Project ID:ELT238 Award No:DE-EE0008450

Intelligent, grid-friendly, modular extreme fast charging system with solid-state DC protection

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Overview

Timeline

- Project Start Date: Oct. 2018
- Project End Date: Dec 2021
- Percent Complete: 5%

Barriers

- Integration to utility at medium voltage
- DC protection
- System siting, integration and deployment

Budget

- Total Project Funding
  - DOE Share: $ 2,675,952
  - Contractor Share: $ 3,323,775
- Funding for 2019
  - DOE Share: $ 1,099,164
  - Contractor Share: $ 1,336,347

Partners

- NCSU/FREEDM – Lead
- ABB
- NYPA

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Relevance

Objectives:

- Develop an extreme fast charging (XFC) station with direct connection to the distribution network
- Demonstrate a improved efficiency and reduced footprint

Project Impact:

- Framework for designing XFC stations to minimize installation and operating costs, manage grid impact, and provide design flexibility
- Field demonstration of novel key enabling technologies for future XFC installations

Key Deliverables:

- Integrated XFC system operational in the field. System will be tested up to 1 MVA loading using a combination of resistive loads and EVs.
- Installation, operation and maintenance guidelines for deployment of XFC infrastructure with proposed unique architecture.

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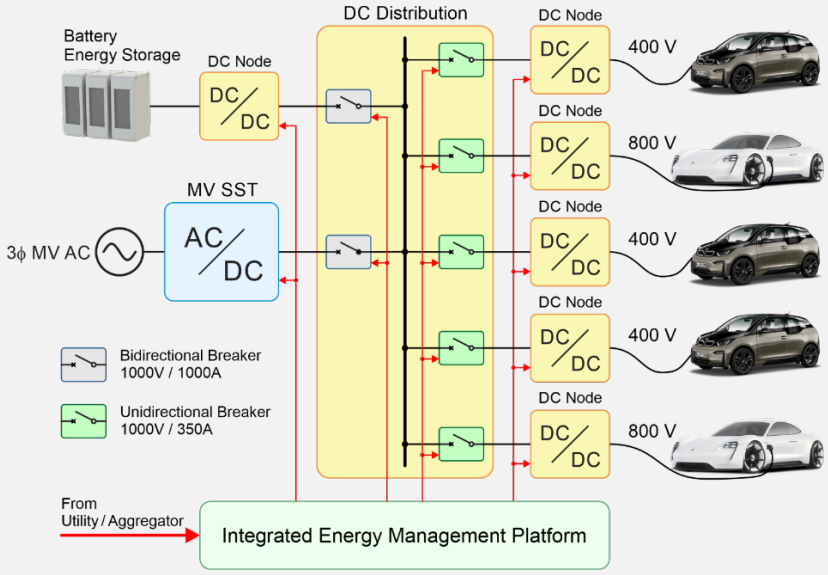
Approach

- Develop 1 MVA medium voltage XFC station with:
  - 1MVA bi-directional MV SST
  - DC distribution network with solid-state DC protection
  - Energy management platform
  - DC Nodes for local isolation and DC/DC conversion
- Deploy XFC system at a NY Power Authority (NYPA) site



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Approach

System Development

BP1

- **Deliver SST & DC node***
- Select site
- SST & DC nodes operational
- Deliver eng. diagrams

10/1/2018 – 12/31/2019

System Integration

BP2

- **Complete system integration ***
- Complete site preparation
- Validate protection
- Safety evaluation

