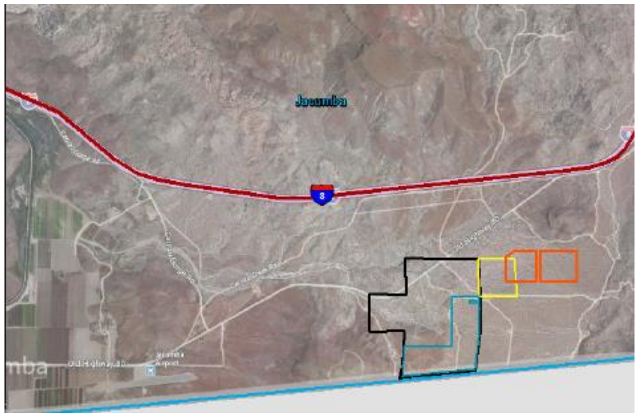
DRAFT FIRE PROTECTION PLAN
Jacumba Solar Energy Project



APNs 661-080-04, 661-080-05, and 661-080-08

MUP # PDS2014-MUP-14-041

Environmental Review Project Number

PDS2014-ER-14-22-001

Prepared for:

County of San Diego

Project Proponent:

Jacumba Solar, LLC
700 Universe Boulevard
Juno Beach, Florida 94104
Contact: Jesse Marshall

Prepared by:

DUDEK
605 Third Street
Encinitas, California 92024
Michael Huff, Project Manager

APRIL 2015

Printed on 30% post-consumer recycled material.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

Page No.

APPENDICES

FIGURES

TABLES

EXECUTIVE SUMMARY

This Fire Protection Plan (FPP) is submitted pursuant to Section 4903 of the County Consolidated Fire Code to address the adverse environmental effects that the proposed Jacumba Solar Energy Project may have from wildland fire. It provides documentation that the project does not expose people or structures to a significant risk of loss, injury or death involving wildland fires based on its conformance with applicable fire and building codes.

The Proposed Project is a solar facility that would produce up to 20 megawatts (MW) of solar energy consisting of approximately 81,108 photovoltaic (PV) modules fitted on 2,253 fixed tilt rack panels, and an approximately 10 MW battery energy storage facility. The Project would be on approximately 304 acres in southeastern San Diego County, near the unincorporated community of Jacumba Hot Springs California. Individual PV module array "row" dimensions are approximately 144 feet in length and approximately 6.5 feet wide. They are elevated eight feet above the ground on metal pipe or beam foundations. In addition, the Proposed Project will construct a new gen-tie line that extends for approximately 0.25 mile from the solar facility to the San Diego Gas & Electric (SDG&E) East County (ECO) Substation off of Old Highway 80 and to the northeast of the Project site.

The Proposed Project site is located in High and Very High Fire Hazard Severity Zones, as designated by the California Department of Forestry and Fire Protection (CALFIRE) (FRAP 2014). Fire hazard severity zone designations are based on topography, vegetation, and weather, amongst other factors that indicate the likelihood of wildfire occurrence. The project site is located in an area dominated by relatively sparse chaparral and scrub vegetation, which are vegetation communities that experience occasional wildfire and can burn in an extreme manner under windy, dry conditions. The terrain on, and within the vicinity of the project site, is dominated by a relatively gentle west-facing slope (>5%), although some small knolls and peaks provide some variation and steeper slopes (30%). The project site, like all of inland San Diego County, is subject to seasonal weather conditions that can heighten the likelihood of fire ignition and spread. Based on the region's fuels, fire history, and expected fire behavior, a moderate-intensity fire can be expected to occur in the project area. Given the relatively gentle terrain and sparse fuel beds, fire behavior on the project site is expected to be moderate, although spotting distances may be long during peak Santa Ana wind conditions. The applicable fire codes and measures required by this FPP directly address the fire concerns associated with this project's location.

Fire protection in the project area is shared by several agencies, with the San Diego County Fire Authority (SDCFA), San Diego Rural Fire Protection District (SDRFPD) and CALFIRE providing significant resources. The closest fire station is SDRFPD's Jacumba (Station 43). CALFIRE has the primary responsibility for wildfire protection within State Responsibility

Areas (SRAs). Both SDCFA and CALFIRE also operate fire stations within a short driving distance of the project.

The project will introduce a solar facility, electrical transmission line and related activities into a rural setting that currently includes semi-disturbed and undisturbed wildland fuels. The Project may increase potential ignition sources in the area with the ongoing operation and maintenance program, but will reduce the available wildland fuels and will result in a higher level of fire monitoring and awareness due to on-site personnel and security measures. The site is currently subject to ignition sources including a major electrical transmission line easement to the north of the property, roadways, regular U.S. Border Patrol operations, and construction work occurring nearby, amongst others. The Project will include compliance with the San Diego County Consolidated Fire Code, as applicable and will provide additional measures that enhance fire safety and protection.

Based on the project's conformance with applicable fire and building codes along with the additional measures identified in this FPP, the project would not result in a significant impact under CEQA.

1 INTRODUCTION

This Fire Protection Plan (FPP) has been prepared for the Jacumba Solar Energy Project (Proposed Project) near the community of Jacumba Hot Springs, California. The purpose of the FPP is to assess the potential impacts resulting from wildland fire hazards and identify the measures necessary to adequately mitigate those impacts. As part of the assessment, this FPP has considered the property location, topography, geology (soils and slopes), combustible vegetation (fuel types), climatic conditions, and fire history. The plan addresses water supply, access (including secondary/emergency access where applicable), solar component and structure ignitability and ignition resistive features, fire protection systems and equipment, impacts to existing emergency services, defensible space, and vegetation management. The plan identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment that will protect this project and its essential infrastructure. The plan recommends measures that the property owner will take to reduce the probability of ignition of equipment or structures throughout the project area addressed by this plan.

This FPP is consistent with the 2014 County Consolidated Fire Code (2011 CCFC and 2014 CFC Ordinance #10337). Further, the Project is consistent with the County Building and Electrical Codes and will employ all related CPUC regulations including the General Order 95: Rules for Overhead Electric Line Construction.

The purpose of this FPP is to analyze the project's various components and siting in a fire hazard area and to generate and memorialize the fire safety requirements of the Fire Authorities Having Jurisdiction (FAHJ). Recommendations of this FPP incorporate analysis of the project and of the cumulative impact on the area's emergency service resources from foreseeable projects in the area. Recommendations for effectively mitigating identified impacts are based on site-specific characteristics and incorporate input from the project applicant and the SDCFA and San Diego Rural Fire Protection District (SDRFPD). This FPP incorporates applicable fire safety regulations and requirements and documents a selection of these regulations that are most pertinent to the Project's unique facility and location.

1.1 Project Summary

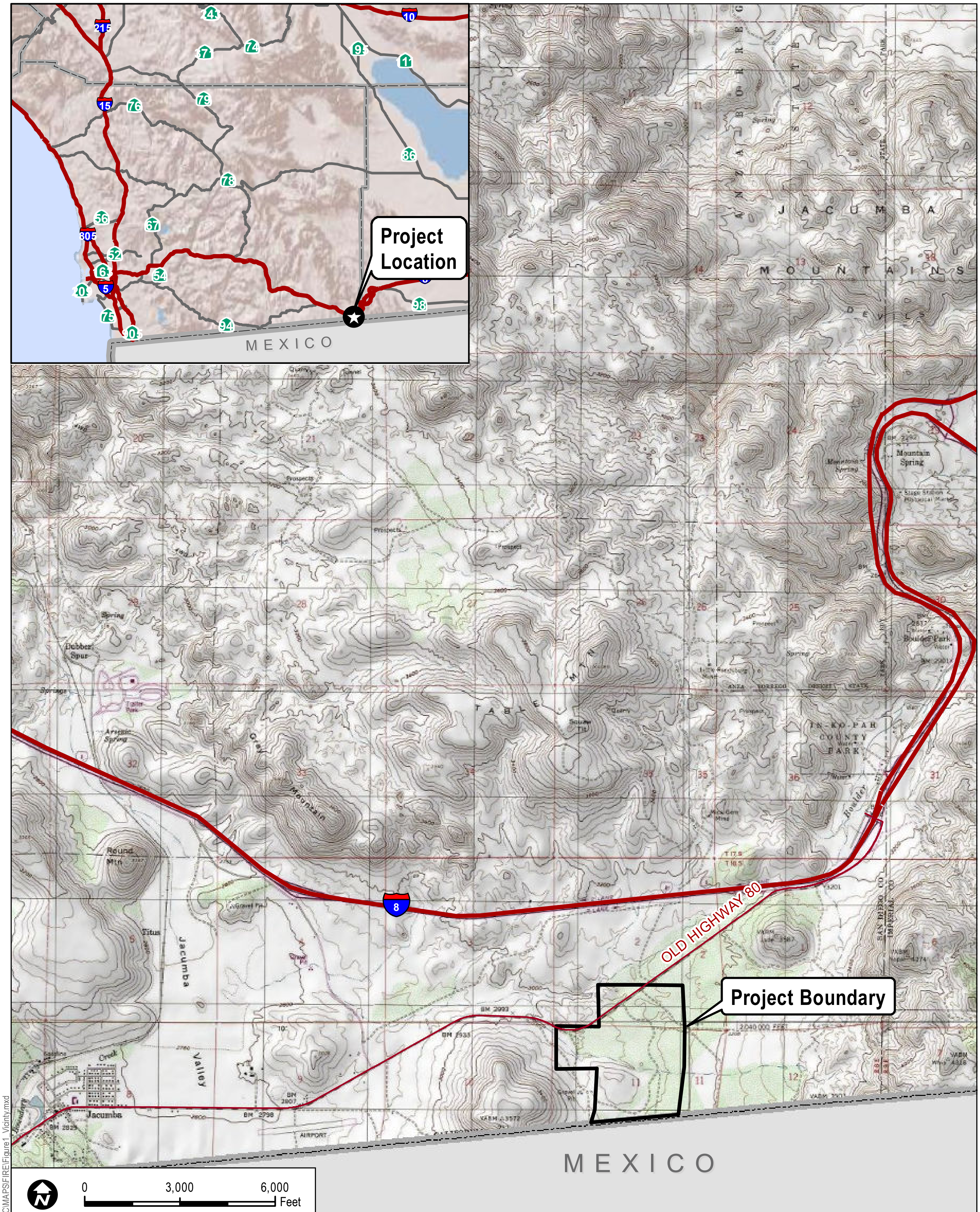
1.1.1 Project Location

The project is located on private land located approximately 3 miles east of the community of Jacumba Hot Springs, 0.5 mile south of Interstate 8 (I-8), and immediately north of the U.S./Mexico International Border. Old Highway 80 traverses through the northern portion of the project site (Figure 1). The property includes Assessor's Parcel Numbers (APN) 661-080-04, 661-080-05, 661-080-08 and access across APN 661-041-03. Surrounding land use/ownership includes private and public lands to the north, east, and west with various rural land uses and rural residential land use to the south in Mexico. The project site is located in Sections 2 and 11 of Township 18 South, Range 8 East, on the U.S. Geographical Survey (USGS), 7.5 minute, Jacumba, California quadrangle map and within the Mountain Empire Subregional Plan area in unincorporated San Diego County (Figure 2). The majority of the project site will be constructed in areas of San Diego County classified as a High Fire Hazard Severity Zone by CALFIRE. A small portion in the southeast corner of the project site and the adjacent area to the southeast is classified as a Very High Fire Hazard Severity Zone by CALFIRE (FRAP 2014).

1.1.2 Project Description

The proposed Jacumba Solar Energy Project (Project) would produce up to 20 megawatts (MW) of solar energy and would consist of approximately 2,253 photovoltaic (PV) panels utilizing fixed-tilt rack panels located on approximately 108 acres within an approximately 304-acre property. In addition to the PV panels and direct current (DC) to alternating current (AC) conversion equipment (i.e., inverter and transformer units), the project would include the following primary components:

- A 1,000- to 1,500-volt DC underground collection system and a 34.5-kilovolt (kV) underground AC collection system linking the inverters to the on-site project substation.
- An on-site collector substation located on an approximately 23,650 square feet (110-foot by 215-foot) pad.
- A 138 kV overhead transmission line (gen-tie) would connect the project substation to the ECO Substation (approximately 1,500 feet).
- An approximately 10 MW battery energy storage system that would be located on an approximately 21,600 square feet (135-foot by 160-foot) pad adjacent to the collector substation.



Path: Z:\Projects\j847701\MAPDOC\MAPS\FIRE\Figure1_Vicinity.mxd

DUDEK

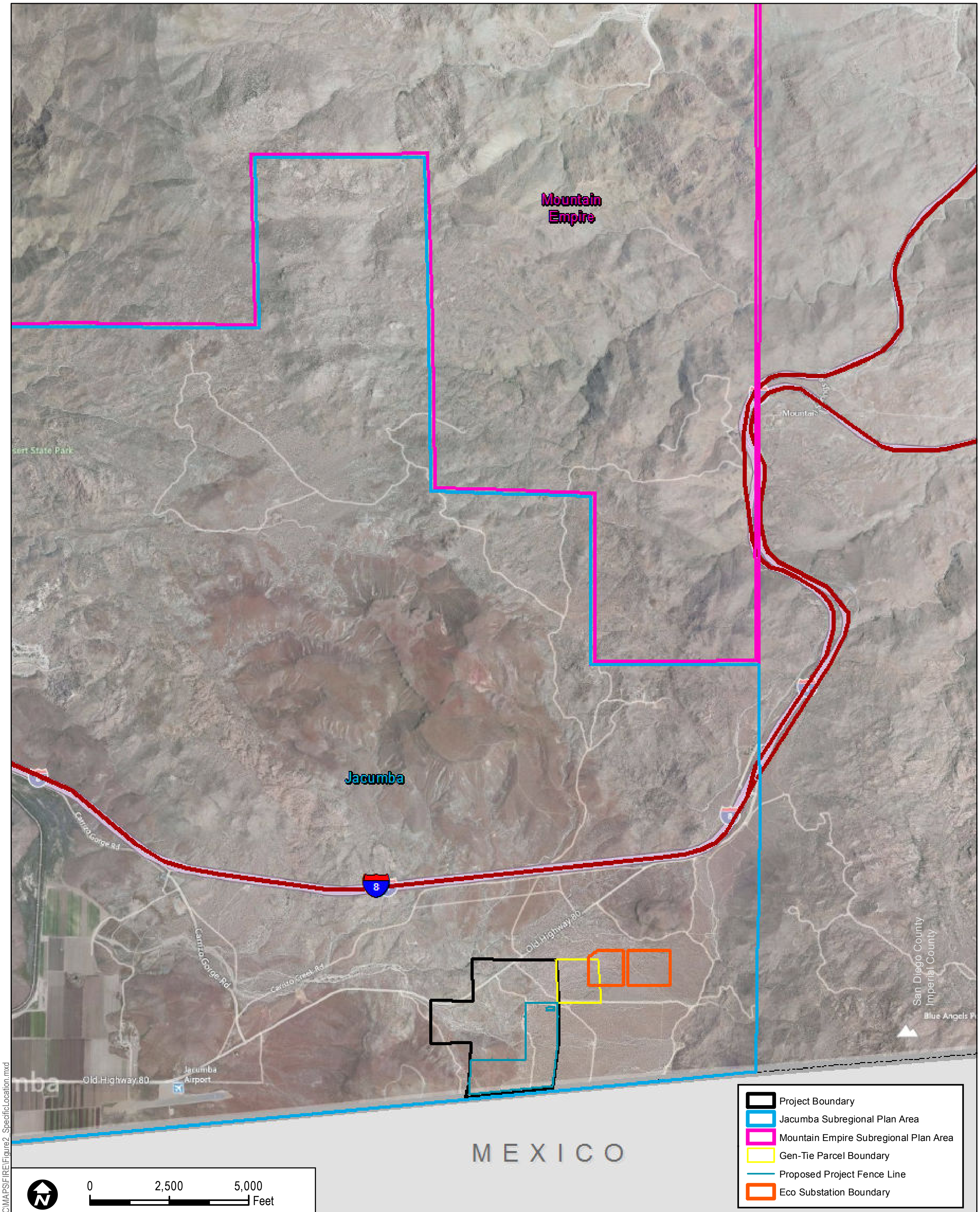
8477

SOURCE: Bing 2014

FIGURE 1
Regional Map

Jacumba Solar Energy Project - Fire Protection Plan

INTENTIONALLY LEFT BLANK



Path: Z:\Projects\j847701\MAPDOC\MAPS\FIRE\Figure2_SpecificLocation.mxd

DUDEK

8477

SOURCE:Bing 2014

FIGURE 2

Specific Location Map

Jacumba Solar Energy Project - Fire Protection Plan

INTENTIONALLY LEFT BLANK

The following sections provide more detail regarding project components. A map of the project site plan is included in Figure 3.

Modules

The project would include installation of individual fixed-tilt-mounted PV modules that would comprise the majority of the proposed facilities. PV modules, which are 12.5 feet in width, generate electricity by safely converting the energy of the sun's photons into DC electrons. PV modules can be wired in series and/or parallel to obtain a required nominal voltage. The PV modules are interconnected and arranged to increase overall reliability.

The majority of PV module manufacturers advertise that they have been stringently tested and are robustly constructed to guarantee a useful life of 30 years in adverse weather conditions. The PV modules are uniformly dark in color, non-reflective, and designed to be highly absorptive of all light that strikes their glass surfaces. The PV modules deployed for use in the project would comply with all industry standard quality testing. The PV modules would be electrically connected to the grounding system of the facility in accordance with local codes and regulations. The final PV module selection would be determined during the detailed engineering phase.

Support Structures

Racking refers to the support structure to which the solar PV modules are affixed that allows them to be properly positioned for maximum capture of the sun's solar energy. The PV module arrays (a row of PV modules) would be a fixed-tilt system that would be oriented along an east to west axis. The mounting structures are typically mounted on metal pipe pile or beam foundations 4 to 6 inches in diameter. The beams would be driven into the soil using a pile/vibratory/rotary driving technique similar to that used to install freeway guardrails. Driven pier foundations offer multiple benefits, including quick installation and minimal site disturbance, and are a "concrete-free" foundation solution that would allow for easy site reclamation at the end of the project lifecycle. Most foundations would be driven to approximate depths of 10 to 15 feet deep. The PV modules, at their highest point, would be approximately 8 feet above the ground surface.

Depending on final engineering, the arrays may be equal in length, creating a uniform rectangular project footprint, or may vary in length in order to avoid sensitive resources and work with the site terrain. The east to west arranged fixed-tilt arrays, if used, would be constructed approximately 25 feet apart (centerline to centerline) in a north to south direction, with an east to west array spacing of approximately 12.5 feet. Each PV module array "row" would measure approximately 144 feet in total combined length and approximately 6.5 feet in width. The PV module arrays' final elevations from ground would be determined during detailed project design;

however, it is common to maintain as low of an elevation profile as possible to reduce potential wind loads on the PV module arrays.

Inverters, Transformers and Associated Equipment

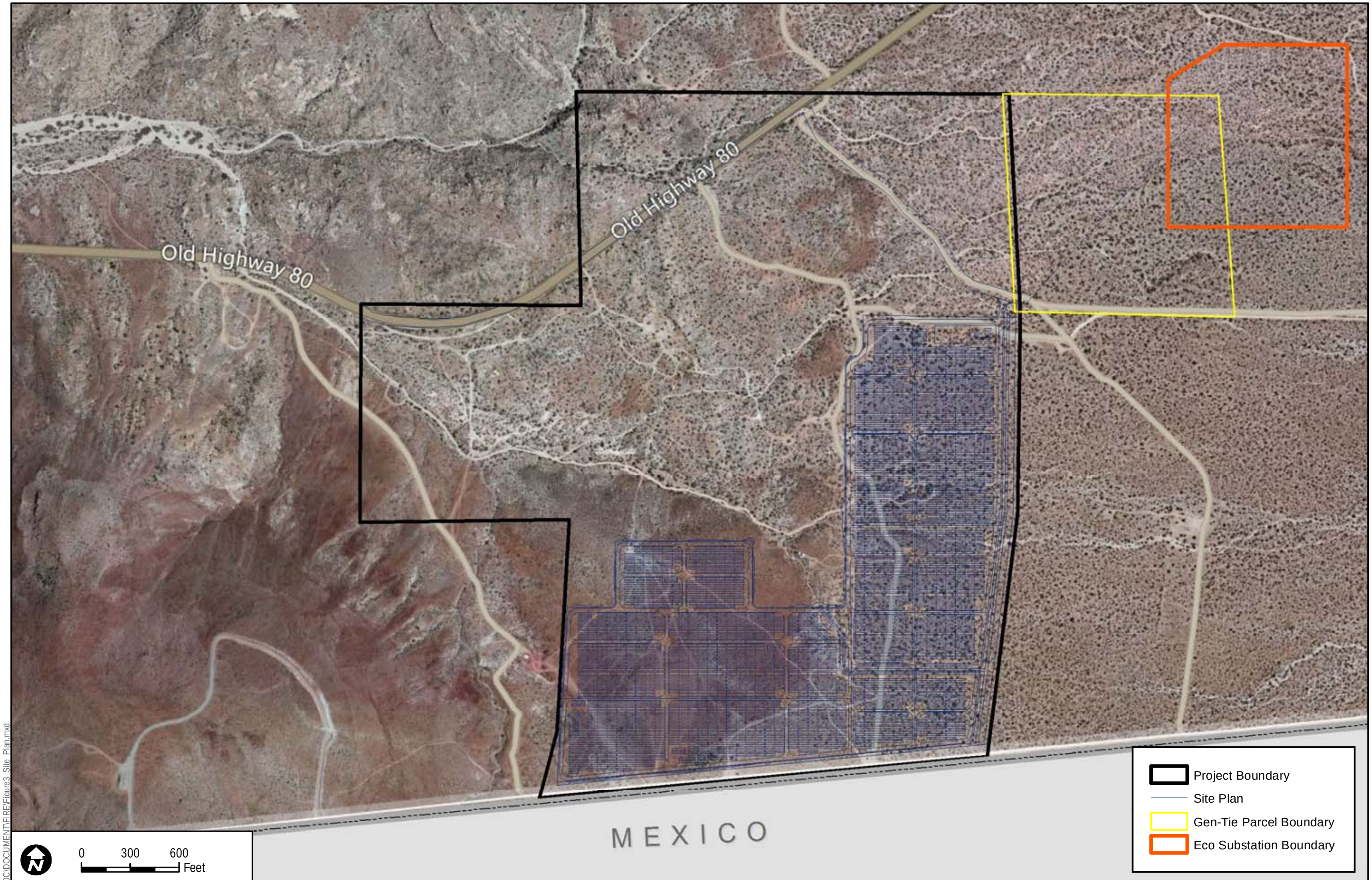
PV modules would be electrically connected to adjacent modules to form module “strings” using wiring attached to the support structures. PV module strings would be electrically connected to each other via underground wiring. Wire depths would be in accordance with local, state, and federal codes. String wiring terminates at PV module array combiner boxes, which are lockable electrical boxes mounted on or near an array’s support structure. Output wires from combiner boxes would be routed along an underground trench system approximately 3.5 feet deep and 1 foot wide, including trench and disturbed area, to the inverters and transformers.

Inverters are a key component of solar PV power-generating facilities because they convert the DC generated by the PV module array into AC that is compatible for use with the transmission network. The inverters within the electrical enclosures would convert the DC power to AC power and the medium-voltage transformers would step up the voltage to collection-level voltage (34.5 kV).

The inverters, medium-voltage transformers, and other electrical equipment are proposed to be located on skids throughout the project site. These power conversion stations would be either shop fabricated as one unit, or field assembled on site. The inverter and medium-voltage transformer units would be mounted on concrete foundation pads or concrete piers depending on local soil conditions. All electrical equipment would be either outdoor rated or mounted within the enclosures designed specifically for outdoor installation. The proposed equipment poses no electrical shock risk and is safe to touch.

Project Substation

The Proposed Project requires the use of an on-site collector substation (110-foot by 215-foot (23,650 square foot)) that would be located on the northeastern corner of the project site. The purpose of the substation is to collect the power received from the collector lines and convert the voltage from 34.5 kV to 138 kV as well as to be able to isolate equipment (i) in the event of an electrical short-circuit, or (ii) for maintenance.



Path: Z:\Projects\j847701\MAPDOC\DOCUMENT\FIRE\Figure3_Site_Plan.mxd

DUDEK

8477

FIGURE 3

Project Site Plan

Jacumba Solar Energy Project - Fire Protection Plan

INTENTIONALLY LEFT BLANK

The major components of the on-site substation are as follows:

- One 138 kV transformer including secondary containment area per local and state regulations.
- One 138 kV circuit breakers used to protect equipment from an electrical short circuit on the gen-tie. Disconnect switches, wire, cables and aluminum bus work used to connect and isolate the major pieces of equipment.
- The substation also includes a single 34.5 kV circuit breaker used to protect equipment from an electrical short circuit on the collection system, disconnects and bus work to connect and isolate the collector circuits, relays used to detect short circuits, equipment controls, telemetering equipment used to provide system control and data acquisition, voice communication, and the meters used to measure electrical power generated from the project. Switching gear and other components would be a maximum of 35 feet in height.
- A 138 kV dead-end structure that would have a maximum height of 35 feet. This structure is where the power output from each transformer is delivered to the gen-tie line.

Energy Storage Facility

A battery energy storage facility is proposed adjacent to the on-site substation in the northeast section of the Proposed Project. It would consist of approximately 10 enclosures equipped with batteries capable of delivering approximately 10 MW AC of energy. Each enclosure would include an air conditioning unit for cooling purposes and a self-extinguishing fire system. Critical information from the system would be monitored along with the solar plant performance. A master control system would coordinate operation of the solar generation equipment and the energy storage system.

Connector line, Fiber Optic Line, and Point of Interconnection

The project would interconnect to the ECO Substation project which is owned and operated by SDG&E. A 138 kV line interconnecting from the ECO Substation project to the Jacumba Solar Energy Project would be constructed above grade. The length of the interconnecting or “gen-tie” line would be approximately 1,500 feet.

The 138 kV interconnection line would consist of two or three overhead steel poles that would be up to 150 feet in height. The vertical distance between the cross-arms on the steel case riser would be 20 feet. Non-specular conductors would be installed along the interconnection line alignment in order to minimize the reflectivity and general visibility of new facilities. The distance between the ground and the lowest conductor would be at least 30 feet and the distance between conductors would be 18 feet horizontally and 12 feet vertically. Although span lengths between poles would be dependent on terrain, lengths would generally be between 400 and 800 feet. Components used to construct the proposed 138 kV transmission line would all feature non-reflective surfaces.

Control System

Operation of the solar facility would require monitoring through a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system would be used to provide critical operating information (e.g., power production, equipment status and alarms, and meteorological information) to the power purchaser, project owners and investors, grid operator, and project operations teams, as well as to facilitate production forecasting and other reporting requirements for project stakeholders. The project would also have a local overall plant control system (PCS) that provides monitoring of the solar field as well as control of the balance of facility systems. The microprocessor-based PCS would provide control, monitoring, alarm, and data storage functions for plant systems as well as communication with the project's SCADA system. Redundant capability would be provided for critical PCS components so that no single component failure would cause a plant outage. All field instruments and controls would be hard-wired to local electrical panels. Local panels would be hard-wired to the plant PCS. Wireless technology would be considered as a potential alternative during final project design. The SCADA system would be monitored remotely and no on-site operations and maintenance facilities or personnel would be necessary.

