Using Second Life Batteries from Electric Vehicles to Provide Grid Services

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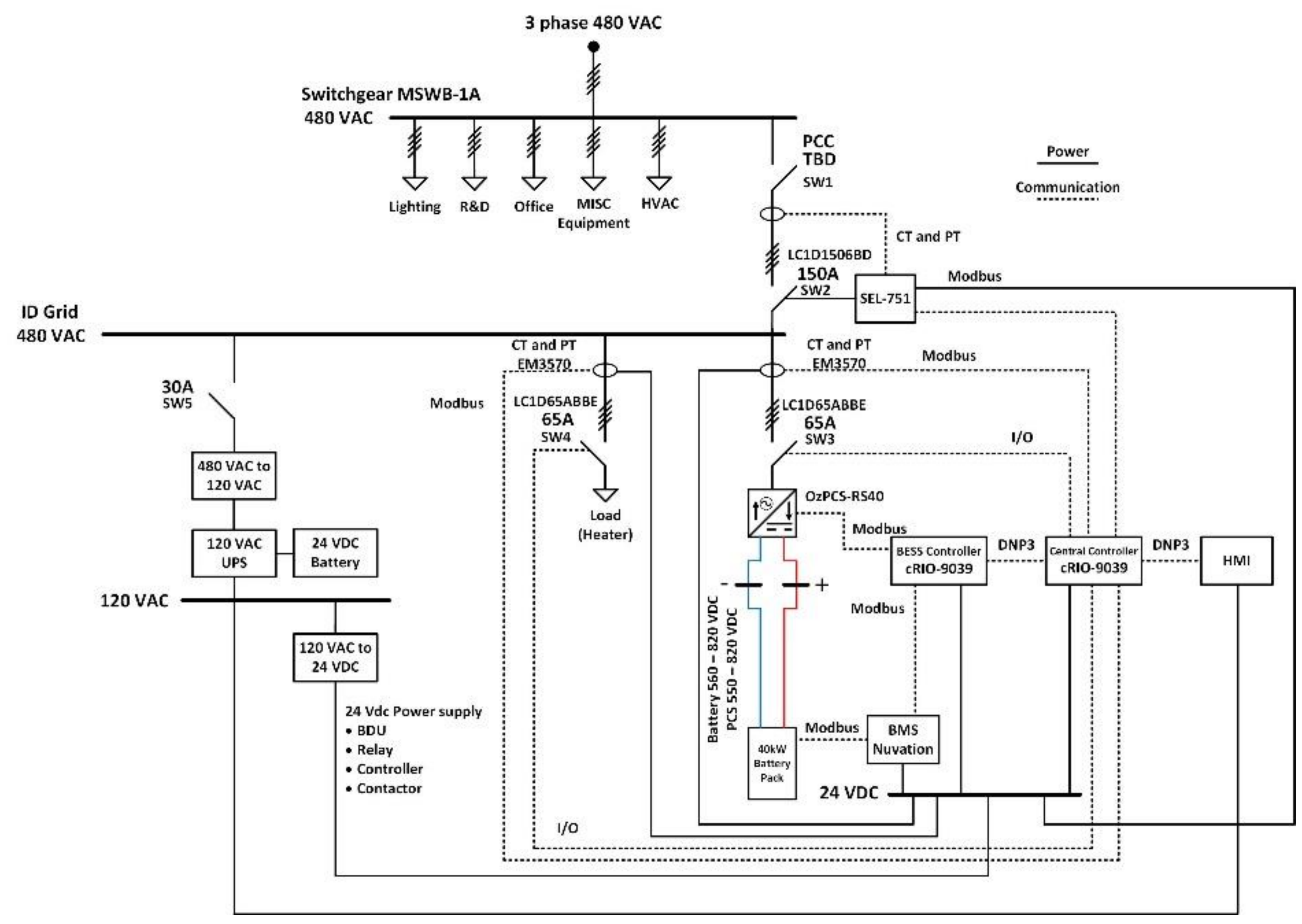
Introduction

- There has been a significant emphasis on recycling batteries from electric vehicles (EVs) recently.
- As the adoption of EVs increases globally, so does the concern about the management of their batteries, particularly regarding their end-of-life disposal and recycling.
- This is the second phase of using second life batteries from electric vehicles to provide grid services collaborating with Volkswagen.
- Using second-life batteries from electric vehicles (EVs) to provide grid services represents a new approach to both sustainable energy storage and grid stability.

