Civil Aviation Authority of Nepal

Airport Rescue and Fire Fighting Services Manual

Second Edition
February 2022

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Record of Amendment

No. of Amendment	Details of Amendment	Date of Amendment	Entered by Name/Sig	Date entered	Remarks
1					

Foreword

Nepal as a Contracting State to the Convention on International Civil Aviation has an obligation to the international community to ensure that civil aviation activities under its jurisdiction are carried out in strict compliance with the Standards and Recommended Practices contained in the nineteen Annexes to the Convention on International Civil Aviation in order to maintain the required aviation standards.

This manual has been prepared by complying with latest editions of Civil Aviation Requirements (CAR-14) Part 1 Aerodrome Design and Operations, and Airport Services Manual Part 1 Rescue and Fire Fighting (ICAO Doc 9137) to the extent possible and commensurate the provisions of Airport Emergency Plan of the respective irports.

Users of this manual are requested that the provisions of the **Civil Aviation Authority Act - 1996 (2053 B.S.), CAAN Airport Certificate Regulations - 2004 *(First Amendment - 2016)* and Civil Aviation Regulation 2002, (Third Amendment 2017)** rather than this manual, determine the requirements of, and the obligations imposed by or under, the civil aviation legislation. Users should refer to the applicable provisions when any doubt arises.

Any suggestions from the stakeholders shall be appreciated and considered as important elements for the amendment and updating the manual towards implementing it in more effective way.

This Authority may, without any prior notice, change the content of this manual as appropriate

Director General

Civil Aviation Authority of Nepal

February 2022

List of Abbreviations

AED:	Automated External Defibrillator
AEP:	Airport Emergency Plan
AIP:	Aeronautical Information Publication
APU:	Auxiliary Power Units
ARFF:	Aircraft Rescue and Fire Fighting
ATC:	Air Traffic Control
ATS:	Air Traffic Services
BA:	Breathing Apparatus
BAECO:	Breathing Apparatus Entry Control Officer
CAAN:	Civil Aviation Authority of Nepal
CAP:	Corrective Action Plan
CAR:	Civil Aviation Requirements
CCTV:	Closed-Circuit Television
EOC:	Emergency Operations Centre
FAT:	Factory Acceptance Test
GPS:	Global Positioning System
HRET:	High Reach Extendable Turrets
ICAO:	International Civil Aviation Organization
ISO:	International Standards Organization
MFT:	Major Foam Tenders
MOU:	Memorandum of Understanding
NCASP:	National Civil Aviation Security Programme
NFPA:	National Fire Protection Association
NID:	Noise Induced Deafness
NOTAM:	Notices to Airmen
OEM:	Original Equipment Manufacturer
ORE:	Oxygen Resuscitation Equipment
PIC:	Pilot in Command
PPE:	Personal Protective Equipment
RESA:	Runway End Safety Area
RFFS:	Rescue and Firefighting Service
RFFTP:	Rescue and Firefighting Service Training Programme
RVP:	Rendezvous Point
SCBA:	Self-Contained Breathing Apparatus
SHEL:	Software- Hardware- Environment- Livewire
SOP:	Standard Operating Procedures
SPAAT:	Skin Penetrating Agent Applicator Tool
STOL:	Short Take-off and Landing
TIA:	Tribhuvan International Airport
TRA:	Task Resource Analysis
VVIP:	Very Very Important Person

CHAPTER 1. General

1.1 Introduction

The principal objective of Rescue and Fire Fighting Services(RFFS) is to save lives in the event of an aircraft accident or incident occurring at, or in the immediate vicinity of, an airport. The RFFS is provided to create and maintain survivable conditions, to provide egress routes for occupants and to initiate the rescue of those occupants unable to make their escape without direct aid.

This manual sets out the minimum requirements to be met in the provision of RFF Services at aerodromes.

Requirements to be dealt with building fires and fires involving fuel installations, or recommendations for the foaming of runway are not taken into account. The quantities of extinguishing agents and numbers of RFF personnel required for certification of airport are not designed to deal with building fires, runway foaming and fires involving fuel installations. However, if Aerodrome Operator choose to deploy RFF resources to any such incidents, this should not prejudice the response time and minimum discharge rates specified in this manual.

The RFFS should be established at a level commensurate with the size of aircraft using the airport and organized, equipped, staffed and trained to ensure rapid and effective deployment in the event of an accident. Policies and procedures relating to the provision and management of the RFFS should be described in, or reference to the Aerodrome Manual where available.

Information concerning the level of protection to be provided by aerodrome operator should be made available in the AIP of Nepal.

1.2 Objective of the Manual

Primary objective of this manual is to ensure the smooth operation of RFF service in accordance with the airport category to protect lives in the event of aircraft and airport emergencies specifically in case of fire. Guidance is also given on equipment, extinguishing agents,personnel, training and emergency procedure to provide RFFS effectively, efficiently in a consistent manner.

