ELECTRICAL SYSTEMS

The following narrative pertains to UNL city and east campus buildings only. The design of Electrical Systems for UNL Housing or outstate buildings shall be coordinated with FPC engineering on a project by project basis.

Compliance: The design and construction of all building electrical systems shall be in complete compliance with all current adopted codes as outlined in the code section of this narrative. Referenced codes are to be viewed as the "final authority" for establishing the minimum requirements of electrical devices, equipment and systems. The requirements in these documents often exceed the minimum requirements of the code, when this occurs the more stringent requirement shall be complied with.

Quality of Workmanship and Materials: The selection, design, and specification of the materials and workmanship to be incorporated into the electrical systems of the project should respond to the demanding environment of a major educational institution providing reliable, durable, low-maintenance, long-life usage, while recognizing the budget constraints for the project.

General Narratives: Refer to General Narratives within these Guidelines for additional information on Application Guidelines; Codes Standards and Regulations; Commissioning, Design Deliverables; Project Design Calculations and Sustainability.

Electrical Design Deliverable: Refer to Design Deliverable Checklist within these Guidelines.

Service Entrance: Refer to the Utility Electrical Service and Utility Electrical Distribution Section for additional information. Each building shall be served by a single pad mounted transformer located as close as possible to the main electrical room. There should be a single disconnect, allowing the complete elimination of all electric service to the facility located at the main switchgear. Electrical design shall take power system harmonics into consideration. Each transformer shall be K factor rated where applicable. Calculated fault currents and short circuit calculations shall be applied. Where electrical service is provided by the local utility company, ascertain all their requirements are met and provide metering accordingly. A KYZ output electronic meter shall be provided in the main switchgear regardless of main utility metering requirements.

Utilities: Refer to Utilities Narrative within these Guidelines for additional electrical requirements.

Service Switchgear and Metering: Consider replacement of the existing main disconnect, switchgear and distribution system on a case by case basis with the project manager or UNL representative. Evaluation shall include the age of existing equipment and extent of renovation. Switchgear and distribution system equipment shall be sized and located within facility and in accordance with the following:

- Meet actual building system loads
- Minimize distribution system losses
- Ensure safety of patrons
- Function within the architectural environment of the facility
- Be cost effective

Refer to the Utility Metering Section for additional information. Provide Switchgear with solid state metering, such as Westinghouse IQ Data Plus. KYZ output shall be specified on solid state metering.

Transient Voltage Surge Suppression: TVSS System Requirements:

- Specify service entrance TVSS device with clamping voltage of 2 - 3 KV and high heat dissipation capabilities.
- Specify panelboard TVSS clamped at 500 - 600 volts for panelboards serving sensitive loads.

Overcurrent Protection/Coordination: Each electrical system shall have a fuse coordination and arc flash study done by the switchgear provider. All distribution equipment shall be marked with appropriate arc flash rating per NFPA requirements and switchgear labeled with CT ratios.

Service Grounding: A central grounding system will be provided for the electrical service, all switchboards, and step-down transformers. A low impedance connection to earth will be obtained using ground rods, a concrete encased electrode and bonding to the building steel and main water piping. All grounded busses from switchboards, transformers, panelboards will be connected at a central ground bus in the electrical room. The telecommunications room grounds will also use the main building ground bus as the reference point.

Service for Mechanical Systems: Project A/E consultants shall structure contract documents to reflect the assignment of responsibilities for procuring materials and equipment and installing/setting/placing of such procured materials and equipment. A responsibility table shall be provided for electrical/mechanical providing and installation responsibilities included as follow but not limited to:

- Safety switches
- Starters
- VFD's
- Control wiring
- Horse Power
- Voltage
- Full load Amperage
- Main Overcurrent Protection
- Connections for simultaneous run

Building Automation/Energy Management and Control Systems: Coordinate construction documents with Energy Management and Control Systems documents prepared by UNL BSM. Show location of electrical work for control devices on electrical drawings. Low voltage control wiring in mechanical rooms or other occupied spaces should be run in EMT, (coordinate size with UNL BSM) except the final connection from junction box to actuators should be run in 3/8" flexible aluminum conduit. The length of the flexible conduit should not exceed 24" or the length of the actuator's power/data cable.

