

**HANDBOOK
FOR
COMMISSIONING REQUIREMENTS
OF
S1 – S5 PUBLIC SHELTERS**

Issued By:



Building and Construction Authority

CIVIL DEFENCE SHELTER ENGINEERING DEPARTMENT

SPECIAL FUNCTIONS DIVISION

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1 INTRODUCTION

1.1 This handbook provides the qualified persons (QPs) the procedure and necessary documents on the commissioning tests required for the commissioning of a public shelter.

1.2 The QPs are required to follow the procedure described herein to obtain approval for the commissioning tests from Civil Defence Shelter Engineering Department (CDSD), Special Functions Division of Building and Construction Authority (BCA) and the Shelter Operation and Management Branch (SOM) of Fire Safety & Shelter Department (FSSD) of the Singapore Civil Defence Force (SCDF).

(Note: The SOM of FSSD will conduct commissioning inspection with respect to shelter management requirements.)

2 REFERENCES

2.1 The QPs are advised to read this handbook in conjunction with the following documents:

- a) "Technical Requirements for S1 – S5 Public Shelters";
- b) "Technical Specifications for Works of Public Shelter"; and
- c) "Guidelines on Construction and Commissioning of S1 – S5 Public Shelters"

3 INSPECTION OF SHELTER STRUCTURAL WORKS

3.1 Air-Tightness Inspection

3.1.1 The following items are to be checked during the air-tightness inspection:

- a) Protective doors and hatches;
 - Visual inspection
 - Light penetration test
 - Chalk trace examination
- b) CD valves;
- c) Floor traps;
- d) Sumps with gully trap; and
- e) Scupper drains

3.1.2 A sample record for air-tightness inspection is given in Annex C1 as reference.

4 INSPECTION OF SHELTER BUILDING WORKS

4.1 Visual Inspection of Completed Public Shelter

4.1.1 The visual inspection of the completed public shelter requires the following items to be checked:

- a) Building works, including penetration details;
- b) Protective doors and hatches;
- c) Blast louvres, CD valves and sealing devices;
- d) Floor traps, sumps and scupper drains; and
- e) Water tank.

4.1.2 A sample record for visual inspection of completed public shelter is given in Annex C2 as reference.

4.2 Anchor Bolts Pull-Out Test

4.2.1 Anchor bolts shall be tested in batches from the same system; e.g. water

supply system. The minimum batch size shall be 26 and the maximum shall be 90. The sample size of a batch of anchor bolts and the acceptance/rejection criteria is based on the Double Sampling Plan for General Inspection Level II (Normal) as shown:

Batch Size	Sample Size		AQL = 6.5%	
			Ac	Re
26 to 50	1 st Sample	5	0	2
	2 nd Sample	10*	1*	2*
51 to 90	1 st Sample	8	0	3
	2 nd Sample	16*	3*	4*

Legend:

- AQL - Acceptable Quality Level
- Ac - Acceptance number
- Re - Rejection Number
- * - Cumulative number

4.2.2 The criteria for acceptance/rejection of a batch of anchor bolts based on the Acceptable Quality Level of 6.5% are as follows:

- a) For 1st Sample of test bolts:
 - i) If the number of defects found is less than or equal to the acceptance number (Ac), the batch is accepted.
 - ii) If the number of defects found is equal to or more than the rejection number (Re), the batch is rejected and 100% inspection shall be conducted on the rejected batch and all defects shall be rectified.
 - iii) If the number of defects found is more than Ac but less than Re, a second sample of bolts shall be selected from the same batch for the test; and

- b) For 2nd Sample of test bolts:
 - i) If the cumulative number of defects found in the two samples is less than or equal to the Ac, the batch is accepted.
 - ii) If the cumulative number of defects found in the two samples is equal to or more than Re, the batch is rejected and 100% inspection shall be conducted on the rejected batch and all defects shall be rectified.

4.2.3 A sample record for anchor bolts pull-out test is given in Annex C3 as reference.

5 COMMISSIONING OF SHELTER MECHANICAL & ELECTRICAL SYSTEMS

5.1 Individual Functional System Test (IFST)

5.1.1 Air-Conditioning and Mechanical Ventilation (ACMV) System / Environmental Control System (ECS)

5.1.1.1 The QP shall ensure that the ACMV system / ECS is in working condition and that it is checked, balanced and tested to ensure compliance with peacetime requirements.

5.1.1.2 For total supply air quantity less than or equal to 4.5 cubic m/s, the tolerance for air quantity shall be within +10% of the design air quantity. Thereafter, the tolerance shall be reduced by 1% for every increment of 4.5 cubic m/s of air quantity.

5.1.1.3 A sample record of IFST for ACMV system / ECS is given in Annex C4 as

reference.

5.1.2 Water Supply System

5.1.2.1 Prior to the commencement of the IFST, the water supply system shall be sterilised, tested and inspected to ensure compliance with peacetime requirements.

5.1.2.2 A sample record of IFST for water supply system is given in Annex C5 as reference.

5.1.3 Sanitary and Drainage System

5.1.3.1 Prior to the commencement of the IFST, the sanitary and drainage system shall be tested and inspected to ensure compliance with peacetime requirements.

5.1.3.2 A sample record of IFST for sanitary and drainage system is given in Annex C6 as reference.

5.1.4 Electrical Distribution System

5.1.4.1 Prior to the commencement of the IFST, the system shall be tested and inspected to ensure compliance with peacetime requirements.

5.1.4.2 A sample record of IFST for electrical distribution system is given in Annex C7 as reference.

5.1.5 **Communications and Monitoring System**

5.1.5.1 Prior to the commencement of the IFST, the system shall be tested and inspected to ensure compliance with peacetime requirements.

5.1.5.2 A sample record of IFST for communications and monitoring system is given in Annex C8 as reference.

5.1.6 **Generator and Fuel Delivery System**

5.1.6.1 Prior to the commencement of the IFST, the system shall be tested and inspected to ensure compliance with peacetime requirements.

5.1.6.2 A sample record of IFST for generator and fuel delivery system is given in Annex C9 as reference.

5.2 Combined Electrical and Communications Systems Test

5.2.1 The QP shall conduct a combined electrical and communications systems test after IFST for all the electrical systems have been conducted, using normal electricity supply or supply from the standby generator set if the latter is available.

5.2.2 A sample record of the combined electrical and communications system test is given in Annex C10 as reference.

6 COMMISSIONING TESTS FOR PUBLIC SHELTERS

6.1 Requirements for Internal Overpressure Test

6.1.1 General

6.1.1.1 Internal overpressure test is conducted after the completion of the air-tightness inspection to check if the external envelope of the public shelter, such as reinforced concrete floor slabs, roofs and walls, protective doors, frames and sleeves of CD valves and sealing devices for penetration of cables and pipes etc., are air-tight against air leakage.

6.1.2 Documents to be submitted with Method Statement

6.1.2.1 The QP is required to submit the following documents together with the method statement for the internal overpressure test to CDS for approval:

- a) All relevant as-fitted drawings, such as penetration of services at the external envelope, sanitary and drainage drawings, etc;
- b) Type test certificates of approval of CD valves, e.g. OV, OBV, BV, etc;
- c) Type test certificates of approval of sealing devices for cable transits, e.g. MCT;
- d) List of all test/measuring equipment. Calibration reports or certificates of test and measuring equipment shall be included; and
- e) Schematic layout of the test and measuring equipment.

6.1.3 Preparation Works

6.1.3.1 The QP shall check that the following items are carried out before commencing the test:

- a) Openings and services penetrations at the shelter external bounds of protection are properly sealed up;
- b) Blast doors and hatches at the shelter external bounds of protection are closed for the test;
- c) Floor / gully traps are water-sealed;
- d) Overpressure blast valves are installed;
- e) Test equipment are set up in accordance with the approved method statement; and
- f) Calibrated recording instruments and pressure differential meters are used.

