

September 16, 2013

GILDRED BUILDING COMPANIES

Ocotillo Wells Solar Project *Draft Glare Study Executive Summary*

PROJECT NUMBER:

131599

PROJECT CONTACT:

Jason Pfaff

EMAIL:

jason.pfaff@powereng.com

PHONE:

509-758-6029



*Ocotillo Wells Solar Project
Draft Glare Study Executive Summary*

PREPARED FOR: GILDRED BUILDING COMPANIES

PREPARED BY: POWER ENGINEERS

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
2.0	SENSITIVE VISUAL RESOURCES	1
3.0	METHODS	5
4.0	GLARE EVALUATION	6
5.0	RESULTS	6
6.0	CONCLUSION.....	7

TABLES:

TABLE 1	TOTAL MINUTES OF GLARE/DAY	6
---------	----------------------------------	---

FIGURES:

FIGURE 1A	KEY OBSERVATION POINTS A - D	2
FIGURE 1B	KEY OBSERVATION POINTS 1 - 16	3
FIGURE 2	SOLAR TECHNOLOGIES	4

1.0 INTRODUCTION

POWER Engineers, Inc. (POWER) has prepared three separate glare technology studies for Gildred Building Companies' Ocotillo Wells Solar Project (Project) located in northeastern San Diego County, just east of the community of Ocotillo Wells, California. This executive summary provides an overview of each technology and the potential for glare to sensitive off-site viewers. Detailed descriptions of each technology, analysis methods and results are located in each glare report.

Purpose of the Study

Fixed photovoltaic (PV), single axis tracker PV, and dual axis concentrating photovoltaic (CPV) systems were analyzed to determine the following:

- Identify Key Observation Points/Sensitive Viewers (KOPs) associated with the Ocotillo Wells Project (see Figure 1).
- Document how long glare will it occur, where will it occur, and when will it occur.
- Provide description of glare intensity and comparisons to other reflective surfaces (see individual technology reports).

