

Amphitheater Public Schools

Amphitheater High School

GENERATORS

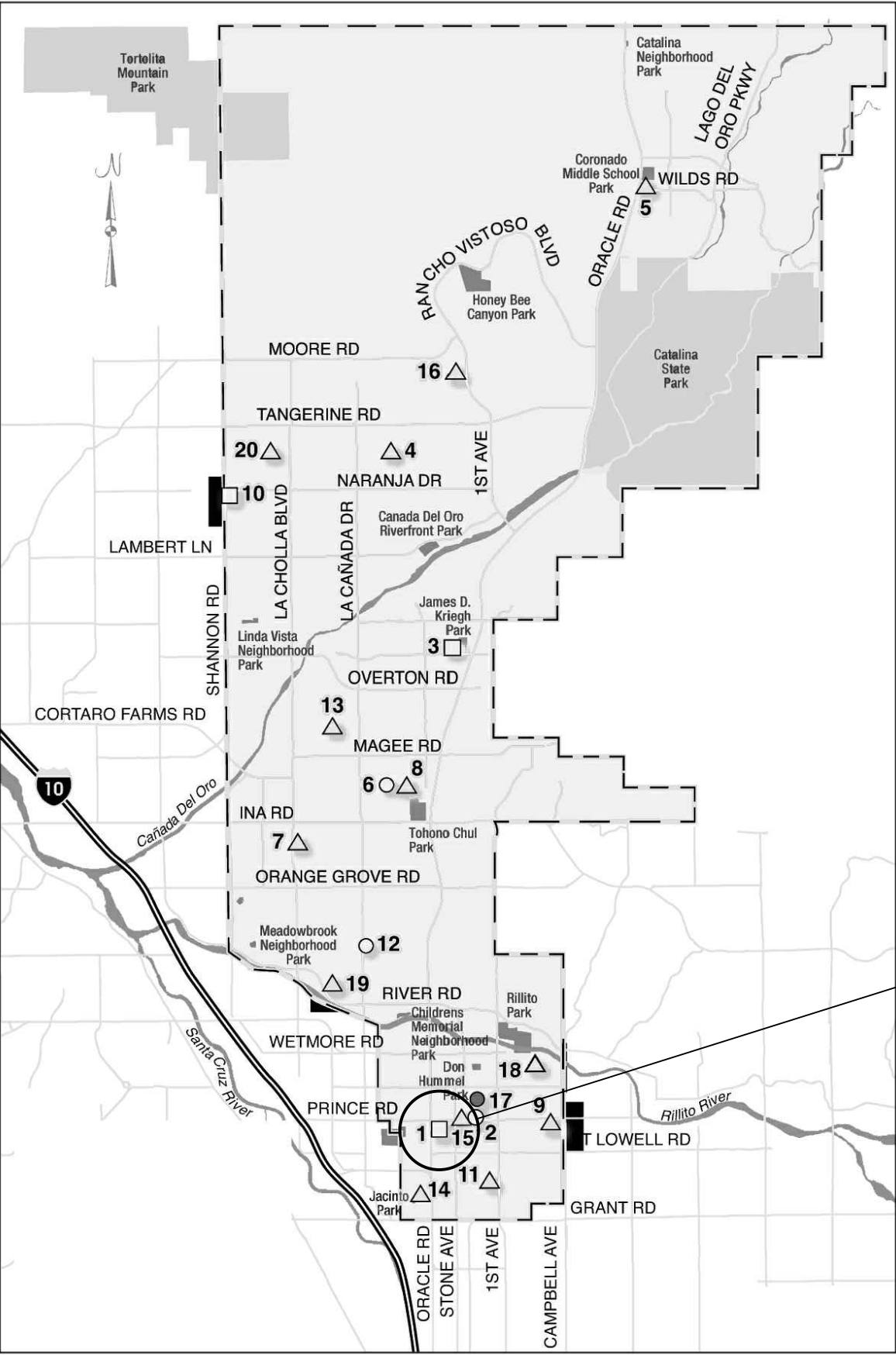
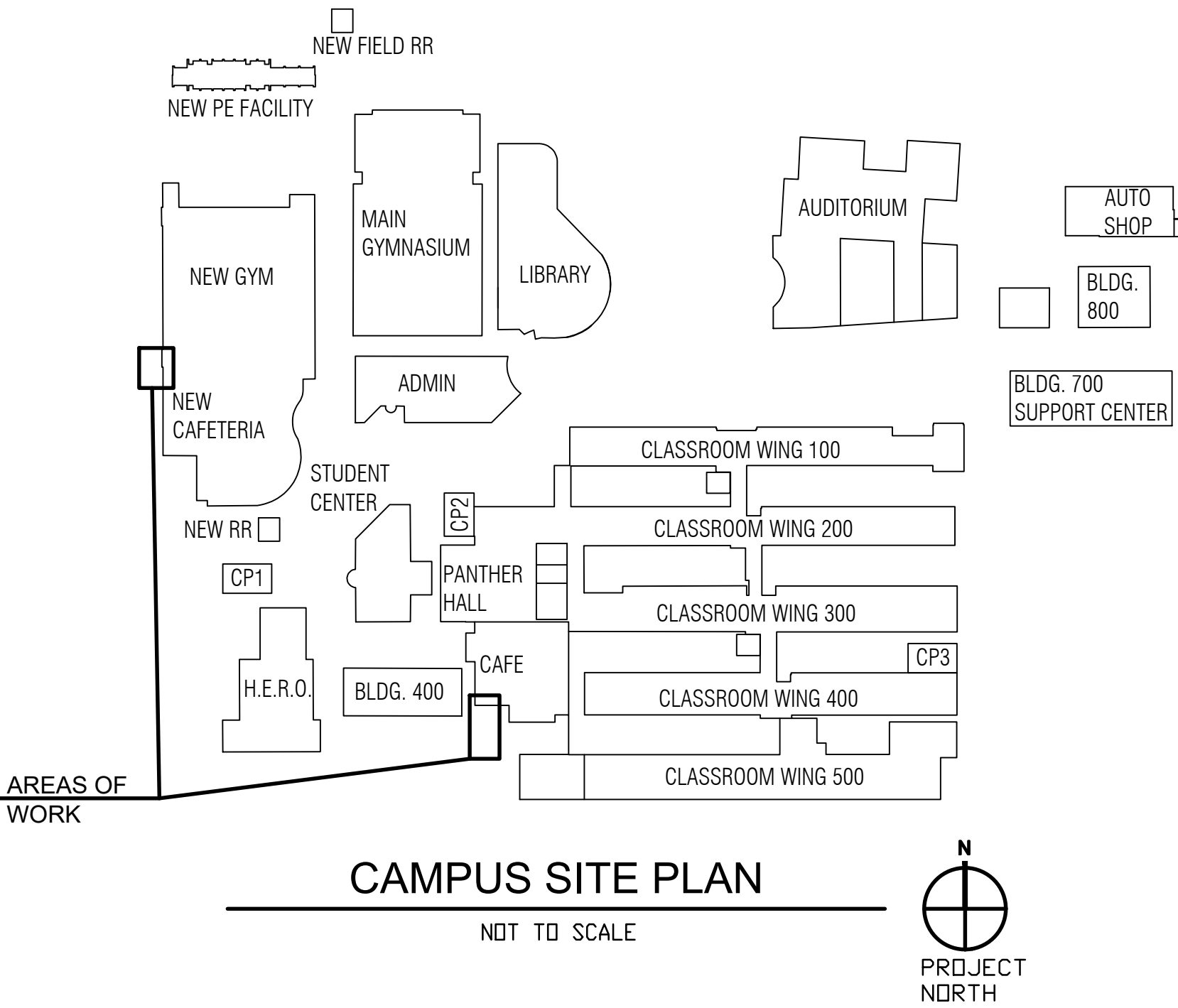
Amphitheater High School
125 W. Yavapai Rd., Tucson, Az., 85705

100% CONSTRUCTION DOCUMENTS
04/06/2023

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DESCRIPTION OF WORK

THIS PROJECT INCLUDES BUT IS NOT LIMITED TO THE REMOVAL OF EXISTING ELECTRICAL FEEDERS AND INSTALLATION OF NEW GAS NATURAL STAND BY GENERATORS, AUTOMATIC TRANSFER SWITCHES, EMERGENCY PANELS AND ASSOCIATED FEEDERS/CONTROLS.



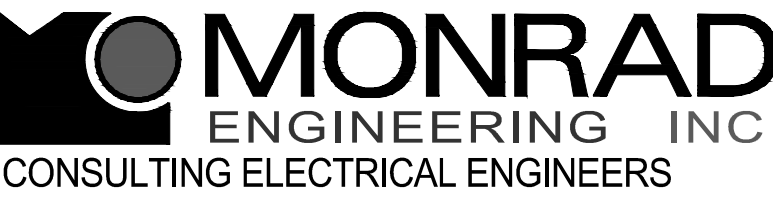
OWNER

AMPHITHEATER PUBLIC SCHOOL DISTRICT
701 W. WETMORE ROAD
TUCSON, ARIZONA 85705
www.amphi.com
ph: 520.696.5000
Contact: Kevin Chester



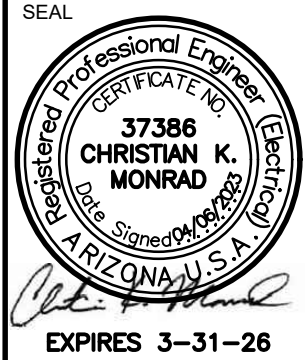
ELECTRICAL ENGINEER

MONRAD ENGINEERING INC.
1926 E. FORT LOWELL ROAD SUITE 200
TUCSON, ARIZONA 85719
www.monraengineeringinc.com
ph: 520.884.0045
Contact: Chris Monrad



MECHANICAL ENGINEER

KELLY - WRIGHT ASSOCIATES - PC
737 E. Tanque Verde Rd.
TUCSON, ARIZONA 85715
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Contact: Donovan Kelly



REV.	DATE	DESCRIPTION

AMPHITHEATER PUBLIC SCHOOLS
AMPHITHEATER HIGH SCHOOL
IT GENERATORS
125 W. Yavapai Rd. Tucson, Arizona 85705

TITLE SHEET

Project Number	M22110
Drawn By	SV
Checked By	CM
Date	4/06/2023
Scale	AS-SHOWN
DRAWING NO.	E0.0

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ELECTRICAL SITE NOTES

- A. LOCATE AND PROTECT UNDERGROUND UTILITIES PRIOR TO START OF WORK. REPAIR OF DAMAGED UTILITIES SHALL BE AT CONTRACTOR EXPENSE.
- B. CUT, PATCH, AND RESTORE ALL FINISHES DISTURBED BY NEW WORK. WHERE TRENCHING OCCURS, RESTORE ALL SURFACES TO MATCH THOSE EXISTING PRIOR TO TRENCHING ACTIVITIES.
- C. ALL CONDUIT SHALL BE CONCEALED IN BUILDING.
- D. ALL PENETRATIONS THROUGH EXTERIOR WALL AND ROOFS SHALL BE SLEEVED, FLASHED AND SEALED WATERPROOF. PROVIDE ESCUTCHEON PLATES WHERE WALL PENETRATIONS ARE EXPOSED.
- E. ALL CONDUCTORS INSTALLED AT EXTERIOR AND/OR ABOVE ROOF SHALL BE THWN OR XHHW-2 TYPE.
- F. ELECTRICAL SITE FROM ONLINE SOURCE, SITE VISIT AND LIMITED RECORD DRAWINGS, VERIFY ALL LENGTHS/DIMENSIONS ON SITE.

