



To: SUNDA Project Cooperatives

From: February 3, 2015

Re: Reference Block Design for Utility Scale PV Solar System

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**Purpose:** Provides a reference block design with simple, convenient features, which is intended to reduce field time and provides monitoring features. This is a reference design and will need to be adjusted for the particulars of a field site, including electrical string length (based on minimum site temperatures), climatic conditions (such as wind and snow loads), row spacing (based on latitude), land contours, shading, and others. Typical engineering time for such adjustment is intended to be, and historically has been, under 100 hrs for site specific modifications.

**What's included:** a cover sheet that provides a drawing sheet list, six site plans (layouts, trenching and grounding), single line diagrams, schedules, labels, partial plans for inverter pad, conduit details and stringing plans for arrays.

**Design Criteria and Attributes used in creating this design:**

- Maximize ground coverage ratio, expandable symmetric block
- Fixed, non-tracking design for cost effective construction and low O&M costs
- Efficient design, allows for most of the array construction to be duplicated
- Combiner box locations optimized to reduce DC conductors, avoiding jumpers or other pull boxes in unusual locations
- Equipment pad centrally located, driving reduced feeder cost and transformation local to solar inverters – configurable with other variations
- Immediate transformation drives lower cost of AC MV conductors
- Access roads can be on either side
- Grounding and Surge Protection: metallic array parts, pad halo grounding, fence grounding, surge arrestors in gear
- MV switch is used as site AC disconnect, reduces pad footprint
- Racking system is ETL listed for grounding, reducing significant bonding requirements and on-site labor
- Racking has integrated wire management
- Racking design is very modular, fast to install and accessible height good for install
- AC Switchgear contains the AC bus, the step down transformer for local 120V power and the revenue meter for DAS
- Using 500kw inverters allows for a centralized electrical equipment pad
- Electrical equipment pad is conveniently accessible. Designed to provide easy service access, minimize concrete, optimize feeder stub ups, 1MW pad is cost effective and allows ability to use shared transformer.
- Expandability and flexible re-design options to meet site specific issues
- Track environmental offsets

- Public view website to view performance online or any internet device
- Remotely troubleshoot and track on-site weather data
- Option features: cell-modem, online storage of data, historical data exports, monthly reporting, alarms, curtailment, fault codes and sensors (horizontal/plane of array pyranometers, wind speed/direction, humidity, ambient temp, cell temp, revenue grade meters, load or bus kw meters

## **DISCLAIMER**

While significant effort has been made to incorporate all applicable standards and ensure good engineering and correct practice in the development of this design, and this design has been used to develop actual field deployed, utility-scale, solar PV systems, no warranty or guaranty is made on this design for its fitness, suitability, safety or applicability for any purpose. Utilities must employ a trained engineer to interpret and adjust this reference design for the specific requirements of their application.

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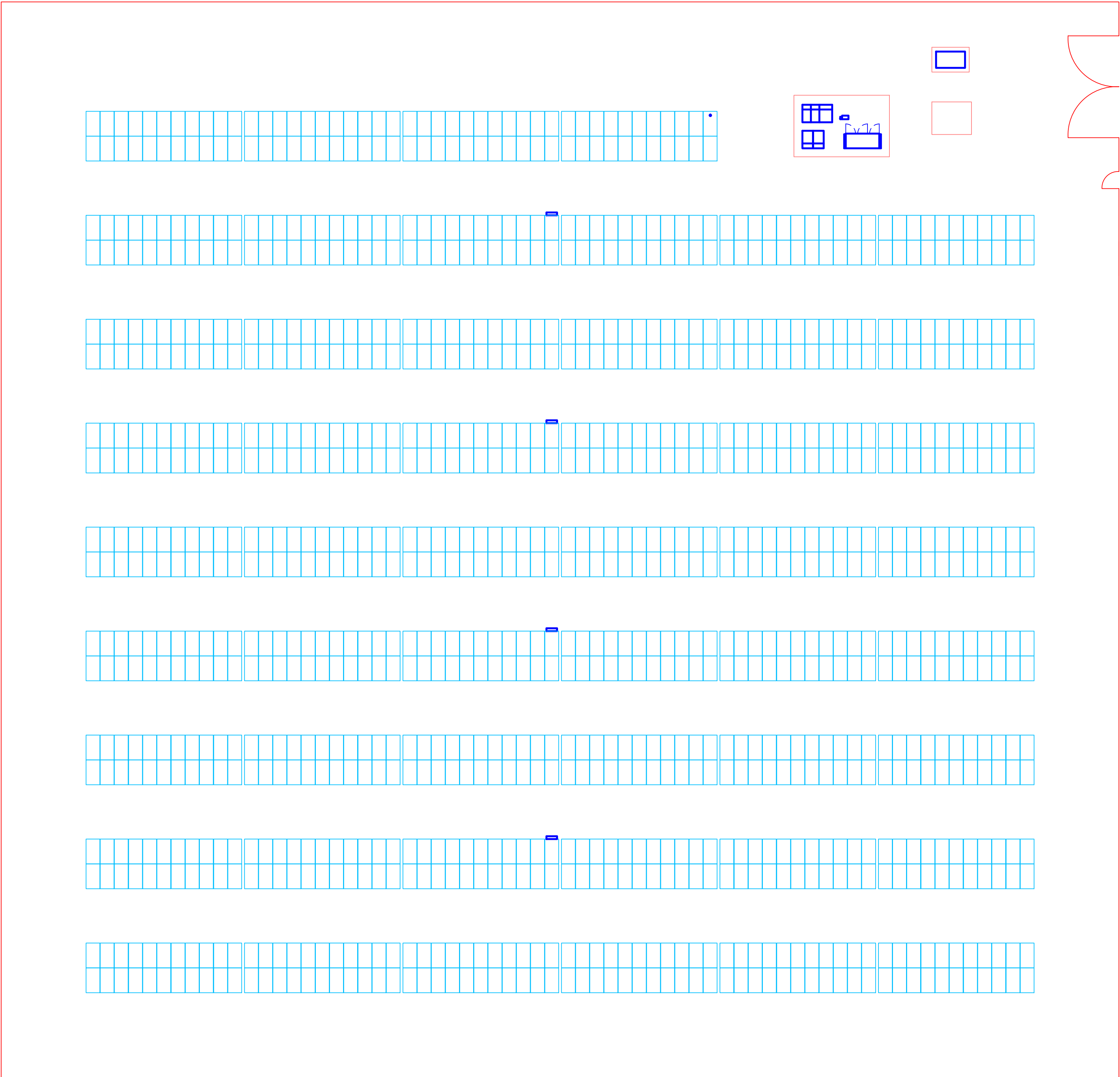
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# SUNDA REFERENCE DESIGN

250KWac 600Vdc

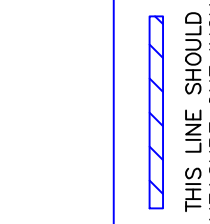
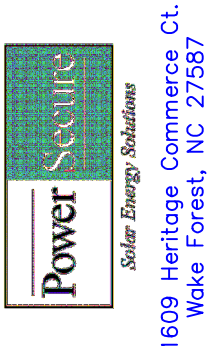
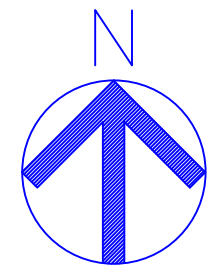
AC SYSTEM SIZE: 250 KW AC  
DC SYSTEM SIZE: 348.9 KW DC  
STRING SIZE: 11 MODULES  
STRING COUNT: 104  
MODULES: 1,144 REC 305W  
INVERTERS: 1 ADVANCED ENERGY 250KW  
DC VOLTAGE: 600V  
AC VOLTAGE: 480V, 3φ  
ARRAY TILT: 25°  
RACKING: SCHLETTER FS  
2 HIGH PORTRAIT X 11 WIDE



## DRAWING SHEET LIST

PV0.1	COVER SHEET
PV1.0	SITE PLAN - ARRAY LAYOUT
PV1.1	SITE PLAN - FENCE LAYOUT
PV1.2	SITE PLAN - MEDIUM VOLTAGE ROUTING
PV1.3	SITE PLAN - COMBINER LAYOUT
PV1.4	SITE PLAN - DC ROUTING
PV1.5	SITE PLAN - ARRAY GROUNDING
PV2.0	PV SINGLE LINE DIAGRAM
PV2.1	PV SCHEDULES
PV3.0	PARTIAL PLAN - EQUIPMENT PAD DIMENSIONS
PV3.1	PARTIAL PLAN - EQUIPMENT PAD FEEDER ROUTING
PV3.2	PARTIAL PLAN - EQUIPMENT PAD GROUNDING
PV4.0	PV RISER DIAGRAM
PV4.1	FENCE GROUNDING DETAIL
PV4.2	COMBINER GROUNDING DETAIL
PV5.0	CONDUIT STUB UP DETAILS
PV5.1	CONDUIT DETAILS
PV6.0	STRINGING PLAN - ARRAY A

PRELIMINARY  
NOT FOR  
CONSTRUCTION



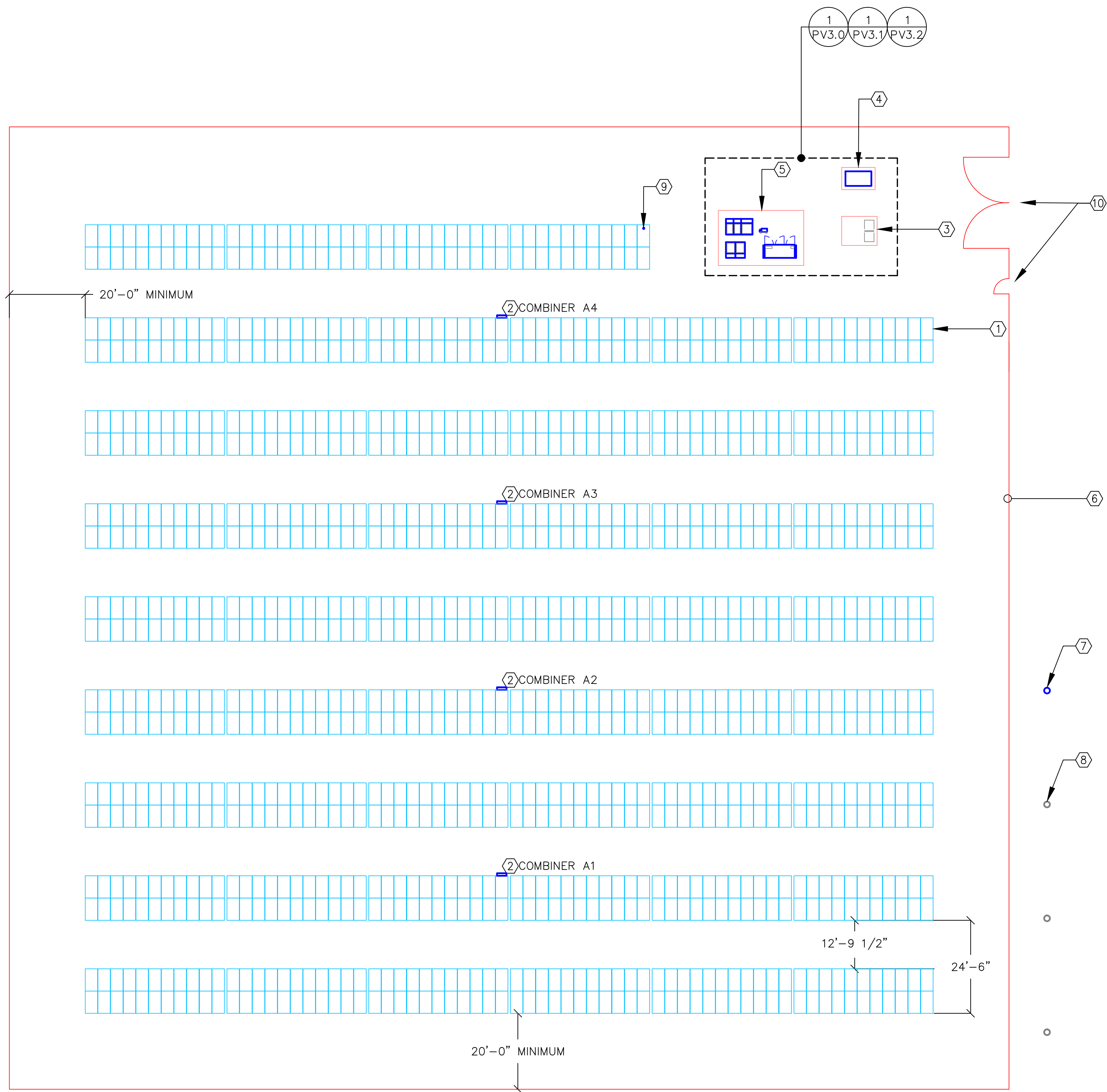
REV.	DATE	DESCRIPTION

TITLE:	COVER SHEET
PROJECT:	NRECA SUNDA REFERENCE DESIGN 250KW - 600Vdc

DATE:  
02.06.2015  
SHEET:

PV0.1

Prel Date: 2/18/2015



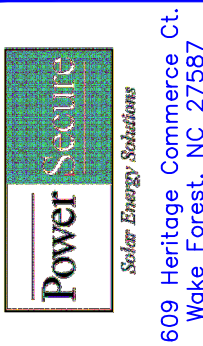
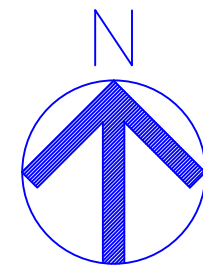
LINE TYPE LEGEND	
MODULE	
CONCRETE PAD	
FENCE LINE	
CONTRACTOR PROVIDED EQUIPMENT	
EXISTING/UTILITY PROVIDED EQUIPMENT	

KEYED NOTES: (X)	
1.	PV MODULE, TYPICAL OF 1,144.
2.	DISCONNECTING COMBINER BOX.
3.	MEDIUM VOLTAGE TRANSFORMER.
4.	GROUND MOUNTED MEDIUM VOLTAGE FUSED DISCONNECT SWITCH.
5.	EQUIPMENT PAD.
6.	FENCE LINE.
7.	CONTRACTOR PROVIDED POLE MOUNTED COORDINATED SWITCH.
8.	UTILITY PROVIDED POLE, POINT OF INTERCONNECTION.
9.	BACK OF MODULE SENSOR.
10.	GATE.

GENERAL NOTES:	
1.	REFER TO EQUIPMENT SCHEDULE FOR SPECIFICATION.
2.	REFER TO SINGLE LINE DIAGRAM AND FEEDER SCHEDULE FOR SPECIFICATIONS.
3.	PROVIDE RACKING SYSTEM AT 25° TILT. RACKING SYSTEM SHALL BE A PIER DRIVEN SYSTEM. EACH RACKING SECTION SHALL CONTAIN 2 MODULES HIGH IN PORTRAIT. HORIZONTAL DISTANCE BETWEEN RACK SECTIONS SHALL BE SPECIFIED BY MANUFACTURE. THE RACKING SYSTEM SHALL BE UL LISTED FOR GROUNDING CONTINUITY. COMPONENTS WITHIN THE RACKING SYSTEM SHALL FORM AN ELECTRICALLY BONDED UNIT AND WILL REQUIRE ADDITIONAL BONDING FROM ONE INDIVIDUAL RACK SECTION TO ADJACENT SECTIONS. MANUFACTURER SHALL PROVIDE SIGNED AND SEALED STRUCTURAL DOCUMENTATION.
4.	STRINGING FEEDERS SHALL BE ROUTED IN RACKING INTEGRATED WIRE MANAGEMENT OR BELOW GRADE AS NOTED ON DC ROUTING PLAN.
5.	COMBINER FEEDERS SHALL BE ROUTED BELOW GRADE TO EQUIPMENT PAD, REFER TO DC ROUTING PLAN.

1 SITE PLAN - ARRAY LAYOUT  
SCALE: 1/16"=1'-0"

PRELIMINARY  
NOT FOR  
CONSTRUCTION



THIS LINE SHOULD  
MEASURE ONE WAY

REV.	DATE	DESCRIPTION

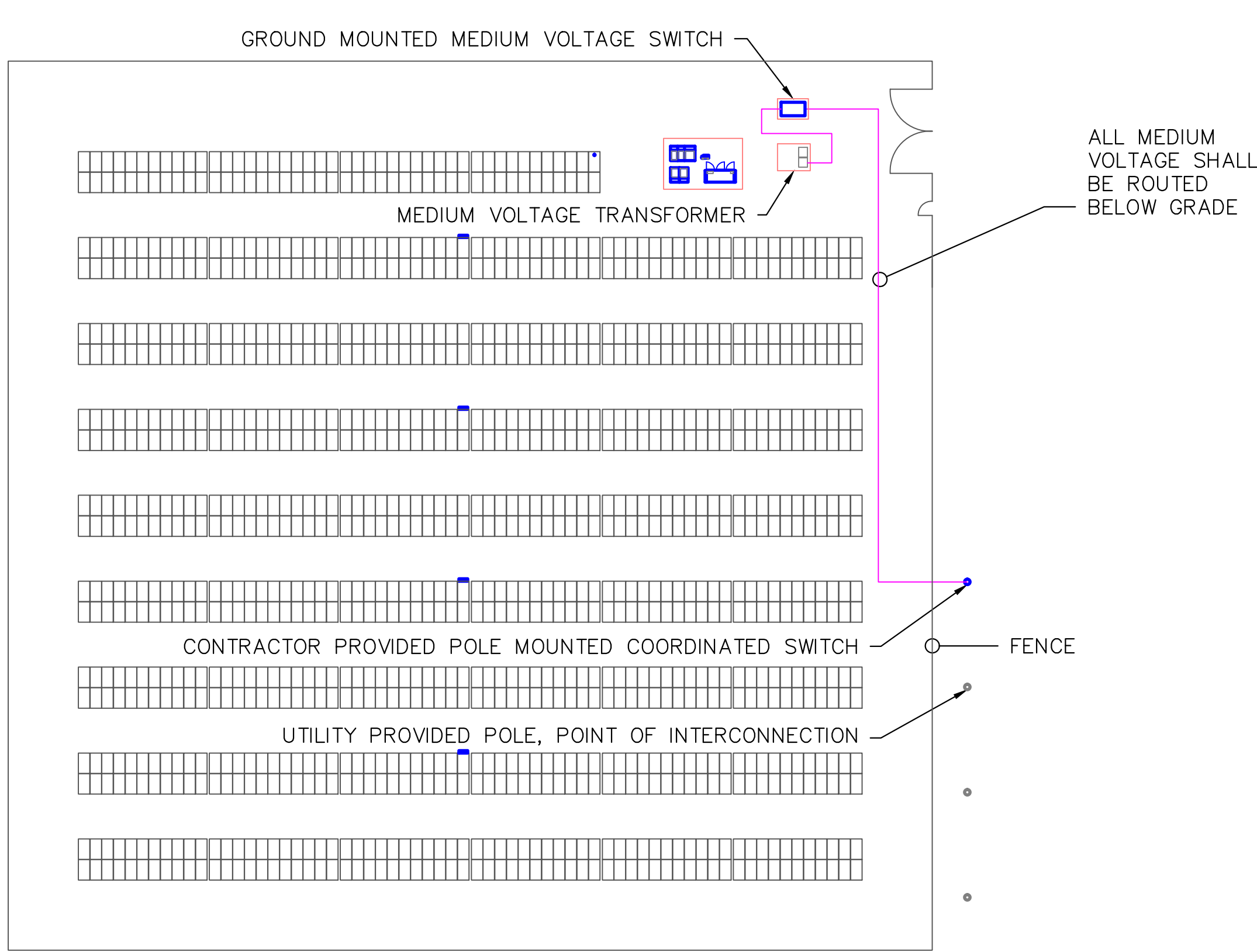
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PROJECT:	NRECA SUNDA REFERENCE DESIGN 250KW - 600Vdc

DATE:  
02.06.2015  
SHEET:

