October 17, 2019

Sunrun Inc.
133 Technology Dr, Suite 100
Irvine, CA, 92618

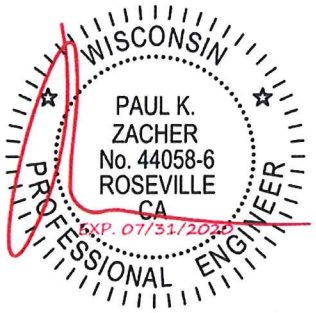
Attn.: To Whom It May Concern

re: Job 19-10872 : Stephen Green - 701R-126GREE

The following calculations are for the structural engineering design of the photovoltaic panels located at 124-126 McCall St., Waukesha, WI 53186. After review, PZSE, Inc. certifies that the roof structure lacks sufficient structural capacity for the applied PV loads. See the following calculations and Plan Sheets for location and repair to bring the roof structure up to the required capacity. Seismic analysis not required per IBC 1613.1 as the current structure is located in Seismic Design Category (SDC) B, with a mapped short period spectral response acceleration, Ss, of 0.089g < 0.4g

If you have any questions on the above, do not hesitate to call.

Prepared By:
PZSE, Inc. - Structural Engineers
Roseville, CA



Gravity Loading

Roof Snow Load Calculations		
p_g = Ground Snow Load =	30 psf	
C_e = Exposure Factor =	0.9	(ASCE7 - Table 7-2)
C_t = Thermal Factor =	1.1	(ASCE7 - Table 7-3)
I = Importance Factor =	1	
$p_f = 0.7\ C_e\ C_t\ I\ p_g$	30 psf	(ASCE7 - Eq 7-1)
where $p_g \leq 20$ psf, P_f min = I x p_g =	N/A	
where $p_g > 20$ psf, P_f min = 20 x I =	N/A	
Per ASCE 7-05, minimum values of Pf shall apply to hip and gable roofs with slopes less than the larger of 2.38° and (70/W)+0.5.		
Therefore, p_f = Flat Roof Snow Load =	30 psf	
$p_s = C_s p_f$		(ASCE7 - Eq 7-2)
Cs = Slope Factor =	1.000	ARRAY 1
Cs = Slope Factor =	1.000	ARRAY 2
Ps = Sloped Roof Snow Load =	**30.0 psf**	ARRAY 1
Ps = Sloped Roof Snow Load =	**30.0 psf**	ARRAY 2
PV Dead Load = 3 psf (Per Sunrun Inc.)		

Roof Live Load =	**20.00**	**psf**	ARRAY 1
Roof Live Load =	**20.00**	**psf**	ARRAY 2

Note: Roof live load is removed in area's covered by PV array.

Roof Dead Load ARRAY 1		
Composition Shingle	2.00	
Roof Plywood	1.50	
2x6 Top Chords @ 24"o.c.	0.76	
Vaulted Ceiling	0.00	Ceiling Not Vaulted
Miscellaneous	0.00	
Total Roof DL ARRAY 1	**4.3 psf**	
DL Adjusted to 16 Degree Slope	4.4 psf	

Roof Dead Load ARRAY 2		
Composition Shingle	2.00	
Roof Plywood	1.50	
Double 2x6 Top Chords @ 24"o.c.	1.51	
Vaulted Ceiling	0.00	Ceiling Not Vaulted
Miscellaneous	0.99	
Total Roof DL ARRAY 2	**6.0 psf**	
DL Adjusted to 15 Degree Slope	6.2 psf	

Wind Calculations

Per ASCE 7-05 Components and Cladding

Input Variables	
Wind Speed	90 mph
Exposure Category	C
Roof Shape	Gable
Roof Slope	16 degrees
Mean Roof Height	22 ft
Building Least Width	62 ft
Effective Wind Area	13.0 sf
Roof Zone Edge Distance, a	6.2 ft
Controlling C&C Wind Zone	Zone 3

Design Wind Pressure Calculations		
Wind Pressure P = qh*(G*Cp)		
qh = 0.00256 * Kz * Kzt * Kd * V^2 * I		(Eq_6-15)
Kz (Exposure Coefficient) =	0.916	(Table 6-3)
Kzt (topographic factor) =	1	(Fig. 6-4)
Kd (Wind Directionality Factor) =	0.85	(Table 6-4)
V (Design Wind Speed) =	90 mph	
Importance Factor =	1	(Table 6-1)
qh =	16.1 psf	

Standoff Uplift Calculations	Zone 1	Zone 2	Zone 3	Positive	
GCp =	-0.90	-1.68	-2.58	0.49	
Uplift Pressure =	-14.48 psf	-27.18 psf	-41.65 psf	10.00 psf	(Minimum)
Attachment Dead Load =	2.70 psf	2.70 psf	2.70 psf		
Max Rail Span Length =	4.00	4.00	4.00		
Longitudinal Length =	3.25	3.25	3.25		
Attachment Tributary Area =	13.00	13.00	13.00		
Attachment Uplift =	-167.00	-332.00	-520.00		

Lag Screw Uplift Capacity Check		
Fastener =	5/16	inch
Number of Fasteners =	1	
Minimum Threaded Embedment Depth =	2.5	inch
Withdraw Capacity Per Inch =	205 lb	(NDS Eq 11.2.1)
Allowable Withdraw Capacity =	820 lb	(NDS Eq 10.3.1)
820 lb capacity > 520 lb demand	**Therefore, OK**	

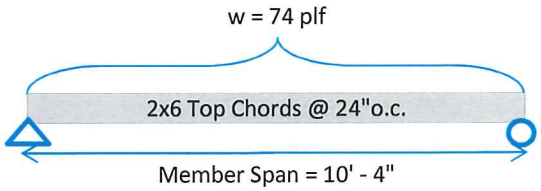
Lag Screw Shear Capacity Check		
Embedment Depth Reduction Factor	1	
Lateral Force from Gravity Loads=	118 lb	
Attachment Lateral Capacity =	**288 lb**	(NDS Table 11K)
288 lb capacity > 118 lb demand	**Therefore, OK**	

Framing Check

ARRAY 1

PASS

Dead Load	4.4 psf
PV Load	2.7 psf
Snow Load	30.0 psf



Governing Load Comb. DL + SL

Total Load **37.1 psf**

Note: Attachments shall be Staggered.

Member Properties

Member Size	S (in^3)	I (in^4)	Lumber Sp/Gr	Member Spacing
2x6	7.56	20.80	SPF#2	@ 24"o.c.

Check Bending Stress

Fb (psi) =	f'b	x	Cd	x	Cf	x	Cr	(NDS Table 4.3.1)
	875	x	1.15	x	1.3	x	1.15	

Allowed Bending Stress = 1504.3 psi

Maximum Moment = (wL^2) / 8
= 990.364 ft#
= 11884.4 in#

Actual Bending Stress = (Maximum Moment) / S
= 1571.5 psi

104.5% Stressed -- Passes as less than 5% over per 2009 IBC CH34. Therefore, OK

Check Deflection

Allowed Deflection (Total Load) = L/180 (E = 1400000 psi Per NDS)
= 0.688 in

Deflection Criteria Based on = Continuous Span

Actual Deflection (Total Load) = (w*L^4) / (185*E*I)
= 0.199 in
= L/624 < L/180 **Therefore OK**

Allowed Deflection (Live Load) = L/240
0.516 in

Actual Deflection (Live Load) = (w*L^4) / (185*E*I)
0.220 in
L/564 < L/240 **Therefore OK**

Check Shear

Member Area = 8.3 in^2 Fv (psi) = 135 psi (NDS Table 4A)

Allowed Shear = Fv * A = 1114 lb Max Shear (V) = w * L / 2 = 383 lb

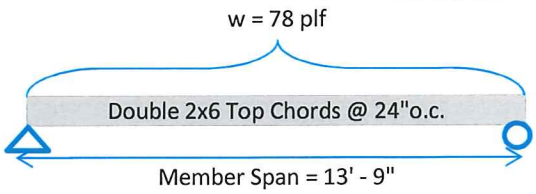
Allowed > Actual -- 34.5% Stressed -- Therefore, OK

Framing Check

ARRAY 2

PASS - With Framing Upgrades

Dead Load	6.2 psf
PV Load	2.7 psf
Snow Load	30.0 psf



Governing Load Comb. DL + SL
Total Load **38.9 psf**

Note: Attachments shall be Staggered.

