PRSOL20250112

Calculations required to be provided by the Permittee on site for all Inspections

City of Puyallup
Development & Permitting Services
ISSUED PERMIT
Building | Planning
Engineering | Public Works
Fire | Traffic

City of Puyallup
Building
REVIEWED FOR COMPLIANCE
BSnowden
01/29/2025
11:30:32 AM

EQUILUX ENGINEERS

December 31, 2024

REFERENCE: CERTIFICATION LETTER - SOLAR ARRAY INSTALLATION
PSE TODD ROAD - 325 TODD ROAD NW, PUYALLUP, WA 98371

To Whom It May Concern,

Per your request, Equilux Engineers LLC has performed a review of the sealed design plans provided by A & R Solar SPC, which contained framing system information for the structure at the address referenced above. These plans consisted of the building construction drawings developed by Kingworks Structural Engineers dated 1/26/2024 and sealed by Daniel Davis Linkhart, License # 41390. All review is based on these observations and the design criteria listed below.

On the above referenced project, the roof structural framing has been reviewed for loading due to the installation of the solar PV system to the roof. The existing roof framing was originally designed to support a PV system with a maximum weight allowance of 5 pounds per square foot in addition to other design roof dead loads. The proposed PV system has a maximum weight of 5.45 pounds per square foot which is less than 105% of the original PV weight allowance, thus the roof framing is deemed to have the required structural capacity to support the proposed PV system.

This review is only for the connection of the PV system to the roof framing. The structural review only applies to the section of the roof that is directly supporting the solar PV system.

Existing Roof Structure

Roof Structure: 20 Gage steel deck supported by 24LH OWSJ

Design Criteria:

- Authority Having Jurisdiction (AHJ) = Pierce County
- Applicable Codes = 2021 Washington State Building Code as amended by Pierce County
- Wind Speed = 98 mph (Vult), Exposure Category B, Risk Category = II
- PV System DL = 5.45 psf
- Proposed PV System Type: Attached Ballasted, Panel Claw FR10 Racking and U-Anchor 2400 TPO Mechanical Attachments

Based on this evaluation, I certify that the connection of the PV system to the roof framing meet or exceed the requirements of the applicable existing building and/or new building provisions adopted/referenced above.

The PV system shall be connected to the existing metal roof decking using the U-Anchor U-2400 TPO mechanical attachments. Each mechanical attachment shall be attached using a minimum of four (4) #14 Heavy Duty Fasteners as manufactured by OMG Inc, or other fasteners with similar structural capacity and applicability, symmetrically installed on the anchor plate, with a minimum of 3/4 inches of penetration through the underside of the metal deck. All screws shall be stainless steel or galvanized. The installation of the attachments shall comply with the manufacturer's published installation instructions. The PV system attachment layout shall be as indicated on the drawings by A&R Solar.

The scope of this report is strictly limited only to an evaluation of the connection of the PV system to the roof supporting framing. The design of all non-structural items related to the installation of the PV system, including but not limited to the solar panel racking system (mounts, hardware, etc), electrical and mechanical engineering, roofing and drainage is the responsibility of others. The solar panel ballast design and specifications are to be designed and reviewed by the racking manufacturer. Additionally, the capacity of the solar racking system and connections to resist uplift, overturning and sliding forces due to wind and seismic loading is to be provided by the racking manufacturer and shall be installed per the manufacturer's specifications.

All solar PV panels, mounts and hardware shall be installed per manufacturer specifications and within specified design limitations. All waterproofing around roof penetrations is the responsibility of others. Equilux Engineers assumes no responsibility for misuse or improper installation of the solar PV panels or racking system.

Sincerely,

HUMPHREY K. KARIUKI
STATE OF WASHINGTON
57836
REGISTERED
PROFESSIONAL ENGINEER

STRUCTURAL ONLY

Humphrey Kariuki, P.E., LEED AP

EQUILUX ENGINEERS

Project: PSE TODD ROAD - PUYALLUP, WA

CAPACITY OF PV SYSTEM MECHANICAL ATTACHMENTS

ATTACHMENT TYPE - UANCHOR U2400-TPO

Required MA capacity per Ironridge Racking Design		
Uplift	525 lbs	**Per Panel claw racking design**
Shear	650 lbs	**Per Panel claw racking design**

MA UPLIFT Check			
Maximum Design Uplift	T-actual	525 lbs	
Standoff Uplift Capacity, UANCHOR U2400-TPO	T-allow	543 lbs	See attached cutsheet, fos = 5.0
Standoff Demand/Capacity Check	D/C	525 lb Demand < 543 lb Capacity	**THEREFORE, OK**

MA SHEAR Check			
Maximum Design Uplift	T-actual	650 lbs	
Standoff Uplift Capacity, UANCHOR U2400-TPO	T-allow	868 lbs	See attached cutsheet, fos = 5.0
Standoff Demand/Capacity Check	D/C	650 lb Demand < 868 lb Capacity	**THEREFORE, OK**

Fastener UPLIFT Capacity Check			
Screw Diameter	D	0.237"	OMG #14 HD
Number of Screws / standoff	N	4	
Pull out Capacity	W	178 lbs	F=3.0 - 20ga deck, See attached cutsheet
Total Fastener Capacity	C	C=N*W 712 lbs	
Standoff Demand/Capacity Comparision		525 lb Demand < 712 lb Capacity **THEREFORE, OK**	

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OMG ROOFING PRODUCTS
153 BOWLES ROAD
AGAWAM, MA 01001 USA
413·789·0252
800·633·3800
FAX: 413·789·1069
OMGROOFING.COM

PRODUCT DATA SPECIFICATIONS

AUGUST 2016

Typical Pullout Values

DECK TYPE	#12 STANDARD	#14 HEAVY DUTY	#15 XHD
18 ga. Steel	540 lbs.	585 lbs.	NA
20 ga. Steel	501 lbs.	535 lbs.	625 lbs.
22 ga. Steel	400 lbs.*	527 lbs.*	563 lbs.*
24 ga. Steel	325 lbs.	360 lbs.	450 lbs.
26 ga. Steel	280 lbs.	297 lbs.	325 lbs.
28 ga. Steel	245 lbs.	265 lbs.	295 lbs.

