TESTING AND COMMISSIONING PROCEDURE

FOR

ELECTRICAL INSTALLATION

IN

GOVERNMENT BUILDINGS

OF

THE HONG KONG SPECIAL ADMINISTRATIVE REGION

2017 EDITION

ARCHITECTURAL SERVICES DEPARTMENT
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

PREFACE

This Testing and Commissioning (T&C) Procedure aims to lay down the minimum testing and commissioning requirements to be carried out on Electrical Installation in Government Buildings of the Hong Kong Special Administrative Region (HKSAR). Such requirements are applicable to both new installations upon completion and existing ones after major alteration.

The present edition was developed from the 2012 edition by the Electrical Specialist Support Group that was established under the Building Services Branch Technical Information and Research & Development Committee of the Architectural Services Department (ArchSD). This T&C Procedure has incorporated the latest changes in the 2017 edition of the General Specification for Electrical Installation.

With the benefit of information technology, electronic version of this T&C Procedure is to be viewed on and free for download from the ArchSD Internet homepage. As part of the Government's efforts to limit paper consumption, hard copies of this T&C Procedure will not be put up for sale.

The ArchSD welcomes comments on this T&C Procedure at any time since the updating of this T&C Procedure is a continuous process to tie in with technological advances.

DISCLAIMER

This T&C Procedure is solely compiled for use on Electrical Installation carried out for or on behalf of the ArchSD in Government Buildings of the HKSAR.

There are no representations, either expressed or implied, as to the suitability of this T&C Procedure for purposes other than that stated above. The material contained in this T&C Procedure may not be pertinent or fully cover the extent of the installation in non-government buildings. Users who choose to adopt this T&C Procedure for their works are responsible for making their own assessments and judgement of all information contained herein. The ArchSD does not accept any liability and responsibility for any special, indirect or consequential loss or damage whatsoever arising out of or in connection with the use of this T&C Procedure or reliance placed on it.

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Testing and Commissioning Procedure for Electrical Installation

1. Introduction

The procedures stated in this Testing and Commissioning (T&C) Procedure cover the activities in preliminary tests and inspections, functional performance tests and the commissioning of newly completed installations and existing ones after major alteration. They are so compiled to facilitate the work of Project Building Services Engineer (PBSE) and Project Building Services Inspector (PBSI), who are appointed as the Supervising Officer's Representatives, in the following aspects with respect to T&C:-

(i) To vet and approve the T&C procedures proposed and submitted by the contractor for the Electrical Installation (EE Contractor);

(ii) To witness those T&C procedures as specified; and

(iii) To accept the T&C certificates and other supporting data.

The EE Contractor shall carry out the T&C works as detailed in this T&C Procedure. Supplementary T&C plans may be proposed by the EE Contractor as appropriate and agreed by PBSE, e.g. for special equipment supplied and/or installed by the EE Contractor.

The administrative requirements for T&C works are in general as specified in the General Specification for Electrical Installation 2017 Edition and all current corrigenda/amendments thereto published before the date of first tender invitation for the Contract issued by the ArchSD (the General Specification).

All words and expressions shall have the meaning as assigned to them under the General Specification unless otherwise specified herein.

"Major Alteration" of an existing electrical installation means alteration involving work on any distribution board or electrical equipment having an electrical current rating exceeding 100A single phase or 60A three phases in an existing electrical installation.

This T&C Procedure is also intended to lay down the minimum testing and commissioning requirements to be carried out by the EE Contractor on a new Low Voltage Cubicle Switchboard Installation upon completion or on an existing Low Voltage Cubicle Switchboard Installation after a major alteration involving modification of the main busbar such as upgrading, reposition and extension.

This T&C Procedure also covers the verification of the electrical installation and lighting installation to demonstrate the compliance with the Building Energy Code (hereinafter named as BEC) issued under the Buildings Energy Efficiency Ordinance (Cap 610). The EE Contractor is required to check, measure and submit the required information to PBSE for his/her consolidation to verify the design in compliance with the BEC.

2. Objectives of the Testing and Commissioning Works

The objectives of the T&C works are:-

(i) To verify proper functioning of the equipment/system after installation;

(ii) To verify that the performance of the installed equipment/systems meet with the specified design intent and statutory requirements, if any, through a series of tests, measurements and adjustments; and

(iii) To capture and record performance data of the whole installation as the baseline for future operation and maintenance.

For the avoidance of doubt, depending on the specific demands of individual installation, the PBSE may require additional or substitute T&C works in regard to any elements in the installation other than those indicated in this T&C Procedure.

3. Scope of the Testing and Commissioning Works

3.1 Tests and Inspections during Construction

The purpose of these tests is to ensure that all components and systems are in a satisfactory and safe condition before start up. Preliminary adjustment and setting of equipment at this stage shall also be carried out at the same time to pave way for the coming functional performance tests.

Before carrying out any test, the EE Contractor shall ensure that the Installations comply with all relevant statutory requirements and regulations. The T&C works shall also comply with all site safety regulatory requirements currently in force. In particular, the EE Contractor shall note the following:-

(a) Electricity Ordinance (Cap.406), and other subsidiary legislation made under the Ordinance;

(b) Code of Practice for the Electricity (Wiring) Regulations published by the EMSD (hereinafter named as COP);

(c) Occupational Safety and Health Ordinance (Cap.509), and other subsidiary legislation made under the Ordinance;

(d) Factories and Industrial Undertakings Ordinance (Cap.59), and other subsidiary legislation made under the Ordinance, including but not limited to Construction Sites (Safety) Regulations;

(e) Electricity supply rules of the relevant power supply companies;

(f) Buildings Energy Efficiency Ordinance (Cap 610) and other subsidiary legislation made under the Ordinance;

(g) Fire Service (Installations and Equipment) Regulations, Fire Services Ordinance (Cap. 95), and other subsidiary legislation made under the Ordinance;

(h) Dangerous Goods Ordinance (Cap. 295), and other subsidiary legislation made under the Ordinance; and

3.2 Statutory Test and Inspection

The EE Contractor shall carry out tests for the Installations to meet statutory requirements as specified in the Specification. After the proper testing and commissioning of the Installations, the EE Contractor shall notify the appropriate authority as specified in the Specification, through the PBSE of the completion of the Installations and its readiness for inspection and testing. The EE Contractor shall arrange for the necessary inspections and tests as required by the Authority.

The statutory test and inspection herein stated in this T&C Procedure shall refer to the Regulations Nos. 19, 20, 21 and 22 of the Electricity (Wiring) Regulations (Cap.406E) under the Electricity Ordinance (Cap.406).

3.3 Functional Performance Tests

The purpose of functional performance tests is to demonstrate that the Installations can meet the functional and performance requirements as specified in the Specification. Functional performance tests should proceed from the testing of individual components to the testing of different systems in the Installations.

The EE Contractor may have to make temporary modifications as the tests proceed. The specific tests required and the order of tests will vary depending on the type and size of systems, number of systems, sequence of construction, interface with other installations, relationship with the building elements and other specific requirements as indicated in the Specification. The testing of systems may have to be carried out in stages depending on the progress of work or as proposed by the EE Contractor.

Part of the tests may be required to be carried out in suppliers' premises in accordance with the provisions in the Specification.

Any performance deficiencies revealed during the functional performance tests must be evaluated to determine the cause. After completion of the necessary corrective measures, the EE Contractor shall repeat the tests.

If any test cannot be completed because of circumstances that are beyond the control of the EE Contractor, it shall be properly documented and reported to the PBSE, who shall then liaise with the relevant parties to resolve the situation. The EE Contractor shall resume his testing work immediately upon the attainment of a suitable testing environment.

3.4 Documentation and Deliverables

The EE Contractor shall submit his proposed T&C procedures together with the

Testing and Commissioning Progress Chart shown in Annex II and Annex IV, where applicable, to PBSE for approval.

All inspection and T&C results shall be recorded by the EE Contractor in the appropriate test record forms. A complete set of these forms can be found in Annex I and Annex III.

Data recorded in other formats may also be acceptable subject to prior approval of the PBSE. Upon completion of all the required T&C works, the EE Contractor shall complete and sign the testing and commissioning certificate as shown in Part 1 and 2 of Annex I and/or Annex III to the effect that the agreed T&C works have been duly carried out.

Functional test reports covering all measured data, data sheets, and a comprehensive summary describing the operation of the system at the time of the functional tests shall be prepared and submitted to the PBSE. Deviations in performance from the Specification or the design intent should be recorded, with a description and analysis included.

Where required in the Specification, the EE Contractor shall conduct a final evaluation of the performance of the Installations, the results of which shall be included in the commissioning report.

The EE Contractor shall sign work completion certificate(s) and issue to the PBSE after completion of the Installations or any work subsequent to repair, alteration or addition to an existing installation. This should be done before the installations are energised.

4. Testing and Commissioning Procedures

4.1 Preliminary Steps for Testing and Commissioning

Before carrying out T&C, the EE Contractor shall take the following steps:-

(a) Submit draft T&C procedures to the PBSE for approval. The draft T&C procedures shall include essential procedures mentioned in this T&C Procedure plus additional T&C procedures required for specific installations as well as manufacturer's recommendation;

(b) Obtain design drawings and specifications and to be thoroughly acquainted with the design intent;

(c) Obtain copies of approved shop drawings and equipment schedules;

(d) Review approved shop drawings and equipment schedules;

(e) Check manufacturer's operating instructions and statutory requirements;

(f) Physically inspect the installation and equipment to determine variations from designs and/or specifications;

(g) Check individual components, e.g. key switches, control equipment, circuit breaker status, etc. for proper position and settings for completeness of installation; and

(h) Check inclusion of manufacturer's typical equipment testing data or factors before T&C of particular equipment.

4.2 Tests and Inspections during Construction

For those tests to be carried out on different systems of the Installations during construction to ensure their suitability for operating at the design conditions, certificates of such completed tests shall be issued.

The tests and inspection shall include, but not limited to, the followings:-

(a) Visual inspection;

(b) Earth electrode resistance; and

(c) Continuity of protective conductor.

Details of these tests shall be in accordance with relevant sections of this T&C Procedure.

4.3 Statutory Inspection and Test for Low Voltage Installations

4.3.1 Inspection before Test

A visual inspection shall be made to verify that the Installations as installed is correctly selected and erected in accordance with the COP Code 21A and COP Appendix 13, and that there is no apparent damage. The visual inspection shall include a check on the following items, where appropriate:-

(a) Adequacy of working space, access, and maintenance facilities;

(b) Connections of conductors;

(c) Identification of conductors;

(d) Adequacy of the sizes of conductor in relation to current carrying capacity and voltage drop;

(e) Correct connections of all equipment with special attention to socket outlets, lampholders, isolators, switches, residual current devices, miniature circuit breakers, and protective conductors;

(f) Presence of fire barriers and protection against thermal effects;

(g) Methods of basic protection with live parts (including measurement of distances where appropriate), i.e. protection by insulation of live parts, or protection by barriers or enclosures;

(h) Presence of appropriate devices for isolation and switching;

(i) Choice and setting of protective and indicative devices;

(j) Labelling of circuits, fuses, protective devices, switches, isolators and terminals;

(k) Selection of equipment and protective measures appropriate to adverse environmental conditions;

(l) Presence of danger and warning notices;

(m) Presence of diagrams, instructions and other similar information;

(n) Connection of single pole devices for protection or switching in phase conductors only;

(o) Method of protection against indirect contact;

(p) Prevention of mutual detrimental influence;

(q) Presence of undervoltage protective devices;

(r) Erection method; and

(s) Any other appropriate inspection as listed in COP Appendix 13.

4.3.2 Sequence of Tests

The following items, where relevant, are to be tested preferably in the sequence indicated below:-

(a) Continuity of protective conductors, including main and supplementary equipotential bonding;

(b) Continuity of ring final circuit conductors;

(c) Insulation resistance;

(d) Polarity;

(e) Earth electrode resistance;

(f) Earth fault loop impedance;

(g) Functions of all protective devices; and

(h) Functions of all items of equipment.

In the event of any test indicating failure to comply, that test and those preceding, the results of which may have been influenced by the fault indicated, shall be repeated after the fault has been rectified.

4.3.3 Conductor Continuity

(a) Continuity of Protective Conductors

The test shall be carried out in accordance with COP Code 21B(3).

Every protective conductor, including all conductors and any extraneous conductive parts used for equipotential bonding should be tested for continuity. The test should be made by connecting together the neutral and protective conductors at the mains position and checking between earth and neutral at every outlet by a continuity tester, which should show a reading near zero.

(b) Continuity of Ring Final Circuit

The test shall be carried out in accordance with COP Code 21B(4).

The ring circuit should be tested from the distribution board. The ends of the two cables forming the phase conductor should be separated, and a continuity test should show a reading near zero between the two; the same tests to be made between the two cables that form the neutral conductor, and between the two cables that form the protective conductor.

The testing method in above paragraph is only applicable when the ring circuit has been inspected throughout, prior to the test, to ascertain that no interconnection (multi-loops) exists on the ring circuit. Otherwise, the testing methods stipulated in Part 3 of the Guidance Note 3 to BS7671, should be adopted instead.

4.3.4 Insulation Resistance

The test shall be carried out in accordance with COP Code 21B(5).

A suitable direct current (d.c.) insulation resistance tester should be used to measure insulation resistance. Care should be taken to ensure that the insulation of the equipment under test could withstand the test voltage without damage.

The main switchboard and each distribution circuit should be tested separately. To carry out this test, it is acceptable to divide large installation into sections with groups of outlets. The term ‘outlet’ in this case includes every point and every switch. A socket outlet or appliance or luminaire incorporating a switch is regarded as one outlet.

