

# **MOTOR CONTROL CENTER DESIGN CRITERIA**

## 1. INTRODUCTION

This specification is related to the tailings facility located in Bolnisi Georgia. The present technical sheet covers the specifications for Motor Control Centers.

## 2. PROJECT GENERAL DATA

- Mining method: Underground.
- Process type: Flotation.
- Ore type: Polymetallic ore.
- Location: Bolnisi - Georgia (Eastern Europe).

## 3. SCOPE OF SUPPLY

The present document describes the minimum specifications required for the design, installation and tests of motor control centers (MCC). The supplier will remain responsible on the technical quality of its supply. The MCCs will be installed in inside.

The expected lifetime cycle shall be 25 years.

The quantities of equipment to be provided are listed in the table below:

ITEM	TAG	Service voltage	Frequency	Rating	Remarks
1	MCC-00	400 V	50Hz	...A	
2	MCC-00	400 V	50Hz	...A	

## 4. REFERENCE DOCUMENTS

- Applicable Standards.
- The present document.
- The Single Line Diagram
- Load list
- Typical wiring diagrams
- Data sheet

## 5.0 STANDARDS, CODES AND REGULATIONS

The equipment shall comply with the latest editions of appropriate IEC standards, codes and regulations.

In general, the MCCs will be designed, manufactured, tested and installed in accordance with the relevant European standards.

## 6. TECHNICAL SPECIFICATIONS

- Service Voltage: 400V.
- Frequency: 50Hz.
- Construction: Self - supporting

- Material: galvanized or electro – galvanized steel sheets
- Protection: IP 42
- Incoming cables: top side
- Outgoing cables: top side
- Installation: Indoor

## **7. MCC DESIGN**

- Fully compliant with Standards: IEC 60051; IEC 60112; IEC 60044-1,2; IEC 60143; IEC 60269; IEC 60439; IEC 61641; IEC 60445; IEC 60529; IEC 60664-1; IEC 60688; IEC 60947-1; IEC 61000; IEC 61800
- Local/Remote Selector on front doors
- the main busbars shall be rated for the nominal current over the entire length of the assembly and shall not be rated lower than the main incoming unit
- In the event of an internal fault in a functional unit, the damage shall be confined to that unit, so that the bus bar system and all other functional units remain fit for further service. Likewise, an internal fault in a dropper system shall be confined to the associated panel, so that the bus bar system and the other panels of the assembly remain operational
- In motor starter circuits, the coordination between starter and protective device shall comply with Type 2 as specified in IEC 60947-4-1. This generally implies that a starter is sufficiently protected by the shortcircuit protection and that no damage will occur to the starter in the case of a through going fault current. Type test reports shall be made available in the quotation stage
- All current-carrying bus bars, including circuit connections, shall be made of copper unless specified otherwise. The bus bar system shall be accessible for construction and maintenance duties. The main (phase) bus bars in the bus bar compartment shall be completely covered with insulation made from suitable material with a durability to withstand the mechanical, electrical and thermal stresses to which it may be subjected in service. Assembled bus bar system shall be durable to withstand thermal and electrodynamic effects of short-circuit current, the value and duration of which are specified in the requisition documentation. The insulation shall be color coded (A-Yellow, B-Green, C-red, PE Yellow and green lines) for phase designation and shall be so constructed that it can only be removed by destructive measures. The insulation of the bus bar joints and branching points shall be of equal quality to that of the main bus bars and shall be removable for inspection and easily replaceable. Enclosing and support structures on the bus bars shall have sufficient hygroscopicity and arc endurance. Consumers shall be arranged ensuring an equal load distribution over the bus bar.

- The following information shall be given on the general equipment nameplate, which shall be mounted on the front of the assembly: vendors name, purchase order number, year of manufacturing, rated voltage and frequency, rated current of bus bar system, rated voltage of auxiliary circuits, rated short time withstand current and time, rated peak current, degree of protection. Also to provide instruction plates and warning plates.

- Each circuit of the assembly shall be provided with following circuit identification labels (Circuit label shall be white and black lettering). Circuit labels shall be installed on the front of the back plate of the fixed part and on the upper side of the removable part of withdrawable units and repeated at main and auxiliary cable terminations if they are not clearly identifiable from the physical layout. Identification number of the connected equipment or circuit destination number shall be installed on the removable part of a withdrawable unit.

internal main components shall be clearly identified in accordance with Vendors wiring and connection diagrams

- MCC assemblies shall be back-to-back or back-to-wall arrangement, accessible from the front only.

