

**OMAN WASTEWATER
SERVICES COMPANY S.A.O.C**



**الشركة العمانية
لخدمات الصرف الصحي ش.م.ع.م**

OMAN WASTEWATER SERVICE COMPANY

ELECTRICAL STANDARD SPECIFICATION

SECTION 04

HIGH VOLTAGE MCC

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1-0 SCOPE

This specification covers the design, manufacture and testing of factory assembled HV motor control centers (MCC's) to be installed within Oman Wastewater Services Company Projects.

2-0 STANDARDS SPECIFICATIONS

The MCC shall conform in design, materials and performance (except where otherwise specified) with the current issue and amendments (at time of order) of the appropriate Oman Electrical Standard and relevant international standards:

- British Standards
- All relevant IEC recommendations relating to electrical equipment
- National Fire Protection Association (NFPA)
- Omani Electrical Standards

3-0 SERVICE AND ENVIRONMENTAL CONDITIONS

The MCC shall, in all respects, be suitable for operation under service conditions stated on section - 01

4-0 ELECTRICAL SYSTEM

- 4-1 The electrical arrangement of the MCC's, protection, metering, control, interlocking, intertripping etc. shall be shown on the MCC single line diagrams.
- 4-2 The MCC electrical rating (voltage, current, frequency, fault current, etc.) shall be as stated on the MCC single line diagram. The ratings shall be quoted on the basis of the starters being housed in enclosures under natural ventilation conditions. The ratings of units shall take full account of all heat sources within the enclosure.

- 4-3 MCC's Shall be suitable for operation, without deleterious effect, with variations of voltage and frequency as stated on the MCC single line diagram.
- 4-4 Transient voltage depressions down to 80% of rated voltage shall not affect MCC performance.

5-0 STRUCTURAL & MECHANICAL REQUIREMENTS

- 5-1 MCC cubicles shall be metal-enclosed, free standing, floor mounting, flush fronted and arranged to form a single structure with a common busbar assembly.
- 5-2 It shall be possible to extend the MCC and the busbars safely by installing additional units at either end and cabling up with existing units live except when making the busbar connections.
- 5-3 Automatic safety shutters shall be provided to cover the busbar and circuit spouts during isolation. They shall be positively driven in each direction and padlocked in the closed position. A self-cancelling latch shall be included in each shutter mechanism for testing and maintenance purposes.
- 5-4 Comprehensive mechanical interlocks shall be provided to prevent any malfunction.
- 5-5 Circuit breakers shall be vacuum or SF6 type to comply with the relevant British or harmonised European Standards.
- 5-6 The equipment shall be rated in accordance with the Particular Specification. Unless specified otherwise.
- 5-7 Circuit breakers shall be capable of clearing any fault condition, which may occur in the system without damage to equipment or personnel.
- 5-8 Spring operated mechanisms shall be provided with volt-free contacts to give indication that the springs are charged.
- 5-9 The closing solenoids of dc solenoid operated mechanisms shall be suitable for operation at a minimum of 80% of the nominal supply voltage. They shall not malfunction or cause excessive vibration when energised at the rated voltage, or when energised from a full wave rectified source designed for multiple simultaneous operations.

- 5-10 To facilitate maintenance and adjustment of contacts, it shall be possible to 'slow-close' the circuit breaker but this operation shall only be possible in the fully withdrawn position. Any necessary operating handle or lever shall be supplied.
- 5-11 Where mechanical key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove a trapped key from the mechanism.
- 5-12 Control and auxiliary switches shall comply with the requirements of BS EN 60947-5-1. With a minimum of two spare contacts. They shall be readily accessible and enclosed in a transparent plastic cover.
- 5-13 A voltmeter and ammeter shall be fitted to each motor starter arranged to monitor phase and line voltages and line currents on the load side in conjunction with selector switches. Ammeter switches shall be make-before-break type to avoid open circuits in the C.T. circuits.
- 5-14 High-voltage motor starters at 3.3kV or 6.6kV shall be of the metal clad totally-enclosed pattern in accordance with BS 5227, and with construction and general component standards in accordance with those specified for AC switchboards and control gear.
- 5-15 High-voltage starters shall be of single-tier withdraw-able truck-mounted or fixed pattern and compliant with BS 5856.
- 5-16 Fixed housings shall be provided with automatic safety shutters on the busbar-isolating spouts for motor or single end circuit control. Feeder-isolating spout shutters shall be fitted when specified.
- 5-17 Contactors shall be operated by 110V dc derived from a transformer-rectifier in each starter.
- 5-18 Each starter shall have low-voltage and high-voltage equipment fully segregated.
- 5-19 Contactors, high-voltage HBC fuses, control transformers and associated components shall be mounted on the starter withdraw-able truck providing safe maintenance access to all main active equipment. Truck-mounted low-voltage equipment shall be segregated from the high-voltage circuit by an earthed metallic screen.

