

Texas Tech University GLEAMM Microgrid Research Facility - Advancing Grid Resiliency and Sustainability

Stephen Bayne¹, Taufique Atique,¹ Sanka Liyanage² Giesselmann, Michael¹, and Beibei Ren²,
¹Dept. Of Electrical & Computer Engineering, Texas Tech University, ²Dept. of Mechanical Engineering, Texas Tech University
 stephen.bayne@ttu.edu, michael.giesselmann@ttu.edu, beibei.ren@ttu.edu,

Introduction

GLEAMM (Global Laboratory for Energy Asset Management and Manufacturing) is a Texas State funded collaborative project with **Texas Tech University and Group NIRE** to provide a research platform for both academic and industrial research on microgrid technologies together with grid resiliency. GLEAMM consists of two state-of-the-art research facilities, namely GLEAMM microgrid and the SMART (Simulation of the Microgrid Activities for Research and Training) center.

GLEAMM microgrid consists of a 150kW solar array, two batteries (24kW and 50kW), a 500kW tier four generator, two configurable load banks (500kW each), and a SCADA system. The microgrid can be operated in both islanded mode and grid-tied mode. In addition, the state-of-the-art SCADA system is equipped with MATLAB and LABVIEW programming interfaces, which enables the ability to conduct advanced research related to microgrid control and optimization, big data analytics, cyber-security, and remotely accessible testbeds.

The other portion of the GLEAMM facility is a research center called the SMART center. It provides an advanced research platform for cyber-physical research on microgrid for both academic and industrial endeavors. On the research apparatus, it facilitates with digital real-time simulator (OPAL-RT), multiple physical Phasor Measurement Units (PMUs, from NI, GE, SEL), SCADA system, inverters, battery and updated license on different software like, MATLAB, eMEGASIM (RT-LAB), HYPERSIM, ePHASORSIM, eFPGASIM, PowerWorld (both industrial and educational). Also, The SMART center has a modernly equipped classroom with 12 seated capacity. Currently, this facility is used for research like advanced microgrid control, cyber security, false tolerance, weak grid vs. strong grid and many more.

GLEAMM has identified the importance of advancing technologies for microgrids and grid resiliency in next-generation power systems. On that note, with all its advanced technologies, GLEAMM envisions a great potential of empowering research related to microgrids and grid resiliency.

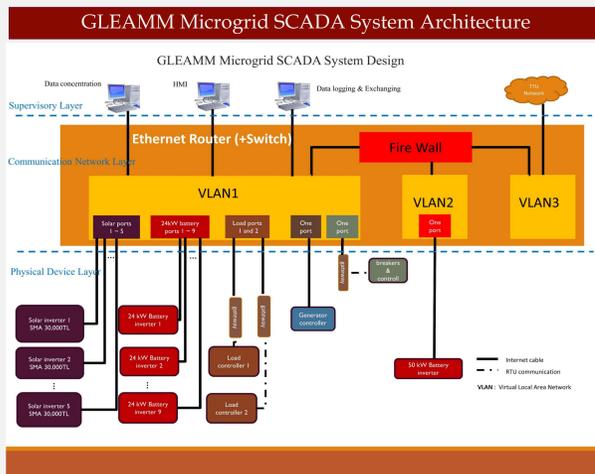


Figure 1: The GLEAMM microgrid SCADA system architecture

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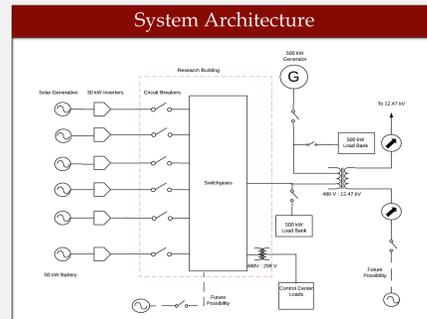