6.1.4 Test Duration

6.1.4.1 The test shall run continuously for 30 minutes.

6.1.5 Test Procedure

6.1.5.1 The entire envelope shall be tested to 1.5 times the design overpressure in the main shelter area to check whether the public shelter envelope is air-tight against air leakage.

6.1.5.2 The test shall begin after the conditions have stabilised. The results of the test shall be recorded in *Record COM/1 - Internal Overpressure Test Record*. The following readings are to be recorded:

- a) Readings of overpressure shall be continuously recorded; and
- b) Readings for the air intake shall be recorded at 15 minutes interval. Airflow shall be measured in accordance with BS 848 or equivalent.

6.1.6 Approval Criteria

6.1.6.1 The test shall achieve the following results:

- a) Measured overpressure is maintained within $\pm 5\%$ of the test overpressure throughout the test; and
- b) The measured airflow is within $\pm 5\%$ of the airflow corresponding to the test overpressure.

6.2 Requirements for Overpressure Regime and Airflow Test

6.2.1 General

6.2.1.1 Overpressure regime and airflow test is carried out to test and commission the air supply system to ensure that it can regulate the airflow through the

ducts, dampers and CD valves in accordance with the functions and requirements of the public shelter.

6.2.2 Documents to be submitted with Method Statement

6.2.2.1 The QP shall submit the following documents together with the method statement for the overpressure regime and airflow test to CDS for approval:

- a) Test records of the Individual Functional System tests (IFST) for all mechanical systems;
- b) A set of final as-fitted drawings of all the mechanical systems installed in the public shelter;
- c) Letter of confirmation by QP that the gas filters comply with the technical specifications together with the batch test results;
- d) Type test certificate of approval for gas tight shut off valves;
- e) List of all test and measuring equipment, such as:
 - Hot-wire anemometers for measuring airflow
 - Pressure differential meters and gauges
 - Tachometers for measuring fan and motor speeds
 - Sound level meters
 - Sling psychrometers
 - Water flow meters
 - Thermo-hygrographs
 - Voltmeters, ammeters or multi-meters;
- f) Calibration reports or certificates of testing and measuring equipment shall be included; and

- g) Schematic layout of the test and measuring equipment.

6.2.3 Preparation Works

6.2.3.1 The QP shall check that the following items are in order before commencing the test:

- a) All services penetrations at CD bounds of gas protection and bounds of blast and gas protection are properly sealed. All other openings shall be sealed by appropriate sealing devices;
- b) All gas-tight doors, blast doors and hatches are closed;
- c) All floor/gully traps are water-sealed;
- d) All blast valves, overpressure valves and overpressure blast valves are installed;
- e) Pre-filters for air intake blast valves are installed;
- f) All pressure differential meters are installed. The pressure differential meter measuring the main shelter area shall be connected to a chart reader capable of recording continuous readings;
- g) Test equipment is set up in accordance with the approved method statement; and
- h) A combined electrical and communications systems test using normal electricity supply. A sample record of the combined electrical and communications systems test is given in Annex C10 as reference.

6.2.4 Test Duration

6.2.4.1 The duration of the entire test shall be 4 hours. The ventilation mode shall be tested continuously for 2 hours before switching over to the filtration mode for another 2 hours of testing.

6.2.5 Test Procedure

6.2.5.1 The test shall begin only after the required overpressure has been maintained. The results of the test shall be recorded in *Record COM/2 - Overpressure Regime and Airflow Test Record*. The following test results shall be recorded:

- a) Readings of the overpressure at the main shelter area shall be continuously recorded;
- b) Readings of the fresh air intake quantity shall be recorded at 30 minutes interval. The airflow shall be measured in accordance with BS 848 or equivalent;
- c) Readings of the airflow quantity and pressure drop at all the overpressure and overpressure blast valves locations shall be recorded at 30 minutes interval. The readings shall be tabulated for all rooms with overpressure valves and overpressure blast valves;
- d) The temperature and relative humidity (RH) in the main shelter area shall be continuously recorded on the thermo-hygrographic chart. Readings of temperature and RH for other rooms, including the plant rooms, shall be recorded at half hourly intervals; and
- e) The sound power level (in dbA) at designated locations in the main

shelter area and the plant rooms shall be recorded at the start and end of the test.

6.2.6 The above test procedure (para 6.2.5) shall be repeated for the filtration mode. Pressure drop simulators shall be installed to simulate the gas filter flow resistance as specified by the manufacturer of the gas filters.

6.2.7 Upon completion of the test, the button-up mode shall be simulated (i.e. closing the valves and shutting off the fresh air intake). The time taken for the pressure to drop to atmospheric pressure shall be recorded.

6.2.8 Approval Criteria

6.2.8.1 The test shall achieve the following results:

- a) Measured overpressure is maintained within $\pm 5\%$ of the design overpressure throughout the test; and
- b) Measured airflow is within $\pm 5\%$ of the design airflow.

6.3 Requirements for Integrated Systems Test (IST)

6.3.1 General

6.3.1.1 The purpose of the integrated systems test is to ensure that all the systems in the public shelter continue to function properly and reliably under normal supply and when electricity supply is switched from normal supply to the supply from the standby generator set.

6.3.1.2 The test shall be conducted after all shelter mechanical and electrical systems, including standby generator set, are installed and the individual functional system tests of all shelter M&E systems, internal overpressure

test and overpressure regime and airflow test are completed and approved.

6.3.2 Documents to be submitted with Method Statement

6.3.2.1 The QP shall submit the following documents together with the method statement for the integrated systems test to CDS for approval:

- a) Test reports and results for the Individual Functional System Test (IFST) for all electrical systems;
- b) Test report and results for the combined electrical and communications systems test;
- c) A set of final as-fitted drawings of all the electrical systems installed in the public shelter;
- d) List of test and measuring equipment together with the calibration certificates (similar to those for the overpressure regime and airflow test);
- e) Schematic layout of the test and measuring equipment;
- f) 1 set of "*Operations and Maintenance Manual for Public Shelter*";
- g) 1 set of "*Conversion Manual for Public Shelter*"; and
- h) *Public Shelter Management Requirements Inspection* (See Annex C11).

(Note: The QP shall also submit a copy of the Public Shelter Management Requirements Inspection to SOM of FSSD.)

6.3.3 Preparation Works

6.3.3.1 Preparation works shall be similar to those given in Section 6.2.3 for the overpressure regime and airflow test.

6.3.3.2 Before commencing the integrated systems test, the QP shall ensure that all preparation works are carried out and the standby generator set remains functional when switched over from the normal supply.

6.3.4 Test Duration

6.3.4.1 The duration of the entire test shall be 12 hours. All shelter M&E systems, including the electrical installations and standby generator set, shall be tested continuously for 6 hours in the ventilation mode before switching over to the filtration mode for another 6 hours of testing to test the performance, safety and reliability of the systems.

6.3.4.2 For public shelters designed with generator redundancy, the generators shall be switched over at least once during each mode.

6.3.5 Test Procedure

6.3.5.1 The test shall begin only after the required public shelter overpressure has been maintained. The following test results shall be recorded:

- a) For mechanical systems, the results shall be recorded in *Record COM/3A - Integrated Systems Test Record (Mechanical Systems)*. The readings shall be recorded as follows:
 - i) Readings of the overpressure shall be continuously recorded.

