Commanding Inverters to Establish Coordinated µGrid Functionality

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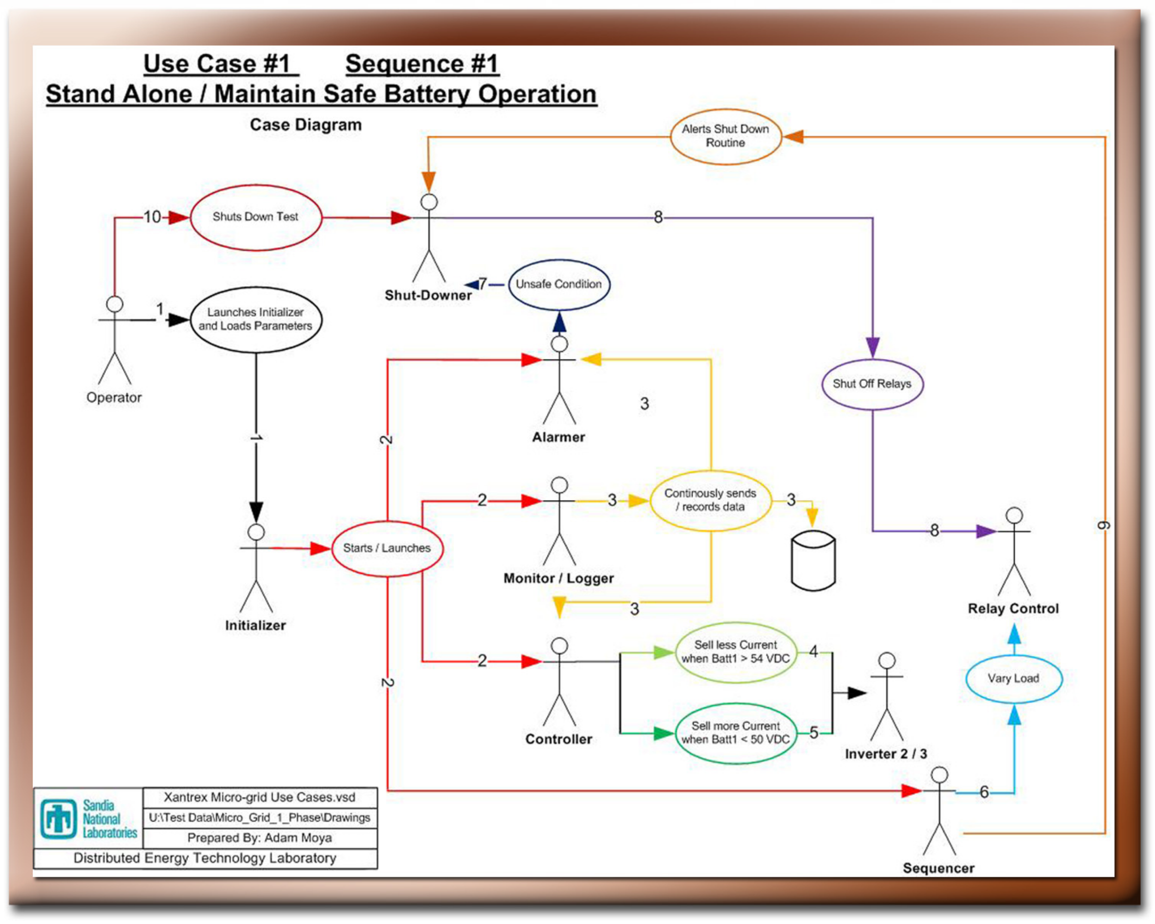
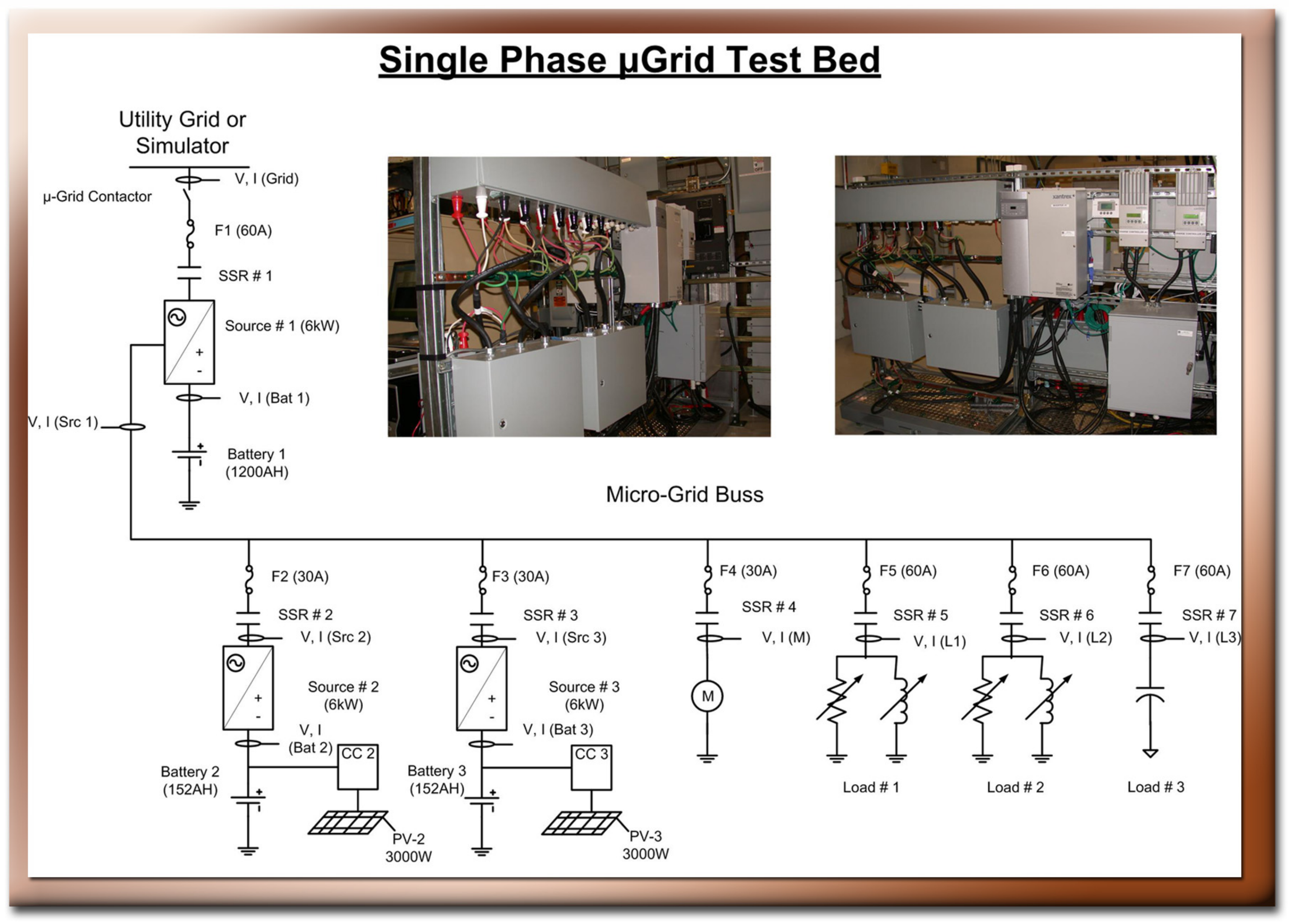
Abstract

