



BANGLADESH PETROLEUM  
EXPLORATION & PRODUCTION CO.LTD



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## SPECIFICATION FOR LOW VOLTAGE MOTOR CONTROL CENTER

Doc.No.: 240-0101 -EMEL-SP00-0003

**Job No.** : 240

**Client** : BANGLADESH PETROLEUM EXPLORATION & PRODUCTION CO. LTD

**Location** : SRIKAIL GAS FIELD, BANGLADESH




**Item No.** : 02-MCC-1401~1406

**Equipment Name** : MOTOR CONTROL CENTER

**Project Title** : 60 MMSCFD SILICAGEL DEHYDRATION TYPE GAS PROCESS PLANT




**Year Built** : 2015

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## ABBREVIATIONS

Abbreviation	Description
AC	Alternating Current
API	American Petroleum Institute
BOD	Basis of Design
BS	British Standard
CT	Current Transformer
CTEP	Central Treatment Export Plant
DC	Direct Current
GOSU	Gas Oil Separation Unit
ICSS	Integrated Control Safety System
IDC	Inter Discipline check
IEC	International Electro technical Commission
IFC	Issued for comments
IP	Ingress Protection
KO	Knock Out (Drum)
LMS	Load Management System
LP	Low Pressure
LV	Low Voltage
MCC	Motor Control Centre
MCCB	Molded Case Circuit Breaker
MMscf/d	Million Standard Cubic Feet per Day
N/C	Normal Close
N/O	Normal Open
OD	Outer Diameter
Ppm	Parts per million
RIPI	Research Institute of Petroleum Industry
RTU	Remote Terminal Unit
SI	International System of Units
SINOPEC	SINOPEC PETROLEUM ENGINEERING CORPORATION
TVP	True Vapour Pressure

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Abbreviation	Description
Vol	Volume
VT	Voltage Transformer
VTA	Vendor to advise
PFI	Power Factor Improvement Plant

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## 1.0 INTRODUCTION

### 1.1 Project Description

Bangladesh SRIKAIL field 60 MMSCFD, silicagel dehydration type gas process plant project is the EPC project.

The scope of work of this project is to design, supply, erection, construction and installation, testing and commissioning of a solid desiccant (Silicagel) type gas processing plant complete with necessary gas gathering pipelines and other associated facilities. In addition to the gas process plant, condensate tanks with pumps, electricity generators, raw and processed gas connections etc. are to be included in the scope of work.

Plant inlet header will be connected with well # 2 and well # 3. The design capacity of each flow line shall be 30 MMSCFD.

The main process of the dehydration plant is solid desiccants, three tower gas process plants to dehydrate and recover all economically possible condensate from natural gas.

Maximum processing capacity of the plant is 60 MMSCFD (170 x 10<sup>4</sup> nm<sup>3</sup> /d) and the minimum capacity is 15 MMSCFD (about 42.5 x 10<sup>4</sup> Nm<sup>3</sup>/d) in respect to different wellhead pressure range (from the beginning to the minimum 1100 psig). In addition to the gas process plant, manifolds, condensate tanks with pumps, electricity generators, raw and processed gas connections etc. are to be included in the scope of work. The engineering designs adopted IEC standard, metric and imperial standards.




ZICOM AND SINOPEC will provide all materials and services for construction, installation and commissioning on turn-key basis. In addition to the gas process plant, condensate tanks with pumps, electricity generators, raw and processed gas connections etc. are to be included in the scope of work.

### 1.2 Scope of Document

This specification defines the minimum requirements for the material selection, design, manufacture, installation and testing of the electrical equipment.

