VILLAGE OF SUGAR GROVE
BOARD REPORT

TO:	VILLAGE PRESIDENT & BOARD OF TRUSTEES
FROM:	WALTER MAGDZIARZ, COMMUNITY DEVELOPMENT DIRECTOR DANIELLE MARION, PLANNING & ZONING ADMINISTRATOR
SUBJECT:	DISCUSSION: SPECIAL USE PERMIT FOR SOLAR GARDEN, COMMUNITY SOLAR 2 (AURORA AIRPORT)
AGENDA:	MARCH 5, 2024 VILLAGE BOARD MEETING
DATE:	FEBRUARY 27, 2024

ISSUE

Shall the Village Board discuss granting a Special Use Permit for a solar farm on a portion of the Aurora Airport property.

DISCUSSION

The applicant, Sun Code Energy, LLC, entered into a contract with the City of Aurora to develop a solar farm on the runway protection zone property located on the south side of US 30 and west of Indigo Drive. Sun Code is a solar energy developer specializing in development of solar gardens and farms with similar projects across the country. This site is referred to as Community Solar 2 and is one of two locations on the Airport property being considered for solar field development.

The State of Illinois recognizes that Illinois utilities and their customers in Illinois need to transition from carbon-emitting energy sources to renewable sources. Wind and solar energy technologies are the focus of the State's renewable energy initiatives. The proposed solar farm will both benefit and benefit from the State's renewable energy initiatives and programs designed to encourage the shift to renewable energy in Illinois. Specifically, the developer will developing the solar field for a community solar program which is eligible for tax credits the state makes available for facilities such as this for this purpose.

Community solar programs are subscription services allowing businesses and residents to utilize solar energy for their energy needs without having to make an investment in solar collectors on their own property. By becoming a subscriber to the community solar program, the customer receives the benefit of the electricity produced by the solar field in the form of a lower electric bill., along with the knowledge that they are contributing to the reduction in greenhouse gases.

The facility proposed at this location is a 6.21 MW facility occupying 20.88 acres within the security fence. It will use 9,632 solar panels. The solar panels will be of the tracking-type and will follow the sun as it moves across the sky. The solar collectors will be surrounded by an eight foot tall security fence, as required. A small shed-like building will be constructed to house the inverter and other necessary equipment. The grounds will be planted in a pollinator-friendly mix and will be low growing and not require mowing. Relative to the Airport, the location of the solar field is within the (south) runway protection zone (RPZ) of Runway 33.

The developer will need to string a new wire on existing utility poles to accommodate the solar field production. We have no indication from the developer or Com Ed that any further changes or improvements, e.g. taller or additional poles or towers, are necessary to serve the project.

Glare. Pilots using Aurora Airport contended that the solar collectors produce glare. Most solar panel manufacturers use non-glare surfaces these days. The facility will use non-glare panels but the applicant had a glare study performed and it concluded the glare produced by the collectors would be akin to that from a body of water, such as a pool in someone's backyard. Until the applicant makes application to the FAA for approval, the glare issue is speculative.

While the FAA has complete discretion and final say whether a solar field is approved on airport property, solar fields exist at more than 20% of the 488 public airports in the US *(Kim, University of Colorado Denver School of Public Affairs)*. Dulles International Airport (Northern Virginia) has a 150 MW facility on 835 acres with more than 200,000 panels and a 50 MW storage facility. Chattanooga International Airport is currently the only airport in the US that produces all of its energy with on-field solar. Solar fields are found at other major US airports, such as Denver, San Francisco, Minneapolis, Indianapolis, Orlando, and Tallahassee, FL to name a few. Solar panels on airport property are not prohibited.

Regardless, the applicant needs to obtain FAA approval of the type of collectors used, as well as use of the airport property for this purpose. Approval of the Special Use Permit will be subject to FAA approval. Improvements on the airport property affecting aviation are not within the Village's jurisdiction.

Impact on property values. The solar field produces no traffic, emits no noise or effluents. Officials in communities where these facilities are operational liken their impacts to cemeteries.

The public raised concerns about property values being affected negatively by the presence of the solar field. To date, there are no studies corroborating this assumption. However, there is a study of home value impacts conducted by Lawrence Livermore Laboratories in California that detected some instances where home values dropped or did not appreciate as fast as others but the amount of decline, according to the authors, is not statistically significant. The authors also admit to not knowing why declines in property values occurred only in some states and not others. Illinois was not included in the study as solar fields are relatively new to Illinois.

Safety concerns. The public expressed concerns about the safety of these facilities. Be advised, the Village Code requires a security fence around these facilities to keep people out. Solar panels pose a safety hazard as they are producing direct current once they are exposed to sunlight. But any hazards associated with the solar panels are only a hazard to persons trespassing in the solar farm.

Decommissioning plan. The public was concerned about the disposition of the facility if the operator goes away or abandons the project in the future. The Village Code requires a decommissioning plan which details how the facility will be dismantled the property restored to its original state. The Village Code also requires a guarantee, in a form acceptable to the Village Board, to cover these costs in the event the facility is abandoned or the applicant fails to perform its duties. During cross-examination, the applicant indicated that the facility would likely be sold to another party. Be advised this is not unusual and occurs with all types of revenue-generating real estate development. Shopping centers, industrial buildings, apartment buildings and the like are constantly sold and re-sold over time, sometimes during the same year. The decommissioning plan is a requirement of the Special Use Permit and as such would run with the land, meaning any subsequent owner/operator of the solar field would be subject to the terms of the decommissioning plan.

Battery storage. There is misinformation out there about battery storage being part of the proposed facility. It is **not** part of the application or included in the site plan or specifications. It became an issue only because during the applicant's introduction/statement of qualifications an example of one in a project they constructed in another state was provided. The applicant, under oath at the public hearing, stated that battery storage is not included in the Airport solar fields. Regardless, Village staff intends to add this prohibition as a condition of approval of the Special Use Permit.

Tax benefits. The solar gardens will generate property tax. The State has a formula (based on MW production) for calculating property taxes for these facilities. Presently, the Community Solar 1 site generates zero property taxes, and Community Solar 2 generates $1,678.98 in property taxes. It is estimated both sites combined will generate $78,907 annually in property taxes. The public interpreted the developer's explanation of the tax benefits to the community and the school district as a blatant attempt to curry favor.

Other environmental concerns.

Solar fields of the size being proposed on the Airport property do not increase surface water run-off to the extent that detention basins are needed. To the contrary, best management practices, generally suffice to address surface run-off. The Village applies the Kane County Storm Water Management Ordinance requirements to facilities such as this. Since Kane County has much more experience with solar fields such as this, Village staff and the project engineer met with Kane County Water Resources staff to understand the County's expectations with solar development. Kane County has adopted stormwater management requirements and methodologies used by the State of Minnesota for these installations and the same will be applied at this location. The Village Code requires a drain tile investigation prior to land improvements such as this and this will assure solar field improvements do not interfere with existing agricultural subsurface drainage infrastructure.

Wetlands on the proposed locations are not impacted; the solar collectors comply with buffer requirements for wetlands and floodplains as required by the US Army Corps of Engineers and the Kane County Storm Water Ordinance. The applicant performed a wetlands delineation, as required.

The solar collectors do not emit any noise. However, the inverter housed in a small shed-like building emits a low-level hum but if one is more than 100 hundred feet from the shed it will not be audible. No part of the proposed solar fields are within one hundred feet of any residence. In fact, the nearest homes in Prairie Glen (894 Indigo Drive and 895 Snow Street) are 655 +/- feet and the nearest homes in Dugan Woods are 381 +/- feet, including the solar field 75-foot setback, from the solar field boundaries. Homes in Dugan Woods are also separated from the subject property by the railroad embankment.

The ground cover in the solar fields will be a pollinator-friendly mix to attract birds, butterflies, and the like. It will have a low height since shading the collectors would be counterproductive. Small critters are expected to occupy the space as well, as they often do.

While the solar fields will take land out of agriculture production, they also will allow the land to regenerate. If at the end of the useful life of the solar field (35 years) solar collection ceases, the land can revert back to agriculture, unlike a subdivision. That the State is permitting and encouraging these facilities on agricultural lands should be a signal that the trade-off is necessary and desirable.

The process. Approval of the Special Use Permit is not the end of the process. Rather it is the beginning of the process for the developer. Zoning approval is required for the developer's application for community solar tax credits and other approvals.

The Planning Commission held the requisite public hearing and interested persons were heard. The proposed solar garden facility complies with the Village's requirements for a solar garden. The Commission recommended approval of the PUD amendment, subject to certain conditions and restrictions as described in their Recommendation report (attached). Village staff recommends adding development of the site in accordance with the approved site development plans; and, prohibiting battery storage facilities on the site, as additional conditions of approval.

ATTACHMENTS

- Planning Commission Recommendation PC24-03
- Selected application materials. *Complete application submittal is available on the public hearing page of the Village website.*

RECOMMENDATION

That the Village Board discuss and provide direction and input to the applicant and Village staff to prepare an Ordinance granting a Special Use Permit to establish and operate a solar farm on the property as requested.

R E C O M M E N D A T I O N
PC24-03

TO: Village President and Board of Trustees

FROM: Planning Commission

DATE: February 21, 2024

PETITION: 24-003 Aurora Airport Solar Garden Special Use Permit (Community Solar-2)

PROPOSAL

The applicant is requesting approval of a Special Use Permit for a ground-mounted solar garden energy system comprised of 9,632 ground-mounted PV modules that will generate approximately 6.21-megawatts direct current and 5.00-megawatts alternating current. The subject property is a 83.2 acre parcel located on Aurora Airport property, in the runway protection area on the south side of US Route 30, just west of the Prairie Glen subdivision. The project will cover approximately 22 of these acres. The maximum height of the panels will not exceed 10 feet and the entire installation will be surrounded by an eight foot tall security fence, as required. A 5ft vegetative screening berm will be installed between the US Route 30 right-of-way and the security fence, as required. The site once completed will be seeded to establish pollinator friendly habitat wherever feasible.