The purpose and scope of this manual is to implement thestandardsand recommended practices of Civil Aviation Requirements (CAR-14) Part 1 Aerodrome Design and Operations as well as to assist all rescue and firefighting personnel in performing their role and responsibilities in systematically,efficienty and ultimately more effective manner to protect lives and properties.

1.3 Legal Requirements

This manual has been given legal requirements by virtue of:

i. International:
- International Civil Aviation Organization – ICAO Annex -14 Volumme I
- International Civil Aviation Organization – ICAO Airport Services Manual Part – 1 (9137-AN/898)

ii. National:
- Civil Aviation Authority of Nepal Act1996

- Airport Certificate Regulations (ACR),2004 (First amendment 2016)
- Civil Aviation Requirements (CAR-14, Part-1) Aerodrome Design and Operations

1.4 RFF Administration and Management

1.4.1 Administration and Management

The RFF service at an aerodrome should normally be under the administrative control of the aerodrome operators, which should also be responsible for ensuring that the service provided is organized, equipped, staffed, trained and operated in such a manner as to achieve its principle objective of saving lives in the event of an aircraft accident or incident. It is intended that the fire station housing the RFF service be located on the airport premises and suitably located so that responses will not be delayed and will ensure response times can be met.

1.4.2 Daily Station Routine

To ensure the effectiveness of the service and performance of the RFF personnel, Chief of Fire Station shall be responsible to prepare and implement daily station routine as well as Standard Operating Procedures (SOP).

1.5 Coordination between Mutual Aid agencies

A prior agreement with aerodrome operator and city fire fighting service and other responding agencies such as local police, armed police force, Nepal Army, red cross, hospitals should be made to gain their assistance in the emergency situation.

1.6 Grid Map

A detailed grid map(s) of the aerodrome and its immediate vicinity (with date of revision) should be provided for the use of the airport rescue and firefighting services concerned. Information concerning topography, access roads and location of water supplies should be indicated. This map should be visibly posted in the control tower, fire watch tower, fire station, fire fighting vehicle and as well as other supporting vehicles required to respond to an aircraft accident or incident. Copies should also be distributed to external agencies, such as police and medical services as required. The issuing authority for the detailed grid maps should have a document control process to ensure all agencies are made aware of any changes or re-issues.

CHAPTER 2. Definitions

Aerodrome - A defined area in land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft. *Also See "airport".*

Acts of Unlawful Interference– These are acts or attempted acts such as to jeopardise the safety of civil aviation, including but not limited to:

- unlawful seizure of aircraft,
- destruction of an aircraft in service,
- hostage-taking on board aircraft or on aerodromes,
- forcible intrusion on board an aircraft, at an airport or on the premises of an aeronautical facility,
- introduction on board an aircraft or at an airport of a weapon or hazardous device or material intended for criminalpurposes,
- use of an aircraft in service for the purpose of causing death, serious bodily injury, or serious damage to property or theenvironment,
- communication of false information such as to jeopardize the safety of an aircraft in flight or on the ground, ofpassengers, crew, ground personnel or the general public, at an airport or on the premises of a civil aviation facility.

Aircraft – *A*ny machine that can derive support in the atmosphere from the reactions of the air against the earth's surface.

Aircraft Accident – An occurrence during the operation of an aircraft in which any person involved suffers death or serious injury or in which the aircraft receives substantial damage.

Aircraft Incident – An occurrence, other an accident, associated with the operation of an aircraft, which affects or could affect continued safe operations if not corrected. An incident does not result in serious injury to persons or substantial damage to aircraft.

Aircraft in Flight – An aircraft shall be deemed to be in flight at any time from the movement with all its external doors closed following embarkation until the moment when any such door is opened for disembarkation. Provided that in case of a forced landing, the aircraft shall be deemed to be continued in flight until the competent authorities take over responsibility for the aircraft and for persons and property on board.

Aircraft in Service – An aircraft shall be deemed to be in service from the beginning of the pre-flight preparation of the aircraft by ground personnel or by the crew for a specific flight until twenty-four hours after landing. Such period of service shall, in any event, extend for the entire period during which the aircraft is in flight as defined above.

Aircraft Operator– A person, organization or enterprise engaged in or offering to engage in regular public transport or charter aircraft operations. Within the context of this Programme "aircraft operator" shall mean the operator of any aircraft engaged in commercial air transport operations and any entity conducting general aviation operations, including corporate aviation operations, using aircraft with a maximum take-off mass greater than 5,700 kg.

Aircraft Stand – A designated area on an apron intended to be used for parking an aircraft.

Air Navigation Installation - Any building, works, apparatus or equipment used wholly or mainly for the purpose of assisting air traffic control or as an aid to air navigation, together with any land contiguous or adjacent to such buildings, works, apparatus or equipment and used wholly or mainly for the purpose connectedtherewith.

Airport – Any area of land or water designed, equipped, set apart or commonly used for affording facilities for the landing and taking off of aircraft and includes any area of the space, whether on ground, on the roof of a building or elsewhere, which is designed, equipped or set apart for affording facilities for the landing and taking off of aircraft capable of descending or climbing vertically.

