

**Zishan Engineers (Pvt.) Ltd.****An ISO 9001-2008 certified company,**

47/F, Block 6, PECHS, Karachi-Pakistan

Tel: (92-21) 34393045-48 &amp; 34310151-54

Fax: (92-21) 34533430 &amp; 34310156

E-mail : [contact@zishanengineers.com](mailto:contact@zishanengineers.com),Web : [www.zishanengineers.com](http://www.zishanengineers.com)**Document No.**

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**OIL & GAS DEVELOPMENT COMPANY LTD.****LOW VOLTAGE SWITCHGEAR (MCCs)**

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## 1.0 **INTRODUCTION**

### 1.1 **Scope**

This Specification is for the design, manufacture, assembly and testing of 400V Low Voltage Switchgears & MCCs to be installed indoors, in non-hazardous area.

The scope of this Specification includes specific technical requirements for indoor switchgears & MCCs, such that, the design, manufacture, testing and performance of equipments, and components, included in this specification shall comply with all applicable IEC Standards / Documents (latest issues, amendments, and supplements to these documents shall apply, unless otherwise indicated), as listed below:

### 1.2 **Definitions**

Following definitions apply throughout this document:

|                   |   |
|-------------------|---|
| Company / Owner   | : Oil and Gas Development Company.<br>(OGDCL)   |
| Consultant        | : Zishan Engineers (Pvt.) Ltd.  |
| Vendor / Supplier | : The organization, firm or agency with whom order for the supply of equipment and or material has been placed. |

### 1.3 **Errors or Omissions**

- Any errors or omissions noted by the Supplier in this Specification shall be immediately brought to the attention of Company.

### 1.4 **Deviations**

All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of the Company in the bid. Such deviations shall be shown in the documentation submitted to Company/Consultant.

### 1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the Contract scope of work, this Specification, National Codes & Standards referenced in this Specification or any other documents, the Supplier shall refer to the COMPANY / CONSULTANT whose decision shall prevail.

## 2.0 **CODES AND STANDARDS**

IEC 60947-2 Low Voltage Switchgear and Control gear, Part:2 - Circuit Breakers

IEC 60439-1 Low Voltage Switchgear and Control gear Assemblies, Part: 1 – Type Tested and partially Type Tested Assemblies

IEC 60529 Degree of Protection provided by Enclosures (IP Code)

## 3.0 **ENVIRONMENTAL CONDITIONS**

### 3.1 **Ambient Temperature**

- Maximum : 50 °C
- Average : 22.5 °C

### 3.2 **Relative Humidity**

- Maximum : 81 %
- Minimum : 21 %

## 4.0 **GENERAL**

- Switchgears & MCCs shall comply with, and configured and wired as detailed in IEC 60439-1.
- Measurements shall be in SI Units.
- Documents shall be in English.
- Rated Voltage and Current for Switchgears & MCCs shall be based on 50 Hz.

## 5.0 **GENERAL ELECTRICAL CHARACTERISTICS**

The Switchgears shall be as per the following Electric Supply System:

- Voltage: 400 Volts,  $\pm 10\%$
- Frequency: 50 Hz,  $\pm 5\%$
- Phase / Wire: 3 Phase / 4 Wire
- Fault Level: As per SLD
- Neutral Grounding Solid

The Switchgears & MCCs shall be equipped with ACBs (Draw out Type), MCCBs (Fixed Type), Motor / MCCBs / Contactors (Draw out Type), as indicated on respective SLDs.

Each incoming breaker and BUS Coupler (ACBs) shall be furnished with dedicated electronic protection relay modules (EPRs) covering the minimum protection features as shown in relevant single line diagram and data sheets.

These EPRs shall be connected (pre-wired) by supplier in RS-485 daisy chained Loop(s). Supplier shall terminate the other end of each loop to dedicated external terminal block / JB for onward connection to RS-485 module of PMS.

All EPRs shall be connected in redundant loop.

In addition to above mentioned RS-485 serial connection to purchaser's PMS, circuit breaker (incoming and Bus coupler) status is also required to be connected to PMS system through hardwired IOs. For this purpose, switchgear supplier's scope shall include relevant control wiring from breaker's auxiliaries contacts up to a dedicated external terminal block/JB for onward connection.

The Cable Entry shall be of "Bottom" Type.

