Technical Memorandum

To: Steve Coyne
Back Bay Barrels LLC
3857 Birch Street, #521
Newport Beach, CA 92660

From: Nick Johnson, Johnson Aviation, Inc.
Date: 11/22/2024
Subject: Solar Glare Analysis – Solar Photovoltaic (PV) Installation – Snug Harbor Project

A. Findings

The findings of this Solar Glare Analysis are that the Proposed Project **PASSES** the Federal Aviation Administration's (FAA's) recommended solar glare tests. This Technical Memorandum outlines the study of the proposed solar PV Project and substantiates these findings.

B. Introduction

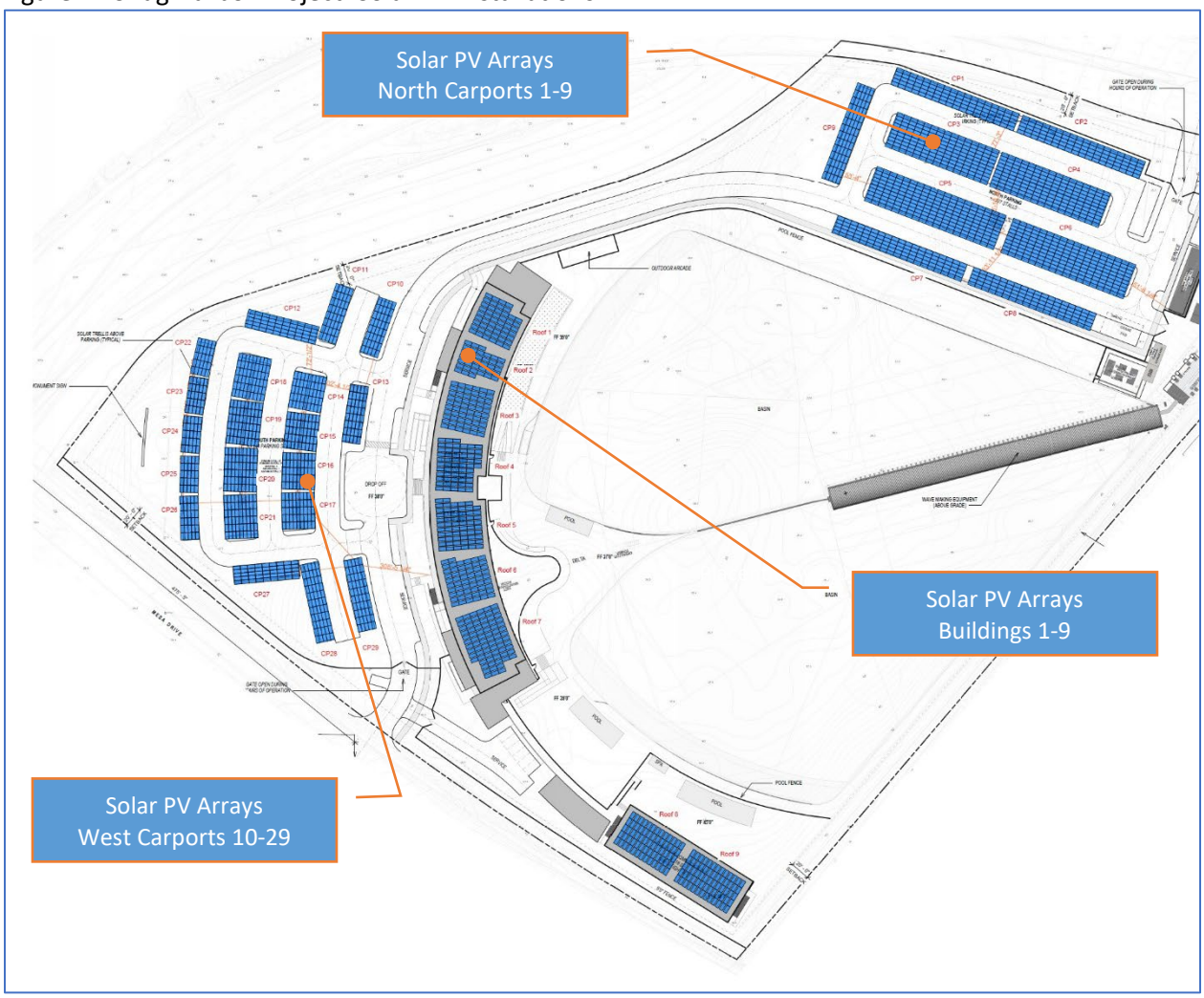
The purpose of this technical memorandum is to assess the airport compatibility of a proposed solar PV installation on the roof and carports as part of the Snug Harbor Project (Project). The Project site is generally located at 3100 Irvine Avenue in the northern boundary of the City of Newport Beach, near the California 73 Toll Road (SR73) and the California 55 Freeway (SR 55); between Irvine Avenue and Mesa Drive. John Wayne Airport is located approximately 2,700 feet to the north (Figure 1).

Figure 1: Project Site Location

C. Proposed Solar PV Installation

The Snug Harbor Project includes a plan for a series of rooftop and carport-mounted solar PV installation on the Project site. The solar PV array installation would cover approximately 70,908 square feet of rooftop and carport area on the north, west, and south sides of the project (See Figure 2).

Figure 2: Snug Harbor Project–Solar PV Installations



D. Standard of Review

This study and its findings have been prepared consistent with the Federal Aviation Administration's (FAA) policy to eliminate hazards to air navigation that may arise as the result of implementing solar energy facilities on and near airports. The FAA adopted an Interim Policy[1] for Solar PV project review in 2013 and completed a final solar glare policy in 2021[2]. In both the 2013 Interim Policy and the 2021 Final Policy, off-airport solar arrays are not required to meet the FAA's policies, but they are strongly encouraged to

[1] Background on the Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports, Federal Register, October 23, 2013.

[2] Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports, 86 Fed. Reg. 25801 (May 11, 2021), https://www.federalregister.gov/documents/2021/05/11/2021-09862/federal-aviation-administration-policy-review-of-solar-energy-system-projects-on-federally-obligated

consider the requirements of this policy guidance when siting systems. The FAA does not control land use off airport property. The FAA encourages collaboration with local land use jurisdictions like the City to avoid solar glare impacts on airport operations.

As solar PV was being implemented on and near airports in recent years, the FAA was finding that solar PV reflections of sunlight glint and glare were affecting pilots' vision, particularly on final approach to runways, and was also impacting some air traffic controllers' vision when controlling aircraft near airports. In conjunction with Sandia National Laboratories, the FAA developed a computer analysis tool to measure the potential impact of reflected glint and glare from Solar PV installations. The analysis of this impact is achieved through use of the Solar Glare Hazard Assessment Tool (SGHAT). At the time of the Interim Policy, Sandia Labs produced the tool to meet the analysis requirement. Since then, Sandia Labs has licensed the tool to other providers to sell commercially for solar glare analysis. ForgeSolar licensed the SGHAT tool and incorporated its software into their Glare Analysis tool. Johnson Aviation, Inc. uses the ForgeSolar Glare Analysis tool under subscription license from Sims Industries d/b/a ForgeSolar.

The following is the Standard for Measuring Ocular Impact from the FAA's 2013 Interim Policy:

> Standard for Measuring Ocular Impact
> FAA adopts the Solar Glare Hazard Analysis Plot as the standard for measuring the ocular impact of any proposed solar energy system on a federally obligated airport. To obtain FAA approval to revise an airport layout plan to depict a solar installation and/or a "no objection" to a Notice of Proposed Construction Form 7460-1, the airport sponsor will be required to demonstrate that the proposed solar energy system meets the following standards:
>
> 1. No potential for glint or glare in the existing or planned Airport Traffic Control Tower (ATCT) cab; and
> 2. No potential for glare or "low potential for after-image" along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glidepath.
> 3. Ocular impact must be analyzed over the entire calendar year in one (1) minute intervals from when the sun rises above the horizon until the sun sets below the horizon.

After significant additional study of the issue, the FAA concluded in its final 2021 Policy that less restrictive analysis can achieve the same goals for limiting solar PV glare. The following are the revised FAA 2021 Policy limitations:

> This policy does not apply to:
>
> 1. Solar energy systems on airports that do not have an ATCT,
>
> 2. Airports that are not federally-obligated, or
>
> 3. Solar energy systems not located on airport property.

Though this policy does not apply to proponents of solar energy systems located off airport property, they are encouraged to consider ocular impact for proposed systems in proximity to airports with ATCTs. In these cases, solar energy system proponents should coordinate with the local airport sponsor.

E. Solar Glare Analysis Reports

The following pages of this Technical Memorandum provide the solar glare analysis reports for each of the suggested studies. The FAA standard study of the final approach paths to the runway ends and the Air Traffic Control Tower analysis is included in each individual report. The results of this study show that the proposed Project would not produce any glint or glare on the air traffic control tower cab or in any of the final approach areas to the runways.

- FAA 2013 Policy Review
    - (See Attachment A-1)
    - (See Attachment A-2)
    - (See Attachment A-3)
- FAA 2021 Policy Review
    - (See Attachment B-1)
    - (See Attachment B-2)
    - (See Attachment B-3)
- Full Solar Glare Analysis Report 2021 Policy
    - (See Attachment C-1)
    - (See Attachment C-2)
    - (See Attachment C-3)

Attachment A-1
2013 FAA Policy Review

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Carport 1-9**
Analysis conducted by Nick Johnson (nick.johnson@johnson-aviation.com) at 23:03 on 21 Nov, 2024.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Default glare analysis parameters and observer eye characteristics (for reference only):

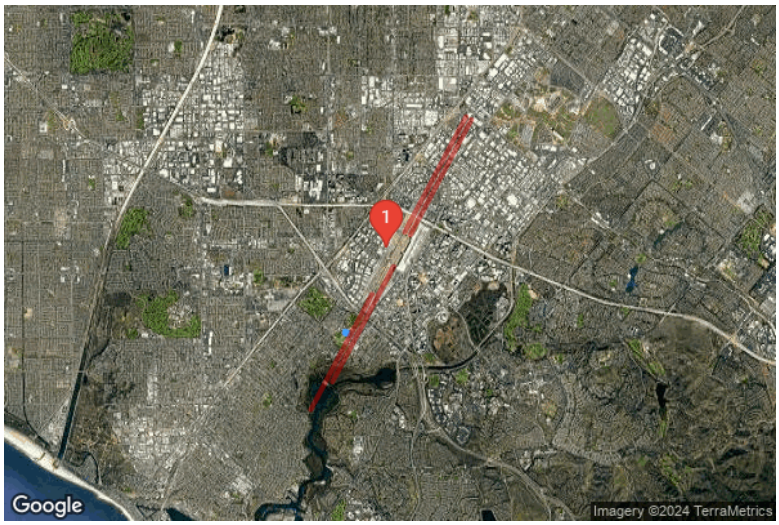
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 134889.22911
Methodology: V2



PV Array(s)