Aerodrome Operator – A person or organization whose name appears on the licensed document of an airport.

Airside – The movement area of an airport, adjacent terrain and buildings or portionsthereof, access to which is controlled.

Apron – A defined area, on a land aerodrome, intended to accommodate aircraft for the purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance.

Bomb Threat – A communicated threat, anonymous or otherwise, which suggests, or implies, whether true or false, that the safety of an aircraft in flight or on the ground, or any airport or civil aviation facility or any person may be in danger from an explosive or other item or device.

Command Post – The location at the scene of an emergency where the on-scene commander is located and where command, co-ordination, control, and communications are centralized.

Crew Member – A person assigned by an aircraft operator to duty on an aircraft during a flight duty period.

Dangerous Goods – Articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in the Technical Instructions or which are classified according to those instructions.

Explosive Device – Any device that can be triggered to explode. A list of such articles shall be attached to Airport Security Programmes.

Flight Crew member– A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Fire Pit – A pit where hot fire drill is carried out.

Full Emergency – Aircraft emergency to be instituted when it is known that an aircraft approaching an airport is or is suspected to be in such trouble that there is danger of incident/accident.

Incendiary Device – Any device containing an inflammatory substance for causing a fire.

Landside – That area of an airport and buildings to which both traveling passengers and the non-traveling public have unrestricted access.

Local Standby – Aircraft emergency to be instituted when an aircraft approaching an airport is known or is suspected to have developed some trouble but the trouble is not such as would normally involve any serious difficulty in effecting a safe landing.

Movement Area – That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron(s).

Ramp – see Apron.

Response Time –Response time is considered to be the time between initial call to the rescue and firefighting service and the time when the first responding vehicle is in position to apply foam at a rate of at least 50% of discharge rates specified in this manual.

Rendezvous Point – A pre-arranged reference point i.e. road junction, cross-road or other specified place, to which personnel and vehicles responding to an emergency situation initially proceed to receive directions to staging areas and /or accident/ incident site.

Staging Area – A pre-arranged, strategically placed area where support response personnel, vehicles and other equipment can be held in readiness for use during an emergency.

S***tandby Point*** – It is pre-determined point/ place for the fire fighting vehicle to stay stand by to cope with any type of pre-informed emergency.

Triage and Triage Area– Triage is the sorting of casualties at an emergency according to the nature and severity of the injuries. Triage Area is the location where triage operations are performed.

Vulnerable Point – An installation or facility at an airport which, in the opinion of the Civil Aviation Authority, would impair civil aviation operations at the airport if damaged or destroyed.

CHAPTER 3. Level of Protection

The level of protection to be provided at an airport should be based on the dimensions of the largest aeroplanesnormally using the airport as adjusted for their frequency of operations.

The airport category for ARFF Services should be based on the overall length of the longest aeroplanes normallyusing the airport and their maximum fuselage width. The airport category should be determined using Table 3-1 bycategorizing the aeroplanes using the airport, by first evaluating their overall length and second, their fuselage width. Ifafter selecting the category appropriate to an aeroplane's overall length that aeroplane's fuselage width is greater thanthe maximum width in column (3) for that category, then the category for that aeroplane is actually one category higher.

3.1 Airport Category

3.1.1 Airports should be categorized for RFF purposes by counting the aeroplane movements in the busiest consecutive three months of the year as follows:

a) when the number of movements of the aeroplanes in the highest category normally using the airport is700 or greater in the busiest consecutive three months, then that category should be the airportcategory (see examples nos. 1 and 2); and
b) when the number of movements of the aeroplanes in the highest category normally using the airport is less than 700 in the busiest consecutive three months, then the airport category may be one less than the highest aeroplane category (see examples nos. 3 and 4) even when there is a wide range of difference between the dimensions of the aeroplanes which are included in reaching 700 movements)(see example no. 5).

Table 3-1: Aircraft Category for rescue and fire fighting

Airport Category	Aeroplane overall length	Maximum fuselage width (m)
1	0 up to but not including 9 m	2
2	9 m up to but not including 12 m	2
3	12 m up to but not including 18 m	3
4	18 m up to but not including 24 m	4
5	24 m up to but not including 28 m	4
6	28 m up to but not including 39 m	5
7	39 m up to but not including 49 m	5
8	49 m up to but not including 61 m	7
9	61 m up to but not including 76 m	7
10	76 up to but not including 90 m	8

3.1.2 It should be noted that the level of protection provided based on frequency of operations in 3.1.3 b) shall not be less than one category below the determined category.

3.1.3 Either a take-off or a landing constitutes a movement. Movements of scheduled, non-scheduled andgeneral aviation operations should be counted in determining the airport category. A classification of representativeaeroplanes by the airport category shown in Table 3-1 .

