TESTING AND COMMISSIONING PROCEDURE

FOR

EMERGENCY GENERATOR INSTALLATION

IN

GOVERNMENT BUILDINGS

OF

THE HONG KONG SPECIAL ADMINISTRATIVE REGION

2022 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 Emergency Generator 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 General Specification for Building Services Installation in Government Buildings of the Hong Kong Special Administrative Region 2022 Edition that was established by the Architectural Services Department (ArchSD).

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 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 Emergency Generator Installation carried out for or on behalf of the ArchSD in Government premises 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. 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 here. The ArchSD does not accept any liability and responsibility for any special, indirect or consequential loss or damages whatsoever arising out of or in connection with the use of this T&C Procedure or reliance placed on it.

The materials contained in this document may not be pertinent or fully cover the extent of the installation in non-government buildings and there is no intimated or implied endorsement of the sales, supply and installation of the materials and equipment specified in this T&C Procedure within the territory of the HKSAR.

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Testing and Commissioning Procedure for Emergency Generator 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) / Project Electrical and Mechanical Inspector (PEMI), who are appointed as the Supervising Officer's Representatives, in the following aspects with respect to testing and commissioning :

(a) to vet and approve the T&C procedures proposed and submitted by the contractor for the Emergency Generator Installation (Contractor);

(b) to witness those T&C procedures as specified; and

(c) to accept the T&C certificates and other supporting data.

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

The administrative requirements for T&C works are in general as specified in the General Specification for Building Services Installation in Government Buildings of the Hong Kong Special Administrative Region 2022 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.

2. Objectives of the Testing and Commissioning Works

The objectives of the T&C works are:

(a) to verify proper functioning of the equipment/system after installation;

(b) 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 and adjustments; and

(c) 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 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 Contractor shall note the statutory requirements listed in the General Specification in carrying out the works.

3.2 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 Contract. Functional performance tests should proceed from the testing of individual components to the testing of different systems in the Installations.

The 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 Contract. The testing of systems may have to be carried out in stages depending on the progress of work or as proposed by the Contractor.

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

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

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

3.3 Commissioning, Statutory Tests and Inspections

Commissioning is the advancement of the Installations from the stage of static completion to full working conditions and to meet the performance requirements as specified in the Contract. This will include setting into operation and regulation of the Installations. Fine-tuning of the commissioned system shall be done by the Contractor to match system performance to the actual needs of the building occupier more closely.

The Contractor shall carry out tests for the Installations to meet statutory requirements as specified in the Contract. After the proper testing and commissioning of the Installations, the

Contractor shall notify the appropriate authority as specified in the Contract, through the PBSE of the completion of the Installations and its readiness for inspection and testing. The Contractor shall arrange for the necessary inspections and tests as required by the Authority.

3.4 Documentation and Deliverables

The Contractor shall submit his proposed T&C procedures together with the Testing and Commissioning Progress Chart shown in **Annex I** to PBSE for approval.

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

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 Contractor shall complete and sign a testing and commissioning certificate as shown **Annex II** to the effect that the agreed T&C works have been duly carried out.

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

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

3.5 Other Requirements

3.5.1 Testing Equipment Calibration

A list of calibrated equipment/instruments necessary for the T&C Works shall be provided as specified in **Annex III**.

3.5.2 Tests for Specific Facilities or Devices

Tests for specific facilities or devices that are installed in the Installations, such as Catalytic Converter.