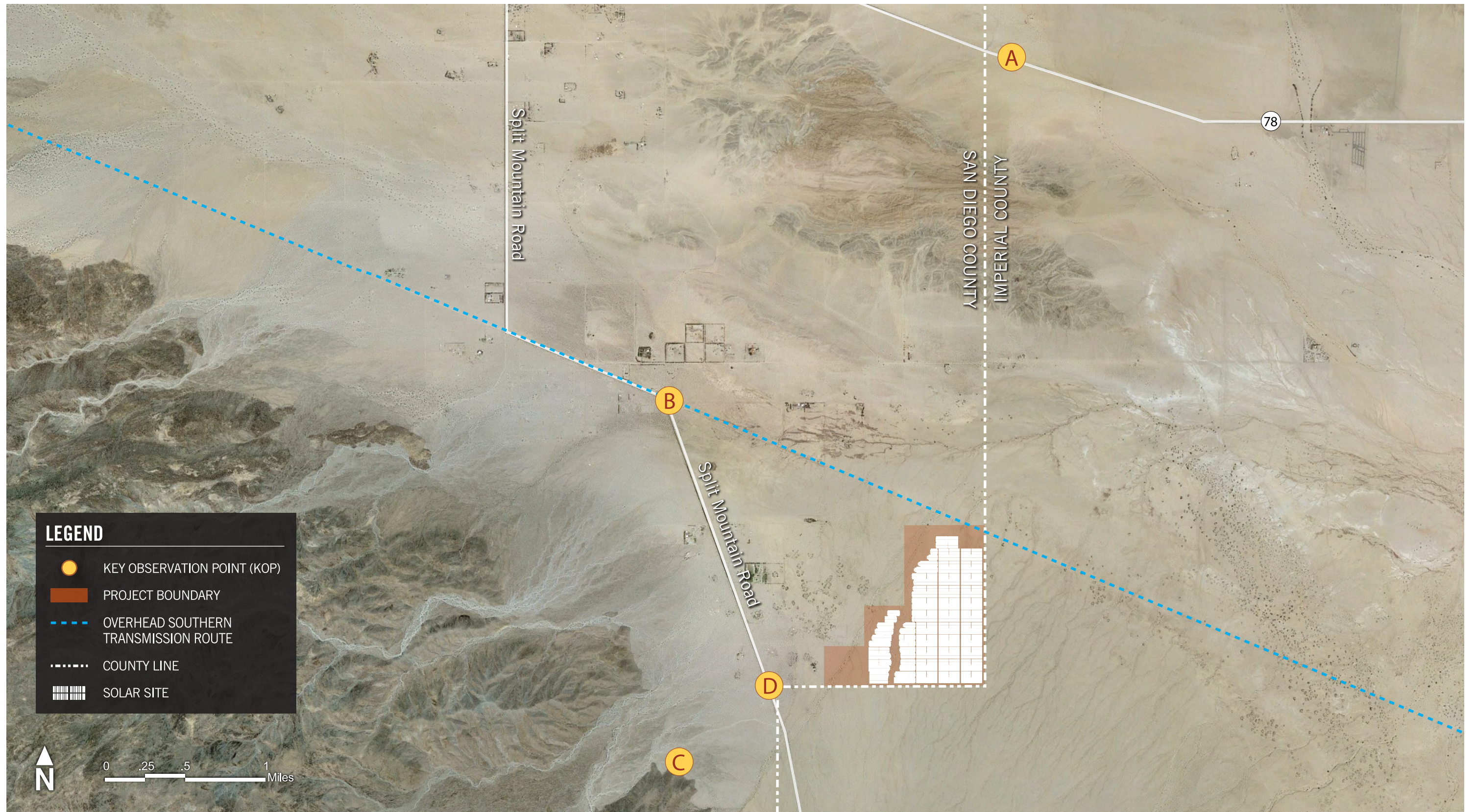
Description of Solar Technology Studied

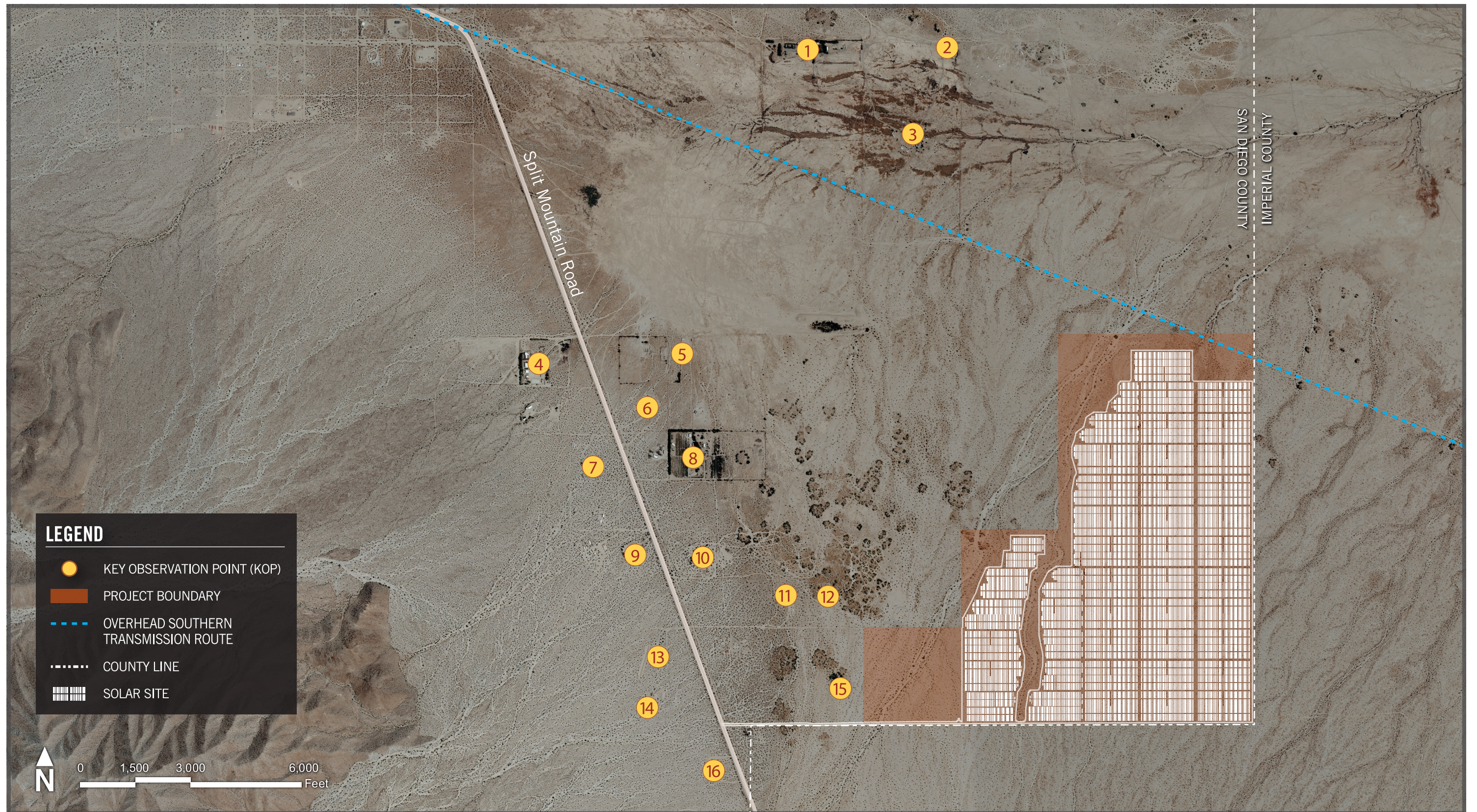
POWER reviewed three solar technologies and its potential to produce glare to KOPs (described below):

