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DG SYNCHRONIZING & AMF PANEL

Clients –Bharat Petroleum Corp.Ltd

PROJECT- DG Synchronization panel with AMF function.

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DG SYNCHRONIZING & AMF PANEL

USER HANDBOOK

TABLE OF CONTENTS

<u>CHAPTER – 1</u>	4
<u>Leading Particulars and General Data</u>	5
<u>1.1 System Configuration</u>	5
<u>CHAPTER – 2</u>	6
<u>Brief Technical Description</u>	7
<u>2.1 Function of AMF Panel</u>	7
<u>2.2 Function of DG Synchronizing Panel</u>	8
<u>CHAPTER – 3</u>	09
<u>Operating Instructions</u>	09
3.1 DG Synchronizing in Auto Mode	10
3.1.1 DG Synchronizing in Auto Mode in Night	10
3.1.2 DG Synchronizing in Auto Mode in Day	10
3.2 AMF with DG Synchronizing in Manual Mode	13
3.3 AMF with DG Synchronizing in Dayl Mode	16
3.4 AMF with DG Synchronizing in Night Mode	18

• CHAPTER – 1
Leading Particulars and General Data

Leading Particulars and General Data

DG Synchronizing System to be used to power saving and Start and Stop DG as per required load in auto AMF function. From this system we can save fuel consumption of DG, wastage of power, DG protection, auto load sharing. On AGC controller screen we can see the status of system as below..

DG power , total run hour .

DG voltage , current , frequency.

DG load .

BUS Voltage , Frequency.

Alarms.

SLD status with led indication.

voltage, Phase sequence and Phase angle, If all the required data is ok then Controller will start DG otherwise it stop DG.

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- **System Configuration**

Items	Quantity
Generator controller With Synchronization	3
Generator Controller without sync with AMF	1
AMF Controller	1
DG Sync Controller Panel With Above	1

- **CHAPTER – 2**
- **Brief Technical Description**

Brief Technical Description

DG Synchronizing Panel System to be Start DG as per required load. Basically it can be operated By Auto Mode and Manual Mode. As per required Load we can change Consumption mode it Night Mode and Day Mode. In Night production is very less so we activate 125 KVA DG, but in Day Mode load is much more than night so we activate 250 KVA DGs, In day Mode first and second DG 250 KVA will start and if load in field is more then automatically 3rd DG 250 KVA will be start automatically start and sync and start load sharing with already running two DGs.

In Case we want to operated DG BY Manual mode, in this mode you start DG one By one through push bottom on controller and close breaker from DG controller button or from PCC panel. If you start 2nd DG in this mode then at the time of breaker closing from DG controller button it will sync before closing breaker.

2.1 Function of DG synchronizing panel

DG Sync functions can be summarized in the following way-

- Auto Mode
- Manual Mode
- Day Mode
- Night Mode

2.2 Functional Description

AMF SYSTEM:-

The abbreviation of AMF is Auto Mains failure, it means if the main supply will fail then AMF panel will start DG but main condition is DG Sync controller should be in AUTO mode and in healthy condition.

- DG Panel should be in power on.
- DG controllers should be in auto.
- Day or night mode should be selected.
- DG controller should be in healthy condition there should be no alarm.
- Emergency button should be release condition.
- All mobs that behind the PCC panel should be on for acceptance command from DG controllers.
- All DG should be in healthy condition and ready for receiving the command from panel
- DG panel front door should be locked for safety.

• CHAPTER – 3
OPERITING INSTRUCTIONS

3.1 AMF WITH DG SYNCHRONIZING IN AUTO MODE:-

STARTING:-

AUTO

MANUAL

AUTO MODE IN DAY

FIRST STEP

START

INACTIVE

READY

START



SECONDE STEP AS PER REQUIRED LOAD

START

INACTIVE

START

START



- PRE CONDITION SHOULD BE OK AS ABOVE DESCRIBED IN POINT.....
- If mains supply fail
- AMF activate as per day or night mode selection.
- 1st dg of group will start and charge the BUS.
- 2nd DG start and close 2nd DG breaker after sync.
- Continue running with load sharing until mains resume or more load require.
- If more power required
- Then 3rd DG will start and close breaker after sync.

- If mains supply resume.
- Then DGs will stop one by one.
- All three DG breakers will open and main breaker will close and charge BUS.
- All DG will stop after cooling
- System will ready for next cycle.

