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WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION E-00-02

SITE INSTALLATION AND TESTING OF

ELECTRICAL AND INSTRUMENTATION

PLANT AND EQUIPMENT

I N D E X

WATER SUPPLIES DEPARTMENT
STANDARD SPECIFICATION E-00-02
SITE INSTALLATION AND TESTING OF ELECTRICAL AND INSTRUMENTATION PLANT AND EQUIPEMNT

1. SCOPE

This standard specification stipulates the requirements for site installation and testing of electrical plant including instrumentation and control equipment.

It shall be read in conjunction with the following WSD Standard Specifications:-

EM-00-02 Site Installation and Testing of Mechanical, Electrical and Instrumentation Plant and Equipment - General

2. SITE INSTALLATION

2.1 General

2.1.1 Equipment Layout and Finishes

The Plant shall be installed in accordance with the recommendation or instruction of the manufacturer. Adequate space shall be allowed for the safe operation and maintenance of the equipment. Access platforms where required shall be supplied and installed by the Contractor with the prior approval of the Engineer.

All mounting brackets, supporting steelwork etc. shall be supplied and installed by the Contractor. Steelwork shall be of adequate strength with suitable surface treatment for the prevailing conditions on site. All mounting brackets and supporting facilities shall be hot-dip galvanised to BS 729 and be painted with an approved colour.

No water pipes other than that for the sink in the battery room shall be installed in the electrical plant rooms.

Equipment labels to be provided at site shall have engraved characters in both Chinese and English. They shall be properly fixed or stencilled on the equipment to give a clear identification prior to cable termination particularly where a number of identical items are installed. "Danger", "Busbar Alive" and other warning labels shall be fixed prior to commissioning. Touch-up paint shall be applied to scratched or bare metal surfaces.

Any temporary modification to the existing building finishes, fixtures and equipment during the course of the installation work shall be made good afterward by the Contractor to the satisfaction of the Engineer.

2.1.2 Provision of Structural Details and Built-in Parts

The Contractor shall submit within the time specified for the approval of the Engineer full details of all concrete and support structures required for the Plant and associated ancillaries, including the loadings (horizontal, vertical and bending moment) at each point of support on the concrete sub-structure. Full building details shall also be submitted of all thrust blocks, holes, ducts, chases, openings, recesses, rebates, plinths, drains, built-in parts and the like to enable the civil contractor to proceed with the design and construction of the plant foundations and other civil work.

The Contractor shall include details of the location and loading of metallic supports and anchors to be attached to building floor, plinths, columns or beams in order that the necessary builder's work provisions can be made.

The Contractor shall supply all necessary parts of the Plant to be "built-in" to the concrete work and shall be responsible for checking the alignment of built-in parts both before and after concrete is placed. The Contractor shall ensure that all parts to be built-in are delivered to the Site at the appropriate time to suit the civil contractor's construction programme.

2.1.3 Foundation Work

The Contractor shall supply all holding-down, alignment and levelling bolts complete with anchorages, nuts, washers and packings required to attach the Plant to its foundations, and all bedplates, frames and other structural parts necessary to spread the loads transmitted by the Plant to concrete foundations without exceeding the design stresses.

2.1.4 Setting Out and Grouting

The Contractor shall be responsible for checking all civil work provided for the Plant, such as plinths, openings, etc., and shall immediately bring to the attention of the Engineer any defects, deficiencies, levelling, dimensional errors or other factors which affect the proper installation of the equipment.

Before grouting in of equipment is carried out the Contractor shall give the Engineer the option of inspecting the equipment and shall obtain the Engineer's approval for the correct setting-out, level and alignment of each item of the Plant.

All grouting work shall be carried out by the Contractor unless otherwise specified. The Contractor shall be responsible for ensuring that such grouting is satisfactorily carried out and shall check the setting-out, level and alignment of each item of the Plant after the grout has been placed but before it has set. A similar check shall be carried out after the grout has set.

2.2 Motors and Generators

2.2.1 General

The Contractor shall be responsible for the true and proper setting out of the installation work and for the correctness of the positions, levels, dimensions and alignment of the motors and generators.

2.2.2 Motors

The pump motors shall be numbered in a proper sequence in line with the pump bays in which they are to be installed.

Adequate access to the motors and their associated facilities shall be allowed such that the necessary periodical testing, cleaning and maintenance can be carried out. The motors shall not be installed in a position where surrounding plant or building work may obstruct in meeting such requirements.

Except armoured cables, all cables appearing above the floor level shall be enclosed in approved trunking, solid or flexible conduit with approved provision for movement of the motor. The terminal boxes for cable connection shall be suitably arranged to make a neat joint with the conduits or cables.

The protective guards shall be rigidly constructed. It shall not be possible to remove any guard without the aid of a tool.

2.2.3 Generators

Special attention shall be paid for the construction dimensions and location of the air intake/outlet louvres to ensure that the capacity of the radiator fan is sufficient for the air requirements of the generator set, complete with appropriate noise attenuators as requird.

The diesel generating sets shall be properly erected and aligned onto the concrete plinth and the vibration generated by the set shall be isolated from the generator room.

All moving parts, bare exhaust manifolds, pipes and pressure charger (if any) shall be properly and completely guarded and or insulated in accordance with the relevant regulations. The guards shall be of such design that will guard against the serviceman from coming into contact with any part which is likely to cause injury to personnel. All guards shall be detachable.

An exhaust air duct from the radiator to the louvres mounted in the wall shall be of 1mm galvanised M.S. sheet and shall be properly supported near the radiator end. It shall then be connected to the radiator flanges through a flexible joint to isolate the vibrations generated by the diesel generating set. An inspection panel shall be provided for the ease of future maintenance.

The engine exhaust system shall comprise silencer, bellows, hangers, piping, clamps, flange couplings and heat resisting jointing to suit actual site requirements. The installation of the exhaust outlet shall comply with the requirements of the Environment Protection Department.

The complete exhaust from the exhaust manifold to the end of the exhaust pipe including the silencers, flexible joint and pressure charger (if any) shall be coated with heat resisting paint, lagged with non-combustible insulating material and enclosed with aluminium cladding. Asbestos shall not be used for insulation. The exposed portion of exhaust pipe outside the generator room shall be of stainless steel, grade 316.

The exhaust system shall not create a back-pressure exceeding the amount recommended by the engine manufacturer, and shall be sufficiently flexibly installed in order to allow for reasonable amount of expansion and contraction.

The engine exhaust pipe hangers shall incorporate anti-vibration spring mechanism.

Suitable water draining device shall be provided for the exhaust system so that no liquid could enter the diesel generating set through the exhaust outlet.

Independent earthing system shall be provided for each of the neutral connection and earthing of the diesel generating set. The installation of diesel generating set shall be solidly and effectively earthed in accordance with the Code of Practice for the Electricity (Wiring) Regulations issued by the Electrical and Mechanical Services Department (EMSD). Where circumstances necessitate due to vibration, the earthing connections shall be made of flexible copper conductor having PVC sheath.

2.3 Switchboards and Panels

High voltage switchboards, low voltage switchboards, switchgear and control panels shall be properly secured. Normally, four fixing bolts at corners of each panel shall be considered the minimum. Unless otherwise required by the manufacturer, the panels shall be levelled to within 1 in 1000. The panel front shall be aligned to give a neat and tidy appearance. High voltage switchboards and low voltage switchboards shall be mounted on the concrete floor in accordance with the requirements of the manufacturers. The Contractor shall provide all necessary mounting accessories including those to be embedded to the floor. Design details of the mounting arrangement shall be submitted to the Engineer for approval prior to installation. Mounting of the switchboards on embedded unistrut channels is preferred.

Each panel of the high voltage switchboard shall be inspected prior to fixing permanently in position and connection of busbars. The Contractor shall give one week's advance notice to the Engineer's Representative for the inspection of the panels.

A 12mm minimum thick insulating rubber floor mat with minimum dielectric constant of 4000V/mm shall be provided at the front and rear of the high voltage and

low voltage switchboard. Floor mats shall be 1m longer than the total width of the switchboard.

2.4 Power Transformers

The Contractor shall ensure that the power transformers are suitable to be accommodated in the transformer room or compound. The Contractor shall design, supply and install the mounting and supporting facilities to facilitate installation of the transformers on the concrete plinths inside the transformer room or compound.

Design details of the mounting and supporting facilities shall be submitted to the Engineer for approval prior to installation.

For bulk oil power transformers, the Contractor shall exhaust all air which may be trapped within the tank and pipework after the transformers are erected and completely filled with oil at site. The Contractor shall also ensure that, in case of transformer oil leak, the transformer oil is contained in such a way that spillage of oil to the environment is avoided.

For power transformers installed in open and semi-open compounds, suitable mounting and supporting facilities shall be provided to ensure that the footings of the transformers will not be corroded due to the presence of water.

2.5 Power Factor Correction Capacitors

The Contractor shall design, supply and install the mounting facilities to support the power factor correction capacitors.

The capacitors shall be arranged in a proper numbering sequence. The layout of the capacitors in the capacitor room shall be submitted to the Engineer for approval prior to installation.

2.6 Battery Equipment

The Contractor shall design, supply and install the mounting facilities to support the battery equipment. The layout of the battery and charger in the battery room shall be submitted to the Engineer for approval prior to installation.