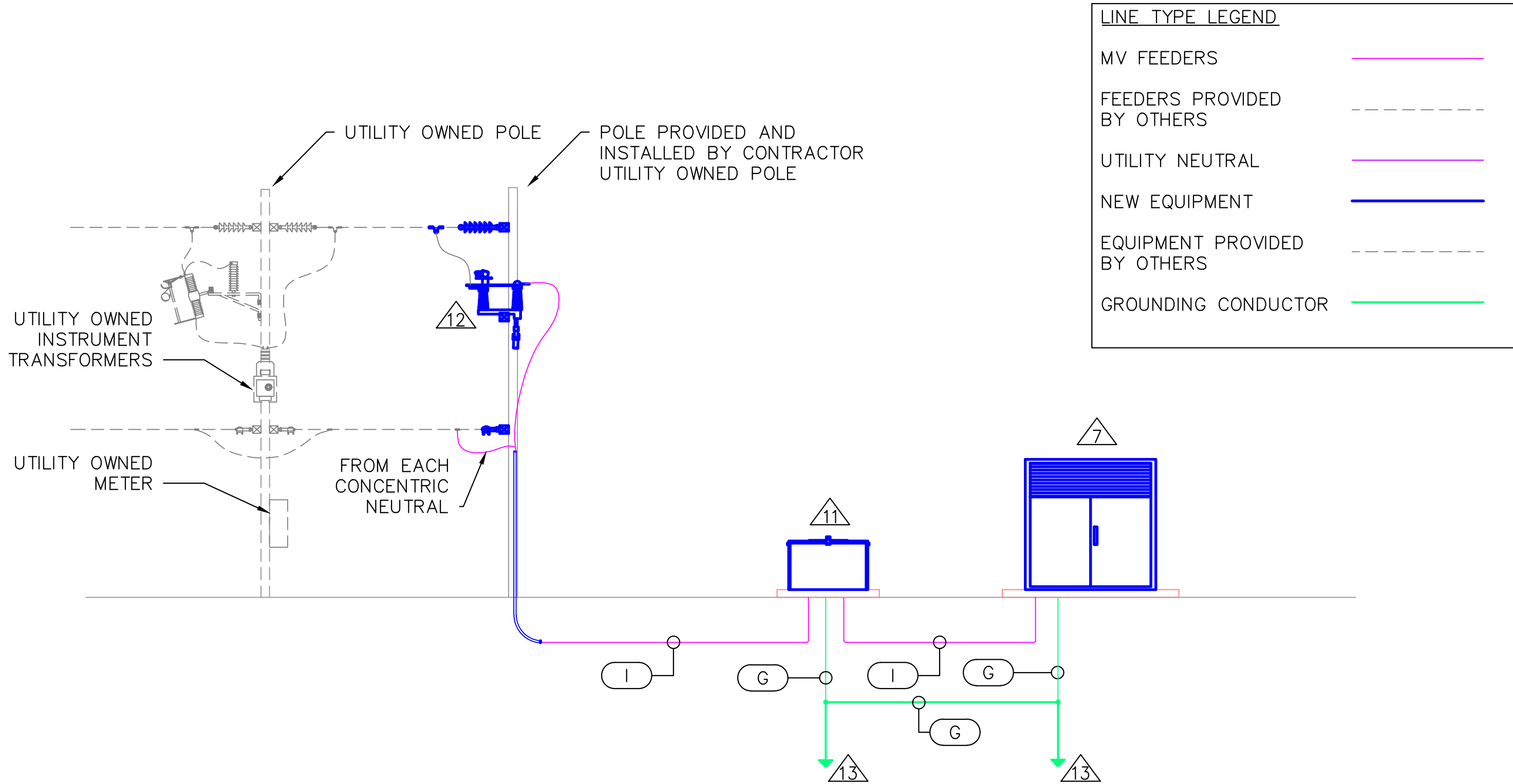
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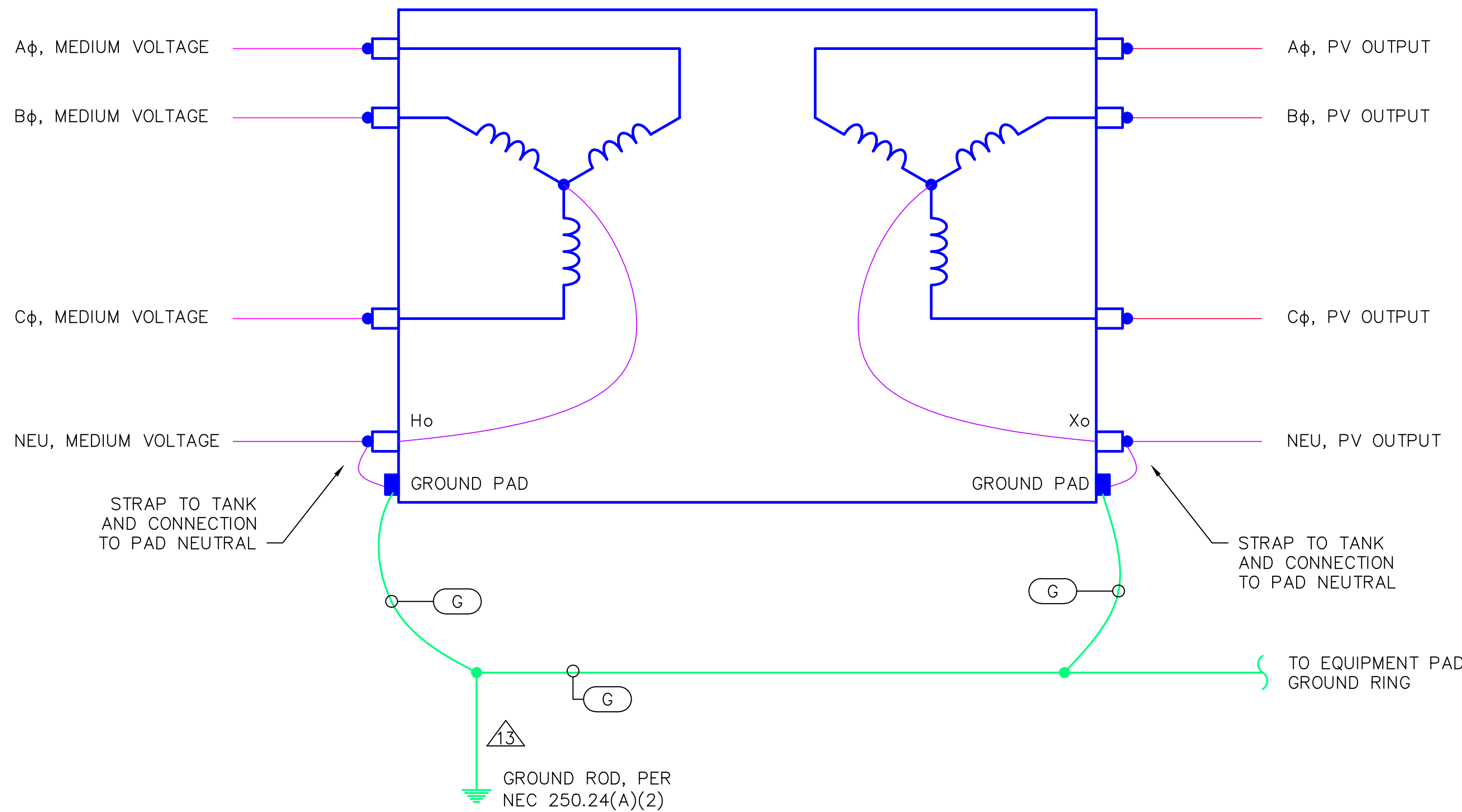




1 SITE PLAN – MEDIUM VOLTAGE ROUTING  
SCALE: 1/32"=1'-0"



2 MEDIUM VOLTAGE – INTERCONNECTION DETAIL  
SCALE: NONE

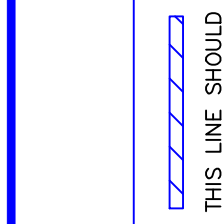
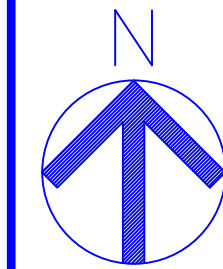


3 MEDIUM VOLTAGE TRANSFORMER DETAIL  
SCALE: NONE

EQUIPMENT SCHEDULE			
**EQUIPMENT IS NOTED BY #			
TAG	DESCRIPTION	QUANTITY	DESCRIPTION
1	SOLAR PV MODULE	1144	305 WATT MODULE (REFER TO DRAWINGS FOR QUANTITY AND LOCATION). MODULES SHALL BE LABELED PER NEC 690 VI.
2	CONTACTOR COMBINER	4	26 STRING DISCONNECTING COMBINER TO CONTAIN 26 STRINGS, RATED AT 400A WITH (26) 15A FUSES, 600 VDC, RATED FOR CONTINUOUS DUTY, WITH DISCONNECT HANDLE MOUNTED ON DOOR EXTERIOR, NEMA 3R ENCLOSURE, TRANSIENT SURGE SUPPRESSION. ENCLOSURE SHALL BE A MINIMUM OF 30" W X 30" H X 8" DEEP.
3	DC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE WITH (4) 400A, 600Vdc CIRCUIT BREAKERS
4	INVERTER	1	250 KWATT, 600VDC, 3 PHASE 480 VAC, NEGATIVLY GROUND CONFIGURATION. (REFER TO INVERTER RATING SCHEDULE FOR ADDITIONAL INFORMATION)
5	AC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE, 800A BUS WITH 400AF/AT MAIN CIRCUIT BREAKER, (1) 400AF/400AT 3 POLE CIRCUIT BREAKER, (1) 15A 3 POLE CIRCUIT BREAKER PROVIDE SURGE PROTECTION, RATED FOR SERVICE ENTRANCE. INTEGRATED REVENUE GRADE METER. INTEGRATED 2KVA STEPDOWN TRANSFORMER WITH CAPACITY FOR (1) 15A SINGLE POLE 120V CIRCUIT BREAKER AND (1) 15A SINGLE POLE 120V CIRCUIT BREAKER.
6	RECEPTACLE	1	120V, 20 AMP, WEATHER PROOF GFI DUPLEX RECEPTACLE.
7	MEDIUM VOLTAGE TRANSFORMER	1	250KVA, THREE PHASE, 12.47KV YGRD/7.2KV PRIMARY AND 480V WYE SECONDARY, LIQUID COOLED TRANSFORMER, BAYONET FUSES ON PRIMARY SIDE. REQUIRED TO MEET UTILITY REQUIREMENTS.
8	PHOTOVOLTAIC PRODUCTION MONITORING EQUIPMENT	1	CENTRAL DATA ACQUISITION UNIT, NEMA 3R ENCLOSURE WITH BATTERY BACK UP, LOCAL DATA STORAGE, INTEGRAL CELL MODEM COMMUNICATIONS, WEB BASED DISPLAY AND LOCAL KEYPAD DISPLAY
9	PHOTOVOLTAIC MONITORING METEOROLOGICAL STATION	1	STATION INCLUDES: PYRANOMETER - PLANE OF ARRAY, BACK OF MODULE TEMPERATURE SENSOR, AMBIENT TEMPERATURE, ANEMOMETER
10	PHOTOVOLTAIC PRODUCTION MONITORING METER	1	REVENUE GRADE METER WITH MODBUS RTU COMMUNICATIONS
11	MEDIUM VOLTAGE FUSED SWITCH	1	15KV PAD MOUNTED SWITCH WITH INTEGRATED 60A STANDARD SPEED FUSES
12	COORDINATED POLE MOUNTED SWITCH	1	SWITCH TO MEET THE REQUIREMENTS OF THE UTILITY
13	GROUND ROD	4	3/4" DIAMETER, 10' -0" LONG COPPER CLAD GROUND ROD

FEEDER SCHEDULE									
**FEEDER IS NOTED BY α									
TAG	CONDUCTOR TYPE	CONDUCTOR TYPE	INSULATION TYPE	GROUND SIZE	GROUND TYPE	GROUND INSULATION TYPE	RACEWAY SIZE	RACEWAY QUANTITY	NOTES
A4	(4) #10 PER RACEWAY	COPPER	USE-2	(1) #10 PER RACEWAY	COPPER	USE-2	3/4" NOTE 5	(1)	
A8	(8) #10 PER RACEWAY	COPPER	USE-2	(1) #10 PER RACEWAY	COPPER	USE-2	1-1/4" NOTE 5	(1)	
A16	(16) #10 PER RACEWAY	COPPER	USE-2	(1) #10 PER RACEWAY	COPPER	USE-2	1-1/2" NOTE 5	(1)	
A20	(20) #10 PER RACEWAY	COPPER	USE-2	(1) #10 PER RACEWAY	COPPER	USE-2	1-1/2" NOTE 5	(1)	
A24	(24) #10 PER RACEWAY	COPPER	USE-2	(1) #10 PER RACEWAY	COPPER	USE-2	2" NOTE 5	(1)	
B	(4) 250 KCMIL PER RACEWAY	ALUMINUM	THWN-2	(1) #3 PER RACEWAY	COPPER	THWN-2	3"	(1)	
C	(3) 250 KCMIL PER RACEWAY	ALUMINUM	THWN-2	(1) #3 PER RACEWAY	COPPER	THWN-2	2-1/2"	(2)	
D	(3) 300 KCMIL PER RACEWAY	ALUMINUM	THWN-2				3"	(2)	
	(1) 300 KCMIL NEU PER RACEWAY	ALUMINUM	THWN-2						
E	(1) #12 PER RACEWAY	COPPER	THWN-2	(1) #12 PER RACEWAY	COPPER	THWN-2	3/4"	(1)	
	(1) #12 NEU PER RACEWAY	COPPER	THWN-2						
F	MANUFACTURED PROVIDED WHIP						3/4"	(1)	
G				(1) #1/0 PER RACEWAY	COPPER	BARE		(1)	
H				(1) #3 PER RACEWAY	COPPER	THWN-2	3/4"	(1)	
I	(3) #1/0 PER RACEWAY	ALUMINUM	MV TR-XLPE WITH CONCENTRIC NEUTRAL				3-1/2"	(1)	
J	BELDEN #3084A						3/4"	(1)	

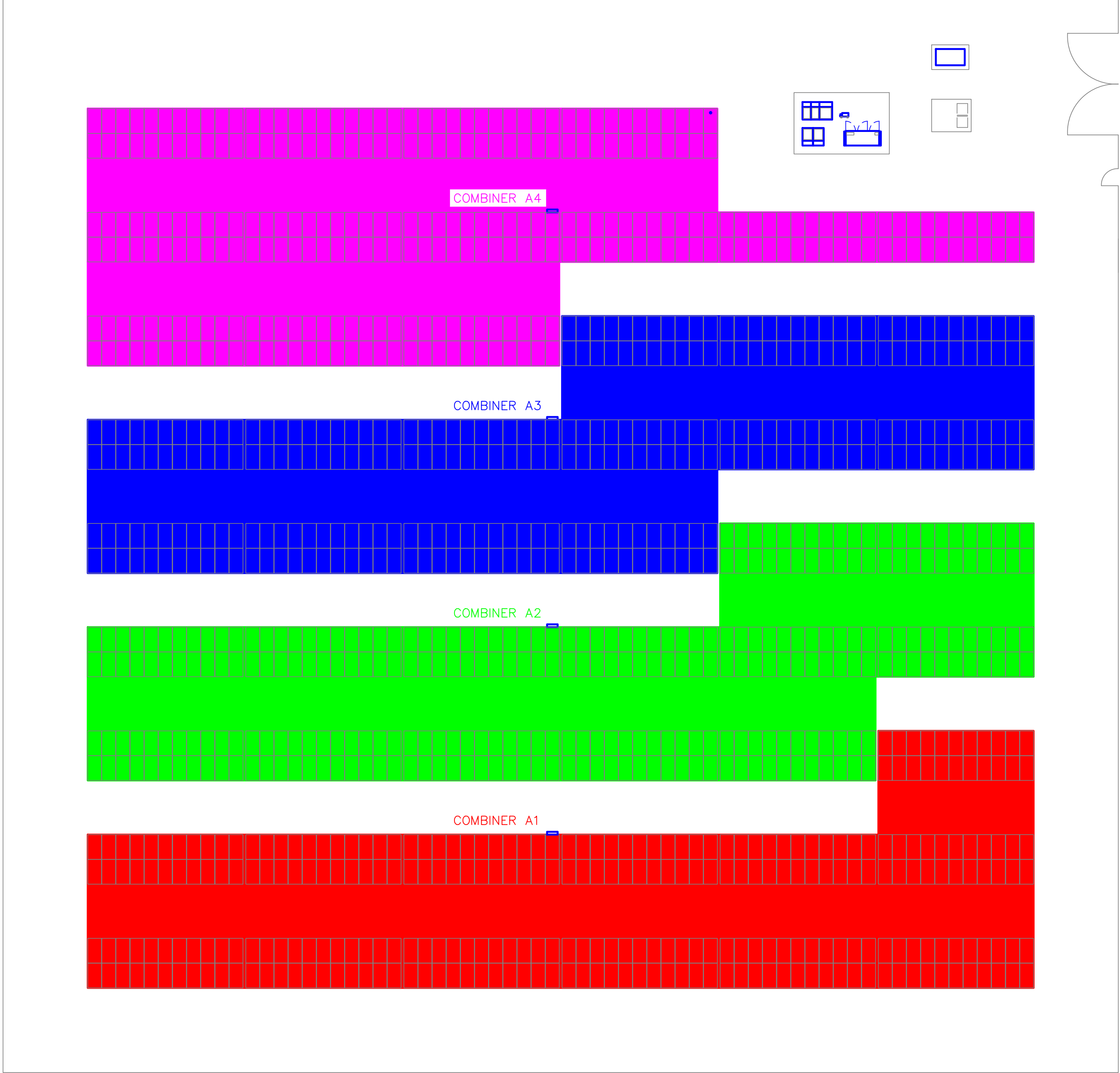
- NOTES:
- (#) - DENOTES QUANTITY TO BE PROVIDED
  - WHERE MULTIPLE CONDUITS ARE NOTED, THE RACEWAYS SHALL BE PROVIDED IN PARALLEL.
  - REFER TO RACEWAY APPLICATION SCHEDULE FOR RACEWAY TYPE.
  - ALL RACEWAY SIZES ARE NEC MINIMUM REQUIREMENTS, LARGER CONDUITS ARE PERMITTED FOR EASE OF INSTALLATION.
  - PV SOURCE CIRCUITS SHALL NOT BE REQUIRED TO BE IN RACEWAY IF CONDUCTORS ARE NOT READILY ACCESSIBLE AND NOT EXPOSED TO PHYSICAL DAMAGE. BELOW GRADE PV SOURCE CIRCUITS SHALL BE IN RACEWAY.
  - PROVIDE 15KV RATED MEDIUM VOLTAGE FEEDERS WITH 100% INSULATION.



