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RECORD OF AMENDMENTS

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Abbreviations

A & A	-	Addition and alteration
AC (Ops)	-	Air Cargo Operations
AES	-	Airport Emergency Service
A/FO	-	Airworthiness / Flight Operations
AO	-	Airport Operations
ATC	-	Air Traffic Control
ATS	-	Air Traffic Services
AULD	-	Aircraft Unloading Loading Device
AMG	-	Airport Management Group
AT	-	Air Transport
BCA	-	Building and Construction Authority
BCF	-	Bromochlorodifluoromethane
CAAS	-	Civil Aviation Authority of Singapore
CAES	-	Chief, Airport Emergency Service
CAFHI	-	Changi Airport Fuel Hydrant Installation
CAG	-	Changi Airport Group (Singapore) Private Limited
C	-	Commercial
CDIR	-	Corporate Development and International Affairs Division
CCS	-	Casualty Clearance Station
CH	-	Channel
CIAS	-	Changi International Airport Services
CP	-	Code of Practice
D	-	Director
DD	-	Deputy Director
DDG	-	Deputy Director-General, Civil Aviation
DG & CEO	-	Director General & Chief Executive Officer Civil Aviation
DH	-	Division Head
EM	-	Estate Management
E&MP	-	Engineering & Master Planning
F	-	Finance
FCC	-	Fire Command Centre
FMC	-	Fault Management Centre
FSSD	-	Fire Safety and Shelter Department

FSU	-	Fire Safety Unit
FWO	-	Fire Warrant Officer
FS	-	Fire Safety
F&B	-	Food & Beverages
HR	-	Human Resource
HT	-	High Tension
IA	-	Internal Audit
LEW	-	Licensed Electrical Worker
LORADS	-	Long Range Radar Station
LPG	-	Liquefied Petroleum Gas
LT	-	Low Tension
MINDEF	-	Ministry of Defence
OC	-	Officer Commanding
OIC	-	Officer-In-Charge
PA	-	Public Address
PCD	-	Pollution Control Department, ENV
PSB	-	Singapore Productivity and Standards Board
QP	-	Qualified Person
SAA	-	Singapore Aviation Academy
SASCO	-	Singapore Aerospace Company
SATCC	-	Singapore Air Traffic Control Centre
SATS	-	Singapore Airport Terminal Services
SCDF	-	Singapore Civil Defence Force
SEOC	-	Singapore Engine Overhaul Centre
SEL	-	Seletar
SGH	-	Singapore General Hospital
SIA	-	Singapore Airlines
SPRING	-	Standards, Productivity and Innovation Board
SS	-	Singapore Standards
SUPT (FS)	-	Superintendent, Fire Safety

WRO - Watchroom Operator

Foreword

1 Aims

1.1 Owing to the nature of airport operations, airport terminal buildings are generally atrium designed. As such buildings are large and spacious, any fire outbreak can spread rapidly. This, coupled with the high number of passengers commuting through the airport daily, places airport buildings in the high fire load category. Because of the global nature of airport operations, a major fire outbreak will draw adverse publicity, both locally and overseas. In addition, a major fire could disrupt flying operations, resulting in high losses to the airport as well as the nation.

1.2 Therefore, the fire safety at the airports needs to be at a high level. This Manual contains fire safety procedures, which are based on existing regulations, and other codes already promulgated in Singapore. These procedures spell out the fire safety measures to be observed by airport operators and tenants so that a high standard of fire safety can be maintained at key buildings of Singapore Changi and Seletar Airports.

2 General Terms of Reference

2.1 This Manual seeks to spell out:-

- a) the fire safety precautions that need to be provided at key buildings of the airports;
- b) the parties responsible for the implementation and compliance of these and other fire safety codes;
- c) the types of fire safety tests and checks to be carried out by each concerned party; and
- d) the general procedures to be complied with in the event of a fire outbreak.

2.2 This Manual is intended to cover both CAG owned/managed and non-CAG buildings. Section A and Section B cover CAG owned/managed properties and the Fire Emergency Plans for these buildings respectively. Section C covers Non-CAG owned/managed properties. The requirements are by no means exhaustive and where appropriate should be used in conjunction with

the codes of other authoritative bodies such as the National Fire Protection Association (NFPA) and the Codes of Practice for Fire Precautions in Buildings by the Singapore Civil Defence Force (SCDF) and the Singapore Standards by Standards, Productivity and Innovation Board (SPRING Singapore).

- 2.3 Occupants of premises in CAG owned/managed buildings are given 30 days to comply with recommendations submitted in the AES Fire Safety Inspection Reports, which are also copied to their respective “owner” divisions. After 30 days, AES would carry out a re-inspection of the premises and if there are still outstanding shortcomings, shall convey this to the “owner” division as to whether the deficiencies are serious or minor. The “owner” division shall then take the necessary actions as stated in paragraphs 2.5 and 2.6 below.
- 2.4 If the deficiencies are serious, the tenant shall be given 14 days to rectify. If he fails, the business would be shut down and the tenant would be given another 14 days before action is taken to terminate his lease.
- 2.5 For minor infringements, if the tenant fails to rectify them after the grace of 14 days, the “owner” division, on behalf of CAG, will rectify for the tenant and recover all costs with an administrative charge (as set by CAG Finance Division).
- 2.6 In addition to the fire safety inspections, fire safety patrols and fire safety checks are conducted by AES at the terminal buildings every other day. Any fire safety irregularity or deficiency is recorded on the respective forms for follow-up actions.
- 2.7 Fire safety deficiencies in CAG owned/managed buildings are followed up at the CAG Fire Safety Committee meeting held regularly as necessary. In particular, the results of all checks conducted randomly by AES are followed up at this forum. The co-operation of all concerned is sought to promote a high standard of fire safety at Singapore Changi Airport and Seletar Airport.

3 AES Service Charge

- 3.1 All air carriers, ground handling agents, facilities managers, project/maintenance contractors, owners, tenants; or any contractors/sub-contractors engaged by them; and all parties operating or working in Changi Airport, the Changi Airfreight Centre or Seletar shall comply with all fire safety requirements, safety instructions, permit to work system and hot work

procedures required by SCDF and as stipulated by CAG's Fire Safety Manual. Non compliance to these procedures and guidelines resulting in false fire alarm activations and turnout of AES resources may result in a service charge being levied as per the schedule of rates listed in Para.3 below.

3.2 To prevent abuse of AES resources, AES may levy a service charge on all airlines, air carriers, ground handling agents, cargo agents, facilities managers, project/maintenance contractors, owners, tenants; or any contractors/sub-contractors engaged by them; and all parties operating or working in Changi Airport, the Changi Airfreight Centre or Seletar Airport for any of the following services:

- i) Removal of Fuel Hazards
- ii) Refuelling / Defuelling Standby
- iii) Explosives Escort
- iv) Hot Works Standby
- v) First Aid Fire Appliances (FAFA) training
- vi) False fire alarm activation turnout
- vii) Vehicle escort
- viii) Fire Patroller duties
- ix) DECAM line connection

3.3 The schedule of rates are listed in Table 1 below:

Table 1

	Service	Charge
i)	Fire Vehicle	\$350 per vehicle per hour or part thereof*
ii)	Sea Rescue Craft	\$870 per vessel per hour or part thereof*
iii)	Fire Officer	\$50 per officer per hour or part thereof*
iv)	Firefighter	\$25 per firefighter per hour or part thereof*
v)	DECAM line connection	\$750 per line connection*

*excludes GST

4 Amendments

4.1 This Manual will be reviewed from time to time. Suggestions to improve this Manual are welcome. All proposed amendments should be submitted in duplicate, type-written in double spacing, and addressed to:

Superintendent, Fire Safety
Airport Emergency Service
Fire Safety Unit
Changi Airport Group (Singapore) Pte Ltd
Singapore Changi Airport
P O Box 168
Singapore 918146

SECTION A : CAG OWNED / MANAGED PROPERTIES**CHAPTER 1 - GENERAL FIRE SAFETY -
DUTIES AND RESPONSIBILITIES****1 General**

1.1 The responsibility of ensuring that fire safety measures are observed at each airport building shall be that of the owner. In the case of CAG owned / managed properties, the head of division in charge of the premises shall be responsible as the "owner". He should also exercise surveillance over the tenants and staff occupying such premises. The AES and E&MP shall be promptly notified of any suspected deficiencies.

2 Duties and Responsibilities of Divisions in CAG owned / managed properties

2.1 The duties and responsibilities of each division shall be as follows:

I Airport Emergency Service (Division of CAG)

- (a) Promote fire safety at key airport buildings and conduct fire safety inspections of these buildings at least once a year and follow-up to ensure that fire hazards, if any, are eradicated;
- (b) Check to ensure that fire detection and protection systems installed in buildings are adequate for the appropriate risk;
- (c) Carry out spot checks on the maintenance of the fire protection systems, e.g. by random checks of the water flow through some sprinkler heads;
- (d) Advise other Divisions on fire safety measures before renovation, alteration or addition works are carried out at CAG owned / managed premises and then follow-up to ensure that they are incorporated;
- (e) Conduct annual briefings for the fire wardens in the terminal buildings to update and familiarise them with their roles, the evacuation procedures, the escape routes, the assembly areas, etc;
- (f) Conduct annual fire safety awareness workshops for airport restaurant and canteen staff; and

- (g) Provide advice and guidance to “owner” divisions on the establishment of fire evacuation plans and the conduct of annual fire evacuation drills for premises under their management.

II Air Cargo Operations (Division of CAG)

- (a) Exercise surveillance over tenants at the cargo agents buildings to ensure that they comply with fire safety precautions. To also institute appropriate actions against any non-compliance;
- (b) Ensure that the tenants at the cargo agents buildings observe the fire prevention measures listed in Chapter 2 of this Section and submit their declaration of compliance with the list of fire safety Do’s and Don’ts (see Appendix A-I) to AC Ops annually;
- (c) Ensure that the tenants at the cargo agents buildings carry out tests on electrical wiring and systems as required in this Manual and forward reports of these tests to the E&MP;
- (d) Take action on tenant(s) as appropriate, when they do not comply and keep AES/E&MP;
- (e) Be the overall coordinator of the fire wardens for the cargo agents buildings during a fire/emergency; and
- (f) Establish a fire evacuation plan for each cargo agents building based on the procedures spelt out in Section B, Chapter 4 and conduct at least two evacuation drills annually at Megaplex 1 and CAG AFT in accordance with the requirements prescribed by the FSSD.

III Airport Operations (Division of CAG)

- (a) Exercise surveillance over tenants at the terminal buildings to ensure that they comply with fire safety precautions and take action as appropriate, on tenants who do not comply and keep AES/E&MP;
- (b) Ensure that the tenants at the terminal buildings observe the fire prevention measures listed in Chapter 2 of this Section and submit their declaration of compliance with the list of fire safety Do’s and Don’ts (see Appendix A-I) to Airport Operations annually;
- (c) Ensure that the terminal buildings and the cargo agents buildings are adequately protected by fire hoses (Chapter 3 of this Section), fire extinguishers (Chapter 4 of this Section) and other fire safety equipment based on the advice provided by QP;

- (d) Ensure that all renovations, alterations and additions to CAG owned / managed buildings are properly authorised in accordance with Chapter 5 of this Section;
- (e) Ensure that tenants of CAG owned / managed buildings, under the charge of Airport Operations, carry out tests on electrical wiring and systems as required in this Manual and forward reports of these tests to the E&MP;
- (f) Be the overall coordinator of the fire wardens for the terminal buildings during a fire/emergency;
- (g) Establish a fire evacuation plan for each terminal building based on the procedures spelt out in Section B, Chapter 2 and conduct at least two evacuation drills annually for each terminal building, in accordance with the requirements prescribed by the FSSD;
- (h) EM to ensure all portable fire extinguishers belonging to CAG are serviceable and maintained regularly in accordance to SS CP:55;
- (i) EM to ensure that all CAG building hosereels are inspected for their serviceability;
- (j) EM to ensure that all cabinets used to house fire extinguishers and hosereels are accessible for use during a fire;
- (k) EM to ensure the proper disposal of bulk rubbish at CAG buildings;
- (l) EM to ensure cigarette butt bins at specified smoking areas are cleared of rubbish on a regular basis; and
- (m) EM to ensure that no bulk disposal of rubbish obstructs the means of escape.

IV Commercial Division (Division of CAG)

- (a) Exercise surveillance over tenants at the terminal buildings to ensure that they comply with fire safety precautions, and to take action as appropriate on tenants who do not comply. AES/E&MP are to be kept informed;
- (b) Ensure that the tenants at the terminal buildings observe the fire prevention measures listed in Chapter 2 of this Section, and submit their declaration of compliance with the list of fire safety Do's and Don'ts (See Appendix A-I) to Commercial Division annually;

- (c) Ensure that all renovations, alterations and additions by tenants to CAG owned / managed buildings are properly authorised in accordance with Chapter 5 of this Section;
 - (d) Ensure that all concessionaires/tenants at the terminal buildings managed by Commercial Division carry out tests on electrical wiring and systems as required in this Manual and forward reports of these tests to the Engineering Division; and
 - (e) To act on errant tenants who do not take proactive actions to eliminate fire hazards within their premises.
- V Engineering & Master Planning (Division of CAG)
- (a) Ensure that fire detection and protection systems at all CAG owned / managed buildings are installed in accordance with SPRING Singapore Codes of Practice;
 - (b) Conduct tests and inspections on electrical circuits in all CAG owned / managed buildings and installations. The tests and inspections to be conducted shall be as follows:
 - (i) Fortnightly - Visual inspection on the electrical wiring terminations at the main LT switchboards in the LT switchrooms.
 - (ii) Quarterly - Thermal scanning of LT switchboards and automatic transfer switches in the LT switchrooms.
 - (iii) Annually - Meggar test on incoming and outgoing feeder cables to and from the main LT/HT switchboards in the LT/HT switchrooms.
 - (c) Conduct regular tests, inspections and maintenance of fire detection and protection systems in CAG owned / managed buildings (including the fire protection/detection and gas detector systems installed and maintained by tenants and lessees) in accordance with the schedule spelt out in Chapter 3 of this Section and in accordance with the relevant CPs;
 - (d) Ensure contractors do not obstruct fire detectors, sprinklers, other fire equipment or impede any access/escape route during renovation, alteration and addition, construction works and comply with fire safety requirements stipulated in this manual;

- (e) Ensure that all renovations, alterations and additions to buildings are properly authorised in accordance with Chapter 5 of this Section; and
- (f) Ensure that the exhaust systems, beyond the cooker hoods, for all restaurants are maintained and serviced on a regular basis as appropriate.

VI Air Traffic Services Division (Division of CAAS)

- (a) Exercise surveillance over the staff and occupants at LORADS complex and the Control Tower to ensure that they comply with fire safety precautions and take action as appropriate on occupants (other than staff) who do not comply and keep AES/E&MP informed;
- (b) Ensure that the staff and occupants at LORADS complex and the Control Tower observe the fire prevention measures listed in Chapter 2 of this Section and that the occupants submit their declaration of compliance with the list of fire safety Do's and Don'ts (See Appendix A-I) to Air Traffic Services annually;
- (c) Ensure that the LORADS complex and Control Tower are adequately protected by fire hoses (Chapter 3 of this Section), fire extinguishers (Chapter 4 of this Section) and other fire safety equipment based on the advice provided by QP;
- (d) **Ensure that** fire wardens are appointed for LORADS complex and the Control Tower **at all times**;
- (e) Establish evacuation plans for LORADS complex and the Control Tower based on the procedures spelt out in Section B, Chapter 3 and conduct at least one evacuation drill annually at the complex and tower in accordance with the requirements prescribed by the FSSD;
- (f) Ensure that all pieces of electronic equipment installed in LORADS complex, the Control Tower and airfield installations are regularly checked and properly maintained; and
- (g) Ensure that all electronic safety devices, e.g. switch breakers installed to protect the electronic equipment in LORADS complex, the Control Tower and airfield installations are in working condition.

VII Corporate Development and International Affairs Division (Division of CAG)

- (a) Ensure that all electronic equipment and wiring are regularly checked and properly maintained;

- (b) Observe good housekeeping by separating combustible materials, e.g. thermal facsimile paper, diskettes, etc from electrical peripherals;
- (c) Exercise surveillance over the CAG staff offices at Changi Airport. Take action as appropriate on those occupants who do not comply and keep AES/E&MP informed;
- (d) Ensure that all fire warden's contact details are updated in the Singapore Changi Airport Telephone Directory (SCATD); and
- (e) Ensure that all CAG corporate security doors are linked to IBMS.

VIII Singapore Aviation Academy (Division of CAAS)

- (a) Exercise surveillance over the staff and occupants at the SAA to ensure that they comply with fire safety precautions. Take action as appropriate on occupants who do not comply and keep AES/ E&MP informed;
- (b) Ensure that the fire protection system installed at SAA is regularly maintained and tested;
- (c) Ensure that the staff and occupants at SAA observe the fire prevention measures listed in Chapter 2 of this Section;
- (d) Ensure that all pieces of electronic equipment installed in SAA are regularly checked and properly maintained;
- (e) Ensure that fire wardens are appointed for the SAA; and
- (f) Establish a fire evacuation plan for the SAA and conduct at least two evacuation drill annually at SAA.

IX All Divisions

In addition to the above, each Division shall:

- (a) Ensure that its premises are adequately protected by fire extinguishers and other fire safety equipment based on the advice provided by AES in accordance with Chapter 4 of this Section;
- (b) Ensure that its staff observe the fire prevention measures listed in Chapter 2 of this Section;
- (c) Appoint fire wardens / assistant fire wardens for its own premises, and inform FSU of any changes to their appointed fire wardens / assistant fire wardens;

- (d) Ensure that its staff are familiar with the fire evacuation plan;
- (e) Encourage its staff to attend relevant fire safety training at the Singapore Aviation Academy; and
- (f) Ensure all renovations, major alterations and additions have been approved by FSSD and AES.

CHAPTER 2 - GENERAL FIRE PREVENTION MEASURES**1 Introduction**

- 1.1 Singapore Changi Airport has a wide range of occupancies such as restaurants, duty-free shops, lounges, etc, and also a large overall volume of combustibles such as alcohol, furniture, carpets etc. These together with the large number of aircraft passengers commuting through the airport daily result in a high fire load at the terminal buildings. Therefore, fire prevention measures need to be practised by all staff, occupants and tenants of buildings at Changi Airport. Staff and tenants at Seletar Airport should also observe such safety standards.
- 1.2 Fire prevention measures may be grouped into distinct categories; viz: fire detection and protection equipment, passive measures, housekeeping, electrical systems and wiring, and other hazards.

