

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with **black**-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections.
  - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  - 2. Test Instruments: Use instruments that comply with UL 1436.
  - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).
- F. Wiring device will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION 262726

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Nonfusible switches.
  - 2. Molded-case circuit breakers (MCCBs).
  - 3. Enclosures.

#### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in **PDF and** electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.



## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
    - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in **PDF and** electronic format.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2010 m).

## 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: **One** year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

### 2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

### 2.3 NONFUSIBLE SWITCHES

- A. Type GD, General Duty shall not permitted.
- B. Type HD, Heavy Duty, Three Pole, Single Throw **600-V ac**, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
  - 4. Auxiliary Contact Kit: **One Two** NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating **120-V ac**.
  - 5. Lugs: **Mechanical** type, suitable for number, size, and conductor material.
  - 6. Service-Rated Switches: Labeled for use as service equipment.

### 2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing

international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be **100 percent rated**.
- D. Lugs shall be suitable for **194 deg F (90 deg C) rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70**.
- E. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- F. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- G. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- H. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

## 2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be **gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12)**.
- C. Operating Mechanism: The circuit-breaker operating handle shall be **directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R)**. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

### 3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify **Construction Manager** and **Owner** no fewer than five days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without **Construction Manager's** and **Owner's** written permission.
  - 4. Comply with NFPA 70E.

### 3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, **Type 1**.
  - 2. Outdoor Locations: NEMA 250, **Type 3R**.
  - 3. Other Wet or Damp, Indoor Locations: NEMA 250, **Type 4**.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

### 3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

### 3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections for Switches:
  1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    - i. Verify correct phase barrier installation.
    - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
  2. Electrical Tests:
    - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

- b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
  - 1) Use a low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar

- connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
  - e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
  - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
  - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
  - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
  - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
- 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 4. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit

breaker. Remove front panels so joints and connections are accessible to portable scanner.

- b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
- c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

- 1. Test procedures used.
- 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
- 3. List deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816



## SECTION 263100 - PHOTOVOLTAIC COLLECTORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. PV system description.
  - 2. Manufactured PV units.
  - 3. PV module framing.
  - 4. PV array construction.
  - 5. Inverters.
  - 6. System overcurrent protection.
  - 7. Mounting structures.

#### 1.3 DEFINITIONS

- A. CEC: California Energy Commission.
- B. ETFE: Ethylene tetrafluoroethylene.
- C. FEP: Fluorinated ethylene propylene.
- D. IP Code: Required ingress protection to comply with IEC 60529.
- E. MPPT: Maximum power point tracking.
- F. PTC: PVUSA Test Condition. Commonly regarded as a "real-world" measure of PV output. See below for definition of "PVUSA."
- G. PV: Photovoltaic.
- H. PVUSA: Photovoltaics for Utility Systems Applications.
- I. STC: Standard Test Conditions defined in IEC 61215.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For PV modules.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly.
4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For PV modules to include in operation and maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.

1. Manufacturer's materials and workmanship warranties include, but are not limited to, the following:
  - a. Faulty operation of PV modules.
  - b. Linear Power Performance Warranty
2. Warranty Period:
  - a. Twenty Five years on materials and workmanship from date of Substantial Completion.
  - b. Thirty years on linear power performance

B. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, applies to materials only, on a prorated basis, for period specified.

1. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:

- a. Specified minimum power output to **80** percent or more, for a period of 30 years.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Hazardous Locations: FM Global approved for NFPA 70, Class 1, Division 2, Group C and Group D.

### 2.2 PV CAPACITIES AND CHARACTERISTICS

- A. Minimum Electrical Characteristics:
  - 1. Rated Open-Circuit Voltage: 39.6 V dc.
  - 2. Maximum System Voltage: 1500 V dc.
  - 3. Maximum Power at Voltage (V<sub>pm</sub>): 33.4 V dc.
  - 4. Short-Circuit Temperature Coefficient: .045% /deg C>.
  - 5. Rated Short-Circuit Current (I<sub>sc</sub>): 16 amps.
  - 6. Rated Operation Current (I<sub>mp</sub>): 14.98 amps.
  - 7. Maximum Power at STC (P<sub>max</sub>): 500 watts.

### 2.3 PV SYSTEMS DESCRIPTION

- A. Interactive PV System: Collectors connected in parallel to the TBPP main bus and BESS; and capable of providing power for Project and supplying power to a distributed network.
  - 1. A module array sized as noted on the project plans to generate a total nominal rated output as noted on the project plans.
  - 2. System Components:
    - a. PV modules.
    - b. Array frame.
    - c. BESS interactive inverter. BESS to be grid forming.
    - d. Overcurrent protection, disconnect, and rapid shutdown devices.
    - e. Mounting structure.
    - f. System kW/kWh meter.
    - g. DC combiner boxes.
- B. System shall be a Stand Alone PV system: Collectors connected to provide power to Project dc and ac loads through an energy storage system.

### 2.4 MANUFACTURED PV UNITS

- A. Cell Materials: N-Type TOPCon Technology

B. Module Construction:

1. Nominal Size: 44.6 inches (800 mm) wide by 77.2 inches (1600 mm) long.
2. Weight: 51.4 lb (19.4 kg).

C. Front Panel: Fully tempered glass.

D. Backing Material: Tempered glass.

E. Frame: Anodized aluminum

F. Bypass Diode Protection: Internal.

G. Junction Box:

1. Size: 1.56 by 3.96 by 0.52 inch (39.6 by 100.6 by 13.2 mm).
2. Fully potted, vandal resistant.
3. IP Code **IP68**.
4. Flammability Test: UL 1703.

H. Output Cabling:

1. Quick, multiconnect, polarized connectors.

I. Series Fuse Rating: 25 amp.

## 2.5 PV MODULE FRAMING

A. PV laminates mounted in anodized extruded-aluminum frames.

1. Entire assembly UL listed for electrical and fire safety, according to UL 1703, and complying with IEC 61215.
2. Frame strength exceeding requirements of certifying agencies in subparagraph above.
3. Finish: Anodized aluminum.
  - a. Alloy and temper recommended by framing manufacturer for strength, corrosion resistance, and application of required finish.
  - b. Color: As indicated by manufacturer's designations.

## 2.6 PV ARRAY CONSTRUCTION

A. Framing:

1. Material: **Extruded aluminum**.
2. Maximum System Weight: Less than 4 lb/sq. ft. (19.53 kg/sq. m).
3. Raceway Cover Plates **Aluminum**.

## 2.7 INVERTER

A. Inverter Type: String.

- B. Inverter size: AC output wattage as noted on project plans.
- C. Control Type: Maximum power point tracker control.
- D. Inverter Electrical Characteristics:
  - 1. Inverter shall have electrical ratings as listed for its size and are similar to those manufactured by SMA, SolarEdge, Chint (CPS), or equal.
- E. Operating Conditions:
  - 1. Operating Ambient Temperatures: Minus 4 to plus 122 deg F (20 to plus 50 deg C).
  - 2. Storage Temperature: Minus 40 to plus 122 deg F (minus 40 to plus 50 deg C).
  - 3. Relative Humidity: Zero to 95 percent, noncondensing.
- F. Enclosure:
  - 1. NEMA **Type 3R minimum**.
  - 2. Enclosure Material: **Steel**.
  - 3. Cooling Methods:
    - a. Passive cooling.
  - 4. Protective Functions:
    - a. AC over/undervoltage.
    - b. AC over/underfrequency.
    - c. Ground overcurrent.
    - d. Overtemperature.
    - e. AC and dc overcurrent.
    - f. DC overvoltage.
  - 5. Standard LCD, four lines, 20 characters, with user display and on/off toggle switch.
- G. Disconnects: Rated for system voltage and conductor.
- H. Regulatory Approvals:
  - 1. IEEE 1547.1.
  - 2. IEEE 1547.3.
  - 3. UL 1741.

## 2.8 SYSTEM OVERCURRENT PROTECTION

- A. Fuses: Per project plans requirements.
- B. Circuit Breakers: Per project plans requirements.

## 2.9 MOUNTING STRUCTURES

- A. Rack Mounts per project plans.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Do not begin installation until mounting surfaces have been properly prepared.
- C. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
- E. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of PV panels with **[roof]** **[support]** assembly and other construction.
- C. Support PV panel assemblies independent of supports for other elements such as roof and support assemblies, enclosures, vents, pipes, and conduits. Support assembly to prevent twisting from eccentric loading.
- D. Install PV **[inverters,]** **[energy storage,]** **[charge controller,]** **[rapid shutdown,]** **[and]** **[system control]** in locations indicated on Drawings.
- E. Install weatherseal fittings and flanges where PV panel assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. See Section 079200 "Joint Sealants" for materials and application.
- F. Seismic Restraints: Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electric Systems."
- G. Wiring Method: Install cables in raceways.
- H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.3 CONNECTIONS

- A. Coordinate PV panel cabling to equipment enclosures to ensure proper connections.
- B. Coordinate installation of utility-interactive meter with utility.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Make splices, terminations, and taps that are compatible with conductor material **and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.**

END OF SECTION 263100

## SECTION 263213.16 - GASEOUS EMERGENCY ENGINE GENERATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes packaged engine generators for emergency use with the following features:
  - 1. **Natural gas with LP backup** engine.
  - 2. Gaseous fuel system.
  - 3. Control and monitoring.
  - 4. Generator overcurrent and fault protection.
  - 5. Generator, exciter, and voltage regulator.
  - 6. Outdoor acoustic modified engine generator enclosure.
  - 7. Engine driven radiator.
  - 8. Vibration isolation devices.
  - 9. Finishes.
- B. Related Requirements:
  - 1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

#### 1.3 DEFINITIONS

- A. EPS: Emergency power supply.
- B. EPSS: Emergency power supply system.
- C. LP: Liquid petroleum.
- D. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Include thermal damage curve for generator.
  - 3. Include time-current characteristic curves for generator protective device.



4. Include fuel consumption in cubic feet per hour (CFH) at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include airflow requirements for cooling and combustion air in cubic feet per minute (CFM) at 0.8 power factor, with air-supply temperature of 95. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **manufacturer**.

B. Seismic Qualification Data: Certificates, for engine generator, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight, **supplied enclosure, silencer**, and each piece of equipment not integral to the engine generator, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.

5. Report of sound generation.
  6. Report of exhaust emissions showing compliance with applicable regulations.
  7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- D. Field quality-control reports.
- E. Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    - b. Operating instructions laminated and mounted adjacent to generator location.
    - c. Training plan.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
  2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
  3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
  4. Tools: Each tool listed by part number in operations and maintenance manual.

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Accredited by NETA.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 2 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.
- B. Acceptable manufacturers shall be those whose final, fully assembled packaged gaseous engine generator product meets or exceeds all performance requirements as specified herein for gaseous emergency engine generators.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Engine generator housing, engine generator, batteries, battery racks, silencers, sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7 level 4**.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified[ **and the unit will be fully operational after the seismic event**]."
  - 2. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst-case normal levels.
  - 3. Component Importance Factor: **1.0**.
- B. B11 Compliance: Comply with B11.19.
- C. NFPA Compliance:
  - 1. Comply with NFPA 37.
  - 2. Comply with NFPA 70.
  - 3. Comply with NFPA 99.
  - 4. Comply with NFPA 110 requirements for Level 1 EPSS.
- D. UL Compliance: Comply with UL 2200.
- E. Engine Exhaust Emissions: Comply with EPA Tier **2 for non-road SI engine** requirements and applicable state and local government requirements.
- F. Noise Emission: Comply with **applicable state and local government requirements** for maximum noise level due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation. See silencer requirements in paragraph 2.4 in this specification. See enclosure requirements in paragraph 2.10 of this specification.
- G. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: **5 to 104 deg F**.
  - 2. Altitude: Sea level to **3000 feet**. Generator rated output shall be at the stated elevation.

- H. Unusual Service Conditions: Engine generator equipment and installation are required to operate under the following conditions:

- 1. **High salt-dust content in the air due to sea-spray evaporation when installed within 50 miles of the coast.**

## 2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. EPSS Class: Engine generator shall be classified as **Class 48** according to NFPA 110.
- D. Service Load: 1000 kW/1250 kVA.
- E. Power Factor: **0.8**, lagging.
- F. Frequency: 60 Hz.
- G. Voltage: 277/**480V** ac as required for the site
- H. Phase: Three-phase, **four**-wire **wye**.
- I. Induction Method: **Turbocharged**.
- J. Governor: Adjustable isochronous, with speed sensing.
- K. Mounting Frame: Structural-steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
  - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.
- L. Capacities and Characteristics:
  - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
  - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- M. Engine Generator Performance:
  - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage, from no load to full load.

2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency, from no load to full load.
4. 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.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, **Type 10**, system requirements.

N. Engine Generator Performance for Sensitive Loads:

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.
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.
8. Sustained Short-Circuit Current: For a three-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.

- a. Provide permanent magnet excitation for power source to voltage regulator.
- 10. Start Time: Comply with NFPA 110, **Type 10**, system requirements.
- O. Parallel Engine Generators:
  - 1. Automatic reactive output power control and load sharing between engine generators operated in parallel.
  - 2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.
  - 3. Protective relays required for equipment and personnel safety.
  - 4. Paralleling suppressors to protect excitation systems.
  - 5. Reverse power protection.
  - 6. Loss of field protection.

## 2.4 ENGINE

- A. Fuel: **Natural gas with LP backup.**
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Engine or skid mounted.
  - 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.
- D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and with UL 499.
- E. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
  - 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. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant-system pressure for engine used. Equip with gage glass and petcock.
  - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.

- a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and non collapsible under vacuum.
  - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- F. 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 25 feet from exhaust discharge after installation is complete shall be **78 dBA** or less.
- G. Air-Intake Filter: **Heavy** duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- H. Starting System: **24V** electric, with negative ground.
  - 1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" 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: **Lead acid** with capacity within ambient temperature range specified in "Performance Requirements" 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 50 deg F regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
  - 7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
  - 8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  - 9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for **lead-acid** batteries. Unit shall comply with UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A 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 to 140 deg F 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.

## 2.5 GASEOUS FUEL SYSTEM

- A. Natural Gas Piping: Comply with project requirements.
- B. LP Gas Piping: Comply with project requirements.
- C. Gas Train: Comply with NFPA 37.
- D. Tanks: Comply with requirements for propane storage containers.
- E. Engine Fuel System:
  - 1. **Natural Gas with LP Gas Backup, Vapor-Withdrawal System:**
    - a. Carburetor.
    - b. Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to building exterior.
    - c. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
  - 2. Fuel Filters: One for each fuel type.
  - 3. Manual Fuel Shutoff Valves: One for each fuel type.
  - 4. Flexible Fuel Connectors: Minimum one for each fuel connection.
  - 5. LP gas flow adjusting valve.
  - 6. Fuel change gas pressure switch.

## 2.6 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 engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- B. Manual Starting System Sequence of Operation: Switching On-Off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.



- C. Provide minimum run-time control set for **15** minutes, with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. 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 engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.
- F. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel. Panel shall be powered from the engine generator battery.
- G. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine generator battery. Panel features shall include the following:
  - 1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6.
  - 2. Switchboard Construction: Freestanding unit complying with Section 262413 "Switchboards." Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
  - 3. Switchgear Construction: Freestanding unit complying with Section 262300 "Low-Voltage Switchgear."
- H. Control and Monitoring Panel:
  - 1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
  - 2. Instruments: Located on the control and monitoring panel and viewable during operation.
    - a. Engine lubricating-oil pressure gage.
    - b. Engine-coolant temperature gage.
    - c. DC voltmeter (alternator battery charging).
    - d. Running-time meter.
    - e. AC voltmeter **connected to a phase selector switch**.
    - f. AC ammeter **connected to a phase selector switch**.
    - g. AC frequency meter.
    - h. Generator-voltage adjusting rheostat.
  - 3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication as required by NFPA 110 for Level 1] system, including the following:
    - a. Cranking control equipment.
    - b. Run-Off-Auto switch.
    - c. Control switch not in automatic position alarm.
    - d. Overcrank alarm.

- e. Overcrank shutdown device.
- f. Low water temperature alarm.
- g. High engine temperature pre-alarm.
- h. High engine temperature.
- i. High engine temperature shutdown device.
- j. Overspeed alarm.
- k. Overspeed shutdown device.
  
- l. Coolant low-level alarm.
- m. Coolant low-level shutdown device.
- n. Coolant high-temperature prealarm.
- o. Coolant high-temperature alarm.
- p. Coolant low-temperature alarm.
- q. Coolant high-temperature shutdown device.
- r. EPS load indicator.
- s. Battery high-voltage alarm.
- t. Low-cranking voltage alarm.
- u. Battery-charger malfunction alarm.
- v. Battery low-voltage alarm.
- w. Lamp test.
- x. Contacts for local and remote common alarm.
- y. Remote manual-stop shutdown device.
- z. Air shutdown damper alarm when used.
- aa. Air shutdown damper shutdown device when used.
- bb. Generator overcurrent-protective-device not-closed alarm.

I. Connection to Datalink:

- 1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
- 2. Provide connections for datalink transmission of indications to remote data terminals via **Ethernet**.

J. Common Remote Panel with Common Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.

K. Remote Alarm Annunciator: Comply with NFPA 99. An LED indicator light 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 mounting type to suit mounting conditions indicated.

- 1. Overcrank alarm.
- 2. Coolant low-temperature alarm.
- 3. High engine temperature pre-alarm.
- 4. High engine temperature alarm.
- 5. Low lube oil pressure alarm.
- 6. Overspeed alarm.
- 7. Low coolant level alarm.

8. Low-cranking voltage alarm.
  9. Contacts for local and remote common alarm.
  10. Audible-alarm silencing switch.
  11. Air shutdown damper when used.
  12. Run-Off-Auto switch.
  13. Control switch not in automatic position alarm.
  14. Lamp test.
  15. Low-cranking voltage alarm.
  16. Generator overcurrent-protective-device not-closed alarm.
- L. 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.
- M. Remote Emergency-Stop Switch: Wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

## 2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
  2. Trip Settings: Selected to coordinate with generator thermal damage curve.
  3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
  4. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms. Contacts shall be available for load shed functions.
  2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
  3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.

4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- D. Ground-Fault Indication: Comply with NFPA 70 Article 700, "Emergency System" signals for ground fault.
1. Indicate ground fault with other engine generator alarm indications.
  2. Trip generator protective device on ground fault.

## 2.8 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. Provide 12 lead alternator.
- E. Range: Provide **broad** range of output voltage by adjusting the excitation level.
- F. 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.
- G. Enclosure: Drip-proof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
  2. Maintain voltage within **20** percent on one step, full load.
  3. Provide anti-hunt provision to stabilize voltage.
  4. Maintain frequency within 5 percent and stabilize at rated frequency within **two** seconds.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: **12** percent, maximum.

## 2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable 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.

1. Sound Attenuation Level: To reduce noise level to 70db at 23 feet from genset enclosure.
- B. Description: Prefabricated or pre-engineered, galvanized-steel-clad, integral structural-steel-framed, acoustically attenuated, enclosure; erected on concrete foundation or provided assembled with genset.
- C. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.
- D. Seismic Design: Comply with seismic requirements in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Provide smoke detector in enclosure; mounted according to NFPA 72.
- F. Hinged Doors: With padlocking provisions.
- G. Space Heater: Thermostatically controlled and sized to prevent condensation.
- H. Lighting: Provide weather-resistant **LED** lighting with **30 fc** average maintained.
- I. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- J. Muffler Location: **Within** enclosure.
- K. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours or 100% continuous for 48 hours with ambient temperature at top of range specified in system service conditions.
  1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.
  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.
  3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- L. Interior Lights with Switch: Factory-wired, vaporproof luminaires within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
  1. AC lighting system and connection point for operation when remote source is available.
  2. DC lighting system for operation when remote source and generator are both unavailable.
- M. Convenience Outlets: Factory-wired, GFCI. Arrange for external electrical connection.

## 2.10 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
  - 1. Material: **Standard neoprene** separated by steel shims.
- B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

## 2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

## 2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
  - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
  - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  - 2. Test generator, exciter, and voltage regulator as a unit.
  - 3. Full-load run.
  - 4. Maximum power.
  - 5. Voltage regulation.
  - 6. Transient and steady-state governing.
  - 7. Single-step load pickup.
  - 8. Safety shutdown.
  - 9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
  - 10. Report factory test results within 10 days of completion of test.

## PART 3 - EXECUTION - THIS IS SITE SPECIFIC

### 3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

- B. Examine roughing-in for piping systems and electrical connections to verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- 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 according to requirements indicated:
  - 1. Notify **Construction Manager** and **Owner** no fewer than five working days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without **Construction Manager's** and **Owner's** written permission.

### 3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:
  - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in project plans.
  - 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Cooling System: Pre-piped as part of packaged engine generator system.
- F. Exhaust System: Pre-piped as part of packaged engine generator system.
- G. Drain Piping: Pre-piped as part of packaged engine generator system.
- H. Gaseous Fuel Piping:
  - 1. Natural gas piping, valves, and specialties for gas distribution are to be provided for the pipe size and gas volume required.
  - 2. LP gas piping, valves, and specialties for gas piping are to be provided for the pipe size and gas volume required.
- I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect cooling-system water piping to engine generator and **radiator** with flexible connectors.
- D. Connect engine exhaust pipe to engine with flexible connector.
- E. Gaseous Fuel Connections:
  - 1. Connect fuel piping to engines with a gate valve and union and flexible connector.
  - 2. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.
  - 3. Vent gas pressure regulators outside building a minimum of 60 inches (1500 mm) from building openings.
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- H. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

### 3.5 IDENTIFICATION

- A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections **with the assistance of a factory-authorized service representative**.



E. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
  - a. Visual and Mechanical Inspection:
    - 1) Compare equipment nameplate data with Drawings and the Specifications.
    - 2) Inspect physical and mechanical condition.
    - 3) Inspect anchorage, alignment, and grounding.
    - 4) Verify that the unit is clean.
  - b. Electrical and Mechanical Tests:
    - 1) Perform insulation-resistance tests according to IEEE 43.
      - a) Machines Larger Than 200 hp (150 kW): Test duration shall be 10 minutes. Calculate polarization index.
      - b) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
    - 2) Test protective relay devices.
    - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
    - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
    - 5) Perform vibration test for each main bearing cap.
    - 6) Conduct performance test according to NFPA 110.
    - 7) Verify correct functioning of the governor and regulator.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
  - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
  - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
  - c. Verify acceptance of charge for each element of the battery after discharge.
  - d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. 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.

6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
  7. Exhaust Emissions Test: Comply with applicable government test criteria.
  8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
  9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
  10. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at **four locations 25 feet (8 m) from edge of the generator enclosure**, and compare measured levels with required values.
- F. Coordinate tests with tests for transfer switches and run them concurrently.
- G. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- H. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- I. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- J. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- K. Remove and replace malfunctioning units and [retest] [reinspect] as specified above.
- L. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
- M. 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.
- N. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels, so terminations and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
  2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **12** months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.16

## **SECTION 263373 - BATTERY ENERGY STORAGE SYSTEM (BESS)**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Battery energy storage system (BESS).

#### **1.02 RELATED REQUIREMENTS**

- A. Section 262713.16 - Power Quality Meters  
Section 263713 - Low-Voltage Microgrid Energy Management System

#### **1.03 ABBREVIATIONS AND ACRONYMS**

- A. BESS: Battery energy storage system.
- B. BMS: Battery management system.
- C. HVAC: Heating, ventilation, and air conditioning.
- D. IEC: International Electrotechnical Commission.
- E. IEEE: Institute of Electrical and Electronics Engineers.
- F. kWh: Kilowatt hour.
- G. kW: Kilowatt.
- H. LFP: Lithium ferrophosphate/lithium-ion iron phosphate.
- I. NEC: National Electrical Code.
- J. PCS: Power conversion system.
- K. SOC: State of charge.
- L. UL: Underwriters Laboratories.

#### **1.04 DEFINITIONS**

- A. C Rate: Power/energy capacity.

#### **1.05 REFERENCE STANDARDS**

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. IEC 61800-3 - Adjustable Speed Electrical Power Drive Systems - Part3: EMC Requirements and Specific Test Methods for PDS and Machine Tools; 2022.
- D. IEEE 693 - Recommended Practice for Seismic Design of Substations; 2018.
- E. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).
- F. ISO 12944-5 - Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems – Part 5: Protective Paint Systems; 2019.

- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NFPA 69 - Standard on Explosion Prevention Systems; 2024.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems; 2023.
- K. UL 1642 - Lithium Batteries; Current Edition, Including All Revisions.
- L. UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources; Current Edition, Including All Revisions.
- M. UL 1973 - Batteries for Use in Stationary and Motive Auxiliary Power Applications; Current Edition, Including All Revisions.
- N. UL 9540 - Energy Storage Systems and Equipment; Current Edition, Including All Revisions.
- O. UL 9540A - Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems; Current Edition, Including All Revisions.

## **1.06 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Review material selections and installation procedures with manufacturer's representative and affected installers.
- B. Scheduling: Do not schedule functional demonstration testing until operational readiness testing is complete and associated report and certification have been submitted.

## **1.07 SUBMITTALS**

- A. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.
- B. Indicate deviations from Contract Documents with reference to corresponding drawing or specification number and written justification for deviation.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets, including physical data, electrical performance, electrical characteristics, and connection requirements.
- D. Shop Drawings: Indicate enclosure dimensions, shipping section dimensions, weights, foundation requirements, required clearances, location and size of each field connection, and mounting and installation instructions.
  - 1. Structural calculations.
  - 2. Inspection and test plan.
- E. Operational Readiness Report:
  - 1. Document test results, including assumptions, conditions, allowances, and corrections made.
  - 2. Provide listing of field modifications and adjustments made including settings/parameters not identified as factory defaults within equipment's operations and maintenance manual documentation.
  - 3. Include certification, signed by Contractor and manufacturer's representative, that equipment and associated system have been installed, configured, and tested in accordance with manufacturer's recommendations, conforms to requirements of Contract Documents, and is ready for operation.
- F. Functional Demonstration Testing Report: Document test results, including assumptions, conditions, allowances, and corrections made.

- G. Manufacturer's qualification statement.
- H. Operation and Maintenance Data:
  - 1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
    - a. Include contact information for parts stocking location closest to Owner.
    - b. Identify critical spare parts associated with long lead times and/or those critical to unit operation.
    - c. Identify maintenance spare parts required to regularly perform scheduled equipment maintenance including, but not limited to, consumable parts required to be exchanged during scheduled maintenance periods.
- I. Project Record Documents:
  - 1. Construction, installation, schematic, and wiring diagrams updated to as-installed and commissioned state.
  - 2. Configured settings/parameters for adjustable components updated to as-installed and commissioned state, noted if different from factory default.
- J. Specimen Warranty: Statement of standard warranty and extended warranty options/costs.
- K. Executed warranty.
- L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
  - 1. Spare Parts: For each type and size of unit installed.
    - a. Provide minimum spare parts recommended by manufacturer.
    - b. Fuses: **One set**] of each type of power and control fuse installed within equipment.
    - c. Package and mark spare parts for long-term storage. Provide separate anti-static containers for printed circuit boards.
  - 2. Tools: Manufacturer-specific special tools required to install, remove, test, and maintain equipment components.
    - a. Equipment Configuration Software: PC-based or smart mobile device application; provide **one** of each different communication interface cable required to connect computer/device for configuration and programming.
    - b. Electronic Configuration Files: For future upload into replaced/repaired components, in media format acceptable by Owner.

## 1.08 QUALITY ASSURANCE

- A. Comply with the following:
  - 1. NFPA 70.
  - 2. NFPA 855.
  - 3. Requirements of local authorities having jurisdiction.
  - 4. Applicable local codes.
- B. Manufacturer Qualifications:
  - 1. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
  - 2. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
- C. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.09 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.
- B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.
- C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.
- D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Owner.
- E. Provide crane for handling of up to 20 ft BESS or as required.
- F. Energize/charge BESS within 2 weeks after delivery to project site.

## **1.10 FIELD CONDITIONS**

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

## **1.11 WARRANTY**

- A. Manufacturer Warranty:
  - 1. Provide manufacturer warranty for defects in material and workmanship for 3 years, including performance guarantee, labor, and parts. Complete forms in Owner's name and register with manufacturer.
  - 2. Offer warranty extension for coverage through year 4 for customers that enable remote support.
  - 3. Offer warranty extension for coverage through year 10 for additional cost.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. See approved list of manufacturers.

### **2.02 BATTERY ENERGY STORAGE SYSTEMS (BESS)**

- A. BESS sizing based on project requirements for TBPP size being installed. See project plans.
- B. BESS Ratings/Configurations: As indicated on drawings.
- C. Provide battery energy storage system (BESS) units factory assembled in non-walk-in, outdoor-rated only enclosure including but not limited to power conversion system (PCS), lithium-ion iron phosphate/lithium ferrophosphate (LFP) batteries, output isolation transformer, factory-installed local BESS controller for communication with microgrid controls, UPS for control backup, HVAC system, fire alarm system, gas detection and ventilation system, and factory-installed internal electrical connections.

- D. Listed as complying with UL 9540.
- E. Seismic Qualification:
  - 1. Provide independent third-party analysis and certification in accordance with ICC (IBC)/ASCE 7 and IEEE 693, using importance factor of 1.0.
- F. Fire Safety:
  - 1. UL 9540 certification, which includes UL 9540A large fire battery open rack tests.
  - 2. Dry pipe sprinkler system, requiring first responder water connection.
  - 3. Heat, smoke, and gas sensors.
  - 4. Active ventilation explosion prevention system complying with NFPA 69.
- G. Electromagnetic Compatibility: IEC 61800-3.
- H. Operation Temperature Range: From minus 4 to 122 degrees F (minus 20 to 50 degrees C).
- I. HVAC:
  - 1. Factory-installed packaged HVAC unit, wall mounted, with integral thermostat and disconnect.
  - 2. Capacity: Maintain enclosure interior temperature to battery manufacturer requirements with outside design temperature of minus 4 degrees F (minus 20 degrees C) or 122 degrees F (50 degrees C).
- J. Total Harmonic Distortion:
  - 1. Output Current THD (I): 2 percent, maximum.
  - 2. Output Voltage THD (V): 3 percent, maximum.
- K. Power Conversion System:
  - 1. Rated Power:
    - a. 20 ft BESS (this may be 30 or 40 feet depending on manufacturer): 1000 kW model.
  - 2. AC Output Voltage:
    - a. 20 ft BESS (size depends on manufacturer): 480 VAC (plus/minus 10 percent), 3 phase, 4 wire.
  - 3. Grid Frequency: 60 Hz, plus/minus 2.5 Hz.
  - 4. DC Bus Voltage Range:
    - a. 20 ft BESS (Size depends on manufacturer): 600-900 VDC.
  - 5. Control: Droop, virtual synchronous generation, isochronous.
  - 6. Overload Capability:
    - a. 20 ft BESS (Size depends on manufacturer): 105-115 percent for 10 minutes; 115-125 percent for 1 minute; 125-150 percent for 200 milliseconds.
  - 7. Current Imbalance: 100 percent.
  - 8. Certifications:
    - a. UL 1741, UL 1741 SA, UL 1741 SB, and UL 1741 CRD.
  - 9. Four-Quadrant Inverters: Capable of grid-tie and grid-forming operation.
- L. Batteries:
  - 1. Chemistry: Lithium-ion iron phosphate/lithium ferrophosphate (LFP).
  - 2. Nominal Capacity:
    - a. Cell: 100 Ah.
    - b. Battery Module: 400 Ah.
  - 3. Nominal Energy:
    - a. Cell: 0.32 kWh.
    - b. Battery Module: 20.5 kWh.
  - 4. Voltage Range:
    - a. Cell: 2.8-3.6 V.
    - b. Battery Module: 44.8-57.6 V.
  - 5. Optimize capacity, energy, and voltage range for racks for configuration.
  - 6. C-Rate: 0.5C.
  - 7. Rated Life: 6,000 cycles, 15-20 years; dependent on application and temperature.



- 8. Certifications:
  - a. UL 1642.
  - b. UL 1973.
  - c. UL 9540A.
  - d. United Nations Manual of Tests and Criteria, Section 38.3 (UN 38.3).
- M. Power Quality Meters
- N. Communications:
  - 1. Protocol: Modbus TCP.
  - 2. Ethernet Port: Copper RJ45, maximum 328 feet (100 m).
  - 3. Data logging.
- O. Enclosure:
  - 1. Environmental Rating: NEMA 250, Type 3R.
  - 2. Corrosion Resistance: ISO 12944-5, Class C3.
  - 3. Dimensions:
    - a. 20 ft BESS: 19,9 feet (6.1 m) long by 8 feet (2.4 m) deep by 9,5 feet (2.9 m) high. (Typical dimensions. These may vary by manufacturer.)
  - 4. Weight (Battery Loaded):
    - a. 20 ft BESS: Up to 26.08 tons (23.7 mt), depending on configuration and manufacturer.

## **2.03 SOURCE QUALITY CONTROL**

- A. Perform factory functional testing and first parameter adjusting.
- B. Identify BESS with label indicating inspection/testing agency and date of service.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.
- B. Examine for conditions detrimental to completion of work.

### **3.02 INSTALLATION**

- A. Install equipment in accordance with manufacturer's written instructions.

### **3.03 FIELD QUALITY CONTROL**

- A. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
  - 1. Include necessary material, equipment, labor, and technical supervision.
  - 2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.
  - 3. Identify BESS with label indicating inspection/testing agency and date of service.
- B. Operational Readiness Testing:

1. Inspect and test equipment and associated systems for conformance to Contract Documents, including equipment manufacturer's recommendations, and readiness for operation.
  - a. Visually inspect for physical damage and proper installation.
  - b. Perform tests in accordance with manufacturer's instructions.
  - c. Perform tests to verify compliance with Contract Documents.
  - d. Perform tests to verify equipment is ready for operation.
  - e. Touch-up paint chips and scratches with manufacturer-supplied paint.

### 3.04 CLOSEOUT ACTIVITIES

- A. Functional Demonstration Testing: Demonstrate proper operation of equipment and associated systems to Owner's designated representative, observing and documenting compliance with Contract Documents.
- B. Training:
  1. Train Owner's personnel on operation and maintenance of system.
    - a. Accommodate minimum of **four** attendees.
    - b. Provide not less than **one** session with **four hours** of classroom and hands-on training.
    - c. Training Reference: **Use submitted operations and maintenance manuals.**
    - d. Instructor: Factory-trained manufacturer's representative.
    - e. Location: Project site.
  2. Provide sufficient time and detail in each session to cover the following at minimum:
    - a. Operation theory.
    - b. Major equipment components.
    - c. Equipment operation.
    - d. Equipment configurations.
    - e. Maintenance, troubleshooting, and repair.
    - f. Component-level parts replacement.

### 3.05 MAINTENANCE

- A. Service Plan: Provide separate maintenance contract to Owner, **as proposal in addition to base bid**, for service and maintenance of BESS for **two years** from date of Substantial Completion.
  1. Annual Preventative Maintenance Visit: Perform inspection of equipment and environment and submit report documenting results with recommendations.

### 3.06 PROTECTION

- A. Protect installed equipment from subsequent construction operations.

**END OF SECTION 263373**

## SECTION 263600 - TRANSFER SWITCHES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes **automatic** transfer switches rated 600 V and less.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
  - 2. Include material lists for each switch specified.
  - 3. Single-Line Diagram: Show connections between transfer switch, power sources, and load.
  - 4. Riser Diagram: Show interconnection wiring between transfer switches, annunciators, and control panels.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **manufacturer-authorized service representative**.
- B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Features and operating sequences, both automatic and manual.
- b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

## 1.6 QUALITY ASSURANCE

### A. Testing Agency Qualifications:

1. Member company of NETA.
  - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.7 FIELD CONDITIONS

### 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:

1. Notify **Construction Manager and Owner**] no fewer than five days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without **Construction Manager's and Owner's** written permission.

## 1.8 WARRANTY

### A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Two years** from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.

- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
  - 2. Short-time withstand capability for **three** cycles.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Service-Rated Transfer Switch:
  - 1. Comply with UL 869A and UL 489.
  - 2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
  - 3. In systems with a neutral, the bonding connection shall be on the neutral bus.
  - 4. Provide removable link for temporary separation of the service and load grounded conductors.
  - 5. Surge Protective Device: Service rated.
  - 6. Ground-Fault Protection: Comply with UL 1008 for **normal bus**.
- L. Neutral Switching: Where four-pole switches are indicated, provide **neutral pole switched simultaneously with phase poles**.
- M. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- N. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- O. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- P. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable **shrinkable sleeve** markers at terminations.

Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via **front** access.

- Q. Enclosures: General-purpose NEMA 250, **Type 3R** complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
  2. Switch Action: Double throw; mechanically held in both directions.
  3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
  4. Conductor Connectors: Suitable for use with conductor material and sizes.
  5. Material: **Hard-drawn copper, 98 percent conductivity.**
  6. Main and Neutral Lugs: **Mechanical** type.
  7. Ground Lugs and Bus-Configured Terminators: **Mechanical** type.
  8. Ground bar.
  9. Connectors shall be marked for conductor size and type according to UL 1008.
- C. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- D. Automatic Closed-Transition Transfer Switches: Connect both sources to load momentarily. Transition is controlled by programming in the automatic transfer-switch controller.
1. Fully automatic make-before-break operation when transferring between two available power sources.
  2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
  3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
    - a. Initiation occurs without active control of generator.
    - b. Automatic transfer-switch controller takes active control of generator to match frequency, phase angle, and voltage.

