047. These poles shall be 0.312" thickness to allow for possible banner installations. A 4" x 6" handhole shall be provided with flush fitting aluminum door. Light heads

may be installed on any/all of the sides of the pole. A sample submittal is available from the NKU project manager and the project manager shall verify the poles prior to drawings being sent to bid.

- New lighting shall include a tie-in to the Central Plant via the Building Automation System to allow full control of interior and exterior lighting.
- All new smaller, pedestrian-path light poles/fixtures shall be Bega 8676P or 8101M H. Coordinate exact models for specific new project application with NKU project manager.
- Vibration dampeners shall be included in all site lighting poles to avoid vibration stress failure of the pole standard itself. This can be provided as either a spring-mounted, stiff pendulum dampener mounted in the center of the pole or a chain dampening mechanism hung from top to bottom inside the pole.
- Typically, building exterior lighting, site lighting, parking lot, and parking garage lighting should be designed to operate as "on at dusk" / "off at sunrise" via a photocell. However, some darker locations within parking garages will require certain lights on 24/7, and this schedule shall be coordinated with the NKU Project manager. The exterior
- All exterior lights installed on the building should be equipped with a photo-cell activation device and must be accessible from a 10' ladder, or from inside the building.
- In-ground accent lighting should be avoided. Use a fixture which can be mounted above ground.
- Avoid glaring lights in faces

Emergency Generator:

- Provide (a) natural gas-fired emergency generator(s) for each new building. Carefully locate the generator to prevent disturbance of building occupants.
- Provide 20% extra design capacity in the emergency generator reserved for future loads.
- In addition to providing emergency power to all building code-required life safety systems, each project will likely involve building-specific needs to potentially design enough generator capacity to provide emergency power for the following, non-life safety items. Coordinate exact project-specific requirements with NKU project manager:
    - Main (Data) Distribution Facility room (MDF or ER)
    - Intermediate (Data) Distribution Facility rooms(s) (IDF or TR)
    - Any building-specific, isolated cooling units serving data rooms.
    - One elevator for a 2 hour minimum period after loss of power.
    - Main building air handling units (as applicable)
- The primary data network equipment housed within all building data rooms is increasingly becoming mission critical for the operation of the primary building systems. Other data, video, special networks, security access control network, lighting control, and other computer electronic devices/systems also tend to need the presence of emergency generator power as well. The design team shall coordinate the specific emergency generator power loads for each project with NKU project manager.
- The emergency generator control interface shall be tied into the Central Plant building automation system. This will provide the Central Plant operator the ability to remote start/stop and change the test/exercise schedule of the generator as appropriate. Once this capability is provided, all normal test runs shall be controlled only via the Central Plant. BMS control shall not affect generator cool down cycles.

Other Miscellaneous Electrical Requirements:

- During construction, cover all equipment subject to mechanical damage or contamination in any way.
- Provide utility markers inside buildings, structures and facilities to identify exposed and concealed utilities, including electric.
- All electric motors shall be high-efficiency models.
- All 3 phase electric motors, (10 Hp. and larger), shall be protected against single phasing.

- Transformers to be a minimum of 95% efficient. Acceptable manufacturers are TP-1 and Powersmith. Coordinate any alternate manufacturers with NKU project manager.
- All new buildings must have lightning protection systems specified per the governing building code and applicable NEC standards, including a properly documented grounding system. Lightning damage has been a problem in various campus buildings due to the high elevation of campus relative to the surrounding area. This system shall receive a third party certification.

Division 27: Communications, Audio Visual Systems, & NKU IT Standards

The following section describes the overall infrastructure strategy, as well as general preferences for all the miscellaneous low voltage communication systems used throughout campus. This section shall be consulted and coordinated in concert with Division 28 (Electronic Safety, Security & Fire Alarm). Any deviation from the following guidelines shall be coordinated with the NKU project manager.

Campus Infrastructure for Communications:

All new buildings shall be connected to the campus data and telephone infrastructure and networks. The main telephone demarcation point for the entire campus is located in the penthouse of Nunn Hall. The main data entry point is located in room 370 of the Business Academic Center building. The main feeds from these locations to the new project site should run through the existing campus underground tunnel system, whenever practical.

A campus map showing the distribution of existing communication infrastructure lines is available, and the new feed for each building project shall be designed to accommodate future growth in accordance with the current NKU Master Plan, whenever possible.

NKU typically prefers to separate out the data telecommunication wiring, cabling, and infrastructure equipment and solicit/award this scope of work as an Owner FFE bid package independent of the overall construction project managed by the Construction Manager. However, the design team shall still design the systems and provide drawings and specifications for this scope of work. The data/communication wire-installation contractor hired by NKU will be expected to adhere to the construction manager's coordination and safety requirements for the overall project.

Contractors shall have demonstrated qualifications to install and test a 1000BaseTX/FX intra/inter-building backbone. All station and riser cabling shall be tested and certified by the contractor to support 1000BaseTX/FX technology.

Refer to Division 26 Electrical more information regarding Emergency Generator requirements and preferences regarding Data & Communications networks.

General Communications Requirements:

The NKU Department of Information Technology maintains a comprehensive set of standards for all new communication, phone and data wiring, cabling, equipment, and any other communication infrastructure necessary for installation in any NKU facility. The latest version of these standards is provided in their entirety at the end of this Division 27 section, and the following represents a brief overview:

Data/Communications Rooms:

- In some older campus buildings, data and voice equipment and terminations are located in mechanical/electrical rooms, and sometimes within custodial closets or plumbing chases. With the proliferation and dependency of data/technology in recent years, these locations are obviously no longer acceptable. Provide a dedicated, secure data/communications room on each floor, and more rooms per floor when necessary.

Communications Distribution:

- In general, all necessary wire ways, cable trays, conduits, junction boxes, and rough-in outlet boxes necessary for data/communications wiring distribution shall be furnished and installed by the project electrical contractor. However, all the data/communications wiring, terminations, and face plates will be furnished and installed by a special data/communications wiring contractor hired directly and separately by NKU.

- Electrical contractor shall furnish and install all grounding/bonding required for all data/communications pathways (conduits & wire way/cable tray).
- All data jacks are combination data/voice outlets. Where appropriate, such as offices, a combination data/voice/power faceplate should be used. In every case, there should be a duplex power outlet adjacent to the data/voice outlet.
- For offices, a minimum of (2) data drop locations shall be provided within each office on opposite walls. Each data drop "location" shall involve (2) data jacks, so there will be (4) total data connection jacks provided in each office.

TV System:

- As of April 2009, NKU receives cable service from (2) different local service providers: Cincinnati Bell and Insight Communications.
- On campus, the main cable feed from Cincinnati Bell is located at the Nunn Hall penthouse, and this cable feed currently serves only the needs for the Student Union. The Callahan Hall dormitory, which is remote from main campus on Martha Layne Collins Blvd, also receives cable service from Cincinnati Bell, but this is an independent feed.
- The cable feed from Insight Communications serves University Center, Landrum Academic Center, Albright Health Center, Bank of Kentucky Center, and the older dormitories located at the northwest corner of campus (University Suites, Norse Commons, etc.).
- NKU has a channel (18) reserved on the standard Insight Communications lineup solely dedicated to Norse Media, which is a cable TV station produced by NKU's School of Communication. As of April 2009, the head end for Norse Media is located in Landrum Academic Center, so Insight provides a direct feed into Landrum, and also receives an incoming broadcast feed from the Norse Media head end in Landrum. However, the program for the new Center for Informatics building calls for relocating this Norse Media head end from Landrum over to the new building.
- If the project program requires commercial cable TV service (Fox News, CNN, ESPN, etc), the design team shall coordinate with the NKU project manager on which local cable provider (Cincinnati Bell or Insight Communications) makes the most sense for the new service feed.
- Refer to the project room data sheets for specific locations requiring cable TV outlets, but at a minimum, provide cable outlets in all classrooms, seminar and conference rooms.
- A Cable TV tuner is required if the TV receiving cable service does not have a digital tuner, or if the user desires high definition (HD) quality. As of Spring 2012, the current tuner provided by Cincinnati Bell is a Motorola set top box (model# DCX32007280/013)

Campus Clock System:

- NKU employs a standard, campus-wide clock system linked and synchronized to a central repeater located in Nunn Hall.
- All new clock locations within new and renovated buildings shall be coordinated with the NKU project manager. Refer to the project room data sheets for specific locations requiring clock locations, but at a minimum, plan for them in all corridors, classrooms, seminar, and conference rooms.
- All clocks will be purchased separately from the project FFE budget. The standard clock is a 12.5" diameter, battery-operated clock (Model #14155C) with custom dial face. The batteries used are model #14885.

Audio Visual Systems:

- Coordinate exact Audio Visual requirements for the project with NKU project manager.
- NKU utilizes Crestron equipment and gear for controlling and driving all classroom and conference room Audio Visual systems.