The Contractor shall submit detailed calculation on the battery room ventilation to the Engineer for approval.

2.7 Cabling System

2.7.1 Cable Routing

Power cable spacing shall generally be in accordance with the cable manufacturer's recommendations and the Code of Practice for the Electricity (Wiring) Regulations issued by EMSD to allow adequate heat dissipation. Control and instrumentation cables shall be laid in a single layer only.

Multi-core control and indication circuit cables shall be run in cable trays separately from power circuit cable trays.

Instrumentation (4-20 mA), fieldbus and d.c. circuit cables shall be run in cable trays separately from a.c. circuit cable trays.

Power cables shall generally run on cable trays at the bottom of cable trenches and control cables along side walls.

At the ground floor or basement, cables shall be run in cable trenches. At other floors, cables shall run in cable gallery or under floor slab on trays supported by mounting racks or hangers. Cables in the control room shall run under the raised floor where provided.

Cables shall not be mounted on wall direct. Cable trays shall be used and cables shall run neatly in horizontal and vertical directions only. Cables connected to a group of wall-mounted electrical equipment shall follow one common vertical route in cable tray(s) and then be diverted horizontally to the respective equipment in a neat and systematic manner.

Cables to floor standing equipment shall be properly supported by trays or unistrut channels. Fixing of the cable trays or channels on detachable equipment such as pipework shall not be permitted. The cable routing shall cause minimum obstruction to the equipment nearby.

2.7.2 Openings, Sleeves and Seals

Sleeves of appropriate size shall be provided at locations where cables pass through exterior building walls, to permit watertight sealing of the cable entrances into the building. PVC sleeves shall be provided at locations where cables pass through floors and interior walls of the building. The PVC sleeves shall protrude from the finished floor level by 100mm.

Cables entering the building shall be fitted with identification ferrules at the point of entry if the cable function is not readily apparent.

All holes through wall, beam and floor slab and the annular space between the cable and the PVC sleeve shall be back filled with fire resistant material of appropriate fire resistance rating after cabling. Fire barrier for trunking passing through the structure shall be installed.

2.7.3 Cable Tray and Support

Cable trays shall be mounted on channels. A minimum clearance space of 20 mm shall be allowed between the cable tray and mounting wall. Cable trays supported at high levels shall have fabricated steel angle frames or hangers of robust construction and be fixed onto the ceiling by expansion bolts. Clearance to the bottom of cable trays supported from the ceiling shall be 3m minimum above the finished floor. Cable trays shall have supports at spacing not more than 1200 mm.

Cable tray accessories shall be the standard range of products of the cable tray manufacturer for compatibility. Standard bends, tees and reducers shall be used for tray jointing.

Cable tray sizes and routing shall be clearly shown on the cable tray installation drawing submitted for approval of the Engineer prior to installation.

Cable trays mounted outdoors shall be installed in vertical orientation unless otherwise approved by the Engineer. Cable trays shall have 150mm clearance to floor as a minimum, with 400-600mm mounting height preferred. Prefabricated covers shall be provided for the cable trays.

Cable tray runs shall be vertical or horizontal only, except for the short fittings used for changes in direction. All changes in cable tray direction shall be made with prefabricated fittings (flat 90°, vertical 90° etc.) which are designed to accommodate the cable minimum bending radius.

Cable trays shall be effectively earthed and separate sections of cable tray shall be electrically bonded together.

Cable trays shall not be routed in a manner which obstructs access to equipment for maintenance. Access hatches, window, door and openings shall not be obstructed by cable trays and supports.

Cable trays shall be cut along a line of plain metal, not through the perforation. The burr on the cut edge shall be removed. Holes in cable tray for the passage of cables shall be provided with rubber grommets, else bushed or lined.

Heavy duty cable ladder of same materials as specified for the cable tray or trench and wall mounted channels shall be used to support power cables of 45mm diameter and above. The spacing of ladder rungs shall not exceed 450mm.

2.7.4 Cable Laying

Cables shall be unrolled from the drums in such a manner to avoid loops or kinks and care shall be taken when laying to avoid damage to the outer sheath caused by drawing over sharp obstacles, etc. Cable rollers shall be used whenever necessary.

The use of straight-through and tee joints boxes is prohibited unless approved otherwise.

Cables in draw pits shall be gently snaked to avoid tension in the cable.

Draw wires shall be installed inside the cable duct to facilitate the drawing of cables. On pulling of cable inside the duct, pulling attachment shall be made to the cores, insulation, inner and outer sheath and not to the wire armour only. Cable ends shall be kept dry throughout all phases of handling, laying and jointing and every care must be taken to prevent the ingress of moisture.

Cabling through wall or floor opening shall have the through hole covered in sleeve or bushing to avoid any sharp edges damaging the cable.

Concrete cable markers shall be provided at the ground surface on top of the directly laid cables along the route and at locations of bends and joints.

High voltage cables shall not be directly laid in ground within the site boundary of a waterworks installation. Direct laying of low voltage power and control cables in ground shall be subject to the approval of the Engineer.

2.7.5 Cable Cleating

All cables shall be run on cable trays whether in trench or on the surface. Power and control cables shall be cleated separately. Where die-cast cleats are not used, PVC coated brass strip shaped to the form of cables shall be used for cleating at a spacing to the Code of Practice for the Electricity (Wiring) Regulations issued by EMSD. If the strip length exceeds 150mm, intermediate fixing shall be provided such that the spacing between screws shall be within 150mm. Cables shall be laid in a single tier on tray.

Cables of 45mm diameter and above shall be cleated individually with die-cast aluminium cleats. Each cleat shall be separated at intervals not exceeding 900mm. Single core cables shall be cleated in trefoil die-cast cleats.

2.7.6 Cable Marshalling

Marshalling cubicles and jointing boxes shall not be used for joining power cables. An isolator shall be used for connecting an unarmoured cable to an armoured cable.

Except for emergency shutdown of plant and equipment, small cables for instrumentation and control purposes may be terminated in a marshalling cubicle provided that the cable run exceeds 50m and such cables are located within the same location for termination to a single panel.

The marshalling cubicles shall be constructed in accordance with Clause 3 of WSD Standard Specification E-11-03.

Cables terminating in marshalling cubicles shall have bottom entry only. The marshalling cubicles shall be sized generously to permit proper glands and metallic conduits to be used for such purposes.

The marshalling cubicles shall be installed at a height ease of cable termination. They shall not be installed inside cable trenches.

2.7.7 Cable Termination

Each cable entry into a terminating box shall be made through a suitable gland complying with WSD Standard Specification E-30-12.

Glands shall generally be of the mechanical compression hexagon type. For termination of single core power cables, the associated gland plate shall not have a continuous magnetic path.

Each gland installed shall be complete with a proprietary earth bonding tag providing a ready means of connecting an earth bond to the gland. Adequate earth continuity shall be assured between the earth bonding tag, the gland and the armour wires of the cable where applicable.

Where holes for cable entries are not provided, it shall be the responsibility of the Contractor to mark out and drill such holes. Burrs and swarf shall be removed with care being taken to ensure that they do not enter the equipment.

For XLPE and PVC insulated cables, brass mechanical glands and copper compression type lugs shall be used for termination. Terminations for all high voltage power cables and low voltage power cables exceeding 25mm^2 shall be carried out with heat shrinkable terminations.

Earthing of the single core cable sheath or armour shall be at the source end only and insulated gland shall be used at the power receiving end and clearly labelled as such.

For power supply cables, the number of cores shall match the exact requirement, e.g. 4-core cable not to be used for 3-wire motor supply. For multi-core control cables, spare cores shall be terminated and properly ferruled. 20% spare cores shall be provided for control cables of 12-core or above.

Control cables terminated within a control panel or a marshalling cubicle shall be looped for a length equal to the largest side of the cubicle before termination to permit re-termination subsequently required.

Cables for instrument signals shall be suitably screened and earthed at the receiving end only. Suitable types of cable and screening arrangement shall be made to obviate errors derived from the capacitance and inductance of the cables. Telephone cable cores for speech circuit shall be screened from other circuits.

Cable joints shall only be allowed with the prior approval of the Engineer.

Adequate provision shall be made to bond the cable armouring to the cable box or switchgear panels to withstand the prospective short circuit fault current of the system. This shall be achieved by the rigid clamping of the armour within the cable gland or

an armour clamping ring, and securely bonded to the cable box or the earth terminal of the switchgear panel.

Before and during installation up to the time of making off, all cable ends shall be firmly supported and kept sealed off against the ingress of moisture.

2.7.8 Cable Identification

Each cable shall be permanently identified by its cable number as shown on the cable schedule at each end, entry and exit points of buried ducts, exits from buildings and all such positions required to identify and trace the cable route. Cable tags for indoor use shall be manufactured from white rigid PVC material with engraved characters filled black. Identification for outdoor cables shall be 3mm stainless steel plate with engraved lettering fixed near termination.

All cores of power cables shall be identified with the new cable colour code complying with the "Installation Guideline – New Cable Colour Code for Fixed Electrical Installations" published by EMSD.

