



# MicroGrid Control

*Pioneer the future with innovative solutions!*

## Business Value

- Unify operational control strategies over all MicroGrid components;
- Monitor and respond to grid events such as disruption of power supply, change in conditions, or a spike in energy prices;
- Automate commands to:
  - Connect to/disconnect from utility grid;
  - Shed load based on criticality;
  - Increase power from dispatchable generation resources;
  - Charge/discharge energy storage resource;
  - Operate protective equipment.
- Manage synchronization of the MicroGrid with the utility grid;
- Monitor and coordinate all subordinate controllers; and
- Supports IEEE 1547.4 standards for electric grid safety.

To support energy reliability, security, and independence, Trimark's MicroGrid Control (MGC) solution unifies monitoring and management of generation resources, loads, and protective equipment.

Coordinating the disparate systems within a MicroGrid to accomplish a specific energy management objective is a challenge – particularly when transitioning to islanded mode and while reconnecting the MicroGrid to the utility grid.

MicroGrid operators require status of their resources and loads, real-time electrical conditions, and precise frequency at the Point of Common Coupling (PCC) with the utility electrical grid. Whether for steady-state operation or managing mode transitions, operators need automation to coordinate all of the sub-second responses and actions associated with safely disconnecting resources, shedding load, starting up resources, and discharging storage – all while maintaining nominal voltage, frequency, power factor, and other operating conditions.

Trimark's MicroGrid Control solution maintains equilibrium by continuously monitoring the state of the grid and coordinating commands across appropriate subsystems to accomplish your desired MicroGrid strategy – safely, autonomously, and effectively.

# MicroGrid Control Solution

## What is a MicroGrid?

A MicroGrid is a localized power grid that can operate both independent from, and connected to, the utility electric grid. A MicroGrid supports secure electric power supply strategies required to operate critical infrastructure within a defined area, such as a campus or military base. In many cases, MicroGrid owners can sell excess power while grid connected.

MicroGrids may include multiple static and variable generation sources and energy storage; loads with varying criticality; and various grid-related sensors, meters, and safety equipment.

## MicroGrid Command and Control



Effective MicroGrid management requires real-time monitoring, historical reports and analytics, and context-based automation to coordinate control. Collectively, these functions support electrical reliability for critical loads when grid-connected, islanded, or transitioning between the two.

A comprehensive MicroGrid Control system senses grid conditions; directs connection to/disconnection from the grid; and monitors and controls affiliated power resources. Associated management capabilities include data historization, autonomous decision making, and event-driven control logic to initiate programmed functions. This supervisory system is tightly integrated with SCADA systems dedicated to individual resources as well as building/load controls and other demand response infrastructure.

## Trimark's MicroGrid Control



Trimark's MicroGrid Control (MGC) solution provides advanced monitoring and automated control. The MGC monitors loads within the MicroGrid, the status of the utility grid, as well as integrated energy storage and generation resources. Based on the overarching operational objective, the system sends commands to each sub system to achieve the desired state. Regardless of connection status, the system monitors all sub systems and the utility grid; logs event data for reports and analysis; and makes real-time operational decisions.

The core of this solution is Trimark's T1-S Gateway. This system communicates with sensors, protective relays, control devices (breakers, re-closers, synchrosopes, etc.), third-party systems, and other data sources. The MGC provides master control over all subordinate systems and devices to ensure safe and smooth operations. In addition to control, the MGC presents real-time and historical information for reporting and event analysis.

Trimark's MGC solution is technology agnostic. That means it can integrate with existing control systems through industry-standard communication protocols. This enables Trimark to leverage existing systems infrastructure (SCADA, inverter control, capacitor banks and voltage regulators) to minimize expense.

While grid-connected, Trimark's MGC supports compliance with IEEE 1547 interconnection standards.

Whenever the MicroGrid is connected to the utility grid, the MGC monitors financial conditions and makes decisions to import power, sell power to the grid or use generation or energy-storage resources within the MicroGrid.