- c. Controls ensure that closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
- 4. Failure of power source serving load initiates automatic break-before-make transfer.
- E. 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.
- F. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- G. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- H. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- I. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- J. Automatic Transfer-Switch Controller Features:
  - 1. Controller operates through a period of loss of control power.
  - 2. 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 shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  - 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 zero to 30 minutes, and factory set for 10 minutes. Override shall 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 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. 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 shall be adjustable from 10 to 30 minutes. Factory settings shall be 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 unavailable.

## 2.3 TRANSFER SWITCH ACCESSORIES

### A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. 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:
  - a. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
  - b. Transition: Provide **open**-transition operation when transferring between power sources.
  - c. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
  - d. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

### B. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
3. Annunciation panel display shall include the following indicators:
  - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.



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

## 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. 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.
- B. Prepare test and inspection reports.
  - 1. For each of the tests required by UL 1008, performed on representative devices, for **emergency** systems. Include results of test for the following conditions:
    - a. Overvoltage.
    - b. Undervoltage.
    - c. Loss of supply voltage.
    - d. Reduction of supply voltage.
    - e. Alternative supply voltage or frequency is at minimum acceptable values.
    - f. Temperature rise.
    - g. Dielectric voltage-withstand; before and after short-circuit test.
    - h. Overload.
    - i. Contact opening.
    - j. Endurance.
    - k. Short circuit.
    - l. Short-time current capability.
    - m. Receptacle withstand capability.
    - n. Insulating base and supports damage.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
  - 1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified on the project plans.
  - 2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

3. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Surface mounted on wall unless otherwise indicated.
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

### 3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, 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. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
  1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."
- G. Connect twisted pair cable according to Section 271513 "Communications Copper Horizontal Cabling."
- H. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.
- I. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."
- J. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:
  - 1. After installing equipment, test for compliance with requirements according to NETA ATS.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with Drawings and Specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and required clearances.
    - d. Verify that the unit is clean.
    - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
    - f. Verify that manual transfer warnings are attached and visible.
    - g. Verify tightness of all control connections.
    - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
      - 1) Use of low-resistance ohmmeter.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
    - i. Perform manual transfer operation.
    - j. Verify positive mechanical interlocking between normal and alternate sources.
    - k. Perform visual and mechanical inspection of surge arresters.
    - l. Inspect control power transformers.
      - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
      - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
      - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
  - 3. Electrical Tests:
    - a. Perform insulation-resistance tests on all control wiring with respect to ground.
    - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
    - c. Verify settings and operation of control devices.
    - d. Calibrate and set all relays and timers.
    - e. Verify phase rotation, phasing, and synchronized operation.
    - f. Perform automatic transfer tests.
    - g. Verify correct operation and timing of the following functions:
      - 1) Normal source voltage-sensing and frequency-sensing relays.
      - 2) Engine start sequence.

- 3) Time delay on transfer.
  - 4) Alternative source voltage-sensing and frequency-sensing relays.
  - 5) Automatic transfer operation.
  - 6) Interlocks and limit switch function.
  - 7) Time delay and retransfer on normal power restoration.
  - 8) Engine cool-down and shutdown feature.
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, perform each electrical test for transfer switches stated in NETA ATS and 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 retransfer from emergency source with normal source available.
    - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    - c. 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. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one 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.
  6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
    - a. Verify grounding connections and locations and ratings of sensors.
- D. Coordinate tests with tests of generator and run them concurrently.
  - E. 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.
  - F. Transfer switches will be considered defective if they do not pass tests and inspections.
  - G. Remove and replace malfunctioning units and retest as specified above.

- H. Prepare test and inspection reports.
- I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

#### 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.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 263600



PUBLIC UTILITY COMMISSION OF TEXAS

TEXAS BACKUP POWER PACKAGES

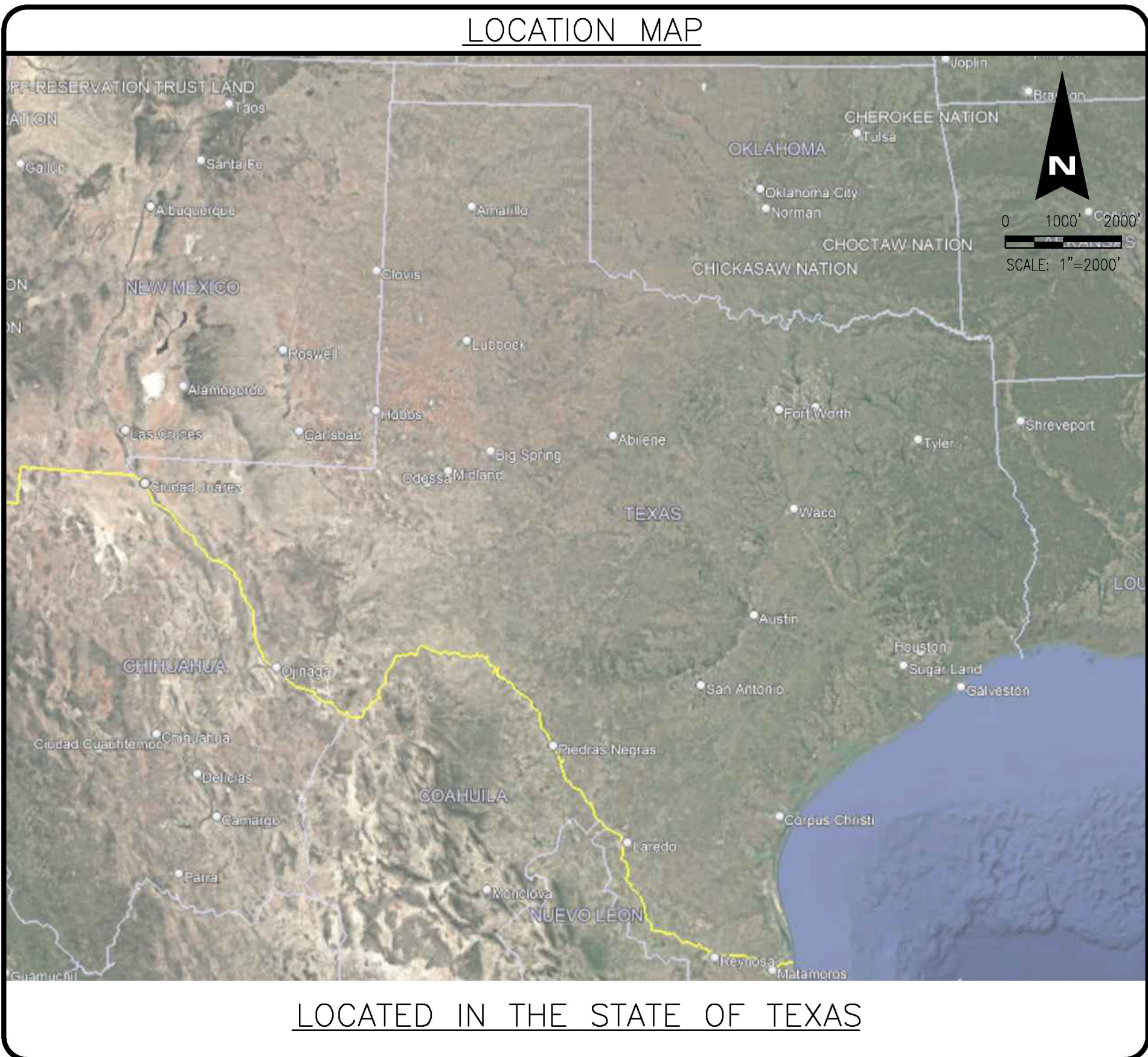
FOR CRITICAL FACILITIES

1000kW

Owner/Client:



INDEX OF DRAWINGS			
SHEET No.	TITLE	REV. NO.	DATE
T0.01	TITLE SHEET	0	01/21/2025
STRUCTURAL			
S0.01	STRUCTURAL GENERAL NOTES	0	01/21/2025
S0.02	STRUCTURAL GENERAL NOTES	0	01/21/2025
S1.01	FOUNDATION DETAILS	0	01/21/2025
S2.01	FENCING	0	01/21/2025
ELECTRICAL			
E1.01	LEGENDS AND ABBREVIATIONS	0	01/21/2025
E1.02	GENERAL SPECIFICATIONS	0	01/21/2025
E2.01	ONE LINE DIAGRAM	0	01/21/2025
E2.02	AGGREGATION SWITCHBOARD	0	01/21/2025
E3.01	100kW TBPP LAYOUT	0	01/21/2025
E3.02	100kW FOUNDATION PLAN	0	01/21/2025
E3.03	SOLAR LAYOUT	0	01/21/2025
E3.04	SOLAR DETAILS	0	01/21/2025
E4.01	NOT USED	0	01/21/2025
E5.01	GROUNDING PLAN	0	01/21/2025
E5.02	GROUNDING DETAILS	0	01/21/2025
E6.01	ELECTRICAL SIGNAGE	0	01/21/2025

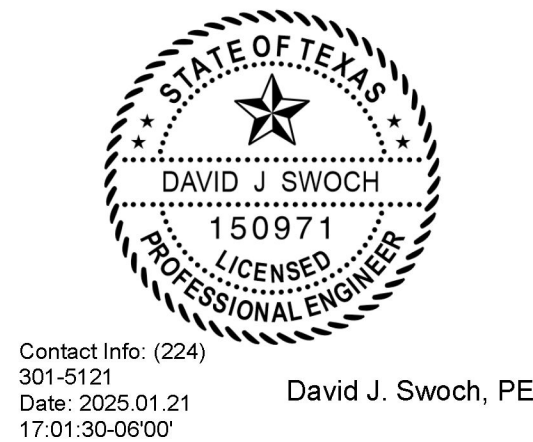
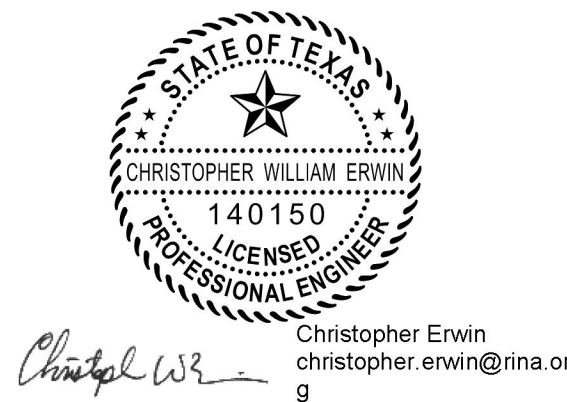


NOTIFICATIONS

 **Know what's below.  
Call before you dig.**

SUMMARY	
TEXAS BACKUP POWER PACKAGES (TBPP) ARE TO BE DEVELOPED IN ACCORDANCE WITH PLANS HEREIN. THEY ARE TO BE USED IN ISLAND MODE ONLY TO PROVIDE BACKUP POWER TO CRITICAL FACILITIES IN THE EVENT OF AN ELECTRICAL POWER OUTAGE. THE TBPPs ARE TO BE SUITABLE FOR INSTALLATION THROUGHOUT THE STATE OF TEXAS. THE PLANS HEREIN ARE FOR THE DEVELOPMENT OF THE TBPPs AND ARE NOT SPECIFIC TO ANY PARTICULAR SITE OR LOCATION WITHIN THE STATE OF TEXAS.	

FOR STRUCTURAL ONLY    FOR ELECTRICAL ONLY



Project: <b>TEXAS BACKUP POWER PACKAGE</b>	
<b>PUBLIC UTILITY COMMISSION OF TEXAS</b>	
Sheet Title: <b>COVER SHEET</b>	
Date: 01/21/2025	Proj. No.: 22483.005
<b>PROJECT PHASE</b>	
XXXX	
Sheet No.: <b>T0.01</b>	
Revision No.: 0	



FILE NAME: \\US-CPH-01\public\c\US2-Projects\Public Utility Commission of Texas (PUC)\24483.005 Backup Power Package Design\11.1.Dwg Project\11.1.Structural\SC01.dwg PLOTED: Tuesday, January 21, 2025 - 3:59pm USER: C2033

1. GENERAL REQUIREMENTS

- A. AS USED IN THESE GENERAL NOTES:  
"DRAWINGS" MEANS THE LATEST STRUCTURAL DESIGN DRAWINGS, UON.  
"SPECIFICATIONS" MEANS THE LATEST PROJECT SPECIFICATIONS, UON.  
"CONTRACT DOCUMENTS" ARE DEFINED AS THE DESIGN DRAWINGS AND THE SPECIFICATIONS  
"SER" IS DEFINED AS THE STRUCTURAL ENGINEER OF RECORD FOR THE STRUCTURE IN ITS FINAL CONDITION.  
"DESIGN PROFESSIONALS" IS DEFINED AS THE SER.  
"OSHA" IS DEFINED AS THE US OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION.  
"CONTRACTOR" IS DEFINED TO INCLUDE ANY OF THE FOLLOWING: GENERAL CONTRACTOR AND THEIR SUBCONTRACTORS, CONSTRUCTION MANAGER AND THEIR SUBCONTRACTORS, STRUCTURAL STEEL FABRICATOR OR STRUCTURAL STEEL ERECTOR.  
"BASE BUILDING STRUCTURE" IS DEFINED AS THE STRUCTURAL FRAME DESIGNED BY PATRICK ENGINEERING INC. "STRUCTURE IN ITS FINAL CONDITION" MEANS ALL STRUCTURAL ELEMENTS SHOWN ON THE STRUCTURAL CONTRACT DOCUMENTS ARE INSTALLED AND COMPLETELY CONNECTED AND INSPECTED WITH NO OUTSTANDING NON-COMPLIANCE ISSUES.
- B. CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF THE STRUCTURAL WORK WITH THE CIVIL, ELECTRICAL CONTRACT DOCUMENTS, AS WELL AS ANY OTHER APPLICABLE TRADES.
- C. CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE STRUCTURE UNTIL THE CONSTRUCTION OF THE STRUCTURE REACHES ITS FINAL CONDITION.
- D. CONTRACTOR IS RESPONSIBLE FOR THE DESIGN, INSTALLATION, AND REMOVAL OF TEMPORARY BRACING AND CONSTRUCTION SUPPORTS, FOR NEW AND EXISTING STRUCTURES, AS NECESSARY TO COMPLETE THE PROJECT.
- E. CONTRACTOR SHALL VERIFY ALL EXISTING DIMENSIONS AND CONDITIONS AND COORDINATE WITH THE STRUCTURAL DRAWINGS, ELECTRICAL DRAWINGS AND DRAWINGS FROM OTHER CONSULTANTS, PROJECT SHOP DRAWINGS AND FIELD CONDITIONS.
- F. IN CASES OF CONFLICT BETWEEN DRAWINGS AND/OR SPECIFICATIONS AND OTHER DISCIPLINES OR EXISTING CONDITIONS, CONTRACTOR SHALL NOTIFY THE DESIGN PROFESSIONALS AND OBTAIN CLARIFICATION PRIOR TO BIDDING AND PROCEEDING WITH WORK.
- G. ONLY USE DIMENSIONS INDICATED ON THE DRAWINGS. DO NOT SCALE DRAWINGS.
- H. CONTRACTOR SHALL PROTECT EXISTING FACILITIES, STRUCTURES AND UTILITIES FROM DAMAGE.
- I. SEE ELECTRICAL CONTRACT DOCUMENTS FOR ADDITIONAL INFORMATION RELATING TO THE COORDINATION OF STRUCTURAL COMPONENTS INCLUDING, BUT NOT LIMITED TO:
- (1) ELECTRICAL:  
GENERATOR, ENCLOSURE, AND FUEL TANK SIZES AND LOCATION  
CONDUIT SIZES FOR OPENING AND SLEEVE COORDINATION

2. CODES AND DESIGN CRITERIA

- A. PERFORM ALL CONSTRUCTION IN CONFORMANCE WITH THE BUILDING AND DESIGN CODES REFERENCED WITHIN THESE PROJECT DOCUMENTS. THE PROJECT DOCUMENTS REFER TO THE FOLLOWING CODES AND STANDARDS, UON:
- REF: INTERNATIONAL BUILDING CODE, 2015
- (1) STRUCTURAL CONCRETE:  
"BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE"  
THE AMERICAN CONCRETE INSTITUTE (ACI 318-14)
- B. LIVE LOADS:  
(1) WET GENERATOR WITH STEEL ENCLOSURE, SKID, AND FUEL TANK 44,000 LBS  
(2) 2,495 GALLON FUEL 15,300 LBS
- C. WIND LOAD DESIGN DATA:  
(1) MAIN WIND FORCE RESISTING SYSTEM  
(a) BASIC WIND SPEED, V TO BE DETERMINED FOR EACH SITE  
(b) EXPOSURE  
(c) WIND IMPORTANCE FACTOR (I<sub>w</sub>)  
(d) OCCUPANCY/RISK CATEGORY  
(e) GUST EFFECT FACTOR
- D. SEISMIC LOAD DESIGN DATA:  
(1) SEISMIC IMPORTANCE FACTOR (I<sub>s</sub>)  
(2) S<sub>s</sub>  
(3) S<sub>i</sub>  
(4) S<sub>0.5</sub> TO BE DETERMINED FOR EACH SITE  
(5) S<sub>1</sub>  
(6) SITE CLASS  
(7) SEISMIC DESIGN CATEGORY
- E. IN CASES WHERE CONTRACTOR DETERMINES THAT EQUIPMENT LOADS EXIST WHICH EXCEED DESIGN LOADS INDICATED ON CONTRACT DOCUMENTS, CONTRACTOR SHALL SUBMIT LOAD DATA TO DESIGN PROFESSIONALS FOR REVIEW PRIOR TO PROCEEDING WITH WORK.
- F. SERVICEABILITY  
(1) LATERAL DRIFT DUE TO WIND LOADS IS LESS THAN OR EQUAL TO H/200

4. SUBMITTALS

- A. CONTRACTOR SHALL REVIEW EACH SUBMITTAL PRIOR TO FORWARDING TO SER. CONTRACTOR SHALL STAMP EACH SUBMITTAL VERIFYING THAT EACH OF THE FOLLOWING IS ADDRESSED:
- (1) SHOP DRAWING IS REQUESTED.  
(2) SHOP DRAWING IS BASED ON THE LATEST DESIGN.  
(3) WORK IS COORDINATED AMONG ALL CONSTRUCTION TRADES.  
(4) REVISIONS FROM PREVIOUS SUBMITTALS ARE CLEARLY MARKED BY CIRCLING OR CLOUDS.  
(5) SUBMITTAL IS COMPLETE.  
(6) SUBMITTAL DOES NOT INCLUDE SUBSTITUTION REQUEST.  
(7) SUBMITTAL STAMP SHALL INDICATE PROJECT NAME AND LOCATION, SUBMITTAL NUMBER.
- SER SHALL RETURN, WITHOUT COMMENT, SUBMITTALS WHICH CONTRACTOR HAS NOT STAMPED OR WHICH DO NOT MEET THE ABOVE REQUIREMENTS. SER'S REVIEW OF SUBMITTALS SHALL BE FOR GENERAL CONFORMANCE WITH THE DESIGN INTENT. NO CONSTRUCTION (FABRICATION OR ERECTION) SHALL BE STARTED WITHOUT SUCH REVIEW.
- B. FOR CONTRACTOR-ENGINEERED COMPONENTS, PROVIDE A NOTE ON EACH SHOP DRAWING, WRITTEN AND SIGNED BY THE SUPPLIER'S ENGINEER, INDICATING THAT THE SHOP DRAWING IS IN CONFORMANCE WITH THE CALCULATIONS OF CONTRACTOR'S ENGINEER.
- C. THE FOLLOWING ITEMS REQUIRE SUBMITTALS FOR STRUCTURAL REVIEW AS OUTLINED IN THE SPECIFICATIONS:
- (1) S CALC CONCRETE FORMWORK  
(2) S CONCRETE REINFORCING LAYOUT  
(3) CALC CONCRETE MIX DESIGNS  
(4) S CONCRETE CONSTRUCTION JOINT LAYOUT
- S = SHOP DRAWINGS REQUIRED
- CALC = SUPPORTING CALCULATIONS REQUIRED, SIGNED AND SEALED BY A LICENSED PROFESSIONAL ENGINEER IN THE STATE OF OHIO.

5. FOUNDATIONS

- A. THE FOUNDATION DESIGN IS BASED ON THE FOLLOWING IBC MINIMUM DESIGN VALUES:
- (1) NET ALLOWABLE BEARING CAPACITY: 1,500 PSF
- DESIGN VALUES SHALL BE FIELD VERIFIED BY QUALIFIED GEOTECHNICAL ENGINEER RETAINED BY THE OWNER.
- B. ALL EXCAVATIONS SHALL BE IN ACCORDANCE WITH OSHA REGULATIONS. WHERE NECESSARY, SHEET AND SHORE THE EXCAVATION WITH ALL REQUIRED TIEBACKS AND BRACING AS DETERMINED BY CONTRACTOR'S STRUCTURAL ENGINEER.
- C. EXISTING SUBBASE SHALL BE COMPACTED TO AT LEAST 95% OF THE MODIFIED PROCTORS MAXIMUM DRY DENSITY. REMOVE AND REPLACE UNSUITABLE MATERIAL WITH STRUCTURAL FILL COMPACTED TO AT LEAST 95% MODIFIED PROCTOR DENSITY. (ASTM D-1557)
- D. GENERAL FILL SHALL BE INORGANIC SOIL, FREE OF WASTE, DEBRIS, DELETERIOUS MATERIAL, AND EXCESS MOISTURE. GENERAL FILL SHALL BE COMPACTED TO AT LEAST OF 90% OF THE MODIFIED PROCTORS MAXIMUM DRY DENSITY.

6. CONCRETE MATERIALS

- A. CONCRETE STRENGTH SHALL MEET THE FOLLOWING 28-DAY COMPRESSIVE STRENGTH (f'<sub>c</sub>), UON:
- (1) STRENGTH, f'<sub>c</sub> 4,500 PSI
- B. PROVIDE NORMALWEIGHT CONCRETE WITH CURED DENSITY OF 145 +/- 5 PCF, AND AGGREGATE CONFORMING TO ASTM C33 CLASS 3S, UON. MAXIMUM COARSE-AGGREGATE SIZE SHALL BE 3/4" NOMINAL. FINE-AGGREGATE SHALL BE FREE OF MATERIALS WITH DELETERIOUS REACTIVITY TO ALKALI IN CEMENT.
- C. FOR CONCRETE EXPOSED TO FREEZE THAW CYCLES, AND/OR DE-ICING CHEMICALS, AND CONCRETE INTENDED TO BE WATER TIGHT, PROVIDE ENTRAINED AIR CONTENT OF 6% +/- 1.5%
- D. THE USE OF CALCIUM CHLORIDE AND OTHER CHLORIDE CONTAINING AGENTS IS PROHIBITED. THE USE OF RECYCLED CONCRETE IS PROHIBITED. PLACEMENT WITHIN AND CONTACT BETWEEN ALUMINUM ITEMS, INCLUDING ALUMINUM CONDUIT, AND CONCRETE IS PROHIBITED.
- E. PROVIDE A 1" BEVEL ON ALL EXPOSED CONCRETE PROJECTIONS UNLESS NOTED OTHERWISE ON THE DRAWINGS. NO BEVEL IS REQUIRED ON CONCRETE EDGES BELOW FINISHED GRADE.
- F. FOLLOW ACI 306R RECOMMENDATIONS FOR COLD WEATHER CONCRETE PLACEMENT AND CURING.

7. CONCRETE REINFORCEMENT

- A. ALL CONCRETE SHALL INCLUDE REINFORCEMENT. IF REINFORCEMENT IS NOT SPECIFICALLY INDICATED ON THE DRAWINGS VERIFY REQUIREMENT WITH THE SER.
- B. REINFORCEMENT SHALL CONFORM TO THE FOLLOWING STANDARDS AND MATERIAL PROPERTIES, UON:
- (1) DEFORMED BARS: ASTM A615 Grade 60  
(2) WELDABLE DEFORMED BARS: ASTM A706  
(3) EPOXY COATED DEFORMED BARS: ASTM A615 / A775
- C. DETAIL REINFORCEMENT BASED ON THE PROJECT REQUIREMENTS, ACI-318 AND ACI-315, UON.
- D. WHERE A 90-DEG, 135-DEG OR 180-DEG HOOK IS GRAPHICALLY INDICATED, PROVIDE CORRESPONDING ACI STANDARD HOOKS, UON.
- E. DOWELS SHALL MATCH SIZE AND SPACING OF MAIN REINFORCEMENT, UON.
- F. REINFORCEMENT SHALL HAVE CONCRETE PROTECTION (CLEAR COVER) PER ACI 318 UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
- G. LAP REINFORCEMENT ONLY AT LOCATIONS AS SPECIFICALLY DETAILED ON THE DRAWINGS EXCEPT REINFORCEMENT MARKED AS CONTINUOUS CAN BE SPLICED AT LOCATIONS DETERMINED BY CONTRACTOR USING TENSION LAP SPLICES (LS). SEE LAP SPLICE AND EMBEDMENT SCHEDULE.
- H. UNLESS OTHERWISE NOTED, ALL LAP SPLICES ARE TO BE TENSION LAP SPLICES PER LAP SPLICE AND EMBEDMENT SCHEDULE.
- I. PLACE REINFORCING BARS IN ACCORDANCE WITH THE APPROVED SHOP DRAWINGS AND WITHIN THE TOLERANCES SPECIFIED IN ACI 117. SUPPORT REINFORCEMENT BY METAL CHAIRS, RUNNER, BOLSTERS, SPACERS, HANGERS AND OTHER APPROVED ACCESSORIES IN A MANNER TO PREVENT DISPLACEMENT DURING PLACEMENT OF CONCRETE.
- J. DO NOT HEAT OR FLAME CUT BARS. BEND BARS COLD. DO NOT BEND BARS WHICH ARE EMBEDDED IN CONCRETE UNLESS SPECIFICALLY APPROVED BY THE SER.

8. SPECIAL INSPECTIONS

- A. THE FOLLOWING STRUCTURAL ITEMS REQUIRE SPECIAL TESTING AND/OR INSPECTIONS:
- CONCRETE CONSTRUCTION  
SOILS

9. POST-INSTALLED ANCHORS

- A. ADHESIVE ANCHOR SYSTEMS USED FOR DESIGN:
- (1) SEISMIC DESIGN CATEGORY A - F
- (a) ADHESIVE: HILTI HIT-HY 200 HILTI, TULSA, OK  
(b) THREADED ROD: HILTI HAS-E HILTI, TULSA, OK
- (2) OVERHEAD AND/OR CONSTANT TENSION ADHESIVE ANCHOR INSTALLATIONS NOT SHOWN ON THE DRAWINGS SHALL NOT BE PERMITTED UNLESS EACH CONDITION IS REVIEWED AND APPROVED IN WRITING BY THE SER.
- B. PROOF TESTING OF ADHESIVE ANCHORS SHALL BE PERFORMED IN ACCORDANCE WITH THE MANUFACTURER RECOMMENDATIONS. UNLESS NOTED OTHERWISE, ADHESIVE ANCHOR PROOF TENSION LOADS SHALL BE PER ICC-ES ACCEPTANCE CRITERIA AC308.
- C. FIELD DRILLED EXPANSION ANCHOR SYSTEMS USED FOR DESIGN:
- (1) SEISMIC DESIGN CATEGORY A - F  
(a) KWIK BOLT T2 HILTI, TULSA, OK  
(2) SEISMIC DESIGN CATEGORY A - B AT LOCATIONS SPECIFICALLY NOTED IN DETAILS ONLY  
(a) KWIK BOLT 3 HILTI, TULSA, OK
- D. PROOF TESTING OF EXPANSION ANCHORS SHALL BE PERFORMED IN ACCORDANCE WITH THE MANUFACTURER RECOMMENDATIONS. UNLESS NOTED OTHERWISE, EXPANSION ANCHOR PROOF TORQUE LOADS SHALL BE PER THE EXPANSION ANCHOR PROOF TORQUE SCHEDULES.
- E. FIELD DRILLED THREADED SCREW ANCHOR SYSTEMS USED FOR DESIGN:
- (1) HUS-EZ HILTI, TULSA, OK
- F. ALTERNATIVE SYSTEM EQUIVALENT TO OR EXCEEDING THE PROPERTIES OF THE SYSTEMS ABOVE WILL BE CONSIDERED AS A SUBSTITUTION REQUEST.
- G. ANCHORS ARE TO BE MINIMUM 3/4-INCH DIAMETER WITH A MINIMUM EMBEDMENT OF 6-INCH, UON.
- H. INSTALL ANCHORS TO MEET THE REQUIREMENTS INDICATED IN THE CONTRACT DOCUMENTS AND THE CURRENT MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII).
- I. LOCATE, BY NON-DESTRUCTIVE MEANS, AND AVOID ALL EXISTING REINFORCEMENT PRIOR TO INSTALLATION OF ANCHORS. IF EXISTING REINFORCING LAYOUT PROHIBITS THE INSTALLATION OF ANCHORS AS INDICATED IN THE DRAWINGS, CONTRACTOR SHALL NOTIFY THE DESIGN PROFESSIONALS IMMEDIATELY.
- J. SEE REQUIRED SPECIAL INSPECTIONS AND TESTS OF CONCRETE CONSTRUCTION FOR POST-INSTALLED ANCHOR INSPECTION REQUIREMENTS.

10. ABBREVIATIONS

ADDL	ADDITIONAL	F/F	FACE TO FACE	OF	OUTSIDE FACE
ADJ	ADJACENT	FND	FOUNDATION	OH	OPPOSITE HAND
ALT	ALTERNATE	FS	FAR SIDE	OSL	OUT-STANDING LEG
APPROX	APPROXIMATE	FTG	FOOTING	OVS	OVERSIZED
B/	BOTTOM OF	GA	GAGE OR GAUGE	PL	PLATE
B/B	BACK TO BACK	GALV	GALVANIZED	PSF	POUNDS PER SQUARE FOOT
BC	BOLT CIRCLE	GEN	GENERAL	PSI	POUNDS PER SQUARE INCH
BM	BEAM	GR	GROUND PENETRATING	PT	POINT
BOT	BOTTOM	RADAR	RADAR	RAD	RADIUS
BRDG	BRIDGING	GRADE	GRADE	REF	REFERENCE
BRG	BEARING	HORIZ	HORIZONTAL	REIN	REINFORCEING
BTWN	BETWEEN	HP	HIGH POINT	REQD	REQUIRED
C	COMPRESSION	HT	HEIGHT	SCHED	SCHEDULE(D)
C/C	CENTER TO CENTER	ID	INSIDE DIAMETER	SDL	SUPERIMPOSED DEAD LOAD
OIP	CAST-IN-PLACE	IF	INSIDE FACE	SECT	SECTION
CL	CENTER LINE	INFO	INFORMATION	SF	SQUARE FOOT (FEET)
CLR	CLEAR OR CLEARANCE	INT	INTERIOR	SHT	SHEET
COL	COLUMN	JOINT	JOINT	SIM	SIMILAR
COMP	COMPRESSION	JT	KIPS (OR 1000 POUNDS)	SOG	SLAB ON GRADE
CONC	CONCRETE	K	KIP PER LINER FOOT	SP	SPACE
CONN	CONNECTION(S)	KLF	KIP PER SQUARE FOOT	STIFF	STIFFENER
CONST	CONSTRUCTION	KSF	KIP PER SQUARE FOOT	STIFF SPEC(S)	SPECIFICATION(S)
CONT	CONTINUOUS	KV	KILOVOLT	SSL	SHORT SLOTTED
CY	CUBIC YARD	LL	LIVE LOAD	LSL	LONG SLOTTED
DBL	DOUBLE	LLV	LONG LEG VERTICAL	STD	STANDARD
DEG	DEGREE(S)	LONG	LONG LEG HORIZONTAL	STL	STEEL
DET	DETAIL	LP	LONG LEG VERTICAL	SYM	SYMMETRICAL
DIA	DIAMETER	LWC	LONG LEG VERTICAL	T	TENSION
DIAG	DIAGONAL	LWT	LIGHTWEIGHT CONCRETE	T/	TOP OF
DM(S)	DIMENSION(S)	M	MOMENT	T&B	TOP AND BOTTOM
DL	DEAD LOAD	MATL	MATERIAL	TEN	TENSION
ECC	ECCENTRICITY	MAX	MAXIMUM	TH	THICK OR THICKNESS
EA	EACH	MECH	MECHANICAL	TYP	TYPICAL
EF	EACH FACE	MEZZ	MEZZANINE	UON	UNLESS OTHERWISE NOTED
EL	ELEVATION	MIN	MINIMUM	V	VERTICAL
ENGR	ENGINEER	MISC	MISCELLANEOUS	VERT	VERTICAL
EOD	EDGE OF DECK	NS	NEAR SIDE	VIF	VERIFY IN FIELD
EOS	EDGE OF SLAB	NTS	NOT TO SCALE	W/	WITH
EQ	EQUAL	NWC	NORMAL WEIGHT CONCRETE	W/O	WITHOUT
EW	EACH WAY	NWT	NORMAL WEIGHT	WF	WORK POINT
EXIST	EXISTING	OC	ON CENTER	WS	WATERSTOP
EXP	EXPANSION	OD	OUTSIDE DIAMETER	WWF	WELDED WIRE FABRIC
EXT	EXTERIOR				



Patrick Engineering Inc.  
55 East Monroe  
Suite 3450  
Chicago, IL 60603  
TEL (312) 201-7900  
FAX (312) 220-0722  
www.rina-us.org

PROFESSIONAL DESIGN FIRM  
LICENSE NO. 184000409-0014



Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: LAB

Checked: CWE

Approved: CWE

A	01/21/2025	ORIGINAL ISSUE
Rev. No.	Date	Description

ISSUES & REVISIONS

THE INFORMATION CONTAINED ON THESE DRAWINGS IS FOR USE ON THIS PROJECT ONLY

Project: TEXAS BACKUP POWER PACKAGE  
PUBLIC UTILITY COMMISSION OF TEXAS

Sheet Title: STRUCTURAL  
GENERAL NOTES

Date: 01/21/2025 Proj. No.: 22483.005

PROJECT PHASE

XXXX

Sheet No:

S0.01

Sheet of

Revision No.: 0



FILE NAME: \\US-01-jed04\civ\52-Project\Public Utility Commission of Texas (10-01)\24483.025 Backup Power Package Design\11. Drawings\11.3 Structural\SO.02.dwg PLOTED: Sunday, January 21, 2025 - 3:28pm USER: C2032