Conductors in multi-core control and signal cables shall be continuously identified by numbering or colour coding. In addition, they shall be provided at each end of terminations with moulded plastic numbered and lettered ferrules in which the numbering and lettering shall be the same as the corresponding circuit drawings and diagrams. Where this number is different from that at the other end of the core then the two different sets of numbers shall be included as a double ferrule.

At each cable termination, laminated plastic labels with engraved characters in both Chinese and English shall be fixed to the cable giving the size, the identification and the designated cable connection, e.g. 2.5mm^2 37/C PVC/SWA/PVC copper cable to pump 1 starter panel.

2.8 Earthing System

The work for the station earthing system shall include the provision of all necessary fixing and mounting accessories, saddles, bonding to metallic parts, sleeving of joints, etc. to form a complete, neat and safe installation for all the equipment in the station.

The earthing system shall be designed, supplied and installed in compliance with BS7430.

The main earthing system shall consist of copper tapes bonded to the main earth electrode plates, station pipework and building structure reinforcement. The main earthing conductors shall consist of 50mm x 6mm copper tapes. Copper tapes shall be PVC sheathed within the station and bare when buried in ground.

The high voltage switchboard, 380V switchboard, pump motors and electrochlorinator power supply panels shall be connected to the main earthing conductors via 50mm x 6mm copper tapes.

Control panels, 24V d.c. battery panels, distribution boards and other equipment shall be earthed with 25mm x 3mm copper tapes connected to the main earthing conductors.

Equipment supplied by armoured cables of size up to 2.5mm^2 may use the armoured wires for earthing connection. Equipment supplied by armoured cables between 4 to 25mm^2 shall have separate single core PVC cables as earthing conductors. The size of the earthing conductor shall not be less than that of the corresponding conductor of supply cable. The minimum size of earthing cables shall be 6mm^2. Copper tapes shall be used for equipment connected with power cables of 25mm^2 and above.

The Contractor shall be responsible for the provision of supplementary bonding to metallic parts of the building including windows, louvre frames, platforms, pipes, etc. as required by the Code of Practice for the Electricity (Wiring) Regulations issued by EMSD. The bonding conductor shall be 4mm^2 single core yellow green cable with cable lug for termination.

Plate electrodes where used shall be installed by the Contractor prior to backfilling of soil around the building. This part of the work may have to be carried out before possession of site subject to one week’s advance notice from the Engineer's Representative.

Buried earth conductors shall be at least 900mm from the ground surface. Exposed earth conductors shall be fixed on the building structures or trench wall by means of brass clamps, suitably spaced, and neatly run vertically, horizontally or parallel to adjacent walls, ceilings, beams etc.

Markers shall be provided at the ground surface on top of the buried earth plates.

Test links shall be provided in cable trenches such that they are easily accessible for routine inspection and testing of individual earth electrodes.

All joints shall be by means of bracing or "thermal weld". The joints shall be covered with green PVC sleeves after inspection and testing.

Earth conductors shall be connected to the equipment at the stud terminals designed for the purpose. Prior to testing of an item of the Plant, the station earth network shall be completed and the item under test shall be properly connected to the earth network.

2.9 Process Instruments

2.9.1 Flow Instruments

Flowmeters shall be installed well clear of fittings such as valves, T-pieces, elbows, etc., meeting the straight pipe requirements specified by the manufacturer. Electromagnetic flowmeters shall be installed with minimum straight pipe runs of five times the pipe diameter upstream and two times the pipe diameter downstream.

The pipeline upstream of the flowmeter shall be thoroughly flushed or cleaned using a proper method prior to the installation of the flowmeter.

The flowmeter detector head shall be supported by a metal cradle. The pipework connected to the detector head shall be accurately aligned and have adequate support to avoid undue stress.

Jointing materials shall not project into the bore of the pipe or flow-measuring device. The jointing material shall be suitable for use with the fluid being measured.

The screened cables connecting between the flowmeter detector head and the flow converter shall be sufficiently long such that no cable jointing is required. The length of the cable shall not exceed the maximum permissible distance between the converter and detector head as stated in the flowmeter instruction manual.

The flowmeter detector head shall be properly earthed to avoid the flow measurement being affected by the presence of stray grounding currents. If metal pipework is used, the pipe immediately on each side of the detector head shall be bonded to the earth terminal of the head and connected to a good earthing point.

The converter shall be wall-mounted or installed in a local panel. It shall not be subjected to vibration, or exposed to high humidity or high ambient air temperature.

No-flow switches for pump protection shall be flange mounted at the pumping mains.

2.9.2 Level Instruments

Separate level sensing instruments shall be installed in each compartment of the service reservoir to enable measurement of level in case one compartment is shut down for maintenance.

Submersible type level sensing instruments and float switches installed in the water tanks, open channels or compartments of service reservoirs shall be suspended using stainless steel supports. They shall be installed in the position to avoid the vortex affecting the transmitters and securely fixed to the supports. Submersible type level sensing instruments shall be installed at the lowest point of the measured chamber and the signal shall be corrected to the corresponding datum.

Ultrasonic type level sensing instruments shall be installed in service reservoirs, tanks and impounding reservoirs as specified and shown on the Drawings.

Level electrodes installed at service reservoirs and header tanks for level control, alarm and protection shall be installed in a stilling well to have a stable detection of the water level.

2.9.3 Pressure Instruments

Pressure gauges, pressure transmitters, pressure indicators and pressure switches shall be installed at appropriate locations of the pipelines.

The number of tappings on the main pipe shall be kept to the minimum. Instruments detecting the same pressure point shall be connected via a stainless steel instrument connection pipe of grade 316.

The connection point and the connection pipe shall be designed to withstand the maximum pressure and a suitable isolating valve shall be provided.

When the pressure medium is a liquid, the connection pipe shall be full of liquid to avoid collection of air or vapour. The installed positions of the pressure sensors shall be accurately measured for proper correction of the pressure signals to the datum of the tapping point as required.

For low pressure applications, instrument tubing shall be in compression-jointed PVC covered, heavy-gauge seamless copper of soft-annealed type. Fittings shall be chosen to be compatible with the application and service conditions called for.

Instrument tubing shall be neatly run and shall be cleated to walls or cable trays. Routes shall not obstruct traffic through the process plant, nor interfere with the accessibility for the removal of equipment. They shall be routed away from hot environments, places with potential fire hazard or likely to be subjected to mechanical abuse or vibration. Where necessary, the pipe run shall slope upwards or downwards with drain or vent facilities at the lowest or highest points respectively.

No water pipes and tubing shall be allowed in the switchgear rooms and control panels.

2.10 DCS Equipment

The Contractor shall design, supply and install the mounting facilities for the DCS equipment. The mounting method and proposed layout plan shall be approved by the Engineer prior to installation. In general, the DCS equipment shall be securely mounted in such a way that access for maintenance shall not be impeded and ventilation of heat shall be adequate.

The man-machine interface devices shall be installed as follows:

(i) Touch screen of PLC – mounted on panel front
(ii) Computer terminals and printers – desk top

2.11 Optical Fibre Network

2.11.1 General

The route for running of optical fibre cables shall be approved by the Engineer prior to installation.

Optical fibre cables shall be installed with minimum bending radius as specified by the manufacturer or otherwise 15 times the outer diameter of the cables.

2.11.2 Fibre Optic Termination and Splicing

Optical fibre cables shall be terminated and spliced properly to ensure a good quality connection. Multi mode fibres shall be directly terminated using an anaerobic adhesive and primer. Single mode fibres shall be terminated using factory terminated and tested SC pigtails fusion spliced directly to the incoming cable.

All fusion splice shall be subject to a tension pull test, encapsulated in a heat shrinkable protector housed in a fusion splice tray.

All terminations at the termination panels shall be via factory assembled pigtail assemblies.

Joining of the pigtail to the fibre optic cable shall be by the fusion method.

Sufficient cable length shall be left at the termination panel to enable easy withdrawal for fusion splicing to the pigtails.

The termination panel shall be complete with all accessories recommended by the manufacturer.

Each panel shall have a connector module complete with coupling including sufficient ports to accommodate all fibres of the incoming cable.

A splice module shall be provided complete with splice tray suitable for fusion splicing.

All fibre patch leads shall have proper cable management.

3 SITE TESTING

3.1 General

Upon completion of the installation of high voltage switchboards, transformers, motors, generators and DCS systems, a factory trained manufacturer's representative shall inspect the installation at Site and shall issue to the Contractor the certification that the equipment has been installed in accordance with the manufacturer's recommendations and requirements. A copy of the certification shall be submitted to the Engineer for record.

A general inspection on the equipment installed to check for correct assembly and quality of workmanship shall be carried out with the presence of the Engineer's Representative.

The site tests shall be carried out by the Contractor after the remedy of any deficiencies noted during the installation inspection and under the supervision of the Engineer's Representative.

Site tests demonstrating the correct functioning of the protection scheme for the complete installation shall also be carried out by the Contractor.

The Contractor shall carry out the site tests in accordance with the site test forms attached in Appendix I. For other site tests which are not included in Appendix I, the Contractor shall submit the test forms and procedures to the Engineer for approval prior to carrying out the tests.

All measuring instruments, indicators, primary injection test sets, high voltage test sets and other apparatus necessary for carrying out the tests shall be provided by the Contractor and approved by the Engineer.