REV.	DATE	DESCRIPTION

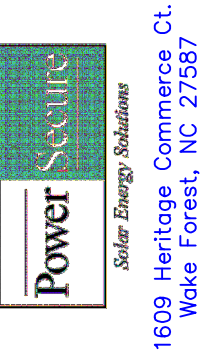
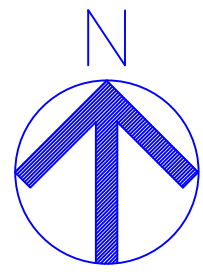
TITLE: SITE PLAN – MEDIUM VOLTAGE ROUTING	
PROJECT: NRECA SUNDA REFERENCE DESIGN 250KW – 600Vdc	
DATE: 02.06.2015	
SHEET: PV1.2	

PRELIMINARY  
NOT FOR  
CONSTRUCTION



1 SITE PLAN - COMBINER LAYOUT  
SCALE: 1/16"=1'-0"

PRELIMINARY  
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THIS LINE SHOULD  
MEASURE ONE WAY

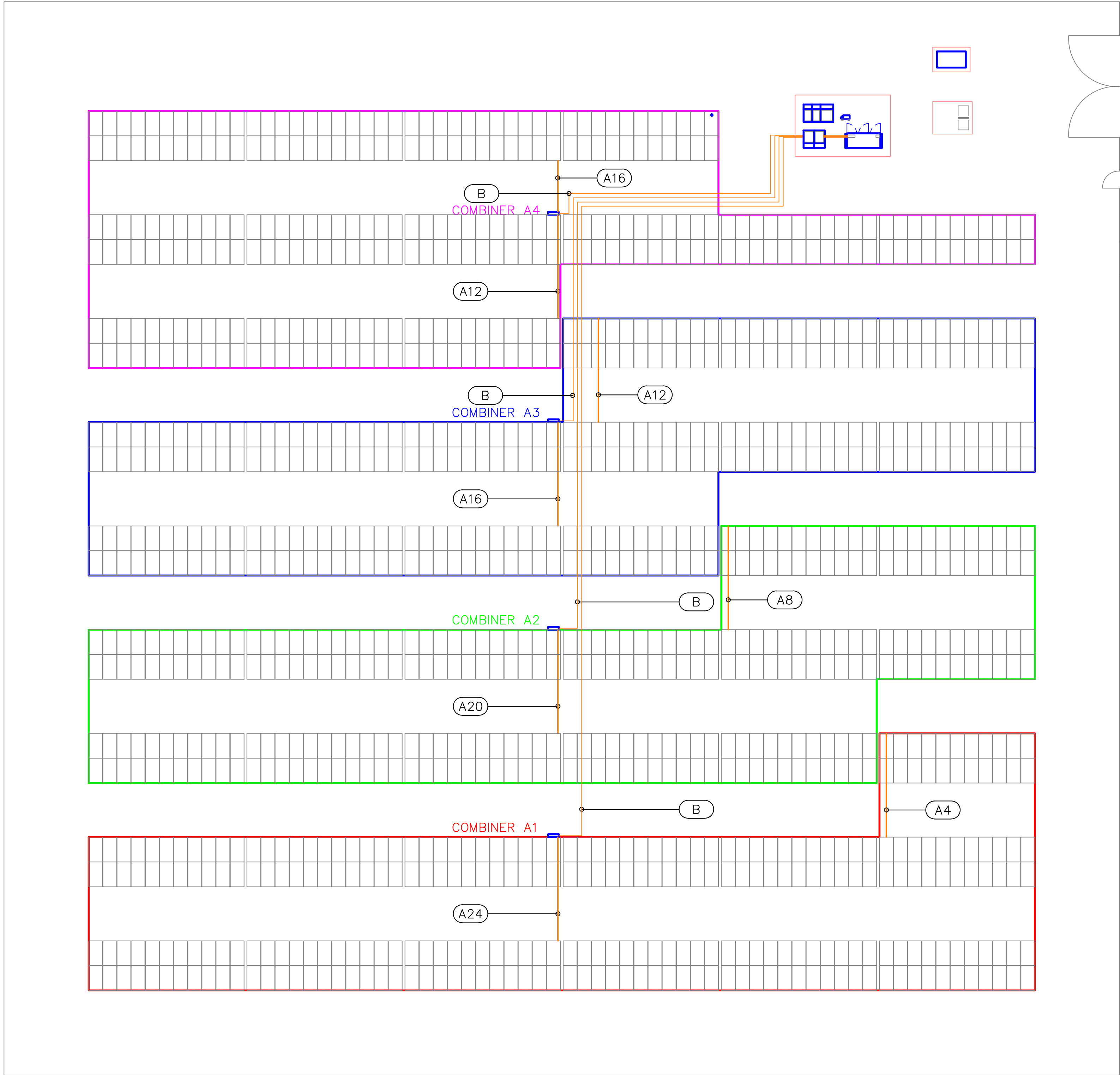
REV.	DATE	DESCRIPTION

TITLE:	SITE PLAN - COMBINER LAYOUT
PROJECT:	NRECA SUNDA REFERENCE DESIGN 250KW - 600Vdc

DATE:  
02.06.2015  
SHEET:

PV1.3

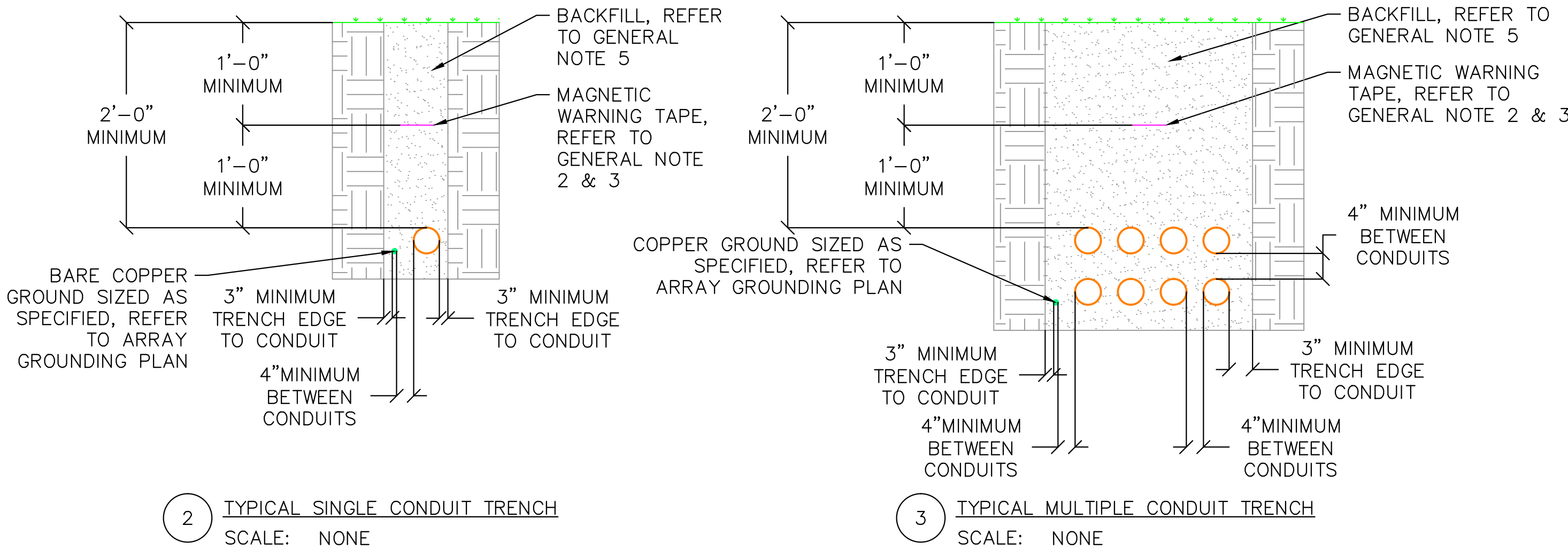
Pkg Date: 7/10/2015



1 SITE PLAN — DC ROUTING  
SCALE: 1/16"=1'-0"

FEEDER SCHEDULE											
**FEEDER IS NOTED BY <span>α</span>											
TAG	CONDUCTOR TYPE			CONDUCTOR TYPE	INSULATION TYPE	GROUND SIZE		GROUND TYPE	GROUND INSULATION TYPE	RACEWAY SIZE	RACEWAY QUANTITY <sup>NOTE 5</sup>
A4	(4)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	3/4" <sup>NOTE 5</sup>	(1)
A8	(8)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	1-1/4" <sup>NOTE 5</sup>	(1)
A16	(16)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	1-1/2" <sup>NOTE 5</sup>	(1)
A20	(20)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	1-1/2" <sup>NOTE 5</sup>	(1)
A24	(24)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	2" <sup>NOTE 5</sup>	(1)
B	(4)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3 PER RACEWAY	COPPER	THWN-2	3"	(1)
C	(3)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3 PER RACEWAY	COPPER	THWN-2	2-1/2"	(2)
D	(3)	300 KCMIL	PER RACEWAY	ALUMINUM	THWN-2					3"	(2)
	(1)	300 KCMIL	NEU PER RACEWAY	ALUMINUM	THWN-2						
E	(1)	#12	PER RACEWAY	COPPER	THWN-2	(1)	#12 PER RACEWAY	COPPER	THWN-2	3/4"	(1)
	(1)	#12	NEU PER RACEWAY	COPPER	THWN-2						
F	MANUFACTURED PROVIDED WHIP									3/4"	(1)
G						(1)	#1/0 PER RACEWAY	COPPER	BARE		(1)
H						(1)	#3 PER RACEWAY	COPPER	THWN-2	3/4"	(1)
I <sup>NOTE 6</sup>	(3)	#1/0	PER RACEWAY	ALUMINUM	MV TR-XLPE WITH CONCENTRIC NEUTRAL					3-1/2"	(1)
J	BELDEN #3084A									3/4"	(1)

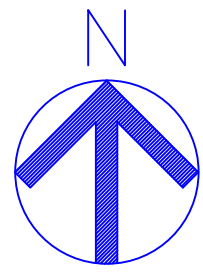
- NOTES:
- (#) - DENOTES QUANTITY TO BE PROVIDED
  - WHERE MULTIPLE CONDUITS ARE NOTED, THE RACEWAYS SHALL BE PROVIDED IN PARALLEL.
  - REFER TO RACEWAY APPLICATION SCHEDULE FOR RACEWAY TYPE.
  - ALL RACEWAY SIZES ARE NEC MINIMUM REQUIREMENTS. LARGER CONDUITS ARE PERMITTED FOR EASE OF INSTALLATION.
  - PV SOURCE CIRCUITS SHALL NOT BE REQUIRED TO BE IN RACEWAY IF CONDUCTORS ARE NOT READILY ACCESSIBLE AND NOT EXPOSED TO PHYSICAL DAMAGE.
  - BELOW GRADE PV SOURCE CIRCUITS SHALL BE IN RACEWAY.
  - PROVIDE 15KV RATED MEDIUM VOLTAGE FEEDERS WITH 100% INSULATION.



GENERAL NOTES:

- ALL UNDERGROUND RACEWAY SHALL BE SCHEDULE 40 PVC. TRANSITIONS BELOW TO ABOVE GRADE SHALL BE PER CONDUIT STUB UP DETAIL.
- FOR TRENCHES 24" WIDE AND LESS, ONLY ONE RUN OF MAGNETIC ELECTRICAL WARNING TAPE SHALL BE REQUIRED PER DETAIL 3.
- FOR TRENCHES WIDER THAN 24" ONE PIECE OF TAPE SHALL BE LOCATED AT EACH SIDE OF THE TRENCH WITH ADDITIONAL RUNS PROVIDED AS NECESSARY. THE MAXIMUM DISTANCE BETWEEN TAPE RUNS SHALL BE 24" ON CENTER.
- TRENCH BOTTOMS: EXCAVATE TRENCHES 3" DEEPER THAN BOTTOM OF PIPE ELEVATION TO ALLOW FOR BEDDING COURSE. HAND EXCAVATE FOR BELL OF PIPE. EXCAVATE TRENCHES 3" DEEPER THAN ELEVATION REQUIRED IN ROCK OR OTHER UNYIELDING BEARING MATERIAL TO ALLOW BEDDING COURSE.
- ALL BACKFILL SHOULD BE FREE OF MATERIALS THAT MAY DAMAGE THE CONDUIT OR CABLE SYSTEM. BACKFILL WITHIN 150 MM (6 IN) OF THE CONDUIT OR CABLE SHOULD BE FREE OF SOLID MATERIAL GREATER THAN 100 MM (2 IN) IN MAXIMUM DIMENSION OR WITH SHARP EDGES LIKELY TO DAMAGE IT. THE BALANCE OF BACKFILL SHOULD BE FREE OF SOLID MATERIAL GREATER THAN 200 MM (8 IN) IN MAXIMUM DIMENSION. BACKFILL MATERIAL SHOULD BE ADEQUATELY COMPACTED.
- REFER TO ARRAY GROUNDING DETAIL FOR BARE COPPER GROUND TRENCH ROUTING.
- FEEDER ROUTING SHOWN DIAGRAMMATICALLY, COORDINATION WITH SITE CONDITIONS REQUIRED.

PRELIMINARY  
NOT FOR  
CONSTRUCTION



THIS LINE SHOULD  
MEASURE ONE WAY

REV. DATE DESCRIPTION

SITE PLAN — DC ROUTING

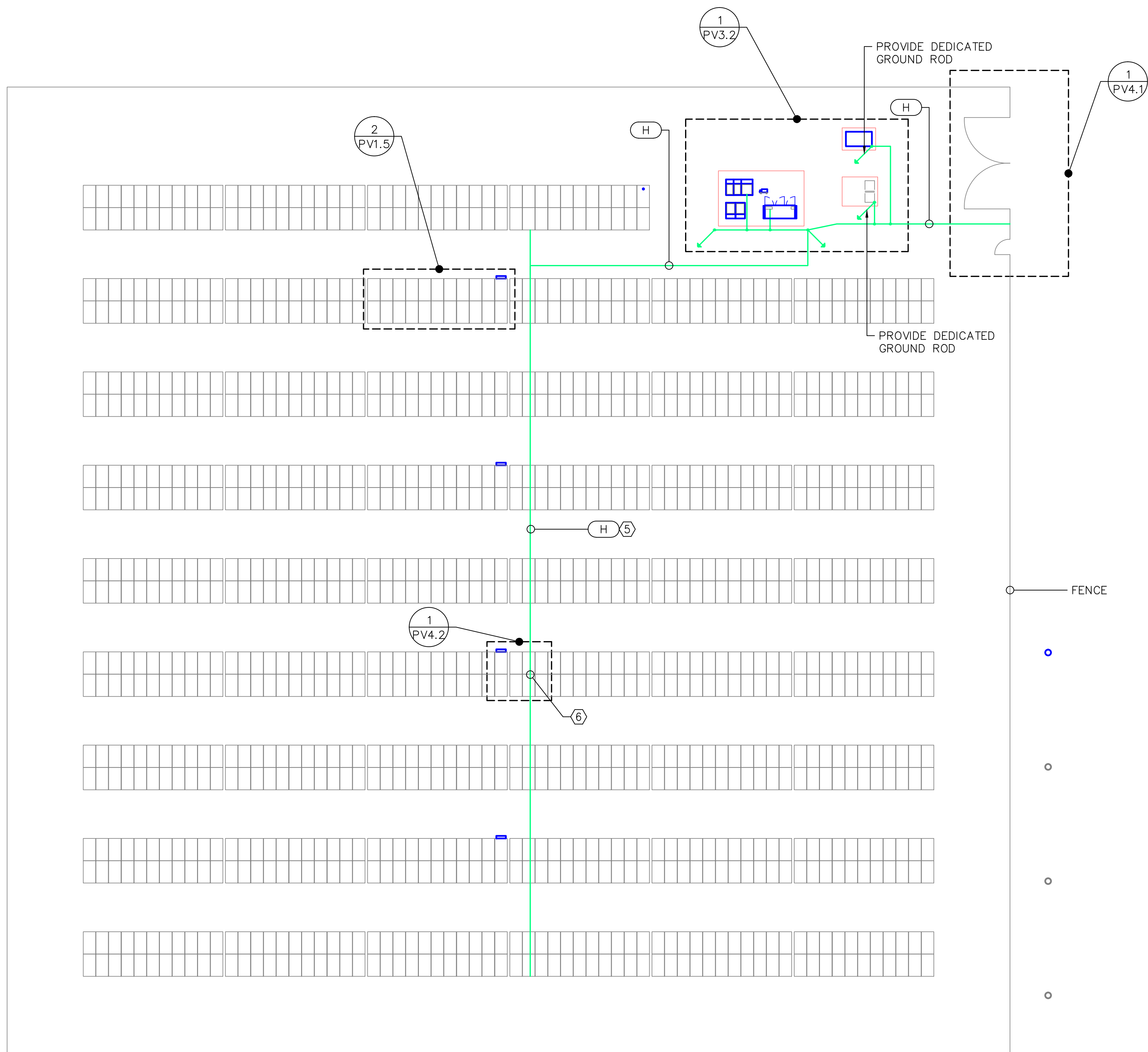
NRECA  
SUNDA REFERENCE DESIGN  
250KW — 600Vdc

TITLE:  
PROJECT:

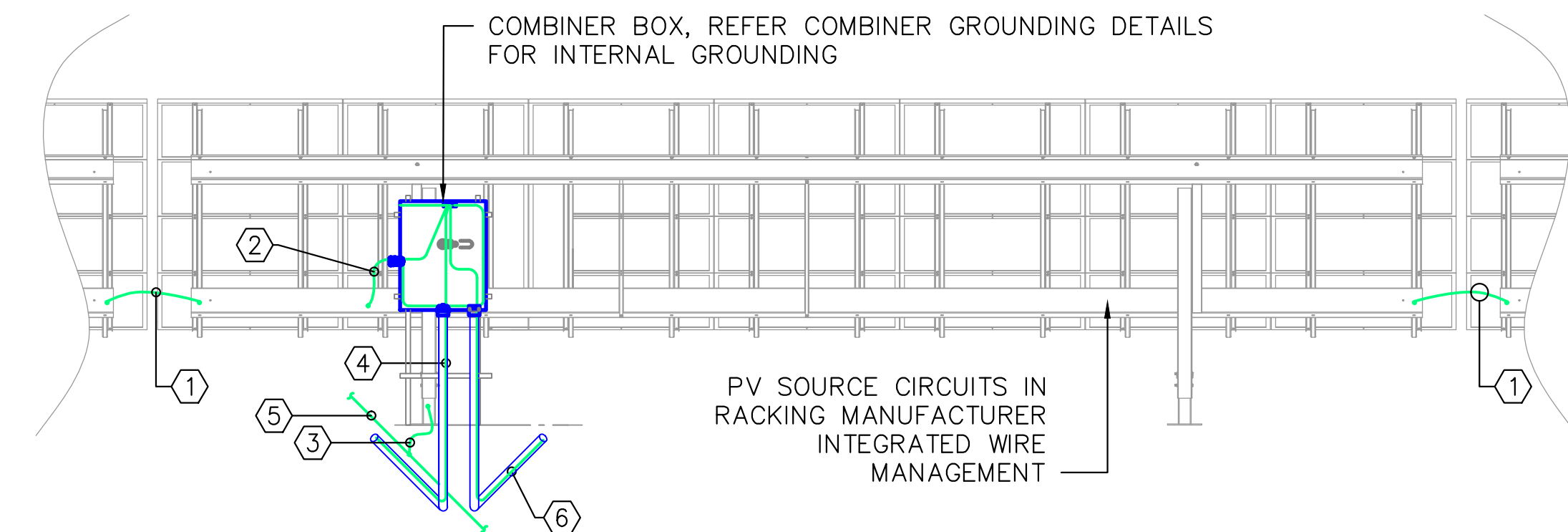
DATE:  
SHEET:

PV1.4





1 SITE PLAN - ARRAY GROUNDING  
SCALE: 1/16"=1'-0"



2 TYPICAL GROUND MOUNT RACKING GROUNDING DETAILS  
SCALE: NONE

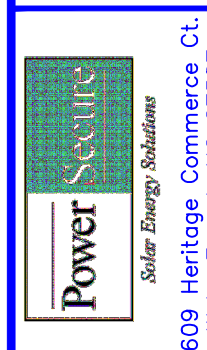
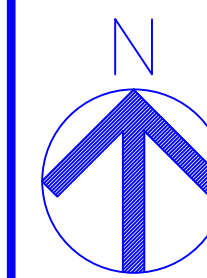
#### GENERAL NOTES

1. THE RACKING SYSTEM SHALL BE UL LISTED FOR GROUNDING CONTINUITY. COMPONENTS WITHIN THE RACKING SYSTEM SHALL FORM AN ELECTRICALLY BONDED UNIT AND REQUIRE ADDITIONAL BONDING FROM ONE INDIVIDUAL RACK SECTION TO ADJACENT SECTIONS.
2. REFER TO PV RISER DIAGRAM FOR SYSTEM GROUNDING.
3. REFER TO SINGLE LINE DIAGRAM AND SCHEDULES FOR SPECIFICATIONS
4. ARRAY EQUIPMENT EGC CONDUCTOR SHALL BE RUN IN TRENCH WITH COMBINER DC WIRES.
5. GROUND ROUTING SHOWN DIAGRAMMATICALLY, COORDINATION WITH SITE CONDITIONS REQUIRED.

#### KEYED NOTES: (X)

1. PROVIDE GROUND BRAID BETWEEN RACKING SECTIONS PER RACKING MANUFACTURER INSTRUCTIONS.
2. PROVIDE #6 BARE COPPER BONDING JUMPER FROM THE COMBINER BOX GROUND BAR TO THE WIRE TRAY.
3. PROVIDE #6 BARE COPPER BONDING JUMPER VIA IRREVERSIBLE CRIMP FROM ARRAY EQUIPMENT GROUND CONDUCTOR WIRE IN TRENCH TO ONE PIER PER ROW OF RACKING. IRREVERSIBLE CRIMP SHALL BE UL LISTED FOR GROUNDING AND BONDING. ENSURE ALL CONNECTIONS ARE TORQUED TO MANUFACTURER'S RECOMMENDED TORQUE VALUE.
4. PROVIDE ARRAY EQUIPMENT GROUND CONDUCTOR (REFER TO SINGLE LINE DIAGRAM AND SCHEDULES FOR EGC SIZE) FROM COMBINER BOX GROUND BUS BAR TO ASSOCIATED INVERTER BUS BAR. EQUIPMENT GROUND CONDUCTOR SHALL BE RUN IN CONDUIT WITH ASSOCIATED PV OUTPUT CONDUCTORS.
5. PROVIDE ARRAY EQUIPMENT GROUND CONDUCTOR ROUTED LENGTH OF THE ARRAY.
6. PROVIDE #10 USE-2 COPPER BONDING JUMPER FROM THE COMBINER BOX GROUND BAR TO THE WIRE TRAY ON ADJACENT ROW SUPPLIED BY ASSOCIATED COMBINER.