### 1.3 Definitions

CLIENT	BAPEX (BANGLADESH PETROLEUM EXPLORATION&PRODUCTION CO.LTD)
COMPANY	ZICOM(ZICOM EQUIPMENT PTE LTD)& SINOPEC (SINOPEC PETROLEUM ENGINEERING CORPORATION)

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CONTRACOR	The firm/corporation with whom the COMPANY has entered into an agreement for the WORK, which can be a VENDOR or a BIDDER (as the case may be).
SUB-CONTRACTOR	The firm/corporation to which the CONTRACTOR may in turn sub-contract part of the WORK subject to prior approval of the COMPANY.
WORK	All temporary and permanent work described in CONTRACT and specifications.
VENDOR/BIDDER	The organisation awarded a Purchase Order/Contract for supply of materials, equipment or service required for the WORK.
MANUFACTURER	VENDOR/BIDDER should be supply all the equipment as below: Brand Name: ABB, Legrand, GE, Siemens, Philips Country of origin: China/ France/ EU/India.
WILL	Used in conjunction with an action
SHALL	Mandatory requirement

#### 1.4 Language and Units of Measurement

All documentation exchanged on this Project shall be in the English language. Units of measurement shall in general follow SI practise. However, there are recognised exceptions and preferred units that are used in the Oil and Gas Industry. The applicable units of measurement are shown in Table 1-1 below.

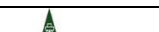


**Table 1-1 Units of Measurement**

Parameter	Units	Abbreviation
Area	Square meters , Square millimeters	m <sup>2</sup> , mm <sup>2</sup>
Current	Ampere, Kilo Ampere	A, kA
Length	Meter	m
Mass flow	Kilogram per hour	kg/h
Pipe / Tubing Diameter	Inches, millimeter	Inch, mm
Power	kilo Watt, kilo Volt Ampere	kW, kVA,
Resistivity	Ohm- Meter	Ω-m

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Parameter	Units	Abbreviation
Temperature	Degree Celsius	°C
	Degree Fahrenheit	°F
Thickness	Inch , millimeter	Inch, mm
Voltage	Volts, Kilo Volts	V, kV
Current	Ampere, Kilo Ampere	A, kA



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## 2.0 CODES, STANDARDS AND REGULATIONS

### 2.1 General

The equipment shall be designed, manufactured, inspected and tested in accordance with the requirements of this specification, the data sheets, the referenced project documents and other documents referenced therein. The latest revisions available at the date of issue of the enquiry shall apply.

The Codes, Standards and Regulations which follow are the industry codes and standards normally referenced for this type of equipment. All equipment supplied shall conform to all relevant national regulations and local codes and regulations.

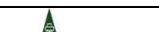


The VENDOR/BIDDER shall obtain his own copies of the Codes, Standards and Regulations referenced herein. Failure to do so does not relieve the VENDOR/BIDDER of his obligation to offer equipment and materials in accordance with the Requisition and its attachments.

Where “in-house” standards have either been developed or are based on recognized National, International or industry standards these may be offered as an alternative, provided adequate detail is contained within the VENDOR/BIDDER's bid.

Compliance by the VENDOR/BIDDER with the provisions of this Specification does not relieve him of his responsibility to furnish equipment and accessories of a proper mechanical design suitable for the specified service conditions and/or local codes governing health and safety.

### 2.2 International Codes, Standards and Regulations

IEC 60038	: IEC Standard Voltage
IEC 61439	Low Voltage Switchgear and Control gear Assemblies
IEC 60051	: Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories
IEC 60073	: Coding of Indicating Devices and Actuators by Colors and Supplementary Means
EC 60079-1	: Electrical Apparatus for Explosive Gas Atmosphere, Flameproof Enclosure “d”
IEC 60079-10	: Electrical Apparatus for Explosive Gas Atmosphere, Classification of Hazardous Areas
IEC 60044-1	: Current Transformers
IEC 60186	: Voltage Transformers

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IEC 60269	: Low voltage fuses
IEC 60445	: Identification of Equipment Terminals
IEC 60446	: Identification of Conductors by Colors or Numerals
IEC 60521	: Class 0.5, 1 and 2 Alternating Current Watt-hour Meters
IEC 60529	: Degrees of Protection Provided by Enclosures (IP code)
IEC 60688	: Electrical Measuring Transducers for Converting ac. Electrical Quantities to Analogue or Digital Signals
IEC 60947-2	: Circuit-Breakers
IEC 60947-3	: Switches, Disconnectors, Switch-Disconnectors and Fuse Combination units
IEC 60947-4	Contactors and Motor-Starters
IEC 60947-5	: Control-circuit Devices and Switching Elements
IEC 60947-6	: Multiple Function Equipment
IEC 60947-7	: Ancillary Equipment
IEC 61850	: Communication Networks and Systems in Substations

### 2.3 Order of Precedence

In case of conflict, the following order of precedence shall apply:

- i) IEC Regulations, Codes and Standards
- ii) This Specification
- iii) Other Referenced Project Specifications
- iv) Other International Codes, Standards and Regulations.