Site Design

Security

The project site would be fenced along the entire property boundary for security with fencing that meets National Electrical Safety Code (NESC) requirements for protective arrangements in electric supply stations. Fencing will be 9 feet in height with an 8-foot chain-link perimeter fence with 1 foot of three strands of barbed wire along the top with a 4-inch maximum clearance from the ground surface. The fence would be constructed with anti-climbing material(s). Signage in Spanish and English for electrical safety would be placed along the perimeter of the project site, warning the public of the high voltage and the need to keep out. Signage would also be placed within the project site where appropriate. Some localized security-related lighting, on-site security personnel, and/or remotely monitored alarm system may be required during construction and/or operation. Remote-monitored cameras and alarm system(s), and perimeter and safety lighting that would be used only on an as-needed basis for emergencies, protection against security breach, or unscheduled maintenance and trouble-shooting would be installed. Locked pedestrian access gates would be provided in the perimeter fence at fire department approved intervals to allow for fire operations or emergency firefighter ingress into the facility.

Maintenance and Security Lighting

Lighting would be designed to provide security lighting and general nighttime lighting for Operations and Maintenance (O&M) personnel, as may be required from time to time. Lighting would be shielded and directed downward to minimize any effects to the surrounding area, and would be used only on an as-needed basis. Lighting would be provided at the entrance gates, and the project substation.

The on-site substation would include lighting inside the substation to allow for safety inspections or maintenance that may be required during the evening hours. Lighting would also be provided next to the entrance door to the control house and mounted at the entrance gates to allow for safe entry. Since maintenance activities are not anticipated to be completed during the evening hours, lights would only be turned on if needed.

All lighting for the solar facility would have bulbs that do not exceed 100 watts, and all lights would be shielded, directed downward, and would comply with the County of San Diego Light Pollution Code Section 59.101 et seq.

1.1.3 Construction Fire Prevention

This FPP is applicable to the ongoing O&M of the Project. This FPP is not intended to apply to the construction phases of the Project. A separate "Construction Fire Prevention Plan" (CFPP) document shall be prepared, reviewed and approved by SDCFA/SDRFPD and CALFIRE a minimum of 45 days prior to construction activities associated with this Project. The document will address fire prevention measures that will be employed during the construction phase, identifying potential sources of ignition and detailing the measures, equipment, and training that will be provided to all site contractors. Example Construction Fire Prevention Plans are available for previously entitled San Diego County energy projects and they can be easily adapted for this project. The Conceptual CFPP includes discussion of the following fire safety, prevention, and protection topics:

Conceptual Construction Fire Prevention/Protection Plan

I. Introduction

This section will identify the intent of the CFPP for the Proposed Project and which mitigation measures the plan satisfies, if any.

All construction work shall follow these guidelines and commitments. The contents of this plan are to be incorporated into the standard construction contracting agreements for the construction of the project. Primary plan enforcement and implementation responsibility will remain with the project applicant and its contractors and vendors. Copies of this plan shall be given to all contractors, and a kick-off safety meeting will be conducted. Workers shall sign a form stating they received this training.

II. Requirements

This section will identify specific requirements of the plan, which shall be implemented to the satisfaction of the fire authorities having jurisdiction, which include the San Diego County Fire Authority (SDCFA) and CAL FIRE (jointly, the Fire Agencies). The following is an outline of requirements for the CFPP.

A. Construction Fire Prevention Plan Definitions

B. Project Description

C. Project Fire Risks

D. Fire Risk Mitigation Measures

E. Staging Areas and Major Operation Work Sites

F. Project Tool and Equipment Requirements

G. Agency Specific Requirements

H. Construction of Access Roads Prior to On Site Construction

I. Training

J. Water Storage Tanks: ID location and capacity.

K. Fire Safety Coordinator: This position is required by the California Fire Code Section 1408.1.

L. Safety briefings, Inspections and Compliance

M. K. Road Widths and Roadside Fuel Modification

N. Fuel Modification at Construction Sites

O. Fire Patrols

P. Firefighting Pump Units

Q. Construction Water Tenders

R. Portable Fire Extinguishers

S. Red Flag Warnings; High Fire Hazard Weather Conditions

T. Project Specific No Work Provisions/Restrictions

U. Agency Specific Requirements

V. Tool Caches

W. Mufflers and Spark Arrestors on Equipment Engines

X. Use of Portable Equipment

Y. Clearing Crews

Z. Storage of Flammable and Combustible Liquids and Fueling of Vehicles and Equipment

AA. Temporary Heating Devices

BB. Storage Areas and Parking Areas

CC. Designated Smoking Areas

DD. Warming and Lunch Fires; No Open Burning

EE. Hot Work (Welding, Grinding, etc.): These requirements are primarily from California Fire Code (CFC) Chapter 26, "Welding and other Hot Work," and NFPA 51-B, "Fire Prevention During Welding, Cutting and other Hot Work".

FF. Storage of Combustibles and Trash

GG. Storage and Use of Hazardous Materials

HH. Warehouses and Construction offices

II. Construction office trailers or modular buildings:

JJ. Temporary Construction Materials:

KK. II. Turbine Construction

LL. Power Line and Structures

MM. Temporary Wiring and Electrical and Heating Equipment

NN. First Aid

OO. Communications Plan

PP. Emergency Alarms

QQ. Calling 911

RR. Emergency Plan

SS. Visitors

TT. Checklists

1. Fire Safety Coordinator
2. Construction Fire Watch
3. Construction Crewmembers
4. Construction Supervisors
5. Example Contents of the Required Laminated Card

III. Summary

This section will summarize that the CFPP has been prepared in response to the requirements of the Fire Agencies and will state the limitations of the requirements listed above, if any. For example, requirements made by the representatives of the Fire Agencies can overrule items in this CPPF.

IV. Disclaimer

This section will provide the disclaimer that the CFPP does not guarantee a fire or other emergency will not occur or cause property damage, injury or loss of life. However, it will also discuss that if the CFPP is complied with, the construction operation should be reasonably fire safe.

V. Appendices

Appendices may include maps, contact information, excerpts from the California Public Resources Code and other applicable regulations.

1.1.4 Environmental Setting

Dudek conducted a site evaluation on June 26, 2014. Appendix A provides photographs of the site and adjacent landscapes. The site inspection included an evaluation of vegetation/fuels, topography, and existing infrastructure and documented existing off-site conditions, including adjacent fuel types, topographic conditions, and surrounding land use types. The site evaluation was also used to confirm necessary fire behavior modeling input data.

1.1.4.1 Topography

Located in east San Diego County, the Project site is situated in a valley at the northeast edge of a mountain range (no name) that extends south into Mexico. The Project area is also adjacent to the Jacumba Mountains to the north and west and the desert to the east. Topography within the Project area varies from gentle slopes (less than 5%) to slightly, steeper terrain (30%) on a low hill near the southwest corner of the Project site. Site elevations range from approximately 3,160 feet above mean sea level (amsl) in the highest portions to the southwest to 3,010 feet amsl in the northwest corner of the Project site. The project site drains to the north and northwest via naturally eroded drainages from a gently sloping ridge which trends approximately north-south to the east of the Project area.

Post project, the site’s topography will be altered such that land beneath and adjacent to the individual panel racks and other site structures will be flat. There will still be changes in elevation across the site, but they will be less abrupt than currently and with a graded/cleared surface.

The gen-tie line extends from the Jacumba site northeast toward the ECO Substation. Elevations along the transmission line range from 3,200 feet amsl near the substation to about 3,150 feet amsl at the northeast corner of the solar farm project site.

1.1.4.2 Vegetation

The Project area is generally an arid semi-desert environment that supports a limited range of habitats and biological communities. Based on Dudek’s site visit and substantiated by the project’s Biological Memorandum, (Dudek 2013), there are five vegetation communities/land cover types within the Project area, including disturbed land, Peninsular juniper woodland and scrub, semi-desert chaparral, Sonoran mixed woody scrub, and upper Sonoran subshrub scrub. The acreage of each of these vegetation communities/land cover types are provided in Table 1 and their spatial distribution on the site is illustrated in Figure 4. As indicated, semi-desert chaparral and pennisular juniper woodland and scrub communities are the most common plant communities on the project site. Chaparral and juniper woodlands are also the most common plant communities adjacent to the site, which represents the fuels that would spread wildfire toward or away from the Project.

Table 1
Jacumba Solar Project Vegetation Communities

Vegetation Community/Land Cover	Acres	Percentage Cover
Upland Scrub and Chaparral		
Sonoran Mixed Woody Scrub	3.2	1.1%
Semi-Desert Chaparral	179.4	60.3%

Table 1
Jacumba Solar Project Vegetation Communities

Vegetation Community/Land Cover	Acres	Percentage Cover
Upper Sonoran Subshrub Scrub	3.6	1.2%
Upland Woodland and Savannah		
Pennisular Juniper Woodland and Scrub	98.2	33.0%
Non-Native Communities and Land Covers		
Disturbed Land	13.1	4.4%
Total	**297.5***	**100.0%**

Note: * Totals do not add up to 304 acres as the above acreages do not include the gen-tie alignment or Old Highway 80 acreage.

In addition to the solar site, the gen-tie interconnect traverses peninsular juniper woodland and scrub. Descriptions of these vegetation types are as follows.

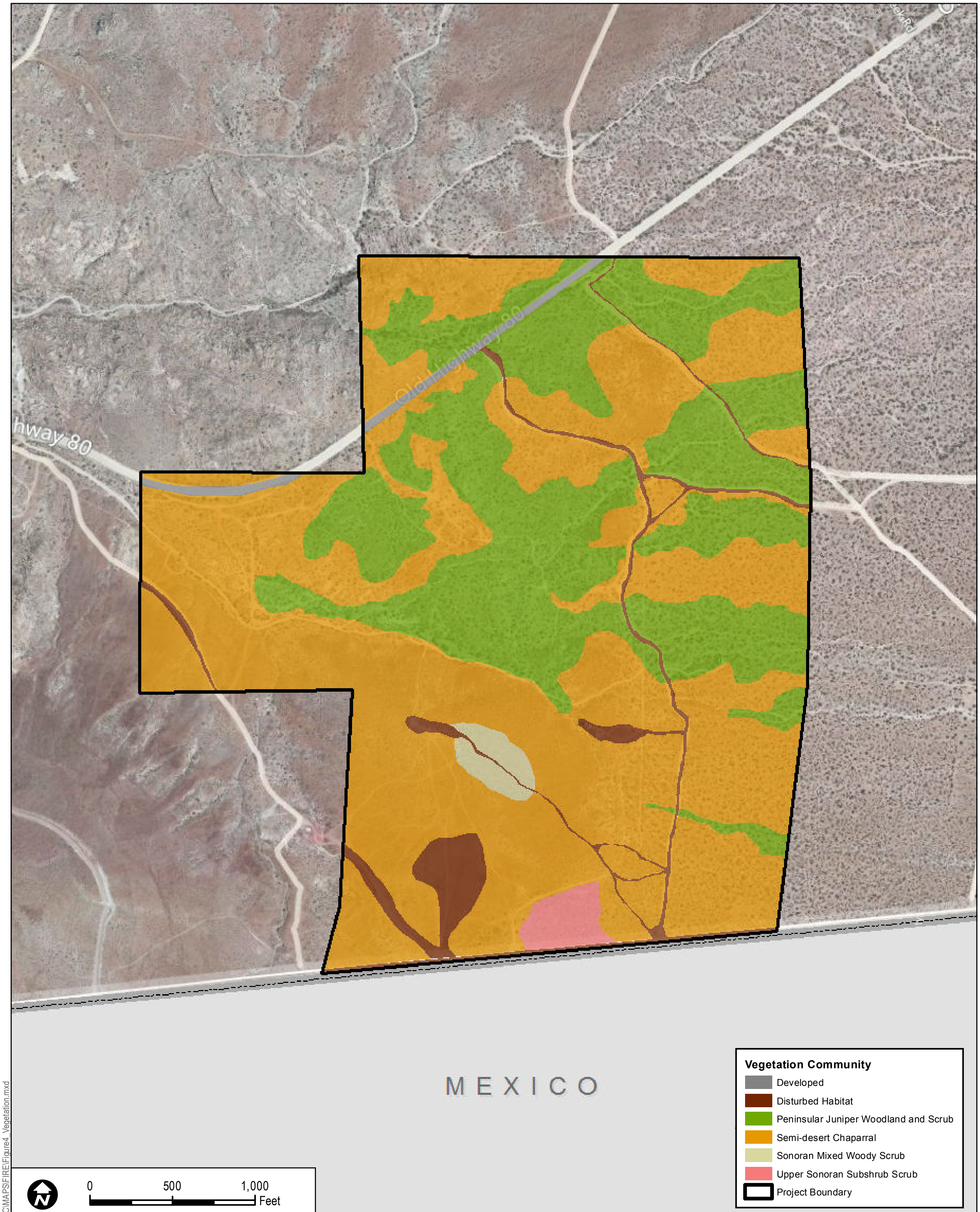
Disturbed Land

Disturbed land refers to areas that have been permanently altered by previous human activity that has eliminated all future biological value of the land for most species. The native or naturalized vegetation is no longer present and the land lacks habitat value for sensitive wildlife, including potential raptor foraging.

Disturbed land found throughout the study area consists primarily of unpaved roads (Figure 4). These roads have been graded and contain little native vegetation. Disturbed land is scattered in various locations throughout the study area.

Peninsular Juniper Woodland and Scrub

Peninsular juniper woodland and scrub consists of relatively dense pinon woodland dominated by Parry pinyon (*Pinus quadrifolia*), with California juniper (*Juniperus californica*) occurring within xeric sites below the trees dripline. This community occurs in alluvial fans and desert slopes that are slightly lower and more xeric than the peninsular pinon woodland community, with which it intergrades (Holland 1986). Other dominant species include: Parry's beargrass (*Nolina parryi*), Sonoran scrub oak (*Quercus turbinella*), Mojave yucca (*Yucca schidigera*), and sagebrush (*Artemisia tridentata*).



DUDEK

8477

SOURCE:Bing 2014; Dudek 2014

FIGURE 4
Site Vegetation Map

Jacumba Solar Energy Project - Fire Protection Plan

Path: Z:\Projects\j847701\MAPDOC\MAPS\FIRE\Figure4_Vegetation.mxd

INTENTIONALLY LEFT BLANK

Peninsular juniper woodland and scrub observed on site contains California juniper at greater than 4% absolute cover and lacks pines (*Pinus* sp.). Other commonly occurring species include creosote bush, jointfir (*Ephedra* sp.), goldenbush (*Ericameria* spp.), and snakeweed (*Gutierrezia* sp.). Peninsular juniper woodland and scrub occurs in large patches throughout the study area (Figure 4).

Semi-Desert Chaparral

According to Holland (1986), semi-desert chaparral is similar to northern mixed chaparral, but it is typically not quite as tall (4.9–10 feet) and more open. Dominant taxa within this community include *Juniperus* sp., *Eriogonum* sp., and *Opuntia* sp. Characteristic species include chamise, *Arctostaphylos* sp., *Ceanothus* sp. *Quercus* sp. and a variety of other shrubs and subshrubs. This community is found on the high desert plateaus and escarpment of the Peninsular Range in San Diego County, associated with drier, cooler winters (Holland 1986).

On site, semi-desert chaparral is found within areas where California juniper is less prominent (less than 4% absolute cover), including areas where California junipers have burned in the past and have not yet recovered. The semi-desert chaparral on site includes creosote bush, jointfir, goldenbush, cholla, Eastern Mojave buckwheat, and deerweed (*Acmispon glaber*). Semi-desert chaparral is the dominant vegetation community on site (Figure 4).

Sonoran Mixed Woody Scrub

According to Holland (1986), Sonoran mixed woody scrub is similar to Sonoran mixed woody and succulent scrub, but with additional woody species. Characteristic species include creosote bush, burrobush (*Ambrosia dumosa*), ocotillo, *Opuntia* sp., brittlebush (*Encelia farinosa*), and *Krameria* sp. In San Diego County, this community is associated with lower alluvial fans, above the desert floor and below the coarse mountain substrates (Holland 1986).

Sonoran mixed woody scrub on site lack California juniper and are dominated by creosote bush, in addition to other shrub and succulent cover. Other commonly occurring species include jointfir, cholla, goldenbush, snakeweed, and strawberry cactus (*Mammillaria dioica*). Sonoran mixed woody scrub occurs in one small patch toward the central portion of the study area (Figure 4).

Upper Sonoran Subshrub Scrub

Upper Sonoran subshrub scrub is comprised of low, fairly penetrable scrub of soft-wooded, summer-dormant, drought-tolerant shrubs (Holland 1986). It is usually associated with well drained soils derived from sandstone, shale, or sterile white diatomaceous deposits. In San Diego County, it intergrades with some chaparrals at higher elevations. Dominant vegetation found on site varies, but usually includes narrowleaf goldenbush (*Ericameria linearifolia*), Eastern Mojave buckwheat (*Eriogonum fasciculatum* var. *polifolium*), bladderpod spiderflower (*Isomeris arborea arborea*), or California jointfur (*Ephedra californica*) (Holland 1986).

Areas mapped as upper Sonoran subshrub scrub are dominated by Eastern Mojave buckwheat, goldenbush, jointfir, cholla, and deerweed. This area contains native shrub cover, but lacks California juniper and creosote bush. Sonoran subshrub scrub occurs in one patch located along the southern portion of the study area (Figure 4).

The Project will include removal of most of the vegetation from the site and replacement with fuel modification areas comprised of consistent low growing, low fuel accumulation species. The gen- tie alignment will not include removal of vegetation, except as necessary for installation and maintenance according to applicable vegetation management standards.

1.1.4.3 Fuel Loads

The vegetation described above translates to fuel models used for fire behavior modeling, discussed in detail in Section 3 of this FPP. Variations in vegetative cover type and species composition have a direct effect on fire behavior. Some plant communities and their associated plant species have increased flammability based on plant physiology (resin content), biological function (flowering, retention of dead plant material), physical structure (leaf size, branching patterns), and overall fuel loading.

Vegetation distribution is consistent on and adjacent to this site and is dominated by semi-desert chaparral with large patches of peninsular juniper woodland and scrub. These plant communities contain gaps with little or no flashy fuels (grasses or forbs) between individuals or clumps of shrubs and junipers. Fuel loads for the chaparral and juniper woodlands vegetation dominating the site is estimated to be 1.0 to 2.0 tons/acre. Other on-site fuels, including mixed and Sonoran scrub vegetation types, have lower fuel loads, typically less than 1.0 ton/acre. Fires burning in these fuel beds often display moderate fire intensity and thresholds for spread that are observed to depend on environmental factors like wind or slope.

Off-site, adjacent fuels are similar to the fuels found on the Project site. These fuel beds would represent the closest fuel sources once the site has been graded and the Project has been constructed.

1.1.4.4 Fire History

Fire history data provides valuable information regarding fire spread, fire frequency, ignition sources, and vegetation/fuel mosaics across a given landscape. One important use for this information is as a tool for pre-planning. It is advantageous to know which areas may have burned recently and therefore may provide a tactical defense position, what type of fire burned on the site, and how a fire may spread. According to available data from the California Department of Forestry and Fire Protection (FRAP 2014)[1], no fires have burned on the project site since the beginning of the historical fire data record.

Fire history for the project vicinity is illustrated in Figure 5, which indicates the potential for fires burning in the general area. However, fire history data indicates that smaller fires are more likely in this portion of the County, relative to those occurring in more dense fuels and mountainous terrain to the west in the Laguna and Cuyamaca Mountains (Cleveland National Forest). Seven fires have burned within 3 miles of the project site over the historic fire data record, of which three burned within 0.5 mile of the project site. The SDCFA may have data regarding smaller fires (less than 10 acres) that have occurred on the site that have not been included herein. Table 3 summarizes the fire history for the area within 3 miles of the project site.

Table 2
Fire History within Three Miles of the Jacumba Solar Energy Project Site

Fire Year*	Fire Name	Interval (years)	Total Area Burned (acres)
1980	In-Ko-Pah Fire	N/A	25
1981	Tower Fire	1	99
1989	In-Ko-Pah Fire	8	53
2003	Range Fire	14	29
2006	Gunn 2 Fire	3	7
2007	Inkopah Fire	1	699
2011	Border 12 Fire	4	36

* FRAP 2014

Based on an analysis of this fire history data set, specifically the years in which the fires burned, the average interval between wildfires in the area (includes areas up to roughly 5 miles from the project site) was calculated to be 5.2 years with intervals ranging between 1 and 14 years. Based on this analysis, it is expected that wildfire that could impact the facility may occur, if weather conditions coincide, roughly every 5 to 6 years with the realistic possibility of shorter interval occurrences, as observed in the fire history record. Further, the large expanses of open space surrounding the project site and potential ignition sources along Interstate 8 and Old Highway 80, contribute to increased potential risk and wildfire hazard in the area.

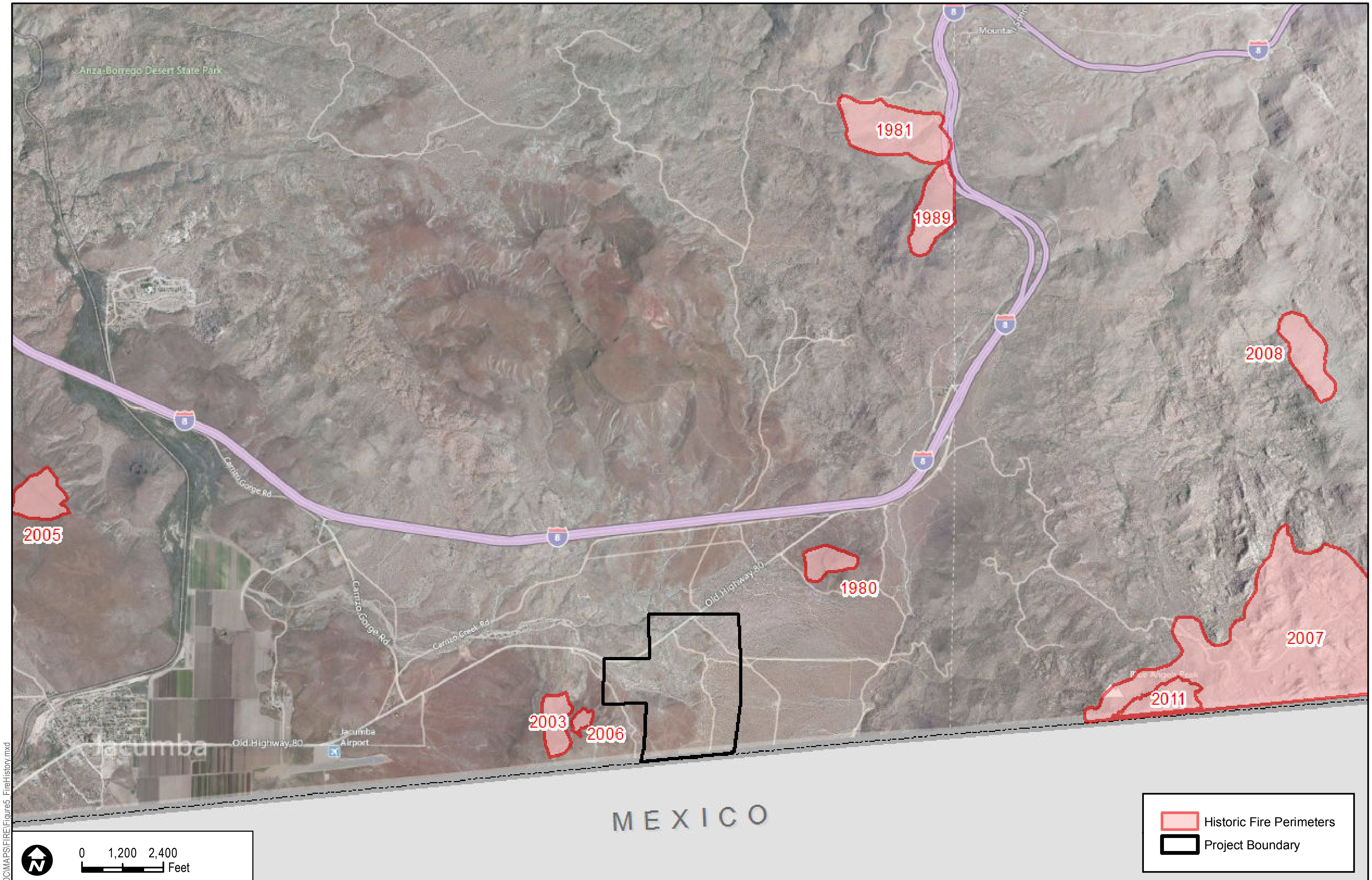
[1] Based on polygon GIS data from CALFIRE's Fire and Resource Assessment Program (FRAP), which includes data from CALFIRE, USDA Forest Service Region 5, BLM, NPS, Contract Counties and other agencies. The data set is a comprehensive fire perimeter GIS layer for public and private lands throughout the state and covers fires 10 acres and greater between 1878–2013.

1.1.4.5 Climate

Eastern San Diego County and the project area are influenced by the Pacific Ocean and are frequently under the influence of a seasonal, migratory subtropical high pressure cell known as the "Pacific High" (WRCC 2014a). Wet winters and dry summers with mild seasonal changes characterize the Southern California climate. This climate pattern is occasionally interrupted by extreme periods of hot weather, winter storms, or dry, easterly Santa Ana winds (WRCC 2014a). The average high temperature for the project area is approximately 76.3°F, with average highs in the summer and early fall months (July–October) reaching 93.8°F. The average precipitation for the area is approximately 14.82 inches per year, with the majority of rainfall concentrated in the months of December (2.06 inches), January (3.04 inches), February (2.77 inches), and March (2.30 inches), while smaller amounts of rain are experienced during the other months of the year (WRCC 2014b).

The prevailing wind pattern is from the west (on-shore), but the presence of the Pacific Ocean causes a diurnal wind pattern known as the land/sea breeze system. During the day, winds are from the west–southwest (sea) and at night winds are from the northeast (land). During the summer season, the diurnal winds may average slightly higher than the winds during the winter season due to greater pressure gradient forces. Surface winds can also be influenced locally by topography and slope variations. The highest wind velocities are associated with downslope, canyon, and Santa Ana winds.

The project area's climate has a large influence on the fire risk as drying vegetation during the summer months becomes fuel available to advancing flames should an ignition be realized. Typically the highest fire danger is produced by the high-pressure systems that occur in the Great Basin, which result in the Santa Ana winds of Southern California. Sustained wind speeds recorded during recent major fires in San Diego County exceeded 30 mph and may exceed 50 mph during extreme conditions. The Santa Ana wind conditions are a reversal of the prevailing southwesterly winds that usually occur on a region-wide basis during late summer and early fall. Santa Ana winds are warm and dry winds that flow from the higher desert elevations in the north through the mountain passes and canyons. As they converge through the canyons, their velocities increase. Consequently, peak velocities are highest at the mouths of canyons and dissipate as they spread across valley floors. Santa Ana winds generally coincide with the regional drought period and the period of highest fire danger. The project site is affected by Santa Ana winds.



Path: Z:\Projects\j847701\MAPDOC\MAPS\FIRE\Figure5_FireHistory.mxd

DUDEK

8477

SOURCE:Bing 2014; FRAP 2014

FIGURE 5

Fire History Map

Jacumba Solar Energy Project - Fire Protection Plan

INTENTIONALLY LEFT BLANK

1.1.4.6 Current Land Use

Land use on site, and in surrounding areas, consists of open space in both private and federal land holdings. Bureau of Land Management lands are adjacent to the Project limits on the west side and the SDG&E ECO substation is currently under construction to the northeast.

The U.S./Mexico border fence is a prominent feature on the landscape and is highly visible to the South of the Project site. The parcels comprising the Project are undeveloped, but include two, small structures near the eastern portion and middle of the Project area. The area is accessed by well-maintained, dirt roads that traverse the Project area.

1.1.4.7 Proposed Land Use

The Project would include removal of existing vegetation and structures from the project site, grading to create flat pad areas, construction of solar facilities and an approximately 0.25 mile long gen-tie line. The Project is planned to provide approximately 20 MW of PV generation to be constructed on the 108-acre solar development site within 297-acre ownership. The Project land use would include solar arrays, access roads, on-site water storage tanks, overhead and underground electrical transmission lines, an approximately 9-foot chain link perimeter fence, and related infrastructure for a solar facility, as described herein.