4. Testing and Commissioning Procedures

		Relevant Clauses In Annex II
4.1	**Emergency Generator**	
(a)	Pre-commissioning and visual inspection on various components/system such as engine, alternator, radiator, and various systems of the generating set	Clauses 3.3, 3.4.1,3.4.2, 4.1.4 & 4.1.5
(b)	Control function test	Clause 4.1.3 to 4.1.7
(c)	Full operating test	
(d)	Insulation test	Clause 3.5
(e)	Earthing protection test	
(f)	Circuit & engine protection tests	
(g)	Fuel consumption test	
(h)	Dummy load test	
(i)	Step load acceptance test	
(j)	Battery charger output test	
(k)	Noise level measurement	
4.2	**Control Cubicle**	
(a)	Pre-commissioning and visual inspection on control panel	Clause 3.4.3
(b)	Performance tests on individual components such as voltmeter, ammeter, frequency meter, wattmeter, indicating lamps, buttons and switches…etc	
(c)	Electrical contact resistance test (Ductor test)	
(d)	Circuit protection & load transfer tests	
(e)	Temperature rise test	
4.3	**Fuel Supply System and Underground/Daily Service Fuel Tank**	
(a)	Pre-commissioning and visual inspection on the construction, welding, painting and components of tank & pipework	Clauses 3.1 &3.2
(b)	Hydraulic test	
(c)	Functional test of fuel pumps and pipeworks (if any)	

Annex I

Testing and Commissioning Progress Chart for Emergency Generator Installation

Contract Number : _____

Contract Title : _____

Name of Sub-contractor : _____

Name of Main Contractor : _____

Contract Period: __/__/20__ to __/__/20__ *Revised /Actual Completion Date: __/__/20__

dd/mm/yyyy dd/mm/yyyy

	Testing and Commissioning Progress Chart for Emergency Generator Installation (Rev.)(Note 1)																		
	Dates (Note 2)																		Remark
	Activities	Reference to Annex II	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
1.	**Visual Inspections**	3.1, 3.2 & 3.3																	
	U/G Fuel Oil Tank																		
	Services Tank																		
	Pipeworks																		
	Generator Set																		
	Battery																		
	Cooling System																		
	Exhaust System																		
	Submission of test record																		
2.	**Pre-commissioning Inspection**	3.4																	
	Submission of test record																		
3.	**Insulation Resistance Test**	3.5 & 4.1.3																	
	Submission of test record																		
4.	**Control Functional Test**	3.5 & 4.1.4																	
	Submission of test record																		

	Testing and Commissioning Progress Chart for Emergency Generator Installation (Rev.)(Note 1)																		
		Dates (Note 2)																	Remark
	Activities	Reference to Annex II	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
5.	**Dummy Load Test**	3.5 & 4.1.5																	
	Submission of test record																		
6.	**Earth Protection Test**	3.5 & 4.1.6																	
	Submission of test record																		
7.	**Submission of T&C Certificate**																		

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

Annex II

Testing and Commissioning Certificate for Emergency Generator Installation

Contract Number : _____

Contract Title : _____

Part 1 Details of Project

1.1 Project title : _____

1.2 P.W.P. No. : _____

1.3 Contract Number : _____

1.4 Sub-contractor : _____

1.5 Main Contractor : _____

1.6 Name of *PBSE : _____

1.7 Name of *PBSI : _____

Part 2 Declaration

2.1 I certify that the Emergency Generator 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 and/or any other procedures as agreed between the *PBSE and the Contractor. The results are satisfactory in the aspects as mentioned in Part 3 and/or as recorded in Part 4 of this Certificate, except that indicated in the COMMENTS items.

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

Name of Authorised Contractor's Representative:	Signature:
Designation /Post of Contractor's Representative:	Date Signed:
Name and Stamp of Contractor:	Telephone Number:

* delete /amend if required

Part 3 Items Inspected and Tested

		Item tested/ checked by Contractor	Items witnessed by PBSE/PBSI
3.1	Underground tank		
3.1.1	The welding has been examined and the effectiveness of the welding and standard of workmanship is satisfactory.	*Yes/No	*Yes/No
3.1.2	The metal surface has been properly prepared in accordance with the specification.	*Yes/No	*Yes/No
3.1.3	The manufacturer's application procedure for the primer has been followed and the type of primer, the number of coatings is in accordance with the specification.	*Yes/No	*Yes/No
3.1.4	The underground tank has been subjected to hydraulic test to a pressure as specified and the results are satisfactory.	*Yes/No	*Yes/No
3.1.5	The size and structure are correct in accordance with the approved plans.	*Yes/No	*Yes/No
3.1.6	The fuel tank has been mounted securely to the concrete plinth in accordance with the approved plans.	*Yes/No	*Yes/No
3.1.7	The pipework from the fuel pump to the underground tank is of proper fall to prevent airlock.	*Yes/No	*Yes/No
3.1.8	Vent pipe is of proper size and arranged at proper location in accordance with the approved drawing.	*Yes/No	*Yes/No
3.1.9	Underground fuel tank chamber is water proofed and back filled with dry sand.	*Yes/No	*Yes/No
3.1.10	Underground and buried fuel pipes are protected with proper coatings against corrosion in accordance with the specifications.	*Yes/No	*Yes/No
3.1.11	Fuel filling point is of proper arrangement in accordance with the approved drawing.	*Yes/No	*Yes/No
3.1.12	Man-holes and hand-holes for the underground fuel tank are properly arranged to allow maintenance access and water tight with double sealed covers	*Yes/No	*Yes/No
3.1.13	Proper types of filters and water separators are provided in the fuel supply lines to the daily fuel tanks.	*Yes/No	*Yes/No
3.1.14	The interior surface of the tank is thoroughly dried out and applied with a thick coat of linseed oil to prevent rusting after hydraulic test completed.	*Yes/No	*Yes/No
3.1.15	Electrical fuel transfer pump complete with all necessary accessories shall be provided.	*Yes/No	*Yes/No

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

		Item tested/ checked by Contractor	Items witnessed by PBSE/PBSI
3.2	Daily service fuel tank		
3.2.1	The daily service fuel tank has been fabricated and welded in accordance with the specifications and drawings.	*Yes/No	*Yes/No
3.2.2	The pipework & socket connections (for filling, overflow, supply, drainage, return and vent) have been properly installed at the fuel tank in accordance with the specifications and drawings.	*Yes/No	*Yes/No
3.2.3	One quick closing valve has been installed properly with all necessary linkage for operation from outside the building.	*Yes/No	*Yes/No
3.2.4	The fuel tank has been fitted with an approved content gauge unit and level sensing equipment.	*Yes/No	*Yes/No
3.2.5	The fuel tank has been subjected to hydraulic test to a pressure as specified and the results are satisfactory.	*Yes/No	*Yes/No
3.2.6	The metal surface has been properly prepared and coated in accordance with the specifications.	*Yes/No	*Yes/No
3.2.7	The tank has been mounted properly in accordance with the specifications.	*Yes/No	*Yes/No
3.2.8	The metal supporting frame is of proper structure and material used is of proper size in accordance with the standard guide drawings.	*Yes/No	*Yes/No
3.2.9	Proper types of filters and water separators are provided in the fuel supply lines to the generator sets.	*Yes/No	*Yes/No
3.2.10	Rotatory hand pump with check-valve, strainers, proper flexible inlet hose and drip tray shall be provided.	*Yes/No	*Yes/No
3.2.11	The interior surface of the tank is thoroughly dried out and applied with a thick coat of linseed oil to prevent rusting after hydraulic test completed.	*Yes/No	*Yes/No
3.3	Visual inspection		
3.3.1	The Generating Set has been properly fixed on a common steel section base frame and fixed at the positon in accordance with the approved drawings.	*Yes/No	*Yes/No
3.3.2	Protection screen has been provided on all moving parts.	*Yes/No	*Yes/No
3.3.3	Protection guard has been provided on hot exhaust.	*Yes/No	*Yes/No
3.3.4	The fresh-water-cooled radiator has been properly fixed and there is no water leakage and with proper maintenance access.	*Yes/No	*Yes/No
3.3.5	The radiator cooling fins and water tank are in good condition and properly fixed.	*Yes/No	*Yes/No

