

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

**P.O. BOX #: 1047,  
Al Khuwair,  
Postal Code 133,  
Sultanate of Oman.**

**Tel: (968) 24693412; Fax: (968) 24693418.  
Web: [www.omanwsc.com](http://www.omanwsc.com)**

## TECHNICAL STANDARD SPECIFICATION ELECTRICAL

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**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 01**

**ELECTRICAL DESIGN CRITERIA**

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## **1-0 SCOPE**

This specification covers the general requirements to be applied to all Electrical system and equipment to be installed within Oman Wastewater Services Company projects. This specification shall be used in conjunction with the separate related sections of the Electrical Standard Specifications as follows:

### 1-1 Related sections :

Section – 02, Power Transformers

Section – 03, High Voltage switchgear

Section – 04, High Voltage MCC

Section – 05, Low Voltage switchgear

Section – 06, Low Voltage MCC

Section – 07, Electrical Alarm panels

Section – 08, Electric Motors

Section – 09, Power Cables

Section – 10, Standby Generators

Section – 11, UPS units

Section – 12, General Electrical Installations

Section – 13, Lighting, Emergency lighting,  
Accessories and General Power

Section – 14, Lightning Protection

Section – 15, Telephone systems

## 2-0 CODES AND STANDARDS

The design of the projects shall comply with the following codes and standards

### 2-1 British Standards:

- § BS 88 - Cartridge fuses for voltages up to and including 1000V.a.c.
- § BS 89 - Direct acting indicating analogue electrical measuring instruments and their accessories.
- § BS 142 - Electrical Protection Relays
- § BS 159 – High Voltage Busbars and connections
- § BS 162 – Electrical Power Switchgear and associated apparatus
- § BS 381C – Colour for Identification, Coding and special purposes
- § BS 449 – The use of structural steel in Building
- § BS 729 – Hot dip galvanized coating
- § BS 2048 – Dimensions of fractional horse power motors
- § BS 4196 – Method of rating industrial noise affecting industrial areas
- § BS 4794 – Control Switches
- § BS 4999 – General requirements for rotating machines
- § BS 5000 – Rotating electrical machines
- § BS 5304 – Code of practice for the safety of machinery
- § BS 5472 – Low Voltage Switchgear and control-gear
- § BS 5685 – Electricity meters

- § BS 6231 – PVC Insulated cables for switchgear
- § BS 7626 – Current Transformers
- § BS EN 60439 – Low Voltage Switchgear and control gear assemblies
- § BS EN 60947 – Low Voltage Switchgear and control gear

- 2-2 All relevant IEC recommendations relating to electrical equipment
- 2-3 National Fire Protection Association (NFPA)
- 2-4 Omani Electrical Standards.

Where the particular specification imposes additional requirements to a British or harmonised European Standard, the requirements of the particular specification shall prevail.

Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.

### **3-0 SERVICE AND ENVIRONMENTAL CONDITIONS**

#### **3-1 Temperature:**

Recorded of extreme of site ambient temperature are: +5°C to +50°C  
Mean Daily temperature is 30°C except where specified otherwise

#### **3-2 Altitude:**

Height above Sea level: 0-300m

#### **3-3 Relative humidity:**

Highest: 95%  
Lowest: 40%

3-3 Atmosphere:

The equipment and material are to be suitable for installation in coastal industrial plant where the atmosphere is subject to dust storms.

Mean annual rain fall: 100mm

Daily average wind speed: 4-5 m/sec

3-4 Seismic requirements:

To satisfy the seismic requirements the equipment shall comply with the Omani regulations.

**4-0 SYSTEM VOLTAGES AND FREQUENCY:**

The nominal voltage used on the plant shall be:

A - HV Voltage power and distribution:  
33kV, 11kV, 6.6kV, 3.3kV, 3 phases, 50Hz

B - LV Voltage power and distribution:  
415V, 240V, 50Hz, neutral solidly earthed

C – Electrical control:  
220V, 1 phase, 50 Hz

D – Switchgear closing and tripping;  
125V d.c. (to be confirmed)

E - Instrument power supplies:  
220V and 120V, 1 phase, 50 Hz

F – Instrument control:  
120V, 1 phase, 50 Hz  
24V d.c.

G – Alarm systems:  
120V, 1 phase, 50 Hz  
24V d.c.

F – Utility socket outlets:  
120V, 1 phase, 50 Hz., centre point earthed for hand tools and lamps;  
220V, 1 phase, 50 Hz for all else.

4-1 Voltage and frequency variations shall be:  
Voltage:  $\pm 10\%$   
Frequency:  $\pm 1\text{Hz}$

**5-0 AREA CLASSIFICATION AND SELECTION OF ELECTRICAL EQUIPMENT:**

The area classification shall be in accordance with relevant standard.

