Missouri S&T Microgrid Lessons Learned

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MISSOURI S&T

Objective

- Identify the steps, issues, and lessons learned from the development of a residential microgrid at Missouri S&T.

Background

- Solar Village Project
- Microgrid System
- Lessons Learned
  - Concept
  - Development
  - Construction
  - Operation
  - Social Engagement

Solar Village

- Houses built from 2002, 2005, 2007, 2009 form a village
- All four houses in the village are rented for student housing

Photo Credit Milbank Manufacturing

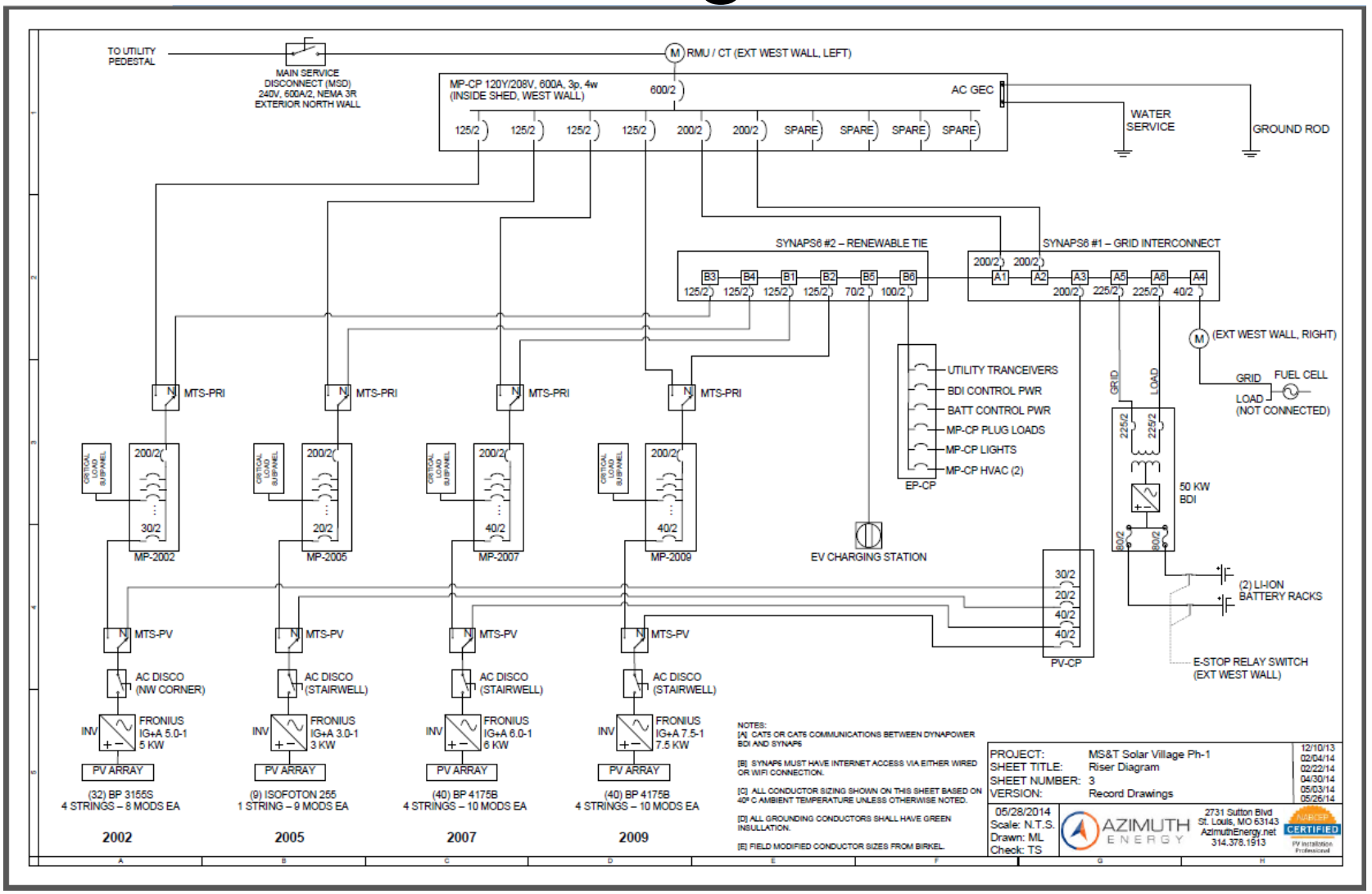
Typical House Specifications

- Approximately 750 sq. ft.
- 1 BR, 1 BA
- Most systems (inverters, hot water, etc.) in basements
- PV array
  - 2002 house: 5 kW
  - 2005 house: 2.8 kW
  - 2007 House: 7 kW
  - 2009 House: 8 kW
- Solar thermal systems
  - Evacuated Tube
  - Prototype Flat Plate

Microgrid System

- Sources
  - Municipal Grid Interconnection
  - Photovoltaics
  - Natural Gas Fuel Cell
- Loads
  - Residential Load (4 homes)
  - PHEV
- Energy Storage
- Control and Switching Infrastructure
  - Autonomous switching
  - Control Interface

Microgrid



One line diagram from Azimuth Energy

PV Systems

- Various PV technologies, all silicon, both single-crystal and multicrystalline
- Fronius grid interconnected inverters
- Single-phase, 120/240 V, 60 Hz
- Total Installed PV- 21 kW

Fuel Cell

- Combined Heat and Power
  - Electric Generation- 5 kW
    - Load Following Generation Capability
  - Thermal Generation- 6.2 kW
- Fuel Source: Municipal Natural gas
- Waste heat to be used for space and water heating

