FILE COPY

MAR 08 2012

NEIL ABERCROMBIE
GOVERNOR
STATE OF HAWAI'I

ALBERT "ALAPAKI" NAHALE-A
CHAIRMAN
HAWAIIAN HOMES COMMISSION

MICHELLE K. KAUHANE
DEPUTY TO THE CHAIRMAN

M. WAIALEALE SARSONA
EXECUTIVE ASSISTANT

STATE OF HAWAI'I
DEPARTMENT OF HAWAIIAN HOME LANDS

P.O. BOX 1879
HONOLULU, HAWAI'I 96805

RECEIVED
'12 FEB 27 P12:54
OFC. OF ENVIRONMENTAL QUALITY CONTROL

February 24, 2012

Mr. Gary Hooser, Director
Office of Environmental Quality Control
235 South Beretania St., Suite 702
Honolulu HI 96813

Aloha Mr. Hooser:

Subject: Draft Environmental Assessment (DEA) Prepared by North Shore Consultants, LLC, for Kalaeloa Home Lands Solar, Island of Oahu

The Department of Hawaiian Home Lands, State of Hawaii, has reviewed the draft environmental assessment for the subject project, and anticipates a Finding of No Significant Impact (FONSI) determination. Please publish notice of availability for this project in the next available edition of the *Environmental Notice*. We have enclosed the following:

- One hard copy of the Draft EA
- A CD containing the PDF file for the EA, the OEQC transmittal documents, including publication form, distribution list, and project summary

Please contact Mr. David M. Robichaux, Project Manager, North Shore Consultants, LLC, at (808) 637-8030, if you have any questions.

Me ke aloha,

Linda Chinn, Administrator
Land Management Division

Enclosures: One (1) copy of Draft EA
OEQC Publication Form and EA Distribution List
One (1) CD of Draft EA

Project Name: Kalaeloa Home Lands Solar, LLC 5.0 MW Photovoltaic Park, Kalaeloa District, Kapolei, Hawai`i

Publication Form
The Environmental Notice
Office of Environmental Quality Control

Applicable Law:	HRS 343
Type of Document:	Draft Environmental Assessment
Island:	Oahu
District:	Kalaeloa
TMK:	(1) 9-1-013:029
Permits Required:	DHHL Lease**,** NPDES Form C, Building/Grading, FAA Obstruction Evaluation, Airport Area Analysis

Applicant

Kalaeloa Home Lands Solar, LLC
Jody Allione, Project Development Manager
jodyallione39@gmail.com (808) 347-3174

Approving Agency

Hawaiian Homes Commission
Department of Hawaiian Home Lands
Land Management Division
Attention: Linda Chinn, Administrator
PO Box 1879
Honolulu, HI 96805
Linda.Chinn@hawaii.gov (808) 620-9500

Consultant:

North Shore Consultants
David M. Robichaux, Principal
PO Box 790
Haleiwa, HI 96712
robichaud001@hawaii.rr.com (808) 368-5352

Project Summary:

The Kalaeloa Home Lands Solar Park will result in 5 MW of renewable power to be provided to the public utility grid. Temporary noise and dust will be generated during construction; however these are expected to be limited in duration and consistent with the surrounding land use. The PV Park is within the controlled activity area for Runway 11-29. Fences at the end of the airport property now serve as arresting gear for emergency overruns. Upon completion of the proposed action the area will contain truss structures that will serve a similar function. Aircraft operations at the Kalaeloa Airport are not expected to be significantly impacted from glint and glare according to a study commissioned for this project. No secondary or cumulative impacts were identified despite the proposed addition of a second PV Park in the area. Pending receipt of comments from agencies and interested parties, DHHL anticipates a finding of no significant impact.

Draft Environmental Assessment

Kalaeloa Home Lands Solar, LLC
5.0 MW Photovoltaic Park,
Kalaeloa, Oahu, Hawaii
TMK # 9-1-013:029

Prepared for

State of Hawaii
Department of Hawaiian Home Lands

February 2012

Draft Environmental Assessment

Kalaeloa Home Lands Solar, LLC
5.0 MW Photovoltaic Park,
Kalaeloa, Oahu, Hawaii TMK # 9-1-013:029

Approving Agency

State of Hawaii Department of Hawaiian Home Lands
Hale Kalanianaole PO Box 1875
Kapolei, Hawaii 96707
Mr. Todd Gray, Project Manager

Proponent

KALAELOA HOME LANDS LLC

Corinne Onetto, Project Director
Jody Allione, Project Development Manager

Prepared by

NORTH SHORE CONSULTANTS, LLC
PO Box 790
Haleiwa, HI 96712
Mr. David Robichaux, Project Manager

PROJECT SUMMARY

This Environmental Assessment (EA) has been prepared in accordance with Chapter 343, Hawai`i Revised Statutes (HRS), for the Kalaeloa Home Lands Solar, LLC 5.0 MW photovoltaic park proposed for the 29 acre parcel designated as TMK # 9-1-013:029 in Kapolei, Island of Oahu, Hawaii.

Name: Kalaeloa Home Lands Solar, LLC 5.0 MW DC Photovoltaic Park

Location: Kalaeloa, Kapolei, Oahu, Hawaii

Judicial District: Kapolei

Applicant: Kalaeloa Home Lands Solar, LLC

Approving Agency: Department of Hawaiian Home Lands

Recorded Fee Owner: State of Hawai`i, Department of Department of Hawaiian Home Lands

Tax Map Key: TMK (1) 9-1-013:029

Land Area: 29 acres

Existing Use: Vacant

Proposed Use: Construction of a photovoltaic park to provide renewable energy to the Island's electric grid.

Land Use Designations:
State Land Use: Urban District
General Plan: Military Use
County Zoning: F-1 Military Use
Kalaeloa Master plan Eco-industrial Use
Special Management Area (SMA): Not within the SMA

Major Approvals Required:
Lease agreement with DHHL
FAA Obstruction analysis/ Airport Area Assessment
NPDES construction Stormwater Permit (NOI and Form C)

Contents

1.0 PROJECT LOCATION, PURPOSE AND NEED 1
1.1 Project Location 1
1.2 Purpose and Need 2
1.2.1 Current Generating Capacity on Oahu 4
2.0 PROPOSED ACTION AND ALTERNATIVES CONSIDERED 5
2.1 Proposed Action (Project Description) 5
2.2 Alternative Actions Considered and Rejected 5
2.2.1 Alternative Technologies 10
2.2.2 No Action Alternative 11
2.2.3 Selection of Project Alternative 12
3.0 ENVIRONMENTAL SETTING AND IMPACTS 13
3.1 Physical Environment 13
3.1.1 Geology and Soils 13
3.1.2 Surface Water Quality 13
3.1.3 Groundwater Resources 14
3.1.4 Climate and Air Quality 14
3.1.5 Noise and Odor 15
3.1.6 Scenic Value and View Plane 15
3.1.7 Hazardous Substances 16
3.2 Biological Environment 16
3.2.1 Vegetation 16
3.2.2 Wildlife 16
3.2.3 Special-Status Species 17
3.3 Socioeconomic 17
3.3.1 Social Factors and Community Identity 17
3.3.2 Public Services, Facility, and Utility 17
3.3.3 Roads and Access 19
3.3.4 Archaeological and Historic Resources 19
3.3.5 Cultural Impacts 19
3.3.6 Land Use 21
3.4 Growth-Inducing, Cumulative, and Secondary Impacts 28
3.5 Required Permits and Approvals 29
4.0 CONSISTENCY WITH PLANS, POLICIES, AND REGULATIONS 32
4.1 Federal Policies Supporting Renewable Energy 32
4.2 Hawaii State Policies Supporting Renewable Energy 32
4.3 City and County of Honolulu Policies Supporting Alternative Energy 35
5.0 SUMMARY OF IMPACTS AND MITIGATION MEASURES 36
5.1 Determination of Significance 37
6.0 COMMENTS AND COORDINATION 40
6.1 Agencies and Organizations Contacted 40
6.2 Public Coordination and Individuals Consulted 41
7.0 LIST OF DOCUMENT PREPARERS 42

8.0 Bibliography.....43

Figures

1-1 Location Map …….…..…..1
1-2 Aerial Photograph …….….....2
1-3 Tax Map Key Map …….3
2-1 Site Layout for the Proposed Kalaeloa PV Park…….7
2-2 Photograph of a PV Park near Denver International Airport …….8
2-3 Example of Solar Trackers …….…….....…….……..8
2-4 Potential Transmission Routes to Substations ……..…….…….9
2-5 Map of Solar Radiation on the Island of Oahu …….…….11
3-1 Land Use Plan from the Kalaeloa Master Plan …….…….23
3-2 General Component of Restricted Areas Surrounding Airports…….…….……25
3-3 Diagrammatic representation of the RPZ slope …….……26
3-4 Aerial Photograph of the RPZ at JRF …….……....26
3-5 Relative reflectivity of various surfaces …….28

Tables

1-1 Sources of Electric Generation on Oahu, 2009 …….…4
2-1 Levelized cost for generators for plants starting in 2016 …….….....12
2-2 Lifecycle greenhouse gas emission estimates for electricity generators ……..….12
3-1 Dimensions of the RPZ …….….25
5-1 Summary of Impacts and Mitigation Measures …….…38

Appendices

A. Comments received from Agencies and Interested Parties during preparation of the DEA
B. Letter from USFWS regarding Threatened and Endangered Species
C. Reflectivity Study for JRF
D. FAA Determination Regarding Hazards to Aircraft Operations

1.0 PROJECT LOCATION, PURPOSE AND NEED

1.1 Project Location

Kalaeloa Home Lands Solar LLC has leased approximately 29 acres near the southwest corner of the Island of Oahu, City and County of Honolulu, Hawaii (Figure 1-1). The site is immediately west of the John Rogers Field (JRF), which was formerly Barbers Point Naval Air Station before the military installation was closed under the Base Realignment and Closure (BRAC) program in 1999. The parcel, (also called the subject property) is designated Tax Key Map Number 9-1-013:029 and is owned by the Department of Hawaiian Home Lands (DHHL), State of Hawaii. It is located at the west end of Runway 29, the cross-wind runway at JRF.

The subject property is accessed by an extension of Midway Road, within the former Barbers Point Naval Air Station (Figure 1-2). The subject property is shown in Figure 1-3.

The approximate latitude/longitude is:

Latitude (north) 21 ^{o} 18’ 46”

Longitude (west) 158° 05’ 07”

Figure 1-1: Site location near the southwest corner of Oahu

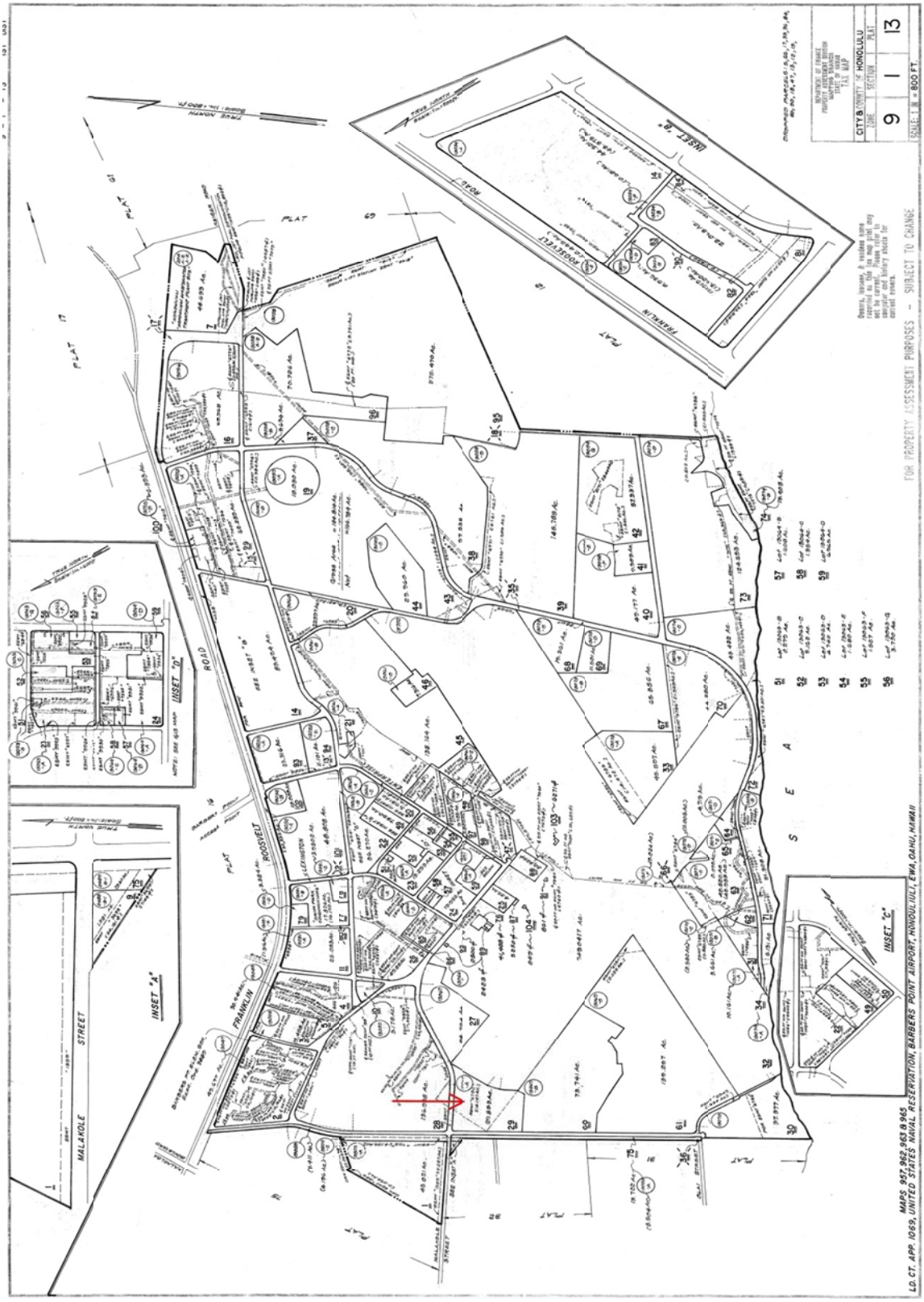
ıe

The purpose of the proposed project is to provide renewable solar electric power to Oahu's electric grid. The proposed action would produce approximately 5.0 MW for sale to Hawaiian Electric Company (HECO). The energy generated would reduce Oahu's dependence on fossil-fuel for power generation by providing electricity to power approximately 1000 homes. This would result in the offset of more than 200,000 tons of emissions over 30 years and eliminate the need of over 16,000 barrels of oil per year. The proposed action would assist the state in reaching the Hawaii Clean Energy Initiative (HCEI) goal of having 70 percent of the State's energy come from renewable sources by 2030.

Reducing the amount of fossil fuels burned for energy generation will improve Hawaii's environment by:

• reducing greenhouse gas emissions;
• reducing dependency on imported fossil fuel and the variations in price and availability associated with geopolitical instabilities; and
• reducing the environmental risks associated with fossil fuel transport and storage.

Figure 1- 3: Tax Map Key Map of the site.



1.2.1 Current Generating Capacity on Oahu

HECO owns and operates 16 power generation units at three stations, Honolulu, Waiau, and Kahe, plus 30 MW of distributed generation. All units are fueled by low-sulfur fuel oil (LSFO), except for two combustion turbines (CT) at Waiau that are fueled by diesel. HECO does not currently operate any renewable energy units. Three large independent power producers (IPPs) furnish firm capacity renewable energy power to the HECO grid. H-POWER provides power for HECO from its 46 MW waste-to-energy facility, and AES-Hawaii (AES) provides power from its 180 MW firm capacity plant using coal and solid waste. Kalaeloa Partners, L.P., the other IPP to HECO, provides electricity from a 208-MW firm capacity facility using fuel oil. In addition to firm capacity IPPs, HECO also purchases electricity from other IPPs on a non-firm, as available basis. Those include energy from Tesoro Hawaii, Chevron, and from a 20 MW wind project located at Kahuku. Table 1 shows Oahu's sources of electricity supplies as of September 2009.

Table 1-1: Sources of Electric Generation on Oahu, 2009

Fuel Type	**MW-Hour Generation/Year**	**Percent**
Diesel or Low Sulfur Fuel Oil	5,949,157	77
Coal	1,448,811	19
Solid Waste	360,323	5
Biofuel	3307	0.04
Wind, Solar, Biomass	0	0
Total	7,761,598	100
Total Renewable	**363,630**	**5**

Source: Department of Business, Economic Development, and Tourism (2010).

Actual generation of energy from renewable and dispatchable sources varies according to availability and need. The most recent data on Oahu's sources of alternative and traditional energy is in HECO's 2009 Renewable Portfolio Standard Report (HECO, 2009). Oahu's Renewable Portfolio Standard (RPS) includes savings from renewable displacement technologies including rooftop PV (15,668 MWh/Yr.) and solar water heating (86,967 MWh/Yr.); The RPS also includes electrical savings from energy efficient technologies such as energy star appliances. Energy efficient technologies contributed 604,348 MWh/Yr. from pre-2009 participants and 46,930 MWh/Yr. from new purchases. The total RPS on Oahu as of 2009 is 15.1% after inclusion of these other energy savings considerations.

Act 95 requires HECO to reach a RPS standard of 15% by 2015. This standard is based on all of the Hawaiian Electric Companies. Due to higher alternative percentages on Maui and The Big Island the overall RPS fraction is 19% as of 2009 (DBEDT, 2010). Data from 2009 is the most recent complete data; however, partial data from March 2011 shows an additional 100 MW from HECO biofuel combustion turbine CT-1 and 30 MW from the Kahuku wind farm (HCEI, 2011). These two

facilities will add roughly 940,000 MWh annually if they are operated continuously. Assuming no other changes, these two facilities increase Oahu's RPS to 28%.

Although both the state and County of Honolulu are in compliance with Act 95 RPS standards, there is considerable room for improvement and we are quite a long way from the Hawaii Clean Energy Initiative goal of 70% by 2030.

2.0 PROPOSED ACTION AND ALTERNATIVES CONSIDERED

2.1 Proposed Action (Project Description)

AES Solar Power, LLC has proposed to build a 5.0 MW solar power photovoltaic system on approximately 29 acres. . The photovoltaic system will be a series of ground supported flat panels with three central control/cabinet enclosures and transformers. Solar panels will be mounted on tracking mechanisms which allow the panels to follow the sun in order to maximize power output. All-weather gravel maintenance roads will be constructed around the site perimeter and between rows of solar panels. The site is laid out to maximize the number of installed solar panels (Figure 2-1). Each panel is approximately 39 inches wide and 66 inches long, dark in color, and stand between 6 and 10 feet above ground level. Approximately 17,000 panels will be required to produce an average of 5.0 MW of peak power. The total annual output from the facility will be approximately 8,400 MWh/Yr. The maximum height varies throughout the day as panels move to maintain the best sun angle. Similar tracker-mounted panels are shown in Figure 2-2 and 2-3.

The facility will be unmanned except for regular maintenance activities such as mowing, landscaping or panel cleaning. Electrical maintenance will be conducted as needed. No employee housing or other habitable structures will be constructed on the site. The installation does not emit noise, dust, or odors during operation. Electrical power is produced during daylight hours; however, in the traditional sense, the hours of operation cannot be determined without instrumentation.

Alternating Current (AC) electric power will be transmitted to one of the nearby substations located to the north of the site (Figure 2-4). Details on transmission and connectivity are dependent upon completion of HECO's interconnection study; but it is likely that transmission will be by underground conduit to an new substation that will be utilized by other alternative energy providers as well as the proponent.

2.2 Alternative Actions Considered and Rejected

Alternatives to the proposed action that were considered as part of the planning process include alternative locations and alternative technologies.

Fixed tilt PV panels were considered at the same location. The trackers are more efficient and produce more daily output. The capability of altering the angle of the tilt in the few instances of potential glare is an important quality at the proposed location.

Figure 2-1: Site layout: Alternative layouts ranging between 3.5 MW AC and 5.0 MW AC are being considered subject to final selection of the EPC contractor. The base configuration for each option is illustrated below.

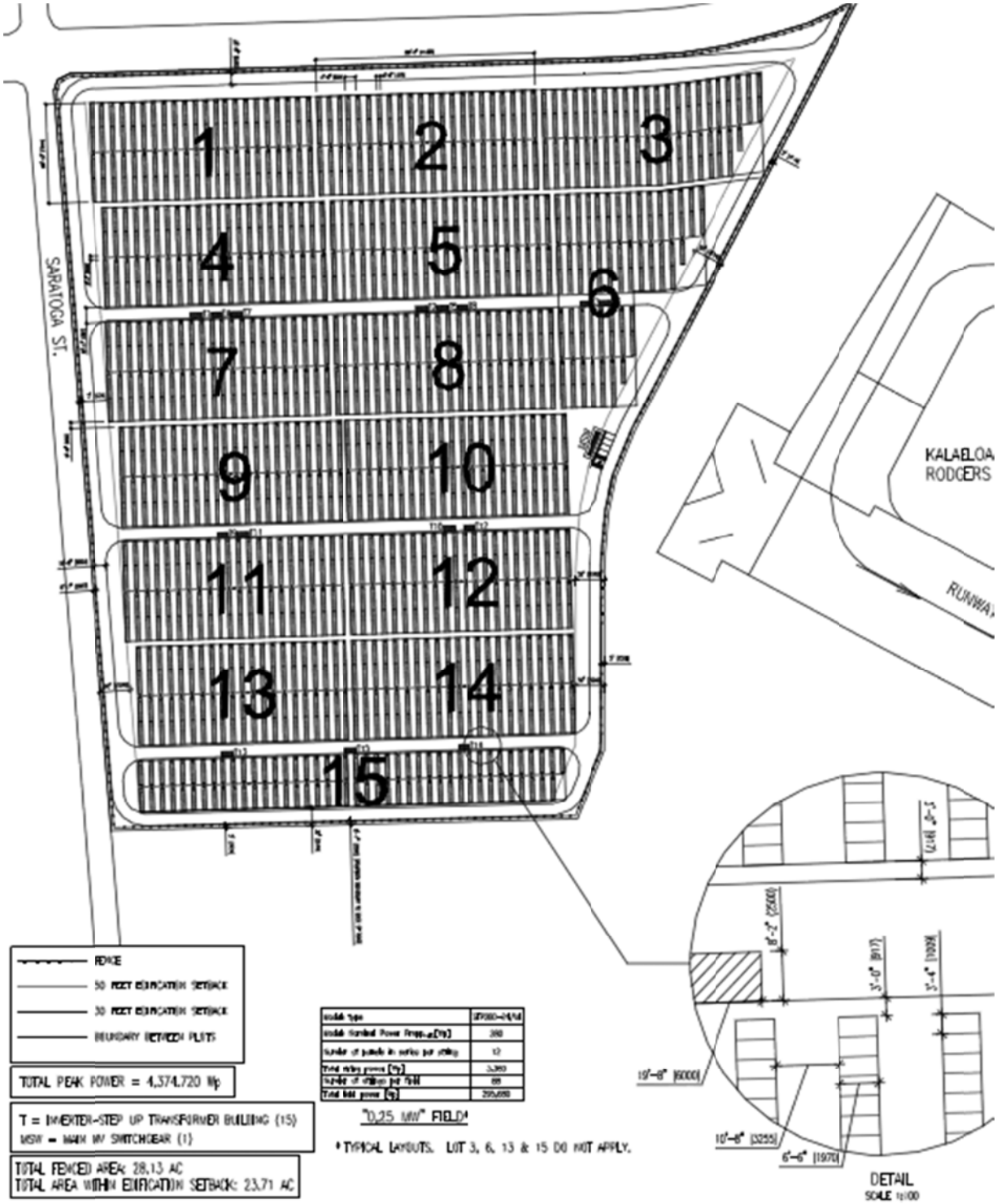
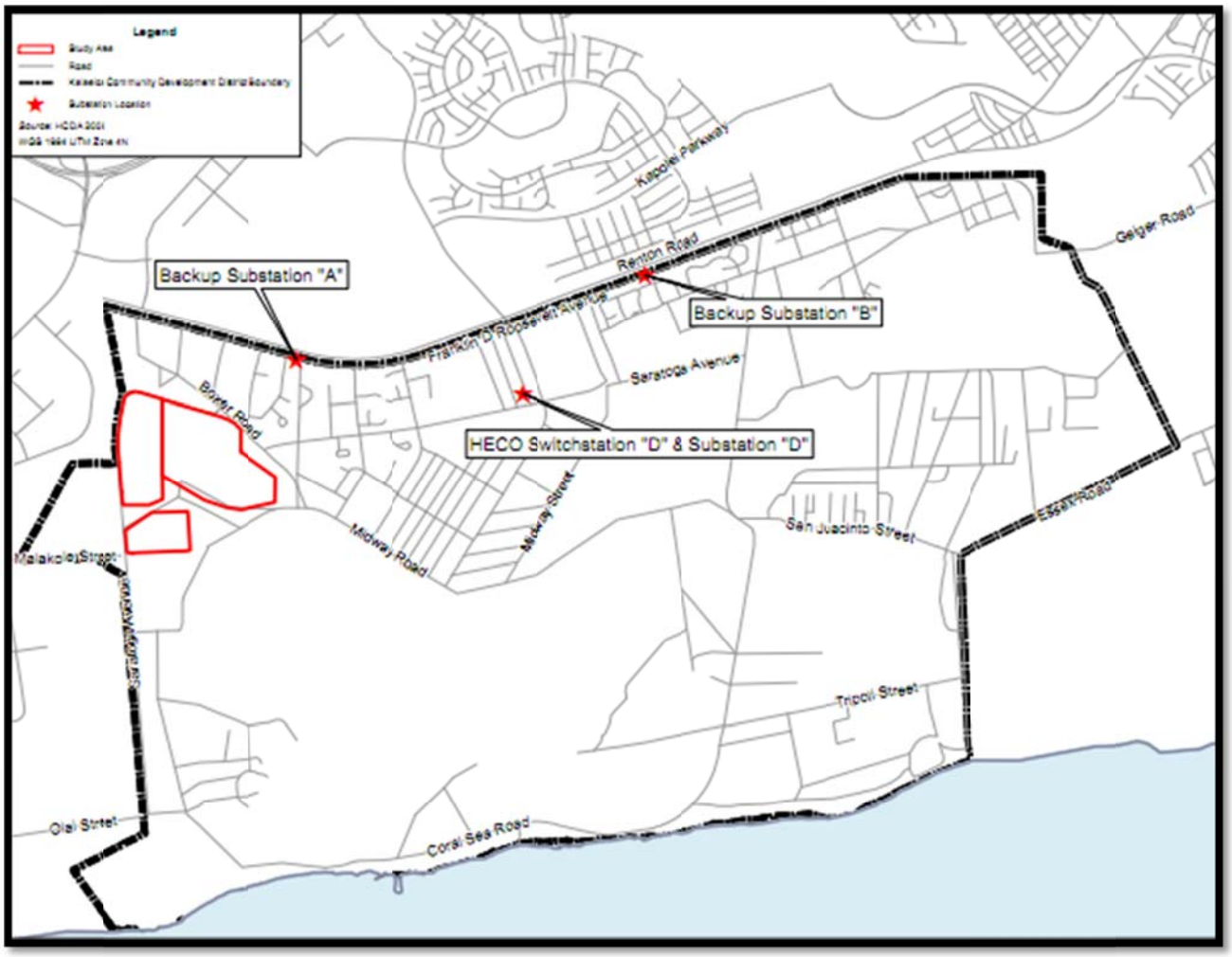


