Tyndall AFB Electrical Systems

5.0 ELECTRICAL

5.1 STANDARDS

Follow these requirements and applicable publications. This list of requirements shall be used in the design for new or altered facilities. These standards shall be used in addition to other codes such as the National Electrical Code (NEC), ANSI C2, NFPA, UFC, and UFGS.

All exterior primary electrical systems and exterior lighting systems shall be constructed by Gulf Coast Electric Cooperative (GCEC).

5.1.1 Drawings

General

(1) These subparagraphs are placed in the normal order of the "E" plates for a new facility.

(2) Use different site and floor plans to separate demolition from new work on separate drawing sheet(s).

First Sheet

(1) Show electrical legend on separate drawing sheet(s).

(2) List general comments for all electrical sheets.

Site Plan

(1) Show all other exterior utilities that will affect the installation of the new underground power. This will point out potential interference between different utilities.

(2) Site work:

(a) Route underground lines to avoid cutting tree roots as much as possible. Run lines outside perimeter of tree drip line.

(b) Call for leveling and seeding over disturbed earth and along trench lines and areas less than 100 sq. ft.; and call for leveling and sodding over disturbed earth areas greater than 100 sq. ft. that are affected by construction.

(c) Bore and jack all lines under road and driveway pavements. Secondary lines (600 volts or less) across parking lots shall be directional bore. Wherever possible and economically advantageous, use directional boring instead of boring and jacking. Typical depth of directional boring is 4', or greater when obstructions are encountered.

Power Plan

(1) Provide separate communications, mechanical, and electrical rooms in new or altered facilities whenever practical.

(a) Provide electrical rooms with exterior doublewide doors of adequate height for future removal of large electrical equipment.

(b) Ensure adequate clear space around electrical equipment in accordance with the NEC.

(2) Provide an electrical single line diagram on the drawings.

(a) Show the available symmetrical short circuit current at each bus.

(b) Show all system(s) grounding for transformers, electrical panels, fire sprinkler system, fire alarms, com lines, lighting protection, gas lines, electrical lines, elevators, motors, and etc.

Interior Lighting

(1) Show a light fixture schedule with minimum of mounting height, watts, lumens, CRI rating, and specific to LEDs the lumens/watt value within the table.

(2) In lighting plans, show a junction box and 6 feet of flexible metal conduit to all light fixture connections above suspended ceilings, acoustical or gypsum.

Lightning Protection

(1) Show roof and counterpoise design.

(2) Provide details of air terminals, conductor attachments, roof penetrations.

(3) Show all details based upon the type of roof on the project. For example, if the project contains a standing seam roof, then all details shall be shown based on attachments to a standing seam roof.

(4) Connect and label lightning protection system labeled to the facility ground system at the designated location as required by the Base Electrical Engineer.

Fire Alarm - Riser Diagram

(1) Provide riser diagram with signal line circuits, notification circuits, LOC location, remote annunciator location, transceiver, and antenna location.

(2) Draw riser conduit system, which means supply and return are separated per NFPA 72 guidelines for non-addressable systems.

Telephone/Communications/CATV

(1) Show both plan views and riser diagrams.

5.1.2 Load Levels

Calculate load levels for branch and feeder circuits, panel boards and switchboards, generators and automatic transfer switches, and transformers. Consider derating for 50°C ambient in uncooled spaces.

5.2 POWER SYSTEM PROTECTION STUDIES

5.2.1 Design

Perform a short-circuit study during design to determine proper AIC ratings of all electrical equipment. Include calculations in the design analysis.

5.2.2 Time Current Coordination Study

For projects that contain adjustable trip settings, perform a short circuit and time current coordination to properly adjust the settings on the breaker trip units. The study needs to be based on the actual equipment that will be supplied on the project. Include in the study all cut sheets on the electrical equipment, breakers, and trip units being furnished on the project.

5.2.3 KVA

At a minimum, use 400 KVA or infinite bus available at the primary side of the main transformer.

5.2.4 Scope

Include the protective system from the nearest upstream devices beyond the transformer primary fuses down to and including all adjustable or selectable low-voltage protective devices.

5.2.5 Limiters

Do not use low voltage cable limiters to achieve short-circuit limitation for equipment.

5.2.6 Transient Voltage Surge Suppression (TVSS)

TVSS are required at the main service entrance and for communications and related systems. Cascading configurations shall be required for buildings identified as having sensitive electronic equipment. Double-ended switchboards will require a TVSS on each side. Reference UFC 3-575-01 (Lightning and Static Electricity Protection Systems) and UFC 3-520-01 (Interior Electrical Systems).

5.2.7 Motors

Motors of 5 HP and more shall be 3-phase. Use reduced voltage motor starting on 75 HP and up. For smaller motors, evaluate motor-starting voltage drop and provide reduced voltage starting if over 10% drop.

Design poly-phase squirrel-cage induction motors to industry standard efficiency. Use premium efficiency units for new and retrofit motors as stated in ASHRAE 90.1, with an operating power factor of 95% or greater. Provide reduced voltage starters or variable speed drives for all 10 HP, or larger. Variable speed drives shall be connected to the base wide EMCS.

5.3 EXTERIOR POWER

Feed all new facilities underground. All exterior electrical primary electrical systems shall be performed by GCEC.