SDG&E is currently constructing the ECO Substation which is located approximately 1,500 feet to the southeast of the Project site. As proposed, the Jacumba Solar Energy Project site would connect to the SDG&E ECO Substation via a 138 kV gen-tie transmission line.

INTENTIONALLY LEFT BLANK

2 DETERMINATION OF PROJECT EFFECTS

FPPs provide an evaluation of the adverse environmental effects a proposed project may have from wildland fire. The FPP must provide mitigation for identified impacts to ensure that development projects do not unnecessarily expose people or structures to a significant loss, injury or death involving wildland fires. Significance is determined by answering the following guidelines:

Would the project expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?

The wildland fire risk in the vicinity of the Project site has been analyzed and it has been determined that wildfires are likely occurrences, but would not be significantly increased in frequency, duration, or size with the construction of the Project. The Project would include non-combustible solar array construction, operation and maintenance structures, and related infrastructure. The site will be largely converted from wildland chaparral fuels to ignition resistant facilities and equipment. The Project would not include full-time inhabitants/employees, but would include increased human activity during construction and for ongoing Project operation and maintenance.

The types of potential ignition sources that currently exist in the area include vehicle and roadway, electrical transmission line, and machinery associated with rural residential, amongst others. The project would introduce potential ignition sources (transformers, capacitors, and energy storage facilities), but would also include conversion of ignitable fuels to lower flammability landscape and include 24 hour surveillance, resulting in faster observation and reporting of fires. With the conversion of the site's fuels, the Project is expected to function as a fire break that results in reduced fire spread, flame lengths and fire intensity based on the lower fuel volume that will be maintained throughout the site. Fires from off-site would not have continuous fuels across this site and would therefore be expected to burn around and/or over the site via spotting. Burning vegetation embers may land on Project structures, but are not likely to result in ignition based on ember decay rates and the types of non-combustible and ignition resistant materials that will be used on site. Ignition resistant materials of glass, steel, aluminum and decomposed granite will provide resistance to ignitions from embers. Understory fuels will be maintained at roughly 6 inches, so ignitions in the ground cover from embers would produce a fast moving, but low intensity fire through the highly compartmentalized fuel modification areas beneath the PV modules.

The Project would comply with applicable fire codes and would include a layered fire protection system designed to current codes and inclusive of site-specific measures that will result in a Project that is less susceptible to wildfire than surrounding landscapes. Further, the facility will provide specific measures to reduce the likelihood of fire igniting on the site from necessary maintenance operations as well as measures to aid responding firefighters to the facility through direct site safety designs and training methods. Additionally, the participation in the local SDRFPD Community Facilities District (CFD) or a similar Developer Agreement provides funds that are used to support fire agency capabilities and combined with other provided fire safety features at the site, results in effective mitigation of potential fire impacts. Maintenance personnel would be able to temporarily remain on site during a wildfire (there will be no full-time staff on the site) and there will be no occupied O&M structure where people would remain overnight. Therefore, the project will not expose people or structures to a significant risk of loss, injury or death involving wildland fires.

Would the project result in inadequate emergency access?

The Project includes fire access throughout the facility and is consistent with the Consolidated County Fire Code. Perimeter roads will be 24 feet wide and supportive of fire apparatus. Additional fire apparatus access to within 300 feet (600 feet road spacing) of all project facilities will be provided and will vary between 20 feet and 24 feet wide. All other site service roads will be 10 feet wide. Fire access on the Project site will be improved from its current condition which provides only limited access on dirt/gravel roads. The on-site roadways are designed as looped access throughout the project and conformance with road surface, width, turning radius, and vertical clearance Code requirements for emergency access. Therefore, emergency access is considered adequate for this type of facility.

Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance service ratios, response times or other performance objectives for fire protection?

The Project is calculated to add an estimated fewer than 0.5 calls per year to the Jacumba Fire Station and the SDCFA Boulevard Fire Station. The addition of 0.5 calls/year to a rural fire station that currently responds to approximately 7 to 10 calls per week is considered insignificant and will not require the construction of additional Fire Station facilities based on that increase alone. However, the project will be part of a cumulative impact from several renewable energy projects in the area that combined could cause service level decline. As such, the Project will participate in the existing CFD, or a similar Developer Agreement, providing fair-share funding to be used to augment existing fire emergency response capabilities of the local Fire Response Resources and off-set cumulative impacts of the Project and other renewable energy projects that are expected to be built in the area. The result is maintained or enhanced fire service ratios and response times to the existing condition.

Would the project have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?

The Project will provide plumbing and on-site water storage tanks (minimum of 2–10,000 gallon tank). The tanks will be placed near the facility entrance and in the southwestern portion of the project and in the northwest portion of the site. The water will provide enough water for array cleaning and maintenance and firefighting needs. Therefore, the Project will have sufficient water supplies to serve the Project and does not require expanded entitlements.

The measures described in the responses to these significance questions are provided more detail in the following sections.

INTENTIONALLY LEFT BLANK

3 ANTICIPATED FIRE BEHAVIOR

3.1 Fire Behavior Modeling

Following field data collection efforts and available data analysis, fire behavior modeling was conducted to document the type and intensity of fire that would be expected on this site given characteristic site features such as topography, vegetation, and weather. Results are provided below and a more detailed presentation of the modeling inputs and results are provided in Appendix B.

3.1.1 Fire Behavior Modeling Inputs

Fire behavior modeling conducted in support of this FPP utilized the guidelines and standards presented by the County of San Diego, Department of Planning and Development Services[2]. These guidelines identify acceptable fire weather inputs for extreme fire conditions during summer months and Santa Ana fire weather patterns. The County analyzed and processed fire weather from Remote Automated Weather Stations (RAWS) between April 15 to December 31 in order to represent the general limits of the fire season. Data provided by the County's analysis included temperature, relative humidity, and sustained wind speed and is categorized by weather zone, including Maritime, Coastal, Transitional, Interior, and Desert.

To evaluate potential fire behavior for the project site, Dudek utilized the BehavePlus (v. 5.0.5) fire behavior modeling software package to determine fuel moisture values and expected fire behavior for the site. The temperature, relative humidity, and wind speed data for the Desert[3] weather zone were utilized for this FPP based on the project location. Reference fuel moistures were calculated in BehavePlus and were based on site-specific topographic data inputs. Fire behavior for the site was calculated in two different locations using worst-case fuels and topography (steepest slopes). One of the modeling scenarios analyzed potential fire behavior to the northeast of the proposed project development area (Scenario 1) during peak, Santa Ana fire weather conditions. The other modeling scenario (Scenario 2) analyzed potential fire behavior in the western portion of the project site during Summer (on-shore) weather conditions. Tables 2 and 3 summarize the fire behavior model inputs utilized for this FPP.

2 County of San Diego Report Format and Content Requirements – Wildland Fire and Fire Protection (August 31, 2010). On-line at http://www.sdcounty.ca.gov/dplu/docs/Fire-Report-Format.pdf

3 http://www.sangis.org

Table 3
BehavePlus Fine Dead Fuel Moisture Calculation

Variable	Scenario 1: Peak Weather (Offshore/Santa Ana Condition)	Scenario 2: Summer Weather (Onshore Flow)
Dry Bulb Temperature	90–109 deg. F	90–109 deg. F
Relative Humidity	5–9 %	5–9 %
Reference Fuel Moisture	1 %	1 %
Month	May June July	Feb Mar Apr Aug Sept Oct
Time of Day	12:00–13:59	12:00–13:59
Elevation Difference	Level (within 1,000 ft.)	Level (within 1,000 ft.)
Slope	0–30%	0–30%
Aspect	West	Northwest
Fuel Shading	Exposed (< 50% shading)	Exposed (< 50% shading)
Fuel Moisture Correction	0 %	1 %
Fine Dead Fuel Moisture	1 %	2 %

Table 4
BehavePlus Fire Behavior Modeling Inputs

Variables	Scenario 1: Peak Weather (Offshore/Santa Ana Condition)	Scenario 2: Summer Weather (Onshore Flow)
Fuel Model	SH1	SH1
1h Moisture	1%	2%
10h Moisture	2%	4%
100h Moisture	4%	6%
Live Herbaceous Moisture	30%	50%
Live Woody Moisture	50%	80%
20-foot Wind Speed (upslope)	56 mph	18 mph
Wind Adjustment Factor	0.5	0.5
Slope Steepness	3%	30%

3.1.2 Fire Behavior Modeling Results

Three fire behavior variables were selected as outputs from the BehavePlus analysis conducted for the project site, and include flame length (feet), rate of spread (mph), and fireline intensity (BTU/feet/second). The aforementioned fire behavior variables are an important component in understanding fire risk and fire agency response capabilities. Flame length, the length of the flame of a spreading surface fire within the flaming front, is measured from midway in the active flaming combustion zone to the average tip of the flames (Andrews, Bevins, and Seli 2004). It is a somewhat subjective and non-scientific measure of fire behavior, is extremely important to fireline personnel in evaluating fireline intensity and is worth considering as an important fire variable (Rothermel 1983). Fireline intensity is a measure of heat output from the flaming front, and also affects the potential for a surface fire to transition to a crown fire. Fire spread rate represents the speed at which the fire progresses through surface fuels and is another important variable in initial attack and fire suppression efforts. The information in Table 3 presents an interpretation of these fire behavior variables as related to fire suppression efforts. The results of fire behavior modeling efforts are presented in Table 4. A graphical illustration is displayed in Figure 6.

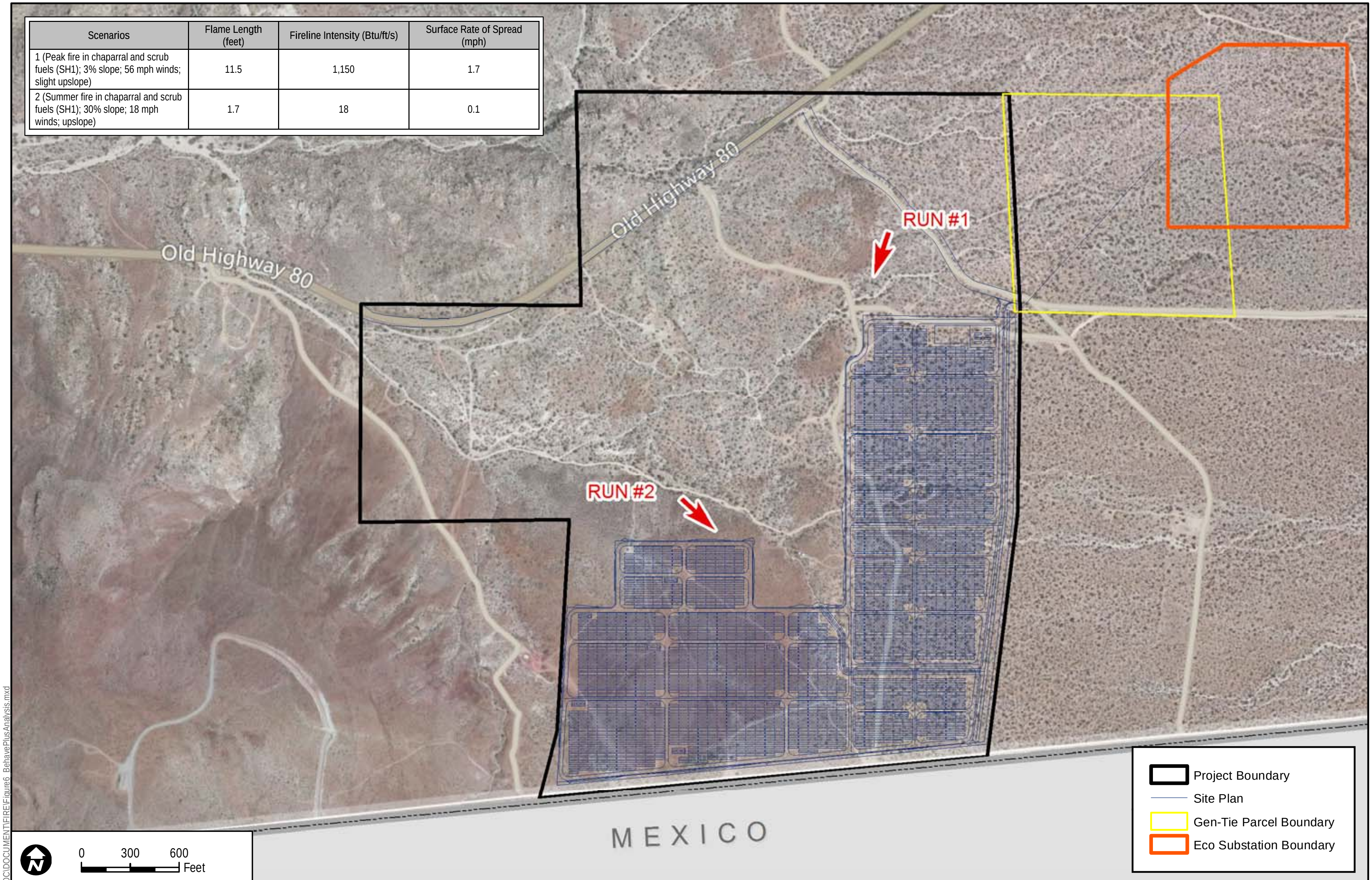
Table 5
BehavePlus Fire Behavior Modeling Results

Scenarios	Flame Length (feet)	Fireline Intensity (Btu/ft/s)	Surface Rate of Spread (mph)
1 (Peak fire in chaparral and scrub fuels (SH1); 3% slope; 56 mph winds; slight upslope)	11.5	1,150	1.7
2 (Summer fire in chaparral and scrub fuels (SH1); 30% slope; 18 mph winds; upslope)	1.7	18	0.1

As presented, wildfire behavior in chaparral and scrub fuel beds on the project site is expected to be of moderate intensity during extreme, Santa Ana weather conditions with maximum sustained wind speeds of 56 mph and low fuel moistures. Sparse chaparral and scrub fuels are predominant on site and in the area immediately surrounding the project site, which would be the fuels affecting the constructed project. Based on the observed fuel beds surrounding the site, off-site fire behavior is expected to be similar to that modeled for the site. Wildfire in the project vicinity is expected to be relatively short in duration as vegetative fuels are consumed rapidly. As such, there would not be a sustained source of heat and or flame associated with site-adjacent wildland fuels.

Further, the project site's fuels would be converted and reduced to ground cover in the developed portion of the project site. The post-project fuel modification areas would provide a significant reduction in the potential for fire ignition as well as the flame length, spread rate, and intensity of fires should ignition occur. The developed portion of the project site may be compared to a large fuel break once completed. Adjacent native and undisturbed fuels may readily carry fire, especially during portions of the year where vegetation moisture content falls and warm temperatures, low humidity and high winds become common. The developed portion of the site will be largely free of combustible vegetation with only a ground cover of maintained vegetation adjacent and beneath the solar panel racks. Flying embers from off-site fire may inundate the project site during wind-driven fire events. The modified fuel areas and construction type and materials for all project features will resist ignition from ember showers. Ignition of the ground cover could result in a fast moving, but lower intensity fire that burns in a patchy manner on the site due to the highly compartmentalized fuel modification areas beneath the panel racks.

Scenarios	Flame Length (feet)	Fireline Intensity (Btu/ft/s)	Surface Rate of Spread (mph)
1 (Peak fire in chaparral and scrub fuels (SH1); 3% slope; 56 mph winds; slight upslope)	11.5	1,150	1.7
2 (Summer fire in chaparral and scrub fuels (SH1); 30% slope; 18 mph winds; upslope)	1.7	18	0.1



DUDEK

8477

FIGURE 6

BehavePlus Analysis Map

Jacumba Solar Energy Project - Fire Protection Plan

Path: Z:\Projects\j847701\MAPDOC\DOCUMENT\FIRE\Figure6_BehavePlusAnalysis.mxd

INTENTIONALLY LEFT BLANK

4 ANALYSIS OF PROJECT EFFECTS

4.1 Adequate Emergency Services

4.1.1 Emergency Response

The project site is located within San Diego County Fire Authority (SDCFA) and San Diego Rural Fire Protection District (SDRFPD) jurisdictions and State Responsibility Area (SRA) lands provided wildland fire protection by CALFIRE/SDCFA. Of note, the SDRFPD will be absorbed by SDCFA by approximately the summer of 2015. Final details of that merger are not available at the time of this report, but it is assumed that the current stations will receive at least the same staffing coverage, if not enhanced.

Emergency response for the Project would be provided, initially, by the SDRFPD from its Station 43 in Jacumba. The Jacumba Fire Station is located at 255 Jacumba Street and is staffed with reserve firefighters. The Jacumba Station is approximately 5.0 miles from the most remote areas of the project and travel time to these areas is approximately 8.8 minutes. This is compliant with the required Consolidated Fire Code and General Plan response time and distance requirements for rural land use zoning. A Fire Service Facility Availability Form is included in Appendix C.

The SDCFA Boulevard Fire Station is also nearby and would respond with additional resources. The SDCFA Boulevard Fire Station is located at 39223 Highway 94 in Boulevard and it is approximately 12 miles from the Project's proposed entrance. The SDCFA Boulevard Fire Station is an all-volunteer fire department that protects an approximately 99-square-mile area in eastern San Diego County. The Department's operations are now financed by SDCFA CSA 135 (CSA 111 that formally included this area has been formally dissolved). The San Diego County Fire Authority is initiating the process to construct a new fire station near the existing Boulevard station and co-locate at that station with CALFIRE. It is not known when that station will be operational, but it will provide additional firefighting resources to the Project. In addition to these responding fire stations, there are additional resources available through automatic or mutual aid agreements. The region's fire resources are discussed further in the following sections.

Within the unincorporated region's emergency services system, fire and emergency medical services are provided by Fire Protection Districts (FPD), County Service Areas (CSA) and CALFIRE. Collectively, there are over 2,800 firefighters responsible for protecting the San Diego region from fire. Generally, each agency is responsible for structural fire protection and wildland fire protection within their area of responsibility. However, mutual and automatic aid agreements enable non-lead fire agencies to respond to fire emergencies outside their district boundaries. Interdependencies that exist among the region's fire protection agencies are primarily voluntary as no local governmental agency can exert authority over another.

Due to the remote location of the project area, fire services generally consist of volunteer departments. CALFIRE provides fire protection for a large part of east San Diego County. The unincorporated area of San Diego County has a Cooperative Fire Protection Agreement with CALFIRE for the provision of fire and emergency services in the San Diego Rural Fire Protection District. CALFIRE responds to wildland fires, structure fires, floods, hazardous material spills, swift water rescues, civil disturbances, earthquakes, and medical emergencies. CALFIRE operates the CALFIRE Whitestar Facility at 1684 Tierra Del Sol Road, located approximately two and three quarter's miles north of the Proposed Project (CALFIRE 2012a). The White Star station is located at 1684 Tierra Del Sol Road in Boulevard and it is approximately 15 miles from the Project's proposed entrance. It is a full-time station staffed 24/7 by career firefighters and paid volunteers, through an Amador contract (staffing continues through the "off season" with the County under which, the County funds CALFIRE presence during this period. The primary responsibility of the White Star station is wildfire protection. CALFIRE, in association with the California Department of Corrections and Rehabilitation, also jointly manages McCain Valley Camp (a prison camp) and provides inmates with a limited level of training in fire safety and suppression techniques. Crew levels at the camp fluctuate and the response is typically for wildland fire, flood control, and community projects. McCain Valley Camp is located at 2550 McCain Valley Road, approximately 11 miles northwest of the Proposed Project (CALFIRE 2012b).

4.1.1.1 Emergency Service Level

The project does not propose any full-time personnel on site, but may include up to five people on site during operations inspections and maintenance activities. This on-site population will vary, not be consistent, and therefore, does not fit into typical models to calculate projected call volume. As a conservative comparison, this analysis uses five people on-site during daylight hours. Therefore, the 24-hour equivalency would be ½ that number since staff would not be on site after dark/overnight (there will be some variation throughout the year with a higher number of persons during the construction phases). Using San Diego County fire agencies' estimate of 82 annual calls per 1,000 population, the project's estimated 2.5 daylight only on-site personnel, would generate up to 0.2 calls per year (1 call every 5 years). The type of call would be expected to be medical-related. These estimates are likely overly conservative because County statistics represent calls from dense urban areas where medical and fire related calls are much higher than would be anticipated from the Project.

Service level requirements are not expected to be significantly impacted with the increase of less than 0.2 calls per year for the Jacumba Fire Station and the SDCFA Boulevard Fire Station) that both currently respond to fewer than 2 calls per day in their respective primary service areas[4]. For reference, a station that responds to 5 calls per day in an urban setting is considered average and 10 calls per day is considered busy. Therefore, the project is not expected to cause a decline in the emergency response times.

Response to the project from nearby fire stations will be within the acceptable time frame as designated in the County General Plan. The Project site is within the Mountain Empire Subregional Plan of San Diego County's General Plan; the land use category Rural Lands (RL-80) Development Area. Based on this category, maximum travel time is greater than 20 minutes, Response from Jacumba Fire Station is calculated at less than 9 minutes. The SDCFA Boulevard Fire Station's engine would be roughly 20 minutes. Therefore, the project complies with the General Plan for response travel time. The Project would construct a facility that is very different from the residential units that could be constructed on the site. The intent of the 20 minute travel time is that very-low rural densities mitigates the risk associated with wildfires by reducing the number of people potentially exposed to wildfire hazard. The Project would include the adjusted equivalent of 2.5 persons, roughly the same as one dwelling unit population, on the entire 304-acre site. Therefore, the Project meets the intent of the RL80 land use category, even though it has a more aggressive footprint than would the allowable rural land use designation.

4.1.1.2 Response Personnel Training

Studies (Grant 2010 and others) indicate that solar facility fire data is lacking, but it is clear that electrical fires (not associated with solar) occur relatively regularly and solar component fires can and do occur, although at much lower levels and typically related to roof-top solar arrays, at least to date. The same studies evaluated what measures provide the best results for improving response capabilities and firefighter safety. Among the types of measures that provide the most benefit are firefighter training, proper labeling, firefighter familiarizing, and extreme caution during fire response. To that end, this FPP requires the Project to implement the following measures:

- Conduct training sessions with local fire station personnel
- Provide a Technical Report identifying project specific firefighting issues

---

4 Jacumba and SDCFA Boulevard Fire Stations responded to 189 and 457 calls, respectively, during 2013 (Personnel communication with Mr. James Pine, SDCFA, June 2014).

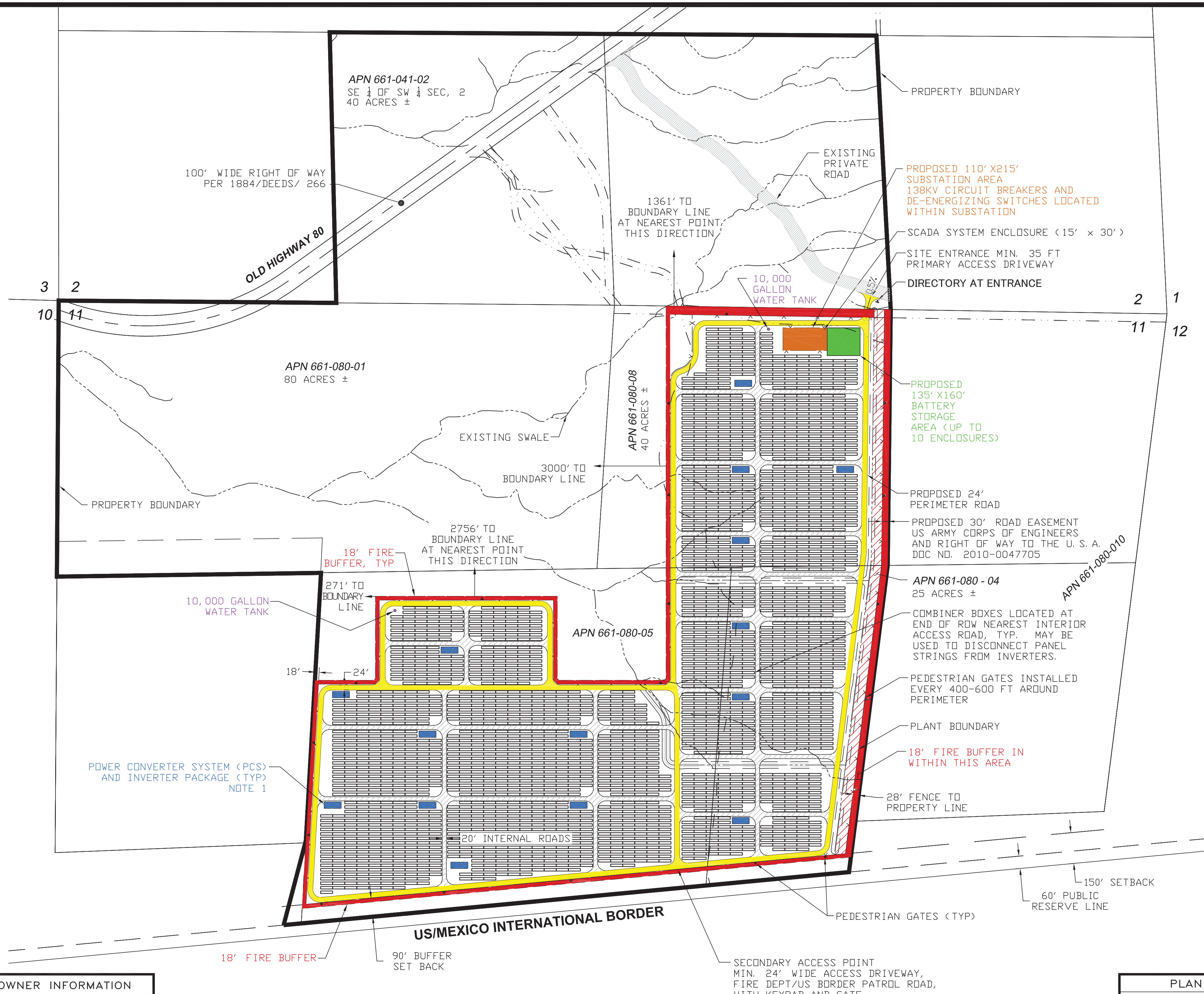
- Create a customized video training CD with SDCFA and CALFIRE input that will be provided to local fire agencies for refresher training and training new firefighters who may rotate into potentially responding stations
- Create consistent and clear labeling and placarding warnings on all electrical equipment
- Provide system technical contact information for reliably available key personnel who can assist responding firefighters with technical aspects of the Project

4.2 Fire Access

4.2.1 Fire and Maintenance Access Roads for Solar Facility

Primary access to the Jacumba Solar site would be provided by a 24-feet wide, paved road that was recently constructed as part of the ECO substation project. The improved roadway intersects with Old Highway 80 to the north of the Project and eventually Old Highway 80 connects with Interstate 8 to the west via Carrizo Gorge Road. Two points of emergency ingress/egress would be provided for the site. First, the northeastern entrance would be accessed from the improved road that also leads to the ECO substation site. This entrance would be controlled by a 24-foot wide security gate. Secondary access leading to/from the project site is provided by a 20 feet wide gate at the south-central portion of the Project site that provides alternative access to a 20 feet wide road that runs along the north side of the U.S./Mexico International border fence. Secondary access is required for development projects that include an increase in the number of people beyond a threshold that could impact the ability to evacuate those people while providing suitable ingress for emergency personnel. This project, once operational, will include an average of 5 people or fewer on site and worst case, up to 20 on site at any given time and will include no overnight accommodations, so no staff will be sleeping at the site. Access gates will be provided from paved road to the north, and access from the border road to the south.

There are two different types of roads for the project that will be improved to different standards: fire access roads and service roads. All road surfaces will be treated with a permeable nontoxic soil binding agent in order to reduce fugitive dust and to reduce erosion. Figure 7 provides detailed road locations.