ELECTRICAL KEYNOTES THIS SHEET ONLY

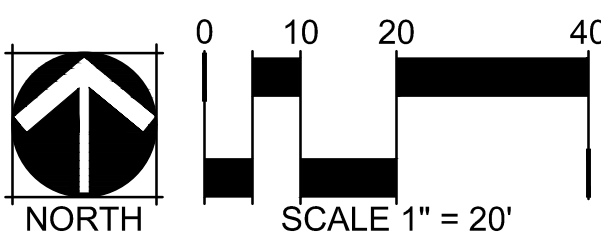
- 1. NEW 60kW/75kVA, 277/480V-3Ø-4W EMERGENCY NATURAL GAS GENERATOR. OBTAIN APPROVED FOOTPRINT WITH NEC WORKING CLEARANCES BEFORE START ANY WORK, REFER TO ONE LINE DIAGRAM ON SHEET E1.
- 2. NEW 60kW/75kVA, 120/208V-3Ø-4W EMERGENCY NATURAL GAS GENERATOR. OBTAIN APPROVED FOOTPRINT WITH NEC WORKING CLEARANCES BEFORE START ANY WORK, REFER TO ONE LINE DIAGRAM ON SHEET E2.
- 3. PROJECTION OF BUILDING INTERIOR ELECTRICAL EQUIPMENT, VERIFY ALL EXISTING CONDITIONS.
- 4. EXISTING TEP TRANSFORMER TO REMAIN, LOCATE AND PROTECT EXISTING U.G. PRIMARY AND SECONDARY FEDERS.
- 5. PROVIDE REMOVABLE STEEL CONCRETE FILLED BOLLARDS FOR EQUIPMENT PROTECTION, PROVIDE NEC WORKING CLEARANCES.

Call at least two full working days before you begin excavation.

ARIZONA 811
Arizona Blue Stake.

Dial 8-1-1 or 1-800-STAKE-IT (782-6348)
In Maricopa County: (602) 263-1100

1 PARTIAL ELECTRICAL SITE PLAN
1" = 20'-0"



LOCKOUT - TAGOUT - TESTOUT

MONRAD
ENGINEERING INC
CONSULTING ELECTRICAL ENGINEERS
1928 East Ft. Lowell Road, Suite 200
Tucson, Arizona 85716-2391
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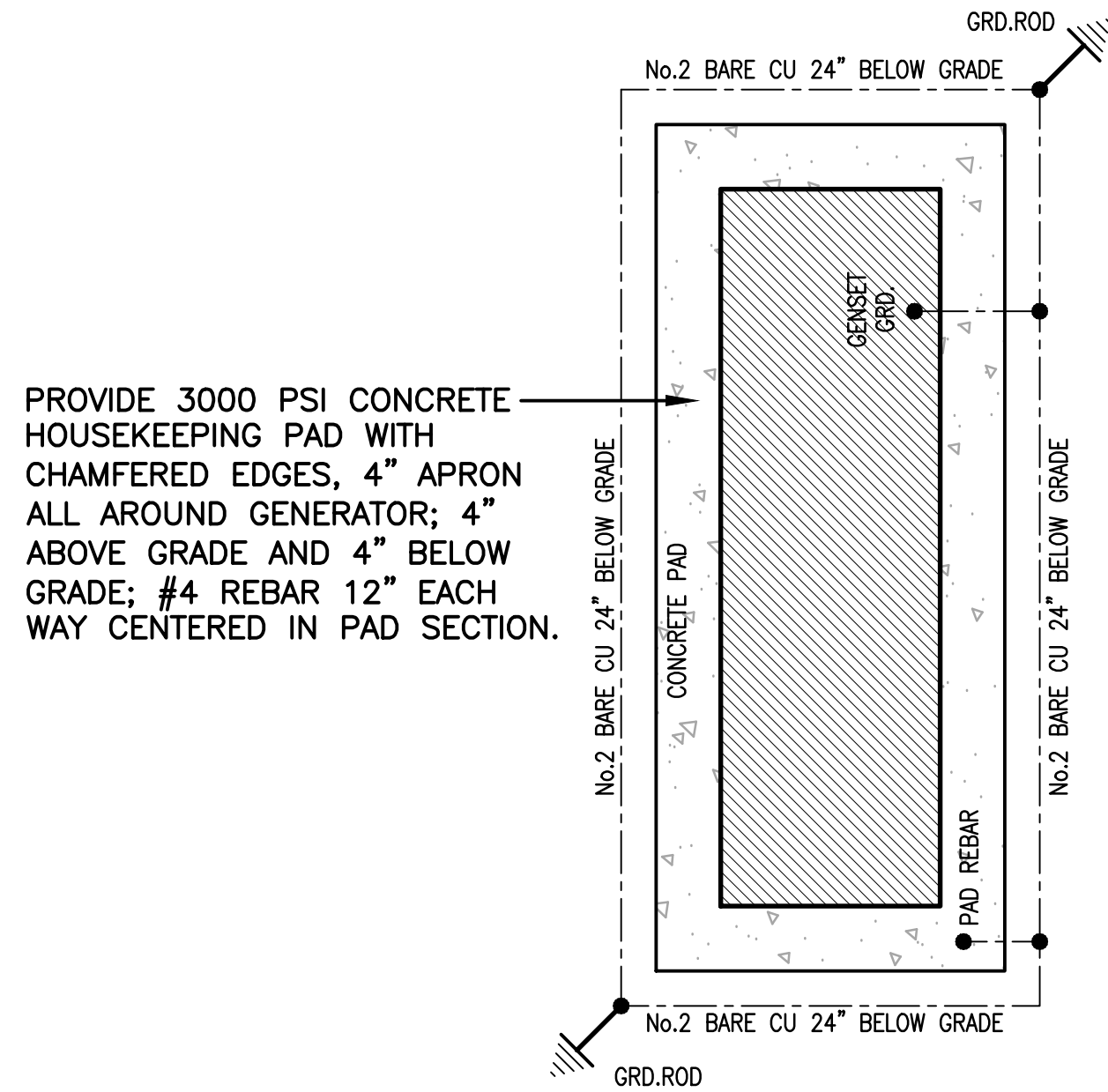
SEAL

EXPIRES 3-31-26

PROJECT
AMPHITHEATER PUBLIC SCHOOLS
AMPHITHEATER HIGH SCHOOL
IT GENERATORS
125 W. Yavapai Rd. Tucson, Arizona 85705

DRAWING TITLE
PARTIAL ELECTRICAL
SITE PLAN

Project Number M22110
Drawn By SV
Checked By CM
Date 4/06/2023
Scale AS-SHOWN
DRAWING NO.
ES1



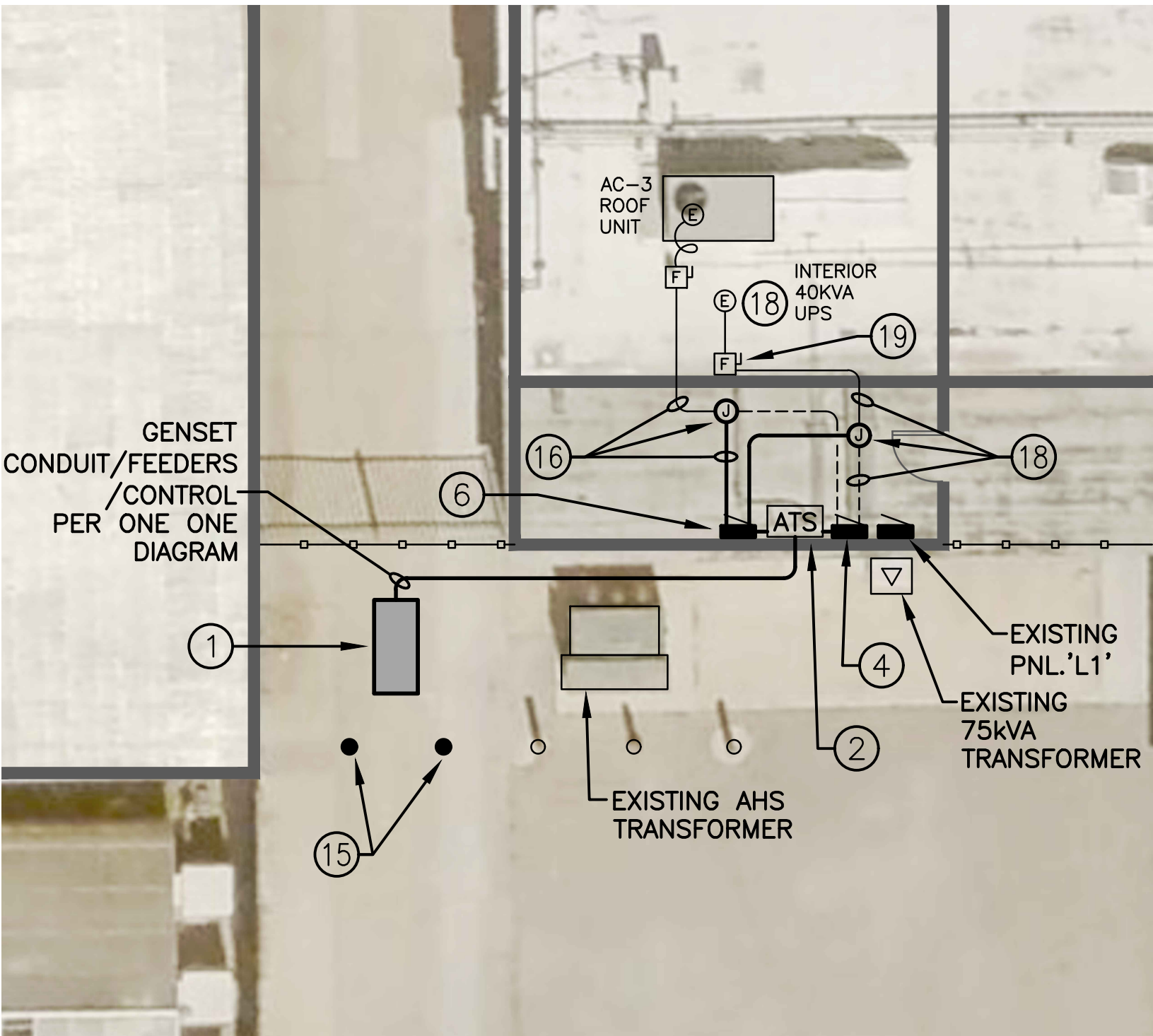
2 GENERATOR GROUNDING SYSTEM PLAN
N.T.S.