The Contractor shall notify the Engineer's Representative and other contractors prior to performing electrical testing at the Site, and shall ensure safety of personnel and complete isolation and fencing off of electrical equipment and cables undergoing tests.

Reports for the site tests shall be submitted to the Engineer for approval prior to energisation of any electrical equipment.

3.2 Motors and Generators

(a) The following tests on the motor above 40kW shall be carried out:-

(1) No load tests including measurement of voltage, current, power factor, bearing temperature, winding temperature and vibration.

(2) Dielectric test and megger test (including test of polarization index for 380V motors of 140kW and above and high voltage motors). The following test voltages shall be applied for new equipment:-

System Voltage		11kV	6.6kV	3.3kV	380V
Test Voltage (Dielectric Test)	AC Test	18.4kV	11.4kV	6.1kV	1.4kV
	DC Test	31.3kV	19.3kV	10.3kV	2.4kV
Test Voltage (Megger Test)	DC Test	5kV	2.5kV	1kV	500V

The test duration of dielectric test shall be 60s. The polarization index shall be measured with a megger in one minute and 10 minutes intervals.

(3) Stator winding resistance measurement.

(4) Megger tests for all motor auxiliary equipment including heater and RTD.

(5) Noise level measurement under load condition.

(6) Vibration measurement under load condition.

(b) Site testing of generators shall be carried out in compliance with the latest edition of the Testing and Commissioning Procedure for Emergency Generator Installation in Government Buildings of the Hong Kong Special Administrative Region issued by the Architectural Services Department, HKSAR Government.

The following tests on the emergency generator shall be carried out:-

(1) Insulation resistance test.

(2) Control function test.

(3) Dummy load test.

(4) Earthing protection test.

(5) Battery charger output test.

(6) Step-load acceptance test.

(7) Noise level measurement.

(8) Vibration measurement.

3.3 Switchboards and Panels

The following tests shall be carried out:-

(1) Power frequency voltage withstand test between phases and phase to earth on the main circuits and busbars. The following test voltages shall be applied for a new switchboard:-

System Voltage	11kV	6.6kV	3.3kV	380V
Test Voltage	24kV	15.2kV	8.6kV	2.5kV

The test duration shall be 60s.

Megger tests (1000V for LV and 5000V for HV switchboards) shall be carried out before and after the power frequency voltage withstand test.

For LV switchboards, the tests shall also be carried out on the neutral busbars.

(2) Insulation test on all secondary small wiring circuits.

(3) Milli-volt drop tests on all main busbars connections, circuit breakers, isolators, earthing switches, fuse-switches, contactors and switchboard main earthing bars.

(4) Primary injection tests up to rated C.T. primary current for all CTs. The test shall measure the C.T. secondary current and spill current and initiate operation of protection relays and tripping of circuit breakers and contactors.

(5) Secondary injection tests for all protection relays.

(6) Intertrip and commissioning tests for incoming supply circuits in conjunction with the power company including phase sequence and rotation tests.

(7) Functional tests to demonstrate the correct operations and connections of all control, alarm and indication circuits and equipment including the PLC circuits and equipment in the metering cubicle.

(8) All mechanical tests specified for testing at the manufacturer's works shall be re-checked to ensure satisfaction operation of the plant in the final erected state.

(9) All electrical and mechanical interlocks for circuit breakers, isolators, earthing switches, contactors and interlocks with other panels shall be demonstrated.

3.4 Power Transformers

3.4.1 Bulk Oil Transformers

The following tests shall be carried out:-

(1) Dielectric test and megger test of transformer winding including bushings and power cable box. The following test voltages shall be applied:-

System Voltage		33kV	11kV	6.6kV	3.3kV	380V
Test Voltage (Dielectric Test)	AC Test	54kV	19kV	12kV	6.9kV	2.0kV
Test Voltage (Megger Test)	DC Test	10kV	5kV	2.5kV	1kV	500V

The test duration of dielectric test shall be 60s.

(2) Measurement of winding resistance.

(3) Voltage ratio, polarity and vector grouping tests.

(4) Ductor test on terminal joints and main earth bars.

(5) Measurement of no-load loss and current at rated voltage and frequency.

(6) Oil sample tests to BS 148.

(7) Tests on winding temperature and oil temperature protection devices and associated temperature sensing probes.

(8) Operation test of the gas actuated relay by the gas injection method.

(9) Noise levels measurement with the transformer on no load at rated voltage and frequency.

(10) Functional tests and megger tests on the air blower control circuits and air blower motors.

(11) Operation tests on off-load voltage tap changer if fitted.

(12) Functional tests of all inter-tripping circuits and interlocking devices.

3.4.2 Epoxy Resin Encapsulated Transformers

The following tests shall be carried out:-

(1) Dielectric test and megger test of transformer winding including bushings and power cable box. The following test voltages shall be applied:-

System Voltage		11kV	6.6kV	3.3kV	380V
Test Voltage (Dielectric Test)	AC Test	24kV	15.2kV	8.6kV	2.5kV
Test Voltage (Megger Test)	DC Test	5kV	2.5kV	1kV	500V

The test duration of dielectric test shall be 60s.

(2) Measurement of winding resistance.

(3) Voltage ratio, polarity and vector grouping tests.

(4) Ductor test on terminal joints and main earth bars.

(5) Measurement of no-load loss and current at rated voltage and frequency.

(6) Partial discharge test on transformer winding.

(7) Tests on winding temperature protection devices and associated temperature sensing probes.

(8) Noise levels measurement with the transformer on no load at rated voltage and frequency.

(9) Functional tests of all inter-tripping circuits and interlocking devices.

3.5 Power Factor Correction Capacitors

The following tests shall be carried out:-

(1) Capacitance measurement.

(2) AC voltage test between terminals and between terminals and containers. The following test voltages shall be applied:-

System Voltage	11kV	6.6kV	3.3kV	380V
Test Voltage	16.5kV	9.9kV	5kV	1.4kV

The test duration shall be 10s.

(3) Test of the internal discharge device, where provided.

(4) Functional tests of all inter-tripping circuits and interlocking devices, where provided.

3.6 Battery Equipment

The following tests shall be carried out:-

(1) A charge and discharge test shall be conducted to verify the declared capacity of the battery system. The Contractor shall replace any cells and components that are found not complying with the Specification. The continuous output current used for the discharge test shall be 120% of the rated value at the 5-hour discharge rate to take into account of the life factor. The voltage of the battery cell at the end of the test shall be not less than that stated in Clause 1.4 of WSD Standard Specification E-60-03.

(2) Functional tests on the automatic cut-in and cut-out feature of series diodes and the limits of output voltage across battery as specified in Clause 3.4 of WSD Standard Specification E-60-03.

(3) Functional tests on the protective devices as specified in Clauses 2.5 and 3.5 of WSD Standard Specification E-60-03.

(4) Functional tests on the alarm and indicating facilities as specified in Clauses 3.5 and 3.6 of WSD Standard Specification E-60-03.

(5) Functional tests on the charger from boost charging mode to float charging mode as specified in Clause 3.4 of WSD Standard Specification E-60-03.

3.7 Cables

The following tests shall be carried out:-

(1) Phasing and continuity tests of the cores shall be carried out for each cable after installation and termination. The continuity of the cable sheath and armour over the whole length of each cable (including termination glands) shall be confirmed by continuity test.

(2) Dielectric tests using very low frequency (VLF) AC and megger test shall be carried out for XLPE HV cables. Dielectric tests (DC pressure tests) and megger test shall be carried out for other types of HV cables. The following test voltages shall be applied:-

System Voltage		11kV	6.6kV	3.3kV	380V
Test Voltage (Dielectric Test)	VLF at 0.1Hz	19.0kV	11.4kV	5.7kV	-
	DC Test	25kV	15kV	7kV	-
Test Voltage (Megger Test)	DC Test	5kV	2.5kV	1kV	1kV

The test duration for dielectric test shall be 15 minutes.

(3) For insulation resistance tests and dielectric tests of cables, the Contractor shall inform and liaise with all parties concerned to ensure that the test is carried out safely. Any special isolation of the equipment shall be carried out and shall not be interfered with during the tests.

3.8 Earthing System

The following tests shall be carried out:-

(1) Earth fault loop impedance tests shall be carried out on each electrical plant to ensure that the earth fault loop impedance of the plant and the continuity of earthing conductors meet the requirements of the Specification. The tests shall be carried out using an earth fault loop impedance tester.

(2) The Contractor shall measure and record the earthing resistance at the test point of each main earth electrode plate. Additional earthing plates shall be provided if the earthing resistance at the test point of each location exceeds 1Ω.

3.9 Process Instruments

The Contractor shall demonstrate that the supplied instruments function properly. The supplied equipment shall be calibrated on Site as follows:-

(1) Electromagnetic flow converters and detector heads

The converter parameter settings shall be checked for correct setup to align with the designed flow rate.

Functional test of the converter shall be carried out using the simulator if required and the results shall be recorded.

The coil resistance and the insulation resistance shall be measured and recorded.

(2) Level transmitters

Water levels in ascending and then descending orders of 0, 25, 50, 75 and 100% of the measuring range shall be applied and the corresponding output readings (4-20mA) shall be recorded.

