

Synchronizing Systems

AGN Technology brings alternative solution to energy projects by using synchronizing systems. With combining more than one generator for your high KVA needs, this system provides significant advantages comparing against single generator with same power. Especially the synchronization panel that design by AGN Technology engineers offers integrated solution through customers with its technology. AGN Technology developed lower priced systems and show its difference by using its technical expertness, global resources and its production methods for obtaining high energies with synchronization of more the one generator against all kinds of scenarios.



More generators far more advantage:

The system that is using synchronization generator has much more advantages than using one high power generator. These are:

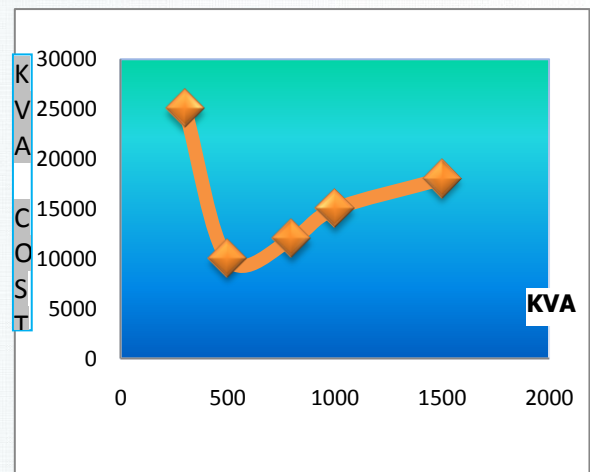
- ❖ Lower cost
- ❖ Cost comparison
- ❖ Lower first investment budget
- ❖ Flexible usage
- ❖ Sustainable and reliable system
- ❖ Easier service and maintenance
- ❖ Easier delivery and maintain spare parts



Lower cost:

Synchronization systems with its other advantages present a serious price advantages comparing against one high power generator. The engine manufactures, the engine that have power up to 625 KVA own a wider usage area. Because of its wide usage in work machines, Lorries and trucks, they have much more production numbers, and there assembly line designed for mass production which creates lower prices than high power engines. The high power engines mostly use in specific project which decrease their production numbers and increase their cost.

- ❖ If you look at the chart you will see the most economic power interval is in 300KVA-800KVA. Because the high demand of these models, production line is adjusted for these models which decrease their production costs.
- ❖ The synchronization systems lower cost also eligible for its spare parts and expenditure necessities.
- ❖ With a result of the high power engines mostly worked under recommended power load, some serious problems appear. These problem increase maintenance cost and smaller generator life. With its flexible work load logic synchronization systems prevent problems and minimize maintenance cost.
- ❖ AGN Technology synchronization systems bring 15% to 20% price advantages in first investment cost and also operational spending.