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659713	-117.881102	25.43	8.50	33.93
2	33.659590	-117.880683	28.04	8.50	36.54
3	33.659542	-117.880703	28.42	8.50	36.92
4	33.659665	-117.881123	25.86	8.50	34.36

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659587	-117.880671	28.47	8.50	36.97
2	33.659464	-117.880251	29.84	8.50	38.34
3	33.659415	-117.880272	30.55	8.50	39.05
4	33.659538	-117.880691	28.92	8.50	37.42

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659587	-117.881096	25.62	8.50	34.12
2	33.659484	-117.880747	28.73	8.50	37.23
3	33.659386	-117.880788	28.94	8.50	37.44
4	33.659489	-117.881137	28.11	8.50	36.61

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659481	-117.880738	28.79	8.50	37.29
2	33.659371	-117.880365	31.81	8.50	40.31
3	33.659274	-117.880406	32.91	8.50	41.41
4	33.659383	-117.880779	29.03	8.50	37.53

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659431	-117.881162	28.89	8.50	37.39
2	33.659301	-117.880719	29.99	8.50	38.49
3	33.659204	-117.880760	31.17	8.50	39.67
4	33.659333	-117.881203	31.05	8.50	39.55

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659294	-117.880694	30.43	8.50	38.93
2	33.659171	-117.880274	32.88	8.50	41.38
3	33.659073	-117.880315	33.41	8.50	41.91
4	33.659196	-117.880735	31.85	8.50	40.35

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659289	-117.881290	31.73	8.50	40.23
2	33.659159	-117.880847	32.17	8.50	40.67
3	33.659110	-117.880868	32.35	8.50	40.85
4	33.659240	-117.881311	31.73	8.50	40.23

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659152	-117.880824	32.63	8.50	41.13
2	33.659029	-117.880405	38.22	8.50	46.72
3	33.658980	-117.880425	38.84	8.50	47.34
4	33.659104	-117.880844	34.06	8.50	42.56

Name: PV array 9
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659667	-117.881235	25.73	8.50	34.23
2	33.659650	-117.881176	26.75	8.50	35.25
3	33.659377	-117.881291	31.49	8.50	39.99
4	33.659394	-117.881349	29.59	8.50	38.09

Flight Path Receptor(s)

Name: FP1-02L
Description:
Threshold height: 55 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.667827	-117.873833	53.40	55.00	108.40
Two-mile	33.642299	-117.890161	3.76	658.06	661.82

Name: FP2-20R
Description:
Threshold height: 51 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681645	-117.865093	39.58	51.00	90.58
Two-mile	33.707173	-117.848762	52.79	591.22	644.01

Name: FP3-02R
Description:
Threshold height: 50 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.674007	-117.868070	51.97	50.00	101.97
Two-mile	33.648479	-117.884400	4.74	650.66	655.40

Name: FP4-20L
Description:
Threshold height: 50 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681008	-117.863632	39.87	50.00	89.87
Two-mile	33.706536	-117.847301	53.45	589.84	643.29

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.73	121.00

Map image of 1-ATCT

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	5.0	200.0	0	0	-
PV array 2	5.0	200.0	0	0	-
PV array 3	5.0	200.0	0	0	-
PV array 4	5.0	200.0	0	0	-
PV array 5	5.0	200.0	0	0	-
PV array 6	5.0	200.0	0	0	-
PV array 7	5.0	200.0	0	0	-
PV array 8	5.0	200.0	0	0	-
PV array 9	5.0	110.0	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Results for: PV array 1

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 2

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 3

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 4

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 5

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 6

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 7

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 8

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 9

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to V1 algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

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Attachment A-2
2013 FAA Policy Review

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Carport 10-29**
Analysis conducted by Nick Johnson (nick.johnson@johnson-aviation.com) at 00:47 on 22 Nov, 2024.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

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ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Default glare analysis parameters and observer eye characteristics (for reference only):

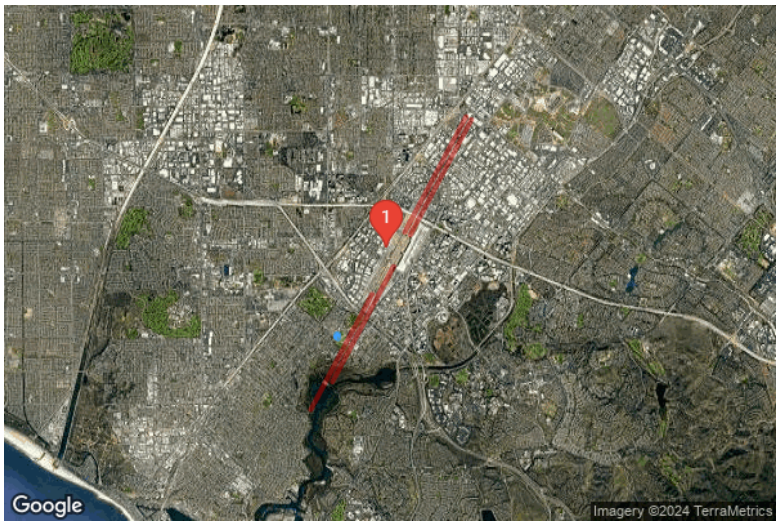
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 134900.22911
Methodology: V2



PV Array(s)

Name: PV array 10
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659025	-117.882841	17.32	8.50	25.82
2	33.659009	-117.882782	17.14	8.50	25.64
3	33.658852	-117.882842	17.30	8.50	25.80
4	33.658867	-117.882901	17.25	8.50	25.75

Name: PV array 11
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659061	-117.882988	15.29	8.50	23.79
2	33.659046	-117.882928	17.12	8.50	25.62
3	33.658887	-117.882986	17.24	8.50	25.74
4	33.658903	-117.883045	16.88	8.50	25.38

Name: PV array 12
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 195.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658981	-117.883283	15.87	8.50	24.37
2	33.658936	-117.883042	16.63	8.50	25.13
3	33.658885	-117.883055	17.23	8.50	25.73
4	33.658930	-117.883296	17.15	8.50	25.65

Name: PV array 13
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658776	-117.882931	17.75	8.50	26.25
2	33.658769	-117.882869	17.83	8.50	26.33
3	33.658605	-117.882894	18.31	8.50	26.81
4	33.658612	-117.882955	18.30	8.50	26.80

Name: PV array 14
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658808	-117.883121	17.86	8.50	26.36
2	33.658794	-117.883011	17.86	8.50	26.36
3	33.658692	-117.883031	18.29	8.50	26.79
4	33.658706	-117.883141	18.28	8.50	26.78

Name: PV array 15
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658693	-117.883143	18.26	8.50	26.76
2	33.658684	-117.883032	18.33	8.50	26.83
3	33.658582	-117.883043	19.32	8.50	27.82
4	33.658590	-117.883154	19.51	8.50	28.01

Name: PV array 16
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658577	-117.883155	20.35	8.50	28.85
2	33.658576	-117.883043	20.54	8.50	29.04
3	33.658473	-117.883044	24.14	8.50	32.64
4	33.658473	-117.883155	21.70	8.50	30.20

Name: PV array 17
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658462	-117.883156	22.08	8.50	30.58
2	33.658467	-117.883045	25.86	8.50	34.36
3	33.658363	-117.883039	32.16	8.50	40.66
4	33.658359	-117.883150	25.90	8.50	34.40

Name: PV array 18
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658856	-117.883311	18.11	8.50	26.61
2	33.658841	-117.883201	17.94	8.50	26.44
3	33.658719	-117.883225	18.18	8.50	26.68
4	33.658734	-117.883335	18.28	8.50	26.78

Name: PV array 19
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658723	-117.883337	18.49	8.50	26.99
2	33.658715	-117.883226	18.30	8.50	26.80
3	33.658592	-117.883239	20.02	8.50	28.52
4	33.658600	-117.883350	19.63	8.50	28.13

Name: PV array 20
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658587	-117.883352	19.65	8.50	28.15
2	33.658586	-117.883241	20.91	8.50	29.41
3	33.658462	-117.883242	21.08	8.50	29.58
4	33.658463	-117.883353	18.24	8.50	26.74

Name: PV array 21
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658450	-117.883353	17.99	8.50	26.49
2	33.658457	-117.883241	21.75	8.50	30.25
3	33.658333	-117.883231	24.58	8.50	33.08
4	33.658327	-117.883343	18.00	8.50	26.50

Name: PV array 22
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658896	-117.883451	14.46	8.50	22.96
2	33.658886	-117.883391	16.12	8.50	24.62
3	33.658785	-117.883416	17.81	8.50	26.31
4	33.658795	-117.883476	18.00	8.50	26.50

Name: PV array 23
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658786	-117.883477	18.49	8.50	26.99
2	33.658780	-117.883415	18.98	8.50	27.48
3	33.658678	-117.883430	19.39	8.50	27.89
4	33.658684	-117.883491	18.63	8.50	27.13

Name: PV array 24
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658674	-117.883494	19.04	8.50	27.54
2	33.658671	-117.883432	19.67	8.50	28.17
3	33.658568	-117.883439	20.78	8.50	29.28
4	33.658571	-117.883501	20.37	8.50	28.87

Name: PV array 25
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658560	-117.883501	20.83	8.50	29.33
2	33.658559	-117.883439	20.95	8.50	29.45
3	33.658456	-117.883440	19.65	8.50	28.15
4	33.658456	-117.883502	20.82	8.50	29.32

Name: PV array 26
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658445	-117.883502	20.12	8.50	28.62
2	33.658448	-117.883440	18.65	8.50	27.15
3	33.658324	-117.883431	17.87	8.50	26.37
4	33.658321	-117.883493	18.15	8.50	26.65

Name: PV array 27
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658250	-117.883315	17.20	8.50	25.70
2	33.658272	-117.883094	24.01	8.50	32.51
3	33.658221	-117.883087	24.88	8.50	33.38
4	33.658199	-117.883307	17.84	8.50	26.34

Name: PV array 28
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658259	-117.883087	27.95	8.50	36.45
2	33.658271	-117.883026	31.69	8.50	40.19
3	33.658050	-117.882963	33.25	8.50	41.75
4	33.658038	-117.883024	30.26	8.50	38.76

Name: PV array 29
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658273	-117.882939	33.21	8.50	41.71
2	33.658285	-117.882879	34.42	8.50	42.92
3	33.658085	-117.882822	37.10	8.50	45.60
4	33.658073	-117.882882	35.22	8.50	43.72

Flight Path Receptor(s)

Name: FP1-02L
Description: None
Threshold height: 55 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.667827	-117.873833	53.40	55.00	108.40
Two-mile	33.642299	-117.890161	3.80	658.00	661.80

Name: FP2-20R
Description: None
Threshold height: 51 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681645	-117.865093	39.60	51.00	90.60
Two-mile	33.707173	-117.848762	52.80	591.20	644.00

Name: FP3-02R
Description: None
Threshold height: 50 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.674007	-117.868070	52.00	50.00	102.00
Two-mile	33.648479	-117.884400	4.70	650.70	655.40