BACKGROUND & HISTORY

The subject property is an 83.2 acre parcel of land owned by the City of Aurora and part of the Aurora Airport that currently is being farmed. The property is the south runway protection zone for Runway 33. The property is zoned M1- limited manufacturing. A ground-mounted solar garden energy system is a special use in the M1 zoning district, therefore, the applicant must obtain the special use permit in order to move forward with the project.

Recently, there has been a lot of interest in solar gardens and solar farms throughout Kane County. Examples of these facilities are at the Kane County Court Center and Mooseheart. The City of Aurora has agreed to lease the property to SunCode Energy for the ground-mounted solar garden. The expected useful life of the system ranges from 20 to 40 years. At the end of the life of the system the system will be decommissioned in accordance with the decommissioning plan that was provided as part of the application, as required.

<u>LOCATION MAP</u>

<u>EVALUATION</u>

The proposed Special Use Permit for a ground-mounted solar garden energy system would be consistent with the Village's Comprehensive Plan since it would not be detrimental to the surrounding areas and that it aids protecting our climate and resource conservation. The proposed site development plan complies with all of the Village's requirements for a Solar Garden Energy System.

Generally, this use is required to conform to the Village of Sugar Grove Special Use Standards. The following evaluation is based on the Special Use standards.

1. **Land Use/General –** The Special Use is consistent with the Comprehensive Plan and the zoning on the property.

2. **Existing Conditions –** The existing use of the property is farmland, the property is located in the runway protection zone of the airport, therefore, greatly limiting what this property may be used for. The Village has no jurisdiction over improvements on the airport property that affect aviation operations.

3. **Lots & Buildings –** Solar panels will be installed on the property and other than a small shed-like building to house an inverter and other electrical equipment there will not be any buildings constructed in connection with the solar garden.

4. **Parking –** Parking is not needed for this use.

PUBLIC RESPONSE

After due notice, the Planning Commission held a public hearing on February 21, 2024. Objectors were present.

The first item of concern that was expressed by the public was glare relative to aviation operations. The glare study that was provided by the applicant included language in the report that raised concerns with the public. In the public's opinion they felt the glare study was a cause of concern, and that the glare from the panels would affect pilots while taking off and landing at the airport. The impact of the facility on property values was raised by the public as they feel that property located near the solar gardens would decrease in value. The public also expressed concerns over safety of the solar garden due to the fact that as soon as the panels are exposed to sunlight they being producing direct current.

The decommissioning plan was the next concern raised. The public expressed concerns over this in the event that the company installing the solar garden could go out of business and essentially abandon the property and leave the Village with dealing with disposing of the panels. The issue of battery storage was also raised by the public due to an example that was used during the developers presentation; this project does not include battery storage, but the public felt that just because the plans do not show it now, the developer could add it at a later date.

During the presentation the developer presented the tax benefits of the solar garden, the public felt this was inaccurate and an attempt from the developer to gain favor for the project. Environmental concerns were raised by the public included drainage, removing farmland from production, wildlife, and noise. The final topic of concern was the inconsistencies on the application material identifying the applicant. They made issue that the LLC listed as the applicant differed from some of the other LLC's listed throughout the application material.

DISCUSSION

Commissioners discussed the proposal, this included inquiring how the project works without battery storage; inquiring if the project is government subsidized; the construction timeframe; if SunCode has ever done another project on an airport property; the multiple LLC's listed throughout the application; if SunCode usually sells most of what they set up; and if shade trees in the screening berms could be replaced with ornamental trees.

Commissioners satisfied themselves that battery storage is not necessary for the operation of this facility. With respect to the inconsistent entities identified on the application materials, Commissioners were comfortable proceeding with discussing the application pending the Village Attorney's review of the application forms.

The shade tree matter has to do with obstructions of a certain height within the runway protection zone. Shade trees would present a conflict with runway protection zone. The matter was resolved when Village staff indicated that substituting ornamental trees for the required shade trees would satisfy the screening objective of the zoning regulations and avoid conflict with the requirements of the runway protection zone.

The concern about glare from the solar collectors relative to aviation operations at the airport is the purview of the FAA, not the Village. However, the Planning Commission can make FAA approval of the collector installation a requirement of the Special Use Permit.

Commissioners, generally, did not share the public's concern about the impact of the solar field on nearby property values. Commissioners also did not share the public's concerns about safety since all potential hazards are within the security fence. Only trespassers would be exposed to safety hazards.

The requirements for the required decommissioning plan were discussed at great length by the Commission. In order to obtain the building permit to construct the facility the applicant is required to provide the required financial guarantee to implement the decommissioning plan.

After thoroughly discussing the concerns raised by the public, the Plan Commission felt all of the issues and concerns could be mitigated with the conditions of approval of the Special Use Permit.

FINDINGS OF FACT

When considering special use requests, the Zoning Ordinance provides certain standards to be considered. The Planning Commission hereby finds that the proposed Special Use:

1. Will be harmonious with and in accordance with the general objectives of the Comprehensive Land Use Plan and/or this zoning ordinance.
   Petitioner: The applicant is committed to ensuring the special use is harmonious with and in accordance with the general objectives of the Comprehensive Land Use Plan and the Zoning Ordinance. The special use will comply with all Local, State and Federal regulations through all phases of the proposed Project. Additional details of how this project complies with the comprehensive land use plan and the Zoning Ordinance are detailed in the Special Use Permit Application.

2. Will be designed, constructed, operated and maintained so as to be harmonious and appropriate in appearance with the existing or intended character of the general vicinity, and that such use will not alter the essential character of the same area.
   Petitioner: The special use will be designed, constructed, operated, and maintained so as to be harmonious and appropriate in appearance with the intended character of the general vicinity, and will not alter the essential character of the area. The proposed special use is a response to a 2017 Request for Proposal from the City of Aurora for a solar photovoltaic generation facility. The Project Drawings detail the design of the project as well as the Special Use Permit Application in which this document is attached.

3. Will not be hazardous or disturbing to existing or future neighborhood uses.
   Petitioner: The special use will not be hazardous or disturbing to existing or future neighborhood uses. The special use will comply with all Local, State and Federal regulations through all phases of the proposed Project.

4. Will be adequately served by essential public facilities and services such as highways, streets, police and fire protection, drainage structures, refuse disposal, water sewers and schools, or that the persons or agencies responsible for the establishment of the proposed use shall be able to provide adequately any such services.
   Petitioner: The special use will be adequately served by essential public facilities and services.

5. Will not create excessive additional requirements at public cost for public facilities and services, and will not be detrimental to the economic welfare of the Village.
   Petitioner: The special use will not create excessive additional requirements at public cost for public facilities and services, and be detrimental to the economic welfare of the village. If needed, please refer to the Special Use Permit Application for additional details.

6. Will not involve uses, activities, processes, materials, equipment and/or conditions of operation that will be detrimental to any persons, property or the general welfare by reason of excessive production of traffic, noise, smoke, fumes, glare or odors.
   Petitioner: The special use does not involve uses, activities, processes, materials, equipment and/or conditions of operation that will be detrimental to any persons, property or the general welfare by reason of excessive production of traffic, noise, smoke, fumes, or odors. A glare study was performed, Solar Glare Hazard Analysis Tool Results. Construction vehicle presence will increase at the time of construction but will be manageable under current roadway conditions and traffic regulations and will return to normal traffic conditions at the end of construction.

7. Will have vehicular approaches to the property which shall be so designed as to not create an undue interference with traffic on surrounding public streets or highways.
   Petitioner: The special use will have vehicular approaches to the property which shall be so designed as to not create any undue interference with traffic on surrounding public streets and highways.

8. Will not increase the potential for flood damage to adjacent property, or require additional public expense for flood protection, rescue or relief.
   Petitioner: The special use will not increase the potential for flood damage to adjacent property, or require additional public expense for flood protection, rescue or relief. Stormwater best management practices will be used and submitted to the Village at a later date.

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9. Will not result in the destruction, loss or damage of natural, scenic or historic features of major importance to the Village.
   Petitioner: The special use will not result in the destruction, loss or damage of natural, scenic or historic features of major importances to the village. The project will be in compliance with Local, State and Federal permits outlined in the Special Use Permit Application.

RECOMMENDATION

After carefully considering the facts and public comments, the Planning Commission accepts the Findings of Fact as presented and recommends the Village Board **approve** the Special Use Permit for a ground-mounted solar garden energy system (Community Solar-2) subject to the following conditions:

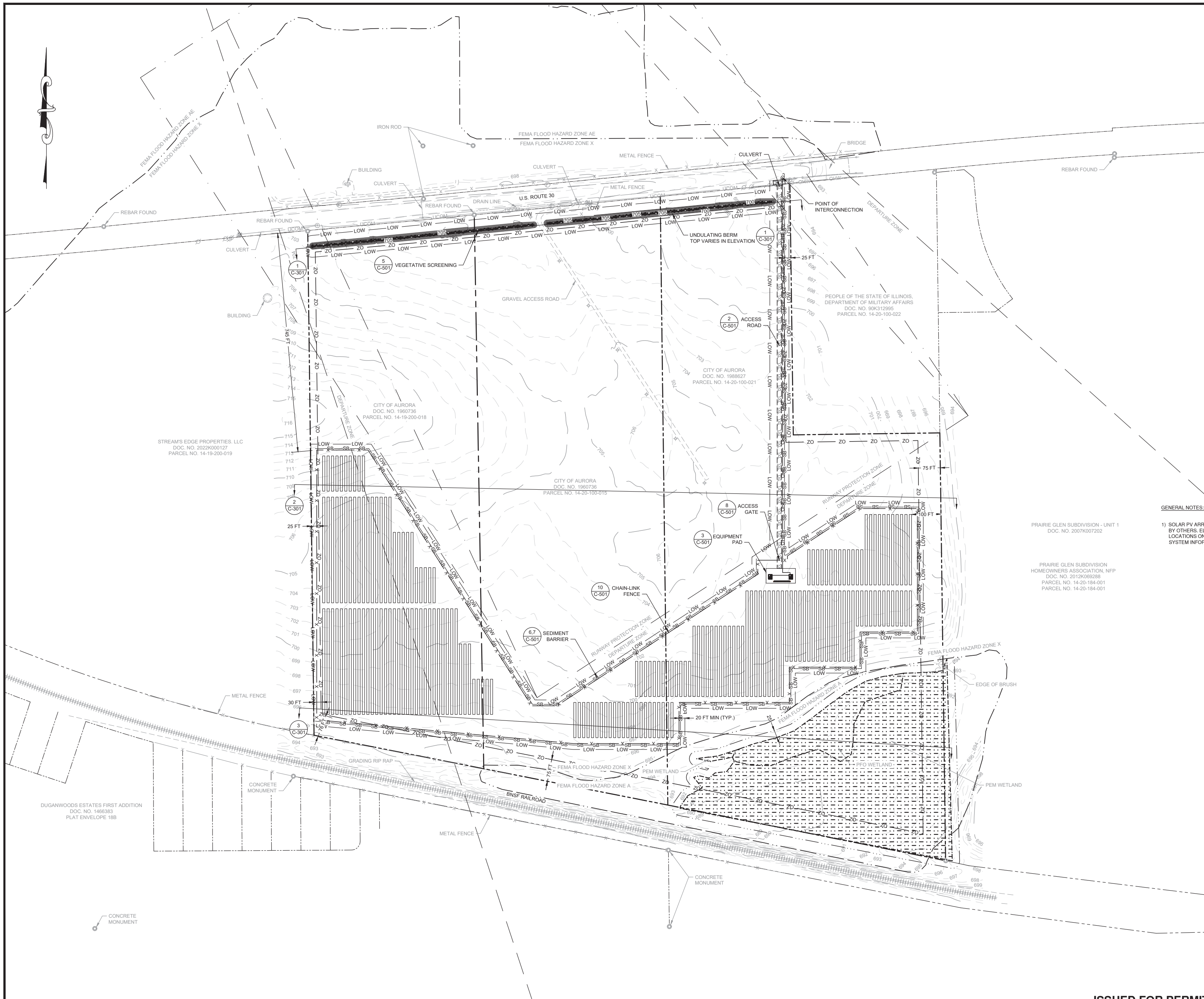
1. Applicant must obtain FAA approval for the facility, including satisfying glare requirements.
2. Verification of applicant's LLC's as they pertain to the application by Village Attorney.
3. The owner/operator of the solar facility shall notify the Village of any changes of ownership during the life of the project.
4. Applicant shall prepare and provide a drain tile investigation prior to issuing the building permit.
5. Applicant shall perform soil and water analysis within the solar field five to ten years after facility is placed on-line.

AYES: Guddendorf, Wilson, Sabo, Speciale, Ochsenschlager

NAYES: None

ABSENT: Jones, Bieritz

MOTION PASSED



LEGEND:

EXISTING:

- 705 — MAJOR CONTOUR
- 713 — MINOR CONTOUR
- PROPERTY LINE
- ABUTTER'S PROPERTY LINE
- ZO — PROPERTY LINE SETBACK
- BUILDING
- RIGHT OF WAY
- EDGE OF ASPHALT
- EDGE OF GRAVEL
- EDGE OF CONCRETE
- X — METAL FENCE
- BRIDGE
- GUARD RAIL
- JERSEY BARRIER
- RAILROAD RAIL
- OHW — OVERHEAD WIRE
- UCOM — COMMUNICATION LINE
- EDGE OF BRUSH
- EDGE OF WETLAND
- WETLAND AREA
- 25' WETLAND BUFFER
- DRAIN LINE
- FEMA FLOOD HAZARD ZONE
- RUNWAY PROTECTION ZONE
- DEPARTURE ZONE
- LOW — PROPOSED LIMIT OF WORK
- BOUNDARY EVIDENCE
- UTILITY POLE
- LIGHT POLE
- TELEPHONE POLE
- WATER VALVE
- FIRE DEPARTMENT CONNECTION
- FIBER OPTICS MARKER

PROPOSED:

- 705 — MAJOR CONTOUR
- MINOR CONTOUR
- X — FENCE (10 / C-501)
- OHE — OVERHEAD ELECTRIC
- SB — SB — SEDIMENT BARRIER (6,7 / C-501)
- EC — ELECTRICAL CONDUIT
- EDGE OF GRAVEL
- GRAVEL ACCESS ROAD (2 / C-501)
- SOLAR PV ARRAY (1 / C-501)
- TREE OR SHRUB (5 / C-501)
- UTILITY POLE

GENERAL NOTES:

1) SOLAR PV ARRAY AND ELECTRICAL DESIGN, INCLUDING UTILITY POLES, PERFORMED BY OTHERS. ELECTRICAL EQUIPMENT AND COMPONENTS SHOWN TO ILLUSTRATE LOCATIONS ONLY. REFER TO ELECTRICAL DRAWINGS FOR DETAILED ELECTRICAL SYSTEM INFORMATION.

0' 75' 150' 225'

1" = 150' WHEN PLOTTED 24"X36"

ISSUED FOR PERMITTING/NOT FOR CONSTRUCTION

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
100 APOLLO DRIVE, SUITE 302
CHELMSFORD MASSACHUSETTS 01824
TELEPHONE: (978) 692-9090
FAX: (978) 692-6633
WEB: WWW.WSP.COM

REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED	APPROVED
0	02/19/2024	ISSUED FOR PERMITTING/NOT FOR CONSTRUCTION	MRM	NWZ

PROJECT: **6.21 MW DC GROUND-MOUNT SOLAR PV DEVELOPMENT U.S. ROUTE 30 SUGAR GROVE, IL 60554**

TITLE: PROPOSED SITE PLAN

CLIENT: SUNCODE LLC

SunCode Energy

SEAL:

DRAFT

DESIGNED BY: MRM	DRAWN BY: MRM
CHECKED BY: APV	SCALE: AS SHOWN
PROJECT NUMBER: 3652230432	
DRAWING NUMBER: C-101	
SHEET NUMBER: 3 OF 5	

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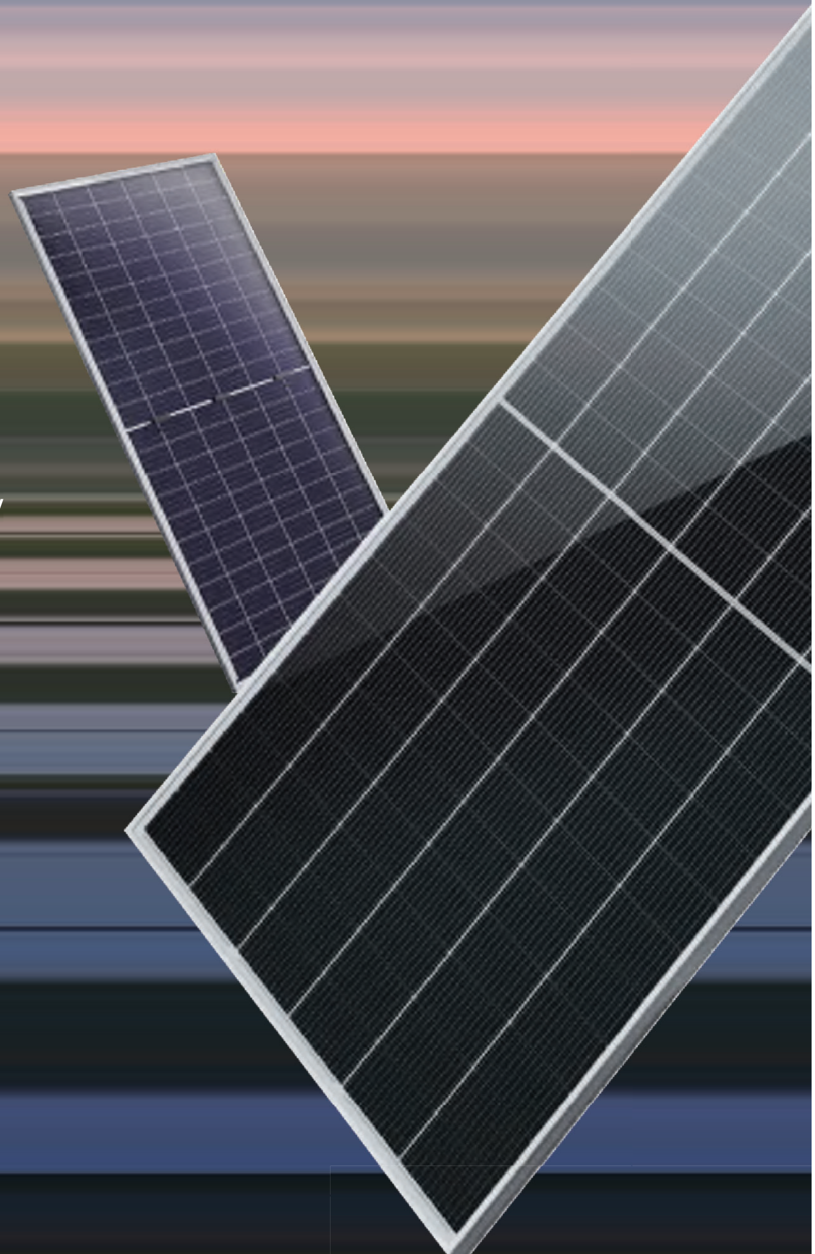
ASTRONERGY
A CHINT COMPANY

ASTRO 6 Twins

Create Sustainable and Efficient Green Energy



CHSM66M(DG)/F-BH
Bifacial Series (210)

645~660W

PERC+ / Multi-busbar / Half-cut

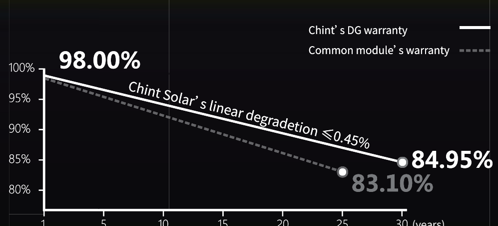
Non-destructive cutting

PID resistance

Bifacial gain

Lower BOS cost & LCOE

Assist carbon neutrality



12-year Product Warranty

30-year Linear Power Warranty

ISO 9001:2015:ISO Quality Management System
ISO 14001:2015:ISO Environment Management System
ISO 45001:Occupational Health and Safety
The first solar company which passed the Nord IEC/TS 62941 certification audit.