Figure 2-2: Photograph of a PV Park at Denver International Airport

Figure 2-3: An example of Solar Trackers

Figure 2-4: Potential location of Substations



2.2.1 Alternative Locations

Hawaii's energy costs are currently the highest in the United States (HCEI 2010). These rates have made alternative energy production profitable in Hawaii, and profitable enough to attract almost all of the national and international alternative energy providers to come to the State. High islands located in low temperate latitudes create a complex climatic condition that can change within a matter of a few miles. Solar photovoltaic energy production is directly related to the amount of sunlight received over a long term basis. Solar irradiation is variable throughout the annual cycle in almost all locations, and there is quite a wide variation in the amount of solar energy based on the angle of the sun and the amount of cloud cover characteristic to a particular site. Figure 7 shows a map of solar irradiation for the Island of Oahu. As a rule solar providers are restricted to areas with solar irradiation above 400 kW/m^2, and prefer those areas that are within the 450 to 500 watt range (Figure 7). Competition for suitable sites between alternative energy providers is brisk.

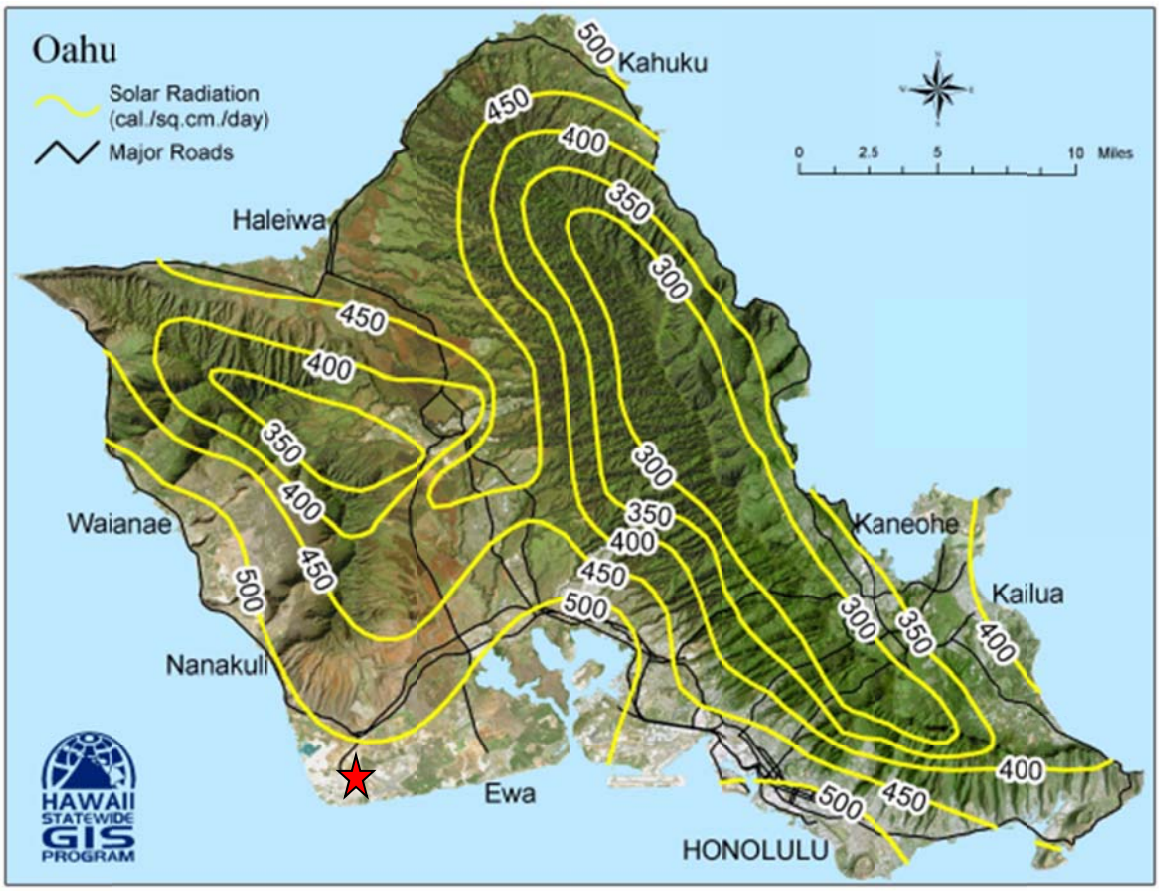


Figure 2-5: Map of solar radiation on the Island of Oahu

Alternative sites considered include The Coral Sea Road Coral Pit located within the retained military area of Kalaeloa. This land is within the 450 Watt/m2 irradiance area and is currently unused. This site was rejected due to the steep sides of the pit, which would block the sun during morning and evening hours, and because it has restricted use due to soil and groundwater contaminants which were discovered upon closure of the Barbers Point Naval Air Station.

The second alternative site considered was immediately adjacent to the north of the subject parcel. TMK # 9-1-013: 028 is also a vacant parcel owned by DHHL and within a favorable solar irradiation area. AES Solar was preempted from further consideration of the site because it was leased to a cooperative consisting of a solar PV and a solar thermal provider. The second alternative site is rejected because it is unavailable.

2.2.2 Alternative Technologies

Choosing which alternative generating technology to use in a specific location is quite difficult using generalizations because not all technologies are appropriate in every location and the cost-benefits analysis suffer from the inability to define the limits of the project impacts. Several comparative measures are useful in assessing the advantages of various technologies. Levelized energy cost (LEC) is a measure often used for financial analysis and project planning. LEC is the price at which electricity must be generated from a specific source to break even. It is an economic assessment of the cost of the energy-generating system including all the costs over its lifetime: initial investment, operations and maintenance, cost of fuel, cost of money, and is very useful in calculating the costs of generation from different sources.

Typically LECs are calculated over different lifetimes depending on the useful life expectancy for a particular technology, and are given in the units of currency per megawatt-hour. For example, Table 2 shows the anticipated cost of electricity during 2016 published from the US Energy Information Administration (US EIA, 2010).

Table 2-1: Levelized cost for various energy generators estimated for plants starting service in 2016. Costs are reported in dollars per Megawatt hour.

Plant Type	**Total System Levelized costs ($/MWh)**
Conventional Coal	94.8
Natural Gas combustion Turbine	124.0
Advanced Nuclear	114
Wind (on-shore)	97
Geothermal	101
Solar PV	211
Solar Thermal	311
Biomass	112
Hydro	86

Source: US Energy Information Administration Annual Report, December 2010.

LEC does not include lifecycle costs for environmental compliance or secondary costs of infrastructure and environmental degradation; nor does it include current tax incentives or subsidies. Per the information above, solar PV is projected to produce power at around 21 cents per Kilowatt-hour (kWh) in 2016. It is worth noting that diesel electric generation is not common enough to be considered in the Energy Information Administration's Annual Report. Current electric rates on Oahu are in the range of 22 - 23 cents per kWh for residential customers. Although solar PV costs twice that of wind and coal, we suspect that the energy resource on Oahu is significantly better than

the irradiance standard used above. It is also notable that between federal and state tax incentives the capital cost of purchase and installation for solar PV is reduced by 40%. Capital costs represent the majority of the LEC for solar PV.

Another popular attribute of a prospective generating system is the greenhouse gas footprint. The lifecycle greenhouse gas emissions include those generated during manufacture, transportation, assembly, operation and decommissioning (Table 2-2).

Table 2-2: Lifecycle greenhouse gas emission estimates for electricity generators

Technology	Description	Estimate (g CO2/kWh)
Wind	2.5 MW offshore	9
Hydroelectric	3.1 MW reservoir	10
Wind	1.5 MW onshore	10
Biogas	anaerobic digestion	11
Hydroelectric	300 kW run-of-river	13
Solar thermal	80 MW parabolic trough	13
Biomass	various	14-35
Solar PV	polycrystalline silicon	32
Geothermal	80 MW hot dry rock	38
Nuclear	various reactor types	66
Natural gas	various combined cycle turbines	443
Diesel	various generator and turbine types	778
Heavy oil	various generator and turbine types	778
Coal	various generator types with scrubbing	960
Coal	various generator types without scrubbing	1050

Source: Sovacool, 2010

Manufacturing apparently pushes solar PV higher than some other alternative technologies; however the anticipated greenhouse gas emissions are 1 order of magnitude less than any of the traditional sources.

2.2.3 No Action Alternative

Under the No-Action Alternative, the PV solar energy farm would not be constructed. 5.0 MW of renewable energy would not be provided to the public. This energy would be generated by the existing portfolio of generating equipment which is 90% fossil fueled. There would be a lost opportunity to assist in meeting the state's current goal of 70 percent renewable energy. The No Action Alternative does not meet the purpose and need it represents existing conditions. Although the no action alternative is rejected, the existing condition is used throughout this document to comparison to impacts resulting from the existing condition.

2.2.4 Selection of Project Alternative

Two alternative locations were reviewed and rejected for reasons discussed above. Alternative technologies were considered; however, the proponent has expertise in the development of photovoltaic installations. Photovoltaic generation will be part of the mix of alternative energies currently being developed to replace imported fossil fuels. This project will not use a significant fraction of the variable wind/solar capacity for stable grid operation. Finally PV is one of the few appropriate land uses for the proposed location near the end of an airport runway. On this basis the proposed alternative is selected and will be discussed further in this document.

3.0 ENVIRONMENTAL SETTING AND IMPACTS

3.1 Physical Environment

3.1.1 Geology and Soils

Soil in the Kalaeloa area is limited to a thin layer of topsoil and is reddish in color (U.S. Department of Agriculture 1972). The site is covered predominantly by soil categorized as Coral outcrop (10%) and Mamala stony silty clay loam (90%) (USDA 2010). Coral outcrop consists of calcareous sand and coral sand. Mamala stony silty clay loam consists of coral stones in the reddish-brown loam surface, underlain by coral limestone. Run-off is slow, infiltration is rapid, and the erosion rate of Mamala stony silty clay loam is low. Neither of the types of soil found on the proposed site qualifies as Prime Farmland (USDA 2010).

According to "Agricultural Lands of Importance to the State of Hawaii" (ALISH, Hawaii Department of Agriculture, 1977), the project site is not classified as prime or unique agricultural land. The site has not been used for agriculture since before the 1930s and is unsuitable for agriculture due to the paucity of water and undesirable soil conditions. Much of the project site is apparently filled with sand and coral rubble.

3.1.2 Surface Water Quality

The project site is close to one mile north of the nearest surface water at the coastline of southwest Oahu. Coastal waters are classified as Class A Open Coastal Marine waters.

The Hawaii Revised Statutes (HRS 11-54) states:

It is the objective of Class A Marine Waters that their use for recreational purposes and esthetic enjoyment be protected. Any other use shall be permitted so long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters.

These waters shall not act as receiving waters for any discharge that has not received the best degree of treatment and control compatible with the criteria established for this class.

A normally dry drainage canal forms the western border of the property and connects to the ocean near the southwest corner of Oahu. The canal floods on spring tides and during rare heavy rains. This portion of the Island receives an average of 20 inches of rain per year (Atlas of Hawaii 1992). Soils are relatively porous and surface water runoff conditions are limited to heavy rain events. The site is located in FEMA flood zone D and is outside the 100-year floodplain. It is also outside the Oahu Civil Defense Tsunami inundation zone.

3.1.3 Groundwater Resources

The groundwater at the site is within the Ewa aquifer system of the Pearl Harbor Aquifer sector. There is a deeper confined aquifer in a deep layer of basalt and a shallow unconfined aquifer in the overlying caprock. The groundwater in the confined aquifer is brackish with a chloride content ranging from 250 to 1,000 milligrams per liter. In the Kalaeloa area, the underlying aquifer meets Federal but not State of Hawaii drinking water standards, thus it is not used for potable water. The shallow aquifer in the Kalaeloa area is also brackish with chloride content ranging from 1,000 to 5,000 milligrams per liter. The water is not suitable for consumption or irrigation without desalination (TEC Inc. 2010a and b). Groundwater depth at the project site is undetermined, but assumed to be near mean sea level. The elevation beneath ground surface may vary with tidal conditions. Groundwater flow is generally assumed to be from north to south toward the ocean beneath the site.

The boundary between non-drinking water aquifers and underground sources of drinking water is generally referred to as the "UIC Line". Restrictions on injection wells differ, depending on whether the area is inland (*mauka*) or seaward (*makai*) of the UIC line. The subject property is seaward of the UIC line. UIC maps are available on the DOH website at: (http://hawaii.gov/health/environmental/environmental/water/sdwb/uic/pdf/oahuic.pdf).

3.1.4 Climate and Air Quality

The project site has a mild, semi-tropical climate of characteristic of most leeward regions of Oahu. The average maximum daily temperature ranges from 78 °F to 87 °F, with an average minimum temperature ranging from 60 °F to 68 °F (Atlas of Hawaii 1992). Rainfall for this area is averages 20 inches annually, with most of it occurring between November and April. Winds from the northeast, known as trade winds, are the most predominant over the Hawaiian Islands. Typical wind velocities range from 3 to 14 knots. There is an occasional shift in the wind patterns to the westerly “Kona” winds which are sometimes quite strong.

In Hawaii, both federal and state environmental health standards pertaining to outdoor air quality are generally met due to prevalent trade winds. The adjacent Campbell Industrial Park is likely the largest source of stationary air emissions on the Island of Oahu, yet due to the consistent winds, the regulated air pollutants in the area are within the air quality limits established by the Clean Air Act. Air quality monitoring stations operated by the Hawaii Department of Health are located in Kapolei, and Campbell Industrial Park.

There are no significant stationary air emissions sources associated with the proposed project. During construction there may be temporary contributions to air pollution from fugitive dust and automobile emissions. Automobile and fuel power construction equipment will be limited to that necessary to build the project, and fugitive dust will be managed under best management practices as defined by the State of Hawaii.

3.1.5 Noise and Odor

Existing sources of noise near the project site include the Kalaeloa Airport, Tesoro Refinery, and various construction equipment baseyards. Noise associated with vehicular traffic is minimal.

Odors within the project area are minimal. Northeasterly tradewinds normally blow emissions from nearby refineries and power generators out to sea. Transient fuel and exhaust odors may be present from aircraft operations and refueling; however, the site is not expected to have background odors associated with adjacent land uses.

The proposed project will not generate noise or odors during operations. Construction equipment and vehicular traffic may contribute relatively small amounts of both noise and odor which are consistent with surrounding industrial land use.

3.1.6 Scenic Value and View Plane

The topography of the area is relatively flat and there are no ocean views. The Waianae range may be seen roughly 2 miles to the north. View planes to the west are occluded by the Tesoro Refinery and other industrial businesses within Campbell Industrial Park. Construction baseyards and the Kalaeloa airport are visible to the west. Scrub vegetation dominates the scenery to the south. The project area is relatively flat and undistinguished with no discernible gradient.

The proposed development will have a relatively low profile. At peak elevation the panels will be no more than 10 feet above ground level. This is approximately the same height as the Airport perimeter fence. The PV park will not be visible from any major roadway and will not obstruct view from aircraft operating in and out of Kalaeloa Airport (Figure 3-2).

3.1.7 Hazardous Substances

Photovoltaic panels and their associated electrical equipment do require the use of hazardous materials while in operation. Electrical transformers are all PCB-free. Leaching from the equipment due to corrosion and rainwater is expected to be undetectable.

Construction equipment using fossil fuels and hydraulic power will be used in grading and building the facility. There is some possibility of leaks, spills or accidents during construction. The construction contractors will be required to develop and maintain an emergency action plan for management and recovery of any release to the environment.

3.2 Biological Environment

3.2.1 Vegetation

During the period when the airport was operated by the Navy, the subject property was regularly graded. Vegetation on the subject property is characteristic of dry land areas that have been recently disturbed. The dominant vegetation types observed on the subject property are koa haole with an understory of various introduced grasses. A few scattered kiawe trees are also present. Koa haole (*Leucaena leucocephala)* and kiawe (*Prosopis pallida)* are both introduced and considered invasive species. This was confirmed in a site visit conducted for the proposed project area in July 2010. Either one or a mix of the two dominant tree species, kiawe and koa haole, was observed throughout the entire parcel. The understory was dominated by the nonnative Buffelgrass (*Cenchrus ciliaris*). The primary native understory species present were the shrub ilima (*Sida fallax*) and the vine *Cassytha filiformis.*

3.2.2 Wildlife

Twenty-three (23) species were identified during a survey of Barbers Point Naval Air Station in 1984, of which 17 were ubiquitous, introduced species; five were indigenous; and one, the Oahu elepaio (*Chasiempis sandwichensis ibidis*), was endemic (Botanical Consultants 1984). The 1984 survey reported that the elepaio was found in an area of mangrove forest. The elepaio is no longer present in the area (USFWS 2006). Species common to the area include northern cardinal (*Cardinalis cardinalis*), spotted dove (*Streptopelia chinensis*), red-vented bulbul (*Pycnonotus cafer*), Indian myna (*Acridotheres tristis*) and gray francolin (*Francolinus pondicerianus*).

Kalaeloa Airport has a formal agreement with the U.S. Department of Agriculture which allows for the controlled eradication of birds that create a hazard to planes. Airport personnel actively control birds and keep records of all bird strike incidences.

Mammals likely to be found at the proposed project site are the introduced Indian mongoose (*Herpestes auropunctatus*), rodents and feral cats.

3.2.3 Special-Status Species

The Hawaii Biodiversity and Mapping Program (HBMP) provided information for occurrences within one-half mile of the proposed site. Past reports have indicated that the general area may contain two varieties rare plants, the Ewa Plains Akoko and Red Ilima. The known locations of these plants are away from the subject property. A letter to the US Fish and Wildlife Service in June 2010 did not identify any special-status species or critical habitats located on the subject property (Appendix B).

3.3 Socioeconomic

The population of the State of Hawaii was 1,360,301 in 2010, which represents an average annual growth rate of 1.2% from 2000 to 2010 (US Census Bureau 2010). This compares with an average annual growth of 0.9% for the remainder of the nation. The vast majority of Oahu neighborhoods lost population over the past decade; however, Ewa gained 34% which is third behind Kapolei/Makakilo at 37% and Mililani Mauka at 73%. The southwestern corner of the island near the subject property is a primary growth and employment center due to public and private developers filling in the dry areas of Oahu.

3.3.1 Social Factors and Community Identity

Employment in the region is largely industrial, commercial and retail. Approximately 15,000 jobs were in the Ewa Region in 2000 and that number is projected to grow to 64,000 in 2020 (HCDA 2010). Median personal income for Ewa was estimated at $27,742; and for Makakilo $38,836.

The project site is undeveloped and located on land that has quite restricted use due to airport operations. The site is owned by DHHL, but does not provide revenue to support DHHL's mission. It is unsuitable for housing development, since it is located immediately adjacent to the end of an active runway. There are no recreational facilities at the site and no evidence of recreational activities (i.e., hiking trails, baseball fields) was observed during the biological and archaeological surveys. No traditional (or modern Hawaiian) cultural activities were identified that occur at the project site today.

3.3.2 Public Services, Facility, and Utility

Much of the infrastructure in the vicinity of the subject property, with the exception of the roads, is still owned by the US Navy. The wastewater collection system is being conveyed to the City and County of Honolulu (US Navy, 2008). The Hawaii Community Development Corporation (HCDA) is reportedly preparing an infrastructure master plan that would address roadways and utility service for the area.

3.3.2.1 Electricity

The existing electrical distribution system at Kalaeloa is owned and operated by the Navy. Electrical power is provided through a Hawaiian Electric Company (HECO) substation located near the main gate along the northern property line. Secondary substations reduce the 46-kilovolt (kV) power for local distribution stations. Substation A is closest to the project site and steps the power down to 11.5

kV. It is a back-up substation for emergency use (US Navy, 2008). The distribution is through a combination of 11.5 kV and 46 kV overhead and underground power lines.

The proposed PV Park would provide a total of up to 5.0 MW of electricity to HECO's existing power grid. This quantity of solar power will contribute an insignificant fraction of the island demand, estimated at 1.3 GW. The proposed action will not significantly affect the stability of the grid due to the small contribution.

3.3.2.2 Telecommunications

Telephone systems in Kalaeloa are currently owned by the Navy. No telephone service will be provided to the project site. Sandwich Isle communications will be utilized for cable or communications service if required.

3.3.2.3 Potable Water

Potable water source and distribution system at Kalaeloa is currently owned and operated by the Navy. No potable water will be provided to the project site.

3.3.2.4 Wastewater

The existing wastewater collection system is owned by the Navy and operated under license by the County Department of Environmental Services and is in the process of being transferred to the county as a public benefit conveyance. No wastewater services will be provided to the project site.

3.3.2.5 Solid Waste

Construction debris and grubbing spoils will be generated during the construction period. No solid waste will be generated or disposed from the site following construction. Solid waste will be disposed at a licensed and permitted disposal facility on Oahu in accordance with State and County requirements.

3.3.2.6 Drainage

Infiltration of stormwater at the project site is rapid. There are no natural drainage ways in southwest Oahu due to the high permeability of the soil and paucity of rainfall. The area is subject to heavy rainfalls on occasion. Stormwater from the site will drain toward the west into a man-made drainage ditch which is designed for the purpose. As discussed in Section 3.1.2 the ditch is normally dry but conveys stormwater to the ocean approximately 1.5 miles to the south.

Stormwater generated on site will be contained during small storm events. Best management practices will be employed to reduce soil erosion. These practices may include soil mats, gravel or silt fences. The proposed action is not required to obtain an NPDES industrial stormwater permit, but will obtain a construction stormwater permit in advance of site grading. New impervious surfaces will consist of footings for the panels and are not expected to be a large fraction of the total

area. The proposed action would not have a major impact on stormwater drainage at the site or in the vicinity.

3.3.3 Roads and Access

Access to the site is through the Kalaeloa Main Gate, west down Midway Street to its end. Midway serves numerous public and private users in the west portion of Kalaeloa, but after the divergence with Hornet Street the level of usage drops substantially. Midway Street ends on the subject property. Saratoga Avenue is the western perimeter road for Kalaeloa, and forms the western boundary of the subject property. Either street could be used for access.