*Grade 33 deck at FM.
Pullout values for steel deck are subject to variation due to deck tolerances and tensile strength.

DECK TYPE	#12 STANDARD	#14 HEAVY DUTY
½" Plywood	364 lbs.	410 lbs.
⅝" Plywood	460 lbs.	502 lbs.
¾" Plywood	531 lbs.	590 lbs.
7/16" OSB	320 lbs.	346 lbs.
2" Spruce Plank	735 lbs.**	820 lbs.**

Pullout values for wood decks are subject to variation due to different species of wood, plywood grade and number of plies.
** Requires 1" embedment into the plank.

DECK TYPE	OLYLOK FASTENERS
Cementitious Wood Fiber	176 lbs.
Gypsum	262 lbs.

Pullout values for OlyLok fasteners are subject to change due to variations in deck manufacturers and condition.

DECK TYPE	CD-10	FLUTED NAIL	#14 HEAVY DUTY
3000 PSI Concrete	800–1000 lbs.§	800–1000 lbs.§	800–1000 lbs.§

§ Values will be affected by aggregate size and type, and the condition/age of the deck.
These are typical values based on independent test results in new deck material.
Field test per ANSI FX-1 should be performed to confirm actual values.

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U-ANCHOR™ | U2400-TPO

Mechanically Attached Solution For Single-Ply Roofing System

ANCHOR PRODUCTS™
Secured Mounting Solutions

Front *Back*

Description

The U2400-TPO is a lightweight rooftop attachment system consisting of an U-Anchor 2000 Series plate and cover membrane. The cover membrane and separator disk are factory sealed to the top of the plate. The U2400-TPO provides a fastened, watertight, warranted attachment for TPO single-ply membranes.

Advantages

- Extremely strong and lightweight.
- Fast installation, approximate rate of 12 per man hour.
- Installs on any surface from flat to vertical.

Product Specifications

Bolts
- 3/8”-16 x 1.5” Bolt*
- Material Type: 304 Stainless Steel

Plate
- Outer Diameter: 5.5”
- Fastener Hole Diameter: 0.265” (8 holes)
- Fastener Hole Pattern: 4.125” Diameter
- Steel Thickness: 0.047” (1.194mm)
- Material Type: Galvanized Steel G90

Cover Membrane
- Manufacturer: Brand or Non-Brand Specific*
- Color: Default White*
- Length: 11.75”
- Width: 11.75”
- Thickness: Default 60 mil*

Patents
- Visit www.anchorp.com/patents

Packaging Specifications

- Sold Individually OR Full Box Quantity
- Individual Weight: Approx. 0.75 lbs
- Full Box Quantity: 10 units
- Box Weight: Approx. 9 lbs
- Box Dimensions: 13” x 11” x 13”
- Full Pallet Quantity: 50 boxes
- Pallet Dimensions: 48” x 40” x 66”

U-Anchor Attachment

The U2400-TPO is attached by lifting the flashing to expose the fastening hole on the plate. Then, fastening through the roofing assembly and into the structural decking with 2-8 approved fasteners, as directed by project specific engineering. The membrane cover is then hot air welded around the perimeter to the roof membrane. After verifying the seam integrity with a probe, seam sealer maybe required per roofing manufacturer’s specifications.

Project-specific data is required to determine the correct type of fastener and number needed to secure each U-Anchor. An ANSI/SPRI FX-1 Pull Test is recommended to measure the pull-out resistance of fasteners included in the load path, (for example, substrate -> fasteners -> the U-Anchor -> other components.)

Equipment Attachment

To securely mount your rooftop equipment to the U-Anchor, after its installed, the connection nut must be tightened to approximately 20-25 ft.-lbs.

Use a calibrated torque wrench during install to ensure appropriate results are achieved.

Refer to product documentation for detailed installation and component requirements.

Testing

Results are based on plate performance only.

- Ultimate Load - Shear: 4,339 lbs
- Ultimate Load - Tension: 2,713 lbs

Tested in accordance with ICC AC467

Individual roof deck assembly tests available upon request as application specific results may vary.

Listings

- ICC-ES Evaluation Report ESR-4152

Warranty

- 20 Year Limited Material Only Warranty.
  Subject to terms and conditions.

* Specified option is standard. Custom options may be available for additional charge. Lead times may apply depending on roofing manufacturer and product availability.

All representations herein are premised on proper installation and use of approved components. Failure to properly install or use of unapproved components voids all Anchor Products representations.

Anchor Products systems are included in many roofing manufacturers’ guarantees! Please contact us for more information.