When measured with all fuse links in place, all switches and circuit breakers (including, if practicable, the main switch) closed and all poles or phases of the wiring electrically connected together, the insulation resistance to earth should not be less than the appropriate values given in Table 21(1) of COP. For best practice, the insulation resistance shall not be lower than 1.0 mega ohm for low voltage installation under a test voltage of d.c. 500V.

When measured between all conductors connected to any one phase or pole of the supply and, in turn, all conductors connected to each other phase or pole, the insulation resistance should not be less than the appropriate values in Table 21(1) of COP. For best practice, the insulation resistance shall not be lower than 1.0 mega ohm for low voltage installation under a test voltage of d.c. 500V.

For the sake of enhanced safety, when the value of insulation resistance measured is near the minimum values as required in this T&C Procedure, or at relatively low value where considered abnormal to trade's practice, the concerned circuit /installation shall be re-checked to improve and re-test shall be conducted afterward.

In carrying out the test:-

(a) wherever practicable, all lamps should be removed and all current using equipment should be disconnected and all local switches controlling lamps or other equipment should be closed;

(b) where the removal of lamps and/or the disconnection of current using equipment is impracticable, the local switches controlling such lamps and/or equipment should be open;

(c) electronic devices connected in the installation should be isolated or short circuited where appropriate so that they are not damaged by the test voltage; and

(d) where the circuits contain voltage sensitive devices, the test should measure the insulation resistance to earth with all live conductors (including the neutral) connected together.

The sequence of test shall be as follows:-

(1) Main switch/switchboard and outgoing circuits with sub-main switches being isolated;

(2) Sub-main switches/switchboards and outgoing circuits with final circuits boards being isolated; and

(3) Final circuit boards and final circuits.

Where equipment is disconnected for the test and the equipment has exposed conductive parts require to be connected to protective conductors,

the insulation resistance between the exposed conductive parts and all live parts of the equipment should be measured separately and should have a minimum insulation resistance not less than 1 mega ohm.

For Site Built Assemblies, the insulation applied to the live parts of the assemblies for basic protection shall be tested with an applied voltage equivalent to that specified in the appropriate Regulation and/or COP for similar factory-built equipment. The supplementary insulation of Site Built Assemblies for fault protection shall be tested for degree of protection not less than IP 2X, and the insulation enclosure shall be tested with an applied voltage equivalent to that specified in the appropriate Regulation and/or COP for similar factory-built equipment.

4.3.5 Polarity

The test shall be carried out in accordance with COP Code 21B(6).

A test of polarity should be carried out to verify that:-

(a) every fuse and single-pole control and protective device is connected in the phase conductor only;

(b) centre-contact bayonet and Edison-type screw lampholders to IEC 60238 in circuits having an earthed neutral conductor, have their outer or screwed contacts connected to that neutral conductor; and

(c) wiring has been correctly connected to socket outlets and similar accessories.

4.3.6 Earth Electrode Resistance

The test shall be in accordance with COP Code 21B(7).

A proper earth electrode resistance tester should be used to measure earth electrode resistance. An alternating current at 50 Hz of a steady value is passed between the earth electrode T and an auxiliary earth electrode T1 placed at a separation distance recommended by the manufacturer of the tester but in any case should not be less than 20 metres away. A second auxiliary earth electrode T2, which may be a metal spike driven into the ground, is then inserted half-way between T and T1, and the voltage drop between T and T2, divided by the current flowing between T and T1, gives a measured earth electrode resistance of earth electrode T.

For an electrical installation having four or more earth electrodes which are installed more or less in line, following a general direction not exceeding 15° deviation and with separation between adjacent electrodes not less than the recommended distance by the manufacturer of the tester but in any case not less than 20 metres, these electrodes can be used in turn as the auxiliary electrodes for the purpose of measuring the earth electrode resistances.

The following alternative method for measuring the earth electrode resistance may be used if the electricity supply is connected. A loop impedance tester should be connected between the phase conductor at the origin of the installation and the earth electrode with the test link open, and a test performed. This impedance reading could be treated as the electrode resistance.

4.3.7 Earth Fault Loop Impedance

The test shall be carried out in accordance with COP Code 21B(8).

The earth fault loop impedance should be measured by a phase-earth loop tester with a scale calibrated in ohms.

The earth fault loop impedance should not exceed the requirements of COP Code 11.

Before the test begins, it is essential to establish, by inspection, that the earthing conductor and all relevant earth connections are in place, and that the bonding connection to electricity supplier's earthing facilities is disconnected. Measures should be taken, during the impedance tests especially when the earth leakage protective devices are effectively removed for the duration of the tests, to ensure that the installation is not being used other than by person(s) carrying out the tests.

4.3.8 Functions of All Devices including Protective Devices

The test shall be carried out in accordance with COP Code 21B(9).

Functional Test of Residual Current Device (RCD):-

(a) Function of residual current devices should be checked by a residual current device tester simulating an earth fault in order to verify its effective operation. The in-built test button should also be tested for proper functioning. One of the testing methods is specified in subparagraph (b) and (c) below. Other testing methods complying with relevant national and/or international standards are also acceptable.

(b) The test should be made on the load side of the RCD between the phase conductor of the protected circuit and the associated circuit protective conductor. The load should be disconnected during the test.

(c) For general purpose RCDs to IEC 61008 or RCBOs to IEC 61009, with a leakage current flowing equivalent to 50% of the rated tripping current of the RCD, the device should not open. When a leakage current is flowing equivalent to 100% of the rated tripping current of the RCD, the device should open in less than 300 ms unless it is of 'Type S' (or selective) which incorporates an

intentional time delay, when it should trip within the time range from 130 ms to 500 ms.

Function of other protective devices, such as miniature circuit breakers, moulded case circuit breakers, air circuit breakers, fused switches, switch-fuses and protective relays etc. should be checked by hand operation as appropriate.

Function of all items of equipment such as isolators, switches and indicative devices should be checked by hand operation.

Secondary Injection Test

(a) The overload and fault current protection characteristics of protection relays should be verified with secondary injection test.

(b) The test should be carried out by injecting a.c. of different magnitudes into the relay terminals and measuring the relay operating time. The operating time should be checked against the manufacturer's data sheet. The waveform and accuracy of the a.c. current injected shall be in accordance with the requirements specified by the manufacturer.

(c) Safety precautions for works on low voltage specified under Code 4G should be observed.

4.3.9 Additional Check for Installation in Hazardous Environment

The following additional check, where appropriate, shall be carried out for installations in hazardous environment in accordance with COP Code 21B(10):-

(a) Where appropriate, the area involved should be checked to ensure 'gas free' condition before insulation and earth fault loop impedance test are carried out.

(b) All equipment should be suitably protected according to the types of protection under COP Code 15. The integrity of the type of protection provided for the equipment should not be jeopardised by the method of installation. No alteration that may invalidate the conditions of protection can be used.

(c) Equipment should be kept clean and free from accumulation of dust, foreign particles and deleterious substances. Equipment is kept free from condensation.

(d) All lamps, fuses and replaceable parts should be checked so that correct rating and types are being used.

(e) The surface temperature of all equipment should be appropriate to the type of protection being provided.

4.4 Statutory Inspection and Test for High Voltage Installations

4.4.1 Inspection before Test

The inspection shall be carried out in accordance with COP Code 21C.

Inspection of H.V. installations should follow those for L.V. installations listed in section 4.2 of this T&C Procedure with additional checks on the following items where relevant:-

(a) provision of suitable locking facilities for every entry to an H.V. switchroom/substation;

(b) continuity of protective conductors especially the bonding of all exposed conductive parts; and

(c) provision of padlock facilities for shutters, key boxes etc.

4.4.2 Safety

Precautionary measures, including those applicable ones stated in Code 4G and 4H, should be taken and the methods of tests should be such that no danger to persons or property can occur even if the circuit being tested is defective.

H.V. test area should be screened or fitted with barrier with appropriate label / sign attached to avoid unauthorised access. Responsible person should be present throughout the duration of the tests, and the area should be continually watched while testing is in progress

Before carrying out the T&C for high voltage installations, the EE Contractor shall submit risk assessment, safety plan and implementation procedure to PBSE for approval.

4.4.3 Testing Requirements

Testing for High Voltage installations should be referred to relevant recognised standards, manufacturers' recommendation, operations and maintenance instructions.

Where the procedures involve the removal of circuit main earths, that is, testing under a sanction-for-test, the earths (except those without lock, for example, portable earth) should be secured with working locks. The keys to these locks should be retained by person in-charge, who will remove and replace the earths as requested.

Live voltage and phase checking on high voltage equipment may only be undertaken by person in-charge, with assistance if necessary from a person who has been specifically trained for live voltage and phase checking acting on verbal instructions from person in-charge.

Where high voltage tests are to be undertaken, a sanction-for-test should be issued to person in-charge who is to be present throughout the duration of the tests.

The EE Contractor shall responsible to submit a full T&C plan with inspection and test details to PBSE for approval.

4.5 Functional Test of System /Equipment

4.5.1 Lightning Protection System

The whole lightning protection system shall be tested for continuity between air terminations and earthing terminations and the resistance shall be recorded.

The earth termination resistance shall be tested and recorded. Each earth termination shall have a resistance to earth not exceeding the product given by 10 ohms times the number of earth terminations to be provided. The whole of the lightning protection system shall have a combined resistance to earth not exceeding 10 ohms.

Where the steel work of the structure is used as down conductor, the continuity of the steel work shall be tested and recorded.

Locations of all earth electrodes and down tape routing shall be checked to be clear of any dangerous goods store, diesel tanks and inflammable stores, etc.

All connections at terminations, tee off points and earth electrodes shall be checked for tightness.

4.5.2 Circuitry Check

All circuits shall be verified through switching operation to ensure that the circuits are installed in accordance with the designated circuit. The tests shall include but not be limited to the following:-

(a) on/off switching of the lighting circuit to ensure that the lighting circuit is installed corresponding to the lighting switch, protective device and labelling;

(b) switching of the general power circuit to ensure that the circuit corresponds to the protective device such as RCD, RCBO and MCB, and that the protective device performs in accordance with the designated duty;

(c) switching of the main switch/isolator to ensure the corresponding circuit is properly controlled by the main switch/isolator;

(d) switching of all sub-main and main distribution circuits, e.g.

busducts, cable feeders, underground cables, etc. to ensure the correct isolation of the connected circuit;

(e) switching of all changeover switches to ensure the changing over sequence corresponds to the design criteria; and

(f) ensuring all the protective devices perform properly against the designated circuit.

4.5.3 Charger and Battery Set

The following inspections and tests shall be carried out after completion of the installation of the respective system and the connection of the permanent supply cable:-

(a) inspection of the charger for correct connection to the mains supply through a suitable rated fuse;

(b) inspection of the batteries proper connections;

(c) inspection of instruments, indicating lamps, fuses, relays and labels on battery charger;

(d) for initial set-up, the batteries shall be charged at the manual highest rate until the charging current remains constant. The starting and finishing time are recorded. The capacity of charger is checked for capability of recharging the batteries from fully discharged to fully charged within the specified duration;

(e) the charger output on load with batteries disconnected shall be measured. This should be between 110% and 115% of the normal batteries voltage and within the operating voltage limits of all connected devices;

(f) the charger current on load with battery disconnected shall be measured. This should be less than the maximum recommended continuous charge current for the batteries;

(g) on interruption of mains input to the charger, the proper operation of connected devices on standby batteries shall be checked. In the case of switch tripping in Switchboard, mains input shall be interrupted to check whether the capacity of the batteries is adequate to trip the associated air circuit breaker consecutively at least 20 times or up to twenty air circuit breakers simultaneously, whichever the greater; and

(h) the correct function of charger fail/mains fail/battery disconnected/boost charge/trickle charge indications as specified shall be checked.

4.5.4 Lighting Installation

Lighting installation shall be tested in terms of its light quality and control as following:-

(a) Before carrying out the lighting measurement and test, all luminaries shall be checked against the specified colour temperature, beaming angle of spot lamp and aiming angle for exterior floodlights.

(b) The aiming angle of external lighting or planter lighting shall be commissioned so as not to create glare or any obstructive light to external environment and neighbourhood building users.

(c) Before commissioning and/or setting of lighting control devices which including but not limited to timer switch, occupancy sensor and photocell sensor, the EE Contractor shall submit commissioning/setting proposal to PBSE for approval.

(d) Illumination level of lighting installation for individual areas/rooms shall be measured to verify conformance with light level as designed. The EE Contractor shall submit the proposed locations and height levels for carrying out the measurement of illuminance level to PBSE for approval before commencement of measurement. Presentation of the measurement result shall be in the form of marked up layout plan for the particular area.

(e) Base on the measured illuminance results for individual areas/rooms, the lighting uniformity of the respective areas/rooms shall be evaluated in terms of minimum to average illuminance ratio and/or any other uniformity ratio as required by the PBSE.

(f) All grouping of luminaries shall be tested by hand operation of the corresponding switches or timers.

(g) For lighting installation with interface connection to building management system (BMS), or central control and monitoring system (CCMS) or similar central computer control system, the EE Contractor shall co-ordinate with other contractors responsible for such computer control system, if required, to demonstrate proper control function of the lighting installation.

(h) For luminaries controlled by occupancy sensor, the ‘on’ and ‘off’ of luminaries shall be tested to demonstrate the function and sensitivity coverage of occupancy sensors.

(i) Luminaires controlled by photocell sensor shall be tested to demonstrate the dimming function in maintaining lighting level within the preset range of illumination.

4.5.5 Digital Multifunction Power Meter

The digital multifunction power meter shall be tested to verify the measurement, recording and interfacing functions as required in the General Specification.

Prior to the test for every digital multifunction power meter, the EE Contractor shall provide manufacturer's calibration certificate for each meter for checking on the accuracy.

The EE Contractor shall provide testing kit to verify the reading accuracy of the digital multifunction power meter.

