TESTING AND COMMISSIONING PROCEDURE

FOR

EMERGENCY GENERATOR INSTALLATION

IN

GOVERNMENT BUILDINGS

OF

THE HONG KONG SPECIAL ADMINISTRATIVE REGION

2007 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 based on its 2000 edition by the Mechanical Installation Specialist Support Group that was established under the Building Services Branch Technical Information and Research & Development Committee. With the benefit of information technology, electronic version of this new edition is to be viewed on and free for download from the Architectural Services Department (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 Architectural Services Department welcomes comments on its contents at anytime 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 emergency generator 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 here. The Architectural Services Department 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.

TABLE OF CONTENTS

Annex

Testing and Commissioning Procedure for Emergency Generator Installation

1. Introduction

The procedures stated in this document 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) / Project Electrical and Mechanical Engineer (PEME) and Project Building Services Inspector (PBSI) / Project Electrical and Mechanical Inspector (PEMI) in the following aspects with respect to testing and commissioning (T & C):

(i) To vet and approve the T & C procedures proposed and submitted by the Contractor;
(ii) To witness those T & C procedures as specified; and
(iii) To accept the T & C certificates and other supporting data.

The Contractor shall carry out the T & C works as detailed in this document. Supplementary T & C plans may be proposed by the Contractor as appropriate and agreed by PBSE/PEME, 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 latest General Specification for Electrical Installation (the General Specification) 2007 Edition issued by the Architectural Services Department. If there is any discrepancy between this procedure and the General Specification, the General Specification shall take precedence.

2. Objectives of the T & C 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 through a series of tests 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 Procedure.

3. Scope of the T & C 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 installation complies with all relevant statutory requirements and regulations. The T & C works shall also comply with all site safety regulatory requirements currently in force namely:

(i) Electricity Ordinance, Chapter 406, and its subsidiary legislations
(ii) The latest Code of Practice for the Electricity (Wiring) Regulations
(iii) IEC 60364 "Electrical Installations of Building"
(iv) Fire Services Ordinance, Cap.95, and its subsidiary legislations
(v) Gas Safety Ordinance, Cap. 51, and its subsidiary legislations
(vi) Air Pollution Control Ordinance, Cap. 311, and its subsidiary legislations

3.2 Functional Performance Tests

The purpose of functional performance tests is to demonstrate that the equipment/installation can meet the functional and performance requirements as specified in the General/Particular Specifications. Functional performance test should proceed from the testing of individual components to the testing of different systems in the installation.

The Contractor may have to make temporary modifications as the test proceeds. 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 General/Particular Specifications. 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 in the General/Particular Specification.

Any performance deficiencies revealed during the functional performance tests must be evaluated to determine the cause and whether they are part of the contractual obligations. 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/PEME, 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 and Statutory Inspections

Commissioning is the advancement of an installation from the stage of static completion to full working conditions and to meet the performance requirements as specified in the General/Particular Specification. This will

include setting into operation and regulation of the installation. It is expected that 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.

Where necessary, after the proper testing and commissioning of the Emergency Generator Installation, the Contractor shall notify the appropriate authority, through the PBSE/PEME of the completion of the installation and its readiness for final inspection.

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/PEME for approval.

All inspection and T & C results shall be recorded in the data record forms shown in Part 3 and 4 of Annex II. Data recorded in other formats may also acceptable subject to agreement between the PBSE/PEME and the Contractor. Upon completion of all the required T & C works, the Contractor's project engineer shall complete and sign a testing and commissioning certificate as shown in Part 1 and 2 of 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/PEME. Deviations in performance from the General/Particular Specifications or the design intent should be recorded, with a description and analysis included.

Where required in the General Specification, the Contractor shall conduct a final evaluation of the performance of the Emergency Generator Installation, the results of which shall be included in the commissioning report.

4. T & C Procedures

4.1 Tests and Inspections during Construction

Certain tests will be carried out on different systems of the installation during construction to ensure their suitability for operating at the design conditions. Certificates of such tests have to be issued together with certificates of any work tests.