AUTO MODE IN NIGHT

ACTIVE

INACTIVE

INACTIVE

INACTIVE



- If mains supply fail
- AMF activate 4th DG 125KVA
- 4TH DG will start and charge the BUS.
- Continue running with load sharing until mains resume or more load require.
- If mains supply resume.
- Then DGs will stop.
- System will ready for next cycle.

3.2 DG SYNCHRONIZING IN MANUAL MODE:-

AUTO

MANUAL

STEP-1

READY

READY

READY

READY



STEP-2

READY

START

READY

READY



STEP-3

READY

START

START

READY



STEP-4

READY

START

START

START



- PRE CONDITION SHOULD BE OK AS ABOVE DESCRIBED IN POINT.....
- If mains supply fail
- AMF activate as per day or night mode selection.
- As per required load 1st DG will start by manually and charge the BUS.
- If load is more and 1st DG not full fill the load then
- 2nd DG start and close manually 2nd DG breaker after sync.
- Continue running with load sharing until mains resume or more load require.
- If more and more power required
- Then 3rd DG will start manually and close breaker after sync.
- If mains supply resume.
- Then DGs will stop one by one manually.

- All three DG breakers will open and main breaker will close and charge BUS.
- All DG will stop after cooling
- System will ready for next cycle.

3.3 AMF DG SYNCHRONIZING IN DAY MODE:-

DAY MODE

NIGHT MODE

STEP-1

INACTIVE

START

START

READY



STEP-2

INACTIVE

START

START

START



- PRE CONDITION SHOULD BE OK AS ABOVE DESCRIBED IN POINT.....
- If mains supply fail
- AMF activate as per day or night mode selection.
- 1st dg of group will start and charge the BUS.
- 2nd DG start and close 2nd DG breaker after sync.
- Continue running with load sharing until mains resume or more load require.

- If more power required
- Then 3rd DG will start and close breaker after sync.
- If mains supply resume.
- Then DGs will stop one by one.
- All three DG breakers will open and main breaker will close and charge BUS.
- All DG will stop after cooling
- System will ready for next cycle.

3.4 DG SYNCHRONIZING IN NIGHT MODE:-

DAY MODE

NIGHT MODE

START

INACTIVE

INACTIVE

INACTIVE



- PRE CONDITION SHOULD BE OK AS ABOVE DESCRIBED IN POINT.....
- If mains supply fail
- AMF activate as per day or night mode selection.
- 1st, 2nd and 3rd DG will stop.
- 4th DG start and close DG breaker.

- Continue running with load until mains resume or more load require.
- If mains supply resume.
- Then DGs will stop.
- All three DG breakers will open and main breaker will close and charge BUS.
- 4th DG will stop after cooling
- System will ready for next cycle.

SPECIFICATION FOR POWER MANAGEMENT SYSTEM

1. CONTROL PHILOSOPHY

1.1 Automatic Start & Stop of Engine:

1.2 Controller Logic for Auto Synchronizing ,Auto sharing & Auto Load Management including auto start / auto stop of DG Set

The system will come in operation after sensing of grid failure initiation of DG operation from Man machine interface to automatically control the start and stop of the engine, depending on the predefined load setting in the controller.

In case engine does not start in the first cranking, two more auto commands will be given with proper interval. Even then if engine fails to starts indication will appear on MMI (main machine interface). In the event, the engines are under loaded load sensed is capable of being catered by less then running engines, command will be given to engine running for shortest duration at the moment. Provision to select number of DG sets to be started at no load to cope up with sudden load without tripping ready the DG's.

2. Power Management Controller

The entire operation of the captive power generation system will be controlled automatically through a controller .These controllers will be state of art equipments using latest technology and of most rugged and reliable design. Since they shall be operating in the harsh & unfriendly environment of DG room, they will be suitable to operate trouble free in those conditions. The chosen equipment will be able to withstand high temperature, humidity and voltage fluctuations, thus making it suitable for the operating conditions described above and will perform the following functions

Controller will have capability to handle multi GRID System.

Tripping of less priority loads in the plant in case of under frequency of bus both in isolation as well as synchronized mode.

Control of all the auxiliary drive of DG set will Auto Synchronizing, start / stop automatically with proper interlock.

Controller system shall have provision to test the DG in auto mode without closing the braker to do the routine electrical / mechanical testing of set without interruption to power generation.

The System supplier will supply built drawing. Along with trouble shooting and operation and maintenance guidelines.