Project specifications should require electrical work installer to provide temporary lighting for UNL BSM personnel at ATC panels to facilitate the installation of energy management and control systems wiring and devices. Specifications should direct the completion of the power circuits required for the control system components to enable the Control Systems Group to test and calibrate components of the control system installation. This should occur well in advance of the date at which the control system is to be made operational. Each piece of equipment or system shall be served by a dedicated control circuit that is wired so as to be disabled when the power circuit is disabled. Standard control circuits shall be 120 Volt. Automated/Energy management controls shall be provided as part of the standby power circuit where a generator is installed. Low voltage wiring in mechanical spaces or other occupied spaces should be run in EMT, (coordinate size with UNL BSM) unless concealed or routed in cable tray.

HVAC Control and Building Automation: Refer to HVAC Control and Building Automation Narrative within these Guidelines for additional electrical requirements.

Energy Conservation: Refer to Energy Conservation Narrative within these Guidelines.

Motor Starters: Each three-phase motor shall be served by a magnetic starter with a hand-off-auto switch, as opposed to a manual starter or a VFD. This facilitates the future application of automatic controls. Motor loads shall be evaluated and provided with 3-phase loss/phase unbalance protection when deemed necessary per specific installations. Coordinate the use of

starters and fused safety switches with Mechanical Engineer and equipment being provided. Provide a responsibility table for coordination of providing and installing equipment necessary for electrical power and control of mechanical equipment.

Generator: An emergency standby power generator system with automatic transfer devices should be provided wherever possible to provide emergency lighting and power for life safety loads and standby power for non-life safety loads. Generator manufacturers shall have a local service department with 1 hour of project location and should be manufactured by Cummins Onan, Caterpillar or approved equal. The preferred location is the exterior of the building with full weather proof enclosure; exact location will be approved by the UNL Project Manager and/or Architect. Fuel source shall be natural gas where loads allow, diesel fuel with a sub-base fuel tank will be approved where loads indicate such use of diesel can be provided more efficiently than natural gas. All gen sets shall be provided with remote annunciators, self-contained battery charging systems and cold weather kits as necessary.

Emergency Distribution: Generally, the emergency panel(s) and optional standby power panel(s) shall be located in the main electrical room. Emergency power systems and optional standby power system shall be separated as required by code. Emergency power shall only serve systems legally required and classified as emergency by code and AHJ. This system is intended to automatically supply illumination and power to designated areas and equipment in the event of normal power failure and which is essential for safety to human life. Exit and emergency egress paths, fire detection and alarms, elevators, public safety communications, some ventilation, etc. are a few systems that require emergency power systems as deemed appropriate and necessary. Optional standby power is used for all other systems in which a backup generator provides power to and that does not impose a threat to human life if gone without power for a period of time.

Optional Standby Power: Where new buildings or building renovation projects are provided with an emergency generator, optional standby power shall be provided and connected to a separate standby power branch circuit through a separate transfer switch.
Coordinate with the University project manager, representative, BSM and occupant interviews for optional standby power required per individual facility needs. The following are typical standby power requirements that shall be evaluated and provided as necessary but not limited to:

- Perimeter heating systems
- Building automated controls
- Energy management systems
- Telecomm & data processing
- Refrigerated systems
- Sump pumps
- Programmatic space needs
- Programmatic equipment

Automatic Transfer Switch: Provide a separate transfer switch and emergency distribution system for emergency life safety power systems and optional standby power system loads as required. Automatic transfer switches shall be 3-pole with solid neutral so as to not create a separately derived system. Evaluate and coordinate with the UNL Project Manager and UNL Facilities Planning and Construction Engineering department the use of closed transition type transfer switch for standby power systems to help deter manual resetting of building controls during monthly generator tests. Emergency life safety branch power does not require the use of closed transition transfer devices.