1/1/2020 – 12/31/2020

System Deployment

BP3

- **System Commissioned**
- Use cases tested
- Data collection

1/1/2021 – 12/31/2021

* Denotes Go/No-Go Milestone

BP: Budget Period

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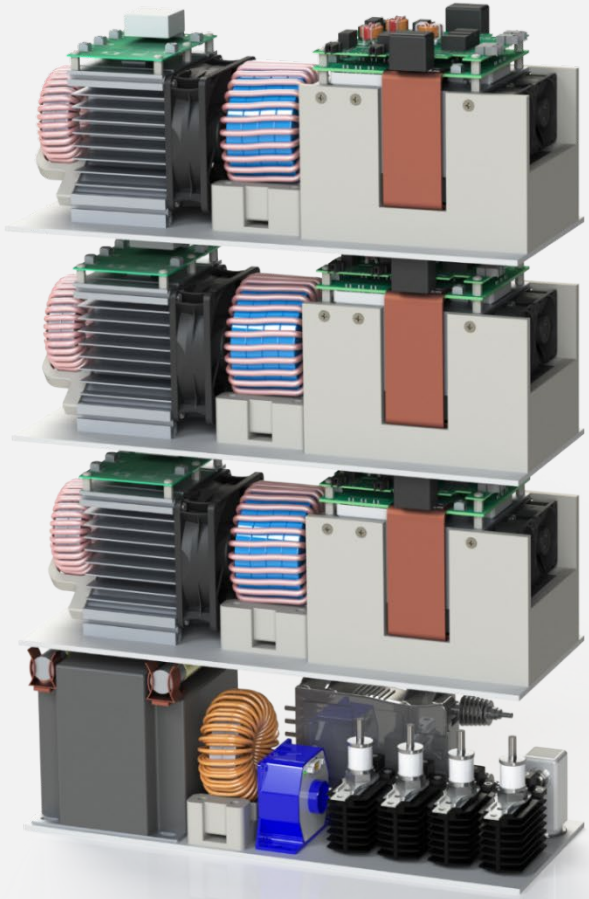
Technical Progress

Building of Significant Team Expertise and Past Success

- NCSU SST development and prototyping, including 50kW MV charger prototype
- ABB has previously developed TRL 5 LVDC breaker rated at 1500 A. ABB will design two variants of the LVDC breaker at 1000 A & 350 A.
- NYPA experience in deploying EV infrastructure through NYS Evolve Program



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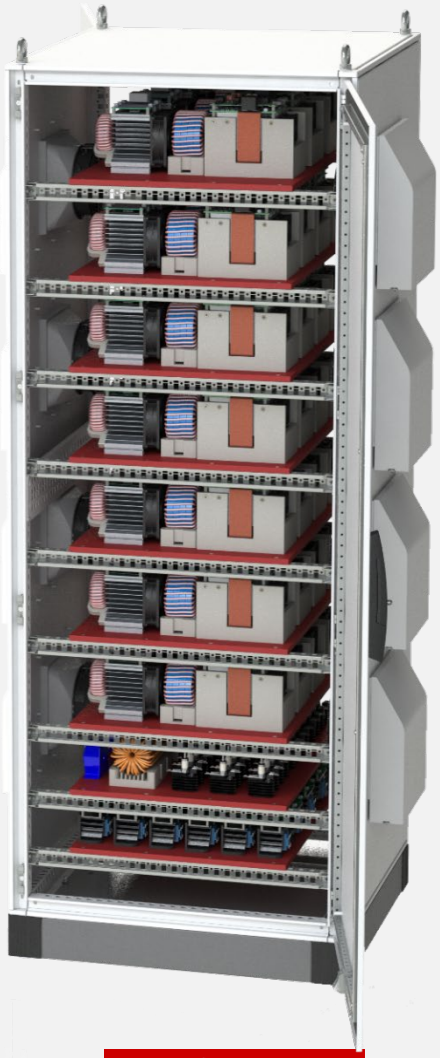
Accomplishments

- Deployment Site Selected
- Initial scaled-down SST prototype under construction
- Leveraging ABB's experience in LVDC marine system to develop EVCI protection coordination
- Leveraging ABB new product line to de-risk DC Node development



