PHOTOVOLTAIC BUILDING INTEGRATED MICRO-INVERTERS: DE-PS26-05NT42396-07

ESTIMATED FUNDS AVAILABLE: $250K

ESTIMATED NUMBER OF PROJECTS: 2

FUNDING CEILING: $100K - $150K

COST SHARE: 50% cost share is encouraged. Federal and cost-shared funds may only be used for the development and deployment of solar technologies as part of the awarded project.

BACKGROUND AND OBJECTIVES: The U.S. Department of Energy (DOE) works to provide clean, reliable, affordable solar electricity for the nation through its research programs in photovoltaic (PV) energy systems. Photovoltaic technology makes use of the abundant energy in the sun, and it has little impact on our environment. Photovoltaics can be used in a wide range of products, from small consumer items to large commercial solar electric systems. DOE's goal is to ensure that photovoltaic energy systems make an important contribution to the energy needs of our nation and the world.

Photovoltaic R&D efforts by the Department of Energy address a broad spectrum of issues—from improving materials and deposition to developing manufacturing processes to testing and engineering PV systems for various uses and locales. These efforts are divided into three development stages for PV materials, components, and systems:

- Fundamental Research
- Advanced Materials and Devices
- Technology Development

Most of the activities in Fundamental Research and in Advanced Materials and Devices seek to improve PV modules, thus leading to lower production costs. Activities in Technology Development mainly consist of engineering and reliability of systems and of developing balance-of-system components.

Innovative micro inverters are a first step toward plug-and-play commercialization of AC Photovoltaic products where the fully integrated PV modules/inverters provide ac power to utility connected or mini-utility loads. These inverters must be rugged, able to withstand brutal environments associated with rooftops, and must have long lifetimes.

PROJECTS REQUESTED/TECHNICAL AREA OF INTEREST: The Department is interested in applications to perform necessary measurements determining the range of environmental conditions that must be considered for several package concepts. This includes an absolute temperature that considers heat produced by the electronics of various configurations along with ambient conditions found in the application. Simulations may be used to adjust the power dissipation commensurate with an inverter or multiple inverters. Known failure mechanisms associated with the proposed inverter topology are to be assessed. Those mechanisms are to include selected material compatibilities, known and suspected physical processes, thermal expansion/contraction, component lifetimes dependent upon temperatures or temperature variations experienced by the devices, corrosion resistance, and likelihood of a 25 year system lifetime. The advantages and disadvantages of the proposed inverter topology relative to other topologies should be discussed.

Communications required for multiple individually packaged products will be key to instilling confidence that everything is working. An assessment of the required communications, the methodologies, costs, and accessibility is also requested.

EVALUATION CRITERIA:

ENVIRONMENTAL CHARACTERIZATION: Applicants should provide a means to completely and accurately assess the environment in which the inverter will survive and operate. A detailed methodology of measuring inverter parameters, to include heating from inverter losses, should be provided to ensure accurate system lifespans will be determined. **(Weight 40)**

FAILURE MECHANISMS: The application should provide a preliminary assessment of failure mechanisms for the proposed topology. Component lifespans should be considered and discussions should adequately address short lifespan component elimination or minimization of impact on system performance. Failure mechanisms associated with each component, thermal cycling, and corrosion should be adequately addressed. **(Weight 30)**

COMMUNICATIONS: The proposed communications package must be fully assessed, advantages and disadvantages discussed thoroughly, and estimated implementation costs must be provided. **(Weight 20)**

LIFESPAN CRITERIA: The proposal must provide information supporting the likelihood of a 25 year lifespan and an overall successful system design. **(Weight 10)**

SPECIAL REQUIREMENTS: A mean-time-before failure (MTBF) goal must be set for all components. Obviously, the use of lifetime-limited components in the inverter must be eliminated and the construction of the inverter and it’s interconnects must minimize vulnerable solder joints or materials prone to corrosion. The inverter packaging will generally be restricted to fitting within the photovoltaic module frame in a back-mounted rail or directly attached to the module. Fully integrated products must also tie to ac bus bars via enclosed or other approved connectors. The size and layout of the inverter and how it interacts with the PV modules and other interconnects presents obvious constraints on the inverter topology. Communications ranging from simply reporting on the wellness of the integrated system to control and data logging are options, but the status of the overall system is a must. Along with the technical requirements, costs must be carefully considered where cost to reliability functions can influence the approach.