VICINITY MAP
NOT TO SCALE

SHEET NOTES:

1. INVERTERS MAY BE USED TO DISCONNECT AC SOURCES TO PCS AND SUBSTATION.

FIRE SAFETY LEGEND:

- PERIMETER ROAD
- BATTERY STORAGE
- WATER TANK
- INTERIOR ROAD
- 18 FT FIRE BUFFER
- 50 FT FIRE BUFFER
- SUBSTATION
- POWER CONVERTER SYSTEM (PCS) AND INVERTER PACKAGE

SHEET LEGEND:

- PROPERTY BOUNDARY
- PLANT BOUNDARY/FENCE
- PCS/INVERTER PACKAGE
- SECTION LINE
- FIXED TILT RACK
- DRAINAGE CHANNEL (TBD PER DRAINAGE STUDY)
- PEDESTRIAN GATE

CONCEPTUAL ENGINEERING PLANS

**NOT FOR CONSTRUCTION
FOR PERMITTING ONLY**

PROPERTY OWNER INFORMATION

NAME: JACUMBA SOLAR, LLC.
ADDRESS: 700 UNIVERSE BLVD
JUNO BEACH, FL 33408
TELEPHONE NUMBER:
(24 HOUR CONTACT NUMBER)
SITE A.P.N. NUMBER: 661-041-02, 661-041-03, 661-080-01, 661-080-04 661-080-05, 661-080-08
SITE ADDRESS: XXX OLD HWY 80
JACUMBA, CA 91934

REFERENCE DRAWINGS:

JSEP-2-DW-112-000-001	COVER SHEET
JSEP-2-DW-112-002-001	PLOT PLAN
JSEP-2-DW-112-735-001	PRELIMINARY GRADING PLAN
JSEP-2-DW-112-735-002	GRADING SECTIONS AND DETAILS
JSEP-2-DW-112-735-003	FENCE DETAILS
JSEP-2-DW-112-717-001	EROSION CONTROL PLAN
JSEP-2-DW-601-206-010	CONCEPTUAL ONE LINE DIAGRAM

FIRE SAFETY PLAN

250 0 250 500 750
SCALE: 1" = 250'

ENGINEER WORLEYPARSONS
2330 E. BIDWELL ST., SUITE 150
FOLSOM, CA 95630
(916) 817-3920

PLAN CHECK/PERMITS

BUILDING RECORD ID:
PARCEL MAP NUMBER:

ENGINEER OF WORK

I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT AND THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT.

NAME: JUAN BRAVO DATE:
RCE NO: EXPIRES:

COUNTY OF SAN DIEGO
PLANNING & DEVELOPMENT SERVICES

MINOR GRADING PLAN FOR:
JACUMBA SOLAR, LLC.
JACUMBA SOLAR ENERGY PROJECT
FIRE SAFETY PLAN
FIGURE 7

SHEET: 1 OF SHEETS: 1

APPROVED DIRECTOR OF PLANNING & DEVELOPMENT SERVICES
BY: DATE:
GRADING RECORD ID: JSEP-2-DW-112-014-001

FIRE SAFETY PLAN

INTENTIONALLY LEFT BLANK

Fire Access Roads (Internal): The perimeter Fire Access Road that encircles the periphery of the site would be constructed to a minimum width of 24 feet improved designed, constructed, and maintained to support the imposed loads of fire apparatus (not less than 50,000 lbs.) and would be provided with an approved surface (6 inches of gravel) so as to provide all-weather driving capabilities. North-south and east-west fire access roads on the site are anticipated to be 20 feet wide. There will be turnout opportunities at each internal road intersection, which are spaced less than 300 feet apart. The purpose of these fire access roads is to allow for two-way access of fire apparatus throughout the project site in order to be within 300 feet of all project components. Therefore, roadways may be spaced as much as 600 feet apart to meet the 300-foot hose pull lengths allowed by the County. An access controlled gate would be installed at the ECO substation roadway which would be constructed off an improved existing roadway with direct access to Old Highway 80. Fire access roads would be oriented in a north–south direction and would have east–west connections.

Service Roads: Graded dirt service roads will occur throughout the site where they could also be used as a fire access road that would facilitate access to PV modules and inverters. Service roads will be constructed to a width of about 10 feet and would be compacted to support washing equipment loads of 15,000 pounds. The service roads would also be treated with a nontoxic soil binding agent to control dust. Service roads will be capable of supporting typical maintenance vehicles and some types of fire apparatus (such as Type VI engines). These roads will be treated with a soil binding agent designed to minimize degradation of surface over time. Service roads would be clearly marked to indicate that they will not support imposed loads of 50,000 pounds, as appropriate.

Deadends

Road distance thresholds specified under Section 503.1.3 of the Consolidated Fire Code restrict maximum dead end road lengths for varying parcel size. The project is zoned RL80 with a minimum allowable parcel size of 80 acres. Parcels of this size are allowed a maximum dead-end road length of 5,280 feet according to Section 503.1.3. The distance from the site entrance where there exists the opportunity to egress in two separate directions, to the most remote portion of the Project is 6,425 feet. However, the Project’s circulatory driveways/roadways will include numerous opportunities for fire engine turn-around, and emergency ingress/egress via the Border Patrol roadway, thus avoiding a dead-end situation and meeting Code requirements. Further, the intent of the dead end road length requirements is for evacuation of civilians from a wildfire emergency as well as fire department access. The Project includes a very low average number of on-site staff so that evacuation during an emergency would not impede fire access.

Vertical Clearance

Minimum vertical clearance of 13 feet 6 inches will be maintained for the Project's Fire Access Road from the driving surface.

Grade

Road grades will not exceed 10%, complying with the Consolidated Fire Code for the proposed decomposed granite aggregate road surface. If during construction it is realized that any road surface may exceed 10%, appropriate mitigations will be provided including providing paved surface for those stretches over 10%.

Surface

The non-load-bearing surface material of the perimeter fire access roads would consist of an all-weather surface (6 inches of gravel over compacted soil) capable of supporting 50,000 pounds as required by County Fire Code.

Secondary Access

Alternative ingress/egress can be an important component to fire protection and safety. In addition to the primary project access point located off of Highway 80 and ECO substation roadway, an additional ingress and egress point is provided along the southern project boundary near the international border. Of the two access points, only one can be accessed from a publically maintained road. Emergency access roads to Border Patrol route is designated for emergency use only and would not be subject to regular project traffic.

Gates

The double swing gate at the entrance to this project shall be equipped with an approved emergency key-operated switch overriding all function commands and opening the gate or a fire accessible padlock. The gate has a measured opening of 24 feet and will be installed in compliance with Section 503.5 and 503.6 of the CCFC and to the satisfaction of the Director of Public Works. The site will be completely fenced with a chain link (8-foot) and barbed wire (1-foot) fence. The 20 feet wide gate for the southern access road will be chain-link with a fire-accessible padlock.

Pedestrian gates will be provided on each side (north, south, east and west) of the project's perimeter fence at spacing acceptable to the fire authority. Pedestrian gates will include chain-link and fire accessible padlocks.

4.2.2 Identification

Identification of roads and structures will comply with CCFC, Section 505. Additionally, an illuminated sign at the Project entrance will be provided that clearly indicates inverter and electrical grid layout, PV module “safe” mode switch location and entire site de-energizing disconnect switch identification and location. Lighting for the sign will be provided by a motion sensor-activation so the light is not on all night, every night. Additionally, the sign lettering will be reflective and the sign locate where vehicle headlights may provide adequate illumination.

4.2.3 De-Energizing

The project will provide one location near the entrance gate that will enable responding firefighters to de-energize/disconnect the components of the project that can be de-energized (inverters, substation, etc.).

4.2.4 Transmission Line

The transmission line Right-of-Way access roads are dirt surfaced and have an average width of 10 feet. These roads are designed for the construction and maintenance of the gen-tie line. Even though a Type 3 engine could travel on the dirt roads, they are not designed to be fire access roads that support 50,000 pounds and meet minimum grade standards.

4.3 Water

Once the project is operational, typical water usage will include ongoing PV panel washing, soil binding agent applications, and other maintenance usage.

Project water will be stored in aboveground tanks complying with the requirements of the SDCFA. The two tanks shall comply with NFPA 22, Private Fire Protection Water Tanks. The water capacity of each tank shall be 10,000 gallons.

The capacity of the water tanks at the facility will be based upon the demand for hand lines, plus a reasonable allocation for water supply for Fire Engines to generate firefighting foam for 15 minutes at an application density of 0.16 gpm/sq ft from a hose line using a 3% Aqueous Film-Forming Foam (AFFF) concentrate, for use on an oil fire in transformer containment. A conceptual estimate at this point, prior to detailed design, is 250 gpm for 15 minutes (3,750 gallons of water) plus 112.5 gallons of foam concentrate for oil firefighting. The actual amount of stored water is to be determined upon detailed design of the substation, transformer secondary containment, and batter energy storage facility.

The project proposes two 10,000 gallon water tanks, one near the primary fire access gate and another near the northwest corner of the site, or to the SDCFA approval. A procedure for ongoing inspection, maintenance and filling of tanks will be in place. The tanks and fire engine connections shall be located on the side of the fire access road(s). The width of the road at the water tank locations shall be at least 18 feet (travel width) plus an additional 10-foot width, for a distance of 50 feet, to allow for fire engine to park and connect to the tank, while leaving the road open. The tanks shall be labeled "Fire Water: 10,000 gallons" using reflective paint.

Final location of the tanks and total number of gallons will be approved by the SDCFA based on a tank location drawing to be submitted by the Project applicant. Drawings shall show tank location, road, and shall include the tank standard drawing and notes.

4.4 Battery Storage

The 10 MW battery storage component of the project would be located in the northeast corner of the site, near the entrance and substation. Depending on the type of lithium ion battery selected for the project, the potential hazards are primarily associated with the possibility of thermal runaway occurring from a malfunctioning or damaged battery. Newer battery technologies have minimized the occurrence of thermal runaway through a system of protections including internal cell monitoring and partitioning, use of non-flammable chemicals, container design and features, HVAC systems and inert gas fire suppression systems. The discussion in Appendix D describes lithium ion battery technology, the risks, and measures to reduce risks. This project will incorporate the following risk reduction measures, or their equivalent:

- Available Battery Management Modules (BMMs) continuously monitor the state of charge, battery health, temperature, and other important information. Also available are Mastery Battery Management Modules (MBMMs) to ensure charge uniformity throughout each string of Li-ion batteries.
- Custom grate or fiberglass t-bar flooring available to cover corrosion resistant secondary containment.
- EPA Compliant Spill Containment and Access.
- IEEE 1547 compliance (to preclude unplanned power backfeed or islanding).
- Electrical fault protection compatible with downstream protection coordination.
- Fault current/voltage limited inverters with full electrical protection and isolation switches.
- AEROS energy control system monitors and ensures operation within safe limits and can disconnect power if needed.

- Ground fault detection, integrated onboard fire suppression system with smoke and heat detection.
- Every rack's battery management system continually monitors for unsafe voltage, current, and temperature and has control of an automated switch to disconnect the rack from the system if necessary.
- High voltage fusing for the entire rack supplements the battery management control system.
- Module electronics will monitor every cell voltage and select cell temperatures, and has its own dedicated overvoltage monitoring chip.
- Two additional levels of fuse safety – individual cell fuses and integral module-level fuse.
- Integrated pressure vent on all cylindrical cells.
- Cells certified to stringent UL1642 Lithium cell safety standards.
- Effective battery standard operating procedures (SOP's) shall be developed and shall include processes that guide every aspect of battery safety, from shipping and receiving, handling, daily use, storage, and other functions involving the batteries.
- An interior inert gas fire suppression system such as the FM-200 or similar shall be installed.
- Firefighters shall have access to the containers to provide water for cooling any battery fire, as possible with a back-up plan to avoid entering a container to cool the exterior of the container through water application (multiple water streams encompassing the involved container) which would positively impact interior temperatures as the batteries burned within.
- Regularly scheduled, on-site training and familiarity with local firefighters shall be conducted and battery system and container specifics provided to the fire agencies for integration in their operation pre-planning efforts.
- The HVAC and venting system shall be engineered to remove the potentially toxic, thick smoke from burning plastics and the toxic fumes from electrolyte should a fire occur. The HVAC system shall be designed so that burning embers and smoke from nearby fires, such as a wildland fire, do not penetrate into the containers and ignite combustibles inside. The HVAC system shall also be on emergency standby power and monitored.
- Seismic engineering and restraint shall be incorporated in the containers and the battery racks. The proposed system comes with a seismic rating.
- Containers shall be separated an acceptable distance from one another to prevent fire/heat spread which will help control the rare occurrence of thermal runaway domino effect.

- Spill control and secondary containment shall be provided for transformers containing any appreciable amount of oil.
- An emergency shutdown device shall be provided to stop electrical flow for battery isolation and Firefighter safety. This type of device/control is proposed as part of the energy storage project.
- The required Heat/Smoke Detection system, per Fire Code, shall comply with NFPA 72 and shall be remotely supervised. The proposed energy storage for the project includes a heat and fire detection system linked to an automatic fire suppression system.
- Safety signs and warning signs shall be installed on all building for firefighter and worker safety.
- Suitable portable fire extinguishers shall be provided.
- Approved Fire Truck access shall be provided to ensure access within 150 feet of all portions of the battery storage containers.

Transmission Line

The gen-tie transmission line will consist of an overhead alignments. The 0.25 miles of transmission would be installed and strung across three new poles, up to 150 feet in height. The transmission line from the transition pole to the ECO substation will be constructed on steel poles designed for extreme winds that meets or exceeds current California Public Utilities Commission (CPUC) standards. The line will also have an overhead static wire to improve lightning performance. The project will incorporate any Federal Aviation Administration required tower or conductor marking and lighting devices, if warranted.

4.5 Defensible Space and Vegetation Management

The Project will be provided defensible space by setting back all PV modules a minimum 50-feet from property boundaries and modifying the natural fuels by removing or maintaining them to a height of 6 inches, or, in the case of perimeter areas, drivable surfaces and vegetation free areas. The perimeter FMZ buffer will include at least 50 feet of modified fuels and will include the 24 foot wide perimeter fire access road, and cleared, contiguous modified fuel areas from the perimeter fence to the outermost panel racks. This area seamlessly meets the modified fuel areas that occur throughout the site where fuels are maintained at a 6 inch height.

The entire site will include modified fuels with fire access roadways and service roads compartmentalizing the low-growing (less than 6-inch) maintained areas beneath all PV solar modules. No off-site clearing is required or authorized, as required fuel modification can be accommodated on site. Combustible vegetation within the Project area shall be limited to approved species. None of the plants on the prohibited plant list (Appendix E) shall be allowed on site.

Prescribed Defensible Space (site-wide fuel management zones) will be maintained on at least an annual basis or more often, as needed, by the applicant or current Project owner. Planting used in the defensible space will consist of low-growing ground cover selected from the SDCFA desirable plant list. A potential plant mix for the fuel modification areas is included as Attachment F. The planting list and spacing will be reviewed and approved by the SDCFA Fire Marshal and included on submitted Landscape Plans.

4.5.1 Fuel Modification

Project fuel modification will include one zone (opposed to multiple zones) that consists of non-irrigated, low growing ground cover. Because this site will utilize non-combustible construction, the proposed fuel modification areas will provide adequate setback for the potential short duration wildfire that may be realized in the adjacent wildland fuels.

A minimum 50 feet wide fuel modification area will be provided at the perimeter of the project between the solar modules and the off-site wildland fuels. This area will include contiguous fuel modification from the perimeter fence inward and includes the perimeter fire access road. Figure 8 provides a depiction of the perimeter fuel modification area along with other project components. The worst-case predicted flame lengths are roughly 12 feet. A rule of thumb standard for residential development is a minimum of two times the flame lengths for structure setback. The PV modules could be exposed to short-duration wildfire, but would not be expected to include consistent, focused heat exposure from the off-site vegetative fuels.

4.5.1.1 Fuel Modification Requirements

The following recommendations are provided for fuel modification, which are proposed to occur throughout the site from perimeter fence to interior preserve area boundaries, including beneath all solar arrays. There would be no fuel modification zone markers in the field.

Site Wide Low-Flammability Zone

The site’s fuel modification is applicable throughout the developed portions of the site. As such, the existing vegetation will be removed and the site will be replanted with low-growing, desirable ground cover. The following specifications apply to the fuel modification area:

- Non-combustible surface (gravel, dirt, etc.) is acceptable, or:

- Cleared of all existing native vegetation and replanted with drought tolerant native species. This area will be maintained to 6 inches or less.
- Ground cover, less than 6 inches high
- Removal of all dead, dying, and dried (low fuel moisture) vegetation
- Refer to Appendix E for Prohibited Plants that will not be allowed on site. Trees are not recommended on the site or its perimeter
- Refer to Appendix F customized fuel modification plant list for potential plants that may be suitable for the site-wide low-flammability zone
- If the area is planted with native annual and perennial grasses they shall be allowed to grow and produce seed during the winter and spring. As grasses begin to cure (dry out), they will be cut to 6 inches or less in height.

4.5.1.2 Other Vegetation Management

Electrical Transmission Line Vegetation Management

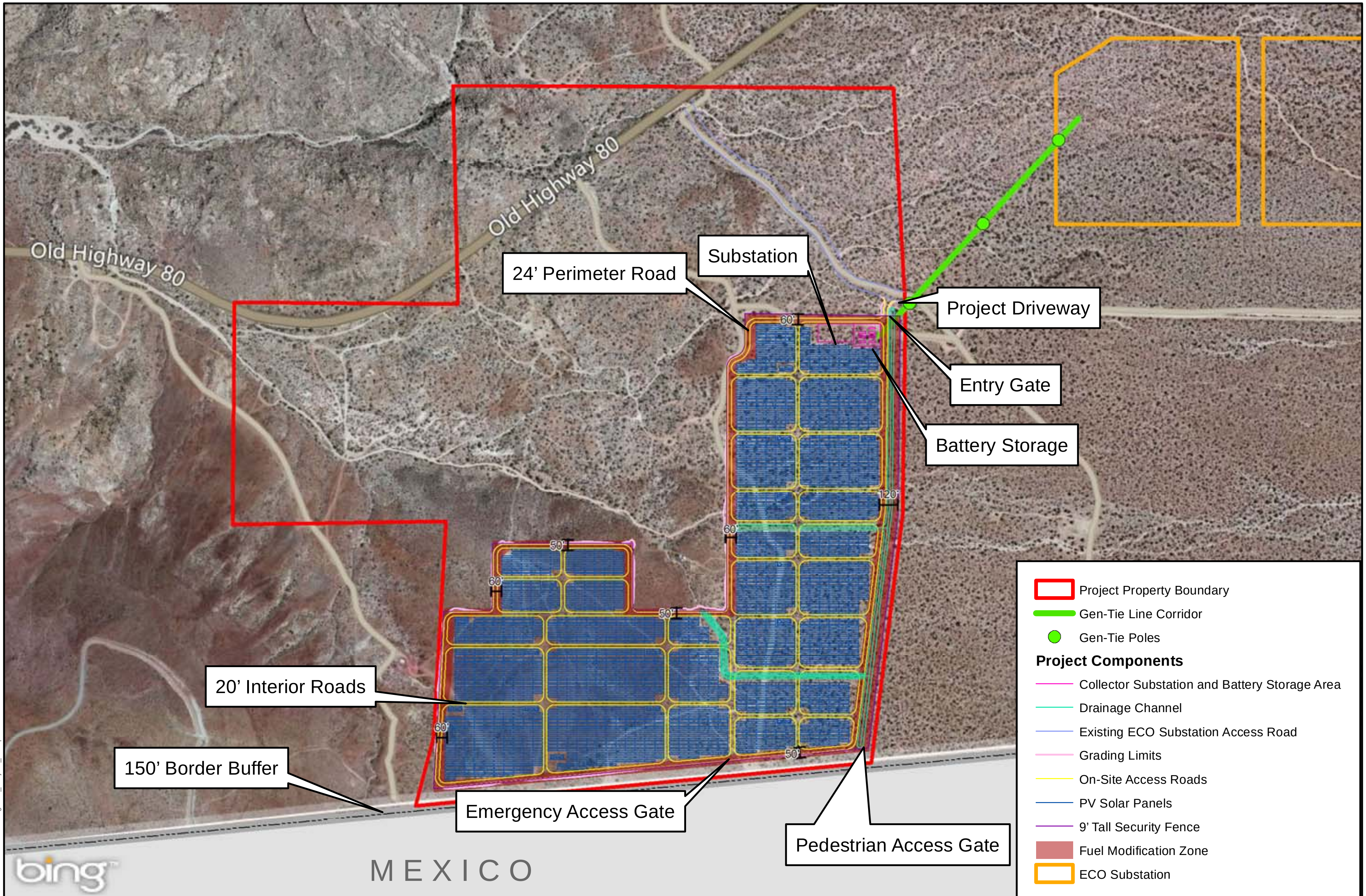
In addition to the Project site fuel modification requirements, the selected interconnection transmission line could require standard vegetation clearance at off-site locations, if above ground. Overhead transmission line and transmission pole vegetation management is regulated by various codes and ordinances including by the following regulations:

California Public Utilities Commission

<u>GO 95: Rules for Overhead Electric Line Construction</u>

GO 95 is the standard governing the design, construction, operation, and maintenance of overhead electric lines in California. It was adopted in 1941 and updated most recently in 2006.

GO 95 includes safety standards for overhead electric lines, including minimum distances for conductor spacing, minimum conductor ground clearance, standards for calculating maximum sag, and vegetation clearance requirements.



DUDEK

8477

FIGURE 8

Select Project Components

Jacumba Solar Energy Project

Path: Z:\Projects\j847701\MAPDOC\DOCUMENT\FIRE\Figure8_Project_Components.mxd

INTENTIONALLY LEFT BLANK

Vegetation clearance requirements of GO 95 are:

GO 95: Rule 35, Tree Trimming Criteria, defines minimum vegetation clearances around power lines.

Rule 35 guidelines specify, at the time of trimming require:

- 4 feet radial clearances are required for any conductor of a line operating at 2,400 volts or more, but less than 72,000 volts;
- 6 feet radial clearances are required for any conductor of a line operating at 72,000 volts or more, but less than 110,000 volts;
- 10 feet radial clearances are required for any conductor of a line operating at 110,000 volts or more, but less than 300,000 volts (this would apply to the project);
- 15 feet radial clearances are required for any conductor of a line operating at 300,000 volts or more.

CCR, Title 14 Section 1254

The firebreak clearances required by PRC § 4292 are applicable within an imaginary cylindrical space surrounding each pole or tower on which a switch, fuse, transformer or lightning arrester is attached and surrounding each dead-end or corner pole, unless such pole or tower is exempt from minimum clearance requirements by provisions of CCR, Title 14 Section 1255 or PRC § 4296.

The radius of the cylindroids is 10 feet measured horizontally from the outer circumference of the specified pole or tower with height equal to the distance from the intersection of the imaginary vertical exterior surface of the cylindroid with the ground to an intersection with a horizontal plane passing through the highest point at which a conductor is attached to such pole or tower. Flammable vegetation and materials located wholly or partially within the firebreak space shall be treated as follows:

- At ground level – remove flammable materials, including but not limited to, ground litter, duff and dead or desiccated vegetation that will propagate fire;
- From 0 to 8 feet above ground level – remove flammable trash, debris or other materials, grass, herbaceous and brush vegetation. All limbs and foliage of living trees shall be removed up to a height of 8 feet;
- From 8 feet to horizontal plane of highest point of conductor attachment – remove dead, diseased or dying limbs and foliage from living sound trees and any dead, diseased or dying trees in their entirety.

Pre-Construction Vegetation Management

- Fuel modification must be maintained on the perimeter throughout construction to achieve the 50 feet of modified fuels for perimeter PV modules, transformers, and inverters.
- Fuel modification of 100 feet must be provided around the energy (battery) storage facilities.
- Perimeter Vegetation Management Zones must be implemented prior to commencement of construction utilizing combustible materials.

Undesirable Plants

Certain plants are considered to be undesirable in the landscape due to characteristics that make them highly flammable. These characteristics can be physical or chemical.

The plants included in the Prohibited Plant List (Appendix E) are unacceptable from a fire safety standpoint, and shall not be planted on the site. The area retained outside of the Project footprint in the western portion of the project that includes terrain not desirable for grading includes non-native pine and eucalyptus trees as well as undesirable native plant species. These trees and flammable plants shall be removed and any subsequent sprouting or volunteering of trees or undesirable plant materials will be removed on an annual basis.

4.5.1.3 Fuel Modification Area Vegetation Maintenance

All fuel modification area vegetation management shall be completed annually by May 15 of each year and more often as needed for fire safety, as determined by the SDCFA. Project applicant or current owner shall be responsible for all vegetation management throughout the facility and Project site, in compliance with the requirements detailed herein. The Project applicant or current owner shall be responsible for ensuring long-term funding and ongoing compliance with all provisions of this FPP, including vegetation planting, fuel modification, vegetation management, and maintenance requirements throughout the Project site.

Fuel modification maintenance work may be provided by mowing, trimming, masticating, managed goat grazing, or other methods that result in the desired low-fuel conditions detailed herein.

As a further means of ensuring the fuel modification area is maintained per this FPP, the Project owner shall obtain an inspection and report from a SDCFA-authorized Wildland Fire Safety Inspector by June 1st of each year, certifying that vegetation management activities throughout the project site have been performed pursuant to this plan. This effort further ensures vegetation maintenance and compliance with no impact on the SDCFA.

4.6 Cumulative Impact Analysis

This and other projects may have a cumulative impact on the ability of local agencies to protect residents from wildfires. This project and other development in the area will increase the population and/or activities and ignition sources in the Jacumba area, which may increase the chances of a wildfire and increase the number of people and structures exposed to risk of loss, injury or death.

The potential cumulative impacts from multiple projects in a specific area can cause fire response service decline and must be analyzed for each project. The Project and its proposed Solar module arrays along with substantial other solar and/or wind projects in the greater Jacumba region represent an increase in potential service demand along with challenges regarding rescue or firefighting within or adjacent to electrical facilities.

Despite the generally low calculated increase in number of calls per year anticipated from the Project, the project contributes to the cumulative impact on fire services, when considered with other anticipated projects in the area. The cumulative impact results in a situation where response capabilities may erode and service levels may decline. In response, the Project will participate in the SDRFPD's CFD, or a similar Developer Agreement, paying fair share funding toward fire services. Funding provided by the project results in capital that can be used toward firefighting and emergency response augments, improvements, and additions so that the SDRFPD/SDCFA and area firefighting agencies will be able to perform their mission into the future at levels consistent with the General Plan.

The requirements described in this FPP, including ignition-resistive construction, fire protection systems, pre-planning, education and training, and fuel modification/vegetation management, are designed to aid firefighting personnel such that the Project is defensible and on-site personnel are protected and potential cumulative impacts to the fire authority are mitigated.