2 Fire Detection and Protection Equipment

- (a) Fire detection, gas detection and protection systems installed, in accordance to the approved QP plan, shall be maintained and regularly checked for serviceability.
- (b) The fire protection systems shall have audible alarm bells or similar facilities to warn the occupants of the building in case of fire.
- (c) DECAM connection shall be made between the fire protection systems and the fire station or other approved fire alarm receiving centre.
- (d) The fire protection systems should be extended to new areas arising from building extension or floor alterations.
- (e) Fire hosereels should be able to provide full coverage over the whole of the floor area where they are installed and take into consideration the physical layout of the area covered.
- (f) Fire hosereels shall be free of obstructions at all times.

3 Passive Measures

- (a) Means of egress shall be so arranged that the occupants can pass through an exit from the building or storey quickly and without obstruction.

- (b) Exit signs and directional exit signs shall be provided, adequately illuminated and displayed.
- (c) Escape routes shall be kept clear and free of obstructions at all times and be suitably marked.
- (d) All emergency exit doors shall not be locked, otherwise there shall be provision for rapid operation of the locking device to release the lock either by manual operation or automatically when the fire alarm is activated.

4 Housekeeping

4.1 Housekeeping or maintenance of orderly cleanliness is a basic factor in fire safety. Good housekeeping practices, both indoors and outdoors, by disposal of unwanted combustibles, limitation or segregation of combustibles, reduce the danger of fire, and they include the following:

- (a) Floors should be regularly swept or cleaned with non-flammable materials.
- (b) As a rule, smoking should not be allowed in CAG owned or managed offices and operational areas. In areas where smoking is allowed, e.g. designated rooms for smokers, suitable ashtrays shall be provided.
- (c) Other than kitchens of restaurants where fire suppression systems are installed, there shall be no naked flame allowed.
- (d) No burning of oil lamps, candles, joss sticks or joss paper, shall take place, especially within the buildings and on the airside.
- (e) Where burning of any sort or Hot Work is required, the prior approval of AES Division shall be obtained.
- (f) In the case of restaurant cooker hoods – these shall be degreased/cleaned on a regular basis as appropriate. The schedule of cleaning shall be extended to AES and E&MP.
- (g) Frequency and method of rubbish and waste disposal should be adequate for the type of occupancy and activity being conducted.
- (h) Rubbish storage bins built of non-combustible materials shall be provided under cutting, boring and turning machines.

- (i) Used cleaning rags and other impregnated materials or waste cloths should be kept in non-combustible containers with self closing and close fitting lids.
- (j) No storage of flammable liquids shall be allowed. If required, the prior approval of AES Division shall be obtained.
- (k) Storage of approved quantities of flammable liquids shall comply as follows:
 - (i) air-tight liquid containers are used and stored in metal cupboards;
 - (ii) no naked flame is allowed within 15m from the metal cupboards;
 - (iii) all ignition sources are excluded within 15m from the metal cupboards; and
 - (iv) display prominently all warning signs.
- (l) Where there is a possibility of a flammable liquid spill, provisions shall be made as follows:
 - (i) the spread of the spill is limited;
 - (ii) non-flammable absorbent material is available for immediate use;
 - (iii) ignition sources can be quickly removed; and
 - (iv) the area is well ventilated.
- (m) All packing materials should be neatly stacked in a separate storage area and not in passageways or aisles.
- (n) There shall be a minimum clear space of 0.5m between the top of storage piles and sprinkler heads or the ceiling. This clear space shall be at least 1m in warehouses.
- (o) In storage areas, aisles shall be maintained for access and egress. These aisles should not be obstructed and should correspond as much as possible in width with the building entry/exit points.
- (p) Provision shall be made for ready access to fire fighting equipment.

- (q) All fire and exit doors shall be kept clear such that stored material will not interfere with their operation.
- (r) Storage shall not mix with other risks and there shall be separation between the two by fire rated walls, self-closing fire doors, etc.
- (s) Hazardous goods, such as gas cylinders and combustible liquids shall be separated from other stores, either by compartmentalisation or distance. Hazardous materials shall be indicated outside each store.
- (t) Stores where hazardous materials are kept shall be clearly marked at the entrance with appropriate labels.
- (u) A floor plan shall be made available at the fire indicator board for arriving emergency services in case of fire outbreak.

5 Electrical Systems and Wiring

- (a) Connections between wires and plugs should not be loose.
- (b) Conduits and raceways should be fastened into position and secured to outlet boxes, cabinets and other equipment.
- (c) All electrical boxes should be closed to prevent the possibility of contact with combustible materials.
- (d) Overloading of electrical circuits must not be allowed. All circuits should be protected by a proper size fuse or circuit breaker.
- (e) All fixtures, switches and sockets should be well maintained.
- (f) Electrical equipment should not be improperly wired or with wiring that have become frayed or loose. All electrical appliances shall be of an approved type, correctly positioned and have well maintained flexible cords.
- (g) Electrical appliances and machinery should be operated by qualified persons and should not be left operating unattended.
- (h) Electrical equipment should not be left energized when not in use especially during after-working hours. They should be switched off when not in use.

- (i) Do not overload the electrical circuit by fitting many extension outlets. If necessary, more permanent power points should be added by a Singapore Power Licensed Electrical Worker (LEW) of the appropriate grade.
- (j) LEW shall operate, maintain and repair electrical installation and conduct thermal scanning checks of the electrical system/wiring on a quarterly basis, meggar tests of out-going / in-coming cables on an annual basis and submit the inspection/test reports to E&MP.

6 Other Hazards

Some works carried out in the terminal buildings and other CAG owned / managed buildings are inherently hazardous. These include hot works such as welding and battery charging operations in which hydrogen is released in large quantities. The safety measures to be observed in such processes are listed in the following Appendices to this Section:

Appendix A-III	:	Welding and Hot Works
Appendix A-IV	:	Precautions during Battery Charging
Appendix A-V	:	Storage of Flammable Liquids

CHAPTER 3 - MAINTENANCE OF FIRE DETECTION AND PROTECTION SYSTEMS

1 Introduction

- 1.1 This chapter spells out the maintenance procedures for fire detection and protection systems in all CAG owned / managed properties in the airport.

2 Duties and Responsibilities

- 2.1 E&MP is responsible for maintaining the fire protection installations in optimum working condition except for those equipment/systems installed and maintained by the tenants/lessees.
- 2.2 **AO/EM** is responsible for the maintenance of fire extinguishers and fire hoses up to the stop cocks.
- 2.3 Both E&MP and **AO/EM** are responsible to notify AES of any defects (and their status of rectification) that affect the operations of the fire protection installations, so that alternative arrangements as deemed necessary by the AES can be made.
- 2.4 Copies of all initial system commissioning, subsequent modification and recommissioning and subsequent annual test reports on the fire protection systems carried out to comply with statutory requirements shall be compiled for audit purposes.

3 Inspection and Test Procedures

3.1 Fire alarm and detection systems

- 3.1.1 Regular testing and inspection shall be conducted as follows:
- (a) **Daily Tests.** A check shall be made on fire alarm and detection systems connected to the Building Automation System to ensure that they are being continuously monitored.

-
- (b) **Weekly Tests.** A simulated fire alarm call, by operating at least 50% of fire alarm group test switches provided on the fire alarm indicator board, shall be carried out so as to transmit a full fire call to the fire station. Check the battery voltage by operating the battery test switch and record voltage under load conditions in the log book.
- (c) **Monthly Tests.** Check battery terminals for cleanliness, ensure they are capped with non-conducting material and to ensure that they are in good serviceable condition; voltages, charging current, and electrolyte to ensure that they are at the correct levels.
- (d) **Annual Tests.** At least 20% of the detectors in an installation shall be checked each year. The selection of detectors shall be made in such a way that all the detectors in an installation should have been checked once in any period of five years. The checking of detectors shall take the form of either:-
- (i) the testing of a detector in-situ and testing the effectiveness of detectors (especially smoke/heat detectors) mounted near air conditioning/exhaust vents;
 - (ii) check for obstructions such as partitions, racks or piled stock which are erected/placed in such a way as to interfere with the effectiveness of the fire alarm/detection system; or
 - (iii) the removal of a detector and its replacement by a detector which has been checked and calibrated by the supplier.
- In addition, the following shall also be conducted:-
- (i) Circuits requiring automatic voltage regulated supplies shall be checked to ensure correct operation and voltage output.
 - (ii) Where the heat-sensitive element of thermal detectors or the enclosure of other detectors are found to be coated with paint or any other material likely to affect adversely the operation of the detectors, such materials shall be cleaned off or detectors replaced.
- e) **Random Tests.** Fire detectors that are installed and maintained by tenants at their respective premises shall be subject to random tests by E&MP.
- f) **Others.** Checks shall be conducted for obstructions such as partitions, racks, piled stocks or detectors located near air-conditioning/exhaust

vents, in such a way as not to interfere with the effectiveness of the detectors' function.

3.2 Fire hydrants and dry rising mains

3.2.1 Inspection, maintenance and testing of fire hydrants shall be carried out **at least once a year** by E&MP. E&MP shall also ensure that all isolating valves for the systems are kept locked in an "open" position.

3.2.2 Dry rising mains inlets, landing valves, drain valves, door hinges and locking arrangements to the inlet and landing valve boxes shall be inspected **every six months**. Special attention should be given to all valves, spindles, glands and washers to ensure that they are in satisfactory conditions so that all equipment continue to be ready for immediate use. Wet tests shall be carried out **annually** when the mains should also be checked for leaks.

3.3 Automatic fire sprinkler systems

3.3.1 Periodic testing of automatic fire sprinkler systems shall be carried out on a weekly, quarterly, annually, and three-yearly basis.

- (a) **Weekly tests.** The following checks and tests should be made every week.
- (i) Check water level and automatic refilling facilities of all water storage tanks in the system.
 - (ii) Check that all stop valves are secured in the open or closed position as appropriate. Particular attention shall be given to the main control valve, drain valve and test valve.
 - (iii) Check and record the pressure at the installation gauge and water supply gauge and ensure that normal water pressure is being maintained.
 - (iv) Check for the correct operation of the water alarm gong.
 - (v) Start all pumping units, by operating the test valve in a manner which will simulate the conditions and check correct cut-in pressure, pump gland operation, both local and remote 'pump run' alarms, and pump priming water. (Note: On electric motor

driven pumps, check the phase failure alarm and check that there is no excessive vibration or noise. Pump shall be fully operational within 30 seconds). For compression-ignition engine driven pumps, run pumps for not less than 10 minutes and check the following items:

- Water, oil and fuel leaks, loose fittings and ancillary equipment.
 - Belt drives.
 - Correct operation of battery charging alternator/generator.
 - Battery charger power failure alarm.
 - Battery terminals for cleanliness, capped with non-conducting material and correct level of electrolyte in each cell to ensure that they are in good serviceable condition.
 - Obvious out of balance.
 - Correct running speed.
 - Before and after running, check water, oil and fuel levels. Top up if required.
 - After running, ensure that the engine stop mechanism automatically returns to the start position.
- (vi) Test the interchangeability and function of the duty and standby pumps.
- (vii) After testing of the pumps and resetting of the systems, check and record the pressure at the installation gauge and water supply gauge to ensure that normal water pressure is being maintained.
- (viii) Check that required spare sprinklers and sprinkler spanner are on hand.
- (ix) Check pump room to ensure it is kept free of combustible materials and accessible at all times.
- (x) Check the Fire Service breaching inlet to ensure they are in good condition.

- (b) **Quarterly tests.** In addition to the normal weekly tests, the following additional tests shall be performed.
- (i) Electric power pump - where secondary power supplies are provided, the pump shall be run off the secondary supply. The pump shall be run for not less than 5 minutes.
 - (ii) Compression-ignition engine driven pump - the engine shall be run at rated speed for a period of not less than 30 minutes and the operating temperature checked.
 - (iii) Test all water flow alarm switches by operation of a 10 mm test valve to simulate fire conditions. These may be tested on a weekly rotating basis; however, each switch must be tested quarterly.
 - (iv) Check condition of all accessible sprinklers. Sprinklers shall be replaced when painted, corroded, damaged or loaded with foreign materials.
 - (v) Operate and check to ensure that all isolating valves on the main connection, and any other water supply stop valves, are fully open.
 - (vi) Check to ensure that all water supply non-return valves are correctly seated.
 - (vii) Clean the strainer and oil the external alarm water motor and gong.
 - (viii) Check for obstructions such as partitions, racks or piled stock which are placed in such a way as to interfere with the effectiveness of water discharging from sprinklers.
- (c) **Annual tests.** In addition to the normal weekly and quarterly tests, the following additional tests shall be performed:
- (i) Compression-ignition engine driven pumps - check, clean and replace, if required, engine fuel sludge and sediment trap, and fuel, oil and air filters; and change engine oil.
 - (ii) Carry out water supply periodic check test to ensure that the water supply satisfies the pressure/flow requirements appropriate to the hazard class.

- (iii) Physical check of the internal mechanism of all pressure switches to ensure that all components are free of corrosion, securely mounted and in working order.
 - (iv) With electrical equipment isolated from all power supplies, the motor starter should be cleaned and the condition of all heavy-current-carrying contacts checked. Any item showing signs of water or corrosion shall be immediately repaired or replaced.
 - (v) Run electric pump for a minimum period of 30 minutes under full load conditions and check the load current per phase for variation from original test readings.
 - (vi) Replace all sprinklers installed in hood over cooking equipment.
 - (vii) Examine the interior and exterior of water tank, clean and paint as required.
 - (viii) Examine all pipes and hangers for corrosion and mechanical damage. Clean, paint and replace as required. Loose hangers shall be replaced or refastened.
 - (ix) Oil or grease all valve stems. Completely close and re-open the valve to test its operation and distribute the lubricant.
 - (x) Check all gauges with an inspection gauge.
- (d) **Three-yearly tests.** In addition to the normal annual tests, every three years, overhaul all stop, alarm, non-return and pressure-reducing valves. Replace all damaged and worn parts as necessary. Where investigation suggests that sediment may have collected in the pipework, all system pipework should be flushed. Conditions that may indicate the need for investigation include the following:
- (i) Discharge of obstructive material during routine water tests.
 - (ii) Foreign material in sprinkler pumps or in check valve.
 - (iii) Heavy discoloration of water during drain tests.
 - (iv) Plugging of sprinklers.
- (e) **Random tests.** Random tests shall be conducted by the actual activation of selected sprinkler heads.

- (f) **Sprinkler Burst Test.** The sprinkler burst test shall be carried out during the opening or commissioning of new premises. In addition, the sprinkler burst test is carried out once a month at the existing installations.

3.4 Gas Flooding Fire Protection Systems

3.4.1 Halon 1301 system

Inspection, maintenance and testing of Halon 1301 fire protection system shall be carried out as follows:

- (a) **Monthly Inspection.** Check to ensure correct pressure gauge reading, correct setting and accessibility of all operating controls, and serviceability of indicators. Carry out visual inspection on its pipeline system and nozzles.
- (b) **Half-yearly Inspection.** Check to determine the amount of agent available by weighing the container. A loss of the agent in nett content of more than 5% shall require the container to be refilled.

3.4.2 FM-200 System

A systematic maintenance programme shall be established for proper operation of FM-200 system. The preventive maintenance schedule shall include the daily, monthly, half-yearly, two-yearly, and five-yearly inspections and maintenance as follows:

- (a) **Daily Inspection.** Check FM-200 cylinder pressure gauges and Nitrogen cylinder for proper operating pressure.
- (b) **Monthly Inspection.** Weigh FM-200 cylinders to ascertain nett weight of agent by subtracting tare weight (as stamped on the cylinder) from the gross weight. If the agent nett weight is less than 95% of the original charge nett weight, replace cylinder with fully charged FM-200 cylinder. Inspect FM-200 cylinders and equipment for damaged or missing parts, viz:
 - (i) flexible actuation hoses for loose fittings, damaged threads, cracks, distortion, cuts, dirt and frayed wire braid;

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- (ii) FM-200 cylinder pressure operated control heads for physical damage, deterioration, corrosion, distortion, cracks, dirt and loose couplings;
 - (iii) FM-200 cylinder electric control heads for physical damage, corrosion, or dirt and check control heads flexible electrical line for wear and damage;
 - (iv) FM-200 cylinder and valve assembly for leakage, physical damage such as cracks, dents, distortion, and worn parts and check burst disc and pressure gauges for damage;
 - (v) FM-200 cylinder brackets, straps, cradles and mounting hardware for loose, damaged, or broken parts and check cylinder brackets, straps, and associated parts for corrosion, oil, grease, grime, etc;
 - (vi) flexible discharge hoses for loose fittings, damaged threads, cracks, rust, kinks, distortion, dirt and frayed wire braid;
 - (vii) nitrogen actuation line (if used) and support brackets for continuity, physical damage, loose fittings, distortion, cracks, or cuts;
 - (viii) discharge nozzles for dirt and physical damage;
 - (ix) all manual pull stations for cracks, broken or cracked glass plate, dirt or distortion and sign of physical damage; and
 - (x) pressure switches for deformations, cracks, dirt or other damage.
- (c) **Half-yearly Inspection.** Perform pressure switch test and electric controls heads test for proper operation.
- (d) **Two-yearly Inspection.** Remove nozzles from piping and all pressure operated control heads from FM-200 cylinders, open distribution valves and blow out all distribution piping with air or nitrogen or ensure that it is not obstructed.
- (e) **Five-yearly Inspection.** Conduct hydrostatic pressure test on FM-200 and nitrogen cylinders and flexible hoses as necessary.

3.5 Fire hosereels

- 3.5.1 The AO/EM shall conduct annual serviceability check of fire hosereels.
- 3.5.2 Once a year the hose shall be completely run out and subjected to operational water pressure test to ensure that the hose is in good condition and that all couplings are water-tight. A flow test should be carried out to ensure that a discharge of at least 0.4 litres per second and the horizontal throw of the jet of at least 6 metres are achieved at all times for either direct-feed system or pump-feed system.

