

ELECTRICAL SYMBOLS

THIS IS A MASTER LEGEND AND NOT ALL SYMBOLS OR ABBREVIATIONS ARE USED

STANDARD MOUNTING HEIGHTS	ANNOTATION
ANNUNCIATOR PANELS (DISPLAY) CONTROLS (TOP OF DEVICE)	60"
EXIT SIGNS (WALL MOUNTED TO BOTTOM)	48"
FIRE ALARM ANNUNCIATOR PANEL (DISPLAY)	105"
FIRE ALARM BELL (EXTERIOR) (CENTERLINE)	60"
FIRE ALARM CONTROL PANEL/UNIT (DISPLAY)	120"
FULL STATIONS (TOP OF DEVICE)	60"
RECEPTACLES (TO BOTTOM)	48"
RECEPTACLES (EXTERIOR)	15"
RECEPTACLES (GARAGES)	24"
RECEPTACLES (POOLS)	24"
RECEPTACLES (ABOVE COUNTER)	27"
RECEPTACLES IN EQUIPMENT ROOMS	42"
REMOTE INDICATING LIGHT (EQUIPMENT ROOMS)	44"
REMOTE INDICATING LIGHT (FINISHED AREAS)	48"
SAFETY SWITCHES (TOP OF DEVICE)	60"
STARTERS (TOP OF DEVICE)	60"
SWITCHES (TOP OF DEVICE)	48"
TELEPHONE DATA OUTLETS	SAME AS ADJACENT DEVICE, UNO
TELEPHONE TERMINAL BOARD (BOTTOM)	0"
TELEVISION OUTLETS	REFER TO ARCH DRAWINGS
FIRE ALARM DEVICES (CENTERLINE)	94"

USE THE DEFAULT MOUNTING HEIGHTS SHOWN ABOVE UNO IN THE CONSTRUCTION DOCUMENTS. MOUNTING HEIGHTS LISTED ARE ABOVE FINISHED FLOOR (AFF) OR ABOVE FINISHED GRADE (AFG) TO BOTTOM OF OUTLET BOX. ALL DEVICES SHALL BE INSTALLED IN COMPLIANCE WITH CURRENT ADA AND LOCAL REQUIREMENTS.

ABBREVIATIONS	
AF AMPERE FRAME SIZE	MCB MAIN CIRCUIT BREAKER
AFC ABOVE FINISHED CEILING	MCC MOTOR CONTROL CENTER
AFF ABOVE FINISHED FLOOR	MFR MANUFACTURER
AFG ABOVE FINISHED GRADE	MIR MINIMUM
AHJ AUTHORITY HAVING JURISDICTION	MLO MAIN LUGS ONLY
AHU AIR HANDLING UNIT	MOCPP MAXIMUM OVERCURRENT PROTECTION
AIC AMPERE INTERRUPTING CAPACITY	MTD MOUNTED
AS AMPERE SWITCH	NA NOT APPLICABLE
AT AMPERE TRIP SETTING	NF NON-FUSED
ATS AUTOMATIC TRANSFER SWITCH	NL NIGHT LIGHT (24HR ON)
AV AUDIO VISUAL	NRTL NATIONALLY RECOGNIZED TESTING LABORATORY (CSA ETL, NSF UL)
BAS BUILDING AUTOMATION SYSTEM	OS OCCUPANCY SENSOR
BKR BREAKER	P POLE
CAT CATEGORY	PART PARTIAL CIRCUIT
CATV CABLE TELEVISION SYSTEM	PHSd PHASE
CCTV CLOSED CIRCUIT TELEVISION	PNL PANEL
CD CANDLE	PNLBD PANELBOARD
CKT CIRCUIT	PNLBD FURNISH AND INSTALL
CODE APPLICABLE CODE ADOPTED BY JURISDICTION	PT POTENTIAL TRANSFORMER
CT CURRENT TRANSFORMER	QTY QUANTITY
CTR CENTER	RCT RECEPTACLE
CVD CUMULATIVE VOLTAGE DROP	RELO RELOCATE
DEMO DEMOLITION	RLA RUNNING LOAD AMPS
DPDT DOUBLE-POLE, DOUBLE-THROW	RTU ROOFTOP UNIT
(E) EXISTING	SCCR SHORT-CIRCUIT CURRENT RATING
EC ELECTRICAL CONTRACTOR	SD SMOKE DUCT DETECTOR
EF EXHAUST FAN	SF SINGLE-POLE, SINGLE-THROW
EM EMERGENCY	SPDT SINGLE-POLE, DOUBLE-THROW
EMS ENERGY MANAGEMENT SYSTEM	SPST SINGLE-POLE, SINGLE-THROW
ETR EXISTING TO REMAIN	ST SHUNT TRIP
SWC ELECTRIC WATER COOLER	SWBD SWITCHBOARD
FAAP FIRE ALARM ANNUNCIATOR PANEL	SWGR SWITCHGEAR
FACP FIRE ALARM CONTROL PANEL	TBB TELECOMMUNICATIONS BONDING BACKSHEATH TO BE DETERMINED
FCA FAULT CURRENT AMPS AVAILABLE	TL TWISTLOCK
FCU FAN COIL UNIT	TMGB TELECOMMUNICATIONS MAIN GROUND BUS BAR
FF FINISHED FLOOR	TYP TYPICAL
FLA FULL LOAD AMPS	TX TRANSFORMER
FLR FLOOR	UF UNDERFLOOR
GC GENERAL CONTRACTOR	UG UNDERGROUND
GEC GROUNDING ELECTRODE CONDUCTOR	UIS UNDERSLAB
GES GROUNDING ELECTRODE SYSTEM	UH UNIT HEATER
GFR GROUND FAULT RELAY	UNO UNLESS NOTED OTHERWISE
G ISOLATED GROUND	UPS UNINTERRUPTIBLE POWER SUPPLY
ISC SHORT CIRCUIT CURRENT	VD VOLTAGE DROP
IB-BOX INTRINSICALLY SAFE EXHAUST BOX	VFD VARIABLE FREQUENCY DRIVE
LF LINEAR FEET	W WIRE
LRA LOCKED ROTOR AMPS	WI WITH
LTGLTS LIGHTING LIGHTS	WP WEATHER PROOF
MAU MAKE-UP AIR UNIT	WR WEATHER RESISTANT
MAX MAXIMUM	WT WATERTIGHT
MCA MINIMUM CIRCUIT AMPACITY	XP EXPLOSION-PROOF

STANDARD MOUNTING HEIGHTS	ANNOTATION
1	ELECTRICAL OR FIRE ALARM PLAN NOTE CALLOUT
1	PLUMBING EQUIPMENT DESIGNATION, (CONTRACTOR FURNISHED AND INSTALLED), REFER TO PLUMBING FIXTURE OR EQUIPMENT SCHEDULES
1	EQUIPMENT DESIGNATION (OWNER FURNISHED, CONTRACTOR INSTALLED)
CU 1	MECHANICAL EQUIPMENT DESIGNATION (CONTRACTOR FURNISHED AND INSTALLED, UNLESS NOTED OTHERWISE)
1 E1	DETAIL REFERENCE UPPER NUMBER INDICATES DETAIL NUMBER LOWER NUMBER INDICATES SHEET NUMBER
1 E1	SECTION CUT DESIGNATION

CIRCUITING & WIRING	
	HOMERUN TO PANELBOARD, INFORMATION AT ARROWS ARE CIRCUIT NUMBERS AND PANELBOARD FOR TERMINATION, REFER TO PANELBOARD SCHEDULES FOR BRANCH CIRCUIT CONDUCTOR SIZES.
	CIRCUIT CONTINUATION OR PARTIAL CIRCUIT
	CONDUIT CONCEALED
	CONDUIT IN UNDER FLOOR/GROUND CONSTRUCTION
	EXPOSED CONDUIT
	LOW VOLTAGE CABLE
	CONDUIT TURNING DOWN
	CONDUIT TURNING UP

LINETYPE LEGEND	
	EXISTING
	DEMOLISH
	NEW
	FUTURE

LIGHTING CONTROL DEVICES	
	SINGLE POLE SWITCH (NO LETTER DESIGNATION)
	SWITCH LETTER DESIGNATIONS AS FOLLOWS: 2 = TWO POLE 3 = THREE-WAY 4 = FOUR-WAY D = DIMMER DO = DIMMING OCCUPANCY SENSOR F = FAN SPEED CONTROL K = KEYPAD LV = LOW VOLTAGE O = OCCUPANCY SENSOR P = SPST FLUIT LIGHT V = VACANCY SENSOR WP = WEATHER PROOF
	AUTOMATIC LOAD CONTROL RELAY
	BRANCH CIRCUIT TRANSFER SWITCH
	RELAY OR CONTACTOR (# = QUANTITY OF RELAYS)
	LIGHTING CONTROL, PHOTOCELL (SHADE INDICATES AIMING)
	TIME SWITCH
	CEILING OCCUPANCY SENSOR DESIGNATIONS: IR = INFRARED DT = DUAL-TECH US = ULTRASONIC MP = MICROPHONE

POWER EQUIPMENT & DEVICES	
	ELECTRICAL PANELBOARD (SURFACE OR FLUSH MOUNT)
	CONTROL SYSTEM CABINET (CONTROLS, SECURITY, AV)
	PLYWOOD TERMINAL BOARD FOR TELEPHONE SYSTEM, UNO, SIZE AS NOTED
	SWITCHBOARD OR MOTOR CONTROL CENTER ON HOUSEKEEPING PAD
	ELECTRICAL DISTRIBUTION PANELBOARD
	TRANSFORMER
	MOTOR
	DISCONNECT SWITCH - "200/150/3R" DENOTES AMPERES/POLE/FUSE/NEMA ENCLOSURE RATING, NF = NON-FUSED, CB = CIRCUIT BREAKER (200/3CB), NO VALUE (200/3/150) FOR NEMA ENCLOSURE MEANS STANDARD NEMA 1 RATING
	COMBINATION DISCONNECT (SAFETY) SWITCH AND MOTOR STARTER "30/3/15/1R" DENOTES AMPERES/POLE/FUSE/NEMA STARTER SIZE/NEMA ENCLOSURE RATING, NF = NON-FUSED, CB = CIRCUIT BREAKER (30/3CB1), NO VALUE (200/3/150/1) FOR NEMA ENCLOSURE MEANS STANDARD NEMA 1 ENCLOSURE RATING
	MAGNETIC MOTOR STARTER, NEMA SIZE AS NOTED, 3-POLE, UNO
	MANUAL MOTOR STARTER DISCONNECT
	VARIABLE FREQUENCY DRIVE
	LOW-VOLTAGE PUSH-BUTTON (AUTO-OPENER / SECURITY)
	STOP-START PUSH BUTTON CONTROL STATION
	EMERGENCY POWER OFF BUTTON
	OVERHEAD PADDLE FAN

LIGHTING (REFER TO LIGHT FIXTURE SCHEDULE FOR MORE INFO)	
	LIGHT FIXTURE a = SWITCHED BY SWITCH "a" A = LIGHT FIXTURE TYPE "A" NL = NIGHT LIGHT FIXTURE L = LIGHT MOUNT > = ARROW INDICATES AIMING DIRECTION
	LIGHT FIXTURE CIRCLED ON BACK-UP POWER (NOT EGRESS)
	EMERGENCY LIGHT FIXTURE WITH EMERGENCY LIGHTING BATTERY PACK OR CONNECTED TO LIFE-SAFETY GENERATOR CIRCUIT NL = NIGHT LIGHT FIXTURE
	LIGHT FIXTURE WITH DUAL BALLASTS CIRCLED SEPARATELY (SHADING IMPLIES EMERGENCY LIGHT FIXTURE)
	LIGHTING TRACK WITH LIGHT FIXTURE TYPES AS INDICATED
	EXTERIOR SITE PARKING LOT LIGHT FIXTURE
	EXTERIOR PEDESTRIAN POST TOP LIGHT FIXTURE
	EXTERIOR LIT BOLLARD LIGHT FIXTURE
	EXIT SIGN - CEILING / WALL MOUNTED, ARROWS AS INDICATED, FACE HATCHED
	EMERGENCY LIGHTING UNIT EQUIPMENT WITH BATTERY PACK - CEILING/WALL MOUNTED

WIRING DEVICES & BOXES	
	SIMPLEX RECEPTACLE - NEMA 5-20R, UNO
	DUPLEX RECEPTACLE - NEMA 5-20R, UNO
	DOUBLE DUPLEX RECEPTACLE - NEMA 5-20R, UNO
	SPECIAL RECEPTACLE - NEMA TYPE AS NOTED
	GFCI TYPE RECEPTACLE*
	ISOLATED GROUND TYPE RECEPTACLE*
	EMERGENCY RECEPTACLE*
	RECEPTACLE INSTALLED ABOVE COUNTER OR BACKSPASH*
	RECEPTACLE INSTALLED IN CEILING*
	RECEPTACLE INSTALLED IN FLOOR*
	RECEPTACLE INSTALLED VIA DROP CORD*
	RECEPTACLE LETTER DESIGNATIONS AS FOLLOWS: C = AUTOMATICALLY CONTROLLED D = DEMOLISHED E = EXISTING EM = EMERGENCY POWER ER = EXISTING TO BE RELOCATED GFI = GROUND-FAULT CIRCUIT INTERRUPTER H = HORIZONTALLY MOUNTED IG = ISOLATED GROUND R = RELOCATED, NEW LOCATION S = MANUALLY SWITCHED TR = TAMPER RESISTANT TV = TELEVISION USB = USB-DUPLEX WP = WEATHER PROOF COVER WR = WEATHER RESISTANT
	JUNCTION BOX/OUTLET BOX

*SYMBOL DEMONSTRATED WITH DUPLEX RECEPTACLE, WHEN USED IN COMBINATION WITH OTHER DEVICES MEANING IS SIMILAR FOR THOSE DEVICE TYPES.