Name: FP4-20L
Description: None
Threshold height: 50 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681008	-117.863632	39.90	50.00	89.90
Two-mile	33.706536	-117.847301	53.50	589.80	643.30

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.70	121.00

Map image of 1-ATCT

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 10	5.0	110.0	0	0	-
PV array 11	5.0	110.0	0	0	-
PV array 12	5.0	195.0	0	0	-
PV array 13	5.0	100.0	0	0	-
PV array 14	5.0	100.0	0	0	-
PV array 15	5.0	95.0	0	0	-
PV array 16	5.0	270.0	0	0	-
PV array 17	5.0	270.0	0	0	-
PV array 18	5.0	100.0	0	0	-
PV array 19	5.0	95.0	0	0	-
PV array 20	5.0	270.0	0	0	-
PV array 21	5.0	270.0	0	0	-
PV array 22	5.0	100.0	0	0	-
PV array 23	5.0	100.0	0	0	-
PV array 24	5.0	95.0	0	0	-
PV array 25	5.0	270.0	0	0	-
PV array 26	5.0	270.0	0	0	-
PV array 27	5.0	180.0	0	0	-
PV array 28	5.0	250.0	0	0	-
PV array 29	5.0	250.0	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Results for: PV array 10

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 11

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 12

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 13

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 14

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 15

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 16

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 17

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 18

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 19

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 20

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 21

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 22

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 23

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 24

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 25

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 26

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 27

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 28

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 29

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to V1 algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

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Attachment A-3
2013 FAA Policy Review

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Building 1-9**
Analysis conducted by Nick Johnson (nick.johnson@johnson-aviation.com) at 19:10 on 22 Nov, 2024.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Default glare analysis parameters and observer eye characteristics (for reference only):

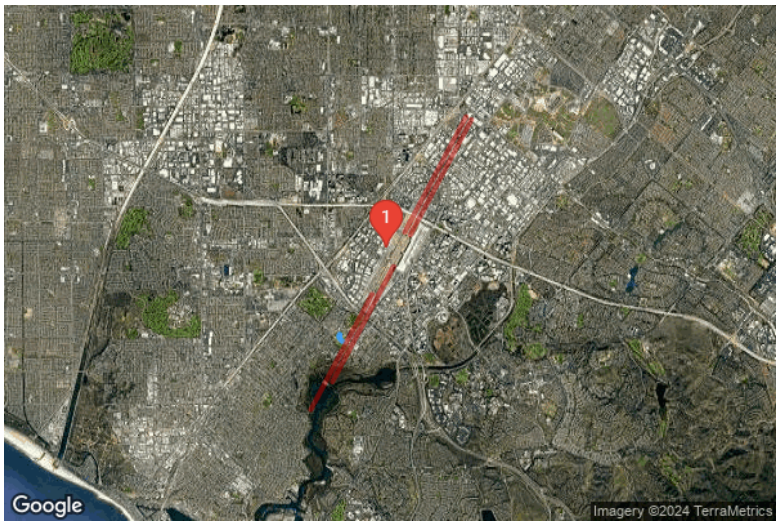
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

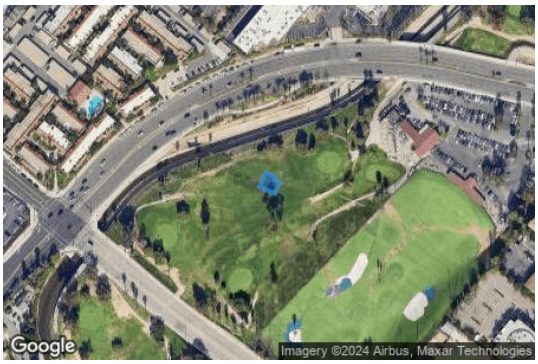
Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 134903.22911
Methodology: V2



PV Array(s)

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 115.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659045	-117.882478	42.00	50.00	92.00
2	33.659011	-117.882385	42.00	50.00	92.00
3	33.658986	-117.882398	42.00	50.00	92.00
4	33.658969	-117.882352	42.00	50.00	92.00
5	33.658884	-117.882396	42.00	50.00	92.00
6	33.658934	-117.882535	42.00	50.00	92.00

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658909	-117.882545	42.00	50.00	92.00
2	33.658889	-117.882473	42.00	50.00	92.00
3	33.658876	-117.882478	42.00	50.00	92.00
4	33.658856	-117.882407	42.00	50.00	92.00
5	33.658794	-117.882432	42.00	50.00	92.00
6	33.658814	-117.882504	42.00	50.00	92.00
7	33.658801	-117.882509	42.00	50.00	92.00
8	33.658821	-117.882580	42.00	50.00	92.00

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 105.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658792	-117.882589	42.00	50.00	92.00
2	33.658766	-117.882441	42.00	50.00	92.00
3	33.658635	-117.882474	42.00	50.00	92.00
4	33.658661	-117.882622	42.00	50.00	92.00

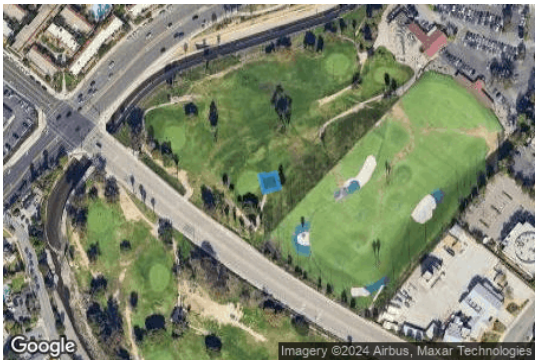
Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 90.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658629	-117.882628	42.00	50.00	92.00
2	33.658627	-117.882553	42.00	50.00	92.00
3	33.658614	-117.882553	42.00	50.00	92.00
4	33.658612	-117.882478	42.00	50.00	92.00
5	33.658546	-117.882480	42.00	50.00	92.00
6	33.658547	-117.882505	42.00	50.00	92.00
7	33.658478	-117.882507	42.00	50.00	92.00
8	33.658481	-117.882633	42.00	50.00	92.00

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 265.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658455	-117.882633	42.00	50.00	92.00
2	33.658459	-117.882583	42.00	50.00	92.00
3	33.658446	-117.882582	42.00	50.00	92.00
4	33.658452	-117.882506	42.00	50.00	92.00
5	33.658438	-117.882505	42.00	50.00	92.00
6	33.658440	-117.882480	42.00	50.00	92.00
7	33.658320	-117.882466	42.00	50.00	92.00
8	33.658308	-117.882616	42.00	50.00	92.00

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 255.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658280	-117.882609	42.00	50.00	92.00
2	33.658291	-117.882561	42.00	50.00	92.00
3	33.658278	-117.882556	42.00	50.00	92.00
4	33.658301	-117.882459	42.00	50.00	92.00
5	33.658184	-117.882421	42.00	50.00	92.00
6	33.658151	-117.882567	42.00	50.00	92.00

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658118	-117.882555	42.00	50.00	92.00
2	33.658164	-117.882414	42.00	50.00	92.00
3	33.658014	-117.882343	42.00	50.00	92.00
4	33.657999	-117.882390	42.00	50.00	92.00
5	33.657973	-117.882378	42.00	50.00	92.00
6	33.657950	-117.882448	42.00	50.00	92.00
7	33.658001	-117.882472	42.00	50.00	92.00
8	33.657993	-117.882496	42.00	50.00	92.00

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 120.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.657584	-117.881935	48.00	45.00	93.00
2	33.657495	-117.881754	48.00	45.00	93.00
3	33.657404	-117.881818	48.00	45.00	93.00
4	33.657493	-117.881999	48.00	45.00	93.00

Name: PV array 9
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 120.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.657481	-117.881727	48.00	45.00	93.00
2	33.657392	-117.881546	48.00	45.00	93.00
3	33.657302	-117.881610	48.00	45.00	93.00
4	33.657391	-117.881790	48.00	45.00	93.00

Flight Path Receptor(s)

Name: FP1-02L
Description: None
Threshold height: 55 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.667827	-117.873833	53.40	55.00	108.40
Two-mile	33.642299	-117.890161	3.80	658.00	661.80

Name: FP2-20R
Description: None
Threshold height: 51 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681645	-117.865093	39.60	51.00	90.60
Two-mile	33.707173	-117.848762	52.80	591.20	644.00

Name: FP3-02R
Description: None
Threshold height: 50 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.674007	-117.868070	52.00	50.00	102.00
Two-mile	33.648479	-117.884400	4.70	650.70	655.40

Name: FP4-20L
Description: None
Threshold height: 50 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681008	-117.863632	39.90	50.00	89.90
Two-mile	33.706536	-117.847301	53.50	589.80	643.30

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.70	121.00

Map image of 1-ATCT

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	10.0	115.0	0	0	-
PV array 2	10.0	110.0	0	0	-
PV array 3	10.0	105.0	0	0	-
PV array 4	10.0	90.0	0	0	-
PV array 5	10.0	265.0	0	0	-
PV array 6	10.0	255.0	0	0	-
PV array 7	10.0	250.0	0	0	-
PV array 8	10.0	120.0	0	0	-
PV array 9	10.0	120.0	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Results for: PV array 1

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 2

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 3

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 4

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 5

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 6

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 7

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 8

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 9

Receptor	Green Glare (min)	Yellow Glare (min)
FP1-02L	0	0
FP2-20R	0	0
FP3-02R	0	0
FP4-20L	0	0
1-ATCT	0	0

Flight Path: FP1-02L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP2-20R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP3-02R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP4-20L

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to V1 algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

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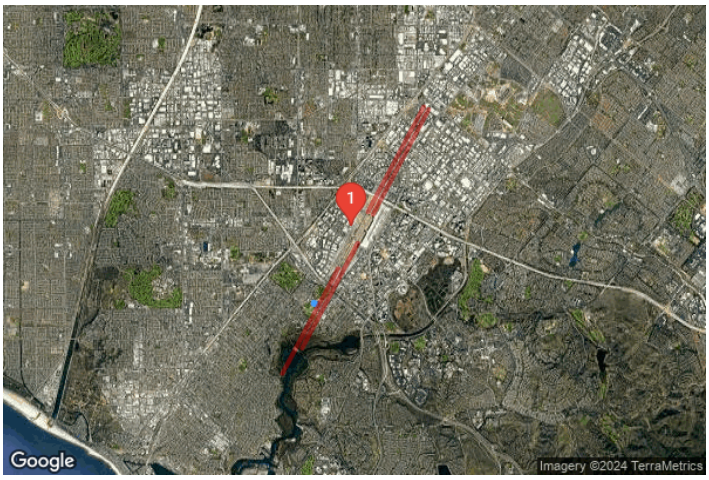
Attachment B-1
2021 FAA Policy Review

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Carport 1-9**

Created 21 Nov, 2024
Updated 21 Nov, 2024
Time-step 1 minute
Timezone offset UTC-8
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Site ID 134889.22911

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Glare Policy Adherence

The following table estimates the policy adherence of this glare analysis according to the **2021** U.S. Federal Aviation Administration Policy:

Review of Solar Energy System Projects on Federally-Obligated Airports

This policy may require the following criteria be met for solar energy systems on airport property:

- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics, including 1-minute time step.

