



INDEX OF SHEETS

SHEET No.	DESCRIPTION
GP	GENERAL PLAN AND LEGEND
ELECTRICAL	
EE-0	EXISTING UTILITY SITE PLAN
EE-1	SITE PLAN
EE-2	SINGLE LINE DIAGRAM GRID-TIED PHOTOVOLTAIC SYSTEM
EE-3	EQUIPMENT STORAGE ROOF PLAN
EE-4	ELEVATION AND DETAILS

EXISTING BUILDING DATA					
1998 CBC					
BUILDING/PORTION	OCCUPANCY GROUP	CONSTRUCTION TYPE	ALLOWABLE AREA	ACTUAL AREA	YEAR BUILT
EQUIPMENT STORAGE	S2	VB	13,500 SF	7600 SF	1970

ROOF DATA: TRUSS JOISTS, PLYWOOD SHEATHING, RIGID INSULATION, BUILT-UP ROOFING (CONCRETE MASONRY BLOCK WALLS)

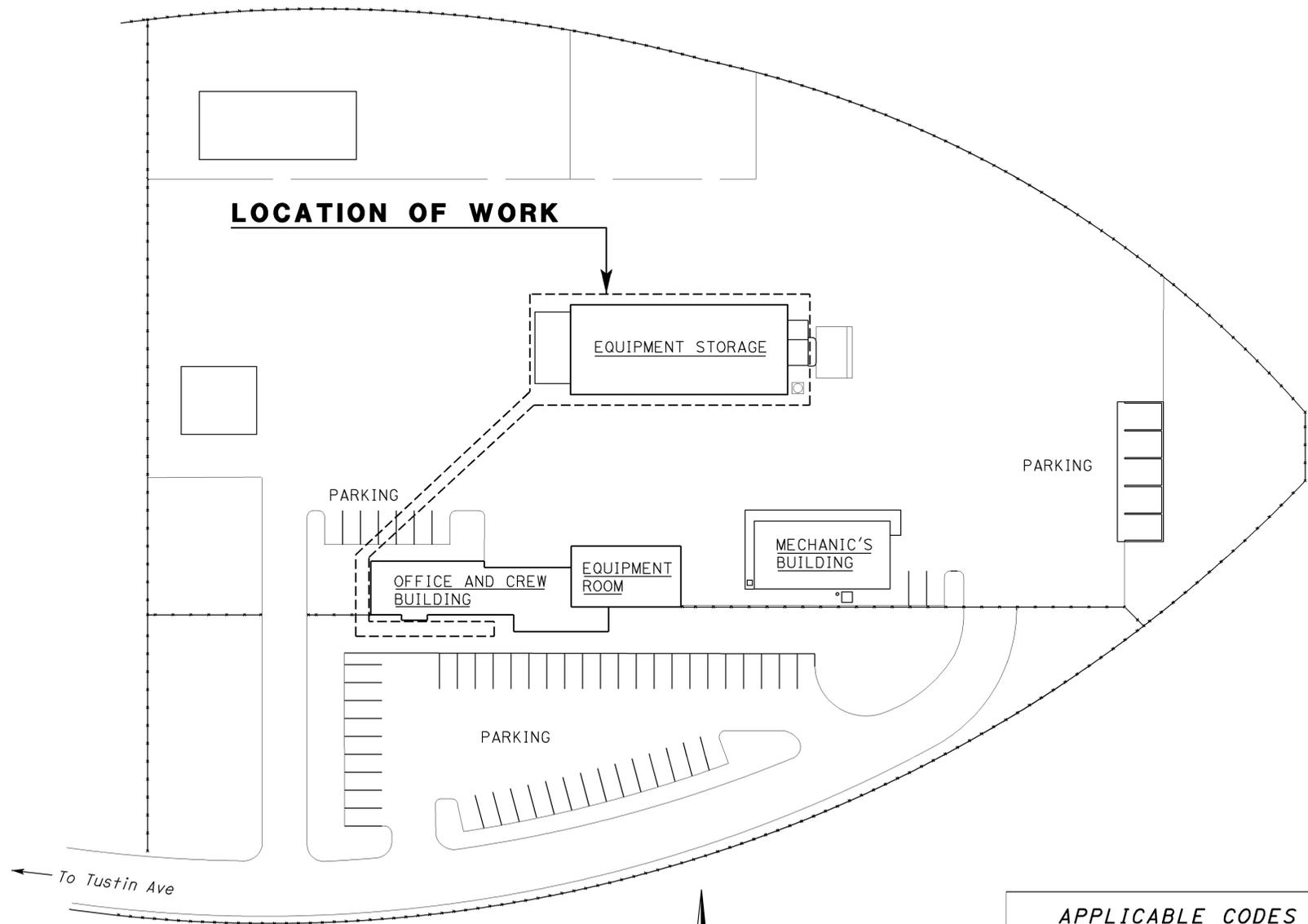
CALIFORNIA STATE FIRE MARSHAL APPROVED  
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 Reviewed by: *[Signature]*  
 MIKE TANAKA  
 Approval date: 07-14-10

