Grid Application Development, Testbed and Analysis for MV SiC (GADTAMS)

NREL, Ohio State Univ., Florida State Univ. Center for Adv. Power Systems, General Atomics, Eaton, Southern California Edison
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Barry Mather Ph.D. - NREL

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Overview

Project Title: Grid Application Development, Testbed, and Analysis for MV SiC (GADTAMS)

Timeline:

Project Start Date: 03/01/2019

Budget Period End Date: 02/28/2020

Project End Date: 02/28/2022

Project Budget and Costs:

Budget	DOE Share	Cost Share	Total	Cost Share %
Overall Budget	$7,500,000	$1,030,000	$8,530,000	13.7%
Approved Budget (BP-1)	$2,500,000	$343,333	$2,843,333	13.7%
Planned Costs for FY19	$1,800,000	$270,000	$2,070,000	15%

Barriers and Challenges:

- Development of a 1 MW MV AC to MV AC grid interconnector (MVB2BC)
- Development of a MW-level controllable grid testbed (including the development of high power, MV power hardware-in-the-loop (PHIL capability)
- Complete grid analysis to determine the value and use cases for the MVB2BC and other MV SiC enabled grid technologies

Project Team and Roles:

- NREL – leads overall project and leads grid analysis and testbed development
- OSU – leads MVB2BC development (10 kV SiC)
- FSU-CAPS – leads PHIL method development and builds ½ MVB2BC
- General Atomics, Eaton – Lead advisors on MVB2BC development and testing
- SCE – Advises on utility uses of MVB2BC

AMO MYPP Connection:

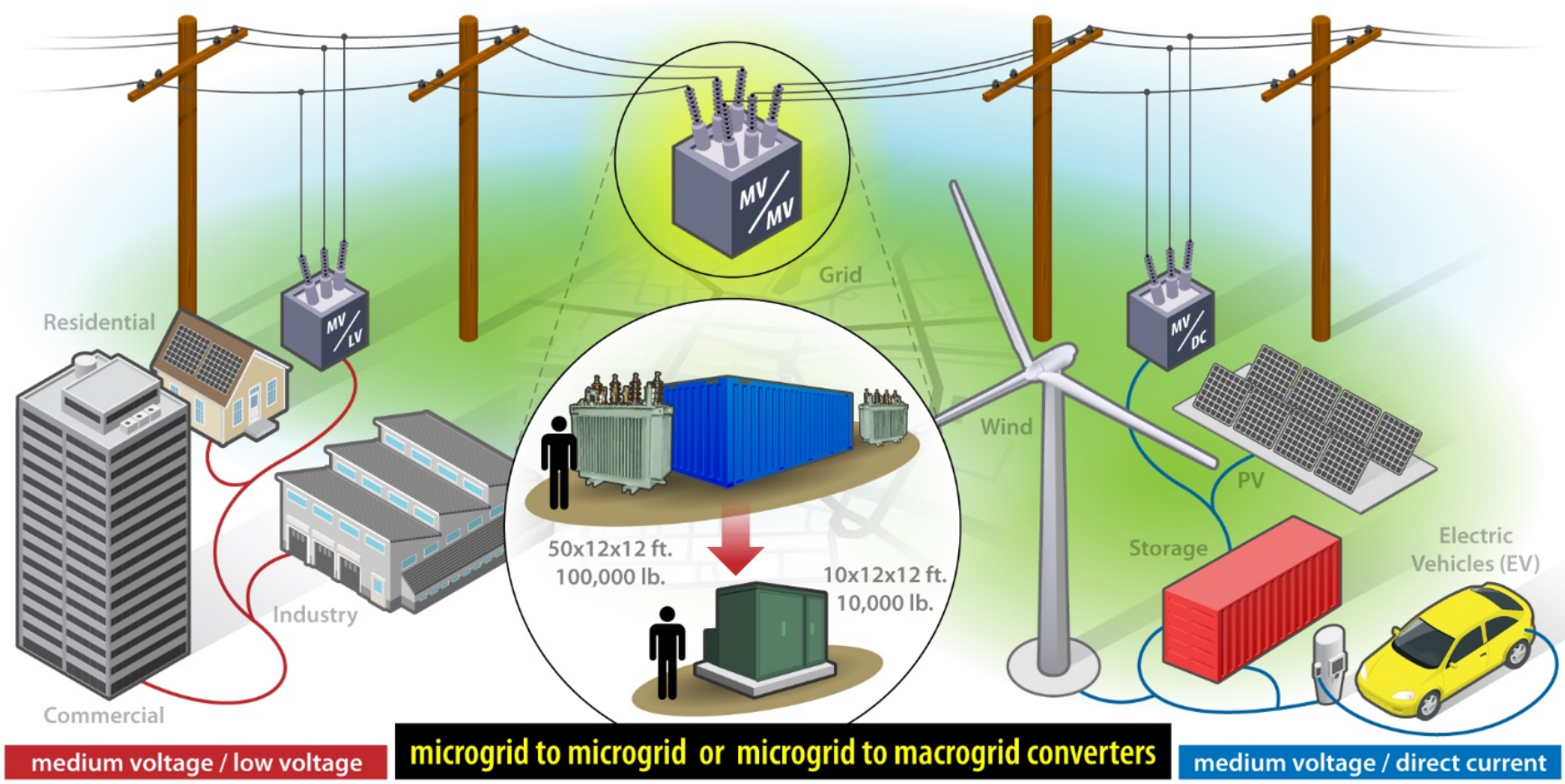
- Broad Goal: Transition DOE supported innovative technologies and practices into U.S. manufacturing capabilities.
- More Specifically:
  - Target 3.1: Reduce volume and weight of targeted power electronic systems by 50% with respect to their silicon based equivalent.
  - Target 3.2: Increase the efficiency of targeted power electronic systems by 2-3% (a reduction in losses of 28%) with respect to their silicon-based equivalents.
- Direct -> Develop a grid application largely enabled by MV SiC which improves grid resiliency while also potentially seeing large-scale, high-volume use.