ForgeSolar is not affiliated with the U.S. FAA and does not represent or speak officially for the U.S. FAA. ForgeSolar cannot approve or deny projects - results are informational only. Contact the relevant airport and FAA district office for information on policy and requirements.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

The referenced policy can be read at https://www.federalregister.gov/d/2021-09862

Component Data

This report includes results for PV arrays and Observation Point ("OP") receptors marked as ATCTs. Components that are not pertinent to the policy, such as routes, flight paths, and vertical surfaces, are excluded.

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659713	-117.881102	25.43	8.50	33.93
2	33.659590	-117.880683	28.04	8.50	36.54
3	33.659542	-117.880703	28.42	8.50	36.92
4	33.659665	-117.881123	25.86	8.50	34.36

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659587	-117.880671	28.47	8.50	36.97
2	33.659464	-117.880251	29.84	8.50	38.34
3	33.659415	-117.880272	30.55	8.50	39.05
4	33.659538	-117.880691	28.92	8.50	37.42

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659587	-117.881096	25.62	8.50	34.12
2	33.659484	-117.880747	28.73	8.50	37.23
3	33.659386	-117.880788	28.94	8.50	37.44
4	33.659489	-117.881137	28.11	8.50	36.61

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659481	-117.880738	28.79	8.50	37.29
2	33.659371	-117.880365	31.81	8.50	40.31
3	33.659274	-117.880406	32.91	8.50	41.41
4	33.659383	-117.880779	29.03	8.50	37.53

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659431	-117.881162	28.89	8.50	37.39
2	33.659301	-117.880719	29.99	8.50	38.49
3	33.659204	-117.880760	31.17	8.50	39.67
4	33.659333	-117.881203	31.05	8.50	39.55

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659294	-117.880694	30.43	8.50	38.93
2	33.659171	-117.880274	32.88	8.50	41.38
3	33.659073	-117.880315	33.41	8.50	41.91
4	33.659196	-117.880735	31.85	8.50	40.35

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659289	-117.881290	31.73	8.50	40.23
2	33.659159	-117.880847	32.17	8.50	40.67
3	33.659110	-117.880868	32.35	8.50	40.85
4	33.659240	-117.881311	31.73	8.50	40.23

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659152	-117.880824	32.63	8.50	41.13
2	33.659029	-117.880405	38.22	8.50	46.72
3	33.658980	-117.880425	38.84	8.50	47.34
4	33.659104	-117.880844	34.06	8.50	42.56

Name: PV array 9
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659667	-117.881235	25.73	8.50	34.23
2	33.659650	-117.881176	26.75	8.50	35.25
3	33.659377	-117.881291	31.49	8.50	39.99
4	33.659394	-117.881349	29.59	8.50	38.09

Observation Point ATCT Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.73	121.00

Map image of 1-ATCT

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	5.0	200.0	0	0.0	0	0.0	-
PV array 2	5.0	200.0	0	0.0	0	0.0	-
PV array 3	5.0	200.0	0	0.0	0	0.0	-
PV array 4	5.0	200.0	0	0.0	0	0.0	-
PV array 5	5.0	200.0	0	0.0	0	0.0	-
PV array 6	5.0	200.0	0	0.0	0	0.0	-
PV array 7	5.0	200.0	0	0.0	0	0.0	-
PV array 8	5.0	200.0	0	0.0	0	0.0	-
PV array 9	5.0	110.0	0	0.0	0	0.0	-

Total annual glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV: PV array 1

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 1 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 2

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 2 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 3

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 3 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 4

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 4 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 5

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 5 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 6

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 6 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 7

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 7 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 8

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 8 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 9

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 9 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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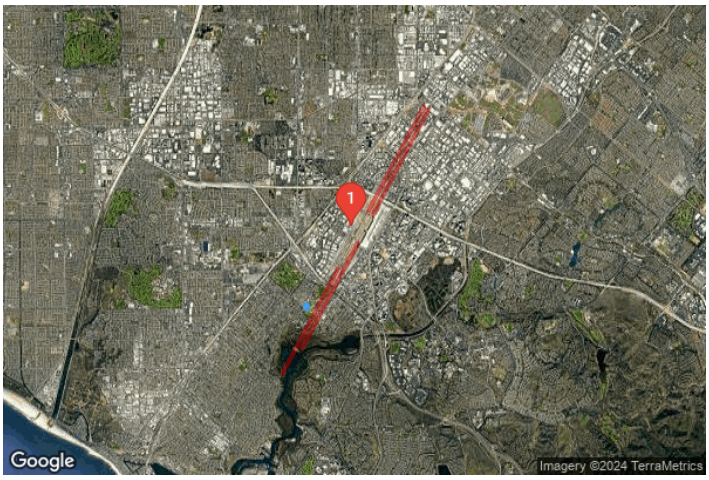
Attachment B-2
2021 FAA Policy Review

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Carport 10-29**

Created 21 Nov, 2024
Updated 22 Nov, 2024
Time-step 1 minute
Timezone offset UTC-8
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Site ID 134900.22911

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Glare Policy Adherence

The following table estimates the policy adherence of this glare analysis according to the **2021** U.S. Federal Aviation Administration Policy:

Review of Solar Energy System Projects on Federally-Obligated Airports

This policy may require the following criteria be met for solar energy systems on airport property:

- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics, including 1-minute time step.

ForgeSolar is not affiliated with the U.S. FAA and does not represent or speak officially for the U.S. FAA. ForgeSolar cannot approve or deny projects - results are informational only. Contact the relevant airport and FAA district office for information on policy and requirements.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

The referenced policy can be read at https://www.federalregister.gov/d/2021-09862

Component Data

This report includes results for PV arrays and Observation Point ("OP") receptors marked as ATCTs. Components that are not pertinent to the policy, such as routes, flight paths, and vertical surfaces, are excluded.

PV Arrays

Name: PV array 10
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659025	-117.882841	17.32	8.50	25.82
2	33.659009	-117.882782	17.14	8.50	25.64
3	33.658852	-117.882842	17.30	8.50	25.80
4	33.658867	-117.882901	17.25	8.50	25.75

Name: PV array 11
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659061	-117.882988	15.29	8.50	23.79
2	33.659046	-117.882928	17.12	8.50	25.62
3	33.658887	-117.882986	17.24	8.50	25.74
4	33.658903	-117.883045	16.88	8.50	25.38

Name: PV array 12
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 195.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658981	-117.883283	15.87	8.50	24.37
2	33.658936	-117.883042	16.63	8.50	25.13
3	33.658885	-117.883055	17.23	8.50	25.73
4	33.658930	-117.883296	17.15	8.50	25.65

Name: PV array 13
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658776	-117.882931	17.75	8.50	26.25
2	33.658769	-117.882869	17.83	8.50	26.33
3	33.658605	-117.882894	18.31	8.50	26.81
4	33.658612	-117.882955	18.30	8.50	26.80

Name: PV array 14
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658808	-117.883121	17.86	8.50	26.36
2	33.658794	-117.883011	17.86	8.50	26.36
3	33.658692	-117.883031	18.29	8.50	26.79
4	33.658706	-117.883141	18.28	8.50	26.78

Name: PV array 15
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658693	-117.883143	18.26	8.50	26.76
2	33.658684	-117.883032	18.33	8.50	26.83
3	33.658582	-117.883043	19.32	8.50	27.82
4	33.658590	-117.883154	19.51	8.50	28.01

Name: PV array 16
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658577	-117.883155	20.35	8.50	28.85
2	33.658576	-117.883043	20.54	8.50	29.04
3	33.658473	-117.883044	24.14	8.50	32.64
4	33.658473	-117.883155	21.70	8.50	30.20

Name: PV array 17
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658462	-117.883156	22.08	8.50	30.58
2	33.658467	-117.883045	25.86	8.50	34.36
3	33.658363	-117.883039	32.16	8.50	40.66
4	33.658359	-117.883150	25.90	8.50	34.40

Name: PV array 18
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658856	-117.883311	18.11	8.50	26.61
2	33.658841	-117.883201	17.94	8.50	26.44
3	33.658719	-117.883225	18.18	8.50	26.68
4	33.658734	-117.883335	18.28	8.50	26.78

Name: PV array 19
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658723	-117.883337	18.49	8.50	26.99
2	33.658715	-117.883226	18.30	8.50	26.80
3	33.658592	-117.883239	20.02	8.50	28.52
4	33.658600	-117.883350	19.63	8.50	28.13

Name: PV array 20
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658587	-117.883352	19.65	8.50	28.15
2	33.658586	-117.883241	20.91	8.50	29.41
3	33.658462	-117.883242	21.08	8.50	29.58
4	33.658463	-117.883353	18.24	8.50	26.74

Name: PV array 21
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658450	-117.883353	17.99	8.50	26.49
2	33.658457	-117.883241	21.75	8.50	30.25
3	33.658333	-117.883231	24.58	8.50	33.08
4	33.658327	-117.883343	18.00	8.50	26.50

Name: PV array 22
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658896	-117.883451	14.46	8.50	22.96
2	33.658886	-117.883391	16.12	8.50	24.62
3	33.658785	-117.883416	17.81	8.50	26.31
4	33.658795	-117.883476	18.00	8.50	26.50

Name: PV array 23
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658786	-117.883477	18.49	8.50	26.99
2	33.658780	-117.883415	18.98	8.50	27.48
3	33.658678	-117.883430	19.39	8.50	27.89
4	33.658684	-117.883491	18.63	8.50	27.13

Name: PV array 24
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658674	-117.883494	19.04	8.50	27.54
2	33.658671	-117.883432	19.67	8.50	28.17
3	33.658568	-117.883439	20.78	8.50	29.28
4	33.658571	-117.883501	20.37	8.50	28.87

Name: PV array 25
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658560	-117.883501	20.83	8.50	29.33
2	33.658559	-117.883439	20.95	8.50	29.45
3	33.658456	-117.883440	19.65	8.50	28.15
4	33.658456	-117.883502	20.82	8.50	29.32

Name: PV array 26
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658445	-117.883502	20.12	8.50	28.62
2	33.658448	-117.883440	18.65	8.50	27.15
3	33.658324	-117.883431	17.87	8.50	26.37
4	33.658321	-117.883493	18.15	8.50	26.65

Name: PV array 27
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658250	-117.883315	17.20	8.50	25.70
2	33.658272	-117.883094	24.01	8.50	32.51
3	33.658221	-117.883087	24.88	8.50	33.38
4	33.658199	-117.883307	17.84	8.50	26.34

Name: PV array 28
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658259	-117.883087	27.95	8.50	36.45
2	33.658271	-117.883026	31.69	8.50	40.19
3	33.658050	-117.882963	33.25	8.50	41.75
4	33.658038	-117.883024	30.26	8.50	38.76

Name: PV array 29
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658273	-117.882939	33.21	8.50	41.71
2	33.658285	-117.882879	34.42	8.50	42.92
3	33.658085	-117.882822	37.10	8.50	45.60
4	33.658073	-117.882882	35.22	8.50	43.72

