

# Facilities Planning and Construction Design and Construction Standards


## DIVISION 26 - Electrical

### Preface

The Texas Tech University System's 'Design and Construction Standards', as administrated by Facilities Planning and Construction, are intended to serve as guidelines to the Design Professional and Construction Management teams for design development and construction administration of Texas Tech University System \$TTUS% Capital Projects'. They communicate the minimum ex#ectations and re(uirements relative to s#ecific building systems, design #rovisions, general s#ecification re(uirements, and administrative #rocedures for ne) facilities being constructed on Texas Tech University System \$\* SU, " SU, TTU, TTU+SC, and TTU+SC , I Paso% cam#uses'. Several, but not all re(uirements for each com#onent -nstitution or \*gency )ithin the TTU System are covered'. Design Professionals, Construction Management

**Division 26 - Electrical**

minimum (uality re(uirements' esign Professionals are encouraged to identify and include e(ivalent #roducts and/or manu!acturers o!!ering com#arable #roducts to !acilitate o#en bidding environments'



Division 26 - Electrical

to coordinate with the Utility Company for connection to the utility company's transformer and/or meter. Contractor shall coordinate with FP5C Project Manager for the temporary power interruption shutdown required to the interconnection and/or addition of new loads to the Utility Transformer.

\* All supports shall be from structural members of the facility. All conduit, wire, cable, boxes, devices, etc., shall be supported from suspended ceiling or support cables of suspended ceilings.

\* All surfaces shall be restored where surface finish damage is evident. Physical material damage will require replacement of part.

The Contractor shall insure that all work has been accomplished to the satisfaction of the Architect, Engineer or Record prior to energizing any circuit or new equipment.

\* All materials and equipment, wherever applicable, shall be listed by Underwriters Laboratories and Factory Mutual approved and the installation shall be in accordance with the NEC, manufacturer's recommendations, local utility company, and Factory Mutual Recommended Good Practices.

The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, and wiring of all equipment and material. The Contractor shall promptly notify the Architect, Engineer or Record, in writing, of any conflict between the requirements of the Contract documents and the manufacturer's directions and shall obtain the Architect and/or Engineer's instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such instructions from the Architect and/or Engineer, he shall bear all costs arising in connection with the deficiencies.

Contractor shall provide temporary construction power and lighting to all trades at the site for the use of all trades.

Where conduit, raceway, cable trays, wiring, etc. pass through floors, walls, partitions or ceilings having a required smoke and/or fire resistive rating, such as 1-hour, 1.5-hour, 2-hour, etc., the Contractor shall provide appropriate fire and smoke protection.

## Division 26 - Electrical

\* At a minimum, provide access panels where required by codes and for maintenance or service. Clean lamps, reflectors and lenses of all lighting fixtures. Clean panelboards and equipment cabinets inside and out. \* Only touch paint of the specified color to any scratches or marks on the finish of all equipment, race way, etc.

Provide a preliminary study and a complete short-circuit study and protective relay and device coordination study from the 16' < /D utility service by 7ubboc/ Po) er and 7ight through the main disconnect of the branch circuit panelboards and motor loads to 19 +P' This ) or/ is to be performed by the manufacturer of the electrical gear and shall include the generator s/id mounted circuit breaker to the largest branch device on the volt emergency and standby panelboards. Provide arc flash calculations and labels for each piece of electrical equipment modified or provided in this contract.

## Basic Electrical Materials and Methods

\* Conduit sleeve shall be of standard sizes larger than the size of conduit it serves, except where 7/8" Seal casing seals are used in sleeves through walls below grade. \* All sleeves in floor shall extend a minimum of 6 inches above the finished floor. \* All conduit passing through concrete masonry walls above grade shall have 18 gauge galvanized steel sleeves. Sleeves set in concrete floor construction shall be at least 1 : 1 gauge galvanized steel except at conduit supports. Sleeves set in concrete floor construction supporting conduit risers shall be standard weight galvanized steel. Sleeves supporting conduit risers @ inches and larger shall have three : inches long reinforcing rods welded at 169 degree spacing to the sleeve and shall be installed embedded in the concrete or grouted to existing concrete. > here the conduit passes through a sleeve, no point of the conduit shall touch the sleeve. Seal around penetrations through sleeving as indicated under fire stopping as specified and in compliance with the requirements of Division 9; specifications.

## Electrical Power Metering and Control Devices

Power metering system at switchgear shall be PowerLogic or approved equal that is compatible with existing PowerLogic solt) are.

Division 26 - Electrical

Contractor shall provide the following Po)erlogic devices and associated hardware:

- 1' For Research, Laboratory, High Computing Processes Building: Provide Po)erlogic series P " 8999 model " , TS , P " 86<9 \$or approved (ual% manufactured by Schneider ,lectric' Contractor shall coordinate )ith Switchgear " manufacturer exact size o! Current Transformers \$CT's% and Po)er Transformers \$PT's%'
- 6' For General Classrooms, Residence Halls, and General Offices Building: Provide Po)erlogic series P " 8999 model " , TS , P " 86<9 \$or approved (ual% manufactured by Schneider ,lectric' Contractor shall coordinate )ith Switchgear " manufacturer exact size o! Current Transformers \$CT's% and Po)er Transformers \$PT's%'

Contractor is responsible to provide data drop \$C \* T1= or C \* T1: % at each meter location'

Contractor shall coordinate )ith TTU Telecommunications Department (or Local Area Act) or/ \$7 \* A% access'

## Wire and Cable

Wire, cable, and connectors shall be new and of manufacturer's standard materials, as indicated by published product information' Provide wire, cable, and connector of design and construction as required for the installation'

Provide factory fabricated wire of the size, rating, material and type as indicated for each service' Where not indicated, provide proper selection as required to comply )ith installation requirements and )ith A , C standards'

## Marking

- 1' Provide new insulated conductors marked according to A , C Article 110.10'
- 6' All wire and cable shall be UL listed' In addition to other standard labeling, all wire and cable shall be marked UL on the outer surface indicating UL certification'

All insulated wire and cable shall conform to the minimum requirements of NEC, \* Standards for Cable - installed in wet locations, )ith the cable subjected to all degrees of moisture conditions' Wire and cable shall comply )ith the applicable requirements of the A , C, latest edition, in

Division 26 - Electrical

regard to cable construction and usage'

The conductors of wires and cables shall be oil-coated and tinned where specified, and have conductivity in accordance with the standardization

Facilities Planning and Construction  
Design and Construction Standards

Division 26 - Electrical

- a' > here more than one conductor o! the same #hase or more than one neutral or ground conductor occurs at the same outlet or lunction box, these conductors shall be identi!iable !rom each other by use o! stri#es or distinguishing mar/ings'
- b' \* ll ) iring associated ) ith isolated ground rece#tacles \$line, neutral, ground% shall have a yello ) tracer on each conductor'
- c' The neutral tracer color shall match the #hase conductor color ) ith ) hich it is associated'
- d' Use di!!erent colors !or control ) iring'

