CITY OF Goodyear Approved 07/01/21 21-2119 - VIP PRODUCTS

ELECTRICAL SYMBOL LEGEND

SOME SYMBOLS AND ABBREVIATIONS MAY NOT BE USED FOR THIS PROJECT.

A. GENERAL

- JUNCTION BOX (4" SQUARE MINIMUM)
- INDICATES HOMERUN.
- CIRCUIT CONDUCTORS. LONG DASH INDICATES NEUTRAL CONDUCTOR, SHORT DASH INDICATES PHASE CONDUCTORS. CODE SIZED EQUIPMENT GROUND NOT INDICATED BUT REQUIRED.
- ISOLATED GROUNDING CONDUCTOR. GREEN, INSULATED WITH YELLOW STRIPE.
- GROUNDING CONDUCTOR. GREEN, INSULATED, SIZE PER PLAN.
- SURFACE PANELBOARD
- FLUSH PANELBOARD
- TRANSFORMER. (KVA SIZE AS NOTED). GROUNDING SYSTEM TO BUILDING STEEL (IF APPLICABLE).
- CONDUIT STUB-UP ABOVE CEILING
- CONDUIT STUB-DOWN TO FLOOR BELOW
- CONDUIT IN UNDERGROUND/SLAB
- CONDUIT STUB-UP WITH CAP
- CONDUIT SEAL-OFF
- FLEXIBLE CONDUIT. PROVIDE LIQUID TIGHT FLEX IN WET OR EXTERIOR LOCATIONS AND AT CONNECTIONS TO VIBRATING EQUIPMENT AND/OR TRANSFORMERS.
- CONDUIT CONCEALED IN WALLS OR ABOVE CEILING.

B. POWER

- 20A SPEC GRADE SINGLE RECEPTACLE MOUNTED AT +15" TO BOTTOM OR AS NOTED
- 20A SPEC GRADE DUPLEX RECEPTACLE MOUNTED AT +15" TO BOTTOM OR AS NOTED
- 20A SPEC GRADE FOURPLEX RECEPTACLE MOUNTED AT +15" TO BOTTOM OR AS NOTED
- 20A SPEC GRADE DUPLEX CONVENIENCE OUTLET MOUNTED ABOVE COUNTER. VERIFY EXACT HEIGHT WITH ARCHITECTURAL ELEVATIONS.
- 20A SPEC GRADE FOURPLEX CONVENIENCE OUTLET MOUNTED ABOVE COUNTER. VERIFY EXACT HEIGHT WITH ARCHITECTURAL ELEVATIONS.
- SPECIAL OUTLET AS NOTED ON DRAWINGS – VERIFY NEMA RATING BEFORE INSTALLATION
- X – SPECIAL OUTLET AS NOTED ON DRAWINGS

  X =
  C – MOUNTED IN CEILING
  DW – DISHWASHER
  MW – MICROWAVE
  P – PEDISTAL MOUNTED
  PD – PEDIATRIC SAFE
  RF – REFRIGERATOR
  SD – SINK DISPOSAL. PROVIDE SWITCH ABOVE COUNTER.
  UCR – UNDERCOUNTER REFRIGERATOR
  VM – VENDING MACHINE
- IG – ISOLATED GROUNDING OUTLET AT +15" TO BOTTOM OR AS NOTED. "LEVITON" #5362-IG (ORANGE) RECEPTACLE WITH ISOLATED GROUND.
- 20A SPEC GRADE HALF SWITCHED DUPLEX RECEPTACLE AT +15" TO BOTTOM OR AS NOTED.
- DUAL COMPARTMENT POWER/TELE DATA POLE
- FLUSH FLOOR POWER OUTLET – WITH 20A SPEC GRADE RECEPTACLES DUPLEX OR FOURPLEX. HUBBELL, THOMAS & BETTS, CARLON OR EQUAL. RATED FOR SCRUB WATER.
- 20A SPEC GRADE GFCI DUPLEX RECEPTACLE AT +15" TO BOTTOM OR AS NOTED.
- 20A SPEC GRADE GFCI DUPLEX RECEPTACLE AT +6" ABOVE COUNTER TO BOTTOM OR AS NOTED.
- DROP CORD POWER OUTLET – WITH 20A SPEC GRADE RECEPTACLES DUPLEX OR FOURPLEX. HUBBELL, THOMAS & BETTS, CARLON OR EQUAL.
- "J" BOX FLUSH MOUNTED IN WALL FOR SYSTEMS FURNITURE POWER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH SUPPLIER PRIOR TO ROUGH-IN. ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR FINAL CONNECTION TO SYSTEM FURNITURE.
- WIRE MOLD. LENGTH AND TYPE AS NOTED ON DRAWINGS. MOUNT AS NOTED ON THE DRAWINGS.

C. COMMUNICATIONS

- FLUSH FLOOR COMBINATION TELEPHONE/DATA OUTLET – PROVIDE 1" MIN CONDUIT TO ABOVE ACCESSIBLE CEILING. HUBBELL, THOMAS & BETTS, CARLON OR EQUAL. RATED FOR SCRUB WATER.
- DATA OUTLET AT +15" A.F.F. TO BOTTOM OF WALL FIXTURE OR AS NOTED. PROVIDE 3/4" CONDUIT STUBBED TO +4" ABOVE FINISHED CEILING.
- X – TELEPHONE OUTLET AT +15" A.F.F. TO BOTTOM OF WALL FIXTURES OR AS NOTED. PROVIDE 3/4" CONDUIT STUBBED TO +4" ABOVE FINISHED CEILING OR AS NOTED:

  X=
  P – PAY PHONE
  W – WALL PHONE OUTLET MOUNTED AT +44" A.F.F.
- COMBINATION TELEPHONE/DATA OUTLET AT +15" A.F.F. TO BOTTOM OF WALL FIXTURES OR AS NOTED. PROVIDE 3/4"C. STUBBED TO +4" ABOVE FINISHED CEILING.
- DIGITAL CABLE TELEVISION OUTLET
- TV – TELEVISION OUTLET WITH DEVICES
- "J" BOX FLUSH MOUNTED IN WALL FOR SYSTEMS FURNITURE TELE/DATA WITH 1-1/4" EMPTY CONDUIT STUBBED ABOVE CEILING. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH SUPPLIER PRIOR TO ROUGH-IN. ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR FINAL CONNECTION TO SYSTEM FURNITURE.
- TELEPHONE TERMINAL BOARD "TMB". 3/4" PLYWOOD TELEPHONE MOUNTING BOARD WITH #6 COPPER GROUND & DEDICATED FOURPLEX CONVENIENCE OUTLET. FURNISH IN ACCORDANCE WITH TELEPHONE COMPANY'S REQUIREMENTS. SIZE AS NOTED ON DRAWINGS. PLYWOOD SHALL BE TYPE "CDX".

D. LIGHTING

- \$L – STANDARD SWITCH AND COVER PLATE WITH LOCKING DEVICE (BRADY NO. 2AF98 OR EQUAL)
- \$ – SINGLE POLE SWITCH MOUNTED AT +44" TO CENTER OF DEVICE OR AS NOTED.
- \$2 – TWO POLE SWITCH MOUNTED AT +44" TO CENTER OF DEVICE OR AS NOTED.
- \$3 – THREE WAY SWITCH MOUNTED AT +44" TO CENTER OF DEVICE OR AS NOTED.
- \$4 – FOUR WAY SWITCH MOUNTED AT +44" TO CENTER OF DEVICE OR AS NOTED.
- \$P – SINGLE POLE SWITCH WITH PILOT LIGHT AT +44" TO CENTER OF DEVICE OR AS NOTED.
- \$D – 2000W SLIDE CONTROL DIMMER AT AT +44" TO CENTER OF DEVICE OR AS NOTED.
- \$K – SWITCH KEY OPERATED MTD AT +44" TO CENTER OF DEVICE OR AS NOTED.
- LV \$D – LOW VOLTAGE SLIDE CONTROL DIMMER WITH PRESET AT +44". CONTRACTOR SHALL SUPPLY SPECIFIC (ELECTRONIC AND/OR MAGNETIC) TO SUIT LOADS.
- \$OS – WALL MOUNTED OCCUPANCY SENSOR. LUTRON-DUAL TECHNOLOGY OR EQUAL. IN RESTROOMS: LUTRON-ULTRASONIC. PROGRAM: MANUAL ON/AUTO OFF UNLESS NOTED OTHERWISE.
- \$UD – SINGLE POLE UP-OFF-DOWN SWITCH FOR CONTROL OF PROJECTION SCREEN. MOUNTED AT +44" TO CENTER OF DEVICE OR AS NOTED.
- LOW VOLTAGE PUSH BUTTON CONTROL STATION AS NOTED. VERIFY MOUNTING HEIGHT.
- PC – ROOF MOUNTED PHOTOCELL (AIM NORTH) INTERMATIC #K1121.
- TS – ASTRONOMIC ELECTRONIC 4 POLE LIGHTING TIMESWITCH, INTERMATIC #ET70415CR.
- OS – CEILING MOUNTED OCCUPANCY SENSOR 360°. LUTRON-DUAL TECHNOLOGY OR EQUAL. IN RESTROOMS: LUTRON-ULTRASONIC. IN WAREHOUSE: LUTRON-HIGHBAY. (WR) WIDE ANGLE (LR) LONG RANGE.
- VS – WALL/CEILING MOUNTED DUAL TECHNOLOGY OCCUPANCY SENSOR SHALL BE PROGRAMMED AS VACANCY SENSOR. MANUAL ON/AUTO OFF.
- PP – OCCUPANCY SENSOR – POWER PACK OR SLAVE PACK.
- FLUORESCENT STRIP LIGHTING FIXTURE – AS NOTED ON DRAWINGS.
- FLUORESCENT LIGHTING FIXTURE – AS NOTED ON DRAWINGS SURFACE MOUNTED.
- J – RECESSED GRID W/FLEXIBLE CONNECTION.
- INDICATES NIGHTLIGHT (NL) AND/OR EMERGENCY FIXTURE WITH 1400 LUMEN MINIMUM (UNSWITCHED) – AS NOTED ON DRAWING.
- WALL MOUNTED LIGHTING FIXTURE – AS NOTED ON DRAWINGS.
- CEILING MOUNTED LIGHTING FIXTURE – AS NOTE ON DRAWINGS.
- H.I.D. HIGH/LOW BAY FIXTURE
- WALL WASH LIGHTING FIXTURE. AIM AS DIRECTED BY ARCHITECT.
- TRACK LIGHTING SYSTEM WITH TRACK FIXTURE HEADS AS INDICATED ON PLANS. VERIFY TYPE LINE OR LOW VOLTAGE.
- POLE MOUNTED AREA LIGHT (ARM MOUNTED) VERIFY HEIGHT SEE POLE DETAIL.
- POLE MOUNTED AREA LIGHT (POST TOP) VERIFY HEIGHT SEE POLE DETAIL.
- WALL PACK.
- SINGLE FACE EXIT SIGN, SEE LIGHTING FIXTURE SCHEDULE FOR SPECIFICATION. DIRECTIONAL ARROW AS INDICATED ON PLANS (CEILING OR WALL.)
- COMBINATION EMERGENCY EXIT SIGN WITH DUAL HEAD LIGHTS WITH EMERGENCY BATTERY BACK-UP.