Construction related traffic will be light over a period of up to 12 months. Construction-related traffic is expected to be within the capacity of existing service roads, which are now little utilized. Following construction, the proposed project will require less than one car per day for on-site management and no full-time employees. The proposed action will not contribute significantly to local traffic impacts.

3.3.4 Archaeological and Historic Resources

A review of the records on file at the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) revealed that numerous archaeological studies have been conducted in the Barbers Point vicinity, however the current parcel does not appear to have been subject to prior archaeological study and there are no archaeological resources known to exist on the parcel. Archival documents, records, and maps indicate that the parcel was historically used as an extension of the adjacent Naval Air Station runway. This can be seen on the Tax Map as an easement area and is clearly indicated in an aerial photograph
A physical inspection revealed that the boundaries of the subject property are easily identifiable and the currently vacant property is covered with moderately dense grasses and *koa haole* (*Leucaena leucocephala*) with occasional *kiawe* (*Prosopis pallida*) trees. The ground surface across the entire parcel appears to have graded in the past, and where visible through the exhibits a mixture of soil and limestone cobbles. No archaeological resources were observed during the field inspection, and given the extensive grading that has no doubt occurred, no such resources are expected to remain intact if any were ever present. Based on the archival research, the documented extensive land alteration, and a physical inspection of the property, Rechtman Consulting, LLC concluded that there are no archaeological resources within the subject parcel that would present any significant development constraints.

3.3.5 Cultural Impacts

There is a long history of Native Hawaiian occupation on the Ewa Plain. The most recent studies suggest the plain was first occupied just after 1,000 AD. The Ewa Plain was part of the Honouliuli ahupuaa, and the population likely settled around the mouth of Honouliuli Stream, inland and up the coastline of Pearl Harbor. It is thought that little agricultural activity occurred on the dry Ewa Plain (Athens et al. 1997).

The land that the HIARNG at Kalaeloa now occupies was used for ranching, and growing sisal and sugarcane from 1877 until the 1930s. The U.S. Marines purchased 206 acres at Kalaeloa in 1932 and

the property became the Barbers Point Naval Air Station (BPNAS). Construction on the base began in November 1941, but the Navy revised the building plans to make the buildings bombproof following the Japanese attacks on Pearl Harbor December 7, 1941. The Navy commissioned BPNAS on April 15, 1942, and the 3,700-acre installation was manned by 12,000 Navy servicemen. BPNAS's primary mission was to support the naval operations in nearby Pearl Harbor, but its role quickly expanded to include aircraft repair and maintenance for carrier-based aircraft for the duration of the war. After World War II ended, BPNAS became the primary naval air station for naval operations in the Pacific throughout the Cold War era until its close in 1989. BPNAS closed in 1999 in accordance with a recommendation from Base Realignment and Closure Committee (BRAC). Since then, the former BPNAS installation has had ongoing redevelopment by federal, state, and county agencies, as well as military and private organizations.

The subject property was extensively graded and built up as a run-out for the crosswind runway during the 1940s. There are no known sacred sites or traditional cultural resources currently in proximity to the site. Athens et al. 1997 found no evidence of prehistoric agricultural activity such as the production of dry land taro, or the growth of medicinal plants or any other activity associated with activities practiced by modern Native Hawaiians. The proposed project is unlikely to impact traditional practices or Native Hawaiian beliefs.

3.3.6 Land Use

The City and County of Honolulu officially designate the project site as F1- Military and Federal Preservation, but the site is no longer federal land. Lands taken out of the federal category are normally changed to P-2 General Preservation zone unless a zone change application is made.

The proposed action would conform to the County's P-2 General Preservation. The County has determined this project is considered a power generation project, which is considered a "Utility Installation, Type B" and subject to a minor conditional use permit.

The Hawaiian Homes Commission Act of 1920 is the enabling legislation for the Hawaiian Homes Commission and the Department of Hawaiian Home Lands. Section 206 releases Hawaiian home lands from the control of State and County regulations including zoning regulations, land-use permits.

§206. Other officers not to control Hawaiian Home Lands; exception.
The powers and duties of the governor and the board of land and natural resources, in respect to lands of the State, shall not extend to lands having the status of Hawaiian home lands, except as specifically provided in this title. (Exceptions are for criminal violations.)

Although the Act seems clear, we understand that by convention The Department declares its lands exempt on a project by project basis. The requirement for environmental permits such as NPDES may remain intact because they are generally mandated by federal regulations. In July 2002, Act 184 of the 2002 Hawaii State Legislature transferred redevelopment responsibility from the NASBP Redevelopment Commission to the HCDA. The Kalaeloa Master Plan was prepared in 2006 (HCDA 2006), and designated land to be used for residential, light industrial, eco-industrial, military, and parks and recreation purposes. Neither the Master Plan nor administrative rules for development standards have been officially adopted.

Under the proposed Kalaeloa Master Plan, the project site is located on lot # 2J, designated for eco-industrial land use (HCDA 2006). The 2006 Master Plan defines Eco-industrial as:

For the purposes of the Master Plan, Eco-industrial uses are defined as environmentally compatible industries that benefit the entire population of Oahu. Potential industries such as solar or hybrid energy, or other such technologies are compatible in these parcels. These industries require large land areas and are located within the airport's accident potential zones where height restrictions limit development.

Properties to the north will also be developed for PV and other solar use (DHHL, 2011). State-retained lands associated with the airport are on the east boundary. Vacant land used by the Navy for baseyards and composting lies to the south, and the industrial properties of Campbell Industrial Park are to the west. The proposed action is consistent with the Ewa Development Plan, Kalaeloa Community Redevelopment Plan, Special Area Plan, Light Industrial zoning designation and the HCDA Kalaeloa Master Plan, land use designation. But these zoning designations have not been adopted and administrative rules for the HCDA Kalaeloa Community Development District are pending (Figure 3-1).

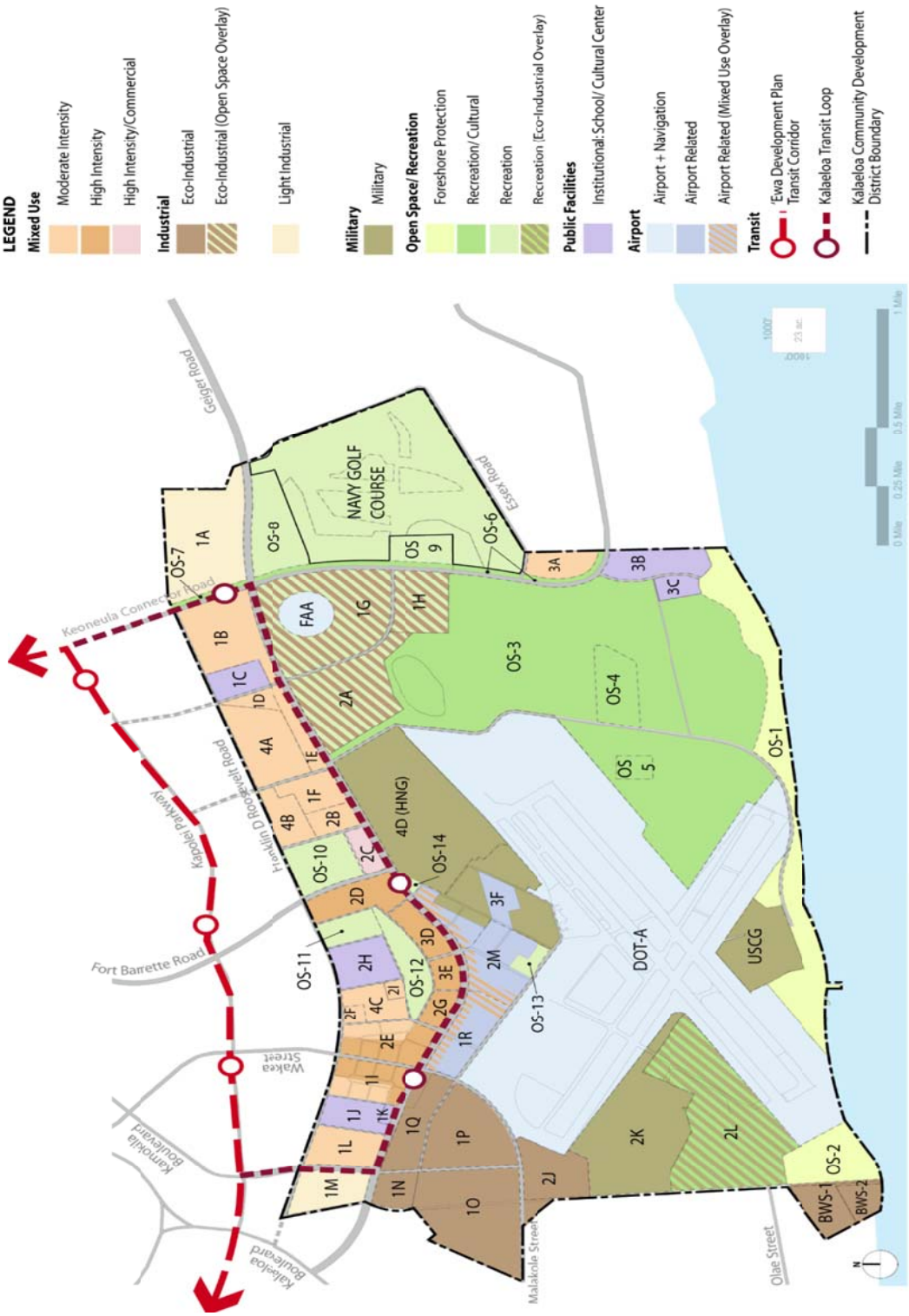


Figure 3-1: Land Use Plan from the Kalaeloa Master Plan. Hawaii Community Development Authority, 2006. Subject Property is designated 2J.

3.3.6.1 Land Use Constraints

Airports have a primary mission to serve the flying public and facilitate safe and convenient air travel. All activities in proximity to airports must be compatible with this mission.

The proposed project site is approximately 1100 feet west of the end of the cross wind runway (11-29). A taxiway, blast pad and perimeter buffer lie between Runway 11 and the project site. Historically Runway 11 has been used for departures only and Runaway 29 arrivals only. The State Department of Transportation is in the process of relaxing that restriction for smaller aircraft. The use restriction is intended to minimize noise impacts to residential areas and schools located north and east of the airport (FAA, 2010a). Runway 11-29 is used infrequently by both private aircraft and the Coast Guard. Kalaeloa Airport is retained as an alternate to Honolulu International Airport, and is the Coast Guard's primary aviation Search and Rescue facility for the Central Pacific Region.

All solar projects must submit to the FAA a notice of proposed construction Form 7460 to ensure that the proposed project is not located in areas or engage in activities that will impact the safety of airport operations. An Obstruction Evaluation /airport airspace analysis is performed to ensure that the proposed activity does not penetrate imaginary surfaces around an airport, cause interference with communications systems, or create glint and glare. The three primary aspects of the Obstruction analysis are discussed below.

Airspace Penetration: 14 CFR Part 77 establishes standards for determining obstructions in navigable airspace. Imaginary surfaces are defined that extend out from the runway at locations where aircraft are likely to fly. This imaginary surface is called the Runway Protection Zone (RPZ). The height above ground of the RPZ is lowest and narrowest near the runway increasing in width and altitude with distance from the runway. The imaginary surface is different for different types of airports. Kalaeloa Airport does not now have instrument landing capacity, thus the angle of the RPZ is 50:1 (H/V). Figure 3-4 shows the components of restricted surfaces and Figure 3-5 shows the slope position of the RPZ and Figure 3-6 shows the approximate location of the RPZ with respect to the project site.

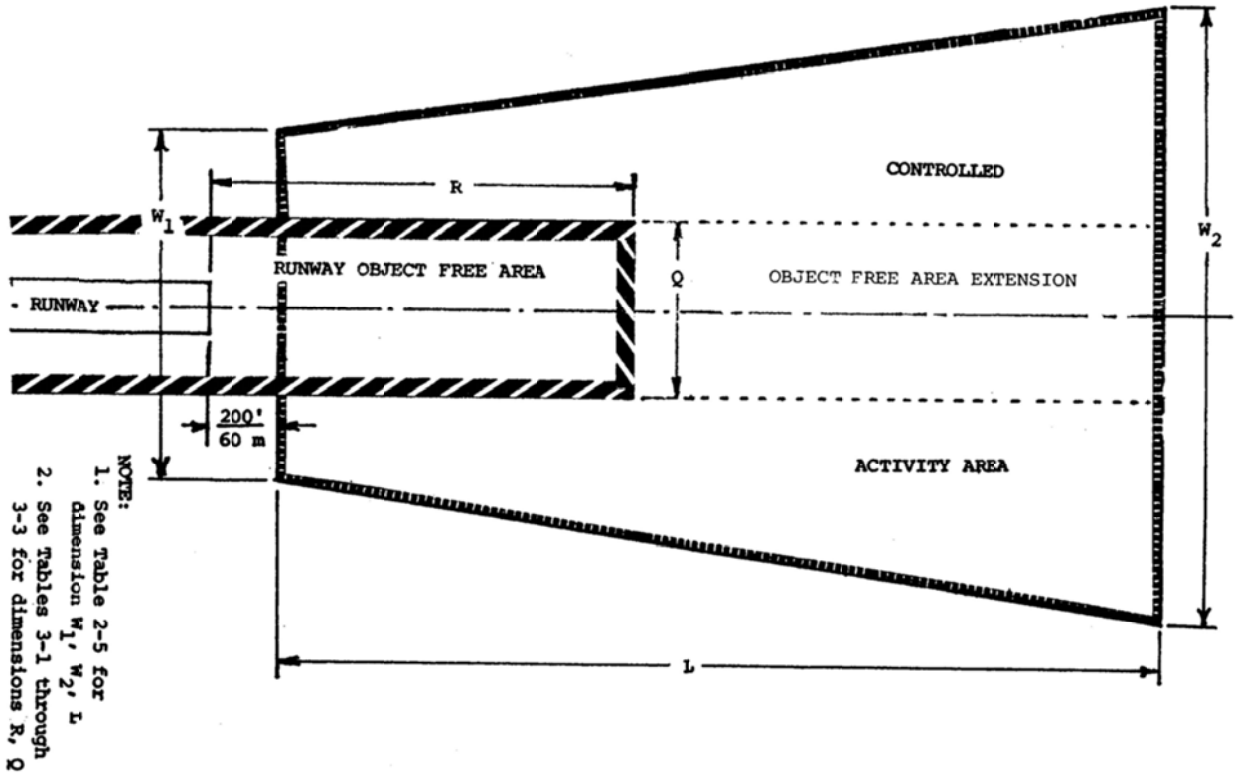


Figure 3-2: General component of restricted areas surrounding an airport. From Advisory Circular 150/5300-13 1989

Table 3-1 Dimensions of the RPZ

Airport Service	**Length (L)**	**Inner Width (W1)**	**Outer Width (w2)**
Small Aircraft only	1,000	250	450
Approach Category A&B	1,000	500	700
Approach Category C&D	1,700	500	1010

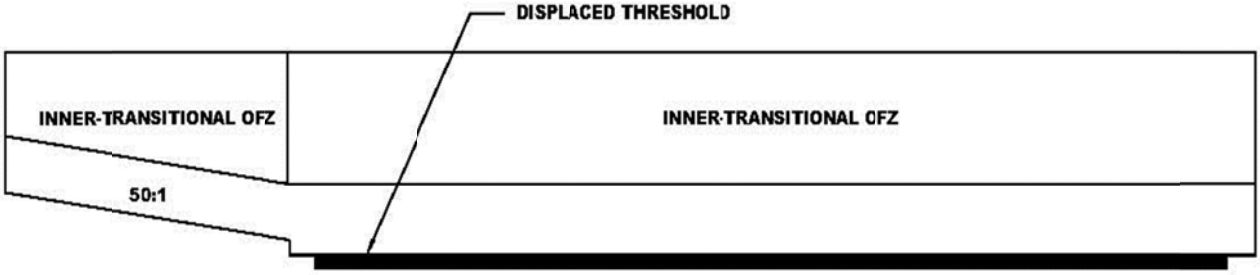


Figure 3-3: Diagrammatic representation of the RPZ slope. All structures must be below the RPZ plane to avoid being an obstruction to aircraft navigation. From FAA Advisory Circular 150/5300-13, 1989

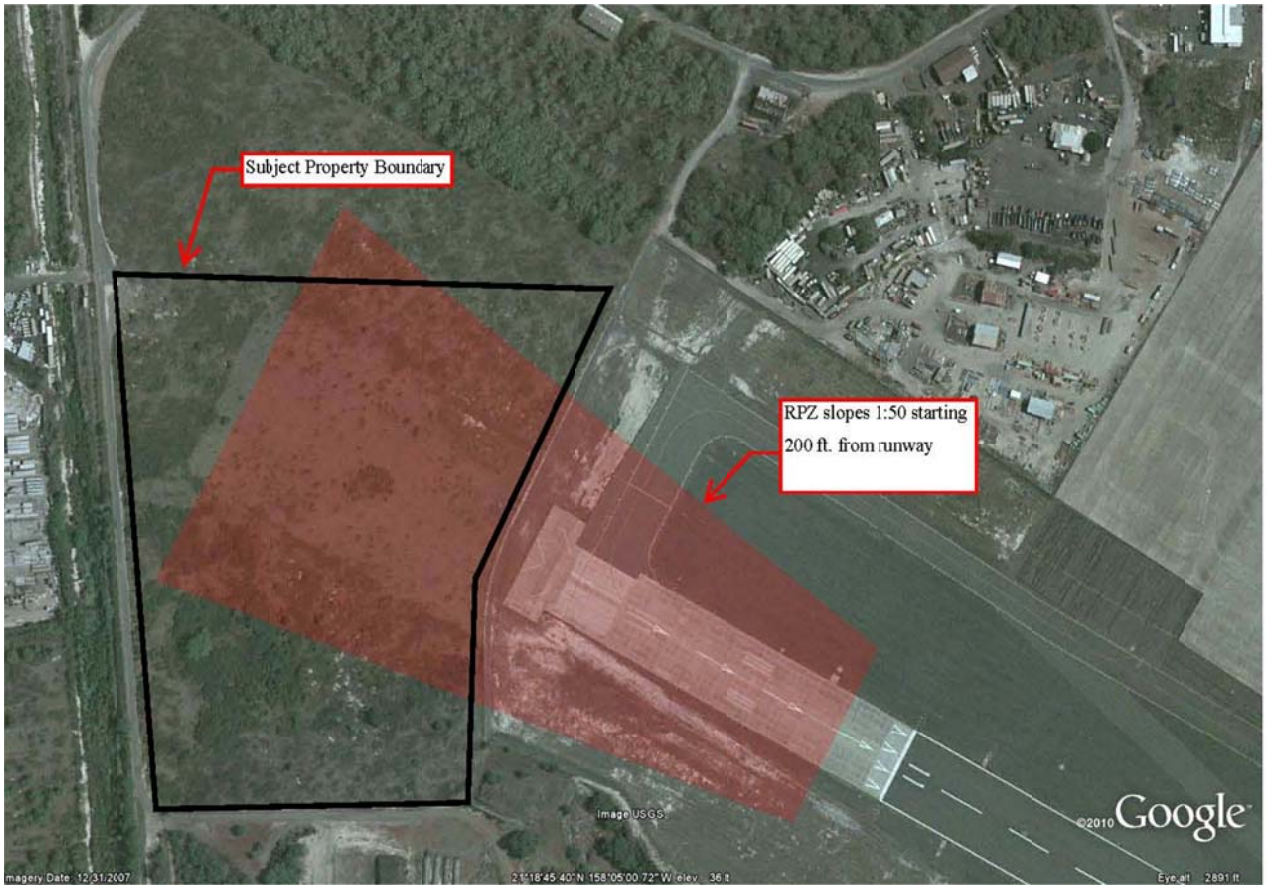


Figure 3-4: RPZ dimensions and slope in relation to the subject property boundaries. The RPZ starts 200 feet from the end of the runway and slopes upwards and outwards. For Kalaeloa Airport the slope angle is 50:1

As the project site is approximateley1100 feet from the end of Runway 11, and the RPZ slope is 50:1 angle starting 200 feet from the end of the runway, the altitude of the RPZ where it enters the project site is approximately 18 feet above ground level. The maximum elevation of the proposed PV panels is 8 feet above ground level which is approximately the level of the airport perimeter fence, and 10 feet below the RPZ.

If Runway 11 is use solely for departures the RPZ becomes less important; however, new developments should not restrict future use of the facility. Further analysis in this document is based on the assumption that Runway 11 will be used for both approach and departure.

Communications systems Interference: Communications interference includes negative impacts on radar, navigational aids and infrared instruments. Radar interference occurs when objects are placed too close to radar antennae and reflect or block the transmission of signals between the transmitter and receiver such as an aircraft. It is possible for interference to be caused by other communications signals, but more commonly it is caused by a physical structure placed between the transmitter and receiver. Navigational aids (NAVAIDS) are passive systems with no transmitted signal. These can be impacted by objects within the line of sight between aircraft and the NAVAID. Infrared (IR) communications systems can be impacted by objects that retain heat after dark creating false signals in the IR communications systems (FAA 2010b).

Glint and Glare: Glint and glare are components of reflectivity, or light reflected off of surfaces which can cause temporary visual interference even after the source of illumination has ceased. Glint is defined as an instantaneous flash and glare is a more steady reflection.

The amount of reflectivity varies greatly among solar technologies with concentrated solar power (CSP) technologies being highly reflective and Photovoltaic (PV) technologies being primarily absorptive rather than reflective (Figure 3-7). Because solar projects will introduce new visible, potentially reflective surfaces in proximity to the airport, the siting and design of these facilities require assessment and approval by the FAA. Existing conditions surrounding most airports include a number of reflective surfaces. In the case of Kalaeloa there are large metal warehouses with reflective roofs, and the Pacific Ocean in close proximity to the runways. The property is near 21 degrees north latitude, which implies that the sun is normally to the south of the site. Panels would be expected to have a slight angle facing south, and will track the movement of the sun as it moves from southeast to southwest.

Solar installations are presently operating at a number of airports. Project managers and air traffic controllers from six airports where solar facilities had been operating for one to three years were contacted regarding complaints about reflectivity. To date there have been no serious complaints from air traffic controllers or pilots due to glare impacts from existing airport solar PV installations. Anecdotal evidence suggests that either significant glare is not occurring during times of operation or if glare is occurring it is a minor part of the landscape to which pilots and tower personnel are exposed (FAA, 2010b).

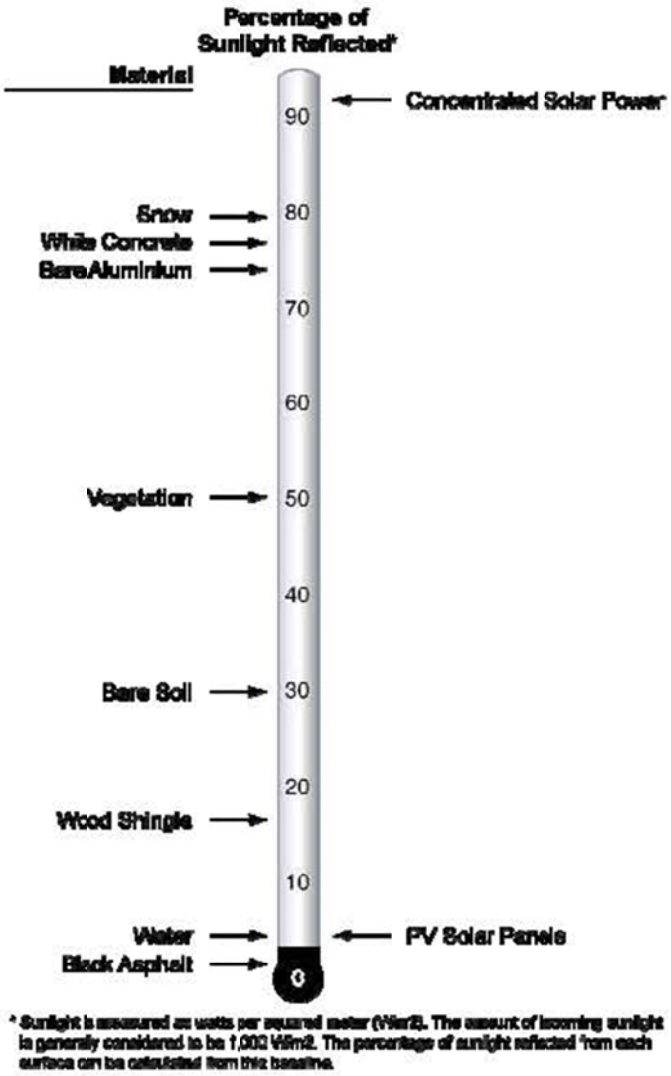


Figure 3-5: Relative reflectivity of various surfaces. Note that CSP technologies are toward the top of the reflective scale and PV is toward the bottom. (Technical Guidance for Evaluating Selected Solar Technologies on Airports. Federal Aviation Administration 2010b)

Kalaeloa Home Lands LLC commissioned a glint and glare study for the proposed development. The Study is appended to this document as Appendix C. In its conclusion the reflectivity study states:

> *It has been demonstrated that, in the few cases when there is some risk of eventual glint by PV modules, the airplane will also be directly facing the sun and the corresponding reflections from the ocean, so it can be concluded that glint from PV modules will not have any relevant effect on airplanes' visibility, nor deteriorate the actual approaching flight conditions. Risk is also diminished by the monthly distribution of predominant wind direction in Kalaeloa when superimposed to the calendar days glint might occur.*

AES solar prepared a Form 7460-1 with attachments and submitted them to the FAA in January 2011. A notice of determination was received on March 8, 2011 which approved the proposed action to proceed. A further discussion of the Obstruction analysis is presented in Section 3.5.