Member Properties - Based on Upgraded Section

Member Size	S (in^3)	I (in^4)	Lumber Sp/Gr	Member Spacing
Double 2x6	15.13	41.59	SPF#2	@ 24"o.c.

Check Bending Stress

Fb (psi) =	f'b	x	Cd	x	Cf	x	Cr	(NDS Table 4.3.1)
	875	x	1.15	x	1.3	x	1.15	

Allowed Bending Stress = 1504.3 psi

Maximum Moment = (wL^2) / 8
= 1838.63 ft#
= 22063.6 in#

Actual Bending Stress = (Maximum Moment) / S
= 1458.8 psi

Allowed > Actual -- 97% Stressed -- Therefore, OK

Check Deflection

Allowed Deflection (Total Load) = L/180 (E = 1400000 psi Per NDS)
= 0.916 in

Deflection Criteria Based on = Continuous Span
Actual Deflection (Total Load) = (w*L^4) / (185*E*I)
= 0.332 in
= L/497 < L/180 **Therefore OK**

Allowed Deflection (Live Load) = L/240
0.687 in

Actual Deflection (Live Load) = (w*L^4) / (185*E*I)
0.345 in
L/479 < L/240 **Therefore OK**

Check Shear

Member Area = 16.5 in^2 Fv (psi) = 135 psi (NDS Table 4A)
Allowed Shear = Fv * A = 2228 lb Max Shear (V) = w * L / 2 = 535 lb

Allowed > Actual -- 24.1% Stressed -- Therefore, OK

October 17, 2019

Sunrun Inc.
133 Technology Dr, Suite 100
Irvine, CA, 92618

Subject: Structural Certification for Installation of Solar Panels
Job Number: 19-10872
Client: Stephen Green - 701R-126GREE
Address: 124-126 McCall St., Waukesha, WI 53186

Attn.: To Whom It May Concern

A field observation of the condition of the existing framing system was performed by an audit team from Sunrun Inc..
From the field observation of the property, the existing roof structure was observed as follows:
The existing roof structure consists of:

- Composition Shingle over Roof Plywood is supported by 2x6 @ 24"o.c. SPF#2 at ARRAY 1. The top chords are sloped at approximately 16 degree and have a maximum projected horizontal span of 10 ft 4 in between load bearing supports.
- Composition Shingle over Roof Plywood is supported by 2x6 @ 24"o.c. SPF#2 at ARRAY 2. The top chords are sloped at approximately 15 degree and have a maximum projected horizontal span of 13 ft 9 in between load bearing supports.

Design Criteria:

- Applicable Codes = 2009 IBC, ASCE 7-05, and NDS-05
- Ground Snow Load = 30 psf; Roof Snow Load = 30 psf ARRAY 1 ; 30 psf ARRAY 2
- Roof Dead Load = 4.4 psf ARRAY 1 ; 6.2 psf ARRAY 2
- Basic Wind Speed = 90 mph Exposure Category C

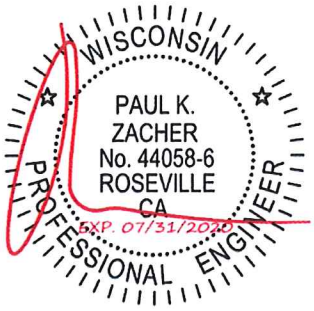
As a result of the completed field observation and design checks:

- ARRAY 1: is adequate to support the loading imposed by the installation of solar panels and modules. Therefore, no structural upgrades are required.
- ARRAY 2: New 2x6 SPF#2 are required to be sistered to the existing roof rafters to support the additional loading. After upgrades, the roof is adequate to support the loading imposed by the installation of solar panel and modules.

I certify that the capacity of the structural roof framing that directly supports the additional gravity loading due to the solar panel supports and modules had been reviewed and determined to meet or exceed the requirements with structural upgrade in accordance with the 2009 IBC.

If you have any questions on the above, do not hesitate to call.

Prepared By:
PZSE, Inc. - Structural Engineers
Roseville, CA



SOLAR'S MOST TRUSTED REC

REC TWINPEAK 2 SERIES

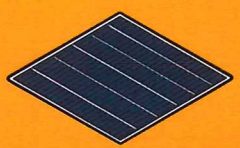
PREMIUM SOLAR PANELS 100% MADE IN SINGAPORE

REC TwinPeak 2 Series solar panels feature an innovative design with high panel efficiency and power output, enabling customers to get the most out of the space used for the installation.

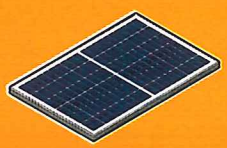
Combined with industry-leading product quality and the reliability of a strong and established European brand, REC TwinPeak 2 panels are ideal for residential and commercial rooftops worldwide.

INTEGRATED MANUFACTURING IN SINGAPORE

WAFERS

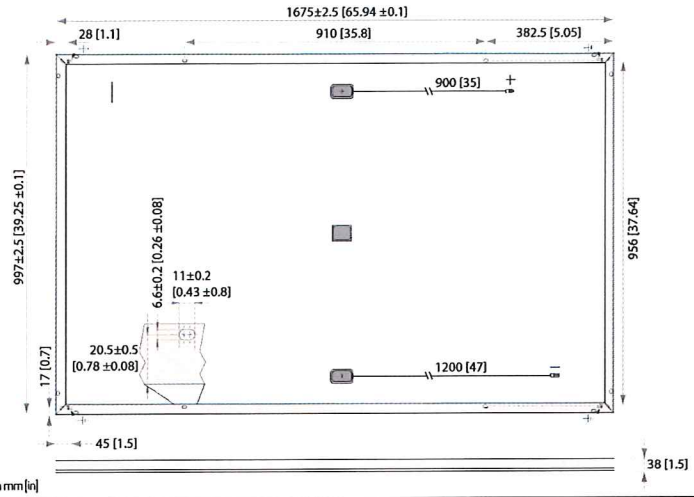


CELLS



MODULES

REC TWINPEAK 2 SERIES



Measurements in mm [in]

ELECTRICAL DATA @ STC	Product Code*: RECxxxTP2				
Nominal Power - P_{MPP} (Wp)	275	280	285	290	295
Watt Class Sorting - (W)	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage - V_{MPP} (V)	31.5	31.7	31.9	32.1	32.3
Nominal Power Current - I_{MPP} (A)	8.74	8.84	8.95	9.05	9.14
Open Circuit Voltage - V_{OC} (V)	38.2	38.4	38.6	38.8	39.0
Short Circuit Current - I_{SC} (A)	9.52	9.61	9.66	9.71	9.76
Panel Efficiency (%)	16.5	16.8	17.1	17.4	17.7

Values at standard test conditions STC (airmass AM 1.5, irradiance 1000 W/m², cell temperature 25°C).
At low irradiance of 200 W/m² (AM 1.5 and cell temperature 25°C) at least 95% of the STC module efficiency will be achieved.
*Where xxx indicates the nominal power class (P_{MPP}) at STC above, and can be followed by the suffix BLK for black framed modules.