For installation of digital multifunction power meter with connection to building management system (BMS), or central control and monitoring system (CCMS) or similar central computer monitoring system, the EE Contractor shall co-ordinate with other contractor responsible for such computer monitoring system, if required, to demonstrate proper functioning and interfacing of the meter.

For installation of digital multifunction power meter without external connection to BMS or CCMS, the interface functions including digital and analogue output shall be tested by means of plugging in communication module provided by the EE Contractor.

The replacement mechanism of the meter shall be tested. The test shall demonstrate that the replacement of the meter does not require the switching off of the respective switchgear. Current transformers shorting block to prevent open circuiting the current transformers shall also be tested.

4.5.6 Digital Power Analyzer

The testing requirement for digital power analyser shall be in accordance to section 4.4.5.

In addition to test requirement as stipulated in section 4.4.5, the event alarm function and waveform capture function of the digital power analyser shall also be tested. The EE Contractor shall propose simulated test method for PBSE's approval.

4.5.7 Busbar Trunking System

In general, busbar trunking system shall be certified by testing laboratories or organisations as stated in the COP. It shall be type tested in accordance with IEC 61439-6. The Certificate on verification of short-circuit strength shall be carried out by an Independent Short Circuit Testing Organisation.

Short-circuit test on the phase and neutral busbars shall be carried out in accordance with IEC 61439-6 to the value of short-circuit current specified in the General Specification.

The busbar insulation shall be tested in accordance with IEC 61439-6. All test certificates shall be presented during inspection and testing.

The busbar trunking system shall also be tested to verify its continuity, insulation resistance, polarity, earth fault loop impedance and other parameters as appropriate after installation.

For installation of busbar trunking with long run, phase transposition of busbar in accordance with manufacturer's recommendation shall be checked.

Plug-in tap-off unit of busbar trunking system shall be tested to verify proper and safe operation. Mechanical interlock, quick fastening and quick releasing mechanism of the tap-off unit shall be tested. Positive earth connection of tap-off unit shall be checked.

After power energisation of the busbar trunking system, infrared scanning at connecting joints shall be carried out to check for abnormal rise in temperature at joints. The EE Contractor shall submit proposal of the test methodology and propose testing points for PBSE approval prior to the test.

4.5.8 Equipment and Appliances

Testing on electrical equipment and appliances supplied within the electrical installation, e.g. meters, fans, etc. shall be carried out in accordance with the relevant sections of other Building Services Branch Testing and Commissioning Procedures for other building services installations and manufacturer's recommended testing procedures.

4.5.9 Voltage Dip Ride-through Device

For equipment installed with voltage dip ride-through device, the EE Contractor shall submit for PBSE's approval testing methodology and testing instrument demonstrating the satisfactorily operation of device be in compliance with the voltage dip ride through requirements stipulated in the Specification.

4.5.10 Harmonic Correction Device

For circuits installed with harmonic correction device, the EE Contractor shall submit test methodology and measuring instrument to PBSE for approval to demonstrate the device can comply with the requirements on elimination of harmonic currents in the Specification to meet the Total Harmonic Distortion (THD) requirements in the BEC.

The measuring points shall be selected as close as possible to the harmonic generating equipment, e.g. the distribution board or isolator feeding the harmonic generating equipment. For three phase harmonic generating equipment, the THD current of each phase shall be measured and recorded

concurrently. Under some circumstances, the THD of the circuits feeding the harmonic generating equipment should be measured for a sufficient long period of time in order to provide an accurate and representative of the maximum THD value. The period of measurement shall be agreed with PBSE.

4.5.11 Any Other Tests that are Considered Necessary to Meet the Design Intent

For any other system /equipment that are not covered by this T&C Procedure, the EE Contractor shall submit full details of testing requirements as recommended by the relevant manufacturer to PBSE for approval.

4.6 Assessment of Any Characteristics of Equipment Likely to have Harmful Effects

Before carrying out the T&C, the EE Contractor shall conduct assessment for any characteristics of equipment likely to have harmful effects upon other electrical equipment or other services, or impair the supply. Those characteristics include the following:-

(a) Overvoltages;

(b) Undervoltages;

(c) Fluctuating loads;

(d) Unbalanced loads;

(e) Power factor;

(f) Starting currents;

(g) Harmonic currents;

(h) Direct current (d.c.) feedback;

(i) High frequency oscillations; and

(j) Necessity for additional connection to earth.

The EE Contractor shall, after conduct the assessment, submit an assessment report to PBSE for consideration.

4.7 Test and Inspection for Low Voltage Cubicle Switchboard

The following sections stipulate the additional inspection and testing requirements for Low Voltage Cubicle Switchboard (LVSB) installation. For comprehensive testing and commissioning, the EE Contractor shall also refer to relevant sections of this T&C Procedure and carry out inspection /test accordingly.

4.7.1 Visual Inspection

Visual inspection shall be carried out for the proper installation of the LVSB Installation in accordance with the Specification. The following components shall be included:-

(a) construction of type tested assembly;

(b) main busbars and droppers/risers;

(c) air circuit breakers/fuse switches;

(d) power factor correction capacitor bank;

(e) harmonic filter;

(f) automatic changeover switch;

(g) instrumentation and protection devices;

(h) incoming/outgoing busbars and cables;

(i) portable earthing equipment;

(j) operating handles/keys;

(k) hydraulic truck; and

(l) rubber insulation mat.

4.7.2 Site Test before Connection of Incoming Supply

The following tests shall be carried out on the Site after completion of installation of the LVSB and before the connection of the incoming supply cable:-

(a) Dielectric Test

Dielectric test shall be carried out to verify the dielectric properties of the LVSB. The test requirements shall be in accordance with IEC 61439-2.

(b) Insulation Test

This shall be carried out by means of a 1000V insulation tester or similar instrument.

(c) Secondary Injection Test

This shall be carried out using a.c. and shall check (approximately) that protection relays or devices function in accordance with their

performance curves by a test at the lowest setting and two further tests of current and timing.

(d) Primary Injection Test

This shall be carried out to prove the correct operation of protective devices or system when set at the agreed setting.

(e) Polarity Check for Current Transformer (C.T.)

This shall be carried out to ensure that all C.T. are correctly connected.

(f) Functional Test of All Devices

This shall be carried out to ensure that all devices can operate properly as intended.

The equipment to be tested shall include, but not limited to, all circuit breakers, isolating switches, changeover switches, contactors, interlocking facilities, protective relays, earth leakage tripping devices, metering facilities and instruments.

(g) Contact Resistance Test

This shall be carried out by means of "Ductor" tester or similar instrument to ensure that contacts and joints for switchgears, cables, busbars as well as the contacts and joints for outgoing cables and busbars are maintained in good condition.

(h) Temperature Rise Limits Test

This shall be carried out as defined in IEC 61439-2.

With the prior approval by the PBSE, the primary injection test and temperature rise limits test can be carried out in factory due to site constraints.

4.7.3 Site Test After Connection of Incoming Supply

The following tests shall be carried out after the incoming supply cables are connected and the LVSB successfully commissioned on no load:-

(a) phase-to-phase voltage test;

(b) phase-to-neutral voltage test;

(c) phase-to-earth voltage test;

(d) neutral-to-earth voltage test; and

(e) phase sequence test on each and every outgoing circuit.

4.8 Power Energisation

4.8.1 Notification of Completion

After the proper testing and commissioning of the electrical installation, the EE Contractor shall notify the appropriate Authority, through the PBSE, on the completion of the installation and its readiness for inspection and testing.

4.8.2 Preliminary Steps for Power Energisation

The followings shall be checked before power energisation:-

(a) busbar chambers, main and sub-main switch connections, i.e. bolts and nuts tightness;

(b) earthing connections at compartments, all switches and earth electrodes;

(c) clearance of live parts from direct contact with or any likelihood of contact with tools, spurious bare conductors remaining in switches, air circuit breakers (ACB) and switch cubicles;

(d) polarity, phase sequence of all switches and relevant fuse ratings;

(e) stand-by battery supply and the operation of shunt trip mechanism;

(f) settings of overcurrent, earth fault relays and current transformer (C.T.) polarity;

(g) vacuum cleaning of switches and ACBs;

(h) provision of danger and warning signs; and

(i) certified Work Completion Certificate in accordance with the requirement of COP Code 19.

4.8.3 Switch On Process

Whenever there is any break of time, e.g. the next day, in carrying out the switch on process, re-test of insulation resistance is required. For the sake of enhanced safety, in case the value of insulation resistance measured is found near the minimum values as required in this T&C procedure or substantially lower than the previously measured result, the concerned circuit shall be re-checked, especially busbar trunking distribution system. The following procedures shall be followed in the switch on process:-

(a) switch on the main switch/ACB with all other sub-main switches off;

(b) if normal, switch on other sub-main switches one by one with all other outgoing switches off;

(c) if normal, then switch on all other out-going switches one by one;

(d) observe the disc of the overcurrent and earth fault protection relays for any movement for IDMT relays or for digital protection relays check whether there are any fault indications; and

(e) keep vigilance for about 30 minutes to see if any smell or abnormal noise being generated.

4.9 Verification of Electrical Installation and Lighting Installation for demonstration of Compliance with the Building Energy Code (BEC)

After notification of completion of the Installations, the EE Contractor shall verify and record the electrical and lighting installation on the Site with PBSI and then submit the records to PBSE for his/her consolidation to demonstrate compliance of the electrical and lighting installation with the BEC. The requirements are:-

4.9.1 Power Distribution Loss (clause 7.4 of BEC)

The cabling route and cable size of the following circuits shall be verified with PBSI on the Site. Base on the verified cable route, the EE Contractor shall submit the cable length and size to PBSE:-

(a) Main circuit connecting the distribution transformer and the main incoming circuit breaker of the LVSB if the transformer room and the main switch room is not adjacent to each other (clause 7.4.2 of BEC) ;

(b) Feeder circuits (clause 7.4.3 of BEC);

(c) Submain circuits (clause 7.4.4 of BEC) ; and

(d) Final circuits with rating of circuit protective device over 32A (clause 7.4.5 of BEC).

4.9.2 Motor Installation (clause 7.5 of BEC)

The relevant BS Contractors responsible for installing the motors shall submit the following information of every installed motor to PBSE if such motor does not form an integral part of an equipment or installation fulfilling electrical power or equipment efficiency requirement under relevant clauses of the BEC:-

(a) Application & designation number (e.g. motor for chilled water pump);

(b) Motor rated output (in kW);

(c) Manufacturer and model number;

(d) 2-pole or 4-pole; and

(e) Full-load motor efficiency (%)

4.9.3 Power Quality (clause 7.6 of BEC)

Total Power Factor (clause 7.6.1 of BEC)

(a) If power factor correction device is not provided to circuit connecting to the meter of the electricity supplier or circuit at 400A or above, single or three phase, (based on circuit protective device rating and not applicable to circuit of lift & escalator installation), the EE Contractor shall verify a spare way of appropriate rating has been reserved at the local distribution board or source motor control centre for the future installation of power factor correction device (clause 7.6.1.3 of BEC)

Total Harmonic Distortion (clause 7.6.2 of BEC)

(a) If harmonic correction device is not provided to circuit connecting to the meter of the electricity supplier or circuit at 400A or above, single or three phase, (based on circuit protective device rating and not applicable to circuit of lift & escalator installation), the EE Contractor shall verify a spare way of appropriate rating has been reserved at the local distribution board or source motor control centre for the future installation of harmonic correction device. (clause 7.6.2.3 of BEC)

(b) The EE Contractor shall measure the harmonic current to demonstrate maximum 5^{th} harmonic current distortion is less than 35% at the VSD input terminals during normal operation within the variable speed range if group compensation at the motor control centre or local distribution board is provided. (clause 7.6.2.4 of BEC)

4.9.4 Metering and Monitoring Facilities (clause 7.7 of BEC)

The installed metering and monitoring facilities shall be verified to demonstrate the compliance with the minimum requirements in BEC:-

(a) Main circuit, feeder and submain circuit exceeding at or above 400A – metering device is installed to measure ‘voltage’, ‘current’, ‘total power factor’, ‘total energy consumption’, ‘maximum

demand' and 'total harmonic distortion' (clause 7.7.1 & 7.7.3 of BEC); and

(b) Feeder and submain circuit exceeding 200A and below 400A – metering device is installed to measure 'current' and 'total energy consumption' (clause 7.7.2 of BEC).

4.9.5 Lighting Power Density (clause 5.4 of BEC)

The EE Contractor shall submit the following information for verification of the installed lighting power density (LPD):- (clause 5.4.1 of BEC)

(a) Data of installed luminaries – circuit wattage of each type of luminaire;

(b) Number and type of luminaires installed in each space; and

(c) Floor area of each space where luminaires were installed.

4.9.6 Lighting Control Point (clause 5.5 of BEC)

(a) The EE Contractor shall demonstrate and verify with PBSI on site the location of installed lighting control point and its satisfactory operation with their corresponding lighting control zones (clause 5.5.1 of BEC).

(b) Where office space with actual lighting power density value lower than the corresponding value in Table 5.4 of BEC, the EE Contractor shall demonstrate and verify with PBSI on site that percentage reduction of lighting control points is not more than the ratio given by the difference between allowable LPD and actual LPD to the allowable LPD (clause 5.5.2 of BEC).

(c) Where multi-functional space is provided, the EE Contractor shall demonstrate and verify with PBSI on site that separate lighting control points have been provided to operate the luminaires for that activity, such that the operation of these luminaires is to be independent of the operation of the luminaires not for the activity (clause 5.5.3 of BEC).

4.9.7 Automatic Lighting Control (clause 5.6 of BEC)

(a) The EE Contractor shall demonstrate and verify with PBSI on site that automatic lighting control, including time scheduling, occupancy detection and daylight responsive, is provided for spaces as stipulated in the Contract and Table 5.4 of BEC (clause 5.6.1.1 of BEC).