**1wo-2o&r 3 '- 'isted 4ire 5ated S\$ste 6 s**

For lire #um# circuits, lire detection\alarm\su##ression circuits, and other critical circuits to remain in service !or a #eriod during a lire'

- 1' Si4e shall be Ao' 16 \* > B minimum'
- 6' Sol!tdra ) n, annealed co##er' Solid !or Ao' 16 and Ao' 19 \* > B' Stranded !or Ao' 8 \* > B and larger ) ith Class12 stranding'
- @' -nsulation shall be Ty#e . . +, :99 volts, I9!degree \$C%' . ubber insulated ) ith silicone ceramilication' -nsulation class!ied lo ) smo/e #er \*ST " 1, 1: :61 I ;'
- <' Sheath shall be nonmetallic, moisture, sunlight and corrosion resistant, and !lame retardant s#eci!ically a##roved !or this a##lication'
- =' Conduit
  - a' T ) o!hour !ire1rated systems shall be installed in rigid metallic conduit as re(uirod to con!orm to U7!listing' Provide rigid metallic conduit system !or installation o! 6!hour !ire1 rated conductors ) here circuits #ass through and into the boundaries o! the building'
  - b'



Division 26 - Electrical

. BS conduit, unless noted otherwise on drawings'

: ' Use ,lectrical " etallic Tubing \$ , " T%, si4e three1( uarter inch or larger, !or 61hour !ire!  
rated systems only ) here a##roved in ) riting by the , ngineer and the 3 ) ner'

; ' , lectrical circuit #rotective system shall be a##roved !or vertical installation, including  
cable su##ort mechanism'

8' , lectrical circuit #rotective system shall be a##roved ) ith a !ire rated seal used to

ellectrical 0.998087 0 0 1 115.92 5.3 (i) 4.19158 (ii) 5.87592 (and 5.9251 (c) 5.15007 (u) 0.590

Division 26 - Electrical

ground, )ire #rovided ground )ire o! same construction as ungrounded circuit conductors'

iii' > here t ) o!hour lire rated circuit system U71listing does not include #ulling lubricant, #rovide U71listed t ) o!hour lire rated circuit system ) ith conductors suitable !or installation ) ithout #ulling lubricant'

11' 3ther U71listed t ) o!hour lire rated circuit #rotective systems may be used ) here a##roved by the A , C and ) here #ro#osed substitutions are acce#ted in ) riting by the esign Professional and the 3 ) ner' . e!er to ivision 91 re(uirements !or submittals and substitutions'

1' " ineral!insulated \$ " -% cable #er A , C1@@6'

6' U71listed lire! ) ra##ing !or conductors rated :99 volt and belo )'

@' Concrete encasement'

16' > here indicated on #lans or s#ecilications, #rovide U717isted 6'+our Fire1 . ated system !or circuit\$S% rated :99 volts or belo )'

1@' -ninstall 6!hour U717isted, !ire!rated system in rigid galvani4ed steel \$ . BS% conduit, unless other ) ise noted on dra ) ings' > here acce#ted in ) riting by , ngineer and 3 ) ner, t ) o!hour U71 7isted !ire!rated system may be installed in electrical metallic tubing \$ , " T%' . e!er to race ) ay re(uirements'

1<' -ninstall t ) o!hour U717isted !ire!rated system in accordance ) ith manufacturer's instructions, the re(uirements o! the A , C and U7'

1=' Substitutions' > here substitution o! alternate t ) o!hour U717isted !ire!rated systems are acce#ted in ) riting by the , ngineer and the 3 ) ner, #rovide alternate systems in accordance ) ith manufacturer's instructions and the re(uirements o! the A , C, U7 7isting, AFP\* , and 3 ) ner's standards' \* lternate systems include, but are not limited to, mineral!insulated \$ " -% cable, concrete encasement, and !ire! ) ra##ing o! designated cable and conduit systems'

iring Connections and 1er 6inations

Division 26 - Electrical

1' Provide factory fabricated, compression metal connectors of the size, rating, material, type and class as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with A, C standards. Select from only following types, classes, sizes and style.

6' Type

a' Solderless pressure connectors

b' Insulated spring wire connectors with plastic caps for 19 \* > B and smaller

c' Insulated ring or saddle type compression terminals for termination of stranded conductors at wiring devices and terminal blocks

d' Crimp

e' Threaded

@' Class Insulated

<' Material Copper or CU to CU connection

= ' Style

a' Insulated terminals. Use ring terminal for control wiring. Use large or saddle compression terminal for termination of stranded conductors at wiring devices, including ground connection.

b' Split bolt parallel connector

c' Pigtail connector

d' Preinsulated multi-tap connector AS- Industries EPolarisF series, -Isco Corp  
EClear

e' Tap type PST, 2urndy 0FC- EUnitaF, or accepted substitution

: ' Install splices, taps and terminations which have both mechanical strength and

Division 26 - Electrical

- insulation equivalent to or better than the conductor's ampacity and temperature rise' terminations to carry full ampacity of conductors without perceiving temperature rise'
- ;' Conductor splices and taps shall be made only in junction boxes or wire ways and shall be accessible' Conductor splices and taps shall be kept to the minimum necessary to completely wire each branch circuit and feeder as indicated on the drawings' Conductor splices and taps shall generally be made and installed above grade'
- 8' Splices below grade shall be in watertight handholes, all boxes, or manholes approved for this use, and shall be made watertight with epoxy resin type splicing /its similar to " Scotchcast Under no circumstances, however, shall the Contractor make or install splices or taps below grade without having first secured the written approval of the Designer's duly authorized representative'
- 1' Use splice tap and termination connectors which are compatible with the conductor material' Use compression pressure type, full circumference lugs or connectors for terminations or splices of all stranded conductors' Use ring tongue type terminators on all control wiring' Use flanged shade type terminators for termination of stranded conductors at wiring devices, including ground connection' Connect all conductors as follows:
- : \* > B and larger using high capacity [ (c) 0.958493 (o) 0.590251 (n) 0.590251 (d) 0.590251 (u) 0.51 (')





Division 26 - Electrical

, lectrical service ) ill be #rovided by 7ubboc/ Po ) er and 7ight ) ith a utility trans!ormer' The