ELECTRICAL DATA @ NOCT	Product Code*: RECxxxTP2				
Nominal Power - P_{MPP} (Wp)	206	210	214	218	223
Nominal Power Voltage - V_{MPP} (V)	29.2	29.4	29.6	29.8	30.0
Nominal Power Current - I_{MPP} (A)	7.07	7.15	7.24	7.32	7.43
Open Circuit Voltage - V_{OC} (V)	35.4	35.6	35.8	36.0	36.2
Short Circuit Current - I_{SC} (A)	7.52	7.59	7.68	7.75	7.85

Nominal operating cell temperature NOCT (800 W/m², AM 1.5, windspeed 1 m/s, ambient temperature 20°C).
*Where xxx indicates the nominal power class (P_{MPP}) at STC above, and can be followed by the suffix BLK for black framed modules.

CERTIFICATIONS

UL 1703, Fire classification Type 2; IEC 61215, IEC 61730, IEC 61701 (Salt Mist - severity level 6), IEC 62804 (PID Free), IEC 62716 (Ammonia Resistance), ISO 11925-2 (Ignitability Class 1), UNI 8457/9174 (Class A), ISO 9001:2015, ISO 14001, OHSAS 18001

WARRANTY

10 year product warranty
25 year linear power output warranty
(max. degression in performance of 0.7% p.a. from 97% after the first year)

See warranty conditions for further details.

17.7% EFFICIENCY

10 YEAR PRODUCT WARRANTY

25 YEAR LINEAR POWER OUTPUT WARRANTY

DUTY*FREE US IMPORT DUTY FREE

TEMPERATURE RATINGS

Nominal operating cell temperature (NOCT)	44.6°C (±2°C)
Temperature coefficient of P_{MPP}	-0.36 %/°C
Temperature coefficient of V_{OC}	-0.30 %/°C
Temperature coefficient of I_{SC}	0.066 %/°C

GENERAL DATA

Cell type:	6 strings of 20 REC HC multicrystalline PERC
Glass:	0.13" (3.2 mm) solar glass with anti-reflective surface treatment
Back sheet:	Highly resistant polyester polyolefin construction
Frame:	Anodized aluminum (Available in silver or black)
Junction box:	IP67 rated, 3-part with 3 bypass diodes 12 AWG (4 mm²) PV wire, 35" + 47" (0.9 m + 1.2 m)
Connectors:	Stäubli MC4 PV-KBT4/PV-KST4, 12 AWG (4 mm²)
Origins:	Silicon: Made in USA & Norway Wafer/Cell/Module: Made in Singapore

MAXIMUM RATINGS

Operational temperature:	-40 ... +185°F (-40 ... +85°C)
Maximum system voltage:	1000 V
Design Loads:	(+) 75.2 lbs/ft² (3600 Pa) (-) 33.4 lbs/ft² (1600 Pa) Refer to installation manual
Max series fuse rating:	20 A
Max reverse current:	20 A

MECHANICAL DATA

Dimensions:	65.9 x 39.25 x 1.5 (1675 x 997 x 38 mm)
Area:	17.98 ft² (1.67 m²)
Weight:	40.8 lbs (18.5 kg)

Note! Specifications subject to change without notice.

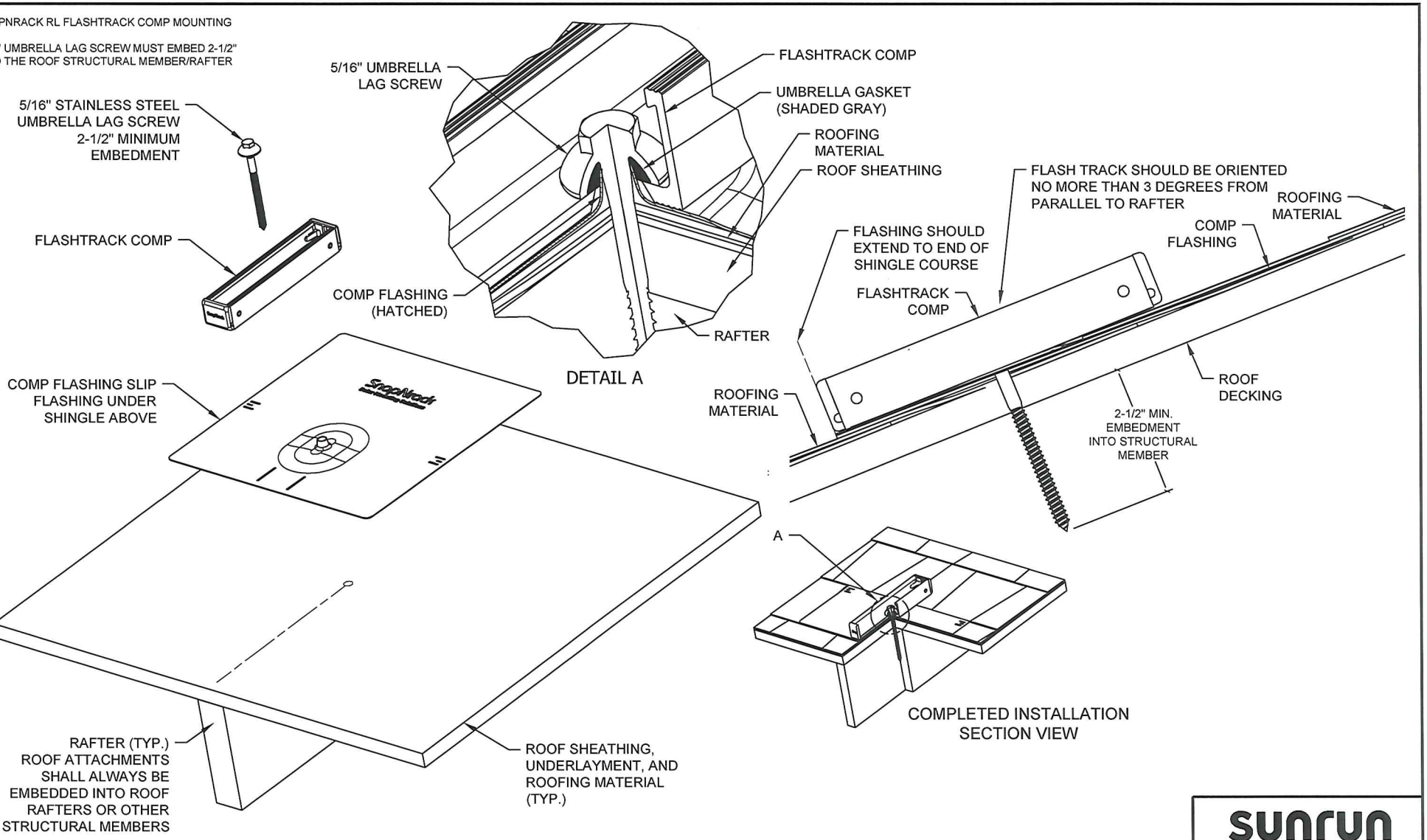
Ref: NE-05-07-07 Rev- F 06.17

REC

www.recgroup.com

SNAPNRACK RL FLASHTRACK COMP MOUNTING

5/16" UMBRELLA LAG SCREW MUST EMBED 2-1/2" INTO THE ROOF STRUCTURAL MEMBER/RAFTER



PENETRATION DETAIL, FLASHTRACK COMP - RAILESS 1.5

sunrun

REV DATE 2/28/2018

PAGE SNAPNRACK MOUNTING DETAIL

INVERTERS

Single Phase Inverter
with HD-Wave Technology for North America

SE3000H-US / SE3800H-US / SE5000H-US /
SE6000H-US / SE7600H-US / SE10000H-US / SE11400H-US

Optimized installation with HD-Wave technology

- Specifically designed to work with power optimizers
- Record-breaking efficiency
- Fixed voltage inverter for longer strings
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Extremely small
- High reliability without any electrolytic capacitors
- Built-in module-level monitoring
- Outdoor and indoor installation
- Optional: Revenue grade data, ANSI C12.20 Class 0.5 (0.5% accuracy)