In the event of any conflicts or doubt refer to COMPANY.

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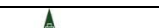


### 3.0 SERVICE CONDITIONS

#### 3.1 Environmental Data

The climate at the project area is defined as tropical monsoon, with three main seasons: Summer/Pre - Monsoon season, Monsoon (Rainy season) and Winter season. Summer/Pre-monsoon is hot and dry, interrupted by cyclonic storm accompanied by heavy rainfall. The rainy season is hot and humid having about 90 percent of the annual rainfall. The winter season is predominantly cool and dry.

#### 3.2 Installation Environment

The equipment shall be suitable in all aspects for continuous operation at full load service. The equipment will be installed in an air conditioned MCC room which is non hazardous and has temperature range defined in the project environmental data specification.

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#### 4.0 APPLICATION

The voltage levels adapted in this project are based on the IEC recommendation No 60038.

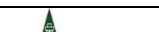


The low voltage system is generally 400/230 volt with solidly earthed neutral.

The low voltage switchgear will be fed from low voltage generator/s with a voltage of 400/230 volt.

The low voltage switchgear is equipment which includes switching devices with associated control, measuring, protective and regulating devices and intended in principle for the control of electric energy consuming equipment, with voltage rating of 400 volt three phase and 230 volt single phase.

The low voltage switchgear includes motor starters and/or motor control center/s (MCC), incomer circuit breaker/s, outgoing feeder breakers and/or switch fuses and auxiliary components as specified in this specification and/or indicated in the single line diagram/s.

Single line diagram/s attached to this specification show/s only the major components of the low voltage switchgear. Control circuit schematic diagrams, wiring diagrams, schedule sheets and interconnection diagrams will be attached when necessary.

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## 5.0 DESIGN AND CONSTRUCTION

### 5.1 General Requirements

#### 5.1.1 Enclosure

The switchboard/MCC shall be indoor, metal enclosed type and in accordance with the requirements of IEC 60439. Unless otherwise stated in data sheet, the ambient air temperature for indoor equipment shall be 15°C ~ +40°C. Enclosure light with door operated switch shall be install. If the switchboard/MCC will be installed outdoor, it shall be indicated in data sheet, and additional requirements shall be supplemented.

The switchgear and motor control centres shall be, multi cubicle type, free-standing, floor mounting, flush fronted and dead-front design with all equipment installed inside vertical steel structures, suitably subdivided by sheet steel barriers into arc-proof compartment at least for:

- The horizontal busbars
- Incoming feeders
- Starters and outgoing feeders

The enclosure together with bus bars and wirings shall be extendable at both ends without the need to cut or drill any part of the enclosure.

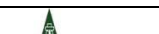


The indoor enclosure for switchgear/MCC shall provide a degree of protection of IP 42.

Individual panels of the switchboard/MCC shall be self-ventilating.

Thermal rating for all current-carrying parts shall be a minimum of 1 second for the rated symmetrical short circuit current, but not less than 150% of that time which is required to clear the faults at the maximum rated symmetrical short circuit level.

Structural main frames, section frames and forming shall provide strength and rigidity. The structures, including doors and panels shall be capable of withstanding the magnetic forces and the thermal effects created by the maximum specified fault current without any damage to equipment and danger to operating personnel. The switchgear shall be supplied with the base channels and holding down bolts, nuts and washers.

Empty compartments at least one on each section of the switchgear shall be foreseen within the enclosure for future use. Such compartments shall be arranged

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so that they can be equipped with minimum energization of the relevant section of the switchgear. The surface area of the empty compartments shall be around 10% of the total surface area of the front of the switchgear enclosure rounded off to nearest figure. The empty compartments shall be sized to accommodate outgoing units of which at least three units are installed. This is in excess of spare units which are indicated in single line diagram/s.