Project Objective(s)

- Opportunity: The availability of MV SiC (10kV) enables new direct-connect (line frequency transformerless) grid converters along with the need for utility-grade equipment for grid resilience applications (ugrids, in-line processing protection, etc.)
- Objective 1: Develop a prototype 1MW MV AC to MV AC asynchronous grid connector
- Objective 2: Develop a comprehensive testbed for MV grid applications
- Objective 3: Determine the value of future MV SiC enabled grid applications

Technical Innovation

- Proposed Approach:

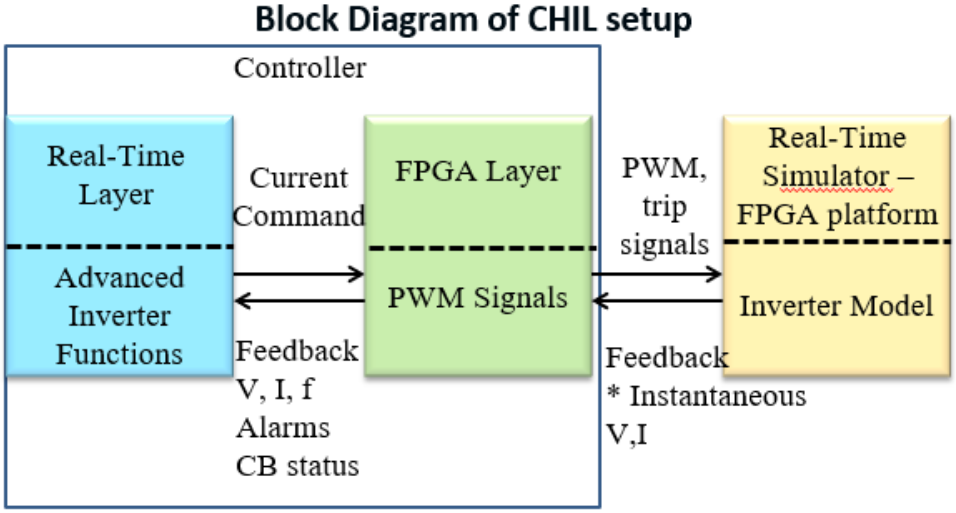


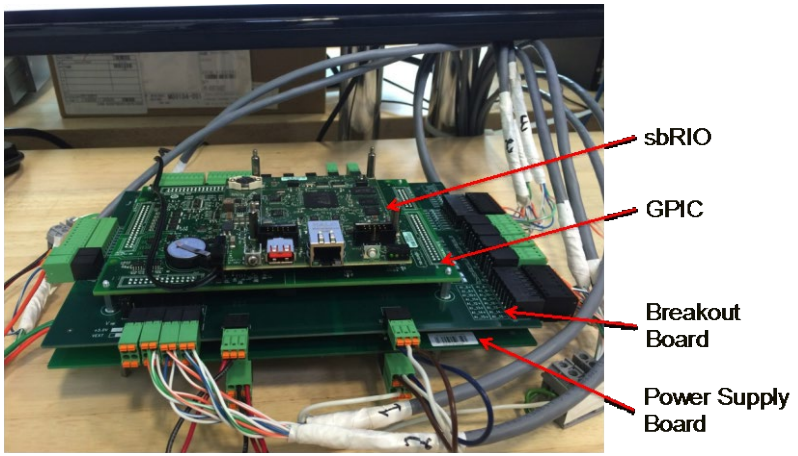
Technical Innovation

- Back-to-back MV AC conversion today entails 60 Hz transformers down to 480-600 V_{ac} then power electronic conversion (system is heavy and expensive)
  - Developing a MVB2BC prototype that will be 1/5 the size and 1/10 the weight with native conversion at MV-levels
- Standards for "grid connectors" are not well defined
  - Developing appropriate grid functionality for the developed prototype to guide future standards and standards testing requirements
- Grid operation on radial feeders is limited, particularly in regions with high-levels of DERs, resulting in hesitation to install more DER and limited flexibility
  - Completing comprehensive analysis of various use cases for the MVB2BC and other SiC enabled grid-connected power electronics to understand potential uses and values of the overall system
- MV power electronics are difficult to test presently
  - Developing IEEE 1547-like evaluation capability using either PHIL or simple lab testing procedures at a native MV level

Technical Approach

- Technical approach for MVB2BC prototype
  - OSU, FSU-CAPS and NREL develop initial design tradeoffs of various topologies/control methods
  - OSU leads 10 kV SiC development of ½ the MVB2BC
  - FSU leads 2.7 kV SiC (due to cost and availability) of other ½ of MVB2BC
  - NREL leads grid connectivity-level control of MVB2BC

