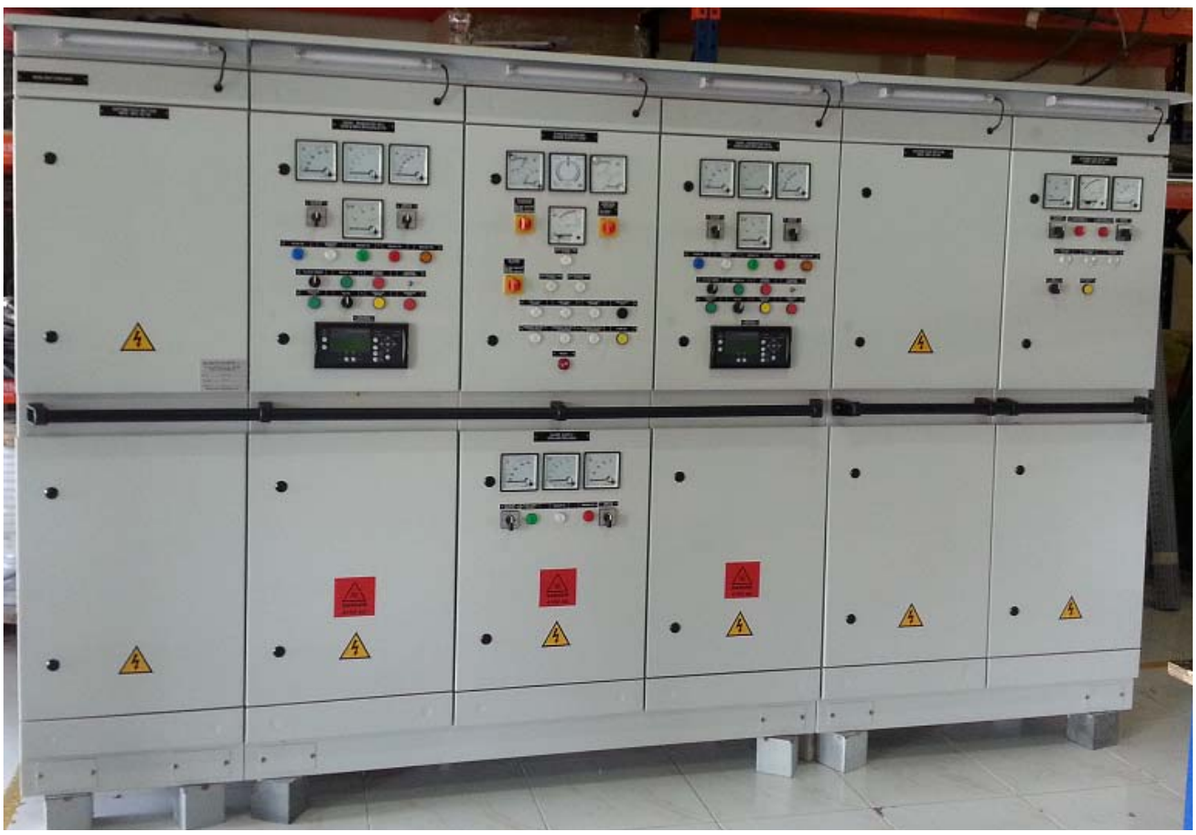
Product Introduction
Marine Switch Boards

Rajkot Marine LLC

Main & Emergency Switchboards

Product Description



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1 Technical description

1.1 General mechanical characteristics

1.1.1 Framework

The switchboards are manufactured in multi-cubicle, self-supporting, and dead-front type. They comprise several individual panels and complete with necessary fittings and instruments. The right and left side of the switchboard are covered with remove-able steel plates. On the front, the doors are hinged on the left side of the frame (if not otherwise specified) which can be opened in an angle more than 90° without disturbing the meters, pilot lamps and etc. mounted on them. The doors are equipped with arrestors to keep the doors in opening position. All doors are earthed to the frame with yellow/green wires. On the rear side, the lift-off covers are arranged as standard (the hinged doors are optional. In case of the switchboard is inaccessible from rear side, screw-fixed lift-off covers are installed instead). The protection degree applicable for switchboards is IP23, if not otherwise specified.