Division 26 - Electrical

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Division 26 - Electrical

Division 26 - Electrical

- @' 2us ) ay Su##ly Circuits -install insulated e(ui#ment grounding conductor !rom the grounding bus in the s ) itchgear, s ) itchboard, or distribution #anel to e(ui#ment grounding bar terminal on bus ) ay'
- <' Com#uter 3 outlet Circuits -install insulated e(ui#ment grounding conductor in branch1 circuit runs !rom com#uter!area #o ) er #anels or #o ) er!distribution units'
- = ' -solated Brounding . ece#tacle Circuits -install an insulated e(ui#ment grounding conductor connected to the rece#tacle grounding terminal' -solate grounding conductor !rom race ) ay and !rom #anelboard grounding terminals' Terminate at e(ui#ment grounding conductor terminal o! the a##licable derived system or service, unless other ) ise indicated'
- : ' -solated , (ui#ment , nclosure Circuits - For designated e(ui#ment su##ied by a branch circuit or leeder, isolate e(ui#ment enclosure !rom su##ly race ) ay ) ith a nonmetallic race ) ay !itting listed !or the #ur#ose' -install !itting ) here race ) ay enters enclosure and install a se#arate e(ui#ment grounding conductor' -solate e(ui#ment grounding conductor !rom race ) ay and !rom #anelboard grounding terminals' Terminate at e(ui#ment grounding conductor terminal o! the a##licable derived system or service, unless other ) ise indicated'
- ; ' Aonmetallic . ace ) ays -install an e(ui#ment grounding conductor in nonmetallic race ) ays > hen called out !or s#eciali4ed e(ui#ment installations'
- 8' \* ir! uct , (ui#ment Circuits -install an e(ui#ment grounding conductor to duct! mounted electrical devices o#erating at 169 D and more, including air cleaners and heaters' 2ond conductor to each unit and to air duct'
- I' > ater +eater, +eat!Tracing, and \*nti!rost +eating Cables -install a se#arate e(ui#ment grounding conductor to each electric ) ater heater, heat!tracing, and anti!rost heating cable' 2ond conductor to heater u



Division 26 - Electrical

structure taking care not to penetrate any adjacent parts' -install straps only in locations accessible for maintenance'

- <' "etal >ater Service Panel Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal ) ater service entrances to building' Connect grounding conductors to main metal ) ater service #ies by grounding clamp connectors' > here a dielectric main ) ater fitting is installed, connect grounding conductor to street side of fitting' 2ond metal grounding conductor conduit or sleeve to conductor at each end'
- =>' ater " eter Panel Use braided #e bonding #umbers to electrically by#ass ) ater meters' Connect to #ie ) ith grounding clamp connectors'
- :>' 2ond interior metal #ing systems and metal air ducts to equipment grounding conductors of associated #ums, fans, blowers, electric heaters, and air cleaners' Use braided #e bonding straps'
- :>' 2ond each aboveground #ortion of gas #ing system upstream from equipment shutoff valve'

## 5acewa\$s and Cond&its

### iring Installation in 5acewa\$s

- 1' >ire and cable shall be #ulled into clean, dry conduit'
- 6' Pull conductors together ) here more than one is being installed in a race ) ay'
- @' Use U7 listed #ulling compound or lubricant, ) hen necessary' Compound must not deteriorate conductor and insulation'
- <' o not use a #ulling means, including fish tape, cable or rope ) hich can damage the race ) ay'
- =>' -install )ire in race ) ay alter interior of building has been #hysically #rotected from the

Division 26 - Electrical



Division 26 - Electrical

polyvinyl chloride (PVC) aluminum is not an approved material

b' Fittings Compression type, malleable iron, with insulated throat, either cadmium plated or hot-dipped galvanized

c' Use For applications as indicated in A, C 691 < \* rt @=9'

7' (uid)tight Flexible Nonmetallic Conduit

a' Conduit, (uid)tight jacket of flexible polyvinyl chloride (PVC) jacket over rigid PVC core

b' Fittings Compression type, malleable iron, with insulated throat, either cadmium plated or hot-dipped galvanized

c' Use For applications as indicated in A, C 691 < \* rt @=:'

8' Sealing Fittings Where conduit sealing fittings are required, they shall be of malleable iron, commercial cast aluminum, ferroalloy, or other suitable construction Provide fitting to facilitate insertion of sealing compound Provide fitting closures, unions, and adapters of the same manufacturer that are compatible with the selected sealing fitting

a' Orientation Unless specifically noted otherwise, provide conduit sealing fittings suitable for installation in both horizontal and vertical race ways

b' Combination Drain/Seal Fitting Where drain/sealing fittings are required, they shall be of malleable iron construction with an internal drainage path which provides a visual means to ensure that the compound chamber is properly filled The installation shall enable the

drain/breather fitting and filler plug to be installed immediately after the sealing compound is poured

c' Finish Hot-dipped galvanized

d' Compound Provide sealing compound compatible with the specified sealing

Division 26 - Electrical

fitting, and in compliance )ith the re(uirements o! A , C1=91'1=\$C%'

e' 7isting' U7 88:.'

irewa\$\$

1' " aterial not less than 1 :1gage sheet steel'

6' Cross section dimensions not less than <F by <F'

@' Provide dividers to se#arate )iring o! di!!erent si











Division 26 - Electrical

contract documents' " a/e transfer s ) itch suitable !or to# entry, bottom entry, or both as indicated on construction dra ) ings and other a###licable contract documents'

Terminal bloc/s shall conform to A , " \* -CS <' Terminal !acilities shall be arranged !or entrance o! external conductors !rom the to# or bottom o! the enclosure'

**7&to 6 atic Solid State Controller#**

- 1' Controller shall be solid state and designed !or a high level o! immunity to #o ) er line surges and transients, demonstrated by test to - , , , Standard =8;' The controller shall have o#tically isolated logic in#uts, high isolation transformers !or \* C in#uts, and relays on out#uts'
- 6' The controller shall be e(ui##ed ) ith self diagnostics, ) hich #er!orms #eriodic chec/s o! the memory, in#ut0out#ut \$-03%, and communication circuits, ) ith a ) atchdog0#o ) er !ail circuit'
- @' The controller shall be accurate to ) ithin 1 #ercent o! !ull!scale value !or measured #arameter' Voltge and current !or all #hases shall be sam#led simultaneously to assure high accuracy in conditions o! lo ) #o ) er !actor or large ) ave!orm distortions'
- <' Voltge sensors shall allo ) !or ad!ustment to sense #artial loss o! voltage on any #hase'
- =' \* utomatic controls shall signal the engine generator set to start u#on signal !rom normal source sensors indicating loss o! normal source' 2attery voltage starting contacts shall be gold, dry ty#e contacts !actory! ) ired to a !ield ) iring terminal bloc/'
- : ' The s ) itch shall transfer ) hen the emergency source reaches the set #oint voltage and !re(uency'
- ; ' The controller shall be ca#able o! storing records in memory !or access either locally or

Division 26 - Electrical

Personnel to maintain all engine-generator sets on campus'

Factory and field test the complete automatic transfer switch assembly to ensure proper



Division 26 - Electrical

regulated lead acid batteries. Sealed cell batteries using a gelled electrolyte in a sealed battery case are acceptable.

