FIRE PROTECTION PLAN
TECHNICAL REPORT

IES/SDG&E Solar Energy Project - Ramona
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1.0 INTRODUCTION

The Fire Protection Plan (FPP) – Letter Report is submitted pursuant to Chapter 49 of the County Consolidated Fire Code, to address the adverse environmental effects that a proposed project may have from wildland fire and to provide mitigation of those impacts to ensure that the project does not expose people or structures to a significant risk of loss, injury or death involving wildland fires.

Photovoltaic systems introduce new hazards to fire fighters when responding. These include but are not limited to potential electrical shock both during and post-incident, inhalation exposure from toxic chemicals as a result of damaged panels, and arc flashes.

Photovoltaics refers to the process of converting energy in the form of light from the sun to usable electric current. A photovoltaic system refers to a system of components that together will generate electricity onsite and may allow, as in this case, excess energy to flow to the utility grid. Storage batteries are not part of this system since the primary purpose of the system is for the production of energy to be transferred to the distribution system for use in the local area. Generally a system is composed of modules (panels) which create the electricity, wiring harness, inverter, and disconnects between the modules and inverters on the direct current side and between the inverter and the alternating current side.

The FPP –Technical Report is prepared primarily to address hazards of the proposed facilities to emergency responders as a result of the unique hazards of photovoltaic systems. This includes pre-suppression actions that would protect and enhance the safety of emergency responders, a discussion of how to properly de-energize equipment, signage recommendations, and recommended training for emergency personnel.

2.0 HAZARDS TO EMERGENCY RESPONDERS

Photovoltaic systems introduce new hazards to fire fighters when responding. These include but are not limited to potential electrical shock both during and post-incident, inhalation exposure from toxic chemicals as a result of damaged panels, and arc flashes.

Inhalation Exposure

During a fire or explosion, the photovoltaic frame can quickly degrade, exposing hazardous chemicals to direct flame and causing them to be dissipated in the smoke plume.

Terrain Hazards

There may be uneven terrain where the arrays are mounted resulting in unexpected trip and fall hazards.

Electrical Shock and Arcing

Electricity can cause a variety of effects, ranging from a slight tingling sensation because of involuntary muscle reaction to burns and even death. A "grounded" firefighter provides an excellent path for electrical current to go to ground. When this happens to a firefighter there are a number of variables that determine the degree of injury that may be sustained. These variables include: amount of current, pathway of current, length of exposure, body size, area of contact, pressure of contact, moisture of contact, clothing and jewelry and type of skin (e.g. callused hands vs. back of hand).

Electrical shock is one hazard when working around electricity—burns are another. Burns that are caused by electricity include electrical, thermal and arc burns. An arc-flash can occur when there is sufficient amperage and voltage and a path to ground or to a lower voltage. Arc-flashing is most common in ac circuits due to the presence of high amperage. Temperatures generated by arcing electricity can reach 15,000 to 35,000 degrees and can melt or vaporize metal in close vicinity. It can also burn flesh and ignite clothing at distances of up to 10 feet. The best way to prevent arc-flash hazards is to de-energize electrical equipment and circuits before approaching or touching electrical equipment. Thermal contact burns occur when skin comes in contact with overheated electric equipment, or when clothing is ignited in an electrical incident.

The photovoltaic array will always generate electricity during daylight even when it is cloudy or raining and the generation of electricity can't be turned off. Spotlights used during evening operations are generally not bright enough for the panels to generate electricity however scene lighting may result in the panels generating electricity. Lightening is bright enough to create an electrical surge. During any of these situations the photovoltaic panels will be energized and can't be de-energized.

3.0 DE-ENERGIZING THE SYSTEM AND SIGNAGE

The photovoltaic panels will always be HOT under adequate light conditions. Emergency responders should always assume the system is hot and there is a risk of electrical shock and arcing. Damage from the fire could result to exposed cables between the photovoltaic panels and the inverters or damage to the grounding system.

De-Energizing the System

A direct current (DC) disconnector switch shall be located between the photovoltaic panels and the inverters. This allows the safe disconnection of a defective inverter or safe disconnection of modules for maintenance purposes or a fire. Additionally the alternating current (AC) shall have a disconnect switch located at the pad mounted switch gear. This will allow alternating current from the distribution system to be shut off effectively de-energizing the system from alternating current entering into the photovoltaic system.