## Disconnection from the Grid



If a disturbance occurs in the utility grid, a MicroGrid may need to disconnect within 0.16 seconds. Then it must shed low-priority loads and start generation resources all while maintaining voltage and frequency.

Trimark's MGC supports these functions by monitoring the PCC and MicroGrid voltage and frequency. It will then automatically draw stored power, start resources, and/or adjust generation and VARs, as necessary.

## Reconnection and Grid Synchronization



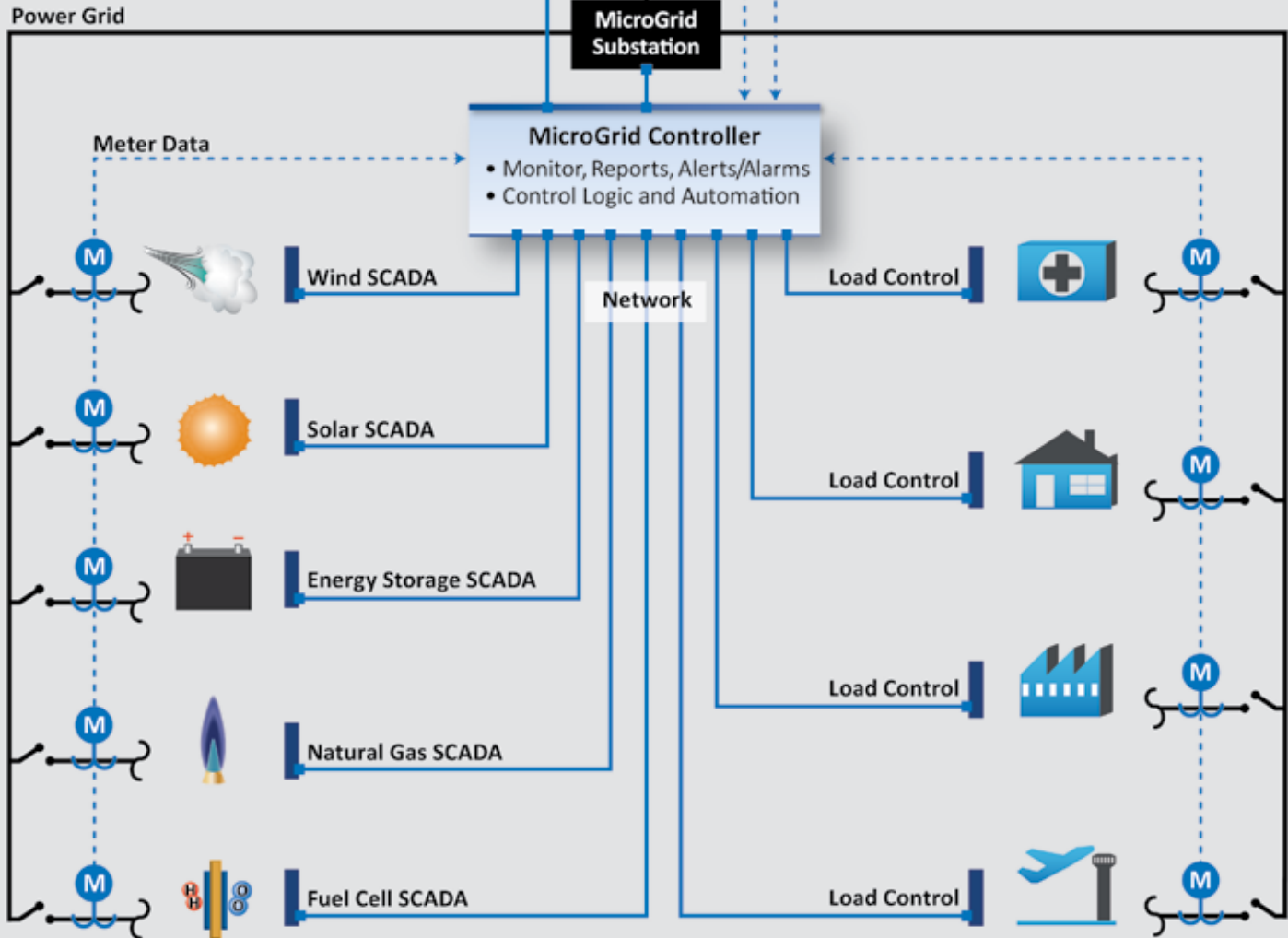
In order to safely reconnect to the electric grid, frequency, voltage, and phase angle on both sides of the PCC must be synchronized.