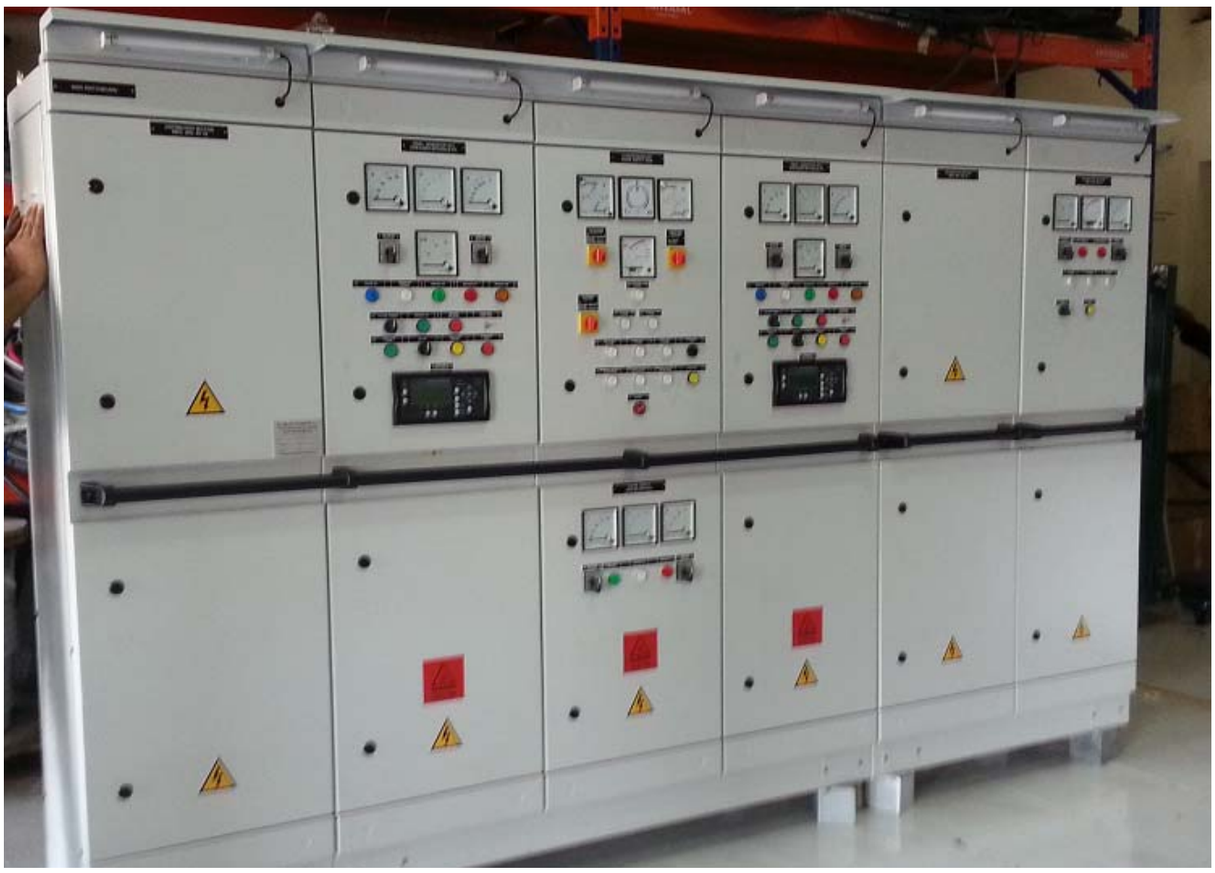
The framework of the switchboards is of maintenance-free welded construction which is designed based upon the basic grid dimension of E=25mm, have horizontal girders on front and rear side at approximately half height of the frame. The frames of switchboard are made of 3mm cold-rolled steel sheet and doors/cover plates are made of 2 mm sheet steel. Switchgears/ components are arranged on equipment compartment with associated mounting plates/ brackets, which are fastened with self-tapping screws to the frames at flexible intervals following the design grid dimension. The frames can be constructed for almost every requirement, depending of its application the three-dimension of the frame can be selected in steps of 50mm (W: 300-1000mm, H: 1800-2400mm, D: 400-1000mm).