3.1.4 The following examples illustrate the method for determining the airport category.

Example No. 1

Aeroplane	*Overall length*	*Fuselage width*	*Category*	*Movements*
Airbus A320	37.6 m	4.0 m	6	600
Bombardier CRJ 900	36.4 m	2.7 m	6	300
Embraer 190	36.2 m	3.0 m	6	500
ATR 72	27.2 m	2.8 m	5	200

The longest aeroplanes are categorized by evaluating, using Table 3-1, first their overall length and second, theirfuselage width, until 700 movements are reached. It may be seen that the number of movements of the longestaeroplanes in the highest category totals more than 700. The airport in this case would be category 6.

Example No. 2

Aeroplane	*Overall length*	*Fuselage width*	*Category*	*Movements*
Airbus A350-900	66.8 m	6.0 m	9	300
Boeing 747-8	76.3 m	6.5 m	10	400
Airbus A380	72.7 m	7.1 m	10	400

The longest aeroplanes are categorized by evaluating, using Table 3-1, first their overall length and second, theirfuselage width, until 700 movements are reached. It may be seen that the number of movements of the longestaeroplanes in the highest category totals more than 700. It may also be noted that when evaluating the categoryappropriate to the Airbus A380 aeroplane's overall length, e.g. category 9, the category selected is actually one higher as the aeroplane's fuselage width is greater than the maximum fuselage width for category 9. The airport in this case would be category 10.

Example No. 3

Aeroplane	*Overall length*	*Fuselage width*	*Category*	*Movements*
Boeing 737-900ER	42.1 m	3.8 m	7	300
Bombardier CRJ 900	36.4 m	2.7 m	6	500
Airbus A319	33.8 m	4.0 m	6	300

The longest aeroplanes are categorized by evaluating, using Table 3-1, first their overall length and second, theirfuselage width, until 700 movements are reached. It may be seen that the number of movements of the longestaeroplanes in the highest category totals only 300. The minimum category for the airport in this case would becategory 6, which is one category below that of the longest aeroplane.

Example No. 4

Aeroplane	*Overall length*	*Fuselage width*	*Category*	*Movements*
Airbus A380	73.0 m	7.1 m	10	300
Boeing 747-8	76.3 m	6.5 m	10	200
Boeing 747-400	70.7 m	6.5 m	9	300

The longest aeroplanes are categorized by evaluating, using Table 3-1, first their overall length and second, theirfuselage width, until 700 movements are reached. It may be seen that the number of movements of the longestaeroplanes in the highest category totals only 500. It may also be noted that when evaluating the category appropriate tothe Airbus A380 aeroplane's overall length, e.g. category 9, the category selected is actually one higher as the aeroplane's fuselage width is greater than the maximum fuselage width for category 9. The minimum category for theairport in this case would be category 9, which is one category below that of the longest aeroplane.

Example No. 5

Aeroplane	*Overall length*	*Fuselage width*	*Category*	*Movements*
Airbus A321	44.5 m	4.0 m	7	100
Boeing 737-900ER	42.1 m	3.8 m	7	300
ATR 42	22.7 m	2.9 m	4	500

The longest aeroplanes are categorized by evaluating, using Table 3-1, first their overall length and second, theirfuselage width, until 700 movements are reached. It may be seen that the number of movements of the longestaeroplanes in the highest category totals only 400. It would appear from 3.1.3 b) above that the minimum category forthe airport would be category 6; however, even when there is a relatively wide range of difference between the length ofthe longest aeroplane (Airbus A321) and the aeroplane for which the 700th movement is reached (ATR 42), theminimum category for the airport may only be reduced to category 6.

3.2 Airport Rescue & Fire Fighting Service category for all-cargo aero planes

The level of protection at aerodromes used for all-cargo aeroplane operations may be reduced in accordance with Table 2-2. This is based on the need to protect only the area around the cockpit of all cargo aeroplane in the critical area concept. Using this rationale, the aerodrome category for an all-cargo aeroplane may be reduced by providing enough water quantity Q1 for the control of fire. Information on the critical area concept and the method by which the scale of extinguishing agents has been related to the critical area may be found in 2.4.

Table 3-2: Airport category for all-cargo aeroplane

Aerodrome Category	Re-classification of aerodrome category for all cargo aeroplanes
	1
2	2
3	3
4	4
5	5
6	5
7	6
8	6
9	7
10	7

3.3 Types of Extinguishing Agents

3.3.1 Both principal and complementary agents should normally be provided at an airport. Principal agents produce a permanent control, i.e. for a period of several minutes or longer. Complementary agents have rapid fire suppression capability but offer a "transient" control which is usually only available during application.

3.3.2 The principal extinguishing agent should be:

a) a foam meeting the minimum performance level A; or
b) a foam meeting the minimum performance level B; or
c) a foam meeting the minimum performance level C; or
d) a combination of these agents.

The principal extinguishing agent for airports in categories 1 to 3 (see 2.4.10) should preferably meet the minimum performance levels B or C foam.

3.3.2 The complementary extinguishing agent should be:

a) dry chemical powders (classes B and C powders); or
b) other extinguishing agents with at least the same firefighting capability.

