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PROBLEMS AND SOLUTIONS: TRAINING DISASTER ORGANIZATIONS ON THE USE OF PV

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ABSTRACT

In 1992, the Florida Solar Energy Center (FSEC) and Sandia National Laboratories (SNL) assisted the University of Miami Field Epidemiology Survey Team (FEST) with photovoltaic systems to power temporary medical clinics after Hurricane Andrew struck south Dade County. At that time, it became apparent that there were no educational materials prepared for disaster relief or emergency management personnel on the use of photovoltaic (PV) to supply electrical power in response to a disaster. This need prompted FSEC to create an education program to develop awareness and train organizations on the proper use of PV in disasters. Since then, FSEC has gained extensive knowledge and experience in analyzing disaster-related energy needs, developing and procuring disaster equipment and maintaining and deploying photovoltaic (PV) power equipment to aid in post-disaster recovery and mitigation efforts. The 9-11 terrorist attack on the World Trade Center added a new dimension to our definition of disaster and the need for emergency power.

Several research studies have been published, educational materials produced and workshops conducted by FSEC on the use of PV in disasters. This knowledge is being transferred to government agencies, the PV industry and disaster relief organizations in Florida and around the world. This paper describes what is being done to deploy PV following disasters, types of training needed, target audiences, available training materials and types of workshops being conducted. The success of these efforts is demonstrated by the growing number of requests for workshops from local and international entities.

1. PROGRAM START

On August 24, 1992, Hurricane Andrew struck south Dade County, Florida with winds over 120 mph. The storm damaged over 85,000 buildings and more than 200,000 people were left homeless. Fifty-one deaths were attributed to the storm. People were without electrical service, functional water and sewage systems and means of communication for several weeks. Emergency response organizations provided life support resources such as food, shelter and medical services to victims. Many of these resources required electrical energy to preserve food, communicate, provide health care and improve human comfort.



Figure 1: Temporary PV powered medical clinic in Dade County after Hurricane Andrew.

Typically, disaster organizations have depended on gasoline and diesel generators to provide electricity. In fact, the broad scale need for electricity in Dade County resulted in over 8,000 generators being used during

recovery. Before Andrew, there had been limited use of photovoltaics in disaster relief efforts. However, a few energy research organizations and industry members had previously introduced photovoltaics following disasters. The University of Miami Field Epidemiology Survey Team had prior experience with PV in their work with developing countries. FEST was one of many organizations responding after Andrew, and one of the few requesting assistance from the Florida Solar Energy Center and Sandia National Laboratories. Teaming together, photovoltaic systems were installed to power four temporary medical clinics in the devastated area. The clear need for viable applications of PV use in disasters and the near void of related educational resources prompted FSEC to develop an education program with the National Renewable Energy Laboratory (NREL), Sandia National Laboratories and the Florida Energy Office (FEO).

2. DISASTER-RELATED ORGANIZATIONS

Over the years, an effective disaster response program has been developed by government and private organizations. Laws define the government's response to disasters and hazardous incidents through an "all hazards" management approach designed to prevent damage and save lives. Disaster relief organizations, volunteer associations and industry work closely together with all levels of government to respond to and mitigate the effects of disasters.

Local government is the management authority over a disaster or hazard and provides initial response. They manage all types of hazards and disasters and have responsibility for creating disaster plans and providing the primary resources for public protection. Police, fire, transportation, municipal facilities, sanitation, schools and other municipal services and resources are typically provided and controlled by local government.

State government provides and maintains a comprehensive emergency management plan, various disaster programs and resources to assist local government with preparedness and recovery activities. The state is the pivotal point between policy guidance and resources available at the federal level and the implementation of comprehensive emergency management programs at the local level. The state also coordinates activities involving more than one community.