CIVIL PROJECT SPECIFICATIONS

1. GENERAL REQUIREMENTS
- A. REFERENCE SPECIFICATIONS
- (1) SITE DEVELOPMENT ACTIVITIES AND IMPROVEMENTS, INCLUDING SITE PREPARATION AND DEMOLITION, EARTHWORK, PAVEMENT, AND EROSION/SEDIMENT CONTROL MEASURES SHALL BE IN ACCORDANCE WITH THE REFERENCE SPECIFICATIONS INDICATED THROUGHOUT THESE PROJECT SPECIFICATIONS. ALL REFERENCE SPECIFICATIONS SHALL BE INCORPORATED INTO AND MADE A PART OF THE PROJECT SPECIFICATIONS, EXCEPT WHEN THE REFERENCE SPECIFICATIONS CONFLICT WITH THESE PROJECT SPECIFICATIONS, CONTRACTOR SHALL COMPLY WITH THE PROJECT SPECIFICATIONS.
- B. GOVERNING REGULATIONS
- (1) ALL PROJECT ACTIVITIES AND IMPROVEMENTS SHALL BE IN ACCORDANCE WITH THE GOVERNING AGENCY REGULATIONS. IN THE EVENT OF CONFLICT WITH THE INDICATED REFERENCE SPECIFICATIONS OR THESE PROJECT SPECIFICATIONS, THE GOVERNING AGENCY REGULATIONS SHALL APPLY.
- C. DEFINITIONS
- (1) WHENEVER IN THESE SPECIFICATIONS OR OTHER CONTRACT DOCUMENTS THE FOLLOWING TERMS, OR PRONOUNS IN PLACE OF THEM ARE USED, THE INTENT AND MEANING SHALL BE INTERPRETED AS FOLLOWS:
- (a) GOVERNING AGENCY: GOVERNMENT OR REGULATORY ENTITY WITH AUTHORITY TO IMPLEMENT AND ENFORCE SPECIFIC LAWS AND PERMIT REQUIREMENTS.
- (b) OWNER: ENTITY OR INDIVIDUAL FOR WHOM THE PROJECT IS BEING PERFORMED.
- (c) CONTRACTOR: ENTITY OR INDIVIDUAL RESPONSIBLE FOR PERFORMING ALL CONSTRUCTION ACTIVITIES AND FURNISHING ALL LABOR, MATERIALS, EQUIPMENT AND OTHER INCIDENTALS NECESSARY FOR THE SUCCESSFUL COMPLETION OF THE PROJECT AND FOR CARRYING OUT ALL DUTIES AND OBLIGATIONS IMPOSED BY THE CONTRACT.
- (d) ENGINEER: LICENSED PROFESSIONAL ENGINEERING ENTITY OR LICENSED PROFESSIONAL ENGINEER, ACTING THROUGH ITS/HIS/HER AUTHORIZED AGENTS, WHO REPRESENTS THE OWNER DURING THE CONSTRUCTION PHASE OF THE PRESCRIBED PROJECT WORK.
- (e) GEOTECHNICAL ENGINEER: LICENSED PROFESSIONAL ENGINEERING ENTITY OR LICENSED PROFESSIONAL ENGINEER, ACTING THROUGH ITS/HIS/HER AUTHORIZED AGENTS, WHO REPRESENTING THE OWNER IS INVOLVED WITH THE PRINCIPLES, PROPERTIES AND BEHAVIOR OF EARTH MATERIALS WITH REGARD TO THE PRESCRIBED PROJECT WORK.
- D. CONTRACT GENERAL CONDITIONS
- (1) THESE PROJECT SPECIFICATIONS SUPPLEMENT THE ENGINEERING PLANS, THE AGREEMENT BETWEEN OWNER AND CONTRACTOR, AND OTHER SUPPLEMENTAL DOCUMENTS THAT COMPRISE THE OVERALL PROJECT CONTRACT. THESE PROJECT SPECIFICATIONS ADDRESS THE TECHNICAL REQUIREMENTS OF THE PROJECT DESIGN AS INDICATED ON THE PROJECT DRAWINGS (PLANS). GENERAL CONDITIONS SUCH AS BID ITEMS, QUANTITIES, UNIT PRICES, CHANGE MANAGEMENT, CONSTRUCTION SCHEDULE, SUBMITTALS, AND OTHER CONDITIONS ARE DEFINED IN THE AGREEMENT AND ARE NOT ADDRESSED WITHIN THESE PROJECT SPECIFICATIONS.
- E. EXISTING UTILITIES
- (1) CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING ALL AGENCIES, UTILITY COMPANIES, AND PIPELINE COMPANIES KNOWN OR SUSPECTED TO HAVE BURIED CABLE, DUCT, SEWER, PIPES, ETC., WHICH MAY CONFLICT WITH THE PROJECT IMPROVEMENTS TO DETERMINE THE LOCATION AND DEPTH OF THE EXISTING UTILITIES.
- (2) IF CONFLICTS OCCUR AFTER THE EXISTING UTILITY CONDITIONS HAVE BEEN DETERMINED BY FIELD INVESTIGATIONS, CONTRACTOR SHALL IMMEDIATELY NOTIFY ENGINEER.
- (a) CONTRACTOR SHALL WORK WITH OWNER AND ENGINEER TO MAKE ARRANGEMENTS WITH THE AFFECTED UTILITY COMPANIES TO HAVE THEIR UTILITIES PROTECTED OR RELOCATED.
- F. EROSION / SEDIMENTATION CONTROL
- (1) EROSION/SEDIMENTATION CONTROL MEASURES, AS REQUIRED SHALL BE EMPLOYED DURING THE COURSE OF CONSTRUCTION OPERATIONS AND UNTIL SUITABLE GROUND COVERS ARE ESTABLISHED ON ALL CONSTRUCTION SITE AREAS.
- G. MATERIAL DISPOSAL
- (1) THE FOLLOWING SHALL BE REMOVED FROM THE CONSTRUCTION SITE AND PROPERLY DISPOSED OF IN A LEGAL MANNER, UNLESS OTHERWISE STATED IN THE AGREEMENT BETWEEN OWNER AND CONTRACTOR, THE COST OF REMOVAL AND DISPOSAL SHALL BE INCLUDED IN THE FIXED OR UNIT PRICES FOR THE VARIOUS CONTRACT PAY ITEMS AND NO ADDITIONAL PAYMENT WILL BE ALLOWED THEREFOR.
- (a) ALL SURPLUS EXCAVATED MATERIALS.
- (b) CONSTRUCTION AND DEMOLITION DEBRIS SUCH AS BUILDING MATERIALS, ASPHALT AND CONCRETE PAVEMENT MATERIALS, AND MISCELLANEOUS LANDSCAPE FEATURES REMOVED DURING THE INSTALLATION OF THE PROJECT IMPROVEMENTS.
- (2) IF CONTRACTOR INTENDS TO DISPOSE OF GENERATED CONSTRUCTION / DEMOLITION DEBRIS MATERIALS OR EXCAVATED SOILS AT A REGULATED CLEAN CONSTRUCTION / DEMOLITION DEBRIS (CCDD) OR UNCONTAMINATED SOIL FILL OPERATION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR TAKING ALL ACTIONS AND PREPARING ALL DOCUMENTS PRIOR TO TRANSPORT OF THE MATERIALS / SOIL TO THE DISPOSAL FACILITY. MATERIALS AND SOILS THAT DO NOT MEET CCDD AND UNCONTAMINATED SOIL CONSTITUENT LIMIT REQUIREMENTS SHALL BE DISPOSED OF AT A PERMITTED LANDFILL FACILITY. THE COST OF TESTING AND DOCUMENTATION TO EVALUATE THE MATERIALS / SOILS AND DETERMINE PROPER DISPOSAL REQUIREMENTS SHALL BE AS DEFINED IN THE AGREEMENT BETWEEN OWNER AND CONTRACTOR.
2. EARTHWORK OPERATIONS
- A. SITE CLEARING
- (1) ALL CONSTRUCTION SITE FEATURES AND ITEMS SUCH AS STRUCTURES, FOUNDATIONS, FENCES, PAVEMENTS, RUBBISH/DEBRIS, AND SURFACE VEGETATION SHALL BE REMOVED WHERE NECESSARY AND AS INDICATED BY ENGINEER FOR THE CONSTRUCTION OF THE PROJECT IMPROVEMENTS.
- B. EXCAVATION
- (1) EXISTING EARTH AND FILL MATERIALS WITHIN THE PROJECT CONSTRUCTION LIMITS SHALL BE EXCAVATED AS NECESSARY TO ESTABLISH THE ELEVATIONS INDICATED ON THE PLANS. EXCAVATED MATERIALS CLASSIFIED BY GEOTECHNICAL ENGINEER AS SUITABLE STRUCTURAL FILL MATERIAL SHALL BE USED TO CONSTRUCT COMPACTED SUBGRADES WITHIN THE PROPOSED STRUCTURAL AREAS. EXCESS MATERIALS SHALL BE REMOVED FROM THE SITE AND LEGALLY DISPOSED OF, UNLESS DIRECTED BY THE OWNER TO STOCKPILE ON-SITE FOR FUTURE USE. STOCKPILE LOCATIONS SHALL BE AS AUTHORIZED BY THE OWNER.
- (2) EXCAVATED MATERIALS CLASSIFIED BY GEOTECHNICAL ENGINEER AS UNSTABLE OR UNSUITABLE FOR STRUCTURAL FILL PURPOSES AND NOT NEEDED FOR NON-STRUCTURAL FILL, SHALL BE REMOVED FROM THE SITE AND LEGALLY DISPOSED OF, UNLESS DIRECTED BY THE OWNER TO STOCKPILE ON-SITE FOR FUTURE USE. STOCKPILE LOCATIONS SHALL BE AS AUTHORIZED BY THE OWNER.
- (3) EXCAVATIONS SHALL BE MAINTAINED IN A WELL-DRAINED CONDITION AT ALL TIMES. TEMPORARY DRAINAGE (DEWATERING) FACILITIES SHALL BE PROVIDED WHERE SURFACE RUNOFF IS NOT POSSIBLE OR EFFECTIVE. SUCH FACILITIES SHALL BE OPERATED DURING THE ENTIRE COURSE OF EARTHWORK OPERATIONS. DEWATERING FACILITIES SHALL INCLUDE EROSION AND SEDIMENT CONTROL MEASURES, AS INDICATED ELSEWHERE IN THESE PROJECT SPECIFICATIONS. UNLESS OTHERWISE STATED IN THE AGREEMENT BETWEEN OWNER AND CONTRACTOR, THE COST OF TEMPORARY DRAINAGE FACILITIES AND DEWATERING ACTIVITIES SHALL BE CONSIDERED INCIDENTAL TO THE VARIOUS PAY ITEMS OF THE WORK.
- C. FILL PLACEMENT
- (1) BEFORE PLACING ANY FILL WITHIN STRUCTURAL AREAS, THE EXISTING SUBGRADE SHALL BE COMPACTED AS INDICATED IN THE "COMPACTION" SECTION OF THESE SPECIFICATIONS. BELOW-GRADE FOUNDATION AREAS SHALL BE INSPECTED BY A GEOTECHNICAL ENGINEER PRIOR TO FOUNDATION INSTALLATION. SOFT, UNSTABLE, OR OTHERWISE UNSUITABLE MATERIALS SHALL BE REMOVED AND REPLACED AS DIRECTED BY GEOTECHNICAL ENGINEER.
- (2) STRUCTURAL FILL MATERIALS SHALL BE NON-FROST SUSCEPTIBLE GRANULAR FILL THAT CAN BE COMPACTED TO DEVELOP A STABILITY SATISFACTORY TO GEOTECHNICAL ENGINEER. STRUCTURAL FILL MATERIALS SHALL NOT CONTAIN FROZEN MATERIAL OR ANY MATERIAL WHICH, BY DECAY OR OTHERWISE, MIGHT RESULT IN AREA OR FOUNDATION SETTLEMENT.
- D. FILL COMPACTION
- (1) FILL MATERIALS SHALL BE PLACED IN LAYERS (LIFTS) AND COMPACTED IN ACCORDANCE WITH THE FOLLOWING SPECIFIED REQUIREMENTS. LIFT THICKNESS SHALL NOT EXCEED 8 INCHES (LOOSE CONDITION) AND THE FILL MATERIAL (WHEN COMPACTED) SHALL HAVE A MOISTURE CONTENT WITHIN THE LIMITS OF -1 TO +3 PERCENTAGE POINTS OF OPTIMUM VALUE. SPECIFIC LIFT THICKNESS AND MOISTURE CONTENT SHALL BE AS DETERMINED BY GEOTECHNICAL ENGINEER TO OBTAIN THE REQUIRED COMPACTION AND STRENGTH OF MATERIAL IN PLACE.
- (2) WELL-GRADED AGGREGATE MIXTURES SHALL BE SAMPLED AND TESTED TO DETERMINE THE LABORATORY MAXIMUM DENSITY AND OPTIMUM MOISTURE CONTENT (CONTROL VALUES) OF THE MATERIAL. THE TEST METHOD SHALL BE THE ASTM STANDARD AS INDICATED BELOW.
- (3) STRUCTURAL AREAS: THE TOP 6 INCHES OF EXISTING SUBGRADE AND WELL-GRADED GRANULAR FILL MATERIALS SHALL BE COMPACTED TO AT LEAST 95% MAXIMUM DRY DENSITY, AS DETERMINED BY THE MODIFIED PROCTOR METHOD (ASTM D1557), FREE-DRAINING AGGREGATE AND SOIL MATERIALS (ASTM D4253 & D4254) SHALL BE PLACED AND COMPACTED AS SPECIFIED BY GEOTECHNICAL ENGINEER.
- (4) SOIL AND AGGREGATE FILL MATERIALS COMPACTED IN PLACE SHALL BE FIELD TESTED TO DETERMINE IN-PLACE DENSITY AND MOISTURE VALUES. A NUCLEAR DENSITY GAUGE SHALL BE USED (IN ACCORDANCE WITH ASTM D6938) TO MEASURE IN-PLACE DENSITY/MOISTURE VALUES OF COHESIVE SOILS AND WELL-GRADED AGGREGATE MATERIALS, UNLESS GEOTECHNICAL ENGINEER DETERMINES OTHER TESTING EQUIPMENT IS MORE SUITABLE FOR THE TYPE OF MATERIAL BEING TESTED. THE DRY UNIT WEIGHT OF THE IN-PLACE COMPACTED MATERIAL SHALL BE COMPARED TO ITS CONTROL VALUE TO DETERMINE THE PERCENT COMPACTION ACHIEVED.
- (5) FREQUENCY OF FILL MATERIAL MOISTURE CONTENT AND COMPACTION TESTS SHALL BE AS FOLLOWS, UNLESS OTHERWISE ADJUSTED BY GEOTECHNICAL ENGINEER.
- (a) UNDER STRUCTURE GROUND SLABS AND MAT FOUNDATIONS, ONE IN-PLACE DENSITY TEST SHALL BE PERFORMED FOR EACH 3,000 SQUARE FEET, OR FRACTION THEREOF, OF EACH LIFT OF MATERIAL PLACED DURING EACH DAY.
- (b) UNDER STRUCTURE COLUMN FOOTINGS, ONE IN-PLACE DENSITY TEST SHALL BE PERFORMED FOR EACH FOOTING, OF EACH LIFT OF MATERIAL PLACED DURING EACH DAY.
- E. GRADING TOLERANCES
- (1) SURFACE ELEVATIONS SHALL BE WITHIN THE FOLLOWING INDICATED TOLERANCES.
- (a) UNDER STRUCTURAL AREAS:  $\pm 0.08\%$  TO  $\pm 0.04\%$
- F. RESTORATION
1. AREAS THAT ARE DAMAGED BY MOVEMENT OR STORAGE OF CONSTRUCTION VEHICLES, EQUIPMENT, OR MATERIALS, OR OTHER CONSTRUCTION ACTIVITIES SUCH AS THE DISCHARGE OF WATER FROM THE CONSTRUCTION SITE, SHALL BE RESTORED TO ORIGINAL CONDITIONS.

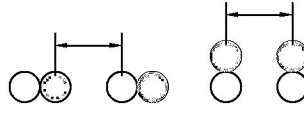
3. SOIL EROSION / SEDIMENT CONTROL AND SITE RESTORATION MEASURES

- A. GENERAL
- (1) CONTRACTOR SHALL TAKE SUITABLE AND SUFFICIENT MEASURES TO CONTROL SOIL EROSION AND SEDIMENTATION DUE TO CONSTRUCTION AND SITE DEVELOPMENT ACTIVITIES. THESE MEASURES SHALL FOLLOW ALL FEDERAL, STATE AND LOCAL CODE REQUIREMENTS. THE MOST STRINGENT REQUIREMENT SHALL BE FOLLOWED WHERE CODE REQUIREMENTS DIFFER.
- (2) CONTRACTOR RESPONSIBILITIES SHALL INCLUDE THE MAINTENANCE AND REPAIR OF ALL SEEDED, SODDED, AND PLANTED SURFACES UNTIL ALL SPECIFIED VEGETATIVE COVERS WITHIN THE PROJECT AREA ARE SUITABLY ESTABLISHED AND EROSION POTENTIAL HAS CEASED.
- B. STABILIZATION PRACTICES
- (1) CONTRACTOR SHALL LIMIT REMOVAL OF EXISTING VEGETATED GROUND COVERS TO ONLY AREAS ABSOLUTELY REQUIRED TO PERFORM THE PROJECT WORK. EXPOSED SOIL SURFACES SHALL BE STABILIZED WITH PROTECTIVE MULCHES OR BLANKETS. IF CONDITIONS PREVENT EFFECTIVE USE OR PLACEMENT OF SUCH MEASURES, THEN THE INSTALLATION OF STRUCTURAL CONTROLS SUCH AS SEDIMENT BARRIER FENCING AND SEDIMENT TRAPS WILL BE REQUIRED.
- (2) SURFACE STABILIZATION MEASURES SHALL BE INITIATED IMMEDIATELY (WITHIN 1 DAY) AFTER EARTHWORK OPERATIONS HAVE TEMPORARILY CEASED FOR A PERIOD THAT WILL EXCEED 14 DAYS AND AFTER FINAL GRADES ARE ESTABLISHED.
- C. SEDIMENT BARRIERS
- (1) TEMPORARY SEDIMENT BARRIERS SHALL BE INSTALLED AS DIRECTED BY ENGINEER AND MAINTAINED UNTIL SOIL SURFACES HAVE BEEN STABILIZED WITH GRASS OR OTHER TYPES OF PERMANENT COVER. SUCH BARRIERS SHALL BE SILT FENCES, COMPOST FILTER SOCKS, OR OTHER DEVICES.
- (2) TEMPORARY SEDIMENT BARRIERS SHALL BE INSTALLED PRIOR TO THE START OF SITE DISTURBANCE AND EARTHWORK OPERATIONS.
- (3) GEOTEXTILE FILTER FABRIC SEDIMENT BARRIERS SHALL BE INSTALLED OVER CASTING GRATES OF DRAINAGE STRUCTURES THAT RECEIVE SURFACE RUNOFF. SILT FENCE OR COMPOST FILTER SOCK BARRIERS SHALL BE PLACED AROUND DRAINAGE STRUCTURES WHERE THE USE OF FILTER FABRIC BARRIERS OVER THE GRATE IS INEFFECTIVE OR NOT FEASIBLE AND WHERE SILT FENCES OR FILTER SOCKS AS DIRECTED BY ENGINEER.
- (4) ALL SEDIMENT BARRIERS SHALL BE REPLACED OR CLEANED AS NECESSARY DURING CONSTRUCTION WHEN THEY BECOME CLOGGED OR INEFFECTIVE. ALL SEDIMENT TRAPS SHALL BE CLEANED PERIODICALLY DURING CONSTRUCTION TO ALLOW THEM TO OPERATE EFFECTIVELY.

REQUIRED SPECIAL INSPECTIONS AND TESTS OF SOILS		
TYPE	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION
1. VERIFY MATERIALS BELOW SHALLOW FOUNDATIONS ARE ADEQUATE TO ACHIEVE THE DESIGN BEARING CAPACITY.	—	X
2. VERIFY EXCAVATIONS ARE EXTENDED TO PROPER DEPTH AND HAVE REACHED PROPER MATERIAL.	—	X
3. PERFORM CLASSIFICATION AND TESTING OF COMPACTED FILL MATERIALS.	—	X
4. VERIFY USE OF PROPER MATERIALS, DENSITIES, AND LIFT THICKNESSES DURING PLACEMENT AND COMPACTION OF COMPACTED FILL.	X	—
5. PRIOR TO PLACEMENT OF COMPACTED FILL, INSPECT SUBGRADE AND VERIFY THAT SITE HAS BEEN PREPARED PROPERLY.	—	X

REQUIRED SPECIAL INSPECTIONS AND TESTS OF CONCRETE CONSTRUCTION				
TYPE	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION	REFERENCED STANDARD <sup>a</sup>	IBC 2015 REFERENCE
1. INSPECT REINFORCEMENT, INCLUDING PRESTRESSING TENDONS, AND VERIFY PLACEMENT.	—	X	ACI 318 CH 20, 25.2, 25.3, 26.6.1–26.6.3	1908.4
2. REINFORCING BAR WELDING: A. VERIFY WELDABILITY OF REINFORCING BARS OTHER THAN ASTM A706; B. INSPECT SINGLE-PASS FILLET WELDS, MAXIMUM $\frac{5}{16}$ " AND C. INSPECT ALL OTHER WELDS.	— X	X	AWS D1.4 ACI 318: 26.6.4	—
3. INSPECT ANCHORS CAST IN CONCRETE.	—	X	ACI 318: 17.8.2	—
4. INSPECT ANCHORS POST-INSTALLED IN HARDENED CONCRETE MEMBERS: A. ADHESIVE ANCHORS INSTALLED IN HORIZONTALLY OR UPWARDLY INCLINED ORIENTATIONS TO RESIST SUSTAINED TENSION LOADS. B. MECHANICAL ANCHORS AND ADHESIVE ANCHORS NOT DEFINED IN 4.A.	X	X	ACI 318: 17.8.2.4 ACI 318: 17.8.2	—
5. VERIFYING USE OF REQUIRED DESIGN MIX.	—	X	ACI 318: CH. 19, 26.4.3, 26.4.4	1904.1, 1904.2, 1908.2, 1908.3
6. PRIOR TO CONCRETE PLACEMENT, FABRICATE SPECIMENS FOR STRENGTH TESTES, PERFORM SLUMP AND AIR CONTENT TESTS, AND DETERMINE THE TEMPERATURE OF THE CONCRETE.	X	—	ASTM C 172 ASTM C31 ACI 318: 26.4, 26.12	1908.10
7. INSPECT CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES.	X	—	ACI 318: 26.5	1908.6, 1908.7, 1908.8
8. VERIFY MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES.	—	X	ACI 318: 26.5.3–26.5.5	1908.9
9. INSPECT PRESTRESSED CONCRETE FOR: A. APPLICATION OF PRESTRESSING FORCES; AND B. GROUTING OF BONDED PRESTRESSING TENDONS.	X X	— —	ACI 318: 26.10	—
10. INSPECT ERECTION OF PRECAST CONCRETE MEMBERS.	—	X	ACI 318: CH. 26.8	—
11. VERIFY IN-SITU CONCRETE STRENGTH, PRIOR TO STRESSING OF TENDONS IN POST-TENSIONED CONCRETE AND PRIOR TO REMOVAL OF SHORES AND FORMS FROM BEAMS AND STRUCTURAL SLABS.	—	X	ACI 318: 26.11.2	—
12. INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED.	—	X	ACI 318: 26.11.1.2(b)	—

- a. WHERE APPLICABLE, SEE ALSO SECTION 1705.12, SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE.
- b. SPECIFIC REQUIREMENTS FOR SPECIAL INSPECTION SHALL BE INCLUDED IN THE RESEARCH REPORT FOR THE ANCHOR ISSUED BY AN APPROVED SOURCE IN ACCORDANCE WITH 17.8.2 IN ACI 318, OR OTHER QUALIFICATION PROCEDURES WHERE SPECIFIC REQUIREMENTS ARE NOT PROVIDED, SPECIAL INSPECTION REQUIREMENTS SHALL BE SPECIFIED BY THE REGISTERED DESIGN PROFESSIONAL AND SHALL BE APPROVED BY THE BUILDING OFFICIAL PRIOR TO THE COMMENCEMENT OF THE WORK.

DEVELOPMENT LENGTH SCHEDULE								(f'c=4,500psi)
BAR SIZE	MINIMUM BAR SPACING 	LAP SPLICE LENGTH		DEVELOPMENT LENGTH		HOOKED BAR DEVELOPMENT LENGTH		
		(ls)		(ld)		(ldh)		
		TOP BARS	OTHER	TOP BARS	OTHER	TOP BARS	OTHER	
#3	1.875	24	18	18	14	8	8	
#4	2.000	32	25	25	19	10	10	
#5	2.125	40	31	31	24	12	12	
#6	2.250	48	37	37	28	15	15	
#7	2.375	70	54	54	42	17	17	
#8	2.500	80	62	62	47	19	19	
#9	2.875	90	70	70	54	22	22	
#10	3.250	102	78	78	60	25	25	
#11	3.625	113	87	87	67	27	27	

NOTES:

1. ALL TABLE DIMENSIONS ARE IN INCHES

2. TOP BARS INDICATE HORIZONTAL BARS WITH MORE THAN 12" OF CONCRETE CAST BENEATH.

3. CLEAR COVER – PROVIDE PER DETAILS OR ACI MINIMUMS WHERE NOT INDICATED.

4. WHERE BARS OF DIFFERENT SIZES ARE LAP SPLICED IN TENSION, THE LAP LENGTH SHALL BE THE LENGTH OF THE SMALLER BAR.

5. WHERE ACTUAL CONDITIONS DIFFER FROM THE PROVIDED SCHEDULE AND/OR NOTES, LENGTHS SHALL BE ADJUSTED ONLY WITH THE APPROVAL OF THE STRUCTURAL ENGINEER.

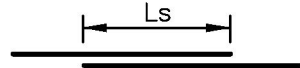
6. LAP SPLICE AND DEVELOPMENT LENGTH VALUES ASSUME NON COATED BARS. FOR EPOXY COATED BARS, LAP SPLICE AND DEVELOPMENT LENGTH VALUES MUST BE INCREASED BASED ON THE FOLLOWING RULES:

6.1. FOR CLEAR COVER LESS THAN 3 TIMES THE BAR DIAMETER OR CLEAR SPACING LESS THAN 6 TIMES THE BAR DIAMETER, INCREASE THE LAP SPLICE LENGTH (ls) AND DEVELOPMENT LENGTH (ld) BY 50%.

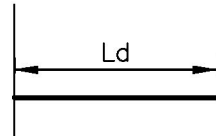
6.2. FOR ALL OTHER EPOXY COATED BAR, INCREASE THE LAP SPLICE LENGTH (ls) AND DEVELOPMENT LENGTH (ld) BY 20%.

6.3. HOOKED DEVELOPMENT LENGTHS (ldh) ARE UNCHANGED BY EPOXY COATINGS.

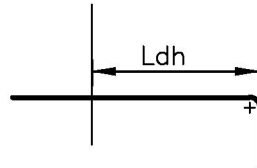
LAP SPLICE LENGTH



DEVELOPMENT LENGTH



HOOKED BAR DEVELOPMENT





Patrick Engineering Inc.  
55 East Monroe  
Suite 3450  
Chicago, IL 60603  
TEL: (312) 201-7900  
FAX: (312) 220-0722  
www.rina-us.org

PROFESSIONAL DESIGN FIRM  
LICENSE NO. 184000409-0014

Owner/Client  


Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: LAB

Checked: CWE

Approved: CWE

A	01/21/2025	ORIGINAL ISSUE
Rev. No.	Date	Description

ISSUES & REVISIONS

THE INFORMATION CONTAINED ON THESE DRAWINGS IS FOR USE ON THIS PROJECT ONLY

Project: TEXAS BACKUP POWER PACKAGE  
PUBLIC UTILITY COMMISSION OF TEXAS

Sheet Title: STRUCTURAL GENERAL NOTES

Date: 01/21/2025  
Proj. No.: 22483.005

PROJECT PHASE

XXXX

Sheet No:

S0.02

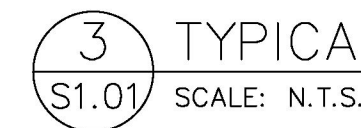
Sheet of

Revision No.: 0

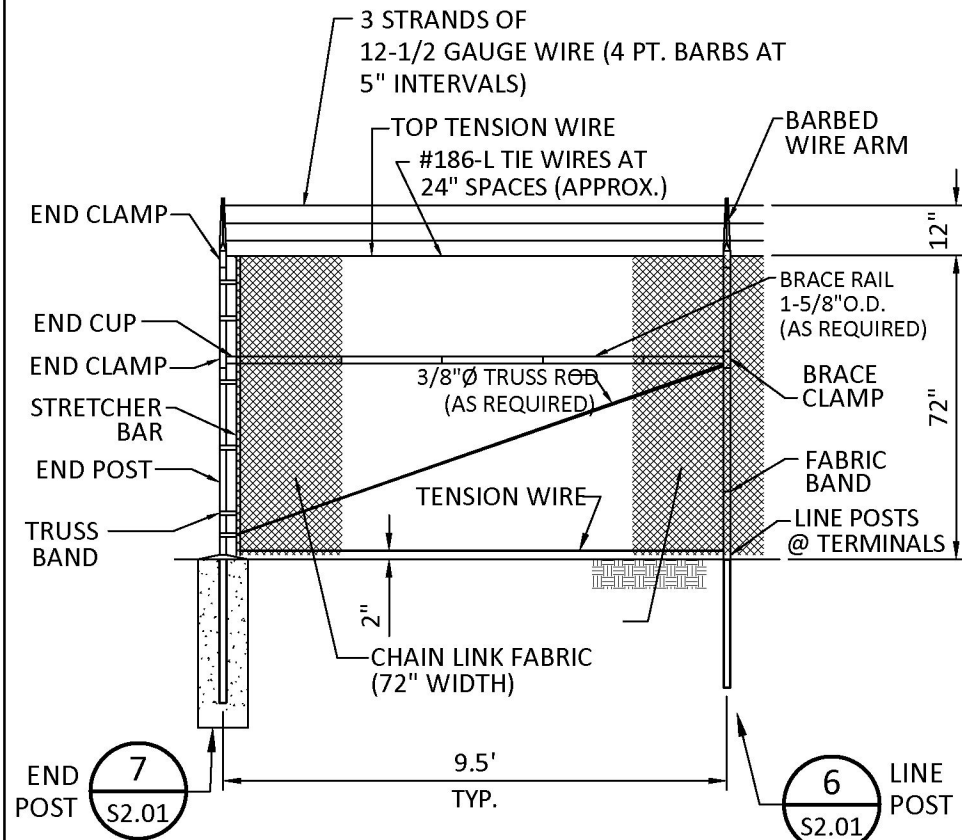




1 GENERATOR  
S1.01 SCALE: 3/4"=1'-0"



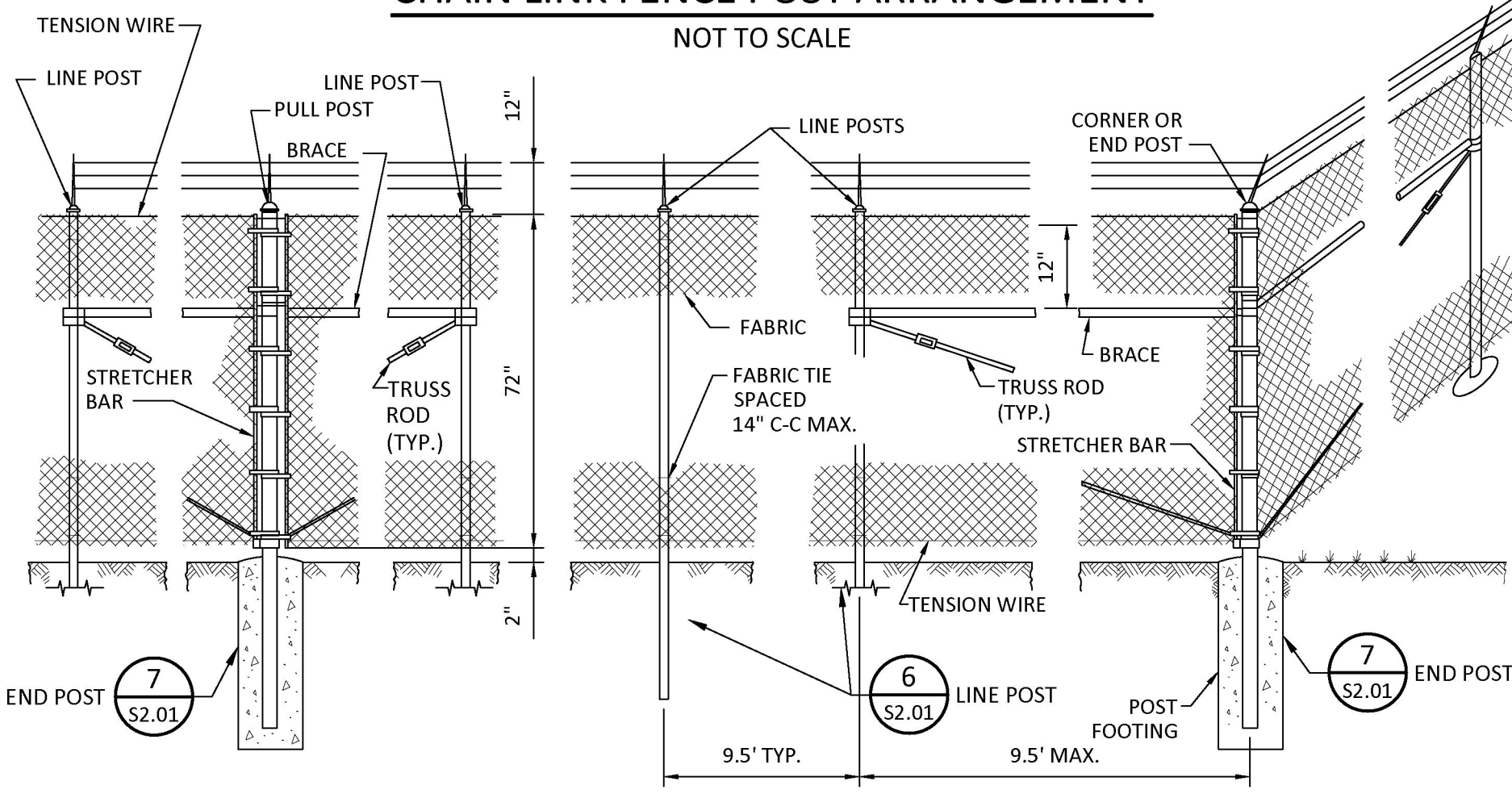
CHAIN LINK FENCE WITH BARBED WIRE



- NOTES:
1. BARBED WIRE ARM AT 45° ANGLE (TYP.), DIRECTED TOWARD EXTERIOR OF FACILITY.
  2. CHAIN LINK FABRIC SHALL BE MINIMUM NO. 9 GAGE 2" MESH.
  3. TENSION WIRE SHALL BE MINIMUM NO. 7 GAGE WIRE.
  4. SEE SHEET E4.01 FOR FENCE MATERIAL AND INSTALLATION SPECIFICATIONS.

3  
\$2.01

CHAIN LINK FENCE POST ARRANGEMENT  
NOT TO SCALE



PULL POST ARRANGEMENT

4  
\$2.01

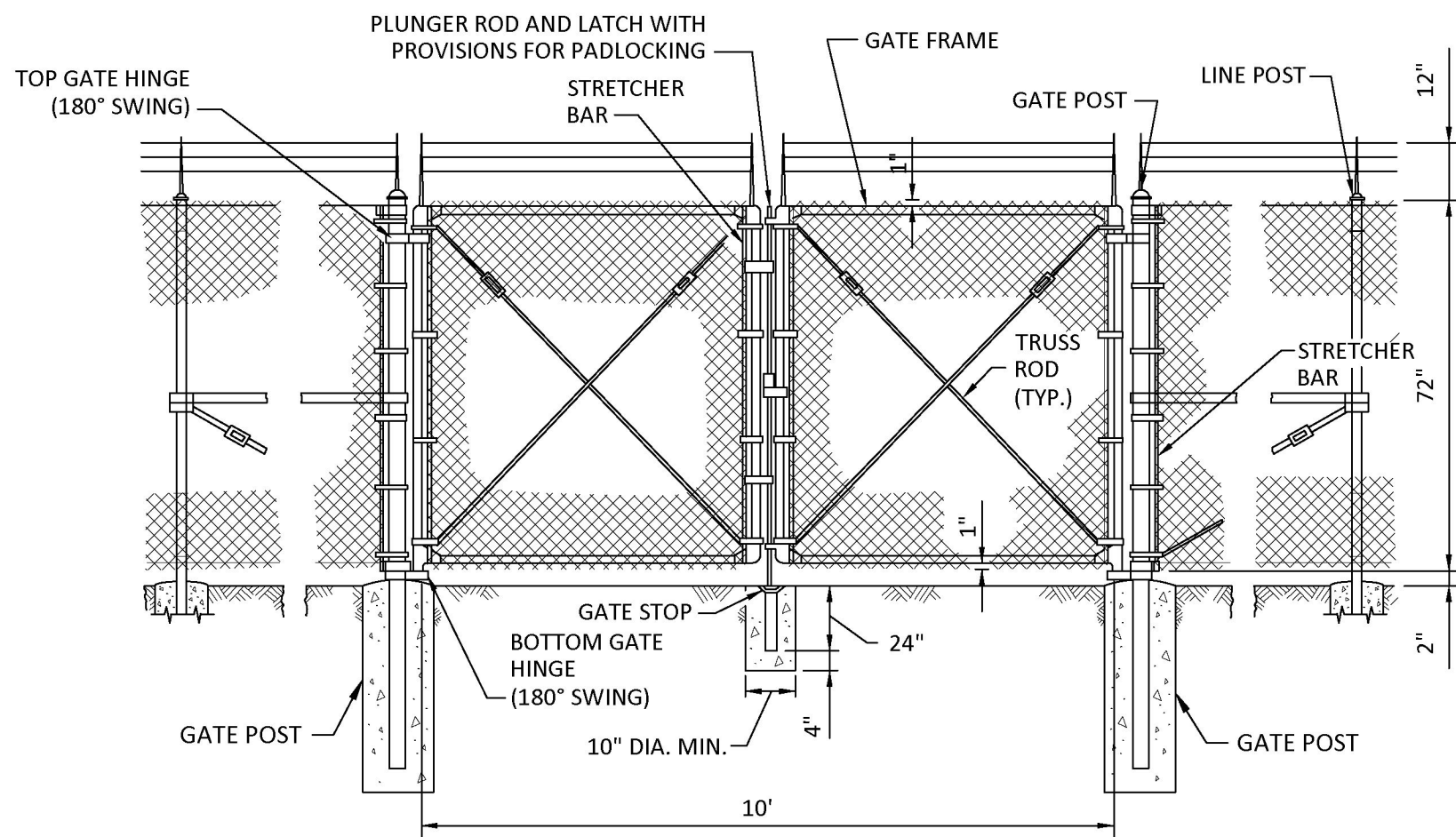
LINE POST ARRANGEMENT

- NOTES:
1. LINE POSTS SHALL BE 2-3/8" O.D. PIPE.
  2. CORNER/END/PULL POSTS SHALL BE 2-7/8" O.D. PIPE.
  3. SEE SHEET E4.01 FOR FENCE MATERIAL AND INSTALLATION SPECIFICATIONS.

CORNER OR END POST ARRANGEMENT

7  
\$2.01

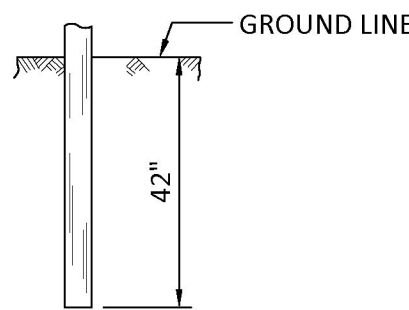
VEHICLE (DOUBLE SWING) GATE DETAIL



- NOTES:
1. PROVIDE COMMERCIAL DOUBLE GATE LATCH.
  2. PROVIDE KEEPER FOR ALL VEHICLE GATES WHICH AUTOMATICALLY ENGAGES THE GATE LEAF AND HOLDS IT IN THE OPEN POSITION UNTIL MANUALLY RELEASED.
  3. FERROUS-METAL COMPONENTS AND ACCESSORIES SHALL BE HOT-DIP GALVANIZED (SEE SHEET C0.03 FOR MATERIAL SPECIFICATIONS).
  4. CHAIN LINK FABRIC SHALL BE MINIMUM NO. 9 GAGE 2" MESH.
  5. TENSION WIRE SHALL BE MINIMUM NO. 7 GAGE WIRE.
  6. SEE SHEET E4.01 FOR FENCE MATERIAL AND INSTALLATION SPECIFICATIONS.