When selecting dry chemical powder for use with foam, care must be exercised to ensure compatibility.

3.4 Amount of Extinguishing Agents

The amounts of water for foam production and the complementary agents to be provided on the RFF vehicles should be in accordance with the airport category determined under 3.1 and Table 3.3, except that for airport categories 1 and 2, up to 100 per cent of the water may be substituted with a complementary agent.

Table 3-3: Minimum usable amounts of extinguishing agents

Airport category	Foam meeting performance level A		Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
	Water (L)	Discharge rate foam solution/minute (L)	Water (L)	Discharge rate foam solution/minute (L)	Water (L)	Discharge rate foam solution/minute(L)	Dry chemical powders (kg)	Discharge rate (kg/second)
1	350	350	230	230	160	160	45	2.25
2	1000	800	670	550	460	360	90	2.25
3	1800	1300	1200	900	820	630	135	2.25
4	3600	2600	2400	1800	1700	1100	135	2.25
5	8100	4500	5400	3000	3900	2200	180	2.25
6	11800	6000	7900	4000	5800	2900	225	2.25
7	18200	7900	12100	5300	8800	3800	225	2.25
8	27300	10800	18200	7200	12800	5100	450	4.5
9	36400	13500	24300	9000	17100	6300	450	4.5
10	48200	16600	32300	11200	22800	7900	450	4.5

The quantity of foam concentrates separately provided on vehicle for foam production should be in proportion to the quantity of water provided and the foam concentrate selected. The amount of foam concentrate should be sufficient to supply at least two full loads of such quantity of waterwhere sufficient additional water supplies are immediately to ensure a rapid replenishment of the water content carried.

The amounts of water supplied for foam production are predicated on an application rate of 8.2 L/min/m^2 for performance level A foam,5.5 L/min/m^2 for performance level B foam and 3.75 L/min/m^2 for performance level C foam. These application rates are considered to be the optimum rates at which control can be achieved within one-minute control time. Control time is the time required to reduce the initial intensity of the fire by 90 per cent. The amounts in Table 3-6 have been determined on the assumption that the foams meet minimum specifications. Guidance on basic characteristics of foams is contained in Chapter 8.

3.5 Critical Area for Calculating Quantities of Water

The critical area is a concept for rescue of the occupants of an aircraft. It differs from other concepts in that,instead of attempting to control and extinguish the entire fire, it seeks to control only that area of fire adjacent to the fuselage. The objective is to safeguard the integrity of the fuselage and maintain tolerable conditions for its occupants. The size of the controlled area required to achieve this for a specific aircraft has been determined by experimental means.

The practical critical area represents the actual aircraft accident conditions and the theoretical critical area within which it may be necessary to control the fire.

3.6 Discharge Rates

Discharge rates should meet the requirement of obtaining one-minute control time on the critical area and therefore it should be determined for each category by multiplying the critical area by application rate. The discharge rates of the foam solution should not be less than the rates shown in Table3-5.

3.7 Supply and Storage of Extinguishing Agents

The quantities of the various extinguishing agents to be provided in the RFF vehicles should be in accordance with the airport category and Table 3-3. A reserve supply of foam concentrates equivalent to 200 per cent of the quantities of these agents identified in Table 3-3 should be maintained on the airport for vehicle replenishment purposes. This will permit an immediate complete recharge of the vehicles, if necessary, subsequent to an emergency and retention of a second complete recharge should another emergency occur before airport stocks can be replenished. For the purpose of determining quantities of reserve supply, the quantities of foam concentrate carried on fire vehicles in excess of the quantity identified in Table 3-3 can be considered contributing to the reserve.

Vehicle foam tanks must be kept full at all times when the vehicle is in operational service so as to avoid stability problems. Where protein foam concentrates are used, the entire contents should be periodically discharged and the entire system washed through to avoid sledging problems due to stale protein foam.

3.8 Response Time

The operational objective of the RFF service should be to achieve response times of two minutes and notexceeding three minutes to the end of each runway, as well as to any other part of the movement area, in optimum conditions of visibility and surface conditions. Response time is considered to be the time between the initial call to the RFF service and the time when the first responding vehicle(s) is(are) in position to apply foam at a rate of at least 50 per cent of the discharge rate specified in Table 3-3. Determination of realistic response times should be made by ARFF vehicles operating from their normal locations and not from positions adopted solely for test purposes.

3.9 Fire Station

All RFF vehicles should normally be housed in a fire station.Fire station should be located at the airport in such an area to meet the response time mentioned in 3.8. Satellite fire stations should be provided whenever the response time cannot be achieved from a single firestation. Details of characteristics of fire stations can be found in Chapter 9 of this manual.

3.10 Communication and Alerting Service

Communication system should be established at an aerodrome, linking fire station(s) with the control tower and the RFF vehicles. An alarming system for RFF personnel should be provided at a fire station, capable of being operated from that station, any other fire station on the airport and the airport control tower. Details on Communication and Alarm Requirements is given in Chapter 15 of this manual.