(b) The EE Contractor shall demonstrate and verify with PBSI on site that the installed automatic lighting control is able to shut off or reduce the general lighting power of the space by at least 50%

automatically of the lighting zone being controlled (clause 5.6.1.1 of BEC).

(c) The EE Contractor shall demonstrate and verify with PBSI on site that where automatic lighting control is provided, the daylight responsive control is provided for the space with fenestrations on exterior wall or overhead skylight (clause 5.6.1.2 of BEC).

(d) The EE Contractor shall demonstrate satisfactory operation to PBSI on site that the provided automatic lighting control devices are able to perform independent control for (i) controlling lighting for area of no more than 200m^2; (ii) controlling lighting no more than one floor (except for spaces at multiple floors with similar configurations, lighting layouts and the lighting installations are under the same ownership); and (iii) catering weekend and holidays operation pattern (except the lighting installation designed for such a space of requiring operation of 24 hours a day and 7 days a week) (clause 5.6.1.3 of BEC).

(e) The EE Contractor shall demonstrate satisfactory operation to PBSI on site that the installed manual control, if any, for overriding automatic lighting control by occupant of the space does not turn the lighting on for more than two hours per activation and does not control the lighting more than 500m^2 (clause 5.6.1.4 of BEC).

(f) Where the space is provided with occupancy sensor, the EE Contractor shall demonstrate and verify with PBSI on site that the switching off or dimming down of lighting to reduce lighting power is automatically activated within 15 minutes of all occupants leaving the space (clause 5.6.1.5 of BEC).

(g) Where daylight responsive control is provided for daylight through fenestrations on exterior wall as stipulated in the Contract and clause 5.6.2.1 – 5.6.2.6 of BEC, the EE Contractor shall demonstrate and verify with PBSI on site that lighting control zone has been configured under control of a separate independent control device, e.g. photocell senor, whereby the power consumption of the corresponding lighting zone is able be automatically reduced to 50% or less of the lighting zone being controlled in response to available daylight (clause 5.6.2.1 – 5.6.2.6 of BEC)

(h) Where daylight responsive control is provided for daylight through overhead skylight as stipulated in the Contract and clause 5.6.3.1 – 5.6.3.5 of BEC, the EE Contractor shall demonstrate and verify with PBSI on site that lighting control zone has been configured under control of a separate independent control device, e.g. photocell senor, whereby the power consumption of the corresponding lighting zone is able be automatically reduced to 50% or less of the lighting zone being controlled in response to available daylight (clause 5.6.3.1 – 5.6.3.5 of BEC)

4.10 Calibrated Equipment/ Instruments

A list of equipment proposed by the EE Contractor to be used for T&C must be agreed with the PBSE prior to T&C.

Testing and Commissioning Certificate on Electrical Installation / Electrical Works of other BS Installation

(Remark: Certificate title to be revised as appropriate per *Note 1*)

Part 1 : Details of Project

1.1 Project title (with location) : _____

1.2 * P.W.P. / Project No. : _____

1.3 * Contract/Sub-contract/Quotation No. : _____

1.4 * Contractor/Sub-contractor : _____

1.5 * PBSE/PEME : _____

1.6 * PBSI/PEMI : _____

Part 2 : Declaration

2.1 I certify that the *Electrical Installation / Electrical Works of the *(Note 1)* Installation as specified in the *Contract/Sub-contract/Quotation at the above location has been inspected, tested and commissioned in accordance with this Testing and Commissioning (T&C) Procedure (*Note 2*) and/or any other procedures as agreed between the PBSE/PEME and the *EE*/(Note 1)*Contractor. The results are satisfactory in the aspects as mentioned in Part 3 and/or as recorded in Part 4 of this Certificate, except as indicated in the COMMENTS item(s).

2.2 I also certify that site tests have been performed in accordance with the requirements set out in this T&C Procedure and that the results are satisfactory. A record of the tests has been prepared and submitted to the PBSE/PEME.

*2.3 I also certify that the lightning protection system has been inspected and tested, in accordance with the requirements of IEC62305-1.

Name of *EE/ *(Note 1)* Contractor's Representative: _____	Signature: _____
Designation / Post of *EE/ *(Note 1)* Contractor's Representative: _____	Date signed: _____
Name and Stamp of *EE/ *(Note 1)* Contractor: _____	Telephone No.: _____

Notes

1. State the type of Building Services Installation for the electrical works.
2. "T&C Procedure" refers to the Testing & Commissioning Procedure for Electrical Installation.
3. The EE Contractor's Representative signing this Certificate must be a person or representative authorised by the EE Contractor.

* Delete if not applicable

			Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
Part 3:	**Items Inspected and Tested**			
3.1	Statutory Inspection and Test for Low Voltage (L.V.) Installation			
3.1.1	Visual Inspection (COP Code 21A and COP Appendix 13)			
3.1.1.1	Working Space and Facilities			
	(a)	Adequacy working space and safe access provided for switch room and /or electrical facilities.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	Entrance /exit to switch room and/or electrical facilities are free of obstruction.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Suitable locking facilities provided for switch room and /or electrical facilities.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	Suitable lighting provision provided for switch room and /or electrical facilities.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Suitable ventilation provision provided for switch room and /or electrical facilities.	*Yes/No/N.A.	*Yes/No/N.A.
	(f)	Suitable tools for withdrawal of fuses at fuse board provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(g)	A warning notice 'DANGER — ELECTRICITY, UNAUTHORISED ENTRY PROHIBITED' and '危險 —— 有電，未經授權不得內進' provided at every entrance of switch room.	*Yes/No/N.A.	*Yes/No/N.A.
	(h)	Fire barriers and other measures for protection against thermal effects are properly installed.	*Yes/No/N.A.	*Yes/No/N.A.
	(i)	Danger notices, warning notices, schematic diagrams, instructions and similar information are correctly and adequately provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(j)	Warning notices for substations and switchrooms provided in compliance with Code 17.	*Yes/No/N.A.	*Yes/No/N.A.
	(k)	Warning notices for earthing and main bonding connections provided in compliance with Code 17.	*Yes/No/N.A.	*Yes/No/N.A.
	(l)	All switchgears, distribution boards and electrical equipment properly labelled.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.2	Switchboard, Main Switch and Circuit Breaker			
	(a)	An up-to-date notice of periodic inspection and testing provided at point of supply (i.e. a switchboard, a circuit breaker or a distribution board) of the installation.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
(b)	Circuits, fuses, switches, terminals, etc. are provided with a legible and durable identification label.	*Yes/No/N.A.	*Yes/No/N.A.
(c)	No visible damage to impair safety.	*Yes/No/N.A.	*Yes/No/N.A.
(d)	Work done properly recorded in logbook.	*Yes/No/N.A.	*Yes/No/N.A.
(e)	An up-to-date schematic diagram displayed and framed.	*Yes/No/N.A.	*Yes/No/N.A.
(f)	All accessible live parts screened with insulating plate or earthed metal.	*Yes/No/N.A.	*Yes/No/N.A.
(g)	All exposed conductive parts effectively earthed.	*Yes/No/N.A.	*Yes/No/N.A.
(h)	Earthing system effectively connected.	*Yes/No/N.A.	*Yes/No/N.A.
(i)	Warning notice displayed at main bonding connections.	*Yes/No/N.A.	*Yes/No/N.A.
(j)	All protective devices are functioned properly and correctly set.	*Yes/No/N.A.	*Yes/No/N.A.
(k)	Suitable interlock scheme provided to prevent parallel operation of two or more sources of supply and 4-pole incoming and interconnecting circuit breakers provided for supply to be taken from more than one source and is interconnected.	*Yes/No/N.A.	*Yes/No/N.A.
(l)	Electrically and mechanically interlocked 4-pole changeover device(s) where standby generator set(s) is installed.	*Yes/No/N.A.	*Yes/No/N.A.
(m)	The breaking capacity of all circuit breakers / interconnection devices are able to withstand the prospective fault current.	*Yes/No/N.A.	*Yes/No/N.A.
(n)	Protective relays have been correctly set and overcurrent protective devices suitably set for all circuits.	*Yes/No/N.A.	*Yes/No/N.A.
(o)	Protective type current transformers are used for protective relays.	*Yes/No/N.A.	*Yes/No/N.A.
(p)	A means of isolation provided for every circuit.	*Yes/No/N.A.	*Yes/No/N.A.
(q)	Operation of circuit breakers and switches checked.	*Yes/No/N.A.	*Yes/No/N.A.
(r)	Control, indication and alarm functions checked.	*Yes/No/N.A.	*Yes/No/N.A.
(s)	No undersized conductor used between the main busbar and fuse/MCB/MCCB.	*Yes/No/N.A.	*Yes/No/N.A.
(t)	Fuses/MCB/MCCB's matching the lowest rated conductor in the circuit.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

			Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
	(u)	Suitable cable terminations provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(v)	Cable conductors of correct phases connected.	*Yes/No/N.A.	*Yes/No/N.A.
	(w)	Single/Double pole devices for protection or switching connected in phase conductors only.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.3	Distribution Board			
	(a)	A warning notice 'DANGER' and '危險' provided on the front panel of every distribution board.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	A notice of periodic testing provided at or near the main distribution board incorporating a residual current device.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Distribution boards securely mounted on suitable supports.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	A suitable switch provided to control each distribution board.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Phase barriers for distribution board provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(f)	The breaking capacity of MCB/MCCB in compliance with COP Code 9.	*Yes/No/N.A.	*Yes/No/N.A.
	(g)	Suitable tools for withdrawal of fuses at a fuse board provided, where necessary.	*Yes/No/N.A.	*Yes/No/N.A.
	(h)	Circuits connected to MCB, MCCB or fuse in accordance with the schematic diagram.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.4	Conductors, Cables and wirings			
	(a)	No visible damage to impair safety.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	All live conductors and their methods of insulation, in relation to design currents of circuits and to the operating currents of the protective devices, are properly selected and erected.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	All cables, flexible cords, switches, plugs and socket outlets, accessories and equipment are found to be in good working conditions.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	All conductors are correctly and securely connected and identified.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Armoured cables properly terminated by proper cable glands.	*Yes/No/N.A.	*Yes/No/N.A.
	(f)	Cables passing through smoke lobby protected by enclosures of adequate fire rating.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
(g)	Non-sheathed cables protected by conduit, trunking, ducting or approved mechanical protective means.	*Yes/No/N.A.	*Yes/No/N.A.
(h)	Cables and cable containments, such as tray, ladder, ducting, trunking, conduit, etc., adequately supported.	*Yes/No/N.A.	*Yes/No/N.A.
(i)	Suitable cable lugs used for terminating cables, including termination at distribution board or busbar	*Yes/No/N.A.	*Yes/No/N.A.
(j)	Main cables connected up with correct polarity.	*Yes/No/N.A.	*Yes/No/N.A.
(k)	Cables protected against mechanical damage and suitably supported.	*Yes/No/N.A.	*Yes/No/N.A.
(l)	All exposed metal parts including the armour effectively earthed.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.5	Busbar trunking system including rising mains		
(a)	The rising mains, lateral mains and meter boards positioned at places accessible from public area.	*Yes/No/N.A.	*Yes/No/N.A.
(b)	Fire barriers provided where the busbar trunking system passes through floor slabs or walls designated as fire barriers.	*Yes/No/N.A.	*Yes/No/N.A.
(c)	Busbar trunking passing through smoke lobby protected by enclosures of adequate fire rating.	*Yes/No/N.A.	*Yes/No/N.A.
(d)	Busbar trunking systems adequately supported.	*Yes/No/N.A.	*Yes/No/N.A.
(e)	The bolts, nuts, screws, etc. for busbar supports, busbar joints/connections have been checked for correct tightness in accordance with manufacturers' recommendations.	*Yes/No/N.A.	*Yes/No/N.A.
(f)	The busbar trunking system is properly and correctly installed and aligned.	*Yes/No/N.A.	*Yes/No/N.A.
(g)	No dust, foreign particles and deleterious substances are accumulated on the busbar trunking system.	*Yes/No/N.A.	*Yes/No/N.A.
(h)	The busbar trunking system is free from condensation.	*Yes/No/N.A.	*Yes/No/N.A.
(i)	Precaution against corrosion taking on aluminium conductor joined to copper conductor.	*Yes/No/N.A.	*Yes/No/N.A.
(j)	Cutout fuses for tapping off supply fitted with insulated carriers.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

			Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.1.1.6	Final Circuits			
	(a)	All fuses and single/double pole switches connected to the phase conductors only with correct polarity.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	Wiring for emergency lightings and fire services installation segregated from other wirings.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Low voltage circuits segregated from extra low voltage circuits.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	Cables of all phases and neutral of the circuit bunched and contained in the same conduit.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Exposed insulated non-sheathed cables with mechanically protected.	*Yes/No/N.A.	*Yes/No/N.A.
	(f)	Wiring inside false ceiling protected by conduit/trunking or metallic sheath.	*Yes/No/N.A.	*Yes/No/N.A.
	(g)	Socket outlets being shuttered type complying with the prescribed requirements.	*Yes/No/N.A.	*Yes/No/N.A.
	(h)	No socket outlet installed close to water tap, gas tap or cooker so as to avoid danger.	*Yes/No/N.A.	*Yes/No/N.A.
	(i)	Floor socket outlets protected with suitable cover.	*Yes/No/N.A.	*Yes/No/N.A.
	(j)	No 2-pin sockets installed. All socket outlets connected with protective conductors and live conductors terminated at correct terminals.	*Yes/No/N.A.	*Yes/No/N.A.
	(k)	Radial final circuits using 5A/15A socket outlets in compliance with Code 6D.	*Yes/No/N.A.	*Yes/No/N.A.
	(l)	Final circuits using 13A socket outlets in compliance with Code 6E.	*Yes/No/N.A.	*Yes/No/N.A.
	(m)	Final circuits using industrial socket outlets in compliance with Code 6F or 6G or 6H.	*Yes/No/N.A.	*Yes/No/N.A.
	(n)	Where circuit protective conductor is formed by the metallic cable containment enclosure, a separate protective conductor between the earthing terminal of socket outlet and its associated metal box being provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(o)	Where circuit protective conductor is not formed by the metallic cable containment enclosure, a separate protective conductor to the earthing terminal of socket outlet being provided.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
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		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
(p)	Residual current device having a rated residual operating current not exceeding 30mA provided for all socket outlets.	*Yes/No/N.A.	*Yes/No/N.A.
(q)	Minimum sizes of protective conductors are provided as per requirement in COP Code 11 for limitation of protective conductor impedance.	*Yes/No/N.A.	*Yes/No/N.A.
(r)	Means of isolation provided for every fixed appliance.	*Yes/No/N.A.	*Yes/No/N.A.
(s)	All chokes, starters and capacitors of discharge lamps enclosed in earthed metal box(es) and suitably ventilated.	*Yes/No/N.A.	*Yes/No/N.A.
(t)	Phase conductors connected to the centre contact of the Edison-type screw lamp holders.	*Yes/No/N.A.	*Yes/No/N.A.
(u)	No switches other than a switch fed from a safety source or operated by an insulation cord or rod or a push-button type of switch having an insulated button of a large surface area provided in bathrooms.	*Yes/No/N.A.	*Yes/No/N.A.
(v)	Shaver supply unit complying with IEC 61558-1 or equivalent.	*Yes/No/N.A.	*Yes/No/N.A.
(w)	Socket outlet in bathroom installed out of zone 2 (i.e. 0.6m away from shower basin or bathtub) protected by an RCD with a residual operating current not exceeding 30mA or protected by an isolating transformer to IEC 61558-2-5.	*Yes/No/N.A.	*Yes/No/N.A.
(x)	No fixed luminaire nor fixed heater/radiator having unguarded heating elements installed within reach of a person using the bath or shower.	*Yes/No/N.A.	*Yes/No/N.A.
(y)	All circuits supplying electrical equipment or feeding power outlets in a room containing a fixed bath or shower protected by RCD having a rated residual operating current not exceeding 30mA.	*Yes/No/N.A.	*Yes/No/N.A.
(z)	Appliances exposed to weather being splash-proof type.	*Yes/No/N.A.	*Yes/No/N.A.
(aa)	Luminaires, switches, sockets and plugs, cable couplers installed outdoor, being splashproof type.	*Yes/No/N.A.	*Yes/No/N.A.
(ab)	Lighting supplied from a safe source.	*Yes/No/N.A.	*Yes/No/N.A.
(ac)	Site lighting protected by RCD having a rated residual operating current not exceeding 30mA.	*Yes/No/N.A.	*Yes/No/N.A.

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Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.1.1.7	Earthing and Bonding		
(a)	Earth rod electrode(s) having a minimum diameter 12.5 mm copper or 16 mm galvanised or stainless steel used.	*Yes/No/N.A.	*Yes/No/N.A.
(b)	Copper tape earth electrode having a cross section of not less than 25 mm x 3 mm.	*Yes/No/N.A.	*Yes/No/N.A.
(c)	Copper plate earth electrode not less than 3mm in thickness and having a maximum dimension of 1200mm x 1200mm.	*Yes/No/N.A.	*Yes/No/N.A.
(d)	No gas/water pipe used as earth electrodes.	*Yes/No/N.A.	*Yes/No/N.A.
(e)	A test link provided at the main earthing terminal.	*Yes/No/N.A.	*Yes/No/N.A.
(f)	Minimum size of protective conductor used in compliance with COP Table 11(1).	*Yes/No/N.A.	*Yes/No/N.A.
(g)	Protective conductor up to and including $6mm^2$ with green and yellow insulation sheath used throughout its length.	*Yes/No/N.A.	*Yes/No/N.A.
(h)	Bonding conductors of not less than $150mm^2$ copper equivalent used for connection to the earthing terminal of the electricity supplier's transformer(s) or underground cable(s).	*Yes/No/N.A.	*Yes/No/N.A.
(i)	Copper links provided at joints of metallic trunking which forms part of a protective conductor.	*Yes/No/N.A.	*Yes/No/N.A.
(j)	Separate protective conductors provided for all flexible conduits.	*Yes/No/N.A.	*Yes/No/N.A.
(k)	A warning notice 'SAFETY ELECTRICAL CONNECTION—DO NOT REMOVE and '安全接地終端——切勿移去' provided at all main earthing and bonding connections.	*Yes/No/N.A.	*Yes/No/N.A.
(l)	Main equipotential bonding conductors effectively connected to main water pipes, main gas pipes, other services pipes/ducting and exposed metallic parts of structural framework.	*Yes/No/N.A.	*Yes/No/N.A.
(m)	Supplementary equipotential bonding effectively provided between exposed conductive parts and extraneous conductive parts.	*Yes/No/N.A.	*Yes/No/N.A.
(n)	Exposed conductive parts of fixed equipment installed outside equipotential zone effectively earthed for 0.4 sec. disconnection.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

			Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
	(o)	Exposed conductive parts of fixed equipment installed within equipotential zone effectively earthed for 5 sec. disconnection.	*Yes/No/N.A.	*Yes/No/N.A.
	(p)	Effectiveness of the main equipotential bonding connection to the main earthing terminal.	*Yes/No/N.A.	*Yes/No/N.A.
	(q)	Earthing conductors of adequate size.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.8	Lightning Protection			
	(a)	The continuity of air termination network /down conductor /earth termination network has been checked and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	All conductors and joints for lightning protection system are electrically and mechanically sound and correctly connected.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Connection link to the main earthing terminal provided. Test joint provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	Rod electrode(s) having a minimum diameter 12.5 mm copper or 16 mm galvanised or stainless steel used.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Copper tape electrode having a cross section of not less than 25 mm x 3 mm.	*Yes/No/N.A.	*Yes/No/N.A.
	(f)	Copper plate electrode not less than 3 mm in thickness and having a maximum dimension of 1200mm x 1200mm.	*Yes/No/N.A.	*Yes/No/N.A.
	(g)	No gas/water pipe used as earth electrodes.	*Yes/No/N.A.	*Yes/No/N.A.
	(h)	No evidence of corrosion likely to lead deterioration of the lightning protection system.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.9	Motors /Transformers			
	(a)	No visible damage to impair safety.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	Local switch provided to control every motor.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Means provided to prevent unexpected restarting of motors where such restarting might cause danger.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	Flexible conduits terminated with suitable brass bushes.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Separate supply to motor heaters having its terminals screened, with warning notice provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(f)	All accessible live parts screened with insulating plate or earthed metal.	*Yes/No/N.A.	*Yes/No/N.A.

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		Tel. No. :	
		Date :	
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		Tel. No. :	
		Date :	

			Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
	(g)	Proper ventilation provided to avoid excessive temperature rise.	*Yes/No/N.A.	*Yes/No/N.A.
	(h)	A warning notice 'DANGER—THIS MOTOR IS AUTOMATICALLY CONTROLLED AND MAY START WITHOUT WARNING. ISOLATE BEFORE INSPECTION and 危險—此機乃自動操作，維修前請先關掣' affixed to motor arranged for automatic restart.	*Yes/No/N.A.	*Yes/No/N.A.
	(i)	Emergency stop switch provided for motor	*Yes/No/N.A.	*Yes/No/N.A.
3.1.2	Conductor Continuity (COP Code 21B(3) and (4))			
3.1.2.1	All protective conductors used for equipotential bonding have been tested for continuity.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.2.2	All final ring circuit conductors including the protective conductors have been tested for continuity.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.2.3	Conductor continuity test results recorded in Annex I, Part 4.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.3	Insulation Resistance (COP Code 21B(5))			
3.1.3.1	The insulation resistance to earth is NOT less than 1 mega ohm.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.2	The insulation resistance between phases/poles is NOT less than 1 mega ohm.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.3	The insulation resistance of equipment between the exposed conductive parts and all live parts is NOT less than 1 mega ohm when tested individually and separately (COP Code 21B(5)(f)).		*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.4	The insulation resistance for extra-low voltage circuit is NOT less than 0.5 mega ohm when the circuit is supplied from a safety isolating transformer/SELV. The test voltage shall be 250V d.c.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.5	Insulation resistance test results recorded in Annex I, Part 4.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.4	Polarity (COP Code 21B(6))			
3.1.4.1	All fuses and single-poles devices are connected in the phase conductors only.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.2	All wiring has been correctly connected to socket outlets and lampholders, etc.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.3	The outer or screwed contacts of centre-contact bayonet and Edison screw lampholders in circuits having an earthed neutral conductor is connected to that neutral conductor.		*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.4	Polarity check results recorded in Annex I, Part 4.		*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.1.5	Earth Electrode Resistance (COP Code 21B(7))		
3.1.5.1	The resistance to earth has been measured at the position of every earth electrode and of the main earth terminal. The results are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.5.2	Details of earth electrode and resistance test results recorded in Annex I, Part 4.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6	Earth Fault Loop Impedance (COP Code 21B(8))		
3.1.6.1	The earth fault loop impedance of all circuits has been tested satisfactory for operation of the protective devices for earth fault protection.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6.2	Earth fault loop impedance measurement results recorded on Annex I, Part 4.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7	Functional Testing of All Devices Including Protective Devices (COP Code 21B(9))		
3.1.7.1	Simulation tests on the operation of devices for earth fault protection are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7.2	50% of the rated tripping current shall not cause the residual current circuit breaker to open.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7.3	100% of the rated tripping current shall cause the residual current circuit breaker to open within 300ms or at any delay time declared by the manufacturer of the device.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7.4	Where the residual current circuit breaker has a rated tripping current not exceeding 30mA and has been installed to reduce the risk associated with direct contact, a residual current of 150mA should cause the circuit breaker to open within 40ms.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7.5	In no event should the test current be applied for a period exceeding one second.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7.6	Hand operation on protective devices such as miniature circuit breakers, moulded case circuit breakers, air circuit breakers, fused switches, switch-fuses and protective relays, etc. are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7.7	Hand operation on all items of equipment such as isolators, switches and indicative devices are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7.8	Secondary Injection Test conducted to verify the overload and fault current protection characteristics of protection relay.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.7.9	Functional test of all devices including protective devices had been recorded on Annex I, Part 4.	*Yes/No/N.A.	*Yes/No/N.A.

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Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.1.8	Additional Checks for Installations in Hazardous Environment (COP Code 21B(10))		
3.1.8.1	The equipment is suitably protected according to the types of protection under COP Code 15. The integrity of the protection provided for the equipment is not jeopardised by the method of installation. No alteration that may invalidate the conditions of protection has been used.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.8.2	No dust, foreign particles and deleterious substances are accumulated on the equipment. The equipment is free from condensation.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.8.3	Lamps, fuses and replaceable parts of correct rating and types are used.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.8.4	The surface temperature of all equipment is appropriate to the type of protection provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.2	Statutory Inspection and Test for High Voltage (H.V.) Installation		
3.2.1	Visual Inspection (COP Code 21C and COP Appendix 13)		
3.2.1.1	Working Space and Facilities		
	(a) Adequacy working space and safe access provided for H.V. switch room and /or electrical facilities.	*Yes/No/N.A.	*Yes/No/N.A.
	(b) Entrance /exit to H.V. switch room and/or electrical facilities are free of obstruction.	*Yes/No/N.A.	*Yes/No/N.A.
	(c) Provision of suitable locking facilities for every entry to an H.V. switch room /substation.	*Yes/No/N.A.	*Yes/No/N.A.
	(d) Suitable lighting provision provided for H.V. switch room and /or electrical facilities.	*Yes/No/N.A.	*Yes/No/N.A.
	(e) Suitable ventilation provision provided for H.V. switch room and /or electrical facilities.	*Yes/No/N.A.	*Yes/No/N.A.
	(f) Suitable tools for withdrawal of circuit breakers provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(g) A warning notice 'DANGER—SUBSTATION, UNAUTHORISED ENTRY PROHIBITED' and '危險——電力分站，未經授權不得內進' provided at every entrance of H.V. switch room.	*Yes/No/N.A.	*Yes/No/N.A.
	(h) Fire barriers and other measures for protection against thermal effects are properly installed.	*Yes/No/N.A.	*Yes/No/N.A.

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		Tel. No. :	
		Date :	

			Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
	(i)	Danger notices, warning notices, schematic diagrams, instructions and similar information are correctly and adequately provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(j)	Warning notices for substations and H.V. switch rooms provided in compliance with Code 17.	*Yes/No/N.A.	*Yes/No/N.A.
	(k)	Warning notices for earthing and main bonding connections provided in compliance with Code 17.	*Yes/No/N.A.	*Yes/No/N.A.
	(l)	All switchgears, distribution boards and electrical equipment properly labelled.	*Yes/No/N.A.	*Yes/No/N.A.
	(m)	Continuity of protective conductors especially the bonding of all exposed conductive parts are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
	(n)	Provision of padlock facilities for shutters, key boxes etc. provided.	*Yes/No/N.A.	*Yes/No/N.A.
	(o)	Logbook provided and work done properly recorded.	*Yes/No/N.A.	*Yes/No/N.A.
	(p)	Other inspection items as required by the manufacturers of related equipment are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.2	Switchboard and Circuit Breakers			
	(a)	No visible damage to impair safety.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	Appropriate devices provided for isolation and switching.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Every circuit breaker provided with a legible and durable identification label.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	An up-to-date schematic diagram displayed and frammed.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	All accessible live parts screened with insulating plate or earthed metal.	*Yes/No/N.A.	*Yes/No/N.A.
	(f)	All exposed conductive parts effectively earthed.	*Yes/No/N.A.	*Yes/No/N.A.
	(g)	Earthing system effectively connected.	*Yes/No/N.A.	*Yes/No/N.A.
	(h)	Warning notice displayed at main bonding connections.	*Yes/No/N.A.	*Yes/No/N.A.
	(i)	All protective devices are functioned properly and correctly set.	*Yes/No/N.A.	*Yes/No/N.A.
	(j)	Initial /maintenance test carried out according to relevant recognised standards and manufacturers' recommendation, where appropriate, with test reports (insulation resistance test, pressure test etc.).	*Yes/No/N.A.	*Yes/No/N.A.