- 5-20 Contactor auxiliary switches shall comply with the requirements of BS EN 60947-5-1. They shall be readily accessible and enclosed in a transparent plastic cover. A minimum of four spare auxiliary switches, two normally open and two normally-closed, shall be provided.
- 5-21 Separate segregated low-voltage compartments shall be provided accessed by separate hinged doors.
- 5-22 Contactors shall comply with BS 775 Part 2 and shall have utilization category AC-3 and duty of Class 0.03 unless otherwise specified.
- 5-23 Contactors shall be of the vacuum type. Operation of vacuum contactors shall be such that current is broken at, or very near to zero, to minimise current chopping.
- 5-24 High-voltage HRC fuses shall comply with BS EN 60282 and BS 2692 and shall be of the striker-pin pattern. Fuse protection shall be fully co-ordinated with the contactor performance throughout the range of operation of all starter components under voltage over-current and earth-fault conditions.
- 5-25 Comprehensive interlocking and padlocking shall be provided to ensure correct operation and operator safety.
- 5-26 Starter control, protection, instrumentation, and metering facilities shall be as specified.
- 5-27 The MCC structure shall be provided with barriers to prevent transfer of ionized gases between starters.
- 5-28 MCC shall be self ventilating.
- 5-29 Interlocks, busbar shutters, covers, etc. shall be provided to prevent incorrect or unsafe operation and to prevent access to live parts.
- 5-30 The busbar shall be labeled “Busbars” and to be positively driven type.
- 5-31 MCC’s shall be designed and constructed to facilitate inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance.
- 5-32 Similar parts and components shall be interchangeable wherever practicable.
- 5-33 Enclosure of degree of protection shall be as stated on the one line diagram.

- 5-34 Isolating mechanisms and unit withdrawal facilities shall be suitable for operation by one man.
- 5-35 All materials shall be of the “self extinguishing” type.

6-0 MOTOR STARTERS

- 6-1 Motor starters shall be one of the following types:
 - a) Fused vacuum contactor
 - b) Circuit breaker (complying with High Voltage Switchgear specification – Section - 03)
- 6-2 Motor starters shall be direct-on-line starting unless otherwise stated. All starters shall be arranged for remote control in addition to any controls specified at the MCC.
- 6-3 Motor starters of the fused contactor type shall be withdrawable and comprise:
 - 6-3.1 Vendor’s standard isolating system mechanically interlocked with the door/witdrawl mechanism, padlockable in the “off” position and interlocked with the contactor so that the isolator cannot be opened unless the contactor is in the de-energized position. The design shall be such that the possibility of a fault between the isolator and the fuse can be considered negligible.
 - 6-3.2 The main fuses shall have an interrupting rating greater than the maximum prospective fault current. Control, indication and instrument circuits shall be protected by fuses.
 - 6-3.3 The contactor shall be suitable for uninterrupted duty.
 - 6-3.4 Contactor and protective devices shall be coordinated to ensure that contactor fault rating is not exceeded. Fault in excess of the contactor rating, shall cause operation of the fuses before initiating fault relay tripping.
- 6-4 Motor starters shall be provided with an ammeter having full scale deflection of not less than six times the motor full load current. The motor full load current reading shall be at approximately 50% of full scale deflection.

- 6-5 Test facilities shall be provided to permit operation of the motor starter without energizing the H.V. circuit.
- 6-6 The motor starter isolator shall be padlockable in the open position.

