FY 2019 Federal Outside DoD Call for Proposals: Topic B9 **January 9, 2018**

Environmental Security Technology Certification Program (ESTCP)

LARGE SCALE ENERGY STORAGE AND MICROGRIDS

OBJECTIVE

The U.S. Department of Defense (DoD) Installation Energy Test Bed seeks innovative approaches to improve energy assurance and resiliency (collectively referred to as energy security) through integration of electric energy storage systems in a microgrid. ESTCP intends to fund multiple projects to assess, demonstrate, and validate the value of integrating large scale energy storage into current and future microgrids at military installations.

Energy storage will be assessed for its ability within a microgrid to provide improved energy security performance as a function of costs relative to an otherwise identical microgrid without energy storage. Storage performance will be measured in terms of the following six key attributes:

- Coverage: kWs of backup power provided
- Availability: number of hours per year for which coverage is available
- Reliability: Level of independent back-ups for reliability (N+1, N+2...)
- Duration: The number of consecutive hours that coverage can be maintained
- Ride-through capability: The fraction of load for which uninterrupted power with appropriate power quality can be provided
- Stacked-value: The combination of revenue and savings and any avoided costs associated with the capital and operations cost of the microgrid.

Cost will be assessed in terms of net life cycle costs over a 20 year period including installation, maintenance, and replacement, as necessary, of the storage system; changes to the facility's electricity bills; and market participation revenues. The cost and energy security performance contributions of energy storage will be calculated relative to a diesel generation only based microgrid configuration with on-site solar generation. A description of the conceptual diesel based microgrid can be found in Appendix A below.

Projects will be executed in two phases.

- Phase I - design and modeling: Organizations must develop a conceptual design and operational model for the use of the proposed large-scale energy storage. Detailed modeling is required to assess system technical and financial outcomes. The designs and modeling will be targeted to realistic conditions found on a selection of installations in various climate zones and energy markets. For the purposes of estimating the level of effort, proposers should plan to model six unique installations or scenarios. Phase I work is anticipated to begin in Summer 2018 and be completed by March 2019.
- Phase II – technology demonstration and validation: A subset of modeled systems will be selected to demonstrate promising technology components and systems at a few of

the sites that served as the representative military installations in Phase I. Phase II proposals will be requested in the spring of 2019.

Pre-proposals are requested for Phase I only. The pre-proposals shall follow the general instructions provided on the ESTCP website and should consider the following information:

- In the Technology Description section, proposers should provide information on their proposed storage system [hardware (including balance of plant), software, as well as market participating control technologies, assumptions on operations and maintenance requirements, replacement cycles, operational constraints to fully utilizing the presented system].
- In the Technical Approach section, the proposed approach for designing and modeling the system's cost and performance should be described. No demonstration plan will be required for Phase I efforts. Discussion on technical risks and maturity should refer to issues associated with a potential future Phase II demonstration at a military installation.
- In the Expected Benefits section a qualitative and semi-quantitative description of the advantages in terms of all the key attributes should be provided for a typical installation. If the stacked value changes due to market conditions, information on the expected value as a function of electricity markets should be provided.
- Project costs should be estimated for all the installations to be studied in Phase I.
- The Technology Transfer plan should discuss actions that would be taken during Phase II. These activities should not be costed in the Phase I proposal.

Those proposers who are requested to submit full proposals will be provided sufficient information to develop a detailed cost proposal for the design and modeling portion of the project. No direct interaction will take place with the individual military installations during Phase I. At a minimum, the following information for each installation will be provided for that Phase:

- Various pricing details on the local electricity markets
- Total hourly (8760 hours) load on the portion of the installation covered by the microgrid
- Critical portion of the total load
- Load requiring ride-through capability (provided by UPS in default microgrid case)
- On site solar generation capacity

In addition, minimum performance requirements for coverage, availability, reliability, and durations for two scenarios for each installation will be defined. Those projects funded will be provided detailed cost and performance information for the diesel generation only based microgrids that serves as the baseline.

BACKGROUND

DoD is the largest single consumer of energy in the United States. Energy is the lifeblood of military installations. Just as the Armed Forces rely on petroleum to drive ships, fly aircraft, and support troops in combat zones, they depend on electricity to power fixed installations. The military's use of installation energy entails risks as well as costs. Installations are dependent on a commercial grid that is vulnerable to disruption due to aging infrastructure, severe weather, and physical- and cyber-attacks. Major power outages are growing in number and severity in the United States, and military bases often experience increased frequency and longer duration outages than typical utility customers because many bases are located in outlying areas.

There is growing concern whether military bases can maintain critical functions during outages that last for days or weeks, as opposed to hours. DoD is actively pursuing the deployment of microgrid technologies to provide improved energy security for longer durations. Additional discussion and analysis of microgrids at military installations can be found in the report *Power Begins at Home*[1].