DIST.	COUNTY	LOCATION CODE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Oran	5728		2	7

Tommy F. Lee  
 REGISTERED ELECTRICAL ENGINEER DATE 02-11-11  
 No. 18534  
 Exp. 12-31-12  
 ELEC  
 STATE OF CALIFORNIA

07-14-2010  
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GRAPHIC SYMBOLS

SYMBOL	DESCRIPTION
	CONDUCTOR INFO (PER CONDUIT)
	CONDUIT TYPE
	CONDUIT SIZE
	NUMBER OF CONDUITS (NO NUMBER INDICATES ONE CONDUIT)
	CONDUIT, RIGID STEEL, UNDERGROUND
	CONDUIT, POLYVINYL CHLORIDE, UNDERGROUND
	CONDUIT, FLEXIBLE
	CONDUIT, TURN UP
	CONDUIT, TURN DOWN
	SECTION/ELEVATION LETTER
	SHEET NUMBER
	DETAIL NUMBER
	SHEET NUMBER
	EXISTING CONDUIT AND CONDUCTORS-TO REMAIN UNLESS OTHERWISE NOTED
	CONDUIT EXPOSED
	INSTALL PULL BOX IN EXISTING CONDUIT RUN
	CIRCUIT BREAKER, SINGLE POLE
	CIRCUIT BREAKER, DOUBLE POLE
	CONTACT, NORMALLY OPEN
	SWITCH, DOUBLE-POLE
	FUSE
	GROUNDING ELECTRODE
	ENCLOSURE BOND

ABBREVIATIONS

A	AMPERES
AC	ALTERNATE CURRENT
C	CONDUIT
DC	DIRECT CURRENT
E	EXISTING
G	GROUND
JB	JUNCTION BOX
MC	METALIC CONDUIT
MT	EMPTY CONDUIT
MIN	MINIMUM
MSB	MAIN SWITCHBOARD
P	POLE
PB	PULL BOX
PTC	PV USA TEST CONDITIONS
PVC	POLYVINYL CHLORINE
PV	PHOTOVOLTAIC
STC	STANDARD TEST CONDITIONS
TYP	TYPICAL
V	VOLT

APPLICABLE CODES

- 2007 California Building Code (CBC) Title 24, Part 2 CCR
- 2007 California Electrical Code (CEC) Title 24, Part 3 CCR
- 2007 California Fire Code (CEC) Title 24, Part 9 CCR

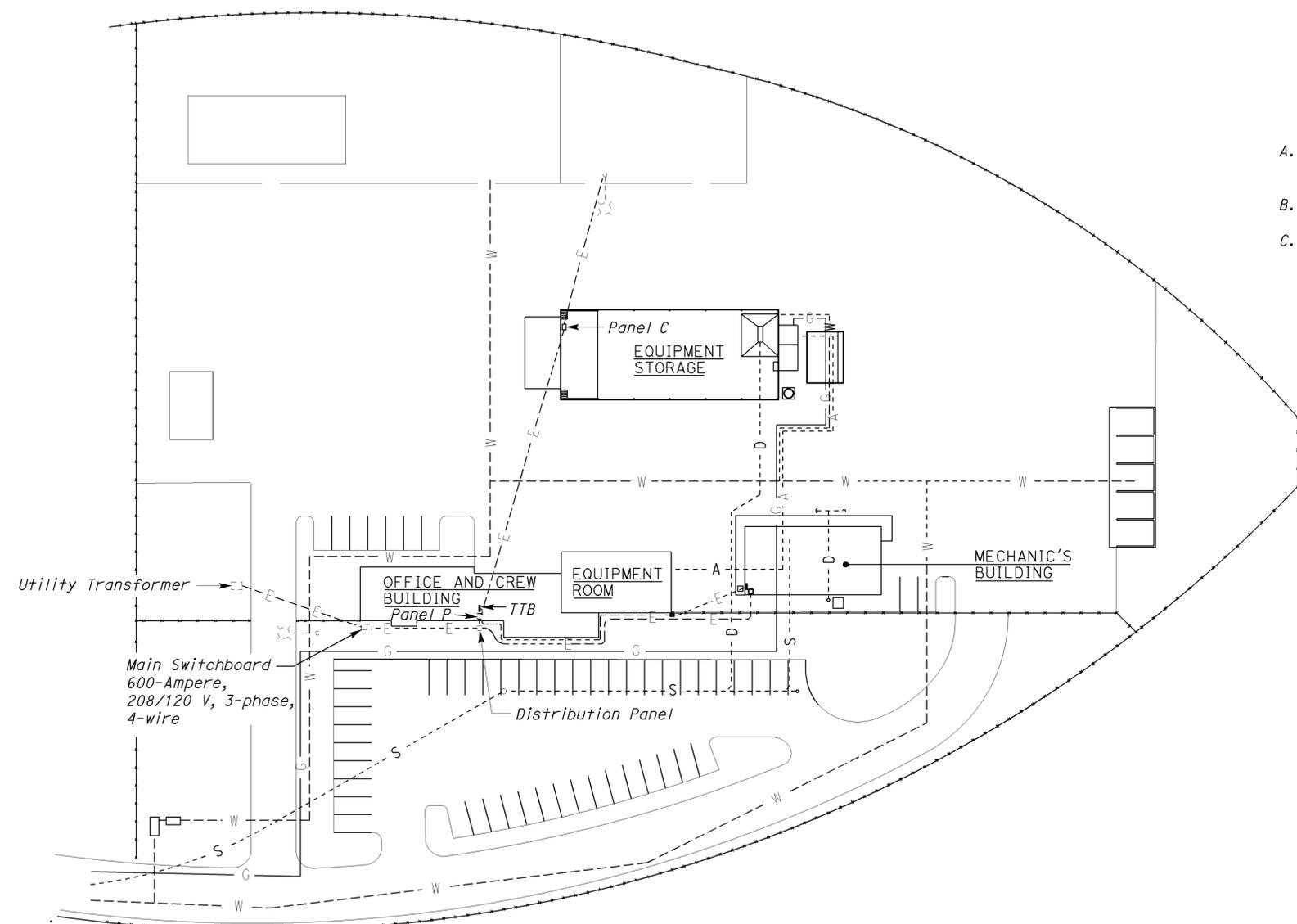
SITE PLAN  
 SCALE 1" = 40'-0"