Specify a static, solid state battery charger unit which automatically controls the charge rate and which has an adjustable charging rate. Include a charging rate ammeter, a voltmeter, and a manual reset, thermal overload circuit breaker to protect the rectifier assembly and transformer. Size charger to recharge the battery from a fully discharged state to a fully charged state within 6 hours or less.

\* Provide charging system such that charging occurs from the normal source when the generator is shut down, and from the generator when the generator unit is supplying emergency power.

Specify closed loop, liquid coolant system complete with unit mounted radiator, fan, coolant manifold, coolant expansion chamber, thermostat, temperature control valve, and engine driven coolant circulating pump.

Specify an engine mounted, corrosion resistant, thermostatically controlled coolant heater for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL listed and labeled.

Specify a high degree, critical rated silencer capable of passing rated engine exhaust gases with maximum silencing capacity.

Specify fuel tank to be in construction. Interstitial space shall have a fuel sensor to detect a leak in the inner tank. Provide leak detection and monitoring system for the fuel tank. The alarm shall be on the remote alarm panel. Fuel tank is to be sized for 16 hours operation at maximum load.

Specify a direct coupled, pole, synchronous, low reactance, brushless type generator (alternator) with amortisseur windings, revolving field permanent magnet generator (PM), exciter, single phase lubricated

sealed bearing, air cooled by a direct drive centrifugal blower fan, and built in static rectifier and statically regulated torque matched excitation system with automatic voltage regulator.

Specify a factory fabricated, wired, and tested microprocessor based monitoring, metering,



Division 26 - Electrical

and control system' The control system shall provide for operator interface, digital voltage regulation, digital governing, protective functions, automatic starting, automatic unloading and cool down, automatic shutdown, and communication of alarm and status signals'

The generator controller shall be capable of communicating all data, including alarm and tripping data, in Modbus RTU format to the digital meter in the Generator, emergency Stop Switchboard' Where the controller does not incorporate or support Modbus communication, provide a Modbus gateway for communication between the generator controller and the 480 volt Generator, emergency Stop Switchboard digital meter'

At time of final acceptance, provide one set of new, unused filters of each size and type required for 16 months of operation and maintenance' Provide filters in factory sealed containers or wrapping, clearly labeled for ease of identification' Deliver filters to location as directed by Engineer'

Warranty shall be warranted from defective workmanship or materials for a period of 6 years after final acceptance'

## Electrical Identification

Electrical identification means, methods, materials and devices required to comply with AS-

C26427403 3 (m) -5 . 56086 (e) 0 (t) -5 . 15007 (e) 0 . 589586 (d) T . 52954851 (t) T -5 c [5 (a) 0259 (25) 10 (t) 59255 (07) (

Division 26 - Electrical

c' , mbedded continuous metallic stri# or core is not suitable !or tracing and not a##roved'

d' Printed legend indicating ty#e o! underground line'Q

@' Ta#e " ar/ersG Diny! or vinyl!cloth, sell!1adhesive, ) ra#around ty#e ) ith #re#rinted numbers and letters !or all control ) iring'

Na 6 e8lates and Signs#

1' Sa!ety SignsG Com#ly ) ith 69 CF . , Cha#ter HD--, Part 1119'1<='

6' , ngraved Plastic Aame#lates and SignsG , ngraving stoc/, melamine #lastic laminate, minimum 101 : inch thic/ !or signs u# to 69 s(' in and 108 inch thic/ !or larger si4es'

a' , ngraved legend ) ith blac/ letters on ) hite !ace'

b' Punched or drilled !or mechanical !asteners'

@' Fasteners !or Aame#lates and SignsG Sell!1ta##ing, stainless steel scre ) s or Ao' 190@6, stainless!steel machine scre ) s ) ith nuts and !lat and loc/ ) ashers'

Installation#

1' -dentification " aterials and evicesG -nstall at luncts

Division 26 - Electrical

c' -dentily normal #o ) er circuits and emergency #o ) er circuits'

<' Paths o! Underground , lectrical 7inesġ uring trench bac/!illing, !or exterior underground #o ) er, control, signal, and communication lines, install continuous underground #lastic line mar/er located directly above line at 16 to 1 : inches belo ) !inished grade'

=' Secondary Service, Feeder, and 2ranch1Circuit Conductorsġ Color1code throughout the secondary electrical system'

## Panel!oards

, nclosure shall be #ro#er A , " \* ty#e as sho ) n on the dra ) ingsġ

1' A , " \* 1ġ

a' 2ac/ box shall be galvani4ed steel !or !lush mounted branch circuit #anelboards' 2ac/ box shall have enamel electro1de#osited !inish over cleaned, #hos#hati4ed steel !or all other ty#e #anelboards'

b' > here #o ) er monitors or metering are s#ecilied on the dra ) ings, the manufacturer shall cut the doors !or !ield mounting o! the unit' . eler to Po ) er " etering section !or details'

6' A , " \* @ . , @S and 16ġ

a' , nclosure and doors shall have enamel electro1de#osited !inish over cleaned #hos#hati4ed steel'

b' oors shall be gas/eted and e(ui##ed ) ith tumbler ty#e vault loc/ and t ) o trun/ latches ) here re(uiired by U7 standard' -nterior trim shall consist o! !our #ieces, each covering one gutter to#, bottom and both sides'

Construct cabinets in accordance ) ith U7 =9' Use not less than 1 :1gauge galvani4ed sheet steel' Provide a minimum <1inch gutter ) iring s#ace on each side'





Division 26 - Electrical

- e' - , C : 69=6111'
- !' - , C : 69=61@1'
- g' U7 : 191911'
- h' U7 : 19191619@9'
- 6' The P " instrument shall comply to the following electromagnetic immunity standards:
  - a' \*AS-0- , , , C@; ' I9'1 \$all inputs tested%
  - b' - , C : 19991<16 \$electrostatic discharge R2S%
  - c' - , C : 19991<1@ \$radiated , " field immunity R2S%
  - d' - , C : 19991<1< \$electric fast transient R2S%
  - e' - , C : 19991<1= \$surge immunity R2S%
  - !' - , C : 19991<1: \$conducted immunity%
  - g' - , C : 19991<1; \$harmonics and interharmonics%
  - h' - , C : 19991<18, \$immunity to #o) er !re (uency magnetic field%
  - i' - , C : 19991<111 \$immunity to voltage dips, short interruptions and voltage variations%
  - ;&' - , C : 19991<116 \$immunity to damped oscillatory waves%
- @' The P " instrument shall comply to the following electromagnetic emission standards:
  - a' FCC Title <; CF . Part 1= \$Sub#art 2, Class 2@ Class 2 digital device, radiated emissions%