Manufactured By ANCHOR PRODUCTS™

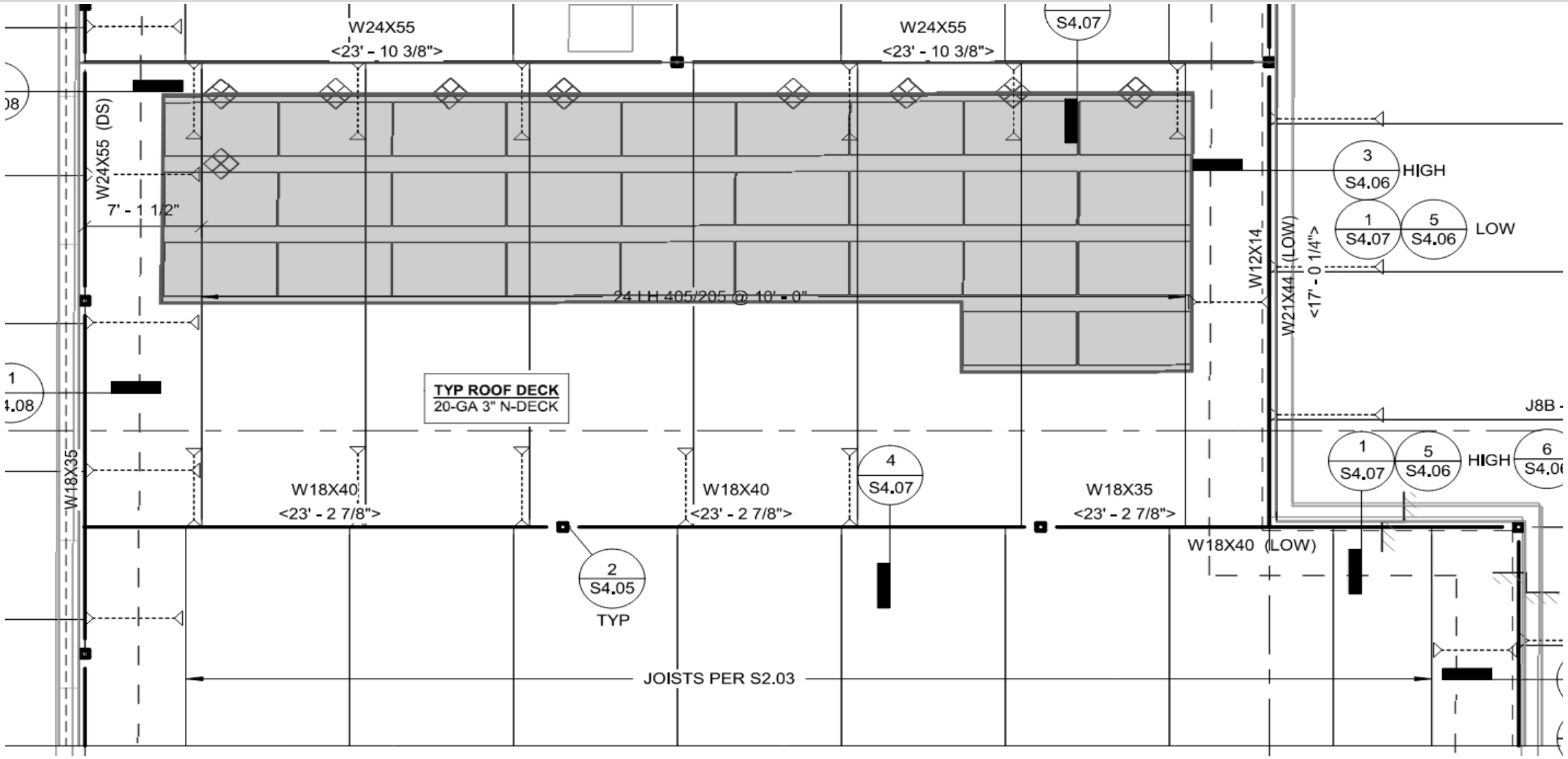
MADE IN U. S. A.

Anchor Products LLC.
PO Box 1551
Colleyville, TX 76034

Secured Mounting Solutions™

888-575-2131
www.anchorp.com
info@anchorp.com

OVERLAY OF PV SYSTEM ON ROOF FRAMING



PRSOL20250112

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Job No. 24-0242-3181 Sheet No. Cover
By DML/TET Date 11/18/24

CARUSO TURLEY SCOTT
structural engineers

CLIENT:

PANELCLAW®
1600 Osgood Street
Suite 2023
North Andover, MA 01845

PROJECT:

PSE Todd Road
325 Todd Road Northwest
Puyallup, WA

STRUCTURAL ENGINEERING EXPERTS

PARTNERS
Sandra Herd, SE, PE, LEED AP
Thomas Morris, SE, LEED AP
Richard Dahlmann, SE, PE
Troy Turley, SE, PE, LEED AP
Brady Notbohm, SE, PE
Craig Porter, SE, PE
Ron Kuklish, SE, PE

PROFESSIONAL REGISTRATION

50 States
Washington D.C.
U.S. Virgin Islands
Puerto Rico

GENERAL INFORMATION:

BUILDING CODE: 2021 IBC, ASCE 7-16
With SEAOC PV1-2012 and PV2-2017

1215 W. Rio Salado Pkwy.
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CARUSO
TURLEY
SCOTT
structural
engineers

Date: November 18, 2024

Mr. Ryan Heil
PanelClaw
1600 Osgood Street, Ste. 2023
North Andover, MA 01845

RE: Evaluation of PanelClaw system

Project Name: PSE Todd Road
CTS Job No.: 24-0242-3181

Per the request of Ryan Heil at PanelClaw, CTS was asked to review the PanelClaw racking system with respect to the system's ability to resist uplift and sliding caused by wind and seismic loads.

Wind Evaluation:

PanelClaw has provided CTS with wind tunnel testing performed by CPP, Inc. The system tested was the "clawFR 10 Degree" system. This system consists of photovoltaic panels installed at a 10 degree tilt onto support assemblies. The support assemblies consist of a support frame for the PV panels, wind deflectors and areas for additional mass/weight as required for the ballast loads.

The wind tunnel testing was performed per Chapter 31 of ASCE 7-16. The parameters of the testing were a flat roof system in both Exposure B and C on a building with and without parapets. The testing has resulted in pressure and/or force coefficients that were applied to the velocity pressure q_z in order to obtain the wind loads on the PV system. From the wind load results it is then possible to calculate the ballast loads required to resist the uplift and sliding forces.

PanelClaw has provided CTS with the excel tool that was developed to obtain the uplift and sliding forces. CTS has reviewed this tool and the wind forces obtained to find that the amounts of ballast and mechanical attachments provided are within the values required. Furthermore, CTS agrees with the methodologies used to develop the uplift and sliding forces for the "clawFR 10 Degree" system per the wind tunnel testing results.

