OPTIMAL POWER SOLUTIONS

Macro Hybrid System
for
High Renewable Contribution Micro-Grids



The Macro Hybrid System is the ideal solution for large off-grid power systems incorporating solar photovoltaics and other renewable sources that aim to achieve substantial fuel savings and extended hours of zero diesel engine operation.

MHS System Overview

Introduction

New advances in small scale micro grid power systems have led to the development of the Macro Hybrid System ("MHS"). This approach brings many advantages to the supply of high quality, reliable electric power in particular applications such as isolated areas, mission critical systems and sites of difficult location. Its is increasingly being seen as an option for utilities where interconnected micro grids can operate together or separately depending on load demands, fuel supply constraints or security prioritised circumstances.

The MHS can also be provided to allow for interconnection to other micro grids as required. This can occur progressively in the future as remote communities can be interconnected for cross-sharing of energy sources and load demand shaping.

The MHS is now being accepted as a new solution to the problem of utility extension to remote communities.

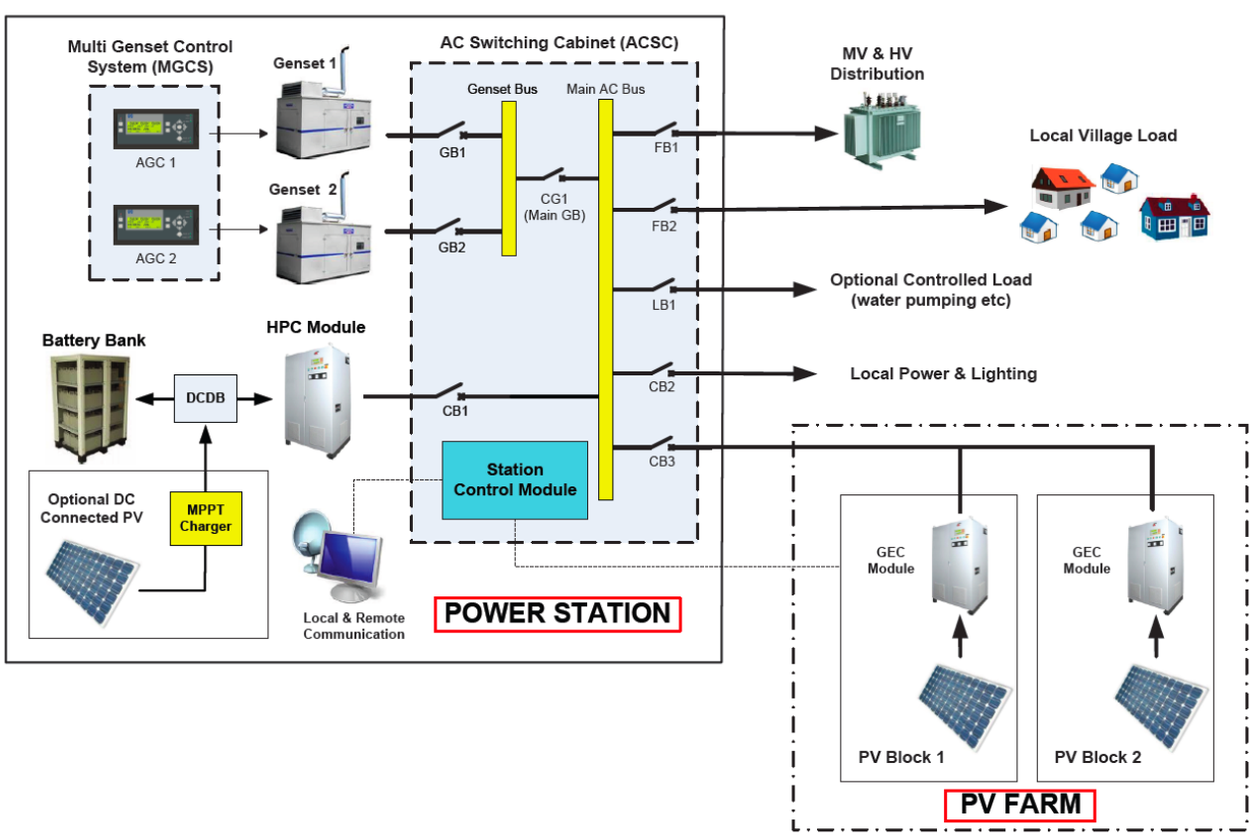
The delivered cost of diesel fuel is increasing whilst the capital cost of solar photovoltaic modules is continuing to decline. Designers are also being introduced to new storage technologies, some of which offer a short term power capability within minutes to the Micro Grid while others can provide longer term energy storage in hours of time duration.

