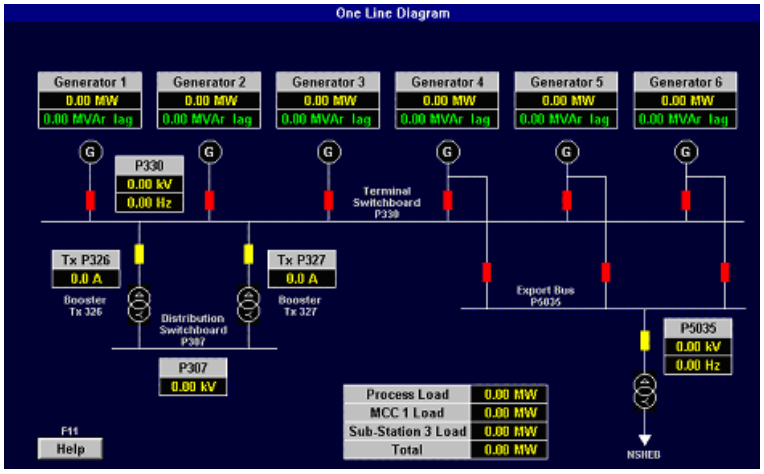


Proeon systems ltd.

Power Management Systems

Overview

Proeon Systems Ltd. embodies over 25 years experience in the design and implementation of complex high criticality control systems for a variety of industries.

Using a variety of Programmable Logic Controller (PLC) platforms, Proeon Systems Ltd. supply robust Power management and control systems. Programmable systems can dramatically increase the availability, reliability and performance over older analog, relay or hydro-mechanical systems. The systems have extensive diagnostics and communication facilities allowing easy interfacing to other plant equipment, SCADA systems or DCS platforms.

Our extensive experience with some of the major international Oil and Gas companies provides us with an understanding of the industry enabling us to implement control systems of the highest quality.

Key Points..

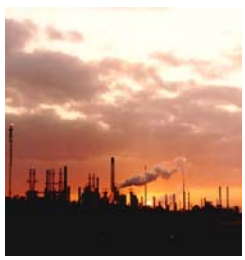
- PLC based PMS control systems using Rockwell and Siemens hardware
- Management of systems Frequency and Voltage control.
- Management of connected loads and prime movers
- Extensive communications to DCS and SCADA systems
- Integrated HMI facilities to allow the set-up of the PMS

Solutions

Proeon Systems Ltd. provides a complete Power Management System (PMS) solution to manage the connected loads and the prime movers using integrated Programmable technology to accurately monitor and control the power systems. The company uses industry standard controllers and is at the very forefront of machinery control and monitoring technology.

Facilities

The PMS is built around integrated high speed PLCs and local HMI systems to monitor, log and control the connected systems. The PMS has extensive communications capabilities to allow the connection of remote 3rd party equipment such as the switchgear and Turbine Control panels. The PMS may also be connected to host systems to allow data to be made available throughout the plant.

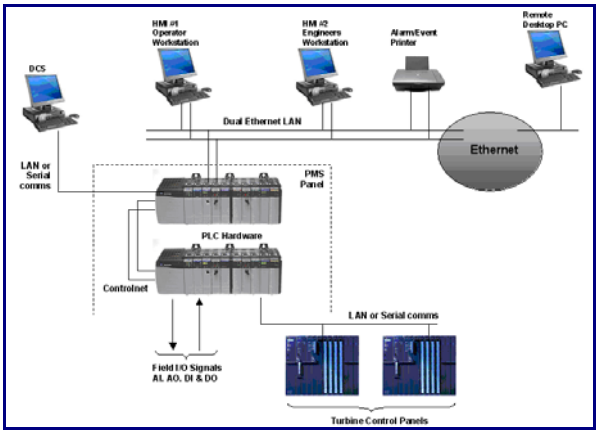


Innovatively Engineered Solutions

Proeon Systems Ltd.