Panelboards and Distribution: Each distribution panel located within the building shall be served by a dedicated circuit breaker within the distribution section of the unit substation. Distribution and branch panels may be located in electrical closets that are directly accessible from a public corridor. These closets shall be labeled “Electrical”. They may also be located in public corridor walls and, if so, shall be flush-mounted. Each panel shall only serve electrical

devices that are located on the same floor as the panel. The only exception to this is an emergency panel, which may serve multiple floors. Branch panels shall be located such that branch circuits will not exceed 100 ft. in total developed length. Each flush-mounted panel shall be fitted with four spare 1" conduits that extend above accessible ceiling space or to a point near the structural ceiling. Each new distribution or branch panel shall have a minimum of 42 spaces and a minimum of 20% spare circuit breakers when the entire installation is complete.

Electrical Identification labels: Every electrical unit substation, switchboard, transfer switch, motor controls, safety and starter switches, distribution panels, branch panelboards, etc. shall be identified with a label designating the building number, the room number where the equipment is located, and the room number where the equipment is fed from. If a lighting panel is located in building 0014, room 435 and fed from a unit substation, located in room #12 in the basement, then the panel will be labeled as 0014-LP435-12). Refer to FPC, specifications, University Project Manager or representative for additional information in regards to equipment labels. All labels must be formally printed out on an acceptable form of media and not hand written.

Flexibility of Electrical Systems: The usage of space within University buildings, especially laboratory spaces, changes frequently. Remodeling, renovations and program space changes are a common occurrence. Therefore, the building electrical systems shall be designed with sufficient flexibility and spare capacity to accommodate substantial future changes. Generally, a spare capacity of 25% minimum, when feasible, shall be provided throughout each electrical system, from the reserve transformer capacity to individual lighting and power circuits to the spare amperage capacity in each branch panel. Of course the initial cost effectiveness and feasibility shall be evaluated and coordinated with the University Project Manager or representative.

Circuiting: General use receptacles shall be served by 20 Amp circuits with a maximum of six duplex receptacles per circuit. Lighting shall be served by 20 Amp circuits using 277 Volt when available. Generally, a spare amperage capacity of 25% minimum, when feasible, shall be provided on each circuit. Shared neutrals should be limited on campus. This is to eliminate common trip breakers on multi-wire branch circuits.

Receptacles located in corridors shall be served by corridor circuits only and shall not be connected with receptacles located in other spaces such as offices, laboratories or other spaces where computers and/or equipment may be in operation. Corridor receptacles are used by custodial staff to power large cleaning equipment, resulting in the occasional tripping of circuit breakers.
Each substantial piece of hard-wired single-phase electrical equipment shall be served by a dedicated circuit. Every piece of hard-wired three-phase electrical equipment shall be served by a dedicated circuit. Equipment that incorporates duplex units for the sake of redundancy such as air compressor units, sump pump units and condensate pump units shall be served by two separate power and control circuits such that one unit can continue to operate when the other has failed. Each piece of equipment or system shall be served by a dedicated control circuit that is wired so as to be disabled when the power circuit is disabled. Standard control circuits shall be 120 Volt.

Separation of Electrical Systems: It is required that each different electrical system be separated and routed in separate conduits and as individual systems, complete with individual conduits, wireways, boxes, and other raceway components. Sharing of raceways and raceway components shall not be allowed, including but not limited to the following:

- 120/208 Volt Power Systems
- 277/480 Volt Power Systems
- Emergency System Power
- Optional Standby Power
- Power Circuits
- Lighting Circuits

- Telecommunication Systems
- CCTV/CATV Systems
- Building Automation Controls
- Security and Access Control

Low voltage wiring in mechanical spaces or other occupied spaces should be run in EMT, (coordinate size with UNL BSM) unless concealed or routed in cable tray.