Equipment Pads for Secondary

(1) Size pads to extend beyond transformer/switch 6″ on all sides, be a minimum of 8″ thick, and to be 4″ above grade.
(2) Pads may have openings in center of pad.
(3) Add one ¾″×10′ copper clad ground rod in center of pad with min of 6″ above pad for connections and tested to 25ohm or less. Extend a #4/0 bare copper conductor to ground stud. This acts as the grounding for pad mount transformers air switches and sectionalizers.

Duct Bank
(1) Install all secondary feeders from the transformer to the service entrance in protective duct bank.
(2) Run neutral with phase conductors in each conduit.
(3) Use metallic backed warning tapes 1′ above all duct banks. Show detail section for duct on drawings.
(4) Install underground secondary conductors in duct sized per the NEC.

Connections
(1) Ensure below grade splices/connections are water and weather proof tight.
(2) Do not use secondary cable T-splices or in-line splices.
(3) Complete splices done in a junction box or cabinet.

Riser Pole Connections When Specified
(1) Use 5″ "U" guard on all secondary risers.
(2) Make transition from overhead riser to underground with rigid steel elbow.
(3) Use fiberglass arms only on pole that are not vertical construction.

Service Entrance Transformers (General Requirements)
(1) Do not install primary transformers indoors.
(2) Feed all new facilities with 480/277 volts, unless special permission is granted by Base Electrical Engineer. On facilities with 480/277 volts and 208/120 volts, service into the facility shall be 480/277 volts with interior dry type step down transformers to supply the 208/120-volt system. Using separate exterior transformers to supply the 480/277-volt system and 208/120-volt system is not acceptable.
(3) Provide minimum of 10′ clearance on the front side for safe working clearance. Space shall be at flat ground level in front of the equipment. Do not plant shrubbery in front of a door on any type of high voltage equipment.

Service Entrance Transformers (Construction Types)
(1) Use low profile utility type in residential areas.

Electrical Facility Metering
(1) Only install metering on facilities greater than 30,000 sq. ft. in area, or at the discretion of the Base Energy Manager. Meter requests shall be forwarded to GCEC to install the meter at the transformer.
(2) The above does not include multifunction metering requirements listed elsewhere for service entrance switchboards.

Exterior Service Entrance Feeders
(1) Secondary Cables
(a) Run underground.
(b) Use single conductor copper with THWN insulation.
(c) Use no conductors larger than 500 MCM.
(2) Use feeder busway when liquid filled substation type transformers are rated 2000 – 2500 KVA.

5.4 EXTERIOR LIGHTING – GENERAL
5.4.1 Parking Lot Lighting
(1) All exterior lighting systems that are not connected to the facility interior electrical shall be performed by GCEC.
(2) General requirements
(a) Use aluminum poles (anodized bronze in color).

(b) Calculate lighting levels based upon Illumination Engineering Society (IES) for maintained levels for parking lots. Design for 2.0 FC average with no point less than 1.0 FC.
(c) Fixtures shall be controlled by individual photocells on each fixture. Photocells shall activate at 3 ft.-candles of ambient light.
(d) Feed at 277 V when practical. If feasible, feed by panel boards mounted adjacent to pad mounted transformers. Otherwise, feed from adjacent buildings served by the parking lots.
(e) Light parking lot and surrounding area with be LED fixtures that output greater than 150 lm/watt and run longer than 50,000 hrs. Poles shall be round, tapered aluminum shaft. Color shall be dark bronze anodized finish.

5.4.2 Street Lighting
All exterior street and road way lighting systems shall be performed by GCEC.

5.4.3 Sidewalk Lighting
(1) All exterior lighting systems that are not connected to the facility interior electrical shall be performed by GCEC.
(2) Any sidewalk that is not adequately lighted by the parking lot lighting and branches into the entryway of the facility shall be lighted with sidewalk lighting. Design based on LED properties: output greater than 150 lm/watt, lifespan longer than 50,000 hrs.

5.4.4 Exterior Doors
Provide fixtures above or next to all exterior doors. Select light fixtures at the main entrance that will accent the architecture.

5.4.5 Facility Site Lighting
If security is a concern or parking lot is adjacent to a wall, provide wall pack LED fixtures spaced to provide 2.0 FC average to the area.

5.4.6 Exterior Storage Area Lighting
Provide lights around the perimeter of the entire storage area.
(1) Install pole on a concrete base with ¾″ × 10′ ground rod in center.
(2) Design poles to withstand steady wind velocity of 130 MPH and have a 1.3 gust factor based on the effective projected area of the fixtures and brackets provided.
(3) Space poles to provide 3 foot candles.
(4) The efficacy must be greater than 100 lumens/watt with an upward efficiency less than 10%.
(5) Install photo sensors to turn lights on/off at sunrise and sunset.

5.4.7 Sports Areas Exterior Lighting
All lighting shall be LED. Calculate lighting levels based upon IES for maintained levels. The type of sports facility shall dictate the type of control (photocell/timer) needed. All pole construction shall be aluminum set in a concrete base.

5.5 LIGHTNING PROTECTION SYSTEM (LPS)

5.5.1 Need
5.5.1.2 Mandated
Provide on all facilities with explosives or hazardous materials. Ground in accordance with Lightning Protection, DOD 6055.9_STD and UFC 3-575-01 (Lightning and Static Electricity Protection Systems) and UFC 3-520-01 (Interior Electrical Systems).