TECHNOLOGY DEVICES & BOXES	
	MULTI-OUTLET ASSEMBLY
	TELEPHONE OUTLET
	DATA OUTLET
	MULTI-SERVICE OUTLET; TELEPHONE AND DATA ABOVE COUNTER, TYP WALL TYP (W - HANGING PHONE) FLOOR, TYP
	MULTI-SERVICE POWER POLE WITH TELEPHONE, DATA AND POWER OUTLETS A = TYPE, REFER TO PLANS, SCHEDULES AND SPECIFICATIONS
	MULTI-SERVICE FLOOR BOX WITH TELEPHONE, DATA AND POWER OUTLETS A = TYPE, REFER TO PLANS, SCHEDULES AND SPECIFICATIONS
	POKE THROUGH, A = TYPE, REFER TO PLANS, SCHEDULES AND SPECIFICATIONS
	THERMOSTAT
	LOW-VOLTAGE JUNCTION BOX/OUTLET BOX
	MULTI-DEVICE TV BACKBOX (1-RECEPT, 1-DATA, 1-CABLE, 1-TBD)

A NUMBER ADJACENT TO ANY TECHNOLOGY SYMBOL INDICATES TOTAL QUANTITY OF CABLES AND PORTS TO BE INSTALLED AT THAT LOCATION.
IF A HOME-RUN IS USED ON ANY FLOOR-BOX OR MULTI-OUTLET ASSEMBLY, IT INDICATES THAT POWER IS ALSO TO BE INSTALLED IN THIS DEVICE.

ELECTRICAL ONE-LINE	
	SWITCH (RATING AS INDICATED)
	FUSED SWITCH (RATING, POLES AND FUSE TYPE AS INDICATED)
	CIRCUIT BREAKER (RATINGS AS INDICATED)
	PANELBOARD, SINGLE OR MULTI-SECTION (REFER TO SCHEDULES)
	ISOLATED POWER PANELBOARD W/ INTEGRAL TRANSFORMER (REFER TO SCHEDULES)
	TRANSFORMER (TYPE AND RATINGS AS INDICATED)
	SHIELDED TRANSFORMER (TYPE AND RATINGS AS INDICATED)
	AUTOMATIC TRANSFER SWITCH (RATINGS AS INDICATED)
	AUTOMATIC TRANSFER SWITCH WITH BYPASS (RATINGS AS INDICATED)
	GENERATOR (RATINGS AS INDICATED)
	NON-SEPARATELY DERIVED SOURCE OR SEPARATELY DERIVED SOURCE
	SWITCHGEAR, SWITCHBOARD AND/OR DISTRIBUTION PANELBOARD (TYPE, RATING, DEVICES AND ACCESSORIES AS INDICATED)
	COMBINATION DIGITAL VOLT METER/AMMETER
	CIRCUIT IDENTIFICATION (REFER TO CIRCUIT SCHEDULE)
	SHUNT TRIP
	UTILITY METER (AS REQUIRED BY UTILITY)
	CURRENT TRANSFORMER RATING AS SPECIFIED OR REQUIRED OTHERWISE NOTED
	POTENTIAL TRANSFORMER RATING AS SPECIFIED OR REQUIRED
	SURGE-PROTECTIVE DEVICE
	GROUND CONNECTION
	TEST WELL
	HEATER
	MOTOR
	BLOCK LOAD KW OR KVA
	Fault point REFERENCED IN SHORT CIRCUIT CURRENT AND VOLTAGE DROP SPREADSHEET
	CONNECTION POINT OR EQUIPMENT TERMINATION

PROJECT NOTES	
1.	FULLY COORDINATE ALL WORK WITH GENERAL CONTRACTOR AND ALL SUBCONTRACTORS ON THE PROJECT.
2.	PRIOR TO SUBMITTING PROPOSAL, BIDDER SHALL EXAMINE ALL GENERAL CONSTRUCTION DRAWINGS AND SHALL HAVE VISITED THE CONSTRUCTION SITE.
3.	BIDDER SHALL BE FAMILIAR WITH THE EXISTING CONDITIONS UNDER WHICH THEY WILL HAVE TO OPERATE AND WHICH MAY AFFECT THE WORK.
4.	ELECTRICAL DRAWINGS ARE DIAGRAMMATIC IN NATURE AND AND REPRESENT THE GENERAL SCOPE OF THE WORK AS IT PERTAINS TO THE ENGINEERED SYSTEMS AT HAND. REFERENCE OTHER DISCIPLINES FOR INFORMATION PRIOR TO SUBMITTING AN RF.
5.	NOTIFY THE ARCHITECT/ENGINEER OF ANY CONFLICTS OR DISCREPANCIES AND FOR EXACT LOCATION OF ANY SYSTEM COMPONENTS.
6.	PRIOR TO PURCHASING ANY PANELS, PROTECTIVE DEVICES, SWITCHES, STARTERS, FUSES, CONDUIT, WIRE, ETC., TO FEED ANY PIECE OF EQUIPMENT VERIFY THE VOLTAGE, PHASE, AND LOAD OF THAT ITEM IN THE FIELD OR WITH CURRENT SUBMITTALS TO ENSURE THAT THE PROPER SIZE AND RATINGS OF THE MATERIALS ARE PURCHASED. CONTACT ENGINEER IF THERE ARE ANY INCONSISTENCIES.
7.	VERIFY EXACT LOCATIONS AND ELEVATION OF ALL EQUIPMENT IN THE FIELD WITH THE CONTRACTOR/OWNER REPRESENTATIVE PRIOR TO ROUGH-IN. FINAL CONNECTIONS ON EQUIPMENT SHALL BE PER MANUFACTURERS APPROVED SHOP DRAWINGS, INSTRUCTIONS, AND RECOMMENDATIONS. ALL MATERIALS REQUIRED TO PROVIDE FINAL POWER CONNECTION TO THE EQUIPMENT SHALL BE PROVIDED BY THE ELECTRICAL CONTRACTOR.
8.	ALL WORK SHALL CONFORM TO THE LATEST EDITIONS OF LOCAL, STATE, AND NATIONAL CODES AND ORDINANCES. DRAWINGS AND SPECIFICATIONS GOVERN WHERE THEY EXCEED CODE REQUIREMENTS.
9.	CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT THE PUBLIC AND OWNERS EMPLOYEES FROM DAMAGE, HARM, OR INJURY THROUGHOUT THE COURSE OF CONSTRUCTION AND PROTECT THE ENVIRONMENTAL SURROUNDINGS FROM DAMAGE.
10.	ALL WIRE SHALL BE COPPER UNLESS OTHERWISE NOTED.
11.	ALL CIRCUITS SHALL BE PROVIDED WITH AN INSULATED GREEN GROUNDING CONDUCTOR.
12.	THE CONTRACTOR SHALL EMPLOY QUALIFIED AND EXPERIENCED WORKMEN FOR THIS WORK.
13.	FURNISH ALL LABOR, MATERIALS, TOOLS, ACCESSORIES, ETC. REQUIRED FOR A COMPLETE WORKING ELECTRICAL SYSTEM.

SHEET LIST	
E-100	ELECTRICAL COVER SHEET
E-200	ELECTRICAL POWER PLAN
E-201	ELECTRICAL ROOF PLAN
E-300	ELECTRICAL LIGHTING PLAN
E-400	ELECTRICAL SCHEDULES AND DETAILS
E-401	ELECTRICAL ONE-LINE DIAGRAM AND CALCULATIONS
E-501	ELECTRICAL SPECIFICATIONS 1
E-502	ELECTRICAL SPECIFICATIONS 2
E503	ELECTRICAL SPECIFICATIONS 3

REVISIONS		
MARK	DATE	DESCRIPTION

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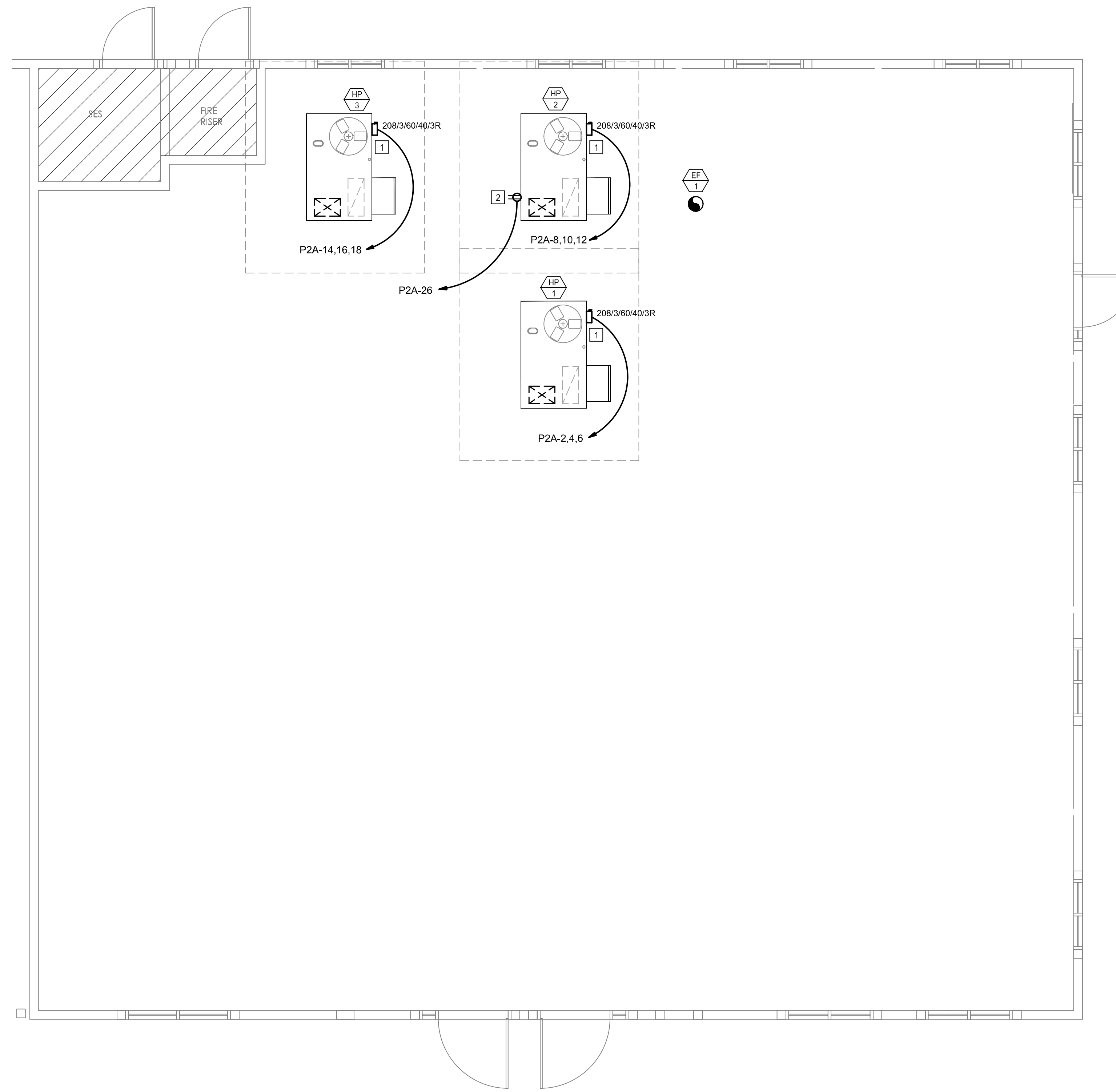
ORIGINAL ISSUE
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JOB No: 1870

SHEET: E-100

SEQUENCE #: 1

OPTIMIZED
Lighting Engineering & Design
842 EAST ISABELLA AVE.
MESA, AZ, 85204
602-699-6224
PROJECT: SPS180030
EOR: BRET LORENZEN
AZ-PE#: 53437 | CA-PE#: 22600
AZ-FIRM#: 21458



SHEET NOTES

1. SEE MECHANICAL DRAWINGS FOR EXACT LOCATIONS.
2. COORDINATE ALL BELOW GRADE CONDUIT, UTILITY STUB-UPS, AND FINAL EQUIPMENT LOCATIONS WITH ALL OTHER TRADES. FINAL COORDINATION IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR.

KEYED NOTES

1. MOUNT NEW EXTERIOR DISCONNECT SWITCH ON MOUNTING RAILS AT ROOF MOUNTED HEAT-PUMP UNIT. PROVIDE PROPER ROOF PENETRATION PER SPECIFICATIONS AND PROVIDE FINAL CONNECTION VIA FLEXIBLE CONDUIT.
2. PROVIDE NEW RECEPTACLE WITH EXTERIOR WATER-PROOF IN-USE COVER MOUNTED ON CONDUIT STUB-UP.