3.4 Growth-Inducing, Cumulative, and Secondary Impacts

Indirect effects may include other impacts related to changes induced by the proposed action such as growth-induced changes in land-use patterns, or air and water quality impacts associated with population growth. Cumulative impacts may be defined as impacts on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes the action. A secondary impact is one that is caused by the proposed action but is removed in time or space from the project (Council on Environmental Quality, 1997).

The proposed action is to build and operate a 29 acre photovoltaic park on currently unused land that has significant use restrictions imposed by its proximity to Runway 11 of the Kalaeloa Airport.

The proposed action does not increase population or traffic. During operation the project will not contribute hazardous waste, air emission, or surface water contamination associated with its operation. The proposed PV park does not utilize any potable water, or sewer. No growth inducing factors, cumulative impacts, or secondary impacts associated with the proposed action have been identified.

The project is one of two planned for the vicinity. Kalaeloa Solar One and Two will consist of 5 MW of PV panels and 5 MW of Concentrated Solar Power (CSP) park is planned for the adjacent parcel to the north of this project site. The proponent, Keahole Solar Power, Inc. published a Draft Environmental Assessment in January 2011. No Final Environmental Assessment has been accepted at the time of this writing, and there is no evidence presented that the proposed facility has completed the Obstacle Evaluation by the FAA.

The cumulative impacts of both solar projects and other planned for central Oahu may include flooding the power market with non-base load power sources. Hawaiian Electric has set a maximum of 7% of its base load to be supplied by wind and solar-type projects. The known solar projects are less than 80 MW on Oahu and do not approach the limits for variable sources.

At full development the subject property will consist of 29 acres of PV and the adjacent parcels to the Northwest will contain approximately 80 acres of PV and CSP facilities. The PV facilities will also be located under a portion of the RPZ, while the CSP facilities will be displaced to the north by several hundred feet. Together the facilities will create a solar farm of slightly over 100 acres.

Together the proposed projects will create approximately 14.0 MW of non-base load power. This quantity does not create a significant excess of electrical power as it is only a small fraction of the island's total demand, and is not likely to lower the cost of energy at the retail level.

3.5 Required Permits and Approvals

Discussion follows for of the major permit approvals required prior to the start of construction.
City and County of Honolulu, Building and Grading. The proposed project will be required to obtain all building and grading permits from the City and County of Honolulu. DHHL may elect to defer this requirement based on Section 206 of the Hawaiian Homes Commission Act of 1920.

City and County of Honolulu, Conditional Use Permit (minor). As discussed previously, the default zoning for this parcel is P-2. Type A utilities, such as the proposed action, require a conditional use (minor) permit prior to approval of building and grading permits. Minor CUP permits do not require public hearings; however, public hearings will be held in connection to this Environmental Assessment. . DHHL may elect to defer this requirement based on Section 206 of the Hawaiian Homes Commission Act of 1920.

State of Hawaii NPDES Construction Stormwater Permit. The Clean Water Act regulates discharge of all types of water from industrial and construction sites as well as discharge of process waters of all types. An NPDES Construction Stormwater Discharge Permit is required of construction projects that are grading areas greater than one acre. The majority of the 29 acres included in the project site will be graded. An NPDES Notice of Intent and Form C will be prepared and approved prior to grading at the project site.

There are no industrial discharges or construction dewatering associated with the project. A PV park is not required to obtain an industrial stormwater permit. The facility will not generate domestic wastewater and does not require a wastewater connection or individual wastewater permit.

State Historic Preservation Division of DLNR. An approval for grading the site will be obtained from the State Historical Preservation Division prior to the start of construction.

The proposed project does not involve stationary sources or air pollution and is not required to obtain Clean Air Act permits.

Federal Aviation Administration, Obstacle Evaluation/ Airport Airspace Analysis. Because the proposed project is in close proximity to the Kalaeloa Airport, AES Solar is required to obtain approval from the FAA. In administering Title 14 of the Code of Federal Regulations CFR Part 77, the prime objectives of the FAA are to promote air safety and the efficient use of the navigable airspace. To accomplish this mission, aeronautical studies are conducted based on information provided by proponents on an FAA Form 7460-1, Notice of Proposed Construction or Alteration.

Advisory Circular 70/7460-1K states that any person/organization who intends to sponsor any of the following construction or alterations must notify the Administrator of the FAA:

- any construction or alteration exceeding 200 ft. above ground level
- any construction or alteration:
    - within 20,000 ft. of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 ft.

  - within 10,000 ft. of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 ft.
  - within 5,000 ft. of a public use heliport which exceeds a 25:1 surface
- any highway, railroad or other traverse way whose prescribed adjusted height would exceed the above noted standards
- when requested by the FAA
- any construction or alteration located on a public use airport or heliport regardless of height or location.

As part of the airspace analysis, FAA's regional offices process the 7460 data and conduct the aeronautical studies to ensure the project will not penetrate the imaginary surfaces or interfere with radar or create a potential glare hazard. The aeronautical studies will be conducted by the following offices:

- Air Traffic Obstruction Evaluation Office (AT OES) – Responsible for evaluating Part 77 requirements.

- Air Traffic Operation Service Group (AT OSG) – Responsible for coordinating with air traffic control to identify any operation impacts.

- Technical Operations (Tech Ops) – Responsible for evaluating the case for impacts to NAVAIDs, conducting electromagnetic and line-of-sight shadow studies, and highlighting frequency problems.

- Flight Standards (FS) Responsible for reviewing proposals to determine the safety of aeronautical operations, and of persons and property on the ground.
- Flight Procedures (FP) - Responsible for evaluating proposals to determine impacts on instrument procedures and whether aircraft instrument operations can be conducted safely.

- Airports (ARP) – Identify the structure's effect on existing airports and planned improvements based on airport design criteria including assessing potential impacts on airport operations, capacity, efficiency, and development, and making recommendations for eliminating adverse effect.

The Form 7460 included a discussion of consistency with the ALP, and address airspace issues of physical penetration, communications systems interference, and reflectivity. It included the following information:

- Location of panels
- Location of radar facilities
- Location of Control Tower
- Verification that panels are located outside of airport design prohibited areas
- Verification that panels will not physical penetrate airport imaginary surfaces
- Verification that solar facilities will not block radar communications

- Assessment of reflectivity including time periods when reflection may contact Control Tower and aircraft

The FAA completed the aeronautical study, and determined that no impacts to air navigation would occur as a result of the proposed action. In issuing the negative determination the FAA has approved the project and allowed it to move forward. A copy of the Notice of Determination is included in Appendix D.

4.0 CONSISITANCY WITH PLANS, POLICIES, AND REGULATIONS

4.1 Federal Policies Supporting Renewable Energy

In the U.S. most energy policy incentives take the form of financial incentives. Examples of these include tax breaks, tax reductions, tax exemptions, rebates, loans, and specific funding. Throughout U.S. history there have been many incentives created through U.S. energy policy. Most recently the Energy Policy Act of 2005, Energy Independence and Security Act of 2007, and Emergency Economic Stabilization Act of 2008, each promote various energy efficiency improvements and encourage development of specific energy sources. U.S. Energy policy incentives can serve as a strategic manner to develop certain industries that plan to reduce America's dependence on foreign petroleum products and create jobs and industries that boost the national economy. The ability to do this depends upon which industries and products the government chooses to subsidize. The federal government provided substantially larger subsidies to fossil fuels than to renewables in the 2002-2008 period. Subsidies to fossil fuels totaled approximately $72 billion over the study period, representing a direct cost to taxpayers. Subsidies for renewable fuels, totaled $29 billion over the same period (Environmental Law Institute, 2009).

The Energy Policy Act of 2005, signed into law by President George Bush on August 8, 2005, was the product of over four years of congressional consideration. Among the many provisions of the Energy Policy Act of 2005 were renewable energy production tax credits**.** The act provided tax credit extensions for wind and biomass for two more years and additional tax credits were made available for other renewables including solar, geothermal, and ocean energy.

The energy policy of the Obama Administration, lists the guiding principles of the administration regarding energy and the environment. They are: creating new clean energy jobs and technologies, making America more energy independent, and reducing carbon emissions. Many of the Obama Administration's initiatives were undertaken as a result of the American Recovery and Reinvestment Act of 2009 and many of those investments were specifically in clean energy. The White House website states that the Recovery Act provided over $80 billion in clean energy investments. The president and Congress have dramatically increased funding for the U.S. Department of Energy's wave and tidal technologies program. In addition, President Obama has advocated that by 2012, 10 percent of our domestic energy supply should come from renewable resources, increasing to 25 percent by 2025. Also, now that federal regulation of greenhouse gas emissions is increasingly likely, the focus is on the lack of CO2 emissions in the renewable energy sector.

4.2 Hawaii State Policies Supporting Renewable Energy

Act 234, Session Laws of Hawaii 2007, established the State's policy framework and requirements to address Hawaii's greenhouse gas emissions, recognizing the potential adverse effects of the recent climate change and global warming to Hawaii's economy, public health, natural resources, and environment (http://hawaii.gov/dbedt/info/energy/greenhouse/). The general purpose of Act 234 is to establish and cost-effectively achieve state policy of greenhouse gas (GHG) emissions reductions and limits at or below the best estimates and updates of the inventory of Hawaii's greenhouse gas emissions estimates of 1990 emissions levels by January 1, 2020.

Hawaii's energy policies have gone through a major advance within the past 5 years. The Hawaii Clean Energy Initiative (HCEI), which has set the goal of transforming Hawaii's energy use to 70% clean energy by 2030. Hawaii's dependence on imported oil creates vulnerability for the state's economy which is greatly affected by the price volatility of this finite energy source. Recognizing the detrimental effects this oil dependency has on Hawaii's environment and local economy, the state signed a Memorandum of Understanding (Hawaiian Electric, 2008) with the U.S. Department of Energy (DOE) in January 2008, which established HCEI as a partnership bringing together local business leaders, policymakers, and industry experts to guide the Hawaii's transition to a clean energy economy.

The Memorandum of Understanding states:

Signaling agreement on key actions, the Hawaiian Electric Co. (HECO) family of utilities voluntarily agreed to a number of actions after extensive discussions with DBEDT and the USDOE. In the Energy Agreement, HECO and the state agreed to move from central-station, oil-based power to a more renewable, distributed- and intermittent powered system while preserving the stability of the grid, minimizing disruption, and keeping the utilities financially sound.

The Energy Agreement includes the following significant goals:

• Increasing Renewable Portfolio Standard goals to 25% by 2020 and 70% by 2030.
• Developing an Energy Efficiency Portfolio Standard.
• Accelerated addition of clean energy resources on all islands.
• Laying an undersea cable linking Oahu and wind farms on Molokai and/or Lanai.
• Establishing feed-in tariffs to standardize rates for utilities' purchase of renewable power.
• Decoupling utility revenue from electricity sales.
• Removing system-wide caps on net energy metering.
• New programs for solar water heating and photovoltaics.
• Aggressively supporting alternative fuel and electric vehicles.
• Installation of advanced meters for customers who request them.

A significant piece of legislation was passed in the 2009 under Act 190 that alters the state's permitting process. First, renewable energy facilities greater than 5 MW are now able to apply for the Renewable Energy Facility Siting (REFS) process from HB2971 HD1—a permitting and regulatory framework for the construction of renewable energy facilities in the state (this was formerly only offered to renewable energy facilities greater than 200 MW). Additionally, while the decision to award or deny permits is retained by the state or county agencies, new legislation allows the Energy Resource Coordinator in DBEDT to force a decision to either grant or deny permits by no later than 18 months after the approval of a complete permit application. A third step that was taken in the 2009 Hawaii Legislature was the passage of Act 155, which requires DBEDT to identify Renewable Energy Zones (REZ)—areas that are rich in renewables, cost effective, and environmentally benign—and encourage development of these REZs for transmission of renewable energy. DBEDT is in the process of determining these zones, which will foster much quicker land-use permitting processes (DBEDT, 2010).

About 90% of Hawaii's energy comes from crude oil and petroleum imports. Disruptions in the world oil market have a considerable impact on Hawaii's economy. Also, Hawaii utilities do not have interconnections with utilities in other states and cannot rely on utilities from other states to provide back-up power to them when needed. Development of Integrated Resource Planning and Renewable Portfolio Standards are thus important for Hawaii in an effort to reduce oil imports, increase diversity of energy sources and provide reliable electricity to end users.

In 2006 Act 162 granted the PUC may establish standards for each utility that prescribe what portion of the RPS shall be met by specific types of renewable electrical energy resources. RPS standards may be met through production of electricity by fuels as well as implementation of conservation measures that save energy

To address these issues The State of Hawaii adopted four statutory energy objectives (HRS § 226-18a):

> *(1) Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;*
> *(2) Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;*
> *(3) Greater energy security in the face of threats to Hawaii's energy supplies and systems; and*
> *(4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.*

The first Renewable Portfolio Standard (RPS) was enacted into law in Hawaii in 2001 (Act 272). The RPS law established the percentage of electricity sales that should come from renewable energy sources. It established the goal of 7% of electricity sales from renewable energy sources by December 31, 2003, 8% by December 31, 2005, and 9% by December 31, 2010. The Hawaii State Legislature revised the State's RPS law in 2004 with Act 95, which required each electric utility company to establish a renewable energy portfolio standard of 10% of its net electricity sales by December 31, 2010; 15% by December 31, 2015; and 20% by December 31, 2020. The RPS law allowed an electric utility company and its electric utility affiliates to aggregate their renewable portfolios in order to achieve the RPS.

(HRS § 269-91) defines renewable energy as: energy generated or produced utilizing the following sources:

(1) Wind;
(2) Sun;
(3) Falling water;
(4) Biogas (including landfill and sewage-based digester gas);
(5) Geothermal;
(6) Ocean water, currents, and waves;
(7) Biomass (including biomass crops, agricultural and animal residues and wastes, and municipal solid waste);
(8) Biofuels; and
(9) Hydrogen produced from renewable energy sources.

4.3 City and County of Honolulu Policies Supporting Alternative Energy

At the City and County level, land use guidelines are defined in a three-tiered system. The basis of the other guidelines is defined in the County General Plan which contains simple broad concepts that are further interpreted in the subsequent tiers. Four objectives in the Honolulu General Plan support the proposed action:

Objective A: Maintain an adequate, dependable, and economical supply of energy for residents.
Objective B: To conserve energy through the more efficient management of its use.
Objective C: To fully utilize proven alternative sources of energy.
Objective D: To develop and apply new, locally available energy resources.

The second level of policy is the Sustainable Communities Plan or Development Plan. Sustainable Communities Plans are prepared in districts that do not wish to be heavily developed. These plans generally describe more land uses that are not acceptable that uses that are acceptable. Only Urban Honolulu and Ewa have Development Plans indicating that they are more suitable for development. The proposed action is located in the Ewa District.

Ordinances and regulations pertaining to power generating and other land uses are contained in the Land-Use Ordinance (LUO) prepared by the Department of Planning and Permitting. The LUO regulates land use in a manner that will encourage orderly development, while also providing more specific development and design standards. Permitting requirements for compliance with the LUO include building, grading and Special Management Area (SMA) permits, which will be required for the proposed action.

5.0 SUMMARY OF IMPACTS AND MITIGATION MEASURES

Affected Environment	Level of Concern	Impact and Mitigation
Water Resources and Drainage	low	*Impact:* Potential stormwater runoff during construction *Mitigation:* NPDES construction permitting with best management practices
Seismic and Geological	No	*None*
Soils and Agriculture	Low	*Impact:* Soil erosion during construction *Mitigation:* Grading permit to include Erosion Control Plan
Flora and Fauna	No	*None:* Area is previously disturbed and dominated by invasive species
Air Quality	Low	*Impact:* Fugitive dust during construction *Mitigation:* Grading Permit to include Dust Control Plan
Visual Character	No	The area is industrial and currently has no scenic vistas or unique view planes
Noise	No	Noise negligible during operation and consistent with surrounding during construction.
Odor	No	None
Social	No	*None:* area is vacant with use restrictions.
Historical and Archaeological	Low	*Impact:* Possible discovery during construction, but not likely due to previous grading and fill *Mitigation:* Employee training in the event of a discovery
Economic	Positive	*Impact:* reduces dependence on foreign oil and provides power at a stable, known cost.
Public Facilities and Services	Low	*Impacts:* Potential safety impacts on use and utility of Kalaeloa Runway 11 *Mitigation:* All studies indicate that glint/glare will not impact use. Structures beneath RPZ to be designed and operated in a manner that will promote aircraft safety.
Roads and Traffic	No	*Impact:* Traffic volumes will be negligible during both construction and operation.
Public Utilities	Positive	Proposed action provides power and does not utilize potable water, wastewater, or other services.
Consistency with Govt. Plans and Policies	Consistent	Eco-industrial designation in HCDA Kalaeloa Master Plan
Irretrievable Commitment of Resources	Positive	Does not utilize public funds and conserves fossil fuels.

5.1 Determination of Significance

In determining whether an action may have a significant effect on the environment under HRS 11-200, the proponent must consider every phase of a proposed action, the expected consequences, both primary and secondary, and the cumulative as well as the short-term and long-term effects of the action.

An action shall be determined to have a significant effect on the environment if it:

1. *Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;*

   The proposed action would not result in an irrevocable commitment, loss or destruction of any protected natural resource. No threatened or endangered species were identified within the development area. Previous archeological studies as well as the review conducted for the benefit of this EA concluded that there is no evidence of cultural or historical artifacts within the area of the proposed action.

2. *Curtails the range of beneficial uses of the environment;*

   The property has been previously graded and the land that would be used is currently vacant. In addition, the site is designated for development and eco-industrial use in the Kalaeloa Master plan. The proposed renewable energy project is an eco-industrial use. The site is beyond the end of a crosswind runway at Kalaeloa Airport, and therefore has restricted uses due to aircraft operations. It will separated by two fences from the aircraft operating areas. These fences are designed as arresting gear in the event of an emergency landing that overruns the end of the runway.

3. *Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;*

   The purpose of HRS 344 is to establish a state policy which will encourage productive and enjoyable harmony between people and their environment, promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, and enrich the understanding of the ecological systems and natural resources important to the people of Hawaii. The renewable energy project would potentially reduce Hawaii's reliance on fossil fuels to produce energy and reduce the amount of greenhouse gases generated from energy production. It would not have direct adverse impacts land, water, mineral, visual, air and other natural resources. The proposed action will provide services to benefit the health and welfare of the population and DHHL beneficiaries.

4. *Substantially affects the economic welfare, social welfare, and cultural practices of the community or State;*

The proposed action has beneficial impacts on socioeconomics during construction related to employment opportunity and purchase of materials. During operations, the benefit to social welfare of the community and State would be realized cumulatively as other renewable energy projects are developed decreasing the State's reliability on fossil fuels for energy production. There would be new fulltime jobs created.

5. *Substantially affects public health;*

   During both construction and operation of the proposed project, no adverse impacts to public health are anticipated. Construction and operation would be compliance with all federal, state, and county regulations. The proposed project would not have any significant adverse effects on public health and welfare and would contribute to decreasing greenhouse gas emissions, a positive effect on public health.

6. *Involves substantial secondary impacts, such as population changes or effects on public facilities;*

   Secondary impacts are defined as those displaced in time or space from the proposed action, yet resulting directly from the action. No substantial changes in population, traffic or land-use are envisioned.

7. *Involves a substantial degradation of environmental quality;*

   Temporary impacts associated with construction will be mitigated through best management practices. These impacts ambient noise and fugitive dust are not expected to be substantial or lasting. During operations the level of use is not expected to result in degradation of the quality of life or the environment within the community.

8. *Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;*

   The proposed action is not part of a larger initiative within the County or State. Construction of the facility implies a larger commitment of personnel and funding to support its operation.

9. *Substantially affects a rare, threatened, or endangered species, or its habitat;*

   A letter to the US Fish and Wildlife Service in June 2010 did not identify any special-status species or critical habitats located on the subject property.

10. *Detrimentally affects air or water quality or ambient noise levels;*

    Temporary impacts associated with construction will be mitigated through best management practices. These impacts ambient noise and fugitive dust are not expected to be substantial or lasting. During operations the level of use is not expected to result in degradation of the quality of life or the environment within the community

11. *Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;*

    The site is located in FEMA flood zone D and is outside the 100-year floodplain. It is also outside the Oahu Civil Defense Tsunami inundation zone. Soils are relatively porous and surface water runoff conditions are limited to heavy rain events. The project site is close to one mile north of the nearest surface water at the coastline of southwest Oahu.

12. *Substantially affects scenic vistas and view planes identified in county or state plans or studies; or,*

    No scenic vistas or unique view planes will be affected by the proposed action.

13. *Requires substantial energy consumption.*

    The proposed project would require some electrical consumption during construction. However, it would not require substantial energy consumption, but in fact would provide a total of 5.0 MW of electricity to HECO's existing power grid, thus contributing to the trend of decreasing Hawaii's dependence on petroleum based electricity.

Based on analysis of the 13 significance criteria listed above, the proposed action is not expected to result in significant adverse environmental impacts when conducted within the constraints of the required plans and permits. Pending comments received from the public and various agencies during this DEA review period, the Department of Hawaiian Home Lands (approving agency) anticipates a Finding of No Significant Impacts (FONSI)

6.0 COMMENTS AND COORDINATION

6.1 Agencies and Organizations Contacted

The following agencies were contacted for assistance during preparation of the Draft Environmental Assessment.

Mr. Cameron Black
Strategic Industries Division
Hawaii State Department of Business, Economic Development, and Tourism
PO Box 2359
Honolulu, Hawaii 96804

Director
State Historic Preservation Division, DLNR
Kakuhihewa Building,
601 Kamokila Blvd., Suite 555,
Kapolei, Hawai`i, 96707

Oahu District Manager
Honolulu International Airport
300 Rodgers Boulevard
Honolulu, HI 96819
(808) 836-6411

Director
Hawaii Dept. of Transportation
Airports Division
400 Rodgers Boulevard, 7th Floor
Honolulu, HI 96819-1880

Director
Department of Transportation
Airports Division Engineering Branch
400 Rogers Blvd, Suite 700
Honolulu, HI 96819-1880

US Coast Guard, Air Station Barbers Point
1 Coral Sea Road
Kapolei, HI 96707

Daniel Oshiro, NEPA Coordinator
Hawaii National Guard Environmental Office
3949 Diamond Head Road Rm. 112
Honolulu, HI 96816

Director
Honolulu Community College
Commercial Aviation Program
Kalaeloa Airport Hangar 111
91-1259 Midway Rd.
Kapolei, HI 96707

HCDA Kalaeloa Field Office
Kapolei Building
1001 Kamokila Blvd, Suite 167
Kapolei, HI 96707

Mr. Robert Mills
Department of Planning and Permitting
City and County of Honolulu
650 S. King St. Honolulu, HI 96823

6.2 Public Coordination and Individuals Consulted

The following individuals and public interest groups were contacted for assistance during preparation of the Draft Environmental Assessment.

Mr. Paul "Kaipo" Pomaikai, Sr., President
Kanehili Homestead Association
91-1335 Kinoiki Street
Kapolei, HI 96707

Ms. Shirley Swinney, President
Kapolei Community Development Corporation
91-216 Koanimakani Place
Kapolei, HI 96707

Ms. Michelle Kauhane, President
Kaupe'a Homestead Association
91-1036 Kahanalei Street
Kapolei, HI 96707

Ms. R. Homelani Schaedel, President
Malu'ohai Residents Association
91-1016 Koanimakani Place
Kapolei, HI 96707

Mr. Brian Daniel, Pilot
3031 Manoa Road

Honolulu, Hawaii 96822

Mr. Rob Moore, Chief Flight Instructor
Gavin Flight Services Hawaii
91-1259 Midway Road
Hanger 111
Kapolei, Hawaii 96707

7.0 LIST OF DOCUMENT PREPARERS

This document was prepared under the direction of The Department of Hawaiian Home Lands

Mr. Todd Gray, Land Manager
Ms. Linda Chinn, Administrator

Kalaeloa Home Lands Solar, LLC Ms. Jody Allione, Project Development Manager and staff of AES Solar, LLC supplied information and technical details that were invaluable for preparation of this Environmental Assessment.