PREFERRED PRODUCTS & SPECIFICATIONS:

- The following list specifies acceptable models of equipment in order to provide consistency and ease of support by NKU IT. Substitutions for discontinued items must be of the same manufacturer and be the current replacement for that model.
    - Spectrum Link Lectern 36" model with Heavy Duty Casters
    - Crestron Control System MP2E
    - Crestron 12-button Keypad control
    - Chief Universal mounting hardware compatible with projectors
    - TOA Integrated Mixer/Amplifier A-706
    - JBL Control23 Speakers Control23-WH
    - Sony DVD/VCR combo SLV-D370P
    - Mid Atlantic 9 Outlet Rack Mount Power Center PD-915R
    - Da-Lite 84"nominal diagonal projection screen manual
    - For classroom and conference room Audio Visual designs, the
    - Amplifier specified should provide 60 watts for each pair of
    - Speakers in the room (30 watts per speaker).
- The vendor is expected to be pro-active in advising NKU in the improvements of relevant AV technology and pricing in a timely manner, and to provide demonstration samples for testing and evaluation in actual use.
- All Audio Visual equipment specified shall be of current design and consist of standard products established manufacturers, carrying valid manufacturer's standard USA warranties.
- All items must be new. Used, including demonstrator equipment is unacceptable.
- The smart controls shall be designed to provide optimum usability for all controllable equipment. They shall imitate the design and functionality of Crestron 12-button type user interface for the University's existing systems.
- ADDITIONAL HARDWARE REQUIREMENTS: Additional requirements include extension cables from podium interior (equipment location) to podium surface to allow convenient plug-in of additional equipment; cable-pack to include two VGA (for desktop PC and laptop connections), composite video, S-Video, audio (for desktop PC and laptop), USB and Fire wire, connector plates, plugs, 20' cables, other required hardware, and installation to allow podium to be moved around the front of the room (i.e. "umbilical cord" with plugs at both ends, to connect podium equipment to wall for power, network, projector, and speakers.
- The following table represents the cable color standards utilized in the Griffin Hall construction for the Audio Visual systems. This is the closest NKU has to color cable standards for Audio Visual systems.

Signal Category	Cable Part Number	Signal Type	Color
Video			
	1855A	**SDI (router to patch)**	**BLUE**
	1855A	**HD (router to patch)**	**YELLOW**
	1855A	**Pulse/Ref (router to**	**WHITE**
	1855A	**Tri-Level (router to**	**WHITE**
	1694A	**Analog**	**BLACK**
	1694A	**SDI**	**BLUE**
	1694A	**HD**	**YELLOW**
	1694A	**Pulse/Ref**	**WHITE**
	1694A	**Tri-Level**	**WHITE**
Audio			
	9451	**Analog Line Level**	**BLACK**
	9451	**Analog Line Level**	**BLACK**

	1800B	110Ohm AES Channel	VIOLET
Control			
	8723	422	GRAY
	8723	232	GRAY
	82723	422 Plenum	GRAY
	82723	232 Plenum	GRAY
	1694A	DPS FS Crtl/RSWR	BLACK
	CAT6a	NETWORK	BLUE
Intercom			
	9451	2 wire	GREEN
	??	4 wire	GREEN

NKU Technology Infrastructure Standards are appended to this document. That document shall supersede design standards included above.

Division 28: Electronic Safety, Security, & Fire Alarm

The following section describes the requirements for properly integrating with NKU's existing campus electronic safety, security, and fire alarm systems. This section shall be consulted and coordinated in concert with Division 27 (Communications). Any deviation from the following guidelines shall be coordinated with the NKU project manager.

Card Reader Access Control System:

All card reader controlled access equipment specified for NKU buildings shall be compatible with the DSX Card Reader Access System and Persona Campus Online Access Control System, which is designed as a dual credential mag-stripe system programmed to read Track 2 and the following contactless credential details:

- A microprocessor based smart card technology
- Allows encryption keys on both the reader and card to be changed as security needs evolve
- Supports the portable Secure Identity Object (SIOs®) data model
- No traceable identifiers exchanged during card sessions, preventing data associated to a card from being divulged or cloned

These above referenced dual credential card readers are required on any new installations on campus. Providing this same equipment for all new card readers is necessary to ensure the new card reader systems will be compatible with the existing campus card reader access system, as well as the university's student/staff ID cards (NKU All- Card).

NKU's requirements for card access safety and security are to use the following basis of design for each application below:

- On doors without automatic operators:
    - High security openings, including exterior, and high traffic are to utilize PoE locking devices that interface using standard IEEE 802.3af Ethernet for data and power communication. These locks must directly integrate with the Persona Campus Online Software, which interfaces with the DSX front-end software. This is for all exit device, mortise lock, and cylindrical lock applications
    - Medium security and low risk areas, per the owner's discretion (NKU access control manager), WiFi locking devices that interface using standard IEEE 802.11 standards for data and communication, will be approved. These locks must directly integrate with the Persona Campus Online Software, which interfaces with the DSX front-end software. This is for all exit device, mortise lock, and cylindrical lock applications
    - These PoE integrated locks connect directly from the onboard single door access controller back to NKU's existing or newly installed PoE network switch. This will then communicate through the TCP/IP network back to the host Persona Campus Online software which interfaces with the DSX front-end software. No additional interfaces, components, or panels (excluding PoE Endspan or Midspan devices) are allowed.
    - These PoE Mortise Locks are to provide true Latchbolt Monitoring as part of the Door Position switch circuit.
    - These PoE integrated locks can be configured as Fail Safe or Fail Secure, for Fail Safe applications where fire alarm drop is necessary due to building or fire codes, verification with AHJ will be required

- On doors where automatic operators are present the following legacy access control devices will

be used.
    - Wall Reader - HID Part#: 922NNNNEK2xxxx *
        - Description: iClass SE with Magnetic Stripe Reader, Reads iClass SE and Seos, Pigtail Connection, Wiegand Output, Black
    - Controller – HID VertX Controllers V1000
    - Access Control Panels – HID VertX 2-door panels HID VertX V100

- On doors that are narrow stile or all glass doors, the following legacy access control devices will be used.
    - Wall Reader - HID Part#: 922NNNNEK2xxxx *
        - Description: iClass SE with Magnetic Stripe Reader, Reads iClass SE and Seos, Pigtail Connection, Wiegand Output, Black
    - Controller – HID VertX Controllers V1000
    - Access Control Panels – HID VertX 2-door panels HID VertX V100

The campus-wide card reader administration system is located on a central server within NKU. A data connection is required for each controller location to link back to the central system administration server. Each card reader installation requires a specific NKU individual to act as the card reader "authority", who is responsible for granting access privileges for each individual card reader. The assigned NKU authority will provide the names and ISO numbers to NKU O&M for initial programming and access privileges.

The following represents the specifications or basis of design required for ensuring all new card reader systems are compatible with the existing campus All-Card system:

1. Access card reader system must be Persona Campus Online and capable of interfacing with the DSX card reader system
2. PoE Locking devices – Sargent Passport 1000 P1 Series Locks
3. PoE Door and Frame Cables – McKinney PoE-QC series cables
4. PoE Transfer Devices – must use standard Molex connectors compatible with McKinney PoE cables.
5. WiFi Locking Devices – Sargent Passport 1000 P2 Series Locks
6. Wall Reader - 922NNNNEK2xxxx * Series (iClass SE with Magnetic Stripe Reader)
7. The system must read track 2 magstripe and also the HID Corporate 1000 SEOS Secure Identity Object (SIO) (Encoding can only be on the 2nd track of 3-track magnetic stripe).
8. Standard ABA encoding format
9. 16-digit ISO 2.
10. (4) digit expiration number
11. Cards or credentials are HID p/n: 5006PG1MN (Seos 8K Byte Composite Card with Magnetic Stripe)
12. Shielded cable from card reader to data closet
13. Wire from door strike back to data closet

Fire Alarm System:

The project specifications shall require fire alarm warranty service 24 hours a day, 7 days a week at no premium charge.

The fire alarm system for each building on NKU's campus is part of an EST-3 Class A network system with Fireworks bases located in the Power Plant and NKU's University Police Dispatch Center (415 Johns Hill Road). NKU fire alarm is a listed proprietary system and monitored 24/7/365 by the University Police Dispatch Center.

All new fire alarm panels must be EST-3 and connect to the existing fire alarm network. When connecting a new building fire alarm panel into the existing loop, the contractor shall coordinate with the NKU project manager and NKU Safety & Environmental Compliance on locating the two (2) nearest existing building EST panels ("nodes"). New wiring from the new building EST panel ("node") needs to be run and connected within the existing fire alarm loop somewhere between the two (2) identified, existing EST panels ("nodes"). The specific communication cable connecting each EST panel "node" within the campus fire alarm loop shall be fiber optic cable (provided by NKU's IT department) or (4)-16 gage twisted, shielded pair. The type of cable used will depend on the length between nodes and the path in which it runs. (Copper wiring will not be used if path is underground at any point).

All new panels shall be equipped with a feature to disable the outputs of the EST-3 panel. Disable buttons shall be segregated into the following functions: Elevator recall and associated functions; HVAC shutdown and related functions, fire door release; and Audible/Visual outputs. Alarm Silence shall be programmed so that the strobes remain active but the voice announcements cease.

Within each building, the fire alarm annunciator panel shall be located as close as possible to the main building entrance and be easily accessible for firefighters. Provide fire alarm pull boxes as required by code and at additional locations if layout is such that additional protection of this type is warranted. Locks on pull stations shall be keyed with a Cat-45 Key for consistency with others on campus. Duct detectors installed shall be programmed as latching supervisory alarms.

All new signaling devices shall be intelligent and programmed accordingly. All new audible indicating devices shall be speakers or speaker/strobes. All audio amplification shall be accomplished using only EST-3 amplifiers. If existing fire alarm panels are used, the proper boards shall be furnished to allow for intelligent devices and amplifiers for voice announcements. Fire alarm panels must also be tied into the mass notification system (Federal System UVIC) and programed to turn off announcements and strobes and allow the mass notification system to take over any speakers.

During construction, programming the new fire alarm panel is a coordinated effort. Before the end of each day during programming, the contractor shall make sure that the updated data file is left at the Power Plant prior to leaving.

During construction, contractors shall closely coordinate with the NKU project manager whenever work could potentially trigger a false fire alarm. The NKU project manager will notify the Power Plant and University Police Dispatch Center and let them know the details and schedule of the work.