1 ELECTRICAL ROOF PLAN
1/4" = 1'

**TENANT IMPROVEMENT FOR
DR. MARTIN DENTAL OFFICE**

ELECTRICAL - ROOF PLAN

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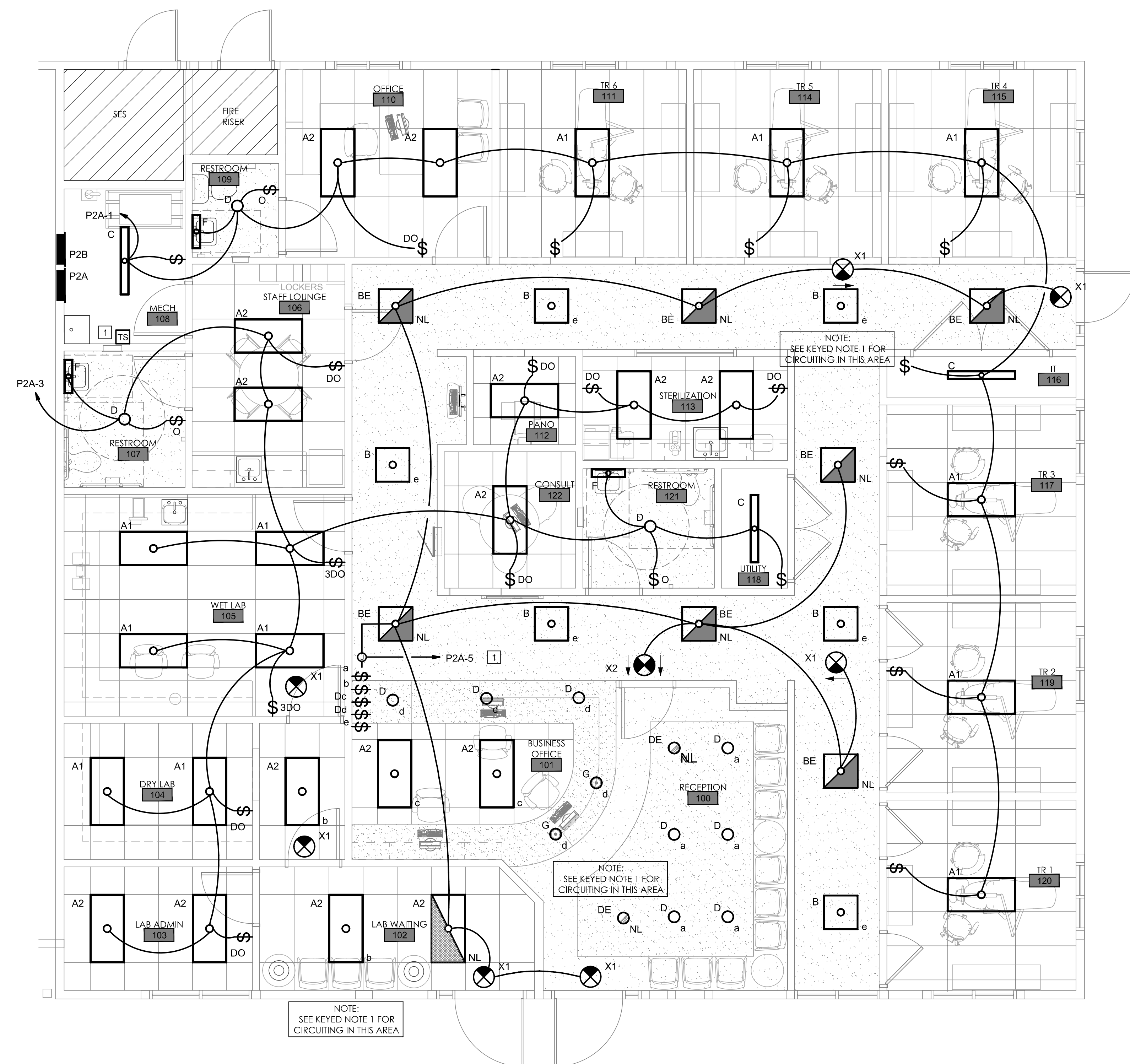
E-201

SEQUENCE #:

OPTIMIZED
Lighting Engineering Design
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PROJECT: SPS180030
EOR: BRETT LORENZEN
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AZ-FIRM#: 21458

SHEET NOTES

- SEE SHEET E-400 FOR LIGHT FIXTURE AND LIGHTING CONTROL SPECIFICATION SCHEDULE.



KEYED NOTES

- PROVIDE NEW 2-ZONE, 2-CIRCUIT ASTRONOMIC TIME-SWITCH (TORK, INTERMATIC OR EQUAL).
- ROUTE THIS CIRCUIT VIA ASTRONOMIC TIME-SWITCH IN MECH 108, CONNECT TO SWITCHES IN THIS LOCATION AND CONTINUE TO ZONES INDICATED.

**TENANT IMPROVEMENT FOR
DR. MARTIN DENTAL OFFICE**

ELECTRICAL - LIGHTING PLAN

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Lighting Engineering & Design
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PROJECT: SPS180030
EOR: BRETT LORENZEN
AZ-PE#: 53437 | CA-PE#: 22600
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LIGHTING AND CONTROL SCHEDULE

TYPE	LOCATION	DESCRIPTION	MANUFACTURER, MODEL	MOUNTING	LIGHT ENGINE			DRIVER		
					TYPE QTY	TEMP CRI	LUMENS EM LUMENS	TYPE	VOLTAGE	WATTS
A1	PATIENT CARE AND LAB AREAS REQUIRING HIGH LIGHT LEVELS	ARCHITECTURAL LED 2X4 TROFFER, SHALLOW 3-1/4" DEEP EXTRUDED ALUMINUM FRAME AND BATWING VOLUMETRIC DISTRIBUTION	EATON/METALUX - 24EN-LD2-67-UNV-L835-CD-1 OMNI - OMJ7-TF-24-50	RECESSED IN CEILING PLANE, VERIFY CEILING TYPE WITH ARCHITECTURAL DRAWINGS PRIOR TO ORDERING TO ENSURE PROPER ACCESSORIES ARE PROVIDED	LED	3500K	6731LM	STANDARD 0-10V DIMMING >9 PF <10%	120V	57
A2	PUBLIC AND OFFICE AREAS REQUIRING LOWER LIGHT LEVELS	SAME AS A1 BUT WITH LOWER LUMEN PACKAGE	EATON/METALUX - 24EN-LD2-45-UNV-L835-CD-1 OMNI - OMJ7-TF-24-35	RECESSED IN CEILING PLANE, VERIFY CEILING TYPE WITH ARCHITECTURAL DRAWINGS PRIOR TO ORDERING TO ENSURE PROPER ACCESSORIES ARE PROVIDED	LED	3500K	4656LM	STANDARD 0-10V DIMMING >9 PF <10%	120V	38
A2E	EMERGENCY LIGHTING IN PUBLIC AND OFFICE AREAS	SAME AS A2 BUT WITH EMERGENCY BATTERY BACK-UP	SAME AS ABOVE WITH EL14W BATTERY BACK-UP	SAME AS ABOVE	LED	3500K	4656LM 2000ELM	STANDARD ELECTRONIC >9 PF <10%	120V	38
B	CORRIDORS	ARCHITECTURAL LED 2X2 TROFFER, SHALLOW 3-1/4" DEEP EXTRUDED ALUMINUM FRAME AND BATWING VOLUMETRIC DISTRIBUTION	EATON/METALUX - 22EN-LD2-34-UNV-L835-CD-1 OMNI - OMJ7-TF-22-28	RECESSED IN CEILING PLANE, VERIFY CEILING TYPE WITH ARCHITECTURAL DRAWINGS PRIOR TO ORDERING TO ENSURE PROPER ACCESSORIES ARE PROVIDED	LED	3500K	3471LM	STANDARD 0-10V DIMMING >9 PF <10%	120V	29
BE	EMERGENCY LIGHTING IN CORRIDORS	SAME AS B BUT WITH EMERGENCY BATTERY BACK-UP.	SAME AS ABOVE WITH EL14W BATTERY BACK-UP	SAME AS ABOVE	LED	3500K	3471LM 1250ELM	STANDARD 0-10V DIMMING >9 PF <10%	120V	29
C	STORAGE, MECHANICAL, UTILITY, AND BACK-OFF-HOUSE ROOMS			SURFACE MOUNT TO CEILING OR SUSPEND WITH CHAIN TO 10' AFF	LED	3500K		STANDARD ELECTRONIC >9 PF <10%	120V	
D	WAITING AREAS AND RESTROOMS	SELF FLANGED ALUMINUM REFLECTOR WITH MEDIUM DISTRIBUTION, 1% 0-10V DIMMING DRIVER, STEEL MOUNTING BARS, AND MET-LOCATION LISTED	EATON/HALO - HC4-15-D010-XX/HM4-12-835-41-MD-HWF	RECESSED IN CEILING PLANE, VERIFY CEILING TYPE WITH ARCHITECTURAL DRAWINGS PRIOR TO ORDERING TO ENSURE PROPER ACCESSORIES ARE PROVIDED	LED	3500K	1500LM	STANDARD ELECTRONIC >9 PF <10%	120V	15
DE	EMERGENCY LIGHTING IN WAITING AREAS AND RESTROOMS	SAME AS D BUT WITH AN EMERGENCY BATTERY BACK-UP.	SAME AS ABOVE WITH REM14 BATTERY BACK-UP	RECESSED IN CEILING PLANE, VERIFY CEILING TYPE WITH ARCHITECTURAL DRAWINGS PRIOR TO ORDERING TO ENSURE PROPER ACCESSORIES ARE PROVIDED	LED	3500K	1500LM 1500ELM	STANDARD ELECTRONIC >9 PF <10%	120V	15
F	ABOVE RESTROOM VANITIES	28" LONG ARCHITECTURAL DAMP LOCATION VANITY FIXTURE WITH SATIN NICKEL FINISH AND MATTE WHITE ACRYLIC DIFFUSER.	OXYGEN - 3-524-3524	WALL MOUNTED AT 8" ABOVE FINISHED FLOOR CENTERED OVER VANITY	LED	3500K	1727LM	STANDARD ELECTRONIC >9 PF <10%	120V	27
G	ABOVE RECEPTION DESK	ARCHITECTURAL SELECTED DECORATIVE GLASS PENDANT	ARCHITECTURAL SPECIFICATION TO BE BELOW SPECIFIED WATTAGE	MOUNT ON JUNCTION BOX AND SUSPEND TO HEIGHT SPECIFIED BY ARCHITECT	LED	3500K		STANDARD ELECTRONIC >9 PF <10%	120V	20
X1	EGRESS PATHWAYS	SINGLE FACE DIE-CAST ALUMINUM RED LED EXIT SIGN		UNIVERSAL MOUNT EXIT SIGN, WALL, CEILING, END INSTALL AS INDICATED ON DRAWINGS. WHEN SHOWN AT DOOR OR OPENING CENTER ABOVE.	LED	RED	-	STANDARD ELECTRONIC >9 PF <10%	120V	5
X2	EGRESS PATHWAYS	DUAL FACE DIE-CAST ALUMINUM RED LED EXIT SIGN		UNIVERSAL MOUNT EXIT SIGN, WALL, CEILING, END INSTALL AS INDICATED ON DRAWINGS	LED	RED	-	STANDARD ELECTRONIC >9 PF <10%	120V	5
	RESTROOMS								120V	
	STORAGE AND SMALL ROOMS	PLASTIC SINGLE ZONE LIGHT SWITCH WITH INTEGRATED PASSIVE INFRARED OCCUPANCY SENSOR AND LIGHT HOLD-OFF DAYLIGHT SENSOR	EATON/GREENGATE - OSW-P-0801-120	RECESSED SINGLE GANG WALL SWITCH, INSTALL WHERE INDICATED ON DRAWINGS	-	-	-	-	120V	-
	ALL STANDALONE ROOMS AND SPACES	PLASTIC SINGLE ZONE LIGHT SWITCH WITH INTEGRATED PASSIVE INFRARED OCCUPANCY SENSOR, 0-10V DIMMING AND LIGHT HOLD-OFF DAYLIGHT SENSOR	EATON/GREENGATE - OSW-P-010	RECESSED SINGLE GANG WALL SWITCH, INSTALL WHERE INDICATED ON DRAWINGS	-	-	-	-	120V	-
	STANDALONE ROOMS AND SPACES WITH 3-WAY SWITCHING	PLASTIC SINGLE ZONE LIGHT SWITCH WITH INTEGRATED PASSIVE INFRARED OCCUPANCY SENSOR, 0-10V DIMMING, 3-WAY SWITCHING, AND DAYLIGHT SENSOR	EATON/GREENGATE - OSW-P-010	RECESSED SINGLE GANG WALL SWITCH, INSTALL WHERE INDICATED ON DRAWINGS	-	-	-	-	120V	-
	MECHANICAL ROOM TO AUTOMATICALLY SHUT-OFF PUBLIC AREA LIGHTING	120/277V 7-DAY ELECTRONIC ASTRONOMIC TIME-SWITCH IN WEATHERPROOF PLASTIC HOUSING. SET ON@5:00AM, OFF@10:00PM.	INTERMATIC - ET8415CR OR EQUAL	RECESSED SINGLE GANG WALL SWITCH, INSTALL WHERE INDICATED ON DRAWINGS	-	-	-	-	120V	-

GENERAL NOTES:
A. BASIS-OF-DESIGN AND ALTERNATE SPECIFICATIONS MAY BE PRICED AND SUPPLIED BY THE APPROVED REGIONAL VENDOR.
B. VERIFY QUANTITIES, MODEL NUMBERS AND DESCRIPTIONS WITH MANUFACTURER PRIOR TO PLACING ORDER.
C. VERIFY FINISH AND COLOR PRIOR TO PLACING ORDER.
D. CATALOG NUMBERS SHALL NOT BE CONSIDERED COMPLETE AND MATERIAL SHALL NOT BE ORDERED BY MANUFACTURER AND CATALOG NUMBERS ONLY. FIRST READ THE COMPLETE DESCRIPTION, NOTES AND SPECIFICATIONS IN CONJUNCTION WITH THE CATALOG NUMBER TO DETERMINE THE EXACT MATERIAL AND ACCESSORIES TO BE ORDERED. THE MANUFACTURES LISTED ARE THE BASIS FOR THE DESIGN.
E. CONTRACTOR SHALL PROVIDE ALL LIGHT FIXTURES UNLESS NOTED OTHERWISE.