The enclosure shall be designed such that anti-condensation heaters will be required in the environment specified. Where such heaters are specified in data sheet, they shall conform to this specification.

All incoming and outgoing cables will enter the switchgear from trenches or floor cut-outs.

#### **5.1.2 Interchange ability**

Breakers of identical rating and control scheme shall be completely interchangeable within the same switchgear.

#### **5.1.3 Safety and reliability**

Switchgear and motor control centres shall offer a maximum degree of safety in accordance with IEC 60439 under all normal operating and fault conditions. In particular, it must be impossible to unwillingly, i.e. without the use of tools, touch live parts of gear, or to perform operations that may lead to arcing faults.

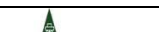


Arc-barriers shall be arranged such that the propagation of a possible arc is hindered in at least the following locations:

- Across or around incoming circuit-breakers, whether in the disconnected or in the operating position
- From one vertical MCC section to another
- From one compartment to another

All circuit breaker, starter and feeder units shall be provided with safety interlocks in accordance with the requirements of IEC 60439. All interlocks shall be mechanical in nature.

All interlocks that prevent potentially dangerous mal-operations must be constructed such that they cannot be defeated easily.

The vertical busbars (droppers) shall be arranged such that accidental finger contact with live parts, when the breaker or starter modules are withdrawn, is prevented.

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It shall not be possible to open the doors of breaker and starter compartments when the breaker or switch is in the ON position. In the OFF position, the breaker operating mechanism or the control circuit shall be lockable.

With starter doors open and the main disconnect switch OFF, there shall be no exposed live parts within reach of the operator. Line-side fuse or breaker terminals shall be concealed or insulated for this purpose.

The switchboard/MCC shall be designed and constructed in accordance with IEC 60439 to facilitate inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance.

Switchgear and Control gear shall be designed to minimize any risk of short circuit and to ensure personnel and operational safety during all operating conditions, inspections and maintenance.

The assembly shall be suitable for continuous operation at full load for at least 20,000 hr without maintenance which would require the busbar and dropper system to be de-energized.

## 5.2 Busbars

The switchgear shall be equipped with a single busbar system. Busbars shall be manufactured from hard drawn, high conductivity copper and shall comply with IEC 60439-2.

Busbars shall be designed for the full rated current at the maximum ambient temperature specified without exceeding their temperature rise limits. Design of the busbars shall be such that future extension of the switchgear to either side will be possible.

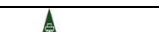


All busbars shall be fully insulated (rated at 1000V) with flame retardant non-hygroscopic insulation material and shall be color coded, Red, Yellow, Blue, Black and also marked as L1, L2, L3, N (for neutral) and PE (for protective earth), from top to bottom and from left to right when facing the front of the switchgear.

The main busbars shall be of the same cross sectional area throughout the length of the switchgear.

All busbars shall be capable of withstanding, without damage, the magnetic forces and the thermal effects created by the maximum specified short circuit current for at least one second. The busbars short circuit withstand current shall be indicated in data sheet.

Busbars shall be encased in separate compartments within the switchboard/ MCC.

Where bus section (tie) breakers are specified, they shall be so arranged that one complete section of busbars and associated connections can be made dead and safe to work on, while the adjoining section of busbars is still alive.

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All horizontal busbar-joints shall be tin or Silver-plated as specified in data sheet/s.

A neutral busbar shall extend the entire length of the switchgear and shall be insulated from the earth potential. The current rating of the neutral busbar shall be at least 50% of the phase busbars. The neutral bus shall extend into each incomer compartment. Means of disconnection (e.g. a bolted link) shall be provided to isolate the neutral bus from the neutral source for testing purposes.

A Copper earth bus, rated for the maximum available earth fault current for 1 second, shall run the entire length of the switchgear. Sufficient connection points with adequate terminating facilities shall be provided for terminating the cables screen and/or armors. The earth busbar shall be equipped with suitable connectors or bolts to be connected to earth copper conductors at each end. The size of earth copper conductors which are generally 70mm<sup>2</sup> or greater will be shown on single line diagram/s.

