

WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION E-00-01

ELECTRICAL EQUIPMENT - GENERAL

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1. **GENERAL**

1.1 **Electricity Supply**

The high voltage electricity supply shall be 11 kV (root mean square value) nominal, 3-phase, 3-wire, 50 Hz and may vary within the limits of plus 10% and minus 2.5% of voltage and plus and minus 2% of frequency. The maximum symmetrical fault level at the incoming supply will be 350 MVA (18.4kA) at 11 kV.

The low voltage electricity supply shall be 380V (root mean square value), 3-phase, 4-wire, 50 Hz and may vary within the limits of plus and minus 6% of voltage and plus and minus 2% of frequency. The maximum symmetrical fault level of the incoming supply will be 26 MVA (40kA) at 380V.

Equipment shall operate satisfactorily for prolonged periods at plus 6% and minus 10% of the nominal voltage without damage.

1.2 **Storage and Operating Conditions**

Equipment supplied shall be capable of withstanding any combination of the following environmental conditions in which it can be stored or operated without mechanical or electrical damage or degradation of performance:

(i) **Indoor Equipment**

0° to 40°C ambient.

0 to 98% humidity with condensation due to temperature change.

0 to 100% humidity with condensation for area with adverse conditions or high relative humidity, including but not limited to caverns, pipework tunnel portals and raw water chambers.

(ii) **Outdoor Equipment**

0° to 40°C ambient under tropical sunlight.

0 to 100% humidity with condensation due to temperature change.

1.3 **Standards**

The equipment supplied shall comply with the latest version of the relevant international standards currently enforced on the date of tender invitation. The standards referred to in the Specification shall also mean similar standards issued by internationally recognised engineering institutions or organisations. Manufacturers

offering equipment to other standards shall supply a copy of such standards in English together with full details of any deviations from the standards referred to in this Specification. The equipment shall comply with the following specific standards where applicable:

BS 88	Low-voltage fuses – Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to K
IEC 60068	Environmental testing
IEC 60085	Electrical Insulation. Thermal evaluation and designation
BS 6231	Electric cables – Single core PVC insulated flexible cables of rated voltage 600/1000V for switchgear and controlgear wiring
BS EN ISO 1461	Hot dip galvanised coatings on fabricated iron and steel articles. Specifications and test methods
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60898	Circuit-breakers for overcurrent protection for household and similar installations
IEC 60947-2	Circuit-breakers
IEC 60947-3	Switches, disconnectors, switch-disconnectors and fuse-combination units
IEC 60947-4-1	Electromechanical contactors and motor-starters
IEC 60947-5-1	Electromechanical control circuit devices
IEC 60947-7-1	Terminal blocks for copper conductors
IEC 61007	Transformers and inductors for use in electronic and telecommunication equipment – Measuring method and test procedures

2. MATERIAL AND COMPONENTS

2.1 Quality of Material

Materials used for and the components incorporated in the equipment shall be new and of first class quality, free from imperfections and selected for long life with minimum maintenance and shall be suitable for the intended purpose.

Parts shall be of corrosion-resistant materials and shall maintain their properties for a minimum period of 25 years with the equipment being idled or subject to the most severe conditions of service as specified.

All materials chosen and used in an electrical equipment shall be purposely designed

for the intended application and shall not cause harmful effects to other equipment, undue fire risk or electrical hazard.

2.2 Non-metallic Material Selection

The use of wood shall be avoided as far as possible. When used, it shall be free from knots and blemishes.

The equipment shall be fire-resistant, non-flame propagating and waterproof.

Glass fibre or plastic components shall be of adequate design taking into account the effects of operating temperatures, humidity and exposure to sunlight. Materials used for equipment exterior shall be resistant to flame propagation.

Asbestos material shall not be used.

2.3 Metallic Material Selection

Where the use of dissimilar metals in contact is unavoidable they shall be so selected that the electro-chemical potential difference between them shall be not greater than 0.3V for outdoor and 0.5V for indoor equipment.

Ferrous screws, nuts, bolts and springs for panel exterior shall be of stainless steel or chromium plated. Instrument screws not forming part of a magnetic circuit shall be of brass, bronze or stainless steel.