INTENTIONALLY LEFT BLANK

5 MITIGATION MEASURES AND DESIGN CONSIDERATIONS

As presented in this FPP, the proposed Project provides customized measures that address the identified potential fire hazards on the site. The measures are independently established, but will work together to result in reduced fire threat and heightened fire protection. Figure 7 provides a Site Fire Safety Plan indicating the locations of important site safety features including roads, on-site water storage tanks, battery storage containers, inverters, and fuel modification areas. The provided measures include both required and Project-volunteered items, as follows:

1. Fuel Modification throughout the Project site from boundaries inward, including beneath PV modules with restrictions on plant species, heights, densities, and locations. Implementation of vegetation management standards for electrical transmission line/interconnect to ECO substation.
2. Provide a technical report indicating special precautions for firefighting response (Appendix G).
3. 24-foot wide perimeter fire apparatus access road and primary access. Fire access roads varying between 20 and 24 feet providing access to within 300 feet of all site components; Service roads that are 12 feet wide turnarounds provided at key areas within the solar array.
4. Participation in a SDRFPD CFD, or a similar Developer Agreement, for funding firefighting and emergency medical resources, the details of which will be determined in the project Fire Service Agreement.
5. Project funded annual fuel modification inspections to ensure compliance with this FPP.
6. Motion sensor illuminated (and/or reflective) signage at main entrance with inverter and electrical grid disconnect and isolation information and identification.
7. Ability of first responders to de-energize the project’s non-panel components from one location.
8. Training program for local fire agencies including preparation of a technical training video with SDCFA input and customized for this facility that can be easily viewed by new firefighters who rotate through the local fire stations.
9. Preparation of a construction fire prevention plan for this project to be implemented by all contractors working on this project.
10. Portable carbon dioxide (CO_2) fire extinguishers mounted at the inverters and medium voltage transformer units
11. Two 10,000-gallon water tanks

12. System contact information with local fire agencies/stations to assist responding firefighters during an emergency
13. Committed on-going maintenance of all facility components for the life of the project
14. Consistent placarding and labeling of all components for fire safety/response

6 CONCLUSION

This FPP is submitted in support of an application for project entitlement of the Jacumba Solar Energy Project. It is submitted as required in compliance with the County's conditions for FPP content. The requirements in this document meet the intent and purpose of the Code for fire safety, building design elements, fuel management/modification, and landscaping requirements of San Diego County. This FPP documents required fire safety features required by applicable codes and recommends additional measures that will enhance the site's fire safety and reduce potential impacts to insignificant without lessening health, life, or fire safety.

Fire and Building Codes and other local, county, and state regulations in effect at the time of each Project phase's building permit application supersede these recommendations unless the FPP recommendation is more restrictive.

The Project provides fire access, on-site water, structures built to ignition resistant standards, fuel modification and vegetation management, and measures for fire protection during construction. The site fuel modification is based on fire behavior modeling representing the fire environment and the type of fire that would be anticipated at this site. The fuel modification areas will be maintained and inspected annually by a SDCFA-approved, Project-funded wildland fire inspector, removing all dead and dying materials and maintaining appropriate horizontal and vertical spacing. In addition, plants that establish or are introduced to the fuel modification area that are not on the approved plant list will be removed.

In addition, the project will participate in a SDRFPD Community Facilities District or a similar Developer Agreement, which has provides resources in this portion of eastern San Diego County by requiring projects to provide funding toward fire department assets (stations, apparatus, equipment, personnel).

Ultimately, it is the intent of this FPP to guide, through code and mitigation requirements, the construction of a Solar Facility and gen-tie transmission line that is defensible from wildfire and, in turn, does not represent significant threat of ignition source for the adjacent native habitat. It must be noted that during extreme fire conditions, there are no guarantees that a given structure will not burn. Precautions and mitigating actions identified in this report are designed to reduce the likelihood that fire would impinge upon the proposed structures. There are no guarantees that fire will not occur in the area or that fire will not damage property or cause harm to persons or their property. Implementation of the required enhanced construction features provided by the applicable codes and the mitigating fuel modification requirements provided in this FPP will accomplish the goal of this FPP to assist firefighters in their efforts to defend these structures and reduce the risk associated with this project's WUI location.

INTENTIONALLY LEFT BLANK

7 LIST OF PREPARERS

Project Manager:

Michael Huff
Fire Protection Planner; San Diego County California Environmental Quality Act Consultant List
Dudek

FPP Preparation, GIS, and Fire Behavior Modeling:

Scott Eckardt
Registered Professional Forester
Dudek

FPP Preparation:

Michael E. Scott
Urban Forester and Fire Protection Planner
Dudek

INTENTIONALLY LEFT BLANK

8 REFERENCES

Anderson, Hal E. 1982. *Aids to Determining Fuel Models for Estimating Fire Behavior*. USDA Forest Service Gen. Tech. Report INT-122. Intermountain Forest and Range Experiment Station, Ogden, UT. http://www.fs.fed.us/rm/pubs_int/int_gtr122.pdf

Andrews, Patricia L.; Collin D. Bevins; and Robert C. Seli. 2008. BehavePlus fire modeling system, version 4.0: User's Guide. Gen. Tech. Rep. RMRS-GTR-106 Revised. Ogden, UT: Department of Agriculture, Forest Service, Rocky Mountain Research Station. 123p.

Finney, M.A., J.D. Cohen, I.C. Grenfell, and K.M. Yedinak. 2010. An Examination of Fire Spread Thresholds in Discontinuous Fuel Beds. International Journal of Wildland Fire. 19, 163–170.

FRAP (Fire and Resource Assessment Program). 2014. CALFIRE Fire Resource and Assessment Program. California Department of Forestry and Fire Protection. Accessed July 2014. http://frap.cdf.ca.gov/.

Grant, Casey C. 2010. Fire Fighter Safety and Emergency Response for Solar Power Systems. Fire Protection Research Foundation. 99 pp.

Holland, R.F. 1986. *Preliminary Descriptions of the Terrestrial Natural Communities of California.* Nongame-Heritage Program, CDFG. October 1986.

National Fire Protection Association (NFPA) 1144. 2013. Standard for Reducing Structure Ignition Hazards from Wildland Fire. Accessed July 2014. http://www.nfpa.org.

NFPA 22. 2013. Standards for Water Tanks for Private Fire Protection. Accessed July 2014. http://www.nfpa.org.

Rothermel, Richard C. 1983. *How to Predict the Spread and Intensity of Forest and Range Fires*. USDA Forest Service Gen. Tech. Report INT-143. Intermountain Forest and Range Experiment, Ogden, UT. http://www.treesearch.fs.fed.us/pubs/24635

Scott, Joe H. and Robert E. Burgan. 2005. *Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model*. Gen. Tech.Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

Shroeder, M.J. and C.C. Buck. 1970. Fire weather – A guide for application of meteorological information to forest fire control operation. USDA Forest Service Agricultural Handbook 360.

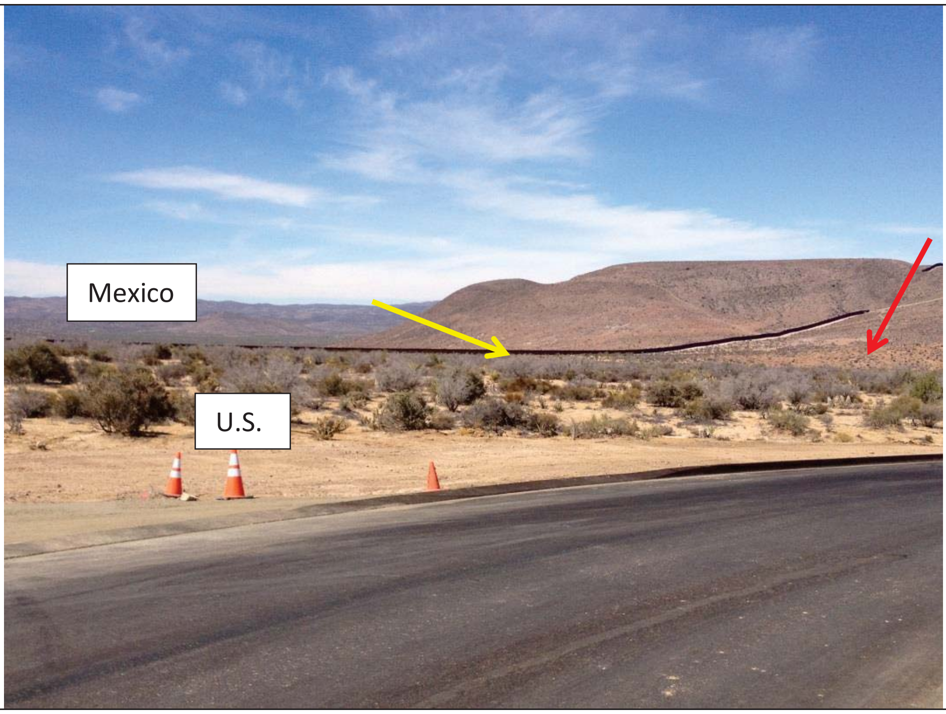
WRCC (Western Regional Climate Center). 2014a. "Climate of California." Western Regional Climate Center. Accessed July 2014. http://www.wrcc.dri.edu/narratives/california/.

WRCC. 2014b. "Period of Record Monthly Climate Summary, Campo, California (041424)." Accessed July 2014. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca1424.

APPENDIX A

Site Photograph Log

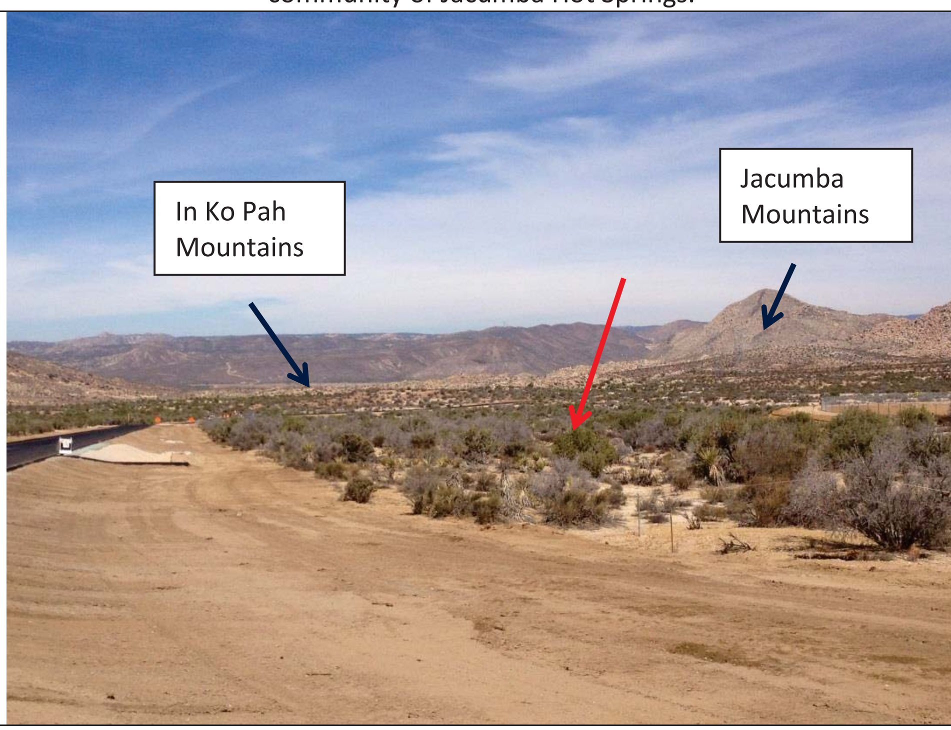
APPENDIX A
Site Photograph Log



Photograph 1. View of southern portion of project area (red arrow). The U.S./Mexico international border fence is visible in the middle of picture (yellow arrow).

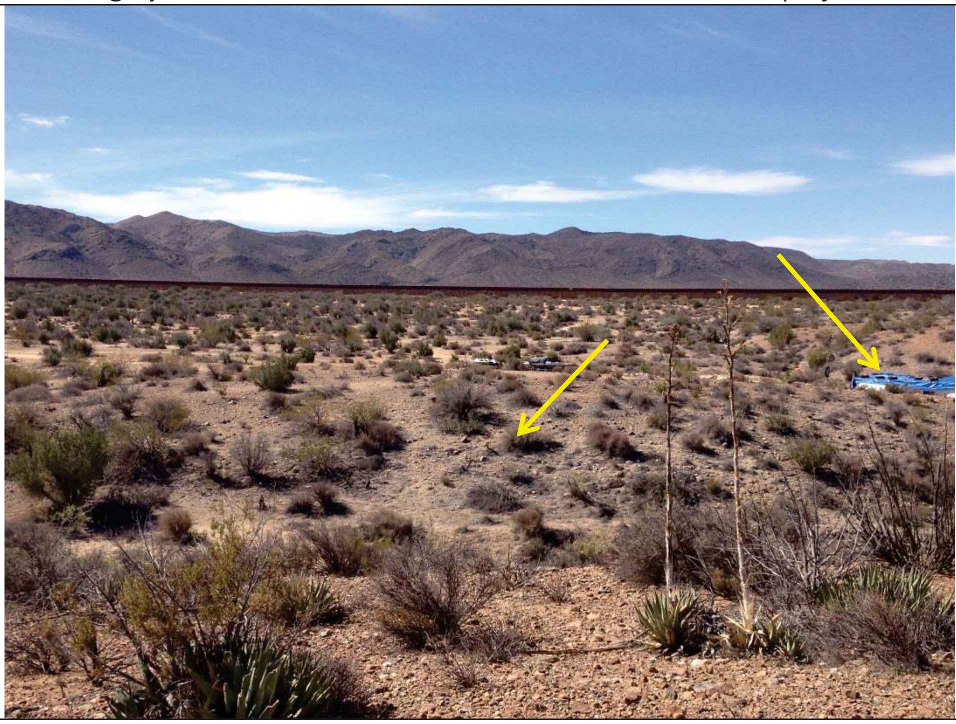
Photograph 2. View of the project area. 24-foot wide asphalt road will be the primary fire access to ECO Substation and the northern entrance to the project site.

Photograph 3. View looking west towards the central portion of project site (red arrow) and the community of Jacumba Hot Springs.



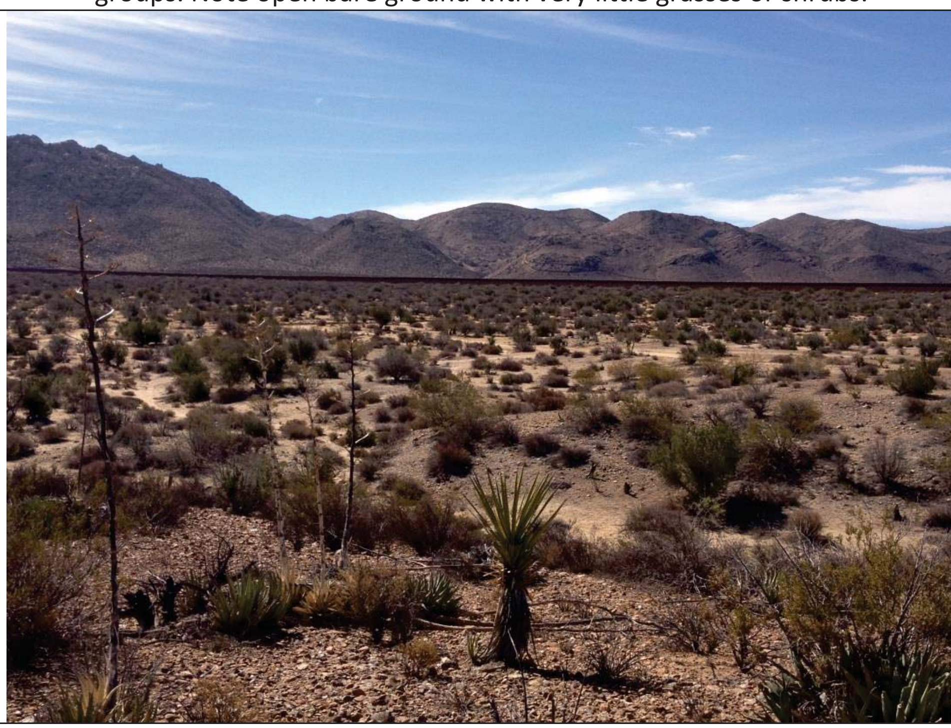
Photograph 4. View looking northwest towards the central and northern portions of project site (red arrow).

Photograph 5. View of ECO Substation to the northeast of the project site.



Photograph 6. View of structures (yellow arrows) and semi-desert chaparral habitat in the project area. U.S./Mexico Border fence is shown in upper portion of photograph.

Photograph 7. Photograph illustrates discontinuous fuel bed (gaps) between juniper woodland/scrub groups. Note open bare ground with very little grasses or shrubs.



Photograph 8. View looking towards the southern portion of project site which is vegetated with semi-desert chaparral.

APPENDIX B

BehavePlus Fire Behavior Analysis

APPENDIX B
BehavePlus Fire Behavior Analysis

1 BEHAVEPLUS FIRE BEHAVIOR MODELING

Fire behavior modeling includes a high level of analysis and information detail to arrive at reasonably accurate representations of how wildfire would move through available fuels on a given site. Fire behavior calculations are based on site-specific fuel characteristics supported by fire science research that analyzes heat transfer related to specific fire behavior. To objectively predict flame lengths, spread rates, and fireline intensities, the BehavePlus 5.0.5 fire behavior modeling system was applied using predominant fuel characteristics, slope percentages, and extreme weather variables for the site.

Predicting wildland fire behavior is not an exact science. As such, the movement of a fire will likely never be fully predictable, especially considering the variations in weather and the limits of weather forecasting. Nevertheless, practiced and experienced judgment, coupled with a validated fire behavior modeling system, results in useful and accurate fire prevention planning information.

To be used effectively, the basic assumptions and limitations of BehavePlus must be understood.

- First, it must be realized that the fire model describes fire behavior only in the flaming front. The primary driving force in the predictive calculations is dead fuels less than one-quarter inch in diameter. These are the fine fuels that carry fire. Fuels greater than one inch have little effect while fuels greater than three inches have no effect on fire behavior.
- Second, the model bases calculations and descriptions on a wildfire spreading through surface fuels that are within six feet of the ground and contiguous to the ground. Surface fuels are often classified as grass, brush, litter, or slash.
- Third, the software assumes that weather and topography are uniform. However, because wildfires almost always burn under non-uniform conditions, length of projection period and choice of fuel model must be carefully considered to obtain useful predictions.
- Fourth, the BehavePlus fire behavior computer modeling system was not intended for determining sufficient fuel modification zone widths. However, it does provide the average length of the flames, which is a key element for determining “defensible space” distances for minimizing structure ignition.

Although BehavePlus has some limitations, it can still provide valuable fire behavior predictions which can be used as a tool in the decision-making process. In order to make reliable estimates of fire behavior, one must understand the relationship of fuels to the fire environment and be able to recognize the variations in these fuels. Natural fuels are made up of the various components of vegetation, both live and dead, that occur on a site. The type and quantity will depend upon the soil, climate, geographic features, and the fire history of the site. The major fuel groups of grass, shrub, trees, and slash are defined by their constituent types and quantities of litter and duff layers, dead woody material, grasses and forbs, shrubs, regeneration, and trees. Fire behavior can be predicted largely by analyzing the characteristics of these fuels. Fire behavior is affected by seven principal fuel characteristics: fuel loading, size and shape, compactness, horizontal continuity, vertical arrangement, moisture content, and chemical properties.

The seven fuel characteristics help define the 13 standard fire behavior fuel models (Anderson 1982) and the more recent custom fuel models developed for southern California (Weise and Regelbrugge 1997). According to the model classifications, fuel models used in BehavePlus have been classified into four groups, based upon fuel loading (tons/acre), fuel height, and surface to volume ratio. Observation of the fuels in the field (on site) determines which fuel models should be applied in BehavePlus. The following describes the distribution of fuel models among general vegetation types for the standard 13 fuel models and the custom southern California fuel models:

- Grasses Fuel Models 1 through 3
- Brush Fuel Models 4 through 7, SCAL 14 through 18
- Timber Fuel Models 8 through 10
- Logging Slash Fuel Models 11 through 13

In addition, the aforementioned fuel characteristics were utilized in the recent development of 40 new fire behavior fuel models (Scott and Burgan 2005) developed for use in BehavePlus modeling efforts. These new models attempt to improve the accuracy of the standard 13 fuel models outside of severe fire season conditions, and to allow for the simulation of fuel treatment prescriptions. The following describes the distribution of fuel models among general vegetation types for the new 40 fuel models:

- Non-Burnable Models NB1, NB2, NB3, NB8, NB9
- Grass Models GR1 through GR9
- Grass-shrub Models GS1 through GS4
- Shrub Models SH1 through SH9
- Timber-understory Models TU1 through TU5
- Timber litter Models TL1 through TL9
- Slash blowdown Models SB1 through SB4

2 BEHAVEPLUS FIRE BEHAVIOR MODELING INPUTS

2.1 Vegetation/Fuels

To support the fire behavior modeling efforts conducted for this Fire Protection Plan, a fuel model was identified for the site to represent its dominant chaparral and scrub vegetative cover. While other vegetation types are located on site, chaparral and scrub fuels represent the most significant wildfire threat for the proposed project. The chaparral and scrub cover on site were both classified as a Fuel Model SH1.

2.2 Weather

Fire behavior modeling conducted in support of this FPP utilized the guidelines and standards presented by the County of San Diego, Department of Planning and Land Use[1]. These guidelines identify acceptable fire weather inputs for extreme fire conditions during summer months and Santa Ana fire weather patterns. The County analyzed and processed fire weather from Remote Automated Weather Stations (RAWS) between April 15 to December 31 in order to represent the general limits of the fire season. Data provided by the County's analysis included temperature, relative humidity, and sustained wind speed and is categorized by weather zone, including Maritime, Coastal, Transitional, Interior, and Desert.

To evaluate potential fire behavior for the project site, Dudek utilized the BehavePlus (v. 5.0.5) fire behavior modeling software package to determine fuel moisture values and expected fire behavior for the site. The temperature, relative humidity, and wind speed data for the Desert[2] weather zone were utilized for this FPP based on the project location. Reference fuel moistures were calculated in BehavePlus and were based on site-specific topographic data inputs. Fire behavior for the site was calculated in two different locations using worst-case fuels and topography (steepest slopes). One of the modeling scenarios analyzed potential fire behavior to the northeast of the proposed project development area (Scenario 1) during peak, Santa Ana fire weather conditions. The other modeling scenario (Scenario 2) analyzed potential fire behavior in the western portion of the project site during Summer (on-shore) weather conditions. Table 1 summarizes the fuel moisture calculations utilized for this FPP.

1 County of San Diego Report Format and Content Requirements – Wildland Fire and Fire Protection (August 31, 2010). On-line at http://www.sdcounty.ca.gov/dplu/docs/Fire-Report-Format.pdf
2 http://www.sangis.org

Table 1
BehavePlus Fine Dead Fuel Moisture Calculation

Variable	Scenario 1: Peak Weather (Offshore/Santa Ana Condition)	Scenario 2: Summer Weather (Onshore Flow)
Dry Bulb Temperature	90 -109 deg. F	90 -109 deg. F
Relative Humidity	5 - 9 %	5 - 9 %
Reference Fuel Moisture	1 %	1 %
Month	May June July	Feb Mar Apr Aug Sept Oct
Time of Day	12:00 - 13:59	12:00 - 13:59
Elevation Difference	Level (within 1,000 ft.)	Level (within 1,000 ft.)
Slope	0-30%	0-30%
Aspect	West	Northwest
Fuel Shading	Exposed (< 50% shading)	Exposed (< 50% shading)
Fuel Moisture Correction	0 %	1 %
Fine Dead Fuel Moisture	1 %	2 %

2.3 Topography

The topography of the site is discussed in greater detail in the FPP. Slope is a measure of angle in degrees from horizontal and can be presented in units of degrees or percent. Slope is important in fire behavior analysis as it affects the exposure of fuel beds. Additionally, fire burning uphill spreads faster than those burning on flat terrain or down hill as uphill vegetation is pre-heated and dried in advance of the flaming front, resulting in faster ignition rates. Slope values for this site were measured from site topographic maps and are presented in units of percent.

The modeling locations were adjacent to proposed development areas on the site with slope measurements ranging from relatively flat (3%) to 30%. Scenario 1 (fire approaching from the northeast) was selected based on the strong likelihood of fire approaching from this direction, driven by Santa Ana winds flowing southwest out of the Boulder Creek drainage. Under Scenario 1, fire is anticipated to burn across the relatively flat northeast portion of the project site toward the proposed development area. Scenario 2 (fire approaching from the northwest) was selected to evaluate fire behavior potential during a summer fire occurring during typical on-shore wind flow patterns with winds aligned along the small drainage approaching the project site from the Jacumba Valley to the west. Under Scenario 2, fire is anticipated to burn up the slope of the knoll on the project site toward the proposed development area. The fire behavior modeling input variables for the project site are presented in Table 2. Locations for each modeling run are presented graphically in Figure 4 of the FPP.

Table 2
BehavePlus Fire Behavior Modeling Inputs

Variables	Scenario 1: Peak Weather (Offshore/Santa Ana Condition)	Scenario 2: Summer Weather (Onshore Flow)
Fuel Model	SH1	SH1
1h Moisture	1%	2%
10h Moisture	2%	4%
100h Moisture	4%	6%
Live Herbaceous Moisture	30%	50%
Live Woody Moisture	50%	80%
20-foot Wind Speed (upslope)	56 mph	18 mph
Wind Adjustment Factor	0.5	0.5
Slope Steepness	3%	30%

3 BEHAVEPLUS FIRE BEHAVIOR MODELING RESULTS

Three fire behavior variables were selected as outputs from the BehavePlus analysis conducted for the project site, and include flame length (feet), rate of spread (mph), and fireline intensity (BTU/feet/second). The aforementioned fire behavior variables are an important component in understanding fire risk and fire agency response capabilities. Flame length, the length of the flame of a spreading surface fire within the flaming front, is measured from midway in the active flaming combustion zone to the average tip of the flames (Andrews, Bevins, and Seli 2004). It is a somewhat subjective and non-scientific measure of fire behavior, is extremely important to fireline personnel in evaluating fireline intensity and is worth considering as an important fire variable (Rothermel 1983). Fireline intensity is a measure of heat output from the flaming front, and also affects the potential for a surface fire to transition to a crown fire. Fire spread rate represents the speed at which the fire progresses through surface fuels and is another important variable in initial attack and fire suppression efforts. The information in Table 3 presents an interpretation of these fire behavior variables as related to fire suppression efforts. The results of fire behavior modeling efforts are presented in Table 4, as well as in Table 4 of the FPP. Additionally, identification of modeling run locations is presented graphically in Figure 4 of the FPP.

Table 3
Fire Suppression Interpretation

Flame Length (ft)	Fireline Intensity (Btu/ft/s)	Interpretations
Under 4 feet	Under 100 BTU/ft/s	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4 to 8 feet	100-500 BTU/ft/s	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold the fire. Equipment such as dozers, pumpers, and retardant aircraft can be effective.
8 to 11 feet	500-1000 BTU/ft/s	Fires may present serious control problems -- torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.
Over 11 feet	Over 1000 BTU/ft/s	Crowning, spotting, and major fire runs are probable. Control efforts at head of fire are ineffective.

Source: BehavePlus 5.0.5 fire behavior modeling program (Andrews, Bevins, and Seli 2004)

Table 4
BehavePlus Fire Behavior Modeling Results

Scenarios	Flame Length (feet)	Fireline Intensity (Btu/ft/s)	Surface Rate of Spread (mph)
1 (Peak fire in chaparral and scrub fuels (SH1); 3% slope; 56 mph winds; slight upslope)	11.5	1,150	1.7
2 (Summer fire in chaparral and scrub fuels (SH1); 30% slope; 18 mph winds; upslope)	1.7	18	0.1

APPENDIX C

Fire Facilities Availability Form

County of San Diego, Planning & Development Services
PROJECT FACILITY AVAILABILITY - FIRE
ZONING DIVISION

F

Please type or use pen			ORG	
Jacumba Solar, LLC.	(760) 846-4421		ACCT	
Owner's Name	Phone		ACT	
700 Universe Boulevard			TASK	
Owner's Mailing Address	Street		DATE	AMT $
Juno Beach	FL	33408	*DISTRICT CASHIER'S USE ONLY*	
City	State	Zip		

SECTION 1. PROJECT DESCRIPTION — **TO BE COMPLETED BY APPLICANT**

A. ☐ Major Subdivision (TM) ☐ Specific Plan or Specific Plan Amendment
☐ Minor Subdivision (TPM) ☐ Certificate of Compliance:
☐ Boundary Adjustment
☐ Rezone (Reclassification) from ______ to ______ zone.
☒ Major Use Permit (MUP), purpose: Maj. Imp. Util. /Solar Facility
☐ Time Extension...Case No.
☐ Expired Map...Case No.
☐ Other

B. ☐ Residential ...... Total number of dwelling units
☐ Commercial ..... Gross floor area
☐ Industrial .... Gross floor area
☐ Other .... Gross floor area

C. Total Project acreage 304 Total lots N/A Smallest proposed lot N/A

Assessor's Parcel Number(s)
(Add extra if necessary)

661-041-02	661-080-05
661-041-03	661-080-08
661-080-01	
661-080-04	

Thomas Guide. Page 430 Grid F9

T. 18 S. R. 8 E. SBBM; 2.5 miles east of Jacumba
Project address Street

Mountain Empire/Jacumba Subregion
Community Planning Area/Subregion Zip

OWNER/APPLICANT AGREES TO COMPLETE ALL CONDITIONS REQUIRED BY THE DISTRICT.