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction

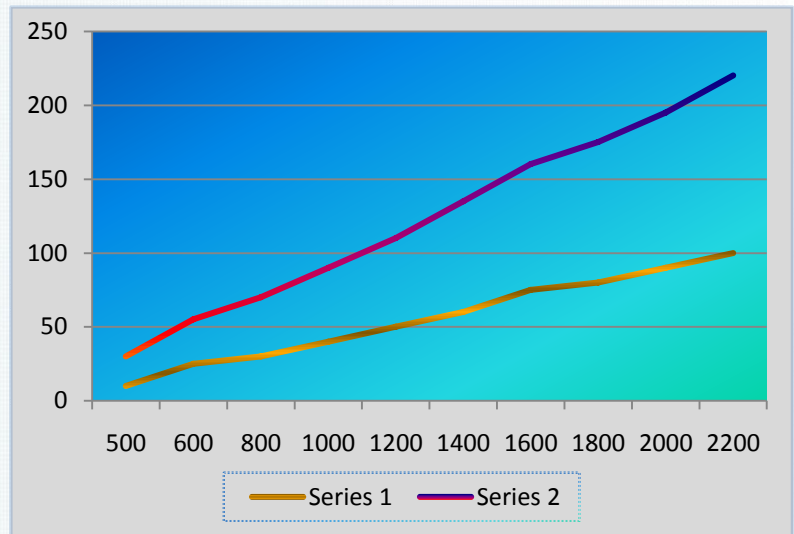


Overview

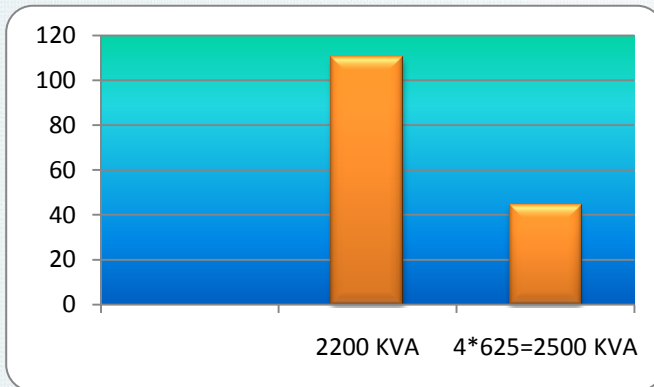
Cost comparison:

As you can see the comparative cost graphic the synchronization systems which gathered from different KVA models bring more advantages both in purchase and also after sale.

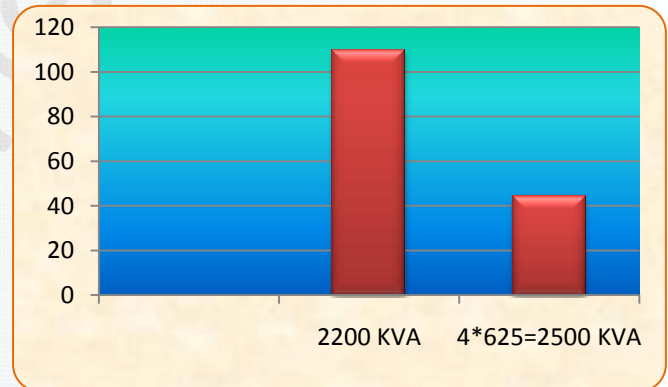
- ❖ **Series 1** represents the cost of synchronization systems for same 2200 KVA power (4x625KVA=2500KVA)
- ❖ **Series 2** represents the cost of one single generator for same 2200KVA power.



Cost Comparison between approximately 2200KVA Synchronization system and single generator with same power.



Maintenance Cost



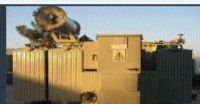
Investment cost

Lower first investment budget:

In the investments that predict a fast growth, purchasing a high power generator at establishment increases the first investment budget. By preferring AGN Technology synchronized systems you can start by purchasing lower power generator which decreases the first investment budget. According to the growth rate you can add generator in various numbers and powers which establish a problem free, flexible system.



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



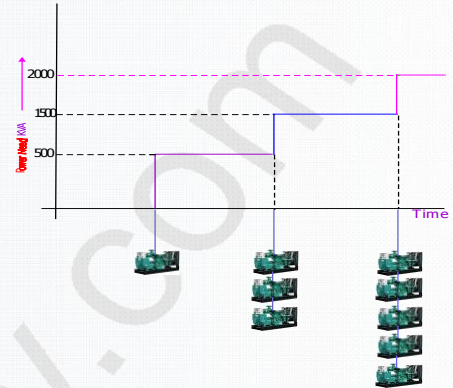
Civil Construction



Overhead

Flexible usage:

We can approach to flexible usage of AGN Technology synchronization systems from both logistic and functional point of view.



On the contrary of common belief synchronization system can be synchronized not just in equal powered generators but also be different powered models. As a result of this application a flexible solution is created for changing power at different time a day. In a hotel that need intense power at summer time, is not also going to need some power at winter time. With the synchronization of different powered generators the intense power need of summer cover by high and small generator synchronize on the other hand you can use the lowered power single generator according to complete the power for the off seasons. Thus fuel expenditures and corrosion are minimized.

In logical point of view, multiple generator systems create substantial advantages for difficulties about setting up systems against single large generators.