Where bronze is used, it shall be zinc-free.

Copper shall not be used in any form in contact with aluminium e.g. copper screws for fixing aluminium. These two metals shall not be used in close proximity where there is possibility of accidental bridging the metals by water or condensation.

Metallic components except when enclosed in enclosures complying with IEC 60529, IP 55 (totally enclosed) shall have a finish for extreme severity of climatic conditions e.g. ferrous parts shall be galvanised or zinc plated and have heavy protective alkaline resistant paint finish.

2.4 Electrical Insulating Material

Electrical insulating materials shall comply with IEC 60085 to suit the working temperature of the equipment. Mass manufactured equipment may be of standard class of insulation of the manufacturer. Non-impregnated paper, fabric or wood shall not be used. Where synthetic resin bonded insulating boards are used, cut-edges shall be sealed with an approved varnish.

Where glass fibre or plastic covers enclose live parts, the design shall be such as to eliminate any risk of electric shock to personnel during operation of the plant, e.g. inclusion of an earthing screen and/or adequate electrical clearances etc.

Porcelain insulators or bushings shall not be used.

2.5 Electrical Components

2.5.1 General

Components shall be adequately rated and circuits shall be so designed that change of component characteristics within the manufacturer's tolerances shall not affect the performance of equipment to be supplied.

2.5.2 Power Components

Transformers for electronic devices shall comply with IEC 61007.

2.5.3 Protective Devices

Fuse bases and carriers for HBC fuses to BS 88 shall be of plastic moulded insulating material and all live terminals and contacts shall be effectively shrouded.

Fuses for short circuit protection of electrical equipment shall be of HBC type except for domestic or building electrical services or mass produced equipment where standard components may be used.

A device for isolation and locking shall be provided for each power supply, motor or similar electrical power equipment.

2.5.4 Switchgear

Switch-fuses may be used for ratings up to 32A. For higher ratings, fuse-switches shall preferably be used. Equipment shall comply with IEC 60947-3.

MCCBs shall comply with IEC 60947-2 and shall incorporate core-balanced earth fault trip elements with adjustable time delay. Upon requested in the particular specification, motorised MCCBs with integration of micro-processors shall enable the remote control and monitoring functions of MCCBs.

MCBs for power electrical equipment shall have a breaking capacity of 9 kA (M9) to IEC 60898.

Switchgear shall be equipped with lockable function such that these devices can be locked off and only be able to be unlocked by the use of keys or tools used to lock off these devices. These keys or tools should be under the control of the authorised person.

2.5.5 Control Equipment

Control equipment including relays, timers, switches, indicating lamps shall comply with IEC 60947-5-1.

Timers and relays shall be of plug-in type, in plastic case and termination socket.

Relays not hermetically sealed shall be of IP 20 protection and housed in dust-proof and totally enclosed case to IEC 60529, IP 54.

Contacts shall be suitable for operating voltages of up to 500V 50 Hz or 250V d.c. and shall have a minimum thermal current rating of 3A. The rated operational current shall be 2A 50 Hz or 20W d.c.. The utilisation category shall be as follows:

Resistance load	:	AC1 or DC1 to IEC 60947-4-1
Small motor load	:	AC3 or DC4 to IEC 60947-4-1
Inductive load or coils	:	AC11 or DC11 to IEC 60947-4-1

Contacts shall not be connected in parallel or in series to achieve the required contact rating. The following minimum number of volt-free changeover contacts shall be provided for each device:

Control relays for equipment above 40 kW	:	6 pairs
General purpose relays	:	3 pairs
Selectors, push buttons and timer relays	:	2 pairs

Coils and indicating lamps shall be rated at the operating voltage and power consumption shall not exceed 3W for each unit.

Components mounted on the panel/cubicle front shall have the degree of protection of IP 54 or that specified for the panel/cubicle.

The colour coding for indicating lamps and push buttons shall be as follows:

<u>Colour</u>	<u>Indicating Lamps</u>	<u>Push Button</u>
Green	Machine running Circuit-breaker on busbar alive	Start motor
Red	Motor tripped Motor off Circuit-breaker off Control/power failed Alarm operated	Stop motor
White	Valve open Auto Trip circuit healthy	Open valve Auto select

Blue	Valve closed	Close valve
Amber	Control available	-
Yellow	Manual	Manual select Accept alarm
Black	-	Reset protection/alarm Lamp test

Emergency stop push buttons shall have red mushroom heads of stay-put and turn-to-reset type operation and shall be fully guarded by transparent plastic covers to avoid unintended operation.