The percentage errors shall be checked for compliance with manufacturer's stated limits. Where necessary, adjustments to the level transmitters shall be made and the above steps shall be repeated until the required accuracy has been obtained.

(3) Pressure transmitters

The pressure transmitters shall be calibrated by using a pneumatic calibrator.

An actuating pressure of approximately full range shall be applied to check system for leaks. When no leak is observed, the equipment shall be re-aligned at zero.

Actuating pressures in ascending and then descending orders of 0, 25, 50, 75 and 100% of the measuring range shall be applied and the corresponding output readings shall be recorded.

The percentage errors shall be checked for compliance with manufacturer's stated limits. Where necessary, adjustments to the pressure transmitters shall be made and the above steps shall be repeated until the required accuracy has been obtained.

Transmitters with indicating scales shall have their indicators calibrated during tests.

3.10 DCS Equipment

The Contractor shall carry out accuracy and functional tests of the DCS equipment to the satisfaction of the Engineer. All manpower, transport, communication devices and equipment necessary to test the correct functioning of the DCS equipment at the monitoring centres, local control stations and field devices shall be provided by the Contractor.

Accuracies of analogue input points shall be verified to fall within specified limits with test equipment having valid calibration certificates.

All input and output points shall be function-tested in a systematic manner so that no points are omitted and the desired outcome, e.g. alarms, colours, appearance, response time, scales and units of measured parameters, control and alarm set points, etc., are as specified and intended.

Where redundancy is specified, failure modes shall be simulated by power-off, disconnecting communication media, withdrawing modules from chassis etc. to ensure the system continues to work as specified.

The operation of the Engineer Workstation shall be tested for programming and fault finding. Fault diagnosis tools, where provided, shall be tested by simulating the various fault scenarios.

3.11 Optical Fibre Network

The following tests shall be carried out:-

(a) Fibre loss testing shall be carried out using an optical loss test set. The test results shall include reflection loss, length, fibre identification and the number and type of connectors and splices used in each fibre link.

(b) All optical fibre cables shall be tested to ANSI / TIA / EIA – 455-8 standard using an Optical Time Domain Reflectometer (OTDR). The OTDR test report shall include the following information:

(i) Date and time of the test
(ii) Cable ID number
(iii) Cable segment ID number
(iv) Fibre colour or sub-cable number
(v) Launch point connector number
(vi) Optical wavelength for the test
(vii) Refractive index setting of the OTDR
(viii) Pulse width setting of the OTDR
(ix) Averaging interval of the test

- End of this Specification -

List of Site Test Forms for Electrical Equipment

Form No.	Title
Switchboard	
1	LV Switchboard
Motor	
2a	Motor Insulation and Winding Resistance Tests
2b	Pump Motor No Load Tests
2c	Functional Tests on Instruments and Pumpset Instrument Panels
2d	Pump Motor On Load Vibration and Noise Level Tests
Transformer	
3a	Bulk Oil Transformer
3b	Epoxy Resin Encapsulated Transformer
Power Factor Correction Capacitor	
4	Performance Tests on Power Factor Correction Capacitor
Battery and Charger Equipment	
5a	Battery and Charger
5b	Battery Discharge Test
Power and Control Cables	
6a	Power Cable Insulation Tests
6b	Multi Core Cable Insulation Tests
6c	Power Cable Continuity Tests
6d	Multi Core Cable Continuity Tests
Earthing Equipment	
7a	Earth Electrode Resistance Test for Main Earthing Plates
7b	Earth Fault Loop Impedance Tests on Electrical Plants
DCS	
8	Functional Tests on DCS

Site Test Form No. 1 - LV Switchboard

Contract No.: _____ Client: Water Supplies Department
Contract Title: _____
Contractor: _____
Location: _____ Test Date: _____

Switchboard: _____ Manufacturer: _____
General Arrangement Drawing No.: _____
Main Busbar Current Rating: _____Short Circuit Rating: _____
System Voltage: _____

Visual Inspection

Item	Yes / No
All earthing completed	
All nuts and electrical connections checked for tightness	
All contact mechanisms correctly aligned and movement free on hand operation	
Mechanical interlock correct	
Mechanical indications correct	
Chassis enters cubicle without difficulty	
Operation of auxiliary switches plugs and sockets correct	
Equipment dust free and in good order	
All arc chutes correctly fitted	
All inter panel busbar connection links correctly fitted	
All alarms, control and indication circuits operate correctly in accordance with the wiring diagrams listed below	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____

Ambient Temperature: _____ Relative Humidity: _____

Power Frequency Voltage Withstand Test and Insulation Resistance Test

Insulation Resistance (1000V megger)

	With all switching devices open (MΩ)	With all switching devices closed (MΩ)
L1 to earth		
L2 to earth		
L3 to earth		
L1 to L2		
L2 to L3		
L3 to L1		
L1 to N		
L2 to N		
L3 to N		
N to earth		

Power Frequency Voltage Withstand Test

Test voltage: 2.5 kV a.c. for 1 minute with all switching devices closed

	Leakage Current (mA)
L1 - L2 to L3 - N (earth)	
L2 - L3 to L1 - N (earth)	
L1 - L2 - L3 - N to earth	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____

Insulation Resistance Test After Power Frequency Voltage Withstand Test

Insulation Resistance (1000V megger)

	With all switching devices closed (MΩ)
L1 to earth	
L2 to earth	
L3 to earth	
L1 to L2	
L2 to L3	
L3 to L1	
L1 to N	
L2 to N	
L3 to N	
N to earth	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____ Circuit: _____

Duty: Overcurrent and Earth Fault Protection

Primary Injection Test

A. Protection Current Transformer

Ratio _____ VA _____ Class _____

Serial No. L1 _____ L2 _____ L3 _____ N _____

Injection	Primary Current (A)	Secondary Current				
		L1 (A)	L2 (A)	L3 (A)	N (A)	Spill (mA)
L1 – L2						
L2 – L3						
L3 – L1						
L1 – N						
L2 – N						
L3 – N						

ACB tripped for each of the above tests: _____ (Yes / No)

B. Metering Current Transformer

Ratio _____ VA _____ Class _____

Serial No. L1 _____ L2 _____ L3 _____ N _____

Injection	Primary Current (A)	Secondary Current (A)			Ammeter Reading (A)				Energy Meter Reading (A)		
		L1	L2	L3	L1	L2	L3	N	L1	L2	L3
L1 – L2											
L2 – L3											
L3 – L1											
L1 – N											
L2 – N											
L3 – N											

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____ Circuit: _____

Duty: Motor Protection

Primary Injection Test

A. Protection Current Transformer

Ratio _____ VA _____ Class _____

Serial No. L1 _____ L2 _____ L3 _____ N _____

Injection	Primary Current (A)	Secondary Current				
		L1 (A)	L2 (A)	L3 (A)	N (A)	Spill (mA)
L1 – L2						
L2 – L3						
L3 – L1						

Contactor tripped for each of the above tests: _____ (Yes / No)

B. Metering Current Transformer

Ratio _____ VA _____ Class _____

Serial No. L1 _____ L2 _____ L3 _____ N _____

Injection	Primary Current (A)	Secondary Current (A)			Ammeter Reading (A)				Energy Meter Reading (A)		
		L1	L2	L3	L1	L2	L3	N	L1	L2	L3
L1 – L2											
L2 – L3											
L3 – L1											

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____

Electrical Resistance Test ('Ductor' Test)

Panel no.	Busbar Joints to be Tested	Resistance (μΩ)			
		L1	L2	L3	N

Panel no.	Earthing Bar Joints to be Tested	Earth (μΩ)

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____ Circuit: _____

Secondary Injection Test for Over Voltage Relay

Type: _____ Serial No.: _____

Rating: _____ Aux. Supply: _____

Relay Characteristics

Voltage Setting (V)	Pick Up Voltage (V)	Drop Off Voltage (V)

	Final Voltage and Time Setting
Voltage Setting (V)	437V (115%)
Time Setting (s)	5s
The relay operated according to the above settings: _____ (Yes / No)	

Secondary Injection Test for Under Voltage Relay

Type: _____ Serial No.: _____

Rating: _____ Aux. Supply: _____

Relay Characteristics

Voltage Setting (V)	Pick Up Voltage (V)	Drop Off Voltage (V)

	Final Voltage and Time Setting
Voltage Setting (V)	304V (80%)
Time Setting (s)	5s
The relay operated according to the above settings: _____ (Yes / No)	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____ Circuit: _____

Secondary Injection Test for Overcurrent and Earth Fault Relay

Type: _____ Serial No.: _____

Rating: _____ Aux. Supply: _____

Time Current Characteristic: _____

Phase Injection	Current Setting (A)	Time Setting	Injection Current (A)	Normal Time (s)	Actual Time (s)
L1			(2x)		
			(5x)		
			(10x)		
L2			(2x)		
			(5x)		
			(10x)		
L3			(2x)		
			(5x)		
			(10x)		
E/F			(2x)		
			(5x)		
			(10x)		

Final Settings of Relay after Test				
	L1	L2	L3	E/F
Current Setting (A)				
Time Setting				
High Set				

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Motor Protection Relay Check Sheet

Board: _____

Panel: _____

Circuit: _____ Relay Rating: _____

Aux. Voltage: _____ C.T. Ratio: _____

Relay Model No.: _____ Serial No.: _____

A. Output Relay Check

	Procedure	Required Result	Test result same as required result (Yes/No)
1.	e.g. Press <TRIP>	Display "PSW"	Yes
2.			
3.			