Receptacle Layout: The density of portable electrical devices used within University buildings is often high and the usage of space changes frequently. Therefore an appropriate, per-space quantity of recessed, wall mounted, permanent 20 Amp duplex receptacles shall be provided in new and remodeled spaces.

Small offices shall have a minimum of two 20 Amp duplex receptacles whereas mid-sized and large offices, Classrooms, Lecture Halls and Labs shall be evaluated on a case by case basis and provided with sufficient 20 Amp receptacles as required by programing space needs. Provide receptacles for all pieces of office equipment (printers, monitors, computers, TV's, Projectors, phones, A/V head-end equipment, etc.) within close proximity to the location of such equipment so as to prevent the additional use of power strips and extension cords. A minimum of one receptacle per wall shall be provided and a minimum of one, four-plex receptacle is to be located adjacent to all new office work stations, office desks and A/V head-end equipment locations. The designer is to use sound judgment and occupant interviews in determining if any additional electrical receptacles are required and accommodate as necessary.

Provide 20 Amp duplex receptacles every 50 ft. (maximum) in corridors and public areas for use by custodial staff. Mechanical equipment rooms, electrical equipment rooms, elevator machine rooms, janitor closets and other service and support areas shall be provided with adequate 20 Amp receptacles as required by space needs. Provide dedicated receptacles for all pieces of equipment located within said space. Convenience receptacles shall be located with sound judgment and user interview input.

The location of outlets shall be coordinated with the layout of modular furniture/partitions with integral raceway. Surface mounted "tombstone" type floor outlets are not allowed. However, recessed, flush mounted floor boxes with hinged/removable covers that contain power and/or voice/data receptacles may be installed to serve equipment that is located remotely from the nearest wall.

An exterior 20 Amp, weather proof, ground fault circuit interrupted receptacle shall be provided adjacent to each piece, or grouping of mechanical equipment at ground level and on rooftops within 25 feet of equipment to facilitate service and maintenance needs. The receptacle shall not be installed on mechanical equipment or on the mechanical equipment circuit.

Refer to the telecommunications section herein this document for additional related receptacle requirements.

All final receptacle layouts shall be coordinated and approved by the University Classroom Support Group.

Building Elements: Refer to General Building Spaces, Rooms, Areas and other Building Element Narratives within these Guidelines for additional receptacle requirements.

Lighting Selection and Layout: Provide high quality equipment to meet the requirements of the design, while providing low cost illumination with a minimum of installation and maintenance expense. For this reason, fixture selection will include, but is not limited to, the evaluation of the following:

- Minimum life cycle cost

- Ease of obtaining and replacing lamps, lenses, lamp sockets, and ballasts
- Structural integrity and fixture finish durability, including ease of cleaning
- Installation labor including aligning fixtures when mounted on stems.

The energy performance of Installed lighting power density shall conform to ASHRAE 90.1, and the A/E shall endeavor to exceed this standard by the widest margin possible. Photometric calculation sheets shall be provided to the owner as part of the design review submittals.

The quality and quantity of all illumination, in all areas shall be in compliance with the requirements of the Illumination Engineering Society of North America (IESNA) Handbook.

Fixtures and lamps that represent the lowest life-cycle-cost installation shall be furnished.

Using LED or other more efficient lighting is encouraged where cost effective. Indirect lighting may be used where room conditions or finishes are compatible.

Incandescent fixtures shall not be installed unless no other lamp source is suitable. Compact fluorescent fixtures shall be kept to a minimum and shall not be used for general illumination purposes.

Recessed fluorescent fixtures in solid ceilings should not be connected with fixture whips. Associated junction boxes should be accessible without removing fixture from ceiling.

Circuit fluorescent and HID lights installed in sports or machinery spaces to minimize "strobe" effect.

In areas with fixed seating and/or tiered or sloping floors, locate light fixtures to facilitate their re-lamping/replacing by maintenance personnel.

Where fixtures are recessed into fire-rated ceilings and fire-rated enclosures are required, the fixtures scheduled for use in such areas should be approved and suitable for use in such areas.