PROVIDE APPROVED ARC-FLASH HAZARD WARNING ON ALL REQUIRED ELECTRICAL EQUIPMENT PER NEC 110.16

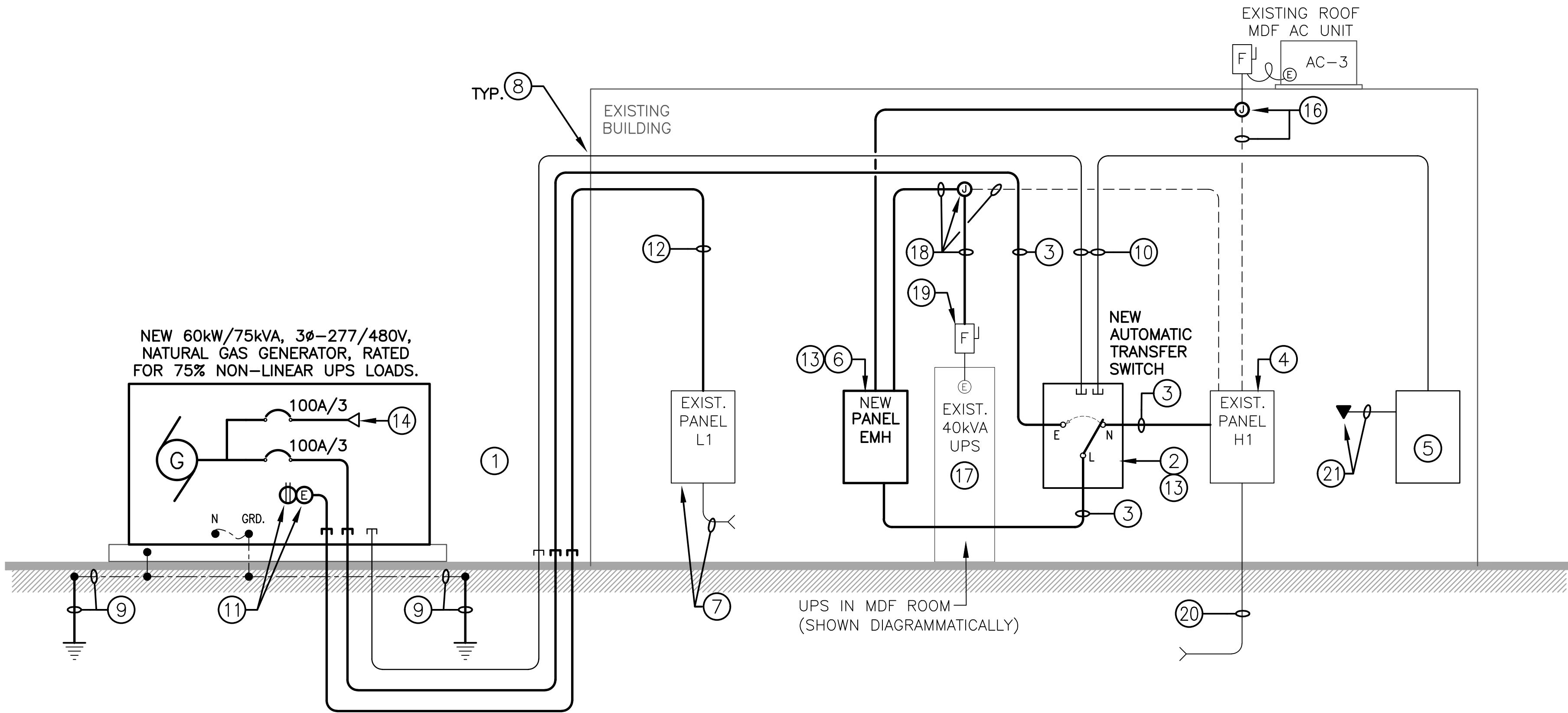
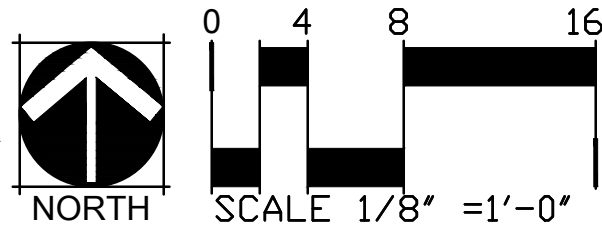
WARNING
Electric Arc Flash Hazard
Will cause severe injury or death
Wear proper protective equipment before opening or performing diagnostic measurements while energized. (See NFPA 70E)

Call at least two full working days before you begin excavation.

ARIZONA 811
Arizona Blue Stake
Dial 8-1-1 or 1-800-STAKE-IT (782-5348)
In Maricopa County: (602) 263-1100



3 PARTIAL ELECTRICAL PLAN
1/8" = 1'-0"



1 ONE LINE DIAGRAM
N.T.S.

ELECTRICAL KEYNOTES THIS SHEET ONLY

- NEW 60kW/75kVA, 277/480V STANDBY NATURAL GAS GENERATOR WITH HOUSEKEEPING PAD, PROVIDE FOOTPRINT SHOP DRAWING WITH WORKING CLEARANCES FOR APPROVAL BEFORE START OF WORK.
- NEW 100A 480V-3Ø-4 POLE AUTOMATIC TRANSFER SWITCH (ATS), WITH SOLID NEUTRAL.
- NEW FEEDER: (4) #2 CU, (1) #6 CU GRD. 1-1/2"C.
- EXISTING 400A-3Ø-4W-27/480V PANEL TO REMAIN WITH NEW WORK PER PANEL SCHEDULE
- INSTALL NEW ANNUNCIATOR PANEL PER OWNER DIRECTIONS.
- NEW 100A-277/480V-3Ø-4W PANEL 'EMH' PER PANEL SCHEDULE.
- EXISTING PANEL 'L1' TO REMAIN WITH NEW WORK PER PANEL SCHEDULE. EXISTING FEEDER FROM PANEL 'H1' VIA EXTERIOR 480-120/208V TRANSFORMER.
- ALL PENETRATIONS THROUGH EXTERIOR WALL AND ROOFS SHALL BE SLEEVED, FLASHED AND SEALED WATERPROOF. PROVIDE ESCUTCHEON PLATES WHERE WALL PENETRATIONS ARE EXPOSED.
- NEW (2) 3/4"x10FT COPPERCLAD STEEL GROUND RODS AT OPPOSITE PAD CORNER PER DETAIL 2 THIS SHEET. PROVIDE #2 CU BOND TO EACH ROD, GENSET GRD. LUG, CONCRETE PAD REBAR. PROVIDE EXOTHERMIC WELD U.G. CONNECTIONS.
- PROVIDE 1"C. FOR CONTROL/SIGNAL WIRING PER GENSET MFR.
- PROVIDE 208V-1Ø-3ØA CIRCUIT TO GENSET BLOCK HEATER. PROVIDE WP/GFCI RECEPTACLE FOR GENSET BATTERY CHARGER.
- 1"C. WITH (2) #10 CU (208V-1Ø), (2) #10 CU (120V), (1) #10 CU GRD.
- PROVIDE "CAUTION, TWO SOURCES OF POWER" LABELS PER NEC.
- FOR PORTABLE LOAD BANK CONNECTIONS.
- PROVIDE NEW STEEL CONCRETE FILL BOLLARDS SIMILAR TO TEP SR-230.
- DISCONNECT AC-3 CIRCUIT FROM PANEL 'H1', REMOVE WIRE CONDUIT FROM PANEL, INTERCEPT CEILING/ROOF MOUNTED CIRCUIT AND RE-DIRECT TO NEW 480V PANEL 'EMH'. USE (3) #12 CU, (1) #12 CU GRD. IN 3/4"C. UPDATE CIRCUIT DIRECTORY AND MARK PANEL BREAKER AS SPARE.
- EXISTING RACK MOUNTED 40kVA UPS IN MDF ROOM TO REMAIN.
- DISCONNECT UPS CIRCUIT FROM PANEL 'H1', REMOVE FEEDER CONDUIT FROM PANEL AND RE-DIRECT TO NEW 480V PANEL 'EMH'. USE (3) #4 CU, (1) #8 CU GRD. IN 1-1/2"C. TO EXISTING DISCONNECT. UPDATE CIRCUIT DIRECTORY AND MARK PANEL BREAKER AS SPARE.
- EXISTING 125A-208V-3Ø HEAVY DUTY SAFETY SWITCH TO REMAIN.
- EXISTING SERVICE CONDUCTORS FROM AHS TRANSFORMER TO REMAIN.
- PROVIDE EMCS CONNECTION THROUGH BACNET SYSTEM PER OWNER DIRECTIONS. COORDINATE ALL REQUIREMENTS.

SHORT CIRCUIT CONSIDERATIONS

EXISTING 400A-277/480V-3Ø-4W POWER CO. PADMOUNT TRANSFORMER CONTRIBUTIONS IS 24,100A.
EXISTING 480V PANEL/BREAKERS ARE 35KAIC.
NEW 480V PANEL IS 18KAIC.
NO CHANGE OF SHORT CIRCUIT LEVEL IN THIS PROJECT

LOAD SUMMARY

NEW PANEL 'EMH' = 52 kVA
FUTURE = 10 kVA
TOTAL = 62 kVA

62 kVA / 53 kW OR 74A AT 480V-3Ø-4W.
NEW 60kW / 75kVA GENSET IS ADEQUATELY RATED.