7-0 BUSBARS

- 7-1 Busbars and connections shall be manufactured from hard drawn copper.
- 7-2 Each busbar shall be completely insulated with a flame retardant material.
- 7-3 Busbars shall be of same cross sectional area throughout the length of the MCC.
- 7-4 An earthing busbar shall be provided along the full length of the MCC structure with provision for earth cable connections at each end.
- 7-5 Busbars and connections shall be adequately sized, braced and supported to withstand the mechanical forces and thermal effects resulting from the MCC rated short circuit current and carry test certification.

8-0 EARTHING

- 8-1 All metallic non-current carrying parts of the MCC shall be bonded together and connected to the MCC earth busbar.
- 8-2 Doors having components mounted on them shall be bonded to the main structure by means of flexible copper connection arranged so that it cannot be trapped as the door is opened or closed.
- 8-3 Withdrawable parts shall be effectively earthed until they are completely withdrawn with all power and control connections disconnected.
- 8-4 Provision shall be made, adjacent to the cable termination, for connecting cable armouring to the earthing busbar.

9-0 SECONDARY WIRING

- 9-1 Secondary wiring shall be XLP insulated 600V grade.
- 9-2 Secondary wiring within the MCC shall be securely held in position.
- 9-3 Secondary wiring layout shall permit alterations to individual circuits without requiring shut down of the complete MCC.
- 9-4 Bus wires for control, motor heaters, etc. shall be run within the MCC.
- 9-5 Wiring identification shall be by numbered, and/or lettered, ferrules, of insulating material adjacent to the terminals.
- 9-6 All wiring of external connections shall be brought out to individual terminals on a readily accessible terminal block.
- 9-7 Wiring connections to door mounted equipment shall be carried out using flexible cables, which shall be loomed, wrapped in flexible PVC conduit and be firmly clamped at both ends to prevent movement at terminations.
- 9-8 The minimum cross-sectional area of the secondary wiring shall be 1 mm².
- 9-9 Plug and sockets connections shall be of robust construction and include a location pin or similar device to prevent the interconnection being made incorrectly.

10-0 CABLE TERMINATIONS

- 10-1 Cable terminating facilities and terminals shall be suitable for the specified cable type, gland and conductor size.
- 10-2 The following cable terminating facilities shall be provided:
 - Adequate space to be able to terminate the specified cables.
 - Undrilled gland plates for top entry cables.
 - Direction of cable entry shall be as stated on the MCC single line diagram.
- 10-3 Cable support shall be provided (where practicable) to avoid undue strain on the cable termination.
- 10-4 Termination of single core cables shall be brought to an insulating or non-magnetic gland plate.

10-5 The power and control cables for a starter shall be terminated within the starter and shall be completely segregated from other starters.

10-6 Terminal blocks shall be of the “single deck” type.

11-0 AUXILIARY SUPPLIES

11-1 Auxiliary supplies (control, indication, heaters, etc.) shall be in accordance with the MCC single line diagram.

11-2 Bus-wired auxiliary supplies shall be individually protected by fuses within each motor starter.

11-3 Anti –condensation heater supplies, for starters and motors, shall be fed from a separate external source for each busbar section.

12-0 INSTRUMENT TRANSFORMERS

12-1 Current transformers and voltage transformers for protection and instrumentation shall be designed in accordance with the British Standard recommendations appropriate for the application.

12-2 Voltage and current transformers shall be provided as shown on the single line diagram. They shall be of the appropriate ratio, output, class and accuracy for the protection and metering being used.

12-3 The vendor shall provide details of ratio, output, class and accuracy for all instrument and protection transformers in his supply.

12-4 The accuracy class of the C.T.’s and V.T.’s shall be suitable for the type of measurement or protective loads supplied. The rated voltage, current and frequency shall be stated. Separate C.T.’s shall be used for protection and for instrumentation

12-5 The secondary windings of instrument transformers shall be earthed at one point, with provision for attaching test links.