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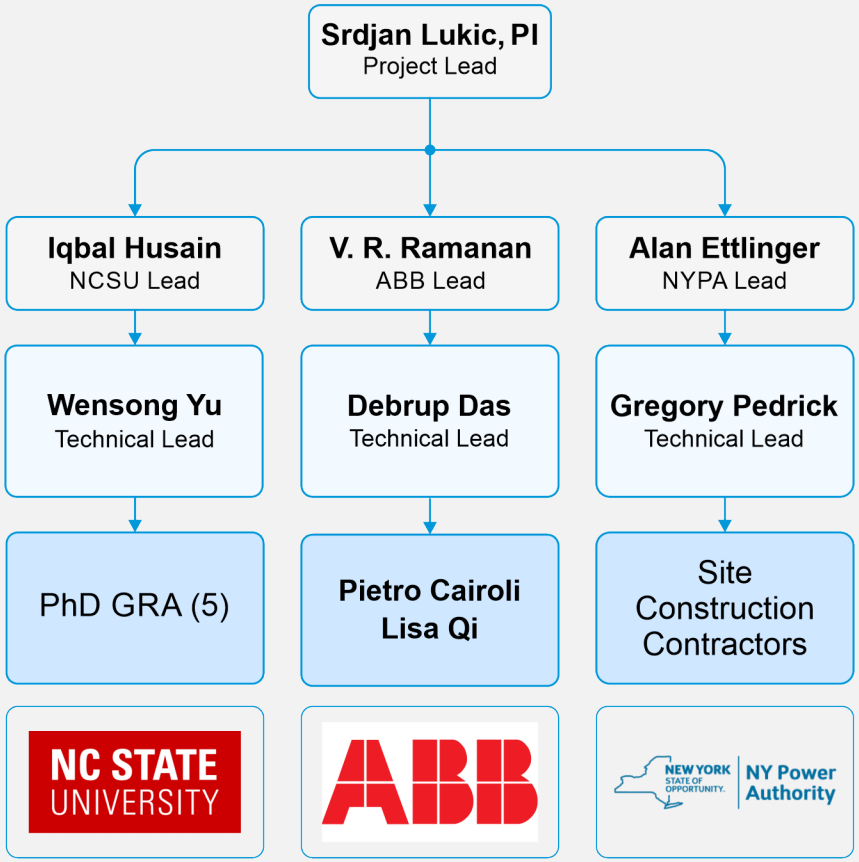
Collaboration and Coordination with Other Institutions

- **NCSU:** SST, DC Node (DC/DC converter) development; XFC system integration.
- **ABB:** development and testing of the solid-state breakers and system protection scheme.
- **NYPA:** system deployment and demonstration.



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Proposed Future Work

Key Challenges

- Design of the SST stage, meeting key safety requirements
- Design and packaging of solid state breaker
- Protection coordination
- Procuring vehicles capable of stressing the charger system

Future Work (BP1)

- Construct and demonstrate SST and DC Nodes
- Demonstrate solid state breaker in operation
- Initial protection coordination
- Site engineering drawings

Any proposed future work is subject to change based on funding levels

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Summary

- Team on track to demonstrate a 1MVA charging station with
  - A MV SST that connects directly to distribution grid and
  - delivers a shared DC bus with allows for local energy management to alleviate stress on the grid
- Three year project plan:
  - 2019: Component Validation
  - 2020: System validation
  - 2021: System Deployment and Data Collection

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Technical Backup Slides

Benefits of Medium Voltage XFC

State of the art Solution			Proposed Solution
Power:	720 kW	Same power	700 kW
Volume:	12,910 L	3x volume reduction	4,110 L
Mass:	13,000 lb.	6x mass reduction	2,150 lb.
Efficiency:	92%	4x loss reduction	98%
Concrete pad:	177 sq. ft.	2.5x footprint reduction	70 sq. ft.

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Benefits of Medium Voltage XFC

- 4x more power available in the same footprint
- 60% lower power losses in the equipment leading to higher revenue (lower operating costs)

State of the art Station

Rated Power: 720 kW

Proposed MV XFC Solution

Rated Power: 2100 kW

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