The incorporation of individual panels for switchboard is normally arranged in a row, it can also be arranged in right-angled or back-to-back according to the special requirement.

Depending of the intended use of the panels, they are respectively designed and equipped into e.g. generator control panel, feeder panel, motor starter panel etc. The individual panels are partitioned with steel sheet plates between each other.

Non-conductive handrails can be provided on the front and/or rear. If the switchboard abuts against the control room wall, then the handrail will not be arranged on the rear.

Option: Canopy lighting in front and/or rear of the switchboards are of the fluorescent type, sockets for interior working light can be arranged on the rear inside, the power is supplied from the switchboard itself. (To be designated in the Scope of Supply)



1.1.2 Surface treatment

The complete steel construction including all steel profiles, partitions, top covers, doors are protected against corrosion by acid washing, phosphate process followed by textured powder coating. The standard colour of the framework is RAL 7024 (graphite grey). The front doors and covers are in standard colour RAL 7035 (light grey). Other colours are available on request. Refer to colour system, RAL, Munsell or NCS and the specific colour ID number. The assembled mounting plates/brackets inside the panel are of zinc-galvanized steel plates.

To prevent the blur on surface during installation onboard, the doors and cover plates are independently protected with transparent plastic membrane, so that they can be properly opened/ closed for handling or inspection under the packaged condition without unpacking.

1.1.3 Cable entry

Entry of external power cables and control cables in switchboards can be from bottom and top as per requirement. For insertion and stripping of the cables sufficient space inside the switchboard is provided. Connection of power cables to the switchgear will be done directly without intermediate terminals. For fastening of power cables inside the switchboard, necessary numbers of perforated angle bars or cable trays will be fitted inside each panel for allowing sufficient fixing strength.

1.1.4 Transport Division

The switchboard is normally split into several transportable divisions (less than 3000mm recommended). Each such division is equipped with hoisting angle steel on its canopy for transportation and installation purposes. All interconnecting wiring between switchboard divisions is provided with plug connectors, which allow easy assembly after transportation and setting up.

The switchboards are equipped with foundation frame (standard 100mm channel steel), which allows to either directly weld or bolt on vessel deck (Material for fastening is not included in the scope of supply

1.1.5 Bus bars

The bus bars are made of electrolytic copper with high conductivity which has sufficient current-carrying capacity for continuous operation and feeder's power distribution. Standard bus bars are of bare copper-not insulated and not coated. Insulated bus bars tin-coated bus bars are optional (to be specified in Scope of Supply for actual project). Bus bars and bus bar isolators are designed for withstanding mechanical strains created by electromagnetic forces during maximum peak short currents. Bus bar isolators are of moisture resistant type. For safety, the PVC transparent plates are provided to shelter the bus bars from where the electroshock hazard possibly happens, and the warning labels are stick on the protective plates.

The phase mark of AC system is R-Y-B (or U-V-W, L1-L2-L3), the bus bar is respectively distinguished with green-yellow-brown labels. The polarity identification of DC system is P-N, the bus bar is distinguished with red-blue labels. Earthing bar is marked with yellow/green label. The bus bar phase R-Y-B and polarity P-N is arranged from left to right, top to below and front to rear.

1.1.6 Nameplates and labels

The manipulative and indicative components on the doors are distinctly marked by engraved nameplates, which are made of laminated PVC plate in flame retardant type, with black text on white background. For any nameplates used for emergency or warning purpose, white text on red background is applicable. The text on nameplates is in English, All the nameplates are fastened by miniature screws.