Seismic Evaluation:

CTS was asked to review the PanelClaw system to determine attachments required to resist seismic loading of the ballasted solar support system on the roof of the existing building. Following IBC Load Combination 16-16 and ASCE Section 2.4.5, the Dead Load value has been reduced by subtracting the vertical component of the seismic forces (0.6*D - 0.14Sds*D). The contribution of friction due to the component weight was not considered to resist lateral forces caused by seismic loads per ASCE Section 13.4.

Utilizing this method, calculations have been provided for the number of mechanical attachments that are required to resist seismic forces that are applied to the system.

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www.ctsaz.com

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Conclusion:

Therefore, it has been determined that the system as provided by PanelClaw is sufficient to resist both wind and seismic loads at this project.

Please contact CTS with any questions regarding this letter or attachments.

Respectfully,

Dylan Le
Structural Designer

Troy Turley, SE, PE, LEED AP
Partner

CARUSO TURLEY SCOTT
structural engineers

STRUCTURAL ENGINEERING EXPERTS

PARTNERS

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PROFESSIONAL REGISTRATION

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APPROVED FOR CONSTRUCTION

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11/19/2024

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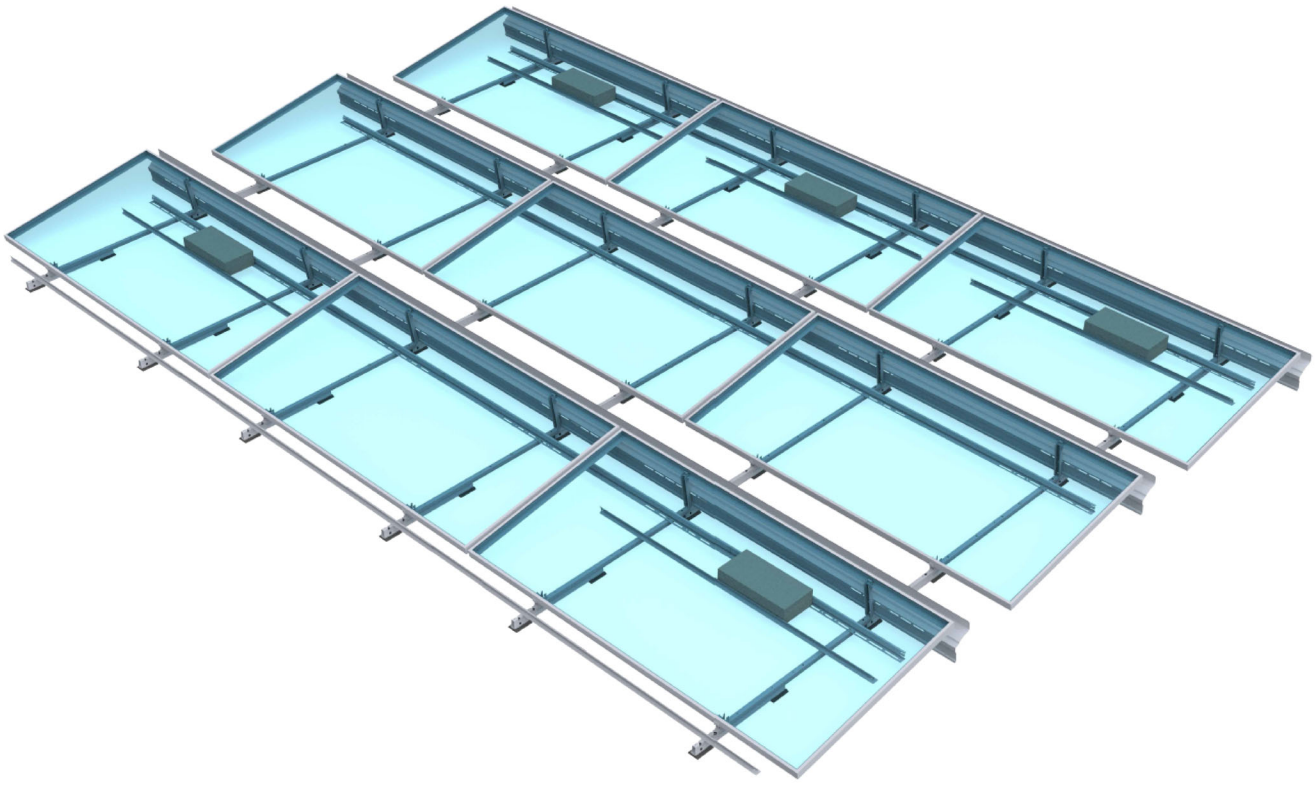
Partner Name: **AR Solar SPC**

Project Name: **PSE Todd Road**

Project Location: **325 Todd Road Northwest, Puyallup, WA, USA**

Racking System: **clawFR 10 Degree**



Structural Calculations for Roof-Mounted Solar Array

Submittal Release: Rev 3

Engineering Seal

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Table of Contents

Section:	Page #
1.0 Project Information	**4**
1.1 General	4
1.2 Building Information	4
1.3 Structural Design Information	5
2.0 Snow Load	**6**
2.1 Snow Load Data	6
2.2 Snow Load Per Module	6
3.0 Wind Load	**7**
3.1 Wind Load Data	7
3.2 Roof / Array Zone Map	7
3.3 Wind Design Equations	7
4.0 Design Loads - Dead	**8**
4.1 Dead Load of the Arrays	8
5.0 Design Loads - Wind	**9**
5.1.1 Global Wind Uplift Summary Table	9
5.1.2 Global Wind Shear Summary Table	10
6.0 Design Loads - Downward	**11**
6.1 Downward Wind Load Calculation	11
6.2 Racking Dimensions for Point Loads	11
6.3 Point Load Summary	12
7.0 Design Loads - Seismic	**13**
7.1 Seismic Load Data	13
7.2 Seismic Design Equations	13
7.3 Lateral Seismic Force Check	14
7.4 Vertical Seismic Force Check	15

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Appendix:

A. Wind Tunnel Tests and Load Analysis for PANELCLAW ROOF MOUNT 10° TILT SOUTH-FACING, CPP Project 19784, Dated 16 April 2024.