### 5.3 Circuit Breakers

In the low voltage switchgear, circuit breakers shall be used for incomers. Some of the loads may also be fed through circuit breakers which shall be shown in the single line diagram/s.

Circuit-breakers used as incomers breaker shall be three pole withdraw able air circuit breakers. Outgoing breaker may be three or four poles as specified in the single line diagram/s.

Circuit breakers shall conform to IEC 60947-2 in terms of rating, testing and performance, and shall be suitable for uninterrupted duty (utilization category B).

Rated currents of circuit breakers shall be selected conforming to IEC recommendations, and shall take into account possible deratings for installation inside the switchgear.

Circuit breakers shall be capable of interrupting the specified short circuit current without the aid of replaceable current limiters or fuses.

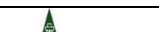


The short circuit capacity of circuit-breakers shall be appropriate to the specified system short circuit and power factor. The breaking and making short circuit capacities of circuit breakers as defined in IEC 60947-2 shall not be less than 25 kA and 55 RMS symmetrical respectively.

Facilities shall be provided for testing the circuit breaker closing and tripping mechanisms when the breaker is in TEST position.

Tripping of circuit breakers shall be by means of manual mechanical tripping device. Electrical and manual closing release shall be provided.

There shall be three distinct positions for circuit breakers. The draw-out mechanism shall hold the circuit breaker rigidly in the three positions of CONNECTED, TEST and



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DISCONNECTED. The breaker disconnect device shall be interlocked with the breaker trip-shaft to prevent withdrawal or insertion of the breaker from/into the cubicle with the breaker in the ON position. If moving of the breaker from or into the operating position requires undue effort by the operator, mechanical aids shall be provided. Automatic shutters shall cover the line-side primary disconnect contacts automatically upon withdrawal of the breaker. The breaker shall be lockable in the DISCONNECT position.

Breaker control connections shall be via fixed; self-aligning disconnects, or via umbilical cord type plugs connections. Either system shall allow test-operation of the breaker in the DISCONNECT position.

Auxiliary contacts required for circuit breaker operation, 2 N/O + 2 N/C similar standby contacts shall be provided, and wired to the terminal strip. If additional auxiliary contacts are required, it will be indicated in data sheet.

All low-voltage wiring to and from the circuit breaker shall be terminated on an easily accessible terminal strip within, or close to the breaker compartment. Each terminal and each wire shall be clearly identified by the same symbols used in the circuit diagrams.

Incomers circuit breakers shall be equipped with the required indicating instruments and protective relays as shown in single line diagram/s.

#### 5.4 Incoming Feeder

Three (3) numbers 250 KW each of 100% continuously gas driven power generator sets shall be connected with Incoming panel, capable of synchronizing and running two units in continuous parallel operation. The electric supply and distribution shall be nominally at 400 VAC, 50-cycles/sec, 3 phase and neutral.

##### 5.4.1 Individual Incoming panel for future generator

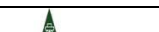


One extra individual control panel for generator equipped with meters, auxiliaries, and interlock system with each other MCCB of generators, all sorts of protection system etc. for future plan is required.

##### 5.4.2 Change Over Panel

A manual interlock type change over switch shall be installed such that the electricity demand for plant and domestic use may be met either from the generators or from the national grid but not from both at the same time.

#### 5.5 PFI (Power Factor Improvement) Plant

PFI (Power Factor Improvement) Plant for improving the degraded Power Factor of the system. Microprocessor based PFC (Power Factor Correction) relay up to 6 stages different ratings capacitors. Capacitors engaged and disengaged by corresponding Magnetic

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contactor for suitable stepping of the Capacitor bank to keep the power factor 0.95. For harmonic filtration of the system Line Reactor with the Capacitors can be used if required.

## 5.6 Motor Starters

The low voltage switchgear shall include with drawable motor starters installed in individual compartments. The numbers and sizes of motor starters will be indicated in the single line diagram/s.

Motor starters shall primarily consist of the following:

- HRC fuses with isolator or moulded case circuit breaker (MCCB)
- Electrically operated air break contactor
- Appropriate protective relays
- Other protection and/or control devices and indicating instruments.

