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Disasters and Energy Security Management

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ABSTRACT

In the past, natural disasters, such as hurricanes, floods, tornados, and earthquakes, were one of our major concern. Now, terrorist events are becoming more common and more destructive. Whether, natural or man made, a disaster can happen at any time, often with little or no advance warning. A disaster can leave many people without adequate medical services, potable water, electrical service and communications for long periods of time. They can be as destructive as Hurricane Mitch leaving several hundred-thousand people homeless or as minor as an afternoon thunderstorm knocking down local power lines to your home. Not only can lives be destroyed, but business, the environment and communities.

In response to disaster, renewable energy sources are an environmentally benign, inexhaustible source of thermal or electrical energy. As an example, photovoltaic (solar electric) modules generate quiet, safe, pollution-free electrical power. Solar powered equipment require no fuel and are less expensive to operate than gas or diesel generators. Photovoltaics play an important roll in the relief efforts after a disaster. There are many applications that PV properly satisfies the need for electrical power. The longer the period the power is out, the greater the benefit PV is as a sustainable energy source.

This report discusses the needs for electrical power and the priority for those needs during disasters and terrorist attacks. Resources for assistance and PV-powered equipment are presented. Emergency response organizations and the general public will benefit from the information and examples provided in this report.

1. INTRODUCTION

Natural disasters, such as hurricanes, floods, tornadoes, and earthquakes often occur with little advance notice, disrupting the normal daily community routine. Emergency management teams, the military, and countless public and private organizations respond to such disasters with massive relief and rebuilding efforts. Food, water and medical supplies for life support are provided to survivors in the disaster area. Generators of all sized and types are provided for electrical power during the recover effort.

In October 1998, Hurricane Mitch struck the coast of Honduras with a tremendous destructive force. With winds of over 100 miles per hour, Mitch displaced over 1 million people and destroyed over 100,000 homes. Thousands of businesses and homes that were still standing were without electrical service, functioning water and sewage systems, communications, and medical services for days, even weeks and months in the aftermath of the storm. Shelters, medical clinics, hospitals, fire stations, and police stations also suffered damages and loss of utility services.

On September 11, 2001, terrorist destroyed the Twin Towers and several adjacent buildings in New York City. Over three thousand people lost their lives and eight city blocks were damaged in that event. Over one hundred gasoline and diesel generator were used to power search and rescue equipment in an effort to find survivors and remove debris. Man made disasters took on a new meaning, they were now more than accidents or chemical spills.

Many of the energy requirements of emergency management organizations, relief workers, and the general public can be satisfied with photovoltaic power systems. This inexhaustible source of clean and quiet energy from the sun can be quickly applied to power a variety of equipment.

2. EMERGENCY MANAGEMENT

Nearly every country has an organization that prepares or response to a disaster. In some countries the military is call in time of a disaster, but most countries have a government agency responsible for disaster efforts. The organized comprehensive handling of

disasters and hazards and their consequences was institutionalized in the United States (US) in 1979 with the creation of the Federal Emergency Management Agency (FEMA) and in 2002 was FEMA became a division of the Homeland Security Department.

In the US, all levels of government (federal, state, county, and local) and the private sector (business and industry, voluntary organizations, and the general public) contribute toward a close working partnership to manage disasters. Local governments manage all types of hazards and disasters, with responsibility for making plans and providing the primary resources for public protection. Local governments provide and maintain police and fire protection, highway resources, municipal facilities, equipment, supplies, and personnel capabilities to resolve prevailing problems. In the event local government does not have sufficient resources to meet demands, assistance is requested from the State or Federal Government.

Emergency management personnel from public agencies, organizations and utilities are organized into teams for resolution of emergency situations within a disaster or incident and also provide resources for recovery. The teams are organized into service areas called Emergency Support Functions (ESF) in Table 1.

Table 1. Emergency Support Function: follows:

Transportation	Communication
Public Works & Engineering	Fire Fighting
Information & Planning	Mass Care
Resource Support	Health & Medical Service
Search & Rescue	Hazardous Materials
Food & Water	Energy
Military Support	Public Information
Volunteers & Donations	Law Enforcement
Animal Issues	

3. PV USAGE DURING DISASTERS

For many years, a few enthusiast have use solar in disaster. There had been limited use of photovoltaics in a disaster until Hurricane Hugo, where it had been first introduced to emergency management organizations by members of the PV industry. There has been a variety of different PV-powered applications demonstrated in the various Emergency Support Functions. In recent years, photovoltaics have supplied emergency power for Hurricanes Hugo, Andrew, Mitch and Luis, along with the Northridge Earthquake in Southern California, USA.