Document preparation and technical research was done by:

North Shore Consultants, LLC David Robichaux, Project Manager
Ming-Li Wang and Janine K. Seymour, Contributing Authors.
Archaeological review was done by Rechtman Consulting, LLC; Bob Rechtman, Principal

8.0 BIBLIOGRAPHY

Athens, J.S., J. Ward, H.D. Tuggle, and D.J. Welch. 1997. Environment, Vegetation Change, and Early Human Settlement on the Ewa Plain: A Cultural Resource Inventory of Naval Air Station Barbers Point, Oahu, Hawaii, Part III: Paleoenvironmental Investigations. Prepared for the Department of Navy, Pacific Division, Naval Facilities Engineering Command.

Environmental Law Institute (2009) Adenike Adeyeye, James Barrett, Jordan Diamond, Lisa Goldman, John Pendergrass, and Daniel Schramm. Estimating U.S. Government Subsidies to Energy Sources: 2002-2008"

Federal Aviation Administration (1999) Advisory Circular. 150/5300. Airport Design Paragraph 5.b Appendix 14

Federal Aviation Administration (2010a) Airport Information Effective June 30, 2011 http://www.airnav.com/airport/PHJR

Federal Aviation Administration (2010b) Technical Guidance for Evaluating Selected Solar Technologies on Airports. FAA Airport Planning and Environmental Division (APP-400) 800 Independence Avenue SW, Washington D.C. 20591

Hawaii Community Development Authority (2006). Kalaeloa Master Plan. Prepared by Belt Collins, EDAW, SMS, BAE, and Ebisu. March 2006.

Hawaii Department of Agriculture (1977) Agriculture Lands of Importance, State of Hawaii.

Hawaii Department of Business, Economic Development, and Tourism (2010a). Hawaii Proposed and Existing Renewable Projects, PowerPoint presentation. December 2010.

Hawaii Department of Business, Economic Development, and Tourism (2010b), Progress Report to the Governor and the Legislature Pursuant to SECTION 196-41, Hawaii Revised Statutes (HRS) Submitted by The State of Hawaii Department of Business, Economic Development and Tourism January 4, 2010. http://hawaii.gov/dbedt/main/about/annual/2010-reports/rps2010.pdf

Hawaii Department of Hawaiian Home Lands (2011), Draft Environmental Assessment Kalaeloa Solar One and Two. Prepared by TEC, Inc. 1003 Bishop St, Suite 1550 Honolulu, HI 96813

Hawaiian Electric, 2008 Energy Agreement among the State of Hawaii, division of Consumer Advocacy of the Department of Commerce and Consumer Affairs and The Hawaiian Electric Companies. http://www.heco.com/vcmcontent/StaticFiles/pdf/HCEI.pdf

Sovacool, Benjamin K. (2010). A Critical Evaluation of Nuclear Power and Renewable Electricity in Asia, *Journal of Contemporary Asia*, Vol. 40, No. 3, August 2010

TEC Inc. 2010b. Phase 1 Environmental Site Assessment (ESA) for 56 Acres of Land within TMK: [1]9-1-13: Parcel 28, Kapolei, Hawaii. December 2010.

US Energy Information Administration (2011). Annual Energy Outlook, 2011; DOE/EIA-0383 2010. December 2010.

US Navy (2008). Final Environmental Impact Statement. Conveyance of Navy Retained Land and Utility Systems, Kalaeloa, Oahu, Hawaii, dated July 2008

Appendix A

Comments received from Agencies and Interested Parties During Preparation of the DEA

NORTH SHORE CONSULTANTS, LLC

Participant

Dear Participant:

The purpose of this letter is to inform you of a proposed Photovoltaic Park to be constructed in your community, and to request information that is relevant to potential environmental impacts or issues that may affect your quality of life. This proposed development will be the subject of an Environmental Assessment required by HRS 343. The Draft Environmental Assessment (DEA) will be published within the next few months. Following publication there will be a 30-day official comment period; however, because you have participated in previous community outreach efforts, I ask that you assist with the development of the DEA by providing comments or questions early in the process. You will receive a copy of the DEA and have a second chance to comment at that time.

Project Location and Description

AES Solar Power, LLC has proposed to build a 3.75 MW solar power photovoltaic system on approximately 29 acres located at the end of the cross-wind runway at John Rogers field (Kalaeloa airstrip) as shown in Figure 1. The photovoltaic system will be a series of ground supported flat panels mounted on tracking mechanisms which allow the panels to follow the sun in order to maximize power output. Each panel is 39 inches wide and 66 inches long dark in color and stand between 4 and 8 feet above ground level. The maximum height varies throughout the day as panels move to maintain the best sun angle. Similar tracker-mounted panels are shown in Figure 2. Approximately 15,840 panels will be required to produce an average of 3.75 MW of peak power. The glass on each panel is treated with a coating to absorb most glint and glare. Studies have shown that the reflectivity of this type of PV panel is acceptable for installation near airports.

All-weather gravel roads will be constructed around the site perimeter and between rows of solar panels. The facility will be unmanned except for regular maintenance activities such as mowing or landscaping. No employee housing or other habitable structures will be constructed on the site. The installation does not emit noise, dust, or odors during operation. Electrical power is produced during daylight hours; however, in the traditional sense the hours of operation cannot be determined without instrumentation. Alternating Current (AC) electric power will be transmitted to the nearby JRF substation on the north boundary of the subject property using underground transmission lines.

Each written comment will be reproduced and addressed in the DEA. If you would like to discuss the proposed project or provide less formal comments please call or email me at your convenience.

Thank You,

NORTH SHORE CONSULTANTS, LLC

David M. Robichaux, Principal

P.O. Box 790
Hale‘iwa, Hawai‘i 96712

Telephone: 808.637.8030
Telephone: 808.368.5352
robichaud001@hawaii.rr.com

Agency

AES Solar Power, LLC Proposed PV Park
TMK# 9-1-013:029 Kalaeloa, Hawaii

North Shore Consultants is beginning an Environmental Assessment under HRS 343 for a proposed photovoltaic park to be located near the west end of Runway 11/29 Kalaeloa Airport (JRF). As a user or stakeholder in JRF, we request your participation with the development of the Draft Environmental Assessment (DEA) through consultation or by providing comments early in its development.

Project Location and Description

AES Solar Power, LLC has proposed to build a 3.75 MW solar power photovoltaic system on approximately 29 acres located at the end of the cross-wind runway at John Rogers field (Kalaeloa airstrip) as shown in Figure 1. The photovoltaic system will be a series of ground supported flat panels mounted on tracking mechanisms which allow the panels to follow the sun in order to maximize power output. Each panel is 39 inches wide and 66 inches long dark in color and stand between 4 and 8 feet above ground level. The maximum height varies throughout the day as panels move to maintain the best sun angle. Similar tracker-mounted panels are shown in Figure 2. Approximately 15,840 panels will be required to produce an average of 3.75 MW of peak power. The glass on each panel is treated with a coating to absorb most glint and glare. A glint/glare study has been performed and is available upon request. It concludes that the reflectivity of this type of PV panel is acceptable for installation near airports.

All-weather gravel roads will be constructed around the site perimeter and between rows of solar panels. The facility will be unmanned except for maintenance activities such as mowing or electrical maintenance. No employee housing or other habitable structures will be constructed on the site. The installation does not emit noise, dust, or odors during operation. Alternating Current (AC) electric power will be transmitted to the nearby JRF substation on the north boundary of the subject property using underground transmission lines.

Each written comment will be reproduced and addressed in the DEA. If you would like to discuss the proposed project or schedule a meeting, please call or email me at your convenience.

Thank You,

NORTH SHORE CONSULTANTS, LLC

David M. Robichaux, Principal

P.O. Box 790
Hale‘iwa, Hawai‘i 96712

Telephone: 808.637.8030
Telephone: 808.368.5352
robichaud001@hawaii.rr.com

David Robichaux

From: Brian Daniel <nairb@lava.net>
Sent: Saturday, July 16, 2011 9:58 PM
To: robichaud001@hawaii.rr.com
Cc: Coiln Perry; Colby Jones; Anthony Ferrara; Rob Moore
Subject: Photovoltaic panels and supporting structures in harm's way

Dear Dave Robichaux;

At every other airport in this state, and nationwide, there is a grass buffer zone on the approach end of every runway for a very good reason. Why put the solar panel farm directly in line with and very close to an active runway? There is lots of Keawe bush all around Kaleloa, can't the solar panel farm be located off to the side, a safe distance from landing and takeoff air traffic? My concern is not only for myself and my airplane, but also for the solar panels, they are expensive, if they are so expendable as to put them directly in the sights of fast aluminum hurtling down a runway, then why not put them on my roof where they will be protected from such hazards?

Brian Daniel
3031 Manoa Road
Honolulu, Hawaii 96822

FRESNO YOSEMITE
INTERNATIONAL AIRPORT

City of Fresno Airports Department

February 22, 2010

Tanya Martinez
US Solar
PO Box 44485
Phoenix, AZ 85064

SUBJECT: Photovoltaic System at Fresno Yosemite International Airport (FAT)

Dear Ms. Martinez:

In 2008 a 2 megawatt PV system was brought on line at FAT. The system is located on a 20 acre parcel of airport land approximately 1500 feet from and within the approach zone of our primary runway. During the design process the issue of reflectivity was vetted to the fullest extent possible at that time. The research involved (i) discussions with various PV manufacturers, (ii) study of other PV systems in close proximity to an airport, and (iii) a complete FAA 7460 airspace review of our PV project. Our research, which was supported by the FAA through the 7460 process, determined that PV panels do not create glare or any other hazard to aircraft. The PV system at FAT was one of the first and is the largest single installation at any airport in the United States. To date, there have been no complaints from any pilot or the FAA Tower. In addition, a second 1 megawatt PV system was installed off airport (approximately 3000' north and abeam the primary runway). This system also went through the FAA 7460 process and has now been operational for over 12 months with no pilot or FAA Tower complaints. These installed systems have reaffirmed our finding that reflectivity is not an issue for aviation and dispels the common misconception that PV panels create glare.

From an airport perspective, we have enjoyed the benefit of using renewable power for 58% of our total demand and have realized financial savings within the first year of operation. The PV system at FAT is big part of our ability to remain self sustaining and meet the financial obligation of our federal grant assurances.

Please feel free to forward this letter on to whomever you feel can benefit from this information. If there are any further questions regarding our solar PV installation, feel free to contact me at 559-621-4536 or kevin.meikle@fresno.gov.

Sincerely,

Kevin Meikle,
Airports Planning Manager

Cc: Riverside County ALUC
Kimchi Hoang, FAA Western Pacific Region

J:\Land Use 2010\PV Reflectivity Letter.doc

4995 E. Clinton Way · Fresno CA, 93727-1525 · (559) 621-4500 · www.flyfresno.com

GACH AIR SCOOP
THE NEWSLETTER OF

General Aviation Council of Hawaii
WWW.GACH.US.COM

90 Nakolo Place
Suite 117
Honolulu, Hawaii 96819

August 17, 2011

North Shore Consultants, LLC
PO Box 790
Haleiwa, Hawaii 96712
Attn.: David M. Robichaux

Dear Mr. Robichaux,

Thank you for giving the pilots of the General Aviation Council of Hawaii (GACH) an opportunity to comment on the AES Solar Power, LLC Proposed PV Park at TMK# 9-1-013:029 at Kalaeloa Airport. The General Aviation Council of Hawaii is made up of pilots and businesses that support and participate in general aviation throughout the Hawaii Islands. The greatest share of our membership is from Oahu. We asked our membership for comments on your project based upon the information that you provided us in your June 2011 letter and subsequent email with project specifics attached.

GACH is very supportive of renewable energy projects that assist Hawaii in becoming less energy dependent. However, two concerns were highlighted by our aviation community. The first concern is the location of the project in reference to Runway 11/29 at Kalaeloa Airport. The project appears to be in line with the runway's centerline which seriously impacts the runway's safety area. The RSA is an area of an airport where out buildings, facilities, and other structures are not built in order to improve pilot/airplane survivability in case of an off –runway landing or overshoot. The proposed structures by AES Solar Power at or near the Runway 11/29 RSA would be a detriment to aviation safety. Secondly while even the provided study appears very through, the aviation community expressed concern with the glint and glare of the panels when on takeoff, approach or landing at Kalaeloa Airport. More information needs to be provided to the aviation community before a final determination can be made.

Again, thank you giving the general aviation community an opportunity to address your project. Please keep us informed of project changes that could mitigate our concerns or that change or expand the project which would cause a new review. If you would like to discuss our comments, please email me at info@gach.us.com or call me at 808-223-9991.

Thank you,

Robert P. Moore, President
General Aviation Council of Hawaii

Appendix B

Letter from USFWS regarding Threatened and Endangered Species

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2010-TA-0329

JUL 2 2 2010

Mr. David M. Robichaux
North Shore Consultants, LLC
P.O. Box 790
Haleiwa, Hawaii 96712

Subject: Species List for a Photovoltaic Installation at Kalaeloa Airport, Oahu

Dear Mr. Robichaux:

Thank you for your letter received July 13, 2010, requesting information regarding the presence of threatened and endangered species or federally designated critical habitat located near the Kalaeloa Airport on the island of Oahu [TMK(1) 9-1-013:033]. The proposed project consists of grading and spot foundations.

We have reviewed the information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program and the Hawaii GAP Program. Land cover information indicates that the proposed project area is classified as high- and low-intensity development. To the best of our knowledge, no federally listed or proposed threatened or endangered species, or proposed or designated critical habitats occur within the project footprint.

If you have any additional questions, please contact Aaron Nadig, Fish and Wildlife Biologist, Consultation and Habitat Conservation Planning Program (phone: 808-792-9400; fax: 808-792-9581). Please also note that Patrick Leonard no longer works in our office; all written correspondence should be addressed to me.

Sincerely,

for Loyal Mehrhoff
Field Supervisor

TAKE PRIDE® IN AMERICA

Appendix C

Reflectivity Study for JRF

Appendix A

KALEOLOA – 5 MW PHOTOVOLTAIC POWER PLANT

REFLECTIVITY ANALYSIS

REVISION INDEX

Page/Reason	REV	Date	PROD	CHECK	APRV
All	0	10/11/2010	JDL	LOC	LTA

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

Contents

1 Introduction 3

2 Definitions 4

3 Mathematical analysis 6
3.1 Reference coordinate system 6
3.2 Sun position 7
3.3 PV modules and reflection equations 9
3.4 Approaching flight plane and reflectivity at Runways 04R & 22L 13
3.5 Reflectivity at Runways 11 and 29 17

4 Predominant wind direction 20

5 Conclusion 22

6 3D Graphic Simulation 23
6.1 Approaching fight to Runway 29 23
6.2 Approaching fight to Runway 22L 25

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

1 Introduction

This document analyzes the risk of sun reflectivity due to a future photovoltaic (PV) power plant being developed by AES Power, LCC. Project location is nearby the Kalaeloa (John Rodgers Field) airport in Kapolei, Hawaii. Reflectivity events due to the presence of PV modules might affect airplane visibility while approaching the corresponding airport runways, if reflected sun light beam intersects the flight path.

Fig. 1 shows the location of the future PV plant relative to Kalaeloa airport:

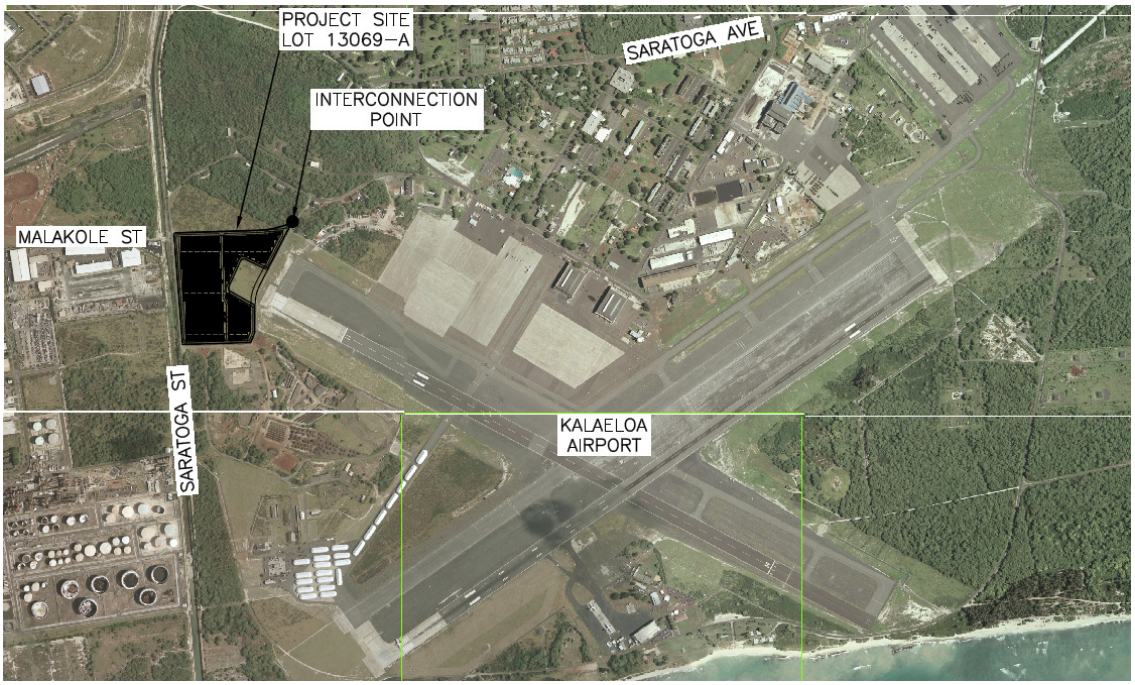


Fig 1.- Location of PV Project

To evaluate the risk of direct sun light reflection events a mathematical (geometric) model has been developed. The model predicts when in the year there is a possibility for approaching airplanes to suffer direct reflection.

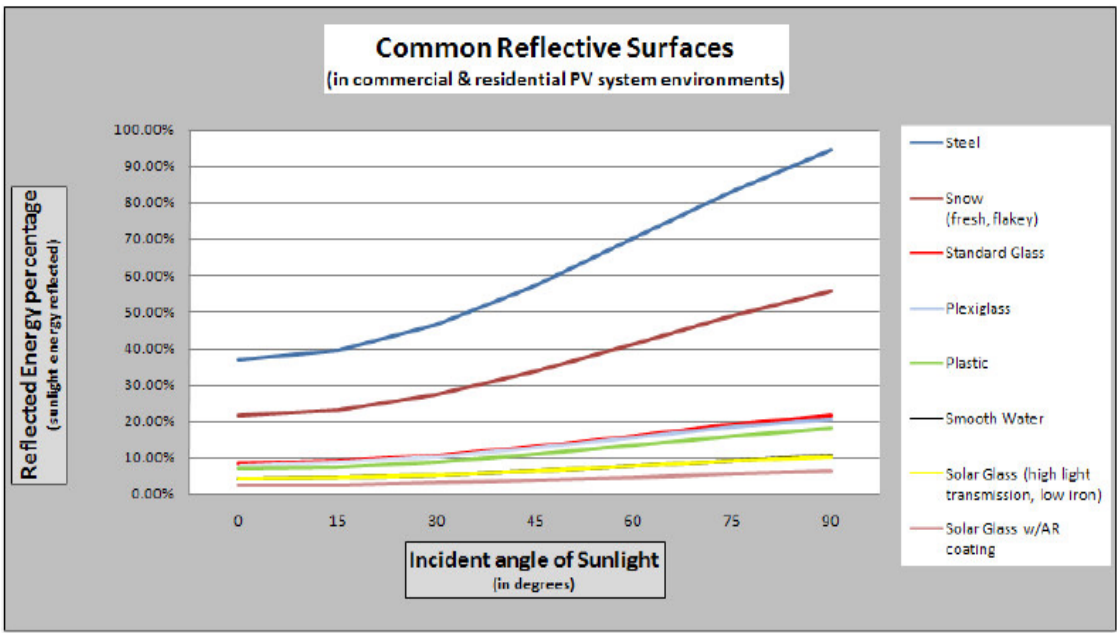
In a second step, 3D graphic simulations (virtual images) are produced to obtain photographs of the scenario in which the reflections might occur, thus allowing visualizing the intensity of the effect. The 3D models also includes other reflecting surfaces in the airport environment, as the ocean and existing constructions built with reflective materials.

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

2 Definitions

The following definitions and descriptions are key to understanding the methodology and results of the study:

Photovoltaic Module – Photovoltaic panels, also known as PV modules. By nature, PV panels are designed to absorb as much of the solar spectrum as possible in order to convert sunlight to electricity. Reflectivity levels of solar panels are decisively lower than standard glass or galvanized steel, and should not pose a reflectance hazard to viewers. The next graph relates the reflectivity properties of solar modules in function of the incidence angle, and compares with other common reflecting surfaces in an airport environment:



Reflected light from PV modules' surface is just between 10% - 20% of the incident radiation, as low as water surfaces, while galvanized steel (used in industrial roofs) is between 40% and 90%. It should also be noted that high incidence angles are always related to low sun elevation angles (i.e, the sun beams are close to be tangent to the reflecting surface) and, in this case, the intensity of incident light is much lower than -say- noon time.

Glint – Also known as a specular reflection, produced by direct reflection of the sun in the surface of the PV solar panel. This is the potential source of the visual issues regarding viewer distraction.

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

Glare – A continuous source of brightness, relative to diffused light. This is not a direct reflection of the sun, but rather a reflection of the bright sky around the sun. Technically this is described as the reflection of the circumsolar diffuse component. Glare is significantly less intense than glint.

Key View Point (KVP) – KVPs are viewpoints used in the glint and glare study, and serve as the offsite viewpoint locations for photo simulations. In this analysis, KVP can be any point in the most probable airplane approaching path to the airport runways.

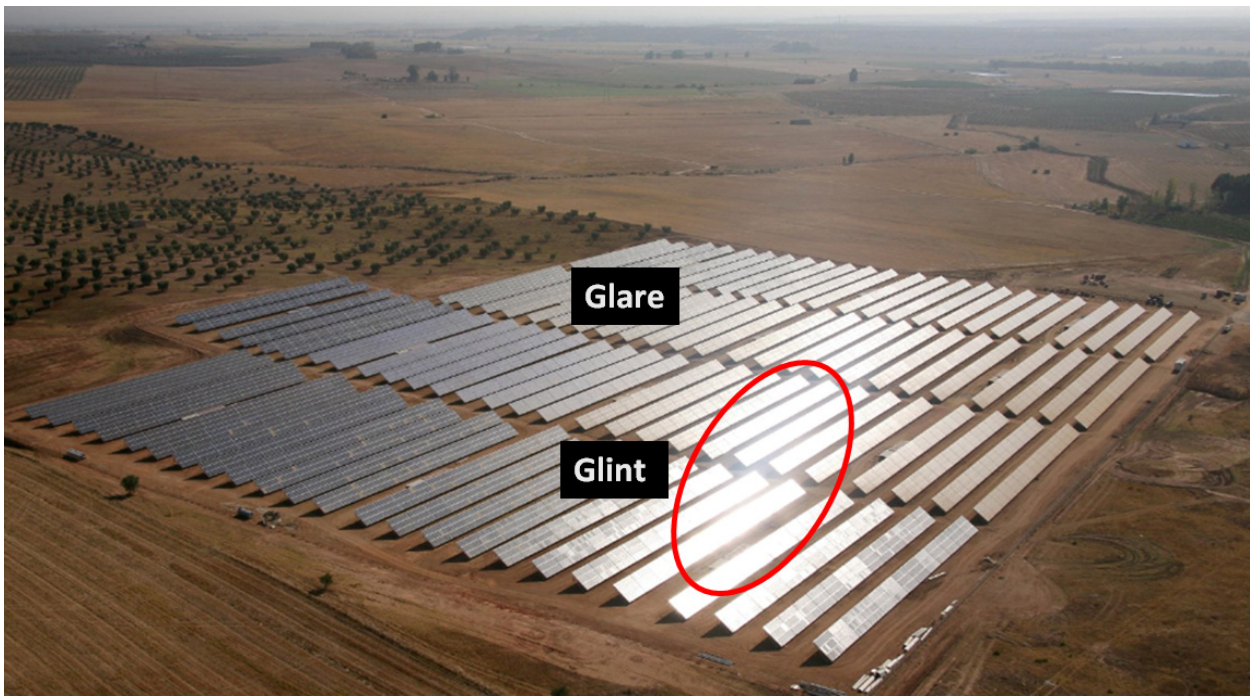


Fig 2 .- Glint and Glare

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

3 Mathematical analysis

3.1 Reference coordinate system

Solar reflection from flat surfaces is a mathematical problem that can be solved by means of 3D geometry concepts. In order to properly relate sun position, PV modules position and orientation, and KVP location; is necessary to define a global coordinate system to which the previous position and orientation will be referred to.