PRELIMINARY  
NOT FOR  
CONSTRUCTION



1609 Heritage Commerce Ct.  
Wake Forest, NC 27587

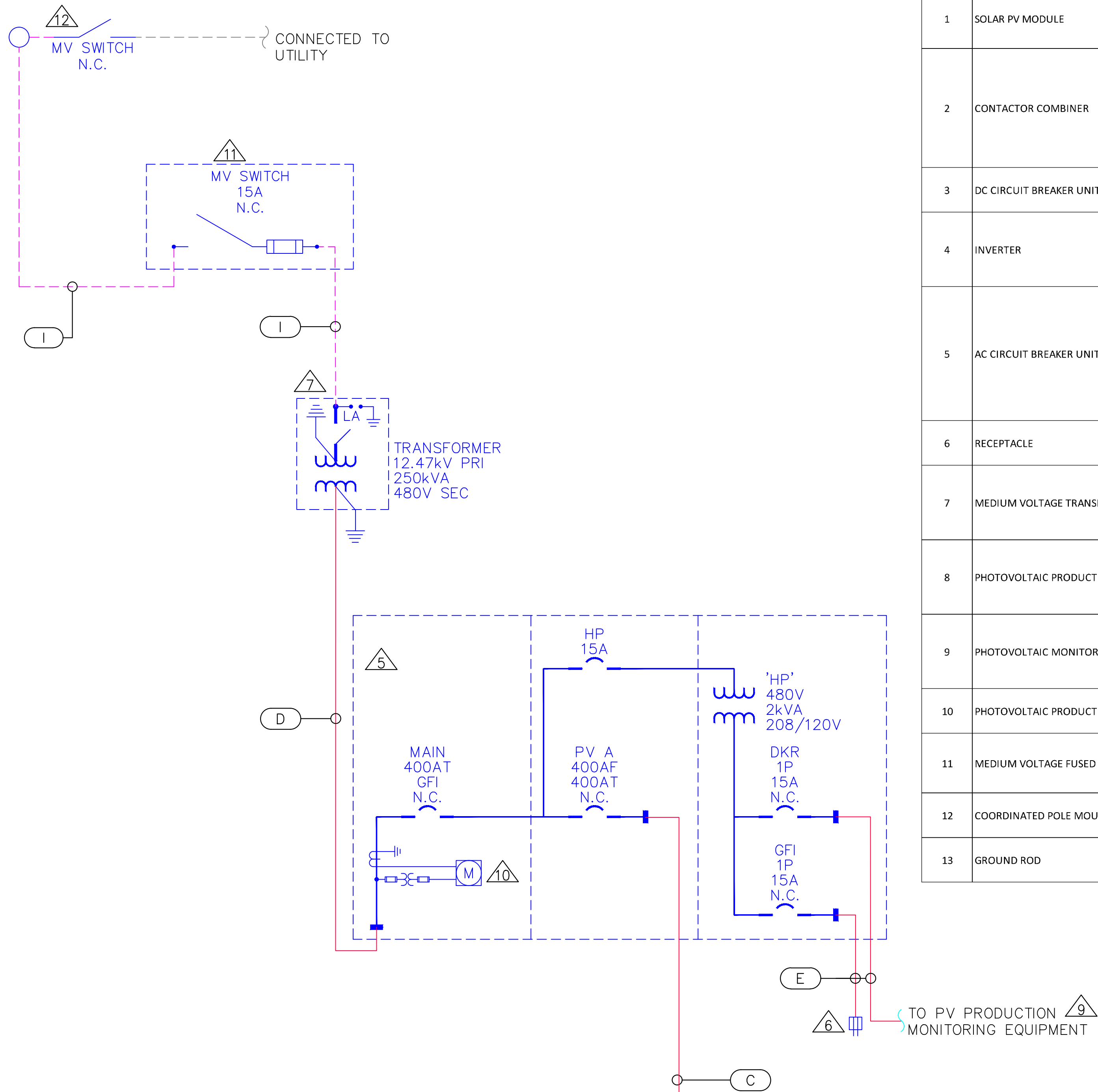
THIS LINE SHOULD  
MEASURE ONE WAY

REV.	DATE	DESCRIPTION

TITLE: SITE PLAN - ARRAY GROUNDING  
PROJECT: NRECA  
SUNDA REFERENCE DESIGN  
250KW - 600Vdc

DATE: 02.06.2015  
SHEET: PV1.5

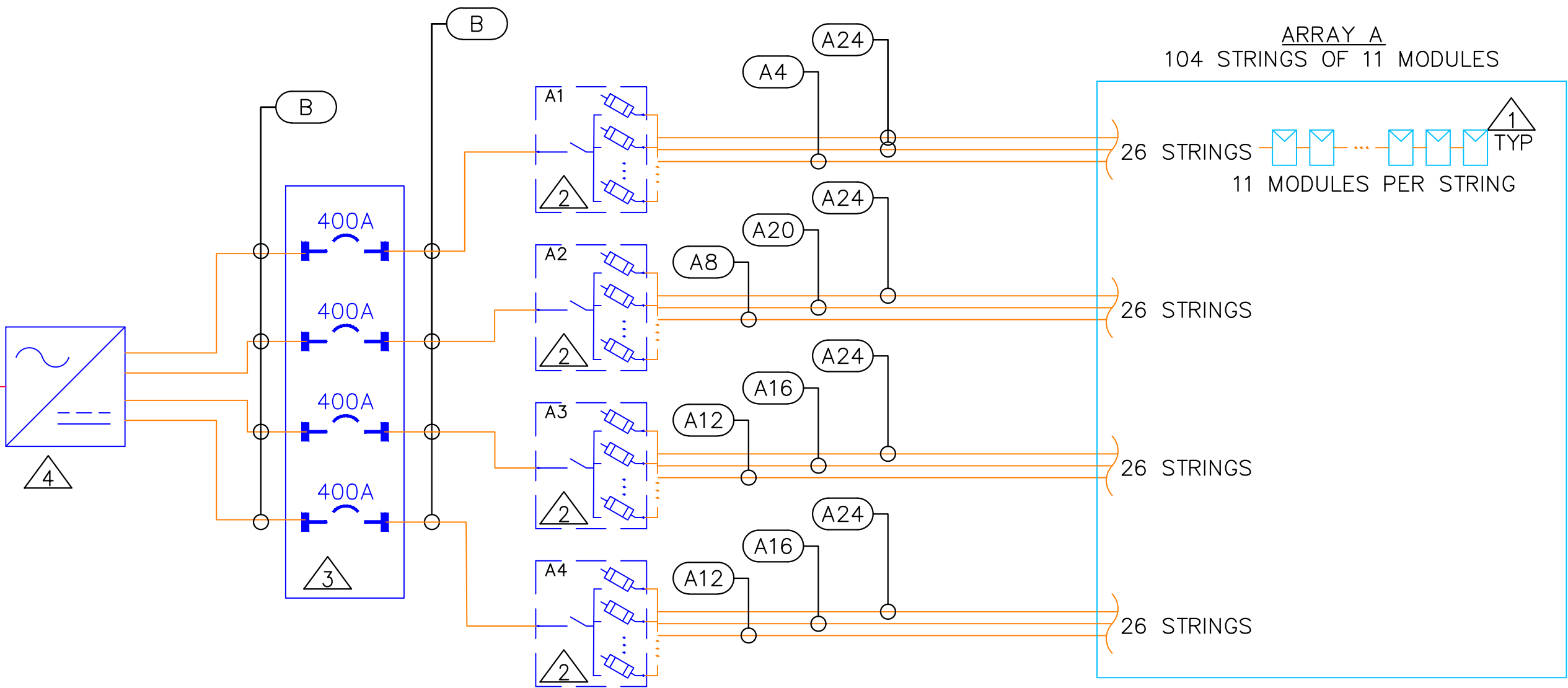
PV1.5









EQUIPMENT SCHEDULE			
**EQUIPMENT IS NOTED BY 			
TAG	DESCRIPTION	QUANTITY	DESCRIPTION
1	SOLAR PV MODULE	1144	305 WATT MODULE (REFER TO DRAWINGS FOR QUANTITY AND LOCATION). MODULES SHALL BE LABELED PER NEC 690 VI.
2	CONTACTOR COMBINER	4	26 STRING DISCONNECTING COMBINER TO CONTAIN 26 STRINGS, RATED AT 400A WITH (26) 15A FUSES, 600 VDC, RATED FOR CONTINUOUS DUTY, WITH DISCONNECT HANDLE MOUNTED ON DOOR EXTERIOR, NEMA 3R ENCLOSURE, TRANSIENT SURGE SUPPRESSION. ENCLOSURE SHALL BE A MINIMUM OF 30" W X 30" H X 8" DEEP.
3	DC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE WITH (4) 400A, 600Vdc CIRCUIT BREAKERS
4	INVERTER	1	250 KWATT, 600VDC, 3 PHASE 480 VAC, NEGATIVLY GROUND CONFIGURATION. (REFER TO INVERTER RATING SCHEDULE FOR ADDITIONAL INFORMATION)
5	AC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE, 800A BUS WITH 400AF/AT MAIN CIRCUIT BREAKER, (1) 400AF/400AT 3 POLE CIRCUIT BREAKER, (1) 15A 3 POLE CIRCUIT BREAKER PROVIDE SURGE PROTECTION, RATED FOR SERVICE ENTRANCE. INTEGRATED REVENUE GRADE METER. INTEGRATED 2KVA STEPDOWN TRANSFORMER WITH CAPACITY FOR (1) 15A SINGLE POLE 120V CIRCUIT BREAKER AND (1) 15A SINGLE POLE 120V CIRCUIT BREAKER.
6	RECEPTACLE	1	120V, 20 AMP, WEATHER PROOF GH DUPLEX RECEPTACLE.
7	MEDIUM VOLTAGE TRANSFORMER	1	250KVA, THREE PHASE, 12.47KV YGRD/7.2KV PRIMARY AND 480V WYE SECONDARY, LIQUID COOLED TRANSFORMER, BAYONET FUSES ON PRIMARY SIDE. REQUIRED TO MEET UTILITY REQUIREMENTS.
8	PHOTOVOLTAIC PRODUCTION MONITORING EQUIPMENT	1	CENTRAL DATA ACQUISITION UNIT, NEMA 3R ENCLOSURE WITH BATTERY BACK UP, LOCAL DATA STORAGE, INTEGRAL CELL MODEM COMMUNICATIONS , WEB BASED DISPLAY AND LOCAL KEYPAD DISPLAY
9	PHOTOVOLTAIC MONITORING METEOROLOGICAL STATION	1	STATION INCLUDES: PYRANOMETER - PLANE OF ARRAY, BACK OF MODULE TEMPERATURE SENSOR, AMBIENT TEMPERATURE, ANEMOMETER
10	PHOTOVOLTAIC PRODUCTION MONITORING METER	1	REVENUE GRADE METER WITH MODBUS RTU COMMUNICATIONS
11	MEDIUM VOLTAGE FUSED SWITCH	1	15KV PAD MOUNTED SWITCH WITH INTEGRATED 60A STANDARD SPEED FUSES
12	COORDINATED POLE MOUNTED SWITCH	1	SWITCH TO MEET THE REQUIREMENTS OF THE UTILITY
13	GROUND ROD	4	3/4" DIAMETER, 10'-0" LONG COPPER CLAD GROUND ROD

FEEDER SCHEDULE												
**FEEDER IS NOTED BY <div>α</div>												
TAG	CONDUCTOR TYPE			CONDUCTOR TYPE	INSULATION TYPE	GROUND SIZE		GROUND TYPE	GROUND INSULATION TYPE	RACEWAY SIZE	RACEWAY QUANTITY <sup>NOTE 2</sup>	
A4	(4)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	3/4" <sup>NOTE 5</sup>	(1)
A8	(8)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	1-1/4" <sup>NOTE 5</sup>	(1)
A16	(16)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	1-1/2" <sup>NOTE 5</sup>	(1)
A20	(20)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	1-1/2" <sup>NOTE 5</sup>	(1)
A24	(24)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	2" <sup>NOTE 5</sup>	(1)
B	(4)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3	PER RACEWAY	COPPER	THWN-2	3"	(1)
C	(3)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3	PER RACEWAY	COPPER	THWN-2	2-1/2"	(2)
D	(3)	300 KCMIL	PER RACEWAY	ALUMINUM	THWN-2					3"	(2)	
	(1)	300 KCMIL	NEU PER RACEWAY	ALUMINUM	THWN-2							
E	(1)	#12	PER RACEWAY	COPPER	THWN-2	(1)	#12	PER RACEWAY	COPPER	THWN-2	3/4"	(1)
	(1)	#12	NEU PER RACEWAY	COPPER	THWN-2							
F	MANUFACTURED PROVIDED WHIP										3/4"	(1)
G						(1)	#1/0	PER RACEWAY	COPPER	BARE		(1)
H						(1)	#3	PER RACEWAY	COPPER	THWN-2	3/4"	(1)
I <sup>NOTE 6</sup>	(3)	#1/0	PER RACEWAY	ALUMINUM	MV TR-XLPE WITH CONCENTRIC NEUTRAL					3-1/2"	(1)	
J	BELDEN #3084A										3/4"	(1)

- NOTES:
- (#) - DENOTES QUANTITY TO BE PROVIDED
  - WHERE MULTIPLE CONDUITS ARE NOTED, THE RACEWAYS SHALL BE PROVIDED IN PARALLEL.
  - REFER TO RACEWAY APPLICATION SCHEDULE FOR RACEWAY TYPE.
  - ALL RACEWAY SIZES ARE NEC MINIMUM REQUIREMENTS, LARGER CONDUITS ARE PERMITTED FOR EASE OF INSTALLATION.
  - PV SOURCE CIRCUITS SHALL NOT BE REQUIRED TO BE IN RACEWAY IF CONDUCTORS ARE NOT READILY ACCESSIBLE AND NOT EXPOSED TO PHYSICAL DAMAGE. BELOW GRADE PV SOURCE CIRCUITS SHALL BE IN RACEWAY.
  - PROVIDE 15KV RATED MEDIUM VOLTAGE FEEDERS WITH 100% INSULATION.



LINE TYPE LEGEND:	
DC FEEDERS	
AC FEEDERS	
MEDIUM VOLTAGE FEEDERS	
EQUIPMENT	
MODULES	
PROVIDED BY OTHERS	

- GENERAL NOTES:
- USE COMPRESSION LUGS WITH BELLEVILLE WASHERS ON AC AND DC FEEDERS WITHIN INVERTER.
  - PROVIDE LABELS TO EACH INCOMING CIRCUIT IN THE INVERTER.
  - PROVIDE LIQUID TIGHT BONDING HUB ASSEMBLY ON EXTERIOR OF ENCLOSURE AT EACH CONDUIT PENETRATION FOR ENCLOSURES EXPOSED TO ELEMENTS.
  - PROVIDE ANTIOXIDANT CORROSION INHIBITOR FOR APPLICATION ON ALL LISTED CONNECTIONS.
  - PROVIDE IRREVERSIBLE BONDS AT ALL GROUNDING ELECTRODE CONDUCTORS.

PRELIMINARY  
NOT FOR  
CONSTRUCTION



THIS LINE SHOULD  
MEASURE ONE WAY

REV. DATE DESCRIPTION

TITLE: PV SINGLE LINE DIAGRAM

PROJECT: NRECA SUNDRA REFERENCE DESIGN 250KW - 600Vdc

DATE: 02.06.2015  
SHEET: PV2.0



EQUIPMENT SCHEDULE **EQUIPMENT IS NOTED BY 			
TAG	DESCRIPTION	QUANTITY	DESCRIPTION
1	SOLAR PV MODULE	1144	305 WATT MODULE (REFER TO DRAWINGS FOR QUANTITY AND LOCATION). MODULES SHALL BE LABELED PER NEC 690 VI.
2	CONTACTOR COMBINER	4	26 STRING DISCONNECTING COMBINER TO CONTAIN 26 STRINGS, RATED AT 400A WITH (26) 15A FUSES, 600 VDC, RATED FOR CONTINUOUS DUTY, WITH DISCONNECT HANDLE MOUNTED ON DOOR EXTERIOR, NEMA 3R ENCLOSURE, TRANSIENT SURGE SUPPRESSION. ENCLOSURE SHALL BE A MINIMUM OF 30" W X 30" H X 8" DEEP.
3	DC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE WITH (4) 400A, 600Vdc CIRCUIT BREAKERS
4	INVERTER	1	250 KWATT, 600VDC, 3 PHASE 480 VAC, NEGATIVLY GROUND CONFIGURATION. (REFER TO INVERTER RATING SCHEDULE FOR ADDITIONAL INFORMATION)
5	AC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE, 800A BUS WITH 400AF/AT MAIN CIRCUIT BREAKER, (1) 400AF/400AT 3 POLE CIRCUIT BREAKER, (1) 15A 3 POLE CIRCUIT BREAKER PROVIDE SURGE PROTECTION, RATED FOR SERVICE ENTRANCE. INTEGRATED REVENUE GRADE METER. INTEGRATED 2KVA STEPDOWN TRANSFORMER WITH CAPACITY FOR (1) 15A SINGLE POLE 120V CIRCUIT BREAKER AND (1) 15A SINGLE POLE 120V CIRCUIT BREAKER.
6	RECEPTACLE	1	120V, 20 AMP, WEATHER PROOF GFI DUPLEX RECEPTACLE.
7	MEDIUM VOLTAGE TRANSFORMER	1	250KVA, THREE PHASE, 12.47KV YGRD/7.2KV PRIMARY AND 480V WYE SECONDARY, LIQUID COOLED TRANSFORMER, BAYONET FUSES ON PRIMARY SIDE. REQUIRED TO MEET UTILITY REQUIREMENTS.
8	PHOTOVOLTAIC PRODUCTION MONITORING EQUIPMENT	1	CENTRAL DATA ACQUISITION UNIT, NEMA 3R ENCLOSURE WITH BATTERY BACK UP, LOCAL DATA STORAGE, INTEGRAL CELL MODEM COMMUNICATIONS , WEB BASED DISPLAY AND LOCAL KEYPAD DISPLAY
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10	PHOTOVOLTAIC PRODUCTION MONITORING METER	1	REVENUE GRADE METER WITH MODBUS RTU COMMUNICATIONS
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12	COORDINATED POLE MOUNTED SWITCH	1	SWITCH TO MEET THE REQUIREMENTS OF THE UTILITY
13	GROUND ROD	4	3/4" DIAMETER, 10'-0" LONG COPPER CLAD GROUND ROD

INVERTER DESIGNATION	A
INVERTER QUANTITY	1
INVERTER MAKE	ADVANCED ENERGY
INVERTER MODEL	AE 250TX
INVERTER TYPE	NEGATIVE GROUND
MAX DC VOLTAGE RATING	600
MAX POWER @ 40°C	250 KW
NOMINAL AC VOLTAGE	480, 3φ
MAX AC OUTPUT CURRENT	304 A
MAX OCPD	400 A
MIN V <sub>MP</sub>	295 V
MAX V <sub>MP</sub>	595 V
START UP VOLTAGE	330 V
ENCLOSURE RATING	NEMA 4
INTEGRATED DC DISCONNECT	YES
INTEGRATED DC FUSING	NO
INTEGRATED AC DISCONNECT	YES

MODULE MANUFACTURER	REC
MODULE MODEL NUMBER	REC305PE72
MAX POWER (P <sub>Max</sub> )	305 W
CELLS	MULTICRYSTALLINE
FRAME	SILVER
MAX POWER-POINT CURRENT (I <sub>MP</sub> )	8.42 A
MAX POWER-POINT VOLTAGE (V <sub>MP</sub> )	36.60 V
OPEN CIRCUIT VOLTAGE (V <sub>OC</sub> )	45.10 V
SHORT CIRCUIT CURRENT (I <sub>SC</sub> )	8.95 A
MAX SERIES FUSE (OCPD)	20 A
MAX VOLTAGE (V <sub>DC</sub> )	1000
V <sub>OC</sub> TEMP COEFF (%/°C)	-0.27
CONNECTOR	MC4 OR EQUIVALENT
ACTURER RECOMMENDED GROUND	WEBB CLIP
WEEB CLIP QUANTITY	2288

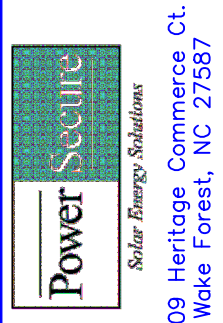
FEEDER SCHEDULE **FEEDER IS NOTED BY <div>α</div>												
TAG	CONDUCTOR TYPE			CONDUCTOR TYPE	INSULATION TYPE	GROUND SIZE		GROUND TYPE	GROUND INSULATION TYPE	RACEWAY SIZE	RACEWAY QUANTITY <sup>NOTE 2</sup>	
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C	(3)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3	PER RACEWAY	COPPER	THWN-2	2-1/2"	(2)
D	(3)	300 KCMIL	PER RACEWAY	ALUMINUM	THWN-2						3"	(2)
	(1)	300 KCMIL	NEU PER RACEWAY	ALUMINUM	THWN-2							
E	(1)	#12	PER RACEWAY	COPPER	THWN-2	(1)	#12	PER RACEWAY	COPPER	THWN-2	3/4"	(1)
	(1)	#12	NEU PER RACEWAY	COPPER	THWN-2							
F	MANUFACTURED PROVIDED WHIP										3/4"	(1)
G						(1)	#1/0	PER RACEWAY	COPPER	BARE		(1)
H						(1)	#3	PER RACEWAY	COPPER	THWN-2	3/4"	(1)
I <sup>NOTES</sup>	(3)	#1/0	PER RACEWAY	ALUMINUM	MV TR-XLPE WITH CONCENTRIC NEUTRAL						3-1/2"	(1)
J	BELDEN #3084A										3/4"	(1)

- NOTES:
- (#) - DENOTES QUANTITY TO BE PROVIDED
  - WHERE MULTIPLE CONDUITS ARE NOTED, THE RACEWAYS SHALL BE PROVIDED IN PARALLEL.
  - REFER TO RACEWAY APPLICATION SCHEDULE FOR RACEWAY TYPE.
  - ALL RACEWAY SIZES ARE NEC MINIMUM REQUIREMENTS, LARGER CONDUITS ARE PERMITTED FOR EASE OF INSTALLATION.
  - PV SOURCE CIRCUITS SHALL NOT BE REQUIRED TO BE IN RACEWAY IF CONDUCTORS ARE NOT READILY ACCESSIBLE AND NOT EXPOSED TO PHYSICAL DAMAGE. BELOW GRADE PV SOURCE CIRCUITS SHALL BE IN RACEWAY.
  - PROVIDE 15KV RATED MEDIUM VOLTAGE FEEDERS WITH 100% INSULATION.