(N.B. The following tests should be conducted in accordance with the procedures as specified by the manufacturers. The testing procedures, instruments and records should be submitted by the Contractor for approval of PBSE/PEME)

Relevant Clauses in Annex II

4.1.1 Emergency Generator

(a) Visual inspection on engine, alternator, radiator, and various systems of the generating set	N.A.
(b) Full operating test	
(c) Control function test	
(d) Circuit & engine protection tests	
(e) Fuel consumption test	
(f) Step load acceptance test	

4.1.2 Control Cubicle

(a) Visual inspection on control panel	N.A.
(b) Performance tests on individual components	
(c) Electrical resistance test (Ductor test)	
(d) Temperature rise test	

4.1.3 Underground/ Daily Services Fuel Tank

(a) Visual inspection on welding surfaces and primer coating	Clause 3.1
(b) Hydraulic test	

4.2 Functional Performance Tests

4.2.1 Emergency Generator

(N.B. The tests marked with "" below should be performed either under section 4.2.1 or 4.3.1 subject to the approval of PBSE/PEME)*

(a) Pre-commissioning inspection on various components / systems	Clause 3.3, 3.4.1, 3.4.2, 4.1.4 & 4.1.5
(b) Control function test*	
(c) Dummy load test*	
(d) Battery charger output test*	
(e) Step load acceptance test*	

4.2.2 Control Cubicle

(a) Pre-commissioning inspection on various components / systems	Clause 3.4.3
(b) Performance tests of individual components such as voltmeter, ammeter, frequency meter, wattmeter, indicating lamps, buttons and switches	
(c) Circuit protection & load transfer tests	

4.2.3 Underground/Daily Services Fuel Tank

(a) Pre-commissioning inspection on the construction, welding, painting and components of tank & pipework	Clause 3.2
(b) Hydraulic test	

4.3 Commissioning and Statutory Inspections

(N.B. The tests marked with "" below should be performed either under section 4.2.1 or 4.3.1 subject to the approval of PBSE/PEME)*

4.3.1 Emergency Generator

Clause 3.5, 4.1.3 to 4.1.7

(a) Insulation test
(b) Control function test*
(c) Dummy load test*
(d) Earthing protection test
(e) Battery charger output test*
(f) Step-load acceptance test*
(g) Noise level measurement

Annex I

Testing and Commissioning Progress Chart for "Emergency Generator Installation"

Contract No.: _____
Contract Title: _____
Name of Contractor/sub-contractor: _____
Contract Period: / /20 to / /20 * Revised/Actual Completion Date : / /20

	Testing and Commissioning Progress Chart for Emergency Generator Installation (Rev.)(1)																		
	Dates (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 Record of Test																		
2.	**Pre-commissioning Inspection**	3.4																	
	Submission of Record of Test																		
3.	Insulation Resistance Test	3.5 & 4.1.3																	
	Submission of Record of Test																		
4.	Control Functional Test	3.5 & 4.1.4																	
	Submission of Record of Test																		

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

Testing and Commissioning Progress Chart for "Emergency Generator Installation"

	Testing and Commissioning Progress Chart for Emergency Generator Installation (Rev.)(1)																		
	Dates (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 Record of Test																		
6.	**Earth Protection Test**	3.5 & 4.1.6																	
	Submission of Record of Test																		
7.	**Submission of T & C Certificate**																		

Notes
* Delete if not applicable
(1) Insert revision no.
(2) Insert additional columns as necessary
S - schedule % completion
A - actual % completion

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

Annex II

Testing and Commissioning Certificate for Emergency Generator Installation

Part 1 : Detail 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 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 procedure and/or any other procedures agreed between the PBSE/PEME 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 as indicated in the COMMENTS items.

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

(Name of Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
(Designation of Contractor's Representative)	Signature - ( )	Post : Tel. No. : Date :	
(Name and Stamp of Contractor)	Signature - ( )	Post : Tel. No. : Date :	

Note : This certificate must be signed by a person authorized by the Firm/Contractor.

* Delete if not applicable

Part 3 Items Inspected and Tested

		Item tested/ checked by Contractor	Items witnessed by PBSE/PEME/ PBSI/PEMI
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 are 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
3.2	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, 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

Tested / Checked by : (Name of 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/PEME/ PBSI/PEMI
3.3	Visual inspection		
3.3.1	The Generating Set has been properly fixed on a common steel section base frame.	*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.	*Yes/No	*Yes/No
3.2.5	The radiator cooling fins and water tank are in good condition and properly fixed.	*Yes/No	*Yes/No
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 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 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 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	Where specified, facilities for generation at 380/220V have been provided.	*Yes/No	*Yes/No
3.3.16	Starting batteries have been provided and properly installed.	*Yes/No	*Yes/No