D. LIGHTING CONTINUED

- DOUBLE FACE EXIT SIGN. SEE LIGHTING FIXTURE SCHEDULE FOR SPECIFICATION. DIRECTIONAL ARROW AS INDICATED ON PLANS (CEILING OR WALL)
- DUAL HEAD EMERGENCY BATTERY PACK, SEE LIGHTING FIXTURE SCHEDULE FOR SPECIFICATIONS.

E. MECHANICAL

- CONTACTOR – FURNISHED AND INSTALL BY OTHERS
- CONTACTOR – FURNISHED/INSTALLED BY ELECTRICAL CONTRACTOR SIZE AS NOTED
- MOTOR STARTER/CONTROLLER– FURNISHED WITH MOTOR.
- MOTOR STARTER/CONTROLLER – FURNISHED/INSTALLED BY ELECTRICAL CONTRACTOR.
- MOTOR – SIZE AS INDICATED ON DRAWINGS.
- DISCONNECT SWITCH – SIZE AND FUSES AS PER MANUFACTURER'S RECOMMENDATIONS (WEATHERPROOF WHERE OUTSIDE). N.F. INDICATES NON-FUSED.
- COMBINATION FUSIBLE DISCONNECT/MOTOR CONTROLLER – 30/3P WITH MIN. SIZE 1 MAGNETIC STARTER (UNLESS NOTED OTHERWISE). PROVIDE FUSES PER MANUFACTURER'S REQUIREMENTS. N.F. INDICATES NON-FUSED.
- \$M – HORSEPOWER RATED MANUAL MOTOR STARTER WITH THERMAL OVERLOAD(S). OVERLOAD HEATERS TO BE SIZED PER HORSEPOWER AND MANUFACTURER'S REQUIREMENTS.

F. FIRE ALARM

- F – FIRE ALARM PULL STATION AT +48".
- FIRE ALARM STROBE: +80" AFF OR 6" BELOW CEILING, WHICHEVER IS LOWER.
- FIRE ALARM HORN/STROBE: +80" AFF OR 6" BELOW CEILING, WHICHEVER IS LOWER.
- D – FIRE ALARM MAGNETIC DOOR HOLDER
- B – FIRE ALARM BELL
- FAAP – FIRE ALARM ANNUNCIATOR PANEL
- FACP – FIRE ALARM CONTROL PANEL
- H – FIRE ALARM HEAT DETECTOR.
- S – FIRE ALARM SMOKE DETECTOR.
- D – FIRE ALARM DUCT SMOKE DETECTOR.
- CO – CARBON MONOXIDE DETECTOR.
- T – FIRE ALARM TAMPER SWITCH.
- F – FIRE ALARM FLOW SWITCH.
- S – SPEAKER.

G. ONE LINE DIAGRAM

- M – (M) METER, (S) SOCKET, (B) BLANK
- M – (M) METER, (S) SOCKET, (B) BLANK, WITH CURRENT TRANSFORMERS.
- BREAKER AS INDICATED.
- FUSED SWITCH.
- BREAKER WITH SHUNT TRIP (SIZE AS INDICATED)
- PULLOUT FUSE

H. SECURITY

- CR – LOW VOLTAGE CARD READER
- KP – LOW VOLTAGE KEYPAD
- SURVEILLANCE CAMERA

I. ABBREVIATIONS

A	AMPERE
AIC	AVAILABLE INTERRUPTING CURRENT
AI	ALUMINUM
AFC	AVAILABLE FAULT CURRENT
AFCI	ARC FAULT CIRCUIT INTERRUPTER
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AH	AIR HANDLER UNIT
APS	ARIZONA PUBLIC SERVICE – (UTILITY CO.)
C	CONDUIT
CCT	CORRECTED COLOR TEMP.
CRI	COLOR RENDERING INDEX
CU	COPPER
D	DEDICATED
DP	DUST – IGNITION PROOF
E	EXISTING
EC	EMPTY CONDUIT
EDF	ELECTRIC DRINKING FOUNTAIN
EF	EXHAUST FAN
EG	EQUIPMENT GROUND
EM	EMERGENCY LIGHT. BYPASS LOCAL SWITCHING AND PROVIDED BATTERY PACK.
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GFP	GROUND FAULT PROTECTION
GND	GROUND/BOND CONDUCTOR
GWH	GAS WATER HEATER
IAW	IN ACCORDANCE WITH
IG	ISOLATED GROUND
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MLO	MAIN LUG ONLY
N	NEW ITEM
NR	NEW LOCATION OF RELOCATED EXISTING ITEM
NL	NIGHT LIGHT. BYPASS LOCAL SWITCHING.
PNL	PANELBOARD
R	EXISTING TO BE RELOCATED
SES	SERVICE ENTRANCE SECTION
SRP	SALT RIVER PROJECT – (UTILITY CO.)
SWBD	SWITCHBOARD
TEP	TUCSON ELECTRONIC POWER
TMB	3/4" PLYWOOD TELEPHONE MOUNTING BOARD WITH #6 CU. SOLID GROUND.
TTC	TELEPHONE TERMINAL CABINET (SIZE INDICATED ON DRAWINGS)
UFER	CONCRETE ENCASED ELECTRODE
UG	UNDERGROUND
UNO	UNLESS NOTED OTHERWISE
VA	VOLT AMPERES
W	WATT
WG	WIRE GUARD
WH	WATER HEATER
WP	WEATHERPROOF (RAIN TIGHT) WEATHER RESISTANT NEMA 3R OR NEMA 4 IN-USE
WR	WEATHER RESISTANT
X	EXISTING TO BE REMOVED
XP	EXPLOSION PROOF

ELECTRICAL SPECIFICATIONS

UPDATED: 09-09-2014

SOME SPECIFICATIONS MAY NOT BE USED FOR THIS PROJECT.

1.0 INTENT

1.1 FURNISH AND INSTALL A COMPLETE AND OPERATIONAL ELECTRICAL SYSTEM IN ACCORDANCE WITH PLANS AND SPECIFICATIONS.

1.2 ALL DRAWINGS ARE SCHEMATIC IN NATURE AND THE REQUIRED INSTALLATION IS NOT LIMITED TO WHAT IS SHOWN. ALL APPURTENANCES NECESSARY TO PROVIDE A COMPLETE AND OPERATIONAL SYSTEM MUST BE INCLUDED IN THE CONTRACTORS BID AND WORK.

2.0 GENERAL

2.1 THE CONTRACTOR SHALL VISIT THE JOB SITE AND FAMILIARIZE HIMSELF WITH ALL EXISTING CONDITIONS WHICH MAY AFFECT HIS BID OR WORK. NO ALLOWANCES WILL BE MADE FOR EXISTING CONDITIONS OR THE CONTRACTORS FAILURE TO ACCOMMODATE EXISTING CONDITIONS ON HIS BID.

2.2 IT IS THE CONTRACTORS RESPONSIBILITY TO OBTAIN CLARIFICATION OF ANY APPARENT CONFLICT OR INCONSISTENCY IN THE DRAWINGS, SPECIFICATION, OR DESIGN, PRIOR TO HIS BID AND IN WRITING WITH THE ENGINEER. OTHERWISE THE CONTRACTOR ACCEPTS RESPONSIBILITY TO CORRECT (AT HIS COST) ANY SUCH ITEMS TO MEET THE INTENT AS INTERPRETED BY THE ENGINEER.

