RIGHT ANGLE *ENGINEERING*

STRUCTURAL CERTIFICATION REPORT

Roof-mounted Solar Panels

April 16, 2024

To: Poly Energy
174 Corley Mill Rd
Lexington, SC 29072

Re: Marie Whitaker
105 Wrench St
Erwin, NC 28339
AHJ: **Erwin (City)**, NC

Poly Energy proposes to install new roof-mounted solar panels at this residence and asked *Right Angle Engineering* to review the existing structure for suitability. This letter summarizes the methods that were used to survey, evaluate, and certify the existing roof framing and the attachment of the new solar panels to it.

STRUCTURAL DESIGN

Building Code:	North Carolina Residential Code 2018
Design Standards:	ASCE 7-16
Snow:	Ground: p_g= 10.0 psf | Flat Roof: p_f= 11.93 psf | Sloped Roof: p_s= 8.75 psf
Wind:	Ultimate Wind Speed = 119.0 mph | Exposure = C
Seismic:	Risk Category = 2 | Seismic Design Category = B | Site Class = D

STRUCTURE

Field Technicians from *Poly Energy* visited the site and observed the existing structure :

Array Name	Panel Quantity	Roof Framing	Material	Pitch
Array 1	6	Pre-Manufactured Truss | 24" o.c.	Asphalt Shingles	26°

ANCHORAGE

The solar panel anchorage shall be installed according to the manufacturer's most current installation manual. Anchorage shall be staggered to distribute the load evenly to adjacent roof members. The solar panels should be mounted parallel (max 10 inches) to the roof surface.

Array Name	Connection Type	Fastener	Max Anchorage Spacing
Array 1	Comp Mount	5/16” lag screw (2.5" embedment) into roof substructure	48"

Installation Instructions

Solar panels and the equipment shall be installed per the manufacturer's installation specifications. Improper installation will void this certification. Deviations from the approved structural plans (including equipment substitutions) are not allowed without written approval from Right Angle Engineering. Prior to installation, the installer should:

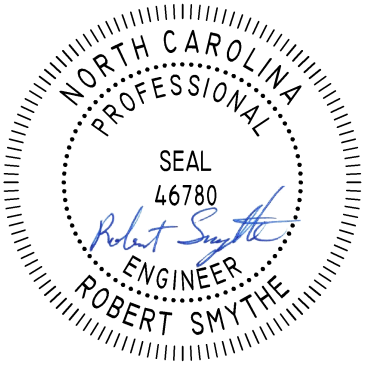
- Confirm that the existing structure matches the information provided in the structural survey, the approved installation plans and this certification.
- Identify discrepancies between this certification and the approved installation plans. If found, then this certification shall govern.
- Identify structural elements that are dangerous (cracked, broken, excessive sag, signs of overstress, rot,decay, fire, water). If found, installation shall cease until those elements are adequately abated and made to comply with the referenced building code.
- Verify that both the existing structure and the solar addition has been permitted through the AHJ.

STRUCTURAL CERTIFICATION

I certify the addition of solar panels on the roof of this structure does not cause the structure to become unsafe or make it generally less compliant with the life-safety requirements of the referenced building code. Based on the evaluation methods described below, for the loads that exist at this site, the existing framing will safely support the new solar panels if they are installed and attached correctly. Electrical design is not included in this certification.

Array Name	Certification Method	Retrofits
Array 1	Prescriptive method North Carolina Existing Building code 807.4	None required

Regards,



04/16/2024

Robert D. Smythe, P.E.
Right Angle Engineering

Job Details

Roof Snow Load - ASCE 7-16	
Ground Snow Load (p_g) *Section 7.2*	10.0 psf
Exposure Factor (C_e) *Table 7.3-1*	0.9
Thermal Factor (C_t) *Table 7.3-2*	1.1
Importance Factor (I_s) *Table 1.5-2*	1
Flat Roof Snow Load (p_f) *Equation 7.3-1*	11.93 psf
Non-Slippery Surface Slope Factor (C_s) *Figure 7.4-1*	1
Slippery Surface Slope Factor (C_s) *Figure 7.4-1*	0.73
Roof Snow Load *Equation 7.4-1*	11.93 psf
Reduced Snow Load (Slippery Surface) *Equation 7.4-1*	8.75 psf

Design Criteria	
Wind Speed (V_{ult}) *Local Design Criteria*	119.0mph
Exposure Category	C
Risk Category	2
Mean Roof Height	20 ft
Roof Type	Gable Roof
Building Type	Enclosed

Roof Live Load	
Existing Roof Live Load *ASCE 7-16 Table 4.3-1*	20 psf
Roof Live Load with Solar Panels	0.0 psf

[1]Roof Dead Load			
Asphalt Shingles	2.0 psf	**No Drywall**	0.0 psf
5/8" Plywood Sheathing	2.0 psf	**Solar Panel Array**	2.8 psf
Roof Framing	4 psf	**Dead Load Without Panels**	9.2 psf
Insulation	1.2 psf		

[1]Roof Dead Load is taken from the worst case scenario dead load from all arrays of the job in order to provide a more conservative evaluation.

Array 1

Array Details	
Roof Framing	Pre-Manufactured Truss
Spacing	24.0"
Beam Span	22.0'
Roof Pitch	26°
Solar Rails	Pegasus Rail
Module Type	Q.PEAK DUO BLK ML-G10+ 405
Module Wind rating [psf] *Safety Factor = 1.5*	55.69
Panel Quantity	6
Panel Array Area	126.81 ft²
Panel Orientation	Portrait
Lag Screw Embedment	2.5"
Roof Attachment Type	Comp Mount 5/16” lag screw
Shear Capacity *NDS 2015 Table 12K*	190.0 lbs
Pullout Capacity *NDS 2015 Table 12K*	665.0 lbs
Velocity Pressure *Equation 26.10-1 (K_z=0.9, K_{ht}=1, K_d=0.85, K_e=0.99)*	27.61 psf

GCP Zones	1/2e	2n/2r /3e	3r
GC_p *Figure 30.3-(2A-5B)*	-1.5	-2.5	-3.6
Design Pressure Up [psf] *Equation 29.4-7 γ_a=0.75 γ_E=1.0,*	-31.1	-51.8	-74.6
Factored Design Pressure Up [psf] *ASD LC (.6D + .6W)*	-17.1	-29.6	-43.3
Exposed Design Pressure Up [psf] *γ_a=0.75 γ_E=1.5,*	-46.6	-77.7	-111.9
Design Pressure Down [psf]	10.4	10.4	10.4
Tributary Area [ft^2]	37.5	22.5	15.4
Maximum Connection Spacing [in]	146	88	60
Maximum Rail Span [in]	67	67	61
Maximum Rail Cantilever [in]	16	16	16
Design Connection Spacing [in]	48	48	48
Deign Connection Spacing (exposed) [in]	67	48	24

Prescriptive Method: North Carolina Existing Building Code 807.4	
Total load on member without solar	1372.4 lbs
Total load on member with solar	1372.4 lbs
Percentage of total design load on member with solar	1.0%

The 2018 North Carolina Existing Building section 807.4 indicates that alterations to an existing building that results in less than a 10.0% increase in the total stress may be performed without a structural evaluation of the existing building. As demonstrated in the above calculations, the additional weight of the solar panels will be less than 10.0% increase in the gravity loading and therefore stress on the existing roof framing. Load case before and load case after solar panels have been added have both been considered.