2.5.6 Termination

Stud terminals shall be provided at the motor for power supply. For external connections, terminal blocks shall be provided.

Cable sockets shall be of annealed copper. Terminal bases shall be of polyester moulding or equivalent. Non-metallic compression glands for instrument cable shall be of glass polyester or tufnol with neoprene rubber ring.

2.6 Instruments

Instruments and associated components shall be fully enclosed in cases.

Instruments for integrated measurement (e.g. energy meter and flow converter etc.) shall not reset automatically on failure of electricity supply, accidental disconnection or reversal of connection. A more secure means shall be provided against inadvertent manual resetting by unauthorised personnel while the instrument is in or out of operation (e.g. by means of password protection).

Instruments on cubicle front shall be flush-mounted without front fastenings.

Scales for indicating instruments shall be so designed as to eliminate parallax error.

Instruments shall attain the specified accuracy without special calibration.

3. CONSTRUCTIONAL FEATURES

3.1 Surface Finish Process

3.1.1 Metallic Material Finish

Machining and dressing shall be completed before galvanising and parts shall have been grit-blasted for not more than four hours before galvanising. Galvanising shall be done by hot-dipped process to BS EN ISO 1461.

Chromium shall not be electro-plated directly onto ferrous parts. Metallic components (inclusive of legend plates) which need chromium plating shall first be nickel plated to a minimum thickness of 0.03 mm.

No parts likely to be in contact with oil shall be galvanised.

3.1.2 Rust Protection

Cutting, drilling and de-burring of metal parts shall be completed with all traces of rust and grease thoroughly removed prior to application of a zinc chromate or other approved rust inhibiting primer.

3.1.3 Painting

At least two coats of corrosion resistant paint shall be applied on metal surfaces after phosphate treatment. A durable matt or semi-matt finish shall be given for indoor equipment and gloss finish for outdoor equipment. The minimum coating thickness shall be 50 micron.

3.2 Equipment Protection

3.2.1 Tropicalisation of Components

Components selected shall be suitable for use in the climatic and environmental conditions as specified. Alternatively, components may be treated in accordance with established techniques to withstand the specified conditions.

3.2.2 Environmental Protection

Where specified, tests conducted shall comply with IEC 60068.

The equipment shall be designed to prevent entry of vermin and to minimise entry of dust and dirt. Adequate safe-guards shall be provided to prevent accidental contact with hot surfaces or electrically live parts during operation and inspection of the equipment. Parts which can be worn or damaged by dust shall be dust-proof, with a degree of protection to IP 65.

Sealing gaskets shall be of neoprene rubber with a thickness of not less than 1.6 mm.

Outdoor equipment shall be protected against direct sunlight and rain by installation inside an IP 65 enclosure or under a canopy.

4. DESIGN FEATURES

4.1 Design - General

The equipment shall be designed for simplicity, safety, and reliability to give long and continuous economical service, with minimum maintenance and to facilitate rapid fault-diagnosis and parts replacement. The manufacturer shall demonstrate this, if required, by submitting the service record of similar equipment elsewhere, or by records of comprehensive type tests for the rating and design specified.

Ratings of equipment mounted in enclosures shall take into consideration the heat dissipated by the equipment and nearby components and the derating factors associated with the enclosure, switching surges, power factor and other operational factors.

The surface temperature of any part that may be contacted accidentally shall not exceed 65°C.

4.2 Access for Maintenance

Components shall be sited such that an easy access is provided for inspection, maintenance or repair without dismantling other components.

Components mounted in layers requiring removal or desoldering of other components before gaining access for maintenance or inspection will not be accepted except for mass produced items.

Side mounted components will not be permitted unless these will not obstruct the access to the front mounted components.

4.3 Interchangeability and Standardisation

Equipment which performs similar functions shall, as far as possible, be of uniform type and manufacturer in order to simplify maintenance and stocking of spare parts. Corresponding parts shall be standardised and interchangeable.