2.3 ALL MATERIAL AND WORKMANSHIP SHALL CONFORM TO THE MOST RECENT ADOPTED EDITIONS OF THE NFPA, NATIONAL ELECTRIC CODE, IBC, APPLICABLE CITY AND STATE CODES AND ORDINANCES, THE AMERICANS WITH DISABILITIES ACT, E.P.A. REGULATIONS (INCLUDING EPACT 1992), INTERNATIONAL ENERGY CONSERVATION CODE (IECC)/TITLE 24/ASHRAE 90.1 AND UTILITY COMPANY REQUIREMENTS. THE FOREGOING CODES AND REGULATIONS ARE REQUIREMENTS AND ARE INCORPORATED IN THIS SPECIFICATION FOR THIS WORK BY REFERENCE.

2.4 THE CONTRACTOR SHALL COORDINATE AND PROVIDE INFORMATION AS REQUIRED TO ALL SERVING UTILITIES IN A TIMELY MANNER AS NECESSARY TO PROVIDE THE SERVICE REQUIRED AND MEET UTILITY REQUIREMENTS. IMMEDIATE COORDINATION WILL BE REQUIRED FOR MOST PROJECTS. FIELD COORDINATE ALL REQUIREMENTS WITH UTILITY Co. PRIOR TO TRENCHING.

2.5 REFER TO ARCHITECTURAL, MECHANICAL, CIVIL, STRUCTURAL, AND/OR EQUIPMENT SUPPLIERS DRAWINGS AND SPECIFICATIONS FOR EXACT EQUIPMENT LOCATIONS, LOADS AND ADDITIONAL REQUIREMENTS. REPRESENTATIONS OF THE WORK SPECIFIC TO THE OTHER DISCIPLINES IS SHOWN ON THE ELECTRICAL DRAWINGS FOR CLARITY ONLY.

2.6 THE CONTRACTOR ASSUMES RESPONSIBILITY FOR ALL EQUIPMENT HE SUPPLIES. ALL EQUIPMENT SHALL BE INSTALLED STRICTLY PER MANUFACTURERS RECOMMENDATIONS. OTHERWISE THE CONTRACTOR ASSUMES RESPONSIBILITY (AT HIS COST) TO CORRECT AND REMEDY ANY INSTALLATION NOT IN COMPLIANCE WITH THE MANUFACTURES RECOMMENDATIONS AND INTENTIONS AS INTERPRETED BY THE ENGINEER.

2.7 ANY VARIANCE OR EXCEPTIONS TO THE DRAWINGS AND SPECIFICATIONS MUST BE REQUESTED AND APPROVED IN WRITING. INTERIM VERBAL APPROVALS WILL ONLY BE PROVIDED WHEN THE ENGINEER DETERMINES THIS TO BE JUSTIFIED AND MUST BE CONFIRMED IN WRITING TO BE FINAL.

2.8 THE CONTRACTOR IS RESPONSIBLE TO OBTAIN ALL NECESSARY PERMITS, VARIANCES, AND APPROVALS, ETC. (AT HIS COST) WHICH MAY BE REQUIRED FOR COMPLETION OF THIS WORK.

2.9 PRIOR TO ROUGH-IN, THE ELECTRICAL CONTRACTOR SHALL COORDINATE THE EXACT LOCATION OF ALL LIGHT FIXTURES AND WIRING DEVICES: TO INCLUDE MOUNTING HEIGHT AND LOCATIONS WITH ARCHITECT/OWNER. ALL CONFLICTS SHALL BE REPORTED TO THE ENGINEER/ARCHITECT.

2.10 THE ELECTRICAL CONTRACTOR SHALL PROVIDE EQUIPMENT AND SUPPORT FOR PROGRESS AND FINAL INSPECTIONS. THIS INCLUDES COMPLETE ACCESS TO ALL EQUIPMENT. ADDITIONALLY A COMPLETE SET OF SPARE FUSES FOR ALL FUSES USED AND A 5% SUPPLY OF ALL LIGHT BULBS PROVIDED IN FIXTURES (TO A MAXIMUM OF 15 FOR EACH STYLE) SHALL BE PROVIDED TO THE OWNER AT FINAL INSPECTION.

2.11 RECONSTRUCTION (TO INCLUDE TENANT IMPROVEMENTS). ALL RECONSTRUCTION OF EXISTING FACILITIES AND EQUIPMENT SHALL REQUIRE COMPLETE RENOVATION (MAKE GOOD AS NEW) FOR ALL EXISTING EQUIPMENT UPON WHICH WORK IS PERFORMED OR EQUIPMENT WHICH IS AFFECTED BY THE WORK PERFORMED. THIS WILL INCLUDE THESE FOLLOWING REQUIREMENTS:
2.11.1 VERIFICATION OF EXISTING SES COMPLIANCE WITH NEC "GROUNDING" ARTICLES.
2.11.2 VERIFICATION OF CABLE SIZE AND AMPACITY OF EXISTING FEEDERS AND BRANCH CIRCUITS WITH NEC TABLES.
2.11.3 EXISTING LIGHT FIXTURES TO BE REUSED MUST BE CLEANED, RE-LAMPED, AND RESTORED TO "LIKE NEW" CONDITION.
2.11.4 EXISTING PANEL BOARDS, SWITCH BOARDS, AND TRANSFORMERS WHICH ARE INCLUDED IN THE PROJECT WORK SHALL HAVE PREVENTATIVE MAINTENANCE PERFORMED TO INCLUDE RE-TORQUING OF ALL LUGS, CLEANING AND INSPECTION.
2.11.5 VERIFY PROPER WORKING CONDITION OF ALL EXISTING EMERGENCY FIXTURES AND EXIT SIGNS. REPAIR OR REPLACE AS REQUIRED.

IN THE EVENT THAT INSPECTION REVEALS DISCREPANCIES AND/OR NONCOMPLIANCE THE OWNER AND THE ENGINEER SHALL BE NOTIFIED IN WRITING, AND EQUIPMENT BROUGHT INTO COMPLIANCE.

3.0 MATERIALS AND METHODS

3.1 THE USE OF **EMT** IS ACCEPTABLE IN ACCORDANCE WITH NEC ARTICLE "ELECTRICAL METALLIC TUBING". EMT SHALL NOT BE USED WHERE IT IS SUBJECT TO SEVERE PHYSICAL DAMAGE. EMT FITTINGS SHALL BE COMPRESSION TYPE. MINIMUM TRADE CONDUIT SIZE IS 1/2" AND 3/4" FOR HOME RUNS.

3.2 **CONDUCTORS** SHALL BE 600V COPPER (98 % CONDUCTIVITY). MINIMUM LINE VOLTAGE WIRE SIZE IS #12 A.W.G. #6 AND SMALLER SHALL HAVE THHN/THWN INSULATION. #4 AND LARGER SHALL HAVE XHHW/XHHW-2 INSULATION. ALL CONDUCTORS SHALL HAVE 90° RATED INSULATION. ALL 120V, 20A BRANCH CIRCUIT CONDUCTORS (#12) OVER 100' IN LENGTH TO BE #10'S MINIMUM. ALL 277V, 20A BRANCH CIRCUIT CONDUCTORS (#12) OVER 200' IN LENGTH TO BE #10'S MINIMUM.

3.3 WHEN SEPARATE BRANCH CIRCUIT NEUTRAL CONDUCTORS ARE USED WITH EACH PHASE CONDUCTOR OR SYSTEMS FURNITURE IS INDICATED, THE MINIMUM NEUTRAL CONDUCTOR SIZE SHALL BE #10 A.W.G. STRANDED COPPER.

3.4 ALL WIRING DEVICES SHALL BE SPECIFICATION GRADE. (MINIMUM 20 AMPS RATED FOR RECEPTACLES AND SWITCHES). HUBBELL, PASS & SEYMOUR, BRYANT, OR LEVITON ARE ACCEPTABLE. ALL SPECIAL RECEPTACLES AND GROUND FAULT PROTECTION DEVICES MUST BE PERMANENTLY MARKED WITH ENGRAVED COVER PLATES. INDICATE USE AND CIRCUIT NUMBER.

3.5 COVER PLATES AND DEVICES SHALL BE PHENOLIC PLASTIC (WHITE OR COLOR SELECTED BY ARCHITECT) IN OFFICE/COMMERCIAL/OR LIVING AREAS, AND GALVANIZED STEEL IN WAREHOUSE/INDUSTRIAL/MANUFACTURING AREAS OR AREAS SUBJECT TO PHYSICAL ABUSE.

3.6 ALL CONDUCTORS TO BE CONCEALED EXCEPT TO SURFACE MOUNTED PANELS AND AT THE CEILING OF EXPOSED STRUCTURE AREAS. CONDUITS WILL BE RUN PARALLEL OR PERPENDICULAR TO BUILDING LINES.

3.7 FLEXIBLE METAL CONDUIT (SEAL TITE FOR EXTERIOR APPLICATIONS) SHALL BE USED FOR CONNECTIONS TO EQUIPMENT SUBJECT TO VIBRATION (E.G. MOTORS) WITH A MAX. OF 6ft.