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		Tel. No. :	
		Date :	

			Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
	(k)	Other inspection items as required by the manufacturers of related equipment are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.3		Conductors, Cables and wirings		
	(a)	No visible damage to impair safety.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	All live conductors and their methods of insulation, in relation to design currents of circuits and to the operating currents of the protective devices, are properly selected and erected.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	All cables, flexible cords, switches, plugs and socket outlets, accessories and equipment are found to be in good working conditions.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	All conductors are correctly and securely connected and identified.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Armoured cables properly terminated by proper cable glands.	*Yes/No/N.A.	*Yes/No/N.A.
	(f)	Cables passing through smoke lobby protected by enclosures of adequate fire rating.	*Yes/No/N.A.	*Yes/No/N.A.
	(g)	Non-sheathed cables protected by conduit, trunking or ducting or approved mechanical protective means.	*Yes/No/N.A.	*Yes/No/N.A.
	(h)	Cables and cable containments, such as tray, ladder, ducting, trunking, conduit, etc., adequately supported.	*Yes/No/N.A.	*Yes/No/N.A.
	(i)	Suitable cable lugs used for terminating cables, including termination at distribution board or busbar	*Yes/No/N.A.	*Yes/No/N.A.
	(j)	Main cables connected up with correct polarity.	*Yes/No/N.A.	*Yes/No/N.A.
	(k)	Cables protected against mechanical damage and suitably supported.	*Yes/No/N.A.	*Yes/No/N.A.
	(l)	All exposed metal parts including the armour effectively earthed.	*Yes/No/N.A.	*Yes/No/N.A.
	(m)	Initial /maintenance test carried out according to relevant recognised standards and manufacturers' recommendation, where appropriate, with test reports (insulation resistance test, pressure test etc.).	*Yes/No/N.A.	*Yes/No/N.A.
	(n)	Other inspection items as required by the manufacturers of related equipment are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.4		Transformers /Motors		
	(a)	No visible damage to impair safety.	*Yes/No/N.A.	*Yes/No/N.A.

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		Date :	
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		Tel. No. :	
		Date :	

			Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
	(b)	All accessible live parts screened with insulating plate or earthed metal.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Proper ventilation provided to avoid excessive temperature rise.	*Yes/No/N.A.	*Yes/No/N.A.
	(d)	Initial /maintenance test carried out according to relevant recognised standards and manufacturers' recommendation, where appropriate, with test reports (insulation resistance test, pressure test etc.).	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Other inspection items as required by the manufacturers of related equipment are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.5	Earth			
	(a)	A warning notice 'SAFETY ELECTRICAL CONNECTION—DO NOT REMOVE and '安全接地終端——切勿移去' provided at all main earthing and bonding connections.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	Earthing conductors of adequate size.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Other inspection items as required by the manufacturers of related equipment are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.6	Direct Current (d.c.) Battery System			
	(a)	Condition of battery system is satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	Voltage of each battery cell measured.	*Yes/No/N.A.	*Yes/No/N.A.
	(c)	Other inspection items as required by the manufacturers of related equipment are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.7	Operation and Testing Tools and Equipment			
	(a)	Proper operation tools and equipment provided for switching and isolation use.	*Yes/No/N.A.	*Yes/No/N.A.
	(b)	Suitable self-test high voltage tester provided for verifying equipment dead.	*Yes/No/N.A.	*Yes/No/N.A.
	(e)	Other inspection items as required by the manufacturers of related equipment are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.8	Other Necessary Inspections			
	(a)	Other inspection items as required by the manufacturers of related equipment shall be stated and appended in separate forms. The items are found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.2.2	Testing of High Voltage (H.V.) Installations (COP Code 21D)		
3.2.2.1	Safety Precaution		
	(a) Safety requirements for testing of H.V. installations are recommended from manufacturers of related equipment and executed.	*Yes/No/N.A.	*Yes/No/N.A.
	(b) Proper precautionary measures are taken and the methods of tests should be such that no danger to persons or property can occur even if the circuit being tested is defective.	*Yes/No/N.A.	*Yes/No/N.A.
3.2.2.2	Testing		
	(a) Testing requirements and detailed test procedures for of H.V. installations are recommended from manufacturers of related equipment and approved.	*Yes/No/N.A.	*Yes/No/N.A.
	(b) All tests for H.V. installations are recorded in separate forms and properly endorsed.	*Yes/No/N.A.	*Yes/No/N.A.
3.3	Functional Test of System /Equipment		
3.3.1	Lightning Protection System		
3.3.1.1	The continuity between air terminations and earthing terminations is tested.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.1.2	Measured earth termination network resistance to earth not more than 10 ohm when the connection to main earthing terminal disconnected.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.1.3	Test results recorded in Annex I, Part 4.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.2	Circuitry Check		
3.3.2.1	All circuits including lighting and power circuits have been verified through switching operation that they are installed in accordance with the designated circuits.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.3	Charger and Battery Set		
3.3.3.1	The original factory test certificates of the charger and battery have been checked and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.3.2	The charger is connected to the mains supply through a suitable rated fuse.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.3.3	Batteries connections have been done properly.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.3.4	Instruments, indicating lamps, fuses, relays and labels on battery charger are provided and installed properly.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.3.3.5	The capacity of the charger is capable of recharging the batteries from fully discharged to fully charged within the specified duration.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.3.6	The charger output on load with batteries disconnected is satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.3.7	The charger current on load with batteries disconnected is satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.3.8	The capacity of batteries has been checked and tested by interrupting the mains input to the charger and actuation / operation of the connected devices and the results are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.3.9	The functions and indications of charger fail / main fail / battery disconnected / boost charge / trickle charge, mains and battery have been checked and tested and the results are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.4	Lighting Installation		
3.3.4.1	Luminaires and Lighting Fittings		
	(a) Colour temperature of light fittings was checked and as specified.	*Yes/No/N.A.	*Yes/No/N.A.
	(b) All lamps are the correct wattage and voltage ratings.	*Yes/No/N.A.	*Yes/No/N.A.
	(c) Beam angle of spot lamp is commissioned.	*Yes/No/N.A.	*Yes/No/N.A.
	(d) Aiming angle of external lighting or planter lighting is commissioned so as not to create glare or any obstructive light to external environment.	*Yes/No/N.A.	*Yes/No/N.A.
	(e) Exterior floodlights have been aimed according to requirements (particularly relevant for sports installations).	*Yes/No/N.A.	*Yes/No/N.A.
3.3.4.2	Lighting Control (On/Off and Dimming)		
	(a) Groups of luminaries are assigned to the correct position in grid switch or grid single circuit dimmer and tested by hand operation.	*Yes/No/N.A.	*Yes/No/N.A.
	(b) Lighting control system (e.g. timer switch, occupancy sensor and photocell, etc.) are correctly commissioned and set.	*Yes/No/N.A.	*Yes/No/N.A.
	(c) Timer switch operated lighting control system can properly operate as commissioned.	*Yes/No/N.A.	*Yes/No/N.A.
	(d) Photocell operated lighting control system can properly operate as commissioned.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
	(e) Occupancy sensor operated lighting control system can properly operated as commissioned.	*Yes/No/N.A.	*Yes/No/N.A.
	(f) Lighting control by CCMS or BMS is tested and properly functioned.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.4.3	Lighting Measurement		
	(a) Illuminance level of lighting installation is measured under its design condition.	*Yes/No/N.A.	*Yes/No/N.A.
	(b) Measurement results recorded.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.5	Digital Multifunction Power Meter		
3.3.5.1	Manufacturer's calibration certificate for each meter is provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.5.2	The readings of electrical parameters by the meter and by test kit are recorded in Annex I, Part 4.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.5.3	Remote monitoring functions by CCMS or BMS are tested and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.5.4	Interfacing functions for self-contained meter are tested by using plug-in communication module and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.5.5	Replacement mechanism of meter is tested and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.5.6	Current transformer (C.T.) shorting block to prevent open circuiting the C.T. is provided and tested.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.6	Digital Power Analyzer		
3.3.6.1	Manufacturer's calibration certificate for each power analyzer is provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.6.2	The readings of electrical parameters by the digital power analyzer and by test kit are recorded in Annex I, Part 4.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.6.3	Remote monitoring functions by CCMS or BMS are tested and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.6.4	Interfacing functions for self-contained digital power analyzer are tested by using plug-in communication module and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.6.5	Replacement mechanism of meter is tested and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.6.6	Current transformer (C.T.) shorting block to prevent open circuiting the C.T. is provided and tested.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.3.6.7	Event alarm and waveform capture functions of digital power analyser is tested and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.7	Busbar Trunking System		
3.3.7.1	Type test certificate issued by testing laboratories or organisations as stated in COP is provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.7.2	Continuity, insulation resistance, polarity, earth fault loop impedance and other required test are carried out, recorded and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.7.3	Phase transposition of busbar trunking with long run in accordance with manufacturer's recommendation is provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.7.4	Operation of plug-in / tap-off unit is tested and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.7.5	Mechanical interlock, quick fastening and quick releasing mechanism of plug-in / tap-off unit are tested and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.7.6	Infrared scanning at selective connection joints to check for hot temperature spot is carried out.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.8	Voltage Dip Ride-through Device		
3.3.8.1	Equipment with voltage dip ride-through device operated satisfactorily under simulated voltage dip condition.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.9	Equipment and Appliances		
3.3.9.1	Equipment and appliances are tested in accordance with relevant sections of other ArchSD T&C Procedures and /or manufacturer's recommended testing procedures.	*Yes/No/N.A.	*Yes/No/N.A.
3.3.10	Any Other Tests that are Considered Necessary to Meet the Design Intent		
3.3.10.1	Details of other tests are enclosed in separate testing checklist and/or form approved by PBSE.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.4	Assessment if Any Characteristics of Equipment Likely to have Harmful Effects Assessment details stated as follows:	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by EE/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.5	Comments	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

Part 4 : Test Record attached to the Test Certificate

		Test record attached
4.1	**Test for Low Voltage (L.V.) Installations**	
4.1.1	Conductor Continuity Measurements	*Yes/No/N.A.
4.1.2	Insulation Resistance Measurements	*Yes/No/N.A.
4.1.3	Polarity Test	*Yes/No/N.A.
4.1.4	Earth Electrode Resistance Measurement	*Yes/No/N.A.
4.1.5	Earth Fault Loop Impedance Measurement	*Yes/No/N.A.
4.1.6	Functions of All Devices Including Protective Devices	*Yes/No/N.A.
4.1.7	Additional Checks for Installations in Hazardous Environment	*Yes/No/N.A.
4.2	**Test for High Voltage (H.V.) Installations**	
4.2.1	Test forms for H.V. installations as recommended by manufacturers of related H.V. equipment /systems	*Yes/No/N.A.
4.3	**Functional Test for System /Equipment**	
4.3.1	Earth Electrode Resistance Measurement for Lightning Protection System	*Yes/No/N.A.
4.3.2	Test of Digital Multifunction Power Meter /Power Analyzer	*Yes/No/N.A.
4.4	**Testing Equipment/ Instruments**	
4.4.1	List of testing equipment/ instruments	*Yes/No/N.A.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.1.1 Conductor Continuity Measurements

Circuit No. or Details of Equipment	Continuity of Protective Conductors Measured Resistance (ohm) at outlet	Continuity of Ring Final Circuit Measured Resistance (ohm) for			Remarks
		Phase Conductor	Neutral Conductor	Protective Conductor	

Notes: The test method for ring final circuit is only applicable when the circuit has been inspected throughout, prior to the test, to ascertain that no interconnection (multi-loops) exists on the ring circuit. Otherwise, the testing methods stipulated in Part 3 of the Guidance Note 3 to BS7671, should be adopted instead.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.1.2 Insulation Resistance Measurements

Circuit nominal voltage : _____
Test Voltage (d.c.) : _____

Circuit No. or Details of Equipment	Insulation Resistance to Earth (mega ohm)	Insulation Resistance Between Phases /Poles (mega ohm)				Remarks
		L1-L2/L3/N	L2-L1/L3/N	L3-L1/L2/N	N-L1/L2/L3	

Notes: Sequence of testing the insulation resistance shall be as follows :-

(a) Main switch/switchboard and outgoing circuits with sub-main switches being isolated;
(b) Sub-main switches/switchboards and outgoing circuits with final circuits boards being isolated; and
(c) Final circuit boards and final circuits.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.1.3 Polarity Test

Circuit No. or Details of Equipment	Polarity Test Results	Remarks

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.1.4 Earth Electrode Resistance Measurements

Earth Electrode Designation	Types, Materials and Size/Dimension of Earth Electrode	Resistance to Earth at Position of Each Electrode (ohm)	Resistance to Earth at Position of Main Earth Terminal (ohm)	Remarks
	Rod / Tape / Plate / Others: ( ) Copper / Stainless Steel / Galvanised Steel / Others: ( ) Size /dimension /diameter: _____			

Separation of Earth Electrodes (for installation having multiple rod electrodes): _____ (m)

Description of Bonding Connections to the Point of Supply:

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.1.5 Earth Fault Loop Impedance Measurements

Circuit No. or Details of Equipment	Earth Fault Loop Impedance (ohm)	Remarks

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.1.6 Functions of All Devices Including Protective Devices

Functional Test of Residual Current Device (RCD)

Circuit No. /Designation of Protective Devices	Test Results				Remarks
	Built-in test button (tripped /not tripped)	50% rated tripping current (tripped /not tripped)	Opening time under 100% rated tripping current (ms)	Hand operation	

Functional check for other protective devices, e.g. MCB, MCCB, ACB, fused switches, switch-fuses and protective relays, etc.