 DESIGN SUPERVISOR  DESIGN ENGINEER	DESIGN BY Tommy F. Lee	CHECKED Jesse S Sandhu	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES ELECTRICAL-MECHANICAL-WATER AND WASTEWATER DESIGN	BRIDGE NO. 55M5728	ORANGE MAINTENANCE STATION PHOTOVOLTAIC SYSTEM GENERAL PLAN AND LEGEND	SHEET GP	
	DETAILS BY Ed D. Tapalla 5/10	CHECKED Jesse S Sandhu			POST MILE			
	QUANTITIES BY Tommy F. Lee	CHECKED Jesse S Sandhu						
DOES SD Imperial Rev. 9/02	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS			UNIT PROJECT NUMBER & PHASE 3596 1200020175S	DISREGARD PRINTS BEARING EARLIER REVISION DATES		REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET OF

11-FEB-2011 07:00  
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12	Orca	5728		3	7
Tommy F. Lee REGISTERED ELECTRICAL ENGINEER				02-11-11 DATE	
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- General Notes:**
- A. For complete right of way, see Right of Way Record Maps at the Orange County Caltrans District office.
  - B. This plan accurate for Utility information only.
  - C. Location of Utility Facilities shown are approximate and shall be verified prior to beginning of construction.

**GRAPHIC SYMBOLS (THIS SHEET)**

SYMBOL	DESCRIPTION
—E—	POWER AND TELEPHONE CONDUITS AND CONDUCTORS
—G—	GAS
—S—	SEWER
—W—	WATER

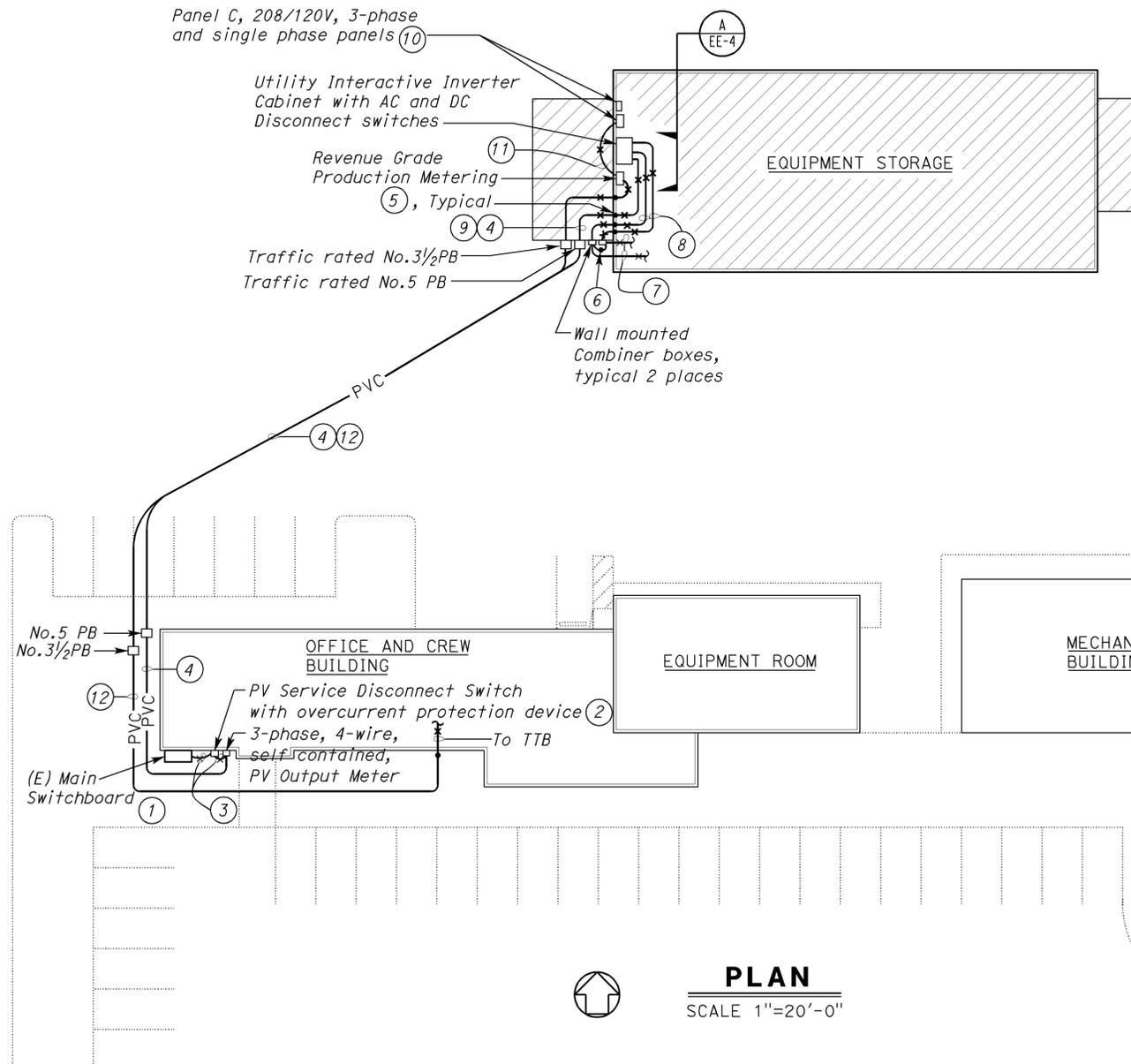
**SITE PLAN**  
SCALE 1" = 40'-0"

DOES SD Imperial Rev. 9/02	DESIGN	BY Tommy F. Lee	CHECKED Jesse S Sandhu	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES	BRIDGE NO.	<b>ORANGE MAINTENANCE STATION          PHOTOVOLTAIC SYSTEM</b>  EXISTING UTILITY SITE PLAN	SHEET	