Tested / Checked by : (Name of 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/PEME/ PBSI/PEMI
3.4	Pre-commissioning inspection		
3.4.1	Diesel engine	*Yes/No	*Yes/No
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-fee insulation.	*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
3.4.2	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

Tested / Checked by : (Name of 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/PEME/ PBSI/PEMI
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 ferrules.	*Yes/No	*Yes/No
3.4.3.3 The following devices are provided in the control cubicle:		
a) Voltmeter & selector switch	*Yes/No	*Yes/No
b) Ammeter & selector switch	*Yes/No	*Yes/No
c) Frequency meter	*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 c/w charging rate ammeter	*Yes/No	*Yes/No
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

Tested / Checked by : (Name of 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/PEME/ PBSI/PEMI
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) 7.5-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 withdraw-able air circuit breaker or 4 pole MCCB c/w overload & short cot. 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
3.5	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
	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
3.6	Comment	*Yes/No	*Yes/No

Tested / Checked by : (Name of 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

(i) Generating Set

1. Manufacturer
2. Model
3. Net prime rating (MCR) (kW)

(ii) Diesel Engine

1. Make
2. Model
3. Serial No.
4. Rated power (kW)
5. Speed (rpm)
6. Governor
7. Turbocharger (type/model)

(iii) Alternator

1. Make
2. Model
3. Serial No.
4. Rated kVA
5. Voltage (V) / Full load current (A)
6. Phase / Rated p.f.
7. Insulation class

(iv) Starting Battery

1. Manufacturer
2. Make/Model No.
3. No. of battery / Voltage (V)
4. Ampere hour
5. Starting time (sec)

(v) Lifting Hoist

1. Manufacturer
2. Make / Model No.
3. Safe working load (kg)
4. Lifting height (m)
5. Test Certificate *Yes/No

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

(vi) Other Accessories

1. Name plate of manual bypass switch
2. Name plate of auto-changeover switch

4.1.2 Type of Control

Starting	*Automatic/Manual
Loading Transfer to Generating Set	*Automatic/Manual
Stopping	*Automatic/Manual
Load Transfer to Mains	*Automatic/Manual

4.1.3 Insulation Resistance Test (Temporarily open alternator star point)

1.	Brown phase (L1) to earth	Megaohm _____
2.	Black phase (L2) to earth	Megaohm _____
3.	Grey phase (L3) to earth	Megaohm _____
4.	Brown phase (L1) to Black phase (L2)	Megaohm _____
5.	Black phase (L2) to Grey phase (L3)	Megaohm _____
6.	Grey phase (L3) to Brown phase (L1)	Megaohm _____

Tested / Checked by : (Name of 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 Overspeed	HL			
		LL			
	Low Lub-oil Pressure (kPa)	HL			
		LL			
	High Water Temp. (^{o}C)	HL			
		LL			
	Under Voltage Trip				
	Overvoltage Trip				
	Under Frequency (Hz)				

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

4.1.4 (Con't)

Control Function Test		Function Test	Setting	Remarks
4. Others	Response Time from Mains Failure to Changeover (Sec)			
	Battery 3 Attempt Start			
	Quick closing Mechanism			
	Governor Function			
	Voltage Regulator (346V - 380V)			
	Auto-starting of Vent. Fan			
	Manual Override Facilities			
	Phase Sequence of Alternator Output			
	Frequency Setting			
	Step-load Acceptance Test			

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. (^{o}C)																					
Engine Oil Pressure (kPa)																					
Fuel Consumption (L)																					
Engine Room Temp. (^{O}C)																					

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

4.1.6 Earthing Protection Test

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

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 (at the nearest Noise Sensitive Receiver)	

4.1.8 Comment

Tested / Checked by : (Name of 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 Instrument Necessary for the T & C Works

Performance Specification	Accuracy	Maximum period between calibrations
Tachometer 30-5000 rpm	+1%	1 year
Multi-tester (AVO) 0-1000V 0-10A 0-W	+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 above, the Contractor shall provide additional calibrated equipment in accordance to the recommendations by the manufacturers to facilitate the inspection, testing and commissioning of Emergency Generator. All equipment shall be calibrated by laboratories accredited by the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or other laboratory accreditation schemes as approved by the PBSE.