3.6 Kitchen Fire Suppression System (KFSS)

- 3.6.1 Restaurant / F&B operators are responsible to maintain the KFSS installed in their premises.
- 3.6.2 Restaurant / F&B operators shall ensure that the KFSS is serviced annually with records updated for AES inspection (refer to appendix A-VI – Summary of Fire Safety Requirements for CAG Managed Buildings in particular point 8).
- 3.6.3 Ensure that the kitchen fire suppression system is always linked to the AES Fire Station through the building Fire Alarm Panel.

CHAPTER 4 - PROVISION AND USAGE OF PORTABLE FIRE EXTINGUISHERS

1 Provision of Portable Fire Extinguishers

1.1 Generally, provision of portable fire extinguishers shall comply to the latest editions of CP55:1991 Code of Practice for use and maintenance of portable fire extinguishers and SS232 : Part 1 : 1999 specification for portable fire extinguishers.

2 Basic Types of Fire Extinguishers and Their Recommended Colours of Identification

2.1	<u>Type of fire extinguisher</u>	<u>Colour</u>
	Water	Signal red
	Foam	Pale cream
	Dry Powder	French blue
	Carbon dioxide	Black
	Halon*	Emerald green

*Note: Existing halon (BCF type) fire extinguishers may still be available although new replacement is discontinued.

2.2 Fire Extinguishing Agents for the Various Classes of Fire

<u>Class</u>	<u>Suitable Extinguishing Agents</u>
A - Fires involving solids of carbonaceous nature (excluding metals) e.g. wood, cloth, paper rubber, plastic etc.	Water, BCF, Dry Chemical (Multi-purpose type)
B - Fires involving liquids, liquifiable solids and flammable gases e.g. petrol, diesel, kerosene, wax and LPG etc.	Foam, Dry Chemical, CO ₂ , BCF

<u>Class</u>	<u>Suitable Extinguishing Agents</u>
C - Fires involving energized electrical equipment etc.	Dry Chemical, CO ₂ , and BCF
D - Fires involving metal e.g. magnesium, sodium, lithium, titanium, etc.	Dry Powder

3 Strategic Locations for Fire Extinguishers

3.1 AES should be consulted for assistance to ensure that the right types of fire extinguishers are provided at suitable locations. The general factors to be considered for choosing a location to install a fire extinguisher are as follows:

- (a) Wherever possible, portable fire extinguishers should be grouped at "fire points" so that a maximum attack can be made onto a fire in minimal time.
- (b) If wall-mounted, fire extinguishers should be mounted not more than 1.5m above the floor, measured from the carrying handle, at a location where it is conspicuous and accessible.
- (c) The maximum distance of travel from any location within the building to a "fire point" should not exceed 15m for general-purpose buildings.

4 Inspection and Maintenance of Fire Extinguishers

4.1 **Inspection Procedures.** The Airport Operations shall conduct a six-monthly inspection that shall include at least a check of the following:

- (a) Fire extinguishers are located in their designated locations.
- (b) There is no obstruction to access or visibility.
- (c) The operating instructions on the label attached to each fire extinguisher are legible and facing outward.
- (d) Seals and tamper indicators are not broken or missing.

- (e) The content level is correct.
- (f) Visual checks for obvious physical damages, corrosion, leakage or clogged nozzles.
- (g) Pressure gauge reading is within the operative range or pressure gauge indicator is in the correct position.
- (h) Essential parts, such as the discharge tube/horn are serviceable and not missing.

4.2 Each fire extinguisher shall be clearly marked with the following information:

- (a) The extinguishing medium contained in the extinguisher.
- (b) Type (e.g. gas cartridge or stored pressure).
- (c) The class of fire for which it is suitable.
- (d) Method of operation.
- (e) Test and working pressures.
- (f) The date of last service or expiry date of serviceability.

4.3 The discharge lever of fire extinguishers should have a safety pin secured with a plastic seal.

4.4 All fire extinguishers, except those that are empty, shall be positioned upright at all times.

4.5 All fire extinguishers shall be serviced annually by competent person(s) from organisations approved by the relevant authority and a label is attached to each extinguisher as proof.

CHAPTER 5 - REQUIREMENTS FOR RENOVATIONS, ALTERATIONS, AND ADDITIONS TO CAG OWNED / MANAGED PROPERTIES**1 Objective**

- 1.1 These requirements are intended to ensure that fire safety and the general safety of occupants are not compromised by any renovation, alteration or addition to the existing configuration inside and outside buildings.
- 1.2 Compliance with the requirements listed hereunder shall be incorporated into the tenancy agreement and rest with the division responsible for co-ordinating the renovation, alteration or addition works, viz; Airport Operations, Air Cargo Operations, E&MP, Commercial or CDIR, and shall be based on Fire Safety Act, Codes of Practice or as advised by the AES Division.

2 General Requirements

- 2.1 In all renovations, alterations and additions to buildings, AES approval in regard to fire safety measures, access for fire vehicles, escape routes and other fire precautions, has to be obtained.
- 2.2 This approval is in addition to other requirements or approval by other CAG Divisions or other relevant authorities e.g. FSSD, BCA, etc.
- 2.3 Copies of the relevant floor plans indicating the extent of renovations, alterations, and/or additions; together with fire safety measures, e.g. fire exits and signs, etc, shall be extended to AES for comments and approval. The co-ordinating division shall ensure that AES comments and/or requirements are complied with and to notify SUPT (FS) on the completion of such works.
- 2.4 E&MP shall be responsible for maintaining fire protection installations. E&MP shall ensure that both existing and new installations are in their proper working order after renovation, alteration, and/or addition works. E&MP shall also ascertain that the work does not compromise fire separation of affected areas.

- 2.5 Permission or clearance from relevant authorities shall be sought and extended to AES. Where the approval of FSSD is not required, a copy of the waiver shall be attached to the floor plans extended to AES for their comments and approval.

3 Fire Alarm Isolation

- 3.1 All isolation of fire alarm system / draining of sprinkler system require “Isolation of Fire Alarm System/Draining of Sprinkler System” permit. The “Isolation of Fire Alarm System/Draining of Sprinkler System” permit shall be applied manually in person or submitted to the CAG AES Division at Fax No.: 6545 7072. This shall be done at least 3 working days before the work is expected to commence. When the work needs to be carried out urgently, CAG AES Division HQ [Tel No.: 6541 2535 (Changi)/6481 3377 (Seletar) during office hours] or Fire Station 1 [Tel: 6541 2526 (Changi)/6481 3377 (Seletar) during non-office hours] shall be notified and approval sought. The “Isolation of Fire Alarm System/Draining of Sprinkler System” can be downloaded from CAG website at <http://www.changiairportgroup.com.sg/cag/html/our-services/airport-emergencyservices/fire-safety/>.
- 3.2 The “Isolation of Fire Alarm System/Draining of Sprinkler System” permit lists the various fire safety requirements involving isolation of fire alarm system / draining of sprinkler system in CAG managed buildings. Non compliance to these requirements resulting in false fire alarm activations and/or turnout of AES resources may result in a service charge and/or ‘stop work order’ being imposed on owners, tenants or any contractors or sub-contractors engaged by them as listed in this Fire Safety Manual.

4 Commencement of works

- 4.1 No work shall commence without the written permit from CAG Divisions or other relevant authorities.
- 4.2 Renovation, alteration, and/or addition works may commence when every proposed plan has been approved by AES together with the written permit from relevant authorities.

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- 4.3 All works carried out shall comply with all statutory requirements imposed by the relevant authorities. The tenant shall indicate when the renovations would be completed and business resumed. About one or two days before this date, the co-ordinating division with AES and other divisions involved will carry out a site inspection.
- 4.4 Upon AES's advice, if there are serious shortcomings, the co-ordinating division shall inform the tenant that he will not be allowed to resume operations until rectification is completed. Contingency arrangements by the co-ordinating division shall be made for critical business such as restaurants.
- 4.5 However, if the shortcomings are minor, the co-ordinating division shall inform the tenant that he will be given 30 days to rectify these, failing which CAG would do so at the tenant's cost with an administrative charge (as set by CAG Finance Division).
- 4.6 Commercial Division (CAG) or coordinating division shall ensure that the tenant can only start operation after FSC is obtained from FSSD and meeting any additional Fire Safety Requirements from AES.
- 4.7 Tenants shall permit the Landlord (or any other authorised by the Landlord) to perform unannounced fire safety inspection of the premises at any time based on Appendix A-VI – Summary of Fire Safety Requirements for CAG Managed Buildings, following which the Tenants and affected CAG division will receive a Fire Safety Inspection report.
- 4.8 Tenants shall rectify any non-compliance of fire safety requirements, procedures or measures listed in the Fire Safety Inspection report issued pursuant to point 3.8 of this chapter within thirty (30) days from the date of the receipt of the said report according to the recommendation(s) mentioned by the Landlord. If any outstanding deficiencies are not rectified to the satisfaction of the Landlord as observed during the re-inspection after the stipulated period, the Landlord shall give the Tenant a further fourteen (14) days from the date of re-inspection to rectify the same before a further re-inspection is held.
- 4.9 If the deficiency remains, the Tenant's business may be suspended without compensation and the Tenant would be given another fourteen (14) days before action is taken to terminate its Tenancy. In addition, the Tenant shall pay a Fire Service Charge, as well as a fifteen percent (15%) administrative charge for each inspection, after the initial re-inspection, at the prevailing rate. Where the Landlord finds that the deficiencies are minor, and the Tenant fails

to rectify these after fourteen (14) days notice so to do, the Landlord shall take all steps necessary to rectify the same immediately thereafter and the Tenant shall bear all costs, expenses, as well as a fifteen percent (15%) administrative charge, or such charges as the Landlord shall impose from time to time, incurred by the Landlord.

4.10 Hot works shall not be allowed without appropriate “Hot Work Approval” and a trained fire patroller on standby at the site.

4.11 No flammable substance (needed for renovation, alteration, and/or addition works) shall be stored in the Airport. If required, the prior clearance of AES Division shall be obtained. It shall be brought to site and removed from the airport on the very same day.

5 After Completion of Works

5.1 The Division responsible for co-ordinating renovation, alteration and/or addition works shall, upon completion of such works, notify AES Fire Safety Unit (FSU).

5.2 SUPT (FS) or his representative shall follow-up to inspect the premises to confirm that all fire safety requirements set out prior to commencement of works were fully complied with.

APPENDIX A-I - FIRE SAFETY DO'S AND DON'TS

1. **Do not** use cardboard boxes, wooden crates or other receptacles that are made of combustible material as makeshift rubbish bins at your workplace.

Do provide and use proper rubbish bins, preferably those made of non-combustible material, like metal.
2. **Do not** accumulate unwanted items at your workplace.

Do dispose of unwanted items at regular intervals to ensure good housekeeping at your workplace.
3. **Do not** use corridors, walkways or passageways that form parts of the emergency escape route at your workplace for storage.

Do keep corridors, walkways and passageways free of obstructions.
4. **Do not** leave food or edibles accessible to rats.

Do ensure food and other edibles are inaccessible to rats by using proper storage facilities.
5. **Do not** remove ceiling boards or use ceiling void (i.e. space above suspended ceiling) for storage.

Do ensure all ceiling boards are in place, not missing, or damaged and refrain from using ceiling voids for storage purpose.
6. **Do not** paint over smoke/heat detectors and sprinkler heads or hang objects on them.

Do ensure the detectors and sprinkler heads are not painted over or obstructed with objects.
7. **Do not** stack up items to a height less than 0.5m (or 1 m for warehouse) from sprinkler heads.

Do ensure that there is clear headroom of 0.5m (or 1 m for warehouse) between stacked goods and sprinkler heads.

8. **Do not** use fragile containers to store flammable liquids or keep flammable substances in places where large amounts of heat will build up or near an ignition source.

Do store flammable liquids in proper, unbreakable containers and keep flammable substances in well-ventilated places and away from any ignition source.

9. **Do not** seal up ventilation openings or leave a non-working/inoperable ventilation fan unrepaired.

Do ensure ventilation openings are not sealed up and have defective ventilation fan repaired quickly.

10. **Do not** use candles or other naked flame for lighting purposes, especially during a power failure.

Do make available battery operated portable torches as a back up.

11. **Do not** smoke in “No-smoking” areas.

Do observe “No-smoking” rule strictly in your premises.

12. **Do not** use or operate dirty or greasy equipment/machinery.

Do have the equipment/machinery cleaned and serviced regularly.

13. **Do not** leave heavy machinery operating or running unattended.

Do ensure that machines that are in use are tended at all times by qualified operators.

14. **Do not** leave electrical appliances or equipment continued to be energized when they are not in use, especially after office/working hours.

Do switch off at the mains all electrical appliances or equipment that are not in use, especially after office/working hours.

15. **Do not** put any liquid or thing that is flammable or combustible near an electrical switchboard or an enclosure containing electrical components.
- Do** ensure that the electrical switchboards and the enclosures of electrical components are kept clear of flammable or combustible substances and liquids.
16. **Do not** dispose of oil-soaked rags in combustible receptacles.
- Do** dispose of oil-soaked rags in self-closing metal bins.
17. **Do not** use electrical equipment that has poor wiring such as frayed cables and loose connections.
- Do** ensure the wiring is in good condition and for any defect, get a licensed electrician to check and rectify it immediately.
18. **Do not** overload the electrical circuit by drawing current from one power outlet to multiple electrical appliances or equipment simultaneously.
- Do** use one power outlet for one electrical appliance or equipment, wherever possible.
19. **Do not** allow electrical fitting works to be carried out by non-qualified or unauthorized personnel.
- Do** engage licensed electricians for all electrical fitting works.
20. **Do not** use electrical closets or compartments that house dry riser inlets/outlets, hose reels, telecom riser ducts etc, for storage.
- Do** ensure that the closets and compartments are clean and free of obstructions at all times.
21. **Do not** use staircases as rest areas or storage space.
- Do** keep staircases free of obstructions at all times.

22. **Do not** burn joss stick, oil, incense paper and other offerings used in religious ceremonies in the premises.

Do use joss sticks, lamps and candles that are electrical or battery operated.

23. **Do not** cook in the premises using open-flame stove or electrical hot-plate except for areas that are allowed for cooking such as kitchens and food stalls.

Do use microwave or electrical oven for heating up food only.

24. **Do not** wedge open any fire door.

Do ensure fire doors are kept closed but unlocked at all times.

25. **Do not** obstruct the access to a fire hose reel or a fire extinguisher.

Do keep the hose reel cabinets and fire extinguishers free from any obstruction.

APPENDIX A-II CONSOLIDATED FIRE SAFETY REQUIREMENTS FOR COMPLIANCE BY CAG TENANTS

- 1 Tenants shall ensure that the fire-fighting installations and/or equipment such as fire sprinklers, dry riser breeching inlets and outlets, hosereels, and fire extinguishers in their demised premises are accessible (unobstructed) at all times. They are provided solely for the purpose of fire fighting and shall not be misused or vandalized.
- 2 Tenants shall ensure that the fire-fighting equipment like fire hosereels, fire extinguishers, kitchen fire suppression system (for food outlets and restaurants) in their demised premises are checked and serviced at least once a year by trained persons of approved organizations, authorized by the relevant authorities. A label certifying that the equipment is checked and serviced shall be attached to the same.
- 3 Tenants shall ensure that staircases, passageways and exits, etc. that form parts of the emergency escape route in their demised premises are unobstructed at all times. Exit signs are to be lit at all times. Exit doors shall not be locked or obstructed in any way when the premises are occupied. Where exit doors are required to be locked for reasons of security, they shall be linked to the fire alarm system which, upon its activation, will automatically unlock the exit doors for immediate access.
- 4 Tenants shall take proper precautions to prevent fire in their demised premises. Tenants shall adhere to the list of fire safety dos and don'ts in Appendix A-I at all times and submit their declaration of compliance to the Landlord every six-monthly.
- 5 Tenants shall ensure no burning of candles, oil lamps, joss sticks, incense paper, etc. on the demised premises without prior written approval of the Landlord.
- 6 Except for approved eateries or restaurants, Tenants shall ensure no open flame cooking is allowed on the demised premises at all times. The use of microwave ovens for warming of food is allowed.
- 7 Tenants shall ensure no flammable liquids, gases or other hazardous substances (e.g. toxic, corrosives) are stored in the demised premises unless with the prior written approval of the Landlord and subject to strict

compliance with all conditions set by the Landlord and with the relevant codes of practice issued by SPRING Singapore and requirements of the relevant authorities including but not limited to the Ministry of Environment & Water Resources and the Fire Safety and Shelter Department (FSSD). Tenants shall also provide to the Landlord the Material Safety Data Sheets (MSDS) for the hazardous materials.

- 8 Tenants shall take part in the fire evacuation drills organized by the Landlord. Every tenant shall appoint at least one fire warden per unit on every floor/level, whose primary duty is to ensure all their staff are evacuated to safety during an emergency. Tenants shall also send their appointed fire wardens to attend the annual fire warden briefing organized by the Landlord.
- 9 Tenants shall submit to the Landlord by 31 January of each calendar year the names and contact numbers of their appointed fire wardens, **assistant fire wardens** and the floor registers listing the names of their staff occupying the demised premises. Subsequently, should the tenants make any changes to the appointed fire wardens, **assistant fire wardens** or floor registers, the tenants concerned shall write to update the Landlord with those changes no later than 30 days.
- 10 All hot works that generate heat or sparks require the prior written approval of the Landlord. Tenants shall apply for online approval at the CAG website or alternatively apply manually using the prescribed application form available on the CAG website. The approval will be subject to such conditions as deemed fit by the Landlord.
- 11 Where due to renovation or A&A works, Tenants require the fire detection and/or protection systems in their demised premises to be temporarily isolated, written approval shall be sought from the Landlord, **through AES Fire Safety Unit**. Tenants shall apply for the approval using the prescribed application form available on the CAG website. The approval will be subject to such conditions as deemed fit by the Landlord.
- 12 Tenants shall ensure that all their staff are aware of the need for them to notify the Airport Emergency Service (AES) Division immediately at Tel: 6541 2525 upon discovery of a fire outbreak on their demised premises. The fire emergency number shall be prominently displayed at the strategic locations on the demised premises. All fires, however small, shall be reported to AES.

- 13 Tenants shall take all reasonable measures to prevent false fire alarm in their demised premises. If the Airport Emergency Service (AES) is activated by a false fire alarm activation that is not due to technical fault of the fire alarm system but due to the negligence or vandalism by the tenant, the tenant concerned shall pay the service charge levied by the Landlord as stipulated in the foreword.