PMS Structure

The PMS is based on a Programmable Logic Controller networked to one or more HMI workstations.



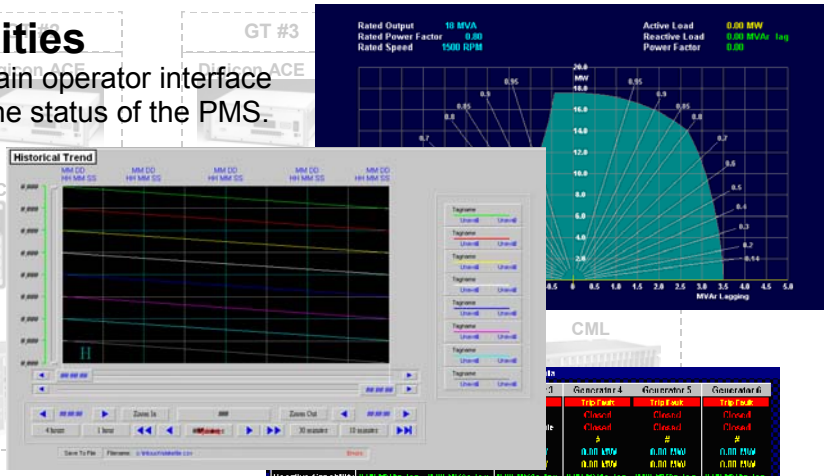
The controller interfaces to either local or distributed hardwired I/O to acquire CB status and power measurements etc. The PMS will also interface to the turbine control panels and the plant DCS or SCADA systems. The network may be integrated with plant-wide management system s and in addition alarm and SOE printers can be connected to provide hard records of alarms and events.

Integration

The PMS can be fully integrated with the turbine control panels and programmable governors to de-rate the available generator capacity and to facilitate the remote start-up and shutdown of the turbine with the minimum of interfaces.

PMS HMI workstation facilities

The PMS HMI workstations act as the main operator interface for viewing, interrogating and adjusting the status of the PMS.



The PMS HMI workstations are provided with a set of graphics pages that typically include:

- Single line diagram and Circuit Breaker control
- System overview
- Generator overview
- Electrical system presets
- Generator presets
- PMS presets
- Generator scheduling
- Vector meter
- Alarm and event displays
- Historical trending displays

Generator MW and frequency control

The PMS will take control of any gas turbine driven generator sets that are selected. The control signals are derived directly from each local Turbine Control Panel (TCP), with the generator circuit breaker also being available for the PMS to control.

Voltage and frequency sensing will be derived from the generator's AVR input supplies. Where the bus coupler circuit breaker is open, the PMS will recognise this and control each half of the power system independently.

The PMS controls the steady state frequency of the system to a demand set point by sending appropriate set point Raise and Lower signals to the TCP controllers. The desired system frequency and parameters are set through the PMS workstation to provide stable control.

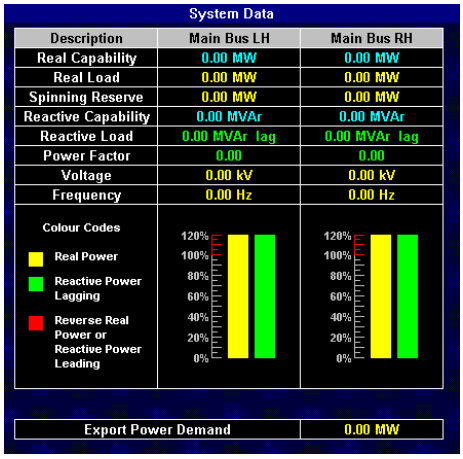
Real Power (MW) load sharing is achieved by adjusting the turbine governor set points in order to

equalise the ratio of powers between interconnected sets. The ratio of powers is determined by calculating the real power load on each set as a proportion of its MW capability.

The PMS can also be configured to 'base load' one or more of the connected sets. In this mode, the operator defines the percentage of the generators rated load that it is to deliver. Assuming that the system load is high enough then the PMS will adjust the turbine governor set point to achieve this loading.