In 1989, Hurricane Hugo cut across the island of St. Croix in the Virgin Islands, disrupting power all over the island. At the time, 12 Volt Catalog (PV distributor) assembled thirty small portable PV systems using Sovonics Solar System or ARCO Solar PV modules by connecting either one of them to a deep cycle Interstate Battery. The units were used at various disaster shelters, medical facilities, and emergency management offices to power 12 VDC florescent lights, fans and Ham Radios. These companies have since become Geosolar, United Solar Systems and Siemens Solar.

Later, Hurricane Hugo struck the State of South Carolina, USA, at which time a trailer mounted, PV-powered generator was transported to the devastated area to assist with relief efforts. This Solar Emergency Response Vehicle powered a law enforcement traffic facility and an orphanage until utility power was restored. The unit built by Arizona Solar Energy Office and Photocomm supplied 12 VDC, 115 and 220 VAC of electrical power which operated 24 hours per day from a 2,640 peak watt PV array.

In the summer of 1991, Barrett Manufacture built an Emergency Mobile Communications and Lighting system for earthquake recovery efforts at Northridge in Los Angeles, California, USA. The trailer mounted, PV-powered generator provided reliable standalone electrical power at both 12 VDC and 120 VAC. The unit contained 4 Siemens 48 watt PV modules.

Several years before Hurricane Andrew struck South Florida, USA, PV-powered streetlights had been installed in a Miami suburb. After the storm, all 33 streetlights were still standing and provided the only light in the area until utility power was restored. The streetlights consisted of a pole-mounted fixture that contained a battery and controller enclosure, two PV modules and a fluorescent lamp. The streetlights were manufactured locally by Solar Outdoor Lighting, who later provided additional units installed at security stations, temporary medical clinics, and shelters in the disaster area.

In response to Hurricane Luis, Miox Corporation provided PV-powered water purification units to the Virgin Islands. The units produce hundreds of gallons of potable water per day.

Military installations are using PV to power surveillance and monitoring equipment to enhance

security and protect facilities. Utilities and business are now using PV to protect their facilities. These fixed known applications benefit from the capabilities of PV.

4. APPLICABLE USES

In modern time, the loss of electrical power after a disaster or terrorist attack quickly makes us realize how dependent our society is on electricity. Medical, fire and police services are needed immediately after a disaster and during the period of reconstruction. Communication was very important to emergency personnel to request assistance, supplies, and information. It would be a difficult task to rebuild businesses and homes without the usual services of water, sewer, and electricity. Emergency Management Teams, the military, and countless public and private organizations providing recovery efforts require varying amounts of electrical power.

The Emergency Support Functions performed by the many emergency management organizations cover a wide spectrum of relief and recovery efforts. Many of the resources needed to perform these support functions require standalone electrical power. Fast and deliberate deployment of equipment is needed in response to a disaster; therefore, ready-to-use systems designed for individual applications are most effective. These resources can be specified as individual equipment related to a function or application and are defined in Table 2.

Table 2. Equipment and Applications:

Building or backup power
Call boxes
Flashing arrow boards
Flashing warning signals and signs
Folding man packs
Hand-held radio transceivers
Highway advisory radio
Instrumentation equipment
Medical equipment
Flashlights
Photovoltaic generators
Portable AM/FM radios
Portable pumping stations
Radio base and repeater stations
Refrigerators and coolers
Security lights
Small battery chargers
Streetlights
Traffic signals
Victim detection equipment
Water purification
Facility surveillance and monitoring
Pipeline leak detection
Utility control and monitoring
Emission monitoring
Backup power.

Listed above are various general applications that are presently available as PV-powered. A few real live applications demonstrating the usefulness of PV in disasters was presented earlier in this report. PV power can be applied to any disaster, whether a hurricane, earthquake, technological hazard or terrorist attack.

A viable use for PV is to meet the emergency demands in large-scale disasters, where power will be out for long periods of time and survivor support is difficult to provide due to the extensive area destroyed. Massive infrastructure damage makes refueling generators a challenge as pumping stations are often inoperable and roads impassable. Power distribution lines are difficult to fix because of these impassable roads, much less transporting materials for reconstruction. When a disaster strikes an island and the port is destroyed, shipping fuel for generators becomes a big problem.

Solar systems are designed and sized for varying needs and applications. Since refueling is not required, length of operation poses no problem when the PV system is properly designed. Communities should be disaster resistant, both structurally and its energy resources. For added energy assurance, PV can be one of the energy sources in a distributed generation system. Solar-powered systems are a natural solution because they can be designed specifically for stand-alone operation without utility power as a critical power supply. If structures are still standing, PV can make your building or community energy supply disaster resistant as a critical power supply or back-up system. PV stand-alone operation make them valuable for energy security application for monitoring, detecting, surveillance and controlling materials, resources, and utilities. For years PV has been used for instrumentation, such as weather station, and now being applied in a similar manor for security applications.