Division 26 - Electrical

- d' -C , S 99@ \$industry Canada, -C , S Class 2 digital device, radiated0conducted emissions%
- e' - , C : 1999!@16 \$limits !or harmonic currents emissions0 e (ui#ment in#ut current less than 1 : am#eres #er #hase%'
- !' - , C : 1999!@1@ \$limitation o! voltage !luctuations and !lic/er in lo ) voltage su##ly systems !or e (ui#ment ) ith rated current less than 1 : am#eres%'
- <' The P " instrument shall com#ly to the !ollo ) ing measurement standards ) ith third #arty com#liance certilication as noted0
  - a' \*AS- C16'69, Class 9'6 \$Tests 11I, 11, 1@, 1< !or accuracy%' Third #arty certified'
  - b' - , C : 1999!<1@9 , dition 6, Class S' Third #arty certified'
  - c' - , C : 69=@166, Class 9'6S' Third #arty certified'
  - d' - , C : 69=@16@, Class 6S' Third #arty certified'
  - e' - , C : 69=@16<, Class 9'=S'
  - !' - , C 0 , A : 1==;116'
- = ' The P " instrument shall com#ly to the !ollo ) ing communications standards ) ith third #arty com#liance certilication as noted0
  - a' , - \*0T- \*1<8='
  - b' - , C : 18=9 \$ , dition 1%' Third #arty certified'
  - c' - , , , 896'@ 1 6916'
  - d' - , , , 181=16916 \$ AP@ 1 istributed Aet ) or/ Protocol%'
  - e' " odbus -ntero#erability'

Current Voltage Inlets

Division 26 - Electrical

- 1' The P " instrument shall have no less than three \$@% voltage in#uts and !our \$<% current in#uts'
- 6' The P " instrument in its standard configuration shall be able to acce#t voltages u# to





Division 26 - Electrical

1'



Division 26 - Electrical

@' The P " instrument shall support the synchronization of the demand interval using a digital input, a command via communications, or internal clock'

7 Accuracy

1' The P " instrument shall meet \* AS- C16'69 accuracy Class 0.6'

6' The P " instrument shall meet - , C : 69=0.166 accuracy Class 0.6S'

@' The P " instrument shall meet - , C : 69=0.16< accuracy Class 0.6=S'

<' The P " instrument shall provide four-quadrant metering'

Sampling

1' The P " instrument shall sample continuously at 6= :

Division 26 - Electrical

- = ' The P " instrument shall have a field installable battery (or real time clock) that can be installed without need to remove the instrument from the installation'
- : ' The P " instrument shall have a timestamped event log with the following features:
  - a' Shall support at least 99 events'
  - b' The number of records in the log shall be programmable'
  - c' Each event shall be recorded with the date and time of the event, the cause and effect of the event, and the priority of the event'









Division 26 - Electrical

- <' The P " instrument shall be able to support at least 6 concurrent " odbus TCP0-P connections'
- = ' The P " instrument shall have a " odbus TCP0-P gateway to provide a network or connection to " odbus serial devices connected to a serial port on the instrument'
- : ' The P " instrument shall have the ability to read from and write to " odbus devices connected to a serial port on the instrument and on a common local area network, ethernet net) or/'
- ; ' The P " instrument shall serve the following capabilities to
  - a' Provide real-time and historical data views in both tabular and graphical formats'
  - b' Provide a histogram of harmonic data through the 19th harmonic'
  - c' Provide an IEC 2, 3% and a S, 1, 19 summary of voltage disturbances'
  - d' Provide a 3-phase motor derating curve'
  - e' Provide a phasor diagram representation of the electrical connections to the meter'
  - f' Provide a summary of power factor (quality data along with a mass mail analysis'
  - g' Provide a graphical trend for voltage, average current, frequency and power demand along with a forecast of the next 60 minutes'
  - h' Support the ability to provide technical documents and drawings in PDF format'
  - i' Support user defined tags containing data from the host meter as well as data from " odbus devices connected to a serial port on the instrument and on a common local area network, ethernet net) or/'
- 8' The P " instruments shall have a 6% , ethernet ports that support the following functions

Division 26 - Electrical

- a' \*utomatically , 1mail alarm notifications or scheduled system status u#dates'  
, 1mail messages sent by the P " instruments shall be able to be received li/e  
any ordinary , 1mail message'
- b' \*bility to #ush historical logs through the , thernet communication #ort to a  
remote server based on a user de!ined schedule or an event'
- c' 2uilt in ) eb #ages in the P " instruments shall enable access to realtime  
values and basic #o ) er (uality in!ormation using a current standard ) eb  
bro ) ser' 2asic con!iguration o! the P " instruments shall also be able to be  
#er!ormed through the bro ) ser'
- l' The P " instruments shall automatically #rovide , 1mail notifications !or alarms and  
system status u#dates based on user con!iguration'
- 19' The P " instrument shall have the ability to #ush historical logs through the , thernet  
communication #ort to a remote server based on a user de!ined schedule or an  
event'
- 11' The P " instrument shall #rovide an - , C :18=9 com#lian1(s) -0 . 957164 ( ) 5 . 7403 3 . 98087 0 0 1

Division 26 - Electrical

- g' Fault capture data for three-phase voltage and current in C3 " T . \* , format, including, but not limited to, the following:
  - 1% U# to 66= C3 " T . \* , fault capture files'
  - 6% The files shall be downloadable via standard FTP client'
  - @% The device shall support client notification through - , C : 18=9 to signal when new fault captures have been created and are available \$ . . , logical node%'
- h' The following logical nodes shall be supported in addition to 77A3 and 7P+ \$mandatory%G
  - 1% " + \* -C harmonics'
  - 6% " " T . C metering'
  - @% " " HUC measurement'
  - <% " S \ -C sequence and imbalance'
  - =% " ST \* C metering statistics'
  - :% BB-3C the ability to view data from and control all -03 #oints in the meter'
  - ;% . . , C disturbance recorder function'
- 16' The P " instrument shall have the ability to announce its presence on a local net ) or/ segment using Device Profile > eb Services \$ P > S% over -Pv: local addressing ) without user interaction' The instrument shall be viewable in a " icrosolt ] > indos ] > indos , x#lorer ) indos ) viewable on net ) or/ devices as a link that ) will provide access to the instrument's ) eb interface'

1) Options#

- 1' The P " instrument shall be capable of having 6; digital inputs capable of one \$1% millisecond timing resolution'





Division 26 - Electrical

Division 26 - Electrical

Some example module types include, but shall not be limited to, minimum, maximum, setpoint, digital input, and digital output

- = Programming through a computer shall be secured by user - and password
- : Programming through the instrument's display shall be secured by password
- ; Programmability shall be sectioned such that when the meter is sealed it shall still be configurable to an extent that does not affect the accumulation of revenue metering related data