5.5.1.3 Determined
Use NFPA 780: Risk Determination for go/no-go decision on whether to install LPS.

5.5.2 Documentation
Present all calculations in the design analysis.
Show all lightning protection zone of protections with rolling ball, if distance exceeds NEC 780 standards for the rolling ball, on a separate sheet.

5.5.3 Design
(1) Design per UL and NFPA 780.
(2) Conductors:
(a) Use only copper, except aluminum is allowed on Galvalume or other aluminum roof materials.
(b) All conductors on roofs shall be treated as main conductors.
(3) Install Transient Voltage Surge Suppression (TVSS) on the service entrance of each protected facility. Assume one service entrance per facility unless field checking or MAFB record drawings indicate otherwise.
(4) Installation:
(a) Conform methods to UL 96A.
(b) Conform components to UL 96.
(c) Contractor shall obtain a UL letter of findings for the facility. The UL letter of findings shall be provided to the Government directly by UL after inspection by UL personnel. The Contractor shall make all corrections listed in the UL letter of findings.
(d) Only allowed penetrations on standing seam metal roofs is the roof cap. Conductors should be concealed under the roof if at all possible. Otherwise, conductors are to be attached to the metal standing seam roofs by adhesive and bolted connections. Under no circumstances are penetrations to be made in the insulated panels of standing seam metal roofs.
(e) All down conductors shall be concealed in the wall with PVC sleeve.
(f) A counterpoise with ground rods shall be installed around the entire facility IAW NEC 780. Counterpoise shall be minimum #1/0 bare copper and installed 30″ below grade per UFC 3-575-01. All below grade connections and facility structural steel shall be exothermic type.
(g) Provide third party testing and acceptance of the lightning protect system(s) IAW with NEC, UFC, and UFCS.

5.6 SYSTEM GROUNDING
For new construction, provide a tripod set of ground rods 20′ apart with thermite-welded bare copper 4/0 wire between them. The closest ground rod to the facility shall be at least 10′ from the facility.

5.6.1 Switchboards, Panel boards, and Motor Control Centers

5.6.1.1 Choice of type
(1) Use switchboard construction when 1000 Amps or larger.
(2) Use power distribution panel board construction when equal to 800 Amps. Boxes shall be minimum 9 ½ ″ deep.
(3) Use panel boards when 600 Amps or less.

5.6.1.2 General
(1) NEMA 4X may be specified in cases where the corrosion potential is high. Fiberglass is preferred over stainless steel for NEMA 4X.
(2) Use copper bus only.
(3) Size to allow for a 25% increase in power demand.
(4) Spare pole/space capacity shall be minimum 15% of total pole/space capacity.
(5) Do not tap panel boards, switchboards, or motor control centers to feed new loads.
(6) When installing breakers in existing panels, insure the manufacturer can still supply them and at reasonable price and delivery schedule.
(7) When doing any work involving the main service entrance, install or re-install a laminated riser diagram of the electrical system on the wall near the panel.
(8) Provide typed directories in each cabinet.
(a) Clearly label each circuit as to type load and specific location. Ex.: Receptacles N. Wall
(b) Note on the directory from where the cabinet is fed. Ex.: Fed from Panel PA in Mech. Room, Ckt. 4.
(9) All service entrance equipment shall contain a main breaker. If the facility requires double ended design, as stated elsewhere in this standard, then two main breakers with a normally open tie breaker shall be provided, with Kirk key interlock.
(10) Feeders to service entrance and any panel board within the facility shall not contain any derated neutrals. As a minimum, neutrals shall have an ampacity of the phase conductors. Feeders to

panels with 200 percent rated neutral busses shall have the neutral conductors rated 200 percent of the feeder phase conductors.
(11) New construction shall be designed with one service entrance, except as noted for transformer requirements over 5,000 KVA.
(12) Labeling of Panel Schedules and Drawings for Branch Circuits: Each homerun symbol on the drawings shall be labeled in accordance with the pole numbers instead of a circuit number.
(a) Three-phase loads shall be designated by the three-pole numbers, such as HB - 1,3,5 or HB - 8,10,12. The single pole number, such as LA-12, shall designate single-phase loads.
(b) Panel schedules shall be numbered with odd numbers on the left side, top to bottom, and even numbers on the right side top to bottom.

5.6.1.3 Distribution Panel boards and Switchboards
(1) Protect by breakers. Fuses are not permitted.
(2) All switchboards and panel boards shall be 3-phase, 4-wire, with ground bus. Install a neutral conductor to all switchboards and panel boards regardless of load.
(3) If the main breaker has ground fault protection, provide it as well on the feeder breakers.
(4) Show future frame space in all service entrance rated or distribution panel boards or switchboards, with full mounting hardware provided for plugging the breakers into them.
(a) For switchboards, 1000 - 1200 amps, provide:
1. 1-400 amp frame space.
2. 2-225 amp frame space.
3. 1-100 amp frame space.
(b) For switchboards, 1600 amps and above, provide:
1. 1-800-amp frame space.
2. 2-400 amp frame space.
3. 2-225 amp frame space.
4. 1-100 amp frame space.
(c) For 800 amp panel boards, provide:
1. 2-225 amp frame spaces.
2. 2-100 amp frame spaces.
(d) For 600 amp panel boards and below, provide:
1. 1-225 amp frame space.
2. 3-100 amp frame spaces.
(e) All frame space sizes shall be based on three pole breakers.
(5) Use an electronic multi-meter in the main panel board or switchboard instead of ammeters,
(6) On double-ended switchboards, connect control switches and meters to the side of the energized source. As soon as power is de-energized from one of the incoming sides of the double-ended switchboard, all control power shall automatically transfer to the other side of the available energized source.
(7) Switchboards
(a) Main through bus shall be fully rated and non-tapered copper bus.
(b) Distribution sections shall have the same depth as the main service section.
(c) TVSS units may be located integrally with service entrance equipment.
(d) For new construction, the main breaker and meter shall be located in a separate section from the distribution feeder breakers.
(e) Provide electronic multi-function meter in the main section.