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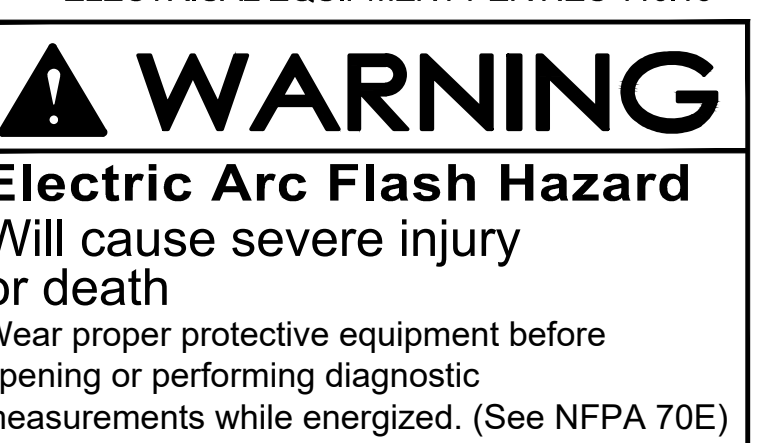
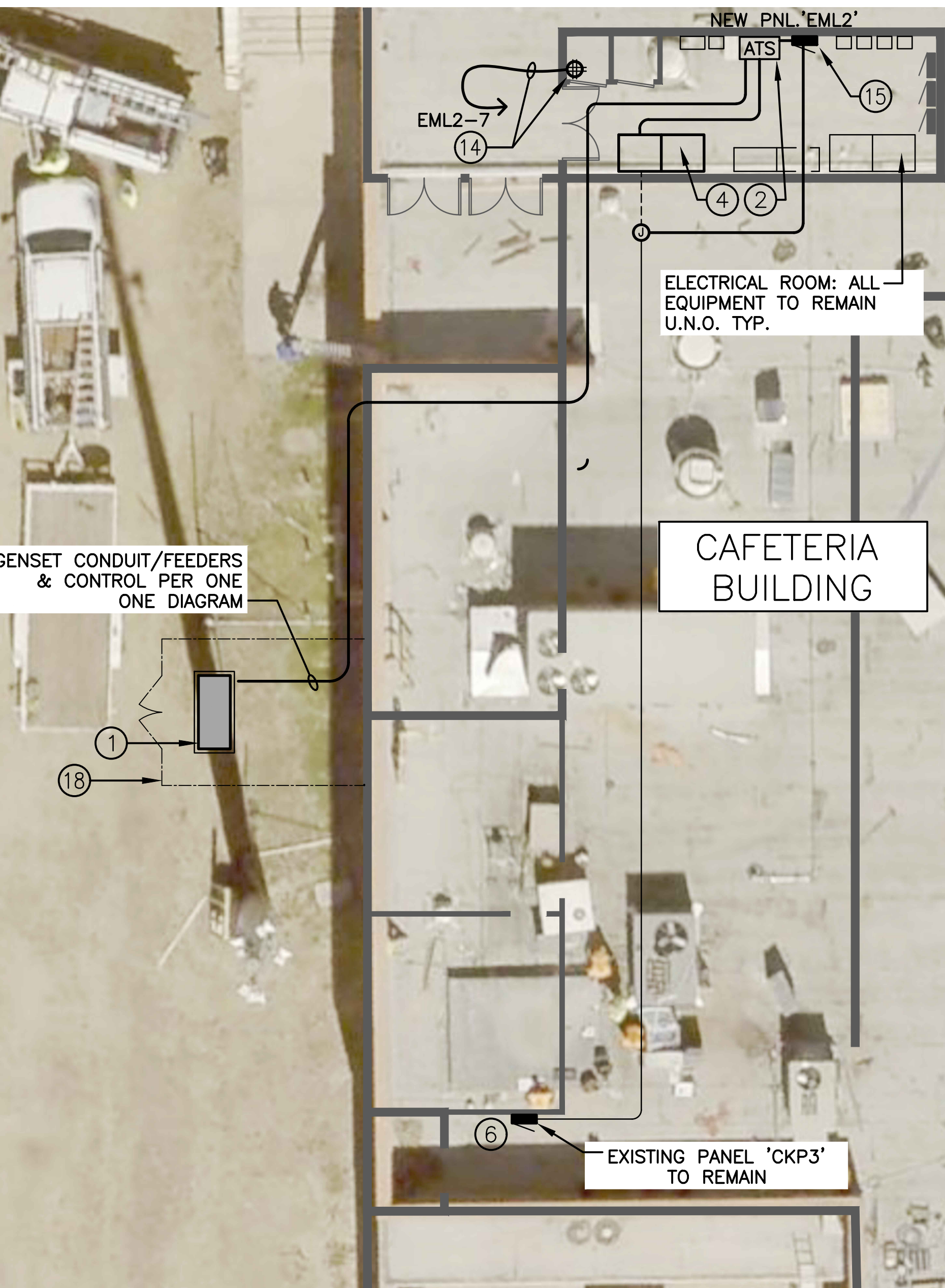
MONRAD ENGINEERING INC.
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SEAL
Professional Engineer
37386
CHRISTIAN K. MONRAD
EXPIRES 3-31-26

PROJECT
AMPHITHEATER PUBLIC SCHOOLS
AMPHITHEATER HIGH SCHOOL
IT GENERATORS
125 W. Yavapai Rd. Tucson, Arizona 85705

DRAWING TITLE
MDF PARTIAL ELECTRICAL PLAN
AND ONE LINE DIAGRAM

Project Number M22110
Drawn By SV
Checked By CM
Date 4/06/2023
Scale AS-SHOWN
DRAWING NO.
E1



EXISTING 1600A-120/208V-3Ø-4W SWITCHBOARD/500kVA
TRANSFORMER AIC RATING IS 50,000AIC.
NEW 208V ATS RATING IS 42 kAIC.
NEW 208V PANEL RATING IS 22kAIC

NEW PANEL 'EML2' =	38 kVA
FUTURE =	15 kVA
<hr/>	
TOTAL =	53 kVA

53 kVA / 45 kW OR 147A AT 208V-3Ø-4W, LOAD IS
ADEQUATE FOR NEW 60kW / 75kVA GENSET.



1. NEW 60kW/75kVA, 120/208V STANDBY UTILITY GAS GENERATOR WITH HOUSEKEEPING PAD, COORDINATE WITH EXISTING UTILITIES (NAT.GAS, WATER, DOWNSPOUT, PULLBOXES), PROVIDE FOOTPRINT SHOP DRAWING WITH WORKING CLEARANCES FOR APPROVAL BEFORE START OF WORK.
2. NEW 200A 208V-3 ϕ -4 POLE AUTOMATIC TRANSFER SWITCH (ATS), WITH SOLID NEUTRAL. REWORK EXISTING WALL CONDUITS TO ALLOW NEW ATS INSTALLATION.
3. NEW FEEDER: (4) #3/0 CU, (1) #6 CU GRD. 2"C.
4. EXISTING 1600A-3 ϕ -4W-27/480V SWITCHBOARD TO REMAIN. INTERCEPT EXISTING FEEDER TO PANEL 'CKP3' AND EXTEND TO NEW 'EML2' AS SHOWN. PROVIDE NEW ID LABEL "PANEL 'EML2' VIA ATS" SIMILAR TO EXISTING.
5. NEW ANNUNCIATOR PANEL.
6. EXISTING 200A-3 ϕ -4W, 120/208V PANEL 'CKP3' TO REMAIN REFER TO PANEL SCHEDULE. PROVIDE NEW RED PLACARD.
7. PROVIDE "CAUTION, TWO SOURCES OF POWER" LABELS PER NEC.
8. EXISTING TELECOMMUNICATIONS RACK.
9. NEW (2) 3/4"x10FT COPPERCLAD STEEL GROUND RODS AT OPPOSITE PAD CORNER PER DETAIL 2 THIS SHEET. PROVIDE #2 CU BOND TO EACH ROD, GENSET GRD. LUG, CONCRETE PAD REBAR. PROVIDE EXOTHERMIC WELD U.G. CONNECTIONS.
10. PROVIDE 1"C. FOR CONTROL/SIGNAL WIRING PER GENSET MFR.
11. PROVIDE 208V-1 ϕ -30A CIRCUIT TO GENSET BLOCK HEATER. PROVIDE WP/GFCI RECEPTACLE FOR GENSET BATTERY CHARGER.
12. 1"C. WITH (2) #10 CU (208V-1 ϕ), (2) #10 CU (120V), (1) #10 CU GRD.
13. FOR PORTABLE LOAD BANK CONNECTIONS.
14. PROVIDE NEW RED 20A/120V QUAD. RECEPTACLE WITH INTEGRAL SPD AND DEDICATED 20A/120V CIRCUIT ADJACENT TO EXISTING RACK SUPPORTED UPS. COORDINATE WITH OWNER.
15. NEW 200A-120/208V-3 ϕ -4W PANEL 'EML2' PER PANEL SCHEDULE. REWORK EXISTING WALL CONDUITS TO ALLOW NEW PANEL INSTALLATION.
16. ALL PENETRATIONS THROUGH EXTERIOR WALL AND ROOFS SHALL BE SLEEVED, FLASHED AND SEALED WATERPROOF. PROVIDE ESCUTCHEON PLATES WHERE WALL PENETRATIONS ARE EXPOSED.
17. PROVIDE EMCS CONNECTION THROUGH BACNET SYSTEM PER OWNER DIRECTIONS. COORDINATE ALL REQUIREMENTS.
18. PROVIDE NEW CHAIN LINK FENCE PER DETAIL 3 THIS SHEET.

PANEL NAME: L1	120/208 VOLTS, 3 PHASE, 4 WIRE
TYPE: GE	10,000 MINIMUM A.I.C. RATING
200 A BUS, 200 A. MAIN BREAKER	MOUNTING: <input checked="" type="checkbox"/> FLUSH
LOCATION: ELECTRICAL RM.418	<input type="checkbox"/> SURFACE

41	BATT.CHARGER	20	1	12	1"			0.6	1.0	-	10	-	-	-	42	N,R
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'R' DENOTES: REMOVE EXISTING WIRING/CONDUIT TO NEW LOCATION

PANEL NAME: H1	277/480 VOLTS, 3 PHASE, 4 WIRE
TYPE: EATON	35,000 MINIMUM A.I.C. RATING
400 A BUS, 400 A. MAIN BREAKER	MOUNTING: <input type="checkbox"/> FLUSH
LOCATION: ELECTRICAL RM.418	<input checked="" type="checkbox"/> SURFACE

B
B
B
N,R
N,R
N,R

'B' DENOTES: NEW BREAKER, NEW WIRING. PROVIDE NEW LABEL.