- ii) Readings of the fresh air intake quantity shall be recorded at hourly intervals. The airflow shall be measured in accordance with BS 848 or its equivalent.
 - iii) Readings of the airflow quantity, overpressure and pressure drop at all overpressure and overpressure blast valves shall be recorded at 30 minutes interval. The readings shall be tabulated for each room where the overpressure and/or overpressure blast valves are located.
 - iv) The temperature and relative humidity (RH) in the main shelter area (MSA) shall be continuously recorded on the thermo-hygrographic chart. Readings of temperature and RH for other rooms, including plant rooms, shall be taken at intervals of 2 hours.
 - v) The sound power level (in dbA) at designated locations in the main shelter area and the plant rooms (clean and dirty) shall be recorded at the start and end of each mode.
- b) For electrical systems, readings shall be recorded in *Record COM/3B - Integrated Systems Test Record (Electrical Systems)*.

6.3.6 The above test procedure shall be repeated for the filtration mode. Pressure drop simulators shall be installed to simulate the dirty filter condition as specified by the manufacturer of the gas filters.

6.3.7 Approval Criteria

6.3.7.1 The test shall achieve the following results:

- a) Measured overpressure is maintained within $\pm 5\%$ of the design overpressure throughout the test;

- b) Measured airflow is within $\pm 5\%$ of the design airflow
- c) All M&E systems shall remain fully functional during the entire test period; and
- d) The generator(s) shall be able to operate within the stipulated number of starts and shall run continuously without any malfunctioning throughout the tests.

7 DOCUMENTATION OF OPERATIONS AND MAINTENANCE MANUALS FOR PUBLIC SHELTER

7.1 General

7.1.1 The "*Operation & Maintenance Manuals for Public Shelter*" which shall be written in a comprehensive and concise manner that can be easily understood. In addition to the items which are required to be incorporated as given in the following sections, the manuals shall also have the regular items such as Contents page, Introduction and Conclusion.

7.2 Operations Manual

7.2.1 Content of Operations Manual

7.2.1.1 The Operations Manual shall include system descriptions (accompanied with schematic diagrams) and detailed descriptions of operating procedures which are necessary for the proper and smooth operation of the public shelter. System descriptions and operating procedures shall be given for the following systems:

- a) Protective Steelworks and Devices;
- b) Shelter Mechanical Equipment and Services
 - ACMV system / ECS (including CD valves)
 - Water supply system
 - Sanitary and drainage system; and
- c) Shelter Electrical Equipment and Services
 - Electrical distribution system
 - Communications and monitoring systems
 - Generator and fuel delivery system

7.2.1.2 The manual shall also include layout plans showing the CD zones and bounds of protection (e.g., gas protection, gas and blast protection, blast protection) and locations of penetrations through CD bounds of protection, including details such as cable transits, puddle flanges, etc.

7.2.2 Protective Steelworks and Devices

7.2.2.1 The following information shall be included:

- a) As-fitted layout plan(s) indicating the locations, types and sizes of all CD doors and hatches (e.g. gas-tight doors, blast doors and blast hatches);
- b) Operating procedures for doors of the air locks in the filtration mode; and
- c) Technical literature, catalogues and equipment operating instructions (such as motor driven doors).

7.2.3 Shelter Mechanical Equipment and Services

7.2.3.1 ACMV System / ECS (including CD Valves)

7.2.3.1.1 The following information shall be included:

- a) As-fitted layout plan(s) showing the entire ACMV system / ECS (including CD valves) and the CD equipment status monitoring system, if applicable;
- b) Detailed descriptions and illustrations of those components of the ACMV system / ECS which require operating procedures, making reference to the layout plan(s) for the identification of such components. The operating procedures for the ACMV system / ECS under the 3 modes of CD operations shall be given;
- c) Detailed descriptions of the operating procedure required to switch from normal to a CD mode and from one CD operation mode to another, namely:
 - i) Peacetime mode to conventional mode and back
 - ii) Conventional mode to filtration mode and back
 - iii) Peacetime mode to filtration mode and back
 - iv) Button-up mode;
- d) Detailed descriptions of the requirements (e.g. required airflow and overpressure) to achieve and maintain a particular CD mode of operation; and
- e) Technical literature, catalogues and equipment operating instructions.

7.2.3.2 Water Supply System

7.2.3.2.1 The following information shall be included:

- a) As-fitted layout plan(s) showing the entire water supply system;
- b) A detailed description of the operating procedure for the water supply system; and
- c) Technical literature, catalogues and equipment operating instructions.

7.2.3.3 Sanitary And Drainage System

7.2.3.3.1 The following information shall be included:

- a) As-fitted layout plan(s) showing the entire sanitary and drainage system;
- b) A detailed description of the operating procedure for the sanitary and drainage system; and
- c) Technical literature, catalogues and equipment operating instructions.

7.2.4 Shelter Electrical Equipment and Services

7.2.4.1 Electrical Distribution Systems

7.2.4.1.1 The following information shall be included:

- a) As-fitted layout plan(s) showing the entire electrical distribution system; and
- b) Technical literature, catalogues and equipment operating instructions.

7.2.4.2 Communications and Monitoring Systems

7.2.4.2.1 The following information shall be included:

- a) As-fitted layout plan(s) for the following communications and monitoring systems:
 - i) Door bell system
 - ii) Intercom system
 - iii) Public address system
 - iv) MATV system
 - v) Telephone system
 - vi) Door monitoring system;
- b) Detailed descriptions and illustrations of those components of the above communications and monitoring systems which require operating procedures, making reference to the layout plan(s) for identification of such components. For the door monitoring system, the operational procedures under the 3 modes of CD operation shall be given; and

- c) Technical literature, catalogues and equipment operating instructions.

7.2.4.3 Generator and Fuel Delivery System

7.2.4.3.1 The following information shall be included:

- a) As-fitted layout plans(s) showing the entire generator and fuel delivery system;
- b) A detailed description of the operating procedure required to switch from one supply mode to another (i.e. electrical mains supply to emergency supply from standby generator set.); and
- c) Technical literature, catalogues and equipment operating instructions.

7.3 Maintenance Manual

7.3.1 General

7.3.1.1 The Maintenance Manual shall contain detailed descriptions of the maintenance procedures needed to keep all the components and systems of the public shelter in good and working conditions. The QP shall make reference to the "*Maintenance Manual for CD Equipment in Public Shelters*" (jointly issued by FSSD and BCA) for the minimum maintenance works and schedules where applicable.

7.3.1.2 Maintenance procedures are required for the following systems:

- a) Structural members and architectural fixtures;
- b) Protective Steelworks and Devices;
- c) Shelter Mechanical Equipment and Services
 - ACMV system / ECS (including CD valves);
 - Water supply system; and
 - Sanitary and drainage system;
- d) Shelter Electrical Equipment and Services
 - Electrical distribution system;
 - Communications and monitoring systems; and
 - Generator and fuel delivery system.

7.3.2 Format of Maintenance Procedure

7.3.2.1 The maintenance procedure for each system (items a – d of Section 7.3.1.2) shall be presented in the format given below:

a) General Description

Short general description of each component or system and their individual equipment. The brand, make, model and capacities of the equipment shall be tabulated.

b) Maintenance Works and Schedule

A table shall be prepared, listing all maintenance works and schedule by components or systems (making reference to the layout plan(s) for identification of such items).

The maintenance works and schedules shall be in accordance with

the manufacturer's or supplier's recommendations, but not less than the minimum maintenance works and schedules stated in the "*Maintenance Manual for CD Equipment in Public Shelters*" (jointly issued by FSSD and BCA).

c) Trouble-shooting Checklist

A table listing the possible faults that may arise during the operation of the equipment, the symptoms indicating such faults and the respective corrective actions to be taken.