DoD also has been working with the private sector to develop renewable generation assets on military installations. The Services' goal has been to reduce their utility costs and meet their respective goals to produce or procure 1 gigawatt (GW) of renewable energy. Most of their sources of renewable energy (commonly solar and wind) are intermittent. Although of value to improving energy security in some circumstances, they cannot be relied on as a backbone of an energy security solution in the absence of energy storage. Given DoD's energy security requirements, its plans to deploy microgrids, and its existing and planned deployment of renewables, the potential to use energy storage to provide a better and more cost-effective energy security solution is significant. The research and demonstrations supported by this announcement will help DoD isolate under what conditions energy storage systems can cost-effectively and materially enhance energy security within military microgrids.

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[1] https://noblis.org/wp-content/uploads/2017/11/Power-Begins-at-Home-Noblis-Website-Version-15.pdf

APPENDIX A - LARGE SCALE ENERGY STORAGE AND MICROGRIDS

The cost and performance of all proposed energy storage systems will be calculated relative to a baseline diesel generation microgrid configuration linked to on-site solar generation without energy storage. Although DoD has long relied on and today predominately depends on standalone generators to provide emergency backup power for critical loads, DoD is currently looking at microgrid systems for the future. Thus to assess the value of energy storage it is important to directly compare a microgrid's cost and performance with and without an energy storage system. The following description is developed from material taken from the report *Power Begins at Home*[1].

Baseline Microgrid

A microgrid is a local system of distributed energy resources (DERs) and electrical loads that can operate as a single entity either in parallel to the commercial grid or independently ("island" mode). Figure 1 illustrates a very simple microgrid, which relies solely on large diesel generators for backup power.

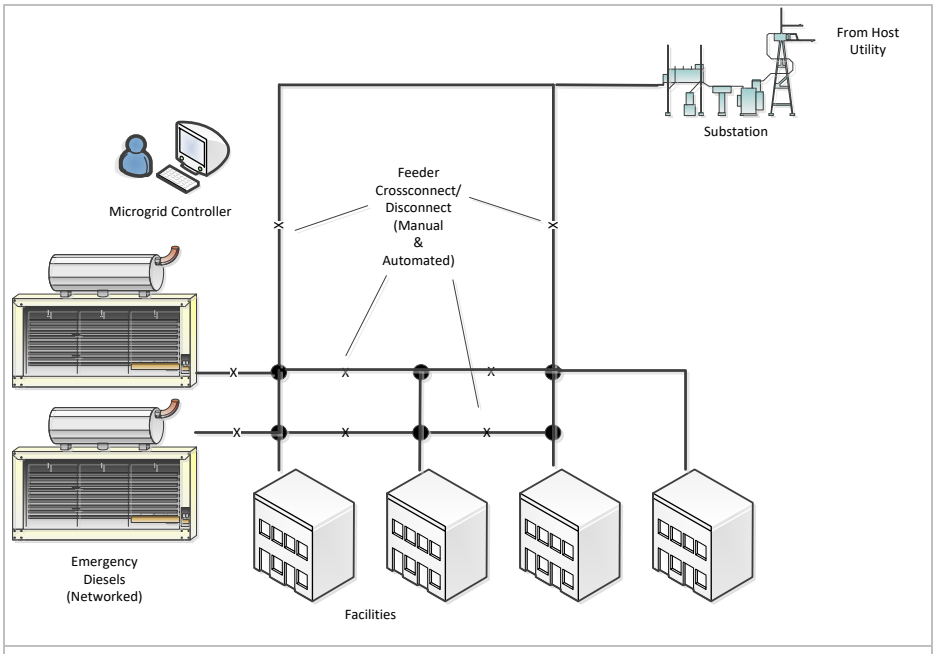

Figure 1. Microgrid with Larger Networked Generators

For its primary DER, the baseline microgrid will rely on a set of large (2,000 kW) diesel generators. Each generator will have a heat rate of 10,618 BTU/kWh. The number of generators will be sized to cover the installation's total peak critical load and configured to provide N+1 reliability. The cost of the diesel generators will reflect the all-in capital cost of installing new 2,000 kW diesel generators fully capable of being networked into a microgrid, operable in islanded or parallel mode within the microgrid, and with the physical configuration and permits allowing the generation units to participate as dispatchable assets in electricity markets. Thus, the baseline microgrid will support peak shaving and limited participation in local electricity markets, where available, while grid-connected. Additionally, the annual O&M cost for maintaining and testing the generators will be calculated.

For each installation an assumed level of installed solar power generation will be provided. For intermittent renewable energy such as solar to meet mission critical needs, it will need to be supplemented by stored energy. Even without storage, however, a microgrid can perform better if it can take advantage of renewable energy. One measure of performance is the duration of the backup power available to an installation. The addition of renewables (without storage) can also extend the scale of backup power provided by a microgrid. These increases in performances will be calculated for the baseline microgrid for each installation.

It will be assumed that for the portion of the critical load that requires ride through capability, standard large scale Uninterruptable Power Systems (UPS) are in use. Their cost will also be calculated for each installation.