Applicant's Signature: [signature] Date: 8/25/2014

Address: 700 Universe Boulevard, Juno Beach, FL, 33408 Phone: (760) 846-4421

(On completion of above, present to the district that provides fire protection to complete Section 2 and 3 below.)

SECTION 2: FACILITY AVAILABILITY — **TO BE COMPLETED BY DISTRICT**

District Name:

Indicate the location and distance of the primary fire station that will serve the proposed project:

A. ☐ Project is in the District and eligible for service.
☐ Project is not in the District but is within its Sphere of Influence boundary, owner must apply for annexation.
☐ Project is not in the District and not within its Sphere of Influence boundary.
☐ Project is not located entirely within the District and a potential boundary issue exists with the ______ District.

B. ☐ Based on the capacity and capability of the District's existing and planned facilities, fire protection facilities are currently adequate or will be adequate to serve the proposed project. The expected emergency travel time to the proposed project is ______ minutes.
☐ Fire protection facilities are not expected to be adequate to serve the proposed development within the next five years.

C. ☐ District conditions are attached. Number of sheets attached: ______
☐ District will submit conditions at a later date.

SECTION 3. FUELBREAK REQUIREMENTS

Note: The fuelbreak requirements prescribed by the fire district for the proposed project do not authorize any clearing prior to project approval by Planning & Development Services.

☐ Within the proposed project ______ feet of clearing will be required around all structures.
☐ The proposed project is located in a hazardous wildland fire area, and additional fuelbreak requirements may apply. Environmental mitigation requirements should be coordinated with the fire district to ensure that these requirements will not pose fire hazards.

This Project Facility Availability Form is valid until final discretionary action is taken pursuant to the application for the proposed project or until it is withdrawn, unless a shorter expiration date is otherwise noted.

Authorized Signature *Print Name and Title* *Phone* *Date*

On completion of Section 2 and 3 by the District, applicant is to submit this form with application to:
Planning & Development Services – Zoning Counter, 5510 Overland Ave, Suite 110, San Diego, CA 92123

APPENDIX D

Lithium ion Battery Storage Fire Safety Analysis

APPENDIX D
Lithium ion Battery Storage Fire Safety Analysis

ANALYSIS SUMMARY

The following analysis of battery storage at the Jacumba Solar Project was conducted in support of preparation of the project's Fire Protection Plan. The result of the analysis is that the battery storage component of the project can be incorporated in a fire safe manner with the inclusion of fire safety measures that are available and already being used with this technology.

The analysis indicates that (1) there is a minimal potential for battery failure that could lead to thermal runaway or fire due to the type of lithium ion (Li-ion) phosphate batteries that would be employed, advanced monitoring systems for the battery system, and climate control within the containers the batteries would be rack-mounted within; and (2) there is minimal potential for a fire in an energy storage container to escape that container and cause a fire based on the fire resistant materials that would be used for the energy storage system (including a 2 to 4 hour rated steel container), automated fire suppression systems within each energy storage container, fuel modification, fire buffer areas around the project, and the accessibility of the energy storage containers to fire fighter response.

1 INTRODUCTION

1.1 Applicable Regulations

This analysis focused on existing codes or guidelines that may be applicable to the proposed energy storage system.

1.1.1 California Fire Code (CFC) (2013)

The Fire Code Section 608 addresses "Stationary Storage Battery Systems" and sets forth general fire protection for stationary storage battery systems, including Li-ion batteries. For Li-ion battery systems, the CFC requires a Smoke detection system, signage indicating the presence of an energized battery system, and seismic bracing.

1.1.2 California Public Utilities Commission

Electric Rule 21. Interconnection Standard for Non-Utility Owned Generation. Electric Rule 21 is a tariff that describes the interconnection, operating and metering requirements for generation facilities to be connected to a utility's distribution system, including storage of energy, over which the California Public Utilities Commission (CPUC) has jurisdiction. Rule 21 addresses safety issues of such facilities including fire safety by minimizing risk of component failure.

2 PROJECT DESCRIPTION

The applicant proposes to include an energy storage component as part of the Jacumba solar project, to be located in southeastern San Diego County. This component consists of energy storage in the form of lithium ion (Li-ion) batteries (energy storage system), which would be located on the project site in order to store energy produced by the fixed, tilt arrays and to provide the ability to dispatch this energy upon request depending upon demand and other factors. The battery storage system would provide 10 Megawatt hours (MWh) of Li-ion battery storage in the form of 10 1 MWh containers, each measuring 40 feet x 8.5 feet x 9.5 feet (LxWxH) on approximately 1 acre with fire appropriate access and approximately 20 feet of spacing on all four sides of each container.

2.1 Location

The energy storage system would be located on a roughly 1 acre portion of the Jacumba solar project site (see Figure 3 of the project's FPP).

2.2 Components

The Li-ion battery storage would be housed in standard 40' International Organization of Standardization (ISO) shipping containers. The containers would be oriented east-west in two rows of five containers each. Approximately 20 feet of spacing would be provided on all four sides of each container measuring 40 feet x 8.5 feet x 9.5 feet (LxWxH).

The Li-ion batteries (cells) would be arranged into modules, which in turn would be stored in battery racks. The racks would be entirely contained within the container. The container would have an access door at each end and overhead lighting on the interior roof. Each container would have an integrated heating, ventilation, and air conditioning (HVAC) unit located on the roof of the container. An inverter with a battery management system and container control system would be installed externally on a concrete pad next to each container. A step-up transformer would be associated with a set of two containers and would be installed alongside the container on a separate concrete pad.

The proposed batteries and containers also include the following important monitoring and safety components:

- Modular battery racks designed for ease of maintenance. Every rack's battery monitoring system (BMS) continually monitors for unsafe voltage, current, and temperature, and has control of an automated switch (contactor) to disconnect the rack from the system if necessary.

- Integrated fire detection and suppression system
- Li-ion nanophosphate chemistry which is considered to be the most stable Li-ion technology and substantially reduces the possibility of thermal runaway and provides for reduced reaction from abuse (Sandia National Laboratories 2012) and A123 Systems (no date).

The energy storage system would be composed of 10 containers that each could store up to 1 megawatt of electrical energy. The containers would be situated internally to the project site, with access from a primary fire apparatus roadway in a linear configuration. Figure 1 provides an example of how the containers can be situated for ease of ongoing maintenance and fire department access with adequate set back from off-site areas as a buffer against potential wildfire ignitions.

Each container includes a step-up transformer and inverter externally connected and in close proximity to the container.

There are various types of Li-ion batteries available for use in this application. The specific battery type proposed for the Jacumba solar farm energy storage system has not been determined at the time of this report's preparation. It is projected that a recent type, such as the lithium ion nanophosphate cell will be selected based on its overall fire safe design. Available data indicates that this particular type of Li-ion battery has proven to be less vulnerable to fire occurrences than typical Li-ion batteries, which as a category, include a very low occurrence of fires, but have experienced some especially high profile fires in recent years. Li-ion nanophosphate batteries include a stable cathode chemistry that substantially reduces the possibility of thermal runaway and provides for reduced reaction from abuse (Sandia National Laboratories 2012) and A123 Systems (no date).

3 LITHIUM ION BATTERY TECHNOLOGY

3.1 Lithium Ion Batteries

The term Li-ion battery refers to a battery where the negative electrode (anode) and positive electrode (cathode) materials serve as a host for the Li-ion (Li+) (Mikolacjzak et al. 2011). Li-ions move from the anode to the cathode during discharge and are inserted into voids in the crystallographic structure of the cathode. The ions reverse direction during charging. An important fact about Li-ion batteries is that based on their materials content and how they operate, there is no free lithium metal within a Li-ion cell. Therefore, if a cell ignition occurs, metal fire suppression techniques are not appropriate for controlling the fire.

The four primary functional components of a practical Li-ion cell are:

- Anode
- Cathode
- Separator
- Electrolyte

Additional components of Li-ion cells, such as the current collectors, case or pouch, internal insulators, headers, and vent ports also affect cell reliability, safety, and behavior in a fire. The chemistry and design of these components varies across multiple parameters, so it is difficult to make blanket statements about fire behavior, prevention and suppression strategies, and other fire safety measures. For example, cell components, chemistry, electrode materials, particle sizes, particle size distributions, coatings on individual particles, binder materials, cell construction styles, amongst others, generally will be selected by a cell designer to optimize a family of cell properties and performance criteria. However, there are fundamental commonalities with regard to fire that are applicable to most of the Li-ion battery types. In addition, since Li-ion cell chemistry is an area of active research, it is anticipated that cell manufacturers will continue to advance cell designs including more fire safety driven updates.

Mikolacjzak, et. al. (2011) indicate that:

> "An individual Li-ion cell has a safe voltage range over which it can be cycled that will be determined by the specific cell chemistry. A safe voltage range will be a range in which the cell electrodes will not rapidly degrade due to lithium plating, copper dissolution, or other undesirable reactions. For most cells, charging significantly above 100% state of charge (SOC) can lead to rapid, exothermic degradation of the electrodes. Charging above the manufacturer's high voltage specification is referred to as overcharge. Since overcharging can lead to violent thermal runaway reactions, a number of overcharge protection devices are either designed into the cells or included in the electronics protection packages for Li-ion battery packs".

There are two methods to measure Li-ion battery life: (1) calendar life and (2) cycle life. Calendar life indicates how many years a battery is expected to last. The calendar life does not depend on amount times the battery has been charge or discharged, but rather how much charge is stored and its operating temperature (Saft 2014). Cycle life is based upon the number of charge and discharge cycles as well as to what level the battery is discharged to, or, its "depth of discharge" (Saft 2014). Li-ion batteries do not suddenly stop functioning in the same way a lead-acid battery would, rather an Li-ion battery exhibits a gradual decrease in performance (Saft 2014).

3.2 Fire Hazards

The primary hazard associated with Li-ion batteries is fire. Li-ion batteries may burn according to two primary factors. The first is being exposed to an adjacent fire or heat source that is hot enough to raise the internal temperature to combustion levels or provides actual flame impingement on the battery and leads to combustion or uncontrolled increased internal temperature. This leads to the second ignition factor, which is known as thermal runaway, where the battery's internal temperature rises and can lead to increased internal pressure, combustion of chemicals, venting or rupture and release of hydrogen or other flammable gasses. Thermal runaway may be caused by a number of issues, but manufacturing defects or physical damage during transport or set up may lead to malfunctions. In most cases, mechanical damage would probably rank as the highest risk factor for initiating a thermal runaway (fire/explosion) event (Butler 2013). Improper handling can result in crush or puncture damage, possibly leading to the release of flammable electrolyte material through venting or leakage, or short-circuiting. These actions could result in thermal runaway and a resulting fire and/or explosion.

When a Li-ion battery has a thermal runaway, the battery physically expands and electrical shorts within the battery can start, or continue if that was the initial cause of the thermal runaway. The stored energy is released and may include an explosion. This process can cause adjacent battery cells to increase internal temperature, catch fire or thermally runaway (VAN 2014), leading to a chain reaction where successive batteries fail. In other words, once one battery cell goes into thermal runaway, it produces enough heat to potentially cause adjacent battery cells to also go into thermal runaway. This produces a fire that repeatedly flares up as each battery cell in turn ruptures and releases its contents. Li-ion batteries do not contain lithium metal, but do contain lithium ions in electrolyte (Butler 2013). Fires occurring in Li-ion batteries are not like a typical fire and therefore, they require a holistic pre-planning approach to reduce the potential for battery failure including battery design, shipping techniques, storage rack design and configuration, monitoring protocols, pre-planning, suppression systems, firefighter training, and extinguishing approaches.

Research (Butler 2013, Ditch & De Vries 2013, Mikolajczak et al. 2011, and others) indicates that the severity of a cell thermal runaway event will depend upon a number of factors, with the level of charge (how much electrical energy is stored in the form of chemical potential energy), the ambient environmental temperature, the electrochemical design of the cell (cell chemistry), and the mechanical design of the cell (cell size, electrolyte volume, etc.) having the greatest influence. For any given cell, the most severe thermal runaway reaction will be achieved when that cell is at 100% (or greater, if overcharged) of its charge capability, because the cell will contain maximum electrical energy. If a typical fully charged (or overcharged) Li-ion cell undergoes a thermal runaway reaction, a number of things occur, including:

- Cell internal temperature increases;
- Cell internal pressure increases;

- Cell undergoes venting;
- Cell vent gases may ignite;
- Cell contents may be ejected; and
- Cell thermal runaway may propagate to adjacent cells.

There is a lack of available data regarding large storage format Li-ion nanophosphate batteries. Testing by one Li-ion nanophosphate battery manufacturer indicates that the thermal runaway potential is reduced due to the reduced oxygen release during a failure (A123 System 2012)) However, it is anticipated that all Li-ion batteries may follow a somewhat predictable path when thermal ruaway occurs, and that some variation is likely for nanophosphate batteries. Butler (2013) predicts that when a single Li-ion battery goes into thermal runaway, the propagation creates identifiable markers, i.e., the battery behaves in a certain way. He concludes that the fire may be a progressive burn-off or one that is explosive in nature.

Li-ion batteries are non-aqueous and therefore lack the capability of dissipating overcharge energy. As such, positive metal-oxide cells will continue to absorb and store overcharge energy to the point where the material becomes unstable causing release of substantial heat and ignition. While overcharge can lead to the most serious of Li-ion failures, it is considered the least probable for stationary batteries due to well controlled charging systems, alarms, and battery isolation switches (McDowall 2014).

3.3 Fire Behavior

Research conducted by Mikolajczak et al. (2011) indicates that the severity of a Li-ion cell failure is strongly affected by the total energy stored in that cell. Stored energy is a combination of chemical energy and electrical energy. Thus, the severity of a potential thermal runaway event can be mitigated by reducing stored chemical energy (i.e., by reducing the volume of electrolyte within a cell), or by changing the electrolyte to a noncombustible material (i.e., the cell chemistry). These are active research areas within the Li-ion field, but there are not currently commercial-ready products available. It is possible that future versions of Li-ion batteries will include lower potential for fire due to the ongoing research in this direction.

It is commonly thought that the most flammable component of a Li-ion cell is the hydrocarbon-based electrolyte. The hydrocarbon-based electrolyte in Li-ion cells results in a drastically different fire behavior than the typical household lead acid, NiMH or NiCad cell batteries, which contain water-based electrolytes.

The importance of understanding the fire behavior of typical Li-Ion cells is that if they are punctured or otherwise damaged to the point that leakage or venting occurs, it will release flammable vapors. Newer cell technology and lithium ion nanophosphate cells have been tested and shown to include reduced venting and less flammable vapors, resulting in reduced intensity of thermal events (A123 2012). Similarly, fire impingement on Li-ion cells will cause release of flammable electrolyte, increasing the total heat release of the fire, assuming there are well-ventilated conditions. Other combustible components in a Li-ion cell include a polymeric separator, various binders used in the electrodes, and the graphite of the anode (Mikolajczak et al. 2011).

When a cell vents, the released gases mix with the surrounding atmosphere. Depending upon a number of factors, including fuel concentration, oxygen concentration, and temperature, the resulting mixture may or may not be flammable (Ditch & De Vries 2013). Ventilation and cooling capabilities of the storage container will have a strong influence on the ability of these gases to reach flammable levels. The combination of the Li-ion nanophosphate batteries and the well-ventilated, cooled, customized storage containers should result in a lower likelihood that flammable gas levels would be experienced.

On fire scenes where large quantities of Li-ion cells would be in close proximity, decisions regarding overhaul procedures must be made with an understanding that as cells are uncovered, moved, or damaged, they may undergo thermal runaway reactions and vent, they may ignite, and they may generate (or may themselves become) hot projectiles. Similarly, the potential for rekindles will be high at such fire scenes, and these scenes will require extended monitoring by trained firefighters.

3.4 Fire Suppression

The observations from various testing previously described in this analysis would appear to have meaningful implications on fire protection/prevention as well as firefighting procedures. As indicated in these tests, battery heating and thermal runaway controls are important to preventing fires. Specifically, if a fire occurs within a energy storage container, the battery cells and battery packs must be protected from overheating, or they may begin to vent and ignite, spreading the fire more rapidly than would be expected for normal combustibles. Therefore, the design of the energy storage racks, spacing, internal container fire walls/separators, HVAC system, venting, fire suppression system and fire fighter capabilities must all be pre-planned for best prevention, protection, and suppression success.

Butler (2013) indicates that at minimum, an effective strategy for storing lithium batteries is to develop fire containment and suppression systems that would deal with the battery fire event. Systems like this would contain the fire event and encourage Suppression through Cooling, Isolation, and Containment (SCIC). Research indicates that suppressing a Li-ion battery fire is best accomplished by extinguishing the flame with a gas-based suppression system and cooling the burning material with water. However, since the risk of fire spread beyond a container is minimal, and water and plumbing systems are cost-prohibitive and logistically challenging, it is anticipated that cooling of the batteries and container, if necessary, can be provided from firefighters. Therefore, a fire sprinkler system for these containers is not supported.

In most instances, Li-ion battery fires would not be treated like common structure fires by responding firefighters. The burn characteristics and potentially toxic by-product release components do not align with a structure fire where wood and household flammables are burning. Among the precautions that would be considered by responding firefighters are:

- The energy storage containers include electric hazard
- The energy storage containers are adjacent to energized solar panels
- There is extra energy that may be released from polymeric materials burning (binder, separator, etc.)
- Burning batteries would present smoke toxicity and environmental issues
- There is no known way to eliminate “ignition sources”; e.g.: fire initiated from an internal short, subsequent to a manufacturing defect
- There may be re-ignitions and post-fire monitoring will be required

Training regarding fire hazards, behavior, and suppression can be provided to all contractors installing the energy storage facilities, operating and maintaining them, and local firefighters who may respond to an emergency in order to preserve both life and property. Training materials should address issues including battery awareness and care, cautions, warning signs, battery fire behavior, emergency response procedures, and fire extinguisher use (Li-ion battery focus).

Firefighter Response

- Every fire emergency is unique and requires a customized approach, but a typical battery incident may include the following response:
- A firefighter would arrive on scene and size up the situation.
- Calls for additional units would be made as necessary.
- Assuming that the fire in the container was not chain reacting (the type of cell being proposed is not likely to chain react), they would confirm that the suppression gas system is performing as intended.
- If so, the fire would likely be out by the time firefighters arrived. If the system malfunctioned, then there could be a situation where fire is burning flammable materials within the container.

- The container would need to be cooled so firefighters would begin blanketing the container and nearby containers with water streams and as possible and necessary, streaming a water fog into the container.
- The fire would continue to burn inside until the flammables were consumed. There would be no need to enter the building unless someone was maintaining the batteries and was incapacitated inside. In that case, a rescue operation would be attempted if conditions allowed.

With the energy storage technology that is being proposed, the possibility of explosion is considered extremely rare. However, unforeseen malfunctions can occur that could result in an explosion. It is not anticipated that a battery explosion would contain enough energy to breach the steel containers. However, should that occur, the containers are separated by 20 feet from the adjacent containers and are situated in an areas free of "targets" and set back from native fuels to provide a buffer for minimizing the likelihood of materials beyond the site boundaries.

3.5 Fire Safety

McDowall 2014 states that Li-ion battery safety requires four (4) elements: (1) materials and process control, (2) choice of chemistry, (3) cell design, and (4) system design. In general, materials and process control is the responsibility of the cell manufacturer as opposed to the battery system operator. The first decision to be made by the battery operator to ensure system safety is appropriate cell chemistry for the intended use (e.g. solar power storage and delivery). Cells are designed to vent as a form of safety; therefore a safe Li-ion battery system must accommodate for large quantities of released gas.

As discussed above, thermal runaway has potential to cause a chain reaction of heat causing extreme failure in adjacent cells. Measures, such as electronic monitoring systems, alarms, circuit breakers and other layer safety features, should be incorporated to lower the possibility of a thermal runaway chain reaction. These electronic safety systems would monitor the individual cell voltages during charge and discharge, internal batter temperature, and cell balance; these systems would also provide communication with a form of management unit or dashboard (Saft 2014). For example, Saft's manufactured battery systems contain a Battery Management Module with two components: (1) battery management unit (manages battery functions) and (2) electrical disconnect unit (enables a safe disconnect of a portion of the system) (Saft 2014). This Battery Management Module is responsible for many of the previously listed system safety functions including: operations supervision, charge and discharge management, thermal management, warnings and alarms, State of Charge, State of Health, first level safety, watchdog, blackbox, and maintenance and diagnostics (Saft 2014). Each of these Battery Management Modules can be connected to a Master Battery Management Module for an additional layer of redundancy and safety (Saft 2014).

4 DESIGN CONSIDERATIONS

As presented in the project's FPP, the proposed Project provides customized measures that address the identified potential fire hazards on the site. The measures are independently established, but will work together to result in reduced fire threat and heightened fire protection. These include Fuel Modification, Special Fuel Management Areas, improved access throughout the site, participation in a community facilities district (CFD), fuel modification inspections, illuminated signage, de-energizing capability, training for firefighters, construction fire prevention plan, fire extinguishers, water tank, and others.

This analysis assumes the implementation of the following additional design features and training/operational protocols, which would ensure the fire impact associated with the energy storage units remain at a level below significance, including compliance with the County's Determination of Significance standards.

The energy storage system shall include the following components, or their equivalent:

- Available Battery Management Modules (BMMs) continuously monitor the state of charge, battery health, temperature, and other important information. Also available are Mastery Battery Management Modules (MBMMs) to ensure charge uniformity throughout each string of Li-ion batteries.
- Custom grate or fiberglass t-bar flooring available to cover corrosion resistant secondary containment.
- EPA Compliant Spill Containment and Access.
- IEEE 1547 compliance (to preclude unplanned power backfeed or islanding).
- Electrical fault protection compatible with downstream protection coordination.
- Fault current/voltage limited inverters with full electrical protection and isolation switches.
- AEROS energy control system monitors and ensures operation within safe limits and can disconnect power if needed.
- Ground fault detection, integrated onboard fire suppression system with smoke and heat detection.
- Every rack's battery management system continually monitors for unsafe voltage, current, and temperature and has control of an automated switch to disconnect the rack from the system if necessary.
- High voltage fusing for the entire rack supplements the battery management control system.

- Module electronics will monitor every cell voltage and select cell temperatures, and has its own dedicated overvoltage monitoring chip.
- Two additional levels of fuse safety – individual cell fuses and integral module-level fuse.
- Integrated pressure vent on all cylindrical cells.
- Cells certified to stringent UL1642 Lithium cell safety standards.
- Effective battery standard operating procedures (SOP's) shall be developed and shall include processes that guide every aspect of battery safety, from shipping and receiving, handling, daily use, storage, and other functions involving the batteries.
- An interior inert gas fire suppression system such as the FM-200 or similar shall be installed.
- Firefighters shall have access to the containers to provide water for cooling any battery fire, as possible with a back-up plan to avoid entering a container to cool the exterior of the container through water application (multiple water streams encompassing the involved container) which would positively impact interior temperatures as the batteries burned within.
- Regularly scheduled, on-site training and familiarity with local firefighters shall be conducted and battery system and container specifics provided to the fire agencies for integration in their operation pre-planning efforts.
- The HVAC and venting system shall be engineered to remove the expected toxic, thick smoke from burning plastics and the toxic fumes from electrolyte should a fire occur. The HVAC system shall be designed so that burning embers and smoke from nearby fires, such as a wildland fire, do not penetrate into the containers and ignite combustibles inside. The HVAC system shall also be on emergency standby power and monitored.
- Seismic engineering and restraint shall be incorporated in the containers and the battery racks. The proposed system comes with a seismic rating.
- Containers shall be separated an acceptable distance from one another to prevent fire/heat spread which will help control the rare occurrence of thermal runaway domino effect.
- Spill control and secondary containment shall be provided for transformers containing any appreciable amount of oil.
- An emergency shutdown device shall be provided to stop electrical flow for battery isolation and Firefighter safety. This type of device/control is proposed as part of the energy storage project.

- The required Heat/Smoke Detection system, per Fire Code, shall comply with NFPA 72 and shall be remotely supervised. The proposed energy storage for the project includes a heat and fire detection system linked to an automatic fire suppression system.
- Safety signs and warning signs shall be installed on all building for firefighter and worker safety.
- Suitable portable fire extinguishers shall be provided.
- Approved Fire Truck access shall be provided to ensure access within 300 feet of all containers.

5 REFERENCES

A123 Systems. 2012. Nanophosphate EXT. Optimizing Lithium Ion Battery Performance over an Expanded Operating Temperature Range. 11 pp.

A123 Systems. No date. Nanophosphate Basics: An Overview of the Structure, Properties, and Benefits of A123 Systems' Proprietary Lithium Ion Technology. 5 pp.

Back, Jerry. May 7, 2014. Personal communication. Fire Protection Engineer with Hughes and Associates.

Butler, R. 2013. Managing the Lithium (ion) battery fire risk. Industrial Fire Journal. http://www.hemmingfire.com/news/fullstory.php/aid/1790/Managing_the_lithium__ion__battery_fire_risk.html.

Ditch, Benjamin and Juap De Vries. 2013. Research Technical Report. Flammability Characterization of Lithium-ion Batteries in Bulk Storage. 174 pp.

DuPont. 2008. DuPont FM-200 Comparison Testing in a Simulated Data Processing/Telecommunications Facility. L. Robin and E. W. Forssell. Technical Information Sheet. 9 pp.

DuPont 2009. DuPont FM-200 Fire Extinguishing Agent. Technical Information Sheet. 4 pp.

Long, R. T., M Kahn, and C. Mikolajczak. 2012. Li-Ion Battery Hazards. October. http://magazine.sfpe.org/content/lithium-ion-battery-hazards.

McDowall, Jim. 2014. A Guide to Lithium Ion Battery Safety. SAFT America. 10 pp.

Mikolajczak, C., M. Kahn, K. White, R.T. Long. 2011. Lithium ion Batteries Hazard and Use Assessment. The Fire Protection Research Foundation. 112 pp.

SAFT. 2014. Lithium Ion Battery Systems. Solar Photovoltaic (PV)– Energy Storage Systems (ESS). Technical bulletin. Document # 21894-20514. May.

SAFT. 2014. Lithium Ion Battery Life. Solar Photovoltaic (PV) – Energy Storage Systems (ESS). Technical Bulletin. 2 pp.

Sandia National Laboratories. 2012. Battery Abuse Testing.

VAN (Ventura Aerospace News). 2014. Suppressing Lithium Ion Battery Fires. http://venturaaerospace.com/news/suppressing-lithium-ion-battery-fires/.