2021 TOP Performance PVEL

Tier 1 BloombergNEF

Underwritten by International Insurer

645~660W	0~+5W	21.2%	≤ 2.0%	≤ 0.45%
POWER RANGE	POWER TOLERANCE	MAX MODULE EFFICIENCY	FIRST YEAR POWER DEGRADETION	YEAR 2-30 POWER DEGRADETION

Electrical Specifications

STC: Irradiance 1000W/m², Cell Temperature 25° C, AM=1.5

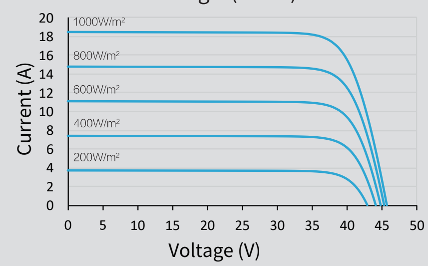
Rated output (Pmpp / Wp)	645	650	655	660
Rated voltage (Vmpp / V)	37.48	37.68	37.88	38.08
Rated current (Impp /A)	17.21	17.26	17.30	17.34
Open circuit voltage (Voc / V)	45.29	45.49	45.69	45.89
Short circuit current (Isc /A)	18.27	18.32	18.37	18.42
Module efficiency	20.8%	20.9%	21.1%	21.2%

NMOT: Irradiance 800W/m², Ambient Temperature 20° C, AM=1.5, Wind Speed 1m/s

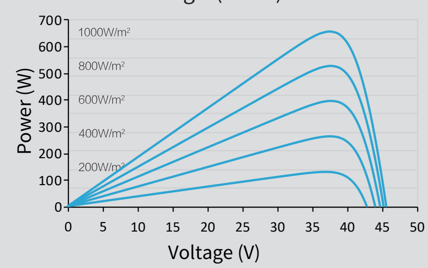
Rated output (Pmpp / Wp)	485.8	489.5	493.3	497.1
Rated voltage (Vmpp / V)	35.03	35.19	35.34	35.47
Rated current (Impp /A)	13.87	13.92	13.97	14.02
Open circuit voltage (Voc / V)	42.43	42.63	42.83	43.03
Short circuit current (Isc /A)	14.72	14.77	14.82	14.87

Curve

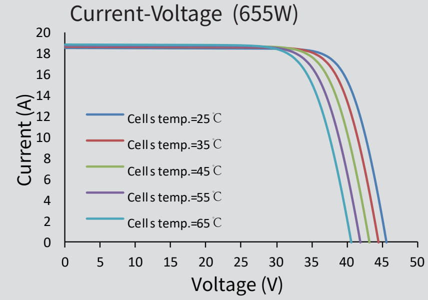
Current-Voltage (655W)



Power-Voltage (655W)



Current-Voltage (655W)



Electrical Specifications (Integrated power)

Pmpp gain	Pmpp / Wp	Vmpp / V	Impp /A	Voc / V	Isc /A
5%	687	37.88	18.17	45.69	19.29
10%	720	37.88	19.03	45.69	20.21
15%	753	37.89	19.90	45.70	21.13
20%	786	37.89	20.76	45.70	22.04
25%	818	37.89	21.63	45.70	22.96

Electrical characteristics with different rear power gain (reference to 655W)

Temperature Ratings (STC)

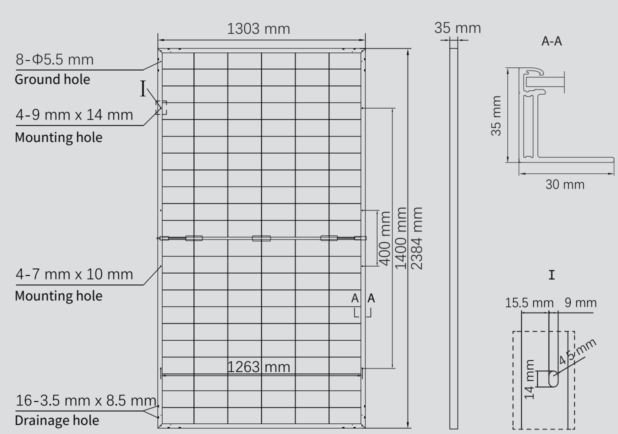
Temperature coefficient (Pmpp)	-0.34%/°C
Temperature coefficient (Isc)	+0.04%/°C
Temperature coefficient (Voc)	-0.25%/°C
Nominal module operating temperature (NMOT)	41±2°C

Operating Parameters

No. of diodes	3
Junction box IP rating	IP 68
Max. series fuse rating	35 A
Max. system voltage (IEC/UL)	$1500V_{DC}$

Mechanical Specifications

Outer dimensions (L x W x H)	2384 x 1303 x 35 mm
Cell Type	P type Mono-crystalline
No. of cells	132 (6*22)
Frame technology	Aluminum, silver anodized
Front glass thickness	2.0 mm
Cable length (IEC/UL)	Portrait: 350 mm; Landscape: 1400 mm
Cable diameter (IEC/UL)	4 mm² / 12 AWG
① Maximum mechanical test load	5400 Pa (front) / 2400 Pa (back)
Connector type (IEC/UL)	HCB40 / MC4-EVO2 (optional)
Module weight	38.2 kg
Packing unit	31 pcs / box (Subject to sales contract)
Weight of packing unit (for 40'HQ container)	1230 kg
Modules per 40' HQ container	527 pcs



① Refer to Astronergy crystalline installation manual or contact technical department.
Maximum Mechanical Test Load=1.5×Maximum Mechanical Design Load.

nextracker™

NX Horizon™

NX Horizon™ is the world's most chosen solar tracker system for utility-scale power plants, deployed and contracted on over 75 gigawatts of solar power plants globally as of March 2023. NX Horizon's unrivaled combination of integrated hardware and software has become the gold standard for the utility-scale solar industry, thanks to its robust design, ease of installation, field-proven weather durability, and LCOE-optimized performance.

Pioneering independent-row technology

NX Horizon's patented independent row, self-powered tracking system provides reliable performance across the widest possible range of site conditions. Simple, robust hardware, including self-aligning module rails and vibration-proof fasteners, enables rapid installation and long life without maintenance. Mechanically balanced rows minimize tracking power requirements and pair with a time-proven, rugged drive & control system for maximum durability and uptime. NX Horizon's decentralized architecture with intelligent communications supports maximum layout adaptability, flexible construction and commissioning sequencing, advanced tracker functionality, and over-the-air updates.

Proven resilience

NX Horizon is designed to withstand extreme weather events, proven season after season across hundreds of systems around the world. Through Nextracker's in-house project-engineering services, NX Horizon is configured and optimized to suit the unique combination of severe weather hazards and climate for each project site. Based on the industry's most comprehensive wind analysis and field testing, NX Horizon is hardened against wind-related failures by robust structural design, an optimized damping system, and advanced stowing functionality. Furthermore, the combination of balanced, independent self-powered rows with integrated UPS, 60° stowing angle, and available smart software enables rapid hail-stow protection to maximize panel survivability, even in the event of a grid outage. NX Horizon is inherently tolerant of flooding with drive and control components 4-5' above grade and available flood stowing functions to protect panels.

Features and Benefits

7 years in a row

Global Market Share Leader

75 GW

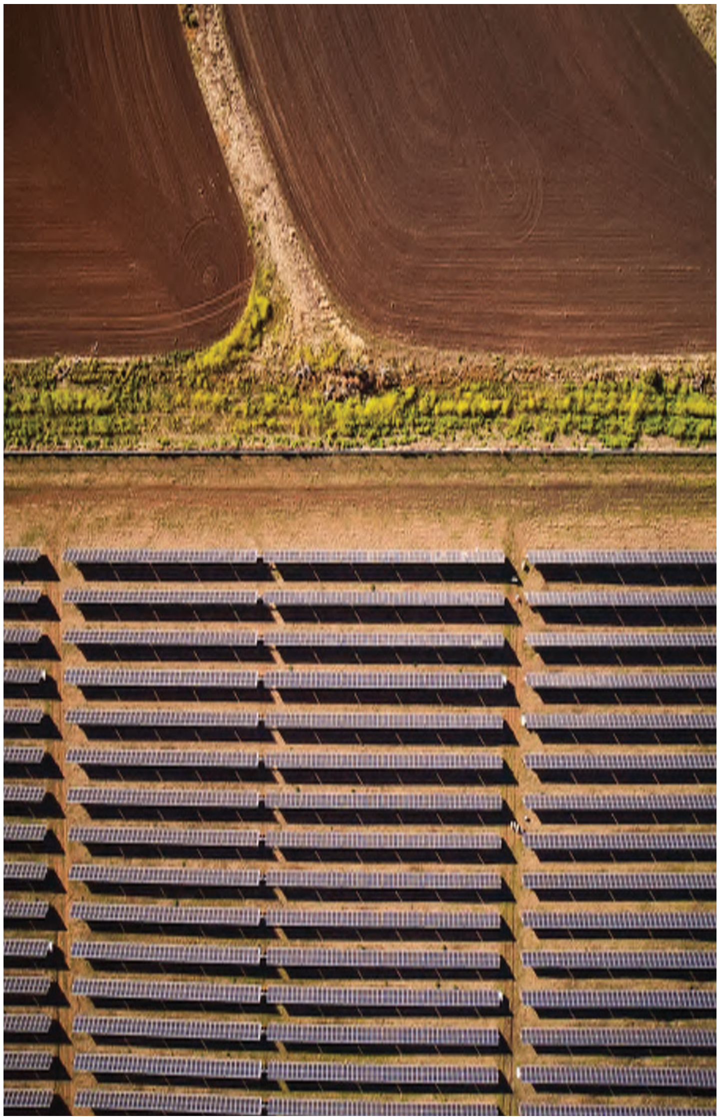
Delivered on 6 Continents

Best-in Class

Software Ecosystem and Global Services

Up to 6% more energy

Using TrueCapture™ Smart Control System



Optimized for the lowest LCOE

Compared with conventional tracking systems, NX Horizon delivers Levelized Cost of Energy (LCOE) reductions of up to 7% by maximizing energy generation and solving for the lowest possible project CAPEX and OPEX. With pre-assembled components, no drive linkages, no AC wiring, self-aligning rails, and available XTR terrain following upgrades, NX Horizon is fundamentally faster to install, requiring less construction labor, less grading, and less total project capital cost. Projects using NX Horizon enjoy open-row access for maximum vegetation management and panel cleaning efficiency. Compared with linked row systems, NX Horizon cuts mowing costs by up to 55% and cleaning costs by up to 73%, reducing total project operations costs.