- **Fixed Panel PV** – Fixed panel PV systems maintain a fixed south facing angle to maximize collection of the sun's energy. The sun moves east to west around the fixed panel.
- **Single Axis Solar Trackers** - Single axis solar trackers are designed to maximize the efficiency of solar operations. Single axis trackers rotate around a fixed axis, allowing PV panels to track the sun's east/west position throughout the day.
- **Dual Axis Concentrating Photovoltaic Panel** – CPV modules are designed to absorb solar energy to produce electricity. Unlike a standard PV module, CPV modules use a Fresnel lens to concentrate large amounts of sunlight onto a solar collector or solar cell in order to produce electricity. CPV modules are mounted to a two-axis solar tracker that allows the module to track the sun and remain in focus with the sun throughout the day.

2.0 SENSITIVE VISUAL RESOURCES

Solar operations were studied from four public KOPs (KOPs A-D, see Figure 1A) and 16 residential locations (KOPs 1-16, see Figure 1B). Public KOPs were provided by Gildred Building Companies. Residential KOPs include residential structures within 1.5 miles of the Project Site. Each KOP is described below:





Fixed Panel PV



Single - Axis Solar Tracker



CPV Module



- **KOP A** – View from State Highway 78 approximately three miles north of the proposed technology. Viewers from this location would mainly consist of vehicles traveling along State Route 78.
- **KOP B** – View from Split Mountain Road adjacent to the existing San Felipe Substation approximately 1.85 miles northwest of the proposed technology. Viewers from this location would mainly consist of vehicles traveling along Split Mountain Road.
- **KOP C** – View from Anza-Borrego Desert State Park approximately 1.25 miles southwest of the proposed technology. Viewers from this location would mainly consist of vehicles and visitors traveling within the State Park, utilizing trails or other recreational facilities.
- **KOP D** – View from Split Mountain Road to the Project site located approximately 0.3 mile west of the proposed technology. Viewers from this location would mainly consist of vehicles traveling along Split Mountain Road.
- **KOPs 1-16** – Residential locations, within 1.5 miles of the proposed technology. Residences beyond 1.5 miles were not included because no glare is possible due to minimal glare angles from the resulting technology.
- **Ocotillo Wells Airport** - Impacts to the Ocotillo Airport operations were considered but eliminated from this study due to orientation and distance from the proposed technology.

3.0 METHODS

In order to characterize glare behavior, POWER created a 3D representation of the site, the sun, and the solar equipment. The 3D models allowed analysts to accurately determine when and where glare may be visible to sensitive viewers. Specifically, the 3D Model incorporated the following:

- **3D Terrain Models** - POWER acquired five foot contour data from the National Elevation Dataset (NED) and aerial imagery from the National Agriculture Imagery Program (NAIP) for the use of 3D structure placement.
- **Solar Sun System** – The 3D computer simulations incorporated an accurate, solar algorithm based on the latitude and longitude of the actual Project. All calculations were performed using 3D software designed for calculating and animating solar cycles. Sun calculations and results were based on hours of operational daylight and solar clocks for spring, summer, winter and fall.
- **3D Solar Equipment**: POWER developed 3D models of the solar equipment. Equipment spacing, layout, and spot elevation used were provided by The Gildred Companies. Additional computer aided design (CAD) information collected from the manufacturer included panel design, panel height, panel orientation, and tracking behavior. The general behavior of each technology is described in the individual reports.