Observation Point ATCT Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.70	121.00

Map image of 1-ATCT

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 10	5.0	110.0	0	0.0	0	0.0	-
PV array 11	5.0	110.0	0	0.0	0	0.0	-
PV array 12	5.0	195.0	0	0.0	0	0.0	-
PV array 13	5.0	100.0	0	0.0	0	0.0	-
PV array 14	5.0	100.0	0	0.0	0	0.0	-
PV array 15	5.0	95.0	0	0.0	0	0.0	-
PV array 16	5.0	270.0	0	0.0	0	0.0	-
PV array 17	5.0	270.0	0	0.0	0	0.0	-
PV array 18	5.0	100.0	0	0.0	0	0.0	-
PV array 19	5.0	95.0	0	0.0	0	0.0	-
PV array 20	5.0	270.0	0	0.0	0	0.0	-
PV array 21	5.0	270.0	0	0.0	0	0.0	-
PV array 22	5.0	100.0	0	0.0	0	0.0	-
PV array 23	5.0	100.0	0	0.0	0	0.0	-
PV array 24	5.0	95.0	0	0.0	0	0.0	-
PV array 25	5.0	270.0	0	0.0	0	0.0	-
PV array 26	5.0	270.0	0	0.0	0	0.0	-
PV array 27	5.0	180.0	0	0.0	0	0.0	-
PV array 28	5.0	250.0	0	0.0	0	0.0	-
PV array 29	5.0	250.0	0	0.0	0	0.0	-

Total annual glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV: PV array 10

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 10 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 11

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 11 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 12

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 12 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 13

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 13 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 14

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 14 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 15

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 15 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 16

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 16 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 17

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 17 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 18

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 18 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 19

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 19 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 20

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 20 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 21

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 21 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 22

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 22 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 23

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 23 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 24

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 24 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 25

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 25 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 26

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 26 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 27

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 27 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 28

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 28 and 1-ATCT

Receptor type: ATCT Observation Point

No glare found

PV: PV array 29

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 29 and 1-ATCT

Receptor type: ATCT Observation Point

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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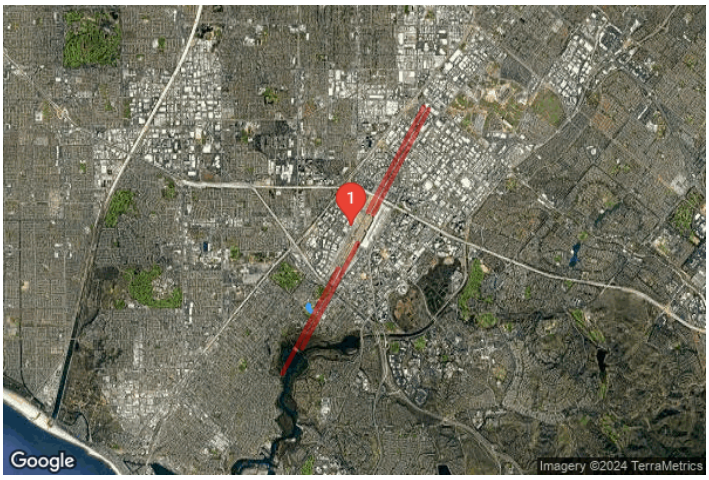
Attachment B-3
2021 FAA Policy Review

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Building 1-9**

Created 22 Nov, 2024
Updated 22 Nov, 2024
Time-step 1 minute
Timezone offset UTC-8
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Site ID 134903.22911

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Glare Policy Adherence

The following table estimates the policy adherence of this glare analysis according to the **2021** U.S. Federal Aviation Administration Policy:

Review of Solar Energy System Projects on Federally-Obligated Airports

This policy may require the following criteria be met for solar energy systems on airport property:

- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics, including 1-minute time step.

ForgeSolar is not affiliated with the U.S. FAA and does not represent or speak officially for the U.S. FAA. ForgeSolar cannot approve or deny projects - results are informational only. Contact the relevant airport and FAA district office for information on policy and requirements.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

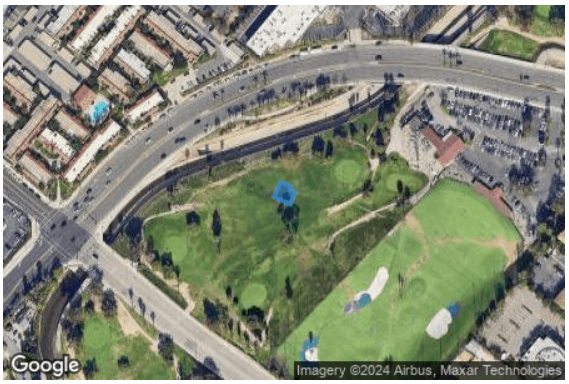
The referenced policy can be read at https://www.federalregister.gov/d/2021-09862

Component Data

This report includes results for PV arrays and Observation Point ("OP") receptors marked as ATCTs. Components that are not pertinent to the policy, such as routes, flight paths, and vertical surfaces, are excluded.

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 115.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659045	-117.882478	42.00	50.00	92.00
2	33.659011	-117.882385	42.00	50.00	92.00
3	33.658986	-117.882398	42.00	50.00	92.00
4	33.658969	-117.882352	42.00	50.00	92.00
5	33.658884	-117.882396	42.00	50.00	92.00
6	33.658934	-117.882535	42.00	50.00	92.00

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658909	-117.882545	42.00	50.00	92.00
2	33.658889	-117.882473	42.00	50.00	92.00
3	33.658876	-117.882478	42.00	50.00	92.00
4	33.658856	-117.882407	42.00	50.00	92.00
5	33.658794	-117.882432	42.00	50.00	92.00
6	33.658814	-117.882504	42.00	50.00	92.00
7	33.658801	-117.882509	42.00	50.00	92.00
8	33.658821	-117.882580	42.00	50.00	92.00

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 105.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658792	-117.882589	42.00	50.00	92.00
2	33.658766	-117.882441	42.00	50.00	92.00
3	33.658635	-117.882474	42.00	50.00	92.00
4	33.658661	-117.882622	42.00	50.00	92.00

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 90.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658629	-117.882628	42.00	50.00	92.00
2	33.658627	-117.882553	42.00	50.00	92.00
3	33.658614	-117.882553	42.00	50.00	92.00
4	33.658612	-117.882478	42.00	50.00	92.00
5	33.658546	-117.882480	42.00	50.00	92.00
6	33.658547	-117.882505	42.00	50.00	92.00
7	33.658478	-117.882507	42.00	50.00	92.00
8	33.658481	-117.882633	42.00	50.00	92.00

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 265.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658455	-117.882633	42.00	50.00	92.00
2	33.658459	-117.882583	42.00	50.00	92.00
3	33.658446	-117.882582	42.00	50.00	92.00
4	33.658452	-117.882506	42.00	50.00	92.00
5	33.658438	-117.882505	42.00	50.00	92.00
6	33.658440	-117.882480	42.00	50.00	92.00
7	33.658320	-117.882466	42.00	50.00	92.00
8	33.658308	-117.882616	42.00	50.00	92.00

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 255.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658280	-117.882609	42.00	50.00	92.00
2	33.658291	-117.882561	42.00	50.00	92.00
3	33.658278	-117.882556	42.00	50.00	92.00
4	33.658301	-117.882459	42.00	50.00	92.00
5	33.658184	-117.882421	42.00	50.00	92.00
6	33.658151	-117.882567	42.00	50.00	92.00

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658118	-117.882555	42.00	50.00	92.00
2	33.658164	-117.882414	42.00	50.00	92.00
3	33.658014	-117.882343	42.00	50.00	92.00
4	33.657999	-117.882390	42.00	50.00	92.00
5	33.657973	-117.882378	42.00	50.00	92.00
6	33.657950	-117.882448	42.00	50.00	92.00
7	33.658001	-117.882472	42.00	50.00	92.00
8	33.657993	-117.882496	42.00	50.00	92.00

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 120.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.657584	-117.881935	48.00	45.00	93.00
2	33.657495	-117.881754	48.00	45.00	93.00
3	33.657404	-117.881818	48.00	45.00	93.00
4	33.657493	-117.881999	48.00	45.00	93.00

Name: PV array 9
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 120.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.657481	-117.881727	48.00	45.00	93.00
2	33.657392	-117.881546	48.00	45.00	93.00
3	33.657302	-117.881610	48.00	45.00	93.00
4	33.657391	-117.881790	48.00	45.00	93.00

Observation Point ATCT Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.70	121.00

Map image of 1-ATCT

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	10.0	115.0	0	0.0	0	0.0	-
PV array 2	10.0	110.0	0	0.0	0	0.0	-
PV array 3	10.0	105.0	0	0.0	0	0.0	-
PV array 4	10.0	90.0	0	0.0	0	0.0	-
PV array 5	10.0	265.0	0	0.0	0	0.0	-
PV array 6	10.0	255.0	0	0.0	0	0.0	-
PV array 7	10.0	250.0	0	0.0	0	0.0	-
PV array 8	10.0	120.0	0	0.0	0	0.0	-
PV array 9	10.0	120.0	0	0.0	0	0.0	-

Total annual glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV: PV array 1

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 1 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 2

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 2 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 3

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 3 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 4

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 4 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 5

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 5 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 6

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 6 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 7

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 7 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 8

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 8 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV array 9

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV array 9 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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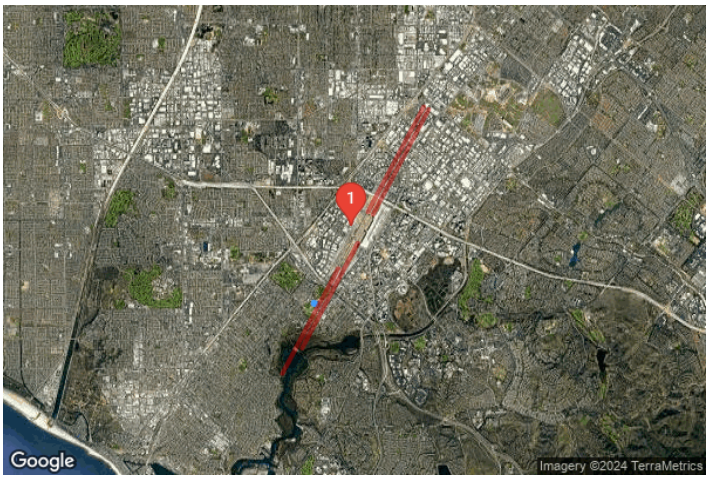
Attachment C-1
Full Solar Glare Analysis Report 2021 Policy

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Carport 1-9**

Created 21 Nov, 2024
Updated 21 Nov, 2024
Time-step 1 minute
Timezone offset UTC-8
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 500 kW to 1 MW
Site ID 134889.22911