Lastly, but crucially for project returns, NX Horizon boosts project energy generation and revenue with its unique bifacial-optimized design as standard, and available IE-validated, 38GW proven TrueCapture Smart Control System with diffuse mode and row to row optimization functions.

GENERAL AND MECHANICAL	
Architecture	Horizontal single-axis, independent row, independently balanced
Configuration	1x module in portrait
Tracking range of motion	Options for ±60° or ±50°
Row Size	Configurable per module type, string length and site layout
Array Height	Rotation axis elevation, 1.3 to 1.8 m / 4'3" to 5'10"
Drive type	High accuracy slew gear
Modules supported	All utility-scale crystalline and thin-film modules
Bifacial optimization	High-rise mounting rails, bearing & driveline gaps, round torque tube
Structural connections	Engineered fastening system, vibration-proof
Materials	Galvanized steel; other coatings available
Foundations	Complete range of foundation solutions available
Slope	Up to 15% N-S and 15% E-W
Ground coverage ratio (GCR)	No specific limit Typical range 25-45%
Operating temperature range	SELF POWERED: -30°C to 55°C (-22°F to 131°F) AC POWERED: -40°C to 55°C (-40°F to 131°F)
Wind speed	Configurable up to 240 kph (150 mph) 10m, 3-second gust
Wind protection	Intelligent wind stowing with symmetric damping system

ELECTRONICS AND CONTROLS	
Solar tracking method	Astronomical algorithm with backtracking standard. TrueCapture™ upgrades available for enhanced energy yield
Tracker controller	Self-Powered Controller (SPC) with integrated inclinometer and UPS
Motor	Brushless DC
Power supply	SELF POWERED: Standalone smart solar power AC POWERED: Customer-provided 120-277 VAC circuit
Communications	Network control units (NCUs) at inverter pads/skids, self-powered weather stations, centralized data hub, encrypted Zigbee wireless mesh communications
Defensive stowing functions	Wind, hail, hurricane, snow, flood, loss of grid power
Operator interface	NX Navigator advanced HMI available, with SCADA integration

SERVICE, WARRANTY, AND STANDARDS	
Tracker engineering & PE stamped design package	Standard
Foundation engineering & PE stamped design package	Available
Onsite construction support & commissioning service	Available
Warranty	10-year structural, 5-year drive and controls standard; extended warranty available
Certifications	UL 2703, UL 3703, IEC 62817, CSA
Codes and standards	UL 3703 / UL 2703 / IEC 62817 / CSA

MEMORANDUM

PROJECT: SunCode Aurora Airport Solar CS 2, LLC

FROM: William Huber, Lead Consultant Environmental Planner, WSP USA Solutions Inc.

SUBJECT: Aurora Municipal Airport (ARR) Solar Glare Hazard Analysis for CS2 Project

DATE: January 16, 2024

WSP is providing this memorandum (memo) related to SunCode Aurora Airport Solar CS 2, LLC proposed siting of a 6.21 MW DC/5.00MW AC Community Solar system on behalf of the Aurora Municipal Airport (ARR) within the airport property boundary. This memo provides a brief summary of the results of a desktop glare hazard analysis and the modeling output report (Attachment 1). The objective of the analysis was to evaluate the potential glare impact from the solar arrays on aircraft flight operations at ARR.

ANALYSIS

A glare hazard analysis was conducted on the proposed Aurora Airport Solar CS2 project using the ForgeSolar Solar Glare Hazard Analysis Tool (SGHAT) software licensed by Sandia National Laboratories, which predicts potential impacts of glare and annual energy production from solar PV arrays on defined receptors, aircraft approach flight paths, and air traffic control towers (ATCT). This analysis factored in the geographic location and the design specifications of the Aurora Airport Solar CS2 project and the potential for glare impacts on the aviation operations at the Aurora Municipal Airport (ARR).

FAA NOTICE OF PROPOSED CONSTRUCTION

The analysis adheres to the Federal Aviation Administration (FAA) 2021 policy (14 Code of Federal Regulations 77) and determined that that the proposed system will not impact the ATCT cab at the ARR. FAA relies on the submittal of Form 7460–1 by the sponsor that confirms that the potential for glint and glare has been analyzed and determined there is no potential for ocular impact to the airport's ATCT cab. CFR Part 77 establishes standards and notification requirements for objects affecting navigable airspace. This notification allows the FAA to conduct an aeronautical study and serves as the basis for evaluating the effect of the construction or alteration on operating procedures; determining the potential hazardous effect of the proposed construction on air navigation; identifying mitigating measures to enhance safe air navigation.

CONCLUSION

Based on the results of the analysis, no significant glint and glare impacts were predicted from the Aurora Airport Solar CS2 project. The analysis did show the potential for moderate (yellow) impacts from glint and glare, "glare with potential to cause temporary after-image," along Runway 33 approach flight path. No impacts from glint and glare were predicted on the ATCT at AAR. The proposed project complies with FAA's 2021 policy and analysis determined that that the proposed system will not impact the ATCT cab.

Attachment:

1) ForgeSolar Solar Glare Hazard Analysis Tool (SGHAT) Modeling Output Report

Attachment 1:

ForgeSolar Solar Glare Hazard Analysis Tool (SGHAT) Modeling Output Report - SunCode Aurora Airport Solar CS 2, LLC

FORGESOLAR GLARE ANALYSIS

Project: **Aurora Solar CS**

Proposed construction of a Community Solar system on behalf of the Aurora Municipal Airport (ARR). The SunCode Aurora Airport Solar CS, LLC (Project) proposed location in Village of Sugar Grove, IL 60554, Kane County.

Site configuration: **Aurora CS2**

Client: SunCode Energy

Created 12 Jan, 2024
Updated 12 Jan, 2024
Time-step 1 minute
Timezone offset UTC-6
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Site ID 109611.18954

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

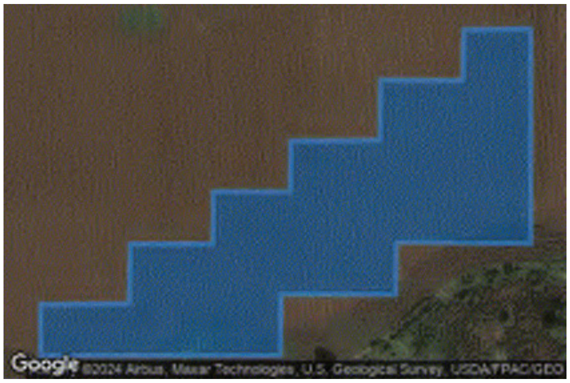
The referenced policy can be read at https://www.federalregister.gov/d/2021-09862

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.

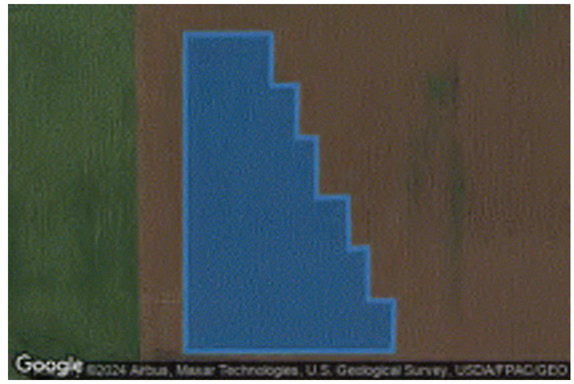
PV Arrays

Name: CS2 array area east
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Ground Coverage Ratio: 0.5
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	41.759846	-88.471878	705.00	10.00	715.00
2	41.759849	-88.471118	703.67	10.00	713.67
3	41.760233	-88.471109	704.25	10.00	714.25
4	41.760232	-88.470399	702.80	10.00	712.80
5	41.760567	-88.470398	703.19	10.00	713.19
6	41.760565	-88.469740	702.49	10.00	712.49
7	41.760891	-88.469734	702.95	10.00	712.95
8	41.760896	-88.468971	703.21	10.00	713.21
9	41.761280	-88.468965	702.56	10.00	712.56
10	41.761277	-88.468259	702.88	10.00	712.88
11	41.761605	-88.468252	701.37	10.00	711.37
12	41.761609	-88.467675	698.63	10.00	708.63
13	41.760233	-88.467675	700.70	10.00	710.70
14	41.760241	-88.468825	702.10	10.00	712.10
15	41.759906	-88.468829	702.76	10.00	712.76
16	41.759907	-88.469812	702.91	10.00	712.91
17	41.759519	-88.469820	702.69	10.00	712.69
18	41.759518	-88.471878	704.06	10.00	714.06