Several industry efforts are underway to develop µGrid control strategies to enhance the deployment of large amounts of distributed resources on the grid in a safe, reliable and efficient manner. Expanded testing capabilities at Sandia National Laboratories Distributed Energy Technologies Lab (DETL) now include a single phase µGrid research testbed platform. This reconfigurable µGrid topology testbed platform is being utilized to evaluate control strategies and communication algorithms.

To demonstrate coordinated µGrid functionality battery based Xantrex inverters were integrated in a µGrid configuration on the DETL platform with custom centralized LAbVIEW based virtual Energy Management System (EMS) software. Enhanced µGrid cooperation was implemented by invoking control schemes based on existing command sets issued over standard communication interface without modifying embedded software. The results of two test scenarios are presented here.





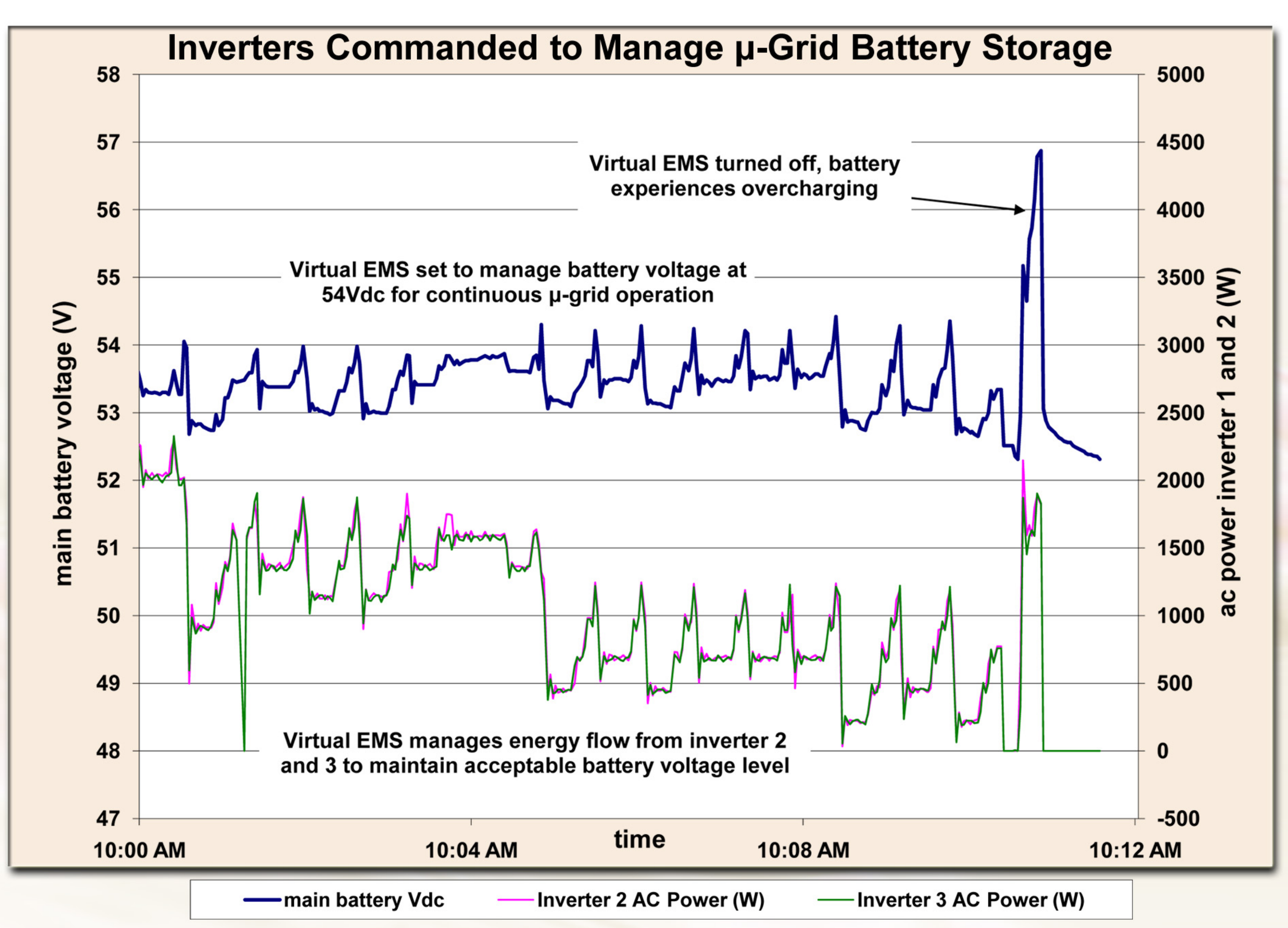
DETL LAbVIEW based virtual Energy Management System (EMS) software