HD wave

www.solaredge.us

Single Phase Inverter
with HD-Wave Technology for North America

SE3000H-US / SE3800H-US / SE5000H-US /
SE6000H-US/ SE7600H-US / SE10000H-US / SE11400H-US

	SE3000H-US	SE3800H-US	SE5000H-US	SE6000H-US	SE7600H-US	SE10000H-US	SE11400H-US	
OUTPUT								
Rated AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400	VA
Max. AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400	VA
AC Output Voltage Min.-Nom.-Max. (183 - 208 - 229)	-	✓	-	✓	-	-	-	Vac
AC Output Voltage Min.-Nom.-Max. (211 - 240 - 264)	✓	✓	✓	✓	✓	✓	✓	Vac
AC Frequency (Nominal)	59.3 - 60 - 60.5[1]							Hz
Maximum Continuous Output Current 208V	-	16	-	24	-	-	-	A
Maximum Continuous Output Current @240V	12.5	16	21	25	32	42	47.5	A
GFDI Threshold	1							A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes							
INPUT								
Maximum DC Power @240V	4650	5900	7750	9300	11800	15500	17650	W
Maximum DC Power @208V	-	5100	-	7750	-	-	-	
Transformer-less, Ungrounded	Yes							
Maximum Input Voltage	480							Vdc
Nominal DC Input Voltage	380				400			Vdc
Maximum Input Current 208V	-	9	-	13.5	-	-	-	
Maximum Input Current @240V	8.5	10.5	13.5	16.5	20	27	30.5	Adc
Max. Input Short Circuit Current	45							Adc
Reverse-Polarity Protection	Yes							
Ground-Fault Isolation Detection	600kΩ Sensitivity							
Maximum Inverter Efficiency	99	99.2						%
CEC Weighted Efficiency	99							%
Nighttime Power Consumption	< 2.5							W
ADDITIONAL FEATURES								
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional), Cellular (optional)							
Revenue Grade Data, ANSI C12.20	Optional[2]							
Rapid Shutdown - NEC 2014 and 2017 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect							
STANDARD COMPLIANCE								
Safety	UL1741, UL1741 SA, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07							
Grid Connection Standards	IEEE1547, Rule 21, Rule 14 (HI)							
Emissions	FCC Part 15 Class B							
INSTALLATION SPECIFICATIONS								
AC Output Conduit Size / AWG Range	3/4" minimum / 14-6 AWG					3/4" minimum /14-4 AWG		
DC Input Conduit Size / # of Strings / AWG Range	3/4" minimum / 1-2 strings / 14-6 AWG					3/4" minimum / 1-3 strings / 14-6 AWG		
Dimensions with Safety Switch (HxWxD)	17.7 x 14.6 x 6.8 / 450 x 370 x 174					21.3 x 14.6 x 7.3 / 540 x 370 x 185		in / mm
Weight with Safety Switch	22 / 10		25.1 / 11.4	26.2 / 11.9		38.8 / 17.6		lb / kg
Noise	< 25				<50			dBA
Cooling	Natural Convection				Natural convection			
Operating Temperature Range	-13 to +140 / -25 to +60[3] (-40˚F / -40˚C option)[4]							˚F / ˚C
Protection Rating	NEMA 3R (Inverter with Safety Switch)							

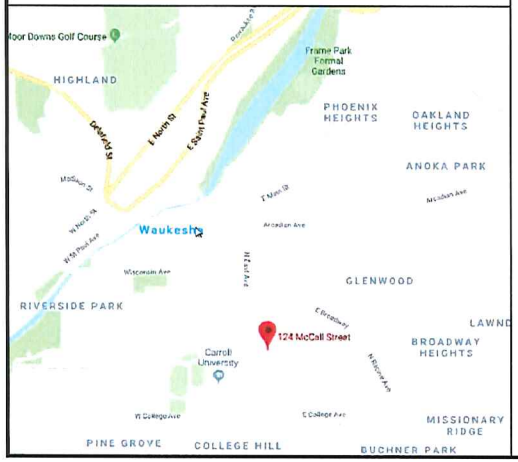
[1] For other regional settings please contact SolarEdge support
[2] Revenue grade inverter P/N: SExxxxH-US000NNC2
[3] For power de-rating information refer to: https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf
[4] -40 version P/N: SExxxxH-US000NNU4

RoHS

SCOPE OF WORK

- **SYSTEM SIZE:** 8990W DC, 7600W AC
- **MODULES:** (31) REC SOLAR: REC290TP2 BLK
- **INVERTER(S):**
  (1) SOLAREDGE TECHNOLOGIES: SE7600H-US WITH REVENUE GRADE METERING
- **RACKING:** SNAPNRACK RL; FLASHTRACK COMP, SEE DETAIL SD-00708

VICINITY MAP

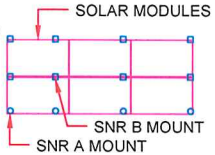


GENERAL NOTES

- ALL WORK SHALL COMPLY WITH NEC 2011, IBC 2009, MUNICIPAL CODE, AND ALL MANUFACTURERS' LISTINGS AND INSTALLATION INSTRUCTIONS.
- PHOTOVOLTAIC SYSTEM WILL COMPLY WITH NEC 2011.
- ELECTRICAL SYSTEM GROUNDING WILL COMPLY WITH NEC 2011.
- PHOTOVOLTAIC SYSTEM IS UNGROUNDED. NO CONDUCTORS ARE SOLIDLY GROUNDED IN THE INVERTER. SYSTEM COMPLIES WITH 690.35.
- MODULES CONFORM TO AND ARE LISTED UNDER UL 1703.
- INVERTER CONFORMS TO AND IS LISTED UNDER UL 1741.
- RACKING CONFORMS TO AND IS LISTED UNDER UL 2703.
- SNAPNRACK RACKING SYSTEMS, IN COMBINATION WITH TYPE I, OR TYPE II MODULES, ARE CLASS A FIRE RATED.
- RAPID SHUTDOWN REQUIREMENTS MET WHEN INVERTERS AND ALL CONDUCTORS ARE WITHIN ARRAY BOUNDARIES PER NEC 690.12(1).
- CONSTRUCTION FOREMAN TO PLACE CONDUIT RUN PER 690.31(G).
- ARRAY DC CONDUCTORS ARE SIZED FOR DERATED CURRENT.
- 9.71 AMPS MODULE SHORT CIRCUIT CURRENT.
- 15.17 AMPS DERATED SHORT CIRCUIT CURRENT [690.8 (a) & 690.8 (b)].