APPENDIX A-III - WELDING AND HOT WORKS**1 Scope**

- 1.1 The procedures in this Appendix are for the protection of persons from injury and illness and the protection of property from damage by fire or from improper handling of equipment.
- 1.2 The requirements listed in this Part shall be in addition to the Singapore Standard 510:2005 Code of practice for safety in welding and cutting (and other operations involving the use of heat).

2 Welding and Cutting Operations

- 2.1 When portable cutting or welding equipment is used, the main danger is that combustible materials may be ignited by sparks, hot metal, heat conduction, the flame, or the electric arc itself. Other fire risks associated with the different types of equipment are flashback fires from gas equipment and the accidental arcs from stray current in electric arc-welding equipment.
- 2.2 The hazards associated with welding and cutting processes are:
- (a) High temperatures such as for oxy-acetylene 3,101.7°C (5,615°F), oxy-propane 2,776.7°C (5,030°F) and flames that may easily cause ignition of nearby combustible materials.
 - (b) Flexible rubber hoses carrying flammable gas to the blow-torch are prone to damage by sharp edges or hot surfaces.
 - (c) Assembled equipment has many joints, which can leak hazardous substances if not properly designed or installed, and hoses improperly secured to connectors may whip off under pressure and cause injury.
 - (d) A great deal of pressure energy is stored in cylinders and this stored energy can be devastating when released in an uncontrolled manner.
 - (e) Leakages, even if they are minor, can give rise to fire, explosion and other hazards especially in unventilated spaces.

- (f) Oxygen enrichment may cause most materials normally accepted as non-combustible to ignite and burn rapidly with just one spark, e.g. asphalt with ignition temperature of 485°C (905°F).
- (g) Oxygen deficiency can cause immediate unconsciousness resulting in death.
- (h) Incorrect operations can make the flame flash back into the hose causing it to rupture, start a fire, explode or burn internally. Flashback arrestors shall be fitted at both ends of the hoses to prevent this.
- (i) During welding and flame cutting operations, toxic hazards can arise from fumes and gases especially metal fumes, deriving from zinc, cadmium, copper, iron and lead, are dangerous.
- (j) Poor ventilation may cause build-up of toxic gases, fumes and explosive mixtures of flammable gases.
- (k) Unsecured gas cylinders may be knocked over and there is risk of damage to the regulator causing a release of flammable gas.
- (l) Operators are exposed to stray sparks and heat.

3 Responsibilities

- 3.1 The following guidance is for cutters, welders, their supervisors and those managing the property where welding or cutting work is being done. These guidelines should be complied with as far as possible. Non compliance to these guidelines resulting in false fire alarm activations and turnout of AES resources may result in a service charge being levied to owners, tenants or any contractors or sub-contractors engaged by them as listed in the Foreword. In addition, a 'stop work order' may also be issued by AES FSSU on any hot works being carried out by owners, tenants or any contractors or sub-contractors engaged by them as a result of any violations to these guidelines.
- 3.2 The "Owner" Division, as Management, shall be responsible for planning and control as follows:
- (a) Recognise its responsibility for safe usage of cutting and welding equipment on its property.
 - (b) Designate / establish approved area for cutting and welding works.

- (c) Designate an individual to be responsible for authorising cutting and welding operations. The individual must be aware of the hazards involved and be familiar with the standard required for cutting and welding processes.
- (d) Ensure that only approved apparatus; such as torches, manifolds, regulators or pressure reducing valves are used.
- (e) Ensure cutters, welders and supervisors are suitably trained in the safe operation of equipment and processes.
- (f) Select contractors who have suitably trained personnel to perform the hot works and who have an awareness of the magnitude of the risks involved.
- (g) Advise workers about flammable materials and hazardous conditions in the vicinity.
- (h) Authorise / permit, such hot works to be carried out after having obtained AES Division's approval in the form of the Hot Work Approval and keep the AES Division informed. The hot work permit shall be valid for a certain period and be certified that:
 - (i) Area is safe before work commences;
 - (ii) Precautions are taken as hot work is in progress; and
 - (iii) Check for smoldering materials is done half-an-hour after completion.

3.3 The Supervisor of welding and/or cutting operations shall:

- (a) Be responsible for the safe handling of welding and cutting equipment, and safety in welding and cutting processes.
- (b) Determine combustible materials and hazards in the work location.
- (c) Protect combustibles from ignition by:
 - (i) having the welding or cutting works moved to a location free from dangerous combustibles; or
 - (ii) having the combustibles moved to a safe distance from the work; or
 - (iii) having the combustibles properly shielded against ignition e.g. protect floor impregnated with paint, grease or oil; and

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- (iv) ensuring that welding or cutting works are so scheduled that operations which might expose combustibles to ignition, (e.g. doping, spray painting, battery charging), do not coincide with welding or cutting works.
- (d) Secure authorisation for cutting or welding operations from the designated management representative and assure himself of the following:
- (i) The cutting and welding equipment used is in satisfactory operating (mechanical and electrical) condition and in good repair.
 - (ii) The floor is swept clear of combustible waste and storage for a radius of 12m from the welding or cutting operations. Combustible floors shall be kept wet, covered with damp sand, or protected by fire resistant shields or non-combustible sheets. Where floors have been wetted down, personnel shall be protected from electric shock.
 - (iii) All combustibles shall be relocated at least 11m from the work site. Where relocation is impracticable, irremovable combustibles shall be protected with flameproof covers / non-combustible screen, or shielded with metal or other appropriate guards or curtains. Edges of covers at the floor shall be tight to prevent sparks from getting under them. This is also important where several covers are used to protect a large pile.
 - (iv) Wall or floor openings, gaps within 11m of the site shall be tightly covered with non-combustible materials to prevent passage of sparks to adjacent areas.
 - (v) Ducts and conveyor systems that might carry spark to distant combustibles shall be suitably protected by a fire damper or other means or be shut down.
 - (vi) Where cutting or welding is done near walls, partitions, ceilings or roofs of combustible construction, fire-resistant shields or guards shall be provided. If welding is to be done on a metal wall, partition, ceiling or roof, precautions shall be taken to prevent ignition of combustibles on the other side due to conduction or radiation of heat. If possible, combustibles shall be removed from the near side of the metal walls, partition or work pieces. Where combustibles

are not relocated, a fire watch on the opposite side from the work shall be provided.

- (vii) Cutting or welding on pipes or other metal in contact with combustible walls, partitions, ceiling or roofs shall not be undertaken if the work is close enough to cause ignition by conduction.
 - (viii) Cutting or welding of tanks, vessels, plant or equipment which had previously contained flammable substances, vapours, liquids or dusts, shall be cleaned and purged properly prior to the cutting or welding works. These containers shall also not be refilled until the metal has cooled down.
 - (ix) Portable fire extinguishers, appropriate for the classes of fires that may break out, shall be suitably placed at the work area. Where hose-lines are available, they shall be connected and ready for use.
 - (x) All welders / cutters shall be fully trained and aware of the fire risks involved.
 - (xi) All persons are suitably protected against heat, sparks, slags, etc.
 - (xii) Ensure adequate ventilation to prevent flammable or toxic fumes build up.
 - (xiii) Ensure non-combustible containers are available for placing hot tools after use. The container shall be made of electrically insulated material if arc electrical welding equipment is used.
- (e) Ensure that the cutter or welder secures his approval and that conditions are safe before starting operations.
 - (f) Ensure that fire protection and extinguishing equipment e.g. hoses, extinguishers, etc; are properly located at the site.
 - (g) The Fire Patroller with portable fire extinguisher shall not be more than 15m from the welding or cutting works. If necessary, another Fire Patroller shall oversee the adjacent welding or cutting works, so that the required distance can be maintained.
 - (h) Ensure that Fire Patrollers are present for every welding or cutting works. Hot works shall be stopped if a Fire Patroller is not present.

3.4 The Cutter or Welder shall:

- (a) Handle his equipment safely and use it so as not to endanger lives or property.
- (b) Have approval of his supervisor before he starts to cut or weld.
- (c) Not to cut or weld where conditions are not safe.
- (d) Continue to cut or weld only so long as conditions are unchanged from those under which approval was granted.
- (e) Watch for fire in all exposed areas and together with the Fire Patroller, try to extinguish them first when within the capacity of the equipment available or otherwise sound the alarm.
- (f) All fire occurrences shall be reported to the AES Division.
- (g) Check for smouldering materials half-an-hour after completion of work.

4 General Fire Prevention

4.1 Cutting or Welding shall be permitted in a fire-safe area and if it is to be carried out within a building, it shall be done in a specific area designed or approved for such works. These areas should be of non-combustible or fire-resistive construction, free of combustibles and flammable contents, and segregated from adjacent areas.

4.2 Cutting or welding shall not be permitted under the following situations:

- (a) The area is not authorised by management.
- (b) In a **sprinkler protected** building where the sprinkler system is impaired.
- (c) Where there is presence of explosive atmospheres (mixtures of flammable gases, vapours, liquids or dusts with air), or uncleaned or improperly prepared tanks or equipment, which previously contained such gases or materials.
- (d) In areas near the storage of large quantities of exposed, readily ignitable materials.

- 4.3 The area shall be inspected by the individual responsible for authorising cutting and/or welding operations to ensure that it is fire safe before cutting or welding is permitted. He shall:
- (a) Determine the precautions to be followed in granting authorisation to proceed with the works in the form of a written permit.
 - (b) Be familiar with the standard for cutting and welding processes.
 - (c) Have fire-extinguishing equipment readily available and be trained in its safe and proper use.
 - (d) Familiar with facilities for sounding an alarm in the event of fire outbreak.
 - (e) Look out for fires in all exposed areas and try to extinguish them first when within the capacity of the equipment available or otherwise sound the alarm.
 - (f) Remain on site for at least half-an-hour after completion of cutting or welding operations to detect and extinguish possible smouldering fires. All cylinders shall be returned to a safe store.

5. Safe Cutting and Welding Practices

5.1 With Gas Cutting and Welding

- (a) All gas cylinders shall be clearly marked to indicate content.
- (b) The cylinders shall be clamped or chained and supported to ensure they remain in an upright position.
- (c) Valve protection caps, where the cylinder is designed to accept a cap, shall be in place, hand-tight except when cylinders are in use or connected for use.
- (d) Both the fuel and oxygen hoses must be fitted with non-return valves and at both ends of hoses with flash back arrestors.
- (e) Equipment shall be checked for damage before use.
- (f) Soapy water may be used to check for leakage.
- (g) Replace leaking hose immediately.

- (h) Damaged equipment shall not be used.
- (i) Repair or replace damaged equipment before commencing the hot works.
- (j) Observe correct ignition procedure.
- (k) Open cylinder valves slowly.
- (l) Cylinder valves should not be lubricated.
- (m) Cylinder valve shall be kept clean.
- (n) When key-operated cylinders are being used, key should be left in position on the spindle. This will allow cylinders to shut quickly if necessary.
- (o) The cylinders must be stood as far as possible from hot work area.
- (p) Cutting and welding nozzles must be kept clean and free of blockage.
- (q) Never release oxygen in the air deliberately or inadvertently. Be aware that excess oxygen in confined space increases danger of fire and explosion.

5.2 With Electric Arc Cutting and Welding

- (a) Easily accessible isolation switch shall be available.
- (b) Separate earthing conductor shall be used to earth the metal work and welding set.
- (c) Welding earthing shall be protected from mechanical heat damage or inadvertent disconnection.
- (d) All electrical components shall be regularly inspected and tested.
- (e) Damaged equipment shall not be used.
- (f) Repair or replace damaged equipment before commencing the hot works.
- (g) Damaged cables shall not be used.
- (h) Replace damaged cables immediately.

- (i) Welding current shall be as low as possible.
- (j) Avoid exposed metals parts in equipment and which may induce accidental arcs.

5.3 **Fire-Fighting Arrangement**

- (a) Qualified Fire Patrollers equipped with the appropriate fire extinguisher shall be available during the hot work process.
- (b) Fire involving electric arc welding equipment can be extinguished with dry chemical or carbon dioxide extinguishers.
- (c) Heated cylinders shall be cooled by copious water spray from a safe distance.
- (d) Remove other cylinders to a safe place in the open and away from aircraft.
- (e) In case of leaking cylinders becoming ignited, turn off cylinder valves and try to extinguish the fire. **DO NOT EXTINGUISH FIRE BEFORE SHUTTING THE VALVE.**
- (f) Evacuate if flame is impinging on the cylinder.

6 Additional Safety Requirements for Hot Works on the Ramp / Apron

- 6.1 Hot works that are performed on the ramp or apron will pose even greater fire hazards because it is where aircraft fuel servicing operations are normally carried out. Should a fire occur in this area, it will jeopardize the nearby aircraft and passengers alike. To safeguard lives and property, the following additional safety measures shall be implemented for hot works that are carried out in the ramp / apron area:

Type of Hot Work	Additional Requirements
Acetylene welding	a) Observe a 75m separation ¹ from aircraft. If the hot work is supervised by a qualified safety officer (registered with Ministry of Manpower), the 75m can be reduced to 50m. b) Engage a fire patroller and a fire engine to stand by at the hot work location. c) Monitor ambient fuel vapors using flammable gas detector (with alarm ²) before and during the hot work.
Shielded arc welding	- ditto -

Type of Hot Work	Additional Requirements
Thermo-plastic painting using LPG	- ditto -
Thermo-plastic painting using non-gaseous fuel	- ditto -
Metal grinding	a) Observe a 35m separation from aircraft and with shield to prevent sparks from flying to the refueling area.

Note¹: Separation is the distance between the hot work location and the tip of the aircraft wing.

²: Hot work shall be stopped immediately upon a flammable gas alarm.

APPENDIX A-IV - PRECAUTIONS DURING BATTERY CHARGING**1 General**

- 1.1 In view of the various hazards associated with the use of lead acid electric vehicles and equipment in the passenger terminal buildings, only electric vehicles and equipment using **sealed** lead acid batteries (commonly known as 'maintenance free', 'dry' or 'dry cell' batteries) shall be allowed to be used and charged in the passenger terminal buildings. Existing electric vehicles and equipment using **flooded** or **non-sealed** lead acid batteries (commonly known as 'wet' or 'wet cell' batteries) will not be allowed to be used in the passenger terminal buildings and are to be replaced or converted.
- 1.2 Although the present system of charging wet batteries is considered safe, the release of hydrogen during the charging process may give rise to a fire outbreak. As such, the following precautions shall be observed whilst charging accumulators.

2 Precautions

- (a) Charging room should be cool and well-ventilated (outdoors where practicable), away from manufacturing and service areas.
- (b) Batteries should stand on non-porous, non-combustible, non-conducting surface (e.g. slate, glazed tiles, etc) which must be kept dry.
- (c) All wood-work must be treated with acid resisting paint.
- (d) Batteries should be spaced at least 25 mm (one inch) apart.
- (e) Batteries shall not be charged at an excessive rate. Booster, if used, shall be switched off after completion. Do not leave charging unattended especially overnight.
- (f) All connections must be properly and firmly made.
- (g) Terminals must be clean, highly greased and capped with insulating material.
- (h) Charging circuit shall be correctly fused.
- (i) Plant/equipment shall be switched off before making or breaking battery connections.

- (j) Bulk storage of electrolytes shall be in separate compartments.
- (k) Smoking and naked lights shall not be allowed within battery charging rooms.
- (l) Charging of lead acid and alkaline shall be carried out independently.
- (m) Finger-rings, wrist watches, waist chains, etc. should not be worn while working near battery terminals because a short circuit may cause an arc or result in severe burns.
- (n) Wrenches and other hand tools must be used carefully to avoid shorting.
- (o) Brushes used to clean batteries shall have neither a metal frame nor wire bristles.

3 Location

- 3.1 Advice and approval shall be obtained from CAG in regard to the location of battery charging rooms.
- 3.2 Fire safety measures shall be recommended by SUPT (FS). Tenants shall comply with these strictly.

APPENDIX A –V - Import, Transport, Storage and Dispense/Decant of Petroleum & Flammable Materials

1 Introduction

1.1 Flammable liquids pose a serious fire hazard if they are improperly stored or handled. They can be easily ignited, with a spark for example, and can cause fire to spread quickly especially if the liquid is spilled or exposed to heat. Any storage of flammable/combustible liquids shall have the prior approval of AES Division. For fire safety requirements related to the storage of flammable liquids, reference can be made to the following documents:

- i. Fire Safety Act - Fire Safety (Petroleum and Flammable Materials) Regulations
- ii. SS 532 : 2007 - Code of practice for the storage of flammable liquids

1.2 SCDF issues a licence for the import, transport and storage of petroleum Singapore according to their class and quantity below:

- i. Class 0 - Liquefied Petroleum Gas (e.g. LPG)
- ii. Class I - flash point less than 23 degree C (e.g. petrol, AVGAS, CNG)
- iii. Class II - flash point between 23- 61 degree C (e.g. Jet A fuel)
- iv. Class III - flash point between 61-93 degree C (e.g. diesel)

1.3 All storage of petroleum and flammable materials, regardless of quantity stored, have to comply with SS 532 and indicated in building plans submitted to SCDF and AES for approval. Storage licence is not required if the quantity stored is below the licence exemption quantity in the tables below but conditions of ‘Minor Storage’ as per SS 532 shall be met.

- i. Class 0 Petroleum

Purpose	Exemption Quantity
For private use in a private dwelling house	Not more than 30 kg in not more than 2 cylinders
For use in an eating place	Not more than 30 kg per stall in the eating place, subject to a maximum quantity of not more than 200 kg to be stored at that eating place
For use in a restaurant	Not more than 200 kg
For use in a factory	Not more than 300 kg per factory

ii. Class I, II, III Petroleum

Purpose	Exemption Quantity		
	Class I	Class II	Class III
For private use in a private dwelling house or for use in any business other than in a factory	Not more than 20 L	Not more than 200 L	Not more than 200L
For use in a factory	Not more than 400 L	Not more than 1000 L	Not more than 1500 L

2 General Fire Safety Requirements

- 2.1 Flammable liquids with a flash point at or below 61° degrees Celsius and in quantities in excess of 200 litres shall be stored under the following conditions:
- (a) A minimum distance of 15m shall separate the store from other buildings, public areas and property boundaries. If a separation distance of 15m cannot be met, a barrier or separating wall of suitable fire resistance shall be erected between the store and other buildings, public areas and property boundaries to reduce the hazard.
 - (b) The store or any fire-separated compartment within the store shall not exceed 140m² in floor area.
 - (c) There shall be adequate natural ventilation to disperse all vapour concentrations of the flammable liquid.
 - (d) All electrical services installed shall have to be flame proofed.
 - (e) Signs reading “FLAMMABLE LIQUID – NO SMOKING OR FLAMES WITHIN 15M” shall be conspicuously posted as a warning.
 - (f) At least two fire extinguishers of suitable type and adequate size shall be provided for fire protection.
 - (g) The floor shall be bunded to minimum requirement, i.e. at least 10% greater than the total volume of the flammable liquid likely to be stored.
 - (h) A fire hydrant shall be provided if the store is less than 90m from any building, public area or property boundary.
 - (i) The drainage system adjacent to the store must not carry spillage, under normal operation, into any building or public areas.

