KALKI COMMUNICATION TECHNOLOGIES

Power Management System Solutions

Energy in its various forms is vital for the modern day world. However, energy and its different forms, mainly electric power whose availability reliably with high quality, with redundant sources and protection capabilities that is critical to Industrialized economy. Because of this dependence on electricity and the volatility of energy costs, combined with a growing environmental consciousness and more stringent legislation, efficient energy management is becoming ever more important.

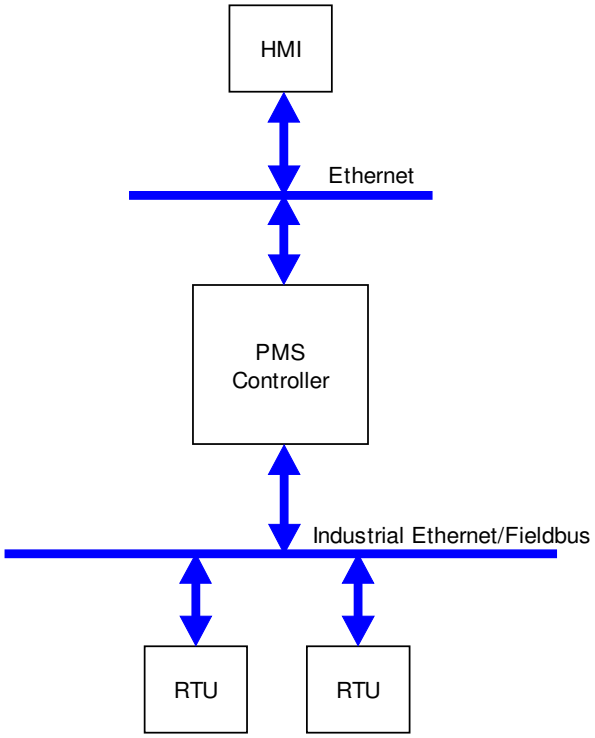
Kalki's Power Management System (PMS) is a family of unique solutions that ensure reliable and stable energy supply for energy-intensive industries. The PMS balances energy demands with the available energy supply, thus preventing disturbances or even blackouts in operations. Furthermore, it enables a company to control its energy costs, to enhance safety, and to mitigate environmental and health impacts.

Overview

Power management refers to maintaining the power balance in an electrical network and to maintain the system voltage and frequency both when the network is connected to grid or islanded. The PMS comprising of real time high-speed controllers, remote input output units, efficient communication network, and software for power management functions and operator interactions, act on the electrical network to maintain the power balance in the network. The PMS actions can be either fast actions like tripping of loads or generators, or slow actions like controlling governors and AVRs of generators or slow load controls.

Solution Architecture

PMS interfaces with the electrical network through Remote Terminal Units (RTU) installed at substations, switchgear panels or protection panels. The RTU can be simple distributed I/O with communication interface or more featured I/O system with CPU and communication interface.



PMS Controller

PMS controller is a programmable controller, which consists of a high-speed processor unit and communication interfaces. The electrical process data like status and power are taken to the controller from RTU over high-speed communication network. The controller processes the inputs and gives out the outputs based on the defined PMS logic.

HMI

PMS uses PC based HMI stations for operation, engineering and maintenance. There can one or more nodes as operator workstation accessing the process data directly from PMS controller connected to the Ethernet LAN or from Server in client-server architecture. Redundant server systems ensure continuous availability of PMS to the operator.

HMI system consists of object oriented graphical interfaces for interacting with electrical process. Graphical objects in the HMI represent all electrical apparatus with fully integrated program logic modules running in the controller. Operator stations consist of dynamic single line diagrams, alarms, and sequence of events, trends and reports.

Communication Network

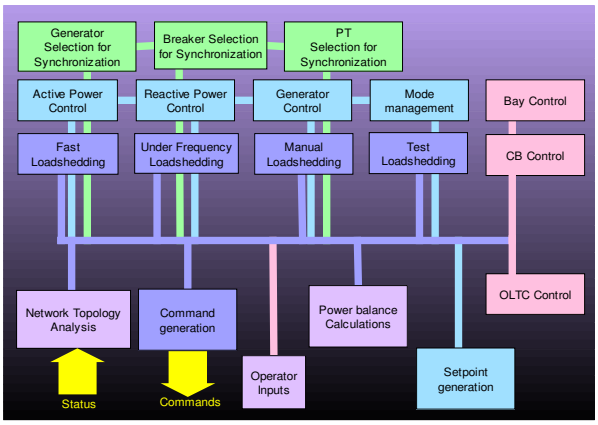
The PMS uses 10/100 mbps industrial Ethernet for high-speed communication between RTU's and controller. A redundant network is preferred for ensuring the high availability.