PANEL NAME: EMH 277/480 VOLTS, 3 PHASE, 4 WIRE
TYPE: EATON 18,000 MINIMUM A.I.C. RATING
125 A BUS, 125 A. MAIN BREAKER MOUNTING: ☐ FLUSH
LOCATION: ELECTRICAL RM.418 ☒ SURFACE

7

ON-CONTINUOUS LOAD X 1.0	17.2	17.2	17.2
--------------------------	------	------	------

DEMAND AMPS/PHASE	62	62	62	DEMAND LOAD:	51.6 kVA
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PANEL NAME: CKP3	120/208 VOLTS, 3 PHASE, 4 WIRE
TYPE: GE	10,000 MINIMUM A.I.C. RATING
200 A BUS, 200 A. MAIN BREAKER	MOUNTING: <input checked="" type="checkbox"/> FLUSH
LOCATION: KITCHEN	<input type="checkbox"/> SURFACE

7

NON-CONTINUOUS LOAD X 1.0	11.4	11.2	12.2
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95	93	102	DEMAND LOAD:	34.8 kVA
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PANEL NAME: EML2	120/208 VOLTS, 3 PHASE, 4 WIRE
TYPE: GE	22,000 MINIMUM A.I.C. RATING
200 A BUS, 200 A. MAIN BREAKER	MOUNTING: <input type="checkbox"/> FLUSH
LOCATION: ELECTRICAL ROOM CAFETERIA	<input checked="" type="checkbox"/> SURFACE

7

NON-CONTINUOUS LOAD X 1.0	13.0	12.2	12.5
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DEMAND AMPS/PHASE	108	102	104	DEMAND LOAD:	37.7 kVA
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PROVIDE RED PLACARDS FOR ALL SAFETY SWITCHED

L1	H1	EMH
-	CKP3	EML2

PANEL SCHEDULES

PROJECT

AMPHITHEATER PUBLIC SCHOOLS
AMPHITHEATER HIGH SCHOOL
IT GENERATORS

DESCRIPTION

SE



EXPIRES 3-31-26

LOCKOUT - TAGOUT - TESTOUT



CONSULTING ELECTRICAL ENGINEERS
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Tucson, Arizona 85719-2391
Ph. (520) 884-0045 / fax. (520) 884-0048
www.monradengineeringinc.com

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ELECTRICAL NOTES:

1. THE WORK COVERED ON THESE DRAWINGS SHALL INCLUDE THE FURNISHING OF ALL LABOR, MATERIALS, TRANSPORTATION, TOOLS, APPLIANCES, FEES, AND PERMITS REQUIRED FOR THE INSTALLATION OF A COMPLETE AND OPERATING ELECTRICAL SYSTEM. DRAWINGS ARE DIAGRAMMATIC IN NATURE AND ARE NOT INTENDED TO SHOW EVERY DETAIL. THE CONTRACTOR SHALL PROVIDE BOXES, ACCESS PANELS, ETC. AS REQUIRED BY CODE AND INDUSTRY PRACTICE.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING THIS PHASE OF THE WORK WITH ALL EXISTING CONDITIONS AND WITH OTHER TRADES.
3. ALL WORK SHALL COMPLY WITH THE APPLICABLE RULES OF THE NATIONAL ELECTRICAL CODE, LOCAL ELECTRICAL CODES AND ORDINANCES.
4. ALL MATERIALS SHALL BE NEW AND BEAR THE U.I. SEAL. MATERIALS SHALL CONFORM TO REQUIREMENTS OF THE 2017 N.E.C., WHERE APPLICABLE.
5. ALL ELECTRICAL CONDUCTORS SHALL BE INSTALLED IN METALLIC STEEL CONDUIT.
6. ALL CONDUCTORS SHALL BE STRANDED SOFT-DRAWN ANNEALED COPPER WITH XHHW INSULATION. MINIMUM WIRE SIZE SHALL BE #12 UNLESS OTHERWISE NOTED.
7. THE COMPLETE ELECTRICAL SYSTEM SHALL BE GROUNDED IN ACCORDANCE WITH N.E.C. ART. 250. PROVIDE GROUNDING WIRE IN ALL CONDUITS.
8. CONTRACTOR SHALL VISIT THE SITE AND FAMILIARIZE HIMSELF WITH ALL EXISTING CONDITIONS PRIOR TO SUBMITTAL OF BID. VERIFY ALL EXISTING CIRCUITS TO BE REUSED PRIOR TO CONNECTIONS.
9. THE ELECTRICAL CONTRACTOR SHALL GUARANTEE AGAINST DEFECTS IN MATERIALS, EQUIPMENT, OR WORKMANSHIP FOR A PERIOD OF TWO (2) YEARS UPON OWNER'S FINAL ACCEPTANCE. CONTRACTOR SHALL REPAIR OR REPLACE ANY DEFECTS TO THE SATISFACTION OF THE OWNER AT NO ADDITIONAL COST.
10. COORDINATE THE DISPOSITION OF DEMOLISHED ELECTRICAL EQUIPMENT WITH THE OWNER PRIOR TO REMOVAL FROM THE SITE.

ELECTRICAL SYMBOL LEGEND

- RACEWAY CONCEALED IN WALL OR CEILING, (2) #12, (1) #12 GRD. IN 1/2" C. U.N.O.
- HA-1,3

HOMERUN TO PANEL "HA", CIRCUITS 1 AND 3. NUMBER OF HASH MARKS INDICATE NUMBER OF CONDUCTORS, NOT INCLUDING GROUND CONDUCTOR, IN RACEWAY. REFER TO PANEL SCHEDULES FOR RACEWAY AND CONDUCTOR SIZES.
- FLEXIBLE STEEL CONDUIT. REFER TO SPECIFICATIONS FOR TYPES.
- \$s

DIMMER ON/OFF SENSOR WALL SWITCH. ACUITY CONTROL OR EQUAL LUTRON, HUBBELL, COOPER.
- \$

SPST TOGGLE SWITCH AT + 48" A.F.F., U.N.O. SUB SCRIPT LETTER INDICATES FIXTURES CONTROLLED..
- ⊙

JUNCTION BOX
- ⊕

WALL MOUNTED NEC COMPLY DUPLEX CONVENIENCE RECEPTACLE AT +18" A.F.F., U.N.O.
- ⊕GFCI

WALL MOUNTED NEC COMPLY GFCI DUPLEX CONVENIENCE RECEPTACLE AT +18" A.F.F., U.N.O.
- ⊕

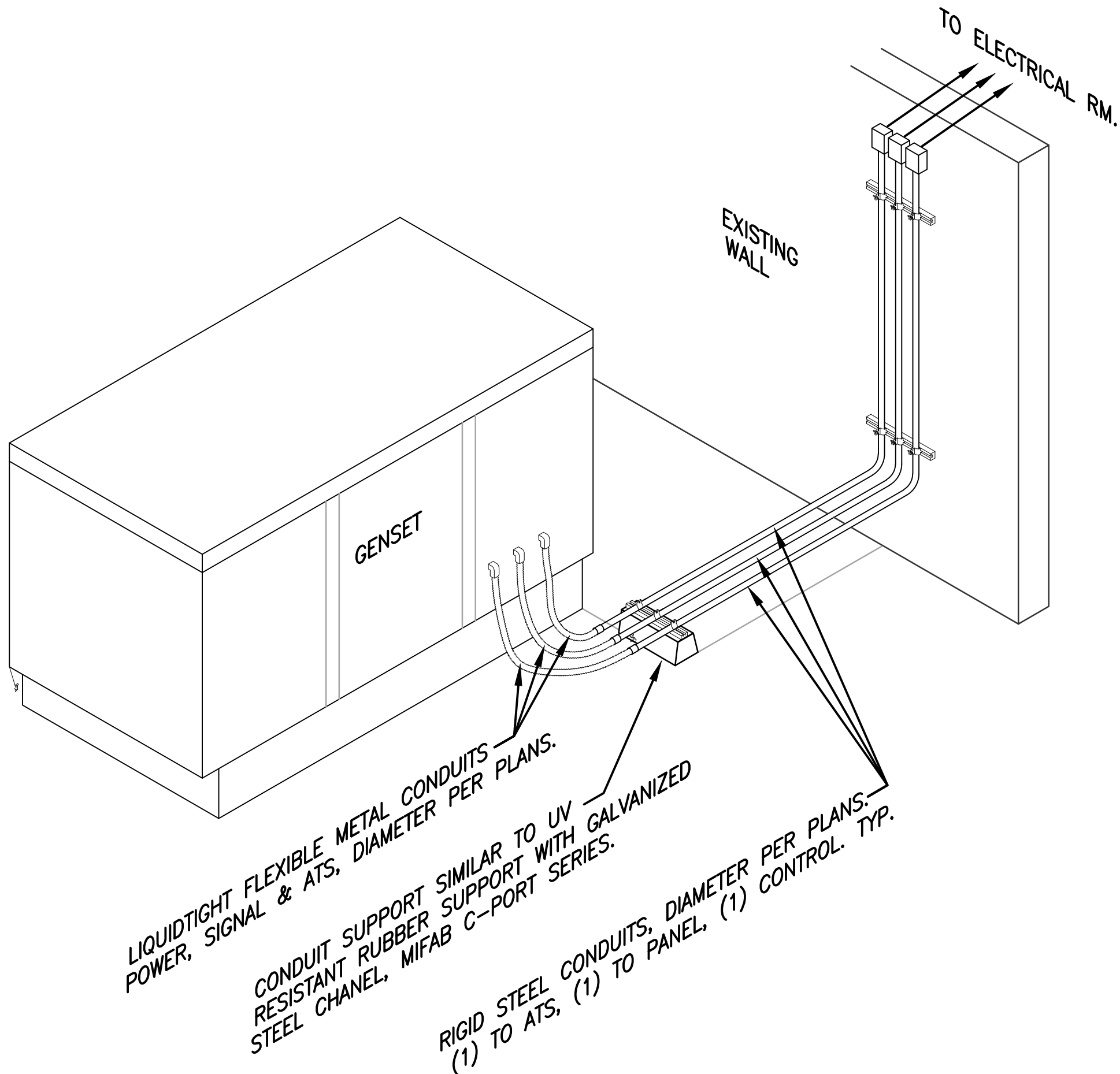
WALL MOUNTED NEC COMPLY GFCI DUPLEX CONVENIENCE RECEPTACLE AT +6" ABOVE BACKSPLASH AT COUNTERTOP U.N.O. REFER TO ARCH. ELEVATIONS FOR EXACT LOCATIONS.
- ⊕

WALL MOUNTED NEC COMPLY QUAD CONVENIENCE RECEPTACLE AT +18" A.F.F., U.N.O.
- ⊕GFCI

WALL MOUNTED NEC COMPLY GFCI QUAD CONVENIENCE RECEPTACLE AT +6" ABOVE BACKSPLASH AT COUNTERTOP U.N.O. REFER TO ARCH. ELEVATIONS FOR EXACT LOCATIONS.
- PANEL PER PANEL SCHEDULE
- ⊕

ELECTRICAL CONNECTION
- F

FUSED DISCONNECT SWITCH



1 GENSET AT-GRADE CONDUIT MOUNTING DETAIL
SCALE : N.T.S.

NOTES:
RMC THROUGH WALL SLEEVED, FLASHED AND SEALED WATERPROOF. PROVIDE ESCUTCHEON PLATES WHERE WALL PENETRATIONS ARE EXPOSED

PROVIDE N.E.C. WORKING CLEARANCES.