TENANT IMPROVEMENT FOR
DR. MARTIN DENTAL OFFICE

ELECTRICAL - SCHEDULES AND DETAILS

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REVISIONS		
MARK	DATE	DESCRIPTION

REVIEWED BY: BSL
DRAWN BY: BSL

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ORIGINAL ISSUE
DATE: 01/08/2019

JOB No: 1870

SHEET:

E-400

SEQUENCE #:

OPTIMIZED
Lighting Engineering & Design
842 EAST ISABELLA AVE.
MESA, AZ, 85204
602-699-6224
PROJECT: SPS180030
EOR: BRETT LORENZEN
AZ-PE#: 53437 | CA-PE#: 22600
AZ-FIRM#: 21458

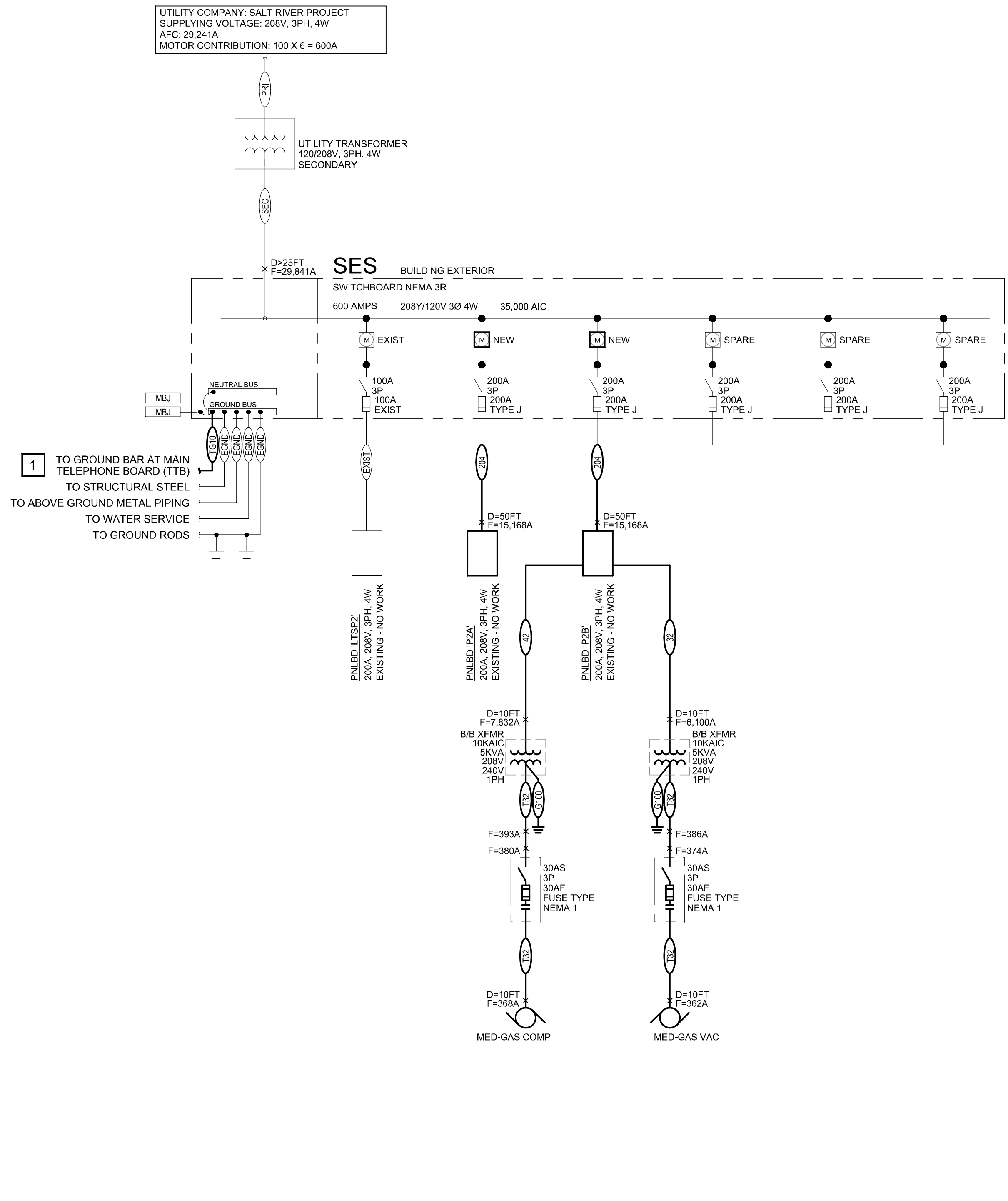
PANELBOARD: P2A (NEW)										FED FROM:										EQUIPMENT GROUND BUS									
BUS AMPS: 225A MAIN SIZE/TYP: MLO VOLTS/PHASE: 208Y/120V, 3PH, 4W SECTION: 1										AIC RATING: 18000 SERVES: BLDG 2 STE 1 MOUNTING: RECESSED LOCATION: MECH ROOM 112																			
CKT NO.	DESCRIPTION	VOLT/AMPS/PHASE			WIRE NO.	BKR AMP	P	BKR AMP	WIRE NO.	P	VOLT/AMPS/PHASE			DESCRIPTION	CKT NO.														
		A	B	C							A	B	C																
1	LTG - PT1-6, OFFICE, MECH	508			12	20	1				3,480			2															
3	LTG - BREAK LAB STERT		594		12	20	1				3,480			4															
5	LTG - CORR BUS WAITING			720	12	20	1				3,480			6															
7	REC - WAITING LAMPS	360			12	20	1				3,480			8															
9	REC - CNTR WET LAB 105		1,080		12	20	1				3,480			10															
11	REC - #41, CNTR WET LAB 105		1,080	1,080	12	20	1				3,480			12															
13	REC - #42, #43 WET LAB 105	1,080			12	20	1				3,480			14															
15	REC - DRY LAB 104		1,080		12	20	1				3,480			16															
17	REC - LAB ADMIN 103			720	12	20	1				3,480			18															
19	REC - LAB GENERAL	540			12	20	1				1,356			20															
21	SPARE				20	1	1				150			22															
23	SPARE				20	1	1				360			24															
25	SPARE				20	1	1							26															
27	SPARE				20	1	1							28															
29	SPARE				20	1	1							30															
31	REC - IT 116				12	20	1							32															
33	REC - IT 116				12	20	1							34															
35	ITEM #60 - COMPRESSOR			2,000	8	40	2							36															
37		2,000												38															
39	ITEM #61 - DRY VACUUM		1,600		10	30	2							40															
41			1,600											42															
SUBTOTAL		4,488	4,354	6,120							11,796	10,590	10,800																
TOTAL PHASE A - VA		16,284																											
AMPS		136																											
TOTAL PHASE B - VA		14,944																											
AMPS		125																											
TOTAL PHASE C - VA		16,920																											
AMPS		141																											
TOTAL PNLBD - VA		48,148																											
AMPS		134																											
TOTAL DEMAND																													
TOTAL PHASE A - VA		16,284																											
AMPS		136																											
TOTAL PHASE B - VA		14,944																											
AMPS		125																											
TOTAL PHASE C - VA		16,920																											
AMPS		141																											
TOTAL PNLBD - VA		48,148																											
AMPS		134																											
TOTAL DEMAND																													
TOTAL PHASE A - VA		16,284																											
AMPS		136																											
TOTAL PHASE B - VA		14,944																											
AMPS		125																											
TOTAL PHASE C - VA		16,920																											
AMPS		141																											
TOTAL PNLBD - VA		48,148																											
AMPS		134																											
TOTAL DEMAND																													

PANELBOARD: P2B (NEW)										FED FROM:										EQUIPMENT GROUND BUS									
BUS AMPS: 225A MAIN SIZE/TYP: MLO VOLTS/PHASE: 208Y/120V, 3PH, 4W SECTION: 1										AIC RATING: 18000 FULLY RATED SERVES: BLDG 2 STE 1 MOUNTING: RECESSED LOCATION: MECH ROOM 112																			
CKT NO.	DESCRIPTION	VOLT/AMPS/PHASE			WIRE NO.	BKR AMP	P	BKR AMP	WIRE NO.	P	VOLT/AMPS/PHASE			DESCRIPTION	CKT NO.														
		A	B	C							A	B	C																
1	REC - PRIVATE OFFICE	900			12	20	1				960			2															
3	REC - RR 107, 109		360		12	20	1				720			4															
5	DISP - STAFF LOUNGE 106			900	12	20	1				720			6															
7	CNTR - STAFF LOUNGE 106	900			12	20	1				720			8															
9	CNTR - STAFF LOUNGE 106		900		12	20	1				960			10															
11	REF - STAFF LOUNGE 106			900	12	20	1				720			12															
13	TV - STAFF LOUNGE 106	720			12	20	1				720			14															
15	REC - CORRIDORS			900	12	20	1				720			16															
17	REC - #73, CONSULT 122, RR			900	12	20	1				960			18															
19	REC - #51 STERI 113	1,440			12	20	1				960			20															
21	REC - #54 STERI 113		1,320		12	20	1				720			22															
23	REC - #52, CNTR STERI 113		720		12	20	1				720			24															
25	REC - #22 STERI 113	1,440			12	20	1				720			26															
27	REC - BUSINESS OFFICE 101		1,620		12	20	1				960			28															
29	REC - WTR CLR RECEPT, 100			360	12	20	1				720			30															
31	REC - TV RECEPT 100, WAIT 102	1,440			12	20	1				720			32															
33	SPARE				20	1	1				720			34															
35	SPARE				20	1	1				960			36															
37	REC - PANO 112	360			12	20	1				900			38															
39	MSC - PANO 112		2,200		12	20	2				2,500			40															
41			2,200								2,500			42															
SUBTOTAL		7,200	7,300	5,980							5,700	7,300	7,300																
TOTAL PHASE A - VA		12,900																											
AMPS		108																											
TOTAL PHASE B - VA		14,600																											
AMPS		122																											
TOTAL PHASE C - VA		13,280																											
AMPS		111																											
TOTAL PNLBD - VA		40,780																											
AMPS		113																											
TOTAL DEMAND																													
TOTAL PHASE A - VA		12,900																											
AMPS		108																											
TOTAL PHASE B - VA		14,600																											
AMPS		122																											
TOTAL PHASE C - VA		13,280																											
AMPS		111																											
TOTAL PNLBD - VA		40,780																											
AMPS		113																											
TOTAL DEMAND																													

PANELBOARD NOTES
 GF PROVIDE GROUND FAULT CIRCUIT BREAKER
 LCK PROVIDE LOCK-OFF PROMIONS

1 ELECTRICAL ONE-LINE DIAGRAM

N.T.S.



FEEDER LEGEND

- PRI EXISTING SERVICE LATERAL
- SEC EXISTING SECONDARY SERVICE FEEDER
- EXIST EXISTING FEEDER - WIRE AND CONDUIT TO REMAIN
- EGND EXISTING SERVICE OR SEPARATELY DERIVED SYSTEM CU GROUND CONDUCTOR
- 20A 200A - (4) #8, #10GND, IN EXISTING CONDUIT
- 4A 40A - (2) #8, #10GND, 3/4" CONDUIT
- 3A 30A - (2) #10, #10 GROUND, 3/4" CONDUIT
- 12A 30A - (2) #10, #8 GROUND, 3/4" CONDUIT
- 8GND #8 COPPER GROUNDING CONDUCTOR
- 10GND #10 COPPER GROUNDING CONDUCTOR

SHEET NOTES

- ALL CONDUCTORS SHALL BE THHN/THWN COPPER WITH 75 DEGREE INSULATION RATING OR HIGHER.

KEYED NOTES

- PROVIDE NEW GROUND CONDUCTOR TO TENANT TELEPHONE MOUNTING BOARD 'TMB' INDICATED ON SHEET E200.