	DETAILS	BY Tommy F. Lee	CHECKED Jesse S Sandhu		ELECTRICAL-MECHANICAL-WATER AND WASTEWATER DESIGN	55M5728		EE-0	
QUANTITIES	BY Tommy F. Lee	CHECKED Jesse S Sandhu				POST MILE			
	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS				UNIT PROJECT NUMBER & PHASE	3596 1200020175S	DISREGARD PRINTS BEARING EARLIER REVISION DATES	REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET OF
				0 1 2 3			2/11/11		

**General Notes:**

- A. The Contractor shall verify true north prior to installation of photovoltaic system.
- B. All AC/DC feeder conductors and equipment grounding conductors shall be sized to meet or exceed the following:
  - Total net voltage drop of the photovoltaic system from photovoltaic source to the existing Switchboard shall not exceed 2%.
  - Upon occurrence of any kind of fault at any point in the system, over current protective devices shall trip within 1/2 cycle.
- C. Not all electrical/mechanical equipment and conduit systems are shown.

- D. Location of all existing equipment and conduit systems as shown are approximate only. Contractor shall verify the exact location of all equipment and conduit systems in the field where required.
- E. Saw cut existing paved surfaces at places where required for installation of underground conduit system and repair disturbed surfaces to match existing.
- F. For photovoltaic system Single Line Diagram, see sheet EE-2.
- G. For Graphic Symbols and Abbreviations, see GP sheet.
- H. Provide conduit flashing as required for penetration through roofing.
- I. Relocate existing equipment shed for Utility Interactive Inverter and Monitoring system as required.



