

BUILDING SERVICES BRANCH
TESTING AND COMMISSIONING
PROCEDURE NO. 11
FOR
EMERGENCY GENERATOR INSTALLATION
IN
GOVERNMENT BUILDINGS
HONG KONG

HONG KONG SPECIAL ADMINISTRATIVE REGION GOVERNMENT

Building Services Branch
Architectural Services Department
(2000 Edition)

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B.S.B. Testing and Commissioning Procedure No. 11

Emergency Generator Installation

1. Introduction

- 1.1 This procedure is intended to lay down the minimum testing and commissioning requirements to be carried out by the Contractor on a new Emergency Generator Installation upon completion or on an existing Emergency Generator Installation after a major alternation. Additional testing and commissioning (T & C) requirements may be proposed by the Contractor as appropriate and agreed by the Project Electrical and Mechanical Engineer (PEME), e.g. for special equipment supplied and/or installed by the Contractor.
- 1.2 This procedure is also written to facilitate the PEME and Project Electrical and Mechanical Inspector (PEMI), in carrying out the following aspects of work with respect to 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.
 - (iii) To receive the T & C certificate and other supporting data.

2. General Requirements

- 2.1 The Contractor shall submit the T&C procedures together with the Testing and Commissioning progress chart in appendix B to the PEME for approval. The submission shall be made at least one month before the commencement of T&C.
- 2.2 Where tests are required to be witnessed by the PEME/PEMI, the Contractor shall give due advance notice (usually not less than three days) and provide details of date, time and type of tests to be performed.
- 2.3 Upon completion of such T & C procedure, the Contractor shall complete and sign a testing and commissioning certificate as Appendix A, to the effect that agreed T & C procedures have been duly carried out.
- 2.4 Before carrying out any test, the Contractor shall ensure that the installations comply with the statutory requirements and regulations.

3. Testing and Inspection

- 3.1 The Contractor shall carry out the tests and inspections as shown in Part 3 and record the test results on Part 4 of Appendix A and as agreed between the PEME and the Contractor.

3.2 The Contractor shall provide all the necessary staff, labour, materials and equipment for a thorough test and examination of the installation.

3.3 Factory Inspection of Underground Tank

3.3.1 The Contractor shall make arrangement with PEME/PEMI to carry out inspection at the factory at appropriate time of the manufacturing process in order that the quality of welding surface preparation and application of primer can be ascertained. The results of hydraulic test shall also be submitted.

3.4 Visual Inspection

3.4.1 Upon of completion equipment installation and prior to carrying out test runs, the Contractor shall visually inspect the installation and satisfy that the equipment has been properly installed for both the primer mover and the alternator. All the moving parts are free from obstructions. A visual inspection checklist has been prepared and is shown in Part 3 of the Testing and Commissioning Certificate in Appendix A. This checklist is not exhaustive, the Contractor should add on other relevant items as appropriate.

3.5. Pre-commissioning Inspection

3.5.1 This pre-commissioning inspection is to be carried out by the Contractor to ensure that the prime mover, the alternator, the control system etc. are ready for the commissioning exercise.

4. Statutory Inspection/Commissioning

4.1 After the proper testing and commissioning of the emergency generator installation, the Contractor shall notify the appropriate Authority, through the PEME, on the completion of the installation and its readiness for inspection and testing.

4.2 A full testing and commissioning exercise shall be carried out by the Contractor after the visual inspections and pre-commissioning inspections.

4.3 The exercise shall consist of the following minimum tests:

- (i) Insulation test
- (ii) Control function test
- (iii) Dummy load test
- (iv) Earthing protection test

(v) Battery charger output test

(vi) Step-load acceptance test

5. Calibrated Equipment

5.1 The contractor shall supply calibrated equipment as stipulated in the Specification of the Contract for the inspection, measuring and testing of the installation. The equipment shall be calibrated by laboratories accredited by the Hong Kong Laboratory Accreditation Scheme (HKLAS) or other recognised accredited laboratories.

Testing and Commissioning Certificate on 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 PEME :
- 1.6 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 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 Appendix A of this procedure and that the results are satisfactory. A record of the tests has been prepared and submitted to the PEME.