3.11 Number of Vehicles

The minimum number and types of conventional RFF vehicles to be provided at an airport so as to effectivelydeliver and deploy the agents specified for the airport category should be in accordance with Table 3-4.

Table 3-4. Minimum number of vehicles

Airport Category	Number of fire fightingvehicle
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	3
9	3
10	3

CHAPTER 4. Airport Facilities Affecting Rescue And Firefighting Services

4.1 Airport Water Supply

Supplementary water supplies, for the expeditious replenishment of ARFF vehicles, should be prearranged. The objective of providing additional water supplies at adequate pressure and flow is to ensure rapid replenishment of Aerodrome Rescue & Fire Fighting Service (ARFFS) vehicles. If the natural water sources are available in airport area, an access to such source should be provided.

Additional water to replenish vehicles shall be required in as little as five minutes after an accident, therefore an analysis should be conducted to determine the extent to which the replenishing vehicles and their associated storage and delivery facilities, should be provided.

4.2 Emergency Access Roads

Emergency access roads should be provided on an airport where terrain conditions permit their construction so as to facilitate the achievement of minimum response times. Particular attention should be given to the provision of ready access to approach areas up to 1000 m from the threshold or at least from the threshold to the airport boundary. Where the airport is fenced, access to outside areas should be facilitated by the provision of emergency gates or frangible barriers.

Emergency access gates or frangible barrier shall be provided at the airport boundary fence for the access of fire fighting vehicle to the areas outside of airport. Where an emergency access road, normally provided with a gate or a frangible barrier, may lead emergency vehicles on to a public road, the exterior face of the gate or barrier should be marked to indicate its purpose with a prohibition of vehicle parking in its immediate vicinity. Suitably designed road curves with adequate radii for the manoeuvring of major RFF vehicles should be provided where necessary. If any gates are secured by mechanical locks, the keys to the gates should be made available in the ARFF vehicles.

The combined facility of emergency access road and gate should be subject to regular inspection and physical tests to ensure their availability in an emergency.

CHAPTER 5. Specifications for Rescue and Fire Fighting Vehicles

ARFF vehicles should be specified so that the response objective is met in all circumstances of optimum visibility and surface conditions.

ARFF vehicles should be capable of carrying their full load with maximum traction and mobility on and off paved surface in optimum weather conditions. Vehicles may also be designed to carry required rescue equipment and complementary extinguishing agents. The amounts of foam concentrate carried should be sufficient to supply at least two full loads of water tank capacity. The vehicle shall be capable of being deployed in a way that ensures that response objective is achieved and that continuous agent application at the appropriate rate may be fully maintained.

5.1 Factors to be considered in determining thespecifications

Following factors should be considered to prepare the specification in procuring the new vehicle

Phase – 1 (Preliminary considerations)

- Role of newvehicle
- Capacities related topresent or futureairport RFF Category
- Quantitative advantage of adopting improved extinguishingagents
- Compatibility of new vehicle with existingfleet
- Dimension orloading limitationsimposed by airportfeatures or localterrain

Phase – 2 (Preparation of Specification)

- Quantities and type of extinguishing agents – output requirements, discharge patterns and replenishmentfacilities
- Crew cab capacity, design and safety aspects – instrumentation, accessibility for operations, control system–ease of driving and operatingsimplicity
- Equipment – range and stowage- need for specialequipment
- Automotive performance – minimum acceptance criteria
- Access for preventive maintenance and support – protective treatments andfinishes

Phase – 3 (Additional contractual consideration)

- Provision of training for fire services personnel and supportingpersonnel
- Pre-delivery acceptance test –Factory acceptance test(FAT)
- Provision of technicalmanual
- Initial commissioning atairport
- In-service support by suppliers' technicalstaff
- Supply of spare parts with newvehicle
- Prompt supply of spare parts when required

5.2 Characteristics and performance of rescue and fire fighting vehicles

In addition to the above factors as mentioned in 5.1, following characteristics and performance should be considered in selecting new fire fighting vehicle to be used also as rapid intervention purpose:

Table 3 Suggested Minimum Characteristics for RFF Vehicles

Details	**RFF Vehicle up to 4500 L**	**RFF Vehicle over 4500L**
Monitor	Optional for categories 1 and 2 Required for categories 3 to 9	Required
Design feature	High discharge capacity	High and low discharge capacity
Range	Appropriate to longest aircraft	Appropriate to longest aircraft
Hand-lines	Required	Required
Under Truck Nozzles	Optional	Required
Bumper Turret	Optional	Optional
Acceleration	80km/hour within 25 sec. at the normal operating temperature	80km/hour within 40 sec. at the normal operating temperature.
Top Speed	At least 105 km/h	At least 100km/h
All-wheel drive capability	Required	Required
Automatic or semi-automatic transmission	Required	Required
Single rear wheel configuration	Preferable for categories 1 and 2 Required for categories 3 to 9	Required
Minimum angle of approach and departure	30 Degree	30 Degree
Minimum angle of tilt(static)	30 Degree	28 Degree
Under chassis clearance	14 inches(356mm)	14 inches(356mm)