The Bus Duct Entry shall be of "Top" Type if any.

The Main Bus Bars, Risers and Earth Bus shall be of "Electrolytic grade Copper" Material.

The Painting shall be of "EPOXY" Type.

The Space Heater, and Auxiliary / Control supply voltage shall be 230 V AC.

The Enclosures Degree of Protection shall be at least IP31, as defined in IEC 60529.

Feeders equipped with Power Transducers (as per SLDs) shall be of "Class 0.5".

All Control Bus Bars shall be of "Tinned Copper".

All ACBs shall be equipped with the following Features / Characteristics:

- DSF
- Sealing Cover
- Shunt Release, 230V AC
- Safety Shutter & Operation Counter with Closing Coil, 230 V AC
- Service Position Switches
- 230 V AC Spring Charged Motors
- Cut Off Switches
- Spring Charged Close Signal Switch
- Auxiliary Contact Switches
- Door Interlocking Kits

All Motor Feeders shall be equipped with separate Contactor for Instrument Interlock, and Instrument Ready Indication.

Current Transformers and Potential Transformers shall be of Cast Resin Type only.

All Motor Feeders shall be equipped with Test Lamp, Push Button, and Inst. Ready Indication Lamp.

The Control Transformer (400V / 230V) shall be Electrically Interlocked, through Contactors of suitable size.

All Motor Feeder Ammeters shall be suppressed end scale (Analog) with Class 1 Accuracy.

All Motor Feeders shall have the provision for incorporating signals from PLC related to:

- Start / Stop Command
- Running / Stop / Tripped status
- Shutdown Command

(Actual usage of such signals from MCC starter circuits shall be as per motor schematic Drawings)

“Direct on Line Starters”, and “Star / Delta Starters” shall be provided with Contactors, and Bimetallic over Load (O/L) Relays, Single Phasing Prevention Features.

Switchgears & MCCs shall be complete with all necessary cable terminations, cable spreader boxes etc., as required to complete the works.

Push Buttons shall be of heavy-duty type. Indication Lights / Lamps shall be push to test type, with wide band LED Pilot Light only.

Control Relays contacts shall be rated for minimum 10 amp and with 230 V AC operating coils. The number and type of contacts shall be as required to perform the operations specified.

Selector switches shall be of rotary type with enclosed contacts and shall have adequate number of contacts to perform their switching functions properly.

All units designated “Spare” on the Single Line Diagrams”, shall be furnished completely wired, and fully equipped with the breakers for the sizes, as designated on SLDs.

Power circuit components shall be rated for the specified operating voltage. The equipments shall be capable of proper operation for voltage deviations of plus minus 10%, and frequency deviations of plus minus 5%.

## 6.0 **OTHER CHARACTERISTICS (Common Enclosure and Cubicle Design)**

The Switchgears & MCCs should be indoor type, free standing, bottom cable entry, cubicle type modular construction, and front operated.

The Switchgears & MCCs shall be designed, and constructed to “Form 4b”, as defined in IEC 60439-1 Standard, such that the failure of one equipment does not affect the adjacent units. Between bus compartment and breaker compartment, and breaker compartment and cable compartment, non- perforated flame retardant partitions shall be provided.

The switchgears & MCCs shall be type tested for mechanical resistance test, which ensures the strength of the structure against electro dynamic forces due to short circuit currents.

The switchgears & MCCs shall be type tested for internal arc withstand as per IEC 1641.

All live parts shall be isolated from direct contact by barriers, and enclosures.

Covers with access to live parts shall be marked as “Danger – Live Parts”. All components shall be labelled with engraved laminated labels.

Properly sized and labelled terminal blocks shall be provided for all connections. All wires and cables shall be terminated with compression type connections, and pins for control wires.

All current carrying parts shall be capable to carry the specified rated current continuously. All de-rating factors shall be allowed for, in the design of the Switchgears & MCCs.

A Copper Earth Bar of appropriate length shall be provided in each Switchgear & MCC.

Relays, meters and control switches shall be located at a height, which shall be convenient for monitoring.

The draw-out mechanism shall hold the breaker rigidly in the service, test, or isolated / disconnected positions. It shall be possible, when the breaker is open to position the breaker in any of the three positions with the door closed.

The circuit breakers and enclosures shall be so interlocked as to prevent removal or re-insertion of the breaker without being in the open position, but the door of each cubicle shall be arranged to permit door opening with the breaker closed.

