

Montana firefighters see benefit of PV



DESPITE A NUMBER OF STUDIES FROM ORGANISATIONS LIKE THE US' **CENTER FOR ENERGY AND ENVIRONMENTAL POLICY** AND THE **FLORIDA SOLAR ENERGY CENTER** – FOCUSED ON USING PV FOR EMERGENCY POWER – MOST FEDERAL, STATE, AND LOCAL AGENCIES HAVE NOT INTEGRATED PV INTO DISASTER PLANNING OR EMERGENCY RESPONSE INFRASTRUCTURE. MONTANA IS A NOTABLE EXCEPTION.

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In the aftermath of Hurricanes Katrina and Rita, the use of PV systems to support the Gulf States' disaster response efforts made headlines. With diesel fuel in short supply, solar-powered lights were installed at emergency headquarters, and mobile PV generators were dispatched to support vital infrastructure. These applications show the ability of solar power to maintain critical capabilities during power outages.

While PV can effectively be used to support disaster recovery efforts, it has long been argued that PV systems can also serve as a reliable source of emergency power for buildings. When coupled with a battery, PV systems can be configured to provide an uninterruptible power supply (UPS) to homes, businesses, and Government agencies.

Although the high cost of PV systems remains a barrier to widespread adoption, the economics of PV in an emergency power role are compelling. According to the **Lawrence Berkeley National Laboratory**, the average cost of a one-hour blackout to large commercial

customers is US\$82,000. If PV-powered back-up systems can reduce these costs, the initial expense of the systems can be justified.

During the past 10 years, there have been a number of studies from organisations such as the **Center for Energy and Environmental Policy** and the **Florida Solar Energy Center** that have focused on the value of PV for emergency power. These studies have helped build the case for expanding PV's role in to disaster preparedness and homeland security.

Despite the evidence in favour of PV, however, most Federal, State, and local agencies have not integrated PV into their disaster planning or emergency response infrastructure. There have been a number of small-scale demonstration projects established across the USA, but to date these demonstrations have not been expanded into broader programs.

The one exception to this trend has been the electric service territory within Montana served by **NorthWestern Energy**. NorthWestern Energy has quietly supported solar energy during the past five years, and what makes the

Utility's solar program unique is that a portion of its focus is dedicated to installing PV-based emergency power systems at local fire stations.

Solar energy in Montana

Although Montana is located along the northern border of the USA, its solar resource is superior to that of Germany, which currently leads the world in PV installations. Montana's PV market has grown steadily during the past five years, and the State now boasts over half a MW of grid-connected PV. The majority of these installations are small (i.e. less than 4 kW) systems funded through the *Universal System Benefits (USB)* program.

The USB was created as part of the US State's 1997 restructuring legislation, and is funded through a surcharge of US\$0.001 on each kWh of electricity sold within the State. In 2005, USB revenues totalled approximately US\$9 million, of which US\$1 million was allocated to renewable energy systems.

NorthWestern Energy (formerly Montana Power) reported that there were 560 kW of PV installed within its territory, and that USB funds had been used to install 198 systems totalling 408 kW between 2000 and 2005. Of this, close to 50 kW have been installed on fire stations.

Solar PV for fire stations

There are currently about 363 fire departments across Montana serving a State with the fourth largest land area in the USA, and the third lowest population density. Montana's vast distances and sparse population pose a dual challenge to its firefighters. First, the size of each fire station's service territory can be quite large. Second, the electricity grids connecting

rural areas do not have the redundancy found in high density urban areas, and may experience more power outages due to faults.

In 2003, the **National Center for Appropriate Technology (NCAT)**, a non-profit organisation based in the State, applied for USB funding to provide PV-based emergency power systems to 6 of the State's fire stations. In response to NCAT's application, NorthWestern Energy agreed to fund the full cost of the PV systems, the storage batteries, and the installation for all 6 stations.

In 2004 and 2005, NorthWestern Energy sought to replicate the success of NCAT's initiative by dedicating a portion of the annual USB funding for PV-based emergency power systems – to fire stations. The Utility issued requests for proposals in both years, for fire stations to host USB-funded PV systems. At least 6 fire stations were successfully outfitted with PV-emergency power systems both years. To date, 20 PV solar systems totalling 47.5 kW of capacity have been installed on fire stations within NorthWestern Energy's Montana service territory. These installations serve 5% of the State's fire stations and represent 8% of total PV capacity. While the majority of Montana's fire stations have not yet been equipped with PV systems, the PV-emergency power program is unique in the USA.