Damaged solar panels/arrays should never be touched without verifying whether or not the solar panels/arrays are energized. Firefighters should never cut the wiring in a solar facility.

Specialized tools may be required for disconnecting the module wiring. Firefighters should consider controlling fires within solar facilities rather than removal due to the inherent electrical hazard. Solar modules, support structures, and conduit should not be disassembled, damaged or removed by firefighters until all of the solar facility's components are isolated or de-energized by a qualified photovoltaic technician or electrician. The phone number of a responsible entity who can dispatch a local photovoltaic technician in a timely manner should be displayed on the lighted directory at the entrance. Firefighters should limit their activities to containment of the fire until it can be confirmed that the solar facility is isolated or de-energized.

In extraordinary circumstances, where all other tactics or options have been exhausted, photovoltaic panels must be removed. Care should be taken to use non-conductive tools since the modules and frames may still be energized. Damaged solar facilities should not be touched without verifying whether or not the solar facility is energized. Specialized tools may be required to disconnect wiring. Firefighters should consider containing fires within the solar facilities rather than removal due to the inherent hazard and limited electrical safety training afforded to firefighters.

Isolation of the inverters and disconnecting the solar facility from the main electrical panel will be an important task. It is recommended that assistance from a local photovoltaic technician be utilized to disable and confirm that all the hazards have been mitigated. The Incident Commander should designate a "Utilities Group" early to aid in locating and disabling inverter structures and photovoltaic solar facility components. This can greatly decrease the electric shock hazard to all crews operating on the fire ground. Firefighters must remember that all photovoltaic components must be considered "HOT" during light conditions. Firefighters must be aware that if only a single array is isolated, all of the others will most likely remain energized.

Signage

The project site must be signed to accurately identify and locate locations and hazards on the project site. Signage requirements are as follows:

- A lighted directory located at the Creelman Lane entrance to the site depicting the overall site plan and the locations of each numbered inverter structure (also must be shown on the plot plan) for the site. The phone number of a responsible entity who can dispatch a local photovoltaic technician in a timely manner should be displayed on the lighted directory at the entrance.

- A sign stating that "Components are always hot!" shall be located at the Creelman Lane entrance to the site. The single most critical message of emergency response personnel is to always consider photovoltaic solar 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. However scene lighting or lightening can also result in an electrical surge.

- Signs to be placed at each disconnecting point and what equipment it de-energizes.

- Each inverter structure will be numbered with a sign that is plainly visible with numbers that contrast with their background.

4.0 RECOMMENDED TRAINING FOR EMERGENCY PERSONNEL

Training at a minimum should include the training course developed by CALFIRE entitled "Fire Operations for Photovoltaic Emergencies" (CALFIRE 2010). At the end of the course emergency personnel shall have a working knowledge of a photovoltaic system, be able to identify the component parts, identify and mitigate potential hazards, perform size up and develop response strategies and tactics. Additionally the emergency responders should be taken to the site in order familiarize themselves with the site. Training shall happen prior to commissioning and as requested by the Fire Authority.

5.0 SUMMARY

Photovoltaic systems introduce new hazards to fire fighters when responding. These include but are not limited to potential electrical shock both during and post-incident, inhalation exposure from toxic chemicals as a result of damaged panels, and arc flashes. CALFIRE recommends that the first line at attack in a fire incident, in which a photovoltaic system is involved, is ensuring that the firefighters on scene are trained in identifying photovoltaic systems and the methods to control them. In addition, CAL FIRE stresses that they must know how to adjust their assessment of the incident involving photovoltaic to ensure appropriate actions are applied to the incident. In any incident, the desired outcome is to always mitigate and/or control the situation in a safe and efficient manner. The strategy and tactics firefighters choose are critical to both the outcome and the safety of all members working on the scene. CAL FIRE indicates that the basics for ensuring a safe, control, and mitigated incidents involving photovoltaic sites are as follows:

- Always wear protective clothing and SCBA
- Avoid wearing jewelry
- Use hand tools with insulated handles
- Be aware that biting and stinging insects could inhabit the module frame and electrical junction boxes
- Lock out/tag out system disconnects should be located and disconnected.

6.0 REFERENCES

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