5.6.1.4 Panel boards - Other
(1) All panel boards shall be “main breaker interior” type unless the upstream circuit protective device is within sight of the downstream bus being fed.
(2) Gutter taps, sub-feed lugs, feed-thru panels, and taps of conductors inside junction boxes are unacceptable circuit feeds to panel boards.
(3) Feed all panel boards from a separate circuit breaker in an upstream bus. The only exception to this shall be when no more than two panel boards shall share the same feeder circuit from a dry type transformer. The second panel board shall be connected from a feeder breaker in the first panel board. The second panel board shall be installed adjacent to the first panel board or inside the same room.
(4) If multiple (three or more) 208Y/120 volt panel boards are fed from the same dry type transformer, then a 208Y/120 volt distribution panel board shall be installed downstream from the dry

type transformer. Each panel board shall be connected to a dedicated circuit breaker in the distribution panel board.
(5) Minimum panel board size:
(a) Use minimum 225 Amp bus rating and main breaker, 42 poles.
(b) If the demand load is 40 Amps or less, then a 100 Amp panel, minimum 30 poles, is permitted.
(6) Mount main breakers at the top or bottom in a vertical position specifically designed for that purpose. Exceptions only apply for approved applications of 100 Amps of less and 30 poles or less.
(7) Do not use load center type panel boards except for military family housing construction and temporary lodging facility construction.
(8) Panel boards with 200% rated neutrals shall be used when supplying power to the following areas:
(a) Office administrative areas
(b) Cubicles or System Furniture
(c) Individual office Rooms
(d) Large open office areas
(e) Computers
(f) Electronic Equipment
(g) Electronic Test Labs
(9) When supplying panel board feeders to panels with 200% rated neutrals, the neutral conductors to the panel shall have an ampacity of twice the phase conductors in the feeder.
(10) When supplying panel board feeders to panels with 100% rated neutrals, the neutral conductors to the panel shall not be derated less than the phase conductors in the feeder.
(11) Column width panel boards are unacceptable.
(12) Panel boards shall not contain integral TVSS units. Any TVSS units installed at panel boards shall be separate units and installed adjacent to the panel boards.

5.6.1.5 Circuit Breakers
(1) Do not use ground fault breakers. Use only individual ground fault receptacles.
(2) Magnetic only switches shall not be installed in any switchboard or panel board. All breakers shall have thermal-magnetic characteristics.

5.6.1.6 Main Breakers and Feeder Breakers
(1) Main (and Tie, if required) Breakers in Main Switchboards – Service Entrance Rated:
(a) Insulated-case
(b) 100% rated
(c) Individually mounted in a separate section from the distribution breakers.
(d) Solid state trips with the following trip functions: Adjustable LT, Adjustable ST, Adjustable GF (where required by Code), with separate adjustable time delay settings for LT, ST, GF (if pickup used).
(3) Feeder Circuit Breakers in Main Switchboards – Service Entrance Rated:
(a) Molded-case
(b) 80% rated
(c) Group mounted - stationary
(d) Use solid state or standard thermal magnetic breakers. Breakers shall contain adjustable magnetic trip on all 225 amp breakers and larger where available.
(e) Main Circuit Breakers in Main Distribution Panels (MDP) - Service Entrance Rated (800 Amp Bus).
(f) Solid state trips with integral digital ammeter display with the following trip functions: Adjustable short time pickup with adjustable delay bands and adjustable instantaneous pickup.
(4) Feeder Circuit Breakers in Main Distribution Panels (MDP) - Service Entrance Rated (800 Amp Bus).
(a) Molded-case.
(b) 80 % rated.
(c) Use standard thermal magnetic breakers. Breakers shall contain adjustable magnetic trip on all 225 amp breakers and larger where available.
(5) Breakers Used in Service Entrance Rated Panel boards 600 Amps and below shall be standard molded-case thermal magnetic.

5.6.1.7 Startup

Provide special startup along with training on setting and maintaining the breakers to CE shops. Use an independent testing firm registered with NETA or manufacturer's service engineer to set the adjustable devices. Include:

(1) Startup in the field.
(2) CE Shop training.
(3) O&M manuals.
(4) Schematics of electronic devices.
(5) Solid state trips tested in field with a portable test kit.
(6) Specified equipment used in the startup provided to CE shops for future maintenance.

5.7 GENERATORS, TRANSFER SWITCHES, & FUEL TANKS

5.7.1 Generators

Base actual size on load analysis for 60-80% loading, based upon field readings when possible.