TENANT IMPROVEMENT FOR
 DR. MARTIN DENTAL OFFICE
 ELECTRICAL - ONE-LINE DIAGRAM AND CALCULATIONS

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ORIGINAL ISSUE
 DATE: 01/08/2019

JOB NO: 1870

SHEET:

E-401

SEQUENCE #:

Short-Circuit and Voltage Drop Calculations

Distances are for calculation purposes only and shall not be used for contractor takeoffs nor bidding - Contractor shall notify Engineer of any field condition that results in a change of 10% or greater circuit distance

The following calculations are based on the "Point-by-Point" method where:

$$ISC_{(2)} = ISC_{(1)} \times M_{(1)}$$

$$M_{(1)} = 1 / (1 + f)$$

Feeder: $f_{(30)} = 1.732 \times L \times I_{sc}$ XFMR: $f_{(30)} = \frac{IP(Se) \times V_p \times 1.73 \times \%Z}{100,000 \times KVA}$ $IS_{(200)} = \frac{V_p \times M \times I_{sc(200)}}{V_s}$

Feeder: $f_{(100)} = 2 \times L \times I_{sc}$ XFMR: $f_{(100)} = \frac{IP(Se) \times V_p \times \%Z}{100,000 \times KVA}$

IP = Primary short circuit current
 Vp = Primary voltage
 IS = Secondary short circuit current
 Vs = Secondary voltage
 L = Length of circuit E = Line to line volts
 C = "C" Factor from Bussman table where "C" = 1 / impedance per linear foot

Feeder Types =
 NM - Non Magnetic Conduit, M - Magnetic Conduit, FB - Feeder Busway, PB - Plug-in Busway, TX - Transformer

Fault Point (F#)	Bus/Feeder Description	Source (Fault Point)	Phase	Source Isc (amps)	Feeder		Conductor	Busway C Value	L-L Voltage (E)	Circuit Length (L)	Load Power Factor (pf)	Circuit Load (Amperage)	Conductor		Transformer		Fault Current (amps)	Voltage Drop (%VD)	Cumulative Voltage Drop (%VD)	Fault Point (F#)					
					Conduit Type/TX	Material							Quantity of Parallel Sets and Bus/Phase & Neutral Size	Resistance (R)	Reactance (X)	Across (pf) (Radians)					Type	Degree Rise	KVA	New Xmr Z	Existing Xmr Z
1	Utility Service Point			29,241 at the tenant metering switchboard																1					
	Motor Contribution			100 The connected full load motor amps (includes compressors) on the system																					
2	PANEL P2A	1	3	29841	M	CU	1	Set(s) of 3/0 AWG	12844	--	208	50	0.9	160	0.000079	0.000052	0.451027			0.967	0.51	15168	-0.62%	-0.62%	2
3	PANEL P2B	1	3	29841	M	CU	1	Set(s) of 3/0 AWG	12844	--	208	50	0.9	160	0.000079	0.000052	0.451027			0.967	0.51	15168	-0.62%	-0.62%	3
4	MEDI GAS COMPRESSOR XFMR PRI	3	1	15168	M	CU	1	Set(s) of 8 AWG	1557	--	208	10	0.85	25	0.000780	0.000065	0.554811			0.937	0.52	7832	-0.17%	-0.79%	4
5	MEDI GAS COMPRESSOR XFMR SEC	4	1	7832	TX															16,290	0.06	393		-0.79%	5
6	MEDI GAS COMPRESSOR DISCONNECT	5	1	393	M	CU	1	Set(s) of 10 AWG	981	--	240	10	0.85	20	0.001200	0.000063	0.554811			0.033	0.97	380	-0.18%	-0.97%	6

GENERAL INSTRUCTIONS

A. GENERAL REQUIREMENTS

- All requirements under the architects general and supplementary conditions apply to this section.
- Where the requirements of this section and division exceed those of the general and supplementary conditions, the requirements of this section take precedence
- Become thoroughly familiar with all of its contents as to requirements that affect this section.
- Work required under this section includes all material, equipment, appliances, transportation, services, and labor required to complete the entire system as required by the drawings and specifications, or reasonable inferred to be necessary to facilitate the function of the system and design intent.
- The specifications and drawings for the project are complementary, and any portion of work described in one shall be provided as if described in both
- In the event of discrepancies between specifications and drawings, notify the engineer and request clarification prior to proceeding with the work involved.
- Limitations to drawings:
 - Drawings are graphic representations of the work upon which the contract is based.
 - Drawings show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They convey the scope of work, indicating the intended general arrangement of the systems without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements
 - Contractor shall use the drawings as a guide when laying out the work and to verify that materials and equipment will fit into the designated spaces, and which when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory, and properly operating system
 - Exact location of any component shall be confirmed and/or dimensioned by architect prior to rough-in

B. DEFINITIONS

- Furnish: "to supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."
- Install: "to perform all operations at the project site including, but not limited to, the actual unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."
- Provide: "to furnish and install."
- Furnished by Owner (or Owner-Furnished) or Furnished by Others: "an item furnished by the Owner or under other divisions or contracts, and installed under the requirements of this division, complete, and ready for the intended use, including all items and services incidental to the work necessary for proper installation and operation. Include the installation under the warranty required by this division.
- Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the work under this division, and is a consultant to, and an authorized representative of the Architect, as defined in the General and/or Supplementary Conditions. When used in this division, Engineer means increased involvement by and obligations to the Engineer, in addition to involvement by and obligations to the Architect.
- AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
- NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA), and acceptable to the AHJ over this project. Nationally recognized testing laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ and standards that meet the specified criteria.
- Home-run: That portion of an electrical circuit originating at a junction box, termination box, receptacle, or switch with termination at an electrical panelboard. Note: Where MC cable is utilized for receptacle and/or lighting branch circulating loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box located in an accessible ceiling space as close as possible to the first load.
- Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
- Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
- Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other project requirements but may offer advantage to Contractor or Owner.
- The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, certified, or all three, by an NRTL, and acceptable to the AHJ over this project.

C. PRE-BID SITE VISIT

- Prior to submitting bid, visit the site of the proposed work and become fully informed as to the conditions under which the work is to be done
- Failure to comply with this requirement shall not be considered sufficient justification to request or obtain extra compensation over and above the contract price.

D. MATERIAL AND WORKMANSHIP

- Provide new material, equipment, and apparatus under this contract unless otherwise stated herein, of best quality normally used for the purpose in good commercial practice, and free from defects
- Model numbers listed in the specifications or shown on the drawings are not necessarily intended to designate the required trim, written descriptions of the trim govern model numbers.
- Provide markings or a nameplate for all material and equipment identifying the manufacturer and providing sufficient reference to establish quality, size, and capacity
- All workmanship shall be of the finest possible by experienced mechanics of the proper trade. In general, provide the following quality grade(s) for all materials and equipment.
 - Commercial specification grade:
- Provide all hoists, scaffolds, staging, runways, tools, machinery, and equipment required for the performance of the electrical work. Store and maintain material and equipment in clean condition, and protected from weather, moisture, and physical damage.
- Furnish only material and equipment that are listed, labeled, certified, or all three, by an NRTL whenever any listing or labeling exists for the types of material and equipment specified.
- At a minimum, general work practices for electrical construction shall be in accordance with NECA 1 (latest edition), "Standard Practices for Good Workmanship in Electrical Construction".

E. MANUFACTURERS

- In other articles where lists of manufacturers are introduced, subject to compliance with requirements, provide products by one of the manufacturers specified.
- Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.
- Where manufacturers are not listed, provide products subject to compliance with requirements from manufacturers that have been actively involved in manufacturing the specified product for no less than 5 years.

F. COORDINATION

- Coordinate all work with other divisions and trades so that various components of the

systems are installed at the proper time, fit the available space, and allow proper service access to those items requiring maintenance. Components which are installed without regard to the above shall be relocated at no additional cost to the Owner.

- Unless otherwise indicated, the General Contractor shall provide chases and openings in building construction required for installation of the systems specified herein. Contractor shall furnish the General Contractor with information where chases and openings are required.
- Contractor shall keep informed as to the work of other trades engaged in the construction of the project and shall execute work in a manner as to not interfere with or delay the work of other trades.
- Figured dimensions shall be taken in preference to scale dimensions. Contractor shall take his own measurements at the building, as variations may occur.
- Contractor shall be held responsible for errors that could have been avoided by proper checking and inspection.
- Provide materials with trim that will properly fit the types of ceiling, wall, or floor finishes actually installed.
- Model numbers listed in the specifications or shown on the drawings are not intended to designate the required trim.
- Make all offsets required to clear equipment, beams, and other structural members, and to facilitate concealing raceways in the manner anticipated in the design.

G. ORDINANCES AND CODES

- Work performed under this contract shall, at a minimum, be in conformance with applicable national, state and local codes having jurisdiction.
- Equipment furnished and associated installation work performed under this contract shall be in strict compliance with current applicable codes adopted by the local AHJ, including any amendments and standards as set forth by the following:
 - National Fire Protection Association (NFPA)
 - Underwriters Laboratories (UL)
 - Occupational Safety and Health Administration (OSHA)
 - American National Standards Institute (ANSI)
 - American Society of Testing Materials (ASTM)
 - Rules and regulations of public utilities and municipal departments affected by connection of services.
 - Other national standards and codes where applicable.
- Where the contract documents exceed the requirements of the referenced codes, standards, etc., the contract documents shall take precedence.
- Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent.
- Promptly bring all conflicts observed between codes, ordinances, rules, regulations, referenced standards, and these documents to the attention of the Architect and Engineer for final resolution.
- Contractor will be held responsible for any violation of the law.
- Procure and pay for permits and licenses required for the accomplishment of the work herein described.
- Where required, obtain, pay for, and furnish certificates of inspection to Owner.
- Provide all safety lights, guards, and warning signs required for the performance of the work and for the safety of the public.

H. PROTECTION OF EQUIPMENT AND MATERIALS

- Store and protect from damage equipment and materials delivered to job site.
- For materials and equipment susceptible to changing weather conditions, dampness, or temperature variations, store inside in conditioned spaces.
- For other materials and equipment, cover with waterproof, tear-resistant, heavy tarp or polyethylene plastic as required to protect from plaster, dirt, paint, water, or physical damage.
- Equipment and material damaged by construction activities shall be rejected, and Contractor shall furnish new equipment and material of a like kind at his own expense.
- Keep premises broom clean of foreign material created during work performed under this contract.
- Conduit, equipment, etc. shall have a neat and clean appearance at the termination of the work.
- Plug or cap open ends of conduits while stored and installed during construction when not in use to prevent the entrance of debris into the systems.

I. SUBSTITUTIONS

- Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- To request a substitution, request the Substitution Request Form from the Architect or Engineer. Complete and send the Substitution Request Form for each material, product, equipment, or system that is proposed to be substituted.
- The burden of proof of the merit of the proposed substitution is upon the proposer.
- Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
 - Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects unless stated otherwise in the substitution request.
 - Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
 - Proposed substitution has received necessary approvals of authorities having jurisdiction.
 - Same warranty will be furnished for proposed substitution as for specified Work.
 - If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
 - Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- No substitutions will be considered unless the Substitution Request is completed in-writing and attached with the appropriate substitution documentation.
- No substitution will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.
- If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum.
- Bidders shall not rely upon approvals made in any other way. Verbal approval will not be given.
- Provide factory generated point-by-point calculations for all exterior light fixtures (photometric files supplied so the engineer can generate a point-by-point do not suffice for the point-by-point calculations). Provide interior point-by-point calculations at the discretion of the engineer.

J. SUBMITTALS

- Assemble and submit for review shop drawings, material lists, manufacturer product literature for equipment to be furnished, and items requiring coordination between contractors under this contract.

- Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept.

- Prior to transmitting submittals, verify that the equipment submitted is mutually compatible with and suitable for the intended use, will fit the available space, and maintain manufacturer recommended service clearances.

- If the size of equipment furnished makes necessary any change in location or configuration, submit a shop drawing showing the proposed layout.

- Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus tollfree mailing time via the Architect, plus a duplication of this time for resubmittals, if required.

- Only resubmit those sections requested for resubmittal or that were modified in any other way.

- Submittals shall contain:
 - The project name
 - Applicable specification section
 - Submittal data
 - Equipment identifications acronym as used on the drawings
 - Contractors review stamp

a. The stamp shall certify that the submittal has been checked by the Contractor, complies with the drawings and specifications, and is coordinated with other trades.

f. Manufacturer product literature shall include:

 - Shop drawings
 - Product data
 - Performance sheets
 - Highlight, mark, list, or indicate the materials, performance criteria, and accessories that are being proposed.

e. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

- Requirements to prevent submittal rejection:
 - Submittals and shop drawings shall not contain firm name, logo, the seal, or signature of the Engineer.
 - They shall not be copies of the work product of the Engineer.
 - Separate submittals according to individual specification sections
 - Illegible submittals will be rejected and returned without review
 - Catalog data shall be properly bound, identified, indexed and tabbed
 - Each item or model number shall be clearly marked and accessories indicated
 - Label the catalog data with the equipment identification acronym or number as used on the drawings and include performance curves, capacities, sizes, weights, materials, finishes, wiring diagrams, electrical requirements and deviations from specified equipment or materials.

- Electronic Submittals:
 - Contractor shall submit the documents in accordance with the procedures specified in general and supplementary conditions
 - Contractor shall notify the Architect and Engineer that the submittals have been posted
 - Contractor shall include the website, user name, and password information needed to access the submittals
 - For submittals sent by e-mail, Contractor shall copy the designated representatives of the Architect and Engineer.
 - Contractor shall allow two weeks for the Engineer review time as specified above.

- The checking and subsequent acceptance of submittals by the Engineer and/or Architect shall not relieve the Contractor from responsibility for deviations from the drawings and specifications, errors in dimensions, details, sizes of equipment, or quantities, omissions of components or fittings, coordination of electrical requirements, and not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

K. ELECTRONIC DRAWING FILES

- Electronic drawing files are the intellectual property of the design professional and are covered under United States Copyright laws.
- Requests for electronic drawing files will be considered on a case by case basis.
- Optimized-LED retains the rights to charge for additional usage of the company's intellectual property outside of the original contractual agreement.
- Request shall be made in writing to utilize electronic drawing files for any reason. Email is considered an acceptable form or written request.

L. RECORD DRAWINGS (AS-BUILT DRAWINGS)

- During progress of the work in this division, Contractor shall maintain an accurate record of all changes made during the installation of the system.
- Upon completion of the work, accurately transfer all record information to three identical sets of the approved shop drawings.

M. OPERATION AND MAINTENANCE INSTRUCTIONS

- During the course of construction, collect and compile a complete brochure of equipment furnished and installed on this project.
- Include operational and maintenance instructions, manufacturer's catalog sheets, wiring diagrams, parts lists, approved submittals and shop drawings, warranties, and descriptive literature as furnished by the equipment manufacturer.
- Include an inside cover sheet that lists the project name, date, Owner, Architect, Engineer, General Contractor, Sub-Contractor, and an index of contents.
- Submit a copy of literature bound in approved binders with index and tabs separating equipment types to the Architect, for Engineer's review, at the termination of the work.
- Include Record Drawings as described above.