In this analysis, the 3D Cartesian coordinate system is defined as follows:

Positive X-Axis	Pointing South
Positive Y-Axis	Pointing East
Positive Z-Axis	Pointing upwards

Origin of the coordinate system is chosen at the future PV plant location, as shown in Fig. 3 below:

Fig 3 .- Reference coordinate system

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

3.2 Sun position

Instantaneous sun position is defined by two angular (spherical) coordinates. These angles are Azimuth (φ) and Elevation (θ). Azimuth is the deviation of sun's horizontal projection from South, while elevation is the angle between the horizontal plane and sun's position. The following graphs illustrates above definitions, and criteria for positive values:

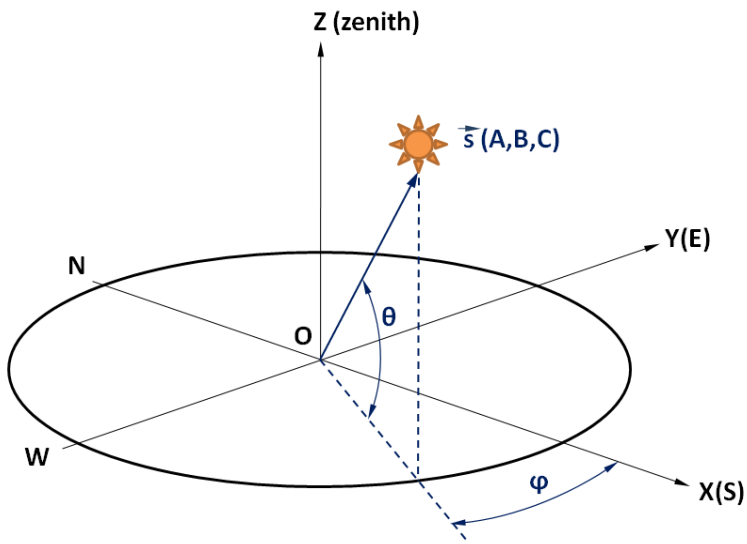


Fig 4.- Sun position coordinates

Sun position can be also defined by a unit-length pointing vector s = (A, B, C). Cartesian coordinates of the sun position vector are written in terms of the azimuth and elevation angles as follows:

$$A = \cos\theta \ \cos\varphi$$
$$B = -\cos\theta \ \sin\varphi$$
$$C = \sin\theta$$

Azimuth and elevation angular coordinates (φ, θ) are both function of:

- Earth latitude (L) at the origin
- Day of the year (i) and hour of the day (H)

and can be calculated as per the following equations:

Earth declination:

$$D = 23.45 \ \sin(0.986[284 + i])$$

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

Azimuth and elevation angles:

$$\sin\theta = \sin D \sin L + \cos D \cos L \cos H$$

$$\cos\varphi = \frac{\sin D \cos L - \cos D \sin L \cos H}{\cos\theta}$$

In the above expressions the day of the year (i) is following a Julian day convention (January, 1st is i=1; February, 1st is i = 32,… until i =365). The hour of the day (H) is referred to noon time (12:00 is H = 0; 10:00 is H = -2; 14:00 is H = +2; … etc).

As an example, the calculated values for azimuth and elevation angles for the equinox (March, 21st, i = 80) are plotted in function of the hour of the day in the next graph:

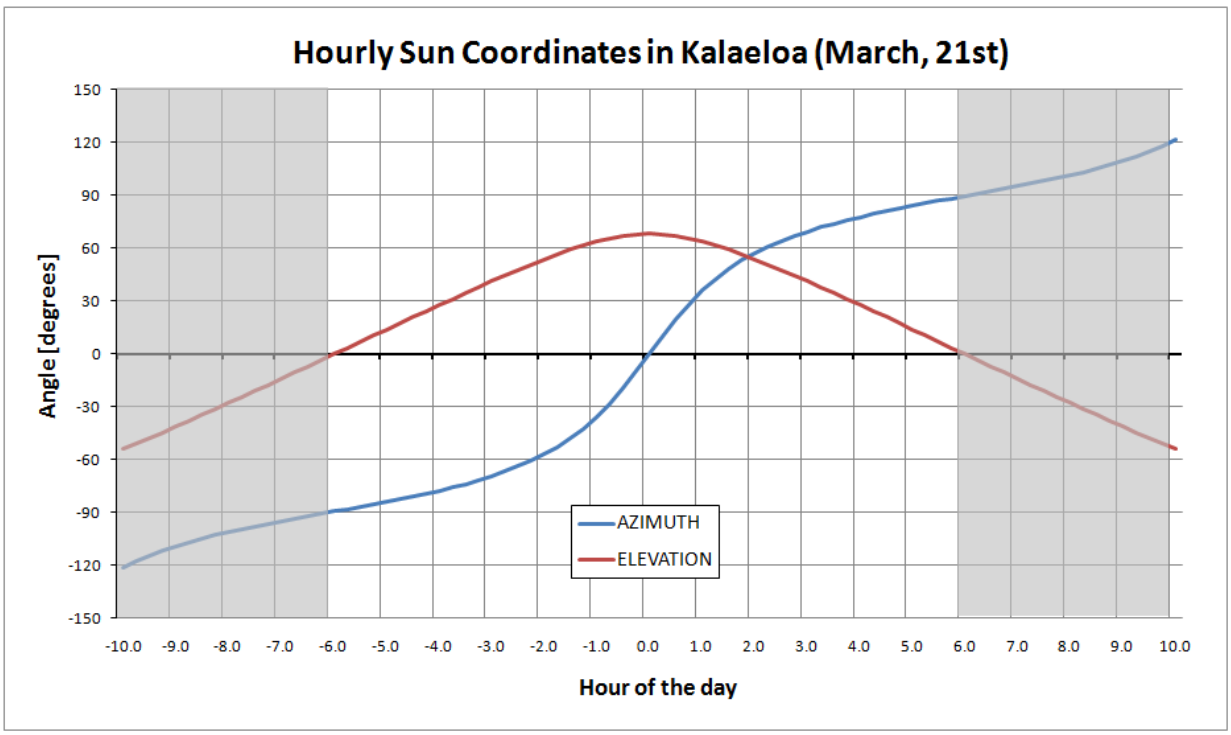


Fig 5.- Sun position coordinates

Negative values of the elevation angle means night time (the sun is below the horizon). In the above example the daylight period is 12 hours and the azimuth at sunrise is -90° (pure East), as expected for the equinox. Maximum elevation angle (at noon) is 68.24° for this latitude and particular day.

For the purpose of geometric calculations later in this report, the relevant results are the Cartesian coordinates of the sun position vector (A, B, C). For the sample day above, these are plotted in Fig. 6:

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

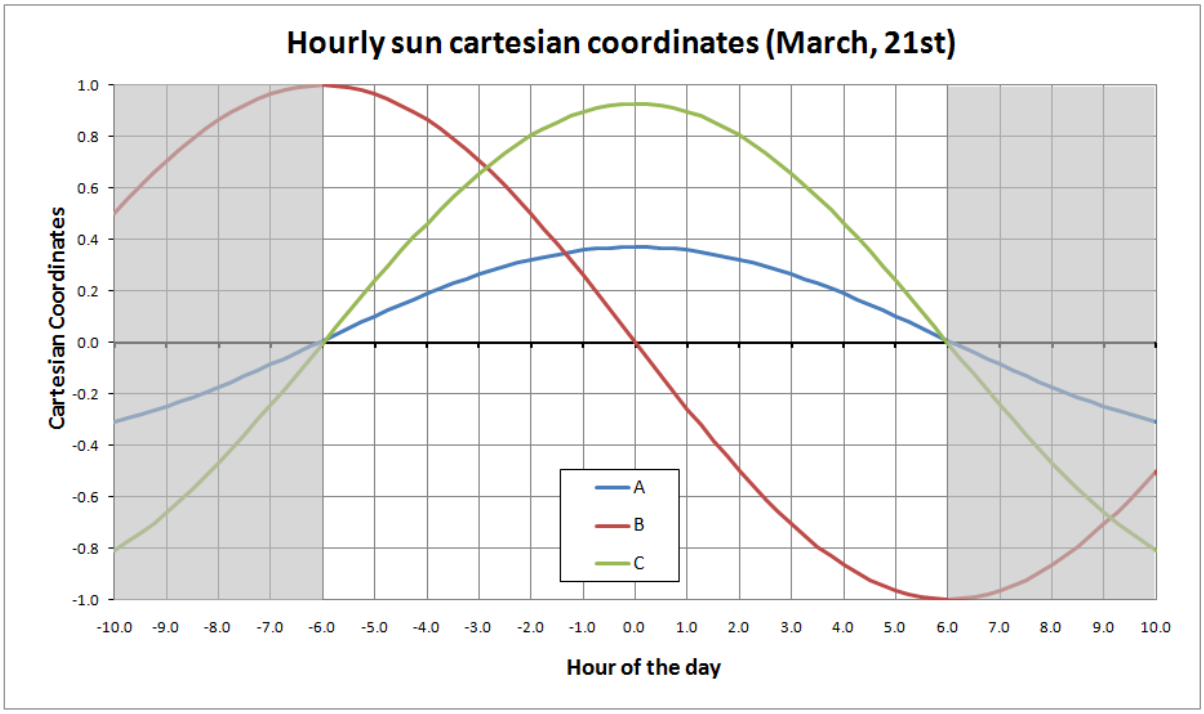


Fig 6.- Sun position Cartesian coordinates

3.3 PV modules and reflection equations

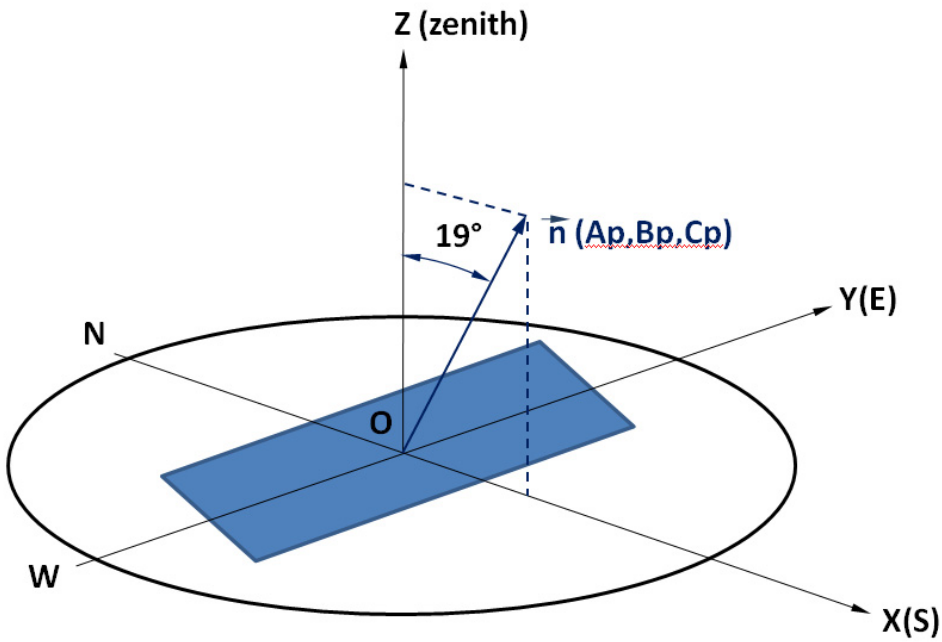
PV modules are considered reflecting planes located at the origin of the coordinate system (O). A plane is geometrically defined by its perpendicular (normal) unit vector [n].

Notation for Cartesian coordinates of this fixed vector is n = (Ap, Bp, Cp). From the PV plant optimum design, the PV modules are facing South with a tilt angle of 19°, as shown in Fig. 7.

Then the fixed coordinates of this normal vector for the reflecting plane are given by:

$$A_p = \sin 19° = 0.32557$$
$$B_p = 0$$
$$C_p = \cos 19° = 0.94552$$

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*



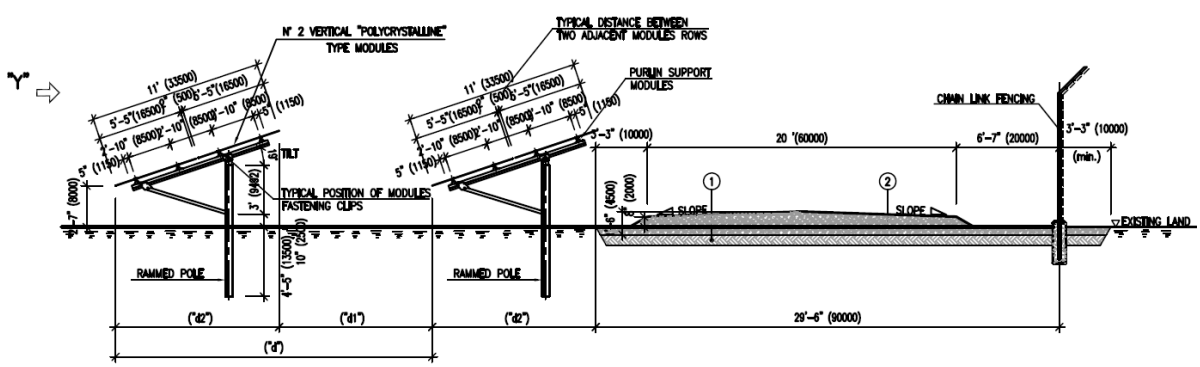
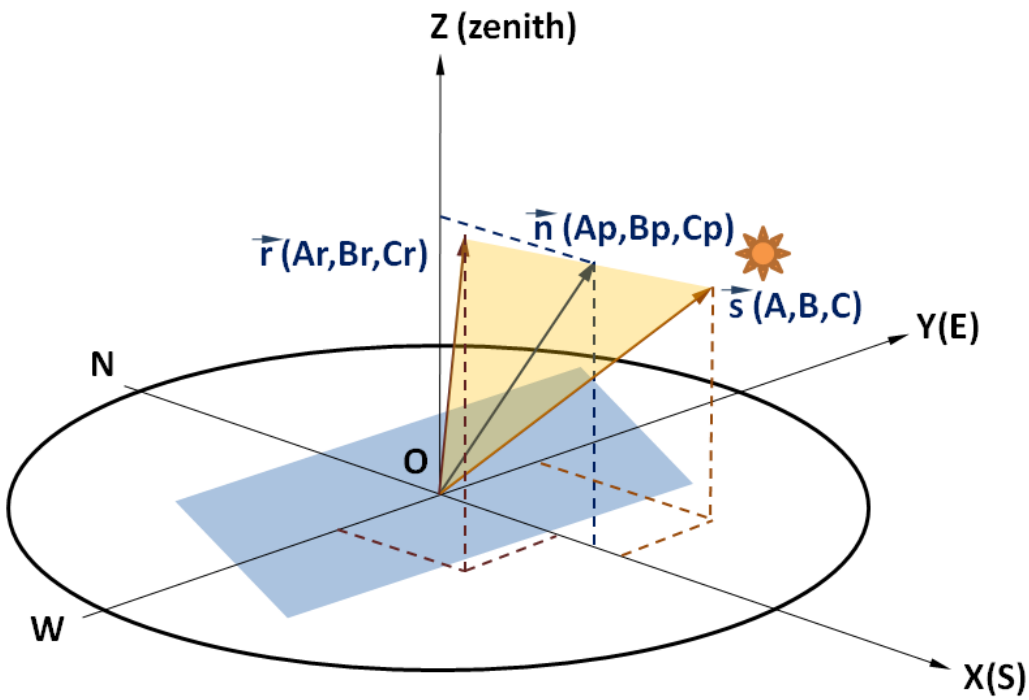


Fig 7.- Reflecting surfaces – Coordinates and typical PV design

Reflection of sun beams by a given surface can be calculated once the direction of the incident beam and plane orientation is known.

Instantaneous solar beam direction vector s = (A, B, C) and reflecting plane normal vector n = (Ap, Bp, Cp) intersects at the origin, and both defines a new plane in the space. From reflectivity laws, the reflected beam vector r = (Ar, Br, Cr) will be contained in this plane and symmetric to the incident beam with respect to the reflecting surface vector, as shown in the next figures:

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*



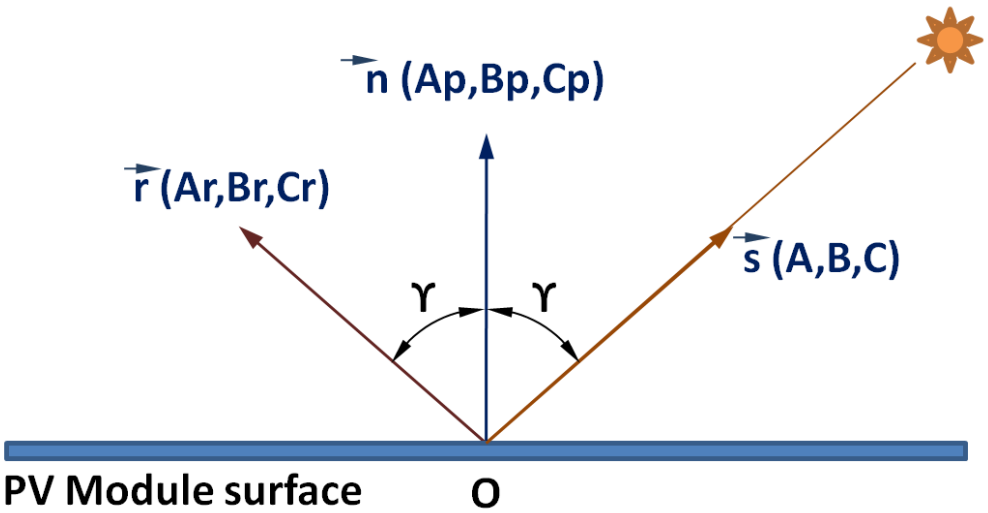


Fig 8.- Reflecting surfaces – Notation for reflected beam vector

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

A relevant variable in this figure is the incidence angle [ϒ], which measures the angle between the incident sun beam vector and the surface normal. No reflection can occur when the incidence angle is equal or larger than 90°. This situation will occur whenever the sun is behind the PV modules surface. The incidence angle can be calculated as per the dot product of unit vectors [s] and [n]:

$$\cos\gamma = \vec{s}\ \vec{n} = A\ A_p + B\ B_p + \ C\ C_p$$

The symmetric-reflected vector [r] is calculated as

$$\vec{r} = 2\ \cos\gamma\ \vec{n} - \ \vec{s}$$

and its Cartesian coordinates given by:

$$A_r = 2\ \cos\gamma\ A_p - A$$
$$B_r = 2\ \cos\gamma\ B_p - B$$
$$C_r = 2\ \cos\gamma\ C_p - C$$

For example, for the equinox day chosen the results for (Ar, Br, Cr) are plotted below in function of the hour of the day. Incidence angle also included.

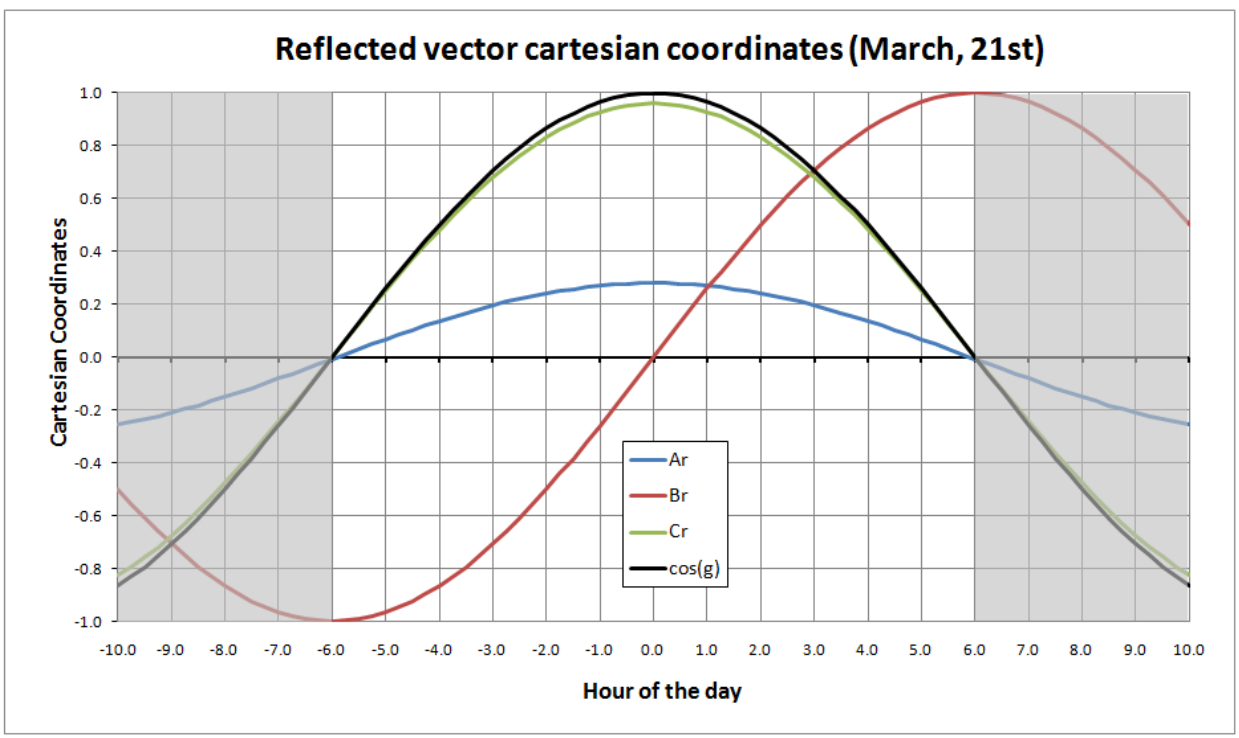


Fig 9.- Reflected vector coordinates and incidence angle

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

3.4 Approaching flight plane and reflectivity at Runways 04R & 22L

To define the location of relevant KVP it is hereby assumed that the approaching airplane follows a straight line contained in a vertical plane (the "flight plane") that also contains the runway axis (Fig. 10).

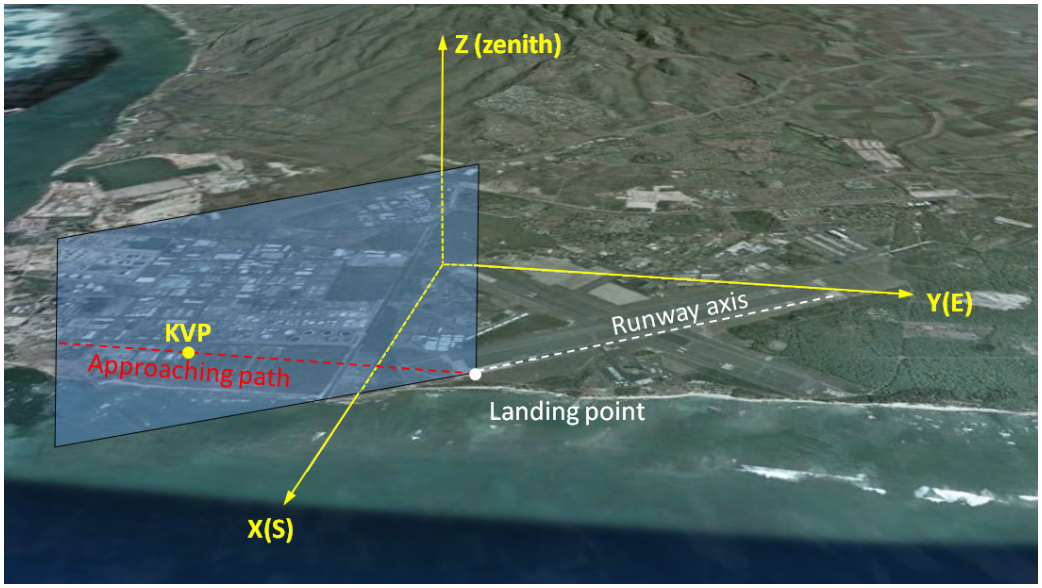
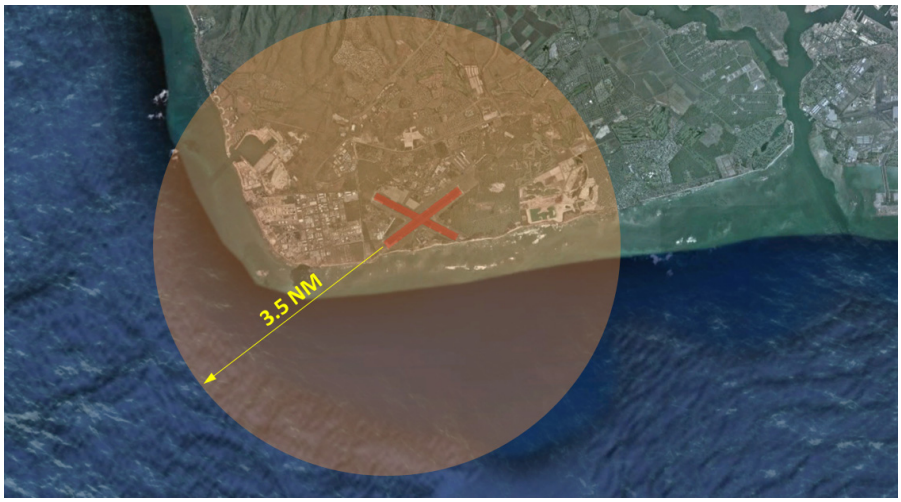


Fig 10.- Geometry of approaching path

The above assumption is valid whenever the airplane aligns the runway and faces the landing point, at the limit of the corresponding runway, which is the normal procedure for distances lower than 3.5 NM from the airport. It is considered that, at larger distances, reflection from the PV plant will not have any impact on visibility.



CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

The vertical flight plane, containing the approaching path, is defined by the following equation in the reference Cartesian axis system:

$$\Pi \equiv 0.70957\, x + 0.70463\, y - 4{,}693 = 0$$

Where 4,693 ft is the horizontal distance from the origin (O) to the landing point (Q).

A reflected solar beam will intersect the above flight plane in a given point P_i, with coordinates relative to the reference systems being $P_i = (x_i, y_i, z_i)$. As the sun moves along its daily path, the intersection point P_i will define the corresponding trajectory curve in the flight plane.

Whenever the curve drawn by successive P_i intersects the landing path of the airplane, at point T_i, there is a risk of glint (Fig. 11).

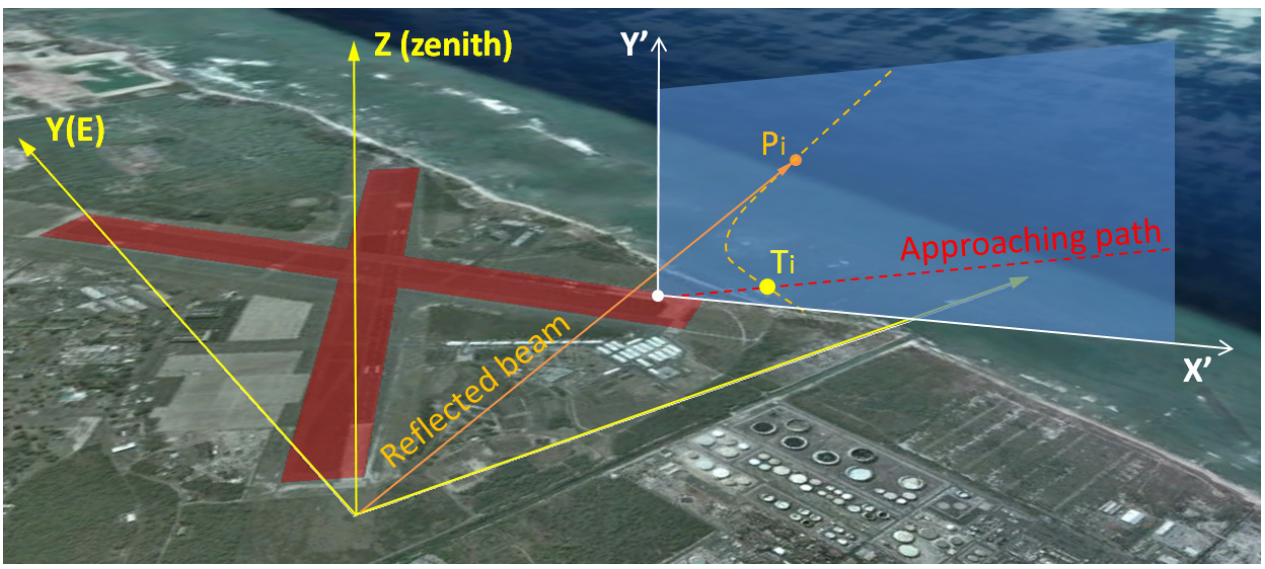


Fig 11.- Intersection of reflected beam with the flight plane(Runway 04R)

To calculate the position of the Ti points along the year, the following procedure applies:

Vector OP_i is an extension of the reflected beam unit vector r = (Ar, Br, Cr), so vector Pi can be written as

$$\overrightarrow{OP_i} = t\,\vec{r}$$

where the proportionality factor [t] is given by the flight plane equation parameters as

$$t = \frac{4{,}693}{0.70957\, A_r + 0.70463\, B_r}$$

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

When calculating the intersection point coordinates (Pi), it is convenient to express them relative to a new coordinate system. The new coordinate system (X' , Y') contains the flight plane and the origin is located at the landing point, as shown in Fig. 11 above.

Position of point Pi referred to the new origin can be obtained with vector [L]:

$$\vec{L} = \overrightarrow{OP_i} - \overrightarrow{R_0}$$

Being vector [Ro] the position of the landing point in the original Cartesian coordinates:

$$R_{0,x} = 4{,}546\ ft \qquad R_{0,y} = 2{,}082\ ft \qquad R_{0,x} = 0$$

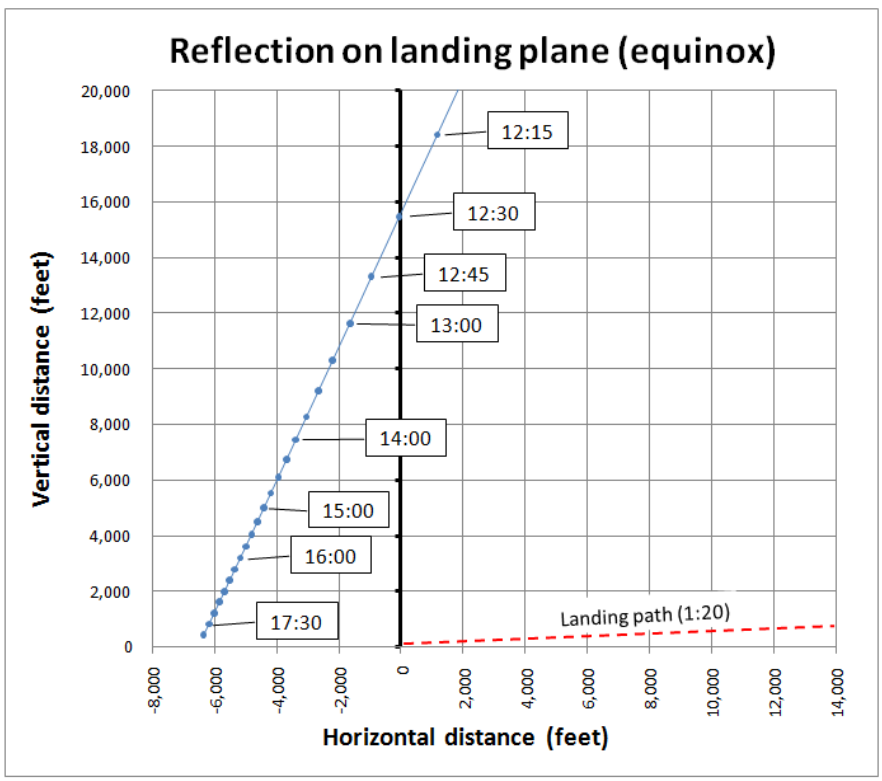
Then

$$L_x = t\ A_r - 4{,}546 \qquad L_y = t\ B_r - 2{,}082 \qquad L_z = t\ C_r$$

Finally, the coordinates of the intersection point in the flight plane reference axis P_i = ($L_{x'}$, $L_{y'}$) are given by:

$$L_{x'} = \sqrt{L_x^2 + L_y^2} \qquad L_{y'} = L_z$$

Fig. 12 below shows the curve drawn by successive intersection points P_i in the flight plane for the equinox days (Runway 04R)



CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

It can be seen that no interference can be expected between the reflected beam and the landing path in March, 21st when landing at the South end of runway 04R.

Interference can occur if the airplane is landing from the North end (Runway 22L). The reflected beam can be seen at 17:45 (solar time); 6,500 ft from the 22L south landing point at a height of 430 ft. However it should be noted that 17:45 is nearly sunset time, so sun's position will then be West (φ = -90°) and just over the horizon (θ = 0). Obviously, the airplane will be landing directly facing the sun and its reflection on the ocean, so reflection from PV plant will not be a relevant visual issue in this context. Also landing at the North end of runway 22L is not usual.

Next figure shows the intersection curves of the reflected light with the flight plane for several days along the year, toghether with the approaching landing cones by South (Runway 04R) and North (Runway 22L).

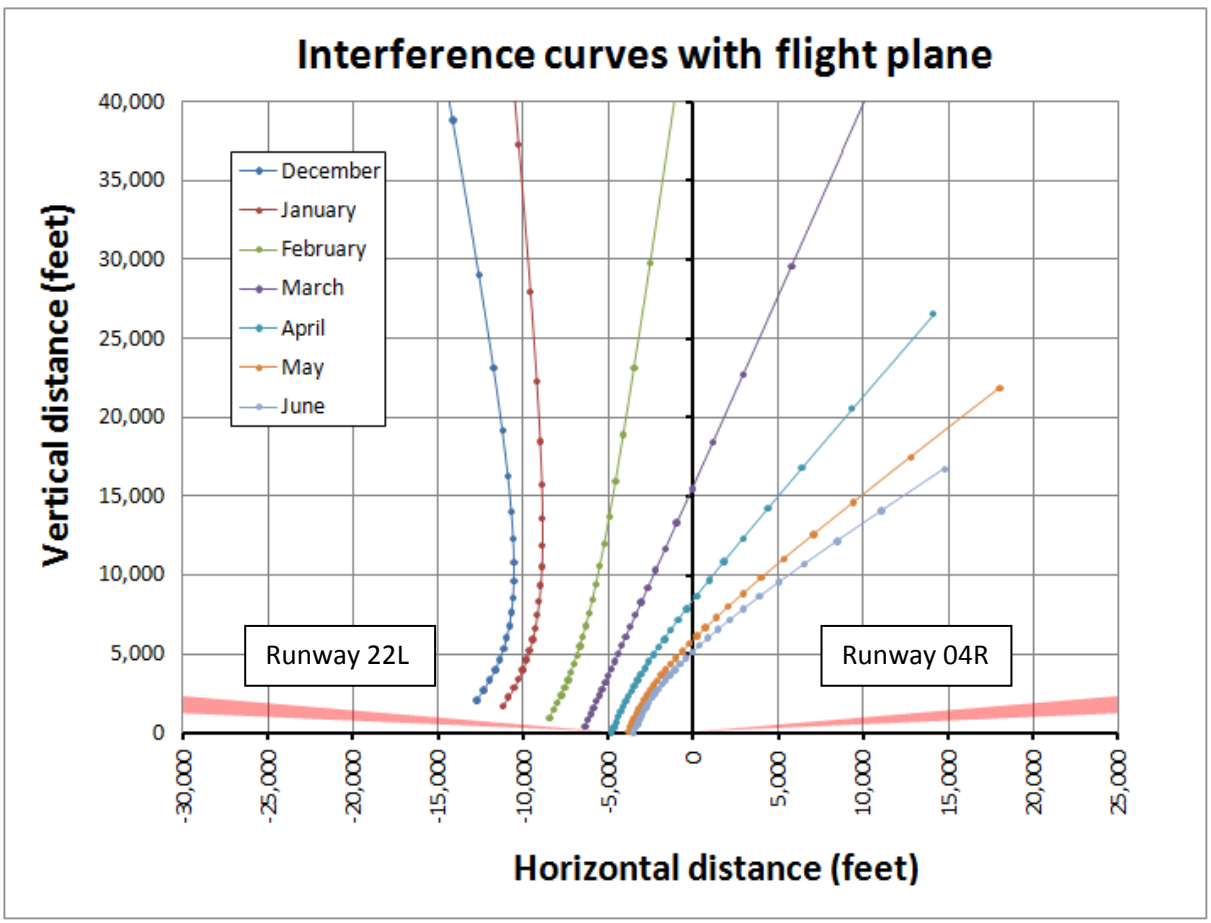
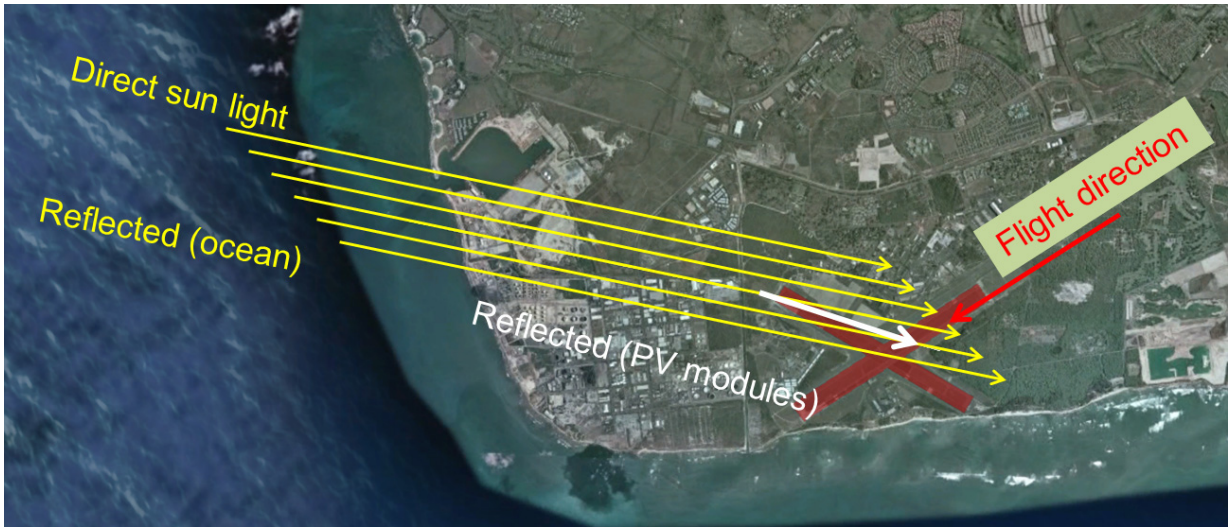


Fig 13.- Intersection of reflected beam with the flight plane at runways 22L & 22R

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

For example, in April 21st the following will be the projected angles at sunset (ground level):



It can be concluded that the effect of glint from the proposed PV plant at runway 22 –whenever it might occur- is negligible when compared to the effect of direct light from the sun and the sun's reflection on the sea. Also reflected beam is not aligned with the Runway, so the pilots shall turn their view to right nearly 45° to see the PV modules and hence face the sun's disk.

3.5 Reflectivity at Runways 11 and 29

The flight plane for runways 11 & 20 contains the PV plant, so the analysis is more straightforward than the previous case. Every day a reflected beam vector will be contained in the flight plane, but relevant glint might occur only if the elevation angle of the reflected beam is coincident with the flight approaching angle.

Runway 11 azimut is -71.8°. Cartesian coordinates for any reflected beam r = (Ar, Br, Cr), if contained in the flight plane, shall satisfy the following condition (beam azimuth):

$$\frac{B_r}{A_r} = \tan 71.8° = 3.0415$$

The angle between the horizontal plane and the reflected vector (reflection elevation angle) is given by

$$\tan \theta_r = \frac{C_r}{\sqrt{A_r^2 + B_r^2}}$$

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

Fig. 14 shows the hourly evolution of the above functions for the sample day (March, 21st)

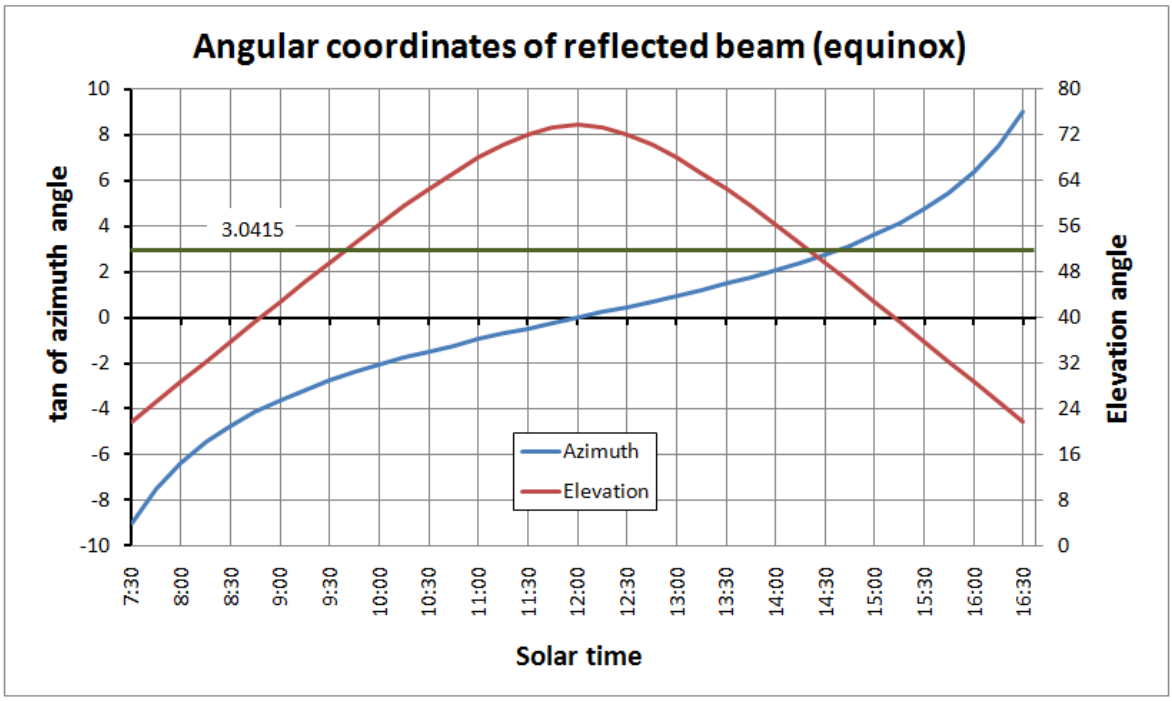
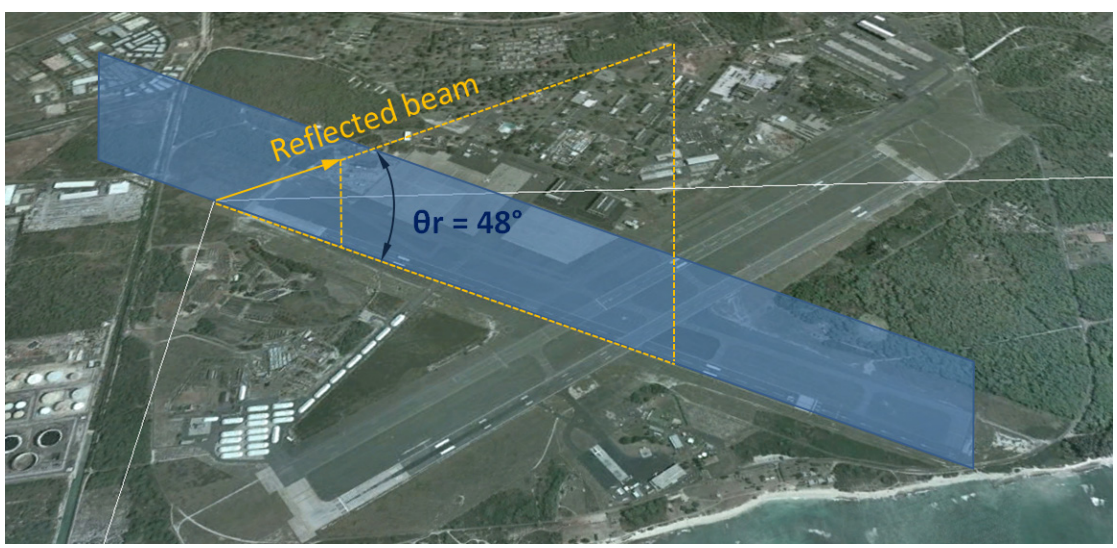


Fig 14.- Angular coordinates of reflected beam (march, 21st)

It can be seen that the reflected beam will be contained in the flight plane at 14:40 , however the vector will be pointing upwards with an angle of 48° from the horizontal plane thus not interfeering with approaching airplanes.



CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

The same method is repeated for several distributed days in a year. Results shows the elevation angle of the reflected beam in function of the day. Bandwith between estimated minimum and maximum landing angles (2.86° and 6°) are superimposed :

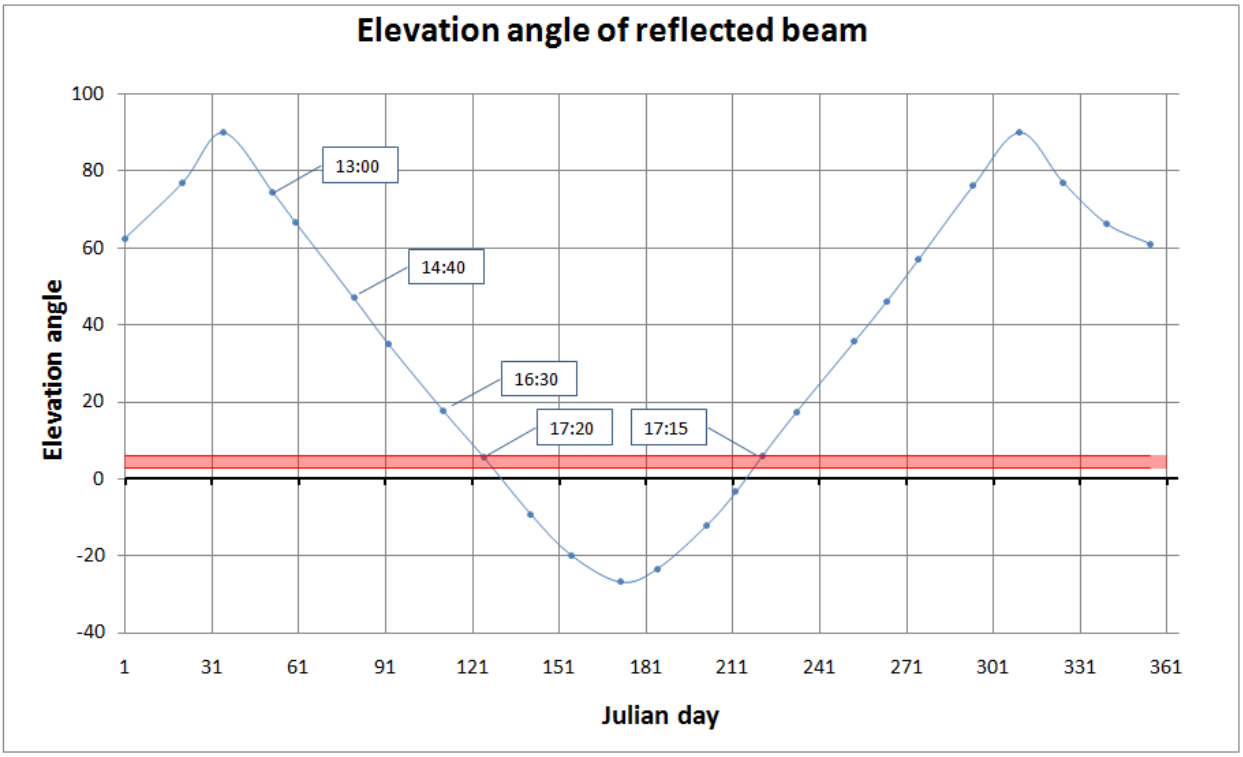


Fig 15.- Reflected beam elevation angle and landing angles – Runway 29

There are a few days in the year where there is a risk of glint from the PV modules to landing airplanes. These particular days are 125 to 130, and 217 to 221 (corresponding to 1st week of May and 1st week of August, respectively).

Fig. 16 shows sun coordinates for a typical day in these periods. Around 17:15 hours, sun azimuth is 102° and elevation only 16°. Therefore airplanes reaching runway 11 from the North side will have the sun back of them and the reflection beam pointing the opposite end of the runway. Obviously no glint can occur.

Planes approaching runway 29 from its south end will be directly facing the sun, and the reflection of the sun by the ocean, so existing glint from PV modules will not have a relevant effect.