INVERTER A DC INPUT SPECIFICATION											
COMBINER DESIGNATION	MODULE	MODULE I <sub>sc</sub>	QUANTITY OF STRINGS	COMBINER RATING	OCPD TRIP	DISCONNECTING MEANS FRAME	RATED MPP CURRENT	RATED MPP VOLTAGE	MAX SYSTEM VOLTAGE	MAX CIRCUIT CURRENT	MAX POWER
A1	REC305PE72	8.95 A	26	400 A	400 A	400 A	218.92 A	402.60 V	538.83 V	290.88 A	87.23 KW
A2	REC305PE72	8.95 A	26	400 A	400 A	400 A	218.92 A	402.60 V	538.83 V	290.88 A	87.23 KW
A3	REC305PE72	8.95 A	26	400 A	400 A	400 A	218.92 A	402.60 V	538.83 V	290.88 A	87.23 KW
A4	REC305PE72	8.95 A	26	400 A	400 A	400 A	218.92 A	402.60 V	538.83 V	290.88 A	87.23 KW
A5	-										
A6	-										
A7	-										
A8	-										
A9	-										
A10	-										
INVERTER TOTALS			104				875.68 A	402.60 V	538.83 V	1163.50 A	348.92 KW

AC SWITCHBOARD		
SERVICE SUPPLY: 480V, 3φ, 4 WIRE BUS: 800A MAIN: 400A FEEDER: REFER TO SINGLE LINE DIAGRAM AIC RATING: VERIFY WITH UTILITY PRIOR TO INSTALLATION		
<div>MAIN CIRCUIT BREAKER 400 AMP</div> <p>*NOTE - MAIN BREAKER SHALL HAVE GROUND FAULT PROTECTION CAPABILITY</p>	INVERTER A 400 AMP TRIP	
	AUXILIARY POWER VIA 2KVA TRANSFORMER 15 AMP	SPACE
	SPACE	SPACE
	SPACE	SPACE
	SPACE	SPACE
	SPACE	SPACE
	SPACE	SPACE

MINIMUM CONDUIT REQUIRED PER APPLICATION	
APPLICATION	CONDUIT TYPE
ROOF MOUNTED (EXPOSED)	RGS
BUILDING INTERIOR (EXPOSED TO PHYSICAL DAMAGE)	RGS
BUILDING INTERIOR (PROTECTED FROM PHYSICAL DAMAGE)	EMT
BUILDING EXTERIOR (EXPOSED TO PHYSICAL DAMAGE)	RGS
BUILDING EXTERIOR (PROTECTED FROM PHYSICAL DAMAGE)	RGS
TRANSITION FROM BELOW GRADE TO ABOVE GRADE	RGS OR PVC SCHED 80



1609 Heritage Commerce Ct.  
Wake Forest, NC 27587

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Wake Forest, NC 27587

REV.	DATE	DESCRIPTION

PV SCHEDULES

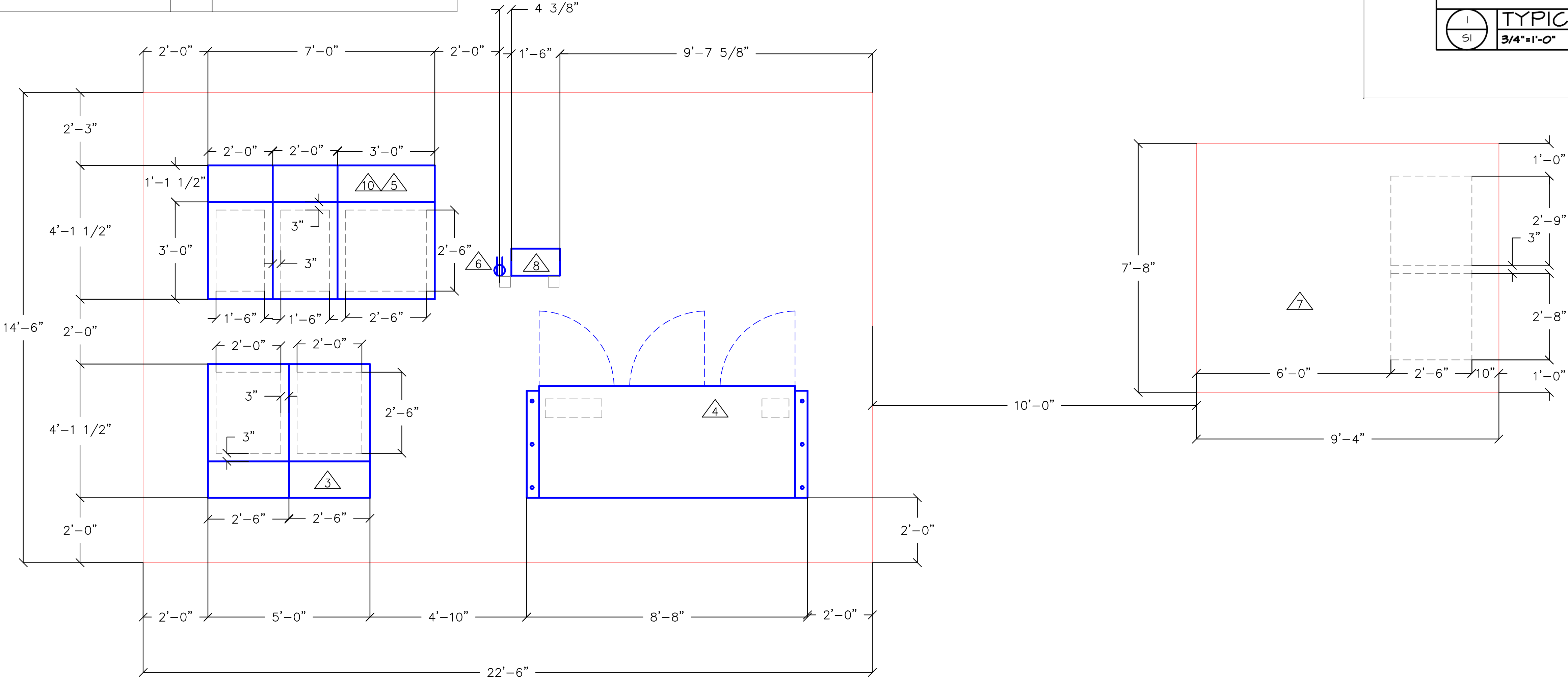
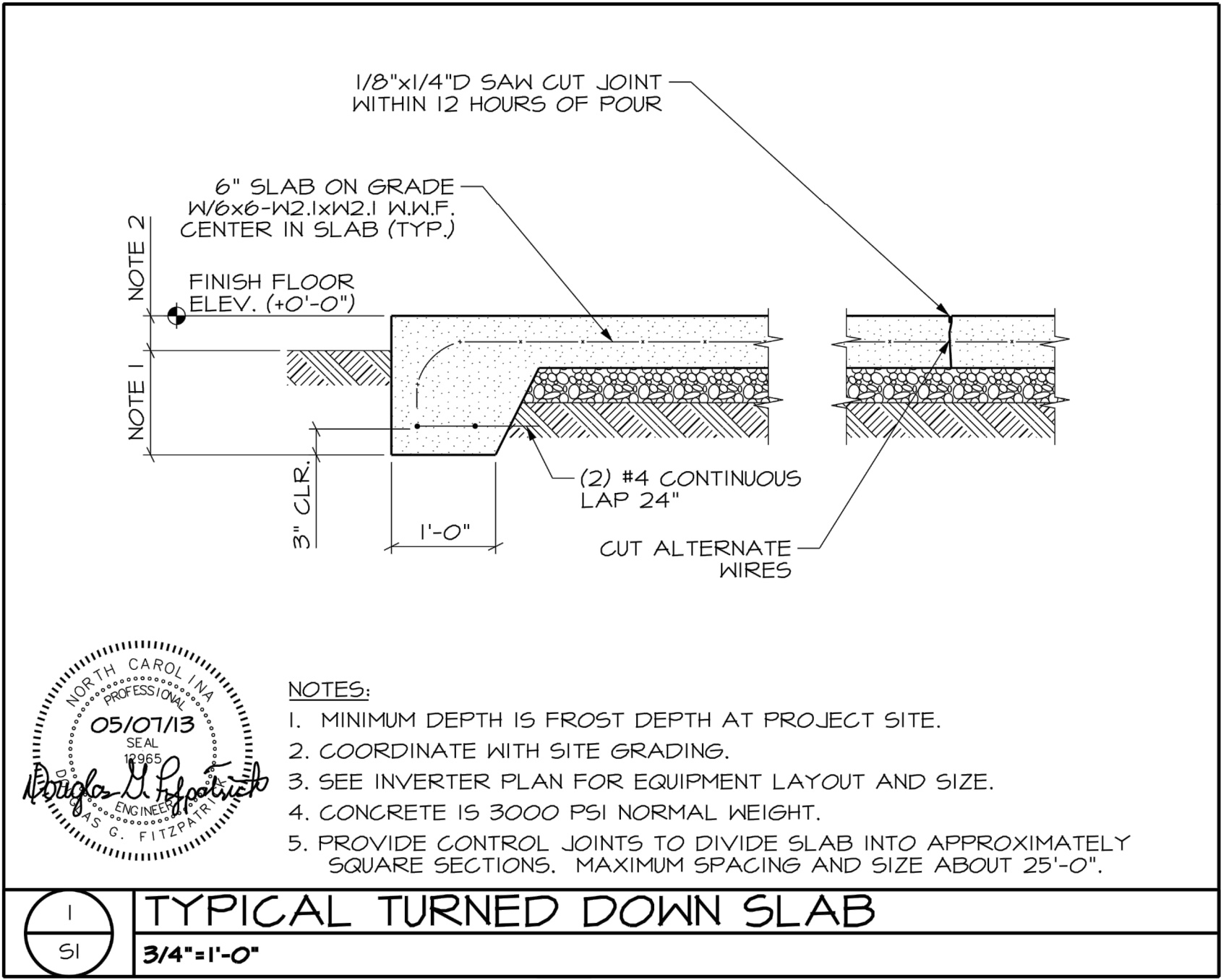
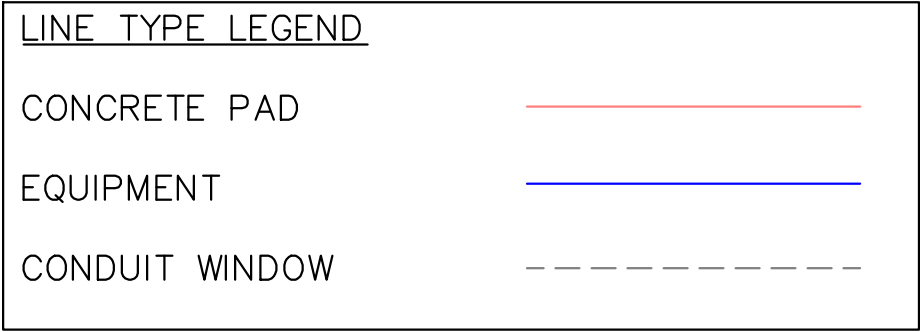
NRECA  
SUNDA REFERENCE DESIGN  
250KW — 600Vdc

TITLE:  
PROJECT:  
DATE:  
SHEET:

PV2.1

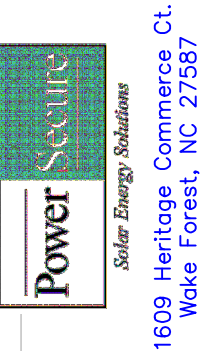
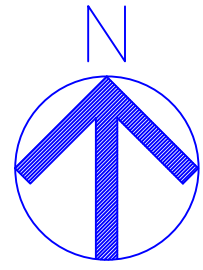
PRELIMINARY  
NOT FOR  
CONSTRUCTION

EQUIPMENT SCHEDULE			
**EQUIPMENT IS NOTED BY			
TAG	DESCRIPTION	QUANTITY	DESCRIPTION
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12	COORDINATED POLE MOUNTED SWITCH	1	SWITCH TO MEET THE REQUIREMENTS OF THE UTILITY
13	GROUND ROD	4	3/4" DIAMETER, 10'-0" LONG COPPER CLAD GROUND ROD



1 PARTIAL PLAN - EQUIPMENT PAD DIMENSIONS  
SCALE: 1/2"=1'-0"

PRELIMINARY  
NOT FOR  
CONSTRUCTION



THIS LINE SHOULD  
MEASURE ONE WAY

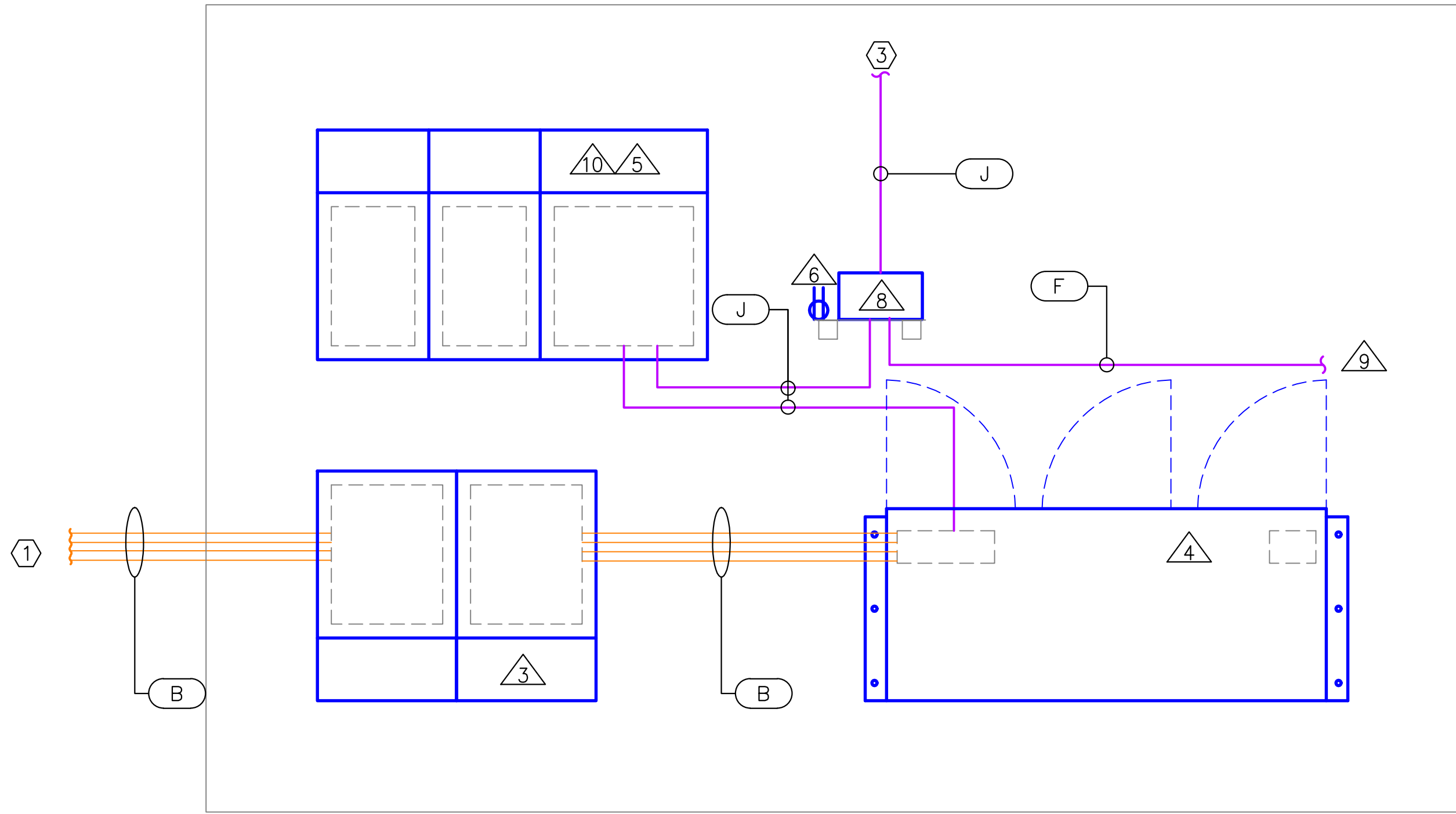
REV.	DATE	DESCRIPTION

TITLE: PARTIAL PLAN - EQUIPMENT PAD DIMENSIONS  
PROJECT: NRECA  
SUNDA REFERENCE DESIGN  
250KW - 600Vdc

DATE: 02.06.2015  
SHEET:

PV3.0





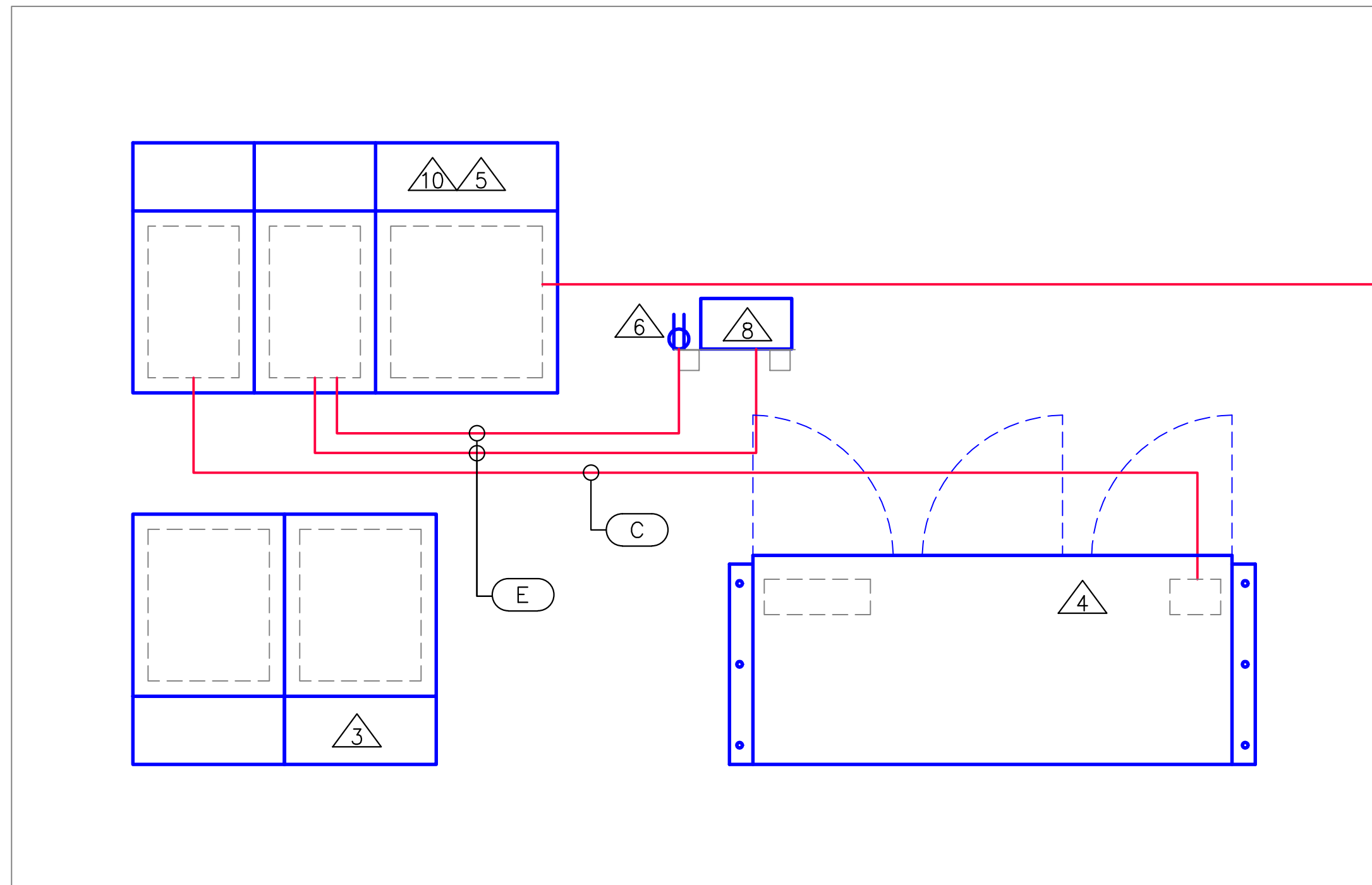
1 PARTIAL PLAN – DC & COMMUNICATION FEEDER ROUTING  
SCALE: 1/2"=1'-0"

LINE TYPE LEGEND

DC FEEDER	
AC FEEDER	
COMMUNICATIONS	
MV FEEDER	

KEYED NOTES:

- REFER TO DC ROUTING PLAN FOR CONTINUATION.
- TO MEDIUM VOLTAGE SWITCH. REFER TO MEDIUM VOLTAGE ROUTING FOR CONTINUATION.
- TO BACK OF MODULE TEMPERATURE SENSOR.

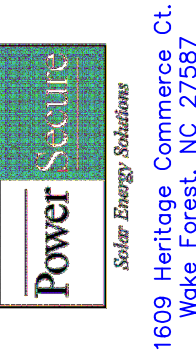
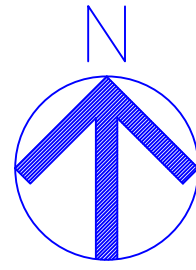


2 PARTIAL PLAN – AC FEEDER ROUTING  
SCALE: 1/2"=1'-0"

FEEDER SCHEDULE													
**FEEDER IS NOTED BY <span style="border: 1px solid black; border-radius: 50%; padding: 2px 10px;">α</span>													
TAG	CONDUCTOR TYPE			CONDUCTOR TYPE	INSULATION TYPE	GROUND SIZE		GROUND TYPE	GROUND INSULATION TYPE	RACEWAY SIZE	RACEWAY QUANTITY	NOTES	
A4	(4)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	3/4" <sup>NOTE 5</sup>	(1)		
A8	(8)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	1-1/4" <sup>NOTE 5</sup>	(1)		
A16	(16)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	1-1/2" <sup>NOTE 5</sup>	(1)		
A20	(20)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	1-1/2" <sup>NOTE 5</sup>	(1)		
A24	(24)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10 PER RACEWAY	COPPER	USE-2	2" <sup>NOTE 5</sup>	(1)		
B	(4)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3 PER RACEWAY	COPPER	THWN-2	3"	(1)		
C	(3)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3 PER RACEWAY	COPPER	THWN-2	2-1/2"	(2)		
D	(3)	300 KCMIL	PER RACEWAY	ALUMINUM	THWN-2					3"	(2)		
	(1)	300 KCMIL	NEU PER RACEWAY	ALUMINUM	THWN-2								
E	(1)	#12	PER RACEWAY	COPPER	THWN-2	(1)	#12 PER RACEWAY	COPPER	THWN-2	3/4"	(1)		
	(1)	#12	NEU PER RACEWAY	COPPER	THWN-2								
F	MANUFACTURED PROVIDED WHIP										3/4"	(1)	
G						(1)	#1/0 PER RACEWAY	COPPER	BARE		(1)		
H						(1)	#3 PER RACEWAY	COPPER	THWN-2	3/4"	(1)		
I <sup>NOTES</sup>	(3)	#1/0	PER RACEWAY	ALUMINUM	MV TR-XLPE WITH CONCENTRIC NEUTRAL					3-1/2"	(1)		
J	BELDEN #3084A												

- NOTES:
- (#) - DENOTES QUANTITY TO BE PROVIDED
  - WHERE MULTIPLE CONDUITS ARE NOTED, THE RACEWAYS SHALL BE PROVIDED IN PARALLEL.
  - REFER TO RACEWAY APPLICATION SCHEDULE FOR RACEWAY TYPE.
  - ALL RACEWAY SIZES ARE NEC MINIMUM REQUIREMENTS, LARGER CONDUITS ARE PERMITTED FOR EASE OF INSTALLATION.
  - PV SOURCE CIRCUITS SHALL NOT BE REQUIRED TO BE IN RACEWAY IF CONDUCTORS ARE NOT READILY ACCESSIBLE AND NOT EXPOSED TO PHYSICAL DAMAGE. BELOW GRADE PV SOURCE CIRCUITS SHALL BE IN RACEWAY.
  - PROVIDE 15KV RATED MEDIUM VOLTAGE FEEDERS WITH 100% INSULATION.

EQUIPMENT SCHEDULE **EQUIPMENT IS NOTED BY $\Delta$			
TAG	DESCRIPTION	QUANTITY	DESCRIPTION
1	SOLAR PV MODULE	1144	305 WATT MODULE (REFER TO DRAWINGS FOR QUANTITY AND LOCATION). MODULES SHALL BE LABELED PER NEC 690 VI.
2	CONTACTOR COMBINER	4	26 STRING DISCONNECTING COMBINER TO CONTAIN 26 STRINGS, RATED AT 400A WITH (26) 15A FUSES, 600 VDC, RATED FOR CONTINUOUS DUTY, WITH DISCONNECT HANDLE MOUNTED ON DOOR EXTERIOR, NEMA 3R ENCLOSURE, TRANSIENT SURGE SUPPRESSION. ENCLOSURE SHALL BE A MINIMUM OF 30" W X 30" H X 8" DEEP.
3	DC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE WITH (4) 400A, 600Vdc CIRCUIT BREAKERS
4	INVERTER	1	250 KWATT, 600VDC, 3 PHASE 480 VAC, NEGATIVLY GROUND CONFIGURATION. (REFER TO INVERTER RATING SCHEDULE FOR ADDITIONAL INFORMATION)
5	AC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE, 800A BUS WITH 400AF/AT MAIN CIRCUIT BREAKER, (1) 400AF/400AT 3 POLE CIRCUIT BREAKER, (1) 15A 3 POLE CIRCUIT BREAKER PROVIDE SURGE PROTECTION, RATED FOR SERVICE ENTRANCE. INTEGRATED REVENUE GRADE METER, INTEGRATED 2KVA STEPDOWN TRANSFORMER WITH CAPACITY FOR (1) 15A SINGLE POLE 120V CIRCUIT BREAKER AND (1) 15A SINGLE POLE 120V CIRCUIT BREAKER.
6	RECEPTACLE	1	120V, 20 AMP, WEATHER PROOF GFI DUPLEX RECEPTACLE.
7	MEDIUM VOLTAGE TRANSFORMER	1	250KVA, THREE PHASE, 12.47KV YGRD/7.2KV PRIMARY AND 480V WYE SECONDARY, LIQUID COOLED TRANSFORMER, BAYONET FUSES ON PRIMARY SIDE. REQUIRED TO MEET UTILITY REQUIREMENTS.
8	PHOTOVOLTAIC PRODUCTION MONITORING EQUIPMENT	1	CENTRAL DATA ACQUISITION UNIT, NEMA 3R ENCLOSURE WITH BATTERY BACK UP, LOCAL DATA STORAGE, INTEGRAL CELL MODEM COMMUNICATIONS, WEB BASED DISPLAY AND LOCAL KEYPAD DISPLAY
9	PHOTOVOLTAIC MONITORING METEOROLOGICAL STATION	1	STATION INCLUDES: PYRANOMETER - PLANE OF ARRAY, BACK OF MODULE TEMPERATURE SENSOR, AMBIENT TEMPERATURE, ANEMOMETER
10	PHOTOVOLTAIC PRODUCTION MONITORING METER	1	REVENUE GRADE METER WITH MODBUS RTU COMMUNICATIONS
11	MEDIUM VOLTAGE FUSED SWITCH	1	15KV PAD MOUNTED SWITCH WITH INTEGRATED 60A STANDARD SPEED FUSES
12	COORDINATED POLE MOUNTED SWITCH	1	SWITCH TO MEET THE REQUIREMENTS OF THE UTILITY
13	GROUND ROD	4	3/4" DIAMETER, 10'-0" LONG COPPER CLAD GROUND ROD



THIS LINE SHOULD MEASURE ONE WAY

REV. DATE DESCRIPTION

TITLE: PARTIAL PLAN – EQUIPMENT PAD FEEDER ROUTING

PROJECT: NRECA SUNDRA REFERENCE DESIGN 250KW – 600Vdc


DATE: 02.06.2015  
SHEET:

PV3.1

PRELIMINARY  
NOT FOR  
CONSTRUCTION

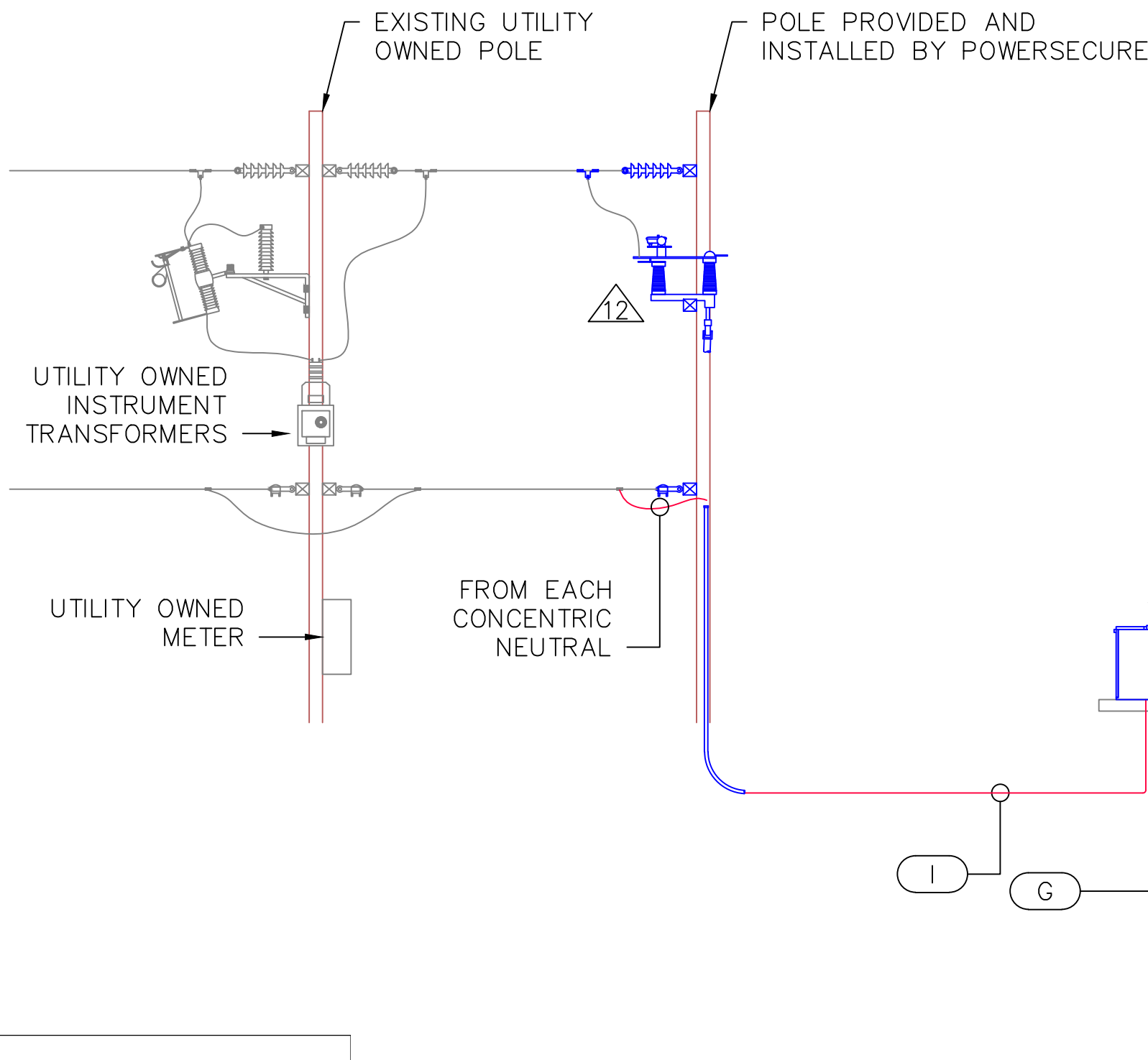









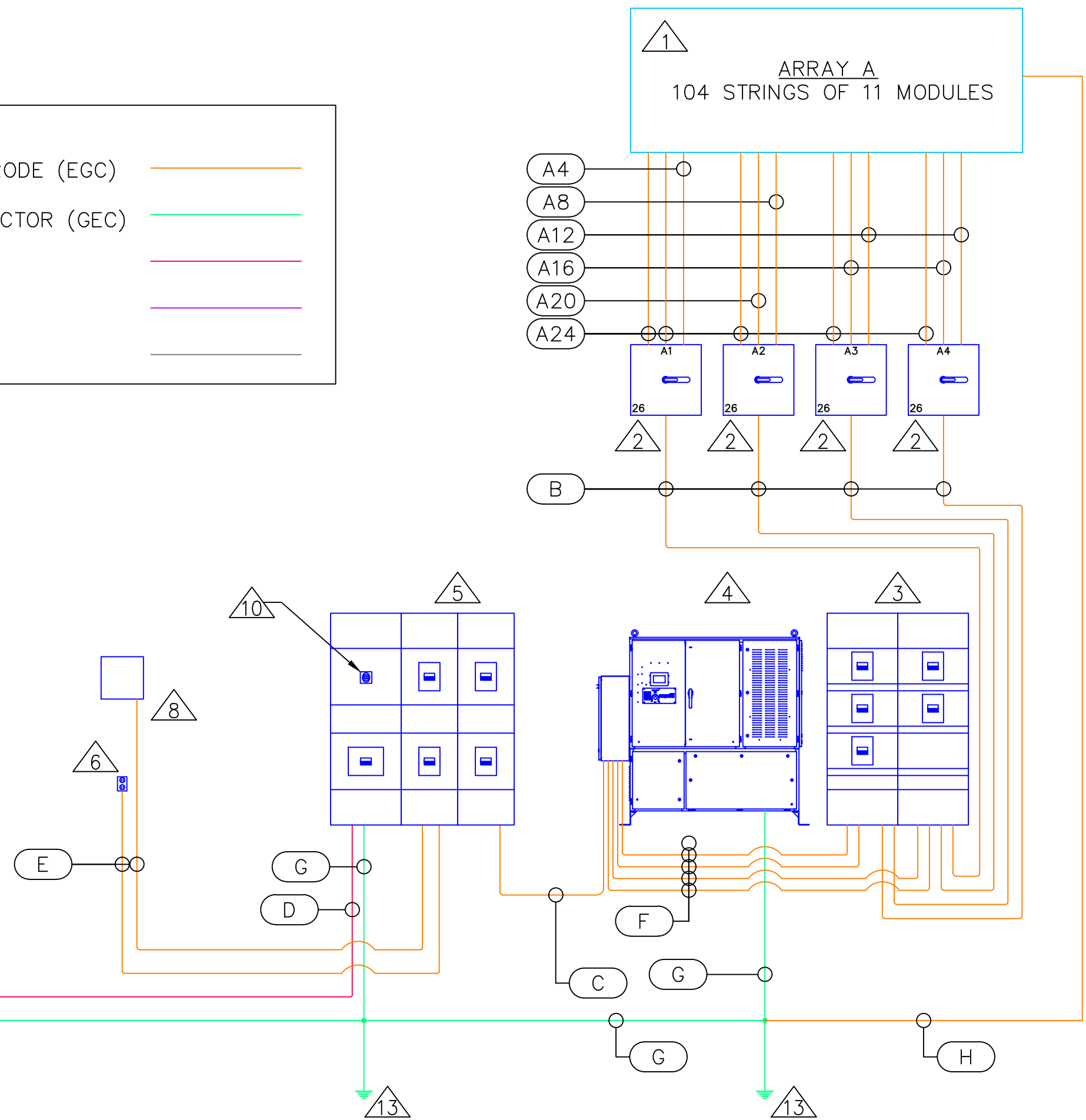
EQUIPMENT SCHEDULE			
**EQUIPMENT IS NOTED BY 			
TAG	DESCRIPTION	QUANTITY	DESCRIPTION
1	SOLAR PV MODULE	1144	305 WATT MODULE (REFER TO DRAWINGS FOR QUANTITY AND LOCATION). MODULES SHALL BE LABELED PER NEC 690 VI.
2	CONTACTOR COMBINER	4	26 STRING DISCONNECTING COMBINER TO CONTAIN 26 STRINGS, RATED AT 400A WITH (26) 15A FUSES, 600 VDC, RATED FOR CONTINUOUS DUTY, WITH DISCONNECT HANDLE MOUNTED ON DOOR EXTERIOR, NEMA 3R ENCLOSURE, TRANSIENT SURGE SUPPRESSION. ENCLOSURE SHALL BE A MINIMUM OF 30" W X 30" H X 8" DEEP.
3	DC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE WITH (4) 400A, 600Vdc CIRCUIT BREAKERS
4	INVERTER	1	250 KWATT, 600VDC, 3 PHASE 480 VAC, NEGATIVLY GROUND CONFIGURATION. (REFER TO INVERTER RATING SCHEDULE FOR ADDITIONAL INFORMATION)
5	AC CIRCUIT BREAKER UNIT	1	NEMA 3R ENCLOSURE, 800A BUS WITH 400AF/AT MAIN CIRCUIT BREAKER, (1) 400AF/400AT 3 POLE CIRCUIT BREAKER, (1) 15A 3 POLE CIRCUIT BREAKER PROVIDE SURGE PROTECTION, RATED FOR SERVICE ENTRANCE. INTEGRATED REVENUE GRADE METER. INTEGRATED 2KVA STEPDOWN TRANSFORMER WITH CAPACITY FOR (1) 15A SINGLE POLE 120V CIRCUIT BREAKER AND (1) 15A SINGLE POLE 120V CIRCUIT BREAKER.
6	RECEPTACLE	1	120V, 20 AMP, WEATHER PROOF GFI DUPLEX RECEPTACLE.
7	MEDIUM VOLTAGE TRANSFORMER	1	250KVA, THREE PHASE, 12.47KV YGRD/7.2KV PRIMARY AND 480V WYE SECONDARY, LIQUID COOLED TRANSFORMER, BAYONET FUSES ON PRIMARY SIDE. REQUIRED TO MEET UTILITY REQUIREMENTS.
8	PHOTOVOLTAIC PRODUCTION MONITORING EQUIPMENT	1	CENTRAL DATA ACQUISITION UNIT, NEMA 3R ENCLOSURE WITH BATTERY BACK UP, LOCAL DATA STORAGE, INTEGRAL CELL MODEM COMMUNICATIONS, WEB BASED DISPLAY AND LOCAL KEYPAD DISPLAY
9	PHOTOVOLTAIC MONITORING METEOROLOGICAL STATION	1	STATION INCLUDES: PYRANOMETER - PLANE OF ARRAY, BACK OF MODULE TEMPERATURE SENSOR, AMBIENT TEMPERATURE, ANEMOMETER
10	PHOTOVOLTAIC PRODUCTION MONITORING METER	1	REVENUE GRADE METER WITH MODBUS RTU COMMUNICATIONS
11	MEDIUM VOLTAGE FUSED SWITCH	1	15KV PAD MOUNTED SWITCH WITH INTEGRATED 60A STANDARD SPEED FUSES
12	COORDINATED POLE MOUNTED SWITCH	1	SWITCH TO MEET THE REQUIREMENTS OF THE UTILITY
13	GROUND ROD	4	3/4" DIAMETER, 10'-0" LONG COPPER CLAD GROUND ROD