Name: CS2 array area west
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Light textured glass with 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	41.761795	-88.474742	711.03	10.00	721.03
2	41.761798	-88.473998	708.16	10.00	718.16
3	41.761462	-88.473998	709.22	10.00	719.22
4	41.761471	-88.473776	708.31	10.00	718.31
5	41.761137	-88.473780	708.39	10.00	718.39
6	41.761134	-88.473610	707.86	10.00	717.86
7	41.760749	-88.473613	707.10	10.00	717.10
8	41.760754	-88.473342	706.78	10.00	716.78
9	41.760420	-88.473334	705.30	10.00	715.30
10	41.760433	-88.473172	704.29	10.00	714.29
11	41.760092	-88.473169	703.36	10.00	713.36
12	41.760091	-88.472946	702.56	10.00	712.56
13	41.759765	-88.472956	701.71	10.00	711.71
14	41.759763	-88.474739	703.32	10.00	713.32

Observation Point ATCT Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	41.768213	-88.467055	707.28	76.00

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
CS2 array area east	SA tracking	SA tracking	0	0.0	0	0.0	-
CS2 array area west	SA tracking	SA tracking	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: CS2 array area east

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

CS2 array area east and 1-ATCT

Receptor type: ATCT Observation Point

No glare found

PV: CS2 array area west

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

CS2 array area west 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

FORGESOLAR GLARE ANALYSIS

Project: **Aurora Solar CS**

Proposed construction of a Community Solar system on behalf of the Aurora Municipal Airport (ARR). The SunCode Aurora Airport Solar CS, LLC (Project) proposed location in Village of Sugar Grove, IL 60554, Kane County.

Site configuration: **Aurora CS2**

Client: SunCode Energy

Created 12 Jan, 2024
Updated 12 Jan, 2024
Time-step 1 minute
Timezone offset UTC-6
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 500 kW to 1 MW
Site ID 109611.18954

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 Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
CS2 array area east	SA tracking	SA tracking	7,389	123.2	5,794	96.6	-
CS2 array area west	SA tracking	SA tracking	1,562	26.0	2,725	45.4	-

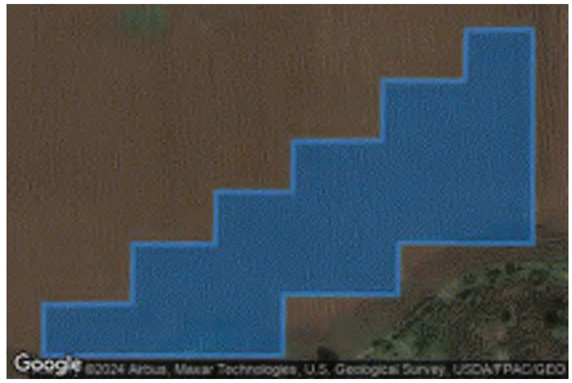
Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP 1_Rwy 09	0	0.0	0	0.0
FP 2_Rwy 27	1,759	29.3	0	0.0
FP 3_Rwy 15	0	0.0	0	0.0
FP 4_Rwy 33	7,192	119.9	8,519	142.0
FP 5_Rwy 18	0	0.0	0	0.0
FP 6_Rwy 36	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

Component Data

PV Arrays

Name: CS2 array area east
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Ground Coverage Ratio: 0.5
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)
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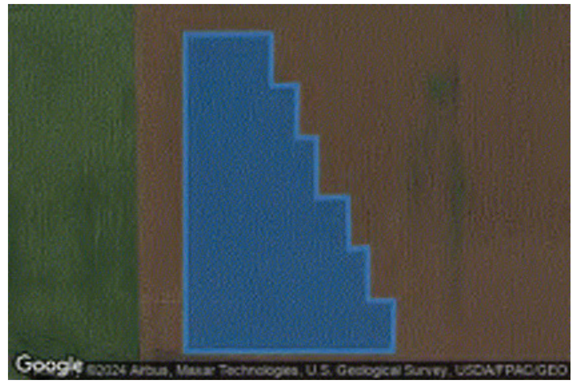
6	41.760565	-88.469740	702.49	10.00	712.49
7	41.760891	-88.469734	702.95	10.00	712.95
8	41.760896	-88.468971	703.21	10.00	713.21
9	41.761280	-88.468965	702.56	10.00	712.56
10	41.761277	-88.468259	702.88	10.00	712.88
11	41.761605	-88.468252	701.37	10.00	711.37
12	41.761609	-88.467675	698.63	10.00	708.63
13	41.760233	-88.467675	700.70	10.00	710.70
14	41.760241	-88.468825	702.10	10.00	712.10
15	41.759906	-88.468829	702.76	10.00	712.76
16	41.759907	-88.469812	702.91	10.00	712.91
17	41.759519	-88.469820	702.69	10.00	712.69
18	41.759518	-88.471878	704.06	10.00	714.06

Name: CS2 array area west
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Light textured glass with 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	41.761795	-88.474742	711.03	10.00	721.03
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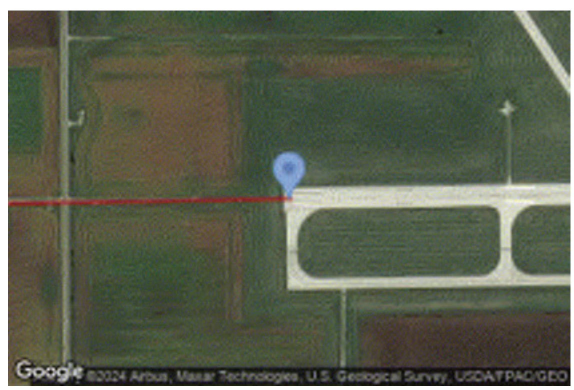
4	41.761471	-88.473776	708.31	10.00	718.31
5	41.761137	-88.473780	708.39	10.00	718.39
6	41.761134	-88.473610	707.86	10.00	717.86
7	41.760749	-88.473613	707.10	10.00	717.10
8	41.760754	-88.473342	706.78	10.00	716.78
9	41.760420	-88.473334	705.30	10.00	715.30
10	41.760433	-88.473172	704.29	10.00	714.29
11	41.760092	-88.473169	703.36	10.00	713.36
12	41.760091	-88.472946	702.56	10.00	712.56
13	41.759765	-88.472956	701.71	10.00	711.71
14	41.759763	-88.474739	703.32	10.00	713.32

Flight Path Receptors

Name: FP 1_Rwy 09
Description:
Threshold height: 50 ft
Direction: 89.0°
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	41.770178	-88.485316	706.65	50.00	756.65
Two-mile	41.769674	-88.524122	695.73	614.35	1310.07

Name: FP 2_Rwy 27
Description:
Threshold height: 50 ft
Direction: 269.0°
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	41.770439	-88.461631	706.95	50.00	756.95
Two-mile	41.770953	-88.422826	705.99	604.39	1310.38

Name: FP 3_Rwy 15
Description:
Threshold height: 50 ft
Direction: 147.0°
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	41.779972	-88.486118	711.72	50.00	761.72
Two-mile	41.804220	-88.507260	731.50	583.65	1315.15

Name: FP 4_Rwy 33
Description:
Threshold height: 50 ft
Direction: 327.0°
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	41.767468	-88.475145	698.20	50.00	748.20
Two-mile	41.743220	-88.454008	695.04	606.58	1301.62

Name: FP 5_Rwy 18
Description:
Threshold height: 50 ft
Direction: 180.0°
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	41.776323	-88.471639	699.43	50.00	749.43
Two-mile	41.805236	-88.471639	716.95	585.91	1302.86

Name: FP 6_Rwy 36
Description:
Threshold height: 50 ft
Direction: 0.0°
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	41.768097	-88.471623	700.90	50.00	750.90
Two-mile	41.739185	-88.471623	698.10	606.23	1304.33

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	41.768213	-88.467055	707.28	76.00

Map image of 1-ATCT

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
CS2 array area east	SA tracking	SA tracking	7,389	123.2	5,794	96.6	-
CS2 array area west	SA tracking	SA tracking	1,562	26.0	2,725	45.4	-

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
FP 1_Rwy 09	0	0.0	0	0.0
FP 2_Rwy 27	1,759	29.3	0	0.0
FP 3_Rwy 15	0	0.0	0	0.0
FP 4_Rwy 33	7,192	119.9	8,519	142.0
FP 5_Rwy 18	0	0.0	0	0.0
FP 6_Rwy 36	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

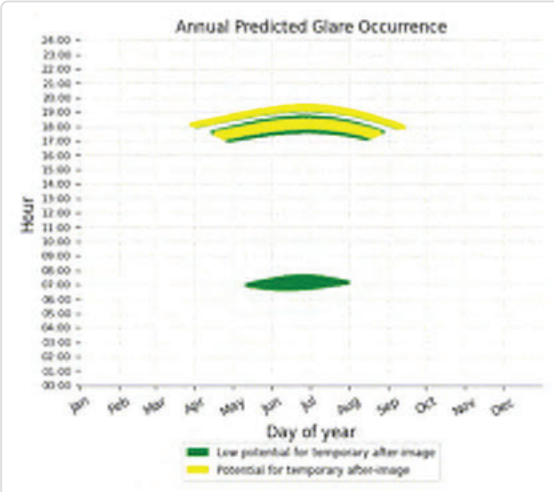
PV: CS2 array area east potential temporary after-image

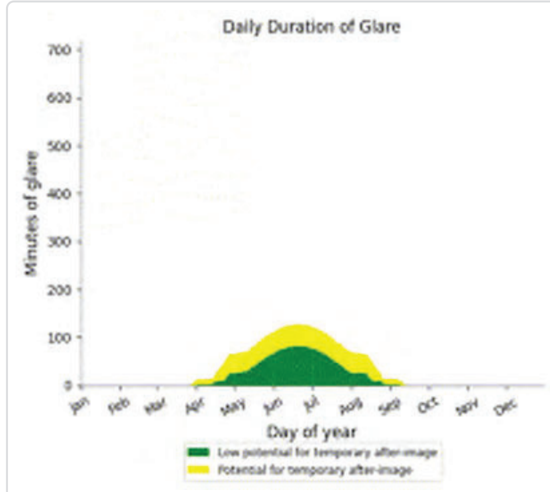
Receptor results ordered by category of glare