Each breaker shall have a locking device to lock the breaker in the open position.

Stored-energy closing springs shall be automatically discharged before the breaker element may be withdrawn from the cubicle.

Busbar alley shall be covered with screwed perforated sheet to avoid direct access to the vertical busbars on opening of the busbar alley door.

Power and Control terminals in cable alleys (min. 350mm wide), for each module shall be covered with bolted type, sloped hylam sheet or FRP sheet which shall be fixed after termination of power cable.

The Switchgears & MCCs enclosures shall have a metal thickness of approx. 2mm, and additional stiffeners.

The Switchgears & MCCs shall be dead front, and dead back construction, with all required access, provided from the front.

The Switchgears & MCCs enclosures shall be minimum IP31 according to IEC 60529, gasketed, and installed in ventilated or air-conditioned electrical equipment rooms located in unclassified areas.

Push buttons, selector switches, and indication lights / lamps shall be installed on approx. 2mm steel device panel.

Separate pan type removable steel doors shall be used for each cubicle. Doors with neoprene rubber gasket shall be hinged to the structure on the left side with concealed hinges, and shall be held with captive screws on the right side.

## 7.0 **TERMINAL BLOCKS, WIRING AND GROUNDING**

Adequate space shall be provided for wiring. All wires shall be properly arranged in wiring gutters or control trays.

Control wiring shall be carried out with flexible heat resistant wires of minimum size 1.5mm<sup>2</sup> for control circuits, and 2.5mm<sup>2</sup> for CT circuits. Wires connected to earth shall be of green color only.

Each wire shall be identified at both ends with wire designation in accordance with the wiring diagram developed from approved control schematics. Interlocking type plastic ferrules of yellow color shall be used for identification. Color of lettering of ferrule shall be black.

Wires forming part of tripping circuit of circuit breaker shall be provided with additional red ferrule, marked "T", or some other acceptable identification mark shall be provided as per manufacturers standard.

All spare contacts of relays, switches and other components shall be wired up to terminal blocks.

Terminal blocks of different voltage classes shall be segregated. Minimum clear space of 200mm shall be provided between gland plate, and terminal block.

The terminal block shall be grouped and segregated according to circuit functions and voltage, and shall have 20% spare terminals. Individual terminals in each block, in each group shall be serially numbered in accordance with the drawings.

Sufficient clear space shall be provided between gland plates and terminal blocks. Gland plates shall be of non-magnetic material for all single core cables.

Motor Starter Feeders / Units shall be grounded in accordance with IEC 60439-1.

Switchgears & MCCs shall be designed and constructed to ensure proper grounding of the individual units. Maximum resistance between the individual Motor Starter Enclosure and Switchgear ground bus shall not exceed 0.1ohms, as per IEC 60439-1.



## 8.0 **INCOMER AND BUSCOUPLER ARRANGEMENT**

### 8.1 **Incomers**

- The incomers to MDB Switchgears (Normal / Emergency) & MCCs shall be ACBs, as per single line diagrams. For MCC, the incomers and bus couplers shall be MCCB.
- The ratings of the incomers shall be as per Single Line Diagrams.
- The incoming busduct / cable shall be terminated to the incoming busbars.
- A main bus compartment section, for incomers, shall be provided complete with meters, current transformers and auxiliary equipment, as shown on the single line diagrams. All equipment in the metering compartment shall be accessible from the front of the switchgear.

### 8.2 **Buscouplers**

- The buscouplers in Switchgears (Normal) shall be as per Single Line Diagrams.
- The ratings of the buscouplers shall be as per single line diagrams.

## 9.0 **BUSES**

Phases for buses and component terminals shall conform to IEC standards for Switchgears & MCCs.

Horizontal and vertical buses shall be braced to withstand the minimum RMS symmetrical fault current, at a utilization voltage of 400 V, as specified in datasheet.

Bus ratings shall be based on 40°C rise over a 50°C ambient.

Bus bar spacing and the spacing of bus fastening point shall not be less than specified in IEC 60439-1.

The bus bar ratings of the main buses for switchgears & MCCs shall be as per Single Line Diagrams.

Each Switchgear and MCC section shall contain three main horizontal bus bars, housed in an isolated compartment, which shall run continuously through all sections of Switchgears & MCCs.