5.7.2 Fuel Tanks

(1) Provide tank large enough for generator to run 72 hrs. at 100% rated load. Exception: Tank may be allowed to be smaller (approximately 12 hr runtime) when the generator set is used as backup source for emergency lighting only.
(2) Construct fuel tank above ground, similar to Convault construction. The fuel tank shall be encased with secondary 3000-PSI concrete spill containment. Concrete sub-base tanks are not acceptable. Tank may be allowed to be skid-mounted when the generator set is used as a backup source for emergency lighting only. In this case, a weatherproof enclosure shall cover the generator set and the fuel tank
(3) A day tank is not required. The fuel shall be fed directly to the diesel fuel pump intake line.
(4) Include a high level alarm in the fuel tank to prevent overflow.
(5) Include an interstitial leak monitoring system to monitor and prevent tank leakage from the tank into the tank enclosure.
(6) Copper tubing is not allowed. Use only threaded black steel.
(7) Install a ¾" × 10' ground rod in a ground well. Extend a #1/0 copper conductor from the ground rod to the tank.
(8) Include on all four sides of the fuel tank the following markings:
(a) Flammable
(b) No Smoking within 50 Feet
(c) Diesel Fuel
(d) Capacity of Tank
(9) If the top of the tank is greater than 42" above finished grade, include steps.
(10) A 3.0-PSI anti-siphon check valve shall control fuel feeding into the diesel fuel pump.
(11) For Above Ground Storage Tanks: Provide a ball cut-off valve on each side of the supply and return fuel line.

5.7.3 Transfer Switches

(1) Switches shall be three-pole with solid neutral. Four-pole switches may be considered upon request with reasoning provided.
(2) Use bypass feature for critical facilities per design guidance.
(3) Automatic transfer switches and controls shall be installed in electrical rooms and not in areas where steam piping or other high humidity "generators" are present. Transfer switches shall not be installed outdoors.
(4) All transfer switches shall be of the automatic type unless noted or requested.

5.8 INTERIOR POWER

5.8.1 General

(1) In existing facilities fed at 208V, convert to 480V. In new facilities the service voltage shall be 480Y/277 unless the Government gives approval for 208Y/120 volts.
(2) Provide small distributed dry-type transformers (delta-wye) as needed for 208Y/120V to step the voltage down from 480Y/277. In administrative areas, locate dry type transformers and branch panel boards in electrical closets distributed throughout the facility to keep the branch circuits below 200 feet.

(3) Use reduced voltage motor starting on 75 HP and up. For smaller motors, evaluate motor-starting voltage drop and provide reduced voltage starting if over 10% drop.
(4) Use generic "off the shelf" equipment. Field fabrication of panels, switches, etc., is not allowed.
(5) The following wiring methods shall not be used:
- Armored Cable (Type AC)
- Flat Cable Assemblies (Type FC)
- Flat conductor Cable (Type FCC)
- Integrated Gas Spacer Cable (Type IGS)
- Metal-Clad Cable (Type MC), Mineral-Insulated
- Metal-Sheathed Cable (Type MI)
- Nonmetallic-Sheathed Cable (Types NM, NMC, and NMS), except for residential use
- Power and Control Tray Cable (Type TC), unless specifically called for in project scope documents
- Underground Feeder and Branch-Circuit Cable (Type UF)
- Nonmetallic Underground conduit with Conductors (Type NUCC)
- Flexible Metallic Tubing (Type FMT)
- Electrical Nonmetallic tubing (Type ENT)
- Those wiring methods by various manufacturers similar to the ones listed

(6) All wiring shall be rated 600 volts, single copper conductor, with Type THHN/THWN insulation.
(7) All wiring shall be installed in metallic conduit raceways above grade or PVC (schedule 40) below grade. Raceways in walls shall be metallic type EMT. Conversion from PVC to metallic shall be done with a metallic elbow below grade.
(8) Cable tray as a raceway for power wiring is highly discouraged and is approved only by exception upon request.
(9) Raceways shall be concealed wherever practical in finished spaces.
(10) Motor Control Centers shall have disconnects, branch circuit overload protection, and controllers mounted in a single assembly. Whenever the starter is located in the MCC, use thermal magnetic or instantaneous trip circuit breaker with separate adjustable overloads. If the unit contains no starter, and the starter is located at the machine, then a thermal-magnetic circuit breaker shall be used to supply the motor feeder.
(11) Coordinate locations of electric-operated project screens in conference rooms, classrooms, or training rooms with user. Provide power and wall switches for control.
(12) Main electrical rooms shall be a separate room with no other trades sharing the electrical room. Main electrical room shall be located on an exterior wall with exterior double doors, and without a center support, in the opening for removal of equipment. Doors shall contain an exterior lock.
(13) Electrical closets within the facility shall be separate rooms with no other trades sharing the closets. Electrical closet doors shall contain a lock.
(14) Unless special permission is granted by Civil Engineering, all dry-type transformers shall be installed within the main electrical room and electrical closets within the facility.
(15) Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit below grade only, or EMT, except where specifically required by NFPA 70 to be installed otherwise. Flexible metallic conduits in lengths less than 6 feet may be used for connections to light fixtures and equipment, such as motors that vibrate.

