## BREK TECHNICAL ASSISTANCE REQUEST

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One of the biggest challenges facing BREK is high-power testing, specifically the tools and facilities required to conduct full-scale tests. On the hardware side, this requires a 1500 $V_{DC}$ supply and solar array emulator, and a 600 V three-phase AC load that can emulate grid conditions and faults; it is difficult for a startup company to acquire this testing capability and such test facilities would significantly benefit the company.

Our proprietary Composite Converter Architecture incorporates partial-power converter modules having high frequency planar magnetics, low current film capacitors, and low loss, leading to high power density and significantly higher power levels. We have begun testing of a single power converter module and achieved a maximum efficiency of over 99%. Our new prototype consists of three power modules linked together but we are rapidly approaching the 30kW power limits of our building. We are in the initial phase of hardware testing with partial-power converter module under DC and AC conditions. The next phase will involve the complete 250 kW inverter having a 1500 $V_{DC}$ PV input and a three-phase 600$V_{AC}$ output.

Over the course of the Go! phase, we have designed and fabricated a prototype inverter module. This module has achieved >99% efficiency at 27.8kW, however, we are power limited at our facility (<30 kW) and cannot test it at full capacity. Required tests include incrementally bringing the power stage up to full voltage and full power, as well as gate driver control circuitry reliability. For these tests, we plan on a simple open loop control to exercise the hardware, as we expect the firmware to still be in development.

Another challenge is compliance to UL 1741 and IEEE 1547 standards. While the tests described above will help prepare BREK for these certifications, it would be extremely helpful to learn from engineers who have experience with such processes. These certification processes are lengthy and expensive. Therefore it is critical that we apply for certification only after meeting both customer specifications and applicable standards.

Over the next few months BREK hopes to achieve the following:

1. Run the prototype inverter in an open-loop configuration at 125 kW connected to a simulated grid with the goal of closed-loop
2. Design and test our peak power tracker with a solar array simulator and simulated grid.
3. Test the inverter with simulated grid faults to ensure it reacts appropriately and fails safe
4. Power curtailment testing with a solar simulator to ensure the inverter performs at all operating points.

A proposed timeline is presented below (Figure 1).

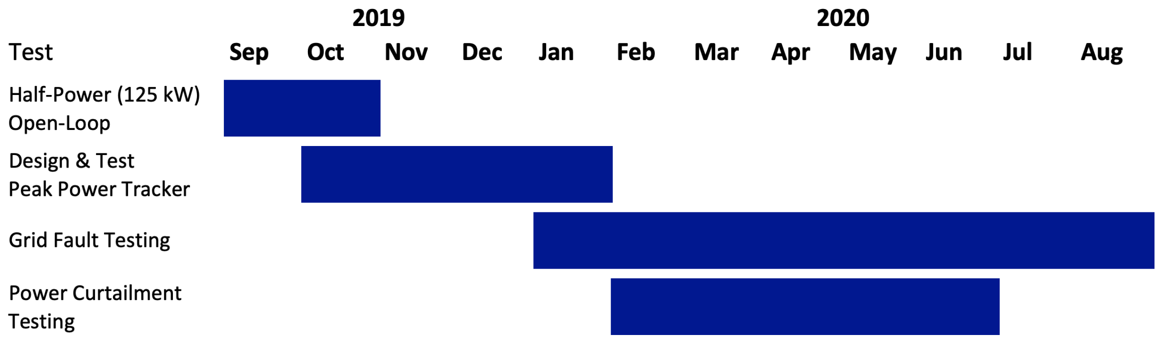


Figure 1. Proposed testing timeline.

Our plan is to continue to use the equipment at the Energy Systems Integration Facility (ESIF) at the National Renewable Energy Lab (NREL). NREL is not only close geographically, but has extensive facilities for solar array simulation and is capable of delivering 1500 $V_{DC}$ at 250 kW with its 1 MW grid simulator, 250 kW bi-directional battery simulator, and 1.5 MW photovoltaic simulator (Figure 2). Furthermore, NREL engineers and scientists have knowledge and experience with the UL and IEEE certification processes. We have already begun working with Dr. Andy Walker, Senor Research Fellow at ESIF, and his team after the Set! phase. NREL has performed a site visit and provided valuable feedback to ensure safe and accurate testing. As a result of their visit, BREK has constructed a hard-guard for high-power tests.

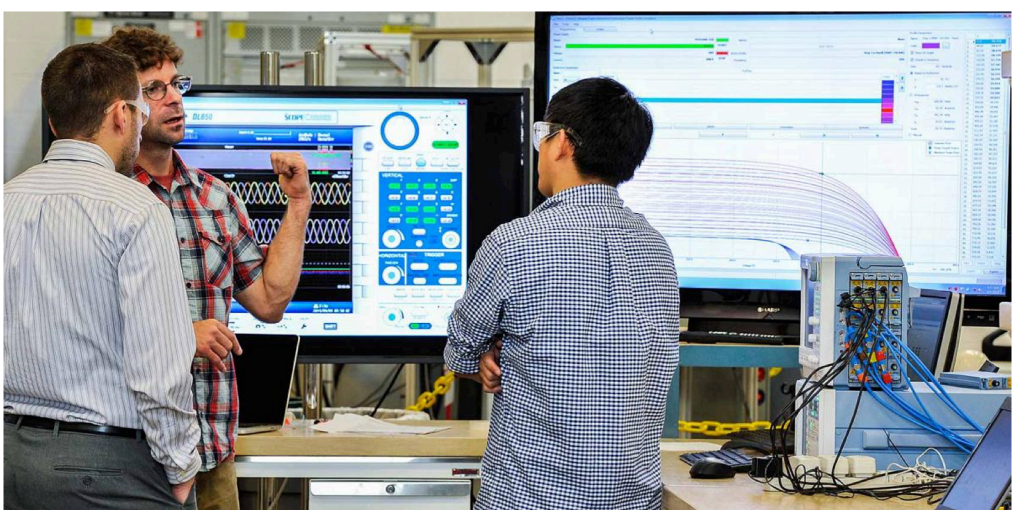

Figure 2. Inside ESIF's Power Systems Integration Laboratory.
(Photo Credit: NREL)