- In addition to the outgoing units specified in the requisition, at least 20 percent fully equipped (a complete fully connected device or equipment, ready for use) and 10 % spare space.

- Terminals shall be suitable for copper conductors. In view of the substantial cable derating that is normally applied, adequate terminals and termination space shall be provided for the main cabling. For bus wiring and outgoing circuits, individual terminals shall be provided for each external connection. These terminals shall be of the non-loosening, wedge type or cage type construction, obviating the use of cable lugs.

- All MCC components requiring maintenance shall be easily accessible from the front only.

All live parts inside the assemblies, including terminals of equipment mounted on compartment doors, shall have a degree of protection of at least IP 20 (doors open).

Compartment doors or covers shall be interlocked to prevent opening when the isolating switch is in the "ON" position. The isolating device shall only be operable when the door is fully closed and when the withdrawable unit is fully inserted. When a withdrawable unit has been removed from the assembly, the live parts inside the fixed compartment shall be protected against touch, with a degree of protection of at least IP20. Where shutters are fitted to comply with the above requirement, they shall be mechanically operated by the movement of the withdrawable unit and not be dependent on gravity.

- Assemblies shall throughout comply with all criteria as stated in clause 5 of EN 60439-1 Supp 2. Test current shall be equal to the rated short-circuit current and test duration shall be minimal 300 ms. Type test reports shall be made available in the quotation stage.
- In case distribution bus bars (droppers) are not able to withstand the rated short-time withstand current as specified for the main bus bar, the distribution bus bars shall have full segregation by insulated material.
- Bus bar arrangement for 380V MCC/ MCC's shall be TN-S. The earth bus bar shall be located in the bottom and in all riser compartments of the assembly and shall be easily accessible. Sufficient connection points with adequate terminating facilities shall be provided for termination of cable earth conductors.
- The bus bar system shall be accessible for construction and maintenance duties. Bus bars shall have equal cross-section throughout the whole length of a MCC, which shall correspond to rated current specified in the requisition documentation. Neutral bus bar cross-section shall be equal to phase bus bar cross-section. The main (phase) bus bars in the bus bar compartment shall be completely covered with insulation made from suitable material with a durability to withstand the mechanical, electrical and thermal stresses to which it may be subjected in service. Enclosing and support structures on the bus bars shall have sufficient hygroscopicity and arc endurance.
- Automatic circuit breakers shall comply with IEC 60947-2. Automatic circuit breakers intended for power distribution (incoming circuit breakers, circuit breakers of outgoing lines to other boards and assemblies) shall comply with utilization category B to ensure time selectivity in short circuit mode. The value of rated short-term withstand current  $I_{cw}$  of a circuit breaker shall exceed short-circuit current specified in the requisition documentation. The time of current  $I_{cw}$  is 1 sec. Rated service breaking capacity  $I_{cs}$  shall be 100% of rated ultimate breaking capacity  $I_{cu}$ . If this condition is not fulfilled, design shortcircuit current specified in the requisition documentation shall be less than rated service breaking capacity  $I_{cs}$  of a circuit breaker. It is allowed to use automatic circuit breakers in cast housing of category A as automatic circuit breakers intended for power distribution provided that the following conditions are fulfilled: Equipment vendor ensures complete selectivity with upstream and downstream automatic circuit breakers; Equipment vendor ensures partial selectivity with upstream and downstream automatic circuit breakers provided that maximum selectivity current  $I_s$  is at least equal to design value of short-circuit current on MCC bus bars, where this device is installed.
- Contactors shall be of the holding coil type with an operating voltage 220V AC, 50 Hz.