Safety considerations shall be highlighted so that equipment will not be damaged and personnel will not be endangered during trouble-shooting.

d) Spare Parts List

The types and quantities of spare parts shall be provided in accordance with the "*Technical Requirements for S1 – S5 Public Shelters*" and tender specifications. The spare parts shall be kept in the plant room.

e) Testing & Commissioning Results for All Systems

Test results of the individual functional system test (IFST) of all M&E systems and the integrated systems test (IST) shall be attached.

f) As-fitted Plans

i) As-fitted shelter building and structural layout plans, elevations and sections;

- ii) As-fitted layout plans, sketches and photographs with identification of equipment and its components for all shelter M&E systems. Legend shall be provided where appropriate; and
- iii) As-fitted plans for protective steelworks

8 DOCUMENTATION OF CONVERSION MANUAL FOR PUBLIC SHELTER

8.1 Content of Conversion Manual for Public Shelter

8.1.1 The "*Conversion Manual for Public Shelter*" shall consist of the following items:

- a) Summary Page;
- b) Preparation for Operation Readiness of Public Shelter;
- c) Conversion of Public Shelter from Peacetime to Emergency;
- d) Layouts of Public Shelter; and

8.1.2 In addition to the above, the manual shall have the regular items such Contents page, Introduction and Conclusion.

8.2 Summary Page

8.2.1 The summary page shall consist of a summary of all the design parameters of the public shelter and shall include the following details:

- a) Location of Public Shelter
- b) Date Commissioned (in the format dd-mmm-yyyy)
- c) Public Shelter Category

- d) Size of Main Shelter Area (m²)
- e) Public Shelter Capacity (no. of shelterees)
- f) Duration of Stay (hours)
- g) Overpressure Regimes (Pa) for:
 - i) Main shelter area
 - ii) Decontamination chamber
 - iii) Separation room
 - iv) Airlocks
 - v) AHU room
 - vi) Water tank room
- h) Effective capacities (litres per person per day) of water tanks for:
 - i) Drinking
 - ii) Decontamination
 - iii) Sanitary
- i) Capacity of each generator (KVA/3 phase)
- j) No. of gas filters (operating)
- k) No. of gas filters (standby)

8.3 Preparation for Operation Readiness of Public Shelter

8.3.1 Details shall be given for the following items:

- a) Removal of peacetime equipment and services
 - shall include a list of peacetime equipment and services that are to be removed during emergency.
- b) Inspection of shelter equipment and services
 - shall include a comprehensive list of all the shelter equipment, services, protective steelworks and devices which have to be inspected prior to the conversion. Reference shall be made to the "*Operations and Maintenance Manuals for Public Shelter*" where applicable.

- c) Preparation for conversion to public shelter
 - shall include a list of preparatory works that need to be carried out prior to the actual conversion.

8.4 Conversion of Public Shelter from Peacetime to Emergency

8.4.1 A public shelter may be converted from its peacetime usage to conventional mode of operation or filtration mode of operation. The procedures shall be given for the following conversions:

- a) Peacetime to conventional mode of operation and back;
- b) Conventional to filtration mode of operation and back;
- c) Peacetime to filtration mode of operation and back; and
- d) Button up mode.

8.4.2 The procedures shall include tabulated lists of the status (whether on/off or open/close) of the various shelter equipment, services, protective steelworks and devices.

8.5 Layout Plans of Public Shelter

8.5.1 The following layout plans shall be included:

- a) Plan showing the different CD zones and bounds of protection, locations of all CD doors and hatches, blast valves and louvres, etc. All peacetime equipment and services which are to be removed during the conversion to public shelter shall also be shown;
- b) Plan showing the layout of shelter equipment and services; and
- c) Plan showing the layout of shut off dampers, volume control

dampers, isolation valves and gas-tight shut-off valves.

9 CONCLUSION

- 9.1 After the commissioning tests has been satisfactorily conducted, the QP can proceed to apply for Approval of Commissioning Test for Public Shelter as described in the "*Guidelines on Construction and Commissioning of S1 – S5 Public Shelters*". Please note that the Notice of Approval of Commissioning Test for Public Shelter (Integrated Systems Test) is required for the purpose of obtaining the Certificate of Statutory Completion from the Building Plan Department of BCA.

COMMISSIONING TEST RECORDS

COMMISSIONING TEST
INTERNAL OVERPRESSURE TEST RECORD

Project Description : _____

 Project Reference No : _____

 Date of Inspection : _____

1. TEST PRESSURE

Test Pressure = 1.5 x Design Pressure
 = 1.5 x _____ Pa
 = _____ Pa

2. TEST AIRFLOW QUANTITY

Type of Valves	Position	Air Flow (CMH) at the Test Pressure (From the attached Charts)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
Total Airflow(CMH) =		

3. **MEASURED AIRFLOW QUANTITY**

Measured Location*	Airflow (CMH)		
	Reading 1	Reading 2	Reading 3
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Avg Airflow (CMH)			

Note : * Minimum is 6 locations per airflow reading

Measured Airflow : _____ CMH (average of the 3 readings)

Airflow Tolerance : _____ % of Test Airflow

4. **MEASURED OVERPRESSURE**

The average recorded overpressure is _____ Pa. The continuous chart reading is attached.

5. **CONCLUSION**

I certify that the Internal Overpressure Test is carried out in accordance with the requirements in the "Guidelines for Construction and Commissioning of S1-S5 Public Shelter" and "Handbook for Commissioning Requirements of S1 - S5 Public Shelters" and the results as attached are satisfactory and within the approval criteria.

Signature and Stamp of Qualified Person

Name & Address of Qualified Person

Date

Contact No

COMMISSIONING TEST
OVERPRESSURE REGIME AND AIRFLOW TEST RECORD

Project Description : _____

 Project Reference No : _____

 Date of Inspection : _____

1. **DESIGN OVERPRESSURE**

Design Overpressure = _____ Pa

2. **DESIGN AIR INTAKE**

Design Air Intake = _____ CMH

3. **GAS FILTER PRESSURE (DIRTY CONDITION)**

Gas Filter Pressure (Dirty Condition) = _____ Pa (for filtration Mode)

4. **MEASURED AIR INTAKE QUANTITY (Half Hourly Interval)**

Measured Location*	Ventilation Mode Airflow – (CMH)				Filtration Mode - Airflow (CMH)			
	1	2	3	4	5	6	7	8
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Avg Airflow (CMH)								

Note: * Minimum is 6 locations per airflow reading

Measured Air Intake : _____ CMH (average of the 8 readings)

Airflow Tolerance : _____ % of Design Air Intake

5. MEASURED PRESSURE DROP/AIR QUANTITY AT VALVES (Half Hourly Interval)

Measured Location/ Valves Designation	Design Over- pressure (Pa)	Ventilation Mode Pressure Drop (Pa)/Airflow (CMH)				Filtration Mode Pressure Drop (Pa)/Airflow (CMH)			
		1	2	3	4	5	6	7	8
1. MSA to Decon Rm									
2. Decon Rm to Separation Rm									
3. Separation Rm to External									
4. MSA to Airlock									
5. Airlock to External									
6.									
7.									
8.									
Total Airflow (MSA to External)									

6. MEASURED OVERPRESSURE (Half Hourly Interval)

Location	Design Over- pressure (Pa)	Ventilation Mode - Pressure (Pa)				Filtration Mode - Pressure (Pa)			
		1	2	3	4	5	6	7	8
1. *MSA									
2. Decon Rm									
3. Separation Rm									
4. Airlock									
5. Others (Pl specify)									
6.									
7.									
8.									

Note: *The reading for MSA is continuously monitored and the chart reading is attached.

Measured Overpressure (MSA) : _____ Pa (average of the 8 readings)

Overpressure Tolerance : _____ % of Design Overpressure

7. **TEMPERATURE & HUMIDITY (Hourly Interval)**

Measured Location	Ventilation Mode Temp(°C) & RH (%)		Filtration Mode Temp(°C) & RH (%)	
	1	2	3	4
1. *MSA				
2. Plant Rm (clean)				
3. Separation Rm				
4. Decon Rm				
5. Plant Rm (dirty)				
6. Others (pl specify)				
7.				
8.				