N. TRAINING

- At a time mutually agreed upon between the Owner and Contractor, train Owner's designated personnel on the operation and maintenance of the equipment provided for this project.
- Provide training to include, but not be limited to, an overview of the system and/or equipment as it relates to the facility as a whole.
- Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention
- Review of data included in the operation and maintenance manuals.
- Notify Owner and Engineer two weeks prior to the scheduled training date to provide the option of attendance on site.
- Submit a certification letter with the following information to the Architect and Engineer stating that the Owner's designated representative has been trained as specified herein. Letter shall include:
 - Date
 - Time
 - Attendees
 - The Contractor and the Owner's representative shall sign the certification letter indicating agreement that the training has been provided.

O. WARRANTIES

- Warrant each system and each element thereof against all defects due to faulty

workmanship, design, or material for a period of 12 months from date of Substantial Completion unless specific items are noted to carry a longer warranty in these construction documents or manufacturer's standard warranty exceeds 12 months.

- Remedy all defects occurring within the warranty period(s) as stated in the General Conditions and Division 01.

- Warranties shall include labor and material, including travel expenses.

- Make repairs or replacements without any additional costs to the Owner, and to the satisfaction of the Owner, Architect, and Engineer.

- Perform the remedial work promptly, upon written notice from the Engineer or Owner.

- Also warrant the following additional items:
 - All raceways are free from obstructions, holes, crushing, or breaks of any nature.
 - All raceway seals are effective.
 - The entire electrical system is free from all short circuits and unwanted open circuits and grounds.

- At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period and any actions the Owner must take in order to maintain warranty status.

- Each warranty instrument shall be addressed to the Owner and state the commencement date and term.

GENERAL MATERIALS AND INSTALLATION

A. BUILDING OPERATION

- Comply with the schedule of operations as outlined in the architectural portions of this specification.

B. EXCAVATION AND BACKFILLING

- Perform excavation and backfill required for installation of underground work under this contract.
 - Trenching:
 - Trenches shall be of sufficient width.
 - Crib or brace trenches to prevent cave-in or settlement.
 - Do not excavate trenches close to columns and walls of new building without prior consultation with the Architect.
 - Use pumping equipment if required to keep trenches free of water.
 - Backfill trenches in maximum 6-inch layers of well tamped dry earth in a manner to prevent future settlement.

- Excavation:
 - Excavation as specified herein shall be classified as common excavation.
 - Common excavation shall comprise the satisfactory removal and disposition of material of whatever substances and of every description encountered, including rock, if any, within the limits of the work as specified and shown on the drawings.
 - Excavation shall be performed to the lines and grades indicated on the drawings.
 - Dispose of excavated materials that are considered unsuitable for backfill, and surplus of excavated material, which is not required for backfill, all to the satisfaction of the Engineer.

C. ROUGH-IN

- Coordinate without delay all roughing-in with other divisions. Conceal all conduit and raceways except in unfinished areas and where otherwise indicated on the drawings.

D. SUPPORT SYSTEMS

- Steel Slotted Support Systems (Slotted Channel): Comply with MFMA-3, factory-fabricated components for field assembly; 12-gauge, 1-5/8-inch by 1-5/8-inch.
- Finishes:
 - Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
 - Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane or polyester coating applied according to MFMA-3.
 - Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-3.
 - Stainless Steel: Type 304, per ASTM A240.
- Manufacturers:
 - Cooper B-Line
 - ERICO International
 - Hilti, Power-Strut
 - Thomas and Betts
 - Unistrut.

- Field Fabrication:
 - Where field cutting of standard lengths of channel are required, make cuts straight and perpendicular to manufactured surfaces.
 - For field-cut or damaged surfaces of coated channels, dress cut ends, damaged surfaces, or both, with an abrasive material (e.g., file, grinding stone, or similar) and cleanser to remove oils, rust, sharp edges, and shards.
 - For channel with a factory-applied coating, re-finish cut edges with a coating compatible with the factory finish and as recommended by the manufacturer (e.g., manufacturer's touch-up paint or zinc-rich cold-galvanizing compound, as applicable).

E. ACCESS DOORS

- Provide access doors for all concealed equipment where indicated or as required, except where above lay-in ceilings.
- Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches.
- Access doors must be of the proper construction for the type of construction in which it is installed.
- Obtain Architect's approval of type, size, location and color before ordering. Provide factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation, concealed hinges, flush screwdriver-operated cam lock, and anchor straps.
- Provide access doors manufactured by:
 - Bar-Co, J.L. Industries
 - Karp Associates
 - Milcor
 - Nystron Building Products
 - Wade
 - Zum.

F. PENETRATIONS

- Coordinate sleeve selection and application with selection and application of fire-stopping specified in Division 07 section "Through-Penetration Firestop Systems."
- Roofs:
 - Coordinate all roof penetrations with Engineer, Owner, and as applicable, the roofing contractor providing a roof warranty.
 - Keep all raceway penetrations within mechanical equipment curbs wherever possible. Coordinate with Division 01.
 - Flash and counterflash all openings through roof, and/or provide pre-fabricated molded seals compatible with the roof construction installed, or as required by the Engineer, Owner, or roofing contractor. All roof penetrations shall be leaktight at the termination of

the work and shall not void any new or existing roof warranties.

- Walls and Floors:
 - Steel Pipe Sleeves for Raceways and Cables: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends, and drip rings.
 - Cast Iron Pipe Sleeves for Raceways and Cables: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - Seals for Rectangular Openings: Galvanized sheet steel with minimum 0.052 [0.138] inch thickness and of length to suit application.

H. FIRESTOPPING

- Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ.
- Manufacturers:
 - Hilti
 - RectorSeal
 - Specified Technologies Inc
 - United States Gypsum Company
 - 3M corp.
- Through and Membrane Penetration Firestopping Systems Product Schedule: Provide UL listing, location, wall or floor rating, and installation drawing for each penetration fire stop system.
- Where project conditions require modification to qualified testing and inspecting agency's illustrations for a particular firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Include qualifications data for testing agency.

I. EQUIPMENT FURNISHED BY OTHERS

- Provide necessary equipment and accessories that are not provided by the equipment supplier or Owner to complete installation of equipment furnished by others in locations as indicated on the drawings, specified herein, or both.
- Equipment and accessories not provided by the equipment supplier may include, but not be limited to, flexible cords and plugs as required for proper operation of the complete system, in accordance with the manufacturers' instructions.
- Contractor shall be responsible for correct rough-in dimensions, and verify them with Architect and/or equipment supplier prior to rough-in and service installations.

J. SYSTEM TESTING AND ADJUSTING

- Adjust, align, and test all electrical equipment on this project provided under this division and all electrical equipment furnished by others for installation or wiring under this division for proper operation.
- Test all systems and equipment according to the requirements in NETA ATS (latest edition) and all additional requirements specified in following sections.

K. EQUIPMENT IDENTIFICATION

- Provide equipment identification nameplates:
 - Switchboards
 - Panelboards
 - Equipment enclosures
 - Access doors
 - Disconnection switches
- Nameplates:
 - Engraved, contrasting color, three-layer, laminated plastic, indicating the name of the equipment, load, or circuit as designated on the drawings and in the specifications:
 - Self-adhering, with a permanent weatherproof adhesive.
 - Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied.
- Nameplate Color:
 - Black background with white letters for Normal Power;
- Letter height:
 - 1/2-inch minimum.

M. SYSTEM START UP

- Perform the following prior to starting up the electrical systems:
 - Check all components and devices and lubricate items accordingly.
 - Tighten screws and bolts for connectors and terminals according to manufacturer's published torque-lightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
 - Adjust taps on each transformer for rated secondary voltage when the transformer is at minimum load.
 - Check and record building's service entrance voltage, grounding conditions, grounding resistance, and proper phasing.
 - Replace all burned-out lamps and lamps used for temporary construction lighting in permanent light fixtures.
 - After all systems have been inspected and adjusted, confirm all operating features required by the drawings and specifications and make final adjustments as necessary.

N. ALTERNATES

- Refer to the architectural portion of the specifications for the list of alternates. Applicable sections of the base specifications apply to all work required by the alternates unless otherwise specified. Determine whether or not and how each alternate affects work. Include labor, materials, equipment, and transportation services necessary for and incidental to the completion of work under each particular alternate. Furnish separate bid for each alternate applicable to work, stating the amount to be added to or deducted from the base bid.

O. ACCEPTANCE TESTING

- Perform acceptance test procedures in accordance with the specifications listed in the Reference Joint Appendices for the Building Energy Efficiency Standards of California. Reference the Non-Residential Certificate of Compliance (NRCC) forms on the drawings for the systems which shall be tested. Submit Non-Residential Certificate of Acceptance (NRCA) forms for each system for which the CLCATT is responsible.

TENANT IMPROVEMENT FOR
DR. MARTIN DENTAL OFFICE
ELECTRICAL - SPECIFICATIONS 1

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REVISIONS		
MARK	DATE	DESCRIPTION

REVIEWED BY: BSL
DRAWN BY: BSL

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PROJECT: SPS180030
EOR: BRETT LORENZEN
AZ-PE#: 53437 | CA-PE#: 22600
AZ-FIRM#: 21458

RACEWAYS

A. METALLIC CONDUIT AND TUBING

- Types:
 - Electrical Metallic Tubing, Couplings, and Fittings (EMT): ANSI C80.3, UL 797. Only steel products allowed. Reduced wall EMT is not allowed.
 - Flexible Metal Conduit (FMC): Zinc-coated steel or aluminum. UL 1. Reduced-wall FMC is not allowed.
 - Intermediate Metal Conduit (IMC): Hot-dip Galvanized Rigid Steel Conduit, ANSI C80.6, UL 1242.
 - Liquidtight Flexible Metal Conduit (LFMC): Flexible steel conduit with PVC jacket. UL 360; fittings: NEMA FB 1.
 - Hot-dip Galvanized Rigid Steel Conduit (GRS): ANSI C80.1, UL 6.
 - Plastic-Coated IMC, RMC, and Fittings: NEMA RN 1, NRTL listed. Coating thickness of 0.04 inches minimum.
 - IMG and RMC Fittings: NEMA FB 1; compatible with conduit type and material. NRTL listed.
- Manufacturers:
 - Western Tube and Conduit
 - Whesland Tube
 - Tycos International
 - Allied Tube and Conduit
 - Republic Raceway

B. NON-METALLIC CONDUIT AND TUBING

- Types:
 - Rigid Nonmetallic Conduit (RNC): Schedule 40 PVC, 90 deg C rated,
 - Electrical Nonmetallic Tubing (ENT): NEMA TC 13, NRTL listed.
 - Liquidtight Flexible Nonmetallic Conduit (LFNC): UL 1660.
 - ENT and LFNC Fittings: Compatible with conduit/tubing type and material, NRTL listed.
- Fittings:
 - NEMA TC 3, TC 6; UL 651, compatible with conduit/tubing type and material, NRTL listed.
- Manufacturers:
 - Amco
 - Canflex
 - Certainteed
 - Prime Conduit
 - Raco,
 - Thomas and Betts.

RACEWAY INSTALLATION

A. GENERAL REQUIREMENTS

- Install raceways parallel and perpendicular to building lines.
- Install raceways to requirements of structure, other work on the project, and to clear all openings, depressions, pipes, ducts, reinforcing steel, and other immovable obstacles.
- Install raceways set in forms for concrete structure in such a manner that installation will not affect the strength of the structure.
- Install raceways continuous between connections to outlets, boxes, and cabinets with a minimum possible number of bends and not more than the equivalent of four 90-degree bends between connections. Use manufactured elbows for all 45- and 90-degree bends, unless approved by the Engineer in advance. Make other bends smooth and even and without flattening raceway or flaking galvanizing or enamel. Radii of bends shall be as long as possible and never shorter than the corresponding trade elbow.
- Use long radius elbows for all underground installations, where necessary, or where otherwise indicated.
- Securely fasten raceways in place with approved straps, hangers, and steel supports as required. Attach raceway supports to the building structure. Hang single raceways for feeders with supports spaced not more than 10 feet. Securely clamp vertical feeder raceways to structural steel members attached to structure. Install cable clamps for support of vertical feeders where required. Add raceway supports within 12 inches of all bends, on both sides of the bends.
- Do not support raceways from suspended ceiling components.
- Ream raceway ends, thoroughly clean raceways before installation, and keep clean after installation. Plug or cover openings and boxes as required to keep raceways clean during construction and fish all raceways clear of obstructions before pulling conductor wires.
- Provide raceways of ample size for pulling of wire, not smaller than code requirements and not less than 1/2-inch in size, unless indicated otherwise on Drawings.
- Homeruns containing more than one branch circuit shall not be less than 3/4-inch in size.
- Protect all raceway installations against damage during construction. Repair all raceways damaged or moved out of line after roughing-in to meet Engineer's approval without additional cost to the Owner.
- Align and install true and plumb all raceway terminations at panelboards, switchboards, motor control equipment, and junction boxes.
- Install approved expansion/deflection fittings where raceways pass through (if embedded) or across (if exposed) expansion joints, and when using RNC or RAC in exposed environments in accordance with NFPA 70 and expansion/contraction properties of RNC or RAC.
- Install a pull wire in each empty raceway that is left for installation of conductors or cables under other divisions or contracts. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 24 inches of slack at each end of pull wire.
- Make all joints and connections in a manner that will ensure mechanical strength and electrical continuity.