**6-0 EQUIPMENT:**

6-1 General:

6-1.1 All materials used in the manufacture of equipment shall be new, and guaranteed free from defects, and shall be capable of resisting corrosion from sewage. The contractor shall ensure that the manufacturer ascertains the conditions and service under which materials and equipment are to operate and warrants that operation under those conditions shall be successful.

6-1.2 All equipment and materials shall be designed to sustain all stresses that are likely to occur during fabrication, handling, transportation, erection and intermittent or continuous operation.

6-1.3 All electrical equipment including cables shall be de-rated for continuous operation in accordance with an ambient temperature of  $50^{\circ}\text{C}$  and in accordance with the appropriate OES.

6-1.4 Equipment shall not be rated for the air-conditioned temperature.

6-1.5 Lubrication of equipment shall ensure constant presence of lubricant on all wearing surfaces.

- 6-1.6 Lubricant fill and drain openings shall be readily accessible. Easy means for checking the lubricant level shall be provided.
- 6-1.7 Equipment lubrication systems shall require no more than weekly attention during continuous operation and shall not require attention during start-up or shut down.
- 6-1.8 Belt or chain drives, fan blades, couplings, exposed shafts and other moving or rotating parts shall be covered on all sides with safety guards to BS 5304.

6-2 High Voltage Switchgear / Motor Control Center:

- 6-2.1 The HV switchgear and motor control contactors shall be either SF6 or vacuum withdrawable type.
- 6-2.2 The HV switchgear shall be in accordance with Electrical Standard Specification – Section 04.

6-3 Low Voltage Switchgear / Motor Control Centre:

- 6-3.1 The 415V switchgear shall consist of withdrawable air circuit breakers and have symmetrical short circuit fault rating.
- 6-3.2 The switchgear shall be in accordance with Electrical Standard Specification – section 06.
- 6-3.3 L.V. / Motor Control Centres shall be provided with 10% extra unequipped spare motor control cubicle space.

6-4 Power Transformer

- 6-4.1 The main power transformer for the grid input shall be oil filled and installed outdoors.

- 6-4.2 The main power transformer shall be equipped with on-load automatic tap changer.
- 6-4.3 The distribution transformers shall be oil filled type and installed outdoors, but protected from direct exposure to sunlight under sunshield. Indoor transformers shall be the dry, cast insulation type.
- 6-4.4 The distribution transformers shall be equipped with off-load tap changing facilities.
- 6-4.5 The Transformers shall be in accordance with Electrical Standard Specification – section 02.

#### 6-5 Electric Motors

- 6-5.1 All electric motors shall be in accordance with the Electrical Standard Specification – Section 08.
- 6-5.2 MV motors shall be suitable for operation on 6.6kV, 3.3kV or 415V 50 Hz 3 phase supply.
- 6-5.3 All motors shall be capable of starting 10 times per hour. The starting current shall not exceed 6 times full load current.
- 6-5.4 The motors shall run free from vibration and the rotors shall be perfectly balanced both statically and dynamically and shall be tested and adjusted for dynamic balance in an approved manner.
- 6-5.5 Connection boxes shall allow sufficient space for glanding and termination of main and auxiliary cables. The connection box when complete with the terminated cables, shall not adversely affect the IP rating of the motor.
- 6-5.6 Sealed-for-life bearings are acceptable on motors rated up to and including 22kW.  
For motors rated above 22kW, bearings shall be fitted with lubrication points and grease relief facilities.

6-5.7 Unless otherwise stated, the motor kW ratings for the various voltage levels shall be as follows:

- a) Ratings above 350kW – 6600V or 3300V, 3 phase, 50Hz
- b) Ratings 0 to 350kW - 415V, 3 phase, 50Hz
- c) Ratings below 0.37 - 415V, 3 phase, 50Hz or 220V, 1 phase, 50Hz.

6-5.8 All motors shall be totally enclosed, fan cooled (TEFC) and of a.c. squirrel cage induction type unless stated otherwise.

6-5.9 All 6600V and 3300V motors shall be equipped with anti-condensation heaters.

6-5.10 The heaters shall be rated for 220V operation and supplied via a normally closed contact on the motor starter contactor witch shall be closed when the contactor is open.

6-5.11 Sun shields shall be provided over motors exposed to direct sunlight.

6-6 Controls:

6-6.1 All motors shall be provided with a local, heavy duty, start and stop/lock-off pushbutton stations. Some drives shall also be provided with locally mounted, “local/remote” or “hand/off/auto selector switches.

Non-corrosive material shall be used for the equipment located in corrosive areas.

6-7 Emergency power:

Critical loads shall be fed from uninterrupted power supply unit (UPS) in accordance with Electrical Standard Specification – Section 11.

## **7-0 BULK MATERIALS**

### **7-1 Cables:**

7-1.1 Electrical cable shall comply with Electrical Standard Specification – Section 09.