Foam tenders equipped with foam monitors should be able to produce foam whilst on the move at minimum speed of10 km/hr. Monitors and side-line branch pipes should have the capability to deliver foam in a jet or dispersed pattern and are to be capable of at least 50 percent of the discharge rate required for the RFF Category. Monitor platforms should be designed to provide a safe area for working. The crew compartment shall be capable of safely accommodating personnel and their equipment, including breathing apparatus. If appropriate, sufficient space shall be provided to facilitate the donning of personal protective equipment. All seats should be fitted with safely restrained to accepted road use standards and face towards.

Foam tenders shall be fitted with fixed or portable lighting equipment sufficient to illuminate the incident/accident site. Adequate communication facilities should be installed in the RFF vehicles.

Following additional factors may be found of benefit to the operation of RFF vehicles:

- Forward and Rear facing cameras with video recording
- Mapping/Global Positioning System (GPS)

- Automatic tyre deflation/ inflation
- Extending working platform
- Safety warning/interlocks for the safe operation of critical systems fitted to the vehicle
- Traction Control
- Anti-lock braking systems

5.3 Equipment to be carried on Rescue and Fire Fighting Vehicle

Equipment Scope	Equipment Item	Airport Category			
		1- 2	3- 5	6- 7	8 -10
Forcible entry Tools	Prying Tool (Hooligan, Biel type)	1	1	1	2
	Crowbar 95 cm	1	1	1	2
	Crowbar 1.65 m	1	1	1	2
	Axe, rescue large non wedge type	1	1	1	2
	Axe, rescue small non wedge or aircraft type	1	2	2	4
	Cutter Bolt 61 cm	1	1	2	2
	Hammer 1.8 kg Lump or Club type	1	1	2	2
	Chisel cold 2.5 cm	1	1	2	2
A suitable range of rescue/cut in equipment including powered rescue tools	Hydraulic/Electrical (or combination) portable rescue equipment	1	1	1	2
	Powered rescue saw complete with minimum 406mm diameter spare blades	1	1	1	2
	Reciprocating/Oscillating saw	1	1	1	2
A range of equipment for the delivery of firefighting agent	Delivery hose 30 m lengths x 50 & 64 mm and air cylinder	6	10	16	22
	Foam Branches (Nozzles)	1	1	2	3
	Water Branches (Nozzles)	1	2	4	6
	Coupling adaptors	1	1	2	3
	Portable fire extinguishers				
	CO_2	1	1	2	3
	DCP	1	1	2	3
Self-Contained Breathing Apparatus - enough to maintain prolonged	Breathing Apparatus (BA) set c/w facemask and air cylinder				
	BA spare air cylinder				
	BA spare facemask				

Equipment Scope internal operations	**Equipment Item**	**Airport Category**			
		1-2	**3-5**	**6-7**	**8-10**
Note: Ideally one BA set per crew member.					
Respirators	Full faced respirators c/w filters	One per responding fire fighter			
A range of ladders	Extension Ladder, Rescue & suitable for critical aircraft	-	1	2	3
	Ladder General Purpose-rescue capable	1	1	1	2
Protective clothing	Firefighting helmet, coats, over trousers (c/w braces), boots & gloves as a minimum	One set per operational fire fighter plus a % of reserve stock			
Additional items for personal protection	Protective goggles	1	1	2	3
	Flash hoods	One per operational fire fighter			
	Surgical gloves	1 box	1 box	1 box	1 box
	Blanket Fire Resisting	1	1	2	2
Rope Lines	Rope Line Rescue 45 m	1	1	2	2
	Rope Line General Use 30 m	1	1	2	2
	Rope Line Pocket 6 m	One per operational fire fighter			
Communication Equipment	Portable transceivers (handheld & intrinsically safe)	1	2	2	3
	Mobile Transceivers (vehicle)	One for each fire vehicle			
A range of handheld/portable lighting equipment	Handheld flashlight (intrinsically safe)	1	2	4	4
	Portable lighting - spot or flood (intrinsically safe)	1	1	2	2
A range of general hand tools	Shovel overhaul	1	1	2	2
Rescue Toolbox & contents		1	1	2	3
	Hammer, Claw 0.6 kg				
	Cutters, cable 1.6 cm				
	Socket set				
	Hacksaw, heavy duty c/w spare blades				
	Wrecking bar 30 cm				
	Screwdriver set - Slotted & Phillips heads				
	Pliers, insulated				
	Combination 20 cm				
	Side Cutting				

Equipment Scope	Equipment Item	Airport Category			
		1- 2	3- 5	6- 7	8 -10
	Slip Joint - Multi Grip 25 cm				
	Seat Belt/Harness cutting tool				
	Wrench, adjustable 30 cm				
	Spanners, combination 10mm-21mm				
First Aid equipment	Medical First Aid Kit	1	1	2	3
	Automated External Defibrillator (AED)	1	1	2	3
	Oxygen Resuscitation Equipment (ORE)	1	1	2	3
Miscellaneous equipment	Chocks & Wedges - various sizes				
	Tarpaulin - lightweight	1	1	2	3
	Thermal Imaging Camera	-	-	1	2

Suitable and adequate lockers and storage facilities should be provided to carry required rescue equipment and complementary extinguishing agents. All equipment shall be safely and securely stored whilst allowing maximum accessibility.