- (j) A suitable firebreak shall be constructed by the removal of grass, weeds, vegetation and rubbish around the store.

3 Outdoor Storage (At Seletar Airport only)

3.1 The following precautions are recommended to minimise the ignition risk from external sources:

- (i) Stacks to be placed at least 2m from perimeter boundaries to prevent arson.
- (ii) The gangway to be at least 3m wide for movement of forklift.
- (iii) To maintain at least 1m gap between the stacks as escape routes.
- (iv) To ensure that the gangway and gap be clear of obstruction.
- (v) All stacks are not more than 6m high.
- (vi) The stack is at least 6m away from a single storey building.
- (vii) The stack is at least 15m from hazardous building.
- (viii) The stack be at least 15m from any outdoor plant e.g. transformer, pressurised gas or dangerous chemicals.
- (ix) The stack at least 9m away from other buildings.
- (x) The entrance to the store is adequate for fire appliances and readily accessible at all times.
- (xi) All rubbish is cleared from the yard when full or at least once at the end of the day.
- (xii) Bonfires should not be permitted on site.
- (xiii) Incinerators be located well away, enclosed, and fitted with spark arrestors.
- (xiv) Kept down undergrowth, grass, weeds and other vegetation.
- (xv) Never burn or use weed killers that aid combustion e.g. Sodium Chlorate.

- (xvi) Naked flames or exposed electrical elements are confined to appropriate building.
- (xvii) Strictly no smoking within 6m from the store.
- (xviii) To display 'No Smoking' notices prominently around the yard.
- (xix) The store to be surrounded with metal fences or brick wall to deter intruder.
- (xx) The store is well secured especially at night with periodic patrols.
- (xxi) Floodlit the yard if possible.
- (xxii) Unlimited supply of water is available.
- (xxiii) Hydrants are strategically positioned.
- (xxiv) Hosereel and extinguishers be available at Fire Point. Hosereel be sited in such manner that no part of storage be more than 6m from its nozzle when fully extended.
- (xxv) At least one 9-litre fire extinguisher for every 200 square meters of floor area.
- (xxvi) Appropriate extinguishers shall be available for machinery, fuel stores and vehicles etc.
- (xxvii) To install one manually operated alarm at each Fire Point.
- (xxviii) In large yard, an electrically operated alarm connected to a Central Control panel is desirable.
- (xxix) To carry out frequent inspection and maintenance of appliances.
- (xxx) All employees shall be trained in use of fire extinguishers and when and how to call AES Seletar.

**APPENDIX A –VI - Summary of Fire Safety Requirements for CAG
Managed Buildings**

1	Fire Detection and Protection Systems	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
1.1	A clear space of 0.5m (Warehouse - 1m) is maintained between the top of storage goods and sprinkler heads.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Goods to be removed immediately.	<input type="checkbox"/>
1.2	Objects are not hung on the sprinkler heads.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Objects to be removed immediately.	<input type="checkbox"/>
1.3	Smoke detectors/sprinklers are not covered or without dust particles.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Obstruction to be removed or cleaned immediately.	<input type="checkbox"/>
1.4	Smoke/heat detectors are not loose from mounting or damaged.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To be rectified.	<input type="checkbox"/>
1.5	Smoke/heat detectors are not painted over.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Paint to be removed from detectors.	<input type="checkbox"/>

2	Passive Fire Safety Measures	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
2.1	Access to EXIT doors and escape routes are not obstructed by objects.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Objects to be removed immediately.	<input type="checkbox"/>
2.2	EXIT doors are not locked or latched. (unless linked to fire alarm)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EXIT doors to be unlocked immediately.	<input type="checkbox"/>
2.3	EXIT signs are lighted.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EXIT signs to be lighted.	<input type="checkbox"/>
2.4	Fire doors are kept closed at all times.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fire door to be closed immediately.	<input type="checkbox"/>

3	Fire extinguisher / Hosereel (Serviced Annually)	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
3.1	Fire extinguishers are visible, unobstructed or clearly indicated when enclosed in a cabinet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Extinguishers to be correctly installed.	<input type="checkbox"/>
3.2	Fire extinguishers are fully charged, serviced annually and labelled.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Extinguishers to be replaced / serviced.	<input type="checkbox"/>

3.3	Fire extinguisher are installed as per QP approved plan.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To provide additional fire extinguishers as per AES FSU recommendation.	<input type="checkbox"/>
3.4	Hosereel and Dry Riser shall not be obstructed or used as storage place.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Obstructing or stored items to be removed.	<input type="checkbox"/>
3.5	Hosereels are tested and serviced annually (not expired).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Hosereel to be tested / serviced.	<input type="checkbox"/>
3.6	Hosereel signage is installed on the cabinets.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To install hosereel signage.	<input type="checkbox"/>
3.7	Fire extinguisher / Hosereel cabinets are in good condition.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cabinets to be fixed.	<input type="checkbox"/>

4	Housekeeping of premises	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
4.1	"No Smoking" signs are displayed. (Store / Workshop).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To display "No Smoking" sign.	<input type="checkbox"/>
4.2	No accumulation of rubbish inside the premises, at the doorway, passageway and stairwells.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Rubbish to be cleared immediately.	<input type="checkbox"/>
4.3	Flammable liquids are not stored in the premises. (Except with official SCDF approval)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To remove flammable liquids immediately.	<input type="checkbox"/>
4.4	Goods are not stacked haphazardly in the storeroom.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To tidy the goods in the store.	<input type="checkbox"/>
4.5	LPG cylinders are not kept in the premises.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To remove LPG cylinders immediately.	<input type="checkbox"/>
4.6	No burning / naked flame (oil lamp, joss stick, candle etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To be removed.	<input type="checkbox"/>

5	Electrical fixture	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
5.1	Electrical fixtures, switches and sockets are not defective or damaged.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Defective / damaged electrical switches or sockets to be rectified.	<input type="checkbox"/>
5.2	Access to Distribution Board (DB) is not obstructed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To remove obstruction immediately.	<input type="checkbox"/>
5.3	DB closet is not used for storage purposes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Objects to be removed immediately.	<input type="checkbox"/>
5.4	"DB Closet" signage posted.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	To fix signage.	<input type="checkbox"/>

5.5	Electric kettle is not placed near to the power outlet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Kettle to be placed away from the power outlet immediately.	<input type="checkbox"/>
5.6	Electrical cords / wires are to be secured in conduits / trunking.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Electrical wires to be covered by trunking.	<input type="checkbox"/>

6	Mechanical & Electrical Room	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
6.1	Diesel Tank Room :-					
	a) No accumulation of oil stain.				To be cleaned.	
	b) Fuelling inlet padlocked.				To be padlocked.	
	c) Bund walls are constructed.				Bund walls to be constructed.	
	d) "No Smoking" signs are displayed.				To display " No Smoking" signs.	
	e) Ventilation system is functioning.				To rectify the fault.	
6.2	Generator Room :-					
	a) Day tank bund walls constructed.				Bund walls to be constructed.	
	b) Battery bank terminals are protected by rubber covers.				To provide rubber covers for the terminals.	
	c) No accumulation of oil at fuel pump.				To be cleaned.	
6.3	HT/LT Switch Room :-					
	Insulation mat provided.				To provide insulation mat.	
6.4	Transformer room					
	Cable troughs are sealed up.				To be sealed up with fire stop material.	
6.5	Battery Room :-					
	a) Ventilation system is functioning.				To rectify the fault.	
	b) Battery charger in good condition.				To be serviced.	

7	Restaurant / Kitchen Cleaning of Cooker Hood / Ducts (Regular Basis)	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
7.1	Cooker hood is clean & free from grease				To be cleaned	
7.2	Cooker hood filters are clean & free from grease				To be cleaned	
7.3	Record of cleaning				To be produced for AES sighting	
8	Restaurant / Kitchen Fire Suppression System (Serviced bi-annually)	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
8.1	Discharge nozzles with nozzle seal/cap				To replace the seal/ cap	
8.2	Discharge nozzles are free from grease				To be cleaned	
8.3	Regulated actuator assembly is visible and free from obstructions				To remove obstruction	
8.4	Service label is attached				To attach service label	
8.5	Fusible links are free from grease				To be cleaned	
8.6	Remote manual pull station (MPS) is not obstructed and tampered seal is intact				To remove obstruction & replace seal	
8.7	Supply lines / pipe fittings are visually connected				To be inspected by maintenance contractor	
8.8	Staff familiar with the location and operation of manual pull station/s				To brief staff	
8.9	Linkage to Fire Station & FMC				To be tested by maintenance contractor	
8.10	Model / Type of Kitchen's Fire Suppression System :					
8.11	Name of Service & Maintenance Company :					
8.12	Date of Service :			Telephone No :		
8.13	Maint Staff Name :					

9	Restaurant / Kitchen Piped Gas System (Serviced annually)	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
9.1	Bypass valve is padlocked				To padlock bypass valve	
9.2	Gas detectors are free from grease				To be cleaned	
9.3	Gas detectors are not damaged				To be checked by maintenance contractor	
9.4	Record of inspection by Licensed Gas Worker (LGW)				To be produced for AES sighting	
9.5	Piped Gas System is linked to FMC				To be checked by maintenance contractor	

10	Restaurant / Kitchen Non CAG Fire Alarm Panel (Serviced annually)	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
10.1	Linkage to Fire Station & FMC				To be checked by maintenance contractor	
10.2	Name of Service & Maintenance Contractor Company :					
10.3	Date of service :	Telephone No :				
10.4	Maint staff name :					

11	Restaurant / Kitchen Fire Warden	C	NC	NA	Corrective Action(s) for non-compliance (if any)	Done
11.1	Appointed Fire Warden(s)				To appoint Fire Warden(s)	
11.2	Name of Fire Warden :					
11.3	Date of last fire safety awareness talk attended :					

SECTION B : FIRE EMERGENCY PLANS FOR CAG OWNED / MANAGED BUILDINGS**1 Procedures for Alerting AES**

- 1.1 The fire alarm systems of all buildings at Changi and Seletar Airports are linked to the Airport Fire Stations. Any person discovering an outbreak of fire, however small it may seem, shall alert AES and the nearby occupants immediately by activating the nearest fire alarm (break-glass) call point.
- 1.2 He shall then inform AES at telephone no. 65412525 (or 64813377 in the case of Seletar Airport) of the following:
- (a) Location of fire,
 - (b) Nature of fire, if known,
 - (c) Injury to personnel, if known,
 - (d) Informant's particulars and contact number.
- 1.3 In case of fire outbreaks within ramp or remote aircraft parking areas where no fire alarm system is installed, AES shall be informed immediately by telephone.

2 Objectives of Fire Emergency Plan

- 2.1 The objectives of this Plan are:
- (a) To safeguard human lives and property in the event of a major fire outbreak;
 - (b) To establish a procedure to ensure systematic and orderly evacuation of all occupants in the building;
 - (c) To ensure prompt raising of the fire alarm and marshalling of first aid fire-fighting efforts;
 - (d) To establish roles and responsibilities for each organization / agency involved in handling the fire emergencies; and
 - (e) To ensure that the airport operations and business can be resumed as quickly as possible.

2.2 Signal for Fire Alarm

The alarm signal for fire is a continuous ringing note resounding from the electrically operated bells located in the building (at all levels in the building and the three multi-storey car parks in the case of Changi Airport).

The fire alarm signal can be raised by:

- (a) Break glass alarm system, which require a person to break the glass of the nearest fire alarm manual call point.
- (b) Automatic heat and smoke detector system.
- (c) Automatic sprinkler system.

The fire alarm system is linked to AES Fire Station 1, Fire Station 2 and FMC which are manned 24 hours.

3 Actions to be Taken in the Event of an Outbreak of Fire

3.1 Informant

The person who discovers the fire shall immediately:

- (a) Raise the alarm by activating the nearest fire alarm “Break Glass” call point.
- (b) Attempt to extinguish any incipient fire with the available fire extinguisher or fire hose reel without taking personal risk. Water shall not be used on fire involving energized electrical equipment. Therefore, fire hose reel or water-based extinguishers shall not be used unless the electrical equipment has been de-energized.

3.2 All Tenants/Staff

Upon hearing the fire alarm, all staff shall lock away important files and cash, shut down machinery and other equipment, and remain alert. When hearing the instructions to evacuate, all staff shall evacuate immediately as guided by their respective fire wardens and/or assistant fire wardens.

Airport staff from Immigration and Checkpoints Authority (ICA), Auxiliary Police, Ground handling agents and airlines who are attending to the passengers at the time when the instructions to evacuate are given, shall guide them to the nearest exit/staircase immediately and evacuate together to the nearest assembly area regardless of its location on the airside or landside.

- (a) When evacuating, do not panic but quickly walk to the nearest exit/staircase and proceed to the nearest assembly area. **Do not use lifts¹**. [Note¹: Immediately upon the activation of the fire alarm, the lifts will automatically home on the ground floor and remain open.]
- (b) The assembly areas are located at both the landside and airside outside the terminal building. See Appendix B-I for Terminal 1, 2, 3 and Control Tower and Appendix B-II for Budget Terminal (site plan).
- (c) All staff shall not re-enter the building once evacuated unless instructed otherwise by the AES or SCDF officer(s) in attendance.

3.3 Airport Emergency Service (AES)

3.3.1 On receiving the fire alarm, the AES Watchroom Operator shall inform AES Operations Commander and immediately deploy fire vehicle(s) to the scene.

3.3.2 Upon arrival, AES responding crew shall ascertain the location of the alarm from the alarm panel and proceed to that location for further investigation.

3.3.3 In the event of a major fire outbreak, the AES Operations Commander shall decide whether total evacuation of all occupants to the assembly areas (See Appendix B-I for Terminal 1, 2, 3 and Control Tower and Appendix B-II for Budget Terminal) is necessary. This shall only be done after having assessed the situation.

3.3.4 Instructions for total or partial evacuation of Terminals 1, 2, 3 and Budget Terminal shall be made from FCC 1, FCC 2, FCC3 and BT PA room respectively.

3.3.5 All lifts will be homed to ground level and rendered unserviceable.

3.3.6 In the event that SCDF is activated, the SCDF OIC will takeover as incident manager upon arrival.

3.4 Duty Terminal Managers (AM Seletar in the case of Seletar) (Chief Fire Warden)

3.4.1 In the event of fire outbreak at Terminal 1, 2, 3 or Budget Terminal (or Seletar Terminal Building), the Duty Terminal Manager (AM Seletar, in the case of Seletar) shall immediately inform all officials deemed necessary.

3.5 Fire Wardens / Assistant Fire Wardens and Airport Staff

- 3.5.1 On hearing the fire alarm:
- (a) Alert everyone on their premises to evacuate in an orderly manner using the nearest exit when the instructions for evacuation are given.
 - (b) Check all rooms, offices, stores, toilets etc on their premises, to ensure that no one is left behind.
 - (c) Ensure that children, pregnant women, and physically-disabled persons, if present, are given particular attention during evacuation.
 - (d) Leave the building after ascertaining that all the occupants of the floor have complied with his order.
 - (e) On reaching the assembly area, conduct a roll call of the staff present and report to the coordinator in person of the evacuation status.
 - (f) Inform AES / SCDF Officers immediately of any missing person.

3.6 Airport Police (Police 'F' Division HQ in the case of Seletar)

- (a) Assume initial control of situation until the arrival of AES Ops Commander.
- (b) Deployed at the ground floor staircase exits to guide the evacuees to the designated assembly areas when the instructions to evacuate are given.
- (c) Ensure that all main entrances and exits to/from the building are adequately manned to prohibit unauthorized entry and also to intensify patrolling in the vicinity of the building.
- (d) Direct SCDF OIC to the Fire Command Centre on his arrival.
- (e) Police officers are to be deployed at the assembly areas and also to facilitate evacuees to the assembly area.
- (f) Control traffic movements to facilitate movement of evacuees at the assembly areas.

4 Command And Control

- 4.1 AES Operations Commander (Duty Officer in case of Seletar)/ Duty Officer shall take charge at the Fire Command Centre (FCC) or BT PA room and exercise command and control of evacuation and fire-fighting operations. He

shall hand over command and control to the SCDF OIC upon his arrival (if the SCDF is notified).

- 4.2 AES Operations Commander (Duty Officer in case of Seletar) shall coordinate with his duty officer or OIC at the scene to ensure all evacuees are directed to the nearest assembly areas. All evacuees shall be requested to remain at the assembly areas until an AES senior officer instructs them otherwise.
- 4.3 At the assembly areas, airline staff and/or their ground-handling agents shall take roll-calls of their passengers who have evacuated the terminal building. Fire wardens/assistant fire wardens shall take roll-calls of their respective airport staff at the assembly areas. Airlines, ground handling agents and fire wardens shall report all missing persons to the AES Operations Commander or Duty Officer (Seletar).
- 4.4 All evacuees shall be allowed to re-enter the building only when the “All Clear” signal is given by the AES Operations Commander.

5 Duties and Responsibilities

- 5.1 Superintendent (Fire Safety) / Operations Commander / OC (Seletar) or (Duty Officer)
- (a) Represents the management of the terminal buildings in respect of all fire safety matters.
 - (b) Has the full responsibility for:
 - (i) Establishment of a Fire Safety Committee.
 - (ii) Training of the employees.
 - (iii) Preparation, drafting and putting into force the Fire Emergency Plan.
 - (c) Ensure that the approved Fire Emergency Plan is abided by all staff of the building.
 - (d) Ensure that all exits, escape routes and fire detection/prevention systems in the premises are in good order through regular inspections and maintenance.
 - (e) Conduct evacuation drill annually for occupants. The date and time of each evacuation drill conducted are to be recorded for verification purposes by the SCDF officer.