- 12-6 Current transformers shall be rated to withstand the thermal and magnetic stress resulting from the maximum available through fault current.
- 12-7 Bridging terminals for current transformers shall be provided at the outgoing terminals where external connections are required.
- 12-8 In addition, terminal blocks shall be provided to permit secondary injection tests on protective relays.
- 12-9 Voltage transformer primary and secondary windings shall be protected by HRC primary fuses, to BS EN 60282-1 and by secondary fuses to BS88 in each relay and metering circuit.
- 12-10 The secondary circuits shall be kept as short as possible and separate leads used to connect the transformer to each relay and metering burden. A means of isolation of the primary shall be included and lockable safety shutters shall cover the fixed isolating contacts when the transformer is isolated.
- 12-11 Current and Voltage transformer nameplates shall be fixed in a position so that details can easily be read when fitted in the cubicle.
- 12-12 Current transformer and voltage transformer connections shall be provided at front panel mounted test blocks located on each switch panel. The test blocks shall enable current, active and reactive power measuring instruments to be connected without open circuiting the current transformer secondary circuits.

13-0 METERING, PROTECTION, CONTROL AND INDICATION

- 13-1 Metering, protection, control and indication shall be provided as shown on the MCC single line diagram.
- 13-2 Meters and relays shall be flush mounting and fitted on the front of the MCC.
- 13-3 Meters and relays shall be capable of withstanding, without damage, the secondary currents associated with the maximum available through fault current.
- 13-4 External zero adjustment shall be possible on all indicating instruments to facilitate adjustment without dismantling the instrument.
- 13-5 Motor running / stopped indication shall be provided on all motor starters.

- 13-6 Protective relays, automatic controls and associated VTs, CTs, timers, auxiliary relays etc. shall be supplied by the vendor and be mounted in the MCC where practicable.
- 13-7 Protection relays shall be mounted on the front of the switchgear or relay panel in such a position that operation and maintenance can be conveniently carried out. Auxiliary relays may be mounted internally and shall be located to be readily accessible.
- 13-8 Protective relays for circuit breakers shall, unless otherwise specified, be the electronic type installed in draw-out cases mounted in an instrument cabinet above the circuit breaker on the front of the panel.
- 13-9 Multiple-function modular relays shall incorporate plug board or similar approved function and characteristic changing devices.
- 13-10 All relay protection elements shall have controls for protection set point and time setting adjustment. Relay characteristics, functions and settings shall be clearly indicated on the relay element front plate.
- 13-11 Relays shall have provision for testing the operation and calibration without disconnecting the permanent wiring by means of integral or separately mounted plug-in test terminal assemblies.
- 13-12 Relays shall be flush, draw-out type. Each relay shall have an indicator device to show the relay has operated and its specific operating function. Each indicator shall be able to be reset by hand. Re-setting devices shall not require the removal or opening of the relay. It shall not be possible to operate or adjust the relay settings without opening the case.
- 13-13 Protection relays shall comply with BS 142.
- 13-14 The following additional protection shall be provided when specified in the Particular Specification:

Bearing Temperature Protection:

- This shall comprise temperature detectors suitably located to detect an over temperature in any of the pump or motor bearings. The over temperature device(s) shall operate into mechanically latched flag relays. Once operated, the drive shall stop and shall not restart until the relay has been reset.

Water Cooled Motor Protection:

- Water cooled motors shall include protection appropriate to the type of installation.
- All water cooled motors shall have Loss of Cooling Water Flow protection. This shall comprise a flow switch (or switches) and a mechanically latched flag relay to detect loss of flow of cooling water. Once operated, the drive shall stop and shall not restart until the relay has been reset.
- Closed air circuit water cooled motors shall, in addition, have a sensor to detect loss of water into the closed air circuit. The sensor shall operate in conjunction with a mechanically latched flag relay. Once operated, the drive shall stop and shall not restart until the relay has been reset

Motor Over temperature Protection:

- Over temperature protection shall comprise thermistors in the motor and a thermistor relay in the starter. The thermistor relay shall operate in conjunction with a mechanically latched flag relay. Once operated, the drive shall stop and shall not restart until the relay has been reset

Pump Over temperature Protection:

- Pump Over temperature Protection shall comprise a temperature sensor in the pump casing. This shall operate in conjunction with a mechanically latched flag relay. Once operated, the drive shall stop and shall not restart until the relay has been reset

Pump Low Flow Protection

- Pump Low Flow Protection may be provided instead of Pump Over temperature Protection. This shall comprise a flow switch/sensor in the pump delivery. This shall operate in conjunction with a mechanically latched flag

relay. One timer (0 to 30 seconds) shall delay the protection during starting. Once operated, the drive shall stop and shall not restart until the relay has been reset

Pump Low Suction Protection:

- Pump Low Suction Protection shall comprise a pressure gauge, with electrical contacts, which open at low pressure, fitted in the suction main to each pump. This shall operate in conjunction with a mechanically latched flag relay. The Low Suction Protection shall be active whenever the pump is running. A timer relay (0 to 30 second) shall delay the protection operating so as to protect against nuisance tripping during transients. Once the protection has operated, the drive shall stop and shall not restart until the relay has been reset.