Power Quality

- 1 Without the use of separate software, the P " instrument shall be able to measure power quality statistically in accordance with IEEE 1000, Class S
- 6 The P " instrument shall be certified by a third party as compliant with IEEE 1000 Class S, Section 6
- 8 The P " instrument shall be certified by a third party as compliant with IEEE 681, Part 1 S
- < Without using separate software, the P " instrument shall determine statistical indicators of power quality parameters that shall include, but shall not be limited to distortion, harmonics, and frequency, in accordance with the IEEE 919 standard
- = Without the use of separate software, the P " instrument shall make available the statistical indicators of power quality provided by IEEE 919 on the instrument's display, or via communications protocols such as IEC 61850, Modbus, Modbus TCP, or via wireless technologies
- : The P " instrument shall be capable of monitoring the value of any statistical indicator of power quality (present, predicted, average, or other

Division 26 - Electrical

;' The P " instrument shall support symmetrical components'

before 6.8.1

1' The P " instrument shall be able to perform 60 samples per cycle waveform recording'

6' The P " instrument shall have at least one programmable oscillographic waveform recorder', each waveform recorder shall have the following features:

a' \* able to record a digitized representation of any phase voltage or current signal with no dead time between such recordings, and the ability to trigger multiple such recordings in continuous succession, and at different resolutions simultaneously'

b' , nabled and triggered manually or through internal operating conditions, including, but not limited to, periodic timer or setpoint activity'

c' +all cycle triggering shall be supported for waveform recorders'

d' The number of records stored on each data recorder, and the overflow conditions when full or circular shall be programmable'

@' The P " instrument shall be able to record contin







Division 26 - Electrical

> K, or delta mode

The meter shall be capable of being applied without modification at nominal frequencies of 50 or 60 Hz

The meter shall have a real time clock with battery backup with at least 1 year ride through time without external power

6.2 Mechanical

The meter unit shall have removable connectors for voltage inputs, control power, communications, input and outputs

The meter unit shall be easily mounted in the standard cutout without tools

Power meter form factor shall be L-A with 16 x 16 mm 1/2" x 1/2" cutout and 1 x 1 1/2" x 1 1/2" panel mount integrated display

The meter unit shall be D-rail mounted with DIN port to connect an optional remote display. The remote display shall be easily mounted in the standard cutout without tools

Remote display form factor shall be L-A with 16 x 16 mm 1/2" x 1/2" cutout and 1 x 1 1/2" x 1 1/2" panel mount remote display

The remote display shall meet A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z ratings at a minimum when properly installed

6.3 Sampling and Harmonic Resolution

The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 1st harmonic fundamental of 90 Hz. The meter shall provide continuous sampling at a minimum of 10 samples/cycle, simultaneously on all voltage and current channels in the meter

The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 5th harmonic fundamental of 90 Hz. The meter shall

Division 26 - Electrical

Provide continuous sampling at a minimum of up to 168 samples/cycle, simultaneously on all voltage and current channels in the meter'

<% Current -n#uts

9119 am#s ) ith = am#s nominal input from CT secondary'

The #o ) er meter may be applied in three-phase, three or four wire systems'. Residual current shall be calculated by vectorial addition of the phase currents'

\* Fourth CT input shall be available to measure neutral or ground current'

=% Voltage -n#uts

Nominal of <99 D 71A 0 : 19 D 717' " maximum of <89 D 71A 0 868 D 717'

:% Control Point or Device%

The monitoring device control #o ) er shall be

1191<89C 71A ^19 J or 16=16=9 ^ 69 J D C

1191<89 ^19 J, D \* C or 16=16=9 ^ 69 J D C

;% , Environmental Characteristics Operating temperature range

" meter 16= to ;9 PC \$11@ to 1=8 PF%, display 169 to ;9 PC \$1< to 1=8 PF%

" meter and remote display 16= to ;9 PC \$11@ to 1=8 PF%

8% \* Accuracy

The #o ) er meter unit shall use four (quadrant metering' The #o ) er meter shall sample current and voltage simultaneously ) ithout gaps ) ith :< samples per cycle zero blind'

The #o ) er meter device shall comply ) ith \* AS- C16'69 Class 9'= and -, C : 1==;116 Class 9'= for revenue meters'

-, C : 1==;116 Class 9'6 for revenue meters'



Division 26 - Electrical

in each Parameter shall include the following data logs, "in" max log files of selected parameter values, alarm logs for each user defined alarm or event and waveform log. The meters shall offer the following on-board nonvolatile memory: 1'1" 2

The meter shall have onboard memory big enough to log 1< values every 1= minutes for 19 days or 6 values for :9 days'

1@% \* alarming

\* alarm events shall be user definable'

Setpoint driven alarm events shall be available for voltage/current parameters, input status, and end of interval status. For each over/under metered value alarm, the user shall be able to define a hic/low#, dro/out, and delay'

The meter shall have a minimum of 68 setpoint driven alarms, or 61 setpoint driven alarms, < digital alarms, < unary alarms, 19 boolean alarms and = custom alarms'

There shall be four alarm severity levels in order to make it easier for the user to respond to the most important events first'

Historical alarms shall have a time stamping with 1 second accuracy. The meter's real time clock shall be able to synchronize using communications command'

Indication of an alarm condition shall be given on the front panel'

Indication of an alarm condition shall be delivered by email and/or text message. Settings for email/on alarm shall be configurable via the meter web pages'

Indication of an alarm condition shall be delivered by SA "P" Trans. Settings for SA "P" shall be configurable via the meter web pages'

1<% Communications

The meter shall communicate via serial, S1<8= " modbus or Nbus protocol'

The meter shall provide , ethernet communications using " modbus TCP at 190199 " baud using UTP'







Division 26 - Electrical

- Individual harmonics up to the order of 1<sup>st</sup>
- Temperature differential ambient
- Z1 Factor per phase
- Crest Factor per phase

11% Energy Readings

- Accumulated energy real / > h, reactive / D \* h, demand / D \* h  
Signed absolute
- Active energy delivered
- Reactive energy delivered
- Energy Total Consumption for water, air, gas, steam > \* B, S for external meters  
69'

69% Demand Readings

- Demand Current Calculations per phase, @1 phase avg, Neutral Present and Peak

61% Demand Calculations @1 Phase Total

- Real Power
- Reactive Power
- Demand Power

66% All demand calculations shall use any one of the following calculation methods, selectable by the user:

- Thermal demand using a sliding window technique
- 2loc/ interval, with optional subintervals' 2loc/ methods available are Sliding,

Division 26 - Electrical

Fixed and . olling'

- emand can be calculated using a Synchroni4ation signal
- emand can be sync0 . 590251(c) -0 . 957164(h) 55xc nusid d lc lichcl1( ) -5 . 150r7812884 . 1o . 9





Division 26 - Electrical

Flux density shall be )ell belo ) the saturation levels and )ell belo ) the usual level for standard transformers'

Provide a 669PC insulation system )hich is the manufacturer's standard for a maximum 11=PC rise over a <9PC ambient' \* ll insulating materials are to exceed A , " \* ST69 Standards and be rated for 669PC U7