Software

PMS application software has a modular architecture and modules can be chosen based on specific requirements. Each of the software modules has its program logic and graphic interface closely connected together. Brief descriptions of the modules are given below:

Network topology analysis

This is the basic module of the PMS application and is required for all PMS functions. This module determines the number of sub networks existing in the network at any time, based on the position of circuit breakers. The output of the topology analysis, the present network configuration status is an input for all the PMS applications.



Load shedding

Disturbances in the power balance that require load shedding are usually caused by loss of generated power. The tripping of a critical circuit breaker, disconnecting generation from load, in almost every case causes the loss.

The load shedding module calculates the Power balance in the network and determines the power to be shed as below:
PToBeShed = PLoad – (PGeneration + PSpinningReserve)

When the result is positive, the power to be shed will be compared to the priority load list for identifying the load feeders to be tripped when required.

The command generating modules issue shed commands to all loads with the lowest priority up and until the calculated

priority when triggered by pre-defined events.

Based on the status of tiebreaker / bus couplers there can be a different number of electrical networks that work independently. The load-shedding module calculates the power balance for each individual electrical network.

Under frequency load shedding

Under frequency load shedding acts as a backup to the fast load shedding. PMS module for under frequency load shedding, receive the under frequency operate signals from relays and triggers the load shedding. Predetermined load values get shed as decided by the load priority table. Triggering can be under frequency or df/dt.

Manual load shedding

This module gives the operator a control over the load shedding the trip the loads manually to maintain the power balance. PMS allows the operator to either select the load feeders to be tripped or the amount of load to be tripped.

On line Load shedding simulation

A simulation module is available in PMS for simulating the load shedding functionality in online mode without issuing any commands to the field. Operator shall be facilitated to create load shedding triggering conditions and the system shall give out the response of the load shedding application i.e. amount of load to be shed, number of priorities to be shed etc.

Active Power/frequency control

The Active Power Control module performs frequency control and active power flow control at an exchange point with the grid. It monitors the actual network configuration and sends an active power set point to the participating generators to:

- Maintain the bus bar frequency at a pre-defined value if that particular network is isolated.
- Or maintain an active power flow between a particular network connected to the grid

Reactive Power/voltage control

The Reactive Power Control module performs voltage control and reactive power flow control at an exchange point with the grid. It sends reactive power set point to the participating generators and/or transformer to:

- Maintain the bus bar voltage at a pre-defined value. Maintain a reactive power flow between a particular network and the grid, or another network.
- Maintain the powerfactor at the exchange point when connected with the grid..

Mode management

This module checks the operating modes of the equipments participating in the active/reactive power control. It takes care of the interlocks regarding the modes of

operation of the equipments. One example is:

All the generators can not be in fixed MW/MVar mode as there should be at least one machine to take care of the load variations.

Generator control

This refers to the equipment level control. Based on the setpoints generated by the active/reactive power control modules, this module shall give the raise/lower commands to the governors and AVRs considering the present MW and MVar working point.

Breaker synchronization

This module achieves synchronizing critical network breakers in PMS. Generally the circuit breakers controlled by this module are:

- Grid connecting breaker
- Generator breakers
- Bus couplers
- Tie feeders

It requires a synchronizing relay, which compares the frequency, voltage and phase sequence. The application gives the inputs to the relay like:

- The breaker selected
- PT selection details

The application passes the commands from the relay to the generators participating in synchronization.

Breaker an Bay control

Separate program modules handle the circuit breaker control and bay control. The program handles general interlocks. Operator dialogs provide information and control facility for the operator with defined security.

OLTC

PMS module for On Load Tap Changer (OLTC) has got Operator dialog for information and control along with an associated controller program. It receives tap changer position input and sends raise/lower commands to the tap changer.

PMS on OEM Platforms

The PMS application modules for various functionalities are basically PLC programs and HMI objects designed as reusable library. The PLC programs are developed in standard IEC 61131-3 languages, mainly Structured Text (ST), Sequential Function Chart (SFC) and Function Block Diagrams (FBD).

Contact for More Information:

INDIA
Kalki Communication Technologies Limited, #147, 2nd Floor
5th Main Road,
Sector 7, HSR Layout, Bangalore 560034
Phone: 91-80-2572-1263/4
Fax: 91-80-25725473
Web: www.kalkitech.com
E-mail: sales@kalkitech.com

US
Kalki Communication Technologies Limited, 9900 Westpark Dr, Suite 284, Houston, TX, 77063,
Telephone: 1-315-219-4198
FAX: 1-313-557-4640
Web: www.kalkitech.com
E-mail: us_sales@kalkitech.com