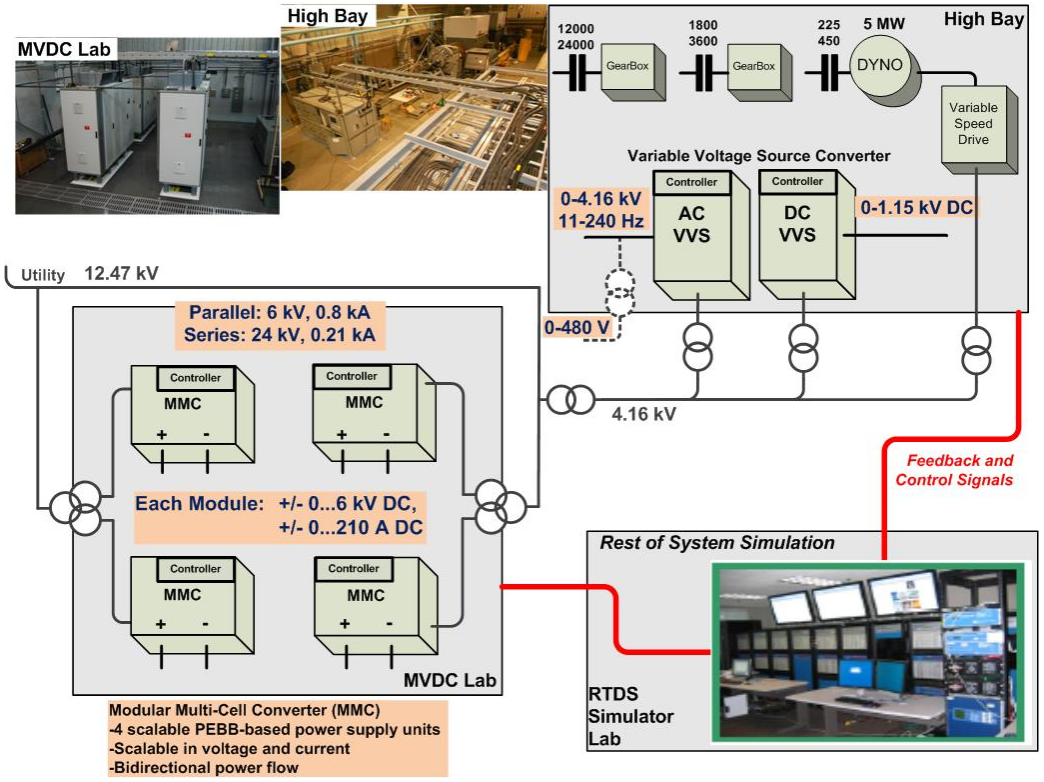




Technical Approach

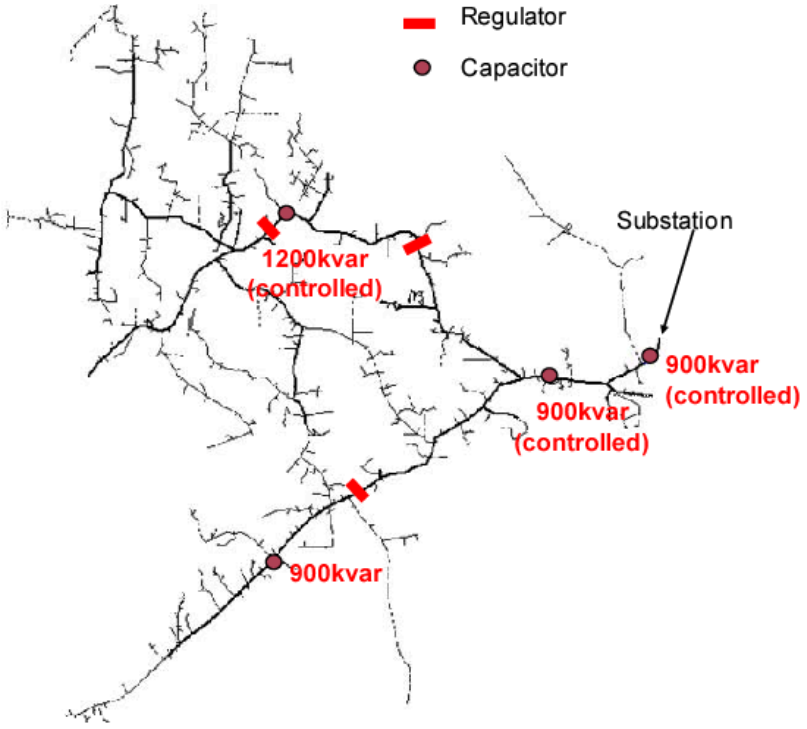
- Technical approach for PHIL Testbed Development
  - FSU-CAPS and NREL develop initial required performance specifications for tests/functionalities
  - Initial prototype tests at FSU-CAPS
  - Final demonstration and test at NREL's ESIF

FSU-CAPS VVS and MMC Capabilities



Technical Approach

- Technical approach for Grid Analysis
  - NREL leads the effort and is starting with quasi-static time-series analysis of distribution systems, protection analysis to follow



Where is the installation of a MVB2BC or SST most advantageous and for what application? What about multiples? Grid operating in emergency scenario? etc…

Results and Accomplishments

- The primary focus thus far has been placing the necessary subcontracts with OSU and FSU-CAPS as they are very significant contributors to the project
- Initial developmental work on the grid analysis portion has also begun
- Working on the procurement of 10kV devices from PowerAmerica's device bank and directly from Wolfspeed

Transition (beyond DOE assistance)

- Potential "1st mover" commercialization partners are part of the project and engaging the in project
- Utility partner, a progressive and likely early demonstrator of the developed technology, is also involved (also consulting on testing requirements for utility acceptance)