General illumination for typical interior spaces such as offices, classrooms, laboratories, lecture halls, stairwells, corridors, and other public areas, equipment rooms, service areas, storage rooms, etc. shall be provided by four foot fixtures.

Illumination of restrooms shall be provided so that failure of a single ballast will not leave room in darkness. If a single two-tube fixture is used, provide two ballasts in fixture. Provide individual lighting fixtures above sink mirrors in all toilet rooms, both single occupancy and multiple occupancy.

Illumination for larger interior areas such as atriums, auditoriums, gymnasiums, warehouses, etc. shall be provided by fixtures and lamps that represent the lowest life-cycle-cost installation. Fixtures shall provide direct illumination.

Specialty lighting used to illuminate blackboards, presentation areas, etc. and associated controls shall be provided as directed by the Program Statement.

Specialty Lighting, if used, display case, decorative, accent and other special needs lighting shall be kept to a minimum and used only in high profile areas, such as main entry lobbies, theaters, etc. or where appropriate for historical preservation. Fixtures shall provide direct illumination.

All final lighting layouts shall be coordinated and approved by the University Classroom Support Group.

Building Elements: Refer to General Building Spaces, Rooms, Areas and other Building Element Narratives within these Guidelines for additional lighting requirements.

Lighting Fixtures, Lamps and Ballasts: In 277 volt fluorescent lighting systems, where inboard lamps and outboard lamps are switched separately, use the same phase for both sets of tubes so that 480 volts is not accessible within the fixture. Require the use of barriers in any boxes where 480 volts would be accessible.

Where multiple lighting levels are desired, first investigate that stepped dimmed ballast fixtures will meet the space needs, next investigate the use of multiple ballasts used to switch inboard and outboard lamps separate and finally if budget allows, utilize a dimmable ballast.

Fluorescent lamp ballasts shall be high-frequency ballasts with <10% total harmonic distortion (THD), a power factor >95% ballast factor (BF) between 85% and 100% instant- or programmed-start with parallel circuitry. Manufacturers should provide certified test of current spectrum as part of shop drawings submittal.

Unless directed otherwise, fluorescent lamps shall be 4-foot T8 25 watt, T5 28 watt or T5HO 54 watt, 4100K color temperature, low-mercury, with color rendering index (CRI) no less than 70.

Fixtures operating in low-temperature or exterior locations should have appropriate ballasts installed.

All lensed troffer type fixtures shall have .125” acrylic lenses. Glass lenses are not allowed. Fixture housings shall be appropriate to the application. The use of glare-reducing baffles or parabolic style lenses shall be minimized.

The use of ornamental or decorative fixtures, particularly those of foreign origin, should be strictly limited to locations of special architectural emphasis and then only where it has been established that domestic-made fixtures providing the same effect are not available. Considerations which should enter into the selection of decorative fixtures should include the long-term availability of replacement parts, including lenses and other glass components and the costs associated with cleaning and re-lamping of the fixtures. The use of fixtures falling into this category should be approved by the University project manager or representative prior to their incorporation into the project construction documents.

In ground fixtures are not approved for use at the University.

Lighted bollards are discouraged for use at the University.

Avoid manufacturers whose replacements ballasts or parts are not in line with customary cost.

Give careful consideration to using LED lighting with 4100K color temperature in all applications to reduce future maintenance and energy costs.

All fixtures should bear the label of the Underwriter’s Laboratories.

Exit and Egress Lighting: Provide emergency egress lighting and exit signage in accordance with all applicable codes and standards, including NFPA 101 and NEC 700. Egress lighting systems shall be designed with the minimum possible maintenance requirements.

All exit lighting shall be LED light source. No self-powered or tritium powered emergency devices are allowed. Do not use units containing radioactive material.

Where head of emergency lighting fixture is located remotely from battery pack, a printed label should be provided, indicating the location of the battery pack.

Where budget permits, provide emergency lighting system wired back to a single point and only one backup system, i.e. generator or inverter.