**PLAN**  
SCALE 1"=20'-0"

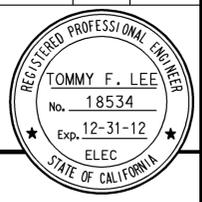
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DIST.	COUNTY	LOCATION CODE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Oran	5728		4	7

Tommy F. Lee  
REGISTERED ELECTRICAL ENGINEER  
DATE 02-11-11

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**Notes:**

- 1 Existing Main Switchboard is General Electric, AV-LINE, 208/120-Volt, 3-phase, 4-wire, switchboard with 600-Ampere main circuit breaker. Drill and tap line side bus bars supplying the main breaker and terminate PV service entrance conductors on the bus bars. Install suitable lugs for terminating conductors as required. Install screw on type sign on the main switchboard with letter height of 1/2" to read "THIS PANELBOARD FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)".
- 2 PV service disconnect switch with overcurrent device shall be NEMA 3R type, 3-pole, 600-volt rated disconnect with 200-ampere fuse and ampere interrupt rating (AIC) of 42,000 symmetrical at 600-Volt. PV service disconnect switch with overcurrent device shall be suitable for use as service entrance equipment. Adjacent to the PV service disconnect switch, install screw on type nameplate with letter height of 1/4" to read "PHOTOVOLTAIC SERVICE ENTRANCE".
- 3 3"C, MC, four conductors; three phase, and one equipment grounding conductor. Equipment grounding conductor shall be same size as phase conductor.
- 4 3"C, PVC, four conductors; three phase, and one equipment grounding conductor. Equipment grounding conductor shall be same size as phase conductor.
- 5 Core drill through existing wall and use conduit body for conduit penetration.
- 6 Install ground rod and connect each combiner box ground bus to ground rod with 1/2"C, RSC, 1#8G by using ground clamp.
- 7 2"C, MC, with DC conductors and equipment grounding conductor from combiner box to weatherproof junction box on the roof.
- 8 2"C, MC, with DC conductors and equipment grounding conductor from combiner box to Utility-Interactive Inverter cabinet.
- 9 To Utility-Interactive Inverter cabinet via NEMA 1 enclosure, see detail A on sheet EE-4.
- 10 Install 20A single pole circuit breaker for PV metering system and install screw on type nameplate with letter height of 1/4" to read "SOLAR METERING".
- 11 1/2" C, RSC, 2#12, 1#12G.
- 12 1/2"C, PVC, Category 6 cable to (E) TTB inside the Telephone Cabinet.

THIS DRAWING ACCURATE FOR ELECTRICAL WORK ONLY

DESIGN	BY	Tommy F. Lee	CHECKED	Jesse S Sandhu	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES ELECTRICAL-MECHANICAL-WATER AND WASTEWATER DESIGN	BRIDGE NO.	55M5728	ORANGE MAINTENANCE STATION PHOTOVOLTAIC SYSTEM	SHEET EE-1
	DETAILS	BY	Tommy F. Lee	CHECKED			Jesse S Sandhu	POST MILE		
QUANTITIES	BY	Tommy F. Lee	CHECKED	Jesse S Sandhu	UNIT PROJECT NUMBER & PHASE	3596 1200020175S	DISREGARD PRINTS BEARING EARLIER REVISION DATES		REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET OF

DOES SD Imperial Rev. 9/02 ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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12	Orca	5728		5	7

**Tommy F. Lee**  
 REGISTERED ELECTRICAL ENGINEER  
 No. 18534  
 Exp. 12-31-12  
 ELEC  
 STATE OF CALIFORNIA

02-11-11  
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**Photovoltaic Module**

PV modules shall be minimum 280 (STC) watt, polycrystalline silicon cell type module with interconnection connectors rated for 90°C. PV modules shall be UL 1703 listed with a maximum system voltage of 600 VDC. PV module manufacturer shall be one of those manufacturers listed as eligible California Solar Initiative (CSI) PV module manufacturer.

**Photovoltaic Array Circuit Combiner Box**

PV array circuit combiner box shall be factory assembled, 600 VDC rated combiner box with fuse for all PV input circuits, two isolated DC bus bars, ground bus bar, all enclosed inside NEMA 3R lockable hinged cover enclosure. The combiner box shall be UL 1741 listed.

PV array circuit combiner box shall have the following components:

- DIN Rail mounted touch safe fuse holders with fuse rated for 600 VDC.
- Positive DC bus bar, Negative DC bus bar and ground bus bar.
- DIN rail mounted Grid-Tie surge arrester: The surge arrester shall be Type 1 heavy duty surge protector and rated to withstand 40 kA (8/20 micro second) induced transient surge type and compatible to use with grounded PV arrays.
- Plastic shield guards to enclose DC buses from all sides.