The MGC monitors both the utility grid and the MicroGrid. The MGC will issue commands to MicroGrid resources, energy storage and capacitor banks to attain unity before closing grid-tie breakers.

# Architecture of an Intelligent MicroGrid

Trimark's MicroGrid Control solution provides operators visibility and unifies control of all generation resources, load and critical connections.

The system monitors real-time conditions and automates logic and resulting commands that are necessary to operate a MicroGrid. The system also captures and historizes operational data and provides reporting and analytical tools.



## Steady State Operation

MicroGrid operators must consider protection and safety while maintaining frequency and voltage.

The MGC coordinates actions across all relevant devices to comply with safety and protection standards,

thereby avoiding personal injury and equipment damage. When faults (e.g. short circuit, over/under voltage, over/under frequency, unauthorized energization) occur, either in the utility grid or the MicroGrid, the MGC issues commands to protective devices as

well as to the breaker at the point of common coupling (PCC).

The MGC also monitors MicroGrid frequency and coordinates adjustments across all devices required to maintain target frequency.

## Economic and Environmental Operation of the MicroGrid

When connected to the utility grid, the MGC can be used to accomplish energy objectives such as generation, conservation, or GHG reduction.

As a result, the MGC executes logic that may dispatch MicroGrid-tied generation resources; charge or discharge electrical storage; or initiate a demand-response event.

The MGC coordinates MicroGrid operation based on power purchase agreements, natural gas and electric tariffs, and incentive programs.

## Why Trimark's MGC Solution?

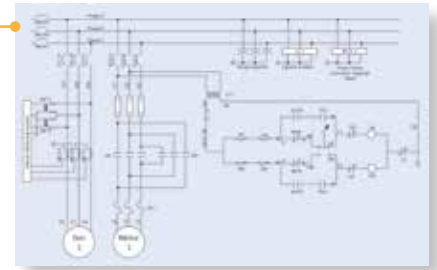
Trimark begins by developing a clear understanding of the MicroGrid's mission. Trimark audits resources and loads and define criticality-based control schemes to support safe, cost effective, reliable and resilient MicroGrid operation.

Trimark's engineering team will then configure the MGC to integrate subsystems, devices, control logic and protective schemes to deliver a functional MicroGrid customized to your site and mission.

## System Components

### MicroGrid Controller

Unified logical control of generation and load to achieve the designated business/operational/defense objective. Trimark's MicroGrid controller provides a set of advanced controls that are tightly integrated with multiple SCADA systems and intelligent devices. The master controller will monitor status of the grid, storage, and local generation and autonomously control each sub system to maintain the system requirements.



### T1-S Vantage User Interface

View real time status of all resources and loads within your MicroGrid. Generate reports, alerts or trends to analyze events.



### SCADA for Balance of Plant

Control individual devices and resources within the MicroGrid including protective relays, reclosers, PV inverters, energy storage, and reactive equipment.

### Meters

Load and generation meters provide real-time power information (voltage, frequency) to measure precise grid conditions, and track power purchases and sales.



### Communication Network

Support real-time information access and commands with Trimark's field-proven network.



## A Proven Player in the Energy Market

Trimark Associates, Inc. develops reliable, affordable business and operational solutions that support compliance and optimization of power production.

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