LEGEND AND ABBREVIATIONS

SE	SERVICE ENTRANCE
MP	MAIN PANEL
SP	SUB-PANEL
LC	PV LOAD CENTER
SM	SUNRUN METER
PM	DEDICATED PV METER
INV	INVERTER(S) WITH INTEGRATED DC DISCONNECT AND AFCI
AC	AC DISCONNECT(S)
DC	DC DISCONNECT(S)
CB	COMBINER BOX
	INTERIOR EQUIPMENT SHOWN AS DASHED



	CHIMNEY
	ATTIC VENT
	FLUSH ATTIC VENT
	PVC PIPE VENT
	METAL PIPE VENT
	T-VENT
	SATELLITE DISH
	FIRE SETBACKS
	HARDSCAPE
—PL—	PROPERTY LINE

SCALE: NTS

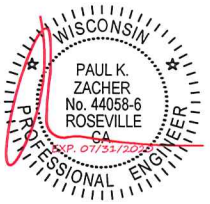
A	AMPERE
AC	ALTERNATING CURRENT
AFCI	ARC FAULT CIRCUIT INTERRUPTER
AZIM	AZIMUTH
COMP	COMPOSITION
DC	DIRECT CURRENT
(E)	EXISTING
EXT	EXTERIOR
FRM	FRAMING
INT	INTERIOR
LBW	LOAD BEARING WALL
MAG	MAGNETIC
MSP	MAIN SERVICE PANEL
(N)	NEW
NTS	NOT TO SCALE
OC	ON CENTER
PRE-FAB	PRE-FABRICATED
PSF	POUNDS PER SQUARE FOOT
PV	PHOTOVOLTAIC
TL	TRANSFORMERLESS
TYP	TYPICAL
V	VOLTS
W	WATTS

REV	NAME	DATE	COMMENTS

TABLE OF CONTENTS

PAGE #	DESCRIPTION
PV-1.0	COVER SHEET
PV-2.0	SITE PLAN
PV-3.0	LAYOUT
PV-3.1	STRUC. UPGRADES
PV-4.0	ELECTRICAL
PV-5.0	SIGNAGE

FOR STRUCTURAL ONLY



sunrun

CL #1410087

N19 W24400 RIVERWOOD DRIVE SUITE 350 WAUKESHA, WI 53188
PHONE (262) 832-3772
FAX (262) 832-3770

CUSTOMER RESIDENCE:
STEPHEN GREEN
124-126 MCCALL ST,
WAUKESHA, WI, 53186

TEL. (262) 385-6000
APN #: WAKC-1303-956

PROJECT NUMBER:
701R-126GREE

DESIGNER: (415) 580-6920 ex3
SPENCER ROBERTS

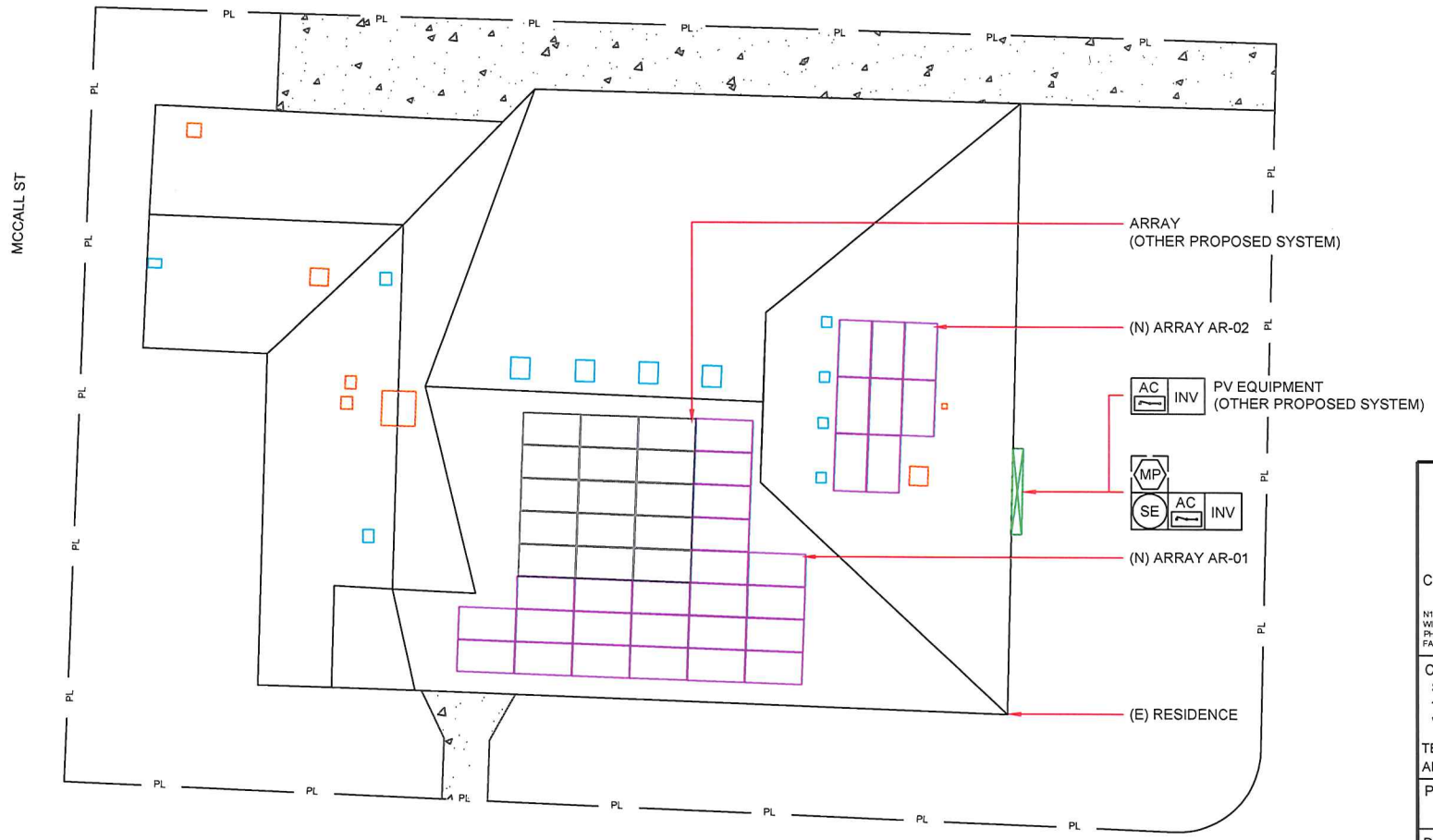
SHEET
COVER SHEET

REV: A 10/7/2019

PAGE PV-1.0

SITE PLAN - SCALE = 3/32" = 1'-0"

