## Overview

### Objective:
- Develop a 150 A (50 kVAR) Active Harmonic Filter (AHF) using interleaved SiC-based inverter
- Peak system efficiency > 98% with switching frequency > 50 kHz
- Four-quadrant operation capability with up to 51th harmonic cancellation and THD < 5%
- Power density > 1 kW/L
- Prepare reference design document with all details and performance
- Skilled WBG technology workforce development
- Provide platform to evaluate fundamental concepts proposed by graduate students

### Method

#### Topology:
- Three-phase SiC inverter with LCL filter
- Each phase consists of three interleaved sub-phases
- Switching frequency: 100 kHz

#### Control Strategy:
- Indirect Current Control with reduction in current sensor requirement and decreased computational burden
- Dynamic current balancing of interleaved sub-phases
- CPU + FPGA based controller (using Xilinx Zynq 7000 System on Module)

#### System Architecture:
- Development of busbar based on “plug-n-play” architecture
- Low inductance local busbar incorporating customized high-current power connectors
- Global busbar for system level interconnection
- Modular voltage and shunt-based current sensor board

## Results

- For same grid inductance and 1% (peak-peak) current ripple injection, interleaved topology needs smaller converter-side inductor (90% volume reduction and 50% power loss reduction), and 87% reduction in DC bus capacitance compared to non-interleaved counterpart
- The LCL filter self-resonance frequency shifts higher (> 3 times) and the effective switching frequency also increases 3 times
- Upper limit of attainable control bandwidth is increased significantly
- Grid-side current has up to 51th harmonic cancellation with <2% THD

## Future Work

- Design of passive components and gate driver
- Controller implementation
- Cooling system design
- Final system assembly and testing

## Potential Impact

- Improved efficiency and power density and reduced cost compared to Si-based solution.
- Utilization of SiC-based power devices for system-level performance improvement.
- Establish viability of SiC-based AHF by providing a benchmark

## Partners

- [NC State University](https://www.ncsu.edu)
- [PowerAmerica](https://poweramerica.org)
- [U.S. Department of Energy](https://energy.gov)