**Utility-Interactive Control Cabinet**

Utility-Interactive Control cabinet shall be outdoor type, factory assembled system consisting of the following equipment:

- NEMA 3R Enclosure.
- 50 kW/50 kVA, 208 V, 3-phase, 4-wire at a power factor of 0.99 or greater.
- Fused Sub-array Combiner with minimum of 4 array inputs for positive DC, negative DC, and DC ground bus bars. Positive array inputs fuse size to match loading.
- Built-In DC and AC disconnect switches size to match loading.
- Integrated output Isolation type transformer.
- Ground Fault Protection.
- Integrated AC and DC Surge Protections.
- Integrated AC and DC contactors.
- Pre-charge circuit.
- Current and potential transformers
- Human Machine Interface (HMI). AC/DC Inverter's HMI shall be equipped with LCD and keypad displaying main menu. HMI main menu shall display system monitoring, status and faults and operation. Monitoring menu shall display system status, metering, daily, weekly and monthly energy production. Status and faults menu shall display status messages, system output, and number of faults. Operation menu shall display control and settings.
- Communication Gateway with datalogging and communications for remote monitoring system with Internet connectivity (TCP/IP). Communication gateway shall be UL listed.
- Sub-array monitoring for detailed each array performance monitoring of combiner inside the Utility-Interactive Inverter cabinet
- AC Ground bus bars.

Enclosure shall be NEMA 3R, 14-Gauge, and powder-coated standard factory finish steel enclosure. All screws, latches, hinge pins and similar hardware shall be stainless steel. HMI, AC and DC disconnect switches, and equipment rating labels shall be mounted on the exterior door. Exterior door shall have interlock switch and be lockable with a padlock. The cabinet shall have MEV13 rated filtered, top entry forced air cooling system with one fan, sloped roof, and shall be suitable for seismic zone 4 compliance.

DC/AC Inverter shall be rated at maximum continuous output power of 50 kW (50 kVA) with input operating voltage range between 315 to 600 VDC and maximum DC input current of 172 A. Inverter shall be capable of operating at ambient temperature range (Full power) of -4°F to +122°F. DC/AC Inverter manufacturer shall be one of those manufacturers listed as eligible California Solar Initiative (CSI) DC/AC Inverter manufacturer.

- \* Contactor for backfeed protection and automatic array fault isolation
- \*\* Contactor to open at night and to minimize standby losses
- \*\*\* Pre-charge circuit

- General Notes:**
- Provide and install all necessary warning labels/markings per Article 690 of California Electrical Code (CEC) and the State Fire Marshal's guideline for solar PV installation.
  - Solar PV installation shall comply with the latest guideline from California Department of Forestry & Fire Protection, Office of the State Fire Marshal and latest Program Handbook from California Solar Initiative (CSI).
  - For graphic symbols and abbreviations, see GP.

**Metering System**

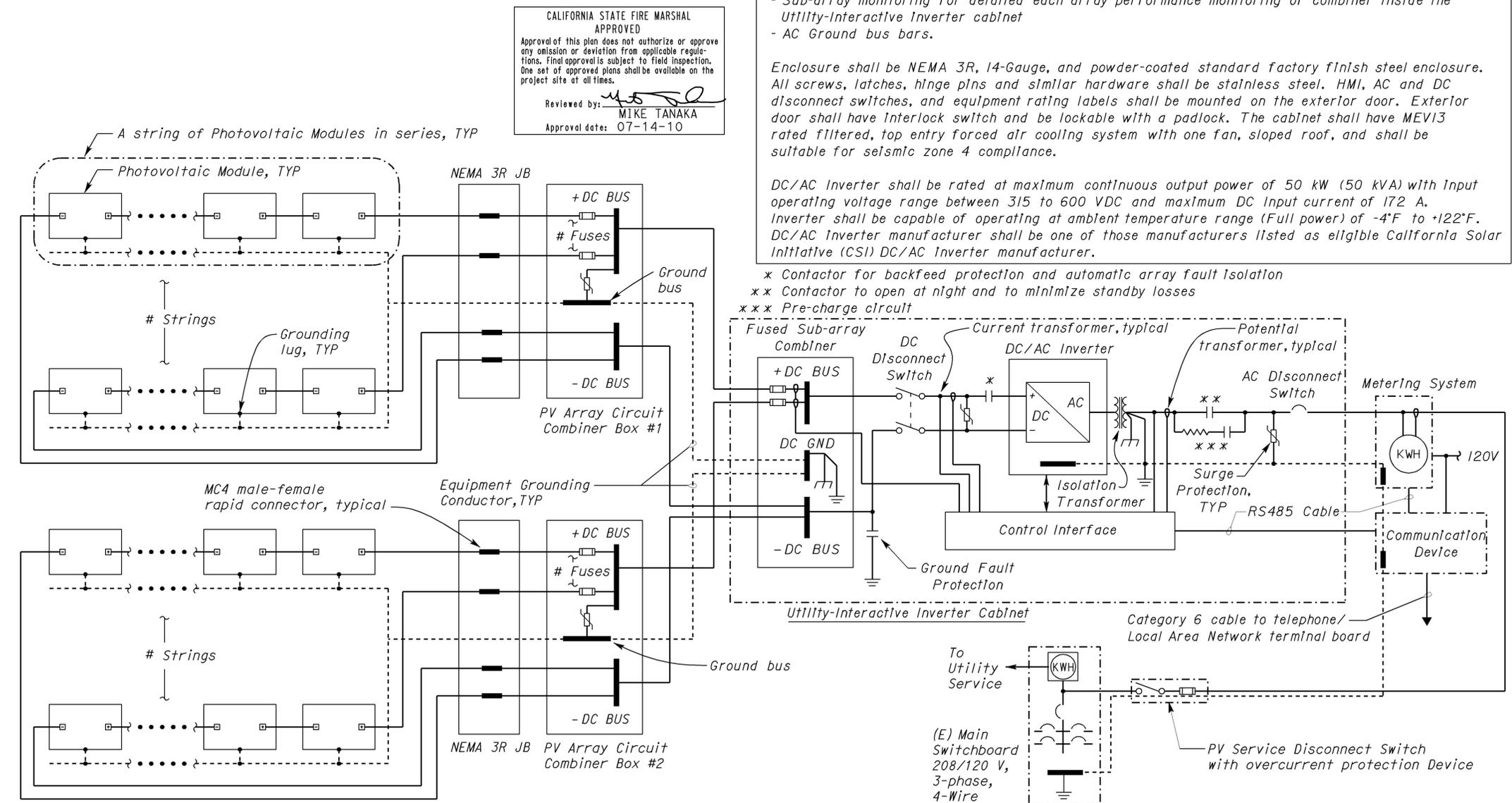
Metering System shall be in NEMA 1 enclosure and it consists of the following equipment:

- Revenue Grade Production Meter
- 0.2% Class Revenue Certifiable Energy and Demand Metering
- Multifunction Electrical Measurement
- RS485 Modbus Protocols
- 3 Line LED display
- Power transducer
- an accuracy of +/- 0.1% or better for volts and amps
- 0.2% for power and energy functions
- Power supply
- DIN Rail Mount Datalog RS485 Surge Protection, IEC61643-21 compliance

**Photovoltaic System Requirements**

Photovoltaic System complete design and installation details inclusive of all Engineering calculations shall be signed by a Professional Engineer of the respective field (both Electrical and Civil Engineering) in the State of California shall be submitted for approval by the Contractor. The PV design shall meet or exceed the following requirements;

- Total designed capacity of photovoltaic system at existing Equipment Storage Building shall be minimum 43.9 kW of the CEC-AC rating. Number of PV module per string shall be arranged in a manner to meet or exceed the following:
  - Maximum system voltage based on lowest excepted ambient temperature at the site (Voc maximum on coldest day) shall be no less than 1% of the inverter's maximum input DC voltage range.
  - Maximum system power voltage based on average high ambient temperature at the site (Vmp on warmest day) shall be 20% greater than the inverter's minimum input DC voltage range.
- Photovoltaic system module row spacing shall be designed to prevent shading from adjacent module.
- All wiring except at module interconnection shall be concealed inside conduit system.
- Photovoltaic system modules structural support system shall be self ballasting type system and designed to withstand wind forces of 85-mile per hour.
- Photovoltaic system wiring and protective devices shall meet or exceed the requirements of all applicable codes.
- PV Array Circuit Combiner Boxes locations as shown are arbitrary only. Contractor shall install the combiner boxes at locations that best suit the photovoltaic system strings layout.
- PV modules installed on different slopes and/or orientation shall not be part of the same string except PV modules installed on flat roof.



**PHOTOVOLTAIC SYSTEM**

DESIGN	BY Tommy F. Lee	CHECKED Jesse S Sandhu	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES ELECTRICAL-MECHANICAL-WATER AND WASTEWATER DESIGN	BRIDGE NO.	ORANGE MAINTENANCE STATION PHOTOVOLTAIC SYSTEM SINGLE LINE DIAGRAM GRID-TIED PHOTOVOLTAIC SYSTEM	SHEET		
DETAILS	BY Tommy F. Lee	CHECKED Jesse S Sandhu			55M5728		EE-2		
QUANTITIES	BY Tommy F. Lee	CHECKED Jesse S Sandhu			POST MILE				
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS			0 1 2 3	UNIT PROJECT NUMBER & PHASE	3596 1200020175S	DISREGARD PRINTS BEARING EARLIER REVISION DATES	2/11/11	REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET OF

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Photovoltaic modules at existing Equipment Storage Building