In the present disaster response structure, federal government provides guidance and assistance to state and local governments when state and local resources

are insufficient. The structure is defined in the Federal Response Plan (FRP) which defines the system for the overall delivery of federal assistance. The Federal Emergency Management Agency (FEMA) is the lead organization, under the authority of the President of the United States, that provides direction for mitigation, preparedness, response and recovery support from the various federal departments and agencies. Most federal assistance is in the form of financial loans and grants to individuals, businesses and communities, which become available after a disaster.

Private social organizations such as churches, clubs, associations, and foundations comprise what is called "Voluntary Organizations." These organizations respond to a disaster as volunteers, coordinating with each other and with government officials, whether or not there is a presidential declaration. They bring individual expertise and resources to the disaster and supply personnel needed to meet a community's disaster needs in all phases of emergency management. They maintain and provide their own supplies and equipment for relief efforts and administer their own programs. Feeding stations, clothing, shelters, cleaning and comfort kits, first aid, blood, supplementary medical care, childcare, social services and other resources are available from these organizations. Many of the organizations supporting disaster relief efforts are members of the National Voluntary Organizations Active in Disasters (VOAD). VOAD members coordinate efforts with government and fellow member organizations.

3. DISASTER PROGRAMS

The heart of this effort is the Comprehensive Emergency Management Plan (CEMP) prepared and maintained by local and state governments. The plan specifies how citizens and property will be protected and how basic human needs will be met in a disaster. The CEMP describes actions that are required related to any natural disaster or technological hazard, including tasks to be carried out by specific organizations, administrations and authorities. Definition of responsibilities, logistics activities, operating procedures and resources are described in the plan. The plan organizes teams of experienced emergency personnel from government agencies, voluntary organizations, industry and utilities to resolve emergency situations.

Short-term recovery or response activities involve

temporary measures to restore essential services, provide immediate life support and restart the community. Next, long-term recovery activities commence to rebuild the community and provide greater safety for the future. Finally, mitigation efforts are incorporated to lessen the impact of the next disaster. Mutual Aid Agreements and Memoranda of Understanding provide means for local and state governments to request disaster response and recovery assistance from other local and state governments, disaster relief organizations and businesses to draw upon a common pool of resources.

The Federal Disaster Relief Act established the philosophy of a plan to supplement the efforts and resources of local and state governments and defines the mitigation, preparedness, response and recovery activities that would be supported on a cost share basis. FEMA administers the Federal Response Plan to coordinate the federal government's response and describes the mechanisms to provide recovery support and guidance to local and state governments.

The plan provides responder support from government agencies and departments in service areas called "Emergency Support Functions" (ESF). The plan relies on the resources and expertise of 27 federal agencies and departments and has responded to less than 1 percent of all disasters.

The country has Regional Operations Centers (ROCs) that function as initial coordination organizations for federal activities. The president may activate an Emergency Response Team (ERT) composed of various agencies and departments from a Disaster Field Office (DFO) to coordinate overall federal activities affecting State and local government ESFs. Also, Emergency Support Team (EST) may be activated to coordinate and support the federal response by serving as an information source and by coordinating needed resources.

Each organization has its particular function during a disaster. Each performs the activities and tasks to which it is committed and operates as defined in its emergency plan. Each organization maintains its own resource list, providing the type and quantity of equipment available, including electrical generators if necessary. Individually, no organization can broadly support needs during and after a disaster, but as a team they have requisite resources and capabilities.

4. PRESENT DISASTER TRAINING PROGRAMS

The government and disaster relief organizations have developed various educational programs. FEMA operates the Emergency Management Institute (EMI) for training FEMA personnel, first responders, emergency managers and members of disaster relief organizations. FEMA training is completed in-house, or through independent study courses, or web-based training or by some State emergency management offices. Courses cover a broad range of topics, including "Emergency Program Manager Orientation," "Animals in Disasters," "The Role of Voluntary Agencies," "Mitigation for Homeowners" and "Emergency Response to Terrorism." There is also an educational program produced by FEMA and the American Red Cross for children to learn about and cope with disasters.