11/19/2024

1.0 Project Information:

1.1 General:

Project Name:	PSE Todd Road	
Project Location:	325 Todd Road Northwest, Puyallup, WA, USA	
Racking System:	clawFR 10 Degree	
Module:	SILFAB	SIL-520 QM
Module Weight:	57.76	lbs.
Module Tilt:	8.99	deg.
Module Width:	44.61	in.
Module Length:	82.60	in.
Module Area:	25.59	sq.ft.
Ballast Block Weight:	32.60	lbs.

1.2 Building Information:

Roof Name	Height (ft.)	Parapet Height (ft.)
Roof 1	22.5	2.3

Sub-Array Name	Pitch (deg.)	Membrane Material	Coeff. of Friction (μ)
1.1	2	TPO	0.80

11/19/2024

1.0 Project Information (Cont.):

1.3 Structural Design Information:

ASCE Code:	ASCE 7-16	
Building Code:	IBC 2021	
Risk Cat.:	II	
Basic Wind Speed (V):	98	mph
Exposure Category:	C	
Ground Snow Load (Pg):	25	psf
Is:	1	
Site Class:	D	
Short Period Spectral Resp. (5%) (Ss):	1.279	
1s Spectral Response (5%) (S1):	0.44	
Ie:	1	
Ip:	1	

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2.0 Snow Load:

Snow Calculations per ASCE 7-16, Chapter 7

2.1 Snow Load Data:

Ground Snow Load (Pg)	=	25.00 psf	(ASCE, Figure 7.2-1)
Exposure Factor (Ce)	=	1	(ASCE, Table 7.3-1)
Thermal Factor (Ct)	=	1.2	(ASCE, Table 7.3-2)
Importance Factor (Is)	=	1	(ASCE, Table 1.5-2)

Flat Roof Snow Load (Pf) =	0.7*Pg*Ce*Ct*Is=	21.00 psf	(ASCE 7.3-1)
Min Snow Load for Low Slope Roof =	20*Is =	20.00 psf	(ASCE 7.3.4)
Snow Load on Array (SL_A) =	21.00 psf		

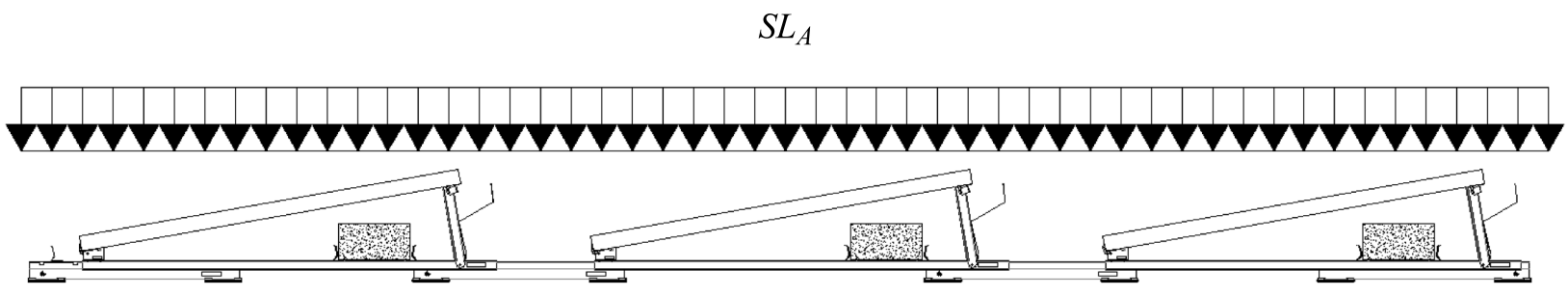

Fig. 2.1 - Uniform Roof Snow Load on Array

2.2 Snow Load Per Module:

Snow Load per Module (SL_M) = *Module Projected Area* SL_A

Where;

Module Projected Area (Amp) = Module Area * Cos(Module Tilt)

Where;

Module Area =	25.59	sq.ft.
Module Tilt =	8.99	deg.
Amp =	25.27	sq.ft.

$SL_M = A_{mp}$ SL_A = **530.71** ***lbs.***

11/19/2024

3.0 Wind Load:

Wind Analysis per ASCE 7-16- Wind Tunnel Procedure, Chapter 31

3.1 Wind Load Data:

Basic Wind Speed (Vult) =	98 mph	*(ASCE, Fig. 26.5-1)*
Exposure Category:	C	*(ASCE, Sec. 26.7.3)*
Topographic Factor (Kzt) =	1	*(ASCE, Fig. 26.8-1)*
Directionality Factor (Kd) =	0.85	*(ASCE, Table 26.6-1)*
Exposure Coefficient (Kz) =	0.92	*(ASCE, Table 26.10-1)*
Ground Elevation Factor (Ke) =	1.00	*(ASCE, Table 26.9-1)*
Velocity Pressure (qz) =	0.00256*Kz*Kzt*Kd*Ke*V^2 =	19.29 psf *(ASCE, Eqn. 26.10-1)*