5.8.2 Branch Circuits

(1) On all new circuits, allow for future expansion by loading to no more than 80% of the NEC maximum. 15 amp circuits are not allowed.
(2) No more than three to six outlets shall be placed per circuit, even if sizing in accordance with the NEC indicates more outlets can be installed on the circuit, IAW UFC-3-520-01, 6-2.10.
(3) Do not use multi-wired circuits (shared neutrals) for single-phase loads. Run a separate neutral.
(4) Do not use underfloor duct systems.
(5) Provide a separate green grounding equipment conductor in all conduits. Raceway shall not be used as a sole equipment ground. Ground shall be sized in accordance with Table 250 of the NEC.
(6) Do not use ground fault breakers for 120 volts, 20-ampere circuits.
(a) Use only individual ground fault receptacles.
(b) Provide GFCI receptacles in all bathrooms, locker rooms, within all wet areas of a facility, and at all outside locations. Exception, GFCI breakers are allowed for chilled water freeze protection cabling.
(7) Branch circuits shall be rated a minimum of 20 amperes, except where lesser ratings are required for specific applications. Branch circuit conductors will in no case be less than No. 12 AWG.

(8) Install a maximum of three phases or poles in any conduit system, which includes single-phase circuits, regardless of derating tables in the NEC. All shall be of separate phases. Exception: For system furniture, maximum of 4 phases may be contained in the same branch circuit raceway for 8 wire systems furniture.
(9) The combined voltage drop on feeders and branch circuits will not exceed 5%. Individual voltage drop on feeder and branch circuits shall not exceed the recommendations of the NEC.

5.8.3 Dry-type Transformers
(1) Use dry-type general purpose (delta-wye) in the facilities except in cases listed below which require K = 13 non-linear dry type transformers.
(2) Use K-rated (K=13) non-linear dry types when providing power to the following areas:
(a) Office administrative areas
(b) Cubicles or System Furniture
(c) Individual office Rooms
(d) Large open office areas
(e) Computers
(f) Electronic Equipment
(g) Electronic Test Labs
(3) Dry type transformers shall not be ceiling-mounted or wall-mounted. Mount the transformer on a concrete pad on the floor with rubber pad isolators.
(4) Maximum size dry type shall not exceed 300 KVA.

5.8.4 Low Voltage Cable and Conduit
(1) Use only copper conductors.
(2) Use THHN indoor and THWN outdoors.
(3) Do not use setscrew or die cast conduit connectors on EMT conduit. Use steel compression fittings only.
(4) Screw-in flex connectors are not allowed. Connectors for flexible metal conduit shall be malleable iron/zinc plated and of the 2-screw clamp type with insulated throats conforming to UL 514B & NEMA FB-1.
(5) For areas without conditioned air, apply the ambient correction factors in NEC, article 310.

5.8.5 Computer Areas
(1) Locate separate emergency shutdown switches (inside hinged covers to prevent accidental activation) for all computerized operations, including their air handling and computer room units. Locate switches at each exit door of the computer room.
(2) Activation of the fire alarm system shall also shut down the computer equipment, computer room units, and air-handling units.

5.8.6 Air Handling Equipment and Devices
(1) Use device plates of type 302, 0.035" thick, brushed finish, and UL Listed stainless steel.
(2) Disconnect Switches:
(a) Heavy duty type.
(b) NEMA 3R outdoors, NEMA 4X in corrosive areas.
(c) When fused, use rejection type R fuses.

5.8.7 Grounding
(1) Ground rods are ¾" × 10' copper clad. Use exothermic weld to connect to grounding system.
(2) Connect a tripod of three ground rods spaced 20 feet apart to the service entrance electrode connection. Tripod shall be at least 10 feet from the facility.
(3) In addition to the service entrance ground electrode listed above, install a ground ring with ground rods around the entire new facility with connections to the steel beams evenly spaced around the perimeter of the structure. Connect the electrical service entrance ground bus to the ground ring at a single point copper ground bus bar located in the main electrical room.
(4) Grounding shall be provided for all new communications rooms. For new construction, connect the grounding in each communication room to the single point ground bus located in the main electrical room.

(5) Grounding shall be provided for all new raised floor systems. Due to the various methods of grounding computer raised floors, details are left to be provided by others.
(6) Static ground receptacles shall be provided for all new hangars and painting facilities. Receptacles shall be interconnected together with the grounding system and steel structure in the facility.
(7) All raceways shall have an insulated equipment ground conductor sized in accordance with the NEC.
(8) All ground wires coming into the single ground point shall be labeled.

5.8.8 Wall Switches
Only type EMT conduit is permitted for any receptacles, switches, or other devices inside walls. They will have a minimum current of 20 Amps and be hard use specification grade or heavy duty specification grade.

5.8.9 Convenience Receptacles
5.8.9.1 General
Only type EMT conduit will be allowed to be used for any receptacles, switches or other devices inside walls.
(1) An outlet is defined as 20 Amp minimum, NEMA 5-20R, and duplex. Minimum locations for convenience receptacles shall be as described in this standard.
(2) Hard Use Specification Grade or Heavy Duty Specification Grade.
(3) When weatherproof, use spring-hinged flap covers.
(4) Convenience receptacles shall be located 18″ AFF, to the center of the outlet.
(5) Explosion proof convenience receptacles shall be provided at all explosion proof areas within a facility. Explosion proof convenience receptacles shall be rated in accordance with Article 500 of the NEC.
(6) Explosion proof convenience receptacles shall be rated 20 amperes.
(7) Provide a plug for each explosion proof convenience receptacle.
(8) Provide dedicated outlets for large copiers (typically 1500 VA) and color laser printers to serve office administrative spaces. Provide outlets for smaller laser printers located throughout office areas. Some copy rooms may have high-capacity printers requiring additional load. Coordinate on type of copy equipment and locations during design.