Co 6 8onent 5ecogni;ed ins&lation s\$ste 6 ,

\*verage sound levels shall not exceed the lollo )ing values as measured in accordance )ith A , " \* ST 69<'16'

/D\* . ating d2

911 <9

191=9 <=

=111=9 =9

Division 26 - Electrical

<' Polarity and phase relation tests on the rated voltage connection'

=' \* Applied potential tests

:' -duced potential test

;' Ao1load and excitation current at rated voltage on the rated voltage connection'

## iring Devices

Provide back and side mounted, industrial grade, factory fabricated switching devices in the type and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection to correspond with branch circuit



Division 26 - Electrical

: Time scroll feature shall allow manual overriding of the #reset timeout #period. Selecting time scroll 3 A shall allow timeout #period to scroll u# throughout





Division 26 - Electrical

exposure AS-0, , , C:6'<11111 environments on the load side of the facility's meter or main overcurrent device'

Single pulse surge current capacity 169/ \* per mode of protection for a combined rating of 6<9/ \* per phase' \*ll protected modes are defined per A, " \* 7S 111116, #aragraph 6'6';' Following -, , , Standard 119911116, section 1'11'6 recommendations, surge protection devices shall provide protection in all modes' >K, configured systems shall provide 7ine to1 Aentral \$71A%, 7ine1to1Bround \$71 B%, 7ine1to17ine \$717%, and Aentral1to1Bround \$A1B% protection'

The system shall provide a U7 168@ 7isted , lectromagnetic -nterference Filter capable of attenuating noise levels produced by electromagnetic interference and radio frequency interference' The system's filtering characteristics shall be expressed per A, " \* 7S11, 11116, Section 6'6'11'

, each unit shall be capable of withstanding temporary overvoltage events that may be encountered within the distribution system, without damaging any of the components within the groB





Division 26 - Electrical

Flash event or motor starter fault conditions'

Division 26 - Electrical

- 1' Motion Sensors
  - a' Coverage: 6999 ft<sup>2</sup> field of view @ 9a
  - b' Technology: Ultrasonic combined with Passive Infrared
  - c' Sensor: intelligent self-addressive with non-volatile memory
  - d' All sensor supplies shall be provided above the ceiling
  - e' Installation: ceiling mounted
  
- 6' Lighting Management Panel
  - a' A, " 11, one single cabinet with 11 modules
  - b' Provides relays, dimming, and switching capabilities
  - c' Panel shall be capable to support all types of loads including but not limited to:  
7, 7, dimmed, electronic low voltage transformers, incandescent, halogen,  
fluorescent 919D dimmed, +/- 919D dimmed
  - d' Solid state lighting controls
  - e' 919v dimming capabilities
  - f' , emergency connections
  - g' Universal voltage of operation 169 to 6 ; ; D \* C % = 90 : 9 + 4
  - h' Feed through, or wire main lug @ phase and neutral
  - i' Branch circuits 6911 : amp's continuous rating, 1 < / \*

Division 26 - Electrical

m'

Division 26 - Electrical

1' Typical Lighting Control "aster Panel shall meet the following standards:

1' UL Listed

6' FCC Part 15

1'



Division 26 - Electrical

- d' Shall be capable for 618 independently programmable buttons per station'
- e' 2ac/lit buttons
- f' Status 7, indicators'
- g' > all plate and face plate shall be in at least 4 colors and easy to customize'
- h' Supply voltage 120 V 60 Hz
- i' Environment 61°F to 95°F
- j' Relative humidity less than 95% non condensing
- k' Communications through RJ45 connector and twisted pair conductors for Ethernet'

Contractor shall provide all related components for controls'

\* Additional control devices necessary to achieve daylight harvesting and other types of lighting  
Control as indicated on \* S+ . \* , 16916 and/or - , CC 691=, shall be provided by engineer!

622

Division 26 - Electrical

8' 7ens UC stabilized extruded polycarbonate'

1' 7, driver at @=99Z and X86 C . -'

19' Protected life 7; 9 at ; =,999 hours at =9aC

11' >arranty 19 years'

16' 7istings U7, > et listed'

1@' 3#erating voltages 16916 ; ; D \* C'

1<' Provide battery #ac/ 196=116=9 Im sel! contained ) ith 19 minutes at 91==aC

1=' The luminaire shall be vandal resistance'

Contractor shall #rovide luminaires in ar/ 2ron4e !nish or as indicated by , ngineer0\* rchitect'

## Exterior Lighting

This section includes exterior luminaires ) ith lam#s and ballasts, luminaire!mounted photoelectric relays, exterior ) ireless controls, and #oles and accessories'

esign all lighting using - , SA \* \$-Illuminating , ngineering Society o! Aorth \*merica%' \* ##ly the information !rom - , SA \* . ecommended Practice, esign Buide and +andboo/ #ublications'

-Illumination levels ) ill be determined in design meeting ) ith the Project Team based on tas/ and other criteria' \* ##ly the lighting distributions set out in the ar/ S/y -nternational guidelines to minimi4e s/y glo ) '

, xterior lighting to be 7 , unless noted other ) ise'

esign should have limited ) all #ac/s'

Derily normal o#eration o! lighting units alter installing luminaires and energi4ing circuits ) ith normal #o ) er source'

Division 26 - Electrical

" Measure light intensities at night' Use photometers )ith calibration referenced to A-ST standards' Comply )ith the -, SA \* testing guide\$% !or the applicable lighted tas/'

Prepare a )ritten report of tests, inspections, obs

Division 26 - Electrical

1' Poles shall be furnished for every 199' of each type and rating installed. Furnish at least one of each

2' Bases and Brackets shall be furnished for every 199' of each type and rating installed. Furnish at least one of each type

General Requirements for Poles and Support Components

1' Structural Characteristics: Comply with ASTM A36/A36M

2' Wind Load Strength of Poles: Determine at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 199 mph, with a gust factor of 1.0

3' Coatings, Fasteners, and Accessories: Corrosion-resistant items compatible with support components

4' Concrete Pole Foundations: Cast in place, with anchor bolts to match pole base. Reinforcement, and formwork are specified in Section 05

a' Bases installed in parking lots in curbed planters that prevent vehicle contact shall be set at 4" above the curb height

b' Bases installed in parking lots that are subject to vehicle contact shall be set 6" above the pavement

c' Bases installed adjacent to sidewalk shall be set flush against the sidewalk and 4" above the edge of the sidewalk

Steel Poles

1' Poles: Round, tapered. Comply with ASTM A572/A572M, Grade 50, carbon steel with a minimum yield of 50,000 psi. Single-piece construction up to 100 feet in height with access handhole in pole. All Poles shall be bolted to a concrete foundation

2' Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate

Division 26 - Electrical

- " Material and finish same as #ole'
- @' 2rac/ets !or 7uminaires@ detachable, cantilever, ) ithout underbrace@ match #ole finish and material'
- <' Pole!To# Tenons@ Fabricated to su##ort luminaire or luminaires and brac/ets indicated, and securely !astened to #ole to#'
- = ' Brounding and 2onding 7ugs@ > elded 1061inch threaded lug, com#lyng ) ith re(uirements in Standard !or MBrounding and 2onding,M listed !or attaching grounding and bonding conductors o! ty#e and si4e listed in that Standard, and \*ccessible through handhole'
- : ' Po) der!Painted Finish@ Com#ly ) ith A \* \* " " ?s M " etal Finishes " anual !or \*rchitectural and " etal ProductsM !or recommendations !or a##lyng and designating !inishes'
  - a' Sur!ace Pre#aration@ Clean sur!aces to com#ly ) ith SSPC1SP 1, MSolvent Cleaning,M to remove dirt, oil, grease, and other contaminants that could im#air #aint bond' Brind ) elds and #olish sur!aces to a smooth, even !inish' . emove mill scale and rust, il #resent, !rom uncoated steel, com#lyng ) ith SSPC1SP =0A \* C , Ao' 1, M > hite " etal 2last Cleaning,M or SSPC1SP 8, MPic/ling'M
  - b' -nterior Sur!aces o! Pole@ 3ne coat o! bituminous #aint, or other ) ise treat !or e(ual corrosion #rotection'
  - c' , xterior Sur!aces@ " anu!acturer's standard !inish consisting o! one or more coats o! #rimer and t ) o !inish coats o! Sher ) in > illiams E ar/ 2ron4eF 3ther " anu!acturers ) ith a dar/ bron4e !inish as standard shall submit a color sam#le o! <F s(uare on similar materials as the construction o! the #ole !or TTU to determine an acce#table match to the standard'

7l&6 in&6 8oles to !e \*/! al&6 in&6 6 ro&nd ta8ered with 8edestal !ase !olted to concrete fo&ndation 6 an&fact&red !\$#

Division 26 - Electrical

1' Lexington Standard Corporation

6' +a#co 7ighting Com#any

@' Dalmont #oles'

Cast concrete poles to be embedded in tamped earth or embedded in concrete

1' Gasau Tile Terraform Division, Gasau, Texas

6' Custom Design Precast Division, Gasau, Texas

@' Stone Legends

6.1.1.1 Poles and Equipment

1' Pole for 1' Lexington round tapered aluminum pole

) with doublet

a' 7umec c 01<19961:=><67, <Z1.1\*C1.7,=16;;1SFO@1DP\*12.TH1  
7" S1@6;92

) without doublet

b' 7umec c 01<19961:=><67, <Z1.1\*C1.7,=16;;1SFO@1DP\*12.TH1  
7" S1@6;9

c' Zing Aluminaire c Z<6813 \*\* .1D1;=\$SS7%1=99916;;1Z@11TTS1HPB

\_ add doublet ) when required

Note: The doublet shall only be used on TTU Athletic Facilities'

6' Pole for TTU concrete Tilt Pole

) with doublet

a' 7umec c 0<;\*19961:=><67, <Z1.1\*C1.7,=16;;1SFO<1TA@1DP\*12.TH1

Division 26 - Electrical

7 " S1@6182

Division 26 - Electrical

3#eration and control 1991<89 D\*C, 1999 ) att

Pea/ #o ) er use by nodes shall be less than t ) o \$6% ) atts'



Division 26 - Electrical

" anagement'

, lectrical Contractor ) ill #rovide the #ole number !rom item 1 ; ) ith the node serial number to the 3!!ice o! , nergy " anagement to enable adding the nodes into the 7ume ) ave system'

\*ll externally mounted nodes are to be rated !or 1991<89 D\*C, =90:9 +4'  
\$T3PI99T7H1<89 ) ith A , " \* \*AS- 1@:'<1 ; 1 #in connector%'

7ume ) ave T3PI99 Series; T3PI99T7H ) ith A , " \* \*AS- 1@:'<1 ;1#in connector; T3PI99TA ) ith threaded ni##le connection'

7ume ) ave system is already de#loyed in Texas Tech Cam#us, and all #arts and com#onents shall be com#atible ) ith existing' 3ther manufacturers ) ill be consider by , ngeiner'

Bollards

7, , @6F height, :F rounds, dar/ bron4e !inish, ) ith louvers on to#' The body shall be extruded aluminum ) ith a heavy cast aluminum base' The internal globe is !luted, clear tem#ered glas590251(e)0 . 5902 ablo en ) tThe 'ii,g te(h)0 . 590251(e)0 . 590cT\* [ (7)0 .

Division 26 - Electrical

Photoelectric Control#



a' \*verage W 69 V @9 !oot1candles'

b' Uni!ormity ratio \$ " ax0 " in% not to exceed :61'

c' > or/ing height W !inished !loor \$4ero inches%'

= ' Corridors and Stairs6

a' " inimum W 19 !oot1candles'

b' Uni!ormity ratio \$ " ax0 " in% not to exceed 1961'

: ' , mergency egress lighting along corridors, stairs, and other egress #aths as designated by  
\*rchitect6

a' " inimum W 1 !oot1candle'

b' Uni!ormity ratio \$ " ax0 " in% not to exceed 1961'

c' > or/ing height W !inished !loor \$4ero inches%'

; ' " echanical .ooms, , lectrical .ooms, and , levator , (ui#ment .ooms6

a' " inimum W 69 !oot1candles'

b' Uni!ormity ratio \$ " ax0 " in% not to exceed :61'

c' > or/ing height W !inished !loor \$4ero inches%'

d' ata0Telecommunications 0-TW @9 !oot1candles'

e' Uni!ormity ratio \$ " ax0 " in% not to exceed =61'

!' > or/ing height W @9 inches above !inished !loor'

8' Storage .ooms'

a' \*verage W 1= !oot1candles'

b' > or/ing height W @9 inches above !inished !loor'



acceptable', exit signs shall have stencil face with 1/2 inch high letters. Provide red letters with smooth

diffusion face, unless otherwise indicated or scheduled. Individual 7, 's shall not be visible through the diffusion material. Provide directional arrows as indicated. Provide exit signs with battery back/UPS'

Battery shall be a maintenance free lead/calcium or nickel/cadmium, < to 12 volt, with 1 hour minimum capacity to supply connected lamp load. Where larger capacity is indicated on plans or schedules, provide unit with larger capacity. Exit signs shall be compliant with UL 924, NFPA 70, NEC, and Energy Star'

Provide enclosed, mechanically held, latching, magnetic lighting contactor designed to withstand the large initial inrush current of tungsten and ballast lamp loads as well as non-motor resistive loads without contact welding'

Install luminaires in accordance with the manufacturer's instructions'