Note: * The temperature & humidity at the MSA is recorded continuously on the thermo-hygrographic unit and the chart is attached.

8. **SOUND LEVEL (Hourly Interval)**

Measured Location	Sound Power Level (dba)			
	Start	End	Start	End
1. MSA				
2. Plant Rm (clean)				
3. Plant Rm (dirty)				
4. Others to specify				
5.				
6.				
7.				

9. **BUTTON-UP MODE**

The Button up mode is simulated for 10 minutes. The air system functions normally with the air intake and all valves at the bounds of protection shut off.

The pressure in the MSA dropped to 0 Pa within _____ minutes.

10. **CONCLUSION**

I certify that the Overpressure Regime and Airflow Test is carried out in accordance with the requirements in the "Guidelines for Construction and Commissioning of S1 – S5 Public Shelters" and "Handbook for Commissioning Requirements for S1 - S5 Public Shelters" and the results as attached are satisfactory and within the approval criteria.

Signature and Stamp of Qualified Person

Name & Address Qualified Person

Date

Contact No

COMMISSIONING TEST
INTEGRATED SYSTEMS TEST RECORD (MECHANICAL SYSTEMS)

Project Description : _____

 Project Reference No : _____

 Date of Inspection : _____

1. **SHELTER INFORMATION**

a) Main Shelter Design Overpressure : _____ Pa
 b) Design Air Intake : _____ CMH

2. **MEASURED AIR INTAKE QUANTITY (at hourly interval)**

*Measured Location	Ventilation Mode (CMH)						Filtration Mode (CMH)					
	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3												
4												
5												
6												
7												
8												
Avg Airflow (CMH)												

Note: * Minimum is 6 locations per airflow reading

Measured Air Intake : _____ CMH (average of the 12 readings)

Airflow Tolerance : _____ % of Design Air Intake

3. MEASURED PRESSURE DROP / AIR QUANTITY AT VALVES (at hourly interval)

Measured Location/ Valves Designation	Design Over- pressure (Pa)	Ventilation Mode Pressure Drop (Pa)/ Airflow (CMH)						Filtration Mode Pressure Drop (Pa)/ Airflow (CMH)					
		1	2	3	4	5	6	7	8	9	10	11	12
1. MSA to Decon Room													
2. Decon Room to Separation Rm													
3. Separation Room to External													
4. MSA to Airlock													
5. Airlock to External													
6. Others (Pl specify)													
7.													
8. Total Airflow (MSA to external)													

4. MEASURED OVERPRESSURE (At hourly interval)

Location	Design Over- pressure (Pa)	Ventilation Mode - Over Pressure (Pa)						Filtration Mode - Over Pressure (Pa)					
		1	2	3	4	5	6	7	8	9	10	11	12
1. *MSA													
2. Decon Room													
3. Separation Rm													
4. Airlock													
5. Others (Pl specify)													
6.													
7.													
8.													

Note: * The reading for MSA is continuously monitored and the chart reading is attached.

Measured Overpressure (MSA) : _____ Pa (average of the 12 readings)

Overpressure Tolerance : _____ % of Design Overpressure

5. TEMPERATURE & HUMIDITY

Measured Location	Ventilation Mode Temp(°C) & RH (%)		Filtration Mode Temp(°C) & RH (%)	
	Start	End	Start	End
1. *MSA				
2. Plant Room (clean)				
3. Separation Room				
4. Decontamination Room				
5. Plant Room (dirty)				
6. Others (Pl specify)				
7.				
8.				

Note : *The temperature & humidity at the MSA is recorded continuously on the thermo-hygrographic unit and the chart is attached.

6. SOUND LEVEL (2 hourly interval)

*Measured Location	Ventilation Mode Sound Power Level (dbA)			Filtration Mode Sound Power Level (dbA)		
	1	2	3	4	5	6
1. MSA						
2. Plant Room (clean)						
3. Plant Room (dirty)						
4. Others (to specify)						
5.						
6.						
7.						
8.						

7. OPERATION OF OTHER MECHANICAL SYSTEMS (2 hourly interval)

Type of Systems	Operation Status of the systems (to tick)											
	1		2		3		4		5		6	
	OK	Not OK	OK	Not OK	OK	Not OK	OK	Not OK	OK	Not OK	OK	Not OK
1. Decon System												
2. Drinking System												
3. Floor Trap (Water Seal maintained)												
4. Others (to specify)												
5.												
6.												

8. CONCLUSION

I certify that I have supervised the installation of the shelter Mechanical systems (including the sanitary and drainage system) and they have been satisfactorily completed in accordance with the requirements of the "Technical Requirements for S1-S5 Public Shelters", "Technical Specifications for Works of Public Shelters", approved detailed plans and the conditions under which the plans were approved.

I also certify that the Integrated Systems Test has been carried out in accordance with the requirements in the "Guidelines for Construction and Commissioning of S1 – S5 Public Shelters" and "Handbook for Commissioning Requirements of S1 - S5 Public Shelters" and the results as attached are satisfactory and within the approval criteria.

Signature and Stamp of Qualified Person

Name & Address of Qualified Person

Date

Contact No

COMMISSIONING TEST
INTEGRATED SYSTEMS TEST RECORD (ELECTRICAL SYSTEMS)

Project Description : _____

 Project Reference No : _____

 Date of Inspection : _____

1A. GENERATOR SYSTEM STATUS CHECK

Capacity Of Generator : _____ KVA

Engine Make : _____ Alternator Make : _____

S/N	TEST	CHECKED	REMARKS
1	a) Lubricating Oil System		
	b) Lubrication Oil Level		
2	a) Cooling Water System		
	b) Radiator Water Level		
3	a) Fuel Oil Pumping System		
	b) Fuel Day Tank / Fuel Oil Level		
	c) Fuel Storage Tank / Fuel Oil Level		
4	Vee Belt		
5	Air Cleaner		
6	Meters / Gauges		
7	a) Control Panel		
	b) Electrical Connections		
	c) MCB's & Indication Lamps		
	d) Selector Switches / Meters		
	e) Rectifiers / Chargers		
8	a) Battery Condition		
	b) Electrolyte Level		

1B. GENERATOR SYSTEM

Duration Of Test : 12 hours (Readings to be taken every hour)

Hour Run Meter : From _____ hrs to _____ hrs

ITEM	TIME											
Oil Pressure												
Oil Temperature												
Coolant Temperature												
Load (KW)												
Voltage (V)												
Current (A) R												
Y												
B												
Power Factor												
Frequency												
Battery Charge Rate												
Room Temperature												

REMARKS :

2. ELECTRICAL AND COMMUNICATIONS SYSTEMS

S/N	SYSTEM	CHECKED	REMARKS
I	POWER		
	<p>a) <u>Manual Transfer Switch</u> Manual transfer switch (MTS) for changeover of supply is tested and is working.</p> <p>b) <u>Remote Start/Stop Buttons</u> Remote start/stop buttons on the generator control panel and generator duplicate control panel are tested and are working.</p>		
II	LIGHTING		
	Power failure is simulated and battery packs of emergency lights in all compartments are tested and are working.		
III	COMMUNICATIONS		
	<p>a) <u>Telephone Socket (s)</u> Telephone socket(s) is/are tested with telephone set(s) and is/are working.</p>		
	<p>b) <u>TV/FM Sockets</u> TV/FM sockets are tested with colour TV/ radio/signal strength meter and are working.</p>		
	<p>c) <u>Door Bell System</u> Bell buttons and bells are tested and are working.</p>		
	<p>d) <u>Intercom System</u> Intercom stations are tested and are working.</p>		
	<p>e) <u>Public Address System</u> All speakers, paging and chimes are tested and are working.</p>		
	<p>f) <u>Door Monitoring System</u> Mimic panel, local status panels and door limit switches are tested and are working.</p>		

3. CONCLUSION

I certify that I have supervised the installation of the shelter Electrical systems and they have been satisfactorily completed in accordance with the requirements of the "Technical Requirements for S1 - S5 Public Shelters", "Technical Specifications for Works of Public Shelters", approved detailed plans and the conditions under which the plans were approved.