The synchronization generators are smaller and lighter so this create an advantage about set ups. AGN Technology does not have to positioning units side by side. Because of this there will be serious advantages by positioning units in different small rooms and connecting them with wire in common feeding line.

Sustainable & reliable system:

If you think about continuity of energy synchronization systems offers more sustainable and reliable than single generator. If any reason if one generator shutdown you can continue to nurture critical energy needs with load take/give system.

Easier service and maintenance:

With the standard co-aging process in multiple generator systems, every generator working time decreases. With this process the synchronized systems utilization time and revision periods increase but execution and maintenance cost decrease.

Synchronization systems also create flexibility at after sale service. In these systems generators can be taking into services while they are still operating. With right scheduling for determining lower workload period, power cuts which caused from maintenance service can prevent. Power cuts can also prevent by shutting one generator and giving the critical load to other synchronization generator.

Easier delivery and maintain spare parts:

Higher powered generators have much longer delivery time because they manufactured only by special order and limited manufacturer numbers. Serial production engines high demand numbers and their big stocks make easier for short time deliveries.



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



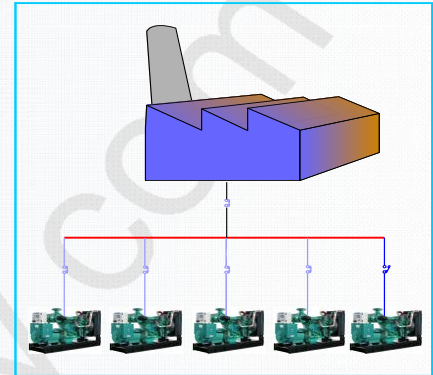
Civil Construction



Over

APPLICATIONS

Multiple generator application for prime power:



In a situation that there is no network energy, two or more synchronization generators feed energy loads constantly and these loads divided among generators by their power ratios. Generator sets allow for economic usage by switching on or off according for the energy needs

Multiple generator application for standby power:

When the mains energy crosses its limits two or more synchronized generators feed energy loads by their power ratio. After the mains power stabilized energy loads transfer to mains step by step.



Soft transfer:

When the mains energy crosses its limits two or more synchronized generators feed energy loads by their power ratio. Generator sets switching on and off according to economical usage of management's workload. If the mains energy becomes useable again than the control system will be synchronized generator or generator sets with system. In short notice synchronized systems uninterruptedly transfers its load to the mains with a platform. This procedure is mostly needed when a system in an energy production stations demands power restoration after its collapse (trip). Generator or generator sets feed station furnishings; after the station starts to produce energy, it transfers it's with soft transfer. This application has known as "black start".

Constant parallel working:

Because of distribution company's change of tariffs during a day, performing high price tariff if the assessment value crossed or forced to limiting electrical energy as a result of inadequate groundwork; staying in constant parallel working with network could be advantageous for customers. There are some different working methods for parallel working. One of them is base load peak lopping in which active load supplied by generator system at intended power factor and other by mains system. This system is very popular among cogeneration systems which prefer constant load. Another method is true peak lopping in which power that supplied from network limited and upper power of this limitation supplied from generator. This method is mostly using in when the tariff price for an upper limits of a specific power is too high or when the supplied power is limited.



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



Over

Multiple mains:

In the managements with two or more mains when the mains system collapses generator system become synchronized and start to feed load. To feed load from single bar which feed from two transformers, coupling cutters is shouted down. When the mains connected with bus-bar then the load transfer to this mains transmission line

AGN Technology synchronization control:

AGN Technology uses its own designed synchronization control panel in generator sets for synchronization and sharing workload.