- All emergency lighting fixtures, whether powered by a central generator or by battery back-up, shall be equipped with identifying markers and provide illumination for at least 90 minutes.
- Battery backup fixtures are allowed if no other emergency source is available.
- Provide Generator Transfer Devices on individual fixtures that are locally controlled for user visual circumstances by manual or automatic switching. i.e. A relay device that switches the lighting load to a generator fed emergency circuit in response to loss of power on the normal circuit regardless of local switching control position or mode.

Lighting Levels: General design illumination levels should not exceed the criteria listed below and should not exceed the average raw foot candle values that are recommended in the IESNA Handbook, latest edition. Maximum to minimum ratios and average to minimum ratios should comply with IESNA guidelines for each application. Illumination levels and quality for areas and tasks in campus buildings shall be within 10 percent of that recommended by the IESNA Handbook for each type of space. It is not the intention of the standard to sacrifice safety, comfort or performance for the sake of energy conservation.

Sample foot-candle calculations for each typical space within the project shall be provided to the owner as part of the design review submittals. Calculations shall also be submitted for review indicating illumination levels and energy consumption are in compliance with program requirements, IESNA recommendations and ASHRAE 90.1.

Refer to the telecommunications section herein this document for additional related lighting level requirements.

Lighting Controls: Where reduced lighting levels are necessary to allow note-taking during video presentations; incremental multilevel switching of stepped dimmed ballast shall be considered. Areas such as conference rooms, lecture halls as well as some classrooms, instructional labs and offices shall be designed with incremental multilevel switching.

If stepped dimmed ballast is not available for intended applications then multilevel switching of (2) dual ballasts which control inboard and outboard lamps shall be considered pending the cost effectiveness.

If the desired level/distribution of lighting cannot be achieved in this manner, dimmable LED lighting shall be provided. Dimmable fluorescent lighting shall only be used as a last resort and as budget allows.

Dual technology occupancy sensors with integral dual level lighting control switches or integral dimming switches shall be used wherever practical. When occupancy sensors are used the lighting that serves an area shall also be controlled by local dual manual override switches.

All manual override lighting control switches shall be installed as close as possible to the entrances that serve the area. Locate lighting control switches at the ends of hallways rather than the middle.

Controls for Specialty lighting used to illuminate blackboards, presentation areas, etc. shall be provided as directed by the Program Statement.

Where multiple circuit switching is necessary, multi-pole contactors or lighting control systems shall be used.

If a building-wide, networked lighting control system is used, it is encouraged to be integrated with the building automation system (BAS) for mechanical systems controls.

Coordinate all lighting control with University Building Systems Maintenance who provide occupancy sensing and control in all new buildings.

Exterior Lighting: Plan lighting to provide maximum visibility along walkways and near entrances. Provide adequate lighting and make provision for the natural view of "gathering areas" such as benches, tables and smoking areas, as well as bike racks and trash collection / pick-up locations.

General exterior illumination shall use the most efficient method available that is compatible with the ambiance of the surrounding area. Life cycle cost analysis shall be performed when multiple systems are being considered. Color temperature of the lamp(s) shall not exceed 4500 K. The quality and quantity of illumination shall be in compliance with the requirements of *Technical Section 26 56 00 – Exterior Lighting* and the *IESNA Handbook*. Particular attention shall be paid to enhancing vertical illumination for safety, while minimizing glare and light pollution.

Street/Roadway Lighting: Lighting for roadways shall be via full cutoff cobra-head or decorative luminaire, as directed for the specific project and location. Pole shall be round tapered steel or aluminum, black, with concrete base. If roadway luminaires are not adequate to light the sidewalk, then secondary luminaires shall be added on the same pole as the roadway luminaires. Two separate rows of poles for street and sidewalk will not be allowed. Particular attention should be paid to lighting levels at crosswalks, bike paths and intersections. Roadway lighting levels, quality and uniformity shall be in compliance with the *IESNA Handbook*. *See Drawing XX XX XX -X, Street Light Installation.*