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12	Oran	5728		6	7

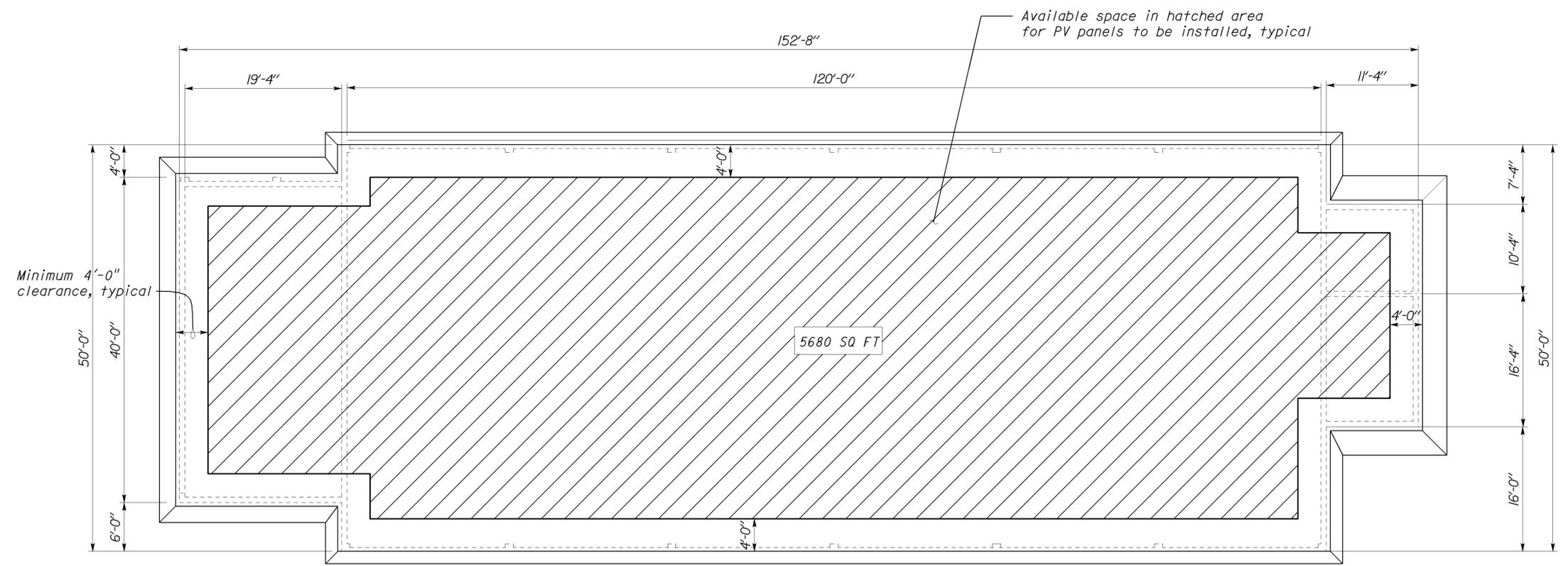
  

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- General Notes:**
- A. Provide and install approved conduit support on top of the roof to support conduit system and junction boxes. Conduit support shall be one-piece and non metallic type. For conduit support details, see Detail 1 on sheet EE-4.
  - B. All exposed conduits shall be galvanized rigid steel, with minimum size 3/4".
  - C. Size conduits to allow for 50% future capacity.
  - D. No DC wiring except at the module connector shall be exposed.
  - E. Use type CGB connectors at conductor/cable terminations at junction boxes.
  - F. DC conduit/conductors between photovoltaic modules and photovoltaic Array Circuit Combiner Boxes are not shown.
  - G. Existing Maintenance Building roof minimum height is approximately 16'-0".
  - H. For Graphic Symbols and Abbreviations, see GP sheet.
  - I. Install photovoltaic panels on a self ballasting type racking system. Photovoltaic panels shall be installed facing due south as shown with a tilt of 10° angle. For photovoltaic self ballasting rack mounting, see Detail 2 on sheet EE-4.
  - J. Provide and install necessary warning labels/markings per Article 690 of California Electrical Code (CEC) and the State Fire Marshal's guideline for solar photovoltaic installation.
  - K. Install MC4 male-female rapid connectors to connect USE/USE-2 conductors and PV strings positive and negative terminals. No splicing inbetween the connectors and combiner boxes.



 **ROOF PLAN**  
 SCALE 1/8" = 1'-0"

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DESIGN	BY Tommy F. Lee	CHECKED Jesse S Sandhu	STATE OF CALIFORNIA	DIVISION OF ENGINEERING SERVICES	BRIDGE NO.	ORANGE MAINTENANCE STATION PHOTOVOLTAIC SYSTEM	SHEET EE-3
	DETAILS	BY Ed D. Tapalla 6/10			CHECKED Jesse S Sandhu		
QUANTITIES	BY Tommy F. Lee	CHECKED Jesse S Sandhu	DEPARTMENT OF TRANSPORTATION	ELECTRICAL-MECHANICAL-WATER AND WASTEWATER DESIGN	POST MILE	EQUIPMENT STORAGE ROOF PLAN	
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