Emergency Call Boxes:

NKU currently maintains a network of emergency call boxes across campus to ensure the safety of pedestrians during all hours of the day. The campus standard is the S-Series Mark III Wireless Call Box manufactured by Call24 Wireless Callbox Systems. Specific call box quantities and locations shall be coordinated with the NKU project manager during design. The preferred configuration is to provide a stand-alone pole and foundation independent of other structures or poles whenever possible.

The call boxes can operate power sources up to 480V.. The preference is to provide continuous "on" hard-wire power, but re-chargeable battery packs can be installed if the only practical power supply available is a site lighting circuit operating via "on/off" photocells.

To ensure the proper location is relayed to the NKU Police Department when the button is pushed, a location description needs to be provided by the contractor for each call box when ordering the new call boxes. Each specific call box number and location description shall be coordinated with the NKU project manager prior to programming the computer chip for each box.

Elevator Phones

Elevator phones will require special coordination with NKU IT via the NKU Project Manager. The phone must, however, communicate the building name and elevator number upon placement of the phone call to the NKU Police Department Dispatch Center. This phone must provide for 2 way communication with the elevator passengers. Preprogrammed messages must be disabled.

Security Cameras:

When required by the project room data sheets, security camera systems shall match the hardware/software requirements of the current campus system. Typical locations requiring security cameras include building entrances, loading docks, and some corridors near rooms containing expensive equipment. The following represents a summary of the current campus security camera system requirements:

- Recorder Component – provide server according to current video management system (VMS) specifications that is capable of recording sixty-four 720p cameras, set to 15 frames per second and motion activation, for a minimum of 30 days of video.
- Software – provide and load latest version of current VMS software on server as required. The current VMS shall be the same as the VMS currently in use elsewhere on campus.
- Camera – cameras shall be Sony IP cameras, or owner approved equivalent, and compatible with current VMS being used by NKU. Cameras shall have a minimum resolution of 720p with a variable focal lens. Exceptions for variable focal lens cameras shall be approved be owner approved prior to submittal. Resolution and magnification will vary depending on specified location and view. Any equivalent shall be owner approved prior to submittal approval.
- Other miscellaneous system notes:
    - Install cameras at locations indicated by project data sheets.
    - Provide necessary hardware to mount cameras.
    - Server shall be located in the university server room (Administrative Center Room 219)
    - Contractor is responsible for running network wiring/cabling from cameras to nearest data switch and must meet NKU IT standards.
    - Data switches used must provide POE to the camera.
    - Contractor is responsible for all required permits and inspections.

Emergency Mass Notification System:

The following represents a summary of the current campus notification system, which assumes an EST3 Fire Alarm Panel with audible speakers is installed:

- Federal Signal Corporation's UltraVoice controller (UVICU) shall be designed and installed by Federal Signal Corporation.
- The UVICU will be located as near as practical to the fire alarm panel.
- Power source needs and specifications to be provided by Federal Signal Corporation.
- Supervisory circuit and audio circuit will be provided to fire alarm service provider from the UVICU.
- Fire alarm service provider will provide Federal Signal Corporation any end-of-line resistors needed to monitor the supervisory circuit.
- Fire alarm service provider will make final termination at fire alarm panel and reprogram the system to disable all fire alarm strobes, horns and messages and allow audio from the UVICU to operate across fire alarm system speakers when the UVICU is activated for a warning.
- Fire alarm service provider will program fire alarm panel to auto-reset after a mass notification system activation when the relay opens and return to original status.
- All wires and termination points are to be labeled at both ends.
- All wiring/cabling must meet NKU IT standards.

The mass notification system will also be utilized for panic buttons via Federal Signal IP Informers.

Division 31: Earthwork

Many buildings on NKU's main campus have developed problems resulting from expansive shale subsoil materials. In some cases, this is a significant problem Efforts should be taken to mitigate/prevent this problem when a project will include work at the subsoil level. Strategies for dealing with this potential expansive shale problem should be identified in the geotechnical investigation report.

Spoils from excavation can potentially be moved to open areas on campus for use on other concurrent or future construction projects. These available areas and overall campus need for extra fill material varies throughout the years, so any possible relocation of spoils to other areas on campus should be coordinated with the NKU project manager. All top soil removed on a project shall be relocated elsewhere on campus to a location identified by the NKU project manager.

When placing soil on a project, the top 18 inches shall be free of rock greater than 6 inches and the top 6 inches shall be free of rock greater than 1 inch.

In projects with costs exceeding $50,000, the contractor shall be responsible for all utility marking. For any project which will have digging, excavations, trenching etc, the contractor shall place an 811 ticket and include the NKU Project Number for reference by NKU Utility Locating.

Division 32: Landscaping & Irrigation

The following section describes the overall strategy and general preferences for Landscaping, as well as the Irrigation systems currently used throughout campus. Any deviation from the following guidelines shall be coordinated with the NKU project manager.

General Landscaping Preferences:

A good landscaping plan is critical to the success of every new project on NKU's campuses. The university is interested in an attractive, but still easily maintained, landscaping scheme. The landscaping and other site amenities should convey a sense of quality as well as a feeling of welcome. For the past 5-7 years, the University has focused energies toward increasing the perceived quality of the campus as a place through place making strategies, particularly through creation of superior landscapes and "greening" the campus. To the extent that seems reasonable in terms of overall budget constraints, this project should include investment in landscape and site improvements. The goal is to impart a "campus" quality to the campus and to offset and balance the hard surfaces and angular nature of the built environment with landscape and lawn areas.

Landscape materials should be selected for ease of maintenance and ability to thrive in the Northern Kentucky environment. Previous landscape designs for NKU have been over-planted initially, which has resulted in more long term maintenance issues and problems. Ongoing issues on campus include ease of care, quantity of species already on campus, previously successful/unsuccessful species plants, and the potential introduction of new species.

In general, the university always seeks to add color and interest to the landscape year round. The university requests intimate involvement from the university's Roads & Grounds superintendent (and main horticulturist) during design for participation in decisions involving the selection of plant materials appropriate for this project.

The following represents some general campus landscaping guidelines:

- Planter beds (i.e. planting soil mixture) should be a minimum of 12" deep for shrubs and 24" deep for trees.
- All new turf areas shall be initially installed as sod. Seeding will only be permitted if approved by the NKU project manager.
- Topsoil should be imported and spread a minimum of 6" deep in areas to receive seed or sod.
- Migration of rock upward from poor subsoil below through a minimal layer of topsoil has been a problem in the past. Removal of all rocks from the topsoil is essential to healthy turf growth, and NKU will review the topsoil for rocks frequently.
- Design initial planting bed density to allow for future growth. Do not provide an initial density to accelerate the perception of growth.
- Provide 5" (minimum) caliper for all new tree locations.
- If seeding is permitted, the seed mixture shall be: Tall and Fine Fescue (Festuca arundinacea and Festuca rubra) varieties such as Falcon II, Shenandoah II, Scorpion, Fine Fescue, Nordic Hard, K-2 Chewings, etc.
- Due to strength of prevailing winds on campus, we have had marginal success with use of straw to protect newly seeded lawn areas. Use of netting, hydro- seeding or a similar process is recommended.
- The use of fertilizer, sulfur and lime should be based upon soil testing.
- Design team shall include very specific and strict verbiage in the specifications regarding responsibility and frequency of temporary watering by contractors during construction. NKU has had bad experiences with previous contractors on keeping up with the proper amounts and

frequency of necessary watering.

General Irrigation Preferences:

In general, NKU prefers an underground irrigation system for all lawn and planting areas. Typically, existing irrigation systems are fed from the main campus water loop. NKU currently does not employ any system or storage devices for detaining storm water and reusing for irrigation purposes. However, NKU is receptive to the idea and encourages design teams to explore and propose systems as applicable and practical for new projects.

The main line feeding new irrigation systems shall be installed with a separate shut-off valve and readable consumption meter, as well as a RPZ-type, back-flow device. Both the consumption meter and back-flow device shall be located in an area that is easily serviceable by NKU O&M staff and protected from freezing.

The following represents some general campus irrigation system design guidelines:

- Provide a full irrigation system design within the project construction documents, as the design-build methodology has resulted in subpar and unacceptable irrigation systems on previous projects. NKU will want to review and comment on the irrigation system design prior to bidding.
- Provide the irrigation system main as a full loop around the site whenever possible.
- NKU prefers (2) 4" sleeves for each hard scape crossing (1 for irrigation piping and 1 for wiring). For main routing under roads, provide (2) - 6" sleeves.
- The sleeve installation contractor shall provide the GPS coordinates and elevation for each end of any provided sleeves. This will help future contractors and/or NKU locate the sleeves when necessary in the future.
- Provide tracer wire for all mains and laterals in the irrigation system.
- For irrigation control, the system must use a 2 wire system, and not a multi- strand system. The irrigation controller provided must come with a 3 year manufacture warranty.
- NKU prefers the Tucor RKD model for the irrigation controller/decoder system, and all controller/decoder-manufacturer-standard wiring shall be installed for complete, integrated system. NKU hopes to control all systems remotely via TC/IP in the near future, so all new controllers/decoders shall include this capability.
- Provide a minimum of (4) quick coupler connections in the irrigation system for each specific project site.
- All irrigation system rotors shall come with a 5 year manufacture warranty, and shall utilize swing joint (PVC or Marlex) connections (not just funny pipe).
- All valve boxes shall be a minimum of 10".
- Before gluing pipe, use a purple cleaner. (This makes it very easy to inspect that all joints have been glued)
- Before any part of the irrigation system is backfilled, it must be inspected by the NKU project manager and a member of the university's Roads & Grounds Department.
- In open trenches, use a 1" thick bed of sand under the pipe and 3"-4" above the pipe. Then, use typical backfill material to fill the remaining trench volume.
- Furnish and install, grounding rods every 500 to 600 feet, at the controller and at terminal ends of wire. The top of the grounding rods should be in a 10 inch round box. The grounding rods are to be 6-8 feet in length. A grounding plate may be substituted at the controller instead of a grounding rod.
- Furnish and install, surge protectors every 500 to 600 feet or at each zone valve and two at the controller. The surge protectors should be put in an existing 10" box or put in a separate box.