I also certify that the Integrated Systems Test has been carried out in accordance with the requirements in the "Guidelines on Construction and Commissioning of S1 – S5 Public Shelters" and "Handbook for Commissioning Requirements of S1 - S5 Public Shelters" and the results as attached are satisfactory and within the approval criteria.

Signature and Stamp of Qualified Person

Name & Address of Qualified Person

Date

Contact No

ANNEXES

RECORD FOR AIR-TIGHTNESS INSPECTION OF PUBLIC SHELTER

Project Description : _____

Project Reference No : _____

Date of Inspection : _____

The following items had been inspected and are in order.

S/N	ITEMS	REMARKS
1.	PROTECTIVE DOORS AND HATCHES	
	a) <u>VISUAL CHECK</u>	
	i) No buckling, twisting, warping, distortion or any other kind of deformation.	
	ii) Protective doors and hatches be locked and unlocked from both inside and outside of the shelter.	
	iii) No hollowness in the door frames.	
	iv) Seals are not damaged and are free from defects, such as distortion, deformation, notches, cracks, tears, hardening, loss of resistance, etc.	
	b) <u>LIGHT PENETRATION TEST</u>	
i) Light cannot penetrate through the door seal into the shelter area.		
c)	<u>CHALK TRACE EXAMINATION</u>	
	i) Chalk powder trace is evenly and continuously transferred from door frame onto seal.	
2	CD VALVES	
	a) CD valves are free from defects and are functional.	
3.	FLOOR TRAPS EXAMINATION	
	a) Water levels in the floor traps do not drop after 1 hour.	
	b) Floor traps are free from chokage.	
	c) Covers for the floor traps are in place.	
4.	SUMPS WITH GULLY TRAP EXAMINATION	
	a) Water levels in the gully traps do not drop after 1 hour.	
	b) Gully traps are free from chokage.	
5.	SCUPPER DRAINS	
	a) No peacetime scupper drain passes through the CD protective wall.	
	b) If there are, the frames for the approved sealing devices used for plugging up peacetime scupper drains are properly installed.	

Inspected by:

 Name and Signature of QP's Representative

 Date

 Name and Address of Qualified Person

RECORD FOR VISUAL INSPECTION OF COMPLETED PUBLIC SHELTER

Project Description : _____

Project Reference No : _____

Date of Inspection : _____

The following items had been inspected and are in order:

S/N	ITEMS	REMARKS
1.	BUILDING WORKS (INCLUDING PENETRATION DETAILS)	
	a) Walls and roof slabs are not plastered or tiled.	
	b) All penetration are installed with approved sealing devices/materials such as Multi-cable Transits (MCT) and puddle flanges.	
2.	PROTECTIVE DOORS AND HATCHES	
	a) Protective doors and hatches can be swung open and close properly.	
	b) The protective doors and hatches can be locked and unlocked from both inside and outside of the shelter. (The door should not be "loose" but should fit properly with the door frame. When closed with seal in place, the clear distance between the door and frame should not exceed 2mm.)	
	c) The welds are of correct thickness and length and are free from welding defects.	
	d) The finishing is good and planed. There is no buckling, twisting, warping, distortion or any other kind of deformation.	
	e) The knife edge locking plates are done in accordance with the accepted plans.	
	f) Washers and bushings are provided for hinges.	
	g) Hinges are provided with correct retaining pins to ensure that the central shaft of the hinge does not rotate when the doors or hatches are being swung.	
	h) Bushings are not loose.	
	i) Moving parts of steel to steel surfaces are adequately greased and are not loose.	
	j) Catalogues and recommended maintenance procedure for bushing and special washer materials are provided.	
	k) No rust or cement grout stain on the protective doors and hatches.	
	l) Seals are not damaged and are free from defects, such as distortion, deformation, notches, cracks, tears, hardening, loss of resistance, etc.	
m) No missing parts, e.g. missing bolts, handles, nuts, washers, etc.		
3.	BLAST LOUVRES AND CD VALVES	
	a) No rust, concrete or grout stains on the louvres.	
	b) No missing bolts, nuts or washers from the louvres.	
	c) CD valves are not defective and are functional.	
	d) All CD valves are in the open position.	
	e) Seals of CD valves (where applicable) are in place and in good condition.	

S/N	ITEMS	REMARKS
4.	FLOOR TRAPS,SUMPS AND SCUPPER DRAINS	
	a) Floor traps and gully traps are not choked.	
	b) Covers for the floor traps are in place.	
5.	WATER TANK	
	a) No leakage through the tank walls or pipelines. (The water level of the tank should not be reduced by more than 10mm or 1% of the full depth, whichever is lesser, within a period of 8 hours).	
	b) Cover of the tank can be opened, closed and locked properly.	
	c) Ball valve, overflow pipe and washout pipe are functioning properly.	

Inspected by:

Name and Signature of QP's Representative

Date

Name & Address of Qualified Person

RECORD FOR ANCHOR BOLT PULL-OUT TEST

Project Description : _____

 Project Reference No : _____
 Date of Test : _____
 Type of Equipment/Services/ Fixtures to be tested : _____
 Location of Anchoring System : _____
 Type of Test Device used : _____

TEST RESULTS**1st Sample of Test Bolts:**

Batch size : _____ Sample size : _____
 No. of bolts failed : _____

Types of Anchoring System	Bolt Ref No.	Test Load (kN)	Result	Remarks
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	

* Delete accordingly.

2nd Sample of Test Bolts:

Batch size : _____ Sample size : _____
 No. of bolts failed : _____

Types of Anchoring System	Bolt Ref No.	Test Load (kN)	Result	Remarks
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	
			*Pass/Fail	

* Delete accordingly.

Witnessed by:

 Name and Signature of QP's Representative

 Date

 Name & Address of Qualified Person

RECORD OF IFST FOR ACMV SYSTEM / ECS

Project Description : _____

 Project Reference No : _____

 Date of Inspection : _____

I ACMV SYSTEM / ECS CHECK

S/N	DESCRIPTION	REMARKS
1	SUPPORT SYSTEM	
	a) Vibration and shock isolators are installed in accordance with the approved shock design plans.	
	b) Absence of vibration at all supports.	
2	AHU	
	a) Pre-filters at BV & Air-filter are properly installed.	
	b) Gas-filters & pressure drop simulator are properly installed.	
	c) Gas-tight shut-off valves are properly installed.	
3	PIPINGS & FITTINGS	
	a) Isolation valves are provided at pipe penetration at external wall, and between clean / dirty area.	