B. Earth Fault Check

	Procedure	Required Result	Test result same as required result (Yes/No)
1.	e.g. Set tIe=1sec, Ie=20% of In	Display "EFFT"	Yes
	Inject 1.0 x In current	Trip time = 1.0s	Yes

C. Thermal Curve Check

	Procedure	Required Result	Test result same as required result (Yes/No)
1.	e.g. Set t6x=10, I_{FLC}=0.5xIn	Display "Thermal Trip"	Yes
	Inject 3.0 x In current	Trip time = 10.26s	Yes

D. High Set Overcurrent Check

	Procedure	Required Result	Test result same as required result (Yes/No)
1.	e.g. Set tI>=0.5, I>700% of FLC	Display "Short Circuit"	Yes
	Inject 15 x In	Trip time = 0.092s	Yes

E. Other Checks

	Procedure	Required Result	Test result same as required result (Yes/No)
1.			
2.			
3.			

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____

Functional Check For Incoming Supply Panel ACB and Associated Circuit

Item	Check (where applicable)	Satisfactory (√)/ Unsatisfactory (X)/ Not applicable (NA)
1	ACB mechanical closing mechanism	
2	Closing interlock at trip condition	
3	All main fuses and circuit fuses provided according to approve drawings	
4	Ammeter functions properly	
5	Voltmeter functions properly	
6	Energy meter functions properly	
7	All protection relays function properly	
8	All auxiliary relays function properly	
9	All timers function properly	
10	All selector switches function properly	
11	All control switches function properly	
12	All push buttons function properly	
13	All indication lamps function properly	
14	All panel auxiliary equipment (operation counter, hour run meter, panel heater, panel humidity sensor, etc.) function properly	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____

Functional Check For Motor Starter No.___

Item	Check (where applicable)	Satisfactory (√)/ Unsatisfactory (X)/ Not applicable (NA)
1	Compartment doors interlock	
2	Main fuseswitch operation	
3	Contactors operation	
4	All main fuses and circuit fuses provided according to approve drawings	
5	Ammeter functions properly	
6	Energy meter functions properly	
7	Motor protection relay functions properly	
8	Tripped on fault relay and all auxiliary relays function properly	
9	All timers function properly	
10	All selector switches function properly	
11	All control switches function properly	
12	All push buttons function properly	
13	All indication lamps function properly	
14	All alarm annunciators function properly	
15	All panel auxiliary equipment (operation counter, hour run meter, panel heater, panel humidity sensor, etc.) function properly	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Board: _____

Panel: _____

Functional Check For Auxiliaries Panel Circuit

Item	Check (where applicable)	Fuseswitch Rating (A)	Satisfactory (√)/ Unsatisfactory (X)/ Not applicable (NA)
1	Station auxiliary supply fuseswitch		
2	Distribution board fuseswitch		
3	Roof extractor control cubicle fuseswitch		
4	Overhead crane fuseswitch		
5	24V dc battery equipment fuseswitch		
6	Sump pump starter cubicle fuseswitch		
7	Air blower starter fuseswitch		
8	Surge vessel air compressor starter cubicle fuseswitch		
	etc.		

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Contract No.:
Contract Title:

Client: Water Supplies Department
Contractor:

Test Date: _____

Site Test Form No. 2a – Motor Insulation, HV Test and Winding Resistance Tests

Testing Instrument:

Testing Instrument: Insulation Continuity Tester Model: _____ Serial No.: _____

Calibration Cert. No. _____ Calibration Due Date: _____ Page: ____ of ____

Result:

Equipment	Dielectric Test (_____V Megger) before HV test	Insulation Resistance (MΩ)						Comment
		U-E	V-E	W-E	U-V	V-W	W-U	
Main Pump Motor No. ____	At 1 min.							Pass / Fail
	At 10 min.(*)							Pass / Fail

High Voltage Test

Test voltage: _____ V for 60 s U – V – W to E, Leakage Current: _____ (mA), Pass / Fail

Equipment	Dielectric Test (_____V Megger) after HV test	Insulation Resistance (MΩ)						Comment
		U-E	V-E	W-E	U-V	V-W	W-U	
Main Pump Motor No. ____	At 1 min.							Pass / Fail
	At 10 min. (*)							Pass / Fail

Motor Stator Winding Resistance Measurement and Megger Test for all Motor Auxiliary Equipment

Equipment	Insulation Resistance (MΩ)				Winding Resistance (Ω)			Comment
	RTD – U	RTD – V	RTD – W	Heater	U1-U2	V1-V2	W1-W2	
Main Pump Motor No. ____								Pass / Fail

(*) For LV motors of 140kW and above and HV motors

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Contract No.:
Contract Title:

Client: Water Supplies Department
Contractor:

Test Date: _____

Site Test Form No. 2b - Pump Motor No Load Tests

Testing Instrument:

Testing Instrument: _____ Model: _____ Serial No.: _____

Calibration Cert. No. _____ Calibration Due Date: _____ Page: _____ of _____

Result:

Item	Pumpset No. and Motor Serial No.	Visual Inspection	E-stop push button function as required?	Rotation Direction from Top of Motor	Motor Rotation Correct?	Apply 3 Phases Power and Measure No-load													Remarks
						Current (A)	Voltage (V)	Power Factor	Vibration		Winding Temperature (°C)						Bearing Temperature (°C)		
									DE	NDE	U1	V1	W1	U2	V2	W2	DE	NDE	
1		Pass / Fail	Yes / No	Clockwise / Anticlockwise	Yes / No														
2																			

Tested By: _____ (Post: /)

Sign: _____

Test Date: _____

Witnessed By: _____ (Post: / WSD)

Sign: _____

Date: _____

Contract No.:
Contract Title:

Client: Water Supplies Department
Contractor:

Test Date: _____

Site Test Form No. 2c – Functional Tests on Pumpset Instruments

Testing Results:

Tested Pumpset: _____ Page: _____ of _____

Item	Description	Installation	Recommended Setting	Setting Check	Operate Correctly	Remarks
1	Pump Discharge No Flow Switch and Monitoring Unit	Pass / Fail		Correct / Not Correct	Yes / No	
2	Pump Seal Coolant Flow Switch and Monitoring Unit	Pass / Fail		Correct / Not Correct	Yes / No	
3	Motor Winding Temperature Sensor and Monitoring Unit	Pass / Fail	120^{o}C (Alarm) / 140^{o}C (Trip)	Correct / Not Correct	Yes / No	
4	Pump Bearing Temperature Sensor and Monitoring Unit	Pass / Fail	75^{o}C (Alarm) / 80^{o}C (Trip)	Correct / Not Correct	Yes / No	
5	Motor Bearing Temperature Sensor and Monitoring Unit	Pass / Fail	75^{o}C (Alarm) / 80^{o}C (Trip)	Correct / Not Correct	Yes / No	
6	Pump Running Indicator	Pass / Fail	-	-	Yes / No	
7	Emergency Stop	Pass / Fail	-	-	Yes / No	
8	Wiring is in line with the approved circuit	Pass / Fail	-	-	Yes / No	
9	Vibration Monitor and Display Unit (for HV Motor)	Pass / Fail		Correct / Not Correct	Yes / No	
10	Motor Exhaust Air Temperature Indicator and Monitoring Unit (for HV Motor)	Pass / Fail		Correct / Not Correct	Yes / No	

Tested By: _____ (Post: /)

Sign: _____

Test Date: _____

Witnessed By: _____ (Post: / WSD)

Sign: _____

Date: _____

Contract No.:
Contract Title:

Client: Water Supplies Department
Contractor:

Test Date: _____

Site Test Form No. 2d - Pump Motor On Load Vibration and Noise Level Tests

Testing Instrument:

Testing Instrument: _____ Model: _____ Serial No.: _____

Calibration Cert. No. _____ Calibration Due Date: _____ Page: _____ of _____

Testing Results:

Tested Pumpset: _____

Test Voltage: V_1: _____ V_2: _____ V_3: _____ Test Current: I_1: _____ I_2: _____ I_3: _____

1. Vibration Test

Description	**DE / Air Inlet**			**NDE / Air Outlet**		
	x	**y**	**z (axial)**	**x**	**y**	**z (axial)**
Vibration Velocity at Bearing House (mm/s)						

2. Noise Level Test

Sound Pressure Level at one metre from Machine (dB(A))	Position	1	2	3					
	Sound pressure level								

Tested By: _____ (Post: /)

Sign: _____

Test Date: _____

Witnessed By: _____ (Post: / WSD)

Sign: _____

Date: _____

Site Test Form No. 3a – Bulk Oil Transformer

Contract No.: _____ Client: Water Supplies Department
Contract Title: _____
Contractor: _____
Location: _____ Test Date: _____

Transformer No.: _____ Manufacturer: _____
Rating: _____ Transformer Type: _____
Ratio: _____ Connection: _____