5  
\$2.01

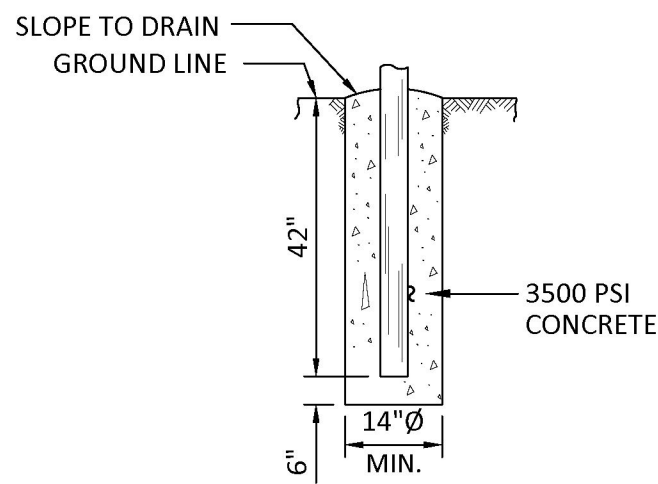
FOOTING FOR LINE POST



- NOTE:
1. LINE POSTS SHALL BE DIRECT-DRIVEN INTO SOIL TO MINIMUM DEPTH SHOWN.

6  
\$2.01

FOOTING FOR GATE & END POSTS



7  
\$2.01

CHAIN LINK FENCE

- A. GENERAL
- 1) FENCE SHALL BE NOMINAL 6 FEET HIGH WITH THREE-STRAND BARBED WIRE SECTION (1-FOOT HEIGHT) ABOVE FENCE FABRIC.
  - 2) GATES SHALL BE SWING TYPE AS SPECIFIED, COMPLETE WITH LATCHES, STOPS, KEEPERS, HINGES, AND WITH THREE-STRAND BARBED WIRE SECTION (1-FOOT HEIGHT) ABOVE FENCE FABRIC.
- B. MATERIALS
- 1) FABRIC
    - a) CHAIN LINK FABRIC SHALL BE MINIMUM 72 INCH WIDE, WOVEN FROM 9 GAUGE (COATED STEEL) SIZE WIRE IN A 2-INCH MESH WITH SELVAGE KNUCKLED AT THE TOP AND TWISTED AT THE BOTTOM.
    - b) FABRIC SHALL BE GALVANIZED COATED A MINIMUM 2.0 OZ/SQ FT CONFORMING TO ASTM A392, CLASS 2.
    - c) FABRIC TIE WIRE SHALL BE 9 GAUGE ALUMINUM.
  - 2) FRAMEWORK
    - a) ALL POSTS AND RAILS SHALL COMPLY WITH THE HEAVY INDUSTRIAL FENCE STRENGTH REQUIREMENTS OF ASTM F669, GROUPS IA, II AND III.

GROUP IA STEEL PIPE, STANDARD WEIGHT (SCH40)

DESCRIPTION	NPS
TOP AND BRACE RAILS	1-5/8 (1.660 INCH OD)
GATE FRAMES (WITH WELDED CORNERS)	1-7/8 (1.900 INCH OD)
LINE POSTS	2-3/8 (2.375 INCH OD)
END, CORNER AND PULL POSTS	2-7/8 (2.875 INCH OD)

NOTE: SEE ASTM-F1043 DIMENSION REQUIREMENTS FOR:  
GROUP II ROLL FORMED STEEL SHAPES ("C" SECTIONS)  
GROUP III HOT-ROLLED STEEL SHAPES ("H" BEAMS)

- PIPE POSTS AND RAILS SHALL BE GALVANIZED WITH 2 OZ/SQ FT OF HOT-DIPPED ZINC IN ACCORDANCE WITH ASTM A1083.
  - ROLL FORMED AND HOT-ROLLED STEEL POSTS AND RAILS SHALL BE GALVANIZED WITH 2 OZ/SQ FT OF HOT-DIPPED ZINC IN ACCORDANCE WITH ASTM A1083.
  - ALL POSTS AND GATE SUPPORTS FOR GATE OPENING LESS THAN 18 FEET WIDE SHALL BE OF SUFFICIENT LENGTH TO ALLOW FOR A MINIMUM 36 INCHES DEPTH BELOW GRADE. FOR GATE OPENING 18 FEET OR WIDER, THE SUPPORT POST LENGTH SHALL ALLOW FOR A MINIMUM 48 INCHES DEPTH BELOW GRADE.
  - IF USED, TOP RAIL SHALL FORM A CONTINUOUS BRACE FROM END TO END OF EACH STRETCH OF FENCE. TOP RAIL COUPLINGS SHALL BE SPACED AT MAXIMUM 21 FEET CENTERS.
- 3) WIRE, FITTINGS AND HARDWARE
- a) ALL TENSION WIRE SHALL BE 7 GAUGE MARCELLED WIRE COMPLYING WITH ASTM A824. MATCH COATING TO THAT OF CHAIN LINK FABRIC.
  - b) ALL BARBED WIRE SHALL BE DESIGN NO. 12-4-5-14R, COMPLYING WITH ASTM A121. MATCH COATING TO THAT OF CHAIN LINK FABRIC.
  - c) ALL FITTINGS AND HARDWARE (TENSION AND BRACE BANDS, POST CAPS, RAIL AND BRACE ENDS, CLAMPS, SLEEVES, TRUSS ROD ASSEMBLY, TENSION BARDS, BARBED WIRE ARMS) SHALL BE PRESSED STEEL IN COMPLIANCE WITH ASTM F626.
  - d) TIE WIRE AND HOG RINGS SHALL BE IN COMPLIANCE WITH ASTM F626.
  - e) ALL BOLTS SHALL BE 3/8 INCH DIAMETER AND 1 1/4 INCH LONG WITH STANDARD HEX NUT.
  - f) LATCHES WILL BE FORKED TYPE FOR SINGLE SWING GATES, AND PLUNGER ROD TYPE FOR DOUBLE SWING GATES. LATCHES SHALL HAVE A PADLOCK EYE AND PERMIT OPERATION FROM EITHER SIDE OF GATE.

- 4) CONCRETE
- a) CONCRETE FOOTINGS FOR POSTS SHALL HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4000 PSI AND BE AIR ENTRAINED 5% TO 7%.

- 5) GATES
- a) SWING GATES AND GATE POST SIZES

GATE WIDTH (FT)	TYPE	NPS	OD (INCHES)
MAN 3	SINGLE SWING	2-7/8	2.875
VEHICLE 20	DOUBLE SWING	4	4.5

- C. INSTALLATION
- 1) FENCE INSTALLATION SHALL BE IN ACCORDANCE WITH ASTM F567 UNLESS OTHERWISE NOTED HEREIN OR ON DRAWINGS.
  - 2) FENCE SHALL FOLLOW GROUND LINE UNLESS OTHERWISE APPROVED. FENCE CLEARANCE ABOVE GROUND SHALL BE 2 INCHES WITH A TOLERANCE OF 1 INCH.
  - 3) LINE POST SPACING SHALL BE 10 FOOT MAXIMUM CENTERS.
  - 4) CONCRETE FOOTINGS:

ITEM	NPS	FTG. DIA.	MIN. DEPTH BELOW GRADE
LINE POSTS	2	12"	48"
CORNER, END AND PULL POSTS		2-7/8	14" 48"
MAN GATE POSTS	2-7/8	14"	48"
VEHICLE GATE POSTS	4	14"	48"

- 5) THE CROWN OF CONCRETE FOOTING SHALL NOT BE LESS THAN ONE INCH ABOVE GRADE AND SHALL BE SLOPED TOWARD THE EDGES TO SHED WATER.
- 6) BRACES AND TRUSS RODS SHALL BE FURNISHED ON GATES, TERMINAL POST TO ADJACENT LINE POST, AND OTHER LOCATIONS AS REQUIRED TO PREVENT SAGGING.
- 7) GATE POSTS SHALL BE CAPPED WITH WATERTIGHT DOME TOPS.
- 8) EACH SWING GATE LEAF OVER 5 FEET WIDE SHALL BE PROVIDED WITH A GATE KEEPER FOR SECURING THE FREE END OF GATE WHEN IN FULL OPEN POSITION.
- 9) CHAIN LINK SHALL BE ATTACHED AS FOLLOWS:

LOCATION	ATTACHMENT
CORNER AND TERMINAL POSTS	TENSION BARS & TENSION BAR BANDS
LINE POSTS	TIE WIRE AT 12 INCH CENTERS
TOP AND BRACE RAILS	TIE WIRE AT 18 INCH CENTERS
GATE SIDE FRAME	TENSION BARS & TENSION BAR BANDS
TOP AND BOTTOM FRAME	TIE WIRE AT 12 INCH CENTERS
TENSION WIRE	HOG RINGS AT 18 INCH CENTERS

- 10) SWING GATES SHALL BE HUNG BY MINIMUM TWO TUBULAR POST HINGES SECURELY FASTENED TO THE GATE POSTS. HINGES SHALL NOT TWIST OR TURN UNDER ACTION OF THE GATE. SHALL BE CAPABLE OF ALLOWING A FULL 180 DEGREE OPENING TURN FOR VEHICLE GATES AND 90 DEGREE OPENING TURN FOR MAN GATES, AND SHALL BE EASILY OPERATED BY ONE PERSON.
- 11) GATE KEEPERS SHALL BE INSTALLED FOR SWING GATE LEAFS.

PROFESSIONAL DESIGN FIRM  
LICENSE NO. 184000409-0014

Owner/Client



Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: LAB

Checked: CWE

Approved: CWE

Rev. No.	Date	Description
A	01/21/2025	ORIGINAL ISSUE

ISSUES & REVISIONS

THE INFORMATION CONTAINED ON THESE DRAWINGS IS FOR USE ON THIS PROJECT ONLY

Project: **TEXAS BACKUP POWER PACKAGE**  
**PUBLIC UTILITY COMMISSION OF TEXAS**

Sheet Title:

**FENCE AND FENCE DETAILS**

Date: 01/21/2025 Proj. No: 22483.005

PROJECT PHASE

XXXX

Sheet No:

**S2.01**





Sheet of




























Revision No.:

0











































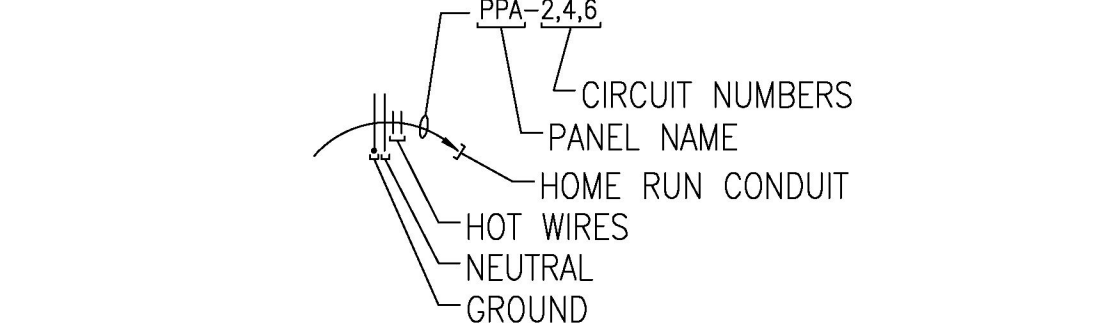
FILE NAME: P:\Utility\Public Utility Commission of Texas (PUC)\22483.002\_Bekus Power Package Design\11. Drawings\11.1 Electrical\11.00A\WT.01\_ Legends and Abbreviations.dwg, PLOTTER: Tundra, January 21, 2025 - 4:30pm, USER: ARJDA

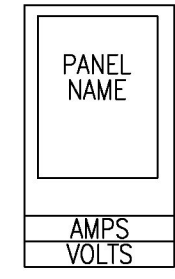
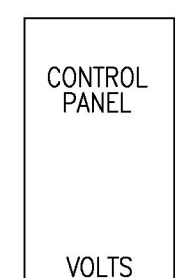
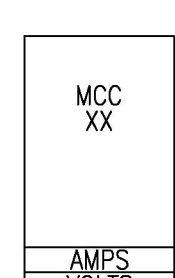


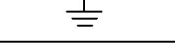
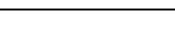
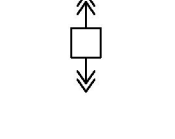
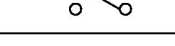
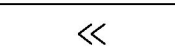
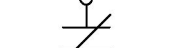
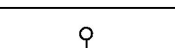
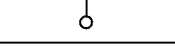
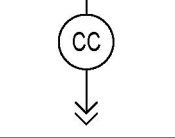
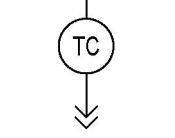




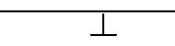


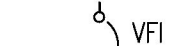


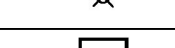

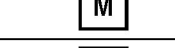

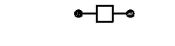



FIRE ALARM SYMBOLS		
SYMBOL		DESCRIPTION
WALL	CEILING	
		KNOX BOX
		GENERATOR REMOTE ANNUNCIATOR PANEL
		FIRE ALARM ANNUNCIATOR PANEL
		FIRE ALARM CONTROL PANEL

ELECTRICAL LIGHTING SYMBOLS		
SYMBOL		DESCRIPTION
WALL	CEILING	
		DOWN LIGHT OR WALL WASH LIGHTING FIXTURE
		FLUORESCENT LIGHTING FIXTURE
		EMERGENCY FLUORESCENT LIGHTING FIXTURE
		NIGHT LIGHTING FLUORESCENT FIXTURE
		DOWN LIGHT OR WALL WASH LIGHTING FIXTURE CONNECTED TO EMERGENCY LIGHTING SYSTEM
		BATTERY EMERGENCY LIGHTING UNIT, TWO-WAY THROW, UL APPROVED, WALL MOUNTED 1'-0" BELOW CEILING OR MAX OF 8'-0" AFF, CEILING MOUNTED-RECESSED IN CEILING
		BATTERY EMERGENCY LIGHTING UNIT, TWO-WAY THROW, UL APPROVED, WALL MOUNTED 1'-0" BELOW CEILING OR MAX OF 8'-0" AFF, SINGLE HEAD EXTENDED THROUGH WALL
		BATTERY EMERGENCY LIGHTING UNIT, SINGLE HEAD ONE-WAY THROW
		EXIT SIGN (TYPE AS NOTED ON EXIT SIGN LEGEND)
		OCCUPANCY SENSOR
		TIME CLOCK
		SINGLE POLE TOGGLE SWITCH +42" AFF, LOWERCASE LETTER DENOTES LIGHTING CONTROL
		3-WAY TOGGLE SWITCH +42" AFF
		4-WAY TOGGLE SWITCH +42" AFF
		MOMENTARY CONTACT SWITCH +42" AFF
		KEY OPERATED SINGLE POLE TOGGLE SWITCH
		DIMMER SWITCH +42" AFF
		TOGGLE SWITCH W/ PILOT NEON LIGHT +42" AFF

NOTE:  
1. THIS IS A COMPOSITE LIST AND ALL SYMBOLS MAY NOT BE USED ON THIS PROJECT.  
2. SEE LIGHTING FIXTURE SCHEDULE FOR LIGHTING FIXTURE TYPE DESCRIPTIONS AND PLANS FOR FIXTURE TYPE TAGS.

ELECTRICAL POWER SYMBOLS			
SYMBOL			DESCRIPTION
FLOOR	WALL	CEILING	
			SIMPLEX CONVENIENCE OUTLET +18" AFF (UNLESS NOTED OTHERWISE)
			DUPLEX CONVENIENCE OUTLET, WEATHERPROOF
			JUNCTION BOX - SIZE AS REQUIRED - MINIMUM 4" SQUARE
			PULL BOX - SIZE AS REQUIRED
			MOTOR OUTLET, HORSEPOWER AS NOTED
			DISCONNECT SWITCH - HORSEPOWER RATED, FUSED OR UNFUSED, AS REQUIRED OR NOTED. WP DENOTES WEATHERPROOF TYPE
			AUTOMATIC TRANSFER SWITCH
			UTILITY METER
			DISTRIBUTION PANEL: 208V: PROVIDE 36" FRONT CLEARANCE 480V: PROVIDE 42" FRONT CLEARANCE
			NEW PANELBOARD-SURFACE MOUNTED 208V: PROVIDE 36" FRONT CLEARANCE 480V: PROVIDE 42" FRONT CLEARANCE
			NEW PANELBOARD-RECESSED 208V: PROVIDE 36" FRONT CLEARANCE 480V: PROVIDE 42" FRONT CLEARANCE
			EMERGENCY PANEL - EM 208V: PROVIDE 36" FRONT CLEARANCE 480V: PROVIDE 42" FRONT CLEARANCE
			EXISTING PANEL 208V: MAINTAIN 36" FRONT CLEARANCE 480V: MAINTAIN 42" FRONT CLEARANCE
			DIGITAL POWER METERING
			SURGE PROTECTION DEVICE
			CONCEALED CONDUIT AND WIRE. RUN DASH WIRE DENOTES GROUND CONDUCTOR EXPOSED CONDUIT RUN. SUBMIT SHOP DWG FOR PROPOSED ROUTING.
			CONDUIT RUN (UNDERFLOOR OR UNDERGROUND)
			WIREWAY RACEWAY - SURFACE MOUNTED SAFETY SWITCHES AS NOTED ON PLANS
			FLEXIBLE CONDUIT CONNECTION
			CONDUIT ROUTED UP
			CONDUIT ROUTED DOWN
			GROUND PER CODE
			EMERGENCY SHUT DOWN PUSH BUTTON (RED MUSHROOM TYPE)
			TRANSFORMER

ELECTRICAL IDENTIFICATIONS	
	
ELECTRICAL RISER DIAGRAM LINETYPES	
PROPOSED _____ EXISTING TO REMAIN _____ EXISTING TO BE REMOVED _____	
E	ADJACENT TO DEVICE OR EQUIPMENT, DENOTES EXISTING TO REMAIN
X	ADJACENT TO DEVICE OR EQUIPMENT, DENOTES EXISTING TO BE REMOVED COMPLETELY, INCLUDING ALL CONDUIT AND WIRE. WHERE BOX REMAINS IN EXISTING WALL PROVIDE SUITABLE BLANK COVER.
ER	ADJACENT TO DEVICE OR EQUIPMENT, DENOTES EXISTING TO BE RELOCATED. EXTEND OR ADD WIRING AS SHOWN ON PLAN OR AS REQUIRED.
R	EXISTING DEVICE TO BE REPLACED WITH NEW
N	ADJACENT TO DEVICE OR EQUIPMENT, DENOTES NEW, WIRE SAME AS SHOWN ON PLAN.

ONE-LINE DIAGRAM SYMBOLS	
SYMBOL	DESCRIPTION
	POWER DISTRIBUTION PANELBOARD
	CONTROL PANEL
	MOTOR CONTROL CENTER
	CAPACITOR
	FUSE
	GROUND SYMBOL
	LOW VOLTAGE CIRCUIT BREAKER
	MEDIUM VOLTAGE CIRCUIT BREAKER Fxxx - DENOTES FEEDER BREAKER Uxxx - DENOTES UTILITY BREAKER Txxx - DENOTES TRANSFORMER BREAKER Gxxx - DENOTES GENERATOR BREAKER BTxx - DENOTES BUS TIE BREAKER "XX" DENOTES BUSES BEING TIED
	NORMALLY OPEN DISCONNECT SWITCH
	NORMALLY OPEN FUSED DISCONNECT
	SEPARABLE DISCONNECTS
	NORMALLY CLOSED CONTACT
	NORMALLY OPEN CONTACT
	CLOSE CIRCUIT COIL
	TRIP CIRCUIT COIL
	TRANSFORMER WITH DELTA/WYE WIRING CONVENTION
	TRANSFORMER WITH WYE/WYE WIRING CONVENTION
	AC WIRING
	MOTOR, HORSEPOWER AS NOTED
	GENERATOR, RATING AS NOTED
	MOTOR STARTER
	RELAY
	MEDIUM VOLTAGE VACUUM FAULT INTERRUPTER
	PHASE RELAY
	CAPACITOR TRIP
	UTILITY POLE
	SWITCHGEAR
	TRANSFORMER
	PRIMARY METER
	RECLOSER
	SOLAR PANEL
	OPTIMIZER
	INVERTER

NOTE: THIS IS A COMPOSITE LIST AND ALL SYMBOLS MAY NOT BE USED ON THIS PROJECT.

ELECTRICAL ABBREVIATIONS			
ABBREV	DESCRIPTION	ABBREV	DESCRIPTION
A	AMPERE	FDC	FIRE DEPARTMENT CONNECTION
AC	ALTERNATING CURRENT	FDR	FEEDER
A/C	AIR CONDITIONING	FIXT	FIXTURE
ACL	ACROSS THE LINE	FLA	FULL LOAD AMPS
ACS	AUXILIARY CONTACTS	FLR	FLOOR
AF	FUSED AMPS	FLUOR	FLUORESCENT
AFCI	ARC FAULT CIRCUIT INTERRUPTER	FPB	FAN POWERED BOX
AFF	ABOVE FINISHED FLOOR	FPC	FIRE PUMP CONTROLLER
AHJ	AUTHORITY HAVING JURISDICTION	F.S.	FUSED SWITCH
AHU	AIR HANDLING UNIT	FT	FOOT/FEET
AI	ANALOG INPUT	FU	FUSE
AIC	AMPERES INTERRUPTING CAPACITY	FVNR	FULL VOLTAGE, NON REVERSING (MAGNETIC STARTER)
AL	ALUMINUM	G	GROUND
ALM	ALARM	GEN	GENERATOR
AMP	AMPERE	GFI	GROUND FAULT INTERRUPTER
ANN	ANNUNCIATOR	GFP	GROUND FAULT PROTECTION
AO	ANALOG OUTPUT	GHW	GALVANIZED HEAVY STEEL CONDUIT
ARCH	ARCHITECT, ARCHITECTURAL	GND	GROUND
AS	SWITCH AMPS	GRD	GROUND
AT	AMPS TRIP	GRS	GALVANIZED RIGID STEEL CONDUIT
ATS	AUTOMATIC TRANSFER SWITCH	H	HEIGHT-MOUNTED ABOVE COUNTER
AVG	AVERAGE	HOA	HAND-OFF-AUTO
AWG	AMERICAN WIRE GAUGE	HP	HORSE POWER
BAL	BALLAST	HPS	HIGH PRESSURE SODIUM
BAS	BUILDING AUTOMATION SYSTEM	HR	HOUR
BESS	BATTERY ENERGY STORAGE SYSTEM	HV	HIGH VOLTAGE
BFC	BELOW FINISHED CEILING	HZ	HERTZ
BGB	BUILDING GROUND BOX	IC	INTERRUPTING CAPACITY
BHP	BRAKE HORSEPOWER	IG	ISOLATED GROUND
BMNT	BASEMENT	IMC	INTERMEDIATE STEEL CONDUIT
BPS	BOLTED PRESSURE SWITCH	IN	INCH(ES)
BR	BRANCH	INC	INCANDESCENT
BRKR	BREAKER	INV	INVERTER
C	CONDUIT	JB	JUNCTION BOX
CAB	CABINET	JPC	JOCKEY PUMP CONTROLLER
CAP	CAPACITY	KCMIL	THOUSAND CIRCULAR MILS WIRE
CATV	CABLE TELEVISION		CROSS SECTION AREA
CB	CIRCUIT BREAKER	KO	KNOCKOUT
CCT	CIRCUIT	KVA	KILOVOLT-AMPERE
CCTV	CLOSED CIRCUIT TELEVISION	KW	KILOWATT
CEC	CHICAGO ELECTRIC CODE	KWH	KILOWATT-HOUR
CECO	COMMONWEALTH EDISON COMPANY	LB	POUND
CLG	CEILING	LCP	LIGHTING CONTROL PANEL
CLO	CLOSET	LL	LOW LIMIT RELAY
CMB	COMBINER BOX	LS	LOUD SPEAKER
CO	CARBON MONOXIDE DETECTOR	LTG	LIGHTING
COAX	COAXIAL	LV	LOW VOLTAGE
COMED	COMMONWEALTH EDISON COMPANY	M	MOTOR
CONN	CONNECTION	MAX	MAXIMUM
CONV	CONVENIENCE	MC	MECHANICAL CONTRACTOR
CP	CONTROL PANEL	MCB	MAIN CIRCUIT BREAKER
CT	CURRENT TRANSFORMER	MCC	MOTOR CONTROL CENTER
CU	COPPER	MCP	MAXIMUM CIRCUIT PROTECTION
C.U.	COEFFICIENT OF UTILIZATION	MDF	MAIN DISTRIBUTION FRAME
CUH	CABINET UNIT HEATER	MECH	MECHANICAL
DC	DIRECT CURRENT	MED	MEDIUM
DGR	DUPLEX GROUNDED RECEPTACLE	MERC	MERCURY VAPOR
DIA	DIAMETER	MFR	MANUFACTURER
DISC	DISCONNECT	MH	MANHOLE
DIST	DISTRIBUTION	MIN	MINIMUM
DIV	DIVISION	MLO	MAIN LUGS ONLY
DN	DOWN	MOCPP	MAXIMUM OVERCURRENT PROTECTION
DO	DRAWOUT	MSB	MAIN SWITCHBOARD
DPDT	DOUBLE POLE DOUBLE THROW	MTD	MOUNTED
DPST	DOUBLE POLE SINGLE THROW	MTR	MOTOR
DS	DISCONNECT SWITCH	MV	MULTI-VAPOR
DT	DUST TIGHT	N	NEUTRAL
DWG	DRAWING	N/A	NOT APPLICABLE
E	EXISTING TO REMAIN	NC	NORMALLY CLOSED
EC	ELECTRICAL CONTRACTOR	NEC	NATIONAL ELECTRIC CODE
EF	EXHAUST FAN	NEMA	NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION
ELEC	ELECTRIC	NEUT	NEUTRAL
EM	EMERGENCY	NF	NON-FUSED
EMT	ELECTRIC METALLIC TUBING	NIC	NOT IN CONTRACT
EP	EXPLOSION PROOF	NL	NIGHT LIGHT
EPO	EMERGENCY POWER OFF DEVICE	NO	NORMALLY OPEN
EQ	EQUAL	NTS	NOT TO SCALE
EQUIP	EQUIPMENT	O/H	OVERHEAD
ER	EXISTING TO BE RELOCATED	OL	OVERLOAD
ESS	ENERGY STORAGE SYSTEM	OPT	OPTIMIZER
EUH	ELECTRIC UNIT HEATER	P	POLE
EWC	ELECTRIC WATER COOLER	PA	PUBLIC ADDRESS
EWB	ELECTRIC WATER HEATER	PB	PULL BOX
EX	EXISTING	PF	POWER FACTOR
F	FUSE	PH	PHASE
F&I	FURNISH AND INSTALL	PNL	PANEL
FA	FIRE ALARM	PR	PAIR
FAAP	FIRE ALARM ANNUNCIATOR PANEL	PRI	PRIMARY
FACP	FIRE ALARM CONTROL PANEL	PROT	PROTECTION/PROTECTIVE
FB	FLOORBOX	PRV	POWER ROOF VENTILATOR
FBO	FURNISHED BY OTHERS		
FCU	FAN COIL UNIT		
PT	POTENTIAL TRANSFORMER		
PWR	POWER		
R	RESISTANCE		
RC	REMOTE CONTROL		
RECP	RECEPTACLE		
REQ'D	REQUIRED		
RLP	RELAY LIGHTING PANEL		
RT	RAINTIGHT		
S	SWITCH		
SC	SHORT CIRCUIT		
SE	SWITCH EMERGENCY		
SEC	SECONDARY		
SF	SQUARE FOOT/FEET		
SGR	SINGLE GROUNDED RECEPTACLE		
SP	SINGLE POLE		
SPD	SURGE PROTECTIVE DEVICE		
SPDT	SINGLE POLE DOUBLE THROW		
SPEC	SPECIFICATION		
SPKR	SPEAKER		
SPO	SPECIAL PURPOSE OUTLET		
SPST	SINGLE POLE SINGLE THROW		
SQ FT	SQUARE FOOT/FEET		
SS	STAINLESS STEEL		
STA	STATION		
STD	STANDARD		
SW	SWITCH		
SWBD	SWITCHBOARD		
SWGR	SWITCHGEAR		
SYM	SYMMETRICAL		
SYS	SYSTEM		
TBPP	TEXAS BACKUP POWER PACKAGE		
TTC	TERMINAL CABINET		
TCP	TEMP. CONTROL PANEL		
TEL	TELEPHONE		
TEL CL	TELEPHONE CLOSET		
TEMP	TEMPERATURE		
TERM	TERMINAL		
TL	TWIST LOCK		
TR	TRANSFORMER		
TTC	TELEPHONE TERMINAL CABINET		
TV	TELEVISION		
TX	TRANSFORMER		
TYP	TYPICAL		
UC	UNDER COUNTER		
UE	UNDERGROUND ELECTRICAL		
UG	UNDERGROUND		
UH	UNIT HEATER		
UL	UNDERWRITER'S LABORATORY		
UNG	UNGROUND		
UNO	UNLESS NOTED OTHERWISE		
UPS	UNINTERRUPTIBLE POWER SOURCE		
V	VOLT		
VA	VOLT-AMPERE		
VDT	VIDEO DISPLAY TERMINAL		
VERT	VERTICAL		
VFD	VARIABLE FREQUENCY DRIVE		
VIF	VERIFY IN FIELD		
VOL	VOLUME		
VP	VAPOR PROOF		
VT	VAPOR TIGHT		
W	WATT		
W/	WITH		
WP	WEATHERPROOF		
WT	WATER TIGHT		
XFMR	TRANSFORMER		
XR	EXISTING TO BE REMOVED		
XRL	EXISTING TO BE RELOCATED		
30cd	"30cd" INDICATES VISUAL STROBE LIGHT CANDELA		



Patrick Engineering Inc.  
55 East Monroe  
Suite 3450  
Chicago, IL 60603  
TEL: (312) 201-7900  
FAX: (312) 220-0722  
www.rina-us.org

PROFESSIONAL DESIGN FIRM  
LICENSE NO. 184000409-0014

Owner/Client



Scale:		
Sheet Size: ARCH D 24"x36"		
Designed:		AMH
Drawn:		LAB
Checked:		CH
Approved:		JS
A	01/21/2025	ORIGINAL ISSUE
Rev. No.	Date	Description
<b>ISSUES &amp; REVISIONS</b>		
THE INFORMATION CONTAINED ON THESE DRAWINGS IS FOR USE ON THIS PROJECT ONLY		



FILE NAME: P:\Utility\Public\_Utility\_Correlation of Texas (PUC)\24483.005\_Backup Power Package Design\11.02\_General Specifications.dwg, LAYOUT: NAME: E1.02, PLOTTED: Tuesday, January 21, 2025 - 4:39pm, USER: AUSA

GENERAL NOTES:

- THE CONTRACTOR SHALL:
1. PROVIDE ALL LABOR, MATERIALS, EQUIPMENT AND TOOLS REQUIRED FOR THE COMPLETE EXECUTION OF THE ELECTRICAL WORK AS SHOWN ON THE DRAWINGS.
  2. PROVIDE ALL ADDITIONAL WORK NOT SPECIFICALLY SHOWN OR SPECIFIED YET REQUIRED TO ENSURE PROPER AND COMPLETE OPERATION OF ALL SYSTEMS, TO SATISFY THE DESIGN INTENT, AND TO COMPLY WITH ALL APPLICABLE CODES AND REGULATIONS.
  3. ENSURE ALL LABOR IS PERFORMED BY EXPERIENCED PERSONS OF THE PROPER TRADE. ALL WORKMANSHIP SHALL BE FIRST CLASS, AND SHALL BE IN COMPLIANCE WITH THE SPECIFIC REQUIREMENTS OF THE CONTRACT DRAWINGS, AS WELL AS ALL APPLICABLE SAFETY CODES AND STANDARDS.
  4. NOTIFY THE ENGINEER IN WRITING OF ALL DRAWING DISCREPANCIES PRIOR TO SUBMISSION OF BIDS.
  5. PERFORM ALL WORK IN ACCORDANCE WITH THE LATEST ADOPTED EDITION OF THE CODES INDICATED ON T1.01, AS WELL AS THE FOLLOWING:
    - ALL LOCAL CODES, ORDINANCES, REGULATIONS;
    - THE AUTHORITY HAVING JURISDICTION.
  6. ENSURE ALL MATERIALS PROVIDED ARE NEW, FREE OF DEFECTS, AND ARE UL LISTED FOR THE INTENDED APPLICATION. ALL ELECTRICAL MATERIALS, INSTALLATION AND SYSTEMS SHALL MEET THE REQUIREMENTS OF THE FOLLOWING STANDARDS, INCLUDING THE LATEST ADDENDA AND AMENDMENTS:
    - AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
    - ELECTRONIC INDUSTRY ASSOCIATION (EIA)
    - INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
    - NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION, (NECA)
    - NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATIONS (NEMA)
    - NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
    - OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)
    - TELECOMMUNICATION INDUSTRY ASSOCIATION (TIA)
    - UNDERWRITER'S LABORATORIES, INC. (UL)
  7. ENSURE THE ELECTRICAL DRAWINGS ARE NOT TO BE SCALED. CONTRACTOR SHALL TAKE MEASUREMENTS AND MAKE LAYOUTS AS REQUIRED FOR THE PROPER INSTALLATION AND COMPLETION OF THE WORK. WHERE SPECIFIC DETAILS AND DIMENSIONS ARE NOT SHOWN ON THE DRAWINGS,
  8. OBTAIN ALL NECESSARY PERMITS, ARRANGE ALL REQUIRED INSPECTIONS, AND PAY ALL FEES AND CHARGES INCIDENTAL THERETO.
  9. INSPECT SITE FOR FIELD VERIFICATION OF ALL ASPECTS OF THE PROJECT PRIOR TO BIDDING. SUBMISSION OF A BID CONSTITUTES ACCEPTANCE OF FIELD CONDITIONS.
  10. INSTALL WORK AS REQUIRED TO FIT STRUCTURE, AVOID OBSTRUCTIONS, AVOID OR PROVIDE PROTECTION IN AREAS SUBJECT TO DAMAGE, RETAIN CLEARANCE, HEADROOM, OPENINGS AND PASSAGEWAYS.
  11. INSTALL ALL MATERIALS AND EQUIPMENT AND COMPLETE ALL WORK IN A NEAT AND WORKMANLIKE MANNER, AND IN ACCORDANCE WITH BEST-IN-CLASS MODERN METHODS AND PRACTICES. ANY MATERIALS INSTALLED WHICH DO NOT PRESENT AN ORDERLY AND REASONABLY NEAT AND/OR WORKMANLIKE APPEARANCE, OR DO NOT ALLOW ADEQUATE SPACE FOR MAINTENANCE, SHALL BE REMOVED AND REPLACED WHEN SO DIRECTED BY THE ENGINEER.
  12. COMMISSION EACH ITEM OF EQUIPMENT IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS; OR WHERE NOTED UNDER EQUIPMENT SPECIFICATION, COMMISSIONING SHALL BE PERFORMED BY QUALIFIED MANUFACTURER'S REPRESENTATIVE.
  13. THE CONTRACT DRAWINGS ARE DIAGRAMMATIC IN NATURE AND INDICATE THE GENERAL ARRANGEMENT OF CIRCUITS AND OUTLETS, LOCATION OF SWITCHES, PANELBOARDS, CONDUITS, AND OTHER WORK. CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS AND LOCATIONS PRIOR TO INSTALLATION OF WORK.
  14. THE ELECTRICAL CIRCUITS, COMPONENTS, AND CONTROLS ARE SELECTED AND SIZED FOR THE EQUIPMENT SPECIFIED AND OR SHOWN. IF SUBSTITUTIONS AND/OR EQUIVALENT EQUIPMENT ARE FURNISHED, IT SHALL BE THE RESPONSIBILITIES OF ALL PARTIES CONCERNED, INVOLVED IN AND FURNISHING THE SUBSTITUTE AND/OR EQUIVALENT EQUIPMENT TO VERIFY AND COMPARE THE ELECTRICAL CHARACTERISTICS OF THAT FURNISHED TO THAT SHOWN.
  15. FIELD COORDINATE EXACT ELECTRICAL CONNECTION POINTS TO EQUIPMENT PRIOR TO ROUGH IN OF ELECTRICAL COMPONENTS.
  16. FIELD COORDINATE EXACT ROUTING OF CONDUIT. SPECIFIED CONDUIT RUNS ARE SHOWN DIAGRAMMATICALLY ONLY.
  17. FURNISH AND INSTALL ALL RACEWAYS, BOXES, ENCLOSURES, AND CABINETS IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS.
  18. FURNISH AND INSTALL ALL CHANNEL AND ANGLE SUPPORTING SYSTEMS, HANGERS, ANCHORS, SLEEVES, BRACKETS, FABRICATED ITEMS, AND HARDWARE AS REQUIRED TO PROVIDE SECURE SUPPORT, PER NATIONAL ELECTRICAL CODE.
  17. MAINTAIN, ON THE JOBSITE, ONE SET OF UP TO DATE AS-BUILT ELECTRICAL DRAWINGS. AS-BUILTS SHALL BE KEPT IN GOOD CONDITION. CONTRACTOR SHALL PROGRESSIVELY, NEATLY, LEGIBLY AND EXACTLY RECORD ON THESE DRAWINGS ALL DEVIATIONS FROM THE ORIGINAL DRAWINGS, INCLUDING THE ROUTING OF ALL CONCEALED CONDUIT RUNS, AND ALL WORK WHICH IS INSTALLED IN A DIFFERENT LOCATION OR MANNER THAN INDICATED ON THE DRAWINGS. RECORD COPIES OF THESE PLANS SHALL BE SUBMITTED TO THE ENGINEER AND THE OWNER UPON PROJECT CLOSE-OUT.
  18. PROVIDE A FULL ONE YEAR WARRANTY ON ALL ELECTRICAL LABOR, EQUIPMENT AND MATERIALS INSTALLED ON THIS PROJECT, STARTING FROM THE ISSUANCE OF THE OWNER'S CERTIFICATE OF COMPLETION, EXCEPT AS FOLLOWS:
    - 18.1. SOLAR MODULES
      - 18.1.1. 15 YEARS MATERIALS AND WORKMANSHIP
      - 18.1.2. 25 YEARS LINEAR POWER PRODUCTION
    - 18.2. INVERTERS
      - 18.2.1. 12 YEARS MATERIALS AND WORKMANSHIP
    - 18.3. DC DISCONNECT SWITCHES
      - 18.3.1. 5 YEARS MATERIALS AND WORKMANSHIP
  19. ALL CONNECTIONS OF DISSIMILAR METALS SHALL BE MADE TO MINIMIZE GALVANIC ACTION, CORROSION OR ELECTROLYSIS. ALL CONNECTORS, CONNECTION HARDWARE, CONDUCTORS, AND CONNECTION METHODS SHALL ENSURE THAT METALS IN DIRECT CONTACT ARE GALVANICALLY COMPATIBLE.
  20. AFTER INSTALLATION OF ALL CONDUCTORS, CONTRACTOR SHALL COMPLETELY SEAL OFF ALL CONDUIT ENDS TO PREVENT THE POSSIBILITY OF ANY MOISTURE FROM ENTERING ANY ELECTRICAL ENCLOSURE. ALL USED AND UNUSED OPENINGS IN ALL EQUIPMENT, BOXES, AND ENCLOSURES SHALL BE SEALED WEATHERTIGHT WITH A MATERIAL THAT WILL ALSO PREVENT INSECT INCURSION.