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	5.0	200.0	0	0.0	0	0.0	-
PV array 2	5.0	200.0	0	0.0	0	0.0	-
PV array 3	5.0	200.0	0	0.0	0	0.0	-
PV array 4	5.0	200.0	0	0.0	0	0.0	-
PV array 5	5.0	200.0	0	0.0	0	0.0	-
PV array 6	5.0	200.0	0	0.0	0	0.0	-
PV array 7	5.0	200.0	0	0.0	0	0.0	-
PV array 8	5.0	200.0	0	0.0	0	0.0	-
PV array 9	5.0	110.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659713	-117.881102	25.43	8.50	33.93
2	33.659590	-117.880683	28.04	8.50	36.54
3	33.659542	-117.880703	28.42	8.50	36.92
4	33.659665	-117.881123	25.86	8.50	34.36

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659587	-117.880671	28.47	8.50	36.97
2	33.659464	-117.880251	29.84	8.50	38.34
3	33.659415	-117.880272	30.55	8.50	39.05
4	33.659538	-117.880691	28.92	8.50	37.42

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659587	-117.881096	25.62	8.50	34.12
2	33.659484	-117.880747	28.73	8.50	37.23
3	33.659386	-117.880788	28.94	8.50	37.44
4	33.659489	-117.881137	28.11	8.50	36.61

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659481	-117.880738	28.79	8.50	37.29
2	33.659371	-117.880365	31.81	8.50	40.31
3	33.659274	-117.880406	32.91	8.50	41.41
4	33.659383	-117.880779	29.03	8.50	37.53

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659431	-117.881162	28.89	8.50	37.39
2	33.659301	-117.880719	29.99	8.50	38.49
3	33.659204	-117.880760	31.17	8.50	39.67
4	33.659333	-117.881203	31.05	8.50	39.55

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659294	-117.880694	30.43	8.50	38.93
2	33.659171	-117.880274	32.88	8.50	41.38
3	33.659073	-117.880315	33.41	8.50	41.91
4	33.659196	-117.880735	31.85	8.50	40.35

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659289	-117.881290	31.73	8.50	40.23
2	33.659159	-117.880847	32.17	8.50	40.67
3	33.659110	-117.880868	32.35	8.50	40.85
4	33.659240	-117.881311	31.73	8.50	40.23

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 200.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659152	-117.880824	32.63	8.50	41.13
2	33.659029	-117.880405	38.22	8.50	46.72
3	33.658980	-117.880425	38.84	8.50	47.34
4	33.659104	-117.880844	34.06	8.50	42.56

Name: PV array 9
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659667	-117.881235	25.73	8.50	34.23
2	33.659650	-117.881176	26.75	8.50	35.25
3	33.659377	-117.881291	31.49	8.50	39.99
4	33.659394	-117.881349	29.59	8.50	38.09

Flight Path Receptors

Name: FP1-02L
Description:
Threshold height: 55 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.667827	-117.873833	53.40	55.00	108.40
Two-mile	33.642299	-117.890161	3.76	658.06	661.82

Name: FP2-20R
Description:
Threshold height: 51 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681645	-117.865093	39.58	51.00	90.58
Two-mile	33.707173	-117.848762	52.79	591.22	644.01

Name: FP3-02R
Description:
Threshold height: 50 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.674007	-117.868070	51.97	50.00	101.97
Two-mile	33.648479	-117.884400	4.74	650.66	655.40

Name: FP4-20L
Description:
Threshold height: 50 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681008	-117.863632	39.87	50.00	89.87
Two-mile	33.706536	-117.847301	53.45	589.84	643.29

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.73	121.00

Map image of 1-ATCT

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	5.0	200.0	0	0.0	0	0.0	-
PV array 2	5.0	200.0	0	0.0	0	0.0	-
PV array 3	5.0	200.0	0	0.0	0	0.0	-
PV array 4	5.0	200.0	0	0.0	0	0.0	-
PV array 5	5.0	200.0	0	0.0	0	0.0	-
PV array 6	5.0	200.0	0	0.0	0	0.0	-
PV array 7	5.0	200.0	0	0.0	0	0.0	-
PV array 8	5.0	200.0	0	0.0	0	0.0	-
PV array 9	5.0	110.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV: PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 1 and FP: FP1-02L

No glare found

PV array 1 and FP: FP2-20R

No glare found

PV array 1 and FP: FP3-02R

No glare found

PV array 1 and FP: FP4-20L

No glare found

PV array 1 and 1-ATCT

No glare found

PV: PV array 2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 2 and FP: FP1-02L

No glare found

PV array 2 and FP: FP2-20R

No glare found

PV array 2 and FP: FP3-02R

No glare found

PV array 2 and FP: FP4-20L

No glare found

PV array 2 and 1-ATCT

No glare found

PV: PV array 3 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 3 and FP: FP1-02L

No glare found

PV array 3 and FP: FP2-20R

No glare found

PV array 3 and FP: FP3-02R

No glare found

PV array 3 and FP: FP4-20L

No glare found

PV array 3 and 1-ATCT

No glare found

PV: PV array 4 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 4 and FP: FP1-02L

No glare found

PV array 4 and FP: FP2-20R

No glare found

PV array 4 and FP: FP3-02R

No glare found

PV array 4 and FP: FP4-20L

No glare found

PV array 4 and 1-ATCT

No glare found

PV: PV array 5 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 5 and FP: FP1-02L

No glare found

PV array 5 and FP: FP2-20R

No glare found

PV array 5 and FP: FP3-02R

No glare found

PV array 5 and FP: FP4-20L

No glare found

PV array 5 and 1-ATCT

No glare found

PV: PV array 6 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 6 and FP: FP1-02L

No glare found

PV array 6 and FP: FP2-20R

No glare found

PV array 6 and FP: FP3-02R

No glare found

PV array 6 and FP: FP4-20L

No glare found

PV array 6 and 1-ATCT

No glare found

PV: PV array 7 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 7 and FP: FP1-02L

No glare found

PV array 7 and FP: FP2-20R

No glare found

PV array 7 and FP: FP3-02R

No glare found

PV array 7 and FP: FP4-20L

No glare found

PV array 7 and 1-ATCT

No glare found

PV: PV array 8 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 8 and FP: FP1-02L

No glare found

PV array 8 and FP: FP2-20R

No glare found

PV array 8 and FP: FP3-02R

No glare found

PV array 8 and FP: FP4-20L

No glare found

PV array 8 and 1-ATCT

No glare found

PV: PV array 9 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 9 and FP: FP1-02L

No glare found

PV array 9 and FP: FP2-20R

No glare found

PV array 9 and FP: FP3-02R

No glare found

PV array 9 and FP: FP4-20L

No glare found

PV array 9 and 1-ATCT

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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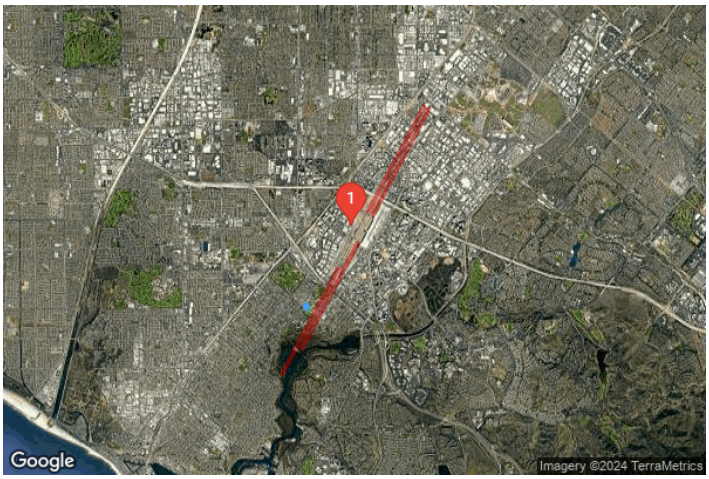
Attachment C-2
Full Solar Glare Analysis Report 2021 Policy

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Carport 10-29**

Created 21 Nov, 2024
Updated 22 Nov, 2024
Time-step 1 minute
Timezone offset UTC-8
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 500 kW to 1 MW
Site ID 134900.22911

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 10	5.0	110.0	0	0.0	0	0.0	-
PV array 11	5.0	110.0	0	0.0	0	0.0	-
PV array 12	5.0	195.0	0	0.0	0	0.0	-
PV array 13	5.0	100.0	0	0.0	0	0.0	-
PV array 14	5.0	100.0	0	0.0	0	0.0	-
PV array 15	5.0	95.0	0	0.0	0	0.0	-
PV array 16	5.0	270.0	0	0.0	0	0.0	-
PV array 17	5.0	270.0	0	0.0	0	0.0	-
PV array 18	5.0	100.0	0	0.0	0	0.0	-
PV array 19	5.0	95.0	0	0.0	0	0.0	-
PV array 20	5.0	270.0	0	0.0	0	0.0	-
PV array 21	5.0	270.0	0	0.0	0	0.0	-
PV array 22	5.0	100.0	0	0.0	0	0.0	-
PV array 23	5.0	100.0	0	0.0	0	0.0	-
PV array 24	5.0	95.0	0	0.0	0	0.0	-
PV array 25	5.0	270.0	0	0.0	0	0.0	-
PV array 26	5.0	270.0	0	0.0	0	0.0	-
PV array 27	5.0	180.0	0	0.0	0	0.0	-
PV array 28	5.0	250.0	0	0.0	0	0.0	-
PV array 29	5.0	250.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

FP1-02L	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 10
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659025	-117.882841	17.32	8.50	25.82
2	33.659009	-117.882782	17.14	8.50	25.64
3	33.658852	-117.882842	17.30	8.50	25.80
4	33.658867	-117.882901	17.25	8.50	25.75

Name: PV array 11
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659061	-117.882988	15.29	8.50	23.79
2	33.659046	-117.882928	17.12	8.50	25.62
3	33.658887	-117.882986	17.24	8.50	25.74
4	33.658903	-117.883045	16.88	8.50	25.38

Name: PV array 12
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 195.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658981	-117.883283	15.87	8.50	24.37
2	33.658936	-117.883042	16.63	8.50	25.13
3	33.658885	-117.883055	17.23	8.50	25.73
4	33.658930	-117.883296	17.15	8.50	25.65

Name: PV array 13
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658776	-117.882931	17.75	8.50	26.25
2	33.658769	-117.882869	17.83	8.50	26.33
3	33.658605	-117.882894	18.31	8.50	26.81
4	33.658612	-117.882955	18.30	8.50	26.80

Name: PV array 14
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658808	-117.883121	17.86	8.50	26.36
2	33.658794	-117.883011	17.86	8.50	26.36
3	33.658692	-117.883031	18.29	8.50	26.79
4	33.658706	-117.883141	18.28	8.50	26.78

Name: PV array 15
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658693	-117.883143	18.26	8.50	26.76
2	33.658684	-117.883032	18.33	8.50	26.83
3	33.658582	-117.883043	19.32	8.50	27.82
4	33.658590	-117.883154	19.51	8.50	28.01