4.4 Component Design

Volt-free contacts shall be electrically isolated from the equipment and shall be used to complete external control alarm or indication circuits.

Selectors shall not be used for on/off control except where specified or for applications such as building electrical services and ventilation fans where resumption of power supply is required to switch on the equipment automatically.

Equipment provided with anti-condensation heaters shall be capable of operation without damage should the heaters be left on continuously; otherwise automatic humidity control shall be incorporated. Heaters shall not cause any damage to equipment or wiring and shall be protected independently with fuses mounted inside the enclosures at accessible locations.

The method of connection to any equipment shall, as far as possible, not require highly skilled personnel nor soldering and wire wrapping techniques. Where these are unavoidable, plug-in modular units shall be used.

5. SMALL WIRING

5.1 General

Terminal blocks at different voltages shall be segregated into groups, distinctively labeled and provided with permanent rigid barriers. Power supply terminals in groups shall have separate insulated covers that do not sustain combustion.

Wiring shall be neatly run and securely fixed in insulated cleats or harness to facilitate wire checking against diagrams.

5.2 Type of Cables

Except for solid state devices, wires subject to movement in service e.g. wires mounted on swing panels and on detachable sockets, shall have stranded copper conductors to BS 6231 (Table 1, Type BK PVC-insulated flexible cable).

The minimum size of small wiring inside switchgear and control panels shall be 1.5 mm² for control circuits and 2.5 mm² for power supply and current transformer circuits.

5.3 Terminal Blocks

Terminal blocks shall comply with IEC 60947-7-1. It shall be single-level feed-through, screw or screwless type connection, DIN rail-mounted, vibration and corrosion resistant, and modular design suitable for harsh industrial environment.

At least 10% spare terminals shall be provided for each panel or otherwise specified in the particular specification.

5.4 Wire Termination Method

Wires shall not be joined or broken between terminal points. Terminations shall be located in accessible positions.

External small wiring, incoming and outgoing cabling shall be terminated on the equipment supplied. Terminal blocks shall be provided on the fixed portion of the equipment.

Termination for stud terminals shall be of the ring type. Terminations of stranded conductors to terminals shall be crimped-on solid rod type.

Only one wire shall be terminated on each terminal block, except for stud type terminals where 2 wires will be permitted.

6. ACCESSORIES

6.1 Locks

Where integral locks are specified, chromium plated brass cylinder locks shall be provided with engraved labels. Two sets of keys shall be provided for each lock.

For power supply and high voltage equipment, different keys shall be used for each equipment.

6.2 Labels

Individual labels shall be supplied for each equipment, and for each of the components of a custom assembled equipment, including relays, instruments, fuses, indication lamps, pushbuttons, selectors and switches. Where more than one set of similar equipment or components are supplied, labels shall identify the separate function of each.

Labels for major plant items such as motors, generators, capacitors, transformers, battery chargers etc. shall be of stainless steel or approved non-tarnishing durable metal other than brass or aluminium. Labels for panels, cubicles and components shall be of laminated plastic with engraved legends or of clear perspex with back-filled legends. Danger and warning labels shall have a red background with white lettering. Character height shall be 1.5 times to that of width and shall be 3 mm minimum for components.

Inscription of labels shall be engraved under the rules of “Chinese characters on the top, English characters at the bottom” or “Chinese characters on the left, English characters on the right” whichever applicable. Both Chinese and English characters shall be of the same size.

6.3 Notice for Renewable Energy Power System

Both English and Chinese versions of the warning notices for Renewable Energy Power System shall be provided as follow: -

(a) ‘DANGER’ and ‘危險’ in white legible letters and characters each not less than 10 mm high, in red background and displayed at or near DC switchgear; and

(b) ‘Warning-Dual Supply’ and ‘警告 - 雙供電’ in black legible letters and characters each not less than 10 mm high, in yellow background and displayed at all electrical equipment with dual power supply.

Notice for Renewable Energy System showing the name and registration number of the registered electrical contractor employed for maintaining the generating facility in continuous safe work order, in legible letters and characters each not less than 5mm, displayed at the facility shall be provided.

- End of this Specification -