II MECHANICAL VENTILATION SYSTEM TEST

Fan Make Model and Serial No : _____

S/N	DESCRIPTION	DESIGN	ACTUAL	REMARKS
a)	Type of fan			
b)	Supply Voltage/Phase/Hertz			
c)	Air Flow (cmh)			
d)	Fan Static pressure (Pa)			
e)	Fan motor running current (Amp)			
f)	Fan motor operating (kW)			
g)	Fan motor speed (rpm)			
h)	Noise level (dBA) at 1m away distance from fan casing			

III AIR-CONDITIONING SYSTEM TEST

1 AIR HANDLING UNIT TEST

AHU Make, Model and Serial No : _____

Cooling Capacity (kW) : _____

S/N	DESCRIPTION	DESIGN	ACTUAL	REMARKS
a)	Chilled Water Entering Temperature (°C)			
b)	Chilled Water Leaving Temperature (°C)			
c)	Chilled Water Flow Rate (l/s)			
d)	Fan Type			
e)	Supply Air Quantity (cmh)			
f)	Static Pressure (Pa)			
g)	Noise Level (dBA) at 1 m away			
h)	Pump head (kPa)			
i)	Noise Level (dBA) (at 1m away from pump casing)			
j)	Supply Air Temperature DB (°C)			
k)	Supply Air Temperature WB (°C)			
l)	Motor Type			
m)	Motor Input Power (kW)			
n)	Motor Voltage / Phase / Hertz			
o)	Motor Running Current (Amps)			

2 AIRFLOW RATE MEASUREMENT

TYPE	POSITION	AIR FLOW RATE (cmh)					ACTUAL (cmh)	DESIGN (cmh)	REMARKS
		1	2	3	4	AVG			

3 AIR COOLED CHILLER TEST

Chiller Make, Model and Serial No : _____
 Chiller Capacity : _____

S/N	DESCRIPTION	DESIGN	ACTUAL	REMARKS
a)	Supply Voltage / Phase / Hertz			
b)	Running Amps (For Compressor)			
c)	Motor Input Power (kW)			
d)	Type of Refrigerant			
e)	Discharge Pressure (kPa)			
f)	Discharge Temperature (° C)			
g)	Suction Pressure (kPa)			
h)	Suction Temperature (° C)			
i)	Supply Header Chilled Water Temperature (°C)			
j)	Return Header Chilled Water Temperature (° C)			
k)	Return Chilled Water Flow rate (l/s)			
l)	Inlet Chilled Water Pressure (kPa)			
m)	Outlet Chilled Water Pressure (kPa)			
n)	Water Flow Rate to the Chiller (l/s)			

4 CHILLED WATER PUMP TEST

Water Pump Make, Model and Serial No : _____

S/N	DESCRIPTION	DESIGN	ACTUAL	REMARKS
a)	Motor Type			
b)	Motor Voltage / Phase / Hertz			
c)	Motor Input Power (kW)			
d)	Motor Running Current (amp)			
e)	Suction pressure (kPa)			
f)	Discharge pressure (kPa)			
g)	Pump Head (kPa)			
h)	Capacity (l/s)			
i)	Noise Level (dBA) at 1 m away from casing			

Witnessed by:

 Name and Signature of QP's Representative

 Date

 Name & Address of Qualified Person

RECORD OF IFST FOR WATER SUPPLY SYSTEM

Project Description : _____

 Project Reference No : _____
 Date of Inspection : _____

I WATER SUPPLY SYSTEM CHECK

S/N	DESCRIPTION	REMARKS
1	SUPPORT SYSTEM	
	a) Vibration and shock isolators are installed in accordance with the approved shock design plans.	
	b) Absence of vibration at all supports.	
2	PIPEWORK & FITTINGS	
	a) Isolation valves are provided at the pipe penetrations at external wall and at clean/dirty area.	

II WATER SUPPLY SYSTEM TEST

S/N	DESCRIPTION	DESIGN	ACTUAL	REMARKS
a)	Water Pump Make / Model No			
b)	Motor Type			
c)	Motor Voltage/Phase/Hertz			
d)	Motor Input Power (kW)			
e)	Motor Running Current (amps)			
f)	Discharge Pressure (kPa)			
g)	Discharge Flow Rate (l/s)			
h)	Pump head (kPa)			
h)	Noise Level (dBA) (at 1m away from pump casing)			

Witnessed by :

 Name and Signature QP's Representative

 Date

 Name & Address of Qualified Person

RECORD OF IFST FOR SANITARY AND DRAINAGE SYSTEM

Project Description : _____

 Project Reference No : _____

 Date of Inspection : _____

I SANITARY AND DRAINAGE SYSTEM CHECK

S/N	DESCRIPTION	REMARKS
1	SUPPORT SYSTEM	
	a) Vibration and shock isolators are installed in accordance with the approved shock design plans.	
	b) Absence of vibration at all supports.	
2	PIPEWORK & FITTINGS	
	a) Isolation valves are provided at pipe penetration at the external wall.	
	b) Blast valves are properly installed at the air vent and discharge pipes.	

II SANITARY AND DRAINAGE SYSTEMS TEST

S/N	DESCRIPTION	DESIGN	ACTUAL	REMARKS
a)	Pump Make / Model No			
b)	Motor Type			
c)	Motor Voltage/Phase/Hertz			
d)	Motor Input Power (kW)			
e)	Motor Running Current (Amps)			
f)	Discharge Flow rate (l/s)			
g)	Pump head (kPa)			
h)	Noise Level (dBA) (at 1m away from pump casing)			

Witnessed by:

 Name and Signature QP's Representative

 Date

 Name & Address of Qualified Person

I(b) ELECTRICAL INSPECTION

S/N	ITEM	CHECKED	REMARKS
1	All circuits and switchboards are labelled.		
2	Single line diagrams and operation instruction sheets of switchboards and generator control panels are laminated and displayed.		
3	Metal parts are earthed and earth links for trunkings are provided.		
4	Separate earth electrodes and inspection pits for shelter main DB and generator system are provided.		
5	Manual Transfer Switch (MTS) for changeover of supply is tested.		
6	Fire Resistant cables are used for all electrical cables in the public shelter		

II AVERAGE ILLUMINANCE LEVEL TEST

	ALL LIGHTS ON					EMERGENCY LIGHTS ON ONLY				
Room(s) Measured										
Number of Points Measured (layout plan is attached)										
Average Illuminance Level (Lux)										
Uniformity Ratio = $\frac{\text{Minimum Illuminance Level}}{\text{Average Illuminance Level}}$										

Note : All luminaires are of the shock tested types.

III LIGHTNING PROTECTION SYSTEM TEST

Location of Earthing Electrodes (layout plan of points tested is attached)	A	B	C	D	E	F	G	Overall
Earth Electrode Resistance								

Witnessed by :

Name and Signature QP's Representative

Name & Address of Qualified Person

Date

RECORD OF IFST FOR COMMUNICATIONS AND MONITORING SYSTEM

Project Description : _____

 Project Reference No : _____

 Date of Inspection : _____

S/N	COMMUNICATIONS ITEMS	REMARKS
1.	<u>Telephone Socket (s)</u> Telephone socket(s) is/are tested with telephone set(s) and is/are working.	
2.	<u>TV/FM Socket</u> TV/FM sockets are tested with colour TV/radio/signal strength meter and are working. (Test reports of signal strengths for all specified channels are to be submitted.)	
3.	<u>Door Bell System</u> Bell buttons and bells are tested and are working.	
4.	<u>Intercom System</u> Intercom stations are tested and are working.	
5.	<u>Public Address System</u> All speakers, paging and chimes are tested and are working.	
6.	<u>Door Monitoring System</u> Mimic panel, local status panels and door limit switches are tested and are working.	
7.	<u>Others</u>	
	a) All communications system panels, circuits and accessories are labelled.	
	b) Laminated schematic diagrams, layout plans and operation instruction sheets are displayed beside the respective control panels of the communications systems.	
	c) Extra low voltage (ELV) communications cables are enclosed in steel conduits or steel trunking.	