3.2 Roof / Array Zone Map:

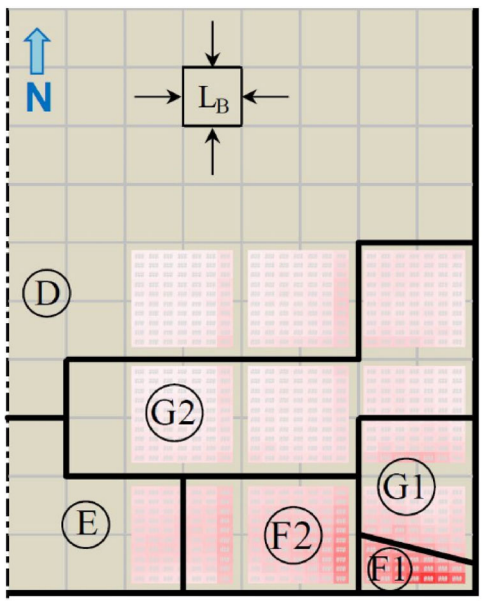

Figure 3-1. South corner zones – 90-180° wind directions

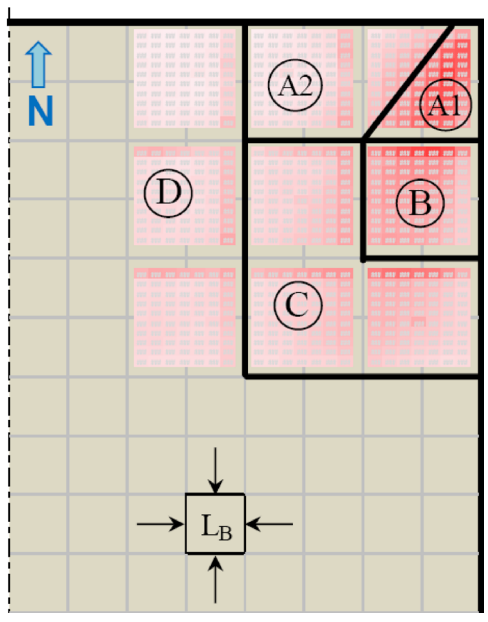

Figure 3-2. North corner zones – 0- 90° wind direction

Roof Zone Map Dimensions per CPP Wind Tunnel Study		
Height (ft.)	**LB* (ft.)**	**Velocity Pressure (qz) (psf)**
22.5	21.70	19.29

*LB = Characteristic length per wind tunnel study

3.3 Wind Design Equations:

$$F_L = q_z A_{ref} GC_L$$
$$F_D = q_z A_{ref} GC_D$$
$$F_{L\text{ - D Companion}} = q_z A_{ref} GC_{L\text{ - D Companion}}$$

F_L = sum of lift on panel and deflector.
F_D = sum of drag on panel and deflector.
$F_{D\text{ - L}}$ = The accompanying uplift corresponding to maximum drag.

Where

q_z = Velocity Pressure *(Ref. Section 3.1, Wind Load)*
A_{ref} = Module Area *(Ref. Section 1.1, General)*
GC_L GC_D , $GC_{L\text{-D Companion}}$= Vary and related to wind zone map *(Proprietary Wind Tunnel Coefficients)*

4.0 Design Loads - Dead:

There are two categories of dead load used to perform the structural analysis of the PanelClaw racking system; Dead Load of the Array (DL_A) and Dead Load of the Components (DL_C).

DL_A is defined as the weight of the entire array including all of the system components and total ballast used on the array.

DL_C is defined as the weight of the modules and the racking components within an array. The DL_C does not include the ballast used to resist loads on this array.

4.1 Dead Load of the Arrays:

Array Information						Results			
Sub-Array Name	Number of Modules	DL_C (lbs.)	DL_A (lbs.)	DL_C (lbs.)/module	Sub-Array Area (ft.^2)	**Sub-Array Roof Pressure (DL_C) (psf)**	**Sub-Array Roof Pressure (DL_A) (psf)**	**Max Allowable Pressure on Roof (psf)**	**Acceptable?**
1.1	29	2,191	5,190	76	953	**2.30**	**5.45**	**5.50**	**Yes**
Total:	**29**	**2,191 lbs.**	**5,190 lbs.**						

*Racking component weight range between 13 to 15 pounds per module

Table 4.1 - Array Dead Loads and Roof Pressures

11/19/2024

5.0 Design Loads - Wind:

5.1.1 Global Wind Uplift Summary Table:

The necessity to add mechanical attachments can arise for several reasons. Building code requirements, roof load limits and array shape all may come into play when determining their need. The table below provides the mechanical attachment requirements for each sub-array within this project.

	Applied Load	Resisting Load			Code Check	
Sub-Array Name	FL = Total Wind Uplift (lbs.)	DL = Total Dead Load (lbs.)	Maximum Allowable Mechanical Attachment Strength (lbs.)	Total MA Capacity (lbs.)	Calculated Factor of Safety*	Check
1.1	5,859	5,190	525	2,056	2.06	**OK**
Total:	**5,859 lbs.**	**5,190 lbs.**		**2,056 lbs.**		

Table 5.1 Summary of Mechanical Attachment Requirements

* Back calculated factor of safety provided to determine factor of safety applied to dead load in lieu of 0.6 in ASCE 7-16 equation 7, BACK CALCULATED FACTOR OF SAFETY = (DEAD LOAD+MECHANICAL ATTACHMENT)/(.6)WIND LOAD

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5.0 Design Loads - Wind (Cont.):

5.1.2 Global Wind Shear Summary Table:

Mechanical attachments may be required for several reasons including building code, roof load limits and array shape. The table below provides the mechanical attachment requirements for each sub-array within this project.

	Applied Load		Resisting Load			Code Check	
Sub-Array Name	FL-D = Wind Uplift (lbs.)	FD = Wind Drag (lbs.)	DL = Total Dead Load (lbs.)	Maximum Allowable Mechanical Attachment Strength (lbs.)	Total MA Capacity (lbs.)	Check Calculated Factor of Safety*	Check
1.1	2,975	974	5,190	650	4,550	3.87	OK
Total:	2,975 lbs.	974 lbs.	5,190		4,550 lbs.		