FEEDER SCHEDULE												
**FEEDER IS NOTED BY <span>α</span>												
TAG	CONDUCTOR TYPE			CONDUCTOR TYPE	INSULATION TYPE	GROUND SIZE		GROUND TYPE	GROUND INSULATION TYPE	RACEWAY SIZE	RACEWAY QUANTITY <sup>NOTE 2</sup>	
A4	(4)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	3/4" <sup>NOTE 5</sup>	(1)
A8	(8)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	1-1/4" <sup>NOTE 5</sup>	(1)
A16	(16)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	1-1/2" <sup>NOTE 5</sup>	(1)
A20	(20)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	1-1/2" <sup>NOTE 5</sup>	(1)
A24	(24)	#10	PER RACEWAY	COPPER	USE-2	(1)	#10	PER RACEWAY	COPPER	USE-2	2" <sup>NOTE 5</sup>	(1)
B	(4)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3	PER RACEWAY	COPPER	THWN-2	3"	(1)
C	(3)	250 KCMIL	PER RACEWAY	ALUMINUM	THWN-2	(1)	#3	PER RACEWAY	COPPER	THWN-2	2-1/2"	(2)
D	(3)	300 KCMIL	PER RACEWAY	ALUMINUM	THWN-2						3"	(2)
	(1)	300 KCMIL	NEU PER RACEWAY	ALUMINUM	THWN-2							
E	(1)	#12	PER RACEWAY	COPPER	THWN-2	(1)	#12	PER RACEWAY	COPPER	THWN-2	3/4"	(1)
	(1)	#12	NEU PER RACEWAY	COPPER	THWN-2							
F	MANUFACTURED PROVIDED WHIP										3/4"	(1)
G						(1)	#1/0	PER RACEWAY	COPPER	BARE		(1)
H						(1)	#3	PER RACEWAY	COPPER	THWN-2	3/4"	(1)
I <sup>NOTE 6</sup>	(3)	#1/0	PER RACEWAY	ALUMINUM	MV TR-XLPE WITH CONCENTRIC NEUTRAL						3-1/2"	(1)
J	BELDEN #3084A										3/4"	(1)

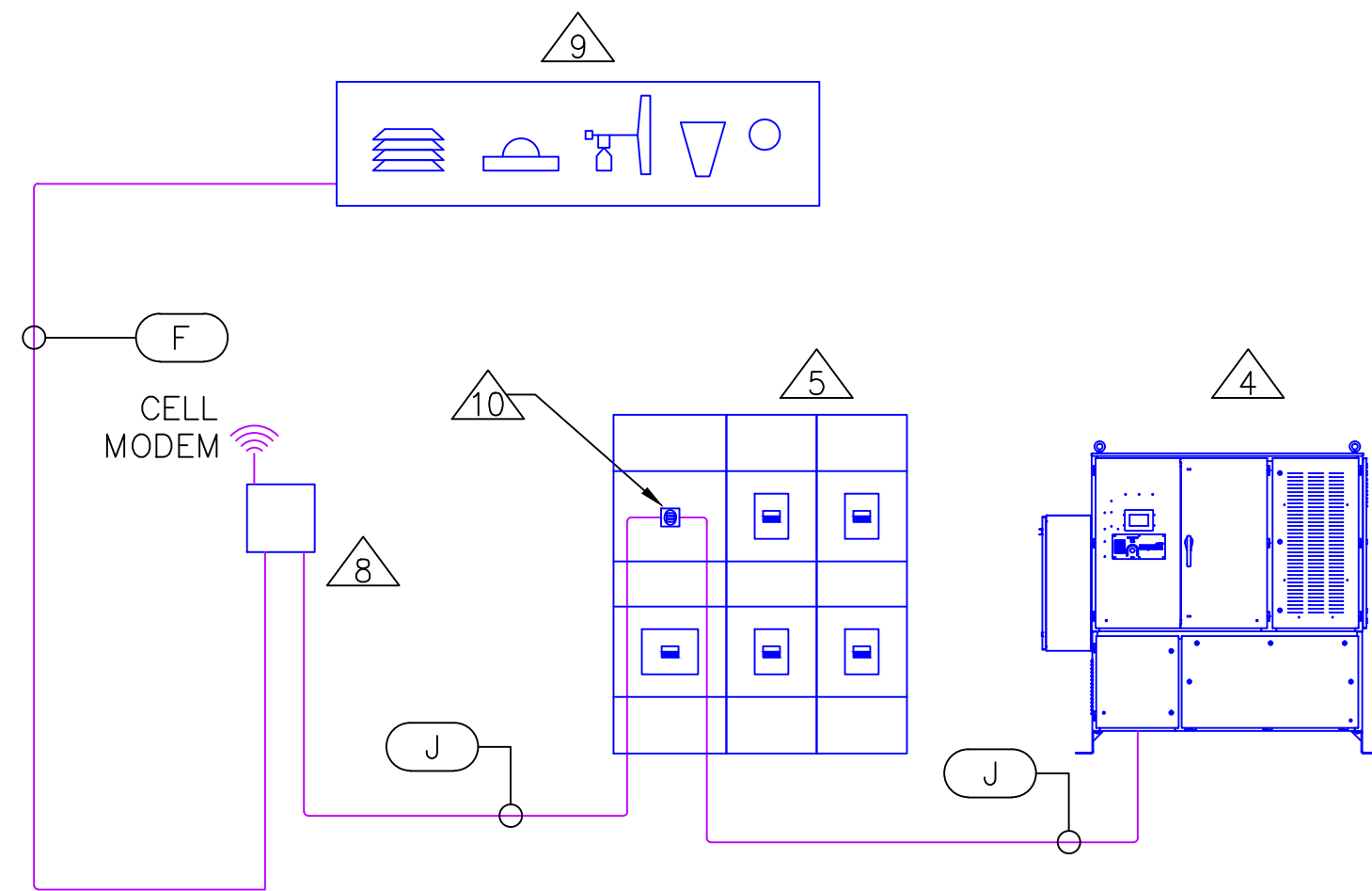
- NOTES:
- (#) - DENOTES QUANTITY TO BE PROVIDED
  - WHERE MULTIPLE CONDUITS ARE NOTED, THE RACEWAYS SHALL BE PROVIDED IN PARALLEL.
  - REFER TO RACEWAY APPLICATION SCHEDULE FOR RACEWAY TYPE.
  - ALL RACEWAY SIZES ARE NEC MINIMUM REQUIREMENTS, LARGER CONDUITS ARE PERMITTED FOR EASE OF INSTALLATION.
  - PV SOURCE CIRCUITS SHALL NOT BE REQUIRED TO BE IN RACEWAY IF CONDUCTORS ARE NOT READILY ACCESSIBLE AND NOT EXPOSED TO PHYSICAL DAMAGE. BELOW GRADE PV SOURCE CIRCUITS SHALL BE IN RACEWAY.
  - PROVIDE 15KV RATED MEDIUM VOLTAGE FEEDERS WITH 100% INSULATION.



LINE TYPE LEGEND	
EQUIPMENT GROUNDING ELECTRODE (EGC)	
GROUNDING ELECTRODE CONDUCTOR (GEC)	
UTILITY NEUTRAL	
COMMUNICATIONS	
PROVIDED BY OTHERS	



1 PV GROUNDING RISER DIAGRAM  
SCALE: NONE



2 PV COMMUNICATIONS RISER DIAGRAM  
SCALE: NONE

PRELIMINARY  
NOT FOR  
CONSTRUCTION

- KEYED NOTES (X)
1. BARBED WIRE.

2. PROVIDE COMPRESSION SPLICE WITH C-TAP TO CONNECT WIRE TO OUTSIDE BARB.

3. PROVIDE EXOTHERMIC WELD TO TOP RAIL.

4. #6 BARE COPPER WIRE, TYPICAL UNLESS NOTED OTHERWISE.

5. PROVIDE COMPRESSION SPLICE WITH C-TAP TO CONNECT WIRE TO FENCE FABRIC.

6. PROVIDE EXOTHERMIC WELD TO FENCE POST.

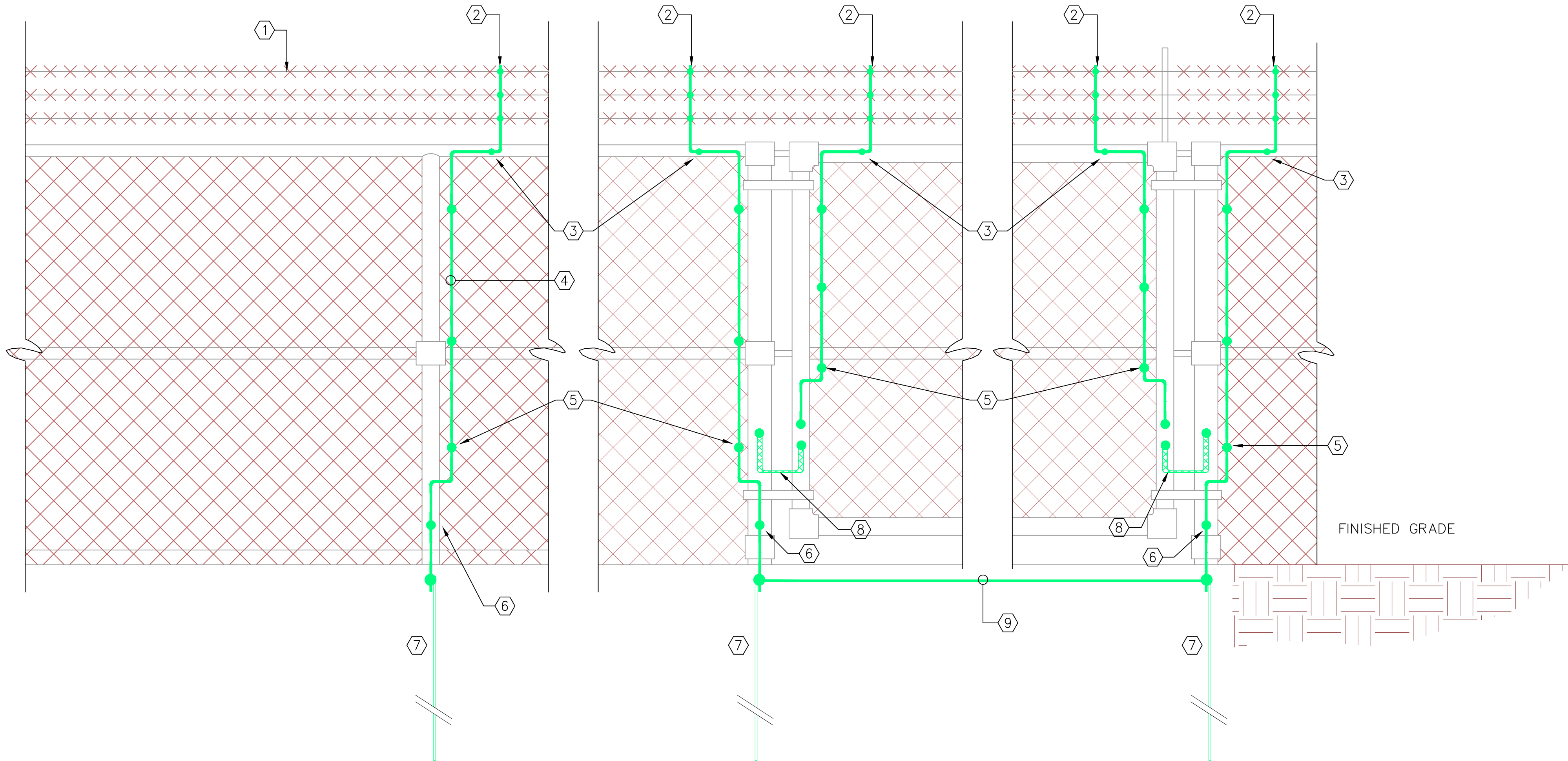
7. 3/4" X 10' COPPER CLAD GROUND ROD BONDED TO BARE COPPER WITH EXOTHERMIC WELD.

8. FLEXIBLE GROUND BRAID SECURED TO GATE WITH EXOTHERMIC WELD.

9. GATES SHALL BE BONDED TOGETHER.
- GENERAL NOTES
1. ALL FENCE GROUNDING POINTS SHALL BE LOCATED WITHIN FENCE PERIMETER.

2. GROUND CORNER POSTS & ADDITIONAL POSTS AT 500' INTERVALS.

3. GROUND ALL GATE POSTS.



PRELIMINARY  
NOT FOR  
CONSTRUCTION

REV.	DATE	DESCRIPTION

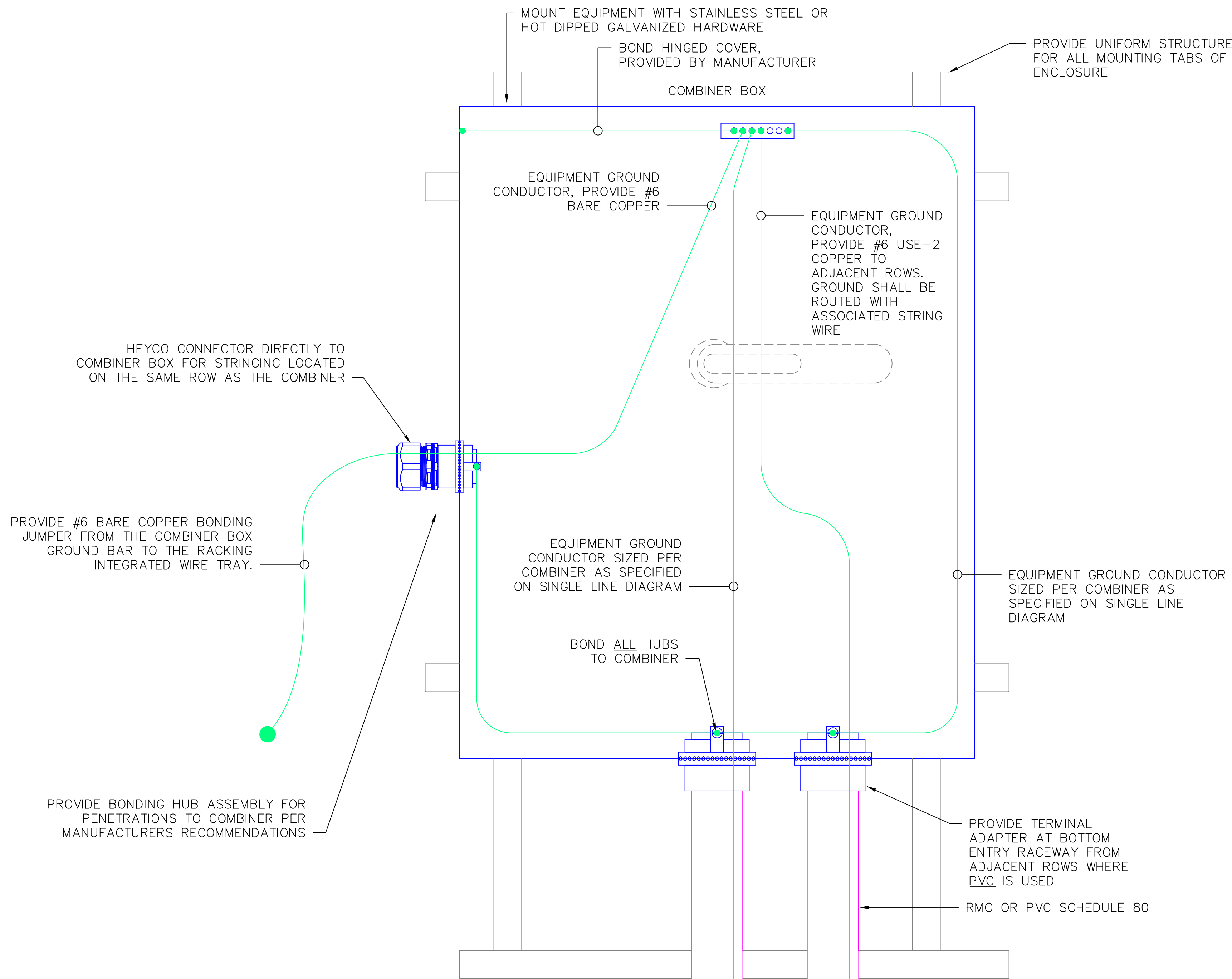
TITLE: FENCE GROUNDING DETAIL

PROJECT: NRECA  
SUNDA REFERENCE DESIGN  
250KW — 600VDC

DATE: 02.06.2015

SHEET:





PRELIMINARY  
NOT FOR  
CONSTRUCTION

REV.	DATE	DESCRIPTION

TITLE:	COMBINER GROUNDING DETAIL
PROJECT:	NRECA SUNDA REFERENCE DESIGN 250KW — 600Vdc

DATE:	02.06.2015
SHEET:	

NOTE  
WHERE SCHEDULE 80 PVC IS PROVIDED BELOW GRADE,  
NO TRANSITION OF RACEWAY SHALL BE REQUIRED  
WHERE EXPOSED TO PHYSICAL DAMAGE.