2.1 Controller will have these protections for Generator.

Protection	ASNI Code	Protection	ASNI Code
Under/Over Voltage	27P/59P	Reverse Power	32R
Under/Over Frequency	81U/81O	Voltage dependent Over Current	51V
Short Circuit	50P/N	Unbalance Voltage	47
Over Current	51	Unbalance Current	46
df/dt	81R(ROCOF)	Under Excitation	32RV
Vector Surge	78	Over Excitation	32FV
Over Load	32	Over Speed	12
Low Battery Voltage	27 DC	High Battery Voltage	59DC
Phase Sequence Error	47	Hz/V Failure	53
Earth Fault	51N		

3.0 GRID Controller: - The entire operation of the captive power generation system will be controlled automatically through a controller.

Separate Controller is required for Transformer breaker Control.

These controllers will be state of art equipments using latest technology and of most rugged and reliable design. Since they shall be operating in the harsh & unfriendly environment of DG room, they will be suitable to operate trouble free in those conditions. The chosen equipment will be able to withstand high temperature, humidity and voltage fluctuations, thus making it suitable for the operating conditions described above and will perform the following functions

Controller will have capability to handle multi GRID System.

On the occurrence on abnormal condition in Voltage / Frequency/ Phase Sequence Controller will open the GRID breaker & start give the start command to DG on CAN communication to DG controller & after receiving the start Command DG will start & synchronized.

When the GRID power resume & after GRID stable timer expiration DG will Stop & GRID Side controller will close the GRID Breaker after checking the all condition.

If GRID Synchronization is required GRID side controller is capable to synchronize the GRID breaker with DG in forward & reverse synchronization condition.

Protection	ASNI Code	Protection	ASNI Code
Under/Over Voltage	27P/59P	Reverse Power	32R
Under/Over Frequency	81U/81O	Voltage dependent Over Current	51V
Short Circuit	50P	Unbalance Voltage	47
Over Current	51	Unbalance Current	46
df/dt	81R(ROCOF)	Under Excitation	32RV
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Phase Sequence Error	47	Hz/V Failure	53

Controller will have capability to handle multi GRID System.

5.0 Communication for PC Based Software & BMS connectivity

- 1 CAN Communication J1939
- 2 Modbus(RS-485)
- 3 Ethernet Communication(Optional)

5.1 Controller Will be 3 Phase Synchronization

3 Phase Generator Voltage

3 Phase Bus Voltage

6.0 Auto Mode

a) System Operation

While the normal mains supply is healthy, the DG set shall be at rest and the load shall be supplied by mains. During this period all the bus couplers shall be in OPEN position.

The controller system shall monitor supply voltage on each phase. When the mains supply fails completely or falls below set value (variable between 80% to 95% of the nominal value) on any phase, the monitor module shall initiate start up of diesel engine. To avoid initiation due to momentary dips or system disturbance, a time delay adjustable between 0.5 to 5 seconds (adjustable) shall be incorporated in the start up initiation.

A three attempt starting facility shall be provided with the sequence 6 seconds ON 5 seconds OFF 6 seconds ON 5 seconds OFF and 6 seconds ON. At the end of the third attempt if the engine has not been already started and built up voltage, engine shall be locked out for start. A master timer shall be provided for the function. An audio visual alarm shall be given.

Suitable adjustable timers shall be incorporated which shall make it feasible to vary independently ON-OFF setting periods from 1-10 seconds. If the alternator does not build up voltage after the first or any start, as may, further starting attempt shall not be made and the starting facility shall be reset.

Once engine has built up voltage, signals shall be provided to operate the alternator, mains and bus coupler circuit breakers as per logic sequence required. The Mains supply circuit breaker shall open before the alternator circuit breaker closes. Before giving close command to alternator breaker, all the bus couplers shall be given close command. At this point of time all the load shall be on one DG. System provided in the DG Synchronization control Panel shall check and ensure that all the engine auxiliaries like cub oil pump, CT fan, cooling water pump are running and healthy. In case of any fault in engine auxiliaries, the system shall automatically stop the DG set and an audio visual alarm shall be given. Suitable inputs for overload and

single phase preventor for alternator and for each of the engine auxiliaries shall also be considered as inputs for this function.

DG Synchronization control system shall continuously monitor total load on the DG set. In case the load on any of the DG sets is less than 60 % of the rated value, the controller shall assess the load on the adjacent DG set. In case the summation of the loads is within 90% of the rating of one of the DG sets, one DG set shall shut down and load shall be transferred to the second DG set.

In case the total load on the system is not more than 90% of the full load rating of a single DG set, the controller shall shut down due to non availability of adequate load and will the load increase, the controller shall automatically start the DG set and shall isolate the buses/loads on the Main LT panel bus.