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

		Item tested/ checked by Contractor	Items witnessed by PBSE/PBSI
3.3.6	The water circulation pump with thermostatically controlled temperature regulator has been properly fixed.	*Yes/No	*Yes/No
3.3.7	The engine mounted instrument panel has been fixed properly and c/w lubrication oil temp. and cooling temp. gauges, tachometer and hour meter.	*Yes/No	*Yes/No
3.3.8	The lubrication oil system with full flow, replaceable element types filter has been properly fixed.	*Yes/No	*Yes/No
3.3.9	The fuel oil system c/w filter, fuel transfer pumps, injection pump and injectors has been properly installed.	*Yes/No	*Yes/No
3.3.10	The fuel control solenoid c/w emergency shut off valve has been provided and properly installed.	*Yes/No	*Yes/No
3.3.11	The tubular exhaust silencer has been properly installed.	*Yes/No	*Yes/No
3.3.12	For remote radiator, if applicable, c/w break tank booster pump, heat exchanger and proper maintenance access etc. has been properly installed.	*Yes/No	*Yes/No
3.3.13	The enclosure to the alternator satisfy IP21 or as specified.	*Yes/No	*Yes/No
3.3.14	Anti-condensate heater for the alternator has been provided and proper fixed.	*Yes/No	*Yes/No
3.3.15	Starting batteries of proper type have been provided and properly installed. Battery connection bars are protected with corrosion resistant petroleum jelly.	*Yes/No	*Yes/No
3.3.16	The air silencers have been properly installed with bird screens at the air-intakes. Sharp edges shall be properly shrouded.	*Yes/No	*Yes/No
3.3.17	Proper lifting appliances and gears are in place to suit the maintenance requirements.	*Yes/No	*Yes/No
3.3.18	A suitable double pole switch for each generator set to isolate the starter unit from the battery is provided. Indication light on the control panel to show its status if it was being put to “OFF” position.	*Yes/No	*Yes/No
3.3.19	Framed schematic diagram of proper size is mounted in place.	*Yes/No	*Yes/No
3.3.20	Durable warning signs needed and in accordance with the requirements for the installations are properly mounted.	*Yes/No	*Yes/No
3.3.21	Adequate illumination level inside the generator room (minimum of 200 lux) as measured at floor level and at the components that required access during normal operation.	*Yes/No	*Yes/No

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

		Item tested/ checked by Contractor	Items witnessed by PBSE/PBSI
3.3.22	Enough working spaces and provision of proper maintenance access to the components that required regular maintenance.	*Yes/No	*Yes/No
3.3.23	Proper hydraulic platform trolley is provided for the maintenance of the draw out type air circuit breaker if any.	*Yes/No	*Yes/No
3.3.24	Proper identification labels are provided for the major components of the generator sets.	*Yes/No	*Yes/No
3.3.25	Proper clearance is provided around the generator sets to allow for maintenance access.	*Yes/No	*Yes/No
3.3.26	The purifier has been properly installed and connected the engine exhaust pipe as required by the Environmental Protection Department.	*Yes/No	*Yes/No
3.3.27	Adequate clearance is provided around the purifier to allow for maintenance access.	*Yes/No	*Yes/No
3.3.28	Governor with manual adjustment of +5% of normal speed.	*Yes/No	*Yes/No
3.3.29	Separate earth terminal for bonding the engine and alternator to the separate earthing system.	*Yes/No	*Yes/No
3.3.30	All wiring of the control and protection system must use or contained in suitable heat and oil resisting cables.	*Yes/No	*Yes/No
3.4	Pre-commissioning inspection		
3.4.1	Diesel engine		
3.4.1.1	Radiator water is at right level.	*Yes/No	*Yes/No
3.4.1.2	Lubrication oil is at right level and with replaceable filter.	*Yes/No	*Yes/No
3.4.1.3	The engine exhaust has been properly fixed and covered with asbestos-free insulation, anti-vibrations and aluminum cladding.	*Yes/No	*Yes/No
3.4.1.4	The engine anti-vibration mounting is effective.	*Yes/No	*Yes/No
3.4.1.5	Proper replaceable air filter has been installed.	*Yes/No	*Yes/No
3.4.1.6	Effective and adequate earth bonding have been provided for the engine and alternator.	*Yes/No	*Yes/No
3.4.1.7	The exposed portion of the exhaust pipe outside the generator room is in stainless steel 316.	*Yes/No	*Yes/No
3.4.1.8	Proper water draining points and devices are installed in the engine exhaust system.	*Yes/No	*Yes/No