Battery Energy Storage System

- 40 kW battery energy storage system (BESS) that uses retired batteries from Volkswagen electric vehicles will be developed in this phase.
- The concept involves repurposing EV batteries that have reached the end of their useful life in vehicles, but still retain a significant portion of their capacity for energy storage applications.
- All of the components have been selected including a battery management system (BMS), a power conditioning system (PCS), controllers, measurements, switches, and an uninterrupted power supply (UPS).
- BESS has a capability to operate in both grid connected mode and grid forming mode.
- BESS schematic is shown in Fig. 1. BESS will be installed and demonstrated at the VW Battery Engineering Laboratory (BEL) facility in Chattanooga, TN.



Experimental Results

- Some of the main selected components, including the PCS and BMS, have been tested in a lab to verify operation conditions and gain experience setting up the system In this phase of the project.
- PCS testing shown in Fig. 2 and 3 are the grid forming and grid connected operation modes of the BESS.
- Testing the BESS in the lab verifies that all protections and measurements of the BESS are operating properly and helps to familiarize with the configuration methods for state of charge (SOC), voltage, current, and thermal limits, contactor setup, etc.
- Human Machine Interface (HMI) illustrated in Fig. 4 is used to control and monitor the BESS.
- Nuvation BMS has been selected to implement in the BESS. Fig. 5 shows an experimental result of BMS.

