March 3, 2020

Technical Assistance Request

American Made Solar Round 2 SET Prize Competition

Sundial Energy TEAM – Solar Powered Backup Systems for Critical Nodes of Networks

Introduction:
We live in a society that depends upon well-functioning networks, such as power, communications and transportation, staying "up", or on 24/7. Our focus is on the "nodes" of networks, initially, we have narrowed our focus to traffic signals, which are the nodes of the transportation network. Further because of a focus on bicyclist and pedestrian safety during outages, and by taking the "minimal viable product" (MVP) approach, we are specifically designing initial solar backup systems to power pedestrian activated hybrid beacons, or HAWKs during outages. We aim to provide resiliency to these critical nodes of networks.

Requested:

1. From NREL:

Anticipated scope of work: Contingent on access to the environmental testing chamber, and budget, scope is estimated at 40 hours testing of improved battery cabinet, and 20 hours modeling of system, simulating PV input to fully functioning backup power battery cabinet via battery controller to battery bank; a battery system voltage of 48 or 24V DC; output of single phase 120V AC via inverter to a simulated load; monitoring/diagnostics/communications accessible via MATE3 controller mounted in cabinet.
Tasks: To improve the performance of the standard cabinet, to better protect sensitive components inside, three improvements are intended for testing, and modeling of system performance:

1. Insulation of cabinet
2. Thermostatically controlled variable speed fan
3. Improved paint to reflect or absorb thermal radiation. Note: depending upon climate, reflectivity or absorption would be selected for future builds, but initial testing will be of enhanced reflectivity for high temperature performance.

Deliverables: Cabinet performance data measured for different climate zones (USDOE-EERE-PNNL is simpler and has fewer climate zones, than ASHRAE). Performance will be against ambient temperature, to answer the question: will the improved cabinet reduce heat gain to the interior, or be able to shed heat more readily, including from that generated by electrical components in the cabinet?
System modeling will be focused on performance under different temperature and humidity regimes, with an emphasis on effective and even airflow through the cabinet. Battery temperature performance improvement merits particular attention.

2. From Sandia National Labs:

Anticipated scope of work: Full system testing outdoors for an extended period of time. While we are not yet funded for this level of testing, we anticipate that eventually, we will need to have "real world" testing done of the entire system to monitor performance. A focus would be on looking for weaknesses, especially with battery and electronics equipment. While these will be off-the-shelf components, with some performance metrics and certifications already done, system integrated performance has not been tested, nor will be at NREL under the Voucher funds. Seasons chosen for testing would be targeted for extreme periods of head and cold and heat. Intense rainfall and high humidity would also be of interest.
Tasks: Yet be determined by Sundial Energy and Sandia researchers.
Deliverables: Data to be converted into information useable to improve design and functioning of system. Testing should achieve certain requirements for being accepted into the federal Manual of Uniform Traffic Control Devices (MUTCD).

3. From 3rd Parties, such as the Connector Network

Anticipated scope of work: We are searching for a Li ion battery that will be able to withstand very high temperatures inside of the traffic cabinet alongside of roadways. There will only be thermostatically activated fans to move air, with no active air conditioning available. The temperature desired is to be able to safely charge batteries at least at 129deg F. The high end found to-date has been 120-122deg F., operational, with charging limits frequently lower.
Tasks: Find a manufacturer willing to warranty a battery to operate and charge at high temperatures.
Deliverables: Successful sourcing of such a battery. Preferred: US made or assembled batteries.

4. From 3rd Parties, such as the Connector Network with a strong Academic Link

Anticipated scope of work: Our proposed solar-powered backup units will touch, or interact, with three networks (traffic signals, electrical and communications). The backup power units essentially will comprise a fourth network overlaying the prior three networks within a given geography (or defined boundary). Each network will interact, or be affected in some manner by the other(s). The choice of where to place the back-up units should depend upon data. Such selection or placement could be based on the importance, impact, or degree of vulnerability (risk analysis) at a set or sets of nodes (or vertices) of networks, all of which can be informed by data and analytics. Obviously, it will not be possible to backup all the signalized intersections in the US (~300,000) at once, but initial deployments might be selected based upon criteria such as: signals along potential evacuation routes, first-responder priorities, presence of key infrastructure such as hospitals, etc. A pertinent recent example was what happened in N. CA when PG&E had to de-energize the grid to prevent additional wildfires, resulting in almost immediate traffic jams at roadways as signals went out, preventing the orderly evacuation of the populace and hampering first-responders. Investigated with grant funding would be questions related to implications of renewable back-up systems effects on critical nodes of networks, from data generation, database development, data handling, to employing possibly new statistical techniques. Such research could yield significant societal benefits to diminish risk and increase safety by providing data-informed guidance for decision. N
Tasks: Identification of a well respected PI to write a proposal(s) to NSF, with Robert Freitas, Sundial Energy, Inc. as Co-PI, and with participation by a National Lab. *Deliverables:* Submitted proposal to NSF.