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MONRAD

ENGINEERING INC

CONSULTING ELECTRICAL ENGINEERS

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ph. (520) 884-0045 / fax. (520) 884-0048
www.monradengineeringinc.com

SEAL

Professional Engineer

37386

CHRISTIAN K. MONRAD

Arizona State Board of Electrical Engineering

EXPIRES 3-31-26

REV.	DATE	DESCRIPTION

PROJECT

AMPHITHEATER PUBLIC SCHOOLS
AMPHITHEATER HIGH SCHOOL
IT GENERATORS

125 W. Yavapai Rd. Tucson, Arizona 85705

DRAWING TITLE

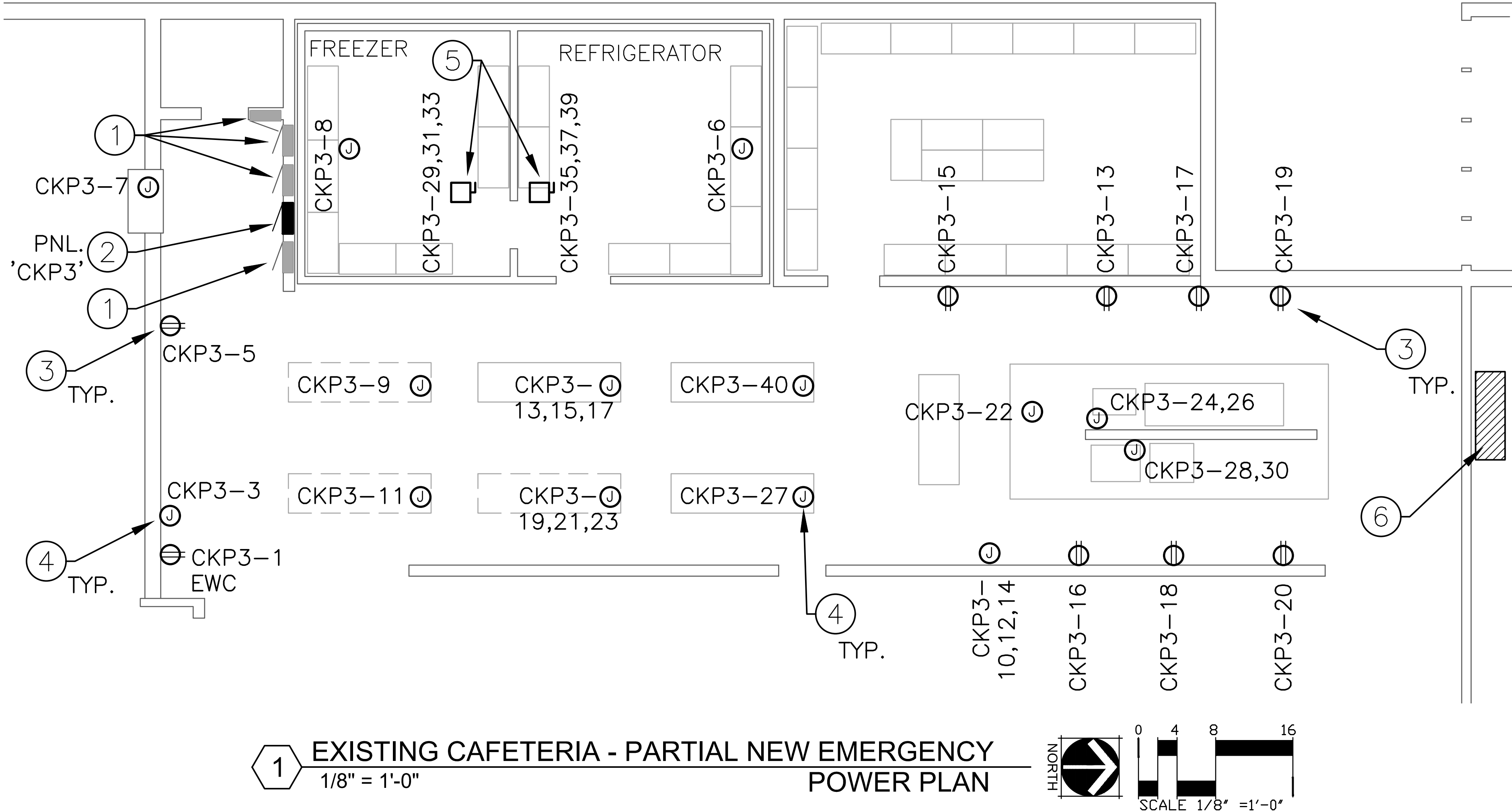
PARTIAL ELECTRICAL
SITE PLAN

Project Number	M22110
Drawn By	SV
Checked By	CM
Date	4/06/2023
Scale	AS-SHOWN

DRAWING NO.

E4

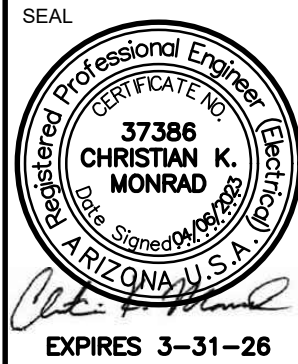
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ELECTRICAL KEYNOTES THIS SHEET ONLY

- EXISTING PANEL TO REMAIN.
- EXISTING PANEL TO REMAIN WITH NEW WORK PER ONE LINE DIAGRAM SHEET E2. PROVIDE NEW RED PLACARD.
- TRACE AND ID ALL RECPETACLES OF PANEL 'CKP3', REPLACE ALL RECEPTACLES AND PLATES WITH NEW RED UNITS. PROVIDE NEW CIRCUIT NUMBER LABEL.
- TRACE AND ID ALL LOADS FROM PANEL 'CKP3', REPLACE ALL JUNCTION BOX COVERS WITH RED COVER AND INDICATE CIRCUIT NUMBER.
- REPLACE/PROVIDE NEW RED PLACARD AT ALL SAFETY SWITCHES FEED FROM PANEL 'CKP3'.
- EXISTING 1600A-3Ø-4W-27/480V SWITCHBOARD PER ONE LINE DIAGRAM.

LOCKOUT - TAGOUT - TESTOUT



REV.	DATE	DESCRIPTION

PROJECT	AMPHITHEATER PUBLIC SCHOOLS AMPHITHEATER HIGH SCHOOL IT GENERATORS 125 W. Yavapai Rd. Tucson, Arizona 85705
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DRAWING TITLE	EXISTING CAFETERIA PARTIAL NEW EMERGENCY POWER PLAN
Project Number	M22110
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6. Generator efficiencies shall be calculated according to IEC 34–2 Section 4, with all current squared times R losses corrected to 115 F.

7. The generator housing shall be close coupled, drip proof and guarded, constructed to NEMA I and IP 22 standards, single bearing, salient pole, revolving field, synchronous type with amortisseur windings in the pole faces of the rotating field.

8. The generator housing shall be one piece and mount directly to the engine flywheel housing without bolted adaptors.

9. Thermal Class 200 magnet wire as described by NEMA Magnet Wire Standard MW 1000, Section MW 35–C, shall be used for rotor and stator windings. The windings shall consist of copper magnet wire. All winding insulation materials shall be Class H in accordance with BS and IEEE standards.

D. Retain paragraph and subparagraphs below for loads involving sensitive electronic equipment, significant nonlinear load elements, or uninterruptible power supply systems. Coordinate with "Governor" Paragraph in "Engine" Article and with "Generator, Exciter, and Voltage Regulator" Article. See Evaluations.

H. Generator–Set Performance for Sensitive Loads, including non–linear UPS equipment:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady–State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.

a. Generator output voltage drift no more than +/- ½% of rated value at constant temperature.

b. Generator output voltage drift no more than +1/– 1% of rated value within a 40° over ambient temperature range of –40°C to 70° C.

3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step–load increase or decrease. Voltage shall recover and remain within the steady–state operating band within 0.5 second.

4. Steady–State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.

5. Steady–State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady–state operational band and no hunting or surging of speed.

6. Transient Frequency Performance: Less than 2–Hz variation for 50 percent step–load increase or decrease. Frequency shall recover and remain within the steady–state operating band within three seconds.

7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

a. Regulator time less than 20 milliseconds.

b. Telephone Influence Factor (TIF) of less than 50.

c. Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to commercial standards.

d. The regulator shall include the following features:

1) Voltage level rheostat to provide generator output voltage adjustment of –25% to +10% of nominal.

2) Gain adjustment to provide output voltage compensation for changes in load or frequency.

8. Sustained Short–Circuit Current: For a 3–phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full–load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

Permanent magnet excitation in subparagraph below is a standard feature of some manufacturers' engine–generator sets larger than 200 kW.

a. The permanent magnet excitation system shall derive excitation current from a pilot exciter mounted on the rotor shaft. It shall enable the generator to sustain 300% of rated current for ten seconds during a fault condition.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. The engine shall be a stationary, liquid cooled, four cycle design, vertical in–line or V–type with dry exhaust manifolds. It shall be manufactured in the United States. Depending on NFPA 110 class and local codes, LP–gas standby may not be required for natural gas–fueled systems. Verify requirements with authorities having jurisdiction.

B. Fuel: Fuel Oil, Grade DF–2.

C. Rated Engine Speed: 1800 rpm.

D. Maximum Piston Speed for Four–Cycle Engines: 2250 fpm (11.4 m/s).

E. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail–safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances. Crankcase drain shall extend outside of the mounting base.

4. The lubrication oil pump shall be a positive displacement type that is integral with the engine and gear driven from the engine gear train. The system shall incorporate full flow filtration with bypass valve to continue lubrication in the event of filter clogging.

5. The bypass valve must be integral with the engine filter base of receptacle. Systems where bypass valves are located in the replaceable oil filter are not acceptable. Pistons shall be oil cooled by continuous jet spray to the underside or inside of the crown and piston pin.

6. System shall utilize synthetic lubricants with compatible filtration, and compatible engine seals,

approved by the engine manufacturer.

F. Engine Fuel System:

Main Fuel Pump: Mounted on engine. Pump ensures adequate fuel flow under starting and load conditions.

7. Relief–Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to tank.

8. A secondary fuel filter, water separator, manual fuel priming pump, fuel shutoff solenoid and all fuel lines must be installed at the point of manufacture.

9. Primary diesel fuel filter shall be a replaceable cartridge type rated to remove contaminants 10 microns or larger.

G. Coolant Jacket Heater: HOTSTART TPS series electric–immersion type, factory installed in coolant jacket system with input and output shutoff valves on each side of the heater for ready maintenance. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

H. Jacket water heater shall be provided to maintain coolant temperature of 80 F to 100F while the engine is idle. Heaters shall accept 120 Volt AC single phase power.

I. Governor, Electronic Speed control:

1. The engine governor shall be a Woodward 2301 Electronic Speed Control with EG Electro–Hydraulic Actuator or Barber Coleman Equal. Speed droop shall be externally adjustable from 0 (isochronous) to 10% from no load to full rated load. Steady state frequency regulation shall be +/- 0.25 percent.

J. Generator frequency change not over ¼ cycle no load to full load and back.

K. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine–generator–set mounting frame and integral engine–driven coolant pump. The engine jacket water cooling system shall be a closed circuit design with provision for filling, expansion, and de–aeration. The cooling pump shall be driven by the engine. Auxiliary coolant pumps required for heat exchangers or separate circuit after cooling shall also be engine driven. Coolant temperature shall be internally regulated to disconnect external cooling systems until operating temperature is achieved.