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

		Item tested/ checked by Contractor	Items witnessed by PBSE/PBSI
3.4.2	Alternator		
3.4.2.1	Batteries electrolyte is at right level.	*Yes/No	*Yes/No
3.4.2.2	Batteries output voltage is as specified.	*Yes/No	*Yes/No
3.4.2.3	The alternator output terminal is at correct phase sequence.	*Yes/No	*Yes/No
3.4.2.4	All main power cable terminals are properly identified with non-ferrous metallic labels.	*Yes/No	*Yes/No
3.4.2.5	Independent earthing system is provided and properly connected for neutral connection.	*Yes/No	*Yes/No
3.4.2.6	Suitable protection against electrical short circuit, overload, earth fault of the stator and rotor windings, over /under-voltage and over /under-frequency, loss of excitation, under-speed and rotation failure of the alternator shall be provided.	*Yes/No	*Yes/No
3.4.3	Control cubicle		
3.4.3.1	Permanent Chinese/English labels have been provided for all accessories.	*Yes/No	*Yes/No
3.4.3.2	All control wirings are fitted with yellow ferrules marked in black.	*Yes/No	*Yes/No
3.4.3.3	The following devices are provided in the control cubicle :		
	(a) # Voltmeter & selector switch and fuse 0-500V	*Yes/No	*Yes/No
	(b) # Ammeter & current transformers and selector switch	*Yes/No	*Yes/No
	(c) # Frequency meter in 45 to 55 Hz range	*Yes/No	*Yes/No
	(d) # Wattmeter	*Yes/No	*Yes/No
	(e) Auto/off/manual selector switch	*Yes/No	*Yes/No
	(f) Start/stop push button	*Yes/No	*Yes/No
	(g) “Simulate main failure” key switch	*Yes/No	*Yes/No
	(h) “On-off” switch for generator anti-condensation element	*Yes/No	*Yes/No
	(i) Automatic 2 rate battery charging equipment completed with charging rate ammeter	*Yes/No	*Yes/No
	(j) Hour meter	*Yes/No	*Yes/No
	(k) 3-phase mains voltage sensing unit	*Yes/No	*Yes/No

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

		Item tested/ checked by Contractor	Items witnessed by PBSE/PBSI
	For # items, provision by a power analyzer/digital meter to serve this purpose is also acceptable.		
3.4.3.4	Indicating lamp & reset button for:		
	(a) Engine fault	*Yes/No	*Yes/No
	(b) Failure to start	*Yes/No	*Yes/No
	(c) Generator supply available	*Yes/No	*Yes/No
	Reset function provided at controller display is also acceptable		
3.4.3.5	Indication lamp for:		
	(a) Mains available	*Yes/No	*Yes/No
	(b) Generator on load	*Yes/No	*Yes/No
	(c) Load supplied from mains	*Yes/No	*Yes/No
	(d) 7-hour fuel capacity	*Yes/No	*Yes/No
	(e) 6.5-hour fuel capacity	*Yes/No	*Yes/No
	(f) Low battery voltage	*Yes/No	*Yes/No
3.4.3.6	Generator output under voltage & over voltage protection devices	*Yes/No	*Yes/No
3.4.3.7	Approved type 4-pole withdrawable air circuit breaker or 4 pole moulded case circuit breaker c/w overload and short circuit protection	*Yes/No	*Yes/No
3.4.3.8	Mechanically & electrically interlocked 4-pole contactor for automatic load transfer & 4-pole manual by-pass	*Yes/No	*Yes/No
3.4.3.9	All indication lamps shall be operated at a voltage not greater than 50V	*Yes/No	*Yes/No
3.4.3.10	Control cubicle shall be installed for each diesel generator set.	*Yes/No	*Yes/No
3.4.3.11	Control cubicle shall be equipped with thermostatically controlled anti-condensation heater.	*Yes/No	*Yes/No
3.4.3.12	Rubber mat of ribbed surface to IEC 61111:2009 in proper size are laid in front of the main control cubicle.	*Yes/No	*Yes/No
3.5	A full testing has been carried out and the results of the following tests have been recorded and submitted to ArchSD		
	(a) Insulation test	*Yes/No	*Yes/No
	(b) Control functions test	*Yes/No	*Yes/No