B. ABOVE GROUND RACEWAY USE:

- Install all circular raceways concealed above suspended ceilings or concealed in walls or floors wherever possible except where otherwise indicated.
- Provide GRS for all conduits exposed to any forms of damage, physical, chemical, or weather related.
- Unless noted otherwise, all other raceway may be EMT. Use compression type fittings for all conduit 2" and smaller. Use set-screw fittings for all conduit over 2".

C. UNDERGROUND RACEWAY USE:

- Provide GRS installed below grade with a corrosion-resistant bonded-plastic or approved mastic coating. This shall include the 90-degree elbow below grade and the entire vertical transition to above grade.
- RNC conduit may be used underground where permitted by local code and where not specifically restricted by these documents.

D. EQUIPMENT CONNECTIONS

- Use FMC or LMFC (liquid or vapor areas) for final connection to each motor, transformer, and any device that would otherwise transmit motion, vibration, or noise. Provide all FMC and LFMC with an insulated green or bare copper bonding ground conductor.

E. BUSHINGS AND LOCKNUTS

- Rigidly terminate conduits entering sheet metal enclosures to the enclosure with a bushing and locknut on the inside and a locknut or an approved hub on the outside. Conduit shall enter the enclosure squarely.
- Provide bushings and locknuts made of galvanized malleable iron with sharp, clean-cut threads.
- Where EMT enters a box, provide approved EMT compression connectors.

CONDUCTORS AND CABLES

A. CONDUCTORS

- Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL standards 44 or 83 as applicable.
- Aluminum conductor option (conductors 1/0 or larger):
 - Compact stranded, aluminum alloy (AA-8000 series), complying with ICEA S-95-658/NEMA WC70.
 - Increase the raceway size as required, at no additional cost to the Owner, to accommodate the increased size of the aluminum Conductors.
 - Aluminum conductor size shall meet or exceed the ampere rating of the scheduled copper conductors at 75 degrees C.
 - Aluminum conductor shall not be utilized for grounding purposes.
- Copper Conductor Manufacturer:
 - General Cable
 - Southwire
 - US Wire and Cable
 - American Wire and Cable
 - Cable USA
 - Okonite
 - Advance Wire and Cable
 - Encore Wire
- Aluminum Conductor Manufacturer:
 - General Cable
- Conductor Insulation Types: 90-degree C-rated, Type THHN/THWN-2 or XHHW-2 complying with ICEA S-95-658/NEMA WC70.
- Sizes of conductors and cables indicated or specified are in American Wire Gage (AWG - Brown and Sharpe).
- All feeder and branch circuit conductors No. 8 AWG and larger: Stranded.
- All conductors, No. 10 AWG and smaller: Solid copper.
- All Branch Circuit Wiring: Not smaller than No. 12 AWG.
- If no conductor size is indicated on the Drawings for a branch circuit, contact engineer.

- Control Wiring:
 - Stranded copper conductors, 600V insulation, of the proper type, size, and number as required to accomplish specified function. Minimum size: No. 18 AWG, unless noted otherwise.
- Flexible Cords and Cables:
 - Stranded copper conductors for all, unless noted otherwise.

B. TERMINATIONS

- Tinned, mechanical type only; NRTL-listed for copper and aluminum conductors at 75 degrees C minimum.
- Where aluminum conductors terminate existing panelboards, switchboards or switchgear that utilize compression connections use hydraulic-compression type connectors with a zinc base, anti-oxidizing compound. Use compression tools of the type that will not release unless the correct pressure has been applied.
- Measure the temperature of all conductors at all splices and terminations. Make each test under typical building load conditions after the building is occupied and in operation for a minimum of two weeks.
 - Replace all joints or splices indicating excessive heating.
 - Take measurements with a non-contact type infrared thermometer.

C. MC CABLE

- 600V, unjacketed; UL Standard 83, 1569, and 1885; NFPA 70 Article 330.
- Aluminum or galvanized steel interlocked armor
- THHN- or XHHW-insulated conductors
- MC Cable manufacturers:
 - AFC Cable Systems
 - Encore Wire Corporation
 - Southwire.
- May be used:
 - in lieu of flexible conduit and wiring from light fixtures located in accessible ceilings to junction boxes attached to building structure directly above the ceiling. Lengths may not exceed six feet.
 - For device connection within stud walls.
- May not be used (examples may include but are not limited to):
 - Homeruns to panelboards (refer to Section 26: Definitions).
 - Where exposed to view.
 - Where exposed to damage.
 - Hazardous locations.
 - Wet locations.
 - When restricted otherwise.
 - When specifically disallowed by the local AHJ.
 - When specifically disallowed by the landlord.
 - Circuits supplied by an emergency or standby power source.
 - Air return ceiling plenum.

CONDUCTORS AND CABLES INSTALLATION

A. GENERAL REQUIREMENTS

- Install all wiring in approved raceway and enclosures, except where specified or indicated for low-voltage wiring or where type MC cable is indicated or specified as acceptable.
- Install all conductors and cables in raceways continuous without taps or splices. Splice or tap only in approved boxes and enclosures with approved solderless connectors and keep to the minimum required. Insulate all splices, taps, and joints as required by codes.
- All materials used to terminate, splice, or tap conductors shall be NRTL listed for the specific application and conductors involved, and installed in strict accordance with the manufacturer's recommendations.
- In general, the direction of branch circuit "home run" routing is indicated on the drawings, complete with circuit numbers and panelboard designation. Continue all such "home run" wiring to the designated panelboard, as though "circuit runs" were indicated in their entirety.
- At contractor's discretion circuits may be combined to multi-wire branch circuits (i.e., shared neutral). In these instances, they shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point the branch circuit originates. Multi-pole breakers or 3 single-pole breakers with a handle tie are acceptable means.
- When multiple home runs are combined into a single raceway the total circuits shall not exceed three and total current carrying conductors including the neutral shall not exceed 4. Unless specifically indicated on the drawings.
- GFCI Circuits:
 - Provide a dedicated neutral and not be shared.
 - Limit the one-way conductor length to 100 feet between the panelboard and the most remote receptacle or load on the GFCI circuit.
- Label all conductors with vinyl stick-on circuit markers equating to the corresponding circuit number.
- Provide an equipment-grounding conductor or bonding jumper, as applicable, in all feeders and branch circuits, sized in accordance with NFPA 70 Tables 250.66 or 250.122.
- Voltage drop in branch circuits shall not exceed 3 percent.

- Cable Color:
 - Wiring shall have insulation of the proper color to match color code system in the table below unless there is a color system currently in use by the facility, in which case the colors are to match the existing system. In larger sizes where properly colored insulation is not available, use vinyl plastic electrical tape of the appropriate color around each conductor at all termination points, junctions, and pull boxes.
 - System Voltage:

240V and under:
Phase A: Black.
Phase B: Red.
Phase C: Blue.
Neutral: White.
Equipment Ground: Green.
Isolated Ground: Green with yellow stripe.

480V and 480Y/277V:
Phase A: Brown
Phase B: Orange
Phase C: Yellow
Neutral: Gray
Equipment ground: green.

D. MC CABLE

- Secure and support cable per NFPA 70 Article 330. Secure cable within 12 inches of every box or fitting.
- Securing and supporting intervals shall not exceed six feet. Maintain consistent spacing to avoid derating due to bundling per NFPA 70 Section 310.15.
- Utilize steel cable hangers, Arlington SMC series or equivalent, to support wherever possible so cables can be routed in a neat and workmanship like manner.

ELECTRICAL BOXES AND CABINETS

A. GENERAL REQUIREMENTS

- Provide junction boxes, pull boxes, cabinets, and wireways wherever necessary for proper installation of various electrical systems according to NFPA 70 and where indicated on the drawings.
- Size as required for the specific function or as required by NFPA 70, whichever is larger. Construction shall be of a NEMA design suitable for the environment installed.
- Manufacturers:
 - Appleton
 - Cooper
 - Erikson Electrical
 - Hoffman
 - Kilark Electric
 - Raco,
 - Robroy Industries
 - Thomas and Betts
 - Steel City

B. OUTLET BOXES

- galvanized steel knockout boxes, suitable in design to the purpose they serve and the space they occupy.
- Size as required for the specific function or as required by NFPA 70, whichever is larger.
- Set all outlet boxes in walls, columns, floors, or ceilings so they are flush with the finished surface, accurately set, and rigidly secured in position. Provide plaster rings, extension rings and/or masonry rings as required for flush mounting.
- Provide approved cast outlet boxes with hubs and weatherproof covers in all areas subject to damp, wet, or harsh conditions.
- Coordinate locations of outlet boxes prior to rough-in, consult architect for exact locations.
- Applications:
 - Light fixture
 - Switch
 - Receptacles

WIRING DEVICES

A. GENERAL REQUIREMENTS

- The catalog numbers listed for wiring devices are generally for 20A rated devices.
- Where 15A rated devices are indicated on the drawings or required for circuit rating limitations, provide wiring devices equivalent to those specified for 20A, but rated for 15A.
- Minor changes relative to the location of electrical equipment may be made to comply with structural and building requirements as determined in the course of construction, but do not move more than 12" horizontally.
- Contractor shall provide all wiring devices of the same manufacturer and not mixed on the project, to the maximum extent possible. Provide color of toggles and receptacles as requested by the Engineer.

B. WIRING DEVICES

- Shall be commercial grade
- Manufacturers:
 - Cooper
 - Hubbell
 - Legrand
 - Leviton.

C. FLOOR BOXES

- UL 514A listed for scrub water exclusion.
- For slab on grade - Watertight, Class 1, and fully adjustable cast iron box.
- For slab above grade - Concrete-tight, fully adjustable, stamped galvanized steel box.
- Floor box shape, quantity of gangs, type and quantity of devices, finish, and flange type per drawings.
- Manufacturers:
 - Hubbell
 - Legrand
 - Thomas and Betts
 - Walker.

SWITCH AND OUTLET COVER PLATES

A. GENERAL REQUIREMENTS

- Contractor shall provide cover plates by the same manufacturer as the wiring devices; complying with NFPA 70 ARTICLES 406.9 (A) or (B).

B. INDOOR DRY APPLICATIONS

- Colored, smooth nylon [Satin stainless steel] [Polished brass] [as directed by Architect]
- By the same manufacturer as the wiring devices.
- Verify desired colors with Architect before installation.
- Install groups of switches under one ganged-plate, usually horizontally; or, where required by details, vertically. Set all cover plates plumb, parallel, and finished flush with the wall.

ELECTRICAL WIRING DEVICE INSTALLATION REQUIREMENTS

A. GENERAL REQUIREMENTS

- Solidly mount all junction boxes to structural elements.
- Concrete Block Walls: As long as ADA requirements are maintained, dimensions above may be adjusted slightly as required to compensate for variable joint dimensions such that bottom or top of boxes, as applicable, are at block joints.

B. OUTLET BOXES

- Set all outlet boxes in walls, columns, floors, or ceilings so they are flush with the finished surface, accurately set, and rigidly secured in position. Provide plaster rings, extension rings and/or masonry rings as required for flush mounting.
- Unless noted otherwise, install wiring devices vertically aligned at height indicated on construction drawings.

C. MOUNTING HEIGHTS

- Receptacles:
 - Unless indicated otherwise, install vertically with the ground slot mounted at the bottom.
 - Where installed horizontally, install with the neutral slot mounted at the top.
 - Above counter: mount vertically aligned.
 - Mechanical and electrical equipment rooms and janitors closets: mount vertically aligned.
 - Garages: mount vertically aligned.
 - Weatherproof exterior receptacles: vertically aligned.
 - GFCI receptacles: Same as general receptacles.
 - Isolated ground receptacles: Same as general receptacles.
- Switches:
 - All switches shall be mounted at the same height throughout the project unless noted otherwise.
 - Above Counters: Same as for receptacles.
 - Walls with Wainscoting: 6 inches minimum above wainscoting, but not exceeding 48 inches above finished floor.
- Communication devices:
 - Match mounting height of adjacent wiring device listed above.
 - Wall-mounted Telephone (Public): One at 48 inches above finished floor and one at 36 inches above finished floor.
 - For other than wiring devices, refer to paragraphs, articles, sections, divisions, or drawings to obtain mounting heights for specific equipment or systems.

ELECTRICAL SERVICE AND GROUNDING

A. ELECTRICAL SERVICE

- See one-line diagram for the following information:
 - Equipment Type
 - Size
 - Voltage
 - Phase
 - NEMA Ratings
 - Existing or New Equipment
- Site voltage verification:
 - Coordinate with the serving utility to ensure that provided voltage at project site is within acceptable limits (+/- 2.5%).
 - Arrange correcting means with the serving utility prior to installation to provide proper regulation voltage to the project site.
- Submit to the Owner a report of maximum and minimum voltage and a copy of the recording voltmeter chart.

B. GROUNDING

- Permanently and effectively ground and bond the electrical installation in a thorough and efficient manner.
- All grounding shall meet or exceed the requirements of NFPA.
- Where grounding on plans indicates grounding above minimum code requirements, drawings shall take precedence.
- Use bare or green insulated conductors as specified herein, and other materials indicated on the Drawings.