For circuit breakers, the following information is marked on its nameplates:

Item letter code number (identical to drawings and in accordance with IEC 750)

Service name (feeder designation or name of appliance)

Setting current / frame rated current (A)

In case of any feeder breakers equipped with emergency stop or preferential trip function, the colour coded labels are additionally added above its nameplate. For the distinguishing purpose, the colour identification nameplate will be accordingly arranged nearby.

The components located on the front doors such as change-over switches, measuring meters, pilot lamps & pushbuttons, are marked with item letter code number (identical to drawings and in accordance to IEC 750) and its service name. Other components located inside the switchboard, such as terminal blocks, transformers, relays, contactors, etc. are provided with item letter code number labels according to actual drawings.

1.2 General electrical characteristics

The switchboard structure is environmentally type-tested by authorized institutions SEARI in compliance with IEC 60439-1, IEC 60068 and IEC 60529 of following technical parameters:

Rated insulation voltage	1000 V AC
Rated maximum operating voltage	Up to 690 V AC
Rated frequency	50 or 60 Hz, +/-5%
Rated insulation level	3000 V rms (one min. 50Hz withstand voltage)
Impulse withstand voltage	8 kV peak (1,2/50 micro-sec. wave)
1 second withstand current	Up to 150 kA
Peak withstand current	330 kA
Bus bar rated current	Up to 5000 A

The environment test is carried out for which is including: High temperature test (70ºC), Low temperature test (-55ºC), Temperature and Humidity test (55 ºC, RH 95 %), Salt spray test, Fungus test, Inclination test (±10 º, ±15 º, ±45 º), Vibration test (0-100 Hz, ±5 m/m2) and Enclosure protection test (IP22 or IP23)

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1.2.1 Internal wiring

All wiring inside the switchboards is of flame retardant types and Ship Class Type approved. They are flexible copper-strand insulated conductors with minimum cross section of 1.0 mm^2 (2.5 mm^2 for CT) unless otherwise required by certain component manufacturer. For the secondary control circuitry, voltage grade of the wires is >400 V. For power source wires and cables connected to mains, voltage grade of >750 V is used. For data-bus line, the suitable screen-shield multi-core twisted cables are used. All the wires and cables used are of tinplated cu types to avoid oxidation.

The control wires are fitted in slotted PVC cable ducts of flame retardant and halogenfree type fixed with plastic isolated screws to prevent abrasion, cutting of its insulation, excessive motion caused by vibration and for easy maintenance. All internal wires are address marked in each end by use of printed PVC sleeve tubes. As per the component terminal shape, suitable connecting ferrules or sleeves are used on wire and cable ends.

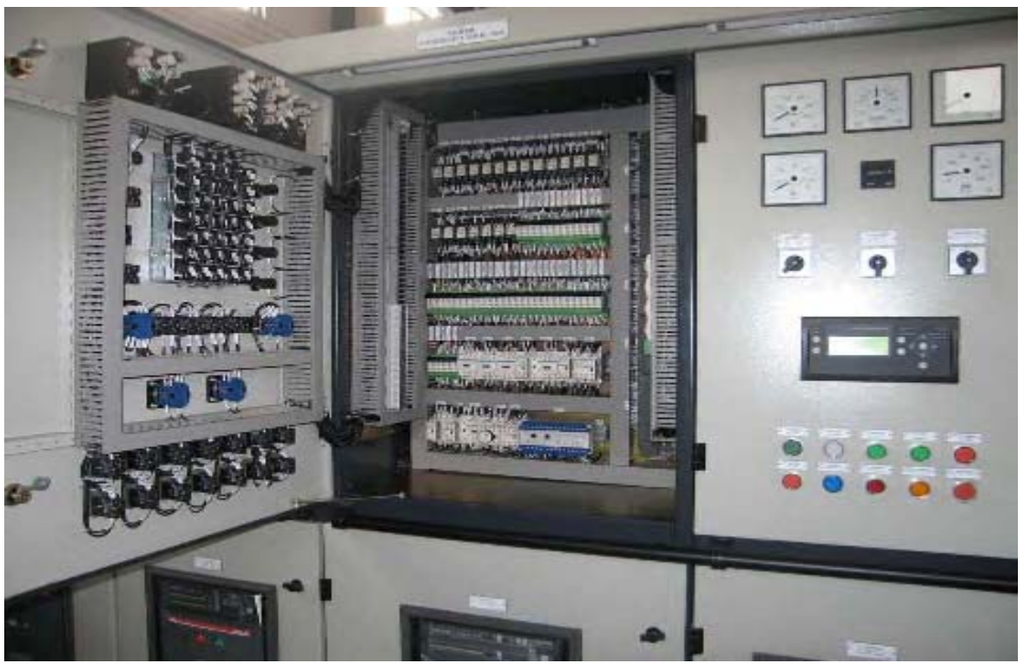
Voltmeter	0 ~120 % of rated voltage
Ammeter	0 ~130 % of rated current (over-current withstanding type for starters)
Watt-meter	-15 % (reverse) to approx. 130 % of rated wattage
Frequency meter	55-60-65 Hz (alternatively 45-50-55Hz)