- (g) Responsible for the formation and training of a fire-fighting team within the building from amongst responsible employees who are physically fit to fulfill this function.
- (h) Ensure that exit doors are kept closed and unlocked during business hours and that hallways, corridors, lobbies and staircases are kept free from obstruction at all times.
- (i) Conduct yearly briefing for fire wardens/assistant fire wardens.
- (j) Ensure that the floor register is updated once a year.

5.2 Fire Wardens / Assistant Fire Wardens

- (a) Acquaint new employees with the Fire Emergency Plan including his/her specific role (if any) during an emergency.
- (b) Be familiar with the Fire Emergency Plan, means of escape, escape routes, fire exits and pre designated areas of the building.
- (c) Be familiar with the operation of the fire alarm system and the use of first aid fire-fighting equipment. (e.g. fire extinguishers, hosereel, etc.)
- (d) Liaise and co-ordinate with each other.

5.3 Airport Police (Police 'F' Division in the case of Seletar)

- (a) Be familiar with the Fire Emergency Plan, means of escape, escape routes, fire exits and pre designated areas of the building.
- (b) Ensure that Police personnel are well versed with their roles as described in the Fire Emergency Plan.

6 **Fire Evacuation Drills**

- (a) Fire evacuation drill shall be conducted at least twice a year for each terminal building.
- (b) All occupants in the building shall participate in the drill.

7 General

7.1 It is in the interest of everyone:

- (a) To know how to report a fire – sound the alarm without delay and call the Airport Emergency Service at **6541 2525**.
- (b) To know what to do in the event of fire – avoid panic and confusion. Decide to fight the fire or evacuate.
- (c) To know the locations of nearby fire extinguishers and hosereels – learn the proper and safe way to use them.
- (d) To know the means of escape in case of fire and to keep staircases, landings and other escape routes clear of obstruction at all times.

7.2 The fire escape tunnels at Terminal 2 and Terminal 3 should also be used for quick and direct evacuation of occupants to the assembly areas outside the terminal building.

7.3 The procedures set out in this Chapter shall apply concurrently with the **CAG Crisis Management Plan**.

CHAPTER 2 - FIRE EVACUATION PLANS FOR CONTROL TOWER AND LORADS COMPLEX (APPLICABLE TO SELETAR WHERE INDICATED)**1 Introduction**

- 1.1 The control tower and the Singapore Air Traffic Control Centre (SATCC) at LORADS Complex (Building 1007 in the case of Seletar) are restricted areas accessible only to essential personnel and authorised visitors. There are critical telecommunication equipment housed in many parts of the buildings and many of the equipment rooms are protected by gas flooding systems which require the occupants to evacuate in the event the gas is released due to fire outbreak.

2 Fire Evacuation Procedures for Control TowerPrimary Evacuation Route

- 2.1 All occupants of the Control Tower shall evacuate to the assembly area at Carpark A (near Building 999 for Seletar) using the staircase as the primary evacuation route.
- 2.2 The last person who leaves the cabin shall activate the Halon System and close the automatic door.

Alternative Route

- 2.3 In the event that the staircase is threatened by fire and is inaccessible, the ATC officers (for Seletar – the ATC officers will escape by external emergency ladder to the ground floor) shall proceed as follows:
- (a) Inform AES
 - (b) Lower the collapsible ladder and secure the joints with bolts.
 - (c) Climb up to the transceiver room in an orderly manner.
 - (d) Unlatch the escape door at the location marked by the “EXIT” sign. The last person to leave shall retrieve the hatch and close the steel door at the balcony to keep out the smoke.
 - (e) Assemble at the balcony on the portion painted yellow outside the transceiver room.

(f) Lower all the collapsible antennas on the rooftop.

(g) Wait for aerial evacuation by helicopter.

2.4 The AES Operations Commander shall decide if aerial evacuation is necessary. If so, the AES WRO shall alert MINDEF Operations Centre (MOC) using the phrase **“REQUEST HELICOPTER AERIAL EVACUATION FOR CHANGI CONTROL TOWER – ALERT” (OR “SCRAMBLE”)** and give a brief description of the situation.

Note: “Alert” shall be used if helicopters are required to be on standby only, and “Scramble” shall be used if helicopters are required for deployment immediately.

2.5 The helicopter landing point at Fire Station 1 shall be used and all evacuees shall be sent to the CCS 1.

3 Fire Evacuation Procedures for LORADS Complex

3.1 In the event of a major fire outbreak at SATCC or any of the other buildings forming the Complex, all occupants from the building on fire and any other building(s), so required by the AES to be evacuated, shall assemble at the open area at LORADS carpark.

4 General

4.1 The procedures set out in this Chapter shall apply concurrently with the **CAG Crisis Management Plan**.

CHAPTER 3 - FIRE EVACUATION PROCEDURES FOR CARGO AGENTS BUILDINGS**1 Procedure for Notification of Fire Outbreak**

1.1 In the event of an outbreak of fire within a cargo agents building, the procedure to notify relevant parties are as follows:

- (a) AES shall, on receiving the fire alarm, immediately inform:
 - (i) the Airport Police;
 - (ii) Assistant Manager (Air Cargo Operations) during office hours, or Duty Terminal Manager (Airport Operations) outside office hours; and
 - (iii) Singapore Civil Defence Force (SCDF) under the instructions of AES Ops Commander / Duty Officer.
- (i) Assistant Manager/Manager (Air Cargo Operations) / Duty Terminal Manager (Airport Operations) shall immediately inform all officials deemed necessary.

2 Evacuation Procedure

2.1 Once evacuation is initiated by the Duty AES Operations Commander, all occupants are to observe the following:

- (a) Stop all work immediately, turn off any gas supplies, and switch off all electrical appliances but not lighting.
- (b) Proceed immediately in a calm and orderly manner to the designated assembly areas as shown in Appendix B-III, via the nearest escape route.

2.2 All evacuees shall be requested to remain at the assembly areas and not disperse unless instructed by the AES Operations Commander.

3 “All Clear” Signal

3.1 The Fire Wardens and Assistant Fire Wardens shall take roll-calls for their staff at the assembly areas. They shall report all missing persons to the AES Officer.

3.1 Evacuees shall be allowed to re-enter the premises only when the AES Operations Commander gives the “All Clear” signal.

4 General

4.1 The procedures set out in this Chapter shall apply concurrently with the **CAG Crisis Management Plan**.

ASSEMBLY AREAS FOR EVACUATION OF TERMINALS 1, 2 & 3 AND CONTROL TOWER

Please contact AES Fire Safety Unit for details.

ASSEMBLY AREAS FOR EVACUATION OF BUDGET TERMINAL

Please contact AES Fire Safety Unit for details.

ASSEMBLY AREAS FOR EVACUATION OF CARGO AGENT BUILDINGS

Please contact AES Fire Safety Unit for details.

ASSEMBLY AREAS FOR EVACUATION OF SELETAR TERMINAL BUILDINGS

Please contact AES Seletar for details.

SECTION C : GENERAL FIRE PRECAUTIONS FOR NON-CAG OWNED / MANAGED PROPERTIES AND LESSEES OF AIRPORT BUILDINGS

CHAPTER 1 - GENERAL FIRE SAFETY – DUTIES AND RESPONSIBILITIES

1 INTRODUCTION

1.1 Besides CAG buildings; Singapore Airlines (SIA), Singapore Airport Terminal Services (SATS), Changi International Airport Terminal Services (CIAS) owned properties and other major buildings located within airport boundary having direct implication and impact are important to airport operations. Hence, there is equally a need to maintain high standards of fire safety at these buildings.

1.2 Furthermore, some of the companies of these buildings are engaged in ground servicing activities, which carry the risk of fire. There is a need to practise a high standard of fire safety to ensure the safety of passengers and no disruption to airport operations.

2 General Responsibilities

2.1 The owners of airport buildings which are neither CAG owned nor managed, shall be responsible in ensuring the following:

- (a) Exercise surveillance over their staff and occupants to ensure that the fire prevention measures listed in Section A Chapter 2 are complied with.
- (b) Maintain and test the protection systems installed in the buildings regularly in accordance with the Codes of Practice.
- (c) Maintain and check the electrical systems in the buildings regularly. The tests listed in Section A Chapter 1, para 2.1, sub-para V (b) should be carried out.
- (d) Test the safety devices of the electrical systems and wiring regularly and also to ensure that they are adequate.

- (e) Arrange for loss prevention checks, which shall be carried out at their premises at least once annually. Copies of such reports should be forwarded to SUPT (FS) (or OC Seletar in case of Seletar).
- (f) Provide adequate fire extinguishers and hosereels in the premises in accordance with FSSD and AES regulations and requirements. These fire protection equipment shall also be properly maintained in accordance with the relevant standards.
- (g) All owners and tenants shall comply with the procedures and guidelines in this Manual and shall take all reasonable measures to prevent false fire alarm activations in their demised premises. Non compliance to these procedures resulting in false fire alarm activations and turnout of AES resources may result in a service charge being levied to owners, tenants or any contractors or sub-contractors engaged by them as listed in Foreword.

3 Fire Prevention Measures

- 3.1 Owners of all non-CAG managed properties shall comply with the Fire Prevention Measures listed in Section A Chapter 2. AES officers shall carry out spot checks to ensure that all fire prevention measures are complied with.

4 Renovations, Alterations and Additions to Buildings

- 4.1 Owners of all non-CAG managed properties have to obtain AES approval in regard to fire prevention measures, access for fire vehicles, escape routes and other fire precautions, and for all renovations, alterations and additions to their buildings.
- 4.2 This approval is in addition to other requirements or approval by the other CAG Divisions or other relevant authorities i.e. FSSD, BCA, URA etc.
- 4.3 Copies of the relevant floor plans indicating the extent of renovation, alteration, and/or addition works together with fire safety measures e.g. fire exits and signs, etc. shall be submitted to AES for comments and approval.
- 4.4 The coordinating CAG division for the renovations, alterations, and/or additions, shall ensure that AES comments and/or requirements are complied with and notify SUPT (FS) (OC Seletar in the case of Seletar) upon the completion of such works.

- 4.5 Permission or clearance from the relevant authorities shall be sought and copies extended to AES. Where the approval of FSSD is not required a copy of the waiver shall be attached to the floor plans extended to AES for comments and approval.
- 4.6 A joint inspection of premises by the owner or his representative together with CAG and an AES officer shall be conducted within one week upon the completion of the approved renovation, alteration, and/or addition works to confirm that all fire safety and all statutory requirements imposed by the relevant authorities set out prior to commencement of works were complied with fully.
- 4.7 The owner of the building shall be responsible in maintaining the existing and the new fire protection installations, should there be any, in proper working order after the renovations, alterations and/or additions made to the building.

5 Fire Evacuation Plan and Exercises

- 5.1 It is the responsibility of the owners of major airport buildings not owned by CAG or lessees of CAG buildings to establish fire evacuation plans for all their premises and conduct fire evacuation exercises at least once a year to test the effectiveness of the plans.
- 5.2 The evacuation plan at Section B, Chapter 2 may be used as a guide and the AES may be consulted when the annual evacuation exercises are planned.

6 Other Hazards

- 6.1 All owners and lessees of airport buildings shall strictly comply with the safety measures listed in the Appendices of Section A. In addition, a few other activities and processes carried out on or in the proximity of aircraft can be hazardous. Hence, the following Chapters on fire safety measures are included in this Manual for owners and lessees of airport buildings to comply:

Chapter 2 : Fuelling Regulations (General)

Chapter 3 : Welding Operations Inside Aircraft Hangars.

Chapter 4 : Fire Precautions During Oxygen Charging and Storage.

CHAPTER 2 - AIRCRAFT FUEL SERVICING REGULATIONS (GENERAL)**1 Scope**

1.1 For the purpose of these regulations "Aircraft fuelling" shall be regarded as including fuelling and defuelling, aircraft fuel tank calibration, aircraft fuel tests and the draining of fuel tanks. Generally, Aircraft fuelling activities shall comply with the latest editions of NFPA 407 Standard for Fuel Servicing, 2007 edition. Aircraft fuel servicing operators shall permit the Landlord (or any other authorized by the Landlord) to perform unannounced Aircraft refueling inspection at the Airside based on Appendix C-I – Fire Safety Requirements involving Aircraft Fuel Servicing.

1.2 Operational requirements make it necessary for fuelling crew to perform their duties efficiently and quickly under all types of weather conditions, at all hours, and concurrent with transport and military aircraft. These aggravate the situation and make it imperative to establish basic fire safety procedures. These regulations are intended to help prevent accidents. It is recognised that there are certain hazards (especially the operation and use of aircraft servicing equipment and ground power generators with internal combustion engines in close proximity to fuelling operations), over which safety cannot be controlled without interference with operations. Therefore, specific caution is given in this Chapter with regard to these hazards.

2 Objective

2.1 These requirements are intended to represent a fire-safe practice for Aircraft fuel servicing operations on the ground.

3 The Different Types of Fuel and Their General Nature of the Hazards

3.1 Presently, the fuels used in aircraft are of three common types:-

- (a) Aviation gasoline, now abbreviated AVGAS;
- (b) Kerosene grade turbine, now abbreviated AVTUR; and
- (c) A wide blend of gasoline and kerosene fractions designated as AVTAG.

- 3.2 There are several grades of AVGAS used in reciprocating engines. These may be recognised by their different colours;

Grade identifications

115/145	Octane Grade	-	Purple
108/135	Octane Grade	-	Brown
100/130	Octane Grade	-	Green
91/98	Octane Grade	-	Blue
80/87	Octane Grade	-	Red

- 3.3 The flash point of AVGAS is approximately 40 degrees below zero centigrade. AVGAS is highly flammable.
- 3.4 The flash point of AVTUR (Jet-A1) has a minimum specification requirement of 38°C. AVTUR, when spilled on hot surfaces such as an exhaust pipe or over sun baked ramp, vapourises sufficiently to form a combustible and highly hazardous vapour.
- 3.5 Because of its low volatility, AVTUR spill on unheated surfaces present a prolonged hazard by not evaporating quickly and completely at normal temperatures. As a result, the danger of fire is prolonged and special treatment of the spill is important.

4 Spillage Sizes

- 4.1 Fuel spills may vary in size and therefore in quantity too. But the hazards inherent in them vary only in small degrees. It is therefore important to consider spills as a potential fire source. Every spill covering an area above 4m² or in quantity exceeding (5 gallons) 22.5 litres, or if in the opinion of the fuelling supervisor the spill constitutes a serious hazard, he shall call for immediate attention of AES so that remedial action can be rendered at once. As far as possible, in all cases of spillage, the entry of fuel into the airport drainage system shall be checked.
- 4.2 All fuel spillage shall be reported to CAG Apron Control and AES. Depending on the severity of the fuel spillage, AES may impose a service charge on airlines, ground handling agents, contractors or sub-contractors engaged by them for the cleaning up of the fuel spillage based on the rates listed in the Foreword.

- 4.3 Small spills need no emergency action and these shall be cleaned up with the use of oil absorbent or rags, which shall then be discarded immediately to a safe spot, or placed in a closed metal container. **Saw dusts shall not be used.**
- 4.4 In the case of larger fuel spills, the immediate safety procedure is as follows:
- (a) Stop the flow or operate the emergency shut-off valve.
 - (b) Notify AES and if the spillage is serious, all unauthorised persons shall be kept away from the affected area and at least 16 metres from the spillage.
 - (c) Inform the Airline representative who should use his discretion to determine if the operation already in progress can be continued safely or if it should be stopped until the emergency is over.
 - (d) Prevent the movement of unauthorised persons or vehicles into the area.
 - (e) Ensure, as far as possible, that activities in the vicinity including the movement of aircraft, vehicles or ground equipment, are restricted so as to reduce the risk of igniting the fuel.
 - (f) Passengers and crew on board aircraft shall be instructed not to smoke.
 - (g) Larger spills shall be blanketed with foam at the discretion of the AES Officer in attendance. In such cases, the passengers and crew on board should be directed to leave the aircraft at once and the aircraft shall be towed away to an uncontaminated area, if necessary.
 - (h) The final treatment for all fuel spillage, whether small or large, is by washing them up with water and detergent, or if necessary, with oil dispersant.
 - (i) The location of the spill, its direction of flow, the wind, etc. shall be taken into consideration when choosing the safest evacuation route.

5 Disposition of the Aircraft

5.1 If the safety of an aircraft near a LARGE SPILL is seriously jeopardised, the aircraft should be towed to an uncontaminated area before cleaning up shall be allowed to commence.

5.2 Aircraft on which fuel has been spilled, shall be carefully inspected for any accumulation of fuel or fuel vapour. Any fuel discovered on the aircraft must be cleaned up, and the fuel vapour shall be cleared.

5.3 All out-going cargo, mail and baggage on the ramp at the time of the spill shall be examined carefully before they are placed on board. All traces of fuel contamination must be removed or allowed to evaporate.

6 Neighbouring Turbine Aircraft

6.1 No fuelling shall be carried out within 46m directly downstream from the tail pipe of an operating turbo-jet engine, or within 23m directly downstream from an operating turboprop engine. Should a turbine-powered aircraft move within these distances, fuelling shall be stopped at once. All refuelling operations downstream of an operating wide-body aircraft shall be stopped until such time that the refuelling can be carried out safely.

7 Static Electricity and Stray Current

7.1 Static electricity is a constant threat to safe fuelling. The presence of static electricity is not readily apparent until a discharge or spark occurs. The danger is increased during fuelling operations.

7.2 Generation of Static Electricity

7.2.1 Static electricity may be generated during the course of fuelling as follows:

- (a) When fuel is pumped through a service hose;

- (b) When fuel is allowed to fall freely through the air from a filler spout into the dome of a truck, or from a tank or line draining into a container; and
- (c) Turbulence in the fuel generates static electricity.

7.2.2 In addition, static electricity may be present under the following circumstances:

- (a) A charge may accumulate in an aircraft during flight or on the ground.
- (b) Particles of rain or other liquid crystals of dust blowing across the aircraft can produce a very heavy charge of static electricity.
- (c) The servicing vehicles, like any rubber-tyre vehicle may become electrified.
- (d) Static electricity can also be built-up by induction from an electrically charged atmosphere.