Contactors shall be three pole magnetically operated air-break type rated for utilization category AC3 according to IEC60947-4.

In addition to the load contacts and the auxiliary contacts required to operate the starter, at least 1 N/O and 1 N/C auxiliary contacts shall be provided for each contactor and shall be wired to the terminal block of the compartment.

The rated control voltage of contactors shall be single phase 230 volt ac supplied from one phase and neutral in each individual compartment, for each motor starter. The control circuit shall be protected by a suitably rated fuse.

All motor starters shall have facilities for remote START/STOP of motors unless otherwise specified in the requisition.

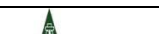


ESD Switch at field shall have facilities for remote STOP of motors unless otherwise specified in the requisition.

Vibration switch shall have facilities for remote STOP in case of vibration of motors unless otherwise specified in the requisition.

Each starter module shall be equipped with one red (ON), one green (OFF) light and One Amber (Trip/Alarm) in the door.

### VFD (VARIABLE FREQUENCY DRIVES)

Variable frequency drives shall be installed in the motor control center as per the wiring diagrams to control the speed of the motor. Additional cooling fan shall be installed in the panel where VFD is installed. The detail of the variable frequency driver refers to VFD datasheet.

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### **RIO (Remote I/O communication)**

Motor control centre can be monitor and control from plant control station by remote I/O. The ability to provide remote or automatic control of motors by standard remote I/O, installed beside the motor Control Centre in separate control panel and traditional interconnecting by hardwire.

Note: Remote I/O panel is not scope of the supply by MCC vendor.

There should be option for control signal connection (Terminal Block or Plug & Socket connector) in between MCC to remote I/O.

### **ESD (Emergency Shut Down)**

The MCC manufacturer shall provide a hard wired option to turn off individual motor during ESD or stop signal activation from main plant control station. MCC vendor will keep option by installing connector for these facilities.

## **5.7 Outgoing feeders**

The low voltage switchgear may include outgoing feeder switch circuit breakers. The type and sizes of feeder breakers will be indicated in the single line diagram/s.

Outgoing Feeder circuit breakers rated up to 400 Ampere can be molded case circuit breaker (MCCB) type.

Outgoing feeders with rating of 100 Ampere and above shall be provided with one ammeter with selector switch.

## **5.8 Light Panel**

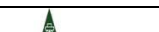


One individual electrical distribution panel for area lighting will be connected with outlet of the MCC panel. Operating voltage of the light is must be 220/240V AC Single phase. Panel input will be three phase + Neutral 380/400V AC and all output will be 220/240V AC Single phase. There should be auto /manual switch to operate the light. In manual mode the light will be turn on and off by manual push button and in auto mode all the light will be activate by photo sensor.

## **5.9 Protection and Control**

Protection equipment shall be in accordance with the single line diagrams, typical schematic diagrams. The generator protection should be supplied by the manufacture of generator.

Monitoring:

- motor status (running /stopped) to ICSS
- local/remote control status

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- fault alarm to ICSS

Control:

- motor stop, start from ICSS

### 5.10 Instruments

Indicating and measuring instruments shall be provided as shown on single line diagrams.

All indicating instruments shall be flush mounted on the front of the cubicle and shall be of the industrial grade with degree of protection IP41.

All instruments shall be manufactured in accordance with the requirements of IEC 60051.

Ammeters and voltmeters shall be of the accuracy class 1.5. The accuracy class of watt-hour meters shall be class 2.5.

Instruments shall not be damaged by the passage of fault currents in the primary of current transformers or voltage variations on the system within the specified system characteristics.

All meters installed on the switchgear shall be of the square pattern type. Scales shall be in actual values.

### 5.11 Current Transformers

Current transformers shall be in accordance with IEC 60044-1.

#### Rating and type:

The rated secondary current shall be preferably 5 Ampere for switchgear mounted protective relays and instruments.

#### Class of accuracy:

Current transformers for measuring purposes shall be of the accuracy class 1.

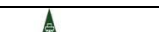


Current transformers for remote ammeters shall be of the accuracy class 3.

The secondary of the current transformers shall be earthed on one side. Where current transformers are connected in Wye, the Wye point shall be earthed.