3.8 THE USE OF **MC CABLE** IS ACCEPTABLE (UPON OWNER NOTIFICATION AND APPROVAL) AND MAY BE USED IN ACCORDANCE WITH NEC ARTICLE "METAL-CLAD CABLE: TYPE MC", BUT LIMITED TO USE FOR CONCEALED BRANCH CIRCUITS ONLY, ADDITIONALLY MC CABLE MAY NOT BE USED FOR HOME RUNS OR OUTDOORS.

3.9 NON-METALLIC CONDUIT (MIN. SCHEDULE 40) MAY BE USED ONLY IN OR UNDER SLABS & IN CONCRETE OR MASONRY WALLS. MIN. 24" COVER REQUIRED FOR UNDERGROUND USE.

3.10 **FUSES** SHALL BE BUSSMAN, LITTLEFUSE, OR GOULD SHAWMUT.

3.11 CONDUCTORS WILL BE SOLID AND/OR STRANDED WITH INSULATION CONTINUOUSLY COLOR COATED UP TO AND INCLUDING SIZE #6 A.W.G. GROUNDING/BONDING CONDUCTORS SHALL BE U.L. LABELED ROPE STRAND.

3.12 CONNECTIONS OR SPLICES SHALL BE EXOTHERMIC WELD (CAD WELD OR THOMAS AND BETTS FURSEWELD) FOR GROUNDING/BONDING CONDUCTORS.

3.13 NEW CONDUCTORS SHALL BE CONTINUOUS. HYDRAULIC CRIMP SPLICES OR CONNECTIONS ARE EXCEPTIONS AND REQUIRE SPECIFIC APPROVAL IN WRITING BY HAWKINS DESIGN GROUP.

3.14 ALL CONDUIT SUPPORT SYSTEMS SHALL BE INSTALLED ON THE BUILDING STRUCTURE. UNISTRUT, BEELINE, SUPERSTRUT STEEL CITY SPRING STEEL FASTENERS OR CADDY MOUNTING SYSTEMS ARE ACCEPTABLE. NO CONDUIT WILL BE SUPPORTED BY THE CEILING WIRES, TIE WIRE OR GRID SYSTEM. PERFORATED STRAPS OR OTHER PIPING AND CONDUIT STRAPS ARE NOT ACCEPTABLE SUPPORTS.

3.15 ACCEPTABLE MANUFACTURES FOR **SWITCH GEAR, DISTRIBUTION GEAR** AND RELATED COMPONENTS ARE: SQUARE D, ACME TRANSFORMERS, GENERAL ELECTRIC, SIEMENS, HPS, AND CUTLER-HAMMER.

3.16 CONDUCTORS SHALL BE COLOR CODED FOR BRANCH CIRCUITS AND PHASE LEGS OF FEEDERS TO PANEL BOARDS, SWITCHBOARDS, ETC. IN ACCORDANCE WITH NEC AND LOCAL MUNICIPAL REQUIREMENTS. SPECIFIC REQUIREMENTS INCLUDE THE FOLLOWING.
- 120-V, 2-WIRE CIRCUIT; GROUNDED NEUTRAL-WHITE; UNGROUNDED LEG-BLACK.
- 208Y/120-V, 3-PHASE, 4-WIRE: GROUNDED NEUTRAL-WHITE; PHASE A-BLACK; PHASE B-RED; PHASE C-BLUE.
- 240/120-V, 3 WIRE, SINGLE PHASE CIRCUIT: GROUNDED NEUTRAL-WHITE; PHASE A-BLACK; PHASE B-RED.
- 240-V, DELTA, 3-PHASE, 3-WIRE: PHASE A-BLACK; PHASE B-RED; PHASE C-BLUE.
- 240/120-V, 3-PHASE, 4-WIRE, HIGH-LEG DELTA: GROUNDED NEUTRAL-WHITE; HIGH LEG (208-V TO NEUTRAL)-ORANGE; PHASE A-BLACK; PHASE C-BLUE.
- 480Y/277-V, 3-PHASE, 4-WIRE: GROUNDED NEUTRAL-GRAY; PHASE A-BROWN; PHASE B-ORANGE; PHASE C-YELLOW.
- 480-V, DELTA, 3-PHASE, 3-WIRE: PHASE A-BROWN; PHASE B-ORANGE; PHASE C-YELLOW.
- 480-V, DELTA, 3-PHASE, 3-WIRE: PHASE A-BROWN; PHASE B-ORANGE; PHASE C-YELLOW.
- EQUIPMENT GROUNDING CONDUCTORS-GREEN; ISOLATED GROUNDS-GREEN WITH A YELLOW STRIPE.

3.17 ALL INSTALLATIONS WITHIN PLENUM RATED CEILING SPACE SHALL BE IN ACCORDANCE WITH NEC ARTICLE "WIRING METHODS" WITH REGARDS TO SMOKE DEVELOPMENT AND FLAME SPREAD.

3.18 ALL UNDERGROUND CABLE, PIPE AND CONDUITS SHALL BE DETECTABLE (METALLIC) OR HAVE A DETECTABLE UNDERGROUND LOCATION DEVICE INSTALLED WITH IT. THE RECOMMENDED DETECTABLE UNDERGROUND LOCATION DEVICE IS A #18 OR LARGER COPPER TRACER WIRE SECURELY ATTACHED TO THE TOP OF ANY NON-METALLIC CABLE, PIPE OR CONDUIT AT 8'-0" O/C AND SHALL HAVE A MINIMUM OF 12" OF TRACER WIRE ACCESSIBLE AT ALL ABOVE GRADE TERMINATIONS.

3.19 ALL HORIZONTAL UNDERGROUND CONDUIT RUNS (INCLUDING UNDER CONCRETE SLABS) SHALL BE A MINIMUM OF 24" BELOW GRADE.

3.20 ALL MATERIAL & DEVICES USED EXTERIOR OF THE BUILDING SHALL BE LISTED U.L. FOR WATERPROOF APPLICATIONS.

4.0 SUBMITTALS

4.1 SUBMIT 6 SETS OF SHOP DRAWINGS AND SAMPLES FOR ALL EQUIPMENT PRIOR TO ORDERING IN A TIMELY MANNER, SUBMITTALS SHALL INCLUDE LIGHT FIXTURES (INCLUDING LIGHT POLES), LIGHTING CONTROLS, SWITCHBOARDS, PANELBOARDS, BREAKERS, STARTERS, HVAC ELECTRICAL EQUIPMENT AND TRANSFORMERS.
4.1.1 SHOP DRAWINGS SHALL INCLUDE LAYOUT DIMENSIONS AND IDENTIFICATION OF SPECIFIC EQUIPMENT FOR INSTALLATION, MINIMUM NEC CLEARANCES SHALL BE INDICATED.
4.1.2 THE CONTRACTOR SHALL INCLUDE COMPARISON DATA AND SAMPLES FOR BOTH THE SUBSTITUTE AND SPECIFIED ITEMS WHEN SUBSTITUTIONS ARE PROPOSED. THE CONTRACTOR REMAINS RESPONSIBLE TO PROVIDE THE ORIGINALLY SPECIFIED INSTALLATION IN ACCORDANCE WITH THE ORIGINAL DELIVERY DATE (AT HIS COST) WHEN SUBSTITUTIONS ARE NOT APPROVED.

4.2 THE CONTRACTOR SHALL PROVIDE PROOF OF PERFORMANCE BOND WITH HIS INITIAL SUBMITTALS (E.G. SHOP DRAWINGS) TO INCLUDE WARRANTY FOR THE WARRANTY PERIOD (2 YEARS).

4.3 THE CONTRACTOR SHALL SUBMIT COMPLETE AND ACCURATE "AS BUILT" DRAWING TO THE OWNER AND ENGINEER WITHIN 2 WEEKS OF OWNER ACCEPTANCE. PROVIDE 4 SETS OF BLUELINES OR REPRODUCIBLES. FAILURE TO COMPLY WILL RESULT IN WITHHOLDING OF PAYMENTS DUE, AND ASSESSMENT OF CHARGES (AGAINST THE CONTRACTOR) FOR AS-BUILT DEVELOPMENT BY THE ENGINEER AT THE CURRENT HOURLY RATE.

4.4 PROVIDE A LETTER TO THE OWNER AND ENGINEER CERTIFYING ALL EQUIPMENT AND TERMINATION'S ARE PROPERLY TORQUED. THIS CERTIFICATION SHALL BE EXECUTED BY A LICENSED CONTRACTOR, AND WRITTEN CERTIFICATION PROVIDED ON COMPANY LETTERHEAD.

4.5 PROVIDE 2 COPIES OF ALL MANUFACTURER/SUPPLIER WARRANTIES AND GUARANTEES TO THE OWNER WITHIN 2 WEEKS OF FINAL ACCEPTANCE BY THE OWNER.