The Automatic Load Management system shall be designed to provide optimum utilization of the DG sets so that operation of the DG sets is need based with higher load factor on each set. The system would therefore transfer loads from one bus to the other on the Main LT panel with Main L.T. panel as per logic sequence required. The controller shall ensure that that the ACB's on the closed and opened and DG sets are started and stopped according to the predetermined logic and interlocking scheme to provide a fail safe system.

When the voltage in the mains get restored, its quality shall be monitored for about one minute and if proven satisfactory, the main supply breaker shall close automatically for retransfer of the load from Diesel engine to the main supply at LT panel. However prior to this operation DG and bus coupler breakers shall open to ensure that all the bus couplers all the bus couplers are in open position before the mains breaker closed.

The Automatic Logic Management system shall also consider that in the eventuality of failure of any component of the controller, adequate safeguards shall be provided in that the system shall revert to the manual mode with visual and audible alarms. These safeguards and the system shall be detailed in the offer.

The Logic Panel shall automatically arrange for sequential starting of DG sets to be based on number of operating hours of each DG set so that to ensure that all DG sets are operated as equally as possible.

In case of over load on the DG system, the logic panel shall give audio visual alarm to enable the operators to switch off loads as required and if this is not taken care of in predetermined time, the Logic Panel shall put the DG in shut down mode with alarm.

The DG set shall stop after idle running of one minute after restoration of main supply.

The DG set reverts to standby conditions and is ready to start will the mains supply fail again.

b) Sequence of operation for Auto start, Auto load management & Auto Synchronizing

One failure of grid supply, DG-1 shall start automatically and close its breaker shall start feeding the load.

On DG-1 attaining its full rated capacity, DG-2 shall start automatically.

Voltage and frequency of DG-2 shall be monitored and necessary commands shall adjust the parameters of DG-2 with bus.

System shall also monitor the slip frequency and the beat voltage of the machine or system.

The above sequence shall be followed for subsequent DG's.

It shall be possible to alter sequence of DG set starting through manual selectors or through Man Machine Interface.

Active Power shall be made equal on both the machines automatically with the help of active load balancing system through governor control.

Reactive power shall be balanced automatically with the help of quadrature droop kit fitted on the machine. However, if quadrature droop system is not functioning accurately, reactive load balancing system shall control AVR to achieve KVAR regulation within present band with direct analog(+/-3,0-5,+/- 5 , etc. volt) control.

Load management system shall have 6 output contacts for tripping various loads by field wiring and also trip the breaker of different DG set and give alarm for shutting off DG in accordance with predefined parameters to avoid under loading / over loading / cascading effect of tripping and unnecessary fuel wastage.

On restoration of grid supply, DG breakers and Bus coupler breakers shall be switched off in sequence with time delays to cover dips and grids supply breakers shall be switched On. Dg sets shall continue to run for one minutes after DG breaker has been switched OFF.

It shall be possible to alter crucial settings / time delays thru. Man Machine Interface.

Controller, annunciation system, protection system and metering system shall have compatibility for future interface with PC for graphics displays / report generation.

System shall have total manual override.

Tenderers may note that the controller controls and sequence of operation are indicative of requirements and the controller shall notwithstanding the above, be complete in all respects to achieve the control, monitoring and operation of DG sets indicated above.

6.1.2 Manual Mode

Under manual mode it shall be possible for the operator to start up the generator set by pressing the (START) push button.

Three attempt starting facility shall also be operative for the start up function.

Alternator, mains and bus coupler circuit breakers 'CLOSE' and 'TRIP' operations as per logic sequence required shall be manual by pressing the appropriate push button on the panel. Closure shall be feasible only after alternator has built up full voltage. If the load is already on 'MAINS' pressure on 'CLOSE' button shall be ineffective.

When running under manual mode, if the mains supply has failed, the load shall automatically get transferred to the alternator immediately overriding the stipulation of pressure on 'CLOSE' button.

Engine shut down, other than due to faults shall be manual by pressing a 'STOP' button.

6.1.3 Test Mode

When under 'TEST' mode pressure of 'TEST' button shall complete the start up sequence simulation and start the engine. The simulation will be that of mains failure. Engine shall build up voltage but the set shall not close alternator circuit breaker when the load is on the mains. Monitoring performance for voltage/ frequency etc. will be feasible without supply to load.

If during TEST run the power supply has failed, the load shall automatically get transferred to alternator.

Bringing the mode selector to auto position shall shut down the sets.