SUBMITTALS:

1. CONTRACTOR SHALL SUBMIT MANUFACTURER CUT SHEETS AND CATALOG DATA FOR ALL MATERIALS, CLEARLY INDICATING THE SPECIFIC PART OR PRODUCT CATALOG NUMBER(S) TO BE USED. ITEMS REQUIRING SIGNIFICANT LEAD TIME SHOULD BE SUBMITTED AS SOON AS POSSIBLE. ELECTRONICALLY SUBMIT 1 COPY OF ALL REQUESTED INFORMATION TO THE ENGINEER, NEATLY INDEXED PER CATEGORY, FOR THE FOLLOWING ITEMS:
  - A. SWITCHBOARDS, PANELBOARDS, AC DISCONNECT SWITCHES.
  - B. CONDUIT, RACEWAYS, WIREWAYS, ENCLOSURES, BOXES, FITTINGS, SUPPORTS AND HARDWARE.
  - C. CONDUCTORS, BOTH DC AND AC.
  - D. LIGHT FIXTURES, RECEPTACLES, SWITCHES AND ASSOCIATED ACCESSORIES.
  - E. EV CHARGING STATION(S) AND ACCESSORIES.
  - F. PHOTOVOLTAIC INVERTERS AND ASSOCIATED CONTROL SYSTEMS.
  - G. PHOTOVOLTAIC MODULES.
  - H. DC PHOTOVOLTAIC COMBINER BOXES, SPICE BOXES AND DISCONNECT SWITCHES.
  - I. METERING AND COMMUNICATIONS EQUIPMENT.
2. FOR ALL OWNER-FURNISHED EQUIPMENT, CONTRACTOR SHALL SUBMIT A COPY OF ALL INSTALLATION, COMMISSIONING AND PROGRAMMING DATA AND/OR SETTINGS, INCLUDING PASSWORD AND LOGIN DATA. CONTRACTOR SHALL ELECTRONICALLY SUBMIT 1 COPY TO THE ENGINEER.

MODULES:

1. CONTRACTOR SHALL RECEIVE, INSPECT, UNLOAD AND INSTALL ALL SOLAR PHOTOVOLTAIC MODULES. ALL MODULES DAMAGED DURING SHIPPING SHALL BE REFUSED AND SHALL NOT BE INSTALLED. COORDINATE SPECIFIC SCOPE REQUIREMENTS DURING BIDDING.
2. MODULES SHALL BE INSTALLED, SECURED, AND MECHANICALLY GROUNDED TO THE RACKING SYSTEM AND EACH OTHER PER THE MANUFACTURER'S WRITTEN INSTALLATION INSTRUCTIONS AND PER UL LISTING TO ENSURE ELECTRICAL CONTINUITY.
3. CONTRACTOR SHALL NOT PLACE ANY TOOLS, EQUIPMENT OR OTHER WEIGHT (INCLUDING BODYWEIGHT) ON THE SURFACE PORTION OF ANY MODULE. CONTRACTOR SHALL PROMPTLY REPORT MODULE DAMAGE, INCLUDING MICRO-FRACTURES, AND SHALL IMMEDIATELY REPLACE THE DAMAGED MODULE WITH A NEW, UNDAMAGED MODULE AT CONTRACTOR'S EXPENSE.

INVERTERS:

1. CONTRACTOR SHALL RECEIVE, UNLOAD AND INSTALL ALL INVERTERS, ASSOCIATED EQUIPMENT AND ACCESSORIES. COORDINATE SPECIFIC SCOPE REQUIREMENTS DURING BIDDING.
2. INVERTERS SHALL BE NEW, UTILITY GRADE, FROM A REPUTABLE MANUFACTURER, AND SHALL BE SPECIFICALLY DESIGNED FOR GRID-TIED PHOTOVOLTAIC INSTALLATIONS.
3. INVERTERS SHALL MEET THE FOLLOWING MINIMUM STANDARDS: UL 1741 SA STANDARD FOR INVERTERS, CONVERTERS, CONTROLLERS AND INTERCONNECTION SYSTEM EQUIPMENT FOR USE WITH DISTRIBUTED ENERGY RESOURCES. IEEE 929-2000 - RECOMMENDED PRACTICE FOR UTILITY INTERFACE OF PHOTOVOLTAIC (PV) SYSTEMS.
4. COORDINATE SPECIFIC SCOPE REQUIREMENTS DURING BIDDING.
5. INVERTERS SHALL BE INSTALLED, SECURED, WIRED, TESTED AND GROUNDED PER THE MANUFACTURER'S WRITTEN INSTALLATION INSTRUCTIONS.
6. CONTRACTOR SHALL CONFIGURE ALL INVERTER PROTECTION AND COMMUNICATIONS SETTINGS IN COMPLIANCE WITH LOCAL UTILITY STANDARDS, AHJ REQUIREMENTS, AND SHALL COORDINATE WITH OWNER'S REPRESENTATIVE TO PROVIDE MONITORING ACCESS.

ENCLOSURES:

1. ALL ELECTRICAL EQUIPMENT ENCLOSURES SHALL BE SPECIFIED AND INSTALLED IN ACCORDANCE WITH NEMA STANDARDS AND TYPE NUMBER AND SHALL BE SUITABLE FOR THE LOCATION CONDITIONS.
2. ALL EXTERIOR ELECTRICAL EQUIPMENT ENCLOSURES SHALL BE MINIMUM TYPE NEMA 4X. THIS SHALL INCLUDE BUT NOT BE LIMITED TO SWITCHBOARDS, DISTRIBUTION PANELS, CONTROL CABINETS, PULL BOXES, JUNCTION BOXES, DISCONNECT SWITCHES, COMBINER BOXES, WIREWAYS, ETC.
3. ALL ENCLOSURES SHALL BE PROVIDED WITH PADLOCKING PROVISIONS OR EQUIVALENT.
4. ALL SOLAR PHOTOVOLTAIC MODULES AND OTHER MATERIALS ENCLOSURES, INCLUDING LARGE CONTRACTOR INSTALLED ELECTRICAL EQUIPMENT (INCLUDING SWITCHBOARDS, DISTRIBUTION PANELS, CONTROL CABINETS, PULL BOXES, JUNCTION BOXES, COMBINER BOXES, AND INVERTERS) SHALL BE ENTIRELY LOCATED AT OR ABOVE THE EQUIPMENT ELEVATION SHOWN, UNLESS OTHERWISE APPROVED BY OWNER. CONTRACTOR SHALL PROVIDE SAFE EGRESS IN COMPLIANCE WITH OSHA AND CUSTOMER STANDARDS TO ALLOW FOR ACCESS TO SUCH EQUIPMENT ENCLOSURES FOR OPERATIONS AND MAINTENANCE RESPONSIBILITIES. SUCH EGRESS FEATURES SHALL INCLUDE BUT NOT BE LIMITED TO STAIRS, LADDERS, HANDRAILS, Tie-OFF POINTS, ETC.

AC SYSTEM WIRING:

1. ALL CONDUCTORS, LUGS AND CABLE ACCESSORIES SHALL BE NRTL LISTED TO APPLICABLE UL STANDARDS.
2. ALL LOW VOLTAGE AC WIRING SHALL UTILIZE COPPER CONDUCTORS WITH INSULATION AS NOTED ON THE PLANS.
3. AC WIRING FROM INVERTERS TO AC COMBINER SHALL BE XHHW-2 AND AC LOW VOLTAGE WIRING BETWEEN AC MAIN CB AND EQUIPMENT LOW VOLTAGE TERMINALS SHALL BE COPPER TYPE XHHW-2, 600V.
4. ALL CONDUCTORS INSTALLED BELOW THE EQUIPMENT ELEVATION (AND THEREFORE INCLUDES CONDUCTORS BELOW GRADE) MUST BE LISTED FOR USE IN WET LOCATIONS (PER NEC AND UL DEFINITIONS, INCLUDING SUBMERSION), AND BE OF A CORROSION RESISTANT DESIGN.
5. ALL CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH CURRENT NEC CODE REQUIREMENTS.
6. CONDUCTORS SHALL HAVE INTEGRAL COLORING OR COLORED HEAT SHRINK SLEEVE AT ALL TERMINATIONS TO INDICATE GROUNDED CONDUCTORS, EQUIPMENT GROUNDING CONDUCTORS, AND AC PHASE CONDUCTORS. COLOR CODING SHALL BE AS FOLLOWS:
  - PHASE A: BROWN (480VAC), BLACK (208VAC)
  - PHASE B: ORANGE (480VAC), RED (208VAC)
  - PHASE C: YELLOW (480VAC), BLUE (208VAC)
  - NEUTRAL: GRAY (480VAC), WHITE (120-208VAC)
  - GROUND: GREEN WITH STRIPE OR BARE
6. ALL LUGS AND CONNECTORS SHALL BE 90C RATED, UL LISTED AND DESIGNATED FOR USE WITH THE CONDUCTOR BEING CONNECTED.
7. LUGS AND CONNECTORS USED TO TRANSITION FROM COPPER TO ALUMINUM WIRE SHALL BE LISTED AND RATED FOR SUCH USE. APPLY ANTI-OXIDANT COATING MATERIAL TO ALL ALUMINUM TERMINATIONS.
8. ALL AC POWER CONDUCTOR TERMINATIONS SHALL BE IRREVERSIBLE, DOUBLE CRIMP, LONG BARREL, TWO BOLT COMPRESSION TYPE LUGS RATED AT 90C AND APPROVED BY THE EQUIPMENT MANUFACTURER OR SUPPLIER. WHERE NOT POSSIBLE, SINGLE BOLT COMPRESSION LUGS MAY BE USED. MECHANICAL SET SCREW TERMINATIONS ARE APPROVED FOR EQUIPMENT TERMINATIONS WITH FACTORY INSTALLED MECHANICAL LUGS. ALL CRIMPED CONNECTIONS MUST BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS. COAT CONDUCTOR WITH DIELECTRIC GREASE PRIOR TO CRIMPING.
9. PROVIDE A MAXIMUM OF TWO STACKABLE COMPRESSION LUGS WHEN MORE THAN ONE COMPRESSION LUG NEEDS TO BE TERMINATED AT A SINGLE SET OF BUS BAR HOLES
10. NO SPLICING OF ANY WIRES WITHOUT WRITTEN CONSENT OF OWNER. ALL UNDERGROUND WIRING SHALL BE CONTINUOUS WITHOUT SPLICES.
11. ALL SINGLE PHASE POWER CIRCUITS SHALL HAVE A DEDICATED NEUTRAL.
12. CLASS 1 AND CLASS 2 CONTROL CIRCUITS SHALL BE TYPE THHN/THWN, INSTALLED IN RACEWAY.
13. TERMINAL SCREW TORQUE SPECS PER MANUFACTURER TO BE FOLLOWED AND WITNESSED BY QA.

DC SYSTEM WIRING:

1. ALL CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH CURRENT NEC CODE REQUIREMENTS, INCLUDING TEMPERATURE RATING, AND OWNER SPECIFIED VOLTAGE DROP.
2. ALL CONDUCTORS INSTALLED BELOW THE EQUIPMENT ELEVATION (AND THEREFORE INCLUDES CONDUCTORS BELOW GRADE) MUST BE LISTED FOR USE IN WET LOCATIONS (PER NEC AND UL DEFINITIONS, INCLUDING SUBMERSION), AND BE OF A CORROSION RESISTANT DESIGN.
3. ALL SOLAR DC STRING AND STRING TO DC COMBINER BOXES, AND BESS DC CONDUCTORS AND CABLES SHALL BE COPPER TYPE "PV-2", 2000VDC, 90C (WET OR DRY), UV RESISTANT, COPPER WIRE, UL 4703. DC CONDUCTORS FROM DC BOXES TO INVERTERS SHALL BE COPPER.
3. FURNISH STRANDED WIRE FOR SIZES #8 AND LARGER UNLESS OTHERWISE NOTED. MINIMUM CONDUCTOR SIZE SHALL BE AWG #12.
5. ALL WIRES AND CABLE SHALL HAVE UV RESISTANT AND OUTDOOR RATED WRAP-AROUND LAMINATING VINYL MACHINE PRINTED ID LABELS OR OTHER APPROVED LABELING METHOD INDICATING DESIGNATION AND POLARITY. CONDUCTORS SHALL HAVE INTEGRAL COLORING OR A COLORED OUTDOOR RATED HEAT SHRINK SLEEVE AT ALL TERMINATIONS TO INDICATE GROUNDED CONDUCTORS, EQUIPMENT GROUNDING CONDUCTORS AND CURRENT-CARRYING CONDUCTORS, PER NEC REQUIREMENTS AND INDUSTRY STANDARDS. COLOR CODING SHALL BE AS FOLLOWS:
  - PV POSITIVE (+): RED
  - PV NEGATIVE (-): BLACK
  - GROUND: GREEN WITH STRIPE OR BARE
6. SERIES STRING CONNECTIONS BETWEEN SOLAR PHOTOVOLTAIC MODULES SHALL BE VIA FACTORY-SUPPLIED TYPE "MCA" QUICK CONNECT CONNECTORS. FIELD INSTALLED QUICK CONNECT CONNECTORS SHALL BE OF THE SAME MAKE AND MODEL AS THOSE FACTORY SUPPLIED WITH THE MODULES. ALL MODULE CONNECTORS SHALL BE UL LISTED, NEC 690 COMPLIANT, LATCHING TYPE WITH POSITIVE LATCHING INDICATOR. CONNECTORS SHALL BE POLARIZED SUCH THAT POSITIVE AND NEGATIVE TERMINALS ARE NOT INTERCHANGEABLE.
7. STRING WIRING SHALL BE RATED FOR DIRECT SUNLIGHT EXPOSURE. STRING WIRING SHALL BE PROPERLY SUPPORTED TO RACK AND/OR MODULE FRAMES USING STAINLESS STEEL PV CABLE CLIPS, AND/OR OTHER OWNER-APPROVED WIRE MANAGEMENT METHOD. NYLON CABLE TIES SHALL NOT BE ALLOWED. PV CABLE CLIPS AND WIRE MANAGEMENT METHOD MUST BE APPROVED BY OWNER BEFORE INSTALLATION. ALL CABLES SHALL BE SECURED MINIMUM 24" ON CENTER AND 6" AT EACH END WHEN CHANGING DIRECTION. NO CABLE SHALL BE ALLOWED TO TOUCH THE SURFACE OF THE GROUND.

8. RUN WIRING UNDERNEATH MODULE FRAMES.
9. STRING WIRING SHALL ENTER ENCLOSURES THROUGH CONDUIT, CORD GRIPS, OR OTHER APPROVED METHOD THAT WILL PROPERLY SEAL THE PENETRATION AND UPHOLD THE WEATHERPROOF RATING OF THE ENCLOSURE OR BOX.
10. ON PROJECTS WITH COMBINERS, COMBINER OUTPUT FEEDERS SHALL BE COPPER, WITH THERMOSET XLPE INSULATION AND JACKET MATERIALS, NON-THERMOPLASTIC INSULATION. CABLE SHALL BE 2000V RATED, WET LOCATION, 90 C OR BETTER.
11. ALL POWER CONDUCTOR TERMINATIONS SHALL BE IRREVERSIBLE, DOUBLE CRIMP, LONG BARREL, TWO BOLT COMPRESSION TYPE LUGS RATED AT 90C WHERE APPROVED BY THE EQUIPMENT MANUFACTURER OR SUPPLIER. WHERE NOT POSSIBLE, SINGLE BOLT COMPRESSION LUGS MAY BE USED. MECHANICAL SET SCREW TERMINATIONS ARE APPROVED FOR COMBINER BOX TERMINATIONS ONLY. ALL CRIMPED CONNECTIONS MUST BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS.
12. ALL CONTROL AND INSTRUMENTATION CONDUCTORS SHALL BE TERMINATED BY CONTRACTOR.
13. ALL LUGS AND CONNECTORS SHALL BE 90C RATED, UL LISTED AND DESIGNATED FOR USE WITH THE CONDUCTOR BEING CONNECTED.
14. NO SPLICING OF ANY WIRES SHALL BE PERFORMED WITHOUT WRITTEN CONSENT FROM OWNER.
15. TERMINAL SCREW TORQUE SPECS PER MANUFACTURER TO BE FOLLOWED AND WITNESSED BY QA.

GROUNDING:

1. SOLAR MODULE EQUIPMENT GROUNDING CONNECTION SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S GUIDELINES AND APPLICABLE LISTINGS. MODULE FRAME GROUNDING HARDWARE SHALL BE LISTED TO UL3703 AND SPECIFIED BY MODULE MANUFACTURER AS ACCEPTABLE FOR USE WITH THE MODULE MODEL. WEBS WILL BE CONSIDERED AN ACCEPTABLE MEANS OF GROUNDING BUT THEIR USE MUST BE AN APPROVED USE BY THE APPLICABLE MANUFACTURER(S). MANUFACTURER'S APPROVAL LETTER FOR THE SPECIFIC CASE MUST BE PROVIDED TO OWNER AND APPROVED BY OWNER, OTHERWISE A CONTINUOUS GROUND LOOP MUST BE INSTALLED.
2. METHODS THAT GROUND MODULE FRAMES BY UTILIZING THE RACKING AS THE GROUNDING MEANS SHALL BE LISTED TO UL 3703.
3. ALL BRANCH AND FEEDER CIRCUITS SHALL CONTAIN A GROUNDING CONDUCTOR, UNLESS OTHERWISE NOTED, AND BE SIZED AND BONDED IN ACCORDANCE WITH NEC ART. 250.
4. UNLESS OTHERWISE NOTED, GROUNDING CONDUCTORS SHALL BE COPPER. EQUIPMENT GROUNDING CONDUCTORS SHALL BE INSULATED WITH GREEN-COLORED INSULATION. UNDERGROUND CONDUCTORS SHALL BE BARE, TINNED, AND STRANDED. USE ONLY COPPER CONDUCTORS FOR BOTH INSULATED AND BARE GROUNDING CONDUCTORS IN DIRECT CONTACT WITH EARTH, CONCRETE, MASONRY, CRUSHED STONE AND SIMILAR MATERIALS. IN RACEWAYS, USE INSULATED EQUIPMENT GROUNDING CONDUCTORS. EXPOSED BARE EQUIPMENT GROUNDING CONDUCTORS WILL BE MINIMUM 6 AWG COPPER.
5. INSTALL INSULATED EQUIPMENT GROUNDING CONDUCTORS WITH CIRCUIT CONDUCTORS FOR THE FOLLOWING ITEMS, IN ADDITION TO THOSE REQUIRED BY NEC: FEEDERS AND BRANCH CIRCUITS; RECEPTACLE CIRCUITS; SINGLE-PHASE MOTOR AND APPLIANCE BRANCH CIRCUITS; THREE-PHASE MOTOR AND APPLIANCE BRANCH CIRCUITS; FLEXIBLE RACEWAY RUNS.
6. ALL NON-CURRENT CARRYING EXPOSED METAL PARTS OF SYSTEM JUNCTION BOXES, EQUIPMENT, MODULE FRAMES, SUPPORT RACKING, INVERTER CASES AND APPLIANCES IN THE ENTIRE ELECTRICAL SYSTEM THAT MAY BE ACCIDENTALLY ENERGIZED SHALL BE GROUNDED PER NEC 690.43 AND 690.45 AND SIZED PER 250.122.
7. GROUND LUGS SHALL BE MECHANICAL AND ACCEPTABLE FOR COPPER CONDUCTOR TERMINATION. LUGS SHALL BE SELECTED SO AS TO PREVENT GALVANIC CORROSION AND DISSIMILAR THERMAL EXPANSION OF LUGS AND CONDUCTORS.
8. TIN-PLATED COPPER LAY-IN GROUND LUGS OR CONDUIT GROUND CLAMPS SHALL BE PROVIDED FOR ALL METALLIC CONDUIT CARRYING POWER CONDUCTORS. SUCH MEANS OF GROUNDING SHALL NOT BE REQUIRED FOR METALLIC CONDUIT CARRYING COMMUNICATION CONDUCTORS.
9. ALL GROUND LUGS NOT INSTALLED IN AN ENCLOSURE MUST BE UL LISTED FOR DIRECT BURIAL.
10. ALL EQUIPMENT GROUNDING CONDUCTORS (EGC) AND GROUNDING ELECTRODE CONDUCTORS (GEC) SHALL BE SIZED IN ACCORDANCE WITH THE PROPER SECTIONS OF THE NEC.
11. METALLIC CONDUIT CONTAINING A GROUNDING ELECTRODE CONDUCTOR MUST BE BONDED AT BOTH ENDS.
12. ALL SOLAR AND BESS INVERTERS AND INTERCONNECTION SWITCHBOARDS SHALL UTILIZE A GROUNDING ELECTRODE SYSTEM CONSISTING OF A GROUND RING/GRID SIZED AND INSTALLED TO COMPLY WITH NEC AND IEEE STANDARDS. IF THE APPLICABLE GOVERNMENTAL AUTHORITY REQUIRES A GROUNDING CONDUCTOR TO BE EXTENDED FROM THE GROUND GRID TO THE EXISTING BUILDING STRUCTURE, SUCH WORK WILL BE INCLUDED IN SCOPE AT NO EXTRA COST TO OWNER.
13. EQUIPMENT GROUNDING CONDUCTORS SHALL BE ROUTED WITH ALL CIRCUIT AND PHASE CONDUCTORS.
14. ALL BELOW GRADE CONNECTIONS SHALL BE CRIMPED AND UL LISTED FOR DIRECT BURIAL APPLICATIONS.
15. GROUND RODS, IF REQUIRED, SHALL BE SECTIONAL TYPE; COPPER-CLAD STEEL, 3/4" IN DIAMETER BY 10' DRIVEN VERTICALLY.
16. PROVIDE MECHANICAL CONNECTIONS FOR CONNECTIONS TO STRUCTURAL STEEL AND FOR UNDERGROUND CONNECTIONS.
17. ALL EXPOSED GROUND CONNECTIONS TO EQUIPMENT SHALL BE CABLE LUGS WITH BOLTED/MECHANICAL ATTACHMENTS.
18. USE INSULATED COPPER EQUIPMENT GROUNDING CONDUCTORS FOR GROUNDING RACKING SYSTEMS WHEN ALUMINUM RACKING IS USED. BOND TO RACKING WITH CU-AL RATED LUGS PER RACKING MANUFACTURER'S REQUIREMENTS.
19. INSTALL #6 CU INSULATED BONDING JUMPERS BETWEEN ADJACENT RACKS PER MANUFACTURERS GROUNDING AND INSTALLATION DETAILS.
20. GROUNDING SCREWS SHOULD BE THREAD-FORMING OR HOT DIPPED, NOT THREAD CUTTING.

CONDUCTOR PROTECTION:

1. ALL ABOVE GROUND AC CABLES SHALL BE PROTECTED IN CONDUIT OR CABLE TRAYS, AS NOTED ON THE PLANS.
2. PULL AND JUNCTION BOXES SHALL BE PROVIDED WHERE REQUIRED TO FACILITATE THE INSTALLATION OF WIRING. BENDS IN CONDUITS BETWEEN PULL BOXES SHALL NOT EXCEED THE EQUIVALENT OF FOUR 90 DEGREE BENDS.
3. CONDUITS REQUIRING FIELD CUTTING SHALL BE CUT SQUARE AND DE-BURRED. CONDUIT END BELLS OR BUSHINGS SHALL BE PROVIDED TO PREVENT CABLE DAMAGE.
4. BENDS IN CONDUITS SHALL NOT DAMAGE RACEWAYS OR SIGNIFICANTLY CHANGE THE INTERNAL DIAMETER OF RACEWAYS (NO KINKS).
5. COMMUNICATIONS WIRING SHALL BE RUN IN SEPARATE CONDUITS FROM POWER CIRCUIT WIRING.
6. ALL AC BRANCH CIRCUIT WIRE SHALL BE INSTALLED IN RACEWAY, UNLESS OTHERWISE NOTED. MINIMUM SIZE SHALL BE 3/4".
7. ALL EXPOSED CONDUITS INSTALLED IN EXTERIOR LOCATIONS SHALL BE RGSC TYPE. RACEWAYS SHALL BE SUPPORTED BY APPROVED TYPES OF GALVANIZED SUPPORTS. USE STAINLESS STEEL HARDWARE AND CONDUIT STRAPS OUTDOORS. PAINT ALL EXPOSED MATERIALS TO MATCH EXISTING COLORS.
8. JOB CUT THREADS SHALL BE GIVEN A COAT OF RUST RESISTANT PAINT SUCH AS ZINC CHROMATE OR EQUAL.
9. WIRE TERMINATIONS AND SPLICES SHALL BE COMPLETED WITH THE APPROPRIATE UL LISTED HEAVY DUTY RATCHETING TYPE JAWS AND INTERCHANGEABLE DIES FOR PROPER CRIMPING OF TERMINALS. TERMINALS SHALL BE UN-INSULATED TYPE AND CORRECTLY SIZED FOR THE WIRE USED.
10. BLOCKS AND TERMINAL LUGS SHALL BE LISTED FOR THE APPROPRIATE CONDUCTOR MATERIAL.
11. AFTER INSTALLATION OF CONDUCTORS, ALL RACEWAYS SHALL BE SEALED WITH DUCTSEAL.

NOTE:

THESE SPECIFICATIONS ARE PROVIDED FOR GENERAL INSTALLATION AND EQUIPMENT REQUIREMENTS. REFER TO TBPP TECHNICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS. SHOULD THERE BE ANY CONFLICTS BETWEEN THE SPECIFICATIONS HEREIN AND THAT OF THE TBPP, THE TBPP SPECIFICATIONS SHALL TAKE PRECEDENCE.

MONITORING:

THE CONTRACTOR SHALL:

1. FURNISH AND INSTALL ALL COMMUNICATIONS DEVICES NECESSARY TO BRING ALL TBPP AS WELL AS ALL PV SYSTEM DATA TO THE OWNER'S IT EQUIPMENT RACK. FINAL SYSTEM CONNECTIVITY TO BE DETERMINED BY OWNER.
2. FURNISH AND INSTALL AN RS485, 2C#16, SHIELDED, TWISTED PAIR CABLE BETWEEN EACH INVERTER AND A SYSTEM COMMUNICATIONS GATEWAY. (GATEWAY TO BE COMPATIBLE WITH SUPPLIED INVERTERS). GROUND SHIELD PER INVERTER MANUFACTURER'S REQUIREMENTS.
3. CONNECT COMMUNICATIONS GATEWAY ETHERNET OUTPUT TO OWNERS LAN SWITCH, IF AVAILABLE. ETHERNET CABLE SHALL HAVE RJ45 CONNECTORS AT EACH END. ETHERNET CABLE SHALL BE CONSISTENT WITH OWNERS LAN (CAT5e OR CAT6).
4. A TBPP CONTROLLER SHALL BE PROVIDED AND SHALL CONTROL THE ENTIRE TBPP PACKAGE IN A COORDINATED MICROGRID FASHION INCLUDING CONTROLLING THE OUTPUT OF GENSET, SOLAR PV ARRAY AND BESS TO MINIMIZE FUEL USAGE AT THE GENSET AND MAXIMIZE THE USE OF THE SOLAR AND BESS TO POWER THE CF. THE CONTROLLER SHALL MAINTAIN POWER OUTPUT TO THE CF FOR A PERIOD OF 48 HOURS.

MISCELLANEOUS:

1. ALL EXTERIOR MOUNTING HARDWARE USED SHALL BE STAINLESS STEEL, SIZED PER SYSTEM MANUFACTURER'S RECOMMENDATIONS. USE ANTI-SEIZE FOR EACH CONNECTION.
2. STRUT TYPE SWITCH RACKS AND SUPPORTS MAY BE GALVANIZED STEEL OR ALUMINUM.
3. PANELBOARDS SHALL BE FULLY RATED TO INTERRUPT SYMMETRICAL SHORT-CIRCUIT CURRENT AVAILABLE AT TERMINALS. PANELBOARDS SHALL UTILIZE CIRCUIT-BREAKER TYPE OCPD'S AND ALL PHASE AND GROUND BUSES SHALL BE COPPER.
4. UNLESS OTHERWISE NOTED, ALL ENCLOSURES FOR OUTDOOR EQUIPMENT SHALL BE NEMA 3R RATED. ENCLOSURES. ENCLOSURES FOR INDOOR EQUIPMENT SHALL BE NEMA 1 RATED.
5. CONTRACTOR SHALL REMOVE AND DISPOSE OF ALL SPOILS FROM THE PROJECT SITE. CONTRACTOR SHALL PROVIDE DUMPSTERS OR OTHER CONTAINERS AS REQUIRED, AND SHALL COORDINATE LOCATIONS AND PICKUP SCHEDULES WITH THE OWNER TO MINIMIZE INTERRUPTION.

COMMISSIONING:

1. CONTRACTOR SHALL PERFORM START-UP AND COMMISSIONING UPON COMPLETION OF INSTALLATION OF THE TBPP AT THE CRITICAL FACILITY. TO SUCCESSFULLY COMMISSION THE TBPP, CONTRACTOR MUST ENSURE A COMPLETE INSTALLATION, APPROPRIATE CONFIGURATION, AND MUST DEMONSTRATE THAT THE TBPP PERFORMS IN ITS FULL, PROPER OPERATING CONDITION. CONTRACTOR SHALL RECORD ALL MEASURED DATA AND PROVIDE OWNER AND ENGINEER WITH A DETAILED REPORT REGARDING ANY ISSUES THAT CONTRACTOR DISCOVERS DURING SUCH PERFORMANCE TESTING.
2. PROVIDE FINAL CLEANUP AND CONDUCT FIELD TESTS AFTER INSTALLATION OF ALL ELECTRICAL WORK. ADJUST ITEMS TO THE SATISFACTION OF THE OWNER AND ENGINEER. LEAVE ALL EQUIPMENT INTERIORS CLEAN AND FREE FROM CONSTRUCTION DEBRIS. NEATLY DRESS ALL WIRING, AND RE-TIGHTEN ALL TERMINATIONS PER MANUFACTURERS' RECOMMENDATIONS.
3. AS A CONDITION OF ACHIEVING SUBSTANTIAL COMPLETION, CONTRACTOR SHALL COMPLETE ALL ITEMS IDENTIFIED IN THE PUNCHLIST. PUNCHLIST SHALL BE PREPARED BY OWNER AND OWNER'S ENGINEER.

REQUESTS FOR INFORMATION:

UNLESS SPECIFIED DIFFERENTLY IN THE CONTRACT DOCUMENTS:

FOR THOSE PROJECTS WHERE TBPP VENDOR IS THE PRIME CONSULTANT, ALL QUESTIONS OR REQUESTS FOR INFORMATION (RFI) SHALL BE SUBMITTED IN WRITING DIRECTLY TO THE VENDOR. PLEASE INCLUDE: 1) DATE; 2) THE PROJECT NAME; 3) FIRM NAME; 4) YOUR NAME ; 5) DRAWING NUMBER, DATE AND REVISION NUMBER &/OR SPECIFICATION SECTION REFERENCE; AND 6) ADEQUATE SPACE FOR REPLY.

UNDOCUMENTED PHONE CALLS TO VENDOR SHALL NOT BE USED AS A BASIS FOR ANY FUTURE CLAIMS.

WIRING AND WIRING METHODS:

1. IF APPLICABLE, PV MODULES SHALL FOLLOW SKIP STRINGING WITH TYPICAL WIRE MANAGEMENT PRACTICES. ALL CONNECTORS SHALL BE MANUFACTURER & ENGINEER APPROVED.
  2. HOMERUNS FROM THE STRINGS BACK TO THE DC COMBINERS, AND FROM THE COMBINERS BACK TO THE INVERTERS, SHALL BE SIZED AS NOTED ON THE PLANS. ALL HOMERUNS SHALL BE MINIMUM #10 AWG. PROVIDE #10 AWG GREEN GROUNDING CONDUCTOR WITH EACH STRING. NO STRING CABLE LENGTH (ROUND-TRIP) SHALL EXCEED 1000'.
- UTILITY COORDINATION**
1. IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO COORDINATE ITS WORK WITH THE CF OWNER AND SERVING UTILITY.
  2. IT MAY BE NECESSARY FOR THE SERVING UTILITY TO INSTALL REVENUE METERING AND UTILITY RELAYING AND RECLOSER. THE CONTRACTOR SHALL COORDINATE ITS WORK WITH THIS EFFORT WITH THE SERVING UTILITY AND OWNER.

MARKING OR LABELING

1. SHALL COMPLY WITH NEC 2023, PART VI OF SECTION 690, FOR SOLAR PV SYSTEMS.

2. FOR LOW VOLTAGE AC AND ALL DC MAIN DISCONNECTS, PROVIDE LABELS:

WARNING  
ELECTRIC SHOCK HAZARD  
DO NOT TOUCH TERMINALS  
TERMINALS ON BOTH THE LINE AND LOAD SIDES  
MAY BE ENERGIZED IN THE OPEN POSITION

3. FOR MAIN AC DISCONNECT, ALSO PROVIDE THE FOLLOWING LABEL:

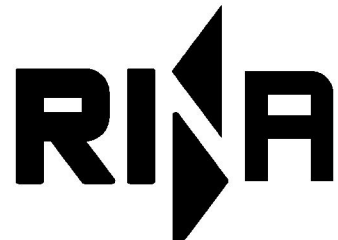
PLACE THIS SWITCH IN THE  
"OFF" POSITION TO SHUTDOWN PV  
SYSTEM AND REDUCE SHOCK HAZARD  
IN THE ARRAY.