DISTRIBUTION AND CONTROL EQUIPMENT

A. LIGHTING AND APPLIANCE PANELBOARDS

- Panelboards:
 - Complete with bolt-on thermal magnetic, molded case circuit breakers
 - Dead-front finished cabinet
 - Fully- [or] [Aeries-] rated and with the integrated short circuit current ratings indicated on the drawings
 - All two- and three-pole breakers shall be of the common trip type.
 - Typewritten card directory indicating exactly what each circuit breaker controls fully- [or] [series-] rated and with the integrated short circuit current ratings indicated on the drawings
- GFCI Circuit Breakers:
 - Single- and two-pole configurations with Class A ground-fault protection (6-mA trip). Use as indicated on drawings.
- Ground-Fault Equipment Protection (GFEF) Circuit Breakers:
 - Class B ground-fault protection (30-mA trip). Use as indicated on drawings.
- Handle Clamp:
 - Loose attachment for holding circuit breaker handle in "on" position
 - Use for all circuits containing emergency lighting loads, fire alarm loads, and as indicated on drawings
 - Breakers serving fire alarm loads must have a permanently-affixed red label stating "FA" in white letters adjacent to the circuit breaker.
- Handle padlocking device:
 - Fixed attachment for locking circuit breaker handle in "on" or "off" position. Use as indicated on drawings.
- Manufacturers:
 - Square D
 - Eaton
 - G.E.
 - Siemens.

OVERCURRENT PROTECTIVE DEVICES

A. MOLDED CASE CIRCUIT BREAKERS

- Comply with:
 - UL 489
 - NEMA AB1
 - NEMA AB3

- Short Circuit Interrupting capacity shall exceed the value indicated on the drawings.

- Thermal Magnetic breakers:

- Standard frame, trip, and number of poles
- inverse time-current element for low-level overloads
- Magnetic trip element for short circuits
- Magnetic element shall be adjustable for breakers over 250A.

- Adjustable Instantaneous-Trip Breakers:

- 200A and larger
- Magnetic trip element with front-mounted, field-adjustable trip settings.

- Electronic Trip Circuit Breakers:

- 400A and larger
- Field replaceable rating plug with rms sensing
- Instantaneous trip setting
- Long and short time pickups
- Long and short time adjustments
- Ground fault pickup level

- Current Limiting Circuit Breakers:

- 400A and smaller
- Provide a short circuit let-through less than NEMA FU-1, RK-5

- Ground Fault Circuit Breaker

- Standard frame, trip, and number of poles
- Class A ground fault 6mA trip

- Ground Fault Equipment Protection Breaker:

- Standard frame, trip, and number of poles
- Class B ground fault 30mA trip

- Optional Features

- Optional ground fault protection
- Communication module compatible with power monitoring
- Shunt-trip coils
- Auxiliary contacts
- Alarm switch
- Key-interlock kit - externally mounted to lock breaker in off-position without key
- Zone selective interlocking using electronic trip unit
- Electrical operator with control buttons
- 24Vac, 12Vac, 120Vac, 208Vac, 240Vac, 6Vdc, 122Vdc, 24Vdc Accessory control power voltage output

- Circuit Breaker within Existing Panelboards

- Provide new circuit breakers for installation in existing panelboards/switchboards, of the same manufacturer and type as the existing panelboard/switchboard circuit breakers.
- Short circuit current interrupting rating of any new breaker shall be the larger of the existing panel rating or the available fault current indicated on the drawings.

B. FUSES

- Provide each circuit and set of fuse clips throughout the work with sizes and types as required or indicated.
- All fuses larger than 600A:
 - UL Class L, similar to type KRP-C Bussmann Low Peak or equal.
- Fuses used to protect motors:
 - UL Class RK5, Bussmann Fusetron or equal.
- Fuses used to protect all other electrical equipment:
 - UL Class RK1, dual element, Bussmann LPS/LPN or equal.
- All fused devices shall be labeled as to type and size of fuse required.
- Furnish three spare fuses of each size and type used on the project (except for main switch fuses, furnish one spare), neatly contained in a properly labeled cabinet.

- Manufacturers:

- Bussmann
- Edison Fuse
- Mersen/Ferraz Shawmut
- Littlefuse.

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REVISIONS		
MARK	DATE	DESCRIPTION

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TENANT IMPROVEMENT FOR
DR. MARTIN DENTAL OFFICE

ELECTRICAL - SPECIFICATIONS 2

SAFETY SWITCHES

A. DISCONNECT (SAFETY) SWITCHES

- Disconnect (Safety) Switches:
 - Heavy-duty, fused or non-fused (as indicated on drawings or required) NEMA KS1, externally operated, visible-blade safety switches
 - NEMA enclosure type indicated on the drawings or suitable for the environment in which installed.
 - Based on fusible switch and fuse sizes indicated, include Class R, J, or L fuse provisions as applicable.
 - Where indicated, provide fusible switches permanently labeled as suitable for use as service entrance equipment
 - Provide integral and separate neutral and ground assemblies, suitable for the sizes of conductors indicated
- Provide switches where not furnished with the starting equipment, at all other points required by NFPA 70, and where indicated on the drawings.
- Where indicated, provide shunt-trip disconnect switch, Bussmann power module switch or approved equal, with a fire protection interface relay and auxiliary contacts.
- Manufacturers:
 - Square D
 - Eaton
 - G.E.
 - Siemens.

B. MOTOR STARTING SWITCHES

- Motor starting switches shall consist of a toggle operated two- or three-pole switch
- Contacts shall be double break silver alloy, visible from both sides of the switch, and shall have a direct linkage to the operator for positive break
- Provide flush mounted units in finished areas and surface mounted units in unfinished areas. Starters shall have NEMA I general purpose enclosure, unless otherwise indicated, and be rated for the motor horsepower required. Provide handle guard with locking provisions.
- Integral horsepower manual controller manufacturers:
 - Square D Class 2510 Type K
 - Eaton 9115 series
 - G.E. TC2000 series
 - Siemens MS series
 - Westinghouse MST series.

LIGHT FIXTURES, LAMPS AND BALLASTS

A. LIGHT FIXTURE LOCATIONS

- Light fixtures shown on the drawings represent general arrangements only
- Refer to architectural drawings and coordinate with architect for exact locations.
- Coordinate location with all other trades before installation to avoid conflicts.
- Coordinate light fixture locations in mechanical rooms with final installed piping and ductwork layouts.

B. LIGHT FIXTURES

- Provide light fixtures as scheduled on drawings, including any lamps, and necessary accessories for a complete and operational system
- Light fixture model numbers scheduled on the drawings are complete and current according to the latest information available at the time of specification. Model number shall be confirmed with description by providing vendor.
- Provide material and labor to securely hang, clean, and make light fixtures completely ready for use.
- Provide all hangers, supports, and miscellaneous hardware required to install light fixtures, proper trim to fit each ceiling condition actually encountered, and additional tie wires connected to structure to conform to seismic requirements where required by the applicable building code.
- Packaging of light fixtures and controls is not acceptable and will be strictly enforced. Packaged price will be confirmed with contractor and failure to provide separate line items will result in complete submittal rejection.
- Where the Light Fixture Schedule indicates an allowance for a specific light fixture, the price is a Contractor price. Include all additional costs for freight, lamps, and installation of light fixture and lamps.
- Install all light fixtures located in areas without ceilings immediately below the roof-framing members, or suspended from chain hangers suitable in length to provide the indicated mounting height.
- Through-wiring of recessed light fixtures in suspended ceilings is not permitted. Connect each light fixture by a whip to a junction box. Provide cable whips of sufficient lengths to allow for relocating each light fixture within a 5-foot radius of its installed location, but not exceeding 6 feet in unsupported lengths.

C. EMERGENCY LIGHTING AND EXIT SIGNS

- Battery:
 - Sealed, maintenance-free, lead-acid type
 - Suitable rating and capacity to supply and maintain at not less than 87-1/2 percent of the nominal battery voltage for the total lamp load associated with the unit for a period of at least 90 minutes
 - Equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 90 minutes.
- Charger:
 - Fully automatic, solid-state type with sealed transfer relay.
- Operation:
 - Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below
 - Automatically disconnects from battery when voltage approaches deep-discharge level
 - When normal voltage is restored, relay disconnects from battery, and battery is automatically recharged and floated on charger.
- Test Push Button:
 - Push-to-test type, in unit housing, simulates loss of normal power, and demonstrates unit operability.

- LED Indicator Light:
 - Indicates normal power on. Normal glow indicates trickle charge, and bright glow indicates charging at end of discharge cycle.

D. LAMPS

- Provide lamps and color temperatures as indicated on the drawings for all light fixtures
- Incandescent Lamps:
 - Type and wattage as shown on the drawings; rated 130V unless otherwise scheduled or specified.
- Manufacturers:
 - Eiko
 - G.E.
 - Osram/Sylvania
 - Philips
 - Soraa
 - Venture.
- LED Lamps and Luminaires:
 - Comply with ANSI C78.377 for white light LED color range
 - Minimum CRI of 80 unless noted otherwise
 - LED binning specification tolerance to be within 3 macadam ellipses of rated values
 - All LEDs used for same fixture type throughout the project must originate from the same production bin
 - Minimum average rated life of 20,000 hours for LED lamps and 50,000 hours for LED luminaires
 - Rohs compliant.
- LED lamp manufacturers:
 - Bridgelux
 - Cree
 - Nichia
 - Osram
 - Philips

E. BALLASTS AND DRIVERS

- General Requirements:
 - Sound levels not exceeding Class A ambient noise levels
 - Line transient withstand ratings as defined in ANSI/IEEE C62.41, Category A; lamp current crest factor of 1.7 or less; 95-percent power factor or greater; low heat type; thermally protected against overheating.
- LED Drivers:
 - Comply with NRTL requirements and ANSI C82.77
 - Designed for type and quantity of lamps served
 - Total harmonic distortion less than 20 percent
 - Tolerate sustained open circuit and short circuit output conditions without damage
 - Shall not over-drive LEDs at a current or voltage above LED rated values
 - ROHS compliant; meets EN61000 requirements for input harmonics

F. DIMMABLE LIGHT FIXTURES

- For dimmable light fixtures provide both control and power wiring between light fixture and control device and between light fixtures
- Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations
- Coordinate light fixture and control device dimming types for compatibility.

LIGHTING CONTROL DEVICES

A. TIME SWITCHES

- Electronic digital astronomical, type as indicated, with manual override switch
- NEMA enclosure suitable for the environment installed
- Number and types of contacts, sequence, and voltage as indicated on the drawings, or as required, based on the time switch function and the number of branch circuits or contactors controlled
- Provide wiring to photocells, contactors, relays or other control points as required.
- Manufacturers:
 - Intermatic
 - Paragon
 - Tork.

B. IN-WALL ELECTRONIC OCCUPANCY SENSORS

- Electronic digital occupancy sensors set for 50% on upon entry, manual control, and turn-off after 10 minutes of no activity.
- Provide technology types listed in lighting control schedule or notes on the drawings:
 - Passive Infrared - Direct line-of-sight monitoring of heat moving between zones
 - Micophone - Monitoring of sound activity within the space
 - Ultrasonic - Monitoring of disruptions in non-audible sound waves within the space
 - Dual-Technology - Combination of Passive Infrared and another technology
- Shall have the following control settings and features specified in the lighting control schedule:
 - Time-delay adjustment from 5min - 60min
 - Adjustment of daylight sensor from 200 - 1000fc
 - Sensitivity adjustment from low - high
- Provide the following features specified in the lighting control schedule:
 - Embedded 0-10V dimming functionality
 - Embedded dual-relay operation technology
 - Architecturally pleasing
- Manufacturers:
 - Lutron
 - Wattstopper
 - Leviton
 - Leviton
 - Eaton/Greengate

MISCELLANEOUS ELECTRICAL

A. WIRING OF MECHANICAL EQUIPMENT

- Provide all raceways and power wiring for all Division 23 equipment requiring electrical connections, including but not limited:
 - Pumps
 - Water heaters
 - HVAC equipment
 - Line-voltage control and interlock wiring not provided under Division 23.
- Connect per manufacturers' wiring diagrams
- Coordinate with mechanical contractor for disconnects and variable frequency drives (VFD) furnished with equipment
- Provide all disconnect switches and final connections as required
- After installing wiring, verify that each motor load has the correct phase rotation.
- Verify the actual "Maximum Overcurrent Protection" (MOCP) device ratings and "Minimum Circuit Ampacity" (MCA) conductor sizing for mechanical equipment from the equipment nameplat
- Verify actual electrical requirements with mechanical equipment submittals and nameplates prior to rough-in. Provide properly sized electrical wiring and equipment without extra cost to the Owner. Notify the Engineer of all changes required in the electrical installation due to equipment variances so that the effects on feeders, branch circuits, panelboards, fuses and circuit breakers can be checked prior to purchasing and installation.
- Contractor is responsible for coordinating with mechanical contractor to verify the actual ampacities and correct sizes of all conductors and overcurrent protective devices for all equipment.

B. OTHER EQUIPMENT AND CONNECTIONS

- All wiring and connections to equipment furnished by others.
- All raceways, wiring, and connections of devices to energy management system that are not the responsibility of Division 23.
- All wiring and connections of exit door alarms.

LOW VOLTAGE SYSTEMS

C. TELEPHONE SYSTEM PROVISIONS

- Provide incoming telephone service raceways as indicated on drawings or as required by the serving telephone company
- Provide 3/4-inch thick plywood board, fire-retardant-treated and stamped FRT, securely anchored to the wall, at the location and of the size as indicated on the drawings
- Provide flush mounted telephone outlet boxes with 1 inch conduit stub-up with pull-string concealed to accessible ceiling space at locations as indicated on the drawings.

B. DATA SYSTEM PROVISIONS

- Provide flush mounted data outlet boxes with 1 inch conduit stub-up with pull-string concealed to accessible ceiling space at locations as indicated on the drawings.