Table 5.2 Summary of Mechanical Attachment Requirements

* Back calculated factor of safety provided to determine factor of safety applied to dead load in lieu of 0.6 in ASCE 7-16 equation 7, BACK CALCULATED FACTOR OF SAFETY = (DEAD LOAD+MECHANICAL ATTACHMENT)/(((.6)WIND SHEAR/FRICTION)+(.6)WIND UPLIFT)

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6.0 Design Loads - Downward:

6.1 Downward Wind Load Calculation:

$WL_{in} = q_z * A_m * G_{CP} * cos\ \theta$

Where:

q_z =	19.29 psf		(Ref. Section 3.1, Wind Load Data)
Am =	25.59 sq.ft.	(Single Module Area)	(Ref. Section 1.1, General Project Information)
θ =	8.99 deg.		(Ref. Section 1.1, General Project Information)
G_{CP} =	1.13	(Inward)	(Proprietary Wind Tunnel Data)
G_{CP} =	0.30	(Inward with snow)	(ASCE, Fig. 30.3-5A)

WL_{in}*(no snow) =* *551 lbs./module*

WL_{in}*(with snow) =* *146 lbs./module*

Contact Base by Location:

1 = South
2 = Interior
3 = 2nd from North
4 = North

Contact Pad by Information:

Distance Between C.C. outer Pads = 18 in.
Typical Pad Area = 9 sq.in.

6.2 Racking Dimensions for Point Loads:

Inter-Module Support spacing (S) = 47.91 in.

Inter-Column Support Spacing (L) = 35.43 in.

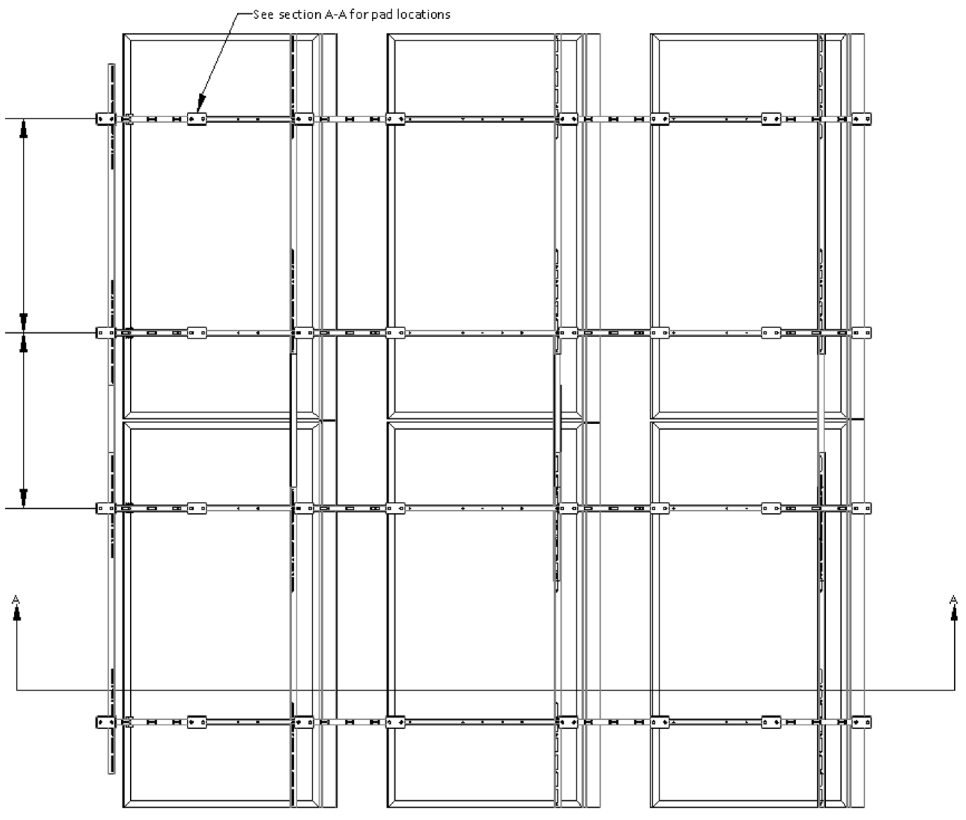

Fig. 6.1 Typical Array Plan View
(Section A-A) on Next Page

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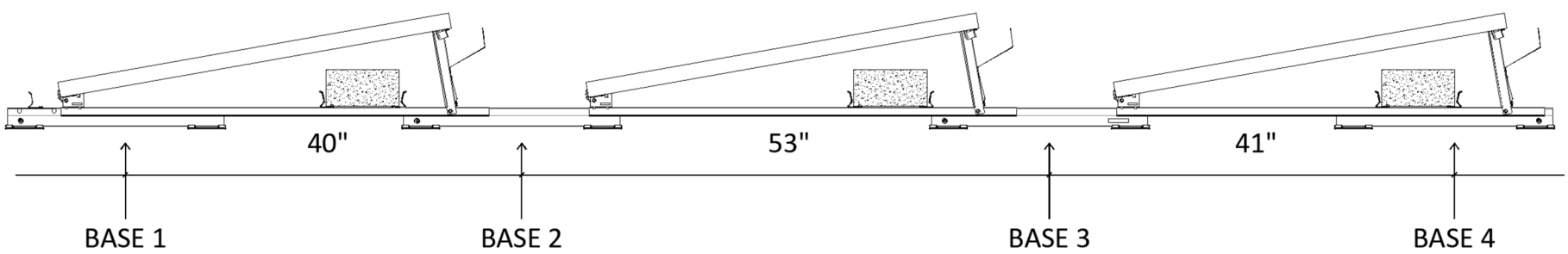
6.0 Design Loads - Downward (Cont.):

6.2 Racking Dimensions for Point Loads (Cont.):



Section A-A

Fig. 6.2 Section A-A

6.3 Point Load Summary:

DLsys = 76 lbs./module
Total DL = (Varies on location and ballast quantity)
SLm = 531 lbs./module
WLin (no snow) = 551 lbs./module
WLin (with snow) = 146 lbs./module

Notes:

-Base 2 repeat for larger width arrays.