4. FOR NEW AC COMBINER AND OCPD PANELS, PROVIDE LABEL:

WARNING  
MULTIPLE POWER SOURCES

TYPICAL TBPP EQUIPMENT LIST:

1. EQUIPMENT SHALL BE AS INDICATED BELOW UNLESS OTHERWISE APPROVED BY OWNER:
  - 1.1. TRANSFORMER (IF REQUIRED TO MEET CF OPERATING VOLTAGE
  - 1.2. INVERTERS
  - 1.3. DC COMBINERS
  - 1.4. AC SWITCHBOARDS
  - 1.5. RELAYS
  - 1.6. SOLAR PV MODULES
  - 1.7. FIXED GROUND MOUNT BALLASTED SOLAR RACKING
  - 1.8. SOLAR ARRAY AND SYSTEM GROUNDING



Patrick Engineering Inc.  
55 East Monroe  
Suite 3450  
Chicago, IL 60603  
TEL. (312) 201-7900  
FAX (312) 220-0722  
www.rina-us.org

**PROFESSIONAL DESIGN FIRM**  
LICENSE NO. 184000409-0014

Owner/Client



Project:

**TEXAS BACKUP POWER PACKAGE**  
**PUBLIC UTILITY COMMISSION OF TEXAS**

Sheet Title:

**GENERAL SPECIFICATIONS**

Date:

01/21/2025

Proj. No:

22483.005

**PROJECT PHASE**

XXXX

Sheet No:

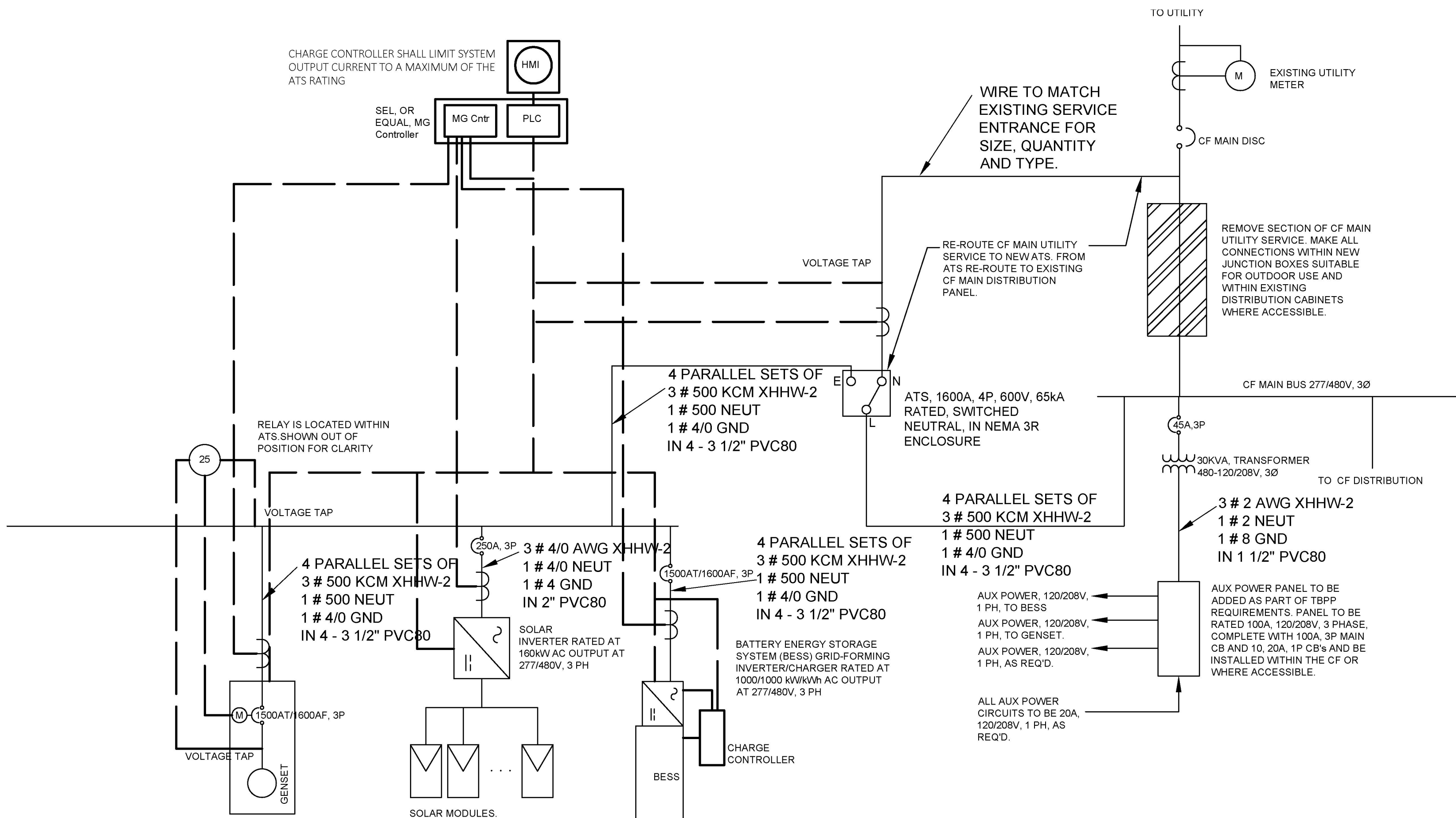
E1.02

Revision No.:

0



FILE NAME: P:\Utility\Public Utility Commission of Texas (PUC)\22483.005 Backup Power Package Design\11 Drawings\11.1 Electrical\11.1.0200\W2.01 ONE-LINE DIAGRAM.dwg LAYOUT NAME: E2.01 PLOTTED: Tuesday, January 21, 2025 - 10:53am USER: AMH04

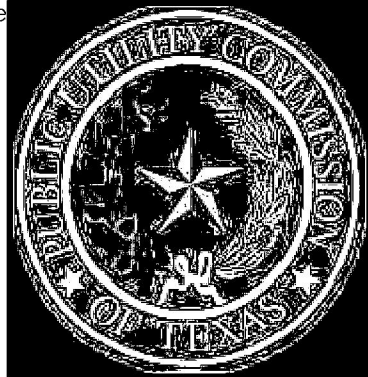


ONE-LINE DIAGRAM FOR OPERATING  
VOLTAGE OF 277/480V, 3 Ø, 4WY

General Notes:

- Equipment sizing is schematic and is representative of actual minimum desired kW. A, watts required for a coordinated system. Actual ratings of equipment are allowed to meet standard offerings from vendor/s that equal or exceed those minimums. All equipment associated with the proposed offering shall be adjusted to meet the actual power generation equipment being offered. For example if a 100kW genset is being offered in lieu of a required 80kW genset the main CB and other associated equipment shall also be upsized to handle the larger power package output.
- One-line is a schematic representation of the component layout of the microgrid. Component sizing requirements can be found in the sizing charts accompanying the plans for the specific TBPP being installed.
- Actual component sizing shall meet the TBPP rating required as a minimum but may be in the range of 0 to +10%.
- Overall basic TBPP sizes shall be 10kW, 25 kW, 100kW, 500 kW, and 1000 kW. Required ratings of installed packages that do not fall into one of these sizes shall be considered as meeting the installed kW rating by aggregating multiple gensets of the base rating together. Other components shall be upsized as listed in the sizing charts. Aggregation limits to no more than three MG's have been set to minimize space requirements.
- Communication standard shall be RS485. Fiber optic may be used at suppliers option. Communications protocols shall be ethernet, CAN, or other approved vendor standard offering.
- All equipment including wire is for the existing 1000kW Critical Facility and is assumed to be served and operated at 277/480V, 3 phase, 1500A. See appropriate one-line for equipment and wire sizing required.
- Solar array sizing is based on a DC/AC ratio of 1.25 with a design AC output equal to 16% of the TBPP kW rating. This should be able to fully charge a 1 hour BESS in 6 hours from a discharge state of 20% charge left on the BESS.

Owner/Client:



Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: AMH

Checked: DJS

Approved: DJS

A	01/21/2025	ORIGINAL ISSUE
Rev. No.	Date	Description

ISSUES & REVISIONS

THE INFORMATION CONTAINED ON THESE DRAWINGS  
IS FOR USE ON THIS PROJECT ONLY

Project: **TEXAS BACKUP POWER  
PACKAGE  
PUBLIC UTILITY COMMISSION OF  
TEXAS**

Sheet Title:  
**ONE-LINE DIAGRAM**

Date: 01/21/2025 Proj. No.: 22483.005

PROJECT PHASE

XXXX

Sheet No:

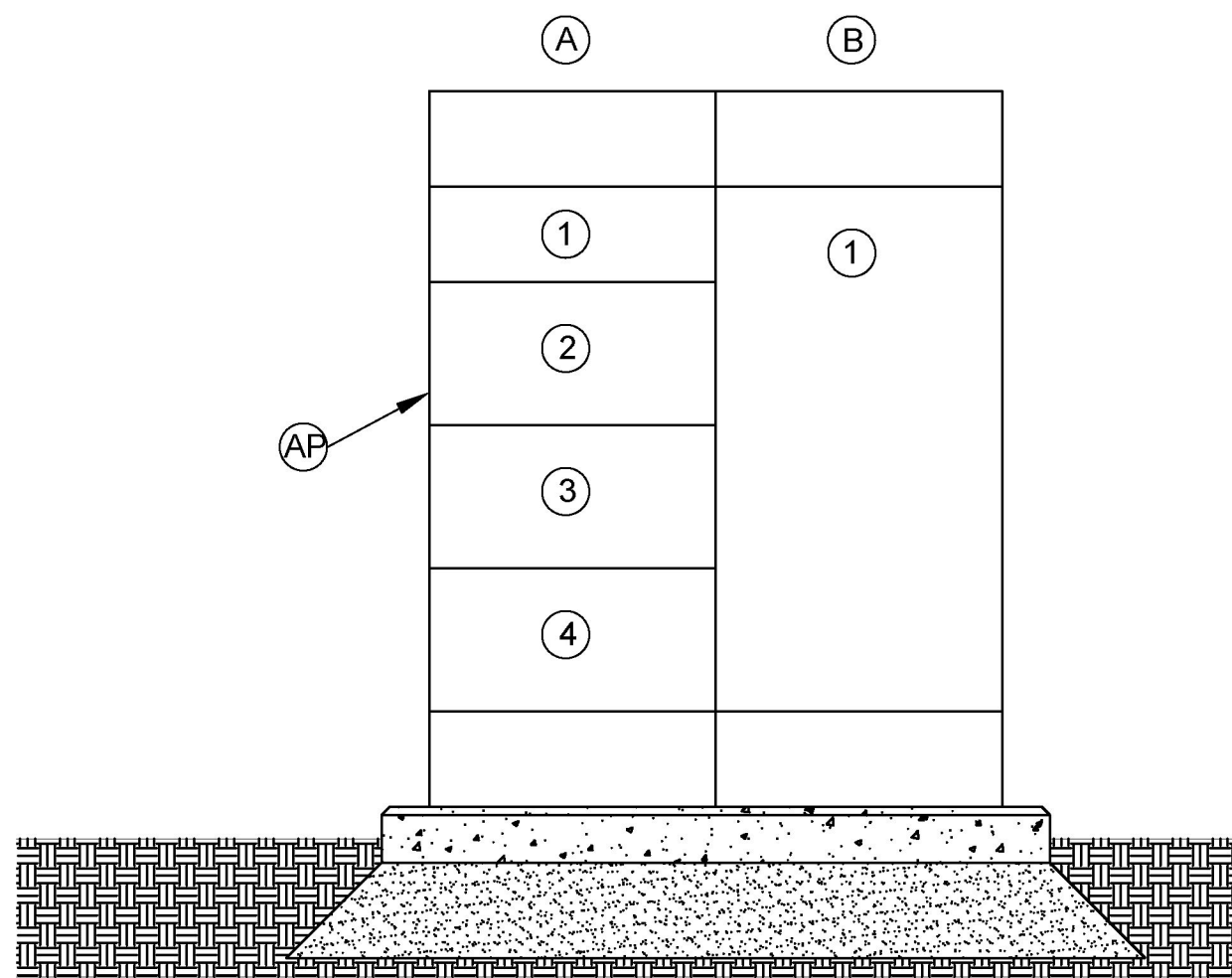
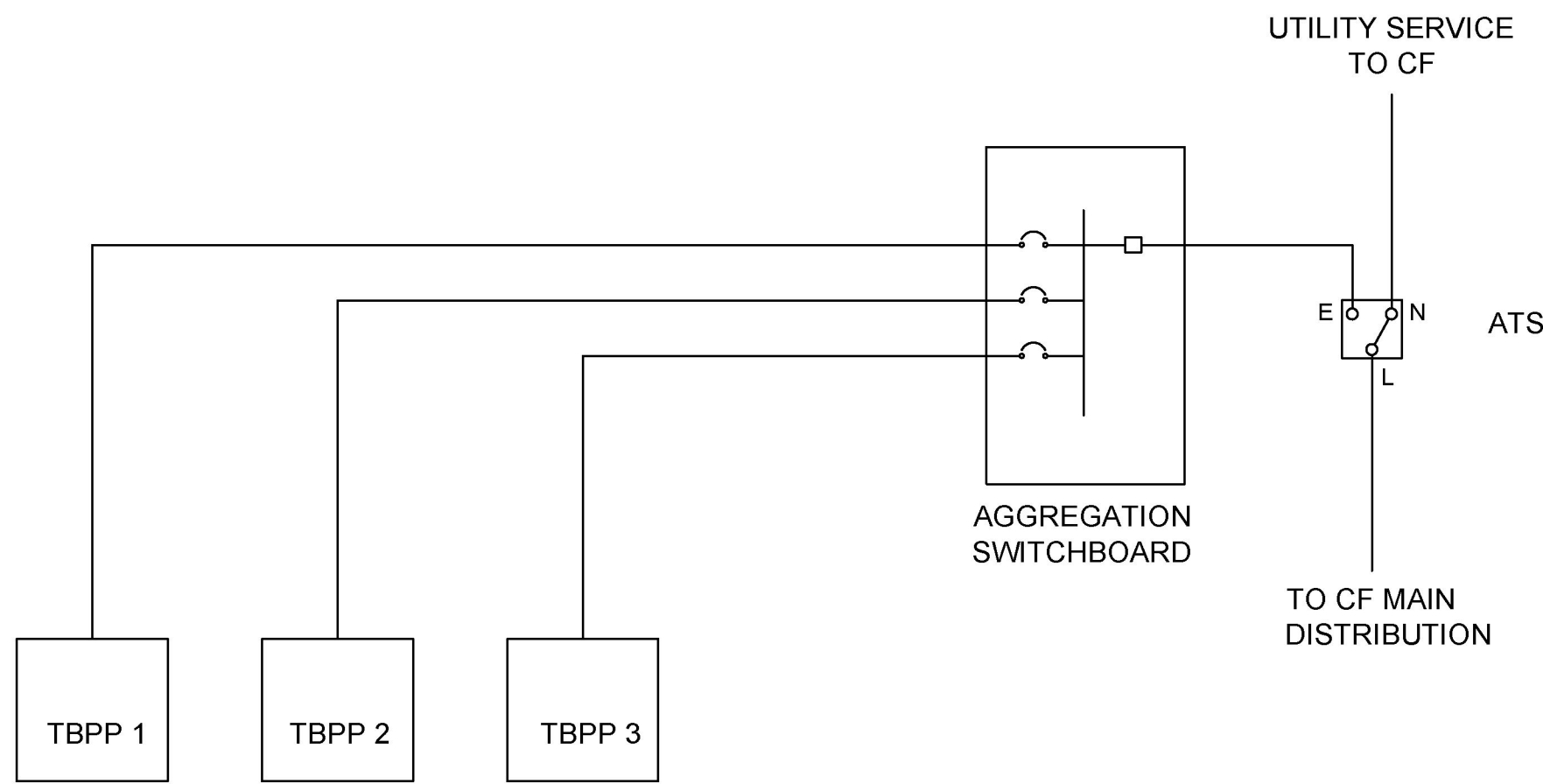
E2.01

Sheet of

Revision No.:

0

FILE NAME: P:\Utility\Public Utility Commission of Texas (PUC)\20483.005 Backup Power Package Design\11. Equipment\120V\2.02 AGGREGATION SWB.dwg, USER: NAME, E2.02 Agg Swb, PLOTDT: Tuesday, January 21, 2025, - 148mm, USFS, A0/24



AGGREGATION  
SWITCHBOARD 1  
120/208V SYSTEMS  
100kW thru 499kW

#### EQUIPMENT NOMENCLATURE (#)

ITEM AP  
NEMA 3R ENCLOSURE, 30"Wx24"Dx90" TALL WITH  
THERMOSTICALLY CONTROLLED HEATERS FOR  
HUMIDITY CONTROL.

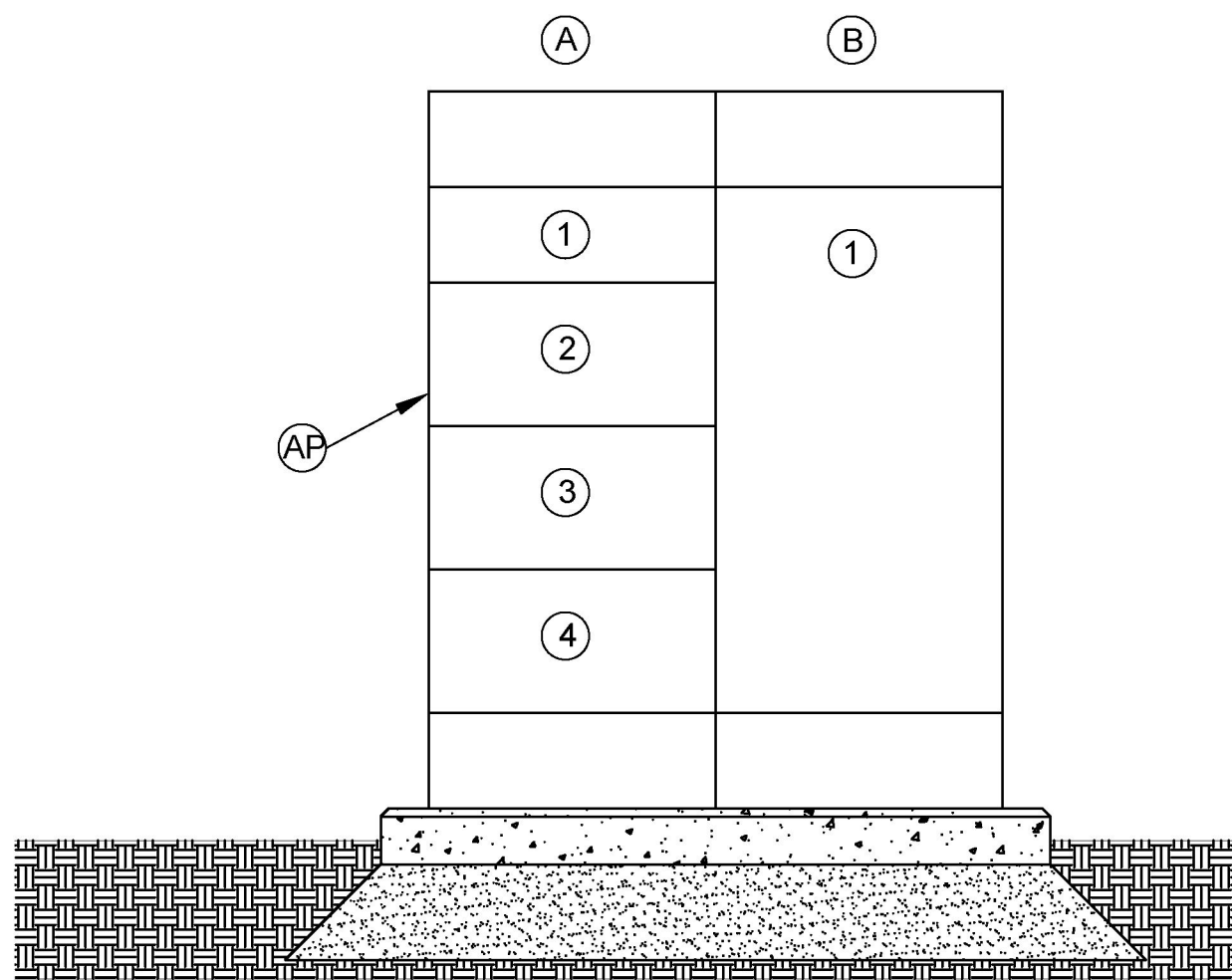
##### SECTION A

- SPACE
- 400A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 400A MAX. ADJUST TO MATCH TBPP RATING.
- 400A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 400A MAX. ADJUST TO MATCH TBPP RATING.
- 400A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 400A MAX. ADJUST TO MATCH TBPP RATING.

##### SECTION B

- 1600A, 3Ø, 600V BUS FOR CABLE CONNECTION TO 400A RATED ATS.

- MAXIMUM RATING OF SWITCHBOARD TO BE 500kW, 600V, 3Ø TO ALLOW FOR AGGREGATING AT LEAST THREE 100kW TBPPs.
- EQUIPMENT SIZING BASED ON OPERATING VOLTAGE OF 120/208V, 3Ø. ADJUST CB AND BUS SIZING FOR USE AT OTHER VOLTAGES.



AGGREGATION  
SWITCHBOARD 2  
277/480V SYSTEMS  
100kW thru 499kW

#### EQUIPMENT NOMENCLATURE (#)

ITEM AP  
NEMA 3R ENCLOSURE, 30"Wx24"Dx90" TALL WITH  
THERMOSTICALLY CONTROLLED HEATERS FOR  
HUMIDITY CONTROL.

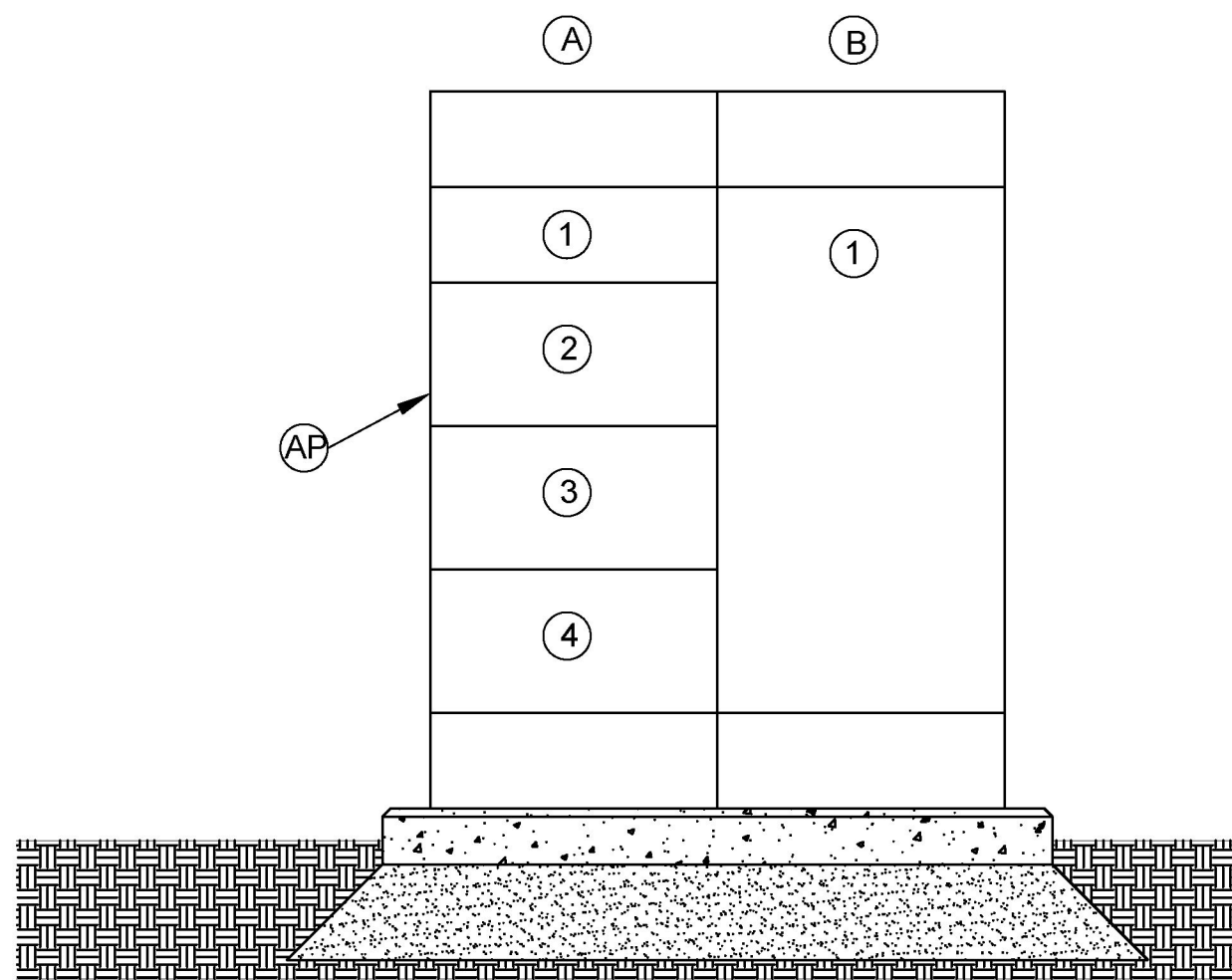
##### SECTION A

- SPACE
- 150A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 150A MAX. ADJUST TO MATCH TBPP RATING.
- 150A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 150A MAX. ADJUST TO MATCH TBPP RATING.
- 150A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 150A MAX. ADJUST TO MATCH TBPP RATING.

##### SECTION B

- 600A, 3Ø, 600V BUS FOR CABLE CONNECTION TO 150A RATED ATS.

- MAXIMUM RATING OF SWITCHBOARD TO BE 500kW, 600V, 3Ø TO ALLOW FOR AGGREGATING AT LEAST THREE 100kW TBPPs.
- EQUIPMENT SIZING BASED ON OPERATING VOLTAGE OF 480V, 3Ø. ADJUST CB AND BUS SIZING FOR USE AT OTHER VOLTAGES.



AGGREGATION  
SWITCHBOARD 3  
500kW thru 999kW

#### EQUIPMENT NOMENCLATURE (#)

ITEM AP  
NEMA 3R ENCLOSURE, 30"Wx24"Dx90" TALL WITH  
THERMOSTICALLY CONTROLLED HEATERS FOR  
HUMIDITY CONTROL.

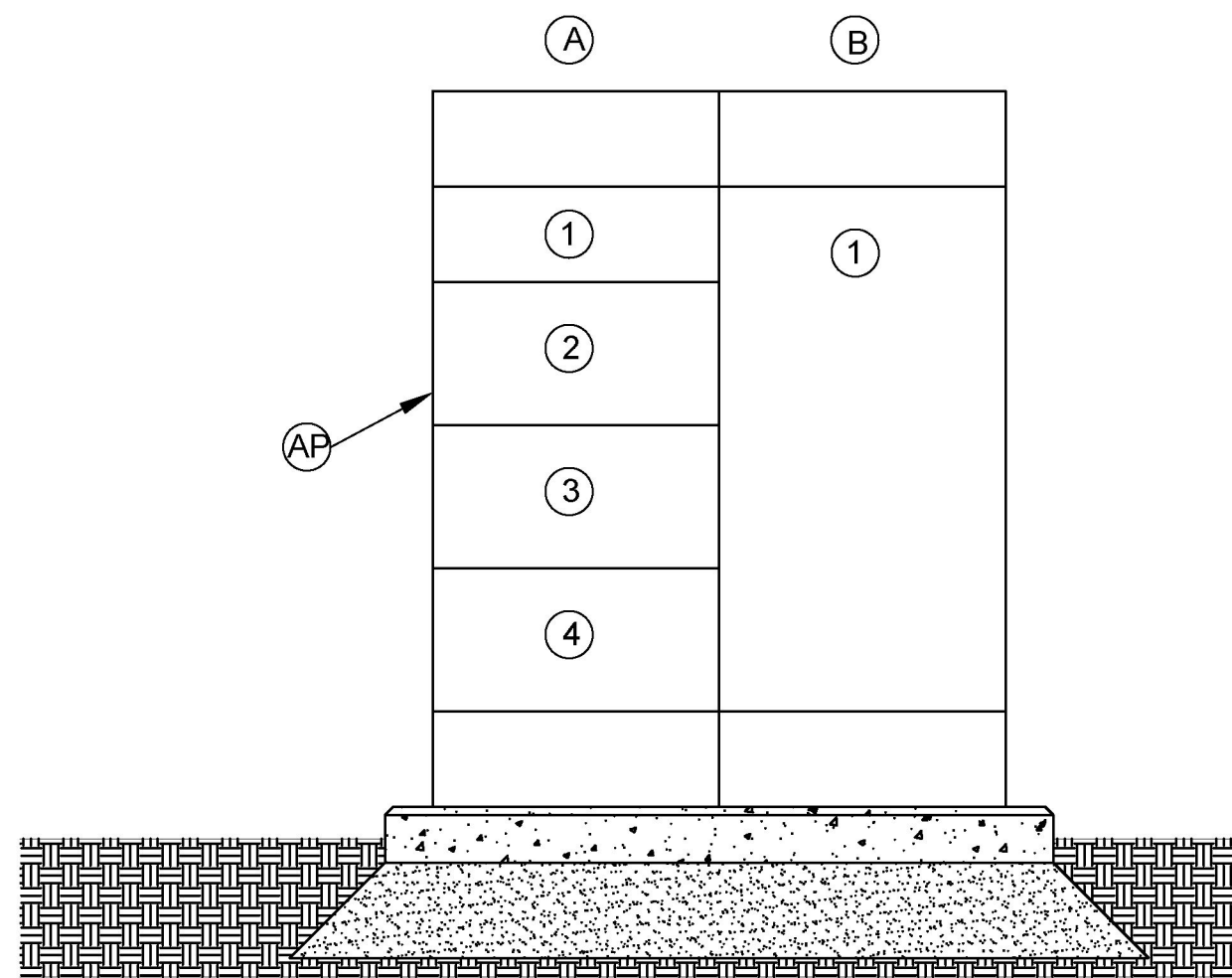
##### SECTION A

- SPACE
- 800A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 750A MAX. ADJUST TO MATCH TBPP RATING.
- 800A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 750A MAX. ADJUST TO MATCH TBPP RATING.
- 800A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 750A MAX. ADJUST TO MATCH TBPP RATING.

##### SECTION B

- 3000A, 3Ø, 600V BUS FOR CABLE CONNECTION TO 3000A RATED ATS.

- MAXIMUM RATING OF SWITCHBOARD TO BE 1000kW, 600V, 3Ø TO ALLOW FOR AGGREGATING AT LEAST ONE 500kW AND TWO 100kW TBPPs.
- EQUIPMENT SIZING BASED ON OPERATING VOLTAGE OF 480V, 3Ø.



AGGREGATION  
SWITCHBOARD 4  
1000kW thru 2500kW

#### EQUIPMENT NOMENCLATURE (#)

ITEM AP  
NEMA 3R ENCLOSURE, 30"Wx24"Dx90" TALL WITH  
THERMOSTICALLY CONTROLLED HEATERS FOR  
HUMIDITY CONTROL.

##### SECTION A

- SPACE
- 1600A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 1500A MAX. ADJUST TO MATCH TBPP RATING.
- 1600A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 1500A MAX. ADJUST TO MATCH TBPP RATING.
- 1600A, 3Ø, 600V, LSIG WITH ADJUSTABLE TRIP, SET TO 800A MAX. ADJUST TO MATCH TBPP RATING.

##### SECTION B

- 4000A, 3Ø, 600V BUS FOR CABLE CONNECTION TO 4000A RATED ATS.

- MAXIMUM RATING OF SWITCHBOARD TO BE 2500kW, 600V, 3Ø TO ALLOW FOR AGGREGATING AT LEAST TWO 1000kW AND ONE 500kW TBPPs.
- EQUIPMENT SIZING BASED ON OPERATING VOLTAGE OF 480V, 3Ø.

Owner/Client



Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: AMH

Checked: DJS

Approved: DJS

Rev. No.	Date	Description
A	01/21/2025	ORIGINAL ISSUE

#### ISSUES & REVISIONS

THE INFORMATION CONTAINED ON THESE DRAWINGS  
IS FOR USE ON THIS PROJECT ONLY

Project: **TEXAS BACKUP POWER  
PACKAGE  
PUBLIC UTILITY COMMISSION OF  
TEXAS**

Sheet Title:

**AGGREGATION SWITCHBOARD**

Date: 01/21/2025 Proj. No.: 22483.005

#### PROJECT PHASE

XXXX

Sheet No.:

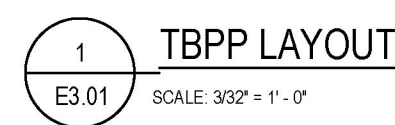
**E2.02**

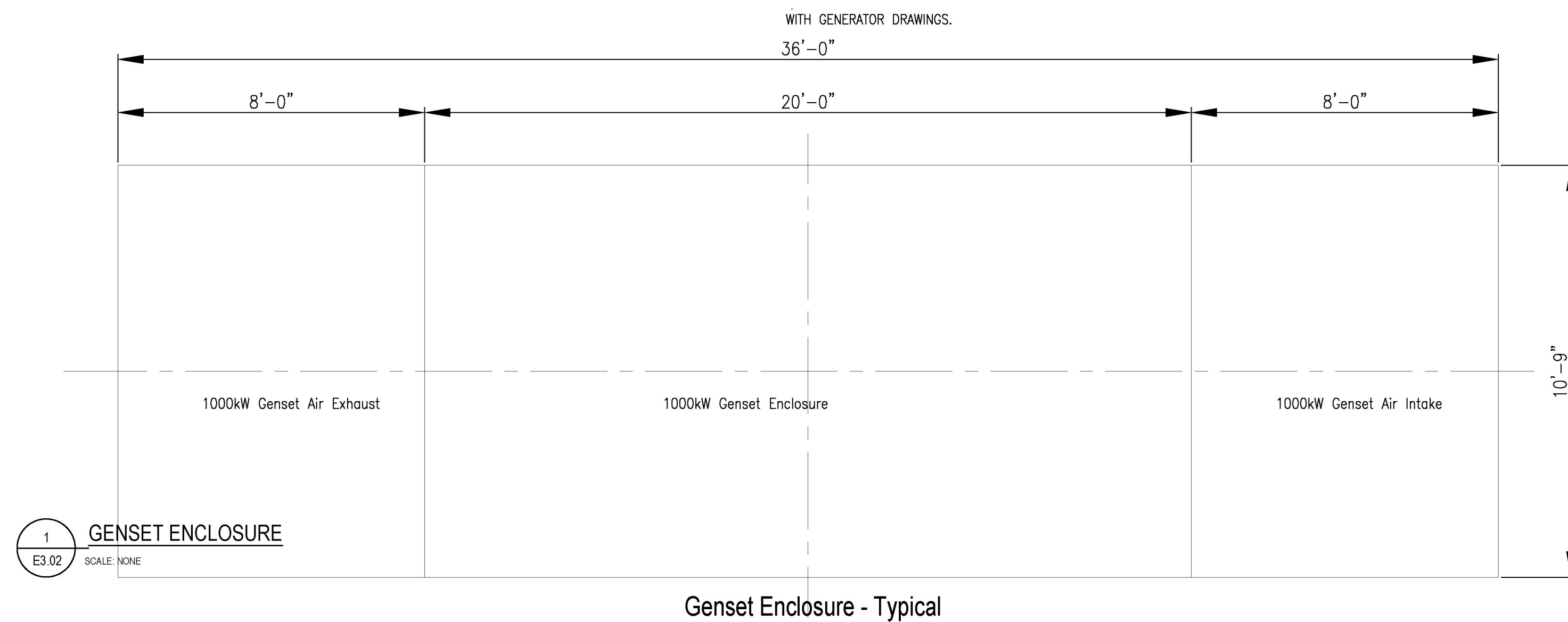
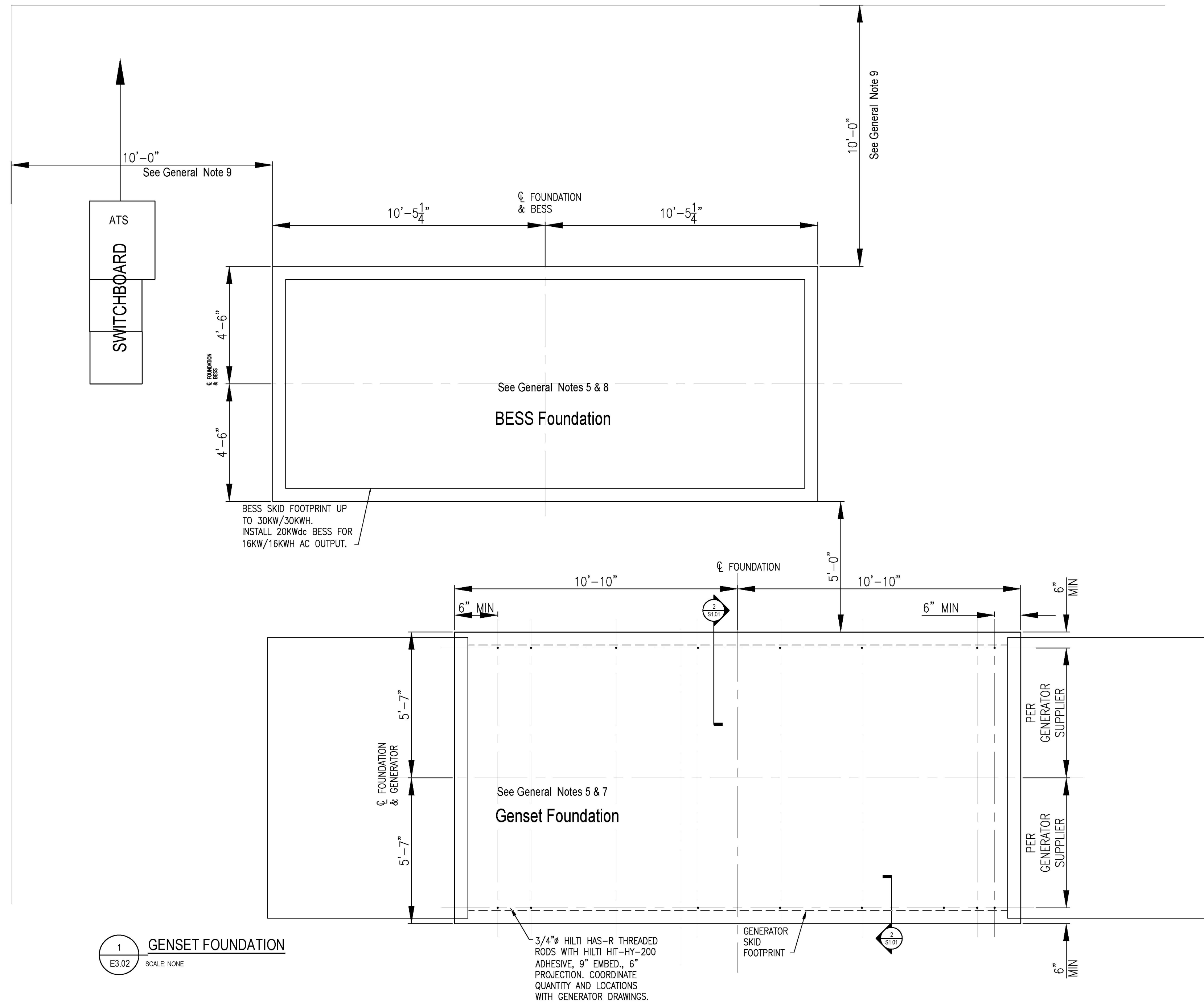
Sheet of