PV is a viable source of electrical power for certain disaster relief applications such as low power needs and long term use. Electrical energy needs can vary

from two watts to charge the batteries in a flashlight to 1,000 watts to power a saw. The systems can be portable when mounted on a trailer or installed in a portable case. Some uses, like communications and medical clinics, require quiet non-polluting operation, which PV is capable of providing. Solar energy is a valuable, cost-effective resource for small portable and stand-alone electrical power applications due to lower operating cost than gasoline generators.

5. PV RESOURCES

Solar equipment sales increase each year. Even though solar equipment is not usually sold in general department stores, there are many manufacturers and distributors of PV systems and equipment. The easiest method to locate PV equipment is in your telephone book or by a industry directory. Presently, there is no list of equipment specifically made for disaster relief. Several directories are available as follows:

Cross, Bruce M., Ed. *World Directory of Renewable Energy Suppliers and Services*, 2000, London, United Kingdom: James & James

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Photovoltaic Products & Manufacturers Directory, 1994. Florida Solar Energy Center, 1679 Clearlake Road, Cocoa, FL, USA

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U.S.A.I.D. *A Directory of U.S. Renewable Energy Technology Vendors*, Washington, D.C., Committee on Renewable Energy Commerce and Trade (CORECT), March 1990. (U.S.A.I.D., Office of Energy, Washington, D.C. 20523)

6. CONCLUSION

Previously, photovoltaic power systems have been used for disaster relief efforts and have been successfully applied to medical clinics, communication operations, shelters, instrumentation and individual people needs. Each Emergency Support Function administrated by emergency management operations has an electrical power need that can be provided by photovoltaic systems. Renewables, including PV, need to be addressed in local Emergency Management Plans and Emergency Energy Plans to fully implement them into disaster relief efforts for the future to assure energy availability. PV stand-alone operation make them valuable for energy security application for monitoring, detecting, surveillance and controlling materials, resources, and utilities. For years PV has been used for instrumentation, such as weather station, and now being applied in a similar manor for security applications. PV can provide energy assurance as well as energy security.

Solar-powered systems are designed and sized for varying needs and applications. PV power systems provide clean, quiet electricity that does not require refueling as the sun supplies an endless supply of energy. PV is a viable source of electrical power for certain disaster relief applications that require low power, long term use, and where survivor support is difficult to provide. The stand-alone operations of solar energy systems make them a valuable cost-effective resource for electrical power due to lower operating cost and the capability for sustainable operation. In a large scale disaster, solar-powered systems are a natural solution because they are designed specifically for stand-alone operation where utility power is unavailable. PV can provide your building or community with a disaster resistant energy source, whether used as portable or building integrated systems as critical power supplies.

However, there are inappropriate applications for photovoltaics in response to disasters. The large-scale power needs of sewer and water facilities, hospitals, large shelters, distribution and emergency operations centers are better met with gasoline or diesel generators. Locations or equipment requiring hundreds of kilowatts of emergency power would require large areas of open space and cost hundreds of

thousands of dollars for PV arrays. If the location affected by the disaster is small and utility power can be restored in a short period of time, then PV may not be the correct solution. Emergency Management personnel need to understand their community energy needs and photovoltaic technology to make the right application choice.

Photovoltaics can provide the electrical power needs for vaccine refrigerators, microscopes, lighting, radios, fans, communications, traffic devices and other general electrical needs. After Hurricane Andrew, the Florida Department of Transportation used PV-power highway advisory radios and portable changeable message signs for traffic control and directions to relief shelters, emergency stations, and safe routes. Relief workers have used PV systems to power temporary medical clinics and supply centers. Emergency communications provided by volunteer amateur radio operators have used PV power. PV has also been used by people remaining with their homes without utility power.

7. REFERENCES

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(3) A Citizen's Guide to Disaster Assistance, IS-7, Federal Emergency Management Agency, Emergency Management Institute, Emmitsburg, MD, USA, Oct. 1999

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Photovoltaics can provide the electrical power needs for vaccine refrigerators, microscopes, lighting, radios, fans, communications, traffic devices and other general electrical needs. After Hurricane Andrew, the Florida Department of Transportation used PV-power highway advisory radios and portable changeable message signs for traffic control and directions to relief shelters, emergency stations, and safe routes.

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