Max Total Load Per Base (lbs.)				
Location	Base	load combinations (ASD)		
		DL + Snow	DL + 0.6Wlin	DL + 0.75SLm + 0.75(0.6WLin)
South	1	176	126	159
Interior	2	385	285	351
2nd From North	3	358	258	325
North	4	233	183	216

Table 6.1-A Max Total Load per Base (lbs.)

Max Contact Pressure Table Per Base (psi)					
# of Pads	Location	Base	load combinations (ASD)		
			DL + Snow	DL + 0.6Wlin	DL + 0.75SLm + 0.75(0.6WLin)
2	South	1	10	7	9
	Interior	2	21	15	19
	2nd From North	3	19	14	18
	North	4	13	10	12
4	South	1	5	3	4
	Interior	2	10	8	10
	2nd From North	3	10	7	9
	North	4	6	5	6

Table 6.1-B Max Point Load Summary (psi)

11/19/2024

7.0 Design Loads - Seismic:

Seismic Calculations per ASCE 7-16, Chapter 11 - Seismic Design Criteria

Chapter 13 - Requirements for Nonstructural Components

7.1 Seismic Load Data:

Site Class :	D		(Ref. Project Information)
Seismic Design Category :	D		(ASCE, Tables 11.6-1 and 11.6-2)
Short Period Spectral Resp. (5%) (Ss) :	1.279		(Ref. Project Information)
1s Spectral Response (5%) (S1) :	0.44		(Ref. Project Information)
Bldg. Seismic Imp. Factor (Ie) =	1		(ASCE, Table 1.5-2)
Adj. MCE Spec. Resp. (Short) (Sms) =	Fa*Ss =	1.535	(ASCE, Eqn. 11.4-1)
Adj. MCE Spec. Resp. (1 sec.) (Sm1) =	Fv*S1 =	0.818	(ASCE, Eqn. 11.4-2)
Short Period Spectral Response (Sds) =	2/3(Sms) =	1.023	(ASCE, Eqn. 11.4-3)
One Second Spectral Response (Sd1) =	2/3(Sm1) =	0.546	(ASCE, Eqn. 11.4-2)
Component Seismic Imp. Factor (Ip) =	1		(ASCE, Sec. 13.1.3)
Repsonse Modification Factor (Rp) =	2.5		(ASCE, Table 13.6-1)
Amplification Factor (ap) =	1		(ASCE, Table 13.6-1)

7.2 Seismic Design Equations:

Lateral Force (F_p) =	$\frac{0.4a_pS_{DS}W_p}{\left(\frac{R_p}{I_p}\right)}\left(1+2\left(\frac{z}{h}\right)\right)$	(ASCE, Eqn. 13.3-1)
Lateral Force (F_{PLmin}) =	$0.3S_{DS}I_pW_p$	(ASCE, Eqn. 13.3-3)
Lateral Force (F_{PLmax}) =	$1.6S_{DS}I_pW_p$	(ASCE, Eqn. 13.3-2)
Vertical Force (F_{pv})) =	$\pm[0.20S_{DS}W_p]$	(ASCE, Eqn. 12.4-4)
Lateral Resisting Force (FRL)* =	0	(Factored Load, ASD)
Vertical Resisting Force (FRV) =	$0.6W_p$	(Factored Load, ASD)

* Frictional resistance due to the components weight may not be used to resist lateral forces caused by seismic loads.

7.0 Design Loads - Seismic (Cont.):

7.3 Lateral Seismic Force Check:

The necessity to add mechanical attachments can arise for several reasons. Building code requirements, roof load limits and array shape all may come into play when determining their need. The table below provides the mechanical attachment requirements for each sub-array within this project.

Nomenclature:

W_P = Sub-Array Weight

F_{PL} = Lateral Seismic Force

F_{RL} = Lateral Seismic Resisting Force

Array Information		Lateral Force Verification			Results			
Sub-Array Name	W_P (lbs.)	F_{PL} (lbs.)	F_{RL} (lbs.)	0.7 F_{PL} - F_{RL} (lbs.)	MA's Required	Total MA Capacity (lbs.)	MA's Provided	Acceptable
1.1	5,190	2,549	0	1,784	3	4,550	7	Yes
Totals:	5,190 lbs	2,549 lbs.	0 lbs.	1,784 lbs.	3	4,550	7	

Table 7.1 -Summary of Mechanical Attachment Requirements

* MA's Required = 0.7 F_{PL}-F_{RL}/MA strength

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7.0 Design Loads - Seismic (Cont.):

7.4 Vertical Seismic Force Check:

Mechanical attachments may be required for several reasons including building code, roof load limits and array shape. The table below provides the mechanical attachment requirements for each sub-array within this project.

Nomenclature:

W_P = Sub-Array Weight

F_{PV} = Vertical Seismic Force

F_{RV} = Vertical Seismic Resisting Force

Array Information		Vertical Force Verification			Results			
Sub-Array Name	W_P (lbs.)	F_{PV} (lbs.)	F_{RV} (lbs.)	0.7 F_{PV} - F_{RV} (lbs.)	MA's Required	Total MA Capacity (lbs.)	Total MA's Provided	Acceptable
1.1	5,190	1,062	3,114	-2,371	0	2,056	7	Yes
Total:	5,190 lbs.	1,062 lbs.	3,114 lbs.	-2,371 lbs.	0	2,056	7	

Table7.2 - Summary of Mechanical Attachment Requirements

* MA's Required = 0.7 F_{PV} - F_{RV}/MA strength