Revision No.:

0

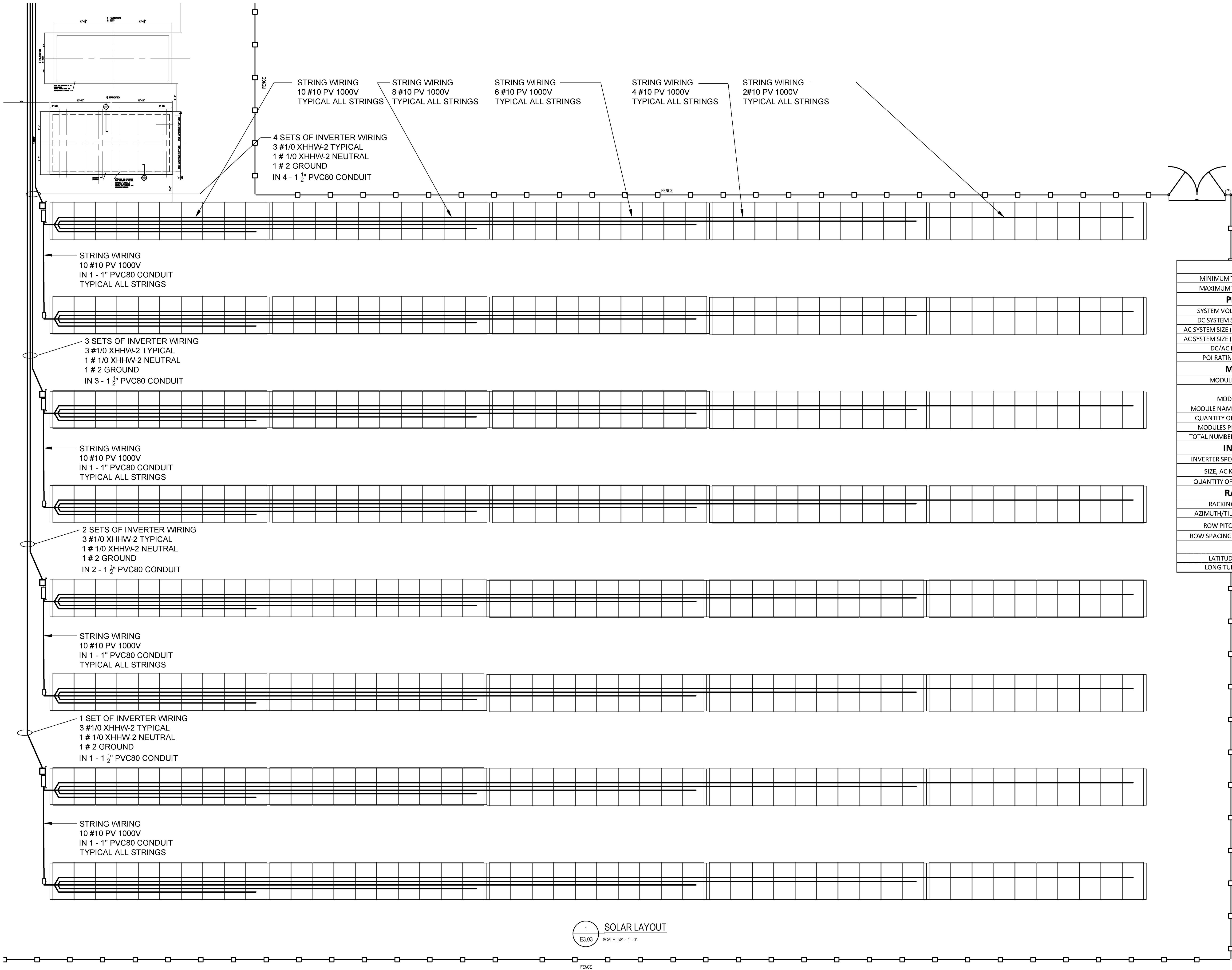






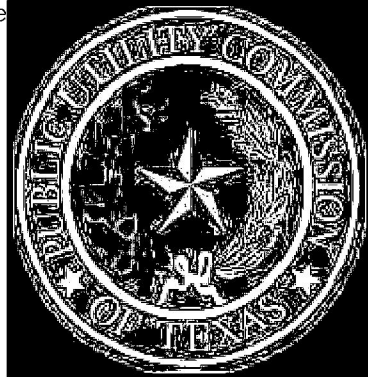


FILE NAME: E:\Utility\Public Utility Commission of Texas (PUC)\22483.005 Backup Power Package Design\11 Drawings\11.1 Electrical\11.1.0300A Solar Layout.dwg (PLOT NAME: E3.03 Solar Layout) PLOTTED: Tuesday, January 21, 2025 - 4:13pm USER: A1024



SITE PARAMETERS	
MINIMUM TEMP (°C)	-19.4
MAXIMUM TEMP (°C)	42
PROJECT PARAMETERS	
SYSTEM VOLTAGE (DC)	600
DC SYSTEM SIZE (kWp)	200.00
AC SYSTEM SIZE (kW AC) @ 45°C	160.00
AC SYSTEM SIZE (kW AC) @ 20°C	N/A
DC/AC RATIO	1.25
POI RATING (MVA)	N/A
MODULE PARAMETERS	
MODULE TYPE	Mono PERC (c-Si)
MODULE	Can Solar CS6.2-54TM500
MODULE NAMEPLATE (Wp)	500
QUANTITY OF MODULES	400
MODULES PER STRING	10
TOTAL NUMBER OF STRINGS	31
INVERTER PARAMETERS	
INVERTER SPECIFICATIONS	Solar Edge SE17.3KUS
SIZE, AC Kw/Type	17.3 / String
QUANTITY OF INVERTERS	10
RACKING PARAMETERS	
RACKING TYPE	Fixed Ground Mount
AZIMUTH/TILT ANGLE (°)	+/- 33
ROW PITCH (ft/m)	16.67/5.09
ROW SPACING (GAP) (ft/m)	10.24/3.13
LOCATION	
LATITUDE (°) N	32.77
LONGITUDE (°) W	-96.78

1 SOLAR LAYOUT  
E3.03 SCALE: 1/8" = 1'-0"



Owner/Client:

Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: AMH

Checked: DJS

Approved: DJS

A	01/21/2025	ORIGINAL ISSUE
Rev. No.	Date	Description

#### ISSUES & REVISIONS

THE INFORMATION CONTAINED ON THESE DRAWINGS  
IS FOR USE ON THIS PROJECT ONLY

Project: **TEXAS BACKUP POWER  
PACKAGE  
PUBLIC UTILITY COMMISSION OF  
TEXAS**

Sheet Title:

**SOLAR LAYOUT**

Date: 01/21/2025 Proj. No.: 22483.005

#### PROJECT PHASE

XXXX

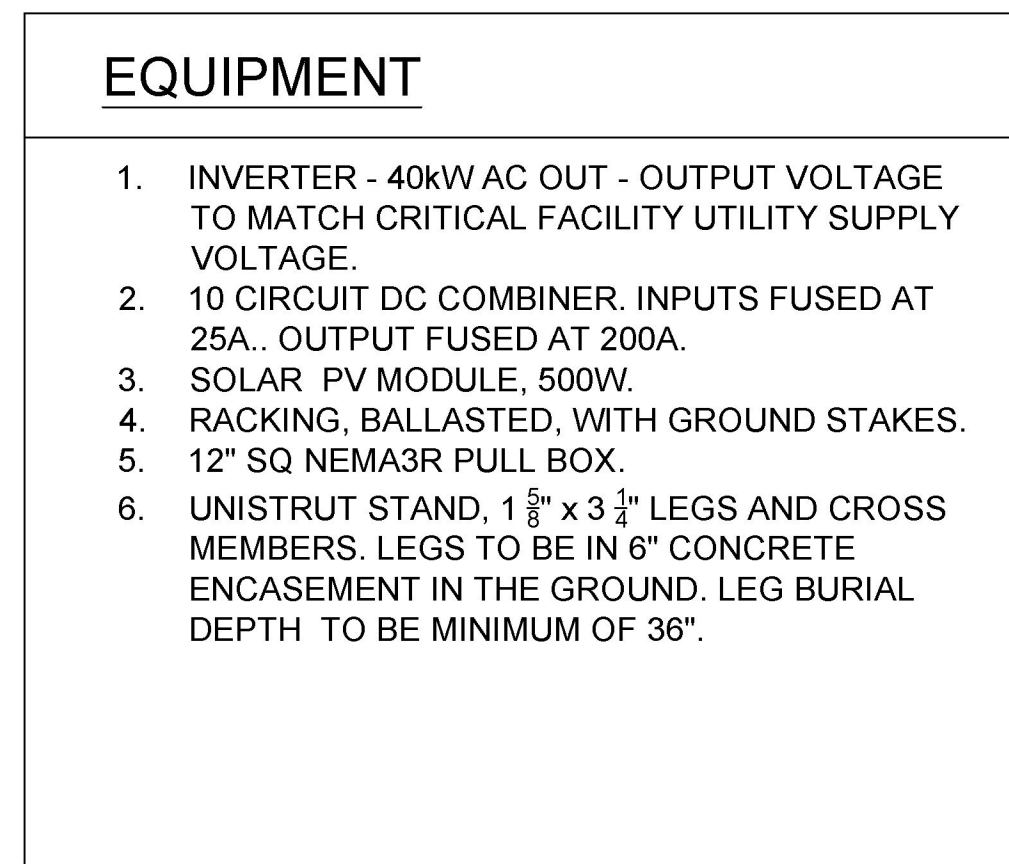
Sheet No.:

**E3.03**

Sheet of

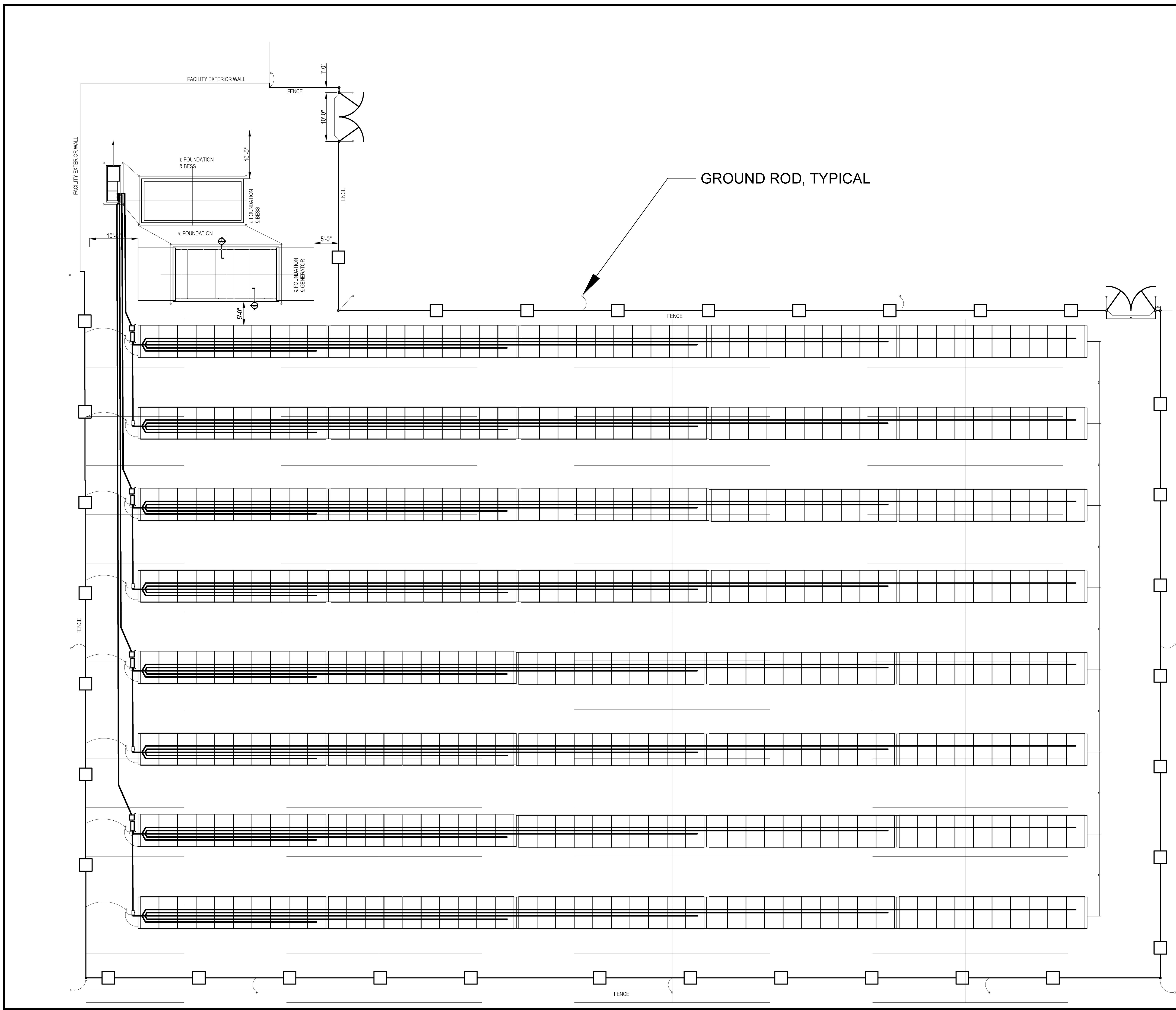
Revision No.:

0



The diagram illustrates a solar string skip wiring configuration for a 1000kW DC Solar Array. It shows four parallel strings of solar panels, each consisting of 20 modules. The wiring is designed to skip strings that are underperforming. On the left, four 'Solar DC 10 Circuit String Combiner' units are shown, each with a 'To 40kW AC out Inverter' connection. The wiring from the panels to the combiners shows how individual strings can be bypassed or 'skipped' to maintain the output of the other strings. The label 'Solar String Skip Wiring' is at the bottom.

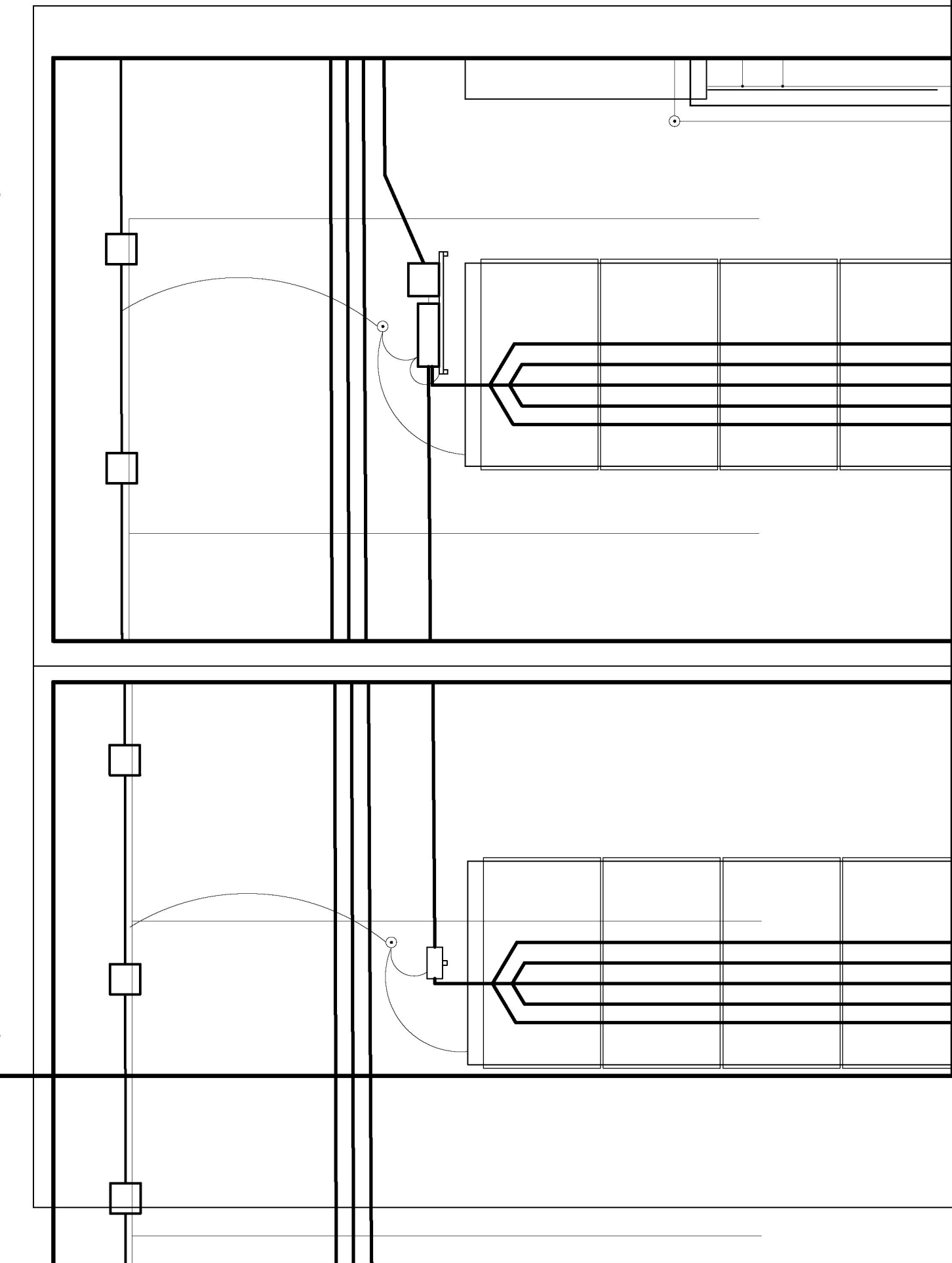
FILE NAME: P:\Utility\Public Utility Commission of Texas (PUC)\22483.005 Backup Power Package Design\11 Drawings\11.1 Electrical\01 Grounding\1020W.dwg, LAYOUT NAME: E5.01, PLOTTED: Tuesday, January 21, 2025 - 5:35pm USER: A1004



1 GROUNDING PLAN  
E5.01 SCALE: 3/32"=1'-0"

#### NOTES

1. RUN GROUND WIRE IN GROUND RING AS DETAILED AROUND PLATFORM. GROUND WIRE SIZE TO BE #4/0 AWG. GROUND WIRE TO BE BARE COPPER.
2. INSTALL GROUND TEST WELLS WHERE NOTED AND AS DETAILED.
3. INSTALL GROUND WIRES FROM GROUND RING TO ALL BUILDING STEEL COLUMNS, PIPE RACK STEEL COLUMNS WHERE AVAILABLE AND ACCESSIBLE.
4. EXOTHERMIC WELD STYLE GROUND CONNECTIONS SHALL NOT BE USED FOR ANY GROUNDING CONNECTIONS.
5. EXTEND SWITCHBOARD GROUND WIRES TO GROUND RING. THESE GROUNDS SHALL BE SIZED IN ACCORDANCE WITH THE 2023 NEC.
6. GROUND RODS TO BE COPPER-CLAD STEEL, 3/4"Ø x 10'L.
7. GROUND RODS TO BE MAXIMUM OF 50' APART AROUND FENCE AND BE 3'-0" OUTSIDE FENCE.
8. SEE SHEET E5.02 FOR ADDITIONAL GROUNDING DETAILS.



2 GROUNDING DETAILS  
E5.01 SCALE: 1/4"=1'-0"

Owner/Client



Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: LAB

Checked: DJS

Approved: DJS

Rev. No.	Date	Description
A	01/21/2025	ORIGINAL ISSUE

#### ISSUES & REVISIONS

THE INFORMATION CONTAINED ON THESE DRAWINGS IS FOR USE ON THIS PROJECT ONLY

Project: **TEXAS BACKUP POWER PACKAGE**  
**PUBLIC UTILITY COMMISSION OF TEXAS**

Sheet Title:  
**GROUNDING PLAN**

Date: 01/21/2025 Proj. No.: 22483.005

#### PROJECT PHASE

XXXX

Sheet No:

**E5.01**

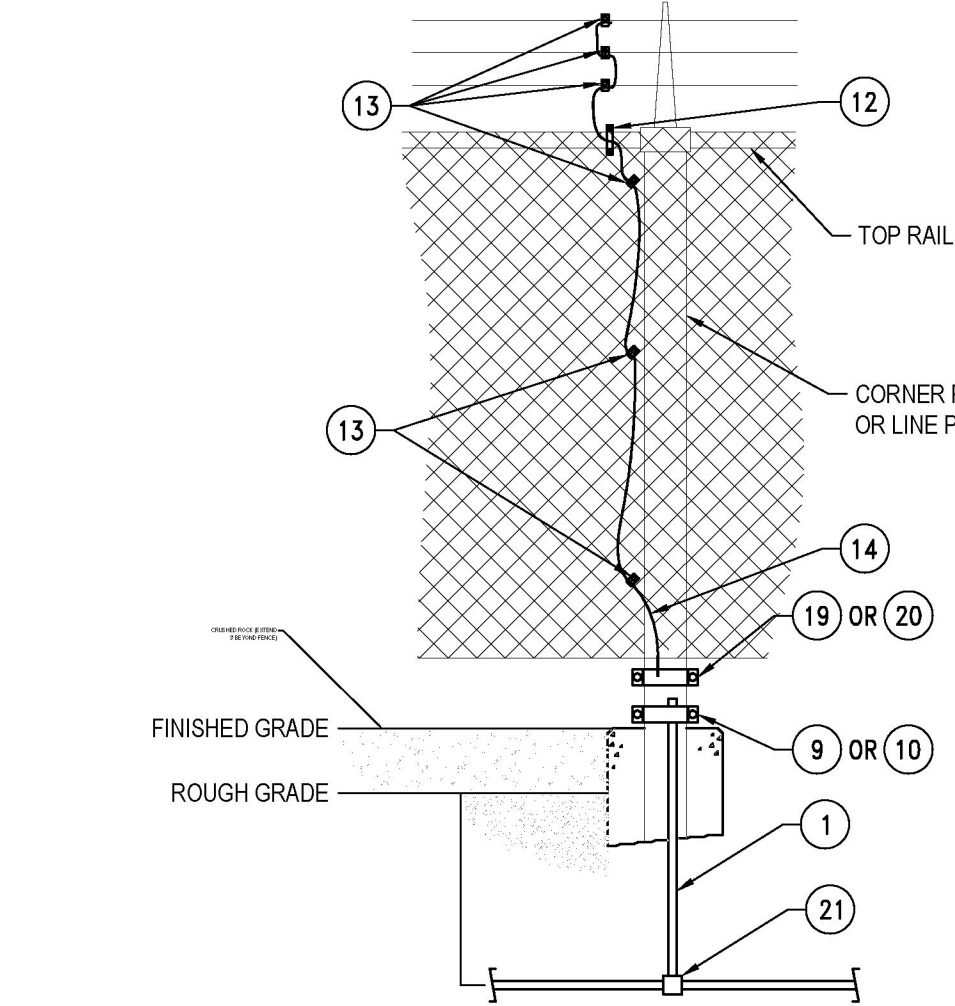
Sheet of

Revision No.:

0

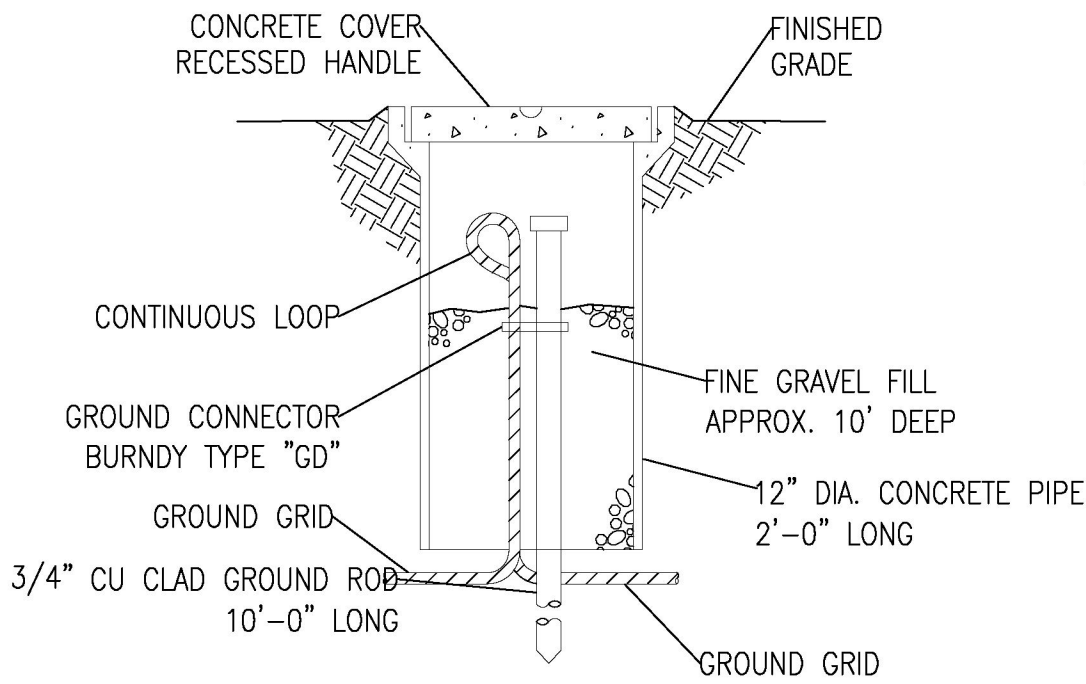


FILE NAME: E:\Utility\Public Utility Commission of Texas (PUC)\29483.005 Backup Power Package Design\11.1 Drawing\11.1.1 Electrical\11.1.1.1 Grounding\_1020W.dwg, LAYOUT NAME: E5.02, PLOTTED: Tuesday, January 21, 2025 - 2:13pm USER: ANJDA

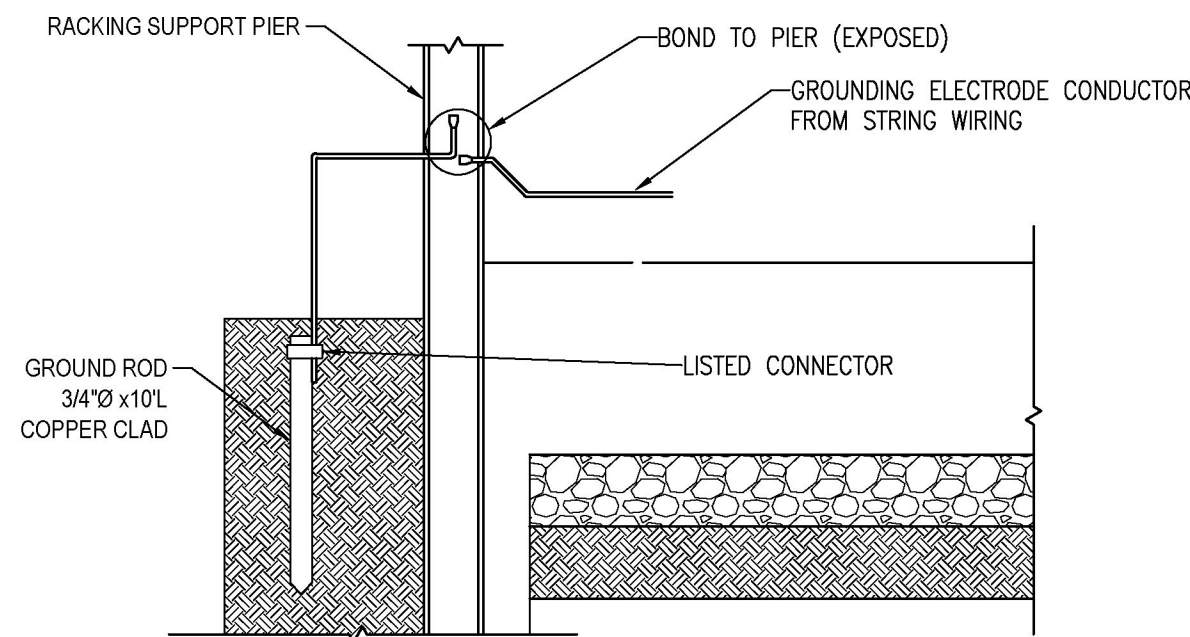


ITEM	DESCRIPTION
1	WIRE, BARE CU, #4/0 AWG SD 7 STR
9	FENCE POST GROUND CLAMP, CORNER POST-2.875" OD PIPE, #4/0 AWG WIRE BURNDY TPE GD
10	FENCE POST GROUND CLAMP, LINE POST-2.375" OD PIPE, #4/0 AWG WIRE BURNDY TPE GD
12	GROUND CLAMP, FENCE TOP RAIL-1.625" OD PIPE, 2 SOL TO 250 MCM
13	TAP CONNECTOR, SPLIT BOLT TYPE, BRONZE, #2 AWG
14	GROUND WIRE, STEEL, 0.25" DIA., 7 STR
19	FENCE POST GROUND CLAMP, CORNER POST - 2.875" OD PIPE, #4-#2/0 AWG CONDUCTOR BURNDY TPE GD
20	FENCE POST GROUND CLAMP, LINE POST - 2.375" OD PIPE, #4-#2/0 AWG CONDUCTOR BURNDY TPE GD
21	GROUND WIRE TO GROUND WIRE IRREVERSIBLE COMPRESSION CONNECTOR BURNDY YGHC29C29

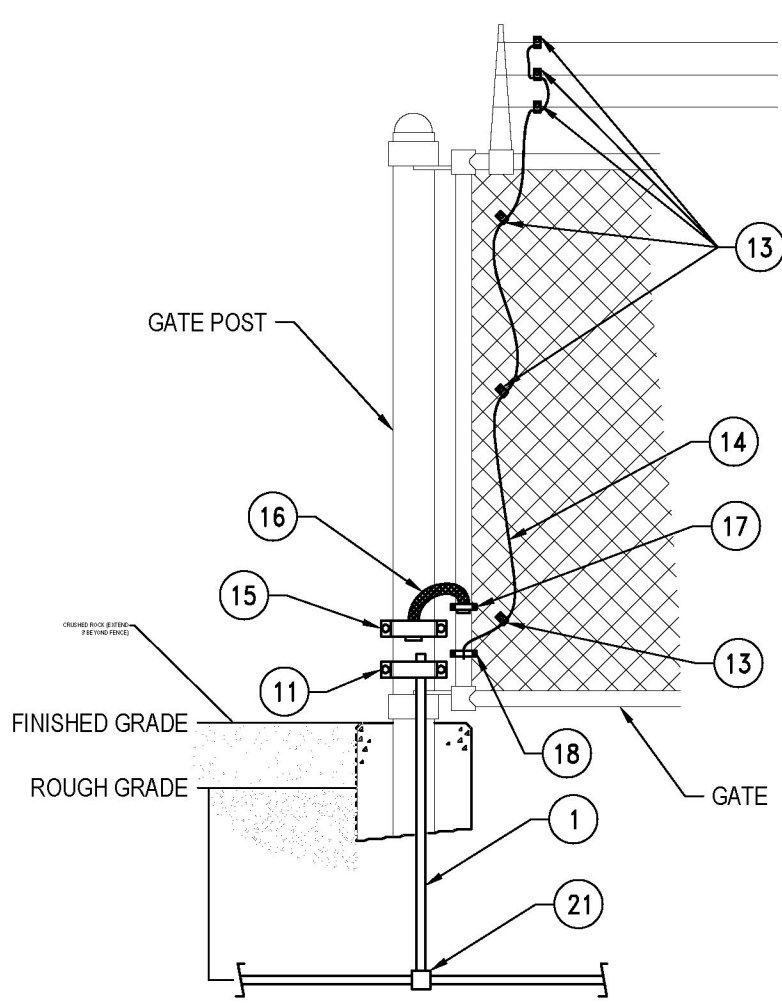
**A**  
E5.02  
SCALE: NONE  
**GROUNDING FENCE POST**



**F**  
E5.02  
SCALE: NONE  
**GROUNDING TEST WELL**

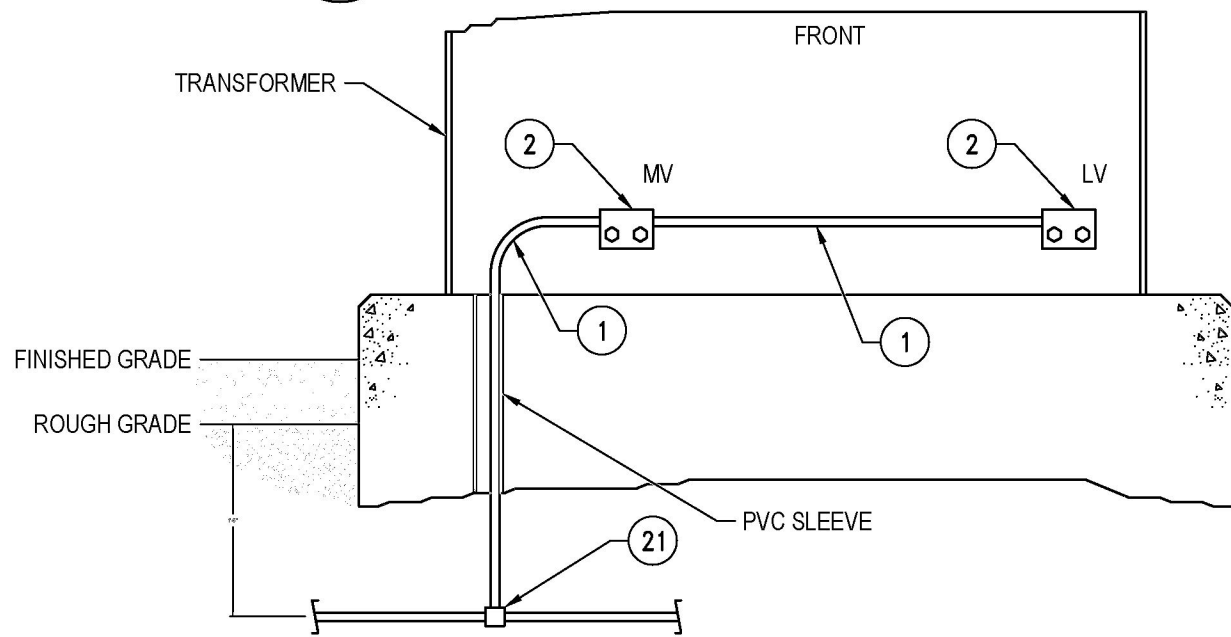


**I**  
E5.02  
SCALE: NONE  
**GROUNDING BOND TO STRUCTURAL STEEL AT RACKING SUPPORTS**



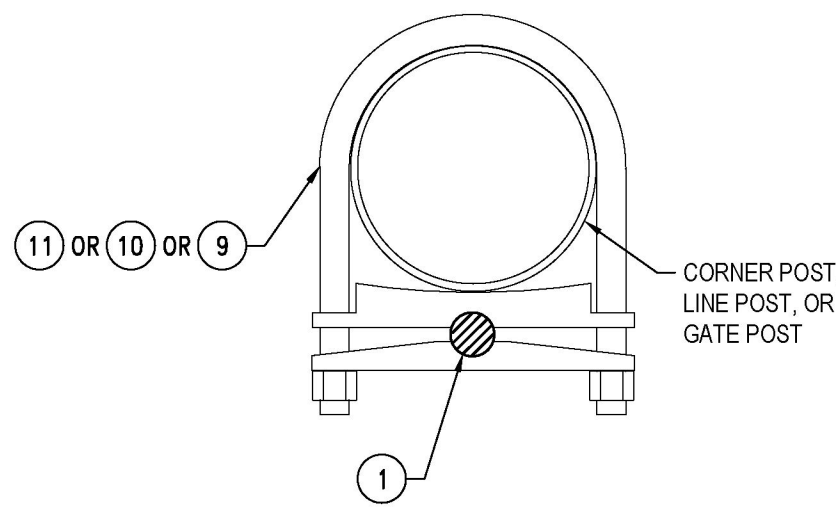
ITEM	DESCRIPTION
1	WIRE, BARE CU, #4/0 AWG SD 7 STR
11	FENCE POST GROUND CLAMP, GATE POST-4" OD PIPE, #4/0 AWG WIRE BURNDY TPE GD
13	TAP CONNECTOR, SPLIT BOLT TYPE, BRONZE, #2 AWG
14	GROUND WIRE, STEEL, 0.25" DIA., 7 STR
15	FENCE POST GROUND CLAMP, GATE POST-4" OD PIPE, 2" COPPER BRAID
16	COPPER BRAID, 1.5" X 18" WITH 3/8" STUD HOLE, 2 HOLE TERMINALS EACH END BURNDY TPE B
17	GROUND CLAMP, GATE POST-1.875" OD PIPE, 2" COPPER BRAID
18	GROUND CLAMP, GATE POST-1.875" OD PIPE, #4-#2/0 AWG CONDUCTOR BURNDY TPE GD
21	GROUND WIRE TO GROUND WIRE IRREVERSIBLE COMPRESSION CONNECTOR BURNDY YGHC29C29