1. Coolant: Solution of 50 percent ethylene–glycol–based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

3. Temperature Control: Self–contained, thermostatic–control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging–, ultraviolet–, and abrasion–resistant fabric.

a. Rating: 50–psig (345–kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.

b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

6. Coolant drain shall extend outside of the mounting base.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.

2. Sound level measured at a distance of 10 feet (3m) from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air–Intake Filter: Heavy–duty, engine–mounted air cleaner with replaceable dry–filter element and "blocked filter" indicator.

1. The engine air cleaner shall be engine mounted with dry element requiring replacement no more frequently than 250 operating hours or once each year.

K. Starting System: 24–V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine–cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Motor: Heavy–duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: Factory fabricated of metal with acid–resistant finish and thermal

insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery–Charging Alternator: Factory mounted on engine with solid–state voltage regulation and 35–A minimum continuous rating.

8. Battery Charger: Current–limiting, automatic–equalizing and float–charging type. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing–charging rate of 10A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float–charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery–charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall–mounted cabinet.

O. Batteries

1. Batteries for starting and control shall be selected and supplied by the generator set manufacturer. They shall be a heavy duty SLI lead acid type with through–partition connectors, and housed in a hard rubber or polypropylene case with provision for venting.

2. Battery warranty shall be the responsibility of the generator set manufacturer.

P. Alternator

1. An engine mounted belt driven battery charging alternator shall be installed with an automatic voltage regulator. It shall be suitable for heavy duty applications with a rating of 24 volts.

Q. Radiator, Engine–Mounted

1. Heat rejected to the engine jacket water shall be discharged to the atmosphere through a close–coupled radiator. The radiator shall be sized to cool the engine continuously while operating at full rated load and at site conditions of 115°F ambient.

R. Fan And Belt Guarding

1. The fan, fan drive, and fan belts shall be covered with punched steel mesh guarding for personnel protection. The guarding shall conform UL 2200.

S. Blowerfan

1. The radiator cooling fan shall be a blower type driven from the engine. Air shall be drawn from the engine side and exhausted through the radiator core with no more than 12.7 mm (0.5 in) of water external restriction in addition to core restrictions.

T. Turbocharging

1. Only single stage turbo charging shall be allowed.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base Mounted Dual–wall Diesel Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:

1. Tank level indicator

2. Capacity: Fuel for 48 hours operation at 100% rated power output.

3. Containment: Integral rupture basin

4. Vandal–Resistant fill cap.

5. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm (both locally and remotely) in the event of a tank leak.

6. Provide fuel quantity to perform acceptance testing and refill tank after testing.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode–selector switch on the control and monitoring panel is in the automatic position, remote–control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode–selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator–set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a

remote emergency–stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator–set vibration.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter.

2. AC ammeter.

3. AC frequency meter.

4. DC voltmeter (alternator battery charging).

5. Engine–coolant temperature gage.

6. Engine lubricating–oil pressure gage.

7. Running–time meter.

8. Ammeter–voltmeter, phase–selector switch(es).

9. Generator–voltage adjusting rheostat.

10. Generator overload.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface– or flush–mounting type to suit mounting conditions indicated.

G. Remote Emergency–Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breakers: Molded–case, thermal magnetic type..

1. Tripping Characteristics: Fixed..

2. Trip Settings: Selected to coordinate with generator thermal damage curve.

3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

4. Mounting: Adjacent to or integrated with control and monitoring panel.

5. Provide multiple output breakers if shown on construction drawings.

6. Provide 5A rated secondary current transformers.

B. Ground–Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground–fault. Integrate ground–fault alarm indication with other generator–set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. COMPLY with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator–Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid–state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output–voltage operating band.

2. Regulator shall use volts–per–hertz control, with true RMS sensing, to improve motor starting ability.

3. Regulator shall meet MIL–STD–461C part 9 for radiated and conducted emissions susceptibility when mounted within alternator standard connection box.

4. Regulator shall be fully encapsulated for protection against moisture or abrasive contamination.

5. Regulator shall be tested to MIL–STD–705 Method 711.1d and salt fog tested to ASTM B117–73.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two–thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR–SET ENCLOSURE

A. Description: Sound attenuating, vandal–resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable with stainless steel security latches and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Description: Prefabricated enclosure with the following features:

1. Construction: Galvanized–steel, metal–clad, integral structural–steel–framed building erected on concrete foundation.

Revise wind speed in first subparagraph below to suit local conditions.

2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.

3. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.


4. Hinged Doors: With padlocking provisions.

5. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.

6. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with jacket heater to maintain winter interior temperature within operating limits required by engine–generator–set components.