5.8.9.2 Areas
Convenience Receptacles shall be provided in all the following areas listed below:
(1) At Communication Outlets - adjacent to each communication outlet
(2) In small individual office rooms (less than 250 sq. ft.): one outlet on each wall but with spacing not to exceed 8′.
(3) Conference Rooms:
(a) One outlet ceiling mounted within 18″ of where a projection screen would be installed.
(b) A minimum of one outlet on each wall additional outlets mounted at 16′ maximum separations around the perimeter of the room.
(c) Install one outlet in the corner of the room opposite where a projection screen would be used.
(d) Install a floor mounted receptacle in the front of the room for a podium.
(4) Communication Rooms: Provide two outlets in the center of each wall.
(5) Receptacles for Pre-wired System Furniture:
(a) Prewired system furniture is defined as furniture that contains pre-wired powered panels with plug-in receptacles and communication outlets mounted in the furniture base. Prewired system furniture would have the power and communication wiring extended into the furniture channel through a power pole or flexible whip.
(b) If furniture is included in the Design Build RFP or Statement of Work, then all raceway, wiring, and power capacity should be provided. Wiring should be extended to the furniture and terminated on the outlets.
(c) Coordinate on the type of systems furniture, and provide a wiring arrangement that best suits the layout and type of furniture. Projects will use either an 8-wire or 10-wire system.
(6) Administrative areas larger than 250 sq. ft. with or without prewired systems furniture:
(a) In these spaces, install outlets at 8′ intervals around all walls and one outlet on each furred out interior column.

(b) Install outlets flush to the walls and interior columns. This is in addition to the outlets specified for prewired system furniture cubicles.
(7) If furniture is installed in areas of the facility, which is not prewired system furniture, but uses the outlets in the walls, then provide the following:
(a) Install two outlets in the center of each cubicle or desk area, flush mounted. Do not exceed 8′ separation on the walls or connect more than two cubicles on one circuit.
(8) For mechanical, electrical rooms and mechanical mezzanines, install one outlet at 20′ intervals around all walls. Provide additional outlets as needed to coordinate with equipment locations.
(9) Install one outlet within 16-20′ of each piece of mechanical or electrical equipment. This shall be provided wherever equipment is located, whether inside or outside, roof, mezzanines, etc.

5.8.9.3 Special Receptacles for Hangars
Obtain special requirements from user or project scope of work.

5.9 INTERIOR LIGHTING

5.9.1 Design
Determine lighting levels based upon UFC for maintained levels. Maintained level is defined as a calculated ft.-candle level taking into consideration all depreciation light loss factors (LLF).

5.9.2 General
(1) Contractor shall utilize either fluorescent T8 or T5 lamps or LED lights with an output greater than 150 lm/watt and life greater than 50,000 hrs., whichever is the most energy efficient.
(2) Contractor shall use a maximum of 4′ lamps.
(3) Use T8 lighting 28 watt bulbs, with ballast capacity either 28 or 32 watt.
(4) Modular wiring systems are not allowed.
(5) Light fixtures in stairways shall be above the landings and not above the steps.
(6) Install a junction box and 6′ of flexible metal conduit to all light fixture connections above suspended ceilings, acoustical or gypsum. Maximum length of flexible conduit shall not exceed 6′.
(7) UFC lighting levels shall be used.
(8) Facilities with a Built-in Service Desk:
(a) Provide down task lighting directly over the entire service desk counter.
(b) Provide switch next to entrance into the service desk area.
(9) Foyer/Halls/Corridors: Fixtures shall be 2′×4′ with refractive acrylic lens troffer. Maximum of three lamps shall be used in a fixture.
(a) Use Highbay LED (>150 lm/watt, 50,000+ hrs.) fixtures in applications with high light levels and where the bottom of the fixture is at least 15′ above the floor.
(b) Use Lowbay LED (>150 lm/watt, 50,000+ hrs.) fixtures in applications where the bottom of the fixture is less than 15′ above the floor.
(c) Use metal reflectors in industrial areas and high bay areas where architectural aesthetics is not a concern.
(10) All dimming systems shall employ switching scenes that will return emergency lights to full brightness upon loss of normal electric power.

5.10 EMERGENCY & EXIT LIGHTING

5.10.1 General
(1) In facilities over 25,000 sq. ft., use a small permanent generator to feed the circuits in the emergency system. Interruptible Power Supplies (IPS) units have been found to have long-term maintenance problems.
(2) For facilities less than 25,000 sq. ft., provide emergency lighting with integral battery packs in the fixtures.
(3) Clearly mark the emergency fixtures with a label designated “emergency” and a printed label with the circuit number, so Shop personnel can find them easily. Install a laminated plastic nameplate on the fixture. Nameplate shall have an orange background with white letters (minimum ¼” letters), which describe the emergency lighting circuit number. All raceways shall be marked with a 3” orange tape band every ten feet. All junction boxes used in the wiring shall have orange covers.
(4) Install an emergency light in each electrical and mechanical room.

(5) Place a laminated drawing of the system always on the building interior, either near the emergency unit, or near the main electrical panel for a system of individual fixtures.