4.6 TESTS
4.6.1 SUBMIT 2 COPIES OF ALL INDEPENDENT TEST RESULTS FOR THE ELECTRICAL POWER DISTRIBUTION SYSTEM AS A COMPLETE PACKAGE TO THE OWNER AND ENGINEER. PACKAGE MUST PROVIDE SPECIFIC VALUES OF TEST DATA OBTAINED AGAINST ACCEPTANCE CRITERIA (SIMPLE PASS/FAIL ALONE IS INADEQUATE).
4.6.2 TESTING PERSONAL SHALL BE CERTIFIED BY THE NATIONAL ELECTRIC TESTING ASSOCIATION (NETA) OR NATIOANL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET).
4.6.3 ALL TESTING SHALL BE DONE IN ACCORDANCE WITH MANUFACTURER RECOMMENDATIONS OR NATIONALLY RECOGNIZED STANDARDS AND PRACTICES.
4.6.4 GROUNDING SYSTEM FALL OF POTENTIAL (RESISTANCE TO GROUND) TESTING.
4.6.4.1 GROUND SHALL PROVIDE 5 OHMS OR LESS RESISTANCE TO GROUND AND LESS THAN 0.5 OHMS POINT-TO-POINT BETWEEN THE MAIN GROUNDING ELECTRODE SYSTEM AND ELECTRICAL EQUIPMENT FRAMES, SYSTEM NEUTRAL AND/OR DERIVED NEUTRAL POINTS (REFERENCE IEEE STANDARDS 81-1983 AND 81-1991) AND SHALL NOT BE PERFORMED WITHIN 24 HOURS AFTER RAINFALL.
4.6.5 OVER-POTENTIAL (HI-POT) TESTING
4.6.5.1 SHALL BE PERFORMED ON ALL BUSSES 1000A OR GREATER OR ON MODIFICATIONS OF SERVICES GREATER THAN 400 AMPS.
4.6.5.2 TEST BOTH PHASE-TO-PHASE AND PHASE-TO-GROUND FOR AT LEAST ONE MINUTE.
4.6.6 GROUND FAULT PROTECTION TESTING
4.6.6.1 PROVIDE GROUND-FAULT PROTECTION TESTING BY CURRENT INJECTION AT SENSOR.
4.6.6.2 TEST PRIMARY CONTROL VOLTAGE TO NOT EXCEED 57% OF THE RATED VOLTAGE.
4.6.6.3 VERIFY PICK-UP TIME AND TIME-DELAY SETTINGS PROVIDED BY ENGINEER.
4.6.6.4 TEST GFP RELAY TIMING.
4.6.6.5 TEST INTEGRITY OF GROUNDED CONDUCTOR AND ITS INSULATION RESISTANCE TO GROUND.
4.6.7 INSULATION RESISTANCE (MEGGER) TESTING
4.6.7.1 TESTING SHALL BE 1000 VOLTS FOR ONE MINUTE AND SHALL PROVIDE 50 MEGAOHMS RESISTANCE OR GREATER.
4.6.7.2 TEST BOTH PHASE-TO-PHASE AND PHASE-TO-GROUND.

5.0 WARRANTY

5.1 THE CONTRACTOR SHALL GUARANTEE ALL MATERIAL AND/OR WORKMANSHIP FURNISHED BY HIM UNDER THIS CONTRACT FOR A PERIOD OF **TWO YEARS** FROM THE DATE OF FINAL ACCEPTANCE OF THE WORK BY THE OWNER. ANY DEFECTS DEVELOPING DURING THE WARRANTY PERIOD TRACEABLE TO MATERIALS OR WORKMANSHIP SHALL BE CORRECTED AT THE CONTRACTORS EXPENSE.

5.2 THE OWNER RETAINS THE RIGHT TO REQUIRE REMOVAL AND INSTALLATION (AT ANY TIME) OF ANY MATERIAL OR EQUIPMENT NOT IN COMPLIANCE WITH THE PROVISIONS AND STANDARDS OF THESE DRAWINGS AND SPECIFICATIONS. NO CLAIM FOR ADDITIONAL COMPENSATION WILL BE ALLOWED FOR WORK PERFORMED IN THIS REGARD.

5.3 THE CONTRACTOR AGREES TO TRANSFER ALL MANUFACTURER'S/SUPPLIER'S WARRANTIES AND GUARANTEES TO THE OWNER. THIS INCLUDES COMPLETION OF ALL DOCUMENTATION FOR THE MANUFACTURER/SUPPLIER.

6.0 SERVICE

6.1 PROVIDE AND INSTALL NEW SERVICE SECTION AS SHOWN ON DRAWINGS. S.E.S. SHALL BEAR U.L. LABEL, HAVE COPPER BUSSING – SILVER PLATED, AND AMPERAGE RATING AS SHOWN ON DRAWINGS. METERING AND PRIMARY PULL SECTION SHALL BE BARRIERED FROM OTHER WORK AND APPROVED BY BOTH THE LOCAL UTILITY COMPANY AND AUTHORITY HAVING JURISDICTION.

6.2 GROUND FAULT PROTECTION SHALL BE PROVIDED FOR SERVICES (480V L-L) WITH DISCONNECTS 1000A OR GREATER.

6.3 GROUND FAULT PROTECTION ON MAINS AND SUB-MAINS MUST HAVE AUDIBLE/VISIBLE ALARMS.

6.4 ENCLOSURES SHALL MEET U.L. AND PUBLIC UTILITY REQUIREMENTS-PHYSICALLY BARRIERED BETWEEN SECTIONS, LINE AND LOAD, BOTH BARRIERED.

6.5 NO COVERS GREATER THAN 1/3 HEIGHT OF EQUIPMENT.

6.6 FULL SIZED NEUTRAL BUSSING AND FULLY RATED (NON-TAPERED) BUSSING WILL BE STANDARD. THIS INCLUDES MAXIMUM RATINGS FOR SUPPLY AND SECTION (i.e. HORIZONTAL AND VERTICAL) BUSSES (UNLESS NOTED OTHERWISE). CENTER FEED SUPPLY BUSSES SHALL BE MAXIMUM RATED ON EITHER SIDE OF THE FEED. ALL SPACE WILL BE FULLY BUSSED FOR FUTURE. ALL BUSSING WILL BE PHYSICALLY BARRIERED.

6.7 ALL SERVICES SHALL BE U.L. LISTED FOR FRONT ACCESSIBILITY ONLY.

6.8 ALL SERVICE SECTIONS SHALL BE OF A CONSISTENT HEIGHT AND INCLUDE PROTECTION OF OPERATIONAL DEVICES AND METERS FROM PHYSICAL DAMAGE.

6.9 PROVIDE CONCRETE HOUSEKEEPING PADS FOR ALL FREESTANDING ELECTRICAL SERVICE ENTRANCE EQUIPMENT PER LOCAL UTILITY COMPANY SPECIFICATIONS.

6.10 **SERVICE COORDINATION STUDY**
6.10.1 **DESCRIPTION**
6.10.1.1 WHEN ADJUSTABLE TRIP CIRCUIT BREAKERS OR 2-TIER GROUND FAULT SYSTEM IS SPECIFIED, PROVIDE A SHORT-CIRCUIT AND PROTECTIVE DEVICE COORDINATION STUDY FOR THE ELECTRICAL DISTRIBUTION SYSTEM. THE INTENT OF THESE STUDIES ARE TO VERIFY THAT THE SPECIFIED AND SUPPLIED EQUIPMENT ARE PROPERLY RATED, CORRECTLY APPLIED, AND WITHIN INDUSTRY AND MANUFACTURER'S TOLERANCES.
6.10.1.2 THE SHORT CIRCUIT STUDY SHALL INCLUDE ALL PORTIONS OF THE ELECTRICAL DISTRIBUTION SYSTEM FROM THE NORMAL AND ALTERNATE SOURCES OF POWER THROUGHOUT THE DISTRIBUTION SYSTEM DOWN TO THE SMALLEST PROTECTIVE DEVICE. THE SHORT CIRCUIT STUDY SHALL CONSIDER OPERATION DURING NORMAL CONDITIONS, ALTERNATE OPERATIONS, EMERGENCY POWER CONDITIONS AND ANY OTHER OPERATIONS WHICH COULD RESULT IN MAXIMUM FAULT CONDITIONS.
6.10.1.3 THE COORDINATION STUDY WILL DETERMINE THE CORRECT SETTINGS FOR THE PROTECTIVE DEVICES WHICH WILL MINIMIZE THE DAMAGE CAUSED BY AN ELECTRICAL FAULT AND ALLOW FOR SELECTIVE COORDINATION BETWEEN THE DEVICES. THE COORDINATION STUDY SHALL INCLUDE THE CLOSET UPSTREAM UTILITY PROTECTIVE DEVICE DOWN TO THE PANELBOARD MAIN, BRANCH OR FEEDER CIRCUIT BREAKERS. THE COORDINATION STUDY SHALL CONSIDER OPERATION DURING NORMAL CONDITIONS, ALTERNATE OPERATIONS AND DURING EMERGENCY POWER CONDITIONS.
6.10.2 **QUALIFICATIONS**
6.10.2.1 THE CONTRACTOR SHALL HAVE THE COORDINATION STUDY PREPARED BY QUALIFIED ENGINEERS OF AN INDEPENDENT CONSULTANT AND OR MANUFACTURER. THE CONSULTANT/MANUFACTURER SHALL BE AN EXPERIENCED REGISTERED PROFESSIONAL ELECTRICAL ENGINEER (LICENSED IN THE STATE WHERE THE PROJECT IS COMPLETED) SPECIALIZING IN PERFORMING POWER SYSTEM STUDIES.
6.10.3 **SUBMITTALS**
6.10.3.1 THE CONTRACTOR SHALL SUBMIT THE POWER SYSTEM STUDIES IN CONJUNCTION WITH THE EQUIPMENT SUBMITTALS. THE ELECTRICAL SUBMITTALS WILL BE REVIEWED BUT WILL NOT BE APPROVED UNLESS THE POWER SYSTEM STUDIES HAVE BEEN RECEIVED AND REVIEWED.