General

Item	Yes / No
Transformer name plate data correct	
Rust free and no damage on transformer body	
All nuts and electrical connections checked for tightness	
Earthing at transformer tank completed	
Earthing at HV cable box completed	
Earthing at LV cable box completed	
Earthing at instrument cubicle completed	
Oil tank and oil level indicator correctly installed	
Oil level recorded	
Oil temperature and winding temperature indicators correctly installed	
Pressure relief device and Buchholz relay correctly installed	
Terminal/ferrule markings inside the instrument cubicle correct	
Flange and fitting connections tight and correct	
Drain/sample valve fully closed	
Operation of off-load tap changer (if fitted) correct and final tap position recorded	Tap position set at:
Air blower motors and control circuits function properly	
All inter-tripping circuits and interlocking devices function properly	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Testing Instruments

	_____ kV dc Insulation Tester	_____ kV dc Insulation Tester	Oil Tester	Ductor Test Set	Sound Level Meter
Manufacturer					
Model No.					
Serial No.					
Cal. Cert No.					
Calibration Due Date					

Insulation Resistance Test before Pressure Test

(____V Megger) before Pressure Test		**Insulation Resistance (MΩ)**
HV winding to LV winding	(1 minute)	
HV winding to earth	(1 minute)	
LV winding to earth	(1 minute)	

Pressure Test

HV side: Test voltage: _____ V for __60__s U-V-W to L1-L2-L3-E
Leakage Current: _____ (mA), Pass/Fail

LV side: Test voltage: _____ V for __60__s L1-L2-L3 to U-V-W-E
Leakage Current: _____ (mA), Pass/Fail

Insulation Resistance Test after Pressure Test

(____V Megger) after Pressure Test		**Insulation Resistance (MΩ)**
HV winding to LV winding	(1 minute)	
HV winding to earth	(1 minute)	
LV winding to earth	(1 minute)	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Winding Resistance Measurement

HV winding terminal	D.C. winding resistance with tap link at different positions (Ω)								
	1	2	3	4	5	6	7	8	9
1U									
1V									
1W									

LV winding terminal	D.C. winding resistance (mΩ)					
	L1 - L2	L2 - L3	L3 - L1	L1 - N	L2 - N	L3 - N

Voltage Ratio Test

Tap Position	Primary Voltage (V)			Secondary Voltage (V)						Ratio
	1U-1V	1V-1W	1W-1U	L1-L2	L2-L3	L3-L1	L1-N	L2-N	L3-N	
1										
2										
3										
4										
5										
6										
7										
8										
9										

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Polarity and Vector Grouping Tests

Applied voltage: _____ V to HV side

Measured Voltage (V)						
1U-1V	1V-1W	1W-1U	1V-L2	1V-L3	1W-L3	1W-L2

Check whether 1W-L2>1V-L2=1V-L3 and 1W-L2>1W-L3 for Vector Group: Dyn 11

Result: OK / Not OK

Ductor Test

HV terminal to cable lug (μΩ)			LV terminal to cable lug (μΩ)				Comment
1U	1V	1W	L1	L2	L3	N	Pass / Fail

Item	(μΩ)	Comment
Transformer tank earthing terminal to main earthing bar		Pass / Fail
Transformer HV cable box earthing terminal to main earthing bar		Pass / Fail
Transformer LV cable box earthing terminal to main earthing bar		Pass / Fail

Measurement of No-load Loss and Current

Applied voltage: _____ V Frequency: _____ Hz

No-load Loss (W)		Current (A)			

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Dielectric Insulation Oil Test (Spark Gap 2.5mm)

Test no.	1	2	3	4	5	6	Average	Comment
Measured Breakdown Voltage (kV)								Pass / Fail

Test on Winding Temperature and Oil Temperature Protection Devices and Temperature Sensing Probes

Oil Bath Temperature (^{0}C)	Reading on Winding Temperature Indicator	Reading on Oil Temperature Indicator	Alarm / Tripping of CB Initiated
		-	
		-	
	-		
	-		

Test on Buchholz Relay Using Gas Injection Method Pass / Fail

Noise Level Measurement

Applied voltage: _____ V Frequency: _____ Hz

Sound Pressure Level at one metre from Transformer (dB(A))	Position	1	2	3					
	Sound pressure level								

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Site Test Form No. 3b - Epoxy Resin Encapsulated Transformer

Contract No.: _____ Client: Water Supplies Department
Contract Title: _____
Contractor: _____
Location: _____ Test Date: _____

Transformer No.: _____ Manufacturer: _____
Rating: _____ Transformer Type: _____
Ratio: _____ Connection: _____

General

Item	Yes / No
Transformer name plate data correct	
Rust free and no damage on transformer body	
All nuts and electrical connections checked for tightness	
Earthing at transformer tank completed	
Earthing at HV cable box completed	
Earthing at LV cable box completed	
Winding temperature indicators correctly installed	
Flange and fitting connections tight and correct	
Operation of off-load tap changer correct and final tap position recorded	Tap position set at:
All inter-tripping circuits and interlocking devices function properly	

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Testing Instruments

	_____ kV dc Insulation Tester	_____ kV dc Insulation Tester	Ductor Test Set	Sound Level Meter
Manufacturer				
Model No.				
Serial No.				
Cal. Cert No.				
Calibration Due Date				

Insulation Resistance Test before Pressure Test

(____V Megger) before Pressure Test	**Insulation Resistance (MΩ)**
HV winding to LV winding	
HV winding to earth	
LV winding to earth	

Pressure Test

HV side: Test voltage: _____ V for __60__s U-V-W to L1-L2-L3-E
Leakage Current: _____ (mA), Pass/Fail

LV side: Test voltage: _____ V for __60__s L1-L2-L3 to U-V-W-E
Leakage Current: _____ (mA), Pass/Fail

Insulation Resistance Test after Pressure Test

(____V Megger) after Pressure Test		**Insulation Resistance (MΩ)**
HV winding to LV winding	(1 minute)	
HV winding to earth	(1 minute)	
HV winding to earth	(10 minutes)	
LV winding to earth	(1 minute)	
LV winding to earth	(10 minutes)	

HV winding polarization index = _____
LV winding polarization index = _____

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Winding Resistance Measurement

HV winding terminal	D.C. winding resistance with tap link at different positions (Ω)								
	1	2	3	4	5	6	7	8	9
1U									
1V									
1W									

LV winding terminal	D.C. winding resistance (mΩ)					
	L1 - L2	L2 - L3	L3 - L1	L1 - N	L2 - N	L3 - N

Voltage Ratio Test

Tap Position	Primary Voltage (V)			Secondary Voltage (V)						Ratio
	1U-1V	1V-1W	1W-1U	L1-L2	L2-L3	L3-L1	L1-N	L2-N	L3-N	
1										
2										
3										
4										
5										
6										
7										
8										
9										

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Polarity and Vector Grouping Tests

Applied voltage: _____ V to HV side

Measured Voltage (V)						
1U-1V	1V-1W	1W-1U	1V-L2	1V-L3	1W-L3	1W-L2

Check whether 1W-L2>1V-L2=1V-L3 and 1W-L2>1W-L3 for Vector Group: Dyn 11

Result: OK / Not OK

Ductor Test

HV terminal to cable lug (μΩ)			LV terminal to cable lug (μΩ)				Comment
1U	1V	1W	L1	L2	L3	N	Pass / Fail

Item	(μΩ)	Comment
Transformer tank earthing terminal to main earthing bar		Pass / Fail
Transformer HV cable box earthing terminal to main earthing bar		Pass / Fail
Transformer LV cable box earthing terminal to main earthing bar		Pass / Fail

Measurement of No-load Loss and Current

Applied voltage: _____ V Frequency: _____ Hz

No-load Loss (W)		Current (A)			

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Test on Winding Temperature Protection Devices and Temperature Sensing Probes

Reading on Winding Temperature Indicator	Alarm / Tripping of CB Initiated

Noise Level Measurement

Applied voltage: _____ V Frequency: _____ Hz

Sound Pressure Level at one metre from Transformer (dB(A))	Position	1	2	3					
	Sound pressure level								

Tested By: _____ (Post: /) Witnessed By: _____ (Post: / WSD)

Sign: _____ Sign: _____

Test Date: _____ Date: _____

Contract No.:
Contract Title:

Client: Water Supplies Department
Contractor:

Test Date: _____

Site Test Form No. 4 – Performance Tests on Power Factor Correction Capacitor

Item	Description	Serial Number	Visual Inspection	Measured Capacitance (μF)* and Capacitor Rating (kVAr)	Voltage Test Between Terminals	Voltage Test Between Terminals and Container	Remarks
1	Capacitor for: (Rating : _____ kVAr @____V)		Pass / Fail		Pass / Fail	Pass / Fail	
2							
3							
4							

* Calculations shall be submitted with the test report.