5.10.2 Exit Signs

(1) For facilities greater than 25,000 sq. ft., connect exit signs to a central emergency unit.

(2) For facilities less than 25,000 sq. ft., exit signs shall contain an integral battery for 90 minutes of illumination.

(3) All exit signs shall be LED type. Exit signs in lobby or vestibule shall be clear with red lettering.

(4) Self-illuminating or reflective types are not allowed.

(5) All dimming systems shall employ switching scenes that will return emergency lights to full brightness upon loss of normal electric power.

5.11 FIRE DETECTION & ALARM SYSTEMS

5.11.1 General

5.11.1.1 System

Fire Alarm system shall be addressable Style 6 signal line circuits and Style Z indicating appliance circuits.

For projects with a fire alarm and mass notification system, use Notifier NFS2-640 panel with Notifier FCPS-24S8 remote power extenders as needed for a combined fire alarm and mass notification panel.

For projects with only a fire alarm, use Notifier NFS-320 (preferred choice for applications with 1 SLC loop), Notifier NFS2-640 (for cases that may desire 2 SLC loops), or Monaco M2.

5.11.1.2 Radio Transmitters

For projects with a fire alarm and mass notification system, use Monaco BT-XM with associated antenna, mounting brackets, cabling, and surge arrestor.

For projects with a fire alarm only, use Monaco BT-X associated antenna, mounting brackets, cabling, and surge arrestor.

5.11.1.3 Remote Local Operator Console (LOC)

Use a Wheelock SP4-LOC with microphone and emergency HVAC button. Install a remote digital display annunciator for lobby area.

5.11.1.4 Speakers

The fire alarm and mass notification systems shall use the same speakers. Design the system in accordance with UFC 4-021-01.

Design speaker layout and wattages used based on “intelligibility”. System shall provide clear “intelligibility” from anywhere within the center of all spaces. Design drawings and shop drawings shall show all wattages and candela ratings.

In large open administrative spaces, speakers shall be evenly spaced throughout in the ceiling.

In large industrial areas, design and layout shall consider the space of the area, structure, and ambient +.noise expected under normal operations. In these spaces, use supervised speaker horns or cluster types mounted overhead that provide high intelligibility with voice reproduction. Speakers shall be UL approved for fire protective signaling systems and meet all applicable UL standards for speaker/ visual devices.

5.11.1.5 LOC

Local operator console with microphone shall be located in an accessible location for local control of emergency messages.

The system shall be connected to the existing base wide Monaco D-21 radio system. Base personnel shall program the Base head-end equipment to accept the new facility for mass notification. Base personnel shall program the radio transmitter for fire alarm.

Standard messages for Tyndall AFB will be provided to the Contractor in a digital format and loaded into the FACP/ MNS panel by the Contractor.

5.11.2 Qualifications
Provide all qualifications and certificates in the submittal.

(1) Provide separate raceways for the SLC loop. SLC wiring shall use shielded wire. Wire sizes shall be determined based on voltage drop calculations in shop drawings.
(2) Amplifier size shall be based on not more than 75% capacity. Strobe circuits shall be designed not to exceed 75% capacity. Follow loading guidelines established for maximum load on remote extension power supplies.
(3) Install control panels and remote expansion power supplies in an air-conditioned space. Due to the amount of panels involved and the exposed raceways, the system shall not be installed in finished spaces.
(4) Use only two-conduit looped system with supply and return conductors separated by 1′ vertical and 4′ horizontal. Follow NFPA 72 recommendations on this as if this is a "shall" requirement in this standard.
(5) Fire alarm riser shall be drawn as a two-loop conduit system.
(6) Install wiring with no splices between devices. Terminal strips shall not be used in between devices unless special approval is granted on a case by case basis by the Alarm Shop.
(7) Do not connect notification devices to the style 6 wiring loop using addressable modules. Notification appliance circuits shall be connected directly to the FACP NAC terminals or to NAC outputs in Government furnished remote expansion power supply panels.
(8) All wiring shall be installed above grade and in metallic raceways. Minimum size of raceways shall be ¾". Use liquid tight flexible metal conduit for short connections (less than 6′) to tamper switches and flow switches only. Provide 3" minimum red tape band on fire alarm conduits every 10 feet. Red tape markings shall be provided on all raceways, whether installed exposed or hidden such as above acoustical ceiling tiles. Junction box covers for fire alarm shall be painted red. Paint markings shall not be allowed in lieu of the red tape makings.
(9) In out buildings or other locations where detectors are connected by underground conduits to the main building, provide MOV-type surge arresters on both ends.
(10) Keep detectors away from HVAC vents.
(11) FACP shall disable all air conditioning computer room units in the event of any alarm within the facility.
(12) Whenever a duct detector goes into an alarm state, the FACP shall shut down the associated air handling system and send a supervisory signal to the Fire Dept. via the transmitter.

5.11.3 Submittals
Contractor shall provide, but is not limited to the following:
(1) Submittals in accordance with Specifications.
(2) As-builts and schematics prior to final acceptance testing.
(3) O&M manuals prior to final acceptance testing.
(4) Testing before acceptance.
(5) CE Shop training.
(6) Place spare of the O & M Manual Contractor-furnished metal cabinet near the FACP. Place a copy of the as-built drawing in a tube next to the FACP/ MNS panel.
(7) Place a laminated drawing of the system near the FACP.