The ability of the PMS to control system frequency will be affected by any on-line generators which are not integrated into the PMS.

Generator MVAr and voltage control



The PMS will control the steady state voltage of the system to a demand set point by sending appropriate voltage set point Raise and Lower signals to the AVR.

The desired system voltage and parameters are set through the PMS workstation to achieve stable voltage control.

Reactive power (MVAr) load sharing is also achieved by adjusting the AVR set points in order to equalise the ratio of reactive powers between interconnected sets. The ratio of powers is determined by calculating the reactive power load on each set as a proportion of its MVAr capability.

Generator capacity calculation

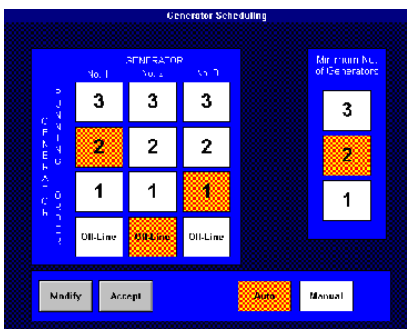
The rated capacity of each generator will be determined during commissioning and the PMS uses this value for load sharing and to calculate the available spare power of the distribution system. The PMS will determine when to start and stop generators and how much load to shed under fault conditions. Reactive power capacity is calculated from the generator's real power capability and the rated power factor of the alternator.

Facilities are provided through the PMS workstation to manually de-ratie the turbine capability from its base rating. This allows the operator to compensate for such factors as mechanical wear.

The PMS will also accept an analogue signal from the TCP to de-rate the turbine capability due to turbine parameters such as ambient air temperature and pressure. The PMS can accommodate the calculations necessary for dual fuel systems.

Faulty generator replacement

If the PMS receives a generator warning signal from the TCP, it will act to remove that set from the power system before its condition deteriorates and the generator trips. The PMS will start a new generator if one is available, synchronise it to the main bus bars and close the generator circuit breaker. Load will then be transferred automatically from the faulty generator to the new set.



When the load on the faulty generator is near zero, its circuit breaker will be opened and the associated turbine shut down.

Load shedding and load control

However carefully a power system is operated, there will be occasions when the system will be overloaded through equipment failure or operator error. In order to maintain the essential supplies it may be necessary to shed non-essential loads.

The PMS can monitor the status of the loads and the power being taken by each. When load shedding becomes necessary, only sufficient load to clear the overload will be disconnected, with the sequence of shedding being set by the operator.

The load monitoring system will prevent loads from being started up though start-inhibit commands to the motor starters of distribution boards.

Load shedding may be necessary in the following situations:

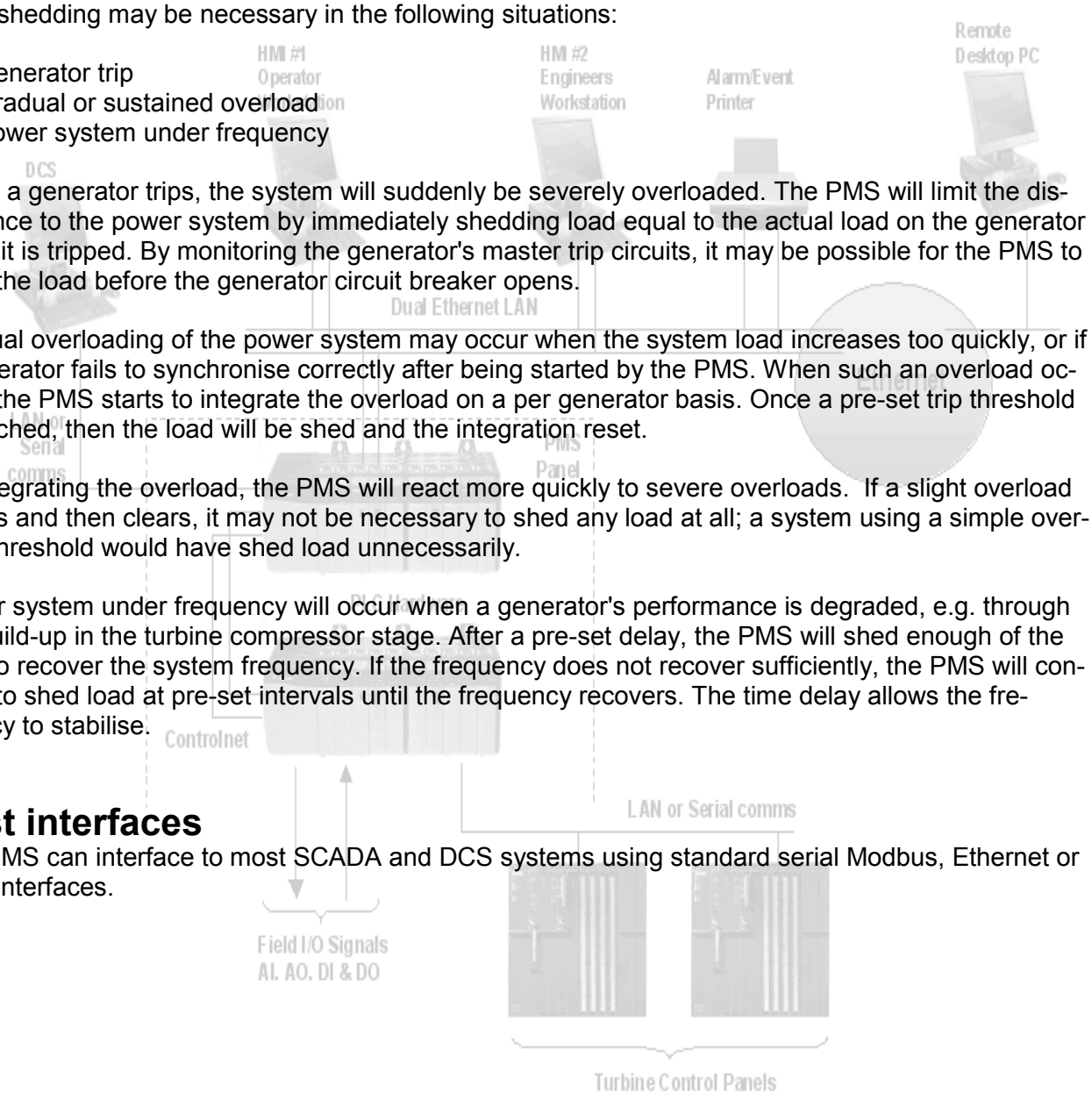
- Generator trip
- Gradual or sustained overload
- Power system under frequency

When a generator trips, the system will suddenly be severely overloaded. The PMS will limit the disturbance to the power system by immediately shedding load equal to the actual load on the generator when it is tripped. By monitoring the generator's master trip circuits, it may be possible for the PMS to shed the load before the generator circuit breaker opens.

Gradual overloading of the power system may occur when the system load increases too quickly, or if a generator fails to synchronise correctly after being started by the PMS. When such an overload occurs, the PMS starts to integrate the overload on a per generator basis. Once a pre-set trip threshold is reached, then the load will be shed and the integration reset.

By integrating the overload, the PMS will react more quickly to severe overloads. If a slight overload occurs and then clears, it may not be necessary to shed any load at all; a system using a simple overload threshold would have shed load unnecessarily.

Power system under frequency will occur when a generator's performance is degraded, e.g. through dirt build-up in the turbine compressor stage. After a pre-set delay, the PMS will shed enough of the load to recover the system frequency. If the frequency does not recover sufficiently, the PMS will continue to shed load at pre-set intervals until the frequency recovers. The time delay allows the frequency to stabilise.



Host interfaces

The PMS can interface to most SCADA and DCS systems using standard serial Modbus, Ethernet or OPC interfaces.

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