7-1.2 Cables shall be installed in accordance with Electrical Standard Specification – Section 12- General Electrical Installation.

### **7-2 Cable Ladder Rack/Tray**

7-2.1 Above ground cables shall generally be run on heavy duty ladder rack or tray.

### **7-3 Lighting**

7-3.1 Lighting panels shall be rated at 415/220V, 3phase, 4 wire, 50Hz.

7-3.2 The following intensity levels, measured at 1m above the floor level in a horizontal plane, shall be used as a basis for lighting design.

Type of location	Lux
Control room general lighting	400
Control room rear of instrument panels	250
Auxiliary and panel rooms	250
Outside, near entrance	150
Pump areas, compressor houses, etc	150
Outdoor operation areas	150
Access Platforms and Walkways	50
Laboratories and offices	400
Drawing offices	700
Toilets	150
First aid rooms	400
Generally inside building	250
Outside lighting	50
Consumable storage	150

7-4 Emergency lighting

7-4.1 The escape lighting shall be provided by luminaries which are complete with lamps, NI-Cad storage batteries, charger and automatic transfer relay. This lighting shall provide sufficient illumination for the safe evacuation of personnel where there is a complete power failure. Sufficient illumination shall also be provided for the location of fire alarm call points and fire fighting equipment.

7-5 Convenient outlets

7-5.1 110V single phase convenience outlets shall be located throughout the plant to meet specific requirements.

7-5.2 The power supplies for the convenience outlets shall be obtained from 415/110V single phase transformers,

7-5.3 415V, 3 phase, 50Hz welding /power outlets shall be installed strategic locations. The power supplies shall be taken on the 415V switchgear/motor control centre and shall be fitted with earth fault protection.

7-6 Earthing

7-6.1 The 33/6.6kV and 33/3.3 kV transformers shall have the star point of secondary winding solidly connected to earth or via a neutral earthing resistor. The ohmic value of the resistor shall be sufficient to limit the earth to a value below the rated full load current on the transformer.


7-6.2 The neutral point of secondary winding of all 6600/415V transformers shall be solidly connected to earth at each substation.

7-6.3 The Earthing system shall consist of a number of earth rods combined with grid networks of bare copper conductors, the main grids being laid around the perimeter of each building or plant.

- 7-6.4 The resistance of the main earthing system to the general mass of earth shall not exceed Five ohm.
- 7-6.5 All non-current carrying metallic parts of electrical equipment structures, vessels tanks etc. Shall be connected to the main earthing system.
- 7-6.6 Major electrical equipment shall be effectively earthed and shall include two paths to earth. One path shall be by an earth conductor which is connected to the main earth system and a second path shall be provided by the cable armour.
- 7-6.7 All connections to the grid network or bare copper conductors shall be made by the exothermic welding process.
- 7-6.8 All earthing conductors liable to mechanical damage or corrosion shall be protected and those run above earth shall be insulated.
- 7-6.9 All equipment earth connections and earth rod connections shall be readily accessible.
- 7-6.10 Separate “clean” earthing systems shall be provided for instrumentation and control systems, where required.

7-7 Lightning protection

- 7-7.1 Lightning protection shall be provided on outdoor structures where required.
- 7-7.2 The copper tape down dropper from the lightning air terminal shall be connected to the main earthing systems, and shall incorporate a bolted link 10M above ground for testing purposes.
- 7-7.3 The resistance of the lightning protection system to the general mass of earth shall not exceed seven ohms.

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## 7-8 Hazardous Areas

Sewage gives off several gases including methane gas and hydrogen sulphide.

1. Methane gas can form an explosive mixture with air. It is classified as a group IIA gas (BS 4683 IEC 79).
2. Wet wells with limited ventilation are classified as Zone 1 hazardous areas (BS 5345).
3. Wet wells with forced ventilation may be classified as Zone 2. However, consideration should be given to the consequences of ventilation or power failure.
4. Dry wells will normally be classified as Zone 2 areas, if forced ventilated.
5. The areas around digester and sludge digestion equipment may be classified as Zone 0, Zone 1 or Zone 2, depending on the amount of gas present.
6. The areas immediately around bulk diesel oil storage tanks are classified as Zone 2 hazardous areas, containing hydrocarbon gases.
7. Consideration must therefore be given to the type of equipment installed in these environments. Electrical and ICA equipment must be rated for the appropriate zone requirement. Fan motors must be rated for Zone 1 use, unless the Contractor can demonstrate there is no risk whatsoever of methane gas being present.

Hydrogen sulphide is highly corrosive and poisonous. It is present in wet wells in high concentrations, but may be present in dry wells at lower concentrations. Any equipment installed in these environments must be resistant to hydrogen sulphide.

Any environment(s) in which explosive or poisonous gases are present, presents a potential safety hazard. The Contractor must select and install equipment which will provide a safe working installation.