- Starters and contactors shall comply with IEC 60947-4-1. Starters and contactors shall be designed both for continuous and intermittent operation mode; intermittent mode class shall provide for 12 operation cycles per hour. Starters and contactors shall ensure direct startup from the circuit. The Vendor shall provide documentation confirming that all the contactors and starters have successfully undergone standard tests in combination with applied short-circuit current protection devices and other connected devices.
- Contactor/Starter shall close at 85% of rated voltage and shall guarantee staying closed if the voltage decreases down to 65% of rated voltage. Contactors used in motor starter circuits shall conform to the requirement of both uninterrupted duty and intermittent duty Class 12 (12 operating cycles per hour at rated operational current) in accordance with IEC 60947-4-1. They shall have a mechanical durability level of one million no-load operating cycles. MCU (Motor Control Unit) like SIMOCODE or UM-102 for LV motor starters shall be utilized.
- HMI LCD display “full numeric keypad” for VFD’s shall be located on the door of the LV MCC. VFD’s shall be installed in separated compartment with separate door to ensure safe maintenance alongside the MCC.
- Thermal relays shall have compensation of ambient temperature impact. Thermal relays shall have a wide current setting range. Disconnection class shall comply with parameters and conditions of protected electric motor startup. Thermal relays shall provide both manual and automatic reset options. For motors with power capacity 30 kW and over instantaneous earth fault protection shall be provided. Motor earth fault protection, if specified in the requisition, shall be provided by integrated motor control system.
- The VSD shall operate on  $\pm 10\%$  of the specified input voltage and  $\pm 0.2$  Hz under normal operation and  $\pm 0.4$  Hz under post-fault operation of the specified input frequency. The VSD equipment shall be designed and manufactured to operate with the motor driver to meet the conditions specified in the Data Sheets. VSD’s shall be the sinusoidal input type, which provides near harmonic free operation to the connected power source. Individual or simultaneous operation of the VSD’s shall not add more than 3% total harmonic voltage distortion and no more than 5% total harmonic current distortion to the normal bus. If harmonic filters are required to meet these requirements, the VSD Manufacturer shall provide the filter, and be responsible for the design and manufacturing of the filter.
- The VSD’s shall have a minimum efficiency of 97% and power factor 0.95 lagging when measured at rated output and torque. VSD output stability shall be  $\pm 1\%$  (digital setting) of maximum frequency. VSD shall be designed to withstand the surge voltage according to the guidelines specified on the attached datasheets, without resulting damage to the controller

or nuisance tripping. The VSD output voltage shall be variable so as to maintain a constant voltage/frequency ratio over the desired constant torque output range. The voltage regulator shall provide regulation to 1% of set point automatically without feedback loop.

Analog speed reference input (process control follower) shall be provided as described on the attached data sheet. VSD control unit shall automatically reset after any under voltage trip without the need for local/manual reset. VSD control unit shall trip on motor over temperature by a motor over temperature switch (NC). One contact rated 220 V AC and 3 A for remote RUN indication shall be provided. One contact rated 220 V AC and 3 A for remote FAULT indication shall be provided.

- The VSD inverter design may be voltage source, current source, or pulse-width modulated. Vendor shall note the proposed design in the Manufacturer's data section of the Data Sheets. VSD speed control shall allow a maximum 1% drift of set frequency in 24 hours with 40 °C ambient temperature.
- Current transformers shall be in accordance with IEC 60044-1, GOST 7746-2001. Current transformers for measuring purposes shall be accuracy Class 1 with a security factor of at least 3. The secondary current rating shall be 5 A for Am-meters and watt-hour meters mounted on the assembly. Current transformers for protection shall be accuracy Class 5 P. The short circuit rating shall be in accordance with the requisition and data sheet(s).
- Voltage transformers shall be of at least class 1. Secondary circuits of voltage transformers shall be earthed.
- Connections between the built-in motor control system and the DCS shall be made by means of a Profibus DP or Modbus TCP IP or RTU). Connection between MCC and SIS shall be hard wired via interposing relays.
- Built-in electric motor operation control system shall be designed to transmit the following signals to/from DCS/SI: Electric motor is "ON"; "Ready to Start"; "Electric Fault"; "VSD Fault" (for electric motor with variable speed drive); "General Fault";  
Control signal from DCS: "Start"; "Stop"; Measurement signal to DCS: Current measurement; Speed measurement (for electric motor with variable speed drive).
- All electrical equipment shall be tested by its manufacturer and adjusted prior to delivery. Certified copies of standard equipment test reports shall be submitted to the Client along with equipment. Test methods, including allowable test voltages, duration and test methods, shall be provided along with equipment and materials.
- The supplier shall provide a Factory Certificate for the MCC and Operations Manual. Erection instructions and any special tools required for maintenance shall form an integral part of the order and shall be packed with the equipment.

- Front doors:
  - Start/Stop Buttons.
  - Red/Green Lights on front doors.
  - Lights for power presence indication.
- Manufacturer shall provide next documents;
  - SLDs
  - wiring diagrams (each feeder)
  - logic diagram
  - technical passport
  - certificate of conformity
  - FAT protocols
  - installation manual
  - pre-commissioning and commissioning manual
  - operation and maintenance manual