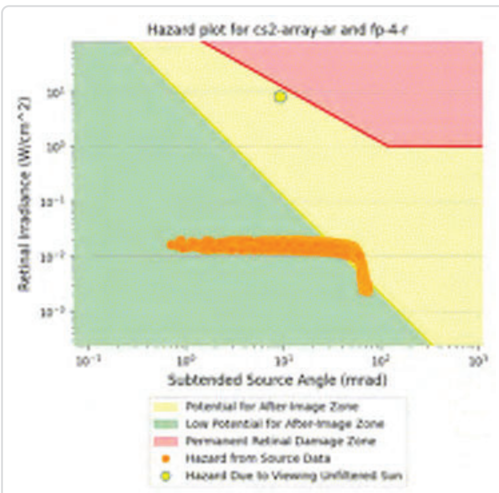
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP 4_Rwy 33	6,042	100.7	5,794	96.6
FP 2_Rwy 27	1,347	22.4	0	0.0
FP 1_Rwy 09	0	0.0	0	0.0
FP 3_Rwy 15	0	0.0	0	0.0
FP 5_Rwy 18	0	0.0	0	0.0
FP 6_Rwy 36	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

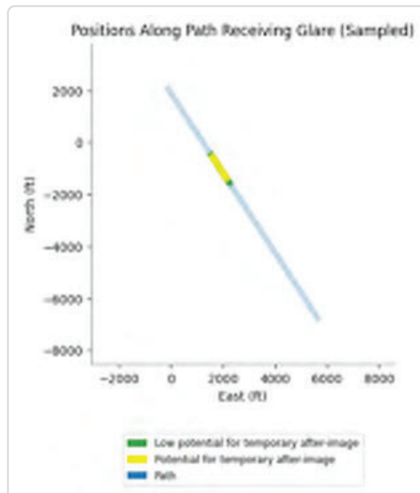
CS2 array area east and FP: FP 4_Rwy 33

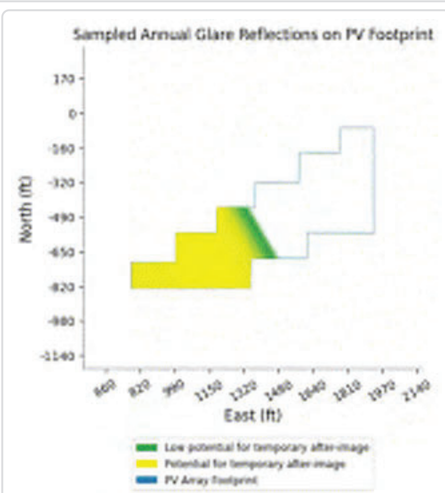
Yellow glare: 5,794 min.
Green glare: 6,042 min.

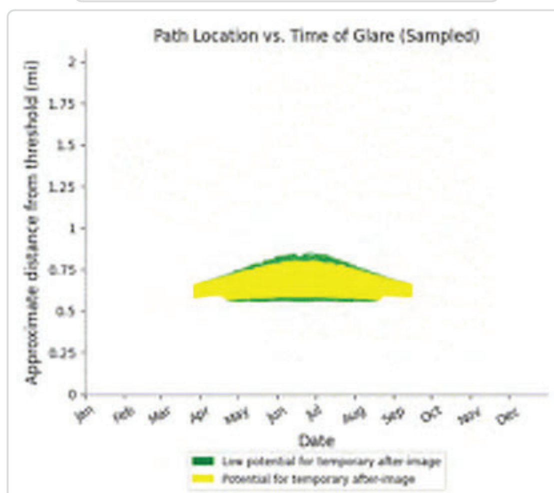






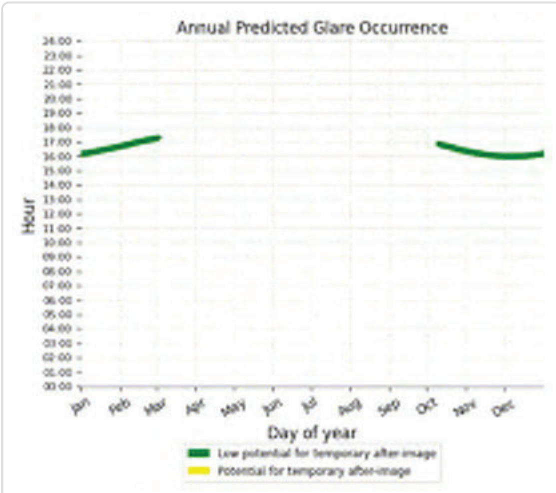


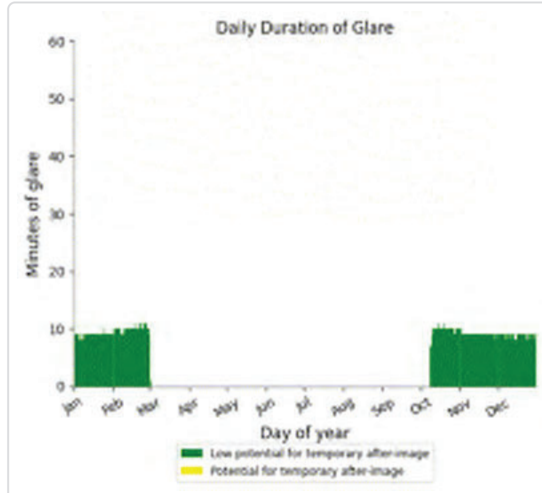


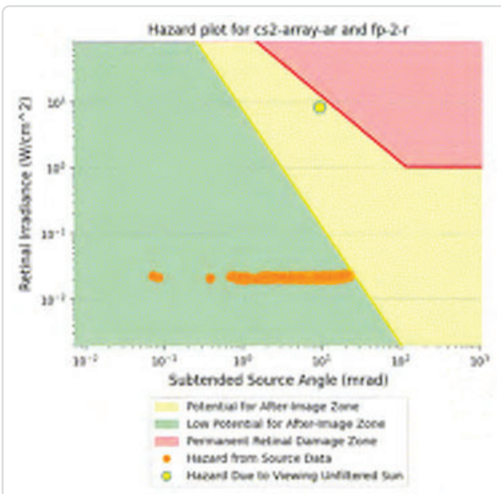


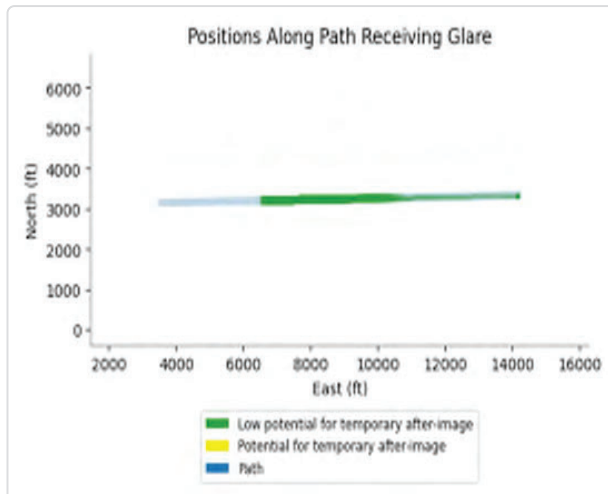
CS2 array area east and FP: FP 2_Rwy 27

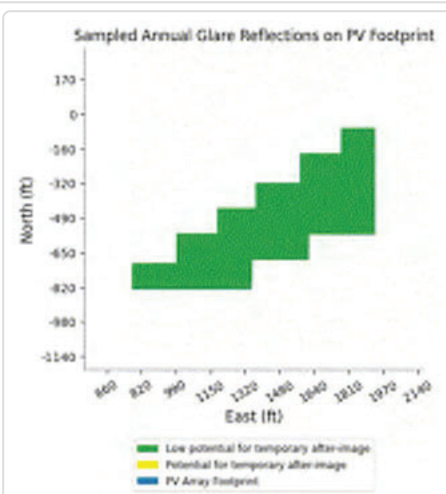
Yellow glare: none
Green glare: 1,347 min.