Division 33: Underground Site Utilities & Tunnel System

Underground Site Utilities:

The NKU project manager will research and provide whatever information is available and known for the existing utilities in the area of concern. However, NKU generally prefers the contractor hire an outside utility locating service for marking the location of all existing utilities. Outside utility locating services will be required for locating all public utilities (when applicable), and most of the underground utilities on campus are private "house" lines owned & maintained by NKU. All requests for assistance from NKU's Operations & Maintenance staff in locating existing utilities shall be submitted through KY811 who will then notify NKU Operations & Maintenance. In projects with costs exceeding $50,000, the contractor shall be responsible for all utility marking. For any project which will have digging, excavations, trenching etc, the contractor shall place an 811 ticket and include the NKU Project Number for reference by NKU Utility Locating.

The following information shall be included in the project specifications for work associated with underground site utilities:

- Permanent utility markers should be installed to mark the location of all underground utilities. See utility marker standards included in this section.
- All existing utility lines determined not necessary or previously abandoned shall be completely removed and discarded by the contractor. Any "abandoned" lines shall not be left in place.
- All plastic underground utilities of any type must have tracer wire installed on pipe (mains and laterals).
- When work is performed on underground site utilities, the closeout documents shall include updating the campus site utility drawing. Any abandoned lines shall be indicated on a separate layer.
- Contractors shall determine and provide a GIS shapefile in the the record drawings for all underground utilities, including but not limited to: valves, valve boxes, manholes, catch basins, quazite boxes, etc.
- Provide a minimum physical separation of 12" between power and telecom duct banks to prevent interference from the power cables to the copper telecomm cables. This means that the duct banks must be physically separated (i.e. not combined in the same pour). All duct banks shall be formed in the trench during initial installation, and each duct bank concrete shall include a colored dye to identify and differentiate between specific duct banks during future excavations.
- Contractors installing underground natural gas piping must have proper certification and training from Duke Energy. In addition, all installed piping must be inspected by Duke Energy and the NKU Plumbing Department prior to burial. Refer to Division 22 for more specific information regarding natural gas services.
- Utility trenches within 6 feet of a roadway shall be filled with flowable fill. In turf areas, flowable fill shall stop at 18 inches below the level of the turf. Any trench that goes under a footing shall be filled with flowable fill.

Tunnel System:

Whenever appropriate and economically feasible, NKU prefers to extend and connect into the existing campus underground tunnel system. The primary purpose of the existing tunnel system is to distribute steam and chilled water (and other miscellaneous utilities) throughout campus. Tunnels shall be at least 8' wide and 10' tall. There shall be a minimum of 8' clearance from the floor to any installed overhead utility piping and associated supports. When utilities are installed on the sidewalls of tunnels, there shall be a minimum clearance of 8' in width after installation of utilities and associated supports. Every effort should be made within the tunnels to achieve changes in elevation with ramps, but lifts and/or freight

elevators have been an acceptable, though not preferable, solution. Any lift or elevator must also be accompanied by stairs. Caps of tunnels shall also have a structural cap installed to support a minimum weight of XXX psf applied to the top of the tunnel.

For the main sections of tunnel containing the main chilled water (16” diameter) and steam (8” supply/4” condensate) primary distribution loop “trunk” lines, the following represents the approximate structural design loads for the steel support cross beams:

- 16" chilled water supply and return, 175#/ft each
- 8" steam supply 75 #/ft
- 4" condensate return 25#/ft

Tunnels shall be designed to allow for no water infiltration. Waterproofing shall be installed on all underground sides of the tunnel. Waterproofing systems shall include drainage tile. Include floor drains via gravity drains wherever possible.

Manholes:

Electronics and electrically powered equipment shall be located outside of manholes and underground vaults when possible. Any equipment that must be located in manholes and/or vaults shall be rated for wet locations or for submersion in water. This equipment must also be installed at a location to easily allow for future service. Power connections and disconnecting means for this equipment shall be located such that they will not be submersed in water in the event of equipment failure. Manholes shall have gravity drainage installed wherever possible. Any exposed piping shall be insulated.

Electrical switching shall be installed above ground via pad-mount switches.

Technology Infrastructure:

Category 6A & SM Fiber to the Desktop Cabling Standards

Revision 6 – 2/1/2018

1.0 GENERAL

1.0. A.
Northern Kentucky University follows all current ANSI/TIA/EIA 568, 569, 570, 607 and 758 standards, National Electrical Code, National Electrical Safety Code, and all local jurisdiction codes.

1.1 STANDARDS

1.1. A.
Building structured cabling systems shall meet Northern Kentucky University's Office of Information Technology cabling conventions to include adherence to the most currently available **BICSI** Building Industry Consulting Service International TDM Telecommunications Distribution Methods Manual, TIA/EIA Telecommunications Building cabling Standards, NFPA National Electrical Code manuals (ANSI/TIA/EIA) and also meet a minimum of **25 year warranty** standards of the manufacturer. This includes addendums to TIA standards such as 568-B.2 addendums 1, 2, 3, and 4. Contractors shall be fully acquainted with the above referenced standards and be fully qualified, as outlined in the NKU Technology Infrastructure contractor qualifications. Contractors shall have demonstrated qualifications to install and test a 10-Gigabit intra/inter-building backbone. All station and riser cabling shall be tested and certified by the contractor to support 10-Gigabit technology. Additionally, the contractor will be required to meet NKU conventions and standards. The following specified Technology Infrastructure Cabling Standards are to be used as a minimum requirement.

1.2 COMMUNICATION CABLING SYSTEM CONTRACTOR QUALIFICATIONS

1.2. A.
The NKU Office of Information Technology requires that only qualified and experienced communication cabling system contractors perform project management and installation services in the construction or remodel of University buildings. Pursuant to this, NKU's Office of Information Technology wants to ensure that successful contractors have the capabilities, qualifications, financial stability, resources, equipment and experience to complete communication cabling system installations using common industry practices (i.e. Current BICSI TDM, ANSI/TIA/EIA 568, 569, 570, 607 and 758 standards, National Electrical Code, National Electrical Safety Code, and all local jurisdiction codes, etc.), while meeting all NKU Office of Information Technology guidelines.

1.2. B.
Contractor (prime and any sub-contractors) must meet the requirement of having continuously performed communication cabling system installation work for a

minimum of **5 years**. Contractor must provide manufacturer technician certification information, customer references, and documentation supporting this requirement. Contractor shall provide at least 2 references from similar installations. One within the last 6 months and one within the last 2 years.

1.2. C.
Communication cabling contractor, at all times during performance and until work is completed and accepted, should have onsite a competent supervisor, satisfactory to NKU's Office of Information Technology. He should have the authority to act for the communication cabling system contractor regarding work schedules and any changes to the scope of work. The supervisor must be a BICSI certified Technician and a BICSI member in good standing.

1.2. D.
Contractor and their installers must be a local, **Legrand Ortronics / General Cable** certified installer, able to obtain a minimum 25 year warranty.

1.2. E.
Communication cabling system contractor must have a current **BICSI certified RCDD** (Registered Communication Distribution Designer) on staff as a full-time employee. A copy of the RCDD certificate and BICSI member number must be provided with bid documents.

1.2. F.
Communication cabling system contractor must provide at least one project manager or lead technician on a project who is a BICSI certified Technician and a BICSI member in good standing. A copy of their certificate and BICSI member number must be provided with bid documents.

1.2. G.
Communication cabling system contractor must be skilled and proficient in both inside cable plant (copper and fiber) design, installation, as well as outside cable plant (copper and fiber) design, installation, termination, splicing, and testing. Communication cabling system contractor must provide a list of equipment owned (i.e. fusion splicer, OTDR, excavation equipment, cable testers, etc.).

1.3 PROGRESS MEETINGS

1.3. A.
The contractor will be required to meet with and coordinate with a representative of the NKU Office of Information Technology prior to work beginning and weekly during the installation process. Weekly meetings will include a site inspection to ensure compliance with established standards. The successful electrical and communication cabling system contractor will follow appropriate installation guidelines, as contained in the most currently available BICSI TDM, ANSI/TIA/EIA Wiring Standards, and NFPA National Electrical Code manuals. Additionally, contractor will work with NKU's Office of Information Technology to ensure proper placement, routing, labeling and documentation of cable and support hardware.

1.4 DOCUMENTATION

1.4. A.
Prior to system acceptance, the contractor shall submit to the owner fully documented and scaled drawings of the entire fiber optic and copper distribution system. Documentation shall be provided in both a **hard copy** binder

and an **electronic copy** on a USB drive capable of being viewed and edited in Visio Professional. This will include building and floor layouts with workstation information outlet locations and labeling, MDF (Main Distribution Frame room), IDF (Intermediate Distribution Frame room), cable routes, interconnect locations, intermediate and main distribution frame locations, riser locations and all other information pertinent to the installation.