7.3 Stray Electric Current

7.3.1 Stray current may provide a source of ignition during fuelling operations.

7.4 Bonding

7.4.1 Hydrocarbon fuels, such as aviation gasoline and Jet A, generate electrostatic charge when passing through the pumps, filters, and piping of a fuel transfer system. Splashing, spraying or free-falling of fuel will further enhance the charge. When charged fuel arrives at the receiving tank (cargo tank or aircraft-fuel tank) either of the following two possibilities can occur;

- (a) The charge relaxes harmlessly to ground; or
- (b) If the charge on the fuel is sufficiently high, a spark discharge may occur. Whether or not an ignition will follow depend on the energy (and duration) of the discharge and the composition of the fuel/air mixture in the vapour space, i.e. whether or not the vapour is within its flammability range.

- 7.4.2 The amount of charge on a fuel when it arrives at the receiving tank, and hence its tendency to cause a spark discharge, will depend on the nature and amount of impurities in the fuel, its electrical conductivity, the nature of the filter media, and the relaxation time of the system; i.e. the residence time of the fuel in the system between the filter (separator) and the receiving tank. The time required for this charge to dissipate is dependent upon the conductivity of the fuel. The duration may be a fraction of a second or several minutes.
- 7.4.3 No amount of bonding or grounding will prevent discharge from occurring inside a fuel tank. Bonding will ensure that the fuelling equipment and the receiving tank (aircraft or fueller) are at the same potential and to provide a path for the charges which are separated in the fuel transfer system, primarily the filter/separator and therefore to neutralise the charges in the fuel.
- 7.4.4 For over-wing fuelling and top loading of cargo tanks, bonding will ensure that the fuel nozzle or the fill pipe is at the same potential as the receiving tank, so that a spark will not occur when the nozzle or fill pipe is inserted into the tank opening. For this reason, the bonding wire must be connected before the tank is opened.

7.5 Use of Chamois Filters

- 7.5.1 The practice of using a chamois filter should be discouraged, as its use is extremely hazardous under any condition. Ordinary plastic funnels or other non-conducting materials can increase static generation. They must be properly bonded.

7.6 Aircraft Engines and Heaters

- 7.6.1 Fuel servicing shall not be done on an aircraft until the aircraft's engine(s) has (have) been stopped (ignition OFF).
- 7.6.2 Aircraft combustion heaters shall not be operated during fuelling operations.

8 Safeguard Against Incidents arising from Automotive Operation

- 8.1 No vehicle, other than those performing servicing functions, shall be permitted within 15m of the aircraft during fuelling operations. Hand brakes should be applied on vehicles before the driver leaves the cabin of his vehicle.
- 8.2 All vehicles performing aircraft servicing functions, other than fuel servicing (i.e. baggage trucks, air conditioning vehicles, etc) shall not be parked under aircraft wings while fuelling is in progress. The starting of equipment or any vehicle shall not be done whilst refuelling is in progress. Drivers shall be thoroughly instructed as to the hazards inherent in operating or parking of such vehicles in close proximity to fuelling operations. (Aircraft servicing normally requires mechanised equipment and it is most often impractical to suspend such operations during fuelling. Minimum precautions dictate superior apron vehicle maintenance and educating vehicle operators in recognising potentially hazardous conditions such as spills).

9 Prevention of Arcing of Electrical Circuits

- 9.1 Electrical circuits frequently produce arcs when switched on or off, when connections are made, or when equipment is not operated properly. The precautions are as follows:
- (a) Aircraft batteries shall not be installed, removed, raised or lowered during fuelling.
 - (b) Aircraft ground-power units should be located as far away from the fuelling points as practical. These shall not be connected or disconnected during fuelling. They should not be placed under the wings of aircraft or just aft of the trailing edge except when the design of the aircraft permits no other suitable location.
 - (c) Electric hand lamps or flashlights used in the immediate proximity of the fuelling operations shall be of the approved type.
 - (d) No electrical tools, drills, buffers, vacuum cleaners or similar tools likely to produce sparks or arcs shall be used during fuelling operations.

- (e) Aircraft electric switches, which control units in the wings or tank areas not needed for the fuelling operations, should not be operated during fuelling except in an emergency.
- (f) Photographic flash bulbs shall not be used within 15m of the aircraft. Electronic flash shall not be used within 15m of fuelling zones.

10 Elimination of Open Flames

- 10.1 Open flames may be used during maintenance work. The presence of the following are sometimes overlooked during aircraft fuelling operations:
- (a) Flare-pots and similar open flame lights;
 - (b) Welding or cutting torches;
 - (c) Blow torches; and
 - (d) Exposed flame heaters (liquid, solid or gaseous devices including portable and wheeled petrol or kerosene heaters).
- 10.2 No fuelling shall be done while any open flame device is in use within 15m of the aircraft.
- 10.3 There shall be no fuelling where the aircraft engine(s) or the aircraft combustion heater(s) is (are) running. These include wing and tail de-icing heaters. Engine ignition shall be switched off.

11 Control of Radar Equipment

- 11.1 The beam from radar equipment can cause ignition of flammable vapour-air mixture from inductive electric heating of solid materials or from electrical arcs or sparks from charge resonant conditions. The ability of an arc to ignite flammable vapour-air mixture depends on the total energy of the arc and the time lapse involved in the arc's duration, which is related to the dissipation characteristics of the energy involved. The intensity or peak power output of the radar unit is thus the key factor in establishing safe distances between the radar antenna and fuelling operations, fuel storage or fuel leading rack areas, fuel tank truck operations, or any operations where

flammable liquid or vapour may be present or created. Radar shall not be operated within 35m of fuelling.

12 Use of Communication Equipment

- 12.1 Communication equipment used during aircraft fuel servicing operations within 3m (10ft) of the fuelling equipment or the fill or vent points of aircraft fuel systems shall be intrinsically safe in accordance with UL913, Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III Division 1, Hazardous (Classified) Locations.

13 Additional Precautions

13.1 Fuelling location

- 13.1.1 All aircraft fuel servicing shall be done outdoor at least 15m from any building to minimise the danger of ignition of flammable vapour discharged during fuelling operations by sources of ignition likely to exist in such buildings. When it is necessary to perform fuelling operation under shelter, special permission must be obtained from the AES.

13.2 Concurrent operations

- 13.2.1 Concurrent operations during fuelling operations is allowed provided that equipment, other than that performing aircraft servicing functions, shall not be permitted within 15 m (50 ft) of aircraft during fuel servicing operations.

13.3 Refuelling with passengers on board aircraft or when there is passenger movement between the aircraft and terminal building

- 13.3.1 Fuelling may proceed with passengers remaining on board the aircraft, if not prohibited as stated in para 13.3.3 below, provided the airline operator ensures:
- (a) Passengers should be warned that refueling will take place and that they must not smoke, operate electrical switches or otherwise produce sources of ignition;

-
- (b) "NO SMOKING" signs and exit lights in the aircraft are switched on;
 - (c) One qualified person trained in emergency evacuation procedures shall be in the aircraft at or near a door at which there is a passenger loading walkway, integral stairs that lead downward, or a passenger loading stair or stand;
 - (d) A clear area for emergency evacuation of the aircraft shall be maintained at not less than one additional exit;
 - (e) For situations or locations not meeting requirements c) & d) above:
 - i) All slides shall be armed;
 - ii) One ARFF vehicle shall be on standby;

Controls shall be established so that passengers avoid hazardous areas when boarding or deplaning and they are not allowed to linger;
 - (f) If during fuelling, the presence of fuel vapour or potential hazard is observed, the airline operator is to be informed and fuelling and all cleaning activities within the aircraft should be stopped until conditions permit resumption;
 - (g) Ground servicing activities and work within the aircraft are conducted in a manner so as not to obstruct exit from the aircraft, should there be an emergency.
 - (h) Two-way communications shall be maintained by aeroplane intercommunications system or other suitable means between the ground crew supervising the refuelling and the qualified personnel on board the aeroplane.

13.3.2 AES may impose a service charge on airlines, ground handling agents, contractors or sub-contractors engaged by them for the provision of the fire vehicle based on the rates listed the Foreword.

13.3.3 Fuelling operations is not permitted on the following aircraft with passengers on board:

- (a) helicopters;
- (b) aircraft with seating capacities of less than 20 passengers; and
- (c) aircraft using JP4 or mixtures of JP4 fuel.

14 Positioning of Aircraft Fuel Servicing Vehicles

- 14.1 Indiscriminate positioning of fuelling trucks, air conditioning plants, etc, near an aircraft where fuelling is in progress should be discouraged to avoid impedance to the rapid removal of the aircraft and other servicing vehicles in case of emergency.
- 14.2 A free passage shall always be maintained so as to allow the speedy removal of service vehicles, and also to allow for safety measures to be rendered quickly.
- 14.3 The hand-brakes of aircraft fuelling vehicles shall be engaged by the drivers before they leave their driving position.
- 14.4 For over-the-wing fuelling, fuel servicing vehicles should be positioned forward of the trailing edge of the aircraft main plane, so that fuel spillage will flow behind the vehicles.
- 14.5 The structure of the aircraft's main-plane trailing edge is such that it is not meant to support the weight of a heavy hose. Therefore servicing (i.e. over-the-wing fuelling) shall only be over the leading edge.

15 Manning of Fuelling Equipment

- 15.1 Adequate manpower shall be constantly available to shut the flow of fuel quickly from the servicing equipment (i.e. vehicles, hydrants, pits or cabinets) in case of emergency.
- 15.2 Fuel nozzles used in over the wing fuelling hose assemblies shall be designed so that nozzles will close and the flow of fuel will stop when the hand of the operator is removed. Blocking nozzles in an open position even if it is only momentarily is prohibited. Only competent and qualified operators shall be permitted to operate the equipment.
- 15.3 It is recommended that other aircraft servicing personnel not engaged in fuelling operations be trained in the operation of emergency fuel shut off controls in the event of a spill or other hazardous conditions.

- 15.4 Kinks and short loops in fuelling hoses should be avoided. The kinked fuel hose shall not be allowed to drag along the ground. The hose should not be stretched with the complete weight of the hose off the ground as this places extra strain on the nozzle coupling.

16 Loose Objects

- 16.1 Persons involved in fuelling operations shall not carry in their breast pockets loose objects, e.g. tools, cigarettes, matches, cigarette lighters, etc, because there is the possibility of these items falling into the fuel tank. It is advisable to have the pockets on shirts and uniform sewn shut or removed completely.
- 16.2 Should there be an occasion of any object getting into the aircraft fuel tank, such object shall be removed before further flight. The supervisor in charge must be notified immediately.

17 Lightning Storms

- 17.1 Extreme caution should be taken during fuelling operations when lightning or electrical storm is imminent. Operations shall be suspended during severe disturbances and shall be determined by the ground handlers or refuellers.

18 Fire Extinguishers

- 18.1 Adequate serviceable fire extinguishers (at least 2 x 9kgs ABC Dry Powder) are available at both sides of the refuelling bowser.
- 18.2 Where the open hose discharge capacity of the aircraft fueling system or equipment is more than 750 L/min, at least one listed wheeled extinguisher having a rating of not less than 80-B:C and a minimum capacity of 55 kg of agent shall be provided.
- 18.3 All fuelling crew should be trained to use fire extinguishers correctly and effectively. The quick and effective use of fire extinguishers is of vital importance.

19 Defuelling Requirements

- 19.1 Defuelling operations present greater fire hazards due to the more difficult procedures that are involved in the draining operations.
- 19.2 Therefore the safeguards listed in the para 7 of this chapter regarding electrostatic bonding and grounding should not be overlooked. Their application is equally important.
- 19.3 Variations between different types of aircraft preclude the establishment of standard procedures but the same principles should apply in all cases.

CHAPTER 3 - WELDING OPERATIONS INSIDE AIRCRAFT HANGARS**1 General**

- 1.1 Aircraft welding operations should be done outdoors whenever possible. When aircraft welding must be done in hangars, the precautions stated in this Chapter shall be followed. Many of the recommended safe practices are also applicable to welding on aircraft regardless of the location.
- 1.2 If welding should be performed on aircraft, only gas shielded-arc is to be employed. Oxy-acetylene, straight arc welding, and other types of welding should be avoided in hangars.
- 1.3 Operations involving the use of heat and flame in hangars shall be permitted only when effective safeguards have been introduced to protect all nearby combustible materials from flying sparks and heat. Fire hazards may occur in the use of all methods of welding, both gas and arc, and in flame cutting. Open flame operations, therefore, shall not be conducted as a regular practice in any hangar. Faulty equipment or misuse of equipment may also cause fire.
- 1.4 Fire Watchers (as recognised by CAG) shall be required whenever cutting or welding is performed. Fire Watchers shall have extinguishing equipment readily available and shall be familiar with facilities for sounding an alarm in the event of a fire. They shall watch for fires in all exposed areas, try to extinguish them if within the capacity of the equipment available or otherwise sound the alarm. A fire watch shall be maintained for at least half-an-hour, after completion of cutting and welding operations, to detect and extinguish possible smouldering fires.

2 Welding Operations

- 2.1 It is recommended that for any contract to perform structural or general welding in a hangar, the hazard to the contents should be taken into special consideration. Aircraft should be removed wherever possible and the precautions herein applied where practicable.

- 2.2 Welding shall not be done on an aircraft in a hangar while work is in progress on the following:
- (a) Any system or component of an aircraft which contains, or did contain, fuel or other flammable liquid; or
 - (b) The fuel systems on any other aircraft within 30m from the point of welding.
- 2.3 Immaculate housekeeping should prevail around the welding area. Any hangar floor drains in the area of a welding operation should be checked periodically to determine that no flammable or combustible liquid or vapours are present.
- 2.4 If other aircraft are located in any adjacent work bays of a hangar, all persons working on or having access to these other aircraft shall be notified in advance that welding is to be carried out.
- 2.5 No other work shall be permitted within 7m radius of the location of any gas shielded-arc welding operation, or within 12m radius of the location of any other type of welding operation. All other work may be conducted routinely, provided flammable vapour is not present.
- 2.6 Fuel tank access plates and any fuel tank openings shall be closed on all aircraft within 30m from the point of any welding. All fuel lines, valves, manifolds and other fuel components on the aircraft on which welding is being done shall be in place, secured or capped prior to the start of welding operations and throughout such welding operations.
- 2.7 All fuel tank vents on the aircraft being worked upon and the vents of other aircraft within 7m radius of the location of any gas shielded-arc welding, or within 11m radius of the location of any other type of welding operation, shall be covered prior to the start of welding operations and throughout such welding operations.
- 2.8 Only qualified welders, trained in the technique and familiar with the hazards involved shall be permitted to carry out welding operation.
- 2.9 The specific location where the welding is being done shall be roped-off or

otherwise segregated by physical barrier to prevent unintended entry into the welding area. A placard reading “WELDING OPERATIONS IN PROGRESS” shall be prominently displayed.

- 2.10 Welding generating equipment shall be placarded as follows:

“WARNING – KEEP CLEAR OF AIRCRAFT ENGINES AND FUEL TANK AREA”.

- 2.11 Welding equipment shall have no electrical components (other than flexible lead cables) within 45 cm (18 inches) from the floor. The ground leads should be as close to the area to be welded as possible and clamps used on such ground leads should be of the 'C' clamp type, not the clip type. Components, which could produce arcs, sparks or hot metal, under any condition of operation, should be of the totally enclosed type or should have suitable guards or screens. The inert gas cylinder should be securely fastened to prevent tipping and the regulator and gauge shall be in proper working condition.

3 Precautions for Aircraft

- 3.1 It is recommended that where welding is to be carried out on an aircraft in a hangar, the aircraft should be in towable condition, with its parking brakes off, the wheels chocked, and it is hooked on to a tow tug. Any equipment, which could obstruct prompt removal of the aircraft, should be cleared away. Where practicable, a qualified operator should be pre-designated to operate the tow tug and mechanics assigned to remove the wheel chocks and to operate controls in the cockpit. It is recognised that under many conditions, the aircraft being worked upon may not be mobile, and when this is true it is of even greater importance to follow the other precautions given in this Chapter.

4 Supervision

- 4.1 The supervisor shall be responsible for the safety of the welding operation. He shall ensure that appropriate measures for fire cover are taken throughout the welding operation. One fire tender shall be on standby throughout the operation with exception where underwing aircraft fire protection system is available, and then the fire engine standby may not be

necessary. If at any time, a hazardous condition develops, the AES shall have the authority to stop the welding operation.

- 4.2 A checklist shall be maintained in order to eliminate all hazards and possible ignition sources when aircraft welding is to be carried out. The supervisor shall be thoroughly familiar with each aircraft to be welded so that he has proper knowledge of the flammable vapour sources and combustible materials on the aircraft. Prior to starting any welding operation, the supervisor in charge of the project shall inspect the area to see that all safety requirements have been complied with and all necessary steps have been taken to ensure that welding works can be conducted safely.

CHAPTER 4 - FIRE PRECAUTIONS DURING OXYGEN CHARGING AND STORAGE**1 Scope**

- 1.1 This Chapter describes the hazards associated with the handling of breathing oxygen aboard aircraft and describes the recommended procedures for safe charging.

2 General

- 2.1 Currently, aircraft breathing oxygen systems may utilise either gaseous or liquid oxygen.
- 2.2 Gaseous oxygen is colourless, odourless, tasteless and non-toxic. It constitutes about 21 percent of normal air by volume and is about 10 percent heavier than air. Above its critical temperature (-82.4°C) or oxygen can exist only as a gas regardless of the pressure exerted upon it.
- 2.3 Liquid oxygen is a light blue, transparent liquid, which flows like water. It boils at minus 147.2°C at standard atmospheric pressure. If a volume of liquid oxygen is confined and allowed to warm to room temperatures, the attempt of the vapourising oxygen to expand will result in the attainment of extremely high pressures (in the order of 40,000 psi).

3 Hazards

- 3.1 Both gaseous and liquid oxygen are stable, non-flammable substances, but they vigorously support combustion and increase the intensity of fires. This makes it necessary to keep concentrations of oxygen separated from combustibles and from any source of ignition. Therefore, the highest standard of housekeeping is essential in areas where oxygen is stored or charged.
- 3.2 Physical damage to, or a failure of, oxygen cylinders, valves or plumbing can result in explosive rupture in oxygen system components causing danger to life, limb and property.