Signature of Contractor's Representative _____

Full Name of Contractor's Representative _____

Designation of Contractor's Representative _____

Name and Stamp of Contractor _____

Date _____

Note : This certificate must be signed by a person authorized by the Firm/Company.
* Delete if not applicable

Items tested/
checked by
Contractor

Items witnessed
by
PEME/PEMI

Part 3 Items Inspected and Tested

3.1	<u>Underground tank</u>		
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	<u>Visual inspection</u>		
3.2.1	The generator set has been properly fixed on a common steel section base frame.	*Yes/No	*Yes/No
3.2.2	Protection screen has been provided on all moving parts.	*Yes/No	*Yes/No
3.2.3	Protection guard has been provided on hot exhaust.	*Yes/No	*Yes/No
3.2.4	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
3.2.6	The water circulation pump with thermostatically controlled temp. regulator has been properly fixed.	*Yes/No	*Yes/No
3.2.7	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
3.2.8	The lubrication oil system with replaceable element types filter has been properly fixed.	*Yes/No	*Yes/No

Tested / Checked by _____ Signature _____
(Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
(Name(s) of *PEME/*PEMI)

Appendix A

		Items tested/ checked by <u>Contractor</u>	Items witnessed by <u>PEME/PEMI</u>
3.2.9	The fuel oil system c/w filter, fuel transfer pumps has been properly installed.	*Yes/No	*Yes/No
3.2.10	The fuel control solenoid c/w emergency shut off valve has been provided and properly installed.	*Yes/No	*Yes/No
3.2.11	The tubular exhaust silencer has been properly installed.	*Yes/No	*Yes/No
3.2.12	For remote radiator, if applicable, c/w break tank booster pump, heat exchanger etc. has been properly installed.	*Yes/No	*Yes/No
3.2.13	The enclosure to the alternator satisfy IP21 or as specified.	*Yes/No	*Yes/No
3.2.14	Anti-condensate heater for the alternator has been provided and proper fixed.	*Yes/No	*Yes/No
3.2.15	Where specified, facilities for generation at 380/220V have been provided.	*Yes/No	*Yes/No
3.2.16	Starting batteries have been provided and properly installed.	*Yes/No	*Yes/No
3.3	<u>Pre-commissioning inspection</u>		
3.3.1	Diesel engine		
3.3.1.1	Radiator water is at right level.	*Yes/No	*Yes/No
3.3.1.2	Lubrication oil is at right level and with replaceable filter.	*Yes/No	*Yes/No
3.3.1.3	The engine exhaust has been properly fixed and covered with asbestos-free insulation.	*Yes/No	*Yes/No
3.3.1.4	The engine anti-vibration mounting is effective.	*Yes/No	*Yes/No
3.3.1.5	Proper replaceable air filter has been installed.	*Yes/No	*Yes/No
3.3.1.6	Effective and adequate earth bonding have been provided for the engine and alternator.	*Yes/No	*Yes/No
3.3.2	Alternator		
3.3.2.1	Batteries electrolyte is at right level.	*Yes/No	*Yes/No

Tested / Checked by _____ Signature _____
(Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
(Name(s) of *PEME/*PEMI)

Appendix A

		Items tested/ checked by <u>Contractor</u>	Items witnessed by <u>PEME/PEMI</u>
3.3.2.2	Batteries output voltage is as specified.	*Yes/No	*Yes/No
3.3.2.3	The alternator output terminal is at correct phase sequence.	*Yes/No	*Yes/No
3.3.3	Control cubicle	*Yes/No	*Yes/No
3.3.3.1	Permanent Chinese/English labels have been provided for all accessories.	*Yes/No	*Yes/No
3.3.3.2	All control wirings are fitted with ferrules.	*Yes/No	*Yes/No
3.3.3.3	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
3.3.3.4	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
3.3.3.5	Indication lamp for:		
a)	Mains available	*Yes/No	*Yes/No

Tested / Checked by _____ Signature _____
(Name of Contractor’s Representative)

Witnessed by _____ Signature(s) _____
(Name(s) of *PEME/*PEMI)