1.4. B.
The contractor will be responsible for accurately labeling and identifying all relevant components of the cabling system, including, but not limited to: Workstation outlet faceplate labeling; workstation cable labeling; patch panel and port labeling; telecom block labeling; riser cable labeling; backbone cable labeling at entrance to MDF or IDF; fiber optic patch panel labeling and strand labeling. The contractor will consult with NKU's Office of Information Technology representative in regards to labeling and identification. The labeling nomenclature is as follows:

All Voice and data cabling for the university will follow one simple **labeling plan: room # - Outlet# - Jack #**. Data and voice ports will be distinguished in the second integer where data ports will use a number and voice ports will use a letter (A, B, C).

Other list of possible extensions to be included:

Security Camera = C

Crestron Panel = CR

Elevator = E

Fire Panel = F

Projector = P

Wireless Access = W

EXAMPLE: 208-1-1 = room #208, data outlet # 1, jack # 1

EXAMPLE: 549-A-1 = room #549, voice outlet # A, jack # 1

EXAMPLE: 128-3-3 = room #128, data outlet # 3 and jack # 3 in that room

EXAMPLE: 745-C-3 = room #745, voice outlet # C and jack # 3 in that room

EXAMPLE: 609-P-1 = room #609, projector outlet # 1 and jack #1 for projector

EXAMPLE 332-W-1 = room #332, wireless access outlet # 1 and jack #1 for wireless access point

The jack colors on workstation side should be Blue.

Outlets will be numbered from the primary entrance into a room in a clockwise fashion, left to right. Numbering the wall outlets first, floor outlets second and the ceiling outlets last.

This simple nomenclature denotes three integers for all voice and data labeling where the first integer is the room number and the second integer is either voice, data, projector or other (denoted by a number or letter)in the room and the third integer is the jack # in the outlet.

Northern Kentucky University also requires that each individual cable be labeled at both ends with the same numbering plan explained above, per BICSI standards. All labels must be machine printed and permanent.

Contractor should consult with NKU for proper labeling standards prior to installation.

1.4. C
The contractor will be responsible for attaching cable tags on all cables that are installed through the NKU manhole, hand-hole and Arial pole systems. These cable tags will be attached to each cable in each manhole and clearly state the: To & from locations, pair counts, strand count, cable type and use.

Examples:
BC > SU -12ST-SM-D = BC building to Student Union, 12 strand, single mode, data.

SC > LA -400PR-CP-V = Science Center to Landrum, 400 pair, Copper, Voice.

1.5 MATERIALS LIST

Items cannot be substituted. Contractors should present quotes based on the material list provided by NKU **(see approved material list document)**.

1.5. A.
Workstation Outlet:

Ortronics is the standard.

NKU prefers to utilize modular faceplates that allow for a variety of modules such as fiber, copper, USB, and audio/visual connections in angled configurations.

Ortronics Single Gang Series II Angled Wall Plate, (holds 4 jacks) Fog White - Ortronics PN: OR-40300158 plus (2) OR-40300656.

RJ45 Jack, 10 Gigabit, RJ45, T568A/B, Snap-In Module, Blue - Ortronics PN: OR-TJ6A-36 used for data outlets

Blank Module, Fog White, TracJack Blank: PN OR-42100002; Series II Blank: PN OR-40300023

Please consult NKU IT for non-faceplate installation (furniture or surface mount box)

1.5. A.1.
Copper Patch Cords:

Ortronics is the standard.

Color is **BLACK** for 6A patch cords

Maximum length of Category patch cords is 7 feet. As such, design and implementations shall consider same by ensuring outlet locations are no more than 7 ft. from devices to be network connected.

Ortronics Cat6A Black Patch Cords:
PN: OR-MC6A03-00 (3 foot); PN OR-MC6A05-00 (5 foot); PN: OR-MC6A07-00 (7 foot)

Fiber Patch Cords:

Ortronics is the standard.

Single Mode: Utilized in backbone & workstation applications

All Fiber jumpers will be SM LC to LC in 1, 2 or 3 meter lengths.

Ortronics PN: OR-P1DC2IRSZSZ001M (1 meter); OR-P1DC2IRSZSZ002M (2 meter); OR-P1DC2IRSZSZ003 (3 meter)

1.5. B.
Horizontal 6A Cable:

General Cable is the standard.

Category 6A, 4 twisted pairs, 23 AWG, small diameter, MTP, CMP Plenum, Blue Station Wire for Data. General Cable PN: 7141849

1.5. C.
Fiber Cable:

Corning fiber is the standard.

Fiber to the desk cable, 6 strand armored plenum indoor single mode with Corning Glass. Corning PN: 006E88-31131-A3

Indoor fiber optic installations will utilize singlemode, 12 strand, plenum-rated, premise distribution cable Corning PN: 012E88-33131-29

Indoor/outdoor fiber optic installations will utilize singlemode, 12 strand, plenum-rated, armored, indoor/outdoor cable Corning PN: 012E8P-31131-A3

Outside plant fiber optic installations will utilize singlemode, 12 strand, armored, outside plant cable Corning PN: 012ZUC-T4F22D20

Fiber optic cable construction, glass type and manufacturer should remain constant through any variation of fiber optic strand count.

Strand count will vary.

1.5. D.
MDF/IDF Data station cable termination and equipment:

Ortronics is the standard.

All data cabling media should be terminated in Ortronics MM20 equipment racks with adequately sized cable management. Minimum 10″ vertical wire management is required between racks and 6″ vertical wire management on the ends. The goal is to not exceed a 40% fill rate at installation.

NKU utilizes modular “panel jack” patch panels. The modular “panel jack” panels will be angled to eliminate the need for multiple horizontal cable managers and should support up to 24 ports in 1RU. Each patch panel port should be 100% tested to ensure NEXT and RL performance. A single 4U horizontal manager shall be used in each rack as a channel for cords to go from one side of the rack to the other.

Unloaded Patch Panel, Angled, 24-port, Ortronics PN: OR-PHAPJU24
Blue Panel Jacks, Category 6A for unloaded panels, Ortronics PN: OR-PJ6A-36

2 post rack; MM20, 7ft, 19” mounting, 30” channel depth for horizontal cable mgt. Ortronics PN: OR-MM20730-B; Used in IDFs

Adjustable 4 post rack MM20, 7ft, 19” mounting, Ortronics PN: OR-MM2042ADJ12-B; used in MDFs

Wire Management as specified in section 1.5.H.

1.5. E.
MDF/IDF Voice station cable & Voice riser cable termination and equipment:

Ortronics is the standard.

By default, all voice cabling media should be terminated on wall mounted backboards. Category 6 96-pair 110 IDC type punch down blocks with mounting legs. Ortronics PN: OR-110ABC6100

Ortronics MM20 7ft Cable Management Rack w/ 6 in deep channels, PN: OR-MM20706-B

Ortronics Mighty Mo Wall-Mount Cable Management Cabinet, 19U x 24w x 26D PN OR-MMW192426P-B

Ortronics Wall-Mount Relay Rack, PN: OR-604045450

1.5. F.
MDF/IDF, Fiber Optic entrance cable, Copper entrance cable termination and equipment:

Corning fiber is the standard.

Indoor fiber optic installations will utilize single mode, 12 strand, plenum-rated, armored premise distribution cable Corning PN: 012E88-33131-A3

Indoor/outdoor fiber optic installations will utilize singlemode, 12 strand, plenum-rated, armored, indoor/outdoor cable Corning PN: 012E8P-31131-A3

Outside plant fiber optic installations will utilize singlemode, 12 strand, armored, outside plant cable Corning PN: 012ZUC-T4F22D20

Fiber optic cable construction, glass type, and manufacturer should remain constant through any variation of fiber optic strand count.

Fiber Distribution Center termination cabinet, 4 rack units with capacity of 12 adapter panels (Ortronics PN: OR-FC04U-P)

Fiber Distribution Center termination cabinet, 2 rack units with capacity of 6 adapter panels (Ortronics PN: OR-FC02U-P)
Fiber Distribution Center termination cabinet, 1 rack unit with capacity of 3 adapter panels (Ortronics PN: OR-FC01U-P)
Single mode LC connector 12 strand (6 duplex) pre-loaded panel (Ortronics PN: OR-OFP-LCD12AC)

Fiber Connectors should be Singlemode LC:

LC individual splice on connector (6 Pack) Ortronics PN: OR-205KNF9SA-09

Fan out Kit (6 fiber) – Ortronics PN: OR-61500858
Fan out Kit (12 fiber) – Ortronics PN: OR-61500868

Circa BET Building Entrance terminal – (110 type) 100 pair increments. Circa PN: 1880ECA1-100.
Circa 5-pin plug in protector units, Digital/Solid State. Circa PN: 4B1FS-240.

1.5. G.
Grounding and Bonding:

Ortronics is the standard.

All grounding must be on an independent, standalone system ground.

Telecommunications Main Grounding Busbars (TMGB) Ortronics PN: OR-GB4X12TMGB
Telecommunications Grounding Busbars (TGB) Ortronics PN: OR-GB2X12TGB

1.5. H.
Wire management:

Ortronics is the standard.

For use with Ortronics 2 and 4 post MM20 racks.

For end racks, Vertical Cable Management 84”H x 6”W x 8”D w/Door. Ortronics PN: OR-MM20VMD706-B

For adjoining racks, Vertical Cable Management 84”H x 10”W x 13”D w/Door. Ortronics PN: OR-MM20VMD710-B

For MM Horizontal management - a single 4U horizontal manager shall be used as a channel to pass patch cords from one side of the rack to the other.
Ortronics PN: OR-MM6HMF4RU

1.5. J.
Firestopping:

STI is the standard.

EZ Path Fire rated cable pathway devices shall be used in fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:

Meet the hourly fire-rating of fire rated wall and or floor penetrated.

Be tested for the surrounding construction and cable types involved.

Have UL Systems permitting cable loads from; “Zero to 100% Visual Fill.” This requirement eliminates need for fill-ratio calculations to be made by cable technicians to ensure cable load is within maximum allowed by UL System.

Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.

Be “Zero-Maintenance”, zero-maintenance is defined as; No action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to: opening or closing of doors; spinning rings to open or close fabric liner; removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.

Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.

Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.

Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

Cable tray shall terminate at each barrier (wall) and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier (wall). Cable tray shall NOT pass through the barrier (wall).

Substituted material is not allowed.

Acceptable Products from STI:

Part Number / Series	Description
EZD22	2″ EZ Path Firestop Device
EZD33FWS	3″ EZ Path Firestop Device
EZDP133CWK	3″ EZ Path Firestop Device Kit (for 4″ conduit)
EZDP33FWS	3″ EZ Path Firestop Device Kit (square mount)
EZP433W	3″ Ganging Accessory (Qty 4) for 3″ EZ Paths
EZD44S	6″ EZ Path Firestop Device
EZDP44S	6″ EZ Path Firestop Device Kit (square or round mount)
EZP544W	Ganging Accessory (Qty1-5) for 6″ EZ Paths
EZGxxxxx	Grid for riser applications
RFG2	Individual Cable EZ firestop grommet (10 pack)

1.5. H
Pathways and Penetrations:

Cable Trays:

Cablofil is the standard.

All cable trays shall be designed to accommodate all types of cabling. Note that installation shall be in non-return air plenum space only. All telecommunications pathways (Caddy J-hooks, basket tray or Legrand/Wiremold raceways) shall be used for communications medium (voice, data and fiber optic cabling) only.

The minimum dimensions for a cable tray shall be 12 inches wide and 4 inches deep. The tray must consist of continuous, rigid, welded steel or stainless steel wire mesh cable management system. The cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories. Wire mesh cable tray will have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers. Basket tray shall be spliced using EDRNs on the sides as well as an SWK washer/nut in the bottom of the tray.

Contract documents should show cross section of the communication wire way or cable tray. The drawing must show reference to other utilities in the building. All sections of the cable tray must be bonded together with approved bonding methods and devices. For installation of other types of “approved” low voltage cables in the cable tray, a separate tray or at minimum a divider in the basket tray to prevent interference from unshielded cables is required.

Supports for cable trays larger than 12 inches in width are to be installed according to the manufacturer specifications. A single support is not acceptable. All supports are to be fastened to the building structure above. If the cable tray will be of a wall mount type, it must be installed properly to provide proper permanent support at trays maximum capacity.

Radius Drop outs shall be used whenever multiple cables are exiting the tray.

Cable trays must maintain a minimum of 6-inch clearance from obstructions above the tray and a minimum of 8 feet AFF. Trays are to provide access via the most direct path to all communications outlets on the floor.

Install sweeping factory 90's for all turns. Use end-of tray terminations where wire drops down to walls to prevent abrasions and cuts from metal tray edges. Use a trapeze supported cable tray mounting method suspended by manufacturer recommended size all-thread. Fasten all-thread to ceiling anchors, allowing no bends in all-thread. Support the cable tray in this manner at every section-to-section junction and at 5 feet to 6 feet intervals (mid span) between joints. Whenever possible, the tray should be no closer than 6 inches from the structural ceiling, ducts or pipes, considering all other possible obstructions. A minimum of 5 inches distance from lighting, especially fluorescent lighting, is desired.

Coordinate layout and installation of cable tray with other trades. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect. Basket tray installation in the TRs shall be installed as depicted on the drawings by the Telecommunications Contractor. The basket tray that is to be installed for the horizontal and backbone distribution will be provided and installed by the electrical contractor.

Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

Refer to the drawings for the size and location of the tray to be installed.

Ground cable trays at end of continuous run. Ground continuous cable tray runs every 60 feet. Cable trays that are not UL Classified will be grounded per NEC requirements and manufacturer recommendations.

Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10’ cable tray section with grounding clamp.

Open Top Cable Supports (J-hooks):

Erico/Caddy HP series is the standard.

All open top cable supports (J-hooks) must be suspended from or attached to the structural ceiling or walls with hardware or other installation aids from Caddy specifically designed to support their weight. When used, Caddy J hooks shall be located on 48 to 60 inch centers to adequately support and distribute the cables weight. These types of supports may typically hold up to fifty 0.25-inch diameter cables.

No other cables shall be run in the same j-hooks along with the voice and data cables. A separate painted (white, red, blue, green) Caddy j-hook system must be provided to facilitate the installation of other low voltage cabling.
For larger quantities of cables that convene at the Telecommunications Closet, provide Cablofil cable trays or other special ERICO/CADDY supports that are specifically designed to support the required cable weight and volume.
No plastic j-hooks will be allowed.

Floor Mounted Assemblies (Floor Boxes and Poke-Thru Devices)

All Floor Mounted Assemblies including floor boxes, poke thru devices, floor outlets, floor mounted whips, tombstones, etc. shall be sized using industry standard guidelines for telecommunications distribution methods; specifically relating to cable fill ratios and limitations. Guidelines can be found in the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual and/or through individual cabling manufacturers’ installation guidelines.

Floor boxes:

Wiremold Evolution series is the standard.

Specifically, be of the “Evolution” series from Wiremold be used in concrete, raised floor and wood floor applications and are fully adjustable both pre and post concrete pour, have removable dividers and a tunnel feature that allows all compartments to be connected, have removable modules through the top or back of the floor box. The floor box hinge must be able to open to a full 180 degrees and lie flat on the floor surface providing easy access to interior modules. Cable egress doors lock in position when open and will automatically close around wires to protect cabling and avoid tripping hazards. They accept single, double or triple wall plates as well as accommodate power, communications and A/V devices. Designed to maintain up to a 2 hour fire rating.

Acceptable part numbers for various sizes are as follows:
6 Gang: EFBS6

8 Gang: EFBS8
10 Gang: EFBS10
2 gang (furniture feed) EFBFF
Cover style for floor boxes shall be brass, unless approved by NKU IT

Poke thru devices shall be Wiremold EVOLUTION series style provide the interface between power, communication and audio/ visual (A/V) cabling in an above grade concrete floor and the workstation or activation location where power communication and/or A/V device outlets are required. Provide recessed device outlets that will not obstruct the floor area. The poke-thru device shall be compatible with the complete line of workstation connectivity outlets and modular inserts. Permit all wiring to be completed at floor level.
The 6AT, and 6ATCFF units shall mount in a 6" [152mm] cored hole, actual 6 1/16" [154mm] core hole.

The 8AT units shall mount in an 8" [203mm] cored hole, actual 8 1/16" [205mm] core hole. Use is defined by the UL Fire Resistance Directory as a minimum spacing of “2 ft. [610mm] on center and not more than one device per each 65 sq. ft. [6m2] of floor area in each span.”

Cover plates for poke-thru devices shall be brass, unless approved by NKU IT

Wall Boxes (A/V, Power, Data behind flat screens):

Wiremold Evolution series is the standard.

Wall Boxes:
Should be used for TVs, Monitors, & Digital Signage for use in new construction and renovation construction projects. Should be compatible with complete line of workstation connectivity outlets and modular inserts, and most audio/video manufacturers’ products. Should provide the interface between power, communication and audio/video (A/V) cabling new construction and renovation location where power and communication and/or A/V device outlets are required. Should provide recessed device outlets that will not obstruct the wall area. Should permit all wiring to be completed at box level.

Ladder Rack & Accessories:

Ortronics is the standard.

Ortronics Tubular Runway 18”W Black. Ortronics PN: OR-TRT10-18B
Ortronics Triangle Support Bracket 18”W Black. Ortronics PN: OR-P139540HB
Ortronics Wall Angle Support Bracket 18”W Black. Ortronics PN: OR-P128440HB
Ortronics Cable Runway to rack mounting brackets. Ortronics PN: OR-MM6CRB16
Ortronics Ladder Rack Splice Kit. Ortronics PN: OR-P820127H
Ortronics Rack Elevation Kit. Ortronics PN: OR-REK-4-6
Ortronics overhead runway cable drop out. Ortronics PN: Or-TRP11-CM

A separate spreadsheet summarizes the entire list of NKU approved materials. This is to be requested from NKU IT.

2.0 CABLE PLANT

2.1 TELECOMMUNICATIONS ROOM REQUIREMENTS:

2.1. A.
Each MDF/IDF should be a (stand-alone wiring room) located such that no single UTP (Unshielded Twisted Pair) horizontal cable run shall exceed **90 meters** in total length including service loops. MCRs must be located on the lowest floor of the building. Every floor must have an IDF or MDF to serve outlets on that same floor. All such rooms must be vertically stacked. Telecommunication Rooms shall not be co-located in custodial, mechanical or other shared space where damage to critical electronics may occur. Each room shall be sized according to use, and meet the below listed criteria. Coordinate with a representative of NKU's Office of Information Technology prior to the installation of backboards, grounding systems, bonding systems, and electrical service.

Floor Size: MDF Rooms 12' x 15' minimum or ANSI/TIA/EIA 569 specification.
Floor Size: IDF Rooms 12' x 12' minimum or ANSI/TIA/EIA 569 specification.

Floor Surface: Treated / sealed concrete.

Floor loading: 50 lb. per ft. minimum or as required by applicable codes.

Riser sleeves/conduits between floors shall be a minimum of 6 inches and provide pulls strings.

Prefer no false / drop ceiling be installed. If drop ceiling must be installed, Ceiling Height: Minimum of 8.5 ft. clear height above finished floor.

Door Size: 3' wide and 6.7' tall w/180 swing out.

Wall Lining (backboard): AC-grade 3/4" x 4' x 8' sheets plywood, with no voids, covered on all sides, with two coats white fire retardant paint, cut outs to allow access to any wall boxes for communications or power.