Figure 2: One line diagram of TTU GLEAMM Microgrid

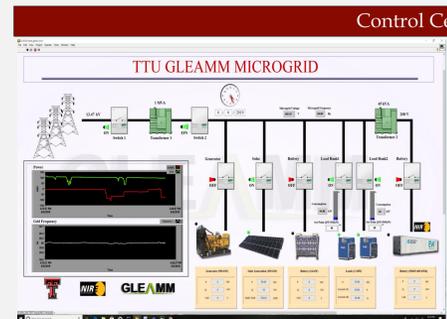


Figure 3: Human machine interface

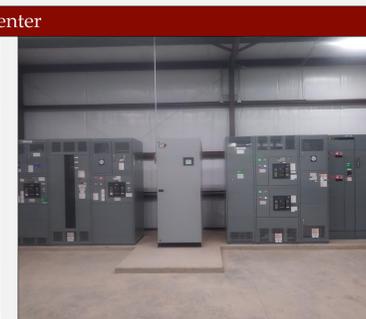


Figure 4: GLEAMM control center

System Components



Figure 5: 150 kW solar array



Figure 6: Load banks



Figure 7: Tier 4 diesel generator



Figure 8: 30 kW solar inverter



Figure 9: Step up transformer



Figure 10: 50 kW battery

System Components : Brief Description

Solar Panel	Inverter	Battery	Transformer	Generator	Load Banks
<ul style="list-style-type: none"> Sunmodule SW 320 XL Mono Panels 320 Wp output power from a panel* Efficiency 16.04%* Maximum system voltage of 1000 V *Under standard test conditions (1000 W/m², 25° C, AM 1.5) 	<ul style="list-style-type: none"> SMA Sunny Tripower 30000TL-US 5 inverters Nominal power 30 kW Rated MPPT voltage range 500 V – 800 V 98.6% efficiency 	<ul style="list-style-type: none"> Iron redox flow battery 8 hours capacity Peak power 50 kW Cycle life >20000 cycles Ambient temp.: -5° C to 50° C Roundtrip efficiency: 75% (DC-DC), 70% (AC-AC) 	<ul style="list-style-type: none"> Transformer rating 1 MVA Common coupling transformer 480 V/12.47 kV step up transformer 	<ul style="list-style-type: none"> US EPA Tier 4 diesel generator Maximum rating of 500 kW Operates at 480 Volts 1800 rpm speed 	<ul style="list-style-type: none"> For each load bank: 500 kW capacity at 480 V AC Resolution of 5 kW 347.22 Amps Current at capacity Equipped with 30 inch panel fan for cooling Equipped with fork tubes for lifting

GLEAMM Smart Training Center

- Real time simulation
- Hardware in the loop (HIL) simulation
- Model in the loop (MIL) simulation
- One fully equipped classroom
- One server room
- Hardware: PMUs, OPAL-RT, UPS, Converter, Master SCADA Panel
- Softwares: OpenPDC, MATLAB/Simulink

Figure 11: OPAL-RT simulator



Figure 12: Classroom



Figure 13: Server room

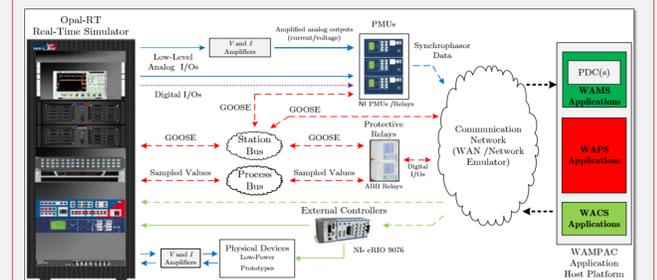


Figure 14: Controlling and monitoring of PMU system with OPAL-RT

Ongoing and Potential Research

- Design and analysis of power system stability and performance
- Wide area monitoring using PMUs
- Testing of various difficult operating scenarios on the real power grid: faults, load rejection, and islanded operation
- Statistical modeling of generation forecasting
- Transient behavior testing between islanded mode and grid-connected mode
- Microgrid energy management and optimization
- Microgrid controller testing