6.11 **PROTECTIVE DEVICE COORDINATION STUDY**
6.11.1 ALL REQUIREMENTS OF THE CURRENT NATIONAL ELECTRICAL CODE AND NFPA 5000 SHALL BE ADHERED TO.
6.11.2 THE COORDINATION STUDY SHALL INCLUDE THE CLOSEST UPSTREAM UTILITY PROTECTIVE DEVICE DOWN TO THE PANELBOARD MAIN, BRANCH, OR FEEDER CIRCUIT BREAKERS. PREPARE THE COORDINATION CURVES TO DETERMINE THE REQUIRED SETTINGS OF PROTECTIVE DEVICES TO ASSURE SELECTIVE COORDINATION.
6.11.3 THE PHASE AND GROUND OVERCURRENT PROTECTION SHALL BE INCLUDED, AS WELL AS SETTINGS FOR ALL OTHER ADJUSTABLE PROTECTIVE DEVICES.
6.11.4 GRAPHICALLY ILLUSTRATE ON LOG-LOG PAPER THAT ADEQUATE TIME SEPARATION EXISTS BETWEEN DEVICES. SUFFICIENT CURVES SHALL BE USED TO CLEARLY INDICATE THE COORDINATION ACHIEVED BETWEEN DEVICES. REASONABLE COORDINATION INTERVALS AND SEPARATION OF CHARACTERISTIC CURVES SHALL BE MAINTAINED. PLOT THE SPECIFIC TIME-CURRENT CHARACTERISTICS OF EACH PROTECTIVE DEVICE IN SUCH A MANNER THAT THE UPSTREAM DEVICES WILL BE CLEARLY DEPICTED ON THE SHEET.
6.11.5 THE FOLLOWING SPECIFIC INFORMATION SHALL ALSO BE SHOWN ON THE COORDINATION CURVES:
6.11.5.1 DEVICE IDENTIFICATIONS.
6.11.5.2 TIME AND CURRENT RATIO FOR CURVES.
6.11.5.3 FUSE, CIRCUIT BREAKER, AND RELAY CURVES, SHOWING COMPLETE OPERATING BANDS OF LOW VOLTAGE CIRCUIT BREAKER TRIP CURVES.
6.11.5.4 LOW VOLTAGE EQUIPMENT CIRCUIT BREAKER TRIP DEVICES, INCLUDING MANUFACTURERS TOLERANCE BANDS.
6.11.5.5 PERTINENT TRANSFORMER FULL-LOAD CURRENTS AT 100 AND 600 PERCENT.
6.11.5.6 GROUND FAULT PROTECTIVE DEVICE SETTINGS.
6.11.5.7 OTHER SYSTEM LOAD PROTECTIVE DEVICES FOR LARGEST BRANCH CIRCUIT AND FEEDER CIRCUIT BREAKER IN EACH MOTOR CONTROL CENTER AND PANELBOARD.
6.11.6 DEVELOP A TABLE TO SUMMARIZE THE SETTINGS SELECTED FOR THE PROTECTIVE DEVICES. INCLUDE IN THE TABLE THE FOLLOWING:
6.11.6.1 DEVICE IDENTIFICATIONS.
6.11.6.2 DURRENT TRANSFORMER RATIO, RELAY TAP, TIME DELAY AND INSTANTANEOUS PICKUP.
6.11.6.3 CIRCUIT BREAKER SENSOR RATING, LONG-TIME, SHORT-TIME AND INSTANTANEOUS SETTINGS AND TIME BANDS.
6.11.6.4 FUSE RATING AND TYPE.
6.11.6.5 GROUND FAULT PICKUP AND TIME DELAY.

6.12 **ANALYSIS**
6.12.1 ANALYZE THE SHORT CIRCUIT CALCULATIONS AND HIGHLIGHT ANY EQUIPMENT THAT IS DETERMINED TO BE UNDERRATED AS SPECIFIED OR NOT COORDINATED. PROPOSE APPROACHES TO EFFECTIVELY PROTECT THE UNDERRATED EQUIPMENT. PROPOSED MAJOR CORRECTIVE MODIFICATIONS WILL BE TAKEN UNDER ADVISEMENT BY THE ENGINEER AND THE CONTRACTOR WILL BE GIVEN FURTHER INSTRUCTIONS.

6.12.2 AFTER DEVELOPING THE COORDINATION CURVES, HIGHLIGHT AREAS LACKING COORDINATION. FOR EACH SHEET, PRESENT A TECHNICAL EVALUATION WITH A DISCUSSION OF THE LOGICAL COMPROMISES FOR BEST COORDINATION.

6.13 **REPORT**
THE RESULTS OF THE POWER SYSTEM STUDY SHALL BE SUMMARIZED IN A FINAL REPORT. THE REPORT SHALL INCLUDE THE FOLLOWING SECTIONS:
6.13.1 PROTECTIVE DEVICE TIME VERSUS CURRENT COORDINATION CURVES, TABULATIONS OF RELAY AND CIRCUIT BREAKER TRIP SETTINGS, FUSE SELECTION AND COMMENTARY REGARDING SAME.
6.13.2 COPIES OF THE MANUFACTURERS TIME CURRENT CURVES FOR THE DEVICES STUDIED AND PLOTTED ON THE TIME CURRENT CURVES.

7.0 DISTRIBUTION

7.1 **PANELBOARDS** (EXISTING): ADD CIRCUIT BREAKERS (FULL SIZED BREAKERS) AS REQUIRED FOR CIRCUITING. MATCH PRECISELY BRAND AND PROVIDE A.I.C. RATING AS INDICATED ON DRAWINGS. TANDEM AND PIGGY-BACK BREAKERS ARE NOT PERMITTED. ALL LUGS OR CONNECTORS TO BE 60°C FOR PANEL LESS THAN OR EQUAL 100 AMPS AND 75°C RATED OF GREATER THAN 100AMPS MINIMUM.

7.2 **PANELBOARDS** (NEW): SHALL BE RATED AS SHOWN ON DRAWINGS WITH PLATED COPPER BUSSING. PROVIDE NEMA ENCLOSURES AS REQUIRED BY CODE FOR REGULATION. BACK BOXES ENLARGED FOR DOUBLE NEUTRALS AND LUGS CAPABLE OF OVERSIZING ISOLATED GROUND AND NORMAL GROUND BUS. ALL LUGS OR CONNECTORS TO BE 60°C FOR PANEL LESS THAN OR EQUAL 100 AMPS AND 75°C RATED OF GREATER THAN 100AMPS MINIMUM. PANELBOARD CABINET SHALL BE EQUIPPED WITH PIANO HINGES WITH DOOR IN DOOR CONSTRUCTION.

7.3 **CIRCUIT BREAKERS** WILL BE SWITCH RATED AND AMBIENT COMPENSATED FOR ALL CIRCUITS. PROVIDE SWITCHED NEUTRALS ON ALL CIRCUIT BREAKERS FEEDING CLASS 1 AND CLASS 2 AREAS WITH NEUTRALS. GFCI ON CIRCUITS WITH NEUTRALS TO DEVICES ABOVE CLASSIFIED AREAS. ALL LIGHTING PANELS/CIRCUIT BREAKERS SHALL BE RATED FOR CONTINUOUS DUTY. HACR RATED BREAKERS SHALL BE INSTALLED FOR ALL HVAC CIRCUITS CONTAINING MULTIPLE MOTOR LOADS.

7.4 ALL EQUIPMENT (PANELS, DISCONNECT SWITCHES, STARTERS, ETC.) WILL BE MARKED WITH BLACK OR RED ENGRAVERS STOCK TAGS EMBOSSED WITH 1/4" HIGH LETTERS DESCRIBING EACH ITEM. CONDUCTORS WILL BE MARKED AT ALL TERMINATION AND JUNCTION POINTS (PANELS, JUNCTION BOXES, SPLICES, ETC.) WITH LABELS BEARING THE PANEL AND CIRCUIT NUMBER WHICH FEEDS EACH CONDUCTOR (PER NEC 210.4, 300.3).

7.5 ALL **PANELBOARDS** WILL HAVE TYPED DIRECTORY CARDS IDENTIFYING ALL CIRCUITS AND SPACES.

7.6 ACCEPTABLE MANUFACTURERS FOR **PANELBOARDS, SWITCHBOARDS, AND TRANSFORMERS** SHALL BE PER SECTION 3.15 OF THIS SPECIFICATION. TRANSFORMERS 15 KVA AND ABOVE SHALL BE 150°C TEMPERATURE RISE ABOVE 40°C AMBIENT. ALL INSULATING MATERIALS TO BE IN ACCORDANCE WITH NEMA ST20-1972 STANDARDS FOR A 220°C UL COMPONENT RECOGNIZED INSULATION SYSTEM. SINGLE PHASE TRANSFORMERS 15 KVA THROUGH 50 KVA, AND THREE PHASE TRANSFORMERS THROUGH 45 KVA SHALL BE DESIGNED SO THEY CAN BE EITHER FLOOR OR WALL MOUNTED. THE TRANSFORMER SHALL BE LISTED BY UNDERWRITERS LABORATORY FOR SPECIFIED TEMPERATURE RISE. TRANSFORMERS 75 KVA AND ABOVE SHALL BE DESIGNED FOR FLOOR INSTALLATION ONLY UNLESS NOTED OTHERWISE.