The main horizontal buses shall be continuous and unspliced.

Each vertical section shall contain three full length vertical bus bars connected to the horizontal main bus bars at the top of each vertical section.

The vertical buses shall be rated for the connected load.

A continuous, horizontal Copper earth bus shall be located across the complete length of Switchgears & MCCs lineup.

A vertical earthing bus shall be provided in each vertical section that makes contact with the plug-in units before the bus stabs engage the vertical bus.

Earth bus shall be rated to carry the maximum fault current.

Hinged doors shall be earthed through flexible earthing braids. All non-current carrying metal parts shall be effectively bonded to the earth bus.

## 10.0 **MOTOR STARTER UNITS**

### 10.1 **Requirements**

- Combination motor starter units / distribution feeders shall be fixed type.
- Every motor starter feeder shall be provided with:
  - Test lamp P.B. & Instrument ready indication lamp
  - Indicating lamps (clustered LED type): ON, OFF, TRIP
  - Manual reset of thermal overload relay
  - ON, OFF, TRIP potential free contacts (to DCS)
  - Terminals for ON, OFF, ESD from PLC
- All motor starter units / distribution feeders shall be equipped with Ammeters, and selector switches, for motors rated up to 75kW; whereas motors rated above 75kW shall be additionally equipped with kWh, and Volt meters.

### 10.2 **Main Disconnect Device Mechanism**

- The main disconnect device shall be MCCB.

### 10.3 **Contactor**

- The motor starter contactor shall be a heavy duty magnetically operated, rated for the maximum continuous current of the starter, it will be installed in.
- In addition to auxiliary control contacts required for starter operation, it shall be provided with two additional nos. of auxiliary contacts. These additional terminals shall be wired to the starter control terminal box.

## 11.0 **SPACE HEATERS**

### 11.1 **For Motor Control Centers (MCCs)**

- A minimum of one space heater per section shall be provided.
- Heater shall be rated for continuous duty at 230 V.
- When required, an additional normally closed auxiliary contact shall be provided on the motor starter contactor to allow motor space heater operation, when the motor is not in operation.

## 12.0 **INSPECTION AND TESTING**

Inspection and Testing shall be carried out at Manufacturer's works, by the Vendor to ensure that the equipments comply with all the specified requirements, as per Data Sheet, and Purchase Order, in particular that the construction, and wiring requirements and enclosures' classifications are met, and that the components (i.e. CTs, VTs, Relays, Instruments, Lamps, and Controls) are complete, and correct in rating and range.

Routine Tests shall be carried out, as per relevant IEC Standards, at Manufacturer's works, on complete Switchgears & MCCs Assemblies. Routine Tests shall include, but not limited to the following:

- i. Mechanical operation of circuit breakers, outgoing feeder modules, auxiliary switches, manual devices etc.
- ii. Operational and safety interlocks.
- iii. Operation of circuit breaker for minimum allowable control voltage.
- iv. Closing and opening of circuit breaker at rated and minimum control voltage.
- v. Millivolt drop test across breaker contacts, and between terminals, when housed in cubicle.

Test Certificates, against Type Tests shall be provided, by the Manufacturer.

## 13.0 **IDENTIFICATION AND LABELING**

Each unit and cubicle on Switchgears & MCCs shall have nameplates on the outside face of the door.

The devices within Switchgears & MCCs shall be identified with a nameplate.

The equipment mounted through the doors shall have nameplates provided on both sides of the mounting surface.

The overall Switchgears & MCCs assemblies shall be centrally and visibly marked with a nameplate of letters 18 mm or larger including, Manufacturer's name, model and serial numbers, etc.

The nameplates shall comprise engraved letters in laminated phenolic, with a white outer surface, and black core.

#### 14.0 **ACCESSORIES AND TOOLS**

Following accessories shall be provided with Switchgears & MCCs lineup.

- Manual Spring charging device.
- Breaker rack in / rack out trolley.
- Earth switch / truck for earthing busbars / incomers & outgoing.

#### 15.0 **SHIPPING**

Switchgears & MCCs shall be packed securely and anchored to skids. Un-mounted parts shall be suitably boxed, and firmly attached for shipment.

Switchgears & MCCs shall be shipped completely assembled, whenever possible. When this is not possible, shipping splits shall be indicated on the drawings.