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

		Item tested/ checked by Contractor	Items witnessed by PBSE/PBSI
	(c) Dummy load test	*Yes/No	*Yes/No
	(d) Earthing protection test	*Yes/No	*Yes/No
	(e) Battery charger output test	*Yes/No	*Yes/No
	(f) Step-load acceptance test	*Yes/No	*Yes/No
	(g) Noise level measurement	*Yes/No	*Yes/No
3.6	Control interlock test of the ventilation exhaust fans for the generator rooms	*Yes/No	*Yes/No
3.7	Testing and verification on the interface signals		
	(a) Generator on load to fire control main panel	*Yes/No	*Yes/No
	(b) Generator fails to start to fire control main panel	*Yes/No	*Yes/No
	(c) Auto/Off/Manual selector switch in manual position to fire control main panel	*Yes/No	*Yes/No
	(d) Generator engine fault to fire control main panel	*Yes/No	*Yes/No
	(e) Generator running to fire control main panel	*Yes/No	*Yes/No
	(f) Essential Power Supply ON/OFF to Lift Machine Room	*Yes/No	*Yes/No
	(g) Essential Power Supply Normal/Trip to fire control main panel	*Yes/No	*Yes/No
	(h) 7 hours fuel capacity limiting control to alert building management	*Yes/No	*Yes/No
	(i) 6.5 hours fuel capacity limiting control to shut down non-FS essential services	*Yes/No	*Yes/No
3.8	Comment		

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

Part 4 Test Record attached to the Test Certificate

4.1 Emergency Generator Installation

4.1.1 Equipment Details

(a) Generator Set

(i) Manufacturer:
(ii) Model:
(iii) Net prime rating (kW):

(b) Diesel Engine

(i) Make:
(ii) Model:
(iii) Serial No.:
(iv) Rated power (kW):
(v) Speed (rpm):
(vi) Governor:
(vii) Turbocharger (type/model):

(c) Alternator

(i) Make:
(ii) Model:
(iii) Serial No.:
(iv) Rated kVA:
(v) Voltage (V) / Full load current (A):
(vi) Phase / Rated p.f.:
(vii) Insulation class:

(d) Starting Battery

(i) Manufacturer:
(ii) Make/Model No.:
(iii) No. of battery / Voltage (V):
(iv) Ampere hour:
(v) Starting time (sec):

(e) Lifting Hoist

(i) Manufacturer:
(ii) Make / Model No.:
(iii) Safe working load (SWL) (kg):
(iv) Lifting height (m):
(v) Test Certificate: *Yes/No

(f) Other Accessories

(i) Name plate of manual bypass switch:
(ii) Name plate of auto-changeover switch:

4.1.2 Type of Control

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

(a) Starting * Automatic / Manual

(b) Loading Transfer to Generating Set * Automatic / Manual

(c) Stopping * Automatic / Manual

(d) Load Transfer to Mains * Automatic / Manual

4.1.3 Insulation Resistance Test (Temporarily open alternator star point)

(a) Brown phase (L1) to earth _____ megaohm

(b) Black phase (L2) to earth _____ megaohm

(c) Grey phase (L3) to earth _____ megaohm

(d) Brown phase (L1) to Black phase (L2) _____ megaohm

(e) Black phase (L2) to Grey phase (L3) _____ megaohm

(f) Grey phase (L3) to Brown phase (L1) _____ megaohm

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

4.1.4 Control Function Test

			Function Test	Setting	Remarks
1. Starting	Manual				
	Simulate Mains Failure	Test 1*			
		Test 2**			
	Delay Start Timer				
	Delay Repeat Start				
2. Stopping	Manual				
	Resumption of Mains ***				
	Delay Stop Timer ****				
3. Engine Protection	Overload Trip (MCCB)				
	Engine Over/ Under Speed (rpm)	HL			
		LL			
	Low Lub-oil	HL			
	Pressure (kPa)	LL			
	Coolant Temperature (°C)	HL			
		LL			
	Over Voltage Trip (V)				
	Under Voltage Trip (V)				
	Over/Under Frequency (Hz)				
4. Others	Response Time from Mains Failure to Changeover (Sec)				
	Battery 2 Attempt to Start (For FSI generator sets)				
	Battery 3 Attempt Start (For non-FSI generator set)				
	Quick closing Mechanism				
	Governor Function				
	Voltage Regulator				
	Auto-starting of Vent. Fan				
	Manual Override Facilities				
	Phase Sequence of Alternator Output				
	Frequency Setting				
	Step-load Acceptance Test (Cold start and accept loading of 75% the rated capacity)				

Note :- * Refer to function test on capability to start and transfer load to Generating Set automatically.
** Refer to function test on capability to start but without load transfer if mains resume during engine starting.
*** Refer to function test on capability to automatic transfer load back to mains automatically after a preset time delay and immediately back to generator if mains fail within the above time delay period.
**** Refer to function test on capability to cool engine for a preset period after load is transferred to mains

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

4.1.5 Dummy Load Test

(Parameters to be recorded at 15 min interval during the whole dummy load test period)

Time from start																				
Duration (HR) (minimum)		1/2			1/2			1			1			1			1/2			
Duration (HR) (actual)																				
Frequency (Hz)																				
Current (Amp)	L1																			
	L2																			
	L3																			
Voltage (Volt)	L1-L2/ L1-N																			
	L2-L3/ L2-N																			
	L3-L1/ L3-N																			
Dummy Load	kW																			
	% Full Load	0%			25%			50%			75%			100%			110%			
Engine Speed (RPM)																				
Cooling Water Temp.																				
Engine Oil Temp. (°C)																				
Engine Oil Pressure (kPa)																				
Fuel Consumption (L)																				
Engine Room Temp. (°C)																				

4.1.6 Earthing Protection Test

Measured Earthing Resistance		
Earthing Relay Make _____ Model _____ Serial No. _____ Rated Current _____	Current Setting	
	Time Setting	
	Function Test	

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

4.1.7 Noise Level Measurement

Location	**Mean Sound Level (dBA)**
Background	
Inside Generator Room (1m from Generator Set)	
Outside Generator Room (1m from Radiator Exhaust)	
Outside Generator Room (1m from Door)	
Outside Generator Room (1m from Louvre)	
Outside Generator Room (1m from flue discharge if possible)	
Outside Generator Room (Pre-defined Site 1 at the nearest Noise Sensitive Receiver)	
Outside Generator Room (Pre-defined Site 2 at the nearest Noise Sensitive Receiver)	
Outside Generator Room (Other pre-defined site at the nearest Noise Sensitive Receiver)	

4.1.8 Comment

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

Annex III

List of Calibrated Equipment/Instruments Necessary for the Testing and Commissioning Works

Unless otherwise specified, the equipment/instruments used shall meet the requirements shown in the table below.

Performance Specification	Accuracy	Maximum period between calibrations
Tachometer 30-5000 rpm	+1%	1 year
Multi-tester (AVO) 0-1000V 0-10A 0-1MΩ	+1%	1 year
Clamp on ammeter 0-1000A	+1%	1 year
Insulation tester 500V-1000V	+1%	1 year
Pressure Gauge 0-100kPa 0-1000kPa	+2%	1 year
Sound meter 0-120 dBA	+2%	1 year
Other necessary testing equipment	+2%	1 year

Notes: Apart from the testing equipment/instruments above, the Contractor shall provide additional calibrated equipment/instruments in accordance to the recommendations by the manufacturers to facilitate the inspection, testing and commissioning of Emergency Generator.