INTENTIONALLY LEFT BLANK

APPENDIX E

Prohibited Plant List

APPENDIX E
Prohibited Plant List

Botanical Name	Common Name
Trees	
Abies species	Fir
Acacia species (numerous)	Acacia
Agonis juniperina	Juniper Myrtle
Araucaria species *(A. heterophylla, A. araucana, A. bidwillii)*	Araucaria (Norfolk Island Pine, Monkey Puzzle Tree, Bunya Bunya)
Callistemon species *(C. citrinus, C. rosea, C. viminalis)*	Bottlebrush (Lemon, Rose, Weeiping)
Calocedrus decurrens	Incense Cedar
Casuarina cunninghamiana	River She-Oak
Cedrus species *(C. atlantica, C. deodara)*	Cedar (Atlas, Deodar)
Chamaecyparis species (numerous)	False Cypress
Cinnamomum camphora	Camphor
Cryptomeria japonica	Japanese Cryptomeria
Cupressocyparis leylandii	Leyland Cypress
Cupressus species *(C. fobesii, C. glabra, C. sempervirens,)*	Cypress (Tecate, Arizona, Italian, others)
Eucalyptus species (numerous)	Eucalyptus
Juniperus species (numerous)	Juniper
Larix species *(L. decidua, L. occidentalis, L. kaempferi)*	Larch (European, Japanese, Western)
Leptospermum species *(L. laevigatum, L. petersonii)*	Tea Tree (Austrailian, Tea)
Lithocarpus densiflorus	Tan Oak
Melaleuca species *(M. linariifolia, M. nesophylla, M. quinqenervia)*	Melaleuca (Flaxleaf, Pink, Cajeput Tree)
Olea europea	Olive
Picea (numerous)	Spruce
Palm species (numerous)	Palm
Pinus species *(P. brutia, P. canariensis, P. eldarica, P. halopensis, P. pinea, P. radiate, numerous others)*	Pine (Calabrian, Canary Island, Mondell, Aleppo, Italian Stone, Monterey)
Platycladus orientalis	Oriental arborvitae
Podocarpus species *(P. gracilior, P. macrophyllus, P. latifolius)*	Fern Pine (Fern, Yew, Podocarpus)
Pseudotsuga menziesii	Douglas Fir
Schinus species (S. molle, S. terebenthifolius)	Pepper (California and Brazilian)
Tamarix species *(T. Africana, T. apylla, T. chinensis, T. parviflora)*	Tamarix (Tamarisk, Athel Tree, Salt Cedar, Tamarisk)
Taxodium species *(T. ascendens, T. distichum, T. mucronatum)*	Cypress (Pond, Bald, Monarch, Montezuma)
Taxus species *(T. baccata, T. brevifolia, T. cuspidata)*	Yew (English, Western, Japanese)
Thuja species (*T. occidentalis, T. plicata)*	Arborvitae/Red Cedar
Tsuga species *(T. heterophylla, T. mertensiana)*	Hemlock (Western, Mountain)
Groundcovers, Shrubs and Vines	
Acacia species	Acacia
Adenostoma fasciculatum	Chamise
Adenostoma sparsifolium	Red Shanks
Agropyron repens	Quackgrass
Anthemis cotula	Mayweed
Arbutus menziesii	Madrone
Arctostaphylos species	Manzanita

APPENDIX E (Continued)

Botanical Name	Common Name
Arundo donax	Giant Reed
Artemesia species *(A. abrotanium, A. absinthium, A. californica, A. caucasia, A. dracunulus, A. tridentate, A. pynocephala)*	Sagebrush (Southernwood, Wormwood, California, Silver, True tarrangon, Big, Sandhill)
Atriplex species (numerous)	Saltbush
Auena fatua	Wild Oat
Baccharis pilularis	Coyote Bush
Bambusa species	Bamboo
Bougainvillea species	Bougainvillea
Brassica species *(B. campestris, B. nigra, B. rapa)*	Mustard (Field, Black, Yellow)
Bromus rubens	Foxtail, Red brome
Cardera draba	Noary Cress
Carpobrotus species	Ice Plant, Hottentot Fig
Castanopsis chrysophylla	Giant Chinkapin
Cirsium vulgare	Wild Artichoke
Conyza bonariensis	Horseweed
Coprosma pumila	Prostrate Coprosma
Cortaderia selloana	Pampas Grass
Cytisus scoparius	Scotch Broom
Dodonea viscose	Hopseed Bush
Eriodyctyon californicum	Yerba Santa
Eriogonum species *(E. fasciculatum)*	Buckwheat (California)
Fremontodendron species	Flannel Bush
Hedera species *(H. canariensis, H. helix)*	Ivy (Algerian, English)
Heterotheca grandiflora	Telegraph Plant
Hordeum leporinum	Wild barley
Juniperus species	Juniper
Lactuca serriola	Prickly Lettuce
Larix species (numerous)	Larch
Larrea tridentata	Creosote bush
Lolium multiflorum	Ryegrass
Lonicera japonica	Japanese Honeysuckle
Mahonia species	Mahonia
Mimulus aurantiacus	Sticky Monkeyflower
Miscanthus species	Eulalie Grass
Muehlenbergia species	Deer Grass
Nicotania species *(N. bigelevil, N. glauca)*	Tobacco (Indian, Tree)
Pennisetum setaceum	Fountain Grass
Perronskia Atriplicifloria	Russian Sage
Phoradendrom species	Mistletoe
Pickeringia montana	Chaparral Pea
Rhus species *(R. diversiloba, R. laurina, R. lentii)*	Sumac (Poison oak, Laurel, Pink Flowering)
Ricinus communis	Castor Bean
Rosmarinus species	Rosemary

Botanical Name	Common Name
Salvia species (numerous)	Sage
Sacsola austails	Russian Thistle
Solanium Xantii	Purple Nightshade (toxic)
Sylibum marianum	Milk Thistle
Thuja species	Arborvitae
Urtica urens	Burning Nettle
Vinca major	Periwnkle
Rhus lentii	Pink Flowering Sumac

Notes:

1 For the purpose of using this list as a guide in selecting plant material, it is stipulated that all plant material will burn under various conditions.
2 The absence of a particular plant, shrub, groundcover, or tree, from this list does not necessarily mean it is fire resistive.
3 All vegetation used in Vegetation Management Zones and elsewhere in this development shall be subject to approval of the Fire Marshal.
4 Additional plants that are considered undesirable due to their invasiveness nature are detailed on the California Invasive Plant Council's Web site at www.cal-ipc.org/ip/inventory/index.php.
5 Landscape architects may submit proposals for use of certain vegetation on a project specific basis. They shall also submit justifications as to the fire resistivity of the proposed vegetation.

INTENTIONALLY LEFT BLANK

APPENDIX F

Potential Plant List for Fuel Modification Areas

APPENDIX F
Potential Plant List for Fuel Modification Areas

Botanical Name	Common Name
Trees	
Achillea spp.	Yarrow – only species growing under 12 inches height
Baccharis pilularis	Dwarf coyote bush – only in areas over 50 feet from structures/CPV trackers
Cerastium tomentosum	Snow in Summer
Coprosma kirkii	Tequila sunrise – only prostrate varieties
Cotoneaster spp.	Cotoneaster – only species growing to less than 12 inches height
Dudleya brittonii	Britton's dudleya
Dudleya pulverulenta	Chalk lettuce
Eschscholzia californica	California poppy
Gazania spp.	Gazania
Helianthemum spp.	Sunrose*
L*asthenia californica glabrata*	California goldfields
Trifolium frageriferum Verbena	Strawberry clover
Trifolium frageriferum rigida	White clover
Viguiera laciniata	Goldeneye
Vinca minor	Dwarf periwinkle
Satureja douglasii	Yerba buena
Sisyrinchium bellum	Blue-eyed grass*
Sisyrinchium californicum	Yellow-eyed grass*

Notes:

1 For the purpose of using this list as a guide in selecting plant material, it is stipulated that all plant material will burn under various conditions.

2 The absence of a particular plant, shrub, groundcover, or tree, from this list does not necessarily mean it is not fire resistive.

3 All vegetation used in Vegetation Management Zones and elsewhere in this development shall be subject to approval of the Fire Marshal.

4 Plants that are considered undesirable due to their invasiveness nature should not be utilized in the fuel modification area plantings. The California Invasive Plant Council's Web site at www.cal-ipc.org/ip/inventory/index.php provides a listing of invasive plants.

5 Landscape architects may submit proposals for use of certain vegetation not included on this list. They shall also submit justifications as to the fire resistivity of the proposed vegetation.

* Project area is outside preferred Zone.

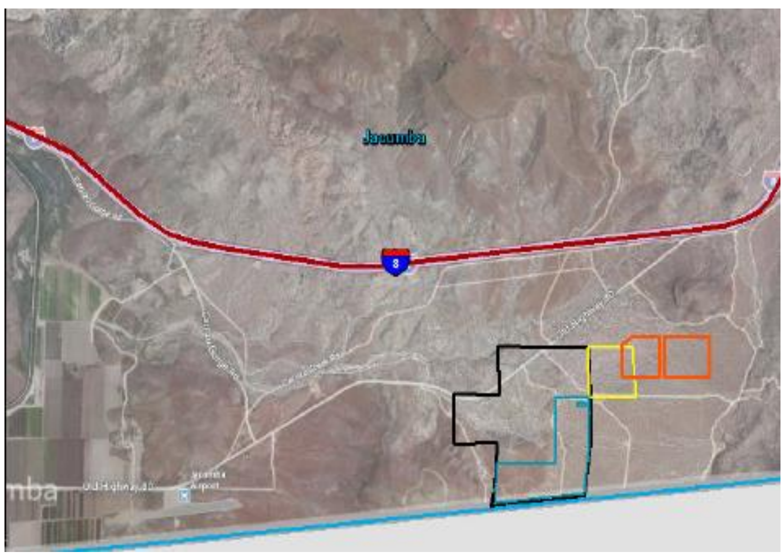
INTENTIONALLY LEFT BLANK

APPENDIX G

Technical Report

APPENDIX G

Jacumba Solar Energy Project
Photovoltaic ("PV") Solar Facility
Technical Report



Printed on 30% post-consumer recycled material.

TABLE OF CONTENTS

Section **Page No.**

FIGURES

TABLES

INTENTIONALLY LEFT BLANK

1 INTRODUCTION

The safety of fire fighters and other emergency first responder personnel depends on understanding and properly handling these hazards through adequate training and preparation. This Technical Report provides basic facility and photovoltaic solar information for responding firefighters. It is important that firefighters who may respond to this or any solar facility understand the potential risks associated with their electricity producing components and what strategies, tools and equipment, and precautions are required for safely responding to emergencies. This Technical Report summarizes project features and readers should refer to the Proposed Project's Fire Protection Plan (Dudek 2014) for additional information.

The Jacumba Solar Energy Project (the Proposed Project) proposes to install and operate a 20 megawatt (MW) alternating current (AC) photovoltaic (PV) electrical power generating facility. The Proposed Project would provide renewable power to the local grid in compliance with California's renewable portfolio standard requirements.

INTENTIONALLY LEFT BLANK

2 BACKGROUND

2.2 Project Location

The Proposed Project is located in the community of Jacumba, adjacent to the US/Mexico border. The project site is located approximately 2.5 miles east of the community of Jacumba Hot Springs along the US/Mexico border. The project area, including a proposed Open Space Preserve, consists of the following Assessor Parcel Numbers (APNs):661-041-02; 661-041-03; 661-080-01; 661-080-04*; 661-080-05*; and 661-080-08*. [* denotes those APNs upon which the facility would be installed.].

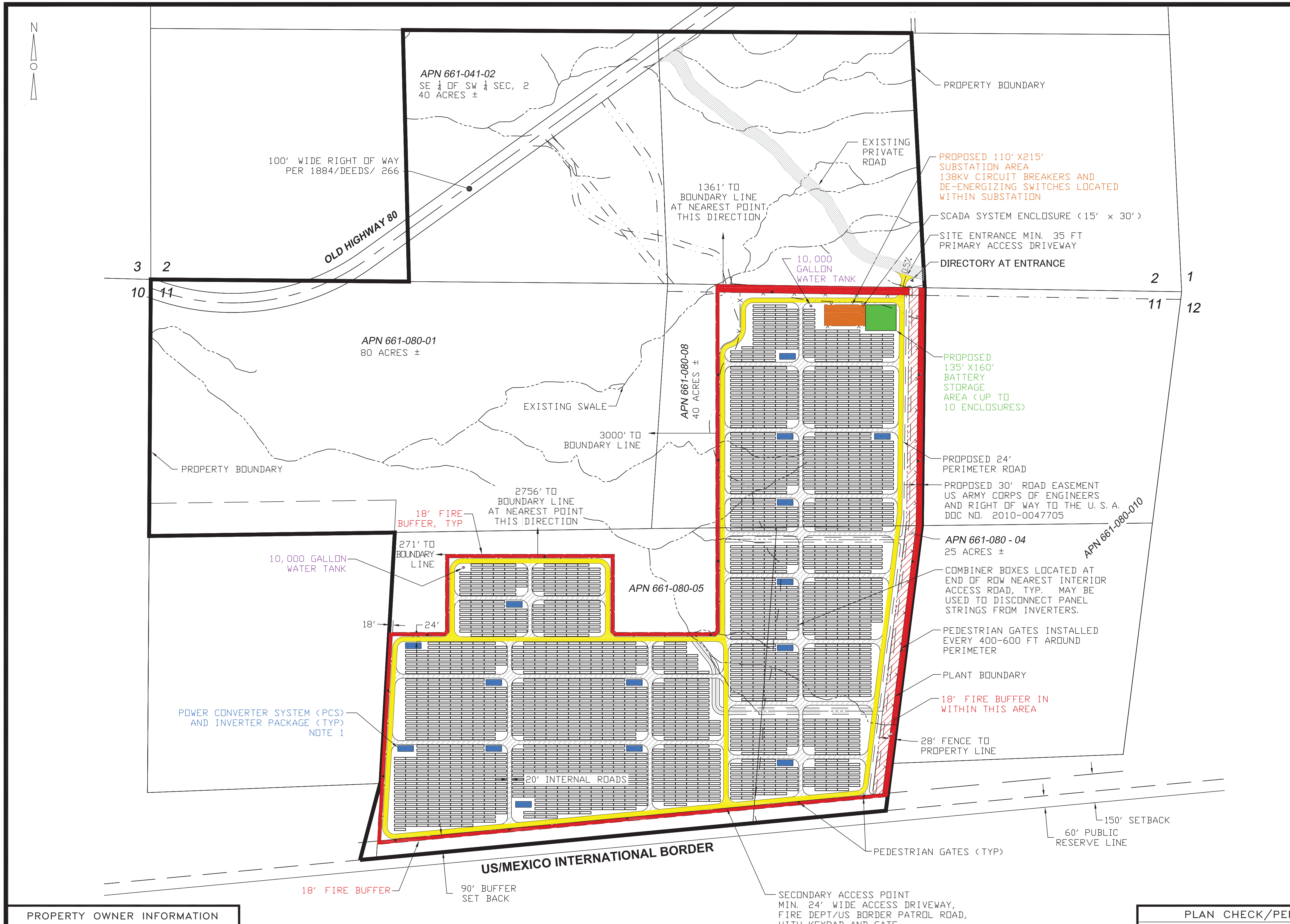
2.3 Proposed Project

The Proposed Project area is approximately 304 acres within the Mountain Empire Subregional Plan area in unincorporated San Diego County. The Proposed Project property includes 297 acres of private lands to be purchased by the applicant. The Project area also includes approximately 7 acres of off project property land not to be brought under the applicant's control, consisting of Old Highway 80 and a corridor across an adjacent property owned by San Diego Gas and Electric (SDG&E). Approximately 184 acres would be dedicated as Open Space Preserve and an additional approximately 5 acres would be an impact neutral area that matches the setback from the adjacent U.S./Mexico international border. The solar facility comprising the Proposed Project would use PV fixed-tilt rack electric generation system technology to produce solar energy at the utility scale on approximately 108 acres. The Proposed Project is designed to produce up to 20 MW of AC generating capacity and would consist of approximately 81,108 PV modules fitted on 2,253 fixed-tilt racks (solar arrays). In addition to the modules, racks and direct current (DC) to AC conversion equipment (i.e., inverter and transformer units), the Proposed Project would include the following primary components:

- A 1,000 to 1,500 volt DC underground collection system and a 34.5 kilovolt (kV) underground AC collection system linking the inverters to the on-site project substation.
- An on-site private collector substation site approximately 23,650 square feet (110 x 215 ft) pad.
- A 138 kV overhead transmission line (gen-tie) would connect the project substation to the ECO Substation (approximately 1,500 feet).
- An approximately 10 MW, 40 MWh battery energy storage system that would be located on an approximately 21,600 square feet (135 x 160 ft) pad adjacent to the collector substation.
- The substation and gen-tie interconnection facilities would be sized to accommodate the full 20 MW. The Proposed Project would be located entirely on private lands within unincorporated San Diego County, including the gen-tie. Upon completion, the Proposed

Project would be monitored off site through a supervisory control and data acquisition (SCADA) system.

- As indicated in Figure 1 (The Site Fire Safety Plan), primary access to the Project site would be provided via an improved access road from Old Highway 80. The access road was recently constructed as part of the ECO Substation project. One additional point of emergency egress/ingress would be provided at the project's south-central point to facilitate U.S. Customs and Border Protection access and to provide an alternate fire access point, respectively.
- Power from the on-site private substation would be delivered to the 138 kV bus at the adjacent San Diego Gas & Electric (SDG&E) ECO Substation via a less than quarter-mile 138 kV transmission line within a 125 foot private right-of-way. The Jacumba Solar gen-tie line would extend overhead directly east from the on-site substation to the ECO Substation. A transition pole would be constructed at the interconnection point at the ECO Substation.
- The Proposed Project would operate, at a minimum, for the life of its long-term Power Purchase Agreement (PPA). The initial term of the PPA is 20 years, with additional terms anticipated. The lifespan of the solar facility is estimated to be 30 to 40 years or longer. Due to the establishment of the project infrastructure (both physical and contractual), the continued operation of the Proposed Project beyond the initial PPA term is very likely. At the end of its useful life, two alternative scenarios are possible: (1) retool the technology and contract to sell energy to a utility or (2) decommission and dismantle the facility.



VICINITY MAP
NOT TO SCALE

SHEET NOTES:

1. INVERTERS MAY BE USED TO DISCONNECT AC SOURCES TO PCS AND SUBSTATION.

FIRE SAFETY LEGEND:

- PERIMETER ROAD
- BATTERY STORAGE
- WATER TANK
- INTERIOR ROAD
- 18 FT FIRE BUFFER
- 50 FT FIRE BUFFER
- SUBSTATION
- POWER CONVERTER SYSTEM (PCS) AND INVERTER PACKAGE

SHEET LEGEND:

- PROPERTY BOUNDARY
- PLANT BOUNDARY/FENCE
- PCS/INVERTER PACKAGE
- SECTION LINE
- FIXED TILT RACK
- DRAINAGE CHANNEL (TBD PER DRAINAGE STUDY)
- PEDESTRIAN GATE

CONCEPTUAL ENGINEERING PLANS

NOT FOR CONSTRUCTION FOR PERMITTING ONLY

PROPERTY OWNER INFORMATION

NAME: JACUMBA SOLAR, LLC.
ADDRESS: 700 UNIVERSE BLVD
JUNO BEACH, FL 33408
TELEPHONE NUMBER:
(24 HOUR CONTACT NUMBER)
SITE A.P.N. NUMBER: 661-041-02, 661-041-03, 661-080-01, 661-080-04 661-080-05, 661-080-08
SITE ADDRESS: XXX OLD HWY 80
JACUMBA, CA 91934

REFERENCE DRAWINGS:

JSEP-2-DW-112-000-001	COVER SHEET
JSEP-2-DW-112-002-001	PLOT PLAN
JSEP-2-DW-112-735-001	PRELIMINARY GRADING PLAN
JSEP-2-DW-112-735-002	GRADING SECTIONS AND DETAILS
JSEP-2-DW-112-735-003	FENCE DETAILS
JSEP-2-DW-112-717-001	EROSION CONTROL PLAN
JSEP-2-DW-601-206-010	CONCEPTUAL ONE LINE DIAGRAM

FIRE SAFETY PLAN

250 0 250 500 750
SCALE: 1" = 250'

ENGINEER WORLEYPARSONS
2330 E. BIDWELL ST., SUITE 150
FOLSOM, CA 95630
(916) 817-3920

PLAN CHECK/PERMITS

BUILDING RECORD ID:
PARCEL MAP NUMBER:

ENGINEER OF WORK

I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT AND THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT.

NAME: JUAN BRAVO DATE:
RCE NO: EXPIRES:

COUNTY OF SAN DIEGO
PLANNING & DEVELOPMENT SERVICES

MINOR GRADING PLAN FOR:
JACUMBA SOLAR, LLC.
JACUMBA SOLAR ENERGY PROJECT
FIRE SAFETY PLAN
FIGURE 7

SHEET: 1 OF SHEETS: 1

APPROVED DIRECTOR OF PLANNING & DEVELOPMENT SERVICES
BY: DATE:
GRADING RECORD ID:
JSEP-2-DW-112-014-001

FIRE SAFETY PLAN

INTENTIONALLY LEFT BLANK

2.3 Solar Generation Technology Definitions

Module: the PV panel.

Rack: the structure on which the PV modules are mounted (can be fixed or tracking)

Array: A group of racks with the PV modules installed (i.e. use rack, not array, if the modules aren't on it); also can refer to the electrical configuration resulting from multiple strings into or out of a combiner box.

Block: A specified number of racks with PV configured into one power conversion station.

Solar Field: a general term for all of the PV equipment which may or may not include the conversion equipment but is generally more than one block and does not include the substation or switchyard.

PCS or Power Conversion Station: the area within the block where the inverters are located (which may or may not have transformer(s)).

String: a single series of DC modules prior to entering a combiner box

Modules

The Proposed Project would include installation of individual fixed-tilt-mounted PV modules that would comprise the majority of the proposed facilities. PV modules generate electricity by safely converting the energy of the sun's photons into DC electricity. PV modules are wired in series within a string to obtain a required nominal voltage before multiple strings are combined in combiner boxes and routed to a DC to AC inverter and step-up transformer in a solar PV block. The power from multiple solar PV blocks is then routed to the onsite substation for transmission to the electric grid.

The PV modules have been stringently tested and are robustly constructed to guarantee a useful life of 25 years in desert weather conditions. The PV modules are uniformly dark in color, non-reflective, and designed to be highly absorptive of all light that strikes their glass surfaces. The PV modules deployed for use in the project would comply with all industry standard quality testing. The PV modules would be electrically connected to the grounding system of the facility in accordance with local codes and regulations. The final PV module selection would be determined during the detailed engineering phase.

Support Structures

The support structure to which the solar PV modules are affixed that allows them to be properly positioned for maximum capture of the sun's solar energy is called a rack. The PV module arrays (rows of PV modules mounted on the racks) would constitute a fixed-tilt system that would be oriented with the modules facing south along an east to west axis. The racks are typically mounted on metal pipe pile or beam foundations of 4 to 6 inches diameter. The foundations would be driven into the soil using a pile/vibratory/rotary driving technique similar to that used to install freeway guardrails. Driven pier foundations offer multiple benefits, including quick installation and minimal site disturbance, and are a concrete-free foundation solution that eliminates the additional steps required for removing concrete during site reclamation at the end of the project lifecycle. Most foundations would be driven to approximate depths of 10 to 15 feet deep. The PV modules, at their highest point, would be approximately 8 feet above the ground surface (final height to be determined during detailed design), as shown in Figure 2, Panel and Fence Details.

Depending on final engineering, the arrays may be equal in length, creating a uniform rectangular project footprint, or may vary in length in order to work within the site constraints. The fixed-tilt arrays would be constructed approximately 25 feet apart (centerline to centerline) in a north to south direction, with an east-west array spacing of approximately 12.5 feet. Each PV rack row would measure approximately 144 feet in total combined length and approximately 6.5 feet in width.

Inverters, Transformers, and Associated Equipment

PV modules would be electrically connected to adjacent modules to form strings using wiring attached to the rack. Modules within the same string but located on different racks would be electrically connected to each other via underground wiring. Wire trench depths would be in accordance with local, state, and federal codes. The string wiring would terminate at an array combiner box, which is lockable and mounted on or near an array's support foundation. Output wires from multiple combiner boxes would be routed along an underground trench system approximately 3.5 feet deep and 1 foot wide, including trench and disturbed area, to the inverters and transformers.

Inverters are a key component of solar PV power-generating facilities because they convert the DC electricity generated by the PV array into three-phase AC electricity that is compatible with the transmission network. Each inverter would be located within a NEMA-rated electrical enclosure next to a medium-voltage transformer that would step up the voltage to collection-level voltage (34.5 kV). Together, the inverter and transformer are known as the power conversion station (PCS).

Multiple PCS would be located on skids throughout the solar field. The PCS would be either shop fabricated as one unit or field assembled on site. The skids would be mounted on concrete foundation pads or concrete piers depending on local soil conditions. All electrical equipment would be either outdoor rated or mounted within enclosures designed specifically for outdoor installation. The PCS equipment would be constructed with appropriate personnel safety devices (enclosures and lockouts) in compliance with OSHA regulations and NFPA/NEC standards so as to provide safe access during operations.

Energy Storage System

A battery energy storage system is proposed to be located adjacent to the on-site substation in the northeast section of the Proposed Project that would supply up to 10 MW with 40 MWh of energy storage. Although the battery chemistry will not be determined until detailed engineering is performed, there are common features among all of the proposed battery chemistries that could be located within the energy storage system. The battery system would consist of a series of cells connected within a totally contained enclosure known as a module. Each module would then be electrically connected to other modules to form a battery rack, and multiple battery racks would be electrically connected to a DC to AC inverter and charge controller, which are also known as the power conversion equipment. The voltage from each inverter would be stepped up through a 480 V to 34.5 kV transformer prior to electrical routing to the onsite substation. The battery containers and all electrical wiring would be constructed per NEMA and NFPA/NEC recommendations to minimize safety risks to personnel during maintenance.

One megawatt of battery racks may be housed in environmentally controlled outdoor enclosures similar in size to a standard 40 x 15 ft. shipping container, resulting in up to ten of these containers located within the energy storage system area, or 10 MW of batteries may be combined within one large enclosure to efficiently utilize HVAC and power conversion equipment. Each container or the battery enclosure would be constructed on concrete foundations and would also house a self-extinguishing fire system. Critical information from the system would be monitored continuously with the solar plant performance. A master control system would coordinate operation of the solar generation equipment and the energy storage system.