Current transformers for circuit breakers shall be installed in the stationary part of the relevant cubicle. Current transformers for motor starters shall be installed in the withdraw able part of the cubicle.

Current transformers shall be capable of carrying, without injurious heating or mechanical damage, the specified fault current of the switchgear.

Current transformers shall have appropriate VA rating and saturation factor. The saturation factor shall not be less than 5.

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### 5.12.1 Control Power Transformer

The control power must be 220/240V AC Single phase, and must be obtain from a control power transformer (CPT) located in panel. The Standard isolation dry type Transformer, where input will be two phase 380/400V AC and output will be 220/240V AC Single phase. The CPT must be 500 VA in size, with approximately 350 VA extra capacity for the future additional use. Appropriately sized primary and secondary fuses will be supplied.

The secondary circuit of the transformer must be disconnected from the control circuit by means of the isolating switch / auxiliary contacts to prevent back feeding through the transformer and to isolate the power when the control circuit is in the test or troubleshooting mode.

### 5.12.2 Primary Fuses

The primary side of the control power transformer must be protected by current limiting fuses sized according to requirements. The interrupting rating of the primary fuses must be 50 kA symmetrical.

### 5.12.3 Secondary Fuses

The secondary side of the control power transformer must be fused appropriately to protect the transformer from overloads. The standard control circuit transformer must have one leg of the secondary grounded.

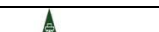


## 5.13 Earthing

All metallic non-current carrying parts of the switchboard/MCC shall be bonded together either by welding or bolting using star washer or equal. The main structure shall be earthed via a hard drawn, high conductivity Copper bar, which shall run the entire length of the switchboard/ MCC.

The main earth bar shall be sized to withstand a bolted earth fault for a duration equal to the longest short-time rating of any item of equipment contained in the switchboard/ MCC.

The main earth bar shall be located at the rear of the switchboard/ MCC and shall be accessible from the bottom. Copper earth strap connections shall be provided from the main bar to each cable gland plate.

The main earth bar shall have provision at each end for connections to the substation main earthing grid. The earth busbar shall be equipped with suitable connectors or bolts to be connected to earth copper conductors at each end.

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All doors shall be bonded to the main structure by means of a flexible Copper connection arranged so that it cannot be trapped as the door is closed or opened.

Particular attention shall be given to the effective earthing of withdrawable items when in the tests position. In addition, the earthing contacts of withdrawable items shall make before the electrical contacts and break after the electrical contacts.

The chassis frameworks and the fixed parts of the metal enclosure of the circuit breakers shall be interconnected electrically and connected to a terminal which enables them to be earthed.

#### 5.14 Wiring and Terminals

All internal wiring shall be continuous from terminal to terminal with no splicing.

Wiring shall be stranded Copper conductor with flame retardant, 90°C, 1000V insulation. Minimum conductor sizes shall be 2.5 mm<sup>2</sup> for control and protection, and 1.5 mm<sup>2</sup> for signal wiring.

Where wiring is run through a metal sheet or barrier, bushing or other mechanical protection shall be provided.

All internal power wiring shall be suitable for the largest continuous current rating of the functional unit and the short circuit current as limited by fuses or circuit breakers.

Flexible wires shall be used for connection of door mounted equipment to the cubicle mounted equipment.

All wires shall be terminated in clamp type terminals such that direct contacts between screw, bolt or nut and conductor are avoided.

Not more than two wires shall be connected to any one terminal. Links shall be provided where more connections are required at one point.

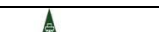


Wiring in various circuit breakers, starter and feeder cubicles performing the same common function shall bear the same wire and terminal numbers.

The control terminal blocks shall include 20% spare terminals.

#### 5.15 Accessories

Accessories required for proper and safe operation of the switchgear shall be supplied. At least the following accessories shall be furnished for each assembly or group of assemblies in the same switch room.

- Device for manually charging the stored energy operating mechanism of circuit breakers (if applicable).
- Handle for moving circuit breakers into positions (if applicable).