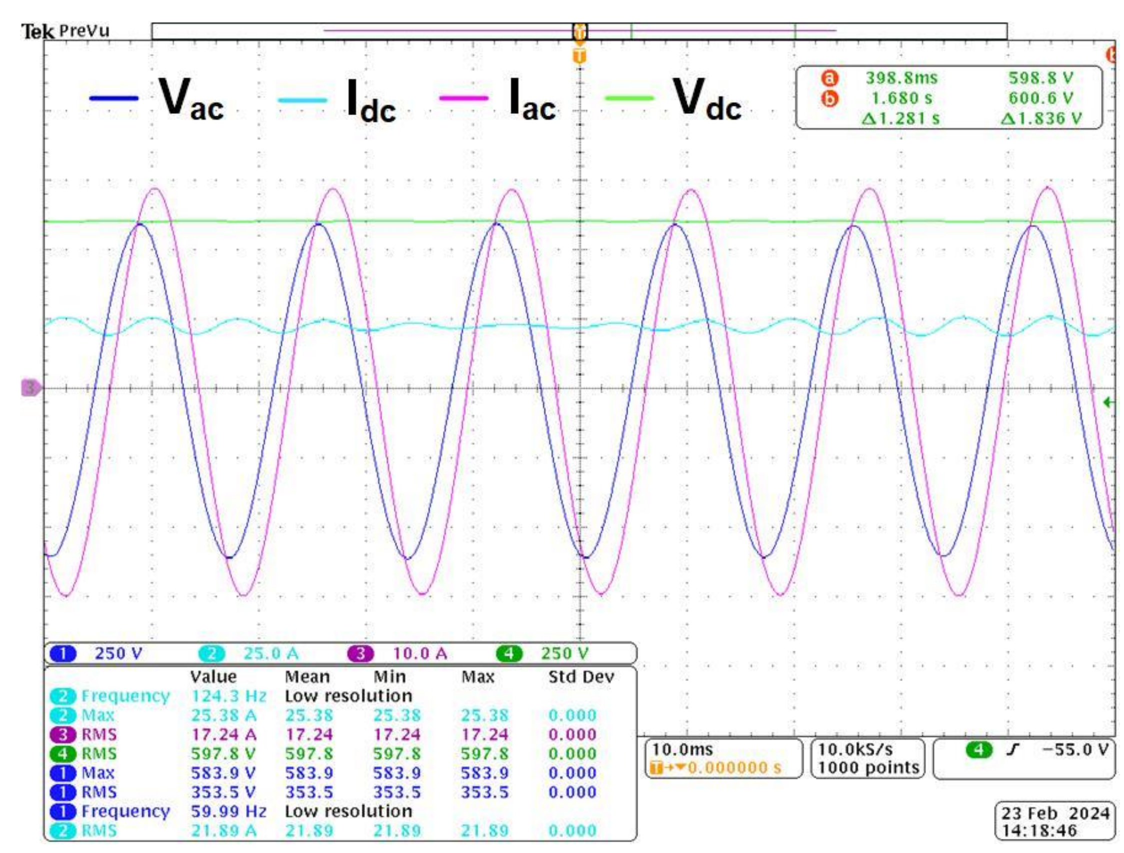


Fig. 2. Grid forming operation

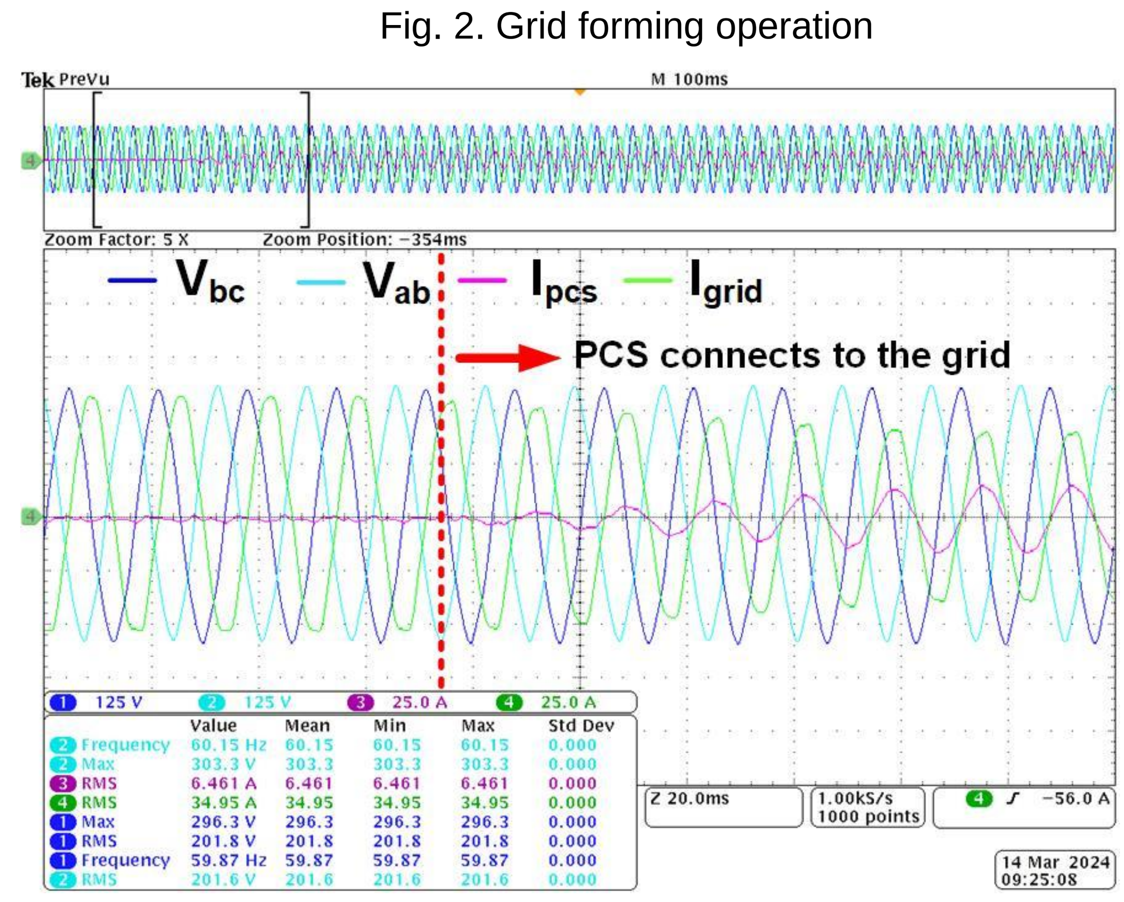


Fig. 3. Grid connected operation.