1.2.2 Connection Terminals

All terminal blocks for secondary circuit are of spring-clamped type without screws. Terminals at least enable the single wire in 2.5 mm^2 cross section easily connected. The terminals used for power incoming/ outgoing cables whose cross section > 6 mm^2 will be screw fastening type.

1.2.3 Measuring indicators

Measuring indicators are provided in standard DIN 43700/IEC 61554 sizes 96x96 mm and 72x72 mm (or 48x48mm) for starters , with black frame, white scale background, black pointers (rotating angle 90 □), black text and red-mark on nominal value. The precision class is of 1.5 and the scale of the indicators normally has the following measuring range:



1.2.4 Air Circuit Breakers (ACBs)

Three-pole Air Circuit Breakers (630A~6300A, frame size current) may be used as power incoming breakers, outgoing feeders or bus-ties, in fixed or withdraw-able type. Manual operation of the breakers (by operating handle) is possible from the front. The electrical motorised operation can be furnished, particularly for remote controlled power incoming breakers or bus-ties. The ACB's are equipped with electronic releases which can be configured with adjustable long time over-current inverse time trip, short time delay trip, and electromagnetic instantaneous trip for short current.

The flexibility for adding accessories such as microprocessor-controlled over current release, shunt releases, under-volt releases, lock and interlocks, etc. creates a lot of possibilities for tailoring the system to fit a wide range of applications. The actual configuration of ACB's is defined hereinafter Scope of Supply.



Above pictures show three different brands of ACBs mounted in our switchboards.

1.2.5 Molded Case Circuit Breakers (MCCB's)

Three-pole Molded Case Circuit Breakers (100A~1600A, frame size current) may be designed as power incoming breakers, outgoing feeders or bus-ties in fixed, plug-in or withdraw-able type. Normally for outgoing feeder breakers, the operation is achieved manually by means of rocker arm on its front if no otherwise specified. The electrical motorised operation can be furnished, particularly for remote controlled power incoming breakers.

The feeder breakers are normally equipped with pyromagnetic release (inverse time thermal over-current trip and/or magnetic instantaneous trip devices). Depending of factual application, the electronic release may be used for more precise protection. Feeder breaker for steering gear motor is equipped with instantaneous trip only.

The flexibility for adding accessories such as auxiliary contacts, shunt releases, under-volt releases, lock and interlocks, etc. creates a lot of possibilities for tailoring the system to fit a wide range of applications. The actual configuration of MCCB's shall be defined in Scope of Supply.

1.2.6 Motor Starters

All motor starters combined in the switchboards or MCC's are of fixed mounting type. According to the respective usage and requirement, starters are available for the following functions:

Direct on line starting (DOL)

Star/delta starting (Y/Δ)

Reversible running

Double speed running

Auto-transformer starting

Soft starting control

Frequency converter start

The motor starters can be configured with 2 options: either Basic type or Intelligent type.