7. Muffler Location: External to enclosure.

LOCKOUT - TAGOUT - TESTOUT



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EXPIRES 3–31–26

PROJECT

AMPHITHEATER PUBLIC SCHOOLS
AMPHITHEATER HIGH SCHOOL
IT GENERATORS

125 W. Yavapai Rd. Tucson, Arizona 85705

DRAWING TITLE

SPECIFICATIONS

Project Number

M22110

Drawn By

SV

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Date

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<div>8. Sound attenuation to provide maximum SPL of 75dba at 23 feet (7 meters) or less.</div> <div>9. All access doors and panels shall be lockable, keyed alike.</div> <div>C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.</div> <div>1. Louvers: Fixed–engine, cooling–air inlet and discharge. Storm–proof and drainable louvers prevent entry of rain and snow.</div> <div>2. Automatic Dampers: At engine cooling–air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.</div> <div>2.9 VIBRATION ISOLATION DEVICES</div> <div>A. Restrained Spring Isolators: Freestanding, steel, open–spring isolators with seismic restraint. Steel spring isolators shall be installed between the generator set base and the mounting surface. The isolators shall bolt to the base, and have a waffled or ribbed pad on their bottom surface. The pads shall be resistant to heat and age, and impervious to oil, water, antifreeze, diesel fuel, and cleaning compounds</div> <div>1. Housing: Steel with resilient vertical–limit stops to prevent spring extension due to wind loads or if weight is removed; factory–drilled baseplate bonded to 1/4–inch– (6–mm–) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.</div> <div>2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.</div> <div>3. Minimum Additional Travel: 50 percent of required deflection at rated load.</div> <div>4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.</div> <div>5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.</div> <div>2.10 FINISHES</div> <div>A. Outdoor Enclosures and Components: Outdoor generator enclosures shall be factory finished with polyester powder coat.</div> <div>2.11 SOURCE QUALITY CONTROL</div> <div>A. Project–Specific Equipment Tests: Before shipment, factory test engine–generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:</div> <div>1. Full load run.</div> <div>2. Maximum power.</div> <div>3. Voltage regulation.</div> <div>4. Transient and steady–state governing.</div> <div>5. Single–step load pickup.</div> <div>6. Safety shutdown.</div> <div>7. Provide 14 days’ advance notice of tests and opportunity for observation of tests by Owner’s representative.</div> <div>8. Report factory test results within 10 days of completion of test.</div> <div>PART 3 – EXECUTION</div> <div>3.1 EXAMINATION</div> <div>A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine–generator performance.</div> <div>B. Examine roughing–in of piping systems and electrical connections. Verify actual locations of connections before packaged engine–generator installation.</div> <div>C. Proceed with installation only after unsatisfactory conditions have been corrected.</div> <div>3.2 INSTALLATION</div> <div>A. Comply with packaged engine–generator manufacturers’ written installation and alignment instructions and with NFPA110.</div> <div>B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.</div> <div>C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 6–inch– (150–mm–) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division26 Section "Vibration and Seismic Controls for Electrical Systems."</div> <div>D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.</div> <div>3.3 CONNECTIONS</div> <div>A. Not Used.</div> <div>B. Connect fuel, cooling–system, and exhaust–system piping adjacent to packaged engine generator to allow service and maintenance.</div> <div>C. Connect engine exhaust pipe to engine with flexible connector.</div> <div>D. Connect fuel piping to engines with a gate valve and union and flexible connector.</div> <div>E. Ground equipment according to Division26 Section "Grounding and Bonding for Electrical Systems."</div> <div>F. Connect wiring according to Division26 Section "Low–Voltage Electrical Power Conductors and Cables."</div> <div>3.4 IDENTIFICATION</div> <div>A. Identify system components per NFPA 70.</div> <div>3.5 FIELD QUALITY CONTROL</div> <div>A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.</div> <div>Retain paragraph below to require a factory–authorized service representative to perform inspections, tests, and adjustments.</div> <div>B. Manufacturer’s Field Service: Engage a factory–authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.</div> <div>Retain paragraph and subparagraph below to require Contractor to perform tests and inspections.</div> <div>C. Perform tests and inspections and prepare test reports.</div> <div>1. Manufacturer’s Field Service: Engage a factory–authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.</div> <div>Retain first paragraph and subparagraphs below to describe tests and inspections to be performed by any of the entities in three paragraphs above.</div> <div>D. Tests and Inspections:</div> <div>1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection.</div> <div>2. Battery Tests: Equalize charging of battery cells according to manufacturer’s written instructions.</div> <div>3. Battery–Charger Tests: Verify specified rates of charge for both equalizing and float–charging conditions.</div> <div>4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine–generator system before and during system operation. Check for air, exhaust, and fluid leaks.</div> <div>E. Coordinate tests with tests for transfer switches and run them concurrently.</div> <div>F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.</div> <div>G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.</div> <div>H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.</div> <div>I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.</div> <div>J. Remove and replace malfunctioning units and retest as specified above.</div> <div>K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.</div> <div>L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.</div> <div>3.6 DEMONSTRATION</div> <div>A. Engage a factory–authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division01 Section "Demonstration and Training."</div> <div>END OF SECTION26 32 13</div> <div>1.2 SUMMARY</div> <div>A. This Section includes transfer switches rated 600V and less, including the following:</div> <div>1. Automatic transfer switches with. Bypass/isolation function, 4–pole, open transition, 800 amp..</div> <div>2.. Remote annunciation systems.</div> <div>B. Code Compliance: The ATS shall conform to the requirements of:</div> <div>1. 3–cycle rating in excess of UL 1008–Standard for Automatic Transfer Switches.(Fully rated.)</div> <div>2. NFPA 70 – National Electrical Code including use in emergency and standby systems in accordance with Articles 571, 700, 701 and 702.</div> <div>4. NFPA 110 – Standard for Emergency and Standby Power Systems.</div> <div>5. IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems (Orange Book).</div> <div>6. IEEE Standard 241 – IEEE Recommended Practice for Electric Power Systems in commercial buildings (Gray Book).</div> <div>7. NEMA Standard ICS – 2–447 – AC Automatic Transfer Switches.</div> <div>8. IEC – Standard for Automatic Transfer Switches.</div> <div>C. General Description:</div> <div>1. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single–solenoid mechanism, momentarily energized to minimize power consumption and heat generation. The switch shall be positively locked and unaffected by voltage variations or momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life. The switch shall be mechanically interlocked to ensure only one of two possible positions – normal or emergency.</div> <div>2. All main contacts shall be silver composition.</div> <div>3. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without</div> <div>disassembly of operating linkages and without disconnection of power conductors. A manual operation handle shall permit the operator to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts when required.</div> <div>4. A control module shall direct the operation of the transfer switch. The module’s sensing and logic shall</div> <div>be controlled by a built–in microprocessor for maximum reliability, minimum maintenance and inherent digital communications capability. The control module shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the control module to be disconnected from the transfer switch for routine maintenance.</div> <div>5. The control panel shall meet or exceed the voltage surge withstand capability in accordance with IEEE standard 472–1974 (ANSI C37, 90a–1974) and the impulse withstand voltage test in accordance with the proposed NEMA Standard ICS 1–109.</div> <div>E. Operation:</div> <div>1. The voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85 to</div> <div>100% and dropout adjustable from 75 to 98% of pickup setting, both in increments of 1%, and shall be fully field–adjustable without the use of any tools, meters or power supplies. Repetitive accuracy of settings shall be +/- 2% or better over an operating temperature range of –20C to –70C. Factory set to pickup at 90% voltage and 95% frequency.</div> <div>2. The control module shall include four time delays that are fully adjustable over the entire range as follows:</div> <div>a. Time delay to override momentary normal source outages to delay all transfer switch and engine starting</div> <div>signals. Adjustable from 0 to 6 seconds. Factory set at 1 second.</div> <div>b. Transfer to emergency time delay. Adjustable from 0 to 5 minutes. Factory set at 0 minutes unless</div> <div>indicated otherwise on the plans.</div> <div>c. Retransfer to normal time delay. Time delay is automatically bypassed if emergency source fails and</div> <div>normal source is acceptable. Adjustable from 0 to 30 minutes. Factory set at 10 minutes.</div> <div>d. Unload running item delay for emergency engine generator cool down. Adjustable from 0 to 60 minutes.</div> <div>Factory set at 15 minutes.</div> <div>e. Exercising and cool down clocks.</div> <div>f. All standard features commonly shown in manufacturer’s literature.</div> <div>g. The operating transfer time* in either direction shall not exceed one–sixth (1/6) of a second. Operating</div> <div>transfer time is the time measured from instant of monitored source deviation to closing of main contacts on a n available alternate power source exclusive of any purposefully introduced time delay.</div> <div>1.3 SUBMITTALS</div> <div>A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.</div> <div>B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.</div> <div>Retain subparagraph below if retaining Part2 "Bypass/Isolation Switches" Article.</div> <div>1. Single–Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources,</div> <div>and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.</div> <div>Retain paragraph and subparagraphs below if required by seismic criteria applicable to Project. Coordinate with Division26 Section "Vibration and Seismic Controls for Electrical Systems."</div> <div>C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:</div> <div>1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled</div> <div>components or on calculation.</div> <div>a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."</div> <div>Retain one of first two subparagraphs below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Second definition is used for essential facilities where equipment must operate immediately after an earthquake.</div> <div>2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.</div> <div>3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.</div> <div>D. Qualification Data: For manufacturer and testing agency.</div> <div>E. Field quality–control test reports.</div> <div>F. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division01 Section "Operation and Maintenance Data," include the following:</div> <div>1. Features and operating sequences, both automatic and manual.</div> <div>2. List of all factory settings of relays; provide relay–setting and calibration instructions, including software,</div> <div>where applicable.</div> <div>3. Trouble shooting hints.</div> <div>4. O & M manuals.</div> <div>5. Complete ladder logic control schematic.</div> <div>6. Wiring diagram.</div> <div>7. Parts list.</div> <div>1.4 QUALITY ASSURANCE</div> <div>A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than 24 hours from time of notification.</div> <div>1. The ATS manufacturer shall maintain a local service center capable of emergency service or routine preventative maintenance contracts. The manufacturer shall maintain records of each switch by serial number for a minimum of 20 years.</div> <div>B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.</div> <div>1. Testing Agency’s Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on–site testing specified in Part3.</div> <div>C. Source Limitations: Obtain automatic transfer switches and/or bypass/isolation switches with respective remote annunciators through respective manufacturers.</div> <div>D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, Article100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.</div> <div>E. Comply with NEMA ICS 1.</div> <div>F. Comply with NFPA70.</div> <div>G. Retain one or both of first two paragraphs below if applicable to Project.</div> <div>A. Comply with NFPA99.</div> <div>H. Comply with NFPA110.</div> <div>I. Comply with UL1008 unless requirements of these Specifications are stricter.</div> <div>1.5 PROJECT CONDITIONS</div> <div>A Retain this Article if interruption of existing electrical service is required.</div> <div>A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:</div> <div>1. Notify Owner no fewer than two weeks in advance of proposed interruption of electrical service.</div> <div>2. Do not proceed with interruption of electrical service without Owner’s written permission.</div> <div>1.6 COORDINATION</div> <div>A. Coordinate size and location of concrete bases. Cast anchor–bolt inserts into bases.</div> <div>PART 2 – PRODUCTS</div> <div>2.1MANUFACTURERS</div> <div>Manufacturers: Subject to compliance with requirements, provide products by one of the following:</div> <div>1. GE Zenith Controls.</div> <div>2. Russ Electric</div> <div>3. ASCO.</div> <div>4. Others as approved.</div> <div>2.2 GENERAL PRODUCT REQUIREMENTS</div> <div>Coordinate paragraph below with Drawings and indicate percentage of tungsten filament lamp load for switches where it exceeds 30 percent. This percentage may affect switch selection. Some manufacturers’ ratings for some switch lines apply to all classes of load, including tungsten lamps.</div> <div>A. The ATS shall be UL listed in accordance with UL 1008 as follows:</div> <div>1. Rated in amperes for total system transfer including control of motors, electric–discharge lamps, electric–heating and tungsten–filament lamp loads as referred to in Paragraph 38.13 of UL 1008.</div> <div>2. Overload and endurance at 480 Volts AC per tables 25.1, 25.2, 27.1 and 27.2 of UL 1008 when enclosed according to Paragraph 1.6.</div> <div>3. Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within the allowable temperature limits.</div> <div>LOCKOUT - TAGOUT - TESTOUT</div> <div></div> <div>AMPHITHEATER PUBLIC SCHOOLS AMPHITHEATER HIGH SCHOOL IT GENERATORS</div> <div>125 W. Yavapai Rd. Tucson, Arizona 85705</div> <div>DRAWING TITLE</div> <div>Project Number M22110</div> <div>Drawn By SV</div> <div>Checked By CM</div> <div>Date 4/06/2023</div> <div>Scale AS-SHOWN</div> <div>DRAWING NO.</div> <div>E6.2</div> <div>SPECIFICATIONS</div>

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4. No welding of contracts. Transfer switch must be electrically operable to alternate source after the withstand current tests.
5. Dielectric tests at 1960 Volts, RMS, minimum after the withstand current tests.
6. Additional optional testing for 3 cycle compliance.
7. The ATS shall be rated to withstand the fault current noted on the contract drawings single line diagram, at the ATS terminals, for 3 full cycles, verified by oscilloscope testing by an independent test agency, in EXCESS of UL 1008 without series protection of fuses or circuit breakers.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- H. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.
- I. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
- J. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

11. Retain one of first two subparagraphs below.

Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.

12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

b. Push-button programming control with digital display of settings.

c. Integral battery operation of time switch when normal control power is not available.
- K. Provide cable adaptor bay for both top and bottom cable entry.

2.4 BYPASS/ISOLATION FUNCTION

- A. Comply with requirements for Level 1 equipment according to NFPA110.
- B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.

2. Drawout Arrangement :Not required.

3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or

- greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.
6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
- C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

Delete one or both of first two articles below. Coordinate location of equipment and wiring with Drawings. Coordinate with transfer-switch description and with Division 26 Section "Engine Generators." Edit retained Article to specify required system features and functions. See Editing Instruction No. 2 in the Evaluations.

2.5 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

Switch position.

Switch in test mode.

Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
- Indicating Lights: Grouped for each transfer switch monitored.
- Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
- Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
- Lamp Test: Push-to-test or lamp-test switch on front panel.

2.6 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Retain applicable mounting paragraphs in this Article. Coordinate with Drawings.
- Retain paragraph below if seismic controls are a project requirement. Coordinate with Drawings.
- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Retain paragraph below for floor-mounting switches and coordinate with Drawings.
- B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Retain subparagraph below to require floor-mounting switches to be installed on concrete bases. Coordinate with Drawings.

Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

c. Verify that manual transfer warnings are properly placed.

d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source

- with normal source available.
- b. Retain test in first subparagraph below if three-phase undervoltage sensing is specified in Part 2. Test requires advance preparation by testing agency.
- c. Simulate loss of phase-to-ground voltage for each phase of normal source.
- d. Verify time-delay settings.
- d. Verify pickup and dropout voltages by data readout or inspection of control settings.
- e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
- f. Usually require test in first subparagraph below only for critical and extensive installations and for switches rated 1600 A and more in other installations.
- f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
- g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

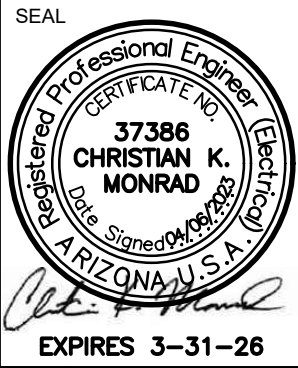
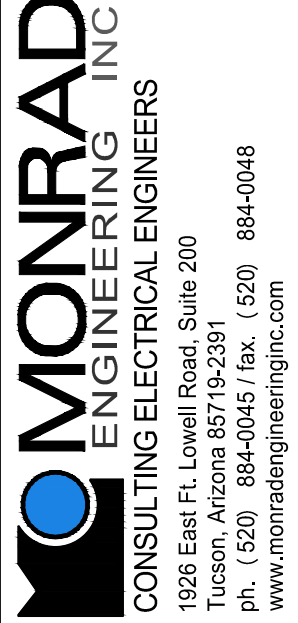
- E. Coordinate tests with tests of generator and run them concurrently.
- F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests. The manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards and withstand current ratings. The certification shall identify by serial number(s) the equipment involved. No exceptions to the specifications other than those stipulated at the time of submittal shall be included in the certification.
- G. Remove and replace malfunctioning units and retest as specified above.
- 3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 26.36.00

LOCKOUT - TAGOUT - TESTOUT



REV.	DATE	DESCRIPTION

AMPHITHEATER PUBLIC SCHOOLS
AMPHITHEATER HIGH SCHOOL
IT GENERATORS
125 W. Yavapai Rd. Tucson, Arizona 85705

SPECIFICATIONS

DRAWING TITLE	Project Number	M22110
Drawn By	SV	
Checked By	CM	
Date	4/06/2023	
Scale	AS-SHOWN	
DRAWING NO.		

E6.3