Circuit No. /Designation of Other Protective Devices	Results of hand operation	Remarks

Functional check of all items of equipment such as isolators, switches and indicative devices

Circuit No. /Designation of Other Protective Devices	Results of hand operation	Remarks

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

Secondary Injection Test

Type of protection relay: Overcurrent Relay*/ Earth Fault Relay*
Rating and Designation of Protective Device:

Phase	Relay settings		Inject Current (A)	Operating time (sec)	
	Current setting %	Time setting		Normal	Actual

4.1.7 Additional Checks for Installations in Hazardous Environment

Note: Details of additional checks for installations in hazardous environment shall be recorded in this form whereas appropriate.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.1.8 Total Harmonic Distortion (THD) Measurements

Floor	Room No. / Equipment No.	Circuit No.	Number of Equipment	Circuit Current (A)	Measuring Location	Total Circuit Current (A)	Max. THD of Current (%)	Circuit Power (kW)	Compliance with COP for Energy Efficiency of Electrical Installation
(a) Lighting Installation (Electronic Ballast)									
									*Yes/No
									Current (I) at Rated Load Condition / Maximum THD of Current (%): I < 40A: 20.0; 40A ≤ I < 400A: 15.0; 400A ≤ I < 800A: 12.0; 800A ≤ I < 2000A: 8.0; I ≥ 2000A: 5.0
(b) Electronic Loads / Equipment									
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No
(c) Uninterrupted Power Supply (UPS)									
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No
(d) Main Busbar									
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No
(e) Variable Speed Drive (VSD)									
	VSD operating frequency (Hz)	50							*Yes/No
		40							*Yes/No
		30							*Yes/No
		20							*Yes/No
		10							*Yes/No
	VSD operating frequency (Hz)	50							*Yes/No
		40							*Yes/No
		30							*Yes/No
		20							*Yes/No
		10							*Yes/No
(f) Lift / Escalator [Maximum Allowable THD: I < 80A: 35.0%; 80A ≤ I < 400A: 22.5%; 400A ≤ I < 800A: 15.0%]									
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No
									*Yes/No

Note: Schematic drawing showing the points of connection of the harmonic measuring instrument to be attached

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.2 Test for High Voltage (H.V.) Installations

Note: Details of test requirements as recommended by manufacturers of relative H.V. equipment /systems shall be stated and appended here. Test results of respective requirements shall also be recorded and appended in this form whereas appropriate.

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.3 Functional Test for System /Equipment

4.3.1 Earth Electrode Resistance Measurement for Lightning Protection System

Earth Electrode Designation	Types, Materials and Size/Dimension of Earth Electrode	Resistance to Earth at Position of Each Electrode (ohm)	Remarks
	Rod / Tape / Plate / Others: ( ) Copper / Stainless Steel / Galvanised Steel / Others: ( ) Size /dimension /diameter: _____		

Combined resistance to earth (for multiple earth terminations): _____

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.3.2 Test of Digital Multifunction Power Meter /Power Analyzer

A. Equipment Details

Circuit Designation : _____

Brand and Model Number : _____

Current Transformer Ratio : _____

Voltage Transformer Ratio : _____

B. Reading Accuracy Test

Parameters	Meter reading	Test kit reading	% error
R.M.S. Voltage (V)			
L1-N			
L2-N			
L3-N			
L1-L2			
L2-L3			
L3-L1			
R.M.S. Current (A)			
L1			
L2			
L3			
N			
3 phase average			
Active Power (kW)			
L1			
L2			
L3			
3 phase total			
Reactive Power (kVAr)			
L1			
L2			
L3			
3 phase total			
Apparent Power (kVA)			
L1			
L2			
L3			
3 phase total			
Active Energy (kWh)			
Instantaneous			
Cumulated			

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.3.2 Test of Digital Multifunction Power Meter /Power Analyzer (Cont'd)

B. Reading Accuracy Test (Cont'd)

Parameters	Meter reading	Test kit reading	% error
Frequency			
Power Factor			
L1			
L2			
L3			
Demand Current (A)			
L1			
L2			
L3			
Demand Active Power (kW)			
3 phase total			
Demand Apparent Power (kVA)			
3 phase total			
THD (%)			
Voltage			
Current			
Voltage THD of Order (%)			
3			
5			
7			
9			
11			
13			
15			
17			
19			
21			
23			
25			
27			
29			
31			

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.3.2 Test of Digital Multifunction Power Meter /Power Analyzer (Cont'd)

B. Reading Accuracy Test (Cont'd)

Parameters	Meter reading	Test kit reading	% error
Current THD of Order (%)			
3			
5			
7			
9			
11			
13			
15			
17			
19			
21			
23			
25			
27			
29			
31			

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.4 Testing Equipment/ Instruments

4.4.1 List of Testing Equipment/ Instruments

Type	Model	Serial No. of Instrument	Date of Calibration

Tested / Checked by : (Name of *EE / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

Testing and Commissioning Progress Chart for Electrical Installation

Contract No. : _____

Contract Title : _____

Name of Electrical Contractor/Sub-contractor : _____

Contract Period: __/__/20__ to__/__/20__ *Revised/Actual Completion Date:__/__/20__
dd/mm/yyyy dd/mm/yyyy dd/mm/yyyy

	Testing and Commissioning Progress Chart for Electrical Installation (Rev.) (1)																		
	Dates (Note 2)																		Remark
	Activities	Reference to T&C Procedure Annex I	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
1.	Statutory inspection and test for L.V. installation																		
1.1	Visual inspection	Section 3.1.1																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
1.2	Conductor continuity test	Section 3.1.2																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
1.3	Insulation resistance test	Section 3.1.3																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
1.4	Polarity test	Section 3.1.4																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		

	Testing and Commissioning Progress Chart for Electrical Installation (Rev.) (Note 1)																		
	Dates (Note 2)																		Remark
	Activities	Reference to T&C Procedure Annex I	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
1.5	Earth electrode resistance test	Section 3.1.5																	
	Submission of Record of Test																		
1.6	Earth fault loop impedance test	Section 3.1.6																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
1.7	Functional testing of all devices including protective devices	Section 3.1.7																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
1.8	Additional checks for installations in hazardous environment	Section 3.1.8																	
	Submission of Record of Test																		
2.	Statutory inspection and test for H.V. installation																		
2.1	Visual inspection	Section 3.2.1																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
2.2	Testing of H.V. installation	Section 3.2.2																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
3.	Functional test of system /equipment																		
3.1	Lighting protection system	Section 3.3.1																	
	Submission of Record of Test																		

	Testing and Commissioning Progress Chart for Electrical Installation (Rev.) (Note 1)																		
	Dates (Note 2)																		Remark
	Activities	Reference to T&C Procedure Annex I	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
3.2	Circuitry check	Section 3.3.2																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
3.3	Charger and battery set	Section 3.3.3																	
	Submission of Record of Test																		
3.4	Lighting installation	Section 3.3.4																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
3.5	Digital multifunction power meter	Section 3.3.5																	
	Submission of Record of Test																		
3.6	Digital power analyzer	Section 3.3.6																	
	Submission of Record of Test																		
3.7	Busbar trunking system	Section 3.3.7																	
	G/F																		
	1/F																		
	2/F																		
	3/F																		
	4/F																		
	_____																		
	Submission of Record of Test																		
3.8	Equipment and Appliances	Section 3.3.8																	
	Submission of Record of Test																		
4.	Submission of T&C Certificate																		

Notes

(1) Insert revision no.
(2) Insert additional columns as necessary
S - schedule % completion
A - actual % completion

* Delete as appropriate

Testing and Commissioning Certificate for Low Voltage Cubicle Switchboard (LVSB) Installation / Motor Control Switchboard of other BS Installation

(Remark: Certificate title to be revised as appropriate per *Note 1*)

Part 1 : Details of Project

1.1 Project title (with location): _____

1.2 * P.W.P. / Project No.: _____

1.3 * Contract/Sub-contract/Quotation No.: _____

1.4 * Contractor/Sub-contractor: _____

1.5 * PBSE/PEME: _____

1.6 * PBSI/PEMI: _____

Part 2 : Declaration

2.1 I certify that the *Low Voltage Cubicle Switchboard Installation / Motor Control Switchboard of (*Note 1*) Installation as specified in the *Contract/Sub-contract/Quotation at the above location has been inspected, tested and commissioned in accordance with this Testing and Commissioning (T&C) Procedure (*Note 2*) and/or any other procedures as agreed between the PBSE/PEME and the *LVSB*/(Note 1)* Contractor. The results are satisfactory in the aspects as mentioned in Part 3 and/or as recorded in Part 4 of this Certificate, except as indicated in the COMMENTS item(s).

2.2 I also certify that site tests have been performed in accordance with the requirements set out in this T&C Procedure and that the results are satisfactory. A record of the tests has been prepared and submitted to the PBSE/PEME.

Name of *LVSB/*(Note 1)* Contractor's Representative: _____	Signature: _____
Designation / Post of *LVSB/*(Note 1)* Contractor's Representative: _____	Date signed: _____
Name and Stamp of *LVSB/*(Note 1)* Contractor: _____	Telephone No.: _____

Notes

1. State the type of Building Services Installation for the motor control switchboard.
2. "T&C Procedure" refers to the Testing & Commissioning Procedure for Electrical Installation.
3. The EE Contractor's Representative signing this Certificate must be a person or representative authorised by the EE Contractor.

* Delete if not applicable

		Items tested / checked by LVSB/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI

Part 3: Items Inspected and Tested

3.1	Visual Inspection		
3.1.1	Construction of Type Tested Assembly (TTA)		
3.1.1.1	General construction and standard of finishing of TTA are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.2	Levelling and alignment of TTA are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.3	The TTA has been properly mounted.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.4	Labels have been properly provided and installed.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.5	Access for maintenance has been allowed.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.6	The layout of the TTA is in conformity with the approved drawings.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.7	The physical dimension of the TTA is in conformity with the approved drawings.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.8	Danger notices and operation instructions have been adequately provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.9	Earthing bar and earthing connections have been provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.10	Earth wire has been installed for hinged front panels carrying L.V. equipment.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.11	The bolts, nuts, washers and screws are of non-ferrous material.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.12	Vermin proof has been satisfactorily provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.1.13	The compartmentation of the TTA conforms with the specified requirements.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.2	Main Busbars and Droppers/Risers		
3.1.2.1	The busbar arrangements, including spacing and means of support, conform with the type-tested drawings.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.2.2	Segregation between the busbar and the cubicle is in accordance with the specified 'Form'.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.2.3	The dimensions of the busbars are adequate for the design loading.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

		Items tested / checked by LVSB/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.1.2.4	The busbars have been electro-tinned.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.2.5	Busbar links have been provided for installation of C.T.s.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.2.6	Phase identifications have been provided for the busbars.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.2.7	The bolts, nuts, screws etc. for busbar supports, busbar connections have been checked for correct tightness.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.3	Air Circuit Breaker (ACB)/Fuse Switches		
3.1.3.1	The ACB ratings are in accordance with the approved working drawings.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.2	Arc chutes are provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.3	Shutters have been provided at the junction of busbar/ACB connection.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.4	The number and rating of ACB/fuse switches are in conformity with the approved working drawings.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.5	The fuse ratings are in conformity with the approved working drawings.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.6	The fuses have been properly fixed.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.3.7	The contact surfaces of the ACB/fuse switches have been kept clean.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4	Instrumentation and Protection		
3.1.4.1	The Power Co.'s meter control fuses, meter board, cabling, etc. have been properly installed.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.2	The type and range of the measuring instruments including digital multifunction meters and digital power analyzers are in accordance with those approved.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.3	Type and range of protection relays including digital protection relays are in accordance with those approved.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.4	The operating voltage of the shunt trip coil complies with the specification.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.5	The battery charger and associated control/instrument comply with the specification.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.6	The battery voltage and charging current have been checked and found satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

		Items tested / checked by LVSB/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.1.4.7	The capacity of the battery has been tested by tripping the ACB and results are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.8	The capacity of the battery for digital multifunction meters/ digital power analyzers/ digital protection relays has been tested and results are satisfactory.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.9	The re-charging time of the battery complies with the specification.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.10	The control cables have been properly identified and connected.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.4.11	Rubber grommets have been provided for holes through which control cables pass.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.5	Incoming-outgoing Cables and Busbars		
3.1.5.1	Proper facilities have been provided for fixing of incoming/outgoing cables.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.5.2	Adequate space has been allowed for fixing of incoming/outgoing cables.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.5.3	The cables for termination have been soldered or properly fitted with sockets.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.5.4	Proper tightness of busbar/cable connection has been checked.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.5.5	Phase identification has been provided by approved means.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.5.6	Proper identification has been provided for each cable.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.5.7	Unwanted openings have been sealed up.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6	Miscellaneous		
3.1.6.1	Portable earthing equipment as approved has been provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6.2	Operating handles and keys c/w mounting board have been provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6.3	Spare fuses as agreed c/w mounting board have been provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6.4	Hydraulic handling truck has been provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6.5	Rubber insulating mat has been provided.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6.6	Schematic diagram has been framed and installed.	*Yes/No/N.A.	*Yes/No/N.A.
3.1.6.7	Operation sequence instructions have been provided for interlock facilities.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