EQUIPMENT SHOWN GENERICALLY  
TO REPRESENT ANY EQUIPMENT  
MOUNTED IN SUCH A WAY AS TO  
LEAVE RACEWAY EXPOSED

EQUIPMENT SHOWN GENERICALLY TO REPRESENT  
ANY EQUIPMENT MOUNTED IN SUCH A WAY AS TO  
PROTECT RACEWAY FROM EXPOSURE

PROVIDE INSULATED  
THROAT OR BONDING  
BUSHING

RGS (OR SCHEDULE 80 PVC)

THREADS SHALL BE  
SEALED WITH 100%  
SILICONE DURING  
ASSEMBLY

CAP THREADED  
UNION WITH  
INSULATED  
THROAT AND NUT

GLAND PLATE

THREADS SHALL BE SEALED WITH  
100% SILICONE DURING ASSEMBLY

CAP THREADED  
UNION WITH  
INSULATED  
THROAT AND NUT

GLAND PLATE

CONDUIT EXPOSED TO  
PHYSICAL DAMAGE

PROVIDE MASTIC COATING ON PIPE EXTERIOR  
WHERE IN CONTACT WITH CONCRETE

6" CONCRETE SLAB

1  
PV5.1

REFER TO  
NEC T300.5  
FOR MINIMUM  
BURIAL DEPTH

PROVIDE PVC 90° TURN UP WHERE CONDUIT  
NOT EXPOSED TO PHYSICAL DAMAGE

PROVIDE PVC 90° TURN UP WHERE CONDUIT  
NOT EXPOSED TO PHYSICAL DAMAGE

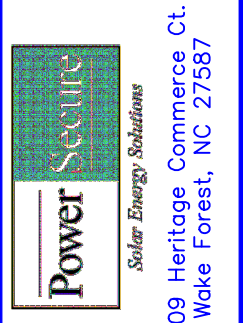
REFER TO NEC T300.5  
FOR MINIMUM BURIAL DEPTH

PROVIDE PVC 90° TURN  
UP AND TRANSITION TO  
RGS VIA PVC THREADED  
CONNECTION WHERE  
CONDUIT EXPOSED TO  
PHYSICAL DAMAGE

SCHEDULE 40 PVC

SCHEDULE 40 PVC

PRELIMINARY  
NOT FOR  
CONSTRUCTION



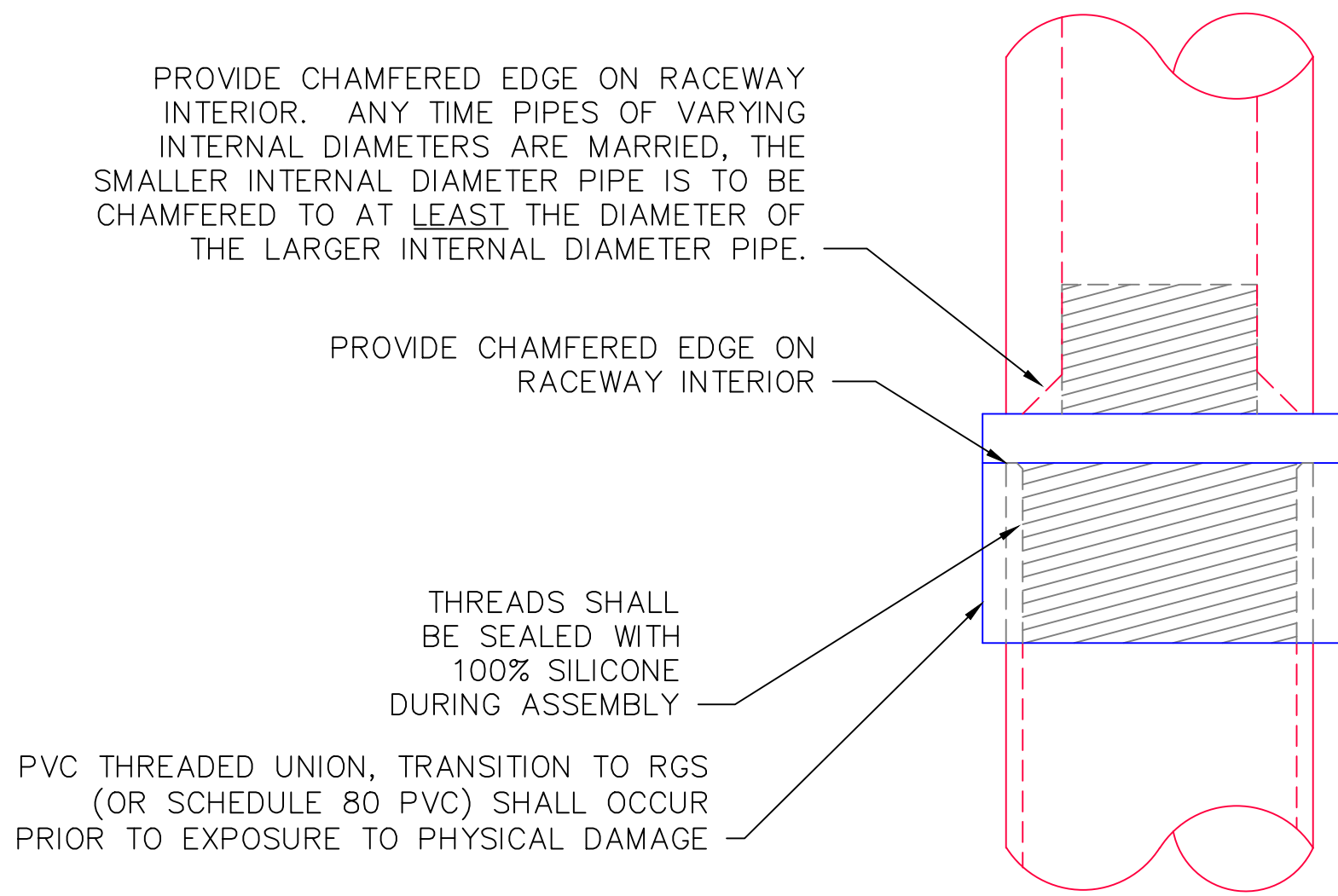
DATE: 02.06.2015  
SHEET: 600VDC  
MEASURE ONE ONLY

REV.	DATE	DESCRIPTION

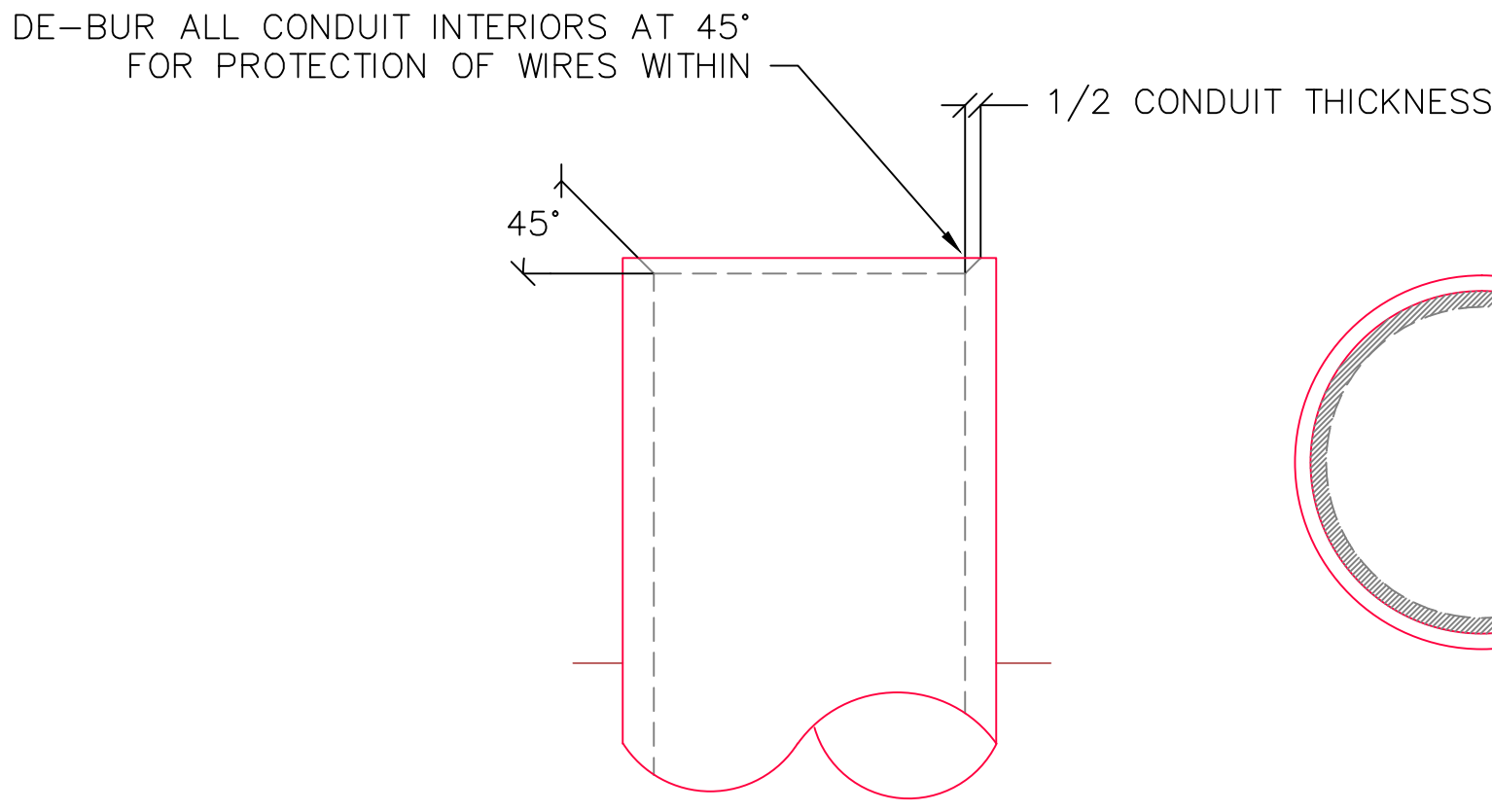
TITLE: CONDUIT STUB UP DETAIL  
PROJECT: NRECA  
SUNDA REFERENCE DESIGN  
250KW — 600VDC

DATE: 02.06.2015  
SHEET:

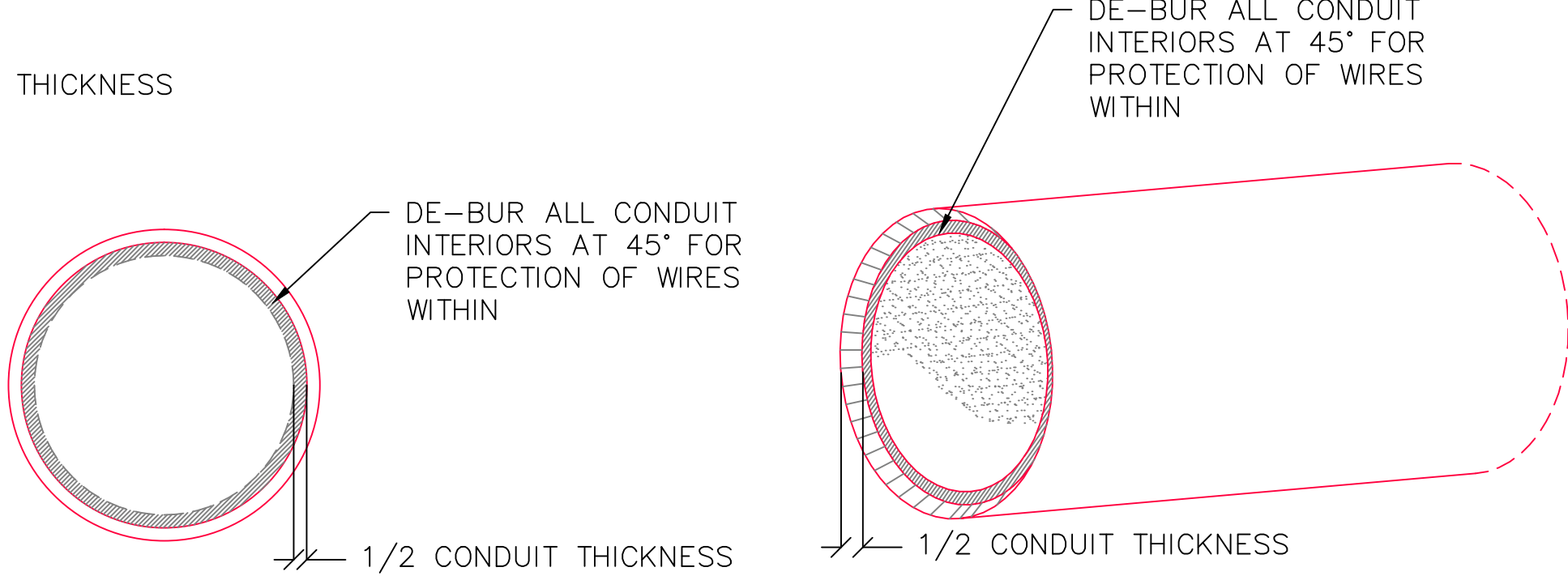
PV5.0



1 CONDUIT MATERIAL TRANSITION DETAIL — PVC TO RGS  
SCALE: NONE



2 CHAMFERED EDGE DETAILS  
SCALE: NONE



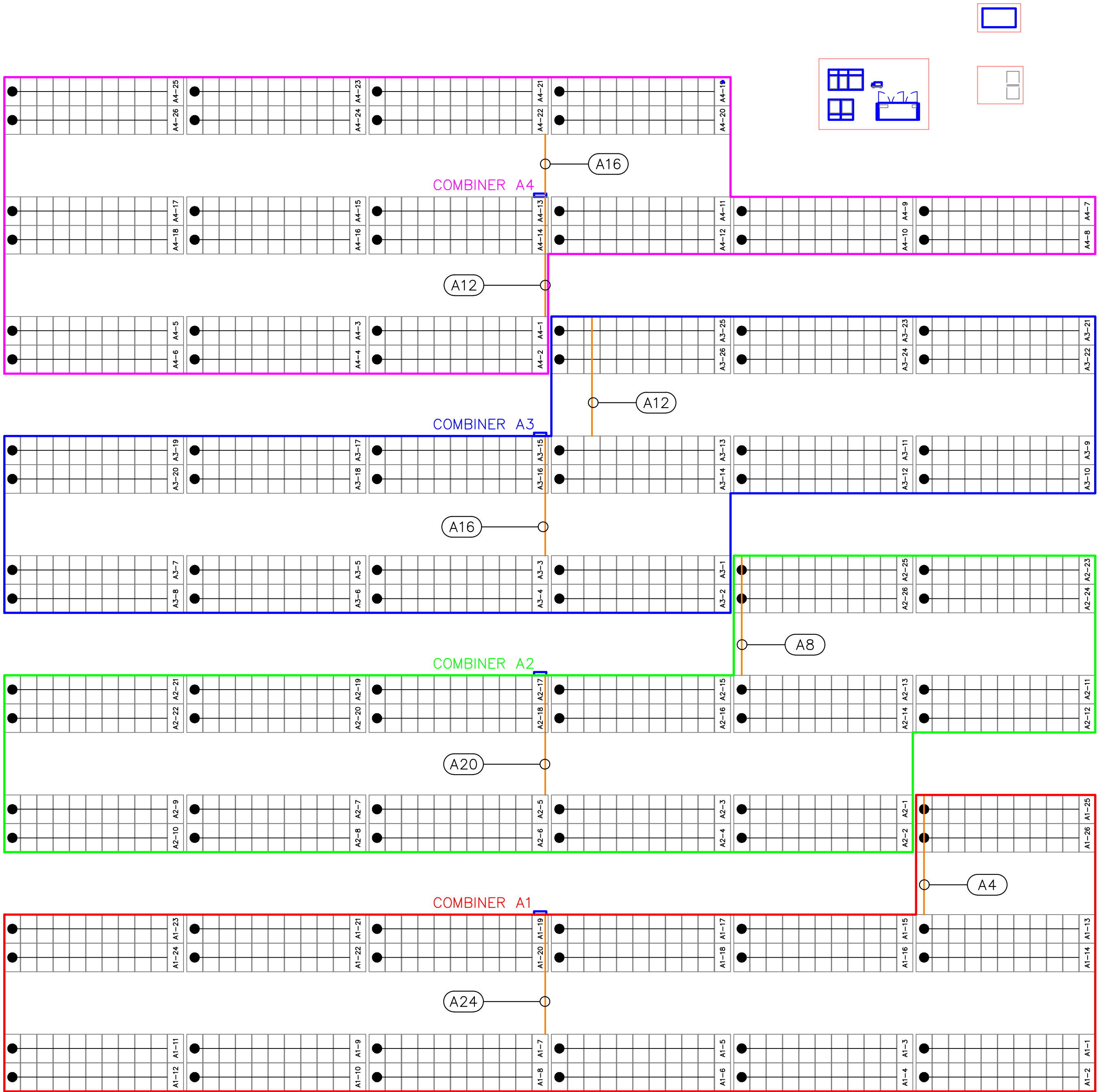
NOTE:  
ALL CHAMFERED EDGE DETAILS APPLY TO  
FIELD-CUT PVC ONLY

PRELIMINARY  
NOT FOR  
CONSTRUCTION

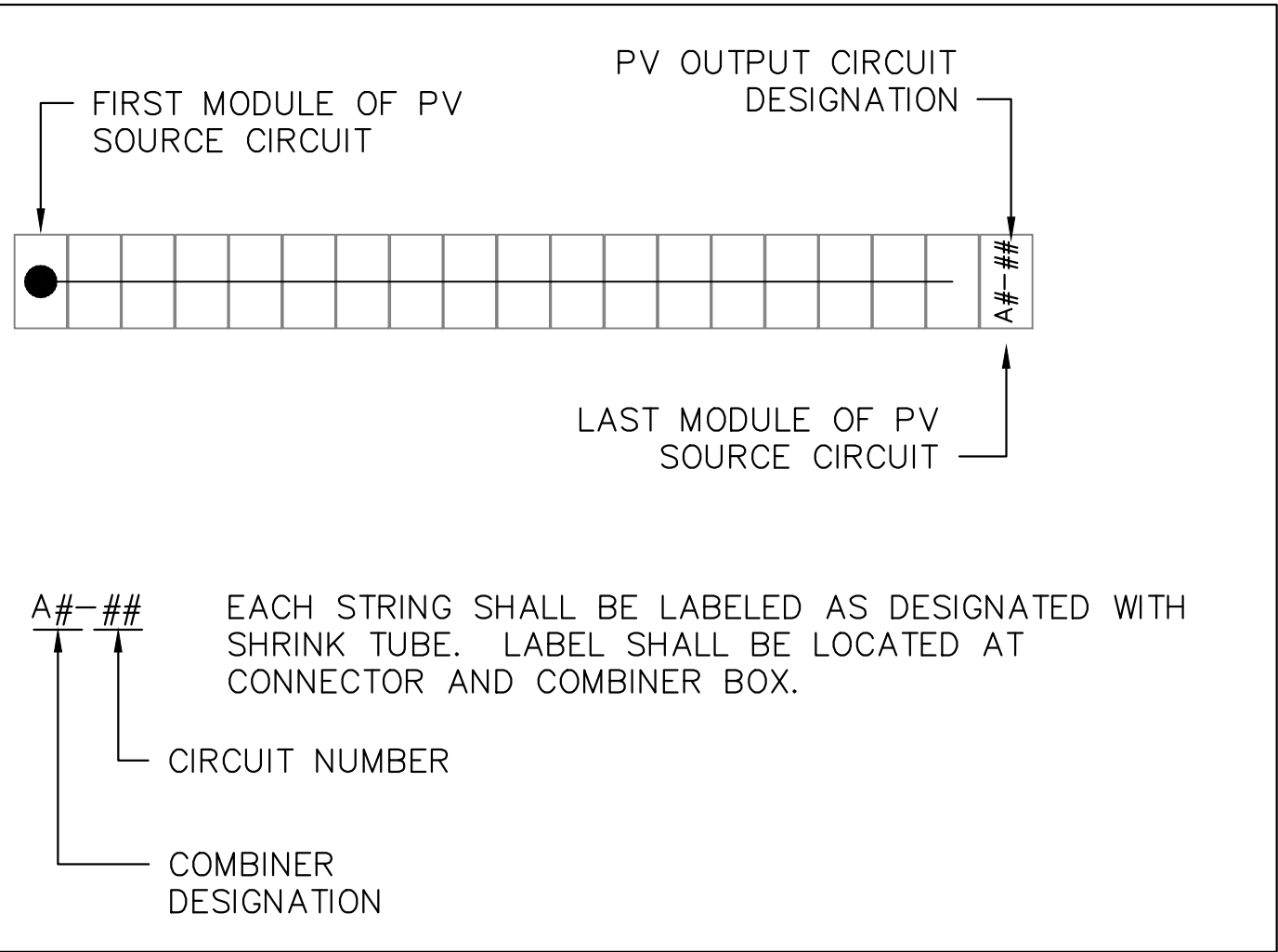
REV.	DATE	DESCRIPTION

TITLE:	CONDUIT DETAILS
PROJECT:	NRECA SUNDA REFERENCE DESIGN 250KW — 600VDC

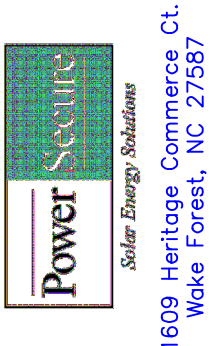
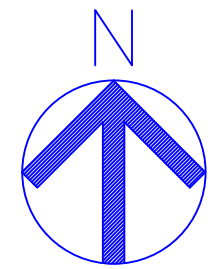
DATE:	02.06.2015
SHEET:	



1 STRINGING PLAN - ARRAY A  
SCALE: 1/16"=1'-0"



PRELIMINARY  
NOT FOR  
CONSTRUCTION



THIS LINE SHOULD  
MEASURE ONE WAY

REV.	DATE	DESCRIPTION

TITLE: STRINGING PLAN - ARRAY A  
PROJECT: NRECA  
SUNDA REFERENCE DESIGN  
250KW - 600Vdc

DATE: 02.06.2015  
SHEET:

PV6.0