Name: PV array 16
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658577	-117.883155	20.35	8.50	28.85
2	33.658576	-117.883043	20.54	8.50	29.04
3	33.658473	-117.883044	24.14	8.50	32.64
4	33.658473	-117.883155	21.70	8.50	30.20

Name: PV array 17
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658462	-117.883156	22.08	8.50	30.58
2	33.658467	-117.883045	25.86	8.50	34.36
3	33.658363	-117.883039	32.16	8.50	40.66
4	33.658359	-117.883150	25.90	8.50	34.40

Name: PV array 18
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658856	-117.883311	18.11	8.50	26.61
2	33.658841	-117.883201	17.94	8.50	26.44
3	33.658719	-117.883225	18.18	8.50	26.68
4	33.658734	-117.883335	18.28	8.50	26.78

Name: PV array 19
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658723	-117.883337	18.49	8.50	26.99
2	33.658715	-117.883226	18.30	8.50	26.80
3	33.658592	-117.883239	20.02	8.50	28.52
4	33.658600	-117.883350	19.63	8.50	28.13

Name: PV array 20
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658587	-117.883352	19.65	8.50	28.15
2	33.658586	-117.883241	20.91	8.50	29.41
3	33.658462	-117.883242	21.08	8.50	29.58
4	33.658463	-117.883353	18.24	8.50	26.74

Name: PV array 21
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658450	-117.883353	17.99	8.50	26.49
2	33.658457	-117.883241	21.75	8.50	30.25
3	33.658333	-117.883231	24.58	8.50	33.08
4	33.658327	-117.883343	18.00	8.50	26.50

Name: PV array 22
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658896	-117.883451	14.46	8.50	22.96
2	33.658886	-117.883391	16.12	8.50	24.62
3	33.658785	-117.883416	17.81	8.50	26.31
4	33.658795	-117.883476	18.00	8.50	26.50

Name: PV array 23
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 100.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658786	-117.883477	18.49	8.50	26.99
2	33.658780	-117.883415	18.98	8.50	27.48
3	33.658678	-117.883430	19.39	8.50	27.89
4	33.658684	-117.883491	18.63	8.50	27.13

Name: PV array 24
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 95.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658674	-117.883494	19.04	8.50	27.54
2	33.658671	-117.883432	19.67	8.50	28.17
3	33.658568	-117.883439	20.78	8.50	29.28
4	33.658571	-117.883501	20.37	8.50	28.87

Name: PV array 25
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658560	-117.883501	20.83	8.50	29.33
2	33.658559	-117.883439	20.95	8.50	29.45
3	33.658456	-117.883440	19.65	8.50	28.15
4	33.658456	-117.883502	20.82	8.50	29.32

Name: PV array 26
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 270.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658445	-117.883502	20.12	8.50	28.62
2	33.658448	-117.883440	18.65	8.50	27.15
3	33.658324	-117.883431	17.87	8.50	26.37
4	33.658321	-117.883493	18.15	8.50	26.65

Name: PV array 27
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658250	-117.883315	17.20	8.50	25.70
2	33.658272	-117.883094	24.01	8.50	32.51
3	33.658221	-117.883087	24.88	8.50	33.38
4	33.658199	-117.883307	17.84	8.50	26.34

Name: PV array 28
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658259	-117.883087	27.95	8.50	36.45
2	33.658271	-117.883026	31.69	8.50	40.19
3	33.658050	-117.882963	33.25	8.50	41.75
4	33.658038	-117.883024	30.26	8.50	38.76

Name: PV array 29
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658273	-117.882939	33.21	8.50	41.71
2	33.658285	-117.882879	34.42	8.50	42.92
3	33.658085	-117.882822	37.10	8.50	45.60
4	33.658073	-117.882882	35.22	8.50	43.72

Flight Path Receptors

Name: FP1-02L
Description: None
Threshold height: 55 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.667827	-117.873833	53.40	55.00	108.40
Two-mile	33.642299	-117.890161	3.80	658.00	661.80

Name: FP2-20R
Description: None
Threshold height: 51 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681645	-117.865093	39.60	51.00	90.60
Two-mile	33.707173	-117.848762	52.80	591.20	644.00

Name: FP3-02R
Description: None
Threshold height: 50 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.674007	-117.868070	52.00	50.00	102.00
Two-mile	33.648479	-117.884400	4.70	650.70	655.40

Name: FP4-20L
Description: None
Threshold height: 50 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681008	-117.863632	39.90	50.00	89.90
Two-mile	33.706536	-117.847301	53.50	589.80	643.30

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.70	121.00

Map image of 1-ATCT

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 10	5.0	110.0	0	0.0	0	0.0	-
PV array 11	5.0	110.0	0	0.0	0	0.0	-
PV array 12	5.0	195.0	0	0.0	0	0.0	-
PV array 13	5.0	100.0	0	0.0	0	0.0	-
PV array 14	5.0	100.0	0	0.0	0	0.0	-
PV array 15	5.0	95.0	0	0.0	0	0.0	-
PV array 16	5.0	270.0	0	0.0	0	0.0	-
PV array 17	5.0	270.0	0	0.0	0	0.0	-
PV array 18	5.0	100.0	0	0.0	0	0.0	-
PV array 19	5.0	95.0	0	0.0	0	0.0	-
PV array 20	5.0	270.0	0	0.0	0	0.0	-
PV array 21	5.0	270.0	0	0.0	0	0.0	-
PV array 22	5.0	100.0	0	0.0	0	0.0	-
PV array 23	5.0	100.0	0	0.0	0	0.0	-
PV array 24	5.0	95.0	0	0.0	0	0.0	-
PV array 25	5.0	270.0	0	0.0	0	0.0	-
PV array 26	5.0	270.0	0	0.0	0	0.0	-
PV array 27	5.0	180.0	0	0.0	0	0.0	-
PV array 28	5.0	250.0	0	0.0	0	0.0	-
PV array 29	5.0	250.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV: PV array 10 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 10 and FP: FP1-02L

No glare found

PV array 10 and FP: FP2-20R

No glare found

PV array 10 and FP: FP3-02R

No glare found

PV array 10 and FP: FP4-20L

No glare found

PV array 10 and 1-ATCT

No glare found

PV: PV array 11 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 11 and FP: FP1-02L

No glare found

PV array 11 and FP: FP2-20R

No glare found

PV array 11 and FP: FP3-02R

No glare found

PV array 11 and FP: FP4-20L

No glare found

PV array 11 and 1-ATCT

No glare found

PV: PV array 12 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 12 and FP: FP1-02L

No glare found

PV array 12 and FP: FP2-20R

No glare found

PV array 12 and FP: FP3-02R

No glare found

PV array 12 and FP: FP4-20L

No glare found

PV array 12 and 1-ATCT

No glare found

PV: PV array 13 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 13 and FP: FP1-02L

No glare found

PV array 13 and FP: FP2-20R

No glare found

PV array 13 and FP: FP3-02R

No glare found

PV array 13 and FP: FP4-20L

No glare found

PV array 13 and 1-ATCT

No glare found

PV: PV array 14 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 14 and FP: FP1-02L

No glare found

PV array 14 and FP: FP2-20R

No glare found

PV array 14 and FP: FP3-02R

No glare found

PV array 14 and FP: FP4-20L

No glare found

PV array 14 and 1-ATCT

No glare found

PV: PV array 15 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 15 and FP: FP1-02L

No glare found

PV array 15 and FP: FP2-20R

No glare found

PV array 15 and FP: FP3-02R

No glare found

PV array 15 and FP: FP4-20L

No glare found

PV array 15 and 1-ATCT

No glare found

PV: PV array 16 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 16 and FP: FP1-02L

No glare found

PV array 16 and FP: FP2-20R

No glare found

PV array 16 and FP: FP3-02R

No glare found

PV array 16 and FP: FP4-20L

No glare found

PV array 16 and 1-ATCT

No glare found

PV: PV array 17 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 17 and FP: FP1-02L

No glare found

PV array 17 and FP: FP2-20R

No glare found

PV array 17 and FP: FP3-02R

No glare found

PV array 17 and FP: FP4-20L

No glare found

PV array 17 and 1-ATCT

No glare found

PV: PV array 18 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 18 and FP: FP1-02L

No glare found

PV array 18 and FP: FP2-20R

No glare found

PV array 18 and FP: FP3-02R

No glare found

PV array 18 and FP: FP4-20L

No glare found

PV array 18 and 1-ATCT

No glare found

PV: PV array 19 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 19 and FP: FP1-02L

No glare found

PV array 19 and FP: FP2-20R

No glare found

PV array 19 and FP: FP3-02R

No glare found

PV array 19 and FP: FP4-20L

No glare found

PV array 19 and 1-ATCT

No glare found

PV: PV array 20 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 20 and FP: FP1-02L

No glare found

PV array 20 and FP: FP2-20R

No glare found

PV array 20 and FP: FP3-02R

No glare found

PV array 20 and FP: FP4-20L

No glare found

PV array 20 and 1-ATCT

No glare found

PV: PV array 21 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 21 and FP: FP1-02L

No glare found

PV array 21 and FP: FP2-20R

No glare found

PV array 21 and FP: FP3-02R

No glare found

PV array 21 and FP: FP4-20L

No glare found

PV array 21 and 1-ATCT

No glare found

PV: PV array 22 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 22 and FP: FP1-02L

No glare found

PV array 22 and FP: FP2-20R

No glare found

PV array 22 and FP: FP3-02R

No glare found

PV array 22 and FP: FP4-20L

No glare found

PV array 22 and 1-ATCT

No glare found

PV: PV array 23 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 23 and FP: FP1-02L

No glare found

PV array 23 and FP: FP2-20R

No glare found

PV array 23 and FP: FP3-02R

No glare found

PV array 23 and FP: FP4-20L

No glare found

PV array 23 and 1-ATCT

No glare found

PV: PV array 24 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 24 and FP: FP1-02L

No glare found

PV array 24 and FP: FP2-20R

No glare found

PV array 24 and FP: FP3-02R

No glare found

PV array 24 and FP: FP4-20L

No glare found

PV array 24 and 1-ATCT

No glare found

PV: PV array 25 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 25 and FP: FP1-02L

No glare found

PV array 25 and FP: FP2-20R

No glare found

PV array 25 and FP: FP3-02R

No glare found

PV array 25 and FP: FP4-20L

No glare found

PV array 25 and 1-ATCT

No glare found

PV: PV array 26 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 26 and FP: FP1-02L

No glare found

PV array 26 and FP: FP2-20R

No glare found

PV array 26 and FP: FP3-02R

No glare found

PV array 26 and FP: FP4-20L

No glare found

PV array 26 and 1-ATCT

No glare found

PV: PV array 27 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 27 and FP: FP1-02L

No glare found

PV array 27 and FP: FP2-20R

No glare found

PV array 27 and FP: FP3-02R

No glare found

PV array 27 and FP: FP4-20L

No glare found

PV array 27 and 1-ATCT

No glare found

PV: PV array 28 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 28 and FP: FP1-02L