Lighting: Minimum 500 lux measured at 3' above finished floor throughout the room.
Overhead fluorescent light fixtures must be installed at minimum nine (9) feet above finished floor or at least two (2) feet away from copper cable pathways, rack tops, and overhead cable runways.

Power: Provide dedicated, isolated, non-switched, 4-way, 120Vac 20Amp, circuits, installed every four (4) feet around room walls. On the bay of data racks provide two (2) each 220Vac, 20 AMP, twist lock, dedicated circuits on standard building electrical power. Also, provide two (2) each 220Vac, 20 AMP, twist lock, dedicated circuits on UPS power.

UPS Power: UPS power should be provided by a single UPS, located in the maintenance area, near the building electrical switching gear and backup generator. UPS power is to be provided for all network equipment in the MDF/IDF's.

Overhead runway: Provide overhead cable runway to ring the room and, at minimum, cross the room over data racks. Drop out devices (water falls) shall be installed at locations where cables drop down out of runway or horizontal conduit or sleeves.

Grounding and Bonding: Install a contiguous Intra-building grounding and bonding system in compliance with NEC Article 250 and TIA/EIA-607 using a

minimum conductor size of 6 AWG to be located on each plywood backboard with Ground Bus Bar as directed.

Service slack: All MDF / IDF closet cables must have industry standard amount of service slack, at each end, within the wiring room. Service loop shall run entire perimeter of IDF / MDF in 18” ladder tray.
Security: Unique telecom key compatible University standard for data closets.

Location: Room shall be located such that no single horizontal workstation cable shall exceed 90 meters in total length including service loops.

HVAC and Humidity: Separate HVAC units need to be designed and strategically placed to serve all data/communications rooms with year-round temperature and humidity control and maintain a constant temperature of 64 - 75 F with one air change per hour.

Fire Protection: As required by applicable codes.

2 post Equipment Rack: 7' x 19" x 30” cable management rack (see 1.5.D) with wire management (see 1.5.H) shall be provided and installed as directed.
All other specifications of ANSI/TIA/EIA 569 apply.

Other Network devices: All equipment housed in the MDF/IDF will be required to have separate data outlets installed to the patch panel and labeled. No equipment will be permitted to plug directly into a network switch.

Network Equipment Installation: No network equipment is to be installed before the MDF/IDF rooms are inspected for electrical power and UPS, HVAC, security (NKU locks installed) and free of dust and debris.

2.1. B.
No copper communication cabling shall be run adjacent and parallel to power cabling. A minimum of 18" distance is required from any fluorescent lighting fixture or 6” from power lines up to 2kVA and 24" from any power line over 5kVA. Similarly, cable should be routed and terminated as far as possible from sources of EMI or RFI, such as ballasts, generators, fans, motor control units, motors, etc.

2.1. C.
The MDF/IDF shall be constructed using 110 wiring distribution systems for voice. Use patch panels, equipment racks and distribution systems for fiber optics as specified in the materials list. Cable terminations, order of terminations, groupings, numbering plans and labeling shall be performed in accordance with NKU’s Office of Information Technology conventions (per paragraph P.1.4.b.). See sections pertaining to Horizontal and Vertical Cable. Coordinate with a representative of the NKU Office of Information Technology prior to installation of MDF/IDF distribution and termination hardware.

2.2 ENTRANCE FACILITIES

2.2. A
Outside plant facility requirements shall be coordinated with the NKU Office of Information Technology. A minimum of (4) 4" inside diameter schedule 40 PVC conduits shall be run from the MDF to the designated vault or tunnel system. Conduits shall be buried a minimum of 24" from the surface on a foundation of 10" wet sand fill. A metallic locator ribbon shall be installed above and parallel to the conduits. There shall be a minimum horizontal separation of 24"

from co-located buried electrical service. One pull string shall be installed in every conduit.

2.2. B.
Outside copper cable pair count shall be a minimum of 100 pair. (Building specific, to be determined in conjunction with building occupancy and purpose) Use only 24AWG, PE-89 Type REA, direct bury cable with foam skin/filled core, 8-mil aluminum shield, polyethylene jacket, where applicable. See material list. Copper cable shall be terminated in a minimum of (100) pair increments in its entirety for the count of the specific cable at the MDF in a Building Entrance Termination (BET) system.

2.2. C.
The other end of the copper cable shall be terminated in a minimum of (100) pair increments in its entirety at the MDF of its origin as determined by the NKU Office of Information Technology. See materials list.

2.2. D.
Copper inter and intra connection cable facilities shall be tested and documented at 100ohm with maximum 0% failure allowed.

2.2. E.
Outside fiber optic cable strand count should be determined by the NKU Office of Information Technology. Fiber optic cables shall be terminated in their entirety at the MDF in a Fiber Patch Cabinet. Fiber terminations that connect separate buildings shall be in their own Fiber Patch Cabinet. Fiber optic fan-out and terminations shall be performed using fan out kits with LC style connectors.

2.2. F.
Indoor and outdoor fiber optic cable should be terminated in its entirety at the TR/ICR/MCR of both its origin and final destination in a Fiber Patch Cabinet. Fiber optic fan-out kits and terminations should be done using singlemode, LC, fusion splice on connectors.

2.2. G.
Single Mode Fiber optic facilities should be OTDR and bi-directional insertion loss tested and documented at 1310nm/1550nm with maximum 0% failure allowed. Max cable attenuation is .4/.3 for loose tube and .7/.7 for tight buffer.

Contractor is required to use a core alignment fusion splicer for all fiber terminations.

Test results for single fiber should not exceed maximum attenuation allowed based on EIA/TIA loss calculation formulas. Test results must be provided to NKU in .pdf format.

2.2. H.
Grounding and Bonding shall conform to NEC Article 250 and ANSI/TIA/EIA-607 using a minimum conductor size of 6 AWG. See material list.

2.3 HORIZONTAL WORKSTATION CABLES AND POWER REQUIREMENTS PER LOCATION

2.3. A
If IP phones are in use, covert Voice outlet for a Data outlet in all spaces.

Single Occupant Office

Minimum 2, Duplex (Data & Voice) Outlets (1 each on opposing walls)
Duplex Power Outlet adjacent to each Data & Voice Outlet.

Cubicle Space

Minimum 2, Duplex (Data & Voice) Outlets
Duplex Power Outlet adjacent to each Data & Voice Outlet.

Shared Offices

Minimum 1, Duplex (Data & Voice) Outlet per Occupant
1 Duplex (Data & Voice) Outlet for Shared Printer and
Duplex Power Outlet adjacent to each Data & Voice Outlet.

Reception/Support Areas

Minimum 1, Duplex (Data & Voice) Outlet per Occupant
Minimum 1, Duplex (Data & Voice) Outlet for Shared Printer
And Duplex Power Outlet adjacent to each Data & Voice Outlet.

Copy Room/Storage Rooms

Minimum 2, (Data & Voice) Duplex Outlets and
Duplex Power Outlet adjacent to each Data & Voice Outlet.

Lounge Space, Café, Study Areas

Layout and quantity depends on design.
Data Duplex Outlets for Laptop Access and
Duplex Power Outlet adjacent to each Data Outlet.

Non-Classroom Instructional Spaces/ Seminar Rooms/ Conference Rooms

Minimum 4 Data & 2 Voice Faceplates (opposing walls) and
Duplex Power Outlet adjacent to each Data & Voice Outlet
Preferred: Level 2 Smart Classroom Technology (scaled to room size and use). See below.

Classrooms and Labs

Minimum 6 Data at instructor station and 2 data at the ceiling mounted projector.
Duplex Power Outlet adjacent to each Data and/or Voice Outlet.
Preferred: Level 2 Smart Classroom Technology. See below.

Computer Labs

Minimum 6 Outlets. Three (3) Data & one (1) Voice at instructor station (1 at the ceiling mounted projector and 1 voice location to be determined by NKU).
Duplex Power Outlet adjacent to each (Data & Voice) Outlet.
Level 2 Smart Classroom Technology, See below
Remainder of layout depends on design.

Level 2 Smart Classroom

Minimum 4 data outlets to be located at the podium location
2 Projector outlets to be located in the ceiling
Regular room layout depending on the room classification and
Duplex Power Outlet adjacent to each Data & Voice Outlet.

Vending Areas

1 Data outlet per vending machine
2 data outlets (minimum) per vending area

Multimedia Outlets
Fiber to the Desktop) Location TBD by NKU
4 Data & 2 Voice outlets per location
2 Fiber outlets

2.3. B.
Provide (1) Category 6A 4-Pair UTP cable for every voice outlet and (1) Category 6A 4-Pair UTP cable for every data outlet as specified in materials list. Cables shall be distributed in a horizontal star topology to the MDF/IDF. Total length of cable from workstation information outlet jack to the MDF/IDF shall not exceed 90 meters total length including service loops. This length includes a 12” service loop at the outlet and a full perimeter service loop in the telecommunications room. Each horizontal cable shall be installed in a "home-run" configuration. No "daisy chained" conduit or cables shall be allowed. All workstation cables are to be terminated using the T568A wiring standard.

2.3. C.
All cables shall be installed in conduit, cable tray, or "J" hooks. Minimum size of conduit should be no less than a 1” conduit. Fill ratios not to exceed the ANSI/TIA/EIA 569 specification. Where cables are not installed in conduit or cable tray, the cable shall not be pulled or installed directly across suspended ceiling tiles or fluorescent lights without proper suspension and consideration of possible electrical interference. If "J" hooks are used, avoid placing any pressure or creating stress points on the cable. Maximum spacing between "J" hooks shall not exceed five feet.