System configuration and cost

Based on the emergency power needs of the typical rural Montana fire station, each PV system was installed with two to three kW of capacity. The PV arrays were installed either on the roofs of firehouses or on fixed, free-standing poles close to the stations. In typical grid-connected fashion, the DC electricity from the PV modules is converted to standard 110/120 Volt AC power by an inverter. The interconnection to the electricity grid



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allows power to flow from the Utility at times of low PV output, and back to the distribution grid during periods of high output under Montana's net metering regulations. When the Utility grid experiences an outage, the PV-UPS system disconnects from the grid and provides dedicated power to the fire station's critical loads.

The total cost of installation for each of Montana's fire station PV-backup systems ranges from US\$11.00-US\$12.00 per Watt, while the average installed cost of a standard grid-connect PV system in Montana ranges between \$8.00-\$8.50 per watt. The additional cost for the emergency systems is primarily attributable to the battery storage systems. The battery banks typically consist of eight sealed absorbed glass mat (AGM) batteries per system. Each battery weighs approximately 155 lbs and the combined system provides a total storage capacity of 23 kWh. Depending on whether a power outage occurs when PV power is available, the fire station systems can supply up to 25-35 kWh of electricity.

Experience to date

Although it is hard to quantify the benefits of adding back-up power to first responder infrastructure, fire stations with installed PV systems report they have been glad to have them. While some of the stations had small diesel or natural gas generators, other stations had no emergency back-up systems prior to the PV installations. The PV-backup systems now provide power to vital loads such as the communication radios, lights, and garage door openers. Back-up power for these systems minimises deployment times and improves the coordination of emergency response during electricity failure.

Anecdotally, Montana fire stations have experienced excellent PV system performance. Installers report that during three years of operation, no significant problems have been reported and only minor preventative maintenance has been performed. Moreover, the systems have kept fire stations operational during blackouts. On 4-5 October 2005, record early-season snowfall caused power outages and line faults throughout south eastern Montana. Billings, which is the State's most populous city, was one of the areas that experienced weather-related blackouts.

In order to deal with the flood of over 250 emergency calls that occurred during just the first hours of the outage, the Billings Fire Department recalled two crews of off-duty firefighters. One of the critical first responder stations, Billings Firehouse #6, lost power during the storm, but maintained continuous operations with the help of its PV-backup system. According to Billings firefighter Alan Lohof, firefighters who were sceptical about the recently installed

system's value were "surprised and convinced" that day: "Many firefighters have been impressed with how it [the PV system] works, and were tickled pink that they had power when the surrounding area was dark...[also] we didn't have to worry about a loud generator running for 24 hours."

Billings fire officials have also pointed out that the benefits of the PV systems go beyond emergency power. Frank Odermann, Fire Marshal in Billings, has noted that the PV systems "provide great benefits for both public safety and public relations," while Lohof noted that "PV has increased energy awareness and energy efficiency concern amongst the firefighters at stations with the systems installed. The guys are better about turning off the lights and TV because they know it wastes electricity."

Next steps

Although Montana's fire station program has only been in place a few years, early data suggests that the program has been a success. The PV systems have provided for quicker emergency response during power failures, reduced tax payer expenditures for fire department power bills, and demonstrated that clean energy can be integrated into emergency planning.

NorthWestern Energy is discontinuing its dedicated fire station funding, but hopes that the critical mass established during the last three years will be sufficient to encourage a steady stream of USB applications from first responders in the future.

It remains to be seen whether NorthWestern Energy will be able to maintain momentum for its innovative program. Nevertheless, the program has allowed the State of Montana to play a leadership role in integrating PV into its emergency infrastructure. Of the 25 states that currently have some kind of solar energy rebate in place, only Montana has had funds dedicated to emergency personnel on an ongoing basis.

In the future, Montana's experience could be a valuable case study and model for other States and cities attempting to integrate clean energy into emergency preparedness and homeland security planning.

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