Pedestrian Walkway Lighting: Lighting for pedestrian walkways (not along roadways) shall be via post top area light, Type V Distribution with photocell control, dark bronze in color. Pole shall be 16' aluminum, dark bronze finish, direct embed. Manufacturer and catalog number KIM PT-CCS21P5-12-L5K-208V-DB-A31-PRA16-4188-DB, Lamps 120-LED's, Load 140W. Illumination levels shall be in compliance with the *IESNA Handbook*. *See Drawing XX XX XX -X, Pedestrian Area Light Installation.*

Parking Lot Lighting: Lighting for parking lots shall be simple and efficient, via full cutoff luminaire on a concrete pole. *See Drawing XX XX XX -X, Parking Lot Light Installation.*

Exterior Lighting Controls: Exterior lighting shall be controlled from the campus central lighting control system whenever feasible. *See Drawing XX XX XX -X, Campus Lighting – Control Schematic.* Otherwise, a single photocell shall be installed to control the operation of exterior lighting in each area not served by the campus central lighting control system. Avoid using individual photocells per fixture.

Project Outages: If project work requires outages of any exterior lighting (including building, sidewalk or street lighting) adequate temporary lighting shall be provided for the entire duration of the outage as part of the project. Location, placement and number of temporary lights shall be coordinated to the satisfaction of the owner's representative before existing lighting is disrupted. Pedestrian and vehicle safety shall be given utmost importance.

Telecommunications Entrance Conduit: Do not install more than two 90 degree bends between pulling points when installing underground conduit. Require that bends be long sweep type, with a radius of not less than six times the internal diameter of conduit for 2" or smaller conduit and ten times the internal diameter for conduit larger than 2".

Keep area around entrance conduit free of any construction, storage, mechanical apparatus, pipes or other items which might interfere with installing or maintaining cables.

Seal the inside-building end of conduit to prevent entrance of water or gases. Reseal conduits after cable is placed.

Provide pull string in all entrance conduits.
Terminate telecomm entrance conduit with metallic insulated-throat threaded bushing at terminal board or at cable tray. Secure conduit to cable tray with Gedney* CTC or comparable clamp.

Provide conduit from exterior of building into telephone entrance area in telecommunications wiring closet, sized in accordance with the following:

Entrance Pairs	Conduit Size
1-99 pairs	One 2-inch conduit
100-300 pairs	One 3-inch conduit
301-1000 pairs	One 4-inch conduit
1001-2000 pairs	Two 4-inch conduits
2001-3000 pairs	Three 4-inch conduits

Telecommunication Protection: Require conformance with Article 250-Grounding and Article 800-Communications of the National Electrical Code (NEC) for grounding, bonding, and protecting electrical and communications circuits. Provide appropriate grounding system in telecommunications equipment and server rooms. Provide appropriate bonding of cable tray and all other raceway devices as required.

Telecommunication Distribution: Cable trays shall be the primary low voltage raceway source for all facilities. Located cable trays in a clear accessible location above ceiling where other infrastructure does not interfere and so that there is ample expansion for future renovations, additions and adaptation to technology cable needs.
Provide fire stops for any cable tray system or riser system as required by the NEC.

Provide adequate raceways, for the distribution of telephone/data wiring, “home runs” the cabling from the telecommunications wiring closet to the work area outlet, without “daisy-chaining” boxes together. The raceways should be sized according to the number of telephone/data outlets to be served. Raceways may be horizontal and vertical conduit, cable trays, cable ladders, or any combination of the foregoing. Install all work area conduits to within three feet of the cable tray and provided with bushings.

Telecomm Cabling Conduit Size:

No. of Wires or Cables	Conduit Size
1	1/2
5	3/4
8	1”
14	1 1/4
18	1 1/2
26	2”
40	2 1/2
60	3”

Telecommunications Closet: Provide 100 amp 120/208 Volt 3-phase panel in each closet, connected to the emergency generator via standby power system when available. Receptacles in each room should include a minimum of one each L6-30R, one each L 6-20R, one each L14-30R, 2 each 120 volt 20 amp quad plex receptacles. A ground plate connected to the building main electrical ground system shall be mounted in the room with wiring sized as necessary by the engineer. The door to the room should be on the building card access system.