Appendix A

		Items tested/ checked by <u>Contractor</u>	Items witnessed by <u>PEME/PEMI</u>
b)	Generator on load	*Yes/No	*Yes/No
c)	Load supplied from mains	*Yes/No	*Yes/No
3.3.3.6	Generator output under voltage & over voltage protection devices	*Yes/No	*Yes/No
3.3.3.7	Approved type 3 pole withdrawable air circuit breaker or 3 pole MCCB c/w overload & short cot. Protection	*Yes/No	*Yes/No
3.3.3.8	Mechanically & electrically interlocked 4-pole contactor for automatic load transfer & 4-pole manual by-pass	*Yes/No	*Yes/No
3.4	<u>A full testing has been carried out and the results of the following tests have been recorded and submitted to B.S.B.</u>	*Yes/No	*Yes/No
a)	Insulation test		
b)	Control functions test		
c)	Dummy load test		
d)	Earthing protection test		
e)	Battery charger output test		
f)	Step-load acceptance test		

Tested / Checked by _____ Signature _____
(Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
(Name(s) of *PEME/*PEMI)

Appendix A

Items tested / Items witnessed
checked by _____ by _____
Contractor PEME/PEMI

3.5

Comments

*Yes/No

*Yes/No

Note: * Delete if not applicable

Tested / Checked by _____ Signature _____
(Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
(Name(s) of *PEME/*PEMI)

Part 4 : Test Record attached to the Test Certificate

4.1 Emergency Generator Installation

4.1.1 Equipment Details

4.1.1.1 Generator Set

- a) Manufacturer
- b) Model
- c) Net prime rating (MCR) (kW)

4.1.1.2 Diesel Engine

- a) Make
- b) Model
- c) Serial No.
- d) Rated power (kW)
- e) Speed (rpm)
- f) Governor
- g) Turbocharger (type/model)

4.1.1.3 Alternator

- a) Make
- b) Model
- c) Serial No.
- d) Rated kVA
- e) Voltage (V) / Full load current (A)
- f) Phase / Rated p.f.
- g) Insulation class

4.1.1.4 Starting Battery

- a) Manufacturer
- b) Make/Model No.
- c) No. of battery / Voltage (V)
- d) Ampere hour
- e) Starting time (sec)

4.1.1.5 Lifting Hoist

- a) Manufacturer
- b) Make / Model No.
- c) Safe working load (kg)
- d) Lifting height (m)
- e) Test Certificate *Yes/No

4.1.1.6 Other Accessories

- a) Name plate of manual bypass switch
- b) Name plate of autochangeover switch

Tested / Checked by _____ Signature _____
 (Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
 (Name(s) of *PEME/*PEMI)

4.1.2	<u>Type of Control</u>	
4.1.2.1	Starting	*Automatic/Manual
4.1.2.2	Loading Transfer to Generator	*Automatic/Manual
4.1.2.3	Stopping	*Automatic/Manual
4.1.2.4	Load Transfer to Mains	*Automatic/Manual
4.1.3	<u>Insulation Resistance Test</u> (Temporarily open alternator star point)	
4.1.3.1	Red phase to earth	Megaohm _____
4.1.3.2	Yellow phase to earth	Megaohm _____
4.1.3.3	Blue phase to earth	Megaohm _____
4.1.3.4	Red phase to yellow phase	Megaohm _____
4.1.3.5	Yellow phase to blue phase	Megaohm _____
4.1.3.6	Blue phase to red phase	Megaohm _____

Tested / Checked by _____ Signature _____
 (Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
 (Name(s) of *PEME/*PEMI)

4.1.4 Control Function Test

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. °C	HL		
		LL		
	Under Voltage Trip			
	Overvoltage Trip			

- Note : *
- ** Refer to function test on capability to start and transfer load to generator automatically.
 - ** Refer to function test on capability to start but without load transfer if mains resumes 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 _____ Signature _____
(Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
(Name(s) of *PEME/*PEMI)

4.1.4 Control Function Test (Con't)

Control Function Test		Function Test	Setting	Remarks
4. Others	Reponse 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			

4.1.5 Dummy Load Test

Time from start							
Duration (HR) (minimum)		1/2	1/2	1	1	1	1/2
Duration (HR) (actual)							
Frequency (Hz)							
Current (Amp)	R						
	Y						
	B						
Voltage (Volt)	B-Y / R-N						
	Y-B / Y-N						
	B-R / B-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 Temperature (°C)							

Tested / Checked by _____ Signature _____
 (Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
 (Name(s) of *PEME/*PEMI)

4.1.6 Earthing Protection Test

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

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 (at the nearest Noise Sensitive Receiver)	

Tested / Checked by _____ Signature _____
 (Name of Contractor's Representative)

Witnessed by _____ Signature(s) _____
 (Name(s) of *PEME/*PEMI)