Tested By: _____ (Post: /)

Sign: _____

Test Date: _____

Witnessed By: _____ (Post: / WSD)

Sign: _____

Date: _____

Site Test Form No. 5a - Battery and Charger

Contract No.: Client: Water Supplies Department

Contract Title: Contractor:

Location: Test Date:

Model No. _____ Serial No. _____

Input

Voltage 380 V ac Frequency 50 Hz Phase 3-phase

Visual Check	Satisfactory (√)/ Unsatisfactory (X)
Physical Dimension	
Construction, Finish & Quantity	
Rating Marking	
Components Integrity	

Output Setting	Factory Setting	Measured Value	
Float Voltage			
Float Voltage Range			
Boost Voltage			
Boost Voltage Range			
Current Range			
Load Voltage Limits			
Current Limits			
AC Voltmeter			
DC Voltmeter			
DC Ammeter			
Charge / Discahrge Ammeter			
Load Ammeter			

Selector Switch	
LED Test	
Boost / Auto / Float	
On / Off Switch	

Tested by: _____ Post: _____ Witnessed by: _____ Post: _____

Signature: _____ Signature: _____

Date: _____ Date: _____

Site Test Form No. 5a - Battery and Charger

	Satisfactory (√)/ Unsatisfactory (X)
LED Indication	
Mains On	_____
Float Charging On	_____
Boost Charging On	_____

Alarm and Indication	Factory Setting	Measured Value	
Mains Failed			_____
Charger Failed			_____
Charger Temperature High			_____
Battery Temperature High			_____
Battery Room Ventilation Failed			_____
Fan Failed			_____
Earth Leakage			_____
Electrolyte Level Low			_____
Charger Voltage High	_____	_____	_____
Charger Voltage Low	_____	_____	_____
Load Voltage High	_____	_____	_____
Load Voltage Low	_____	_____	_____

Multimeter: (Brand / Model / Serial No.) _____

Loader: (Brand / Model / Serial No.) _____

Tested by: _____ Post: _____ Witnessed by: _____ Post: _____

Signature: _____ Signature: _____

Date: _____ Date: _____

Site Test Form No. 5a - Battery and Charger

Contract No.: Client: Water Supplies Department

Contract Title: Contractor:

Location: Test Date:

Cell S.G. Record Sheet (Fully Charged Condition)

Model No. _____ No. of Cells _____

Voltage _____

Cell No.	S.G. Level	Cell No.	S.G. Level	Cell No.	S.G. Level	Cell No.	S.G. Level	Cell No.	S.G. Level
1		21		41		61		81	
2		22		42		62		82	
3		23		43		63		83	
4		24		44		64		84	
5		25		45		65		85	
6		26		46		66		86	
7		27		47		67		87	
8		28		48		68		88	
9		29		49		69		89	
10		30		50		70		90	
11		31		51		71		91	
12		32		52		72		92	
13		33		53		73			
14		34		54		74			
15		35		55		75			
16		36		56		76			
17		37		57		77			
18		38		58		78			
19		39		59		79			
20		40		60		80			

Remarks: _____

_____

Tested by: _____ Post: _____ Witnessed by: _____ Post: _____

Signature _____ Signature _____

Date _____ Date _____

Site Test Form No. 5b - Battery Discharge Test

Contract No.: Client: Water Supplies Department

Contract Title: Contractor:

Location: Test Date:

Model No. _____ No. of Battery Cells _____

Discharge Current _____ End Voltage per Cell _____

Duration: 5 hours Starting Time: _____ Ending Time: _____

Testing Time	0:00	0:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00		
Battery Cell No.	Battery Cell Voltage												
Total Voltage													

Multimeter: (brand/model/serial no.) _____

Tested by:_____Post:_____ Witnessed by:_____Post: _____

Signature: _____ Signature: _____

Date: _____ Date: _____

Contract No.:
Contract Title:

Client: Water Supplies Department

Contractor:

Location:

Test Date:

Site Test Form No. 6a – Power Cable Insulation Tests

Testing Instrument:

Testing Instrument: Insulation Continuity Tester

Make/Model:

Serial No.:

Calibration Cert. No.

Calibration Due Date:

Page: of

Result:

Item	From	To	Cable No.	Insulation Resistance (M-Ohm)										Comment
				L1-L2	L1-L3	L2-L3	L1-N	L2-N	L3-N	L1-E	L2-E	L3-E	N-E	
1														Pass / Fail
2														Pass / Fail
3														Pass / Fail
4														Pass / Fail
5														Pass / Fail
6														Pass / Fail
7														Pass / Fail
8														Pass / Fail
9														Pass / Fail
10														Pass / Fail
11														Pass / Fail
12														Pass / Fail
13														Pass / Fail

Tested By: (Post: /)

Witnessed By: (Post: / WSD)

Sign:

Sign:

Test Date:

Date:

Contract No.:
Contract Title:

Client:

Contractor:

Location:

Test Date:

Site Test Form No. 6b – Multi-core Cable Insulation Tests

Testing Instrument:

Testing Instrument: Insulation Continuity Tester Make/Model: Serial No.:

Calibration Cert. No. Calibration Due Date: Page: of

Result: Cable No.:

		Insulation Resistance (M-Ohm)																										
		Core No.																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	E
Core No.	1																												
	2																												
	3																												
	4																												
	5																												
	6																												
	7																												
	8																												
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	26																												
	27																												
	E																												

Tested By: (Post: /)

Witnessed By: (Post: / WSD)

Sign:

Test Date:

Sign:

Date:

Contract No.:
Contract Title:

Client: Water Supplies Department

Contractor:

Location:

Test Date:

Site Test Form No. 6c –Power Cable Continuity Tests

Testing Instrument:

Testing Instrument: Insulation Continuity Tester

Make/Model:

Serial No.:

Calibration Cert. No.

Calibration Due Date:

Page: of

Result:

Item	From	To	Cable No.	Brown Core (Ohm)	Black Core (Ohm)	Grey Core (Ohm)	Blue Core (Ohm)	Comment
1								Pass / Fail
2								Pass / Fail
3								Pass / Fail
4								Pass / Fail
5								Pass / Fail
6								Pass / Fail
7								Pass / Fail
8								Pass / Fail
9								Pass / Fail
10								Pass / Fail
11								Pass / Fail
12								Pass / Fail
13								Pass / Fail
14								Pass / Fail
15								Pass / Fail

Tested By: (Post: /)

Witnessed By: (Post: / WSD)

Sign:

Sign:

Test Date:

Date:

Contract No.:
Contract Title:

Client: Water Supplies Department

Contractor:

Location:

Test Date:

Site Test Form No. 6d – Multi Core Cable Continuity Tests

Testing Instrument:

Testing Instrument: Insulation Continuity Tester

Make/Model:

Serial No.:

Calibration Cert. No.

Calibration Due Date:

Page: of

Cable No:

Result:

Core No.	Continuity (Ohm)	Core No.	Continuity (Ohm)	Core No.	Continuity (Ohm)	Core No.	Continuity (Ohm)
1		11		21		31.	
2		12		22		32	
3		13		23		33	
4		14		24		34	
5		15		25		35	
6		16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

Tested By: (Post: /)

Sign:

Test Date:

Witnessed By: (Post: / WSD)

Sign:

Date:

Contract No.:
Contract Title:

Client: Water Supplies Department
Contractor:

Test Date: _____

Site Test Form No. 7a – Earth Electrode Resistance Test for Main Earthing Plates

Station Main Earthing System

(1) General

Item	Description	Yes / No
1	All conductors and joints are electrically and mechanically sound and correctly connected	

(2) Earth Electrode Resistance Test for Main Earthing Plates

Item	Main Earthing Plate to be Tested	Resistance (Ω)	Required Result	Comment
1			< 1Ω	Pass / Fail
2				
3				
4				

Tested By: _____ (Post: /)

Sign: _____

Test Date: _____

Witnessed By: _____ (Post: / WSD)

Sign: _____

Date: _____

Contract No.:
Contract Title:

Client: Water Supplies Department
Contractor:

Test Date: _____

Site Test Form No. 7b - Earth Fault Loop Impedance Tests on Electrical Plants

Testing Instrument:

Testing Instrument: Earth Fault Loop Impedance Tester Model: _____ Serial No.: _____

Calibration Cert. No. _____ Calibration Due Date: _____ Page _____ of _____

Result:

Item	Equipment	Maximum Earth Fault Loop Impedance (Ω) from CoP for the Electricity (Wiring) Regulations	Measured Earth Fault Loop Impedance (Ω)	Comment
1	Power Capacitor No.1			Pass / Fail
2	Pumpset Instrument Panel No.1			Pass / Fail
3	Motor No.1			Pass / Fail
4	Suction Valve Actuator for Pump No.1			Pass / Fail
5	Discharge Valve Actuator for Pump No.1			Pass / Fail
6				
7				
8				
9				
10				

Tested By: _____ (Post: /)

Sign: _____

Test Date: _____

Witnessed By: _____ (Post: / WSD)

Sign: _____

Date: _____

Contract No.:
Contract Title:

Client: Water Supplies Department
Contractor:

Test Date: _____

Site Test Form No. 8 – Functional Tests on DCS

Plant / Equipment: _____

Discrete Item	Functional Description	Results	Remarks
1		Pass / Fail	
2		Pass / Fail	
3		Pass / Fail	
4		Pass / Fail	
5		Pass / Fail	
6		Pass / Fail	

Analogue Item	Functional Description	Results	Remarks
1		Pass / Fail	
2		Pass / Fail	
3		Pass / Fail	
4		Pass / Fail	
5		Pass / Fail	
6		Pass / Fail	

Tested By: _____ (Post: /)

Sign: _____

Test Date: _____

Witnessed By: _____ (Post: / WSD)

Sign: _____

Date: _____