	ARRAY PITCH	TRUE AZIM	MAG AZIM	PV AREA (SQFT)
AR-01	16°	182°	185°	413.4
AR-02	15°	92°	95°	143.8



FOR STRUCTURAL ONLY

WISCONSIN
PAUL K. ZACHER
No. 44058-6
ROSEVILLE
CA
EXP. 07/31/2020
PROFESSIONAL ENGINEER

sunrun

CL #1410087

N19 W24400 RIVERWOOD DRIVE SUITE 350 WAUKESHA, WI 53188
PHONE (262) 832-3772
FAX (262) 832-3770

CUSTOMER RESIDENCE:
STEPHEN GREEN
124-126 MCCALL ST,
WAUKESHA, WI, 53186

TEL. (262) 385-6000

APN #: WAKC-1303-956

PROJECT NUMBER:
701R-126GREE

DESIGNER: (415) 580-6920 ex3
SPENCER ROBERTS

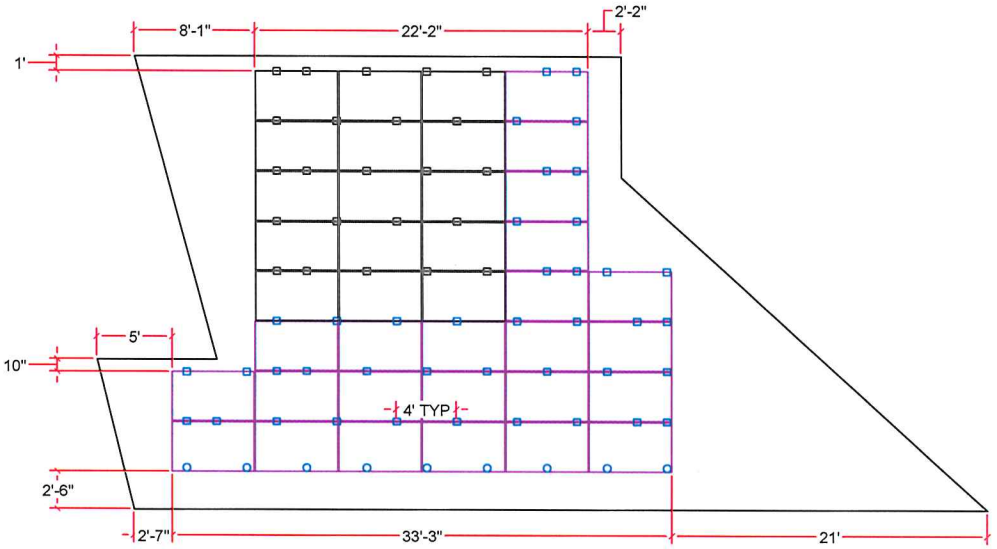
SHEET
SITE PLAN

REV: A 10/7/2019

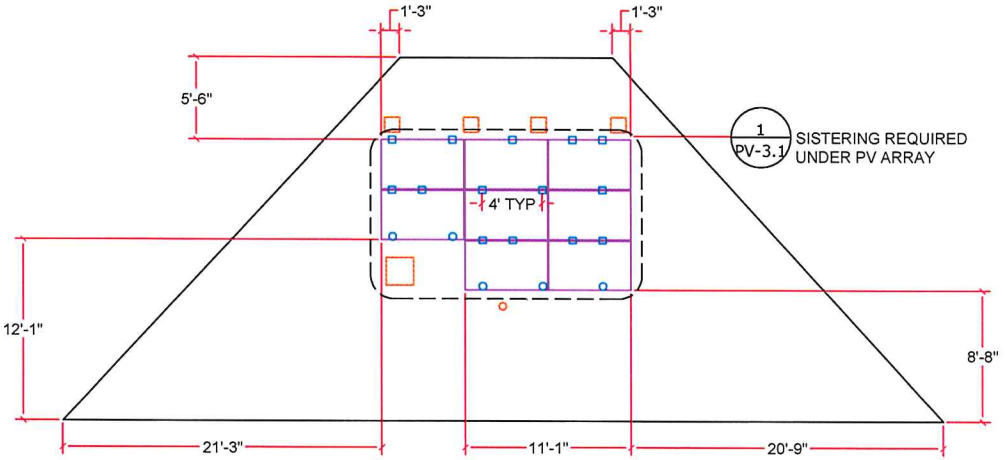
PAGE
PV-2.0

	ROOF TYPE	MOUNTING DETAIL	ROOF HEIGHT	ROOF EXPOSURE	FRAME MATERIAL	FRAME TYPE	FRAME SIZE	MAX FRAME SPAN	OC SPACING	ROOF EDGE ZONE	MAX PEN SPACING	MAX MOD. OVERHANG
AR-01	COMP SHINGLE - RL	FLASHTRACK COMP, SEE DETAIL SD-00708	2 STORY	ATTIC	WOOD	2X6 RAFTERS	2 X 6	10' - 11"	24"	5' - 10"	4' - 0"	1' - 11"
AR-02	COMP SHINGLE - RL	FLASHTRACK COMP, SEE DETAIL SD-00708	2 STORY	ATTIC	WOOD	2X6 RAFTERS	2 X 6	14' - 3"	24"	5' - 10"	4' - 0"	1' - 11"

D1 - AR-01 - SCALE: 1/8" = 1'-0"
PITCH: 16°
AZIM: 182°



D2 - AR-02 - SCALE: 1/8" = 1'-0"
PITCH: 15°
AZIM: 92°



SEE SITE PLAN FOR NORTH ARROW

DESIGN CRITERIA

MODULES:
REC SOLAR: REC290TP2 BLK
MODULE DIMS:
65.94" x 39.25" x 1.49" (38mm)
MODULE CLAMPS:
Portrait: 8.2" - 16.4"
Landscape: 0" - 9.75"
MAX DISTRIBUTED LOAD: 3 PSF
SNOW LOAD: 30 PSF
WIND SPEED:
90 MPH 3-SEC GUST.
LAG SCREWS:
5/16"x4.0": 2.5" MIN EMBEDMENT
NOTE:
INSTALLERS TO VERIFY RAFTER SIZE, SPACING AND SLOPED SPANS, AND NOTIFY E.O.R. OF ANY DISCREPANCIES BEFORE PROCEEDING.

PENETRATION SPACING:
FULLY STAGGERED
ROW SPACING:
1.00" BETWEEN ROWS
COLUMN SPACING:
0.75" BETWEEN COLUMNS

sunrun

CL #1410087

N19 W24400 RIVERWOOD DRIVE SUITE 350 WAUKESHA, WI 53188
PHONE (262) 832-3772
FAX (262) 832-3770

CUSTOMER RESIDENCE:
STEPHEN GREEN
124-126 MCCALL ST,
WAUKESHA, WI, 53186
TEL. (262) 385-6000
APN #: WAKC-1303-956

PROJECT NUMBER:
701R-126GREE

DESIGNER: (415) 580-6920 ex3
SPENCER ROBERTS

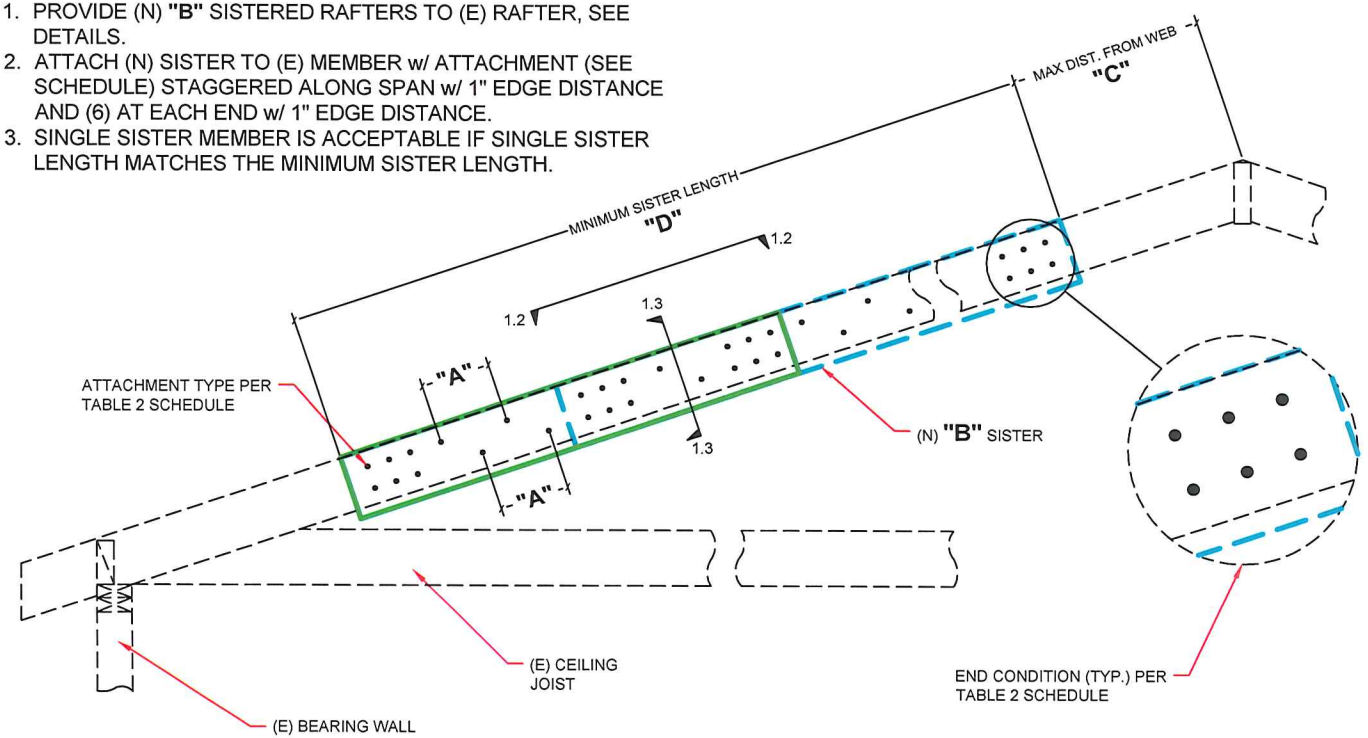
SHEET
LAYOUT

REV: A 10/7/2019

PAGE PV-3.0

NOTES:

1. PROVIDE (N) **"B"** SISTERED RAFTERS TO (E) RAFTER, SEE DETAILS.
2. ATTACH (N) SISTER TO (E) MEMBER w/ ATTACHMENT (SEE SCHEDULE) STAGGERED ALONG SPAN w/ 1" EDGE DISTANCE AND (6) AT EACH END w/ 1" EDGE DISTANCE.
3. SINGLE SISTER MEMBER IS ACCEPTABLE IF SINGLE SISTER LENGTH MATCHES THE MINIMUM SISTER LENGTH.

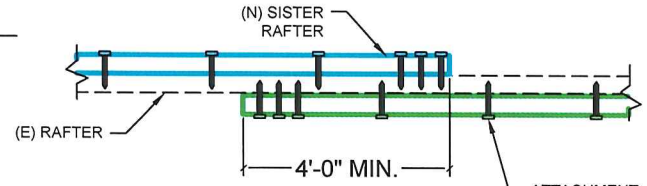


1.1 ELEVATION VIEW
SCALE: NTS

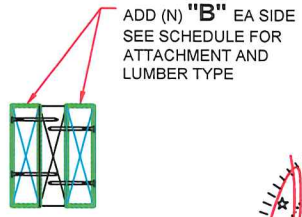
TABLE 1: ACCEPTABLE MIN. LUMBER TYPE	
LUMBER SPECIES & GRADE	MIN. BENDING Fb (psi)
DOUG FIR-LARCH #2	900
SOUTHERN PINE #1	1000
HEM-FIR #2	850
SPRUCE PINE FIR #2	875

TABLE 2: ACCEPTABLE ATTACHMENT SCHEDULE			
OPTION	TYPE	FIELD SPACING "A"	# AT END
1	SIMPSON SDWS TIMBER SCREW	12" OC	6
2	COMMON 10d	6" OC	6

TABLE 3: UPGRADE SPECIFICATIONS	
CALLOUT	VARIABLE
RAFTER SIZE "B"	2"x6"
MAX DIST. FROM WEB "C"	1'-1"
MIN. SISTER LENGTH "D"	12'-0"



1.2 TOP VIEW
SCALE: NTS



1.3 SECTION
SCALE: NTS
NOTES: SEE SECTION 1.1 FOR ATTACHMENT NOTES

1 SISTERING DETAILS
SCALE: NTS

sunrun

CL #1410087

N19 W24400 RIVERWOOD DRIVE SUITE 350 WAUKESHA, WI 53188
PHONE (262) 832-3772
FAX (262) 832-3770

CUSTOMER RESIDENCE:
STEPHEN GREEN
124-126 MCCALL ST,
WAUKESHA, WI, 53186
TEL. (262) 385-6000
APN #: WAKC-1303-956

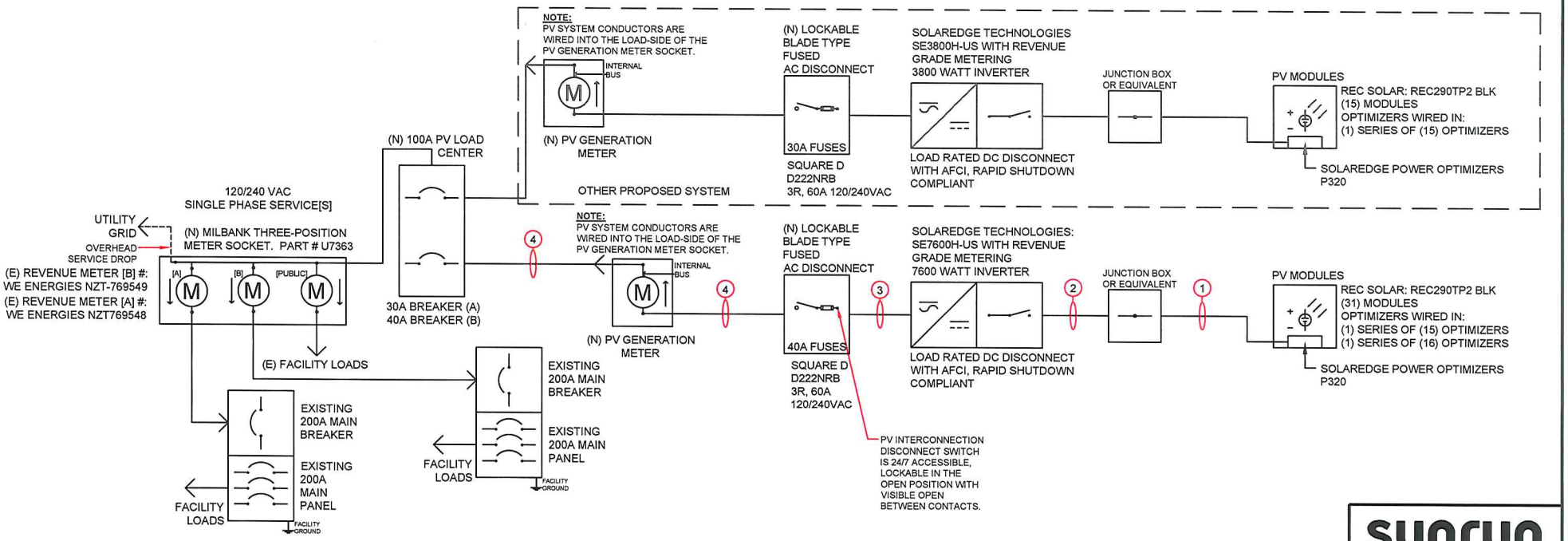
PROJECT NUMBER:
701R-126GREE

DESIGNER: (415) 580-6920 ex3
SPENCER ROBERTS

SHEET
STRUC. UPGRADES

REV: A 10/7/2019

PAGE
PV-3.1



CONDUIT SCHEDULE

#	CONDUIT	CONDUCTOR	NEUTRAL	GROUND
1	NONE	(4) 10 AWG PV WIRE	NONE	(1) 10 AWG BARE COPPER
2	3/4" EMT OR EQUIV.	(4) 10 AWG THHN/THWN-2	NONE	(1) 10 AWG THHN/THWN-2
3	3/4" EMT OR EQUIV.	(2) 8 AWG THHN/THWN-2	(1) 10 AWG THHN/THWN-2	(1) 8 AWG THHN/THWN-2
4	3/4" EMT OR EQUIV.	(2) 6 AWG THHN/THWN-2	(1) 6 AWG THHN/THWN-2	(1) 8 AWG THHN/THWN-2

MODULE CHARACTERISTICS

REC SOLAR: REC290TP2 BLK:	290 W
OPEN CIRCUIT VOLTAGE:	38.8 V
MAX POWER VOLTAGE:	32.1 V
SHORT CIRCUIT CURRENT:	9.71 A

P320 OPTIMIZER CHARACTERISTICS:

MIN INPUT VOLTAGE:	8 VDC
MAX INPUT VOLTAGE:	48 VDC
MAX INPUT ISC:	11 ADC
MAX OUTPUT CURRENT:	15 ADC

SYSTEM CHARACTERISTICS - INVERTER 1

SYSTEM SIZE:	8990 W
SYSTEM OPEN CIRCUIT VOLTAGE:	16 V
SYSTEM OPERATING VOLTAGE:	400 V
MAX ALLOWABLE DC VOLTAGE:	480 V
SYSTEM OPERATING CURRENT:	22.48 A
SYSTEM SHORT CIRCUIT CURRENT:	30 A

NOTES TO INSTALLER:

- 16 VDC EXPECTED OPEN CIRCUIT STRING VOLTAGE.
- INSTALL 100A LOAD CENTER.
- INSTALL 40A MAIN BREAKER IN LOAD CENTER.
- CONNECT SYSTEM VIA INSULATION PIERCING ON LOAD SIDE OF PV GENERATION METER SOCKET.

sunrun

CL #1410087

N19 W24400 RIVERWOOD DRIVE SUITE 350 WAUKESHA, WI 53188
PHONE (262) 832-3772
FAX (262) 832-3770

CUSTOMER RESIDENCE:
STEPHEN GREEN
124-126 MCCALL ST,
WAUKESHA, WI, 53186

TEL. (262) 385-6000
APN #: WAKC-1303-956

PROJECT NUMBER:
701R-126GREE

DESIGNER: (415) 580-6920 ex3
SPENCER ROBERTS

SHEET
ELECTRICAL

REV: A 10/7/2019

PAGE PV-4.0

⚠WARNING

ELECTRICAL SHOCK HAZARD

TERMINALS ON LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

LABEL LOCATION:
INVERTER(S), AC DISCONNECT(S), AC COMBINER PANEL (IF APPLICABLE).
PER CODE(S): NEC 2017: 690.13(B), NEC 2014: 690.17(E), NEC 2011: 690.17(4)

⚠WARNING

ELECTRICAL SHOCK HAZARD

IF GROUND FAULT IS INDICATED ALL NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED

LABEL LOCATION:
INVERTER(S), ENPHASE ENVOY ENCLOSURE (IF APPLICABLE).
PER CODE(S): NEC 2017: 690.5(C), NEC 2014: 690.5(C), NEC 2011: 690.5(C)

INVERTER 1

PHOTOVOLTAIC DC DISCONNECT

MAXIMUM SYSTEM VOLTAGE:	480	VDC
MAXIMUM CIRCUIT CURRENT:	30	ADC
MAX RATED OUTPUT CURRENT OF THE CHARGE CONTROLLER OR DC-TO-DC CONVERTER (IF INSTALLED):	15	ADC

LABEL LOCATION:
INVERTER(S), DC DISCONNECT(S).
PER CODE(S): NEC 2017: 690.53, NEC 2014: 690.53, NEC 2011: 690.53

NOTES AND SPECIFICATIONS:
- SIGNS AND LABELS SHALL MEET THE REQUIREMENTS OF THE NEC 2011 ARTICLE 110.21(B), UNLESS SPECIFIC INSTRUCTIONS ARE REQUIRED BY SECTION 690, OR IF REQUESTED BY THE LOCAL AHJ.
- SIGNS AND LABELS SHALL ADEQUATELY WARN OF HAZARDS USING EFFECTIVE WORDS, COLORS AND SYMBOLS.
- LABELS SHALL BE PERMANENTLY AFFIXED TO THE EQUIPMENT OR WIRING METHOD AND SHALL NOT BE HAND WRITTEN.
- LABEL SHALL BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.
- SIGNS AND LABELS SHALL COMPLY WITH ANSI Z535.4-2011, PRODUCT SAFETY SIGNS AND LABELS, UNLESS OTHERWISE SPECIFIED.
- DO NOT COVER EXISTING MANUFACTURER LABELS.

⚠WARNING

DUAL POWER SUPPLY

SOURCES: UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM

LABEL LOCATION:
UTILITY SERVICE METER AND MAIN SERVICE PANEL.
PER CODE(S): NEC 2017: 705.12(B)(2)(3)(b), NEC 2014: 705.12(D)(3), NEC 2011: 705.12(D)(4)

⚠WARNING

PHOTOVOLTAIC SYSTEM COMBINER PANEL

DO NOT ADD LOADS

LABEL LOCATION:
PHOTOVOLTAIC AC COMBINER (IF APPLICABLE).
PER CODE(S): NEC 2017: 705.12(B)(2)(3)(b), NEC 2014: 705.12(D)(2)(3)(c), NEC 2011: 705.12(D)(4)

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL LOCATION:
UTILITY SERVICE ENTRANCE/METER, INVERTER/DC DISCONNECT IF REQUIRED BY LOCAL AHJ, OR OTHER LOCATIONS AS REQUIRED BY LOCAL AHJ.
PER CODE(S): NEC 2017: 690.12, NEC 2014: 690.12, NEC 690.56, IFC 2012: 605.11.1

PV INTERCONNECTION DISCONNECT SWITCH

LABEL LOCATION:
UTILITY DISCONNECT

PV (SOLAR) SYSTEM METER - POWER DELIVERED

LABEL LOCATION:
UTILITY PV GENERATION METER

SUNRUN PV (SOLAR) GENERATION METER

LABEL LOCATION:
SUNRUN METER

⚠WARNING

INVERTER OUTPUT CONNECTION

DO NOT RELOCATE THIS OVERCURRENT DEVICE

LABEL LOCATION:
ADJACENT TO PV BREAKER (IF APPLICABLE).
PER CODE(S): NEC 2017: 705.12(B)(2)(3)(b), NEC 2014: 705.12(D)(2)(3)(b), NEC 2011: 705.12(D)(7)

WARNING: PHOTOVOLTAIC POWER SOURCE

LABEL LOCATION:
INTERIOR AND EXTERIOR DC CONDUIT EVERY 10 FT, AT EACH TURN, ABOVE AND BELOW PENETRATIONS, ON EVERY JB/PULL BOX CONTAINING DC CIRCUITS.
PER CODE(S): NEC 2017: 690.31(G)(3), 690.31(G)(4), NEC 2014: 690.31(G)(3), 690.31(G)(4), NEC 2011: 690.31(E)(3), 690.31(E)(4), IFC 2012: 605.11.1.4

PHOTOVOLTAIC AC DISCONNECT

MAXIMUM AC OPERATING CURRENT: 31.67 AMPS

NOMINAL OPERATING AC VOLTAGE: 240 VAC

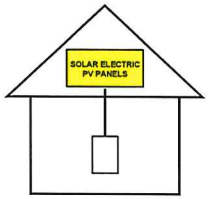
LABEL LOCATION:
AC DISCONNECT(S), PHOTOVOLTAIC SYSTEM POINT OF INTERCONNECTION.
PER CODE(S): NEC 2017: 690.54, NEC 2014: 690.54, NEC 2011: 690.54

6"

3.5"

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN THE ARRAY.



LABEL LOCATION:
ON OR NO MORE THAT 1 M (3 FT) FROM THE SERVICE DISCONNECTING MEANS TO WHICH THE PV SYSTEMS ARE CONNECTED.
PER CODE(S): NEC 2017: 690.56(C)(1)(a)

sunrun

CL #1410087

N19 W24400 RIVERWOOD DRIVE SUITE 350 WAUKESHA, WI 53188
PHONE (262) 832-3772
FAX (262) 832-3770

CUSTOMER RESIDENCE:
STEPHEN GREEN
124-126 MCCALL ST,
WAUKESHA, WI, 53186

TEL. (262) 385-6000
APN #: WAKC-1303-956

PROJECT NUMBER:
701R-126GREE

DESIGNER: (415) 580-6920 ex3
SPENCER ROBERTS

SHEET
SIGNAGE

REV: A 10/7/2019

PAGE
PV-5.0