**B**  
E5.02  
SCALE: NONE  
**GROUNDING FENCE GATE**



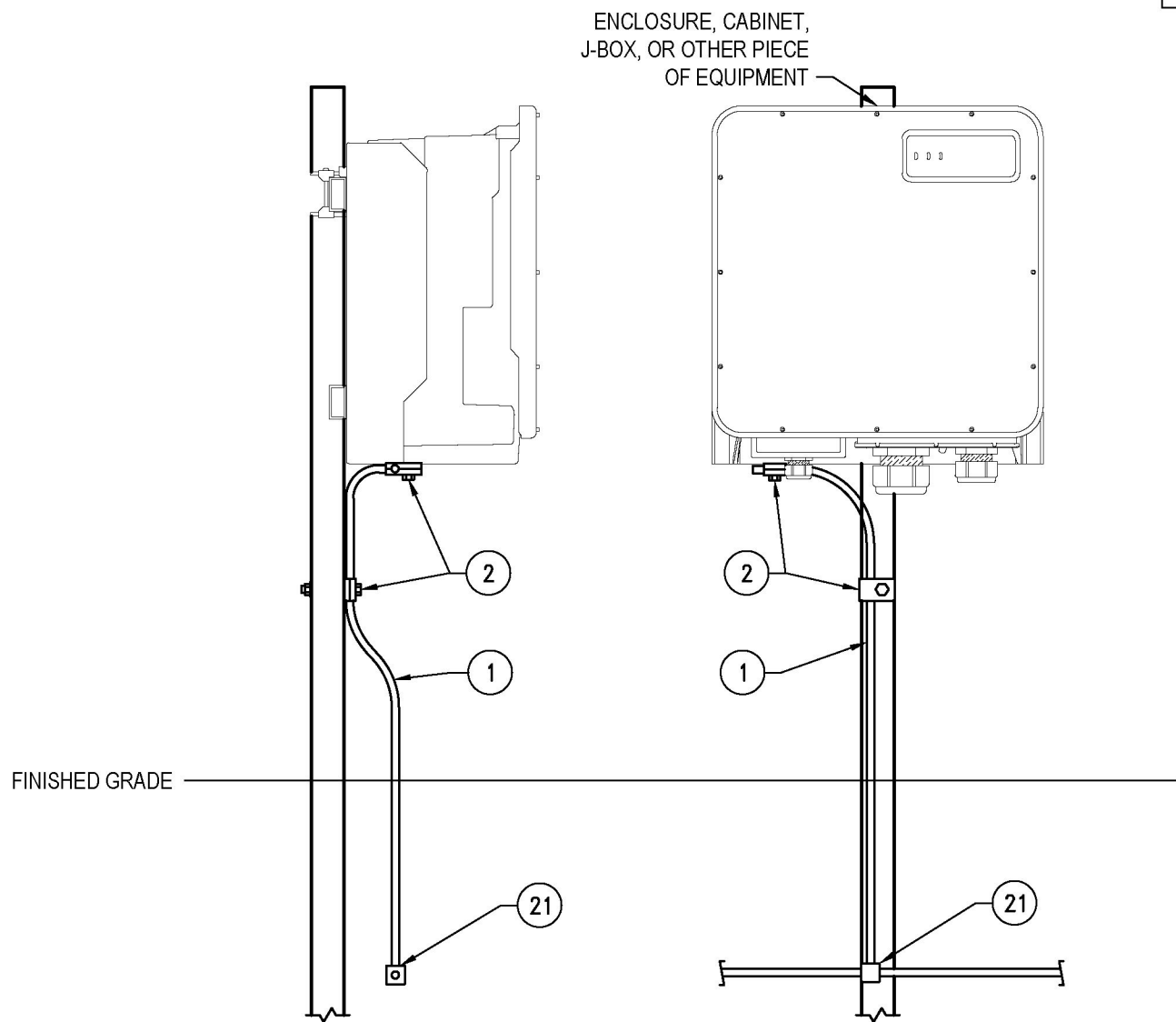
ITEM	DESCRIPTION
1	WIRE, BARE CU, 4/0 SD 7 STR
2	CONNECTOR, CLAMP, 4/0 STR CU, CABLE TO FLAT, 2 BOLT
21	GROUND WIRE TO GROUND WIRE IRREVERSIBLE COMPRESSION CONNECTOR BURNDY YGHC29C29

**G**  
E5.02  
SCALE: NONE  
**GROUNDING TRANSFORMER**



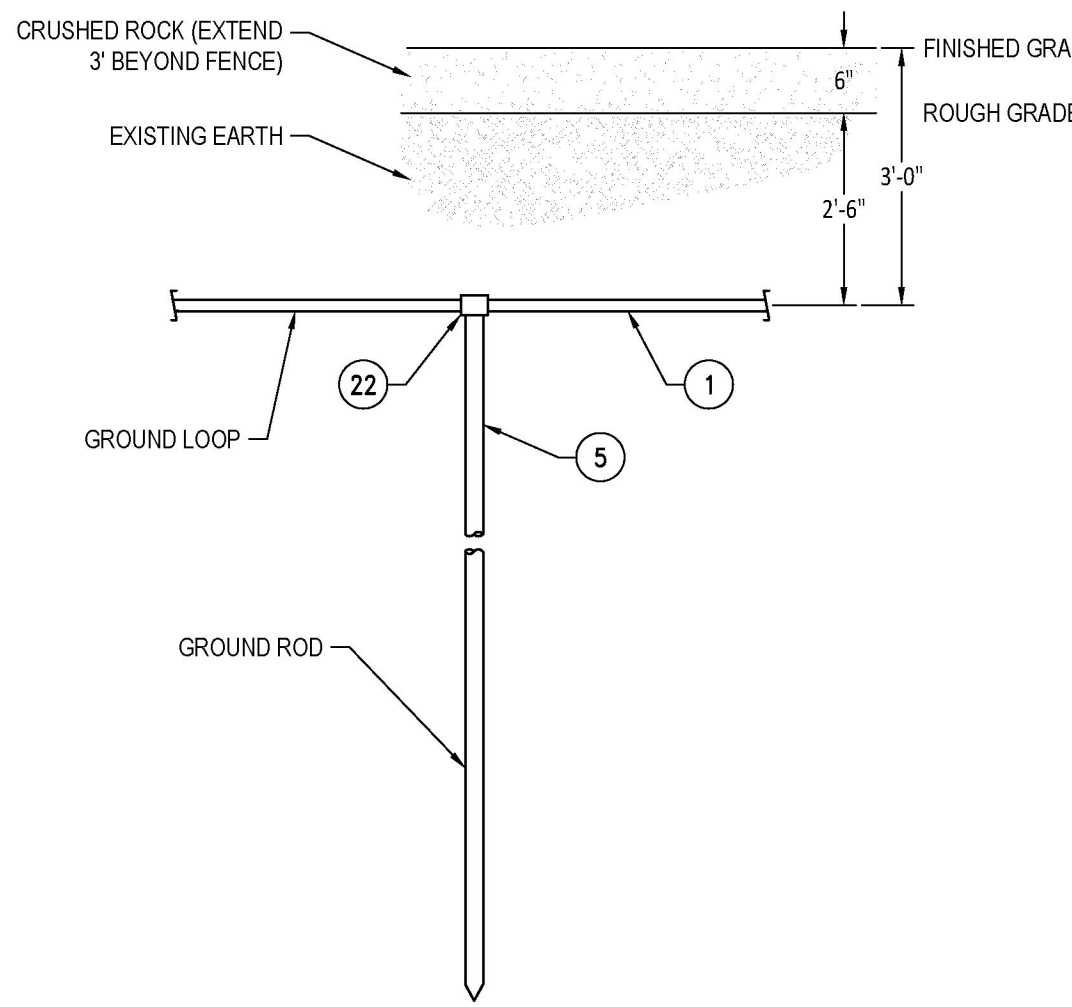
ITEM	DESCRIPTION
1	WIRE, BARE CU, #4/0 AWG SD 7 STR
9	FENCE POST GROUND CLAMP, CORNER POST-2.875" OD PIPE, #4/0 AWG WIRE
10	FENCE POST GROUND CLAMP, LINE POST-2.375" OD PIPE, #4/0 AWG WIRE
11	FENCE POST GROUND CLAMP, GATE POST-3.5" OD PIPE, #4/0 AWG WIRE

**C**  
E5.02  
SCALE: NONE  
**GROUNDING FENCE POST**



ITEM	DESCRIPTION
1	WIRE, BARE CU, #8 SOLID CU
2	CONNECTOR, CLAMP, #8 SOLID CU, CABLE TO FLAT, 1 BOLT
21	GROUND WIRE TO GROUND WIRE IRREVERSIBLE COMPRESSION CONNECTOR BURNDY YGHC29C29

**H**  
E5.02  
SCALE: NONE  
**GROUNDING ENCLOSURE**

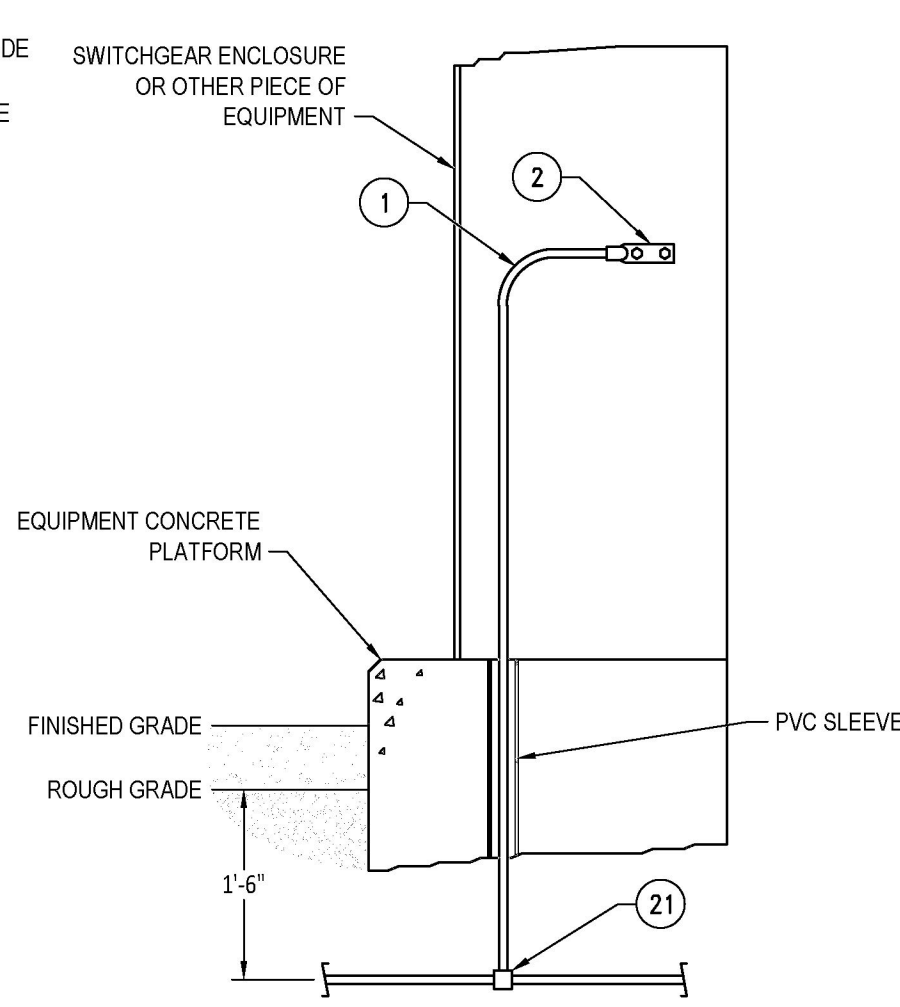


ITEM	DESCRIPTION
1	WIRE, BARE CU, #4/0 AWG SD 7 STR
5	GROUND ROD, CU-CLAD STEEL 3/4" DIA x 10'-0"
22	GROUND WIRE TO GROUND ROD CLAMP IRREVERSIBLE COMPRESSION CONNECTOR BURNDY YGLR29C34

**D**  
E5.02  
SCALE: NONE  
**GROUND ROD**

**NOTES**

1. RUN GROUND WIRE IN GROUND RING AS DETAILED AROUND PLATFORM. GROUND WIRE SIZE TO BE #4/0 AWG. GROUND WIRE TO BE BARE COPPER.
2. INSTALL GROUND TEST WELLS WHERE NOTED AND AS DETAILED.
3. INSTALL GROUND WIRES FROM GROUND RING TO ALL BUILDING STEEL COLUMNS, PIPE RACK STEEL COLUMNS.
4. EXOTHERMIC WELD STYLE GROUND CONNECTIONS SHALL NOT BE USED FOR ANY GROUNDING CONNECTIONS.
5. EXTEND SWITCHBOARD GROUND WIRES TO GROUND RING. THESE GROUNDS SHALL BE SIZED IN ACCORDANCE WITH THE 2023 NEC.



ITEM	DESCRIPTION
1	WIRE, BARE CU, 4/0 SD 7 STR
2	CONNECTOR, COMPRESSION, 4/0 STR CU, CABLE TO FLAT, 2 HOLE, BURNDY CAT. YGHA28-2N
21	GROUND WIRE TO GROUND WIRE IRREVERSIBLE COMPRESSION CONNECTOR BURNDY YGHC29C29

**E**  
E5.02  
SCALE: NONE  
**SWITCHBOARD GROUND**

Owner/Client



Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: LAB

Checked: CH

Approved: DJS


A	01/21/2025	ORIGINAL ISSUE
Rev. No.	Date	Description

**ISSUES & REVISIONS**

THE INFORMATION CONTAINED ON THESE DRAWINGS IS FOR USE ON THIS PROJECT ONLY

Project: **TEXAS BACKUP POWER PACKAGE**  
**PUBLIC UTILITY COMMISSION OF TEXAS**

Sheet Title: **GROUNDING DETAILS**

Date: 01/21/2025 Proj. No: 22483.005

**PROJECT PHASE**

XXXX

Sheet No:

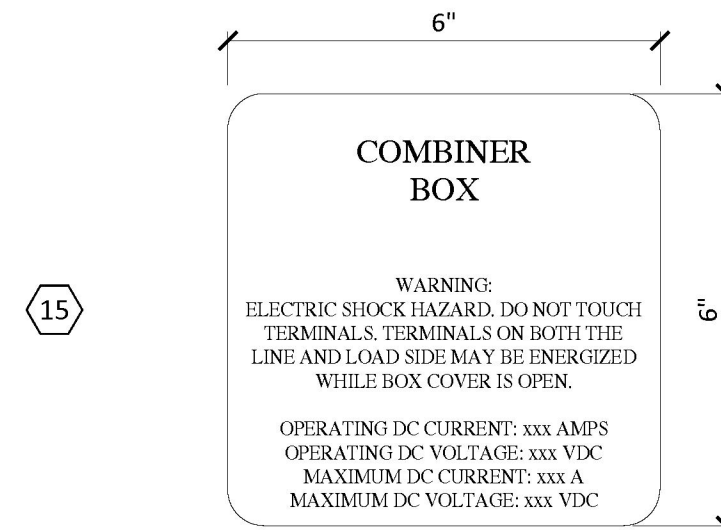
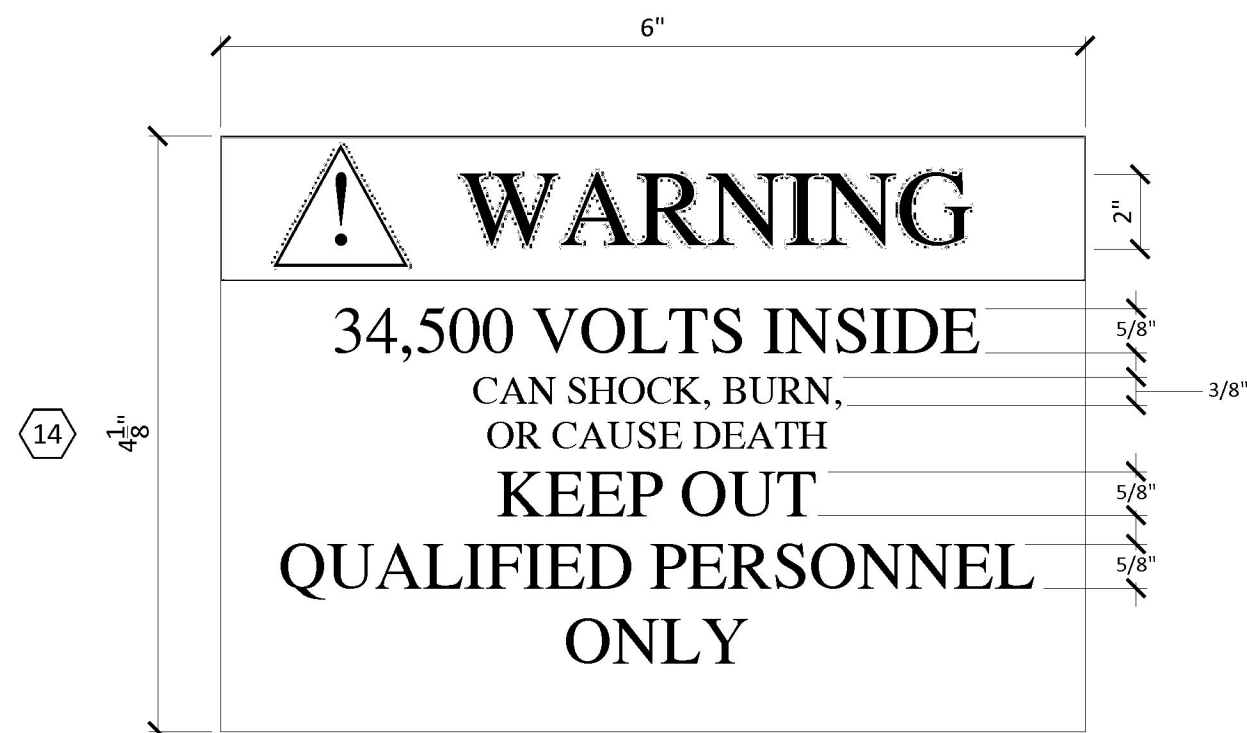
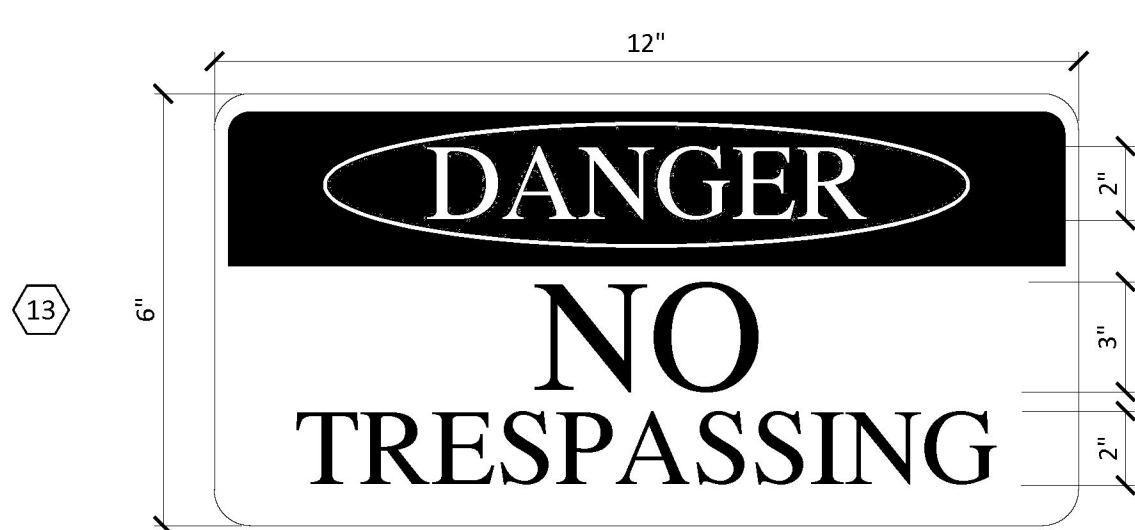
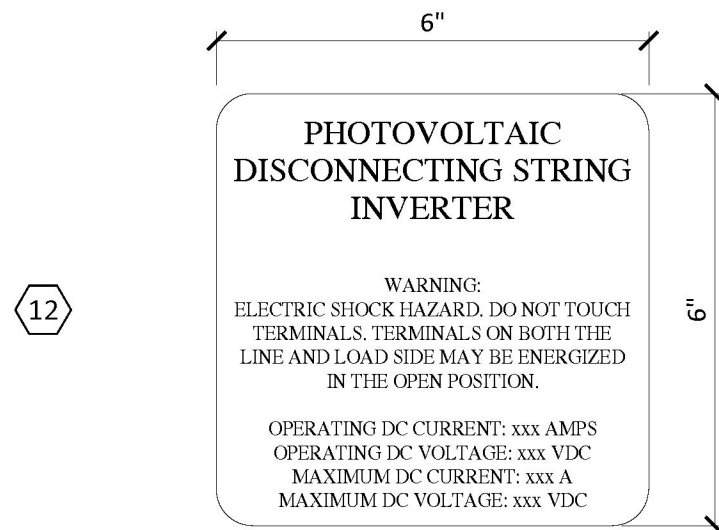
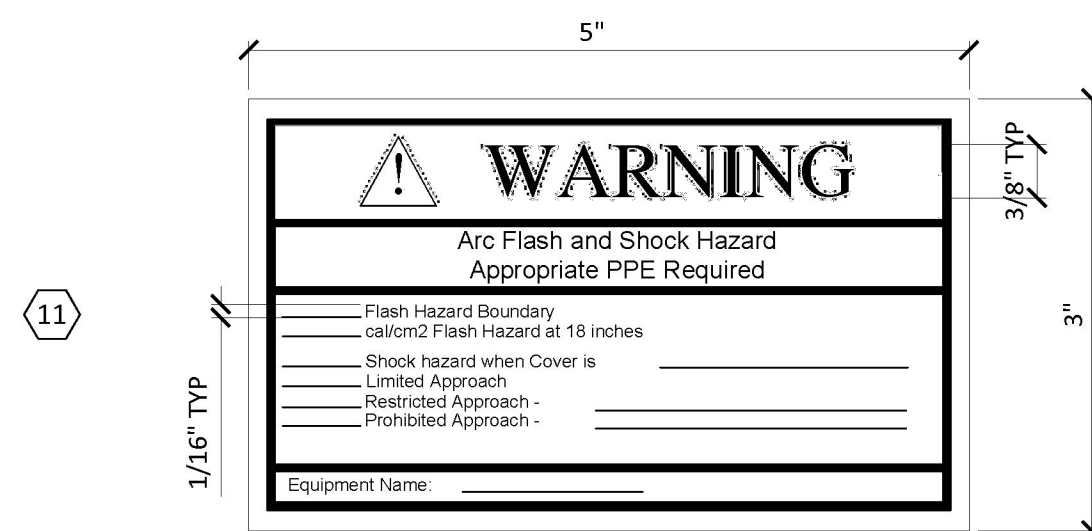
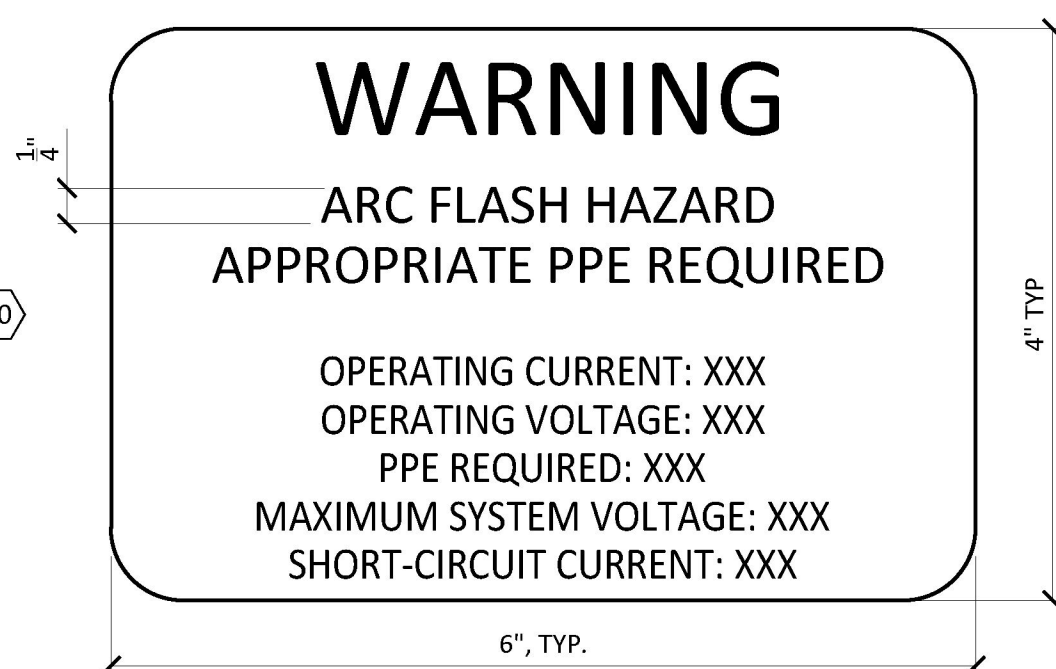
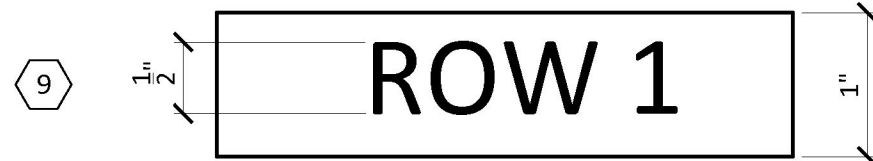
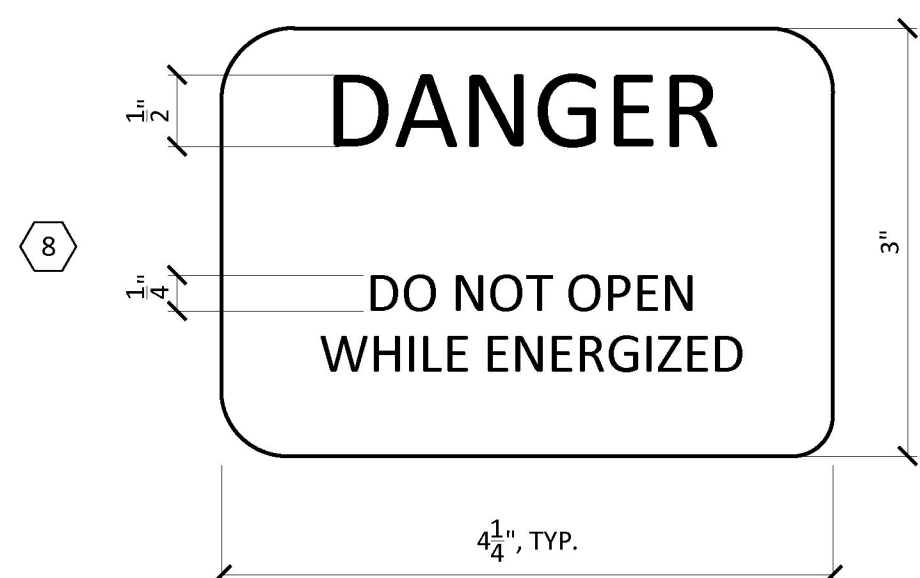
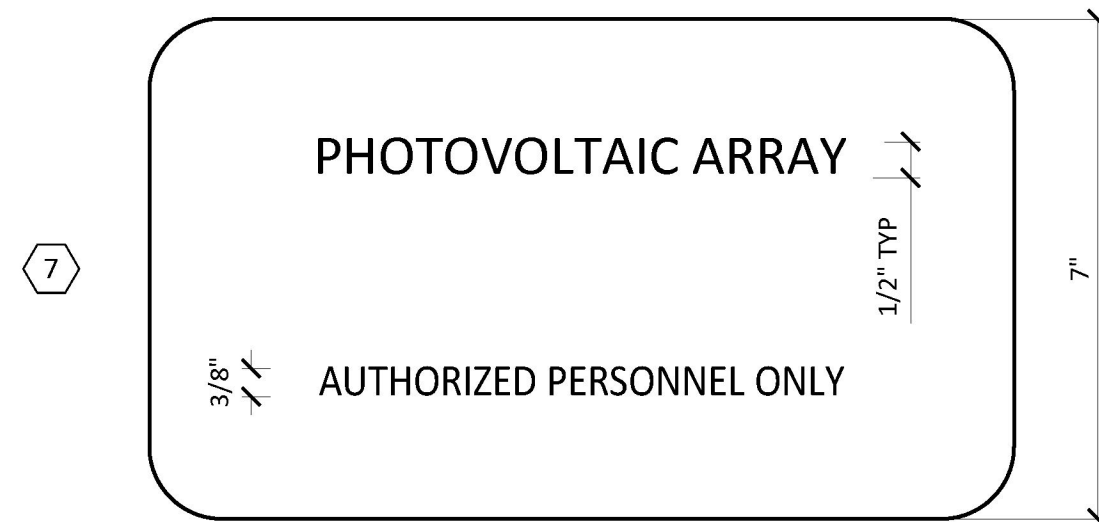
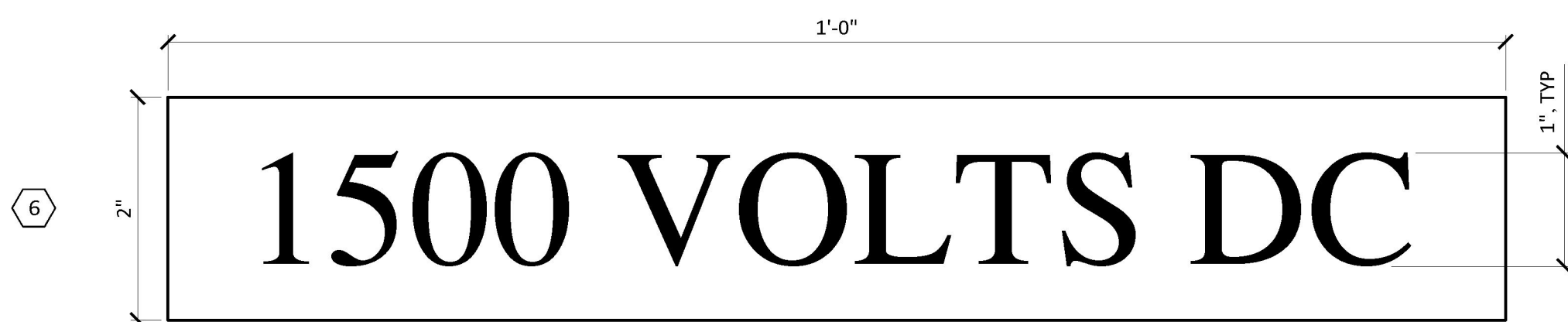
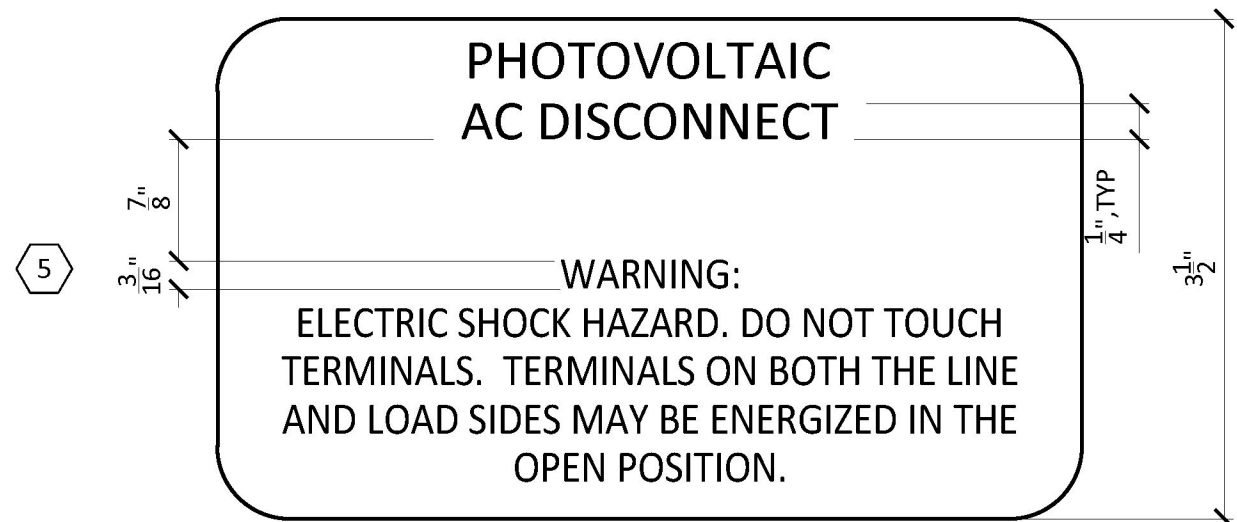
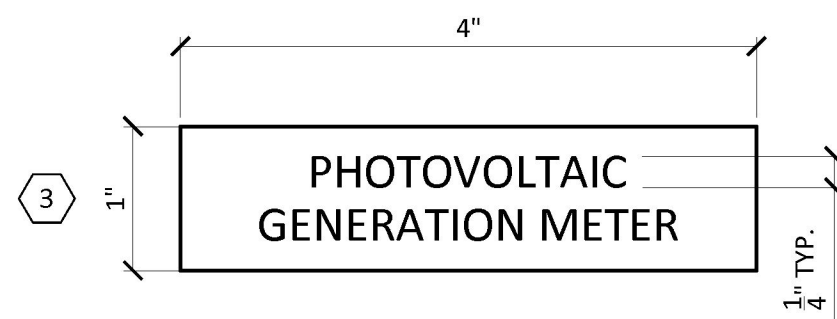
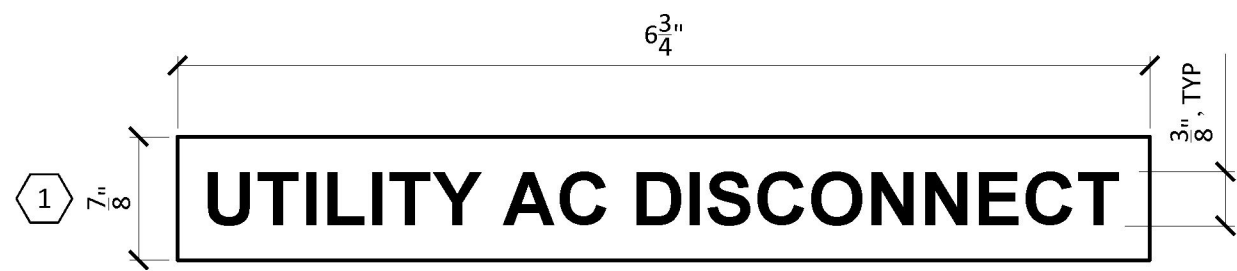
**E5.02**

Sheet of

Revision No:

0

FILE NAME: P:\Utility\Public Utility Commission of Texas (PUC)\24483.005 Backup Power Package Design\11 Drawings\11.3 Electrical\11.30483.005 Electrical Signage.dwg    PLOTTED: Tuesday, January 21, 2025    - 5:33am    USER: JMS04



LABEL AND MARKINGS LEGEND

- 1 LABEL FOR UTILITY AC DISCONNECT; 1 PER AC DISCONNECT
- 2 INVERTER IDENTIFICATION LABEL TO BE PLACED ON EACH STRING INVERTER
- 3 LABEL FOR SYSTEM OWNER'S KWH GENERATION METER; 1 PER OWNER METER (1 TOTAL)
- 4 LABEL FOR REQUIRED UTILITY METER SOCKET; 1 PER UTILITY METER (1 TOTAL)
- 5 PHOTOVOLTAIC AC DISCONNECT GENERIC WARNING LABEL APPLIED TO ALL AC DISCONNECTS
- 6 AT COMBINER AND INVERTER RUNS.
- 7 LABEL FOR CHAIN LINK SECURITY FENCE; SPACED EVERY 150 FEET AROUND PERIMETER OF ARRAY
- 8 CT WIRING WARNING LABEL TO BE PLACED ON OUTSIDE OF EACH CT METERING BOX.
- 9 ROW DESIGNATION LABEL TO BE PLACED ON THE END OF EACH ROW FACING THE ROAD
- 10 ARC FLASH LABEL TO BE PLACED ON EACH INVERTER.
- 11 ARC FLASH WARNING LABEL. TO BE PLACED ON ALL ELECTRICAL EQUIPMENT COVERS AS REQUIRED BY NFPA 70 AND NFPA 70E.
- 12 TO BE PLACED ON EACH INVERTER. OPERATING AND MAXIMUM VOLTAGES AND CURRENTS TO BE VERIFIED BASED ON LOCATION.
- 13 TO BE PLACED ON SITE FENCE AND FENCE GATES. SPACED AS REQUIRED
- 14 TO BE PLACED ON TRANSFORMERS AT EACH INVERTER PAD.
- 15 TO BE INSTALLED ON EACH COMBINER BOX LOCATED WITHIN ARRAY. BOX TRANSITIONS WIRING FROM STRING WIRING TO INVERTER FEEDER WIRING. OPERATING AND MAXIMUM VOLTAGES AND CURRENTS TO BE VERIFIED BASED ON LOCATION.

Owner/Client



Scale:

Sheet Size: ARCH D  
24"x36"

Designed: AMH

Drawn: LAB

Checked: DJS

Approved: DJS

A	01/21/2025	ORIGINAL ISSUE
Rev. No.	Date	Description

ISSUES & REVISIONS

THE INFORMATION CONTAINED ON THESE DRAWINGS IS FOR USE ON THIS PROJECT ONLY

Project: **TEXAS BACKUP POWER PACKAGE**  
**PUBLIC UTILITY COMMISSION OF TEXAS**

Sheet Title: **ELECTRICAL SIGNAGE DETAILS**

Date: 01/21/2025 Proj. No: 22483.005

PROJECT PHASE

XXXX

Sheet No:

E6.01

Sheet 1 of 15

Revision No.:

0