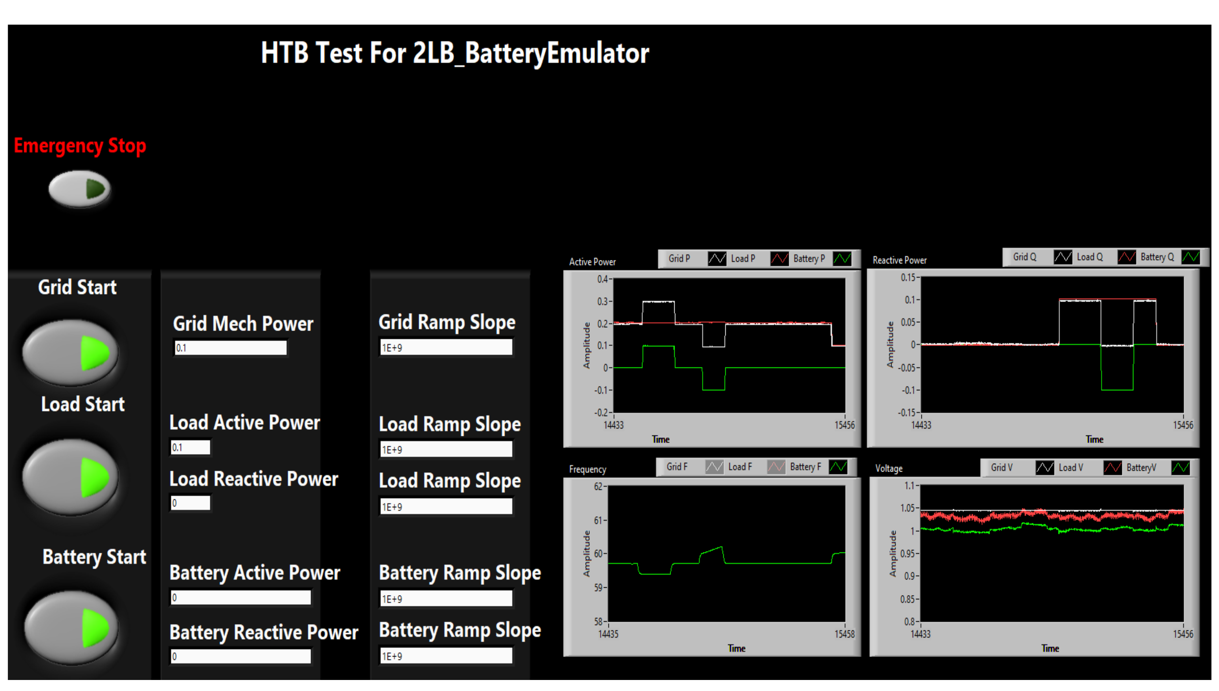


Fig. 4. HMI for BESS.

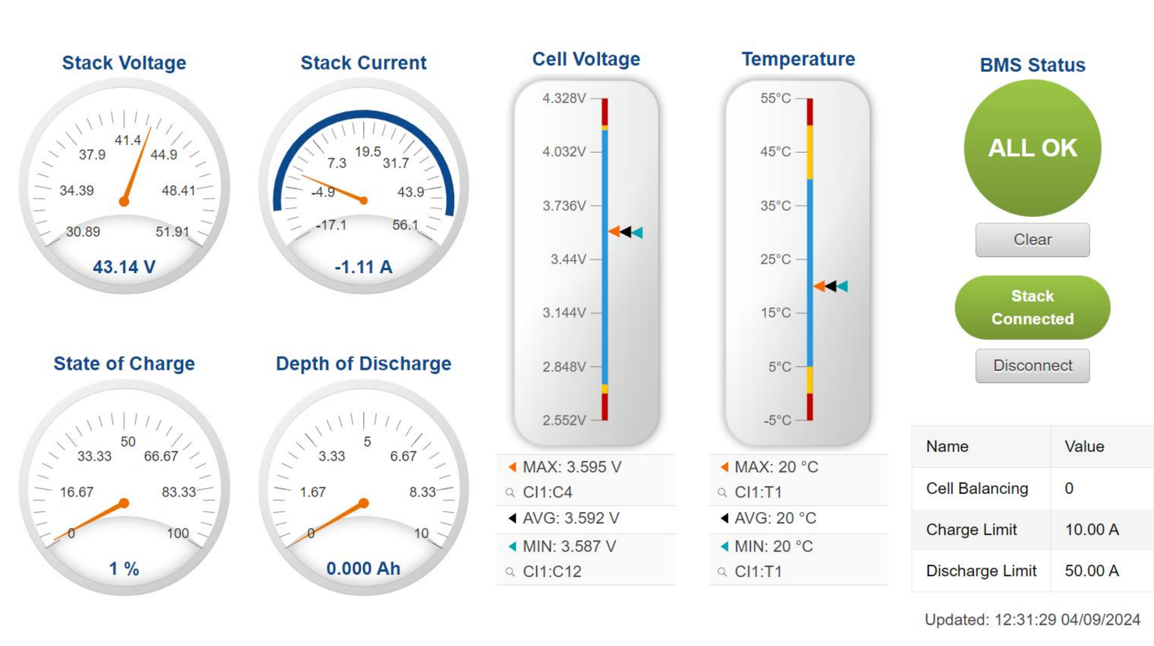


Fig. 5. BMS display.

Conclusion

- PCS has been tested in grid forming and grid connected operations.
- HMI has been developed in LabVIEW to control and monitor BESS.
- BMS protections and measurements have been tested for accuracy.

Future Works

- 40 kW BESS will be developed and tested at CURENT and will be installed and demonstrated at the VW Battery Engineering Laboratory (BEL) facility in Chattanooga, TN.
- Communication between the PCS, HMI, and BMS will be developed with an NI CompactRIO.