For different synchronization application AGN Technology the following solutions are offered –

- ❖ Multiple generator sets synchronization between them (ATSP09 x generator number)
- ❖ One generator sets synchronization with network (ATSP08)
- ❖ Multiple generator sets synchronization with network (ATSP09 x generator number + ATSP08)
- ❖ Multiple generators sets synchronization with multiple network (ATSP09 x generator number + ATSP x network number)



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



Over

ATSP09 SYNCHRONIZATION CONTROL PANEL SPECIFICATIONS

Load properties:

- ❖ Automatic and manual synchronization
- ❖ Can synchronized until 10 generators among themselves and feed the workload
- ❖ Load sharing at generators according to power
- ❖ Automatically start and stop according to load
- ❖ Automatically balancing work hours (co-aging)

Communication properties:

- ❖ Communication over (AQ) bus-bar with electronic engine control units (optional)
- ❖ Alarm message with SMS (optional)
- ❖ Open communication over RS 232 or RS 485 interface
- ❖ Support Motbus RTU protocol (concordant with scada system)

Indicator properties:

- ❖ LCD text indicator
- ❖ All engine and alternator parameters can be watched
- ❖ Engine and alternator protection
- ❖ Keep the records of generator alarms, last 25 records
- ❖ Expansion modules (in and out)

With LCD screen in ATSP09 synchronization panels you can measure the following rates and with the stated protection, system reliability put in first place.

MEASUREMENTS

Direct measures:

- ❖ Oil pressure
- ❖ Coolant temperature
- ❖ Fuel level (optional)
- ❖ Oil temperature (optional)
- ❖ Accumulator voltage
- ❖ Engine circulation
- ❖ Generator frequency
- ❖ Generator phase-neutral voltage
- ❖ Generator inter-phase voltage
- ❖ Generator phase current
- ❖ Generator earth current (optional)
- ❖ Generator phase sequence

Expandable measurements:

- ❖ Generator total active power (KW)
- ❖ Generator total visible power (KVA)
- ❖ Generator total reactive power (KVA_r)
- ❖ Generator average power factor (cosΦ)



2000 kVA Diesel Generator



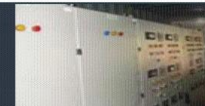
5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



Overhead Power Line

Hidden measurements:

- ❖ Actual time
- ❖ Left time for the next (maintenance)
- ❖ Generator positive KWh
- ❖ Generator negative KWh
- ❖ Generator KVAh
- ❖ Generator KVArh
- ❖ Number of starter
- ❖ Maximum positive vector slide
- ❖ Maximum negative vector slide

SYNCHRONIZATION CONTROL PANEL PROTECTION SYSTEM

Engine protection:

- ❖ Low oil pressure
- ❖ High coolant water temperature
- ❖ High oil temperature (optional)
- ❖ Low/high frequency cycle
- ❖ Battery charger rectifier error
- ❖ Low/high accumulator voltage
- ❖ Low/high fuel level (optional)

Alternator protection:

- ❖ Low/high voltage
- ❖ Low/high frequency
- ❖ Extreme voltage
- ❖ Earthling error (optional)
- ❖ Reverse power
- ❖ Wrong phase rotation of alternator
- ❖ Excitation loss

Circuit breaker protection:

- ❖ Generator switching off error
- ❖ Generator switching on error

ATSP08 SYNCHRONIZATION CONTROL PANEL SPECIFICATION

Load properties:

- ❖ Automatic and manual synchronization
- ❖ Synchronization with mains
- ❖ Workload sharing with peak topping or stable workload methods while working parallel with network
- ❖ Automatic starting of stopping according to load
- ❖ Automatically balancing work hours (co-aging)

Communication properties:

- ❖ Communication over (AQ) bus with electronic engine control units (optional)
- ❖ Alarm message with SMS (optional)
- ❖ Open communication over RS 232 or RS 485 interface
- ❖ Support Modbus RTU protocol (concordant with scada system)



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



Over

Indicator properties:

- ❖ LCD text indicator
- ❖ All engine and alternator parameters can be watched
- ❖ Engine and alternator protection
- ❖ Keep the records of generator alarms, last 25 records
- ❖ Expansion modules (in and out)

With LCD screen in T JPS20 synchronization panels you can measure the following rates and with the stated protection, system reliability put in first place.