Witnessed by:

 Name and Signature QP's Representative

 Date

 Name & Address of Qualified Person

RECORD OF IFST FOR GENERATOR AND FUEL DELIVERY SYSTEM

Project Description : _____
 Project Reference No : _____
 Date of Inspection : _____

I GENERATOR SYSTEM STATUS CHECK

Capacity of Generator : _____ kVA

Engine Make : _____ Alternator Make : _____

S/N	TEST	CHECKED	REMARKS
1	a) Lubricating Oil System		
	b) Lubrication Oil Level		
2	a) Cooling Water System		
	b) Radiator Water Level		
3	a) Fuel Oil Pumping System		
	b) Fuel Day Tank / Fuel Oil Level		
	c) Fuel Storage Tank / Fuel Oil Level		
4	Vee Belt		
5	Air Cleaner		
6	Meters / Gauges		
7	a) Control Panel		
	b) Electrical Connections		
	c) MCB's & Indication Lamps		
	d) Selector Switches / Meters		
	e) Rectifiers / Chargers		
8	a) Battery Condition		
	b) Electrolyte Level		

II GENERATOR ON LOAD TEST

Duration Of Test : 12 hours (Readings to be taken every hour)

Hour Run Meter : From : _____ hrs to : _____ hrs

ITEM	TIME											
Oil Pressure												
Oil Temperature												
Coolant Temperature												
Load (KW)												
Voltage (V)												
Current (A) R												
Y												
B												
Power Factor												
Frequency												
Battery Charge Rate												
Room Temperature												

REMARKS :

III OTHERS

S/N	ITEM	CHECKED	REMARKS
1	Manual Transfer Switch (MTS) for changeover of supply is tested and is working.		
2	Remote start/stop buttons on the generator control panel and generator duplicate control panel are tested and are working.		
3	All alarm and monitoring points for generator system on generator control panel and generator duplicate control panel are tested and are working.		

Witnessed by:

Name and Signature QP's Representative

Date

Name & Address of Qualified Person

RECORD OF COMBINED ELECTRICAL AND COMMUNICATIONS SYSTEMS TEST

Project Description : _____

 Project Reference No : _____

 Date of Inspection : _____

The following items had been checked and tested and are in order :-

S/N	SYSTEM	REMARKS
I	POWER SYSTEM	
	a) <u>Main Switchboards & Distribution Board</u> Main components, circuit breakers, indication lamps, meters, transfer switches, circuits, etc, are tested and are working.	
	b) <u>Electrical Fixtures</u> Switches, power socket outlets and isolators are tested and are working.	
II	LIGHTING SYSTEM	
	a) Lighting levels of all compartments are tested and are acceptable. Average lighting levels measured at rooms : i) _____ = _____ lux ii) _____ = _____ lux iii) _____ = _____ lux iv) _____ = _____ lux v) _____ = _____ lux	
	b) Battery packs of emergency lights are tested and are working. Average emergency lighting levels measured at rooms : i) _____ = _____ lux ii) _____ = _____ lux iii) _____ = _____ lux iv) _____ = _____ lux v) _____ = _____ lux	

S/N	SYSTEM	REMARKS
III	COMMUNICATIONS SYSTEM	
	a) <u>Telephone Socket (s)</u> Telephone socket(s) is/are tested with telephone set(s) and is/are working.	
	b) <u>TV/FM Socket</u> TV/FM socket are tested with colour TV/radio/signal strength meter and are working. (Test reports of signal strength for all specified channels are to be submitted).	
	c) <u>Door Bell System</u> Bell buttons and bells are tested and are working.	
	d) <u>Intercom System</u> Intercom stations are tested and are working.	
	e) <u>Public Address System</u> All speakers, paging and chimes are tested and are working.	
	f) <u>Door Monitoring System</u> Mimic panel, local status panels and door limit switches are tested and are working.	
IV	OTHERS	
	a) All switchboards, communications systems panels, circuits and accessories are labelled.	
	b) Laminated single line diagrams, schematic diagrams, layout plans and operation instruction sheets of electrical switchboards and communications system panels are displayed.	

Witnessed by:

Name and Signature QP's Representative

Date

Name & Address of Qualified Person

RECORD FOR PUBLIC SHELTER MANAGEMENT REQUIREMENTS INSPECTION

Project Description : _____
 Project Reference No : _____
 Date of Inspection : _____

The following items had been inspected and are in order.

S/N	ITEMS	REMARKS	
1.	COLOUR CODE		
	a)	Green: Blast doors/escape hatches	
	b)	Grey: Service doors/louvers	
	c)	Beige: Mechanical air ducts and air pipes	
	d)	Orange: Electrical conduits and trunkings	
	e)	White/Grey: Communication services and conduits	
	f)	Blue: Water supply pipings	
	g)	Black: Water discharge pipings	
	h)	Light colours for shelter walls (internal & external) and ceiling.	
	Notes:	(1) <i>Cable trays may be painted in any colour.</i>	
	(2) <i>For 1(c) -1(g), if colour bands are used, the spacing should not be more than 3m.</i>		
2	ARCHITECTURAL ITEMS		
	a)	'Open' & 'Close' directional signs are provided for blast doors and escape hatches.	
	b)	Handrails (if provided) are fixed on both sides of the staircases.	
3.	ELECTRICAL DISTRIBUTION SYSTEM		
	a)	Lighting luminaries are at least 2.4m above the finished floor level.	
	b)	Switches & socket outlets are 1.8m above the finished floor level.	
	c)	All the electrical switchboards, functional units and control panels are labelled with machine engraved laminated PVC labels pinned to the panels.	

S/N	ITEMS	REMARKS	
4.	COMMUNICATIONS AND MONITORING SYSTEMS		
	a)	Push button for electrical bell outside each entrance is 1.4m above the finished floor level. (The push button shall be installed near each entrance door outside the shelter).	
	b)	Intercom sets are provided at the following locations:	
		i)	All shelter compartments
		ii)	Plant rooms (including AHU room, chiller plant room, generator room, etc.)
		iii)	First aid area
		iv)	Access way adjacent to separation chamber
	v)	Decontamination chamber	
	c)	All intercom sets are installed at a height of 1.4m above the finished floor level.	
	d)	TAS inlet is provided and connected with cable.	
e)	Public address system is provided.		
f)	Radio & TV antenna outlets are provided and complete with connections to the antenna.		
g)	Average radio signal strength of 70dBu V is recorded.		
5.	WATER SUPPLY SYSTEM		
	a)	Various water supply sources to the water tanks (include drinking water tank and decontamination water tank) are indicated on the pipes.	
	b)	Water tanks are also supplied by the breeching inlet.	
	c)	Cat ladders are provided for the water tanks.	
	d)	Excess water from the water distribution points and the overflow pipe of the water tanks discharged into the scupper drains (complete with floor traps).	
	e)	Adequate number of water distribution points is provided in the shelter (at least 750mm above the finished floor level).	
6.	SANITARY AND DRAINAGE SYSTEMS		
	a)	Operating procedures for sump pump is laminated and displayed next to its control panel.	
	b)	Adequate number of permanent toilets is provided.	
	c)	One wash basin is provided at the first aid area.	
	d)	The following facilities are provided near dry toilet area:	
		i)	Floor traps
	ii)	Water outlets (at ceiling level) consists of stop-cock and tap(s) of 20mm external diameter (for connection to flexible water hose with hose clip)	
	Note:	<i>If wash basins are provided near the permanent toilet area, ignore (c) and (d).</i>	

S/N	ITEMS	REMARKS
7.	PRESSURE GAUGES	
	a)	Pressure gauges are provided at the following locations:
		i) Separation chamber
		ii) Decontamination chamber
		iii) Air locks
		iv) Main shelter area
	v) Other overpressure regimes	
8.	DECONTAMINATION ROOM	
	a)	Adequate number of shower points is provided.
9.	SHELTER MANAGEMENT AREA	
	a)	Operating procedures for the remote control panels are laminated and displayed next to them.
	b)	Operating procedures for the distribution boards are laminated and displayed next to them.
10.	GENERATOR ROOM	
	a)	Operating procedures for generator is laminated and displayed next to its control panel.
	b)	A standard toolbox is provided.
11.	AHU ROOM	
	a)	Operating procedures for supply fan are laminated and displayed next to its control panel.
	b)	A diagram showing conversion procedures of the different modes of operation of the public shelter is displayed.
	c)	A set of "Operation and Maintenance Manual for Public Shelter" is kept in AHU room.

Inspected by:

Name and Signature of QP's Representative

Date

Name & Address of Qualified Person