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

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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 PMUs (NI, GE, SEL), SCADA system, Inverter, 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

GLEAMM Microgrid SCADA System Architecture

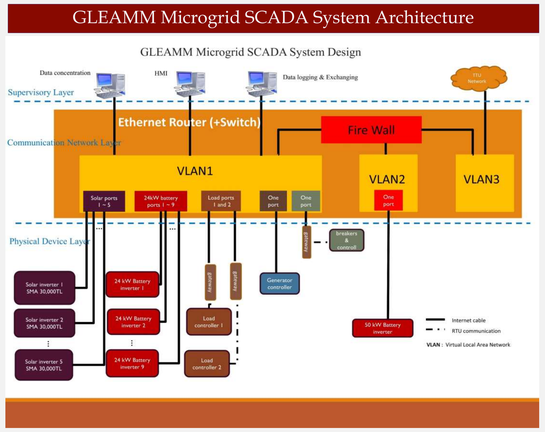

Figure 1: Schematic of the SCADA system architecture

Texas Tech University GLEAMM Microgrid Research Facility

System Architecture

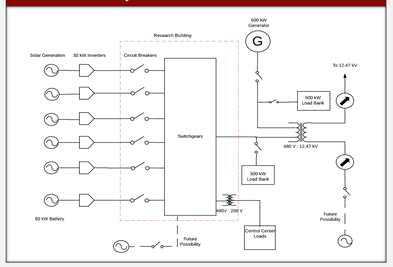

Figure 2: One line diagram of TTU GLEAMM Microgrid

Control Center

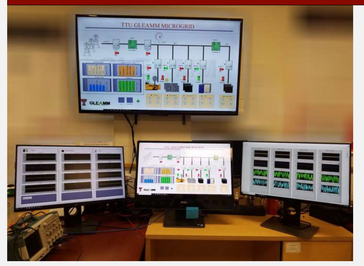

Figure 3: Human machine interface

Figure 4: GLEAMM control center

System Components

Figure 5: 150 kW solar array

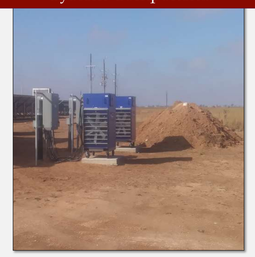

Figure 6: The load banks

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

- 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)

Inverter

- SMA Sunny Tripower 30000TL-US
- 5 inverters
- Nominal power 30 kW
- Rated MPPT voltage range 500 V – 800 V
- 98.6% efficiency

Battery

- 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)

Transformer

- Transformer rating 1 MVA
- Common coupling transformer
- 480 V/12.47 kV step up transformer

Generator

- US EPA Tier 4 diesel generator
- Maximum rating of 500 kW
- Operates at 480 Volts
- 1800 rpm speed

Battery

- 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

Figure 11: OPAL-RT simulator

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

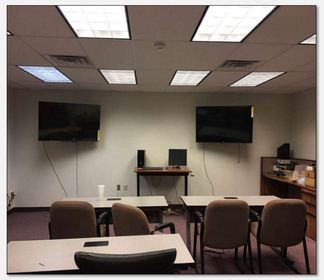

Figure 12: Classroom

Figure 13: Server room

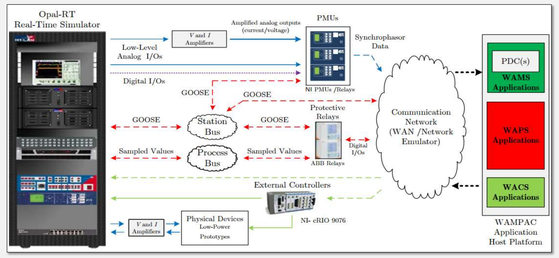

Figure 14: Controlling and monitoring of PMU system with OPAL-RT

Ongoing and Potential Research

- Design and analysis of power system stability and performance
- Phasor Measurement Units (PMU) and wide area monitoring
- Testing of various difficult operating scenarios on the real power grid: faults, load rejection, and islanded operation
- Statistical modeling of generation forecasting
- Transient behaviors testing between islanded mode and grid-connected mode operation of the microgrid
- Microgrid energy management and optimization
- Microgrid controller testing

TEXAS TECH UNIVERSITY

GLEAMM

GROUP NIRE Renewable Energy Solutions