MEASUREMENT SYSTEM

Direct measures:

- ❖ Oil pressure
- ❖ Coolant temperature
- ❖ Fuel level (optional)
- ❖ Oil temperature (optional)
- ❖ Battery charger rectifier voltage
- ❖ Accumulator voltage
- ❖ Engine circulation
- ❖ Generator frequency
- ❖ Generator phase-neutral voltage
- ❖ Generator inter-phase voltage
- ❖ Generator phase current
- ❖ Generator earth current (optional)
- ❖ Generator active power by each phase (kW)
- ❖ Mains frequency
- ❖ Mains phase-neutral voltage
- ❖ Mains inter-phase voltage

Expendable measurements:

- ❖ Generator total active power (KW)
- ❖ Generator total visible power (KVA)
- ❖ Generator total reactive power (KVAr)
- ❖ Generator power factor per phase ($\cos\Phi$)
- ❖ Generator average power factor ($\cos\Phi$)
- ❖ Network total active power (KW)
- ❖ Network total visible power (KVA)
- ❖ Network total reactive power (KVAr)
- ❖ Network power factor per phase ($\cos\Phi$)
- ❖ Network average power factor ($\cos\Phi$)

Hidden Measurements:

- ❖ Actual time
- ❖ Left time for the next maintenance
- ❖ Generator positive kWh
- ❖ Generator negative kWh
- ❖ Generator KVAh
- ❖ Generator KVArh
- ❖ Number of starter
- ❖ Maximum positive vector slide
- ❖ Maximum negative vector slide



2000 kVA Diesel Generator



5 MVA Transformer



VCB



5 ACB



Synchronized Electricity



Civil Construction



Overhead Power Line

PROTECTION SYSTEM

Network protection:

- ❖ Mains G59 low frequency
- ❖ Mains G59 high frequency
- ❖ Mains G59 low voltage
- ❖ Mains G59 high voltage
- ❖ Mains G59 trip
- ❖ Mains low/high voltage
- ❖ Mains error
- ❖ Mains wrong phase rotation direction

Engine protection:

- ❖ Low oil pressure
- ❖ High coolant water temperature
- ❖ High oil temperature (optional)
- ❖ Low/high cycle
- ❖ Battery charger rectifier error
- ❖ Low/high accumulator voltage
- ❖ Low/high fuel level

Alternator protection:

- ❖ Low/high voltage
- ❖ Low/high frequency
- ❖ Extreme voltage
- ❖ Earthling error
- ❖ Reverse power
- ❖ Wrong cycling direction of alternator
- ❖ Excitation loss

Circuit breaker protection:

- ❖ Generator switching off error
- ❖ Mains switching off error
- ❖ Generator switching on error
- ❖ Mains Switching on error

ATSP09 + ATSP08 SYNCHRONIZATION CONTROL PANEL SPECIFICATION WORK LOAD PROPERTIES

- ❖ Automatic and manual synchronization
- ❖ In a system that generator and mains numbers limited with 20, it can synchronized with 10 generator and 10 network
- ❖ Load share among generators according to power and load share among generators while they are parallel situation with network with methods of stable load or puzzle lapping
- ❖ Automatic starting of stopping according to load
- ❖ Automatically balancing work hours (co-aging)

Communication properties:

- ❖ Communication over (AO) bus with electronic engine control units (optional)
- ❖ Alarm message with SMS (optional)
- ❖ Open communication over RS 232 or RS 485 interface
- ❖ Support Modbus RTU protocol (concordant with scada system)



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



Overhead Power Line

Indicator properties:

- ❖ LCD text indicator
- ❖ All engine and alternator parameters can be watched
- ❖ Engine and alternator protection
- ❖ Keep the records of generator alarms, last 25 records
- ❖ Expansion modules (in and out)

With LCD screen in ATSP09 + ATSP08 synchronization panels you can measure the following rates and with the stated protection, system reliability put in first place.