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

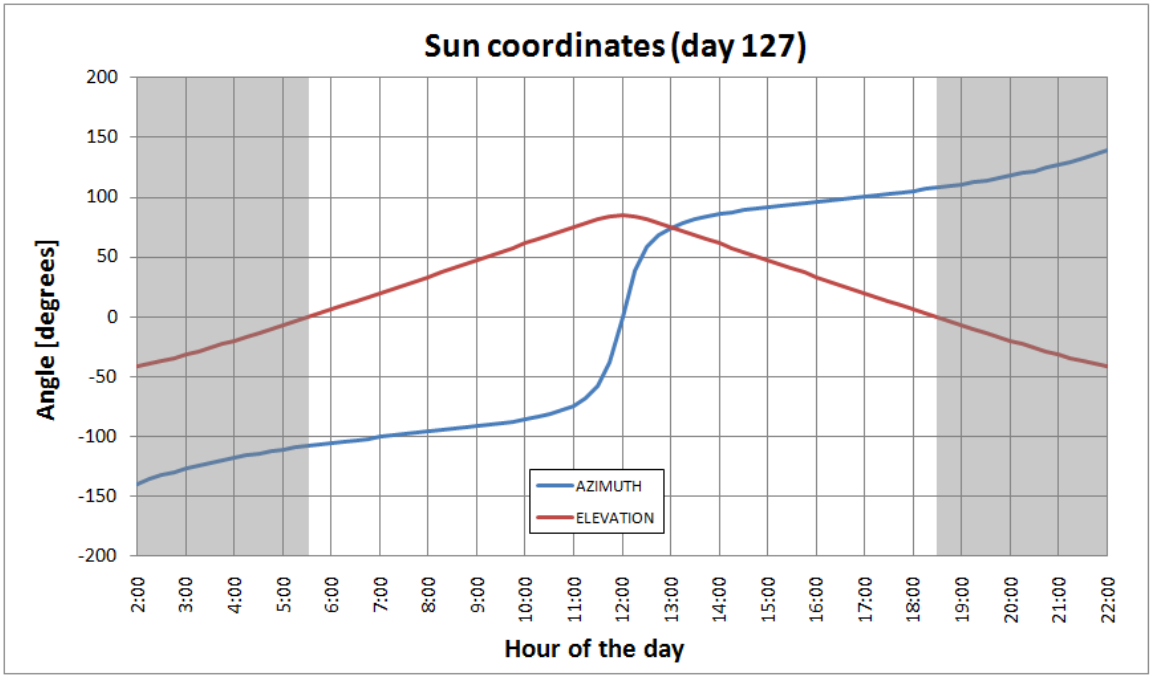


Fig 16.- Sun postion for selected typical day

4 Predominant wind direction

Wind direction is a relevant parameter in this analysis since there is a clear relationship between this variable and the most probable direction airplanes will approach the Kalaeloa airport.

Wind direction statistics have been extracted from the official U.S. Department of Energy – EnergyPlus weather data base (http://apps1.eere.energy.gov/buildings/energyplus/cfm/weather_data3.cfm). Closest meteorological station is Honolulu Airport (WMO station # 911820). This is located 9.5 Miles away from Kalaeloa airport, in the same bay. The following table shows monthly mean wind speeds:

MEAN WIND SPEED (m/s)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	4.1	3.7	4.2	4.8	4.4	5.9	6	5.2	5.4	3.8	5.2	4.4

Wind directions statistics are given in next table:

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

(% of days)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North	23	14	22	15	13	7	1	5	11	15	17	18
NorthEast	38	11	17	50	44	60	58	54	61	41	31	35
East	10	5	26	17	21	28	39	32	22	15	34	12
SouthEast	3	4	4	3	7	1	1	1	2	3	3	9
South	5	11	9	4	6	1	0	2	2	4	3	12
SouthWest	3	16	4	3	3	0	0	2	0	3	1	3
West	2	16	3	3	1	0	0	1	0	2	1	2
NorthWest	17	23	15	6	6	1	1	3	2	16	11	9

Considering months from March to September, wind direction distribution and most probable runway end to be used are as follows:

	N	NE	E	SE	S	SW	W	NW
Number of days (Mar to Sep)	19	90	48	5	6	3	2	9
RUNWAY	04R South	04R South	04R South 11 North	11 North	22 North 11 North	22 North	22 North 29 South	29 South

Fig 16.- Wind direction distribution - Months March to September

The following table summarizes the results of the geometric glint analysis for several approaching flight paths to the Kalaeloa airport and the number of days in a year the corresponding runways are most probably to be used:

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

Approaching flight	Risk of glint	Number days / year
Runway 22L from North	Risk in months: Mar-Apr-May-Jun-Jul-Aug-Sep (at sunset time)	7 days
Runway 04R from South	None	0
Runway 11 from North	None	0
Runway 29 from South	1st week of May and 1st week of Aug (close to sunset time)	2 days

Glint might occur only at sunset time. Considering a 2 hours window for low elevation angles at evenings, the estimated risk of glint is 18 hours per year, i.e. the yearly probability of glint for approaching airplanes is **0.21%.**

Moreover, in the few cases when there is some risk of glint form PV panels, the airplane will be facing the sun and the corresponding reflections from the ocean, so it can be concluded that glint from PV modules will not have any relevant effect on airplanes' visibility.

5 Conclusion

It has been demonstrated that, in the few cases when there is some risk of eventual glint by PV modules, the airplane will also be directly facing the sun and the corresponding reflections from the ocean, so it can be concluded that glint from PV modules will not have any relevant effect on airplanes' visibility, nor deteriorate the actual approaching flight conditions.

Risk is also diminished by the monthly distribution of predominant wind direction in Kalaeloa when superimposed to the calendar days glint might occur.

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

6 3D Graphic Simulation

A better understanding of the conclusions on the mathematical reflectivity analysis can be achieved by 3D graphic modeling of the scenarios in the selected days and coordinates. The following images have been prepared based on a 3D scaled scenario including the following objects:

- Kalaeloa airport
- Surrounding coastline
- Ocean
- Photovoltaic plant
- Sun

Between others, main illumination variables are: sun bright model in function of elevation angle, atmospheric turbidity, PV modules and ocean optical reflectivity characteristics in function of incident angle (as described in paragraph #2 in this report). Results of this graphic simulation are shown below. KVP are located at approaching airplane position.

6.1 Approaching fight to Runway 29

Image #1

*Approaching flight: **2 NM from Runway 29**. Day 127. Sun azimuth = 102.8°. Sun elevation = 13°*

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

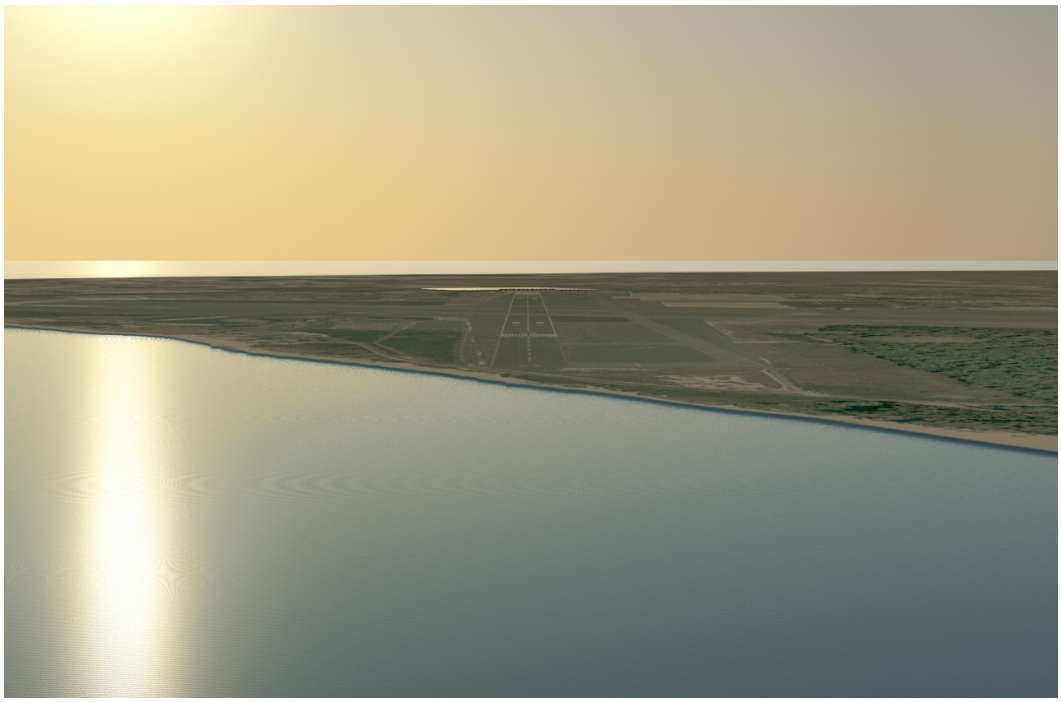


Image #2

*Approaching flight: **1 NM from Runway 29**. Day 127. Sun azimuth = 102.8°. Sun elevation = 13°*

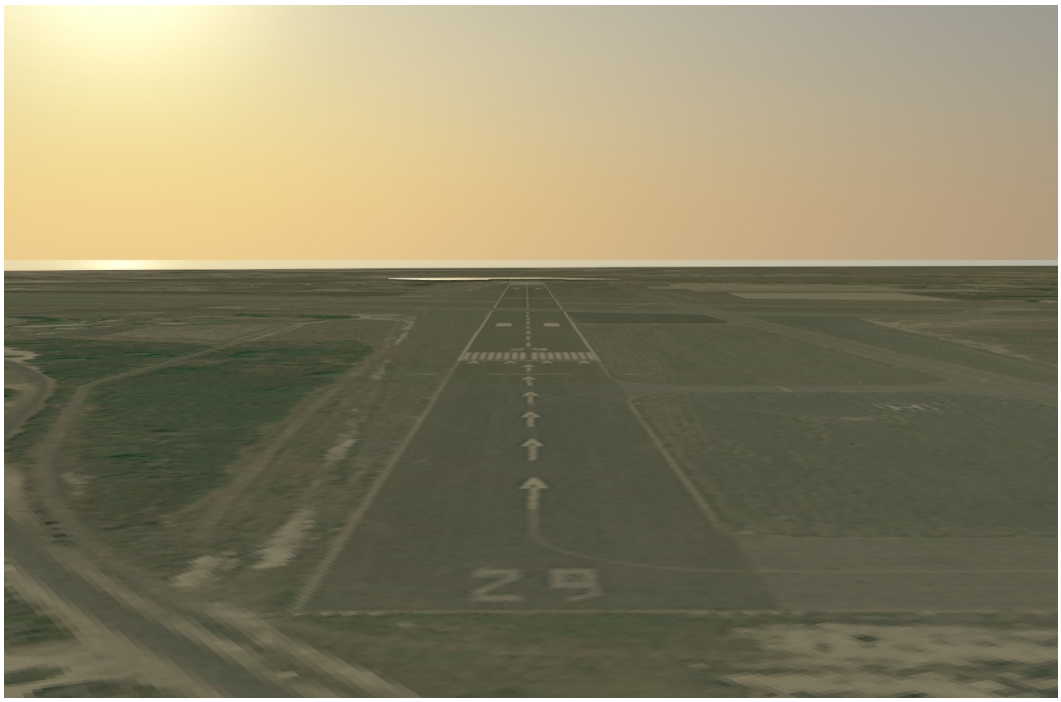


Image #3

*Approaching flight: **0.5 NM from Runway 29**. Day 127. Sun azimuth = 102.8°. Sun elevation = 13°*

***CONFIDENTIAL.** The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

Above sequential images show the approaching flight to Runway 29 (from South) at the selected glint-risk day. Airplane (viewpoint) is located in the flight plane and landing with a 2.45° degree line path.

As can be seen, direct sun light together with reflection from ocean is much more relevant than glint from PV modules, located at the opposite side of the Runway.

Simulation of a day in first week of August will yield the same results because of symmetry of sun position with respect to summer solstice.

6.2 Approaching fight to Runway 22L

Some glint might also occur when approaching Kalaeloa runway 22L from North. As described before risk is limited to low elevation angles (sunset) when planes are already landed. PV modules and any corresponding glint are only visible if pilot turns view to the right around 30 to 45 degrees, in function of the day of the year.

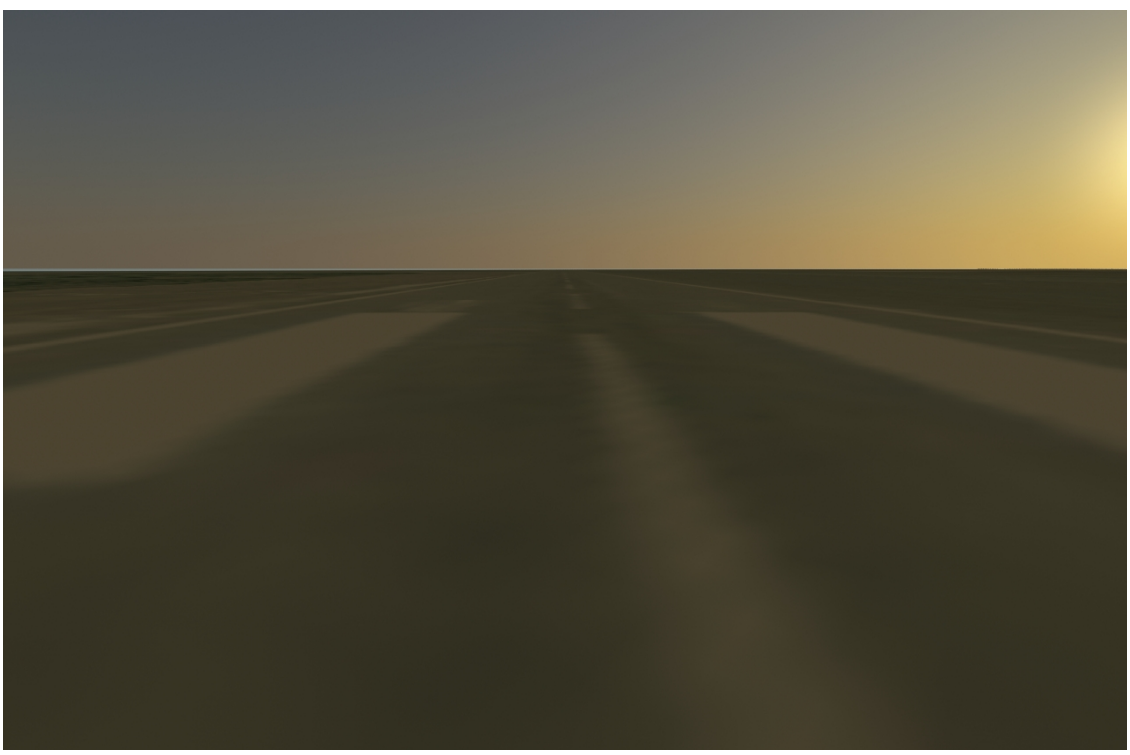


Image #4

*Approaching flight: **Landing point runway 22L**. Day 111 (April, 21st). Sun azimuth = 99.5°. Sun elevation = 7.6°*

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

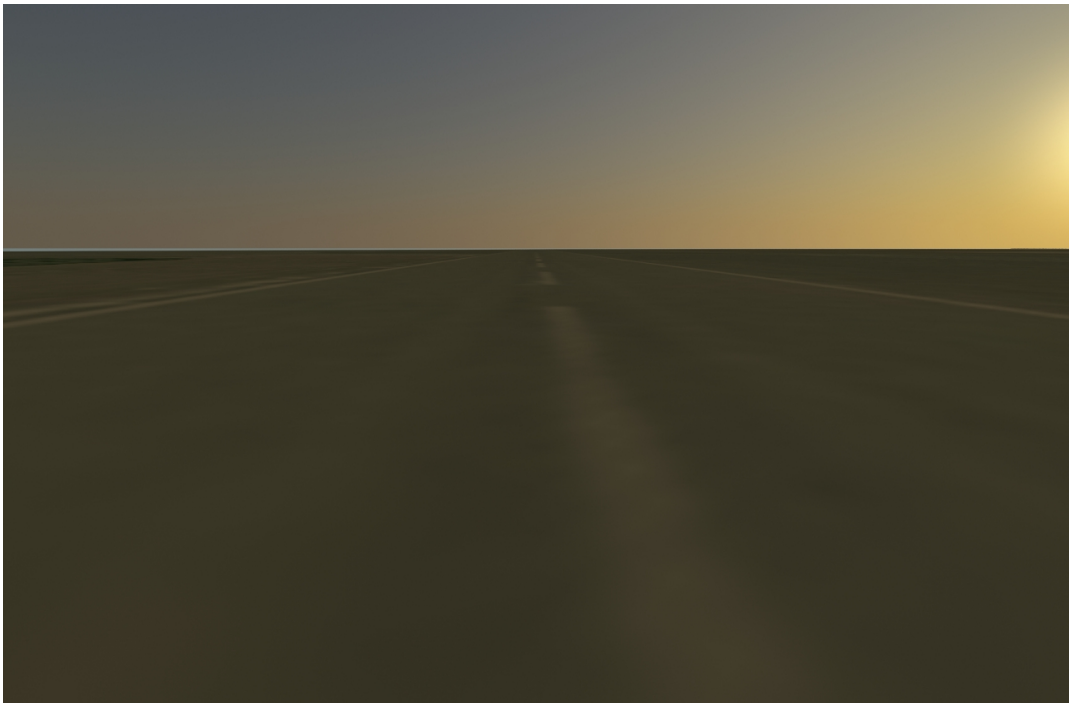


Image #5

Approaching flight: ***135 ft after landing runway 22L****. Day 111 (April, 21st). Sun azimuth = 99.5°. Sun elevation = 7.6°*

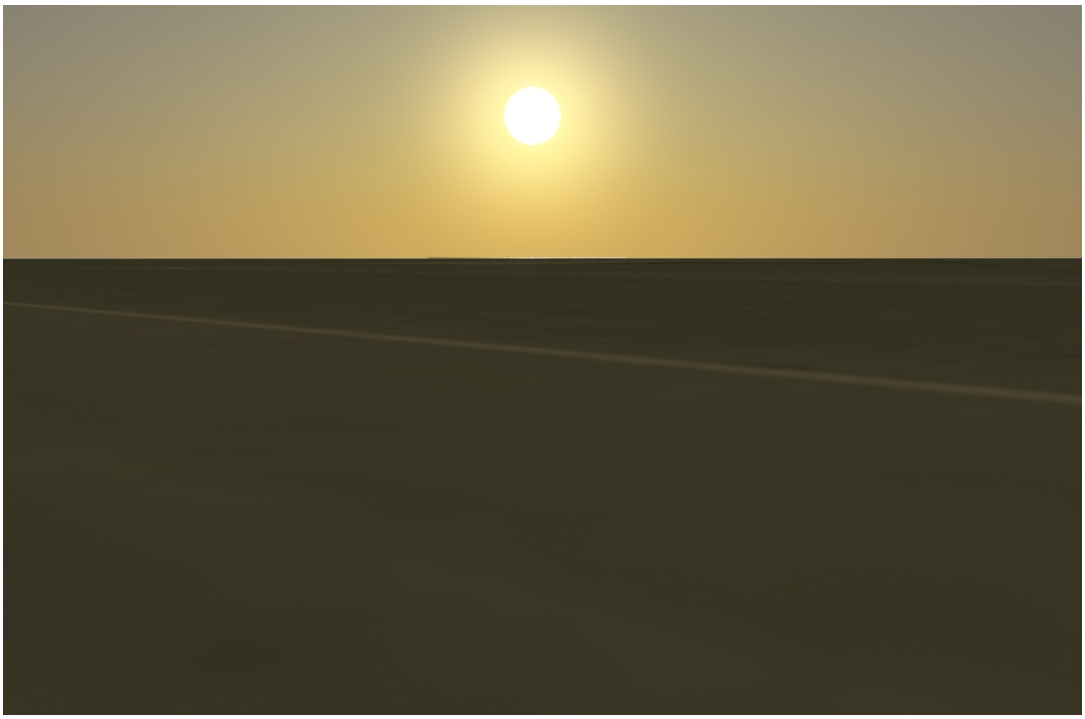


Image #5

Approaching flight: ***135 ft after landing runway 22L****. Day 111 (April, 21st). Sun azimuth = 99.5°. Sun elevation = 7.6°*

Pilot looking at right 45° (directly view PV modules and sun's disk)

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

A similar result is obtained when producing day #172 (June, 21st summer solstice), airplane already landed at 250 ft from the landing point.

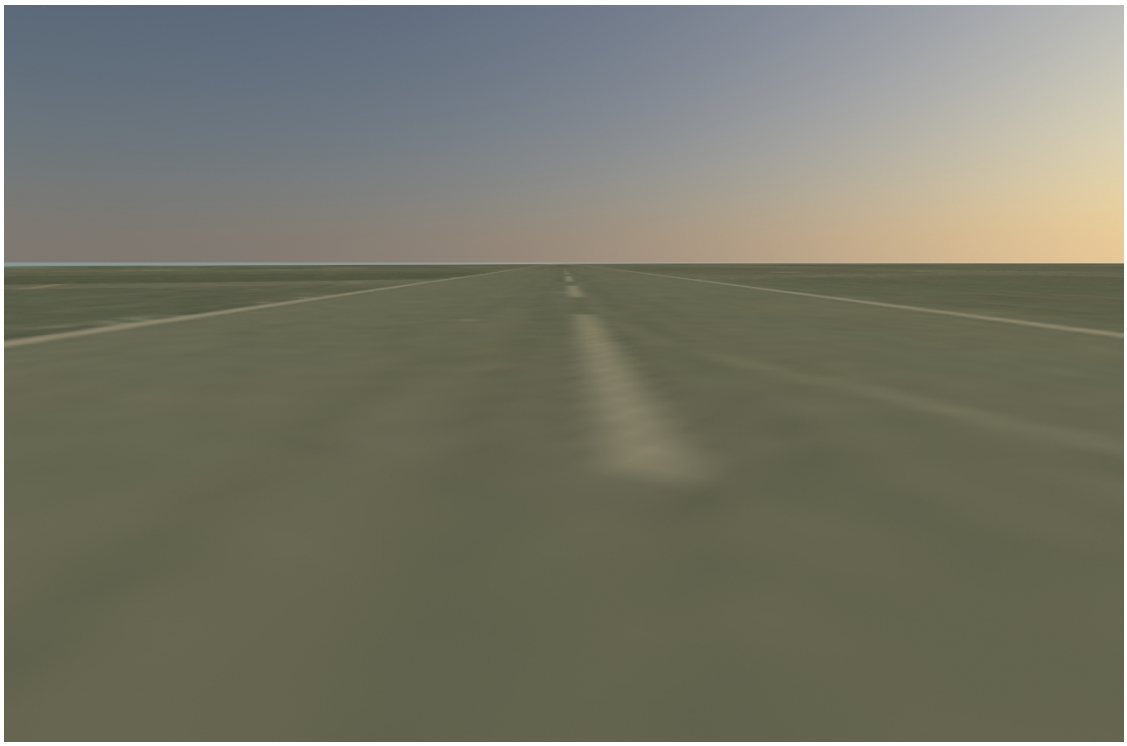


Image #5

Approaching flight: ***250 ft after landing runway 22L****. Day 172 (June, 21st). Sun azimuth=109.8°.Sun elevation =14.8°*

Again some glint might occur only if pilot turns head right to look directly the PV modules, facing also directly the sun disk.

CONFIDENTIAL. *The contents of this document are the property of AES Solar Power, LLC and may not be used, copied or disclosed for any reason except with the prior written consent of AES Solar Power, LLC.*

Appendix D

FAA Determination Regarding Hazards to Aircraft Operation

Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2011-AWP-814-OE

Issued Date: 03/08/2011

Corinne Onetto
AES Solar Power, LLC
505 Montgomery Street
Suite 1023
San Francisco, CA 94111

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel PV panels
Location:	Kapolei, HI
Latitude:	21-18-48.79N NAD 83
Longitude:	158-05-14.29W
Heights:	6 feet above ground level (AGL) 28 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part I)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part II)

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking and/or lighting are accomplished on a voluntary basis, we recommend it be installed and maintained in accordance with FAA Advisory circular 70/7460-1 K Change 2.

ADVISORY RECOMMENDATION - While the structure does not constitute a hazard to air navigation, it would be located within the Runway Protection Zone (RPZ) of the JOHN RODGERS FIELD (JRF) RUNWAY 11.

Structures, which will result in the congregation of people within an RPZ, are strongly discouraged in the interest of protecting people and property on the ground. In cases where the airport owner can control the use of the property, such structures are prohibited. In cases where the airport owner exercises no such control, advisory recommendations are issued to inform the sponsor of the inadvisability of the project from the standpoint of safety to personnel and property.

Any height exceeding 6 feet above ground level (28 feet above mean sea level), will result in a substantial adverse effect and would warrant a Determination of Hazard to Air Navigation.

This determination expires on 09/08/2012 unless:

(a) extended, revised or terminated by the issuing office.
(b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates , heights, frequency(ies) and power . Any changes in coordinates , heights, and frequencies or use of greater power will void this determination. Any future construction or alteration , including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

If we can be of further assistance, please contact our office at (310) 725-6557. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2011-AWP-814-OE.

Signature Control No: 137143769-138382946 (DNE)
Karen McDonald
Specialist

Attachment(s)
Case Description
Map(s)

Construct PV park using polycrystaline Photovoltaic panels

Verified Map for ASN 2011-AWP-814-OE