Presently, FEMA does not have a training course for dealing with energy or electricity. There are references to energy in the Federal Emergency Plan for the section on ESF-12 on energy, in the Community Emergency Response Team training manual and a few other First Responder training manuals. These documents usually address policy and inform the reader to let the local utility handle problems. Or the reader may be directed to call a gasoline or diesel generator contractor or to simply keep his/her distance for safety reasons. Recently, DOE and FEMA developed a guide to be used as a model for incorporating renewable energy into emergency plans. This guide addresses renewable energy at a high level but does not specify operations or types of equipment.

Training conducted by disaster relief organizations is mostly focused on recruiting new members or on training their volunteers on how to perform assigned tasks. Because disaster relief organizations are mostly humanitarian organizations, their training provides information on dealing with basic human needs for food, health care, shelter and mental health. Training is conducted in-house, at meetings or at regional workshops.

5. USE OF PV IN DISASTERS

Almost every disaster produces a need for electricity, as our modern lifestyle depends on it. Emergency management and disaster relief organizations perform a variety of services and operate a vast supply of equipment that requires electricity in order to accomplish their missions. Some organizations are

completely self-sufficient and provide their own means of electricity, while others depend on members of the Emergency Support Function ESF-12. The American Red Cross operates shelters that are dependent on utility power. Amateur radio operators are mobile and carry their own source of power. Whatever the need, PV-powered systems and equipment can be applied in a meaningful way. Fast and focused deployment of equipment is needed following a disaster. Ready-to-use, stand-alone systems designed for individual applications are most effective for response and recovery.

One of the first uses of PV in a disaster was in 1989, when portable PV power systems were used to power lights, fans and communications following Hurricane Hugo. In 1997, FSEC and SNL worked with the PV industry to develop six new PV systems specifically designed to support disaster operations. Since the 9-11 attack, PV is being used to fight terrorism by powering monitoring equipment.

Because of their sustainable, stand-alone operations, PV systems provide a natural energy solution where power will likely be out for an extended time and over a large geographic area. Some needs, like powering communications and medical clinics, require quiet, non-polluting operation. Solar energy is a cost effective resource for small portable and stand-alone applications due to lower operation costs than gasoline or diesel generators. Portable PV systems range from 1 watt to 500 watts. Mobile units can also be reasonably cost effective and range from 200 watts to 2,000 watts.

The new approach for dealing with community preparedness is to create disaster-resistant buildings designed to withstand disasters. If a building is still standing after a disaster, a previously installed PV system should still be operational and the building functional. This will reduce damage, recovery time and costs. Building-integrated PV systems range from 500 watts to 6,000 watts for homes and up to 50,000 watts for commercial buildings.

6. PRESENT PV TRAINING

FSEC and several other organizations conduct training on renewable and solar energy, both photovoltaic and thermal. PV training generally covers design, installation, applications and codes. FSEC has developed three workshops that focus on applying PV to disasters and are 4 to 12 hours in length. Two of the workshops also address information on solar cooking,

solar hot water, biomass and other renewables as technologies that can be used in a disaster. Several workshops are conducted each year at FSEC, as well as around the country and in the Caribbean.

TABLE 1: TOPICS COVERED IN THE WORKSHOPS

- Effects of different disasters
- Energy needs analysis
- Emergency management plans and operations
- How PV works
- How other renewables work
- What's been done before
- Maintenance and reliability
- Disaster resistant communities
- How to fit PV into your needs and operations
- Sources of information and resources
- Hands-on equipment demonstrations

Since 1992, over 15 research studies, professional papers and educational documents have been published by FSEC. The booklet, "Photovoltaic Applications for Disaster Relief," was the first comprehensive overview of the subject supported by NREL. Workshops use the training manual "Emergency Power Systems with Photovoltaic" which covers the topics listed in Table 1. Also, many newspaper and magazine articles have been published to reach the general public.