MEASUREMENT SYSTEMS

Direct measures:

- ❖ Oil pressure
- ❖ Coolant temperature
- ❖ Fuel level (optional)
- ❖ Oil temperature
- ❖ Accumulator voltage
- ❖ Engine circulation
- ❖ Generator frequency
- ❖ Generator phase-neutral voltage
- ❖ Generator inter-phase voltage
- ❖ Generator phase streams
- ❖ Generator earth stream (optional)
- ❖ Mains frequency
- ❖ Mains phase-neutral voltage
- ❖ Mains inter-phase voltage
- ❖ Mains phase streams
- ❖ Mains earth stream
- ❖ Generator earth stream leak
- ❖ Generator phase line
- ❖ Mains phase line
- ❖ Bus-bar phase-neutral voltage
- ❖ Bus-bar inter-phase voltage
- ❖ Bus-bar phase current
- ❖ Bus-bar active power per phase (KW)

Derive measures:

- ❖ Generator total active power (KW)
- ❖ Generator total visible power (KVA)
- ❖ Generator total reactive power (KVAr)
- ❖ Generator average power factor ($\cos\Phi$)
- ❖ Mains total active power (KW)
- ❖ Mains total visible power (KVA)
- ❖ Mains total reactive power (KVAr)
- ❖ Mains power factor per phase ($\cos\Phi$)
- ❖ Mains average power factor ($\cos\Phi$)
- ❖ Bus-bar total active power (KW)
- ❖ Bus-bar total visible power (KVA)
- ❖ Bus-bar total reactive power (KVAr)
- ❖ Load total active power (KW)



2000 kVA Diesel Generator



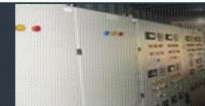
5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



Overhead Line

- ❖ Load total reactive power (KVAr)

Hidden measures:

- ❖ Actual time
- ❖ Left time for the next maintenance
- ❖ Generator positive kWh
- ❖ Generator negative kWh
- ❖ Generator KVAh
- ❖ Generator KVArh
- ❖ Number of starter
- ❖ Mains positive kWh
- ❖ Mains negative kWh
- ❖ Mains KVAh
- ❖ Mains KVArh
- ❖ Bus-bar positive kWh
- ❖ Bus-bar negative kWh
- ❖ Bus-bar KVAh
- ❖ Bus-bar KVArh
- ❖ Maximum positive network ROCOF
- ❖ Maximum negative network ROCOF
- ❖ Maximum positive vector slide
- ❖ Maximum negative vector slide

PROTECTION SYSTEMS

Network protection:

- ❖ Mains active power limit
- ❖ Mains G59 low frequency
- ❖ Mains G59 high frequency
- ❖ Mains G59 low voltage
- ❖ Mains G59 high voltage
- ❖ Mains G59 trip
- ❖ Mains low/high voltage
- ❖ Mains low/high frequency
- ❖ Mains error
- ❖ Mains wrong phase rotation

Engine protection:

- ❖ Low oil pressure
- ❖ High coolant water temperature
- ❖ High oil temperature (optional)
- ❖ Low/high cycle
- ❖ Battery charger rectifier error
- ❖ Low/high accumulator voltage
- ❖ Low/high fuel level

Alternator protection:

- ❖ Low/high voltage
- ❖ Low/high frequency
- ❖ Extreme voltage
- ❖ Earthling error
- ❖ Reverse power



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



Overhead Power Line

- ❖ Wrong phase rotation of alternator
- ❖ Excitation loss

Circuit breaker protection:

- ❖ Generator switching off error
- ❖ Network switching off error
- ❖ Generator switching on error
- ❖ Mains switching on error
- ❖ Bus switching off error
- ❖ Bus switching on error

LOAD SHEARING UNIT CONFIGURATION

C6200 is designed for installation in electrical switch board panels. The sturdy aluminum casing furnishes clear LED indication and easy accessible connection terminals.



C6200 offers the following functionality:

- ❖ Automatic synchronizing
- ❖ Load sharing (active/reactive)
- ❖ Detection of reverse power
- ❖ Detection of excitation loss
- ❖ Programmable I/O
- ❖ ROCOF relay
- ❖ Vector shift relay
- ❖ Frequency monitoring
- ❖ Direct control of electronic speed governors and AVR

C6200 is also equipped with a built-in synchroscope convenient in service and commissioning situations.