		Items tested / checked by LVSB/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.2	Site Tests		
3.2.1	Before connection of incoming supply the following tests have been carried out on the Site after the L.V. cubicle switchboard has been properly erected and visually inspected. The results are satisfactory.		
3.2.1.1	Insulation test	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.2	Dielectric test	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.3	Polarity check for current transformers	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.4	Secondary injection test	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.5	Primary injection test	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.6	Electrical resistance test	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.7	Temperature-rise limit test (at factory / site)*	*Yes/No/N.A.	*Yes/No/N.A.
3.2.1.8	Functional test	*Yes/No/N.A.	*Yes/No/N.A.
3.2.2	After connection of incoming supply the following tests have been carried out and the results are satisfactory.		
3.2.2.1	Voltage test	*Yes/No/N.A.	*Yes/No/N.A.
3.2.2.2	Phase sequence test	*Yes/No/N.A.	*Yes/No/N.A.
3.2.2.3	Functional test for digital multifunction power meter /digital power analyzer	*Yes/No/N.A.	*Yes/No/N.A.
3.2.3	The above test results have been recorded in the “Test Records” as shown in Annex III Part 4 of this T&C Procedure.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor’s Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

	Items tested / checked by LVSB/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
3.3 Any other tests that are considered necessary to meet the design intent.		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

	Items tested / checked by LVSB/(Note 1) Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI

3.4 Comments

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

Part 4 : Test Record attached to the Test Certificate

		Test record attached
4.1	**Test before Connection of Incoming Supply**	
4.1.1	Insulation Test	*Yes/No/N.A.
4.1.2	Dielectric Test	*Yes/No/N.A.
4.1.3	Polarity Check for Current Transformer (C.T.)	*Yes/No/N.A.
4.1.4	Secondary Injection Test	*Yes/No/N.A.
4.1.5	Primary Injection Test	*Yes/No/N.A.
4.1.6	Contact Resistance Test (Ductor Test)	*Yes/No/N.A.
4.1.7	Temperature-rise Limit Test	*Yes/No/N.A.
4.2	**Functional Test of All Devices**	
4.2.1	Air Circuit Breaker	*Yes/No/N.A.
4.2.2	Fuseswitches /Switches /Automatic Changeover Contactor	*Yes/No/N.A.
4.2.3	MCCB c/w Overccurent and /or Earth Leakage Tripping Devices	*Yes/No/N.A.
4.2.4	Digital Protection Relay	*Yes/No/N.A.
4.3	**Test After Connection of Incoming Supply**	
4.3.1	Voltage Test	*Yes/No/N.A.
4.3.2	Phase Sequence Test	*Yes/No/N.A.
4.3.3	Digital Multifunction Power Meter /Digital Power Analyzer	*Yes/No/N.A
4.4	**Testing Equipment/ Instruments**	
4.4.1	List of testing equipment/ instruments	*Yes/No/N.A.

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.1 Test before Connection of Incoming Supply

4.1.1 Insulation Test

To carry out insulation test using a 1000V d.c. meggar.

Poles Measured		Insulation resistance with all switching devices open (mega ohm)	Insulation resistance with all switching devices closed (mega ohm)
L1	E		
L2	E		
L3	E		
L1	L2		
L2	L3		
L3	L1		
E	N		
L1	N		
L2	N		
L3	N		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.1.2 Dielectric Test

4.1.2.1 The test shall be carried out with all switching devices closed

Test voltage : 2500V a.c., 50 Hz
Duration : 1 second

Poles measured		Insulation resistance (mega ohm)
Earth	L1 + L2 + L3 + N	
N	L1 + L2 + L3 + E	
L1	L2 + L3 + N + E	
L2	L3 + L1 + N + E	
L3	L1 + L2 + N + E	

4.1.2.2 After test at 4.1.2.1 another insulation test using 1000V d.c. meggar shall be carried out with all switching devices closed.

Poles measured		Insulation resistance (mega ohm)
L1	E	
L2	E	
L3	E	
L1	L2	
L2	L3	
L3	L1	
E	N	
L1	N	
L2	N	
L3	N	

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.1.3 Polarity Check for Current Transformer (C.T.)

		Satisfactory (√) Unsatisfactory (X) NOT completed (NC) NOT applicable (NA)	Remarks
Measurement C.T.	L1		
	L2		
	L3		
	N		
Protection C.T.	L1		
	L2		
	L3		
	N		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.1.4 Secondary Injection Test

4.1.4.1 Overcurrent Relay

	Relay settings		Current inject (A)	Operating time (sec)	
	Current setting %	Time setting		Normal	Actual
L1 L1 L1	50 50 100	1 1 0.5	5 10 10		
L2 L2 L2	50 50 100	1 1 0.5	5 10 10		
L3 L3 L3	50 50 100	1 1 0.5	5 10 10		

4.1.4.2 Earth Fault Relay

	Relay settings		Current inject (A)	Operating time (sec)	
	Current setting %	Time setting		Normal	Actual
N N N	10 10 20	1 1 0.5	2.5 5 2		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.1.5 Primary Injection Test

4.1.5.1 For overcurrent relays and earth fault relays set at specified settings

	Primary current (A)	Secondary current (A)				Spill current (A)
		L1	L2	L3	N	
L1-L2						
L2-L3						
L3-L1						
L1-N						
L2-N						
L3-N						

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.1.6 Contact Resistance Test (Ductor Test)

Position of Test (It shall include all joints and connections. The followings are for reference only.)	Measured Resistance (milli ohm)
Joints on main busbars	
Connections between horizontal and vertical busbars	
Connections of ACB/fuse switches	
Any other joints /connections	

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.1.7 Temperature-Rise Limit Test

Ambient Air Temperature at Location 1 _____ (^{o}C)

Ambient Air Temperature at Location 2 _____ (^{o}C)

Ambient Air Temperature at Location 3 _____ (^{o}C)

No.	Position (Positions of test should include all joints and connections. The followings are for reference only.)	Temperature Rise At steady state (^{o}C)	
		Test	Limit
1.	Supply connection L1 phase		
2.	Supply connection L2 phase		
3.	Supply connection L3 phase		
4.	Horizontal busbars L1 phase		
5.	Horizontal busbars L2 phase		
6.	Horizontal busbars L3 phase		
7.	Vertical busbars L1 phase		
8.	Vertical busbars L2 phase		
9.	Vertical busbars L3 phase		
10.	Switchgear incoming terminal L1 phase		
11.	Switchgear incoming terminal L2 phase		
12.	Switchgear incoming terminal L3 phase		
13.	Connection busbar to switchgear L1 phase		
14.	Connection busbar to switchgear L2 phase		
15.	Connection busbar to switchgear L3 phase		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.2 Functional Test of All Devices

4.2.1 Functional Test for Air Circuit Breaker

Air Circuit Breaker Designation: _____

Item	Check (where applicable)	Satisfactory (√) Unsatisfactory (X) NOT completed (NC) NOT applicable (NA)	Remarks
1.	Racking in and out of ACB		
2.	Operating of automatic shutter and padlock		
3.	Mechanical closing mechanism		
4.	Electrical closing mechanism		
5.	Mechanical tripping operation		
6.	Overcurrent trip operation		
7.	Earth leakage trip operation		
8.	Undervoltage release operation		
9.	Operation of castell key interlock		
10.	ACB panel door interlock		
11.	Mechanical ON/OFF indicator		
12.	Operation of auxiliary switches		
13.	Alignment of contacts mechanism		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.2.2 Functional Test for Fuse-switches /Switches /Automatic Changeover Contactor

Item	Check (where applicable)	Satisfactory (√) Unsatisfactory (X) NOT completed (NC) NOT applicable (NA)	Remarks
1.	Operating of padlock and interlock		
2.	Mechanical closing mechanism		
3.	Electrical closing mechanism		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.2.3 Functional Test for MCCB c/w Overcurrent and /or Earth Leakage Tripping Devices

Item	Check (where applicable)	Satisfactory (√) Unsatisfactory (X) NOT completed (NC) NOT applicable (NA)	Remarks
1.	Overcurrent trip operation		
2.	Earth leakage trip operation		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post :	
		Tel. No. :	
		Date :	

4.2.4 Functional Test for Digital Protection Relay

Item	Check the following functions (where applicable)	Satisfactory (√) Unsatisfactory (X) NOT completed (NC) NOT applicable (NA)	Remarks
1.	Selection of relay characteristic curves		
2.	Fault recording function		
3.	Self-supervision features which monitor the control circuit of digital relay		
4.	Remote operation function		
5.	Communication facilities		

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.3 Test After Connection of Incoming Supply

4.3.1 Voltage Test

	Voltage (V)
L1-E	
L2-E	
L3-E	
L1-L2	
L2-L3	
L3-L1	
E-N	
L1-N	
L2-N	
L3-N	

4.3.2 Phase Sequence Test

* Satisfactory / Unsatisfactory / NOT completed / NOT applicable

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.3.3 Functional Test for Digital Multifunction Power Meter /Digital Power Analyzer

A. Equipment Details

Circuit Designation : _____

Brand and Model Number : _____

Current Transformer Ratio : _____

Voltage Transformer Ratio : _____

B. Reading Accuracy Test

Parameters	Meter reading	Test kit reading	% error
R.M.S. Voltage (V)			
L1-N			
L2-N			
L3-N			
L1-L2			
L2-L3			
L3-L1			
R.M.S. Current (A)			
L1			
L2			
L3			
N			
3 phase average			
Active Power (kW)			
L1			
L2			
L3			
3 phase total			
Reactive Power (kVAr)			
L1			
L2			
L3			
3 phase total			
Apparent Power (kVA)			
L1			
L2			
L3			
3 phase total			
Active Energy (kWh)			
Instantaneous			
Cumulated			

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.3.3 Test of Digital Multifunction Power Meter /Power Analyzer (Cont'd)

B. Reading Accuracy Test (Cont'd)

Parameters	Meter reading	Test kit reading	% error
Frequency			
Power Factor			
L1			
L2			
L3			
Demand Current (A)			
L1			
L2			
L3			
Demand Active Power (kW)			
3 phase total			
Demand Apparent Power (kVA)			
3 phase total			
THD (%)			
Voltage			
Current			
Voltage THD of Order (%)			
3			
5			
7			
9			
11			
13			
15			
17			
19			
21			
23			
25			
27			
29			
31			

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.3.3 Test of Digital Multifunction Power Meter /Power Analyzer (Cont'd)

B. Reading Accuracy Test (Cont'd)

Parameters	Meter reading	Test kit reading	% error
Current THD of Order (%)			
3			
5			
7			
9			
11			
13			
15			
17			
19			
21			
23			
25			
27			
29			
31			

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

4.4 Testing Equipment/ Instruments

4.4.1 List of Testing Equipment/ Instruments

Type	Model	Serial No. of Instrument	Date of Calibration

Tested / Checked by : (Name of *LVSB / (Note 1) Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
Witnessed by : (Name(s) of * PBSE/PEME/PBSI/PEMI)	Signature - ( )	Post : Tel. No. : Date :	

Testing and Commissioning Progress Chart for Low Voltage Cubicle Switchboard Installation / Motor Control Switchboard of other BS Installation

(Remark: Progress chart title to be revised as appropriate per *Note 1*)

Contract No. : _____

Contract Title : _____

Name of Electrical Contractor/Sub-contractor : _____

Contract Period: __/__/20__ to__/__/20__ *Revised/Actual Completion Date:__/__/20__
dd/mm/yyyy dd/mm/yyyy dd/mm/yyyy

	Testing and Commissioning Progress Chart for *Low Voltage Cubicle Switchboard Installation / Motor Control Switchboard of (Note 1) Installation (Rev.) (Note 1)																		
	Dates (Note 2)																		Remark
	Activities	Reference to T&C Procedure Annex III	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
1.	Visual inspection	Section 3.1																	
	Submission of Record of Test																		
2.	Site tests before connection of incoming supply																		
2.1	Insulation test	Section 3.2.1.1 & 3.2.3																	
	Submission of Record of Test																		
2.2	Dielectric test	Section 3.2.1.2 & 3.2.3																	
	Submission of Record of Test																		
2.3	Current transformer polarity test	Section 3.2.1.3 & 3.2.3																	
	Submission of Record of Test																		
2.4	Secondary injection test	Section 3.2.1.4 & 3.2.3																	
	Submission of Record of Test																		
2.5	Primary injection test	Section 3.2.1.5 & 3.2.3																	
	Submission of Record of Test																		
2.6	Contact resistance test (Ductor Test)	3.2.1.6 & 3.2.3																	
	Submission of Record of Test																		
2.7	Temperature-rise limit test	3.2.1.7 & 3.2.3																	
	Submission of Record of Test																		
2.8	Functional Test	3.2.1.8 & 3.2.3																	
	Submission of Record of Test																		

	Testing and Commissioning Progress Chart for *Low Voltage Cubicle Switchboard Installation / Motor Control Switchboard of (Note 1) Installation (Rev.) (Note 1)																		Remark
	Dates (Note 2)																		
	Activities	Reference to T&C Procedure Annex III	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
3.	Site tests after connection of incoming supply																		
3.1	Voltage test	3.2.2.1 & 3.2.3																	
	Submission of Record of Test																		
3.2	Phase sequence test	3.2.2.3 & 3.2.3																	
	Submission of Record of Test																		
3.3	Functional test for digital power meter/power analyzer	4.2.3																	
	Submission of Record of Test																		
4.	Submission of T&C Certificate																		

Notes

(1) State the type of Building Services Installation for the electrical works

(2) Insert revision no.

(3) Insert additional columns as necessary
S - schedule % completion
A - actual % completion

* Delete as appropriate