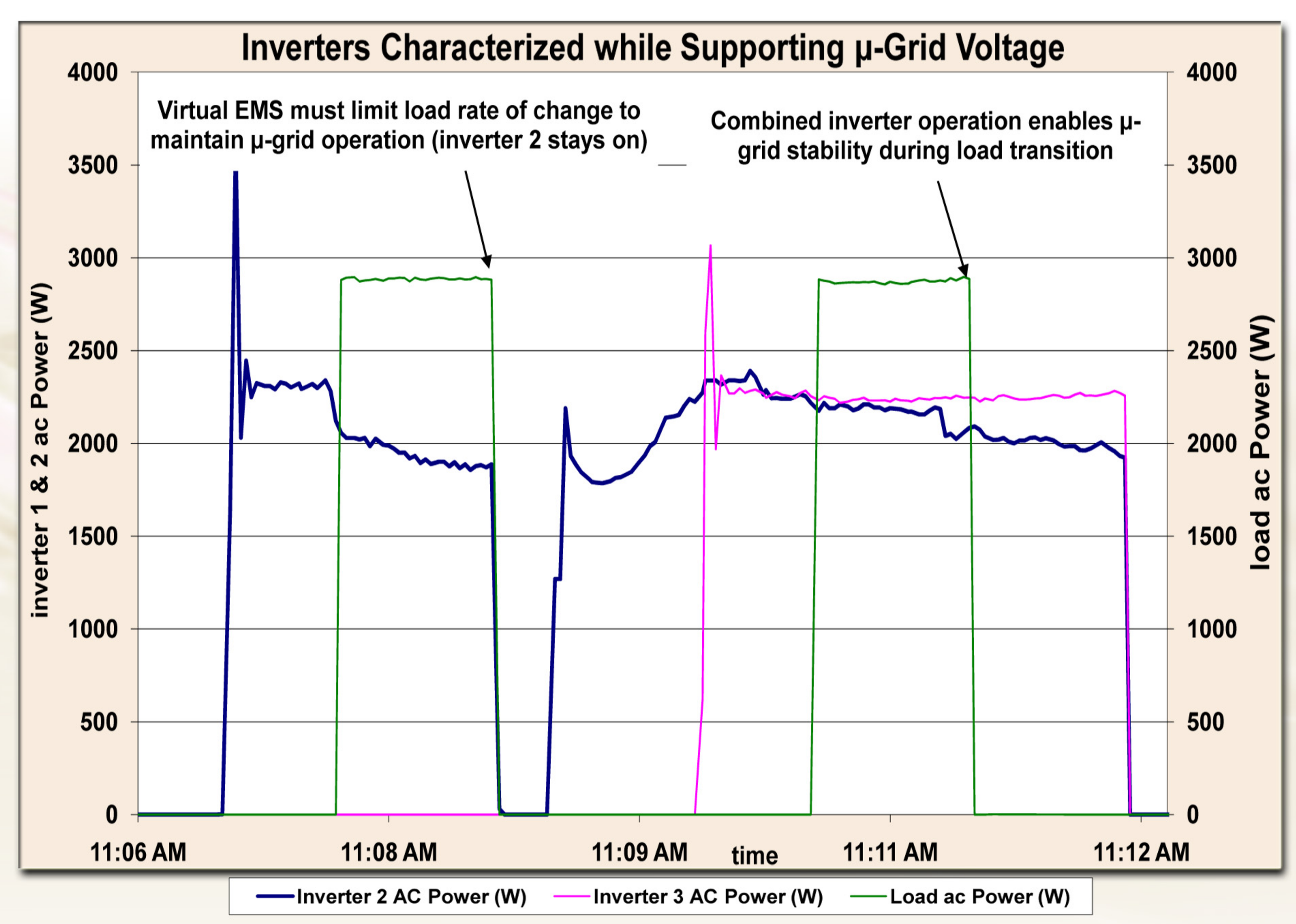
Inverters Commanded to Manage µGrid Battery Storage

- Unconsumed energy in this µGrid configuration will go to charge main battery
- µGrid regulation lost, over-charging battery occurs without µGrid management
- EMS added to manage µGrid energy flow during PV generation, loading cycles
- Virtual EMS achieved continuous µGrid operation independent of battery charge
- Plot shows µGrid stability as EMS controls battery charging voltage

Inverters Characterized while Supporting µGrid Voltage

- Current mode inverters in µGrid configuration respond to µGrid bus voltage sags
- µGrid voltage regulation lost without µGrid load control management
- EMS added to manage µGrid resistive and inductive load ramping profiles
- Virtual EMS could achieve stable µGrid operation by limiting load transitions
- Plot shows µGrid stability of combined inverters during load transition





Conclusions

Sandia National Laboratories has successfully demonstrated using virtual EMS system commands to safely manage µGrid battery storage and characterize inverter response to varying load profiles. An approach of invoking control schemes implemented with existing commands issued over standard communication interfaces without modifications to embedded software can enhance µGrid operation.

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