The C6200 furthermore provides various interface options such as MODBUS for external PC and PLC control and 10 User configurable digital and analogue inputs and outputs that can be set for designated extended functionality.

C6200 is a generator controller comprising auto synchronizing, load sharing and versatile interfacing to speed governors and AVR in one single unit.

APPLICATIONS:

The C6200 is a cost effective solution for grid-parallel generator operation. The unit is well suitable for use in:

- ❖ Co-generation applications including peak shaving or base load operation in heavy energy consuming industries, like oil refineries, petrochemical refineries, steel mills, mines, cement factories, food processing, etc.
- ❖ Back-up power systems where down-time is critical for safety or economic reasons, like in hospitals, airports, cable ways, energy generation and distribution, processing of food and pharmaceutical products, storage of food and pharmaceutical products, etc.
- ❖ Container enclosure gen-sets offered by rental companies for temporary use.



2000 kVA Diesel Generator



5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



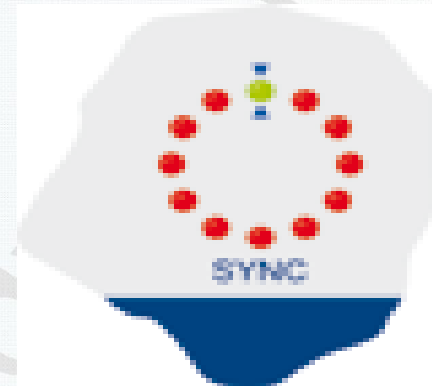
Ove

Speed control, voltage control:

C6200 can control speed governors and automatic voltage regulators (AVR) by speed/ voltage up/down pulses, analogue voltage and current signals and pulse width modulated signals PWM.

Synchronizing:

C6200 is equipped with a built-in synchroscope for manual or semi-automatic synchronization, convenient for service and commissioning situations. Automatic synchronization is a standard function of C6200. It is possible to synchronize complete bus bar sections to each other.



Voltage matching and frequency control:

C6200 can control both voltage and frequency of the generator.

Active load (KW) sharing:

Control parallel operation of generators. The unit can run in parallel with other generators controlled by SELCO C6200

Reactive (KVAR) load sharing:

Reactive load sharing between generators controlled by SELCO c6200.

Generator protection:

Reverse Power Protection and loss of excitation protection are standard features of C6200.

For grid parallel operation a vector shift or ROCOF protection can be activated.



Load depending start and stop:

C6200 offers 8 programmable inputs and outputs. The outputs can be programmed to load depending start and stop functions. In case the load of the running generator increases above a predefined limit, the next available generator will be started. In case the load drops below a predefined limit, the next generator will be stopped. The specific generator priority is given by external selector switch on inputs 1-4.



2000 kVA Diesel Generator



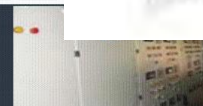
5 MVA Transformer



VCB



ACB



Synchronized Electricity



Civil Construction



Overhead

Operation of generators running in parallel with the grid active load (KW) control:

During grid parallel operation the load of the generators can be controlled without additional equipment. Both peak shaving and base load of the generator are possible. In peak shaving mode load depending start and stop is also available.

Reactive load (KVAr) control:

C6200 offers power factor control. During grid parallel operation the power factor of the generator can be kept constant. The C6200 includes predefined import/export load control schemes that can be activated/ deactivated from the programmable inputs, so generators that sometimes run island mode and sometimes in parallel with the grid can easily be controlled with almost no additional wiring.

Analogue outputs:

Two analogue outputs are available and can be configured as measurement transducer outputs. Any of the measurements can be connected to these outputs.

RS485 Modbus communication:

The C6200 includes RS485 Modbus interface, enabling external control by PC or PLC systems.



2000 kVA Diesel Generator



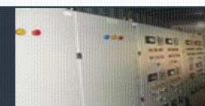
5 MVA Transformer



VCB



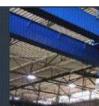
ACB



Synchronized Electricity



Civil Construction



Over