Energy Storage

- A123 lithium ion system
- 60 kWh, 960 Vdc
- Bidirectional inverter from Dynapower, 50 kVA
- Average Charge/Discharge Rate- 22 kW

Switchgear

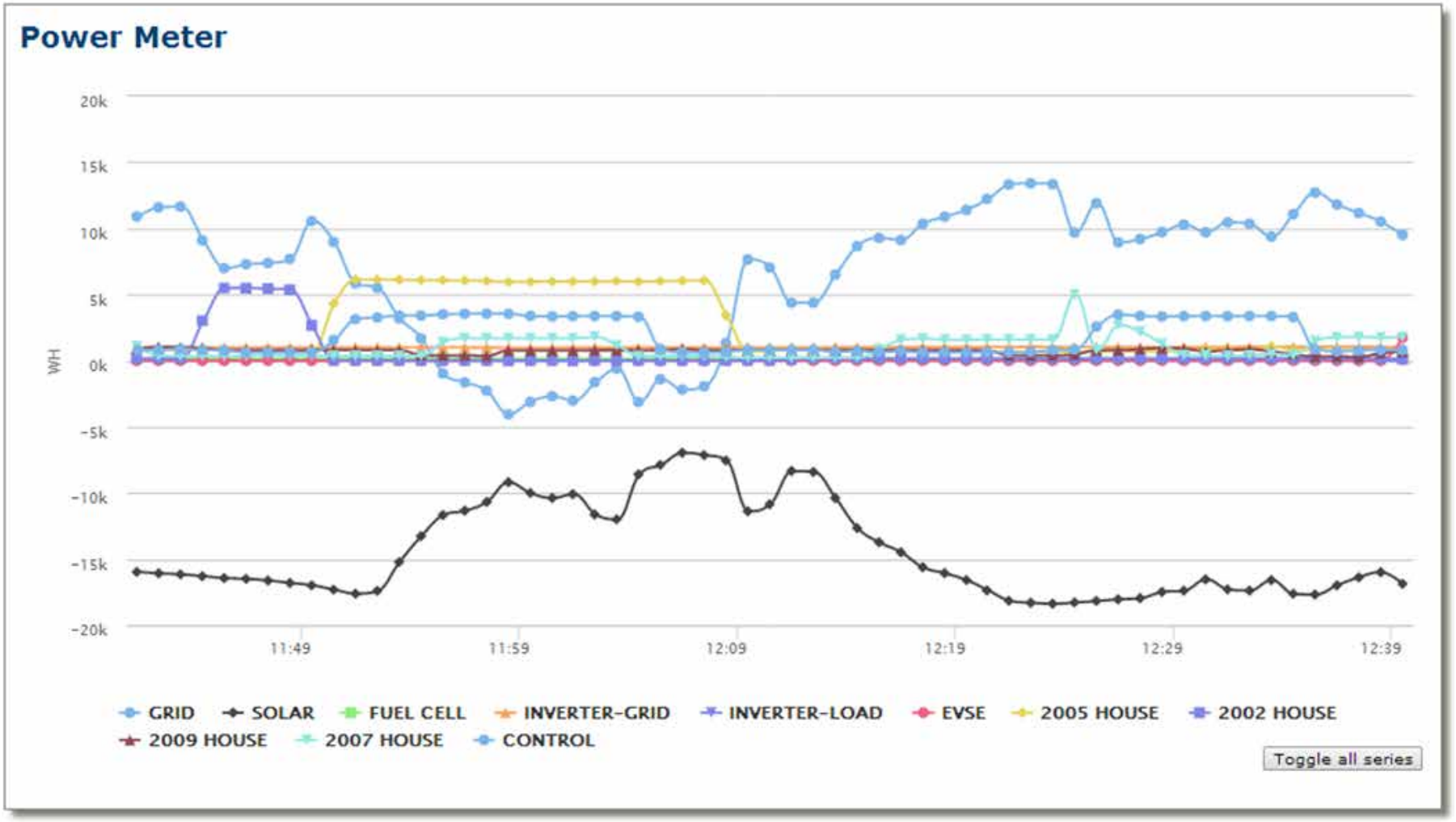
- Synaps6 systems from Milbank
- Currently provides automated switching for islanding, also generation and load management
- More sophisticated control is possible
- Manual transfer switches as backup

Data Acquisition

- Synaps Suite Web Portal
  - Real-time load and generation tracking
  - History
  - Battery Charge and State
  - Inverter State
- Circuit Level Monitoring Project

Home | History | Batteries | Inverter | About

Welcome back, Read Only!



Screenshot from Milbank Synaps Suite Web Portal

Lessons Learned

- Concept
  - Researchers
    - Academic
    - Industrial
  - Military
  - Industry

Development

- Starting from a Baseline
- Finalizing the Components
- Ensuring Compatibility
- Interconnection Management
  - Municipal Utility
  - Natural Gas Supplier
  - Feed-In Agreements

Construction

- Documentation Management
- Contractor Capability
- Physical Interconnection
  - Switching
  - Control

Operation

- Data Collection
- Remote Monitoring and Control
- Rule Making
  - If-Then Functionality
- Scenario Management
  - Economic Minimization
  - Grid Demand Minimization
  - Self- Sufficiency Time Maximization

Social Engagement

- Tenant Management during the Process
- Utility Education
- Tenant and Community Interest

Overview

- Concept Creation
- Development
- Construction
- Operation
- Social Interaction

Questions

Photo Credit Milbank Manufacturing