Option 1: Basic motor starter

Basic motor starters are integrated by traditional circuit breakers, contactors & thermal relays with a basic protection on the motors. The control functionality on the motor is locally achieved by various relay circuits, the remote control and alarm monitoring can be transmitted by separate I/O modules which are the integral part of Automation System by communication cables.

Depending on individual functions, typically a basic motor starter consists of, but not limited to following components:

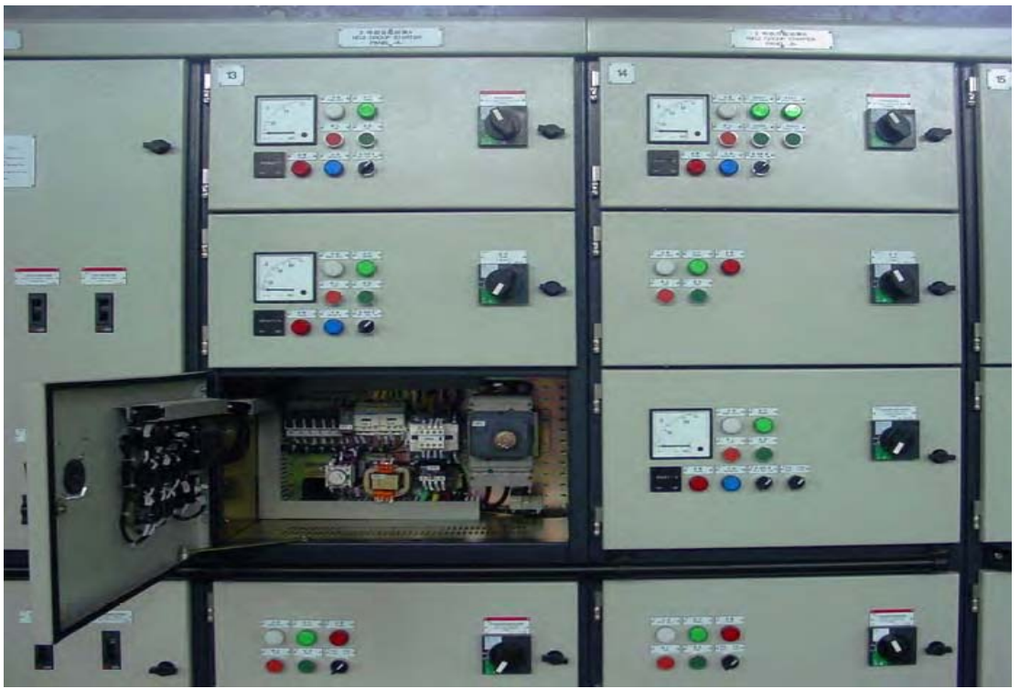
Option 2: Intelligent motor starter

Except 2 necessary components: circuit breaker (or fuse switch) and contactor(s), there is only another component so called Motor Control Unit (MCU) which is essential to make up of an intelligent motor starter. The MCU is a microprocessor based intelligent module which provides full motor control, protection and monitoring functions. It can transmit real-time data upward to control centre and receive operating command in reverse via communicating with up-level Automation System.

Depending on individual functions, typically a basic motor starter consists of, but not limited to following components:

1 pc	MCCB 3P with instantaneous tip, or Fuse Switch
1 pc	MCU with correlating operating panel
1 unit	Magnetic contactor(s)
1 pc	Operation mode switch (Auto/Hand or Local/Remote, where applicable)
1 pc	"Heating" indicating light (blue, where applicable)
1 pc	"Heater on" switch (where applicable)
1 lot	Fuses for control circuit
1 pc	

Components	**Manufacture**
Air circuit breakers (ACBs)	ABB or Schneider
Moulded case circuit breakers (MCCBs)	ABB or Schneider
Contactors & Thermal over-load relays	ABB or Schneider
Instruments & gauges	Deif or Complee