4.0 GLARE EVALUATION

The occurrence of glare was studied by performing a 3D geometric analysis, which takes into account the position of the sun in relation to the angle of the solar modules to determine the path of glare. The computer simulation also included movement of the solar modules (see individual reports for specific analysis methods). Once all the conditions were simulated in a 3D computer program, visual analysts were able to determine if, when, and where glare may cross into the KOPs' vision. A visual analyst recorded the occurrence of glare in a series of charts (refer to individual reports for specific findings).

5.0 RESULTS

Glare results from all technologies analyzed are minimal. The only technology with the potential to produce glare to offsite KOPs is fixed PV technology. This technology does not track the sun and results in brief glare occurrences in the morning when the sun is lowest in the sky relative to the south facing panel angle. Potential glare would occur for approximately less than 15 minutes around the Spring and Fall Equinox and Summer Solstice (Table 1- see also individual solar technology reports for specific times). During the early mornings and late evenings, the angle of incidence will be high. The intensity of glare will be similar to viewing a sun setting over a body of water. No glare will be visible to offsite viewers from CPV or single axis tracker technology.

Table 1 describes the total amount of time each KOP may experience glare relative to the technology studied. Please refer to the individual reports for specific times of day glare may occur.

TABLE 1 TOTAL MINUTES OF GLARE/DAY

KEY OBSERVATION POINT (Refer to Figure 1 for location)	FIXED PV				SINGLE AXIS				CPV			
	Spring	Summer	Winter	Fall	Spring	Summer	Winter	Fall	Spring	Summer	Winter	Fall
KOP A – State Hwy 78	-	-	-	-	-	-	-	-	-	-	-	-
KOP B – Split Mt. Rd./San Felipe Substation	-	-	-	-	-	-	-	-	-	-	-	-
KOP C – Anza Desert State Park	-	15	-	-	-	-	-	-	-	-	-	-
KOP D – Split Mt. Rd	-	15	-	-	-	-	-	-	-	-	-	-
KOP 1 - Residence	-	-	-	-	-	-	-	-	-	-	-	-
KOP 2 – Residence	-	-	-	-	-	-	-	-	-	-	-	-
KOP 3 – Residence	-	-	-	-	-	-	-	-	-	-	-	-
KOP 4 – Residence	15	-	15	-	-	-	-	-	-	-	-	-
KOP 5 – Residence	15	-	15	-	-	-	-	-	-	-	-	-
KOP 6 – Residence	15	-	15	-	-	-	-	-	-	-	-	-
KOP 7 – Residence	15	-	15	-	-	-	-	-	-	-	-	-
KOP 8 – Residence	15	-	15	-	-	-	-	-	-	-	-	-
KOP 9 – Residence	15	-	15	-	-	-	-	-	-	-	-	-
KOP 10 – Residence	15	15	15	-	-	-	-	-	-	-	-	-
KOP 11 – Residence	15	15	15	-	-	-	-	-	-	-	-	-
KOP 12 – Residence	15	15	15	-	-	-	-	-	-	-	-	-
KOP 13 – Residence	15	15	15	-	-	-	-	-	-	-	-	-
KOP 14 – Residence	15	15	15	-	-	-	-	-	-	-	-	-
KOP 15 – Residence	15	15	15	-	-	-	-	-	-	-	-	-
KOP 16 – Residence	-	15	-	-	-	-	-	-	-	-	-	-

6.0 CONCLUSION

It is POWER's professional opinion that glare resulting from the proposed solar operations near the Ocotillo Wells Solar Project will have a low overall impact to nearby sensitive viewers for the following reasons:

- The Fixed PV system is the only technology with the potential to reflect glare to KOPs studied.
- The Fixed PV glare analysis reported a low occurrence of potential glare from proposed solar operations for a period of approximately 15 minutes in the early morning hours.
- Viewers of potential glare would be at least 1,500 feet away from the proposed solar technology.