Project Substation

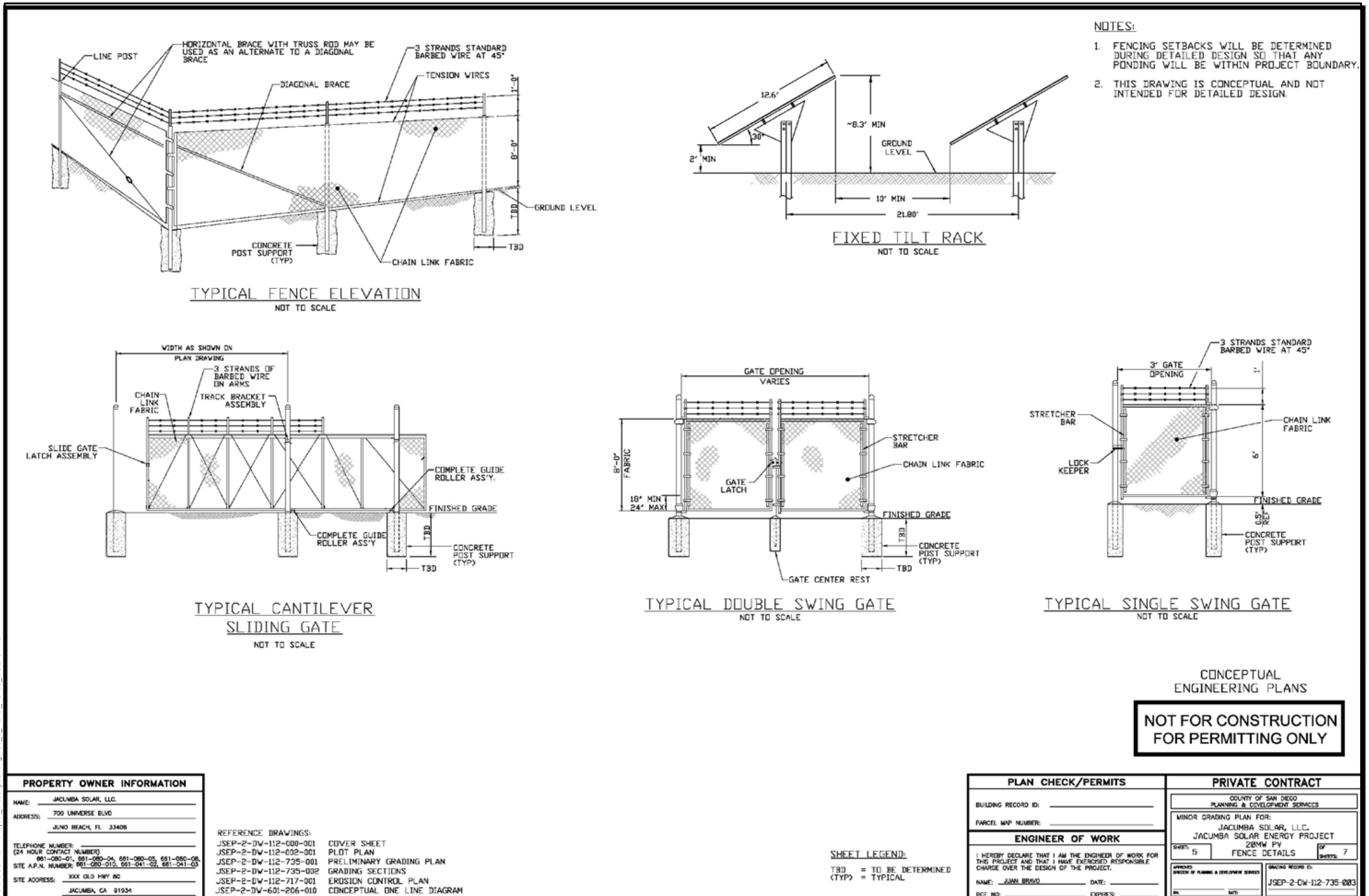
The Proposed Project requires the use of a private on-site 23,650 sq. ft. substation (110 x 215 ft.) that would be located on the northeastern corner of the project site. The purpose of the substation would be to collect the power received from the solar field and energy storage system collection lines and convert the voltage from 34.5 kV to 138 kV as well as to be able to isolate equipment (i) in the event of an electrical short-circuit, or (ii) for maintenance.

The major components of the on-site substation would be as follows:

- One 138 kV transformer including secondary containment area per local and state regulations. One 138 kV line circuit breaker for protection of equipment from an electrical short circuit on the gen-tie.
- One 34.5 kV bus circuit breaker for protection of the solar field and energy storage system from an electrical short circuit on the collection system.
- One 34.5 kV bus circuit breaker for protection of the PV arrays from an electrical short circuit on the 34.5 kV bus.
- One 34.5 kV circuit breaker for protection of the energy storage system from an electrical short circuit on the 34.5 kV bus.
- Disconnects and bus work to connect and isolate the collector circuits, switchgear with relays used to detect short circuits, equipment controls, telemetering equipment used to provide system control and data acquisition, communication fiber and Ethernet wiring, and the meters used to measure electrical power generated from the project. Switching gear and other components would be a maximum of 35 feet in height.
- A 138 kV dead-end structure that would have a maximum height of 35 feet. This structure is where the power output from each transformer is delivered to the gen-tie line.
- Connector Line, Fiber-Optic Line, and Point of Interconnection

The Proposed Project would interconnect to the ECO Substation project, which is owned and operated by SDG&E. A 138 kV line interconnecting from the ECO Substation project to the Jacumba Solar Energy Project would be constructed above-grade.

The 138 kV interconnection line would consist of two or three overhead steel poles that would be up to 150 feet in height. The vertical distance between the cross-arms on the steel case riser would be 20 feet. Non-specular conductors would be installed along the interconnection line alignment in order to minimize the reflectivity and general visibility of new facilities. The distance between the ground and the lowest conductor would be at least 30 feet and the distance between conductors would be 18 feet horizontally and 12 feet vertically. Although span lengths between poles would be dependent on terrain, lengths would generally be between 400 and 800 feet. Components used to construct the proposed 138 kV transmission line would all feature non-reflective surfaces. For instance, the insulators would be constructed of gray polymer, the conductors would be made from aluminum-wrapped steel, and the transmission poles and associated hardware would be composed of galvanized steel.



DUDEK

8477

SOURCE: Worley Parsons 2014

FIGURE 1.6

Solar Panel and Perimeter Fence Details

Jacumba Solar Energy Project

INTENTIONALLY LEFT BLANK

Each pole pad would require a 20 x 20 ft permanent impact area (<0.01 acre) and a 100 x 100 ft temporary impact area (0.23 acres per pole pad) that could be used as an equipment laydown area during construction.

Control System

Operation of the solar facility would require monitoring through a SCADA system. The SCADA system would be used to provide critical operating information (e.g., power production, equipment status and alarms, and meteorological information) to the power purchaser, project owners and investors, grid operator, and project operations teams, as well as to facilitate production forecasting and other reporting requirements for project stakeholders. The project would also have a local overall plant control system (PCS) that provides monitoring of the solar field as well as control of the balance of facility systems. The microprocessor-based PCS would provide control, monitoring, alarm, and data storage functions for plant systems as well as communication with the project's SCADA system. Redundant capability would be provided for critical PCS components so that no single component failure would cause a plant outage. All field instruments and controls would be hard-wired to local electrical panels. Local panels would be hard-wired to the plant PCS. Wireless technology would be considered as a potential alternative during final project design. The SCADA system would be monitored remotely and no on-site operations and maintenance facilities or personnel would be necessary. Fire Access Roads: The interior site roads would be constructed as suitable for fire access roads and would be constructed to a minimum width of approximately 24 feet on the perimeter and 20 feet between panel blocks. The roads would be graded and maintained to support the imposed loads of fire apparatus (not less than 50,000 pounds), and would be designed and maintained to provide all-weather driving capabilities. The purpose of the fire access roads is to allow for two-way access of fire apparatus throughout the project site in order to reach all of the inverter stations.

The fire access roads would be constructed with an all-weather surface capable of supporting 50,000 pounds as required by County Fire Code. Fire access roads would be oriented in a north–south direction and would have east–west connections. An access-controlled gate would be installed at the substation driveways, which would be constructed with access to existing roadways and direct access to the project site.

The proposed arrangement of the PV solar fields, , energy storage system, onsite substation and internal access roads are shown on the MUP Plot Plan to illustrate the general configuration of the proposed solar facility. However, this layout is subject to minor modification at detailed engineering design. Fire Protection design considerations are included on Figure 1 Fire Site Safety Exhibit.

First Responder Training

Because each solar facility includes unique technologies, layouts, and design specifics, prior to commissioning, the operator must provide Training to local First Responders.

3 ANALYSIS

This Technical Report supplements the project's Fire Protection Plan (FPP) which evaluates and recommends actions for the Proposed Project to ensure it does not unnecessarily expose people or structures to fire risks and hazards. The FPP identifies and prioritizes the measures necessary to adequately mitigate those impacts. It considers the property location, topography, geology, combustible vegetation (fuel types), climatic conditions and fire history. It considers water supply, access, structure ignitability and fire resistive building materials, fire protection solar facilities and equipment, impacts to existing emergency services, defensible space and vegetation management.

The primary purpose of this Technical Report is to identify pre-suppression actions that would reduce risk directly associated with the solar facility, actions that would protect and enhance the safety of fire suppression resources, and actions that could protect the solar facility from ignition caused by other sources.

Today's emergency responders face unexpected challenges as new uses of alternative energy increase. These renewable power sources save on the use of conventional fuels such as petroleum and other fossil fuels, but they also introduce new or non-typical hazards that require varying firefighting strategies, procedures, and training.

The safety of firefighters and other emergency first responder personnel depends on understanding and properly handling these hazards through adequate training and preparation. San Diego County firefighters receive the necessary training required to respond to the various types of emergency incidents they may face. Electrical firefighting and solar facility firefighting and emergency response are not new to responding firefighters. There are existing solar facilities as well as other planned facilities that have led to firefighter training in best response strategies. This project will be similar to existing facilities and is not anticipated to result in unfamiliar technology requiring special training.

The goal of this report is to assemble core principle and best practice information for fire fighters, fire ground incident commanders, and other emergency first responders to assist in their decision making process for any emergencies at this site.

3.1 Solar Facilities Effect on Fire Risk

The primary objective of this report is to identify the potential hazards resulting from the installation, operation and maintenance of the solar facility as well as from natural conditions that could result in risk of fire. These hazards include several operations and activities associated with the solar facility that could elevate the probability of ignition.

These could include the following:

- Overhead transmission line contacting vegetation that could cause an ignition, especially when excessive electrical load demands cause line sag. This potential issue is not considered likely given the height of the proposed electrical transmission lines and the low growing nature of the vegetation in the area.
- Maintenance activities such as welding or vegetation clearing underneath the overhead line that could cause an ignition.
- Vehicles used by the solar facility operations that could cause an ignition (catalytic converter, faulty brakes, etc.)
- Malfunctioning panels that result in ignition.
- Malfunctioning transformers at inverters and within the onsite substation that could create an ignition.
- Malfunctioning battery energy storage components that could create an ignition.

Among the potential hazards to responding firefighters are:

During daylight hours, crews should consider that all PV modules cannot be isolated during daylight hours and must always be considered energized. Crews should fight the fire as they would any other electrical fire and use a water fog spray for ordinary combustibles located under or near the modules or dry chemical extinguishers on any electrical wiring and any PV component.

Depending on the level of damage to the solar facility during a fire incident, the electrical connection to ground may have been lost and create an extremely hazardous situation, especially if pooling of water occurs.

The use of electrical conductive tools is hazardous, since the modules, including both the light absorbing components and frames, may be energized. If a ground connection has been compromised, the rack may also be hazardous.

The inverters and DC combiner boxes could be located in the middle or in between rows of the arrays. There could be a delay in locating the inverter or identifying other controls. Fire fighters should not step on or lean on modules and should be aware of the trip, slip and fall potential around PV arrays.

Firefighters must be cautious of water pooling at all times of the day. A de-energized line of the PV solar facility could be energized at dusk or become energized at sunrise.

Care must be taken to avoid unnecessary contact with potentially energized PV components until they can be isolated and confirmed de-energized. Individual modules and complete arrays must be considered energized during daylight hours.

Burning PV modules, batteries and wire insulation nmay produce toxic vapors. Firefighters should wear full personal protection equipment (PPE) and Self Contained Breathing Apparatus (SCBA) due to the potential for toxic or hazardous inhalation that may be produced by these burning components. Crews should work upwind of the smoke whenever possible.

Firefighters should never cut the wiring in a PV solar facility. Specialized tools may be required for disconnecting the array wiring. Arrays, individual modules, and conduit should not be disassembled, damaged or removed by firefighters until all of the PV solar facility's components are isolated or de-energized by a qualified PV technician or electrician. Firefighters should limit their activities to containment of the fire until it can be confirmed that the solar facility is isolated or de-energized.

At any incident where PV is present the Incident Command (IC) must designate a "Utilities Group" early to aid in locating and disabling all of the PV solar facility components. This can greatly decrease the electric shock hazard to all crews operating on the fire ground. Firefighters must remember that all PV components must be considered HOT during day light. Additionally, Firefighters must be aware that if a single array is isolated, all of the others may remain energized. Care must be exercised when operating around the other energized arrays.

At the conclusion of an incident, demobilization and termination efforts should be directed at leaving the property in the safest condition possible. An overall focused size-up and risk-benefit analysis should be conducted.

Along with a structural stability assessment, hazard identification and the marking of any potentially energized areas should be a priority. A qualified PV technician or electrician should be called to the incident to de-energize any solar facility that has been compromised or creates a hazard. Transferring scene safety and security to an appropriate local, municipal authority may be an option if the fire department is unable to quickly secure the assistance of a qualified PV technician or electrician. All hazards should be appropriately marked or barricaded.

Battery storage facilities have unique hazards associated with each type of battery chemistry. Batteries may experience overcharge or overdischarge or short circuit conditions that lead to increased temperature and pressure resulting in risks of explosion. Flammable gas may be present in the energy storage area. Explosion and fire can result in highly flammable gas being released from the battery containment area. Most battery chemistries will react negatively with water and an appropriate dry extinguishing agent should be used within the energy storage area of the facility.

Firefighters operating in or around the battery storage area should only use flashlights and other equipment approved for CLASS I atmospheres. Firefighters should never cut into batteries for any reason. Even if the PV system is disconnected from the battery bank, the batteries themselves will have the potential for electric shock. If a battery is punctured by a conductive object, assume that the object may be charged.

3.2 Fuels Management to Protect Facilities from other Sources

The Proposed Project is in a very high fire hazard severity zone. The FPP for this Proposed Project documents recommendations to protect the facilities from fire from other sources. Any wind or topography driven wildfire and especially those burning under a northeast (*Santa Ana*) wind pattern creates a very high wildland fire hazard scenario, especially for wildland fires starting northeast of the project. In addition, a typical fire day with a southwest wind will create a high wildland wildfire hazard. However, the proposed vegetative fuel modification treatments and the use of building standards compatible with a solar operation will lower the risk for potential loss of solar structures to less than significant levels. Vegetative fuel treatment and setback will most normally eliminate direct fire impingement and radiant heat from around the perimeter of the structures.

4 EFFECTS OF ELECTRICITY ON THE HUMAN BODY

4.1 Physiological Effects

Electricity flowing through the human body can shock, cause involuntary muscle reaction, paralyze muscles, burn tissues and organs, or kill. The typical effects of various electric currents flowing through the body on the average **150-lb male** and **115-lb female** body are given in Table 1.

Burns. Although a current may not pass through vital organs or nerve centers, internal electrical burns can still occur. These burns, which are a result of heat generated by current flowing in tissues, can be either at the skin surface and/or in deeper layers (muscles, bones, etc.). Typically, tissues damaged from this type of electrical burn heal slowly.

Burns caused by electric arcs are similar to burns from high-temperature sources. The temperature of an electric arc, which is in the range of 4,000–35,000°F, can melt all known materials, vaporize metal in close proximity, and burn flesh and ignite clothing at distances up to 10 ft from the arc.

Table G-1
Effects of electric current on the human body (Ref. 1).

Effect/feeling	Direct current (mA)		Alternating current (mA) 60 Hz		Alternating current (mA) 10,000 Hz		Incident severity
	150 lb	*115 lb*	*150 lb*	*115 lb*	*150 lb*	*115 lb*	
Slight sensation	1	0.6	0.4	0.3	7	5	None
Perception threshold	5.2	3.5	1.1	0.7	12	8	None
Shock not painful	9	6	1.8	1.2	17	11	None
Shock painful	62	41	9	6	55	37	Spasm, indirect injury
Muscle clamps source	76	51	16	10.5	75	50	Possibly fatal
Respiratory arrest	170	109	30	19	180	95	Frequently fatal
≥ 0.03-s vent. fibril.	1300	870	1000	670	1100	740	Probably fatal
≥ 3-s vent. fibril.	500	370	100	67	500	340	Probably fatal
≥ 5-s vent. fibril.	375	250	75	50	375	250	Probably fatal
Cardiac arrest	—	—	4000	4000	—	—	Possibly fatal
Organs burn	—	—	5000	5000	—	—	Fatal if it is a vital organ

Delayed Effects. Damage to internal tissues may not be apparent immediately after contact with the current. Internal tissue swelling and edema are also possible.

Critical Path. The critical path of electricity through the body is through the chest cavity. At levels noted in Table A-1, current flowing from one hand to the other, from a hand to the opposite foot, or from the head to either foot will pass through the chest cavity paralyzing the respiratory or heart muscles, initiating ventricular fibrillation and/or burning vital organs.

4.2 Biological Effects of Electrical Hazards

Influential Variables. The effects of electric current on the human body can vary depending on the following:

1. Source characteristics (current, frequency, and voltage of all electric energy sources).
2. Body impedance and the current's pathway through the body.
3. How environmental conditions affect the body's contact resistance.
4. Duration of the contact.

Source Characteristics. An AC with a voltage potential greater than 550 V can puncture the skin and result in immediate contact with the inner body resistance. A 110-V shock may or may not result in a dangerous current, depending on the circuit path which may include the skin resistance. A shock greater than 600 V will always result in very dangerous current levels. The most severe result of an electrical shock is death.

Conditions for a serious (potentially lethal) shock across a critical path, such as the heart, are:

1. More than 30 V root mean square (rms), 42.4-V peak, or 60 V DC at a total impedance of less than 5000
2. 10 to 75 mA
3. More than 10J

Conditions for a potentially lethal shock across the heart are:

1. More than 375 V at a total body impedance of less than 5000
2. More than 75 mA
3. More than 50 J

Frequency: The worst possible frequency for humans is 60 Hz, which is commonly used in utility power systems. Humans are about five times more sensitive to 60 Hz AC than to DC. At 60 Hz, humans are more than six times as sensitive to AC than at 5000 Hz—and the sensitivity appears to decrease still further as the frequency increases. Above 100–200 kHz, sensations change from tingling to warmth, although serious burns can occur from higher radio-frequency energy. At much higher frequencies (e.g., above 1 MHz), the body again becomes sensitive to the effects of an alternating electric current, and contact with a conductor is no longer necessary; energy is transferred to the body by means of electromagnetic radiation (EMR).

Body Impedance: Three components constitute body impedance: internal body resistance and the two skin resistances at the contact points with two surfaces of different voltage potential. One-hand (or single-point) body contact with electrical circuits or equipment will prevent a person from completing a circuit between two surfaces of different voltage potential. Table 2 provides a listing of skin-contact resistances encountered under various conditions. It also shows the work area surfaces and wearing apparel effects on the total resistance from the electrical power source to ground. This table can be used to determine how electrical hazards could affect a worker in varying situations.

Table G-2
Human resistance (Q) for various skin-contact conditions.

Body contact condition	Dry (Ω)	Wet (Ω)
Finger touch	40,000–1,000,000	4,000–15,000
Hand holding wire	15,000–50,000	3000–5000
Finger-thumb grasp	10,000–30,000	2000–5000
Hand holding a pliers	5,000–10,000	1000–3000
Palm touch	3000–8000	1000–2000
Hand around 1.5-in. pipe or drill handle	1000–3000	500–1500
Two hands around 1.5-in. pipe	500–1500	250–750
Hand immersed	—	200–500
Foot immersed	—	100–300

Life-Threatening Effects. Charles F. Dalziel, Ralph H. Lee, and others have established the following criteria for the lethal effects of electric shock:

1. Currents in excess of a human's "let-go" current (≥16 mA at 60 Hz) passing through the chest can produce collapse, unconsciousness, asphyxia, and even death (see also Table 1).
2. Currents (≥30 mA at 60 Hz) flowing through the nerve centers that control breathing can produce respiratory inhibition, which could last long after interruption of the current.
3. Cardiac arrest can be caused by a current greater than or equal to 1 A at 60 Hz flowing in the region of the heart.
4. Relatively high currents (0.25–1 A) can produce fatal damage to the central nervous system.

5. Currents greater than 5 A can produce deep body and organ burns, substantially raise body temperature, and cause immediate death.
6. Delayed reactions and even death can be caused by serious burns or other complications.

Source: Lawrence Livermore National Laboratory. The complete document can be found at: http://www.llnl.gov/es_and_h/hsm/doc_16.01/doc16-01.html

5 DETAILED RESPONSE RECOMMENDATIONS

Every emergency incident to which a fire department responds is unique. Despite the differences, however, there are common characteristics that allow fire service personnel to better understand the tasks that need to be performed and to prepare for their duties. This section provides a review of the common elements of most interest to fire fighters when handling emergencies involving solar power systems.

PV Systems Highest Concerns

1. Tripping/Slipping
2. Structural Collapse 3. Flame Spread
3. Inhalation Exposure
4. Electrical Shock
5. Battery Hazards

Energized System Firefighting

If a photovoltaic solar array becomes engulfed in fire, appropriate care should be exercised in firefighting response, and it should be attacked similarly to any piece of electrically energized equipment. Normally this would involve shutting down the power and applying water in a fog pattern on the photovoltaic array, but it is critical to be aware that a solar panel exposed to sunlight is always on and energized. Further, the electrical energy produced by multiple series connected panels or large solar systems are normally very dangerous.

One additional secondary concern that should always be considered when approaching solar power systems is that the module frame and junction boxes may provide nesting locations for a variety of birds, insects and other animals. This could introduce an additional layer of difficulty for on scene fire fighters, enhancing other hazard concerns such as fire in nesting material or bites along with tripping or slipping.

A photovoltaic system generates electricity when the sun is shining, and when it is receiving sunlight it is operational and generating electricity. This creates additional challenges for the fireground task of shutting off the utilities and the electrical power in the structure that could be a dangerous source of electric shock. **Even with known shutdown steps taken to isolate electrical current, fire fighters should always treat all wiring and solar power components as if they are electrically energized.**

Care should be taken throughout fireground operations never to cut or damage any conduit or any electrical equipment, and they should be treated as energized at all times.

Battery Energy Storage

An additional electrical concern exists for systems that have an optional battery storage arrangement as part of the PV system. The batteries can maintain electrical current at nighttime and when the rest of the system has been isolated, thus presenting an additional electric shock hazard. Further, they can present leakage and hazardous materials concerns, and special attention is required for any battery storage systems that have been damaged in a fire.

Design requirements for batteries are established and can be extrapolated to the battery systems used in a photovoltaic system, such as the requirements for stationary storage battery systems addressed by Chapter 52 of NFPA 1, Fire Code, and Section 608 of the International Fire Code.130,131 Technology commonly used for stationary storage batteries include: flooded lead-acid, flooded nickel cadmium (Ni-Cd); valve-regulated lead-acid; lithium ion; and lithium metal polymer. The battery system for the Jacumba Solar project will include a state-of-the-art system that reduces the potential for thermal runaway.

Batteries generally burn with difficulty, although plastic battery casings provide a limited contribution to the combustion process. However, batteries that do burn or are damaged in a fire generate fumes and gases that are extremely corrosive. Spilled electrolyte can react with other metals and produce toxic fumes, as well as potentially flammable or explosive gases. The risk of additional batteries becoming involved is high during a thermal runaway event, although these events are extremely rare. Full protective clothing and respiratory protection is imperative in such incidents, and special care and maintenance may be required during cleanup. Dry chemical, CO_2, and foam are the preferred methods for extinguishing a fire involving batteries, and water is normally not the extinguishing agent of choice, but may be used as a water fog for cooling purposes.

Respiratory Protection

Proper respiratory protection should be used during all fireground operations that involve a potentially hazardous atmosphere. Similarly, these protective measures apply during post-fire activities such as overhaul or fire investigations. Care should be taken during all fireground operations to protect against respiratory exposure from products of combustion involving PV systems. Under normal conditions the materials used for solar cells and modules are relatively inert and safe, but they can become dangerous when exposed to fire. If solar power components are involved in a fire, care should be taken to avoid exposure to the products of combustion due to the somewhat unusual materials involved. In addition to inhalation concerns, dermal exposure from solar power system materials damaged by fire should also be handled with caution regardless of the type of solar power system.

Emergency responders are required to wear full respiratory protection (e.g., self-contained breathing apparatus) for any atmosphere that is possibly IDLH (immediately dangerous to life or health), and this should be the case when handling damaged solar modules involved in fire unless proven otherwise

Firefighting Strategic Mode

Following an assessment of a fire related situation, the choice of a strategic mode should be made by the Incident Commander (IC) following local jurisdiction Emergency Operation Manuals, SOPs and guides that would normally be used for Electrical Hazards. Tactics, like strategy, should also be based upon normal standard operating procedures for responding to an emergency incident for a PV solar facility.

Before going any further:

Find the Directory for the Site located at/near the primary facility entrance off old Highway 80, as it illustrates the location of key components and emergency contact information.

Locate the Service Disconnects

1. **Strategy** - When a fire incident occurs in the vicinity of a PV solar facility, the following items must be considered when developing a strategy:
   a. Document fire conditions found on arrival – confirm fire location, type of fire, extents, potential threats
   b. Confirm whether a component of the PV solar facility itself is burning or whether fire is confined to the surrounding vegetation
   c. Confirm whether anyone on-site is threatened by the fire
   d. Confirm whether aerial firefighting resources are being used or should be ordered for wildfire and know potential limitations of its use on/near solar facilities
   e. Document any threatened exposures, including wild land areas
   f. Locate water and additional resources available (site includes two 10,000 gallon water tanks with firefighting water (Figure 1).

Once the IC has completed a size-up, the IC should determine the strategy and assign tasks to the fire suppression resources assigned to the incident. Due to the potential hazards associated with PV solar facilities, the IC must adjust the strategy and potentially rearrange the order of the tactics to deal specifically with the PV solar facility technology. If the IC chooses an offensive strategy it needs to be supported as it would under other fire operations with an emphasis on disabling all power sources to and from the PV solar facility or remaining at a safe distance and limiting spread if energy is not confirmed disabled. .

2. **Tactics -** Tactics will be based on the chosen strategy and Department SOPs:

   a. Components are always hot! The single most critical message of emergency response personnel is to always consider photovoltaic facilities and all their components as electrically energized. The inability to power-down photovoltaic panels exposed to sunlight makes this an obvious hazard during the daytime, but it is also a potential concern at nighttime for a solar facility that may be equipped with battery storage.

   b. Isolation of the inverters and disconnection of the solar facility from the main electrical panel will be an important task. Assistance from a local PV technician is key for disabling the PV solar facility and confirming that all of the hazards have been mitigated. An emergency response plan identifying all tasks and the parties responsible for providing the electrical isolation for emergency responders is required.

   c. The battery storage system may include steel containers that house racks of batteries. These containers are required to include remote monitoring by the site's SCADA or similar system and automatic, inert gas fire suppression systems that are very effective at extinguishing ignition, should one occur. The steel containers and fire suppression systems are expected to contain a fire, but if the very unlikely thermal runaway event is experienced, then external firefighting may be required.

   d. Another priority will be preventing fire spread and isolating it to its area of origin. This task may be difficult during a vegetation fire adjacent the site, especially if aerial resources are being used. Ground resources should be removed from the site until the air attack has concluded.

   e. Dry chemical extinguishers should be used to contain or extinguish electrical fires. Water should be used to extinguish any ordinary combustibles under or near the PV solar facility, or if the volume of fire requires its use. If water is used, a 30º fog pattern from at least a 30 foot distance, at 100 psi is recommended.

   f. Full PPE must be used due to the potential toxic inhalation hazard if panels are burning. Fire crews should position themselves upwind and out of any toxic atmosphere.

   g. Ingress and egress will require that gates have an inside measurement of a minimum of 26 feet wide. The primary fire access will require a Knox Lock. Existing gates plus any future gates that may be installed on the access roads or fence lines must be equipped with an approved padlock, Knox key box ("Knox" padlock, or "Knox" weather resistant lock box, for use with a "Knox" sub-master key) or "Knox" box electronic access system.

h. During the overall fire suppression and mop-up phases of an on-site fire, firefighters should avoid all potential electrical hazards until there is confirmation that the solar facility no longer poses an electric shock hazard. Firefighters must avoid inadvertently damaging PV components with their tools.

i. The IC will need the assistance from local PV technician to confirm that all of the hazards have been mitigated before the incident is terminated and the scene is turned over to the owner or responsible party.

j. The tactical approach to a fire incident with solar power equipment must be stressed to all fire suppression personnel (i.e., stay clear). Serious injury can occur with any type of PV solar on a sunny day.

INTENTIONALLY LEFT BLANK

6 REFERENCES

Fire Operations for Photovoltaic Emergencies. CAL FIRE–Office of the State Fire Marshal. November 2010

Fire Fighter Safety and Emergency Response for Solar Power Solar farms. A DHS/Assistance to Firefighter Grants (AFG) Funded Study. Prepared by: Casey C. Grant, P.E. Fire Protection Research Foundation

The Fire Protection Research Foundation One Batterymarch Park Quincy, MA, USA 02169-7471. May 2010

INTENTIONALLY LEFT BLANK