2.3. D.
At no time should pulling tension exceed 25 lbs. on horizontal cables. Exceeding the maximum recommended pulling tension during installation of cables will compromise the wire integrity. If wire integrity is compromised, the wire may not pass testing and certification standards required for a 10-Gigabit infrastructure. The installing contractor will be responsible for replacement of any cable system that does not pass required certification standards. A representative from the NKU Office of Information Technology may randomly test cable installations during weekly coordination meetings.

2.3. E.
Traditional nylon synch style Tie Wraps should not be used to bundle cables in a MDF/IDF. Only Velcro Tie Wraps are acceptable to bundle cables within these rooms. See material list. Traditional nylon synch style tie wraps are acceptable in all other areas. The tie wraps must be installed as directed in the ANSI/TIA/EIA 568 specification.

2.3. F.
No Intra-building telecommunications cable should be run adjacent and parallel to power cabling. A minimum of 6" distance is required from any fluorescent lighting fixture or power line up to 2kVA and 24" from any power line over 5kVA. Similarly, cable should be routed and terminated as far as possible from sources of EMF, such as ballasts, generators, fans, motor control units, motors, etc.

2.3. G.
Horizontal UTP station cable shall be terminated at the MDF/IDF in a manner such that each workstation location will be numbered and terminated in sequential order (see 1.4.b.) Data (Blue) cable shall be terminated in patch panels as specified in materials list and should be located in 19" stand alone

rack as specified in materials list. Horizontal and vertical fiber optic cable should be terminated at MDF/IDF in fiber optic distribution cabinets as specified in materials list. Coordinate with a representative of the NKU Office of Information Technology prior to installation of MDF/IDF distribution and termination cable hardware.

2.3. H.
Each workstation information outlet location should use hardware as specified in materials list. The Category 6A cable should be terminated T568A in a Blue Category 6A RJ45 jack. Striping of cable jacket, untwisting of conductor pairs and termination should be done using ANSI/TIA/EIA conventions. 12" of excess, jacketed, cable should be coiled in ceiling above the drop location or as near as possible to accommodate future re-termination. Maintain UTP cable pair twists up to the point of termination (maximum of up to 1/4'' jacket removal allowed) at both the station/outlet end as well as patch panel/ block end for each horizontal cable. Take caution as to refrain from physically changing or damaging the shape or geometry of the cable during installation, i.e., do not cinch cable ties too tightly; no kinks are allowed and avoid bends of cable. Do not place bundles in such a way that the weight of large bundles is damaging the cables on the bottom of the bundle. Each workstation information outlet jack wall plate shall be numbered sequentially, consistent with the MDF/IDF numbering layout plan. See section 1.4.B for description of cable labeling requirements.

2.3. I
Cables should be dressed in to patch panels directly from vertical wire managers.

2.3. J.
Contractor shall test and certify, in writing, building wiring meets or exceeds all applicable ANSI/TIA/EIA 568, 569, 607, 758 or others as applicable conventions and standards for Cat6a. Contractor shall test and certify, in writing, building wiring shall support 10 Gigabit Ethernet technologies. Contractor shall warrant Communication cabling system wiring for a period of not less than 25 years, upon acceptance.

2.4 VERTICAL RISER CABLE

2.4. A.
A minimum of (4) 4" conduit paths shall be provided between the MDF/IDF’s & BIDF.

2.4. B.
For each (12) workstation locations there should be a (25) pair copper riser from the MDF/IDF to the MDF/IDF as applicable. Copper riser cable should be of a 25 Pair Category 5E riser rated construction as specified in materials list. All riser cable shall be terminated using 110 IDC wiring distribution systems as specified in materials list. Riser cable shall be terminated on a separate 100 pair block from horizontal station cable. Labeling of all riser and workstations cables shall be labeled in accordance with the NKU Technology Infrastructure labeling documentation. Coordinate with a representative of the NKU Office of Information Technology prior to installation and termination of riser cable and hardware.

2.4. C.

Each MDF/IDF shall have a 12 or 24 strand count single mode Fiber optic cable

Indoor fiber optic installations will utilize single mode, 12 strand, plenum-rated, armored premise distribution cable Corning PN: 012E88-33131-A3

Indoor/outdoor fiber optic installations will utilize singlemode, 12 strand, plenum-rated, armored, indoor/outdoor cable Corning PN: 012E8P-31131-A3

Outside plant fiber optic installations will utilize singlemode, 12 strand, armored, outside plant cable Corning PN: 012ZUC-T4F22D20

See materials list. Coordinate with a representative of the NKU Office of Information technology prior to installation of fiber optic riser cable.

2.5 PATHWAY SUPPORT SYSTEM

2.5. A.
All horizontal cable shall be installed using a home-run configuration. Conduit and cable tray are acceptable in any combination to support the cable system and not violate Cat6a rules.

2.5. B.
Conduits shall be dedicated, using no smaller than a 1 1/2" inside diameter per workstation outlet. There shall be no daisy-chain conduit runs. Each workstation location shall require one 1 1/2" conduit, which is a home run back to the appropriate MDF/IDF or cable tray. Provide pull boxes in communications conduit runs spaced not greater than 100 feet apart, and also provide a pull box located at half the distance of the length on any conduit with more than two right angle bends. If more than two bends are in any 100-foot section, increase the conduit by one trade size. See ANSI/TIA/EIA-569-A Section 4.4 Place **TELECOMMUNICATIONS** label on all pull and junction boxes. If a cable tray system is installed, the conduit shall be a home run from the workstation outlet jack to the tray. Conduit runs shall comply with cable fill capacity and bend design as specified in ANSI/TIA/EIA-569-A documents.

2.5. C.
Traditional nylon synch style Tie Wraps should not be used in MDF/IDF’s to bundle cables. Velcro style Tie Wraps are the only acceptable method to secure cable bundles in TR/ICR/MCR’s. At no time shall pulling tension exceed 25 lbs. on horizontal cables. Exceeding the maximum recommended pulling tension on Category 6A cables will compromise cable integrity. If wire integrity is compromised, the wire may not pass testing and certification standards required for a 1000BaseTX infrastructure. The installing contractor will be responsible for replacement of any cable system that does not meet required standards.

2.5. D.
No intra/inter-building telecommunications cable should be run adjacent and parallel to power cabling. A minimum of 6" distance is required from any fluorescent lighting fixture or power line up to 2kVA and 24" from any power line over 5kVA. Similarly, cable should be routed and terminated as far as possible from sources of EMF, such as generators, motors etc.

3.0 Warranty

3.1. A. All work is to be covered by minimum of a twenty-five year warranty supplied by Ortronics and General Cable Corp.

3.2. B Ortronics/General Cable Corp Structured Cabling System Warranty
QUALIFICATIONS AND REQUIREMENTS

To qualify for the 25 year Warranty, all of the following conditions must be met:

1. Products used in the network cabling system for which warranty support is requested must be qualifying Supplier products. System components must be new (never used before).

2. The network cabling infrastructure must be designed in accordance with TIA-568 and other relevant premises series standards in effect at the start of the time of purchase.

3. The network cabling infrastructure must be installed by Supplier approved designers and Certified Contractors at the Certified Installer Plus tier in accordance with manufacturer's installation instructions and specifications. Supplier is not liable for third party design errors or improper construction.

4. Each permanent link or channel in the network must be field tested in accordance with the TIA-568 series industry standard testing requirements in force at the time of purchase. The installed permanent links and channels must have passed all applicable TIA performance requirements. Minimum testing for copper systems includes Wire Map, Length, Attenuation, Near End Crosstalk, Far End Crosstalk, Return Loss, PS NEXT, ELFEXT, and PS ELFEXT. Minimum testing for Fiber Optic links includes horizontal and backbone, Bi-Directional Dual Wavelength, Insertion Loss and Length.

5. Special consideration for Category 6A+ Solutions: Designed specifically to mitigate the effects of Alien Crosstalk (ANEXT) between cable segments, Alien Crosstalk field testing is not required for certification of Category 6A+ systems. Alien Crosstalk testing requirements are only waived if the installed system is comprised entirely of approved Category 6A+ cabling and components including horizontal cabling, patch cords, equipment cords, and associated connectivity. This exception is exclusive to Category 6A+ Alien Crosstalk testing parameters. All Category 6A testing requirements must be performed to certify the installation.

6. Appropriate Warranty Applications should be properly completed online through the Ortronics ConCert certified contractor website prior to initiating the installation.

7. The Warranty Submittal must be completed online within 10 days of installation completion. Copies of all certification test reports must be submitted as part of the Warranty Submittal, and be kept on file by the registrant to be re-submitted when requested by Supplier. Data must be saved and submitted in raw data and summary formats. Test data must be submitted via online upload to the Ortronics ConCert Certified Contractor website. E-mail or disc may be used if the online upload is unsuccessful (please contact the Warranty Administrator for detailed instructions).

8. The 25 year Warranty will be void if (1) the system is not maintained in accordance with industry standards (2) a third party has changed, modified or attempted maintenance or repair on otherwise qualifying Supplier products, or (3) changes are made after warranty issuance and acceptance date, unless Supplier grants written consent for such changes and installation records are updated and forwarded to the Supplier reflecting these approved changes. All changes must be submitted for approval following the original warranty application process.

9. Supplier has issued a registered warranty certificate to Buyer for the Warranty. Buyer may not sell, assign or transfer the Warranty.

ADMINISTRATION

Warranty applications will be approved or disapproved by Supplier with a response sent to the applicant. Access to the Warranty application information can be obtained by contacting the Warranty Administrator at +1-860-405-2988, or by e-mailing your request to contractor.cert@legrand.us. All warranty applications must be completed on Certified Contractor website.

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