Telecommunications Layout: Confirm number of phone/data jack locations with UNL Facilities Management and UNL Telecommunications offices. For initial planning purposes, on combination telephone/data outlet should be allowed for each 50 to 60 sq. ft. of net office or laboratory area.

Office, Lab, Classroom Lecture Hall, Conference Room electrical and telecomm is to be evaluated and designed such that sufficient recessed, wall mounted, permanent, electrical and telecomm outlets are provided for all pieces of office equipment (printers, monitors, computers, TV's, projectors, phones, A/V head-end equipment, etc.) within close proximity to the location of such equipment so as to prevent the additional use of power strips, extension cords and patch cables. The designer is to use sound judgment and occupant interviews in determining if any additional electrical and telecomm outlets are required.

All final telecomm layouts shall be coordinated and approved by the University Classroom Support Group.

Low voltage wiring in mechanical spaces or other occupied spaces should be run in EMT, (coordinate size with UNL BSM) unless concealed or routed in cable tray.

Telecomm. Room Lighting: Provide a lighting level of 50 foot candles at worktop level in Telecommunication Rooms.

Communication Systems: Refer to Communication Systems Narrative within these Guidelines for additional electrical requirements.

Fiber Optics: Where fiber optic entrance is required, provide one 4-inch conduit, with three inner ducts (two 1-1/2" and one 1"). Refer to Telecommunications Systems Narrative herein for additional electrical requirements.

CCTV/CATV Coaxial Cable: Provide separate conduit for coaxial cable entrance; do not combine with other telecommunications entrances.

Provide TV trunk raceways 1" minimum conduit to each wing or floor of the building, terminating in a secure, accessible area, such as an electrical closet. Provide branch paths 3/4" minimum conduit from trunk termination to each television receiver location, terminating in a standard 3" x 5" box.

Provide one 110 Volt duplex receptacle at each television receiver location, located adjacent to television cable outlet.
Refer to Telecommunications Systems Narrative herein for additional electrical requirements.

Door Access Control: Refer to Door Access Control Narrative within these Guidelines for additional electrical requirements.

Fire Alarm: Refer to Fire Alarm Systems Narrative within these Guidelines for additional electrical requirements.

Elevators: Elevator receptacles and telecomm outlets shall be installed in metal boxes and grounded in accordance with code requirements.

Emergency lights shall be installed in all elevators.

Firefighter switches on elevators should be keyed alike and in accordance with University and Lincoln Fire Department standards.

Low voltage wiring in mechanical spaces or other occupied spaces should be run in EMT, (coordinate size with UNL BSM) unless concealed or routed in cable tray.

Elevator Systems: Refer to Elevator Systems Narrative within these Guidelines for additional electrical requirements.

Specification Compliance:

Testing: Define requirements for testing of electrical systems.

Service Interruptions: Provide instructions for arranging for service interruptions.

Existing Exterior Area Lighting: Provide instructions in contract documents for keeping exterior area lighting in the vicinity of the project in service during the construction of the project. Where it is necessary to interrupt service to existing area lights, provide temporary service connections to such lights or provide temporary lighting arrangements with equivalent illumination and area coverage as provided by interrupted permanent fixtures. Control temporary area lighting with photo cells or time clocks.

Temporary Facilities: Insure that requirements for temporary electrical service and temporary lighting are properly defined and coordinated.

Access: Define responsibilities for placing sleeves, cutting and patching, and placing roof penetrations.

Removal of Abandoned Conduit: On remodel projects, require that existing electrical conduit which is not concealed in wall or floor slab construction and which is not being reused to be removed. Wires should be removed and embedded or non-accessible conduits abandoned in place should be cut off flush where it enters floor or wall construction.

Clean Up: Define responsibilities of electrical systems installer for clean up during and at conclusion of construction period.