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- Lifting trolley or similar device to remove circuit breakers or large starter modules from the cubicles. All lifting devices/appendances shall be individually identified, proof load tested and certified (if applicable).
- Adapter cables and/or flexible cords for testing the withdraw able starter modules and circuit breakers in withdrawn positions (if applicable).
- Test cabinet for testing circuit breakers, if required (optional).
- Special tools for erection and maintenance if applicable.

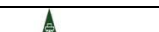


## 6.0 TESTS AND INSPECTION

Full functional tests shall be executed and witnessed. These may require shipment of ICSS equipment to the switchgear VENDOR/BIDDER's works to demonstrate correct communications with intelligent protection and control devices.

Type tests, routine tests and functional tests shall be carried out on the low voltage switchgear according to the recommendations of IEC 60439 and the relevant IEC publications referred to therein.

Prior to shipment of the switchgear an insulation resistance test shall be performed between each phase and neutral against earth, with the remaining phases and neutral connected to earth. The insulation resistance measured shall not be less than 5 mega-ohm. Also visual inspection and spot checks shall be carried out to verify at least the following:

- The degree of protection of the enclosure
- The degree of protection within the compartments
- The effectiveness and reliability of safety shutters, partitions and shrouds
- The effectiveness and reliability of operating mechanisms, locks and interlock systems
- The insulation of the busbar system
- The creep age distances and clearances
- The proper mounting of components
- The internal wiring and cabling system
- The correct wiring of main and auxiliary circuits
- The suitability of clamping, earthing and terminating arrangements
- The correct labelling of functional units
- The completeness of the data on the nameplates
- The availability of the earthing system throughout the switchgear

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- The interchangeability of electrically identical components
- The non-interchangeability of mechanically identical but electrically different withdraw able units

## 7.0 SPARE PARTS

Together with the supply of all equipment under this specification, a complete set of spare parts for commissioning shall be supplied for each switchgear. The supplied spare parts shall comply with the same specifications as the original parts and shall be fully interchangeable with the original parts without any modification.

The vendor shall also supply a list of recommended spare parts for two years of operation.  
4 Nos. MCCB for MCC Panel as Mandatory spare parts needs to be included.

## 8.0 DOCUMENTATION

The vendor shall supply the necessary information with the quotation to enable evaluation of the submitted proposal. General documents/drawings are not acceptable unless they are revised to show the equipment proposed.

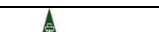


The documents to be supplied with the quotation shall at least include the following:

- Completed enquiry data sheet/s.
- Summary of exceptions/deviations to this standard specification.
- Brochures and catalogues containing description of typical switchgear and technical data on major and auxiliary components such as circuit breakers, contactors, relays, meters etc.
- List of accessories included in the bid.
- Preliminary dimensional drawings.
- Approximate shipping weights and sizes.

The documents which shall be supplied together with the equipment shall at least include the following:

- Updated and completed enquiry data sheet/s.
- Final single line diagram/s.
- Schematic control circuit diagrams of each kind of circuit breaker and starter module.
- General arrangement drawings showing main dimensions, panels' layout, floor panel and shipping sections.
- Drawing/s showing the location of field wiring terminal strips and power cable



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connections.

f) Information concerning interlock sequences.

g) List of major and auxiliary components, showing complete reordering information for all replaceable parts.

h) Recommended spare parts list for two years of operation.

i) Test reports and performance curves of the final routine tests.

j) Painting specification and test result/s.

k) Applicable test certificates.

l) Installation, operation and maintenance instruction/s.

m) Fault finding and troubleshooting manual/s.

n) Protective relay/s types, curves and setting ranges.

o) Cut-off current characteristics of fuses.

p) Total weight of the assembly and of the individual shipping sections.

q) List of accessories and/or any special tools required for erection, operation and maintenance

## 9.0 GUARANTEE

The supplier of the equipment under this specification shall guarantee the equipment and shall replace any damaged equipment/parts resulting from poor workmanship and / or faulty design.

The supplier shall replace any equipment failed under the following condition:

- Failure under startup and commissioning tests performed according to IEC recommendations.
- Failure under normal usage for a period of 12 months, not exceeding 18 months from the date of dispatch from the manufacturers works.