7.7 LABEL ALL PANELS/TRANSFORMERS/DISCONNECTS WITH "WARNING" – ELECTRICAL EQUIPMENT – DANGER – QUALIFIED PERSONNEL ONLY TO OPERATE ON OPEN EQUIPMENT.

7.8 **DISCONNECT SWITCHES** WILL BE COMMERCIAL-DUTY, QUICK-MAKE, QUICK-BREAK, HORSEPOWER RATED, NEMA 1 INDOOR, NEMA 3R GASKETED, (4X) NEMA 12, OR NEMA 7 AS APPLICABLE WITH FUSES PER DRAWING.

7.9 **MANUAL MOTOR** STARTERS WITH THERMAL OVERLOADS WILL BE PROVIDED FOR FRACTIONAL HORSEPOWER MOTORS 1/2 HP OR GREATER. SQUARE 'D' CLASS 2510, 2511, 2512. AMBIENT COMPENSATED AS REQUIRED.

7.10 **MAGNETIC MOTOR STARTERS** WITH THERMAL OVERLOADS, (2) AUXILIARY CONTACT SWITCHES, INTERNAL LINE VOLTAGE TO 24 VOLT TRANSFORMER (250VA. MIN) WITH PROPER PRIMARY/SECONDARY PROTECTION, AMBIENT COMPENSATED, RED RUNNING LIGHT, HAND-OFF-AUTO, ACROSS THE LINE STARTERS. SHALL BE PROVIDED WITH ALL MOTOR SHOWN ON THE DRAWING (1 H.P. TO 25 H.P.).

7.11 **CONTROL PANELS** CONTROL PANELS SHALL HAVE A WITHSTAND RATING OF 10,000 AMPS FOR .5 SEC. UNLESS INDICATED OTHERWISE ON THE DRAWINGS.

8.0 LIGHT FIXTURES

8.1 FURNISH AND INSTALL ALL LIGHTING FIXTURES COMPLETE WITH LAMPS, WHIPS AND ACCESSORIES. ALL RECESSED FIXTURES WILL BE RATED FOR USE IN ANY CEILING APPLICATIONS AND BE THERMALLY PROTECTED.

8.2 MOUNTING TYPE AND VOLTAGE OF FIXTURES IS THE RESPONSIBILITY OF THE CONTRACTOR. (4) EARTHQUAKE CLIPS WILL BE INSTALLED ON EACH FIXTURE MOUNTED IN GRID OR FLANGE TYPE CEILINGS. FLUORESCENT FIXTURE LENSES WILL BE 100% ACRYLIC, .125" THICK MINIMUM.

8.3 ALL FIXTURES TO BE INSTALLED IN SYMMETRICAL MANNER FREE FROM LIGHT LEAKS AND DIRTY LENSES OR REFLECTORS.

8.4 ALL LAY-IN FIXTURES IN ACOUSTICAL CEILING SYSTEMS WILL BE INSTALLED PER IBC STANDARD. VERIFY WITH LOCAL BUILDING AUTHORITY.
8.4.1 SUPPORT FIXTURES PER IBC WITH TWO LOOSE SIZE #9 WIRES TO STRUCTURES ON OPPOSITE CORNERS AND 2 TAUGHT SIZE #9 WIRE TO STRUCTURE AT CORNERS AND/OR FIXTURE SHALL BE FASTENED BY SCREWS INTO T-BAR RUNNERS IN ACCORDANCE WITH LOCAL AUTHORITY HAVING JURISDICTION.

8.5 **LAMPS**
FLUORESCENT LAMPS:
8.5.1 T8-3500 KELVIN TEMPERATURE UNLESS NOTED OTHERWISE.
8.5.2 80 CRI (COLOR RENDERING INDEX) MINIMUM.
H.I.D. LAMPS:
8.5.3 AS NOTED ON PLANS
INCANDESCENT LAMPS:
8.5.4 130V FOR ALL "A" TYPE LAMPS.
L.E.D.
8.5.5 AS NOTED ON PLANS

8.6 **BALLASTS**
8.6.1 ALL BALLASTS SHALL BE:
8.6.1.1 HIGH POWER FACTOR, UL LISTED, CBM CERTIFIED AND ETL TESTED.
8.6.1.2 HAVE A SOUND RATING OF "A"
8.6.1.3 HAVE THD < 10%
8.6.1.4 HAVE GREATER THAN 0.9 POWER FACTOR
8.6.2 FLUORESCENT BALLAST SHALL:
8.6.2.1 START RELIABLY DOWN TO AT LEAST 60°F (0°F WHEN INDICATED AS LOW TEMPERATURE ON THE DRAWINGS OR IN AN OPEN WAREHOUSE OR OUTDOORS)
8.6.2.2 BE RATED FOR AN AMBIENT OF AT LEAST 140°F.
8.6.2.3 ELECTRONIC TYPE (INSTANT OR RAPID START).
8.6.3 HID BALLASTS SHALL:
8.6.3.1 START RELIABLY DOWN TO AT LEAST – 20°F.
8.6.3.2 BE RATED FOR AN AMBIENT OF AT LEAST 131°F.
8.6.3.3 BE POTTED AND ENCASED WHEN INSTALLED IN AN OFFICE ENVIRONMENT.
8.6.3.4 HAVE PULSE START TECHNOLOGY.
8.6.4 ELECTRONIC DIMMING BALLAST SHALL:
8.6.4.1 WITHSTAND SURGES AS SPECIFIED IN ANSI C62.41
8.6.4.2 PREHEAT LAMP CATHODES BEFORE APPLYING ARC VOLTAGE
8.6.4.3 INTERNALLY LIMIT INRUSH CURRENT TO NOT EXCEED THREE AMPS AT 277 VOLTS OR SEVEN AMPS AT 120 VOLTS.
8.6.4.4 BE UL LISTED AND CLASS P THERMALLY PROTECTED
8.6.4.5 BE INAUDIBLE IN A 27Db AMBIENT THROUGHOUT THE DIMMING RANGE.
8.6.4.6 HAVE A DIMMING RANGE FROM 100% TO 10% ILLUMINANCE LEVEL.
8.6.4.7 ACCEPTABLE MANUFACTURERS: ADVANCE, MOTOROLA, LUTRON, HONEYWELL, AND MAGNETEK.

8.7 **DIMMERS AND SWITCHES**
8.7.1 ALL DEVICES SHALL BE UL LISTED SPECIFICALLY FOR THE REQUIRED LOADS (I.E., INCANDESCENT, FLUORESCENT, L.E.D., LOW VOLTAGE, ELECTRONIC LOW VOLTAGE).
8.7.2 DIMMERS AND SWITCHES SHALL MEET OR EXCEED ANSI/IEEE STD.C62.41-1980
8.7.3 DIMMERS AND SWITCHES SHALL MEET UL 20 AND UL 1472.
8.7.4 DIMMER CONTROL SHALL BE LINEAR SLIDE. DIMMER SHALL PROVIDE A SMOOTH AND CONTINUOUS SQUARE LAW DIMMING CURVE.
8.7.5 DIMMERS SHALL UTILIZE AN LC FILTERING NETWORK TO MINIMIZE INTERFERENCE WITH PROPERLY INSTALLED RADIO, AUDIO, AND VIDEO EQUIPMENT.
8.7.6 DIMMER CONTROL SLIDER SHALL BE CAPTURED.
8.7.7 FACEPLATE SHALL SNAP ON TO DEVICE WITH NO VISIBLE MEANS OF ATTACHMENT.
8.7.8 ACCEPTABLE MANUFACTURES FOR DIMMERS ARE LUTRON, LITHONIA, LEVITON AND PRESCOLITE, LIGHTOLIER OR PRIOR APPROVED EQUAL.
8.7.9 ALL DIMMERS WITH L.E.D.'S SHALL BE RATED/LISTED FOR USE WITH THE SPECIFIC LAMP OR LUMINAIRE.

8.8 **LIGHTING CONTACTORS**
8.8.1 LIGHTING CONTACTORS SHALL HAVE A WITHSTAND RATING OF 14,000 AMPS FOR 0.5 SECONDS UNLESS INDICATED OTHERWISE ON THE DRAWINGS.

8.9 **LIGHTING CONTROL PANELS**
8.9.1 PROGRAMMING SHALL BE COORDINATED WITH OWNER AND TENANT PRIOR TO COMPLETION OF PROJECT.
8.9.2 ALL PROGRAMMING SHALL MEET MINIMUM REQUIREMENTS OF ADOPTED INTERNATIONAL ENERGY CONSERVATION CODE (IECC).
8.9.3 ALL RELAYS SHALL BE RATED FOR MINIMUM OF 14,000 A.I.C.