No glare found

PV array 28 and FP: FP2-20R

No glare found

PV array 28 and FP: FP3-02R

No glare found

PV array 28 and FP: FP4-20L

No glare found

PV array 28 and 1-ATCT

No glare found

PV: PV array 29 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 29 and FP: FP1-02L

No glare found

PV array 29 and FP: FP2-20R

No glare found

PV array 29 and FP: FP3-02R

No glare found

PV array 29 and FP: FP4-20L

No glare found

PV array 29 and 1-ATCT

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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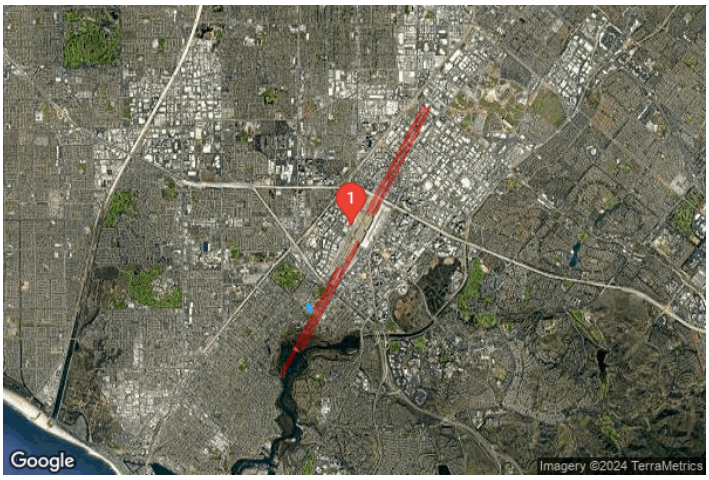
Attachment C-3
Full Solar Glare Analysis Report 2021 Policy

FORGESOLAR GLARE ANALYSIS

Project: **Snug Harbor, Newport Beach, SNA-Back Bay Barrels**
Site configuration: **Building 1-9**

Created 22 Nov, 2024
Updated 22 Nov, 2024
Time-step 1 minute
Timezone offset UTC-8
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 500 kW to 1 MW
Site ID 134903.22911

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	10.0	115.0	0	0.0	0	0.0	-
PV array 2	10.0	110.0	0	0.0	0	0.0	-
PV array 3	10.0	105.0	0	0.0	0	0.0	-
PV array 4	10.0	90.0	0	0.0	0	0.0	-
PV array 5	10.0	265.0	0	0.0	0	0.0	-
PV array 6	10.0	255.0	0	0.0	0	0.0	-
PV array 7	10.0	250.0	0	0.0	0	0.0	-
PV array 8	10.0	120.0	0	0.0	0	0.0	-
PV array 9	10.0	120.0	0	0.0	0	0.0	-

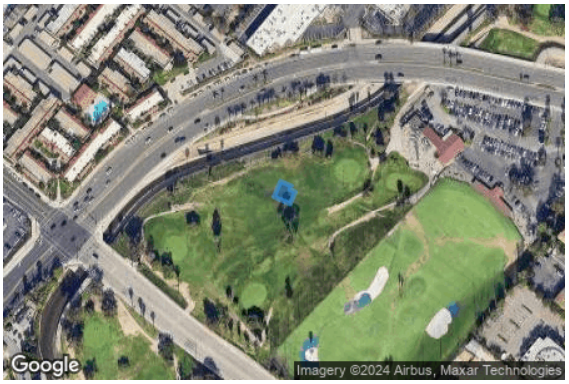
Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 115.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.659045	-117.882478	42.00	50.00	92.00
2	33.659011	-117.882385	42.00	50.00	92.00
3	33.658986	-117.882398	42.00	50.00	92.00
4	33.658969	-117.882352	42.00	50.00	92.00
5	33.658884	-117.882396	42.00	50.00	92.00
6	33.658934	-117.882535	42.00	50.00	92.00

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 110.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658909	-117.882545	42.00	50.00	92.00
2	33.658889	-117.882473	42.00	50.00	92.00
3	33.658876	-117.882478	42.00	50.00	92.00
4	33.658856	-117.882407	42.00	50.00	92.00
5	33.658794	-117.882432	42.00	50.00	92.00
6	33.658814	-117.882504	42.00	50.00	92.00
7	33.658801	-117.882509	42.00	50.00	92.00
8	33.658821	-117.882580	42.00	50.00	92.00

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 105.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658792	-117.882589	42.00	50.00	92.00
2	33.658766	-117.882441	42.00	50.00	92.00
3	33.658635	-117.882474	42.00	50.00	92.00
4	33.658661	-117.882622	42.00	50.00	92.00

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 90.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658629	-117.882628	42.00	50.00	92.00
2	33.658627	-117.882553	42.00	50.00	92.00
3	33.658614	-117.882553	42.00	50.00	92.00
4	33.658612	-117.882478	42.00	50.00	92.00
5	33.658546	-117.882480	42.00	50.00	92.00
6	33.658547	-117.882505	42.00	50.00	92.00
7	33.658478	-117.882507	42.00	50.00	92.00
8	33.658481	-117.882633	42.00	50.00	92.00

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 265.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658455	-117.882633	42.00	50.00	92.00
2	33.658459	-117.882583	42.00	50.00	92.00
3	33.658446	-117.882582	42.00	50.00	92.00
4	33.658452	-117.882506	42.00	50.00	92.00
5	33.658438	-117.882505	42.00	50.00	92.00
6	33.658440	-117.882480	42.00	50.00	92.00
7	33.658320	-117.882466	42.00	50.00	92.00
8	33.658308	-117.882616	42.00	50.00	92.00

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 255.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658280	-117.882609	42.00	50.00	92.00
2	33.658291	-117.882561	42.00	50.00	92.00
3	33.658278	-117.882556	42.00	50.00	92.00
4	33.658301	-117.882459	42.00	50.00	92.00
5	33.658184	-117.882421	42.00	50.00	92.00
6	33.658151	-117.882567	42.00	50.00	92.00

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 250.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.658118	-117.882555	42.00	50.00	92.00
2	33.658164	-117.882414	42.00	50.00	92.00
3	33.658014	-117.882343	42.00	50.00	92.00
4	33.657999	-117.882390	42.00	50.00	92.00
5	33.657973	-117.882378	42.00	50.00	92.00
6	33.657950	-117.882448	42.00	50.00	92.00
7	33.658001	-117.882472	42.00	50.00	92.00
8	33.657993	-117.882496	42.00	50.00	92.00

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 120.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.657584	-117.881935	48.00	45.00	93.00
2	33.657495	-117.881754	48.00	45.00	93.00
3	33.657404	-117.881818	48.00	45.00	93.00
4	33.657493	-117.881999	48.00	45.00	93.00

Name: PV array 9
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 120.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	33.657481	-117.881727	48.00	45.00	93.00
2	33.657392	-117.881546	48.00	45.00	93.00
3	33.657302	-117.881610	48.00	45.00	93.00
4	33.657391	-117.881790	48.00	45.00	93.00

Flight Path Receptors

Name: FP1-02L
Description: None
Threshold height: 55 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.667827	-117.873833	53.40	55.00	108.40
Two-mile	33.642299	-117.890161	3.80	658.00	661.80

Name: FP2-20R
Description: None
Threshold height: 51 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681645	-117.865093	39.60	51.00	90.60
Two-mile	33.707173	-117.848762	52.80	591.20	644.00

Name: FP3-02R
Description: None
Threshold height: 50 ft
Direction: 28.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.674007	-117.868070	52.00	50.00	102.00
Two-mile	33.648479	-117.884400	4.70	650.70	655.40

Name: FP4-20L
Description: None
Threshold height: 50 ft
Direction: 208.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.681008	-117.863632	39.90	50.00	89.90
Two-mile	33.706536	-117.847301	53.50	589.80	643.30

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	33.678173	-117.869826	55.70	121.00

Map image of 1-ATCT

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	10.0	115.0	0	0.0	0	0.0	-
PV array 2	10.0	110.0	0	0.0	0	0.0	-
PV array 3	10.0	105.0	0	0.0	0	0.0	-
PV array 4	10.0	90.0	0	0.0	0	0.0	-
PV array 5	10.0	265.0	0	0.0	0	0.0	-
PV array 6	10.0	255.0	0	0.0	0	0.0	-
PV array 7	10.0	250.0	0	0.0	0	0.0	-
PV array 8	10.0	120.0	0	0.0	0	0.0	-
PV array 9	10.0	120.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV: PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 1 and FP: FP1-02L

No glare found

PV array 1 and FP: FP2-20R

No glare found

PV array 1 and FP: FP3-02R

No glare found

PV array 1 and FP: FP4-20L

No glare found

PV array 1 and 1-ATCT

No glare found

PV: PV array 2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 2 and FP: FP1-02L

No glare found

PV array 2 and FP: FP2-20R

No glare found

PV array 2 and FP: FP3-02R

No glare found

PV array 2 and FP: FP4-20L

No glare found

PV array 2 and 1-ATCT

No glare found

PV: PV array 3 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 3 and FP: FP1-02L

No glare found

PV array 3 and FP: FP2-20R

No glare found

PV array 3 and FP: FP3-02R

No glare found

PV array 3 and FP: FP4-20L

No glare found

PV array 3 and 1-ATCT

No glare found

PV: PV array 4 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 4 and FP: FP1-02L

No glare found

PV array 4 and FP: FP2-20R

No glare found

PV array 4 and FP: FP3-02R

No glare found

PV array 4 and FP: FP4-20L

No glare found

PV array 4 and 1-ATCT

No glare found

PV: PV array 5 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 5 and FP: FP1-02L

No glare found

PV array 5 and FP: FP2-20R

No glare found

PV array 5 and FP: FP3-02R

No glare found

PV array 5 and FP: FP4-20L

No glare found

PV array 5 and 1-ATCT

No glare found

PV: PV array 6 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 6 and FP: FP1-02L

No glare found

PV array 6 and FP: FP2-20R

No glare found

PV array 6 and FP: FP3-02R

No glare found

PV array 6 and FP: FP4-20L

No glare found

PV array 6 and 1-ATCT

No glare found

PV: PV array 7 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 7 and FP: FP1-02L

No glare found

PV array 7 and FP: FP2-20R

No glare found

PV array 7 and FP: FP3-02R

No glare found

PV array 7 and FP: FP4-20L

No glare found

PV array 7 and 1-ATCT

No glare found

PV: PV array 8 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 8 and FP: FP1-02L

No glare found

PV array 8 and FP: FP2-20R

No glare found

PV array 8 and FP: FP3-02R

No glare found

PV array 8 and FP: FP4-20L

No glare found

PV array 8 and 1-ATCT

No glare found

PV: PV array 9 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP1-02L	0	0.0	0	0.0
FP2-20R	0	0.0	0	0.0
FP3-02R	0	0.0	0	0.0
FP4-20L	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

PV array 9 and FP: FP1-02L

No glare found

PV array 9 and FP: FP2-20R

No glare found

PV array 9 and FP: FP3-02R

No glare found

PV array 9 and FP: FP4-20L

No glare found

PV array 9 and 1-ATCT

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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