Figure 2: Workshop attendees discussing operation of PV equipment

In 1997, a workshop was developed from an electric needs analysis conducted with emergency management and disaster relief organizations and supported by SNL. Since then, FEO has supported the enhancement and expansion of the workshop to include renewable energy and emergency plans. Emergency management plans are reviewed in order to help with implementation of

PV into the various organizations' daily operations. The workshops are evaluated for their effectiveness in meeting attendees' needs. This evaluation process has prompted the addition of topics on energy security and terrorism.

7. WHO NEEDS TRAINING?

Everyone needs training on preparedness. The general public needs to be ready and prepared for emergencies and can benefit in understanding how PV can be used in the home. Businesses need continuity plans that provide for sustained operations. Emergency management personnel and members of disaster relief organizations need specific information and experience to use energy sources effectively. Circumstances are unique – whether personal, commercial or public; PV can often be used very effectively to restore and maintain basic operations following a disaster for selected applications. Education brings awareness and experience brings usefulness. The need for that education is the foundation and purpose for the workshops in order to use PV in viable applications.

8. CONCLUSION

Experience has shown that photovoltaics can be used effectively to supply electrical power during emergencies. Training is needed to provide the education for potential users to determine which applications and under what conditions is it the preferred alternative. The key obstacles to using PV in disasters are:

- The PV industry lacks sufficient understanding of the specific needs of emergency response teams and the conditions under which they operate.
- Emergency management and disaster relief organizations lack an understanding of photovoltaic technology and the conditions under which it offers advantages over conventional equipment.

While photovoltaics have been commercially available for over 30 years, disaster-related organizations have not embraced the technology as some markets have. Many of the same handicaps PV faces in the energy and electricity marketplace exist in the disaster marketplace. If the PV industry and disaster-related organizations lack proper understanding then education and experience are essential. Many organizations have

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become aware of PV technology, but do not have the hands-on experience with PV that they possess with generators. The volunteer nature of these organizations and diversity of their administrations add to the difficulty of introducing a new technology. This change lacks government support in favor of what has always been done before. Emergency plans need to be updated to address renewables.

Conventional education and information dissemination approaches are probably not sufficient to spur widespread application of PV for disaster relief. FSEC and SNL completed a small joint design and demonstration project with several disaster organizations and the PV industry. The organizations found the equipment valuable, but lacked funding to purchase more. Funding flows in times of emergencies but PV equipment is not available in mass numbers at that time. In times of emergencies, these organizations go with what they know and have. How do these organizations gain the knowledge and experience they need to accept PV in their operations under these circumstances?

FSEC's educational program has been in existence for only five years. The program has trained only a few hundred of the several hundred thousand people in these organizations. Also, less than 100 systems are in use to support emergency operations. More time and funding to conduct more training will help bring this marketplace to maturity.

9. REFERENCES

- (1) Young, Jr. William, Photovoltaic Applications for Disaster Relief, FSEC-CR-849-95, Florida Solar Energy Center, Cocoa, FL, March 2001.
- (2) Comprehensive Emergency Management Plan, State of Florida Department of Communities Affairs, Tallahassee, FL, Feb. 1994.
- (3) Emergency Preparedness USA, HS-2, Federal Emergency Management Agency, Emergency Management Institute, Emmitsburg, MD, Sept 1992.
- (4) Moskal, Patrick, Energy Needs During Disasters Workshop Assessment, FSEC-CR-967-97, Florida Solar Energy Center, Cocoa, FL, Oct 1997.
- (5) Young, Jr. William, History of Applying Photovoltaics to Disaster Relief, FSEC-CR-934-97, Florida Solar Energy Center, Cocoa, FL, Jan 1997.
- (6) Young, Jr. William, Ventre, Gerard, and Thomas, Michael, Needs Assessment for Applying Photovoltaics to Disaster Relief, FSEC-CR-935-97, Florida Solar Energy Center, FL, July, 1997.