3.3 In addition to aggravating the fire hazard, liquid oxygen can cause severe burns (frostbite) when in contact with the skin because of its low temperature.

3.4 Only corrosion resistant tubing, pipes and fittings suitable for the class of oxygen service it is intended to provide, shall be used.

4 Precautions for Charging Operations

4.1 Because of the possibility of fire or explosion involving large quantities of oxygen, such factors as the presence of other aircraft, vehicles, valuable structures, utilities, and people in the vicinity; and the accessibility of the aircraft to fire-fighting equipment, shall be considered when choosing sites for oxygen charging.

4.2 Where it is necessary to conduct gaseous oxygen system recharging or filling in a hangar or building, it must be done under controlled conditions.

4.3 Liquid oxygen recharging shall not be conducted indoors under any condition. Wherever possible, at least 15m separation shall be maintained between any point of filling and other aircraft, structures, etc.

4.4 Avoid liquid oxygen charging operations within range of any drainage system elements, such as catch basins, through which a liquid oxygen spill could enter the drainage system. Such systems may contain combustible materials, which could be extremely hazardous when in contact with the liquid oxygen in confined space.

4.5 Good housekeeping is necessary in the vicinity of oxygen charging operations. This is particularly true with combustibles like grease, lubricating oil, asphalt, etc.

4.6 Prohibit open flames (including smoking) within 15m of charging equipment.

4.7 Do not permit aircraft servicing or maintenance operations, which may inherently or accidentally introduce ignition source of combustibles simultaneously with oxygen charging operations. These include fuelling,

fuel and hydraulic system repairs, use of flammable cleaning fluids, de-icing fluids, etc.

- 4.8 Do not operate electrical system switches, connect or disconnect ground power generators during oxygen charging operations.
- 4.9 Use only charging equipment, containers, etc, suitable for the specific aircraft breathing oxygen system involved. Identify each container by its marking before connecting to the aircraft system. Never interchange equipment with equipment intended, or used, for other gases.
- 4.10 High-pressure commercial containers 122.4 Bar (1800 psi or higher) must be connected through a pressure regulator to service low pressure aircraft systems. Failure to use a high-pressure regulator specific for oxygen service is extremely dangerous.
- 4.11 Oxygen charging hoses shall be kept clean, capped when not in use and clearly marked or tagged "FOR OXYGEN USE ONLY".
- 4.12 Electro-statically ground the aircraft and electro-statically bond the oxygen charging equipment to a suitable and safe part of the aircraft, when removing or replacing oxygen bottles on the aircraft.
- 4.13 Never permit oil, grease or other readily combustible substances to come in contact with containers, flasks, valves, regulators, fittings or any other part of the aircraft oxygen system or charging equipment. Do not handle oxygen equipment with oily gloves, tools or perform charging operations wearing oily or greasy clothing.
- 4.14 Keep protective caps on equipment in position as long as possible and replace as soon as possible. Before charging, inspect all connections for cleanliness. If dust, dirt, grease or any other contaminant is found, it shall be removed with detergent or solvent approved for oxygen service. Bleed a small amount of oxygen through hose or valve outlet before connecting to the fill fitting to eliminate foreign material, which may escape external inspection.
- 4.15 Use only lubricating and thread compounds specifically approved for oxygen service under pressures and temperatures involved. Do not use oil or grease.

- 4.16 Use only valve packing and transfer hose gaskets, which are suitable for oxygen service.
- 4.17 Avoid damaging oxygen containers, hoses, flasks, converter, etc. Secure equipment so that it cannot fall or roll.
- 4.18 Do not tamper with safety devices or the identifying markings, symbols and nameplates.
- 4.19 Do not direct gaseous oxygen at the body or clothing or allow liquid oxygen to contact the body or clothing because of the possibility of both fire and personal injury.
- 4.20 Desiccant cartridges are sometimes required to assure only dry oxygen is introduced. Check on the need for such cartridges and be sure that drying medicine is fresh. Only desiccant cartridges with filters shall be used.
- 4.21 Before commencing charging, turn all oxygen regulators in the aircraft to the "OFF" position.
- 4.22 Ensure that threaded fittings on regulators, containers, valve outlets, hoses, etc. correspond to each other. Never force connections, which do not fit. Fittings with worn or damaged threads should be replaced.
- 4.23 After connecting containers or charging hoses to the oxygen-fill fitting system, check the connections for gas tightness by audible and visual means. If a leak is suspected, test with a solution that is specially approved for oxygen service.
- 4.24 Close all charging equipment discharge valves when charging is completed.
- 5 Gaseous Oxygen (specific cautions)**
- 5.1 Open container charging valves slowly. Rapid opening and subsequent sudden and fast discharge of oxygen can cause dangerous heating, which could result in a fire or explosion of the combustibles within the system. Container valves should be fully opened to prevent leakage around the valve stem. (See para 6.7 for liquid oxygen).

- 5.2 Never use wrenches, hammers or other tools to force container valves. If a container valve cannot be hand operated, it shall be considered defective and returned to the supplier.
- 5.3 Charge the oxygen bottles to the established pressure having set the supply regulating valve to the proper setting.
- 5.4 When removing oxygen containers from aircraft for recharging, (a condition found particularly where high pressure containers are employed), close the container valve and release all oxygen in the lines at an oxygen station before attempting container removal. It is vitally important that this discharge be done slowly, as sudden release of oxygen might readily create a serious fire hazard. Before removing the container from the aircraft, disconnect, cap the container valve outlet, and plug all distribution lines.

6 Liquid Oxygen (specific cautions)

- 6.1 Do not permit liquid oxygen to contact any part of the body or clothes. It can cause severe skin injury and make clothing highly combustible. Do not handle liquid oxygen lines with bare hands.
- 6.2 Personnel should wear protective clothing while handling liquid oxygen equipment. Such protective clothing include the following:
- (a) Safety goggles or a clear plastic face shield.
 - (b) Clean, dry leather, rubber-coated cotton or canvas gloves. It is recommended that these gloves be loose fitting without wrist gauntlets.
 - (c) Clean overalls with long cuffless sleeves or rubber apron. In cold weather, a clean rubber raincoat, preferably without pockets, may be worn over jackets or coats.
 - (d) Shoes should preferably be of the high top type with cuffless trousers outside the shoes.

NOTE: If liquid oxygen is spilled on clothing the clothing shall be removed immediately and thoroughly aired before re-use.

- 6.3 Personnel who have handled liquid oxygen should refrain from smoking for at least 15 minutes after leaving the charging area.
- 6.4 Exercise care that no moisture is introduced into a liquid oxygen system and that there is no moisture in fill fittings or nozzles where it may be entrained into the system during transfer operations. Dry, oil-free air, oxygen, or nitrogen may be used to eliminate moisture before introduction of liquid oxygen.
- 6.5 Because of its low temperature, liquid oxygen must be handled in equipment constructed of materials suitable for the service. Ordinary rubber or plastic hoses, gaskets, seals, etc. for example are unsuitable.
- 6.6 If it is necessary to transfer liquid oxygen from one container to another, care is needed to avoid splashing. Cool the receiving container gradually to avoid breakage. Fragile containers such as glass should not be used. The container must be clean.
- 6.7 When transferring liquid oxygen, do not leave valves open all the way, open them wide and then immediately close them about one-quarter turn; otherwise they may freeze in the open position. (See paragraph 5.1 for gaseous oxygen).
- 6.8 Use pressure relief devices on all lines in which liquid oxygen may be trapped between closed valves and on closed containers.
- 6.9 Avoid spilling liquid oxygen on pavement. A fire or an explosion can result if pavement has combustibles (e.g. asphalt) or if it is porous and is impregnated with combustibles (e.g. concrete contaminated with oil).
- 6.10 Because of its low temperature and expansion characteristics, liquid oxygen can spall pavement. If a spill occurs, stop the flow of the liquid and where possible, allow the liquid spill some brief time to evaporate. Do not walk on spilled liquid oxygen or roll equipment over.
- 6.11 Variances in the design of aircraft systems and charging equipment may require deviations. Observe the equipment manufacturer's instructions closely.

- 6.12 Under normal circumstances, oxygen re-charging is not permitted to be carried out on the aircraft at the parking apron. Approval from Chief, AES is required if such operation needs to be performed due to unavoidable circumstances.

7 Fire Protection for Oxygen Charging Operations

- 7.1 In case of fire, shut off the oxygen supply to the fire.
- 7.2 A fire involving combustible materials in an oxygen filled atmosphere should be treated as a fire involving combustibles in normal air atmosphere.
- 7.3 If liquid oxygen is involved it is normally desirable, where practical, to allow the fire to burn until the liquid oxygen present in the fire area is evaporated, following which the ignited combustible materials should be attacked with the appropriate extinguishing agent.
- 7.4 Remember that oxygen can combine with a number of combustible materials in a manner to cause an explosion. Liquid oxygen, as a vigorous combustion-supporting substance, cannot be effectively smothered or 'blanketed' by carbon dioxide or foam used as the extinguishing agent.

8 Storage of Oxygen Charging Equipment

- 8.1 Gaseous breathing oxygen is generally received in high-pressure cylinders or containers. The cylinders must be stored and transported to the charging site where they are used to charge the aircraft oxygen system storage containers. In some instances the aircraft system storage containers may be received for charging and in such cases, the containers must be stored after charging until they are transported to the aircraft and interchanged with empty containers in the aircraft system.
- 8.2 Liquid oxygen is generally received in a tank car or truck and transferred to a storage vessel. It is then transferred as needed to a mobile charging vehicle and transported to the charging site where it is used to charge the converter in the aircraft system.

8.3 Oxygen cylinder storage

- 8.3.1 Cylinder should be stored in a specifically assigned location and protected against tampering by unauthorised individuals. Oxygen cylinders shall not be stored in aircraft servicing and maintenance areas of aircraft hangars and should, preferably be stored in a separate building.
- 8.3.2 Oxygen cylinders shall not be stored near flammable materials (such as petroleum products), other readily combustible substances, or in the same area as compressed combustible gases. Empty and full cylinders should be stored separately with empty cylinders clearly marked.
- 8.3.3 Each cylinder should be clearly marked to indicate its content. Breathing oxygen cylinders should not be mixed with other oxygen cylinders.
- 8.3.4 Cylinders shall be stored so that they are never allowed to reach a temperature exceeding 52°C. When stored in the open they should be protected against direct rays of the sun in localities where extreme temperatures prevail, and from the ground beneath to prevent rusting.
- 8.3.5 Cylinders should be protected against abnormal mechanical shock liable to damage the cylinder, valves or safety devices. Valve protection caps should also be used when cylinders are not connected in use.
- 8.3.6 When moving cylinders, care should be exercised to prevent dropping, which may cause damage to the cylinder, valve or safety devices. Lifting magnets, slings of rope/chain, or any other device in which the cylinders themselves form a part of the carrier should not be used for hoisting oxygen cylinders. When transported on hand/power trucks or tractors, cylinders should be secured in the upright position.

8.4 Liquid oxygen storage

- 8.4.1 Liquid oxygen shall be stored outdoors or in a detached non-combustible structure if the quantity exceeds one day's need. Smaller quantities should be located outdoors, in a detached non-combustible structure or in a cut-off room provided the cut-off room has effective ventilation and necessary doorways protected by fire doors with ramps or curbs to prevent entrance of flammable liquids and exit of liquid oxygen.

8.4.2 Storage areas shall be reserved for liquid oxygen storage and be clearly placarded "OXYGEN - NO SMOKING - NO OPEN FLAMES" or equivalent.

8.4.3 The construction and occupancy of liquid oxygen storage areas shall be strictly non-combustible and have no floor drains. Wall scuppers (not connected to drainage systems) are recommended.

9 Miscellaneous Cautions

9.1 Never use oxygen as a substitute for compressed air. It is very dangerous to use oxygen for pneumatic tools, for pressuring containers, for paint spraying, for blowing out pipelines, etc.

9.2 Never attempt to mix gases in an oxygen container.

9.3 Only corrosion resistant tubing, pipes and fittings shall be used.

9.4 Liquid oxygen charging operations are not regarded as more hazardous than gaseous oxygen charging operations. However, a spill of liquid oxygen introduces a new hazard, which must be specifically safeguarded. AES shall be informed of liquid oxygen spills.

9.5 Aircraft oxygen cylinders shall be removed and taken away from aircraft parking areas for charging. On-site charging at the aircraft is not permitted.

CHAPTER 5 - Airfield Vehicle Operations**1 General**

1.1 Fire mishaps can result in disastrous consequences especially at the apron area as flammable aviation fuel fumes can be present. Thus, it is imperative that all Airfield Vehicle are maintained fire hazard free at all times. AES conducts regular joint vehicle inspection with Airside Operations to ensure Airside vehicles driving in the apron are compliant to airside rules and regulations (see Appendix C-II – Fire Safety Requirements involving airfield vehicle operations).

1.2 Some common causes of vehicle fires are:

- a. Electrical short-circuiting;
- b. Poor maintenance of battery and wiring system; and
- c. Long running engine, resulting in engine overheating.

2 Actions when vehicle catches fires

- a. Park vehicle immediately to the side; away from the aircraft and building;
- b. Turn off engine;
- c. Get the passengers and yourself out of the vehicle;
- d. Attempt to put out the fire with the fire extinguisher onboard, without placing yourself in danger;
- e. Inform AES immediately at 6541 2525; and
- f. Stay away from the vehicle and direct traffic away.

3 AES recommends Airside Operators to prevent vehicle fires by:

- a. Regular vehicle maintenance, especially for older vehicles. Particular attention should be given to the electrical systems of the vehicle, e.g. wiring connection of battery compartment;
- b. Ensuring that a fire extinguisher is constantly available in the vehicle;
- c. Turning off the engine before leaving the vehicle;
- d. Ensuring a strict no smoking policy;
- e. Always checking your vehicle for leakage of fluid before starting the engine; and
- f. Ensuring that the coolant container is filled up.

APPENDIX C-I - Fire Safety Requirements involving Aircraft Fuel Servicing

S/No	Item	Compliance with the Safe Practice			Remark
		C	NC	NA	
1	Bonding connections are attached and mechanically firmed.				
2	Lanyard is connected to the quick release valve of the fuel hydrant pit.				
3	Deadman control device is serviceable.				
4	At least 2 x 9kg Dry Powder extinguishers available in the aircraft fuelling vehicle to combat spill fires.				
5	Refuelling operator is familiar with the procedures (e.g. who to inform, how to shut off etc) in the event of fire or any major fuel spills.				
6	Equipment performing aircraft servicing function are not positioned within 3 m radius of aircraft fuel vent openings.				
7	Equipment other than that performing aircraft servicing functions are not positioned within 15 m of aircraft during fuel servicing operations.				
S/No	Safety Practices	Compliance with the Safe Practice			Remark
		C	NC	NA	
8	The accessibility to the aircraft by fire vehicles is established for aircraft fuel servicing positions.				
9	Aircraft refuelling hose does not have evidence of blistering, cuts or abrasions.				
10	The nearest Emergency Fuel Shutoff Control is not obstructed.				
11	The signage displaying the operating instructions for the Emergency Fuel Shutoff Control and CAFHI contact details shall be clearly visible.				
12	Parking brake is set on all refuelling vehicles.				

13	Spark plug and other exposed terminal connection are to be insulated.				
14	Fuel servicing vehicles are positioned forward of the trailing edge of the aircraft main plane.				

Precautionary Measures (Re-fuelling in process)

S/No	Safety Practices	Compliance with the Safe Practice			Remark
		C	NC	NA	
15	Aircraft ground-power generators or other electrical ground power supplies are not connected or disconnected.				
16	All vehicles, other than those performing fuel servicing, are not to be driven or parked under aircraft wings.				
17	Electric tools, drills or similar tools likely to produce sparks or arcs are not used.				
18	Hot work within 75 m of refuelling operations is ceased.				
19	No kinks, short loops or mechanical stress on the hose or hose couplings.				
20	Communication/photographic equipment or portable electronic device (PED) are not used within 3 m of the refuelling equipment unless intrinsically safe for Class I, Division 1, Group D hazardous (classified) locations in accordance with ANSI/UL 913.				
21	Aircraft refueling not done in hangar or enclosed area unless in compliance with NFPA 410 and approved by CAG (helicopters excepted).				
22	Aircraft fuel system vents or fuel tank openings are not closer than 15 m (50 ft) to any terminal building, hangar, service building, or enclosed passenger concourse other than a loading walkway unless approved by CAG.				

23	Small spills (below 4m ²) cleaned up with the use of oil absorbent or other non combustible material and discarded safely.				
24	To engage an AES Foam Tender for fuel spillage above 4m ²				

Additional Precautionary Measures*(When Passengers remain onboard or embark/ disembark during *refuelling)*

S/No	Safety Practices	Compliance with the Safe Practice			Remark
		C	NC	NA	
25	Communication should be maintained between the ground crew supervising the refueling and the qualified personnel on board the aircraft.				
26	The ground service activities do not impede the egress should there be an emergency.				
27	At least one qualified person trained in emergency evacuation procedures shall be in the aircraft at or near a door.				
28	One aerobridge or mobile step or integral stairs are positioned with the aircraft door fully opened for evacuation of passengers.				
29	A clear area for emergency evacuation of the aircraft shall be maintained at the rear (or front) aircraft exit door.				
30	For situations or locations not meeting requirements 28 & 29 i) All slides shall be armed ii) One ARFF vehicle shall be on standby				

APPENDIX C-II - Fire Safety Requirements involving Airfield Vehicle Operations

S/No	Item	Compliance with the Safe Practice		Remark
		Yes	No	
1	The fuel system is free of leaks.			
2	Electrical wirings are not cracked, damaged or having loose connections.			
3	The tail pipe of the exhaust system shall be fitted with an approved type of spark arrestor (for petrol engines without catalytic converter only).			
4	The battery has adequate natural ventilation and terminals are suitably covered.			
5	Switches are of the enclosed type.			
6	The exhaust manifold and the section of the exhaust pipe adjacent to the manifold has a metal cover (or drip tray for carburetor type petrol engines only) to prevent petrol, oil or other combustible material from coming into contact with the hot metal.			
7	Fuses are of enclosed type and protected from breakage by a cover.			
8	The vehicle is equipped with at least one serviceable 1 kg ABC dry powder fire extinguisher (or a suitable alternative as determined by the airport licensee) securely mounted on suitable brackets in a readily accessible position.			