Supplier list for main components

If there is no otherwise specified, the recommended brands of components used for switchboards are as follows:

1 pc	MCCB 3P with instantaneous tip, or Fuse Switch
1 pc	MCU with correlating operating panel
1 unit	Magnetic contactor(s)
1 pc	Operation mode switch (Auto/Hand or Local/Remote, where applicable)
1 pc	“Heating” indicating light (blue, where applicable)
1 pc	“Heater on” switch (where applicable)
1 lot	Fuses for control circuit
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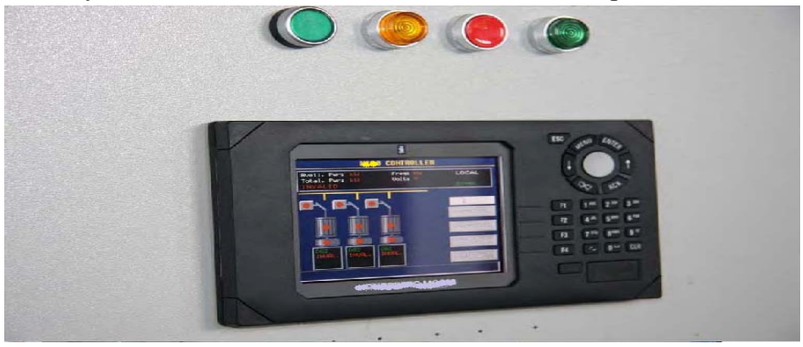
Moulded case circuit breakers (MCCBs)	ABB or Schneider
Contactors & Thermal over-load relays	ABB or Schneider
Instruments & gauges	Deif or Complee
PMS modules	ABB/Schneider
I/O modules (DPUs) for motor starters	ABB/AB
Motor Control Units (MCUs) for motor starters	ABB or Schneider
Voltage transformers	Local maker
Current transformers	Local maker
Auxiliary relays	Idec
Control fuses	Woehner
Terminal blocks	Phoenix
Change-over switches	Kraus & Naimer or ADA
Push buttons/ signal lamps	Moeller or Schneider

3 Mode of operation

3.1 Main switchboard

3.1.1 Automatic operation

The automatic functions can be performed by **Power Management System** either integrated or as stand alone system in the switchboard. The Function Description of the PMS to be negotiated additionally.



Diesel generator monitoring and control

The following automatic functions are performed by PMS which is configured and furnished in the main switchboard:

Diesel engine safety protection and start/stop
Bus line voltage and frequency control
Circuit breaker synchronize & connect
Generator voltage and frequency control
Generator load limitation in kW and %
Symmetric or asymmetric load sharing
Load control with load shedding
Separation of alarm, control and safety protection
Single or multiple switchboard control
Heavy consumers start logic
Automatic start and connect after blackout
Automatic line frequency adjustment
Control of diesel electric propulsion
"Take me home mode", control of PTI with clutches etc.
"One touch auto sequence" automatic mode control

3.1.2 Manual operation

In normal situation the main switchboard is used in automatic operation. The manual operation is equipped as the back-up of the automatic operation. In manual operation all the essential function can be carried out by hand such as generator start and stop, connecting, synchronising and load sharing (by means of synchroscope and governor switches).

3.2 Emergency Switchboard

In normal situation, the Emergency switchboard is energized from Main switchboard. When the voltage of the MSB fails the tie-breaker between MSB and ESB is automatically disconnected, the emergency generator set is automatically started and the emergency switchboard is energized automatically after a total delay of max. 45 seconds (allowing for stand-by generator to connect first). When MSB voltage restored, the emergency generator will be automatically disconnected, and then stopped with time delay. The ESB will be renewably energized by MSB via the reconnection of the bus tie-breaker.

Normally there is now power feed-back to the main switchboard in any occasion. Alternatively the emergency generator can be also used as harbour generator when required. In this case a select switch "Normal / Harbour" will be additionally furnished. In "Harbour" mode, the emergency generator is able to inversely supply the power to main switchboard

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