Pump High Delivery:

- Pump High Delivery Protection shall comprise a pressure gauge, with electrical contacts, which open at high pressure, fitted in the delivery main from each pump. This shall operate in conjunction with a mechanically latched flag relay. The High Delivery Protection shall be active whenever the pump is running. A timer (0 to 30 seconds) shall delay the protection operating during running so as to protect against nuisance tripping due to transients. Once the protection has operated, the drive shall stop and shall not restart until the relay has been reset.

13-15 Stop/start pushbuttons, supply on, motor running and tripped indicator lights, an auto/off/manual selector switch as appropriate, an hours run counter, and other components as necessary shall be included on the front panel to provide the method of control required. Volt free contacts shall be provided for output to SCADA.

14-0 ANTI-CONDENSATION HEATERS

14-1 Heaters suitably rate to prevent condensation shall be provided within the MCC cubicles.

14-2 Heaters shall be individually switched and protected by fuses.

14-3 Motor anti-condensation heaters shall be controlled by auxiliary contacts on the contactor. Contacts shall be arranged so that when the motor is energized the heater is off and when the motor is de-energized the heater is on. Additionally, switches shall be provided to energize the heaters when the contactor trucks are withdrawn from their cubicles.

15-0 LABELS

15-1 The starter's components shall be identified by labels. The designations and tag numbers shall be in accordance with MCC single line diagram.

15-2 A main label shall be affixed in a prominent position on each MCC giving the following information:

- Manufacturers name and type
- MCC designation
- Rated fault current
- Busbar rating
- Year of manufacture

15-3 Each circuit shall be fitted with a label giving the following:

- 15-3.1 Current and voltage rating
- 15-3.2 Rated fault making and breaking current

15-4 Labels shall have black characters on white background and be made by non-corrodible material.

16-0 FINISH

The colour, finish and corrosion protection shall be in accordance with the vendor's specification.

17-0 SPECIAL TOOLS

A complete set of any special tools required for operation, maintenance and testing of the MCC shall be provided.

18-0 SPARES

The vendor shall provide separate lists of recommended commissioning and operating spares.

19-0 INSPECTION AND TESTING

19-1 The vendor shall provide test certificates for each type and rating of interrupting device. Tests shall be those listed in the relevant standards.

19-2 The buyer reserves the right to witness the following tests:

19-2.1 Routine tests on all MCCs/components as stated in the relevant standards and:

- Operational (electrical and mechanical) test on all components
- Primary injection tests to prove current transformers ratios
- Secondary injection tests to prove correct operation of relays, accuracy of metering and integrity of wiring, unless proved in the primary injection tests.

19-2.2 Type tests, where specified, or if there is no type test certificate available.

19-3 The vendor shall give two weeks notice of tests prior to commencement.

20-0 SHIPPING, HANDLING AND STORAGE

20-1 MCC's shall be shipped in sections to suit ease of handling for transportation and installation.

20-2 Withdrawable motor starters shall be shipped separately from their housings, unless the vendor can guarantee it can be shipped without damage when located in the housing.

20-3 Preparation for shipment shall protect the MCC auxiliary devices accessories, etc. Against corrosion, breakage or vibration injury during transportation and handling.

20-4 Each shipping container shall be identified with the contents, purchase order number and item number.

20-5 Instructions shall be provided for reassembly of sections in the field.

21-0 DRAWINGS AND DATA

21-1 The vendor shall provide drawings and data in accordance with relevant standards.

21-2 Full details for installation and setting up shall be included

21-3 Recommended test data shall be stated, covering initial and regular testing.

22-0 DEVIATIONS

Deviations from this specification are only acceptable where the vendor has listed in his quotation the requirements he cannot or does not wish to comply with and the purchaser has accepted, in writing.

In the absence of a list of deviations it will be assumed by the purchaser that the vendor complies fully with this specification.