9.0 TELEPHONE SYSTEM

9.1 PROVIDE AND INSTALL A COMPLETE SYSTEM OF EMPTY RACEWAYS 3/4" EMT MINIMUM WITH PULL STRAP/CORD. PROVIDE REQUIRED/REQUESTED INFORMATION TO TELEPHONE COMPANY PRIOR TO INSTALLATION.

10.0 DATA/INFORMATION SYSTEM

10.1 PROVIDE AND INSTALL A COMPLETE SYSTEM OF RACEWAYS (CABLE TRAYS, J-HOOKS, CONDUIT SLEEVES) OF PREFERABLY OPEN CONSTRUCTION WITH PULL LINE. RACEWAYS TO BE CONTINUOUS.

11.0 FIRE ALARM SYSTEM - SEPARATE PERMIT PROVIDED BY OTHERS.

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GENERAL NOTES

1. REFER TO ELECTRICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS AND COMPLETE CONTRACTUAL OBLIGATIONS.
2. THE ELECTRICAL CONTRACTOR SHALL (PRIOR TO HIS BID) a) VISIT THE SITE AND FIELD VERIFY ALL EXISTING CONDITIONS AND b) TAKE ALL CONSIDERATIONS INTO ACCOUNT AT THE TIME OF BID. NO CONSIDERATIONS WILL BE GRANTED THE CONTRACTOR AFTER THE BID IS ACCEPTED.
3. ALL ELECTRICAL METALLIC TUBING (EMT), RIGID NON-METALLIC CONDUIT, FLEXIBLE METALLIC CONDUIT, FLEXIBLE NON-METALLIC CONDUITS, "SEALTIGHT" TYPE CONDUITS AND ALL OTHER CONDUITS THAT DO NOT CONTAIN A CODE SIZED GROUND WIRE SHALL HAVE A CODE SIZED BOND WIRE PER NEC TABLE 250.122 INSTALLED WITH THE CIRCUIT CONDUCTORS.
4. ALL NIGHTLIGHT/EMERGENCY LIGHT (NL/EM) FIXTURES SHALL BE CONNECTED UNSWITCHED. IF NO EMERGENCY LIFE SAFETY SYSTEM IS INSTALLED (ie: GENERATOR, etc.). THE OUTER LAMPS SHALL BE CONNECTED UNSWITCHED TO LOCAL LIGHTING CIRCUIT AND CONNECTED VIA AN EMERGENCY BALLAST – 1400 LUMEN OR FULL LUMEN OUTPUT MINIMUM. PROVIDE NEW IF NOT ALREADY EXISTING.
5. ALL FIXTURES INSTALLED OUTDOORS SHALL BE RATED FOR DAMP/WET LOCATIONS AS REQUIRED. THE CONTRACTOR SHALL COORDINATE DAMP/WET LOCATION RATING AND INSTALLATION PER NEC ARTICLE "FIXTURE LOCATIONS".
6. ALL RECESSED LIGHT FIXTURES SHALL BE I.C. RATED OR A MINIMUM OF 3" FROM COMBUSTIBLE MATERIAL PER NEC ARTICLE "LUMINAIRES, LAMPHOLDERS AND LAMPS – CLEARANCE AND INSTALLATION".
7. ELECTRICAL CONTRACTOR TO VERIFY A MINIMUM OF 1 FOOT-CANDLE AT 1 FOOT ABOVE FLOOR ALONG EXIT PATH PER IBC ARTICLE "MEANS OF EGRESS ILLUMINATION".
8. LIGHT SWITCHES SHALL BE INSTALLED TO CONFORM TO NEC ARTICLE "SWITCHES – ACCESSIBILITY AND GROUPING".
9. RECEPTACLES LOCATED WITHIN 6'-0" OF SINKS OR WATER SHALL BE CONNECTED EITHER TO A GROUND FAULT CIRCUIT INTERRUPTER TYPE CIRCUIT BREAKER OR TO A GROUND FAULT CIRCUIT INTERRUPTER TYPE RECEPT.
10. PRIOR TO ROUGH-IN, THE ELECTRICAL CONTRACTOR SHALL COORDINATE THE EXACT LOCATION OF ALL HVAC UNITS AND SUPPLY AIR DUCT SMOKE DETECTORS WITH THE MECHANICAL DRAWINGS.
11. PROVIDE ROOF TOP WEATHER PROOF / WEATHER RESISTANT G.F.C.I. WITHIN 25'-0" OF ALL ROOF TOP HVAC EQUIPMENT IN ACCORDANCE WITH NEC ARTICLE "HEATING, AIR-CONDITIONING AND REFRIGERATION EQUIPMENT OUTLET". THE ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF THESE RECEPTACLES IN THE FIELD REGARDLESS PLAN LAYOUT.
12. ALL DISCONNECTS SHALL BE OF THE HEAVY DUTY TYPE AND FUSED PER THE NAMEPLATE RATING OF THE HVAC UNIT OR MOTOR.
13. THE EC SHALL – PRIOR TO ROUGH-IN, FIELD VERIFY ALL HVAC VOLTAGES AND AMPERAGES AGAINST PLAN REQUIREMENTS. FAILURE TO VERIFY AND NOTIFY ENGINEER/ ARCHITECT PRIOR TO ROUGH-IN SHALL INDICATE THAT THE EC SHALL ASSUME ALL RESPONSIBILITY FOR DESIGN AND INSTALLATION REQUIREMENTS.
14. THE ELECTRICAL CONTRACTOR SHALL ENSURE FINAL COORDINATION OF THE MANUFACTURERS RECOMMENDED FUSE SIZE FOR HVAC EQUIPMENT WITH THE SIZE DISCONNECT PRIOR TO OR DURING ROUGH-IN. ADVISE ENGINEER IF CHANGES IN THE FINAL SELECTION OF HVAC EQUIPMENT HAVE IMPACTED DISCONNECT, BREAKER, OR CONDUCTOR SIZE.
15. ALL ROOF TOP UNITS EXPOSED TO AMBIENT TEMPERATURES AND WEATHER SHALL HAVE NEMA 3R MINIMUM RATED DISCONNECTS.
16. MAXIMUM TAP CONDUCTOR LENGTH SHALL BE 25'-0" PER NEC ARTICLE "FEEDER TAPS" AND "TRANSFORMER SECONDARY CONDUCTORS" AND SHALL NOT BE SMALLER THAN 1/3 THE AMPACITY OF FEEDER CONDUCTORS.
17. ELECTRICAL CONTRACTOR SHALL COORDINATE WITH MECHANICAL CONTRACTOR AND FIRE ALARM CONTRACTOR REGARDING SMOKE DUCT DETECTORS TO INCLUDE PURCHASE, INSTALLATION, AND FINAL CONNECTIONS.
18. THE ELECTRICAL CONTRACTOR IS RESPONSIBLE TO COORDINATE WITH THE OWNER OR OTHER SUPPLIERS REGARDING ANY REQUIREMENTS FOR MOTOR STARTERS IN ADDITION TO THAT WHICH IS INDICATED FOR THE HVAC SYSTEM. THIS INCLUDES FURNISH AND INSTALL STARTERS TO INTERFACE WITH ANY ENERGY MANAGEMENT SYSTEM OR OTHER SPECIAL SYSTEMS.
19. ELECTRICAL CONTRACTOR SHALL PROVIDE CORRECT SIZE/ TYPE/ VOLTAGE/ QUANTITY OF DUAL-ELEMENT, TIME-DELAY FUSE(S) SIZED PER HVAC EQUIPMENT MANUFACTURER UNLESS OTHERWISE SPECIFIED BY UNIT NAMEPLATE/ MANUFACTURER DATA.
20. ALL INDOOR FLUORESCENT FIXTURES WITH DOUBLE ENDED LAMPS SHALL HAVE INTEGRAL DISCONNECTS.

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BALMER ARCHITECTURAL GROUP, INC.
2425 E. CAMELBACK RD., SUITE 775
PHOENIX, ARIZONA 85016
PH: 602-954-6718 FAX: 602-468-9680
E-MAIL: ADMIN@BAG-INC.COM

Registered Professional Engineer (Electrical)
CERTIFICATE NO. 52649
ARMANDO GARCIA
Date Signed 05/12/2021
ARIZONA, U.S.A.

SUN STATE BUILDERS

VIP PRODUCTS
GOODYEAR, AZ.
ELECTRICAL SYMBOLS & SPECS

CITY OF Goodyear Approved 07/01/21 21-2119 - VIP PRODUCTS

E-100
40012.010
24FEB21
1 CITY COMMENTS 14MAY21

DESIGN CODES
IECC: 2018 NEC: 2017

ELECTRICAL CONTRACTOR SHALL NOTIFY DESIGNER/ENGINEER PRIOR TO ANY DEVIATION FROM THIS SET OF ELECTRICAL DESIGN PLANS. ANY CHANGES TO THE DESIGN, IF APPROVED BY ENGINEER, WILL REQUIRE REVISIONS TO PLANS AND POSSIBLE ADDITIONAL SERVICE FEE.

Project Contact/Designer: MINDY ADLER
Project # 21058
HAWKINS DESIGN GROUP INC.
ELECTRICAL CONSULTING ENGINEERS
1140 WEST HARWELL ROAD
GILBERT, ARIZONA 85233
PH. 480.813.9000 FAX. 480.813.9001
EMAIL. email@hawkinsdg.com

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BALMER architectural group inc

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