Consistent with the objectives of all electric power systems the MHS system is designed to;

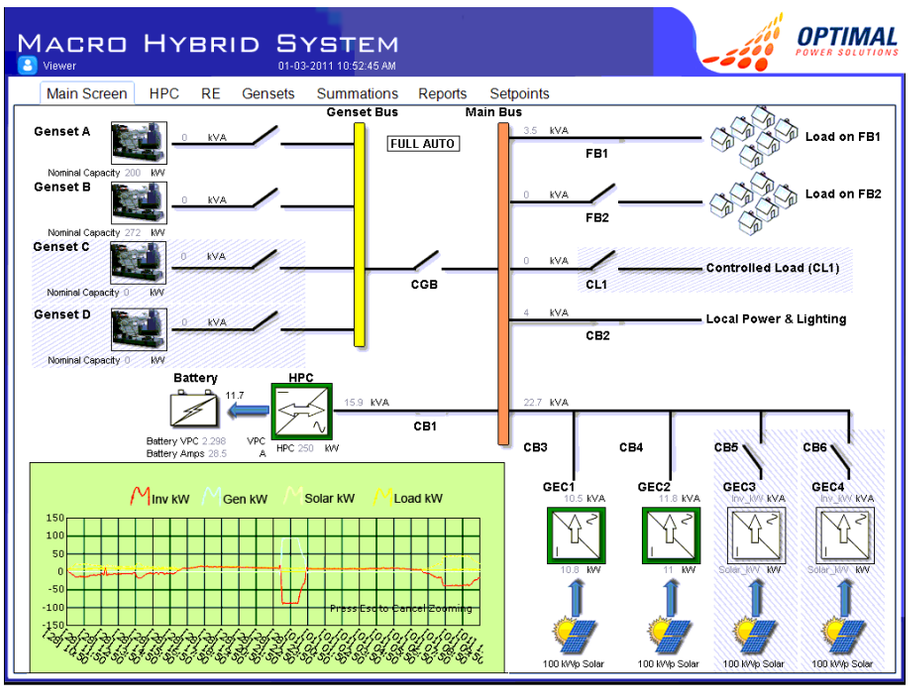
- Deliver reliable continuous 24-hour electricity.
- Meet the target of delivering least cost energy.
- Ensure high quality power with stable voltage and frequency.

With multiple source configurations the MHS can deliver multi-hundred kilowatt or megawatt scale power to the design load.

Schematic: Sample Line Diagram of MHS



MHS System Operation



Screen Shot : OPS MHS SCADA software project example

Operation and SCADA

Advanced Micro Grid systems such as the MHS will act to fully utilize the available renewable energy sources and also actively reduce the diesel fuel consumption at all times. It is therefore assumed that the capacity of the system components have been appropriately selected in conjunction with the average and peak site loads to be encountered.

Where diesel fuel costs are high or if the end user wishes to have an ultra low fuel consumption strategy the MHS can be configured to minimize diesel hours to absolute minimum operating hours. This will require a larger battery system with very large renewable inputs.

System Startup
This is typically called a black-start condition and will require a combination of various available sources to be brought on line before the associated feeder breakers are closed to power the site load. The available sources will include the diesel gensets and possibly the central PV inverter with the local battery bank. Most sites include reactive loads which have significant in-rush currents at startup and the MHS will manage these events. Once the system load has been met and the central hybrid inverter is fully activated, the MHS will continuously manage the battery bank.

Renewable Energy Sources
Once the power supply has been stabilised after startup, the main breakers connecting the renewable sources can be successively energised. The renewable sources may include solar arrays, wind turbines or other devices. Surplus solar photovoltaic energy available from remote arrays that are AC connected can be used to charge the battery bank via the hybrid inverter thereby reducing the loading on the running diesel generators.

Controllable Loads
For constrained power supply circumstances where costs are high and energy is often subsidized, it can be very useful to use demand side management via controlled loads. These can be identified in the community as discretionary in terms of operating times and therefore be enabled / disabled as required by the MHS.

Zero Diesel Generator Operation
For many systems up to about one (1) megawatt of capacity, the diesel generators can be turned off for significant time periods each day. This condition is subject to the load, renewable inputs and available battery storage. This circumstance is more readily achieved at least cost during the daylight hours but can be realised at other times of the day. The central inverter will continuously act as the commutation source for the system as it uses the battery bank as the energy source when operating in this mode.

Diesel Generator Array
The MHS will continually analyse the loading on the system and then decide to either increase or decrease the gensets online or change to a single, larger capacity unit that can carry the entire site load and continue battery charging. The selected genset in this instance will be based on fuel efficiency.

Under appropriate battery bank conditions, and provided the site load can be met by the available renewable inputs, then the MHS can take the all generator sets offline. Various systematic functions of the MHS will be active such as managing engine hours, equalizing the battery, reporting data and clearing various power system faults as they arise.

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