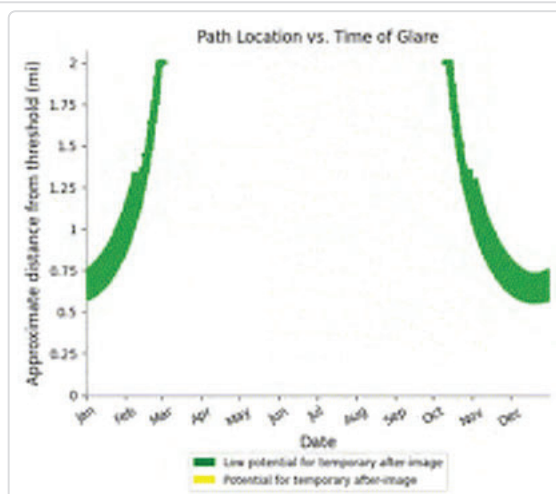












CS2 array area east and FP: FP 1_Rwy 09

No glare found

CS2 array area east and FP: FP 3_Rwy 15

No glare found

CS2 array area east and FP: FP 5_Rwy 18

No glare found

CS2 array area east and FP: FP 6_Rwy 36

No glare found

CS2 array area east and 1-ATCT

No glare found

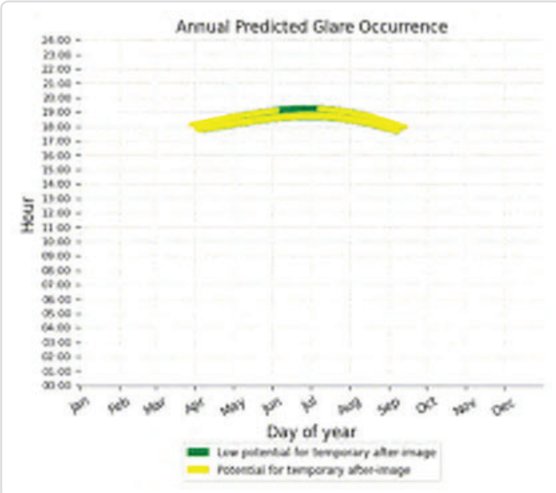
PV: CS2 array area west potential temporary after-image

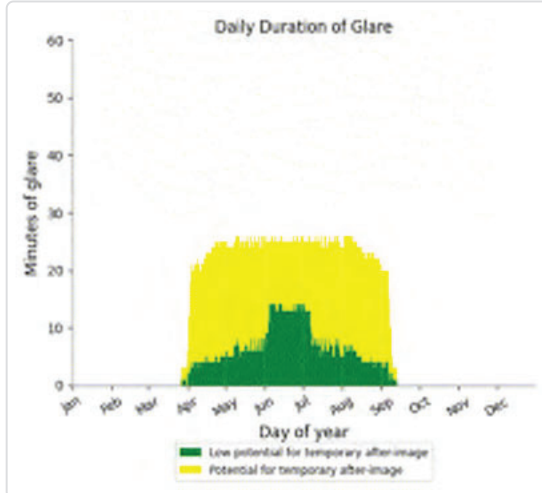
Receptor results ordered by category of glare

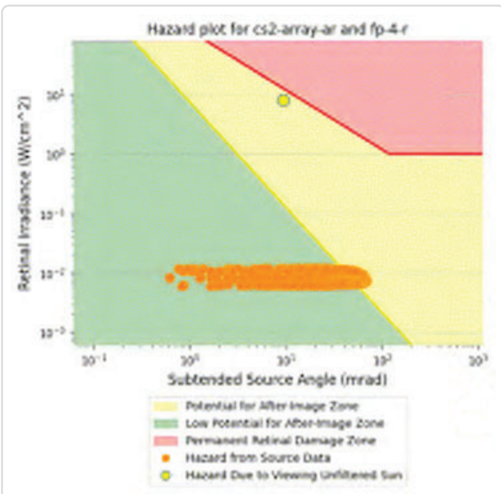
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FP 4_Rwy 33	1,150	19.2	2,725	45.4
FP 2_Rwy 27	412	6.9	0	0.0
FP 1_Rwy 09	0	0.0	0	0.0
FP 3_Rwy 15	0	0.0	0	0.0
FP 5_Rwy 18	0	0.0	0	0.0
FP 6_Rwy 36	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

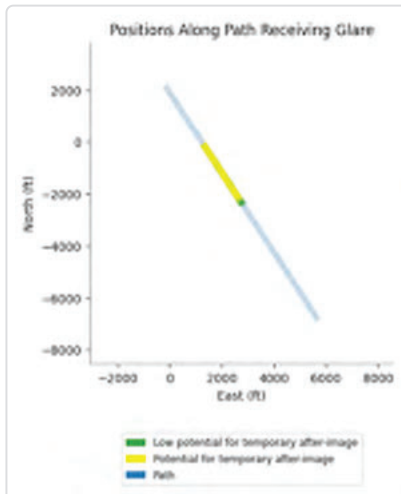
CS2 array area west and FP: FP 4_Rwy 33

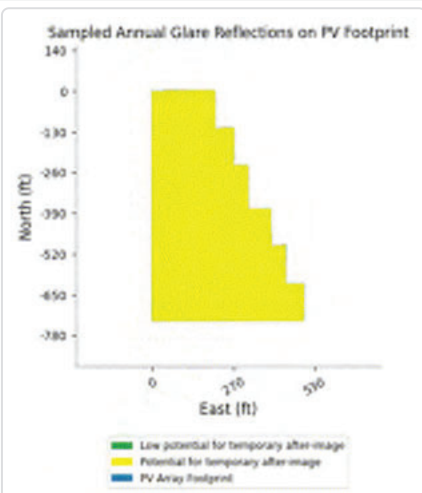
Yellow glare: 2,725 min.
Green glare: 1,150 min.

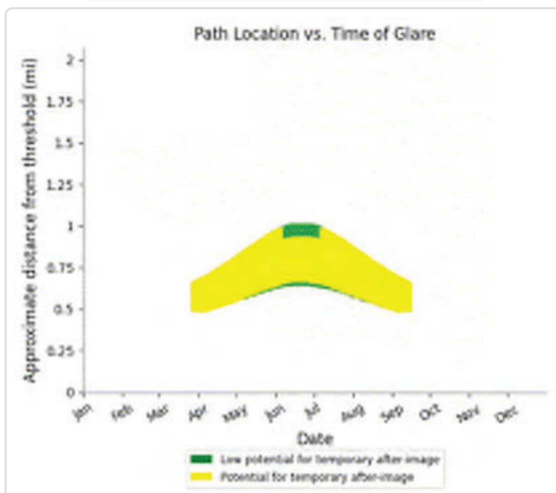






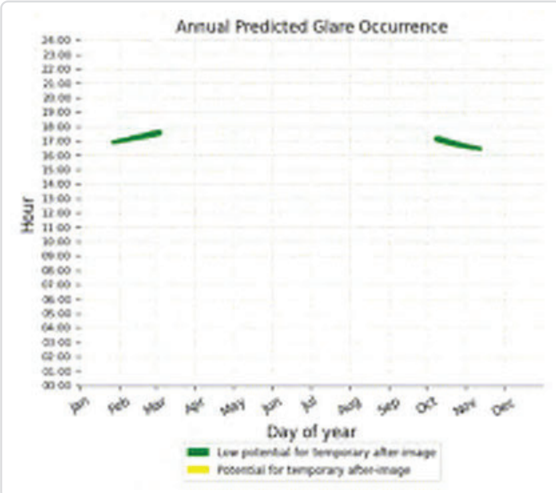


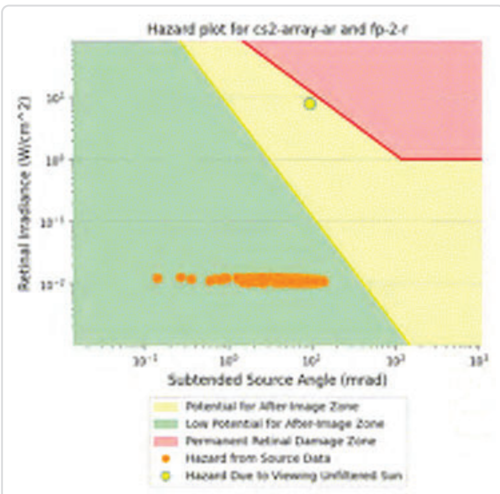


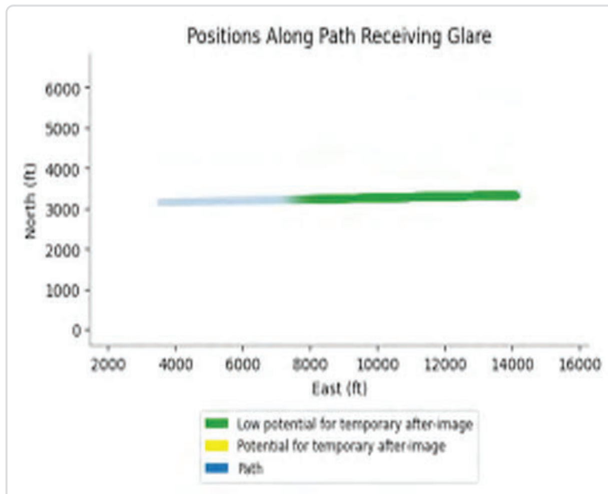


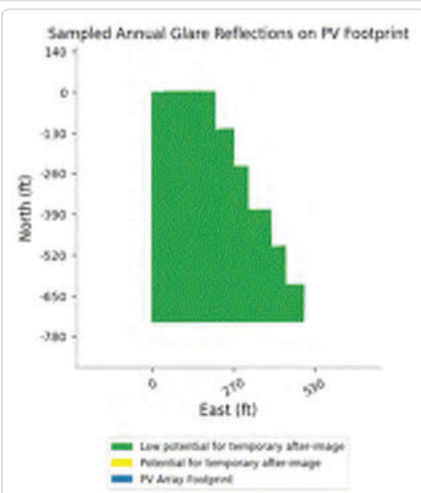
CS2 array area west and FP: FP 2_Rwy 27

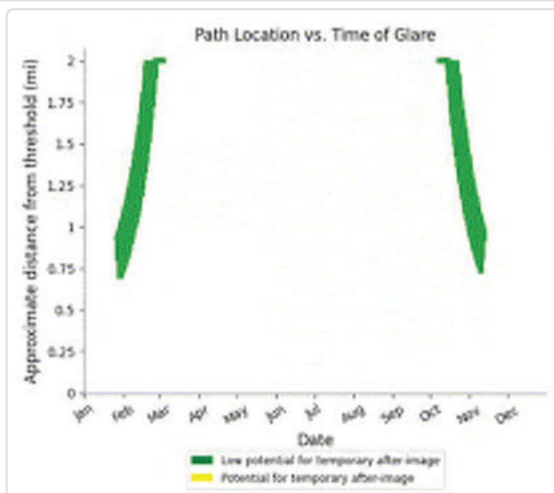
Yellow glare: none
Green glare: 412 min.











CS2 array area west and FP: FP 1_Rwy 09

No glare found

CS2 array area west and FP: FP 3_Rwy 15

No glare found

CS2 array area west and FP: FP 5_Rwy 18

No glare found

CS2 array area west and FP: FP 6_Rwy 36

No glare found

CS2 array area west 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