CHAPTER 6. Protective Clothing and Respiratory Equipment

Protective clothing and respiratory equipment are the Personal Protective Equipment (PPE). All personnel dealing with fire shall be provided with protective clothing and respiratory equipment so as to be able to perform assigned duties. Airport operator or the Airport Civil Aviation Office should provide adequate training to the RFF personnel for the use, care and maintenance of the personal protectiveequipment. The protective clothing and respiratory equipment should be inspected regularly to ensure that all the protection requirements are met.

6.1 Protective Clothing

Protective Clothing is distinct from ordinary fire service uniforms and is worn during rescue and firefighting activities including training. It should be designed to protect fire fighters from radiated heat and injuries that may arise from impact or abrasion during operational activities. Protection from ingress of water is also desirable specially in low temperature operational conditions. Following factors shall be considered in determining the type of clothing to be provided for its use during hours of duty to meet the response time:

6.2 Components of ProtectiveClothing

A typical protective uniform consists of a helmet (with visor), a suit (either in one piece or in a jacket and trousers combinations), boots and gloves. The desirable characteristics of each component is given below.

i. Helmet: It should provide adequate protection from impact, be resistant to penetration and electrical conductivity and should not be susceptible to deformation due to heat absorption. Helmet should not give the wearer impression of being isolated and must permit both speech and the reception of audible signals or words of command. It should have movable visor offering a wideangle ofvision. The visor should be resistant to abrasion, impact and radiant heat.
ii. Protective suits:Protective suits are classified into two categories, proximity suits and structural fire-fighting suits.

- Proximity Suits:Proximity Suits are designed to permit fire fighters to approach and suppress a fire situation. However, these suits are not intended to provide the level of protection necessaryforenteringactivefireareas. These suitsareprovidedinone-pieceoveralldesignsandintwo-piece jacket and trousers combinations. Materials of suits should match the climatic and other considerations in the location of intendeduse. The basic criteria for selection and acquisition of proximity suits are listed below.
    - Proximity suits should provide thermal insulation, and must be resistant toradiant heat, direct flame contact, andwater.
    - Material should be lightweight, provide freedom for movement, comfortable and easy to wear withoutassistance.
    - Fabrics should not bebulky.
    - Fabrics should be resistant to tearing andabrasion.
    - May be coated in a reflective medium or lined to minimize the effects of radiated heat on thewearer.
    - Fastening should be easily secured by the wearer to ensure their security

under stress and resistant to damage by heat or flame contact. Seam should be waterproof and pockets should have drainage holes in the lowercorners.
- ➢ It should be capable of being cleaned without reducing its protectivequalities.

iii. Boots:Uppers should be of tough, flexible, heat resistant material, extended up to the mid-calf or knee level. Soles should be of a non-slip material. Rubber boots should not beused.

iv. Gloves:Gloves should be of type to protect wrist. They should permit the wearer to operate switches, fastenings and hand tools. Back of the gloves should have a reflective surface to minimize radiated heat effects and the palm and fingers should be provided in a material resistant to abrasion and penetration by sharp objects. All seams should be resistant to penetration by liquids.

6.3 Protection Requirements

The protective clothing, when correctly worn, should offer at least the same level of protection as a structural fire-fighting suit. The exact level of protection should be decided with regard to operational considerations and risk assessment.

Guidance for fire-fighting suits is available in the following standards:

a) ISO 11613: Protective clothing for fire-fighters- Laboratory test methods and performance requirements;
b) EN 469: Protective clothing for fire-fighters- Requirements and test methods for protective clothing for fire-fighting;
c) NFPA 1971 Standard on protective clothing for structural fire-fighting; and
d) ISO 15538:2001 Protective clothing for firefighters- Laboratory test methods and performance requirements for protective clothing with a reflective outer surface.

6.4 Respiratory Equipment

Fire fighters should be provided with respiratory equipment to protect themselves against dangerous toxic gases such as carbon monoxide, hydrogen chloride, chlorine, hydrogen cyanide those may be produced by burning aircraft cabin interior materials.

It is essential to ensure that the respiratory equipment selected is adequate in terms of its basic function and its operational duration for rescue and firefighting operations involving aircraft fire. Industrial smoke masks and certain types of limited capacity compressed air equipment are unlikely to meet the stringent requirements of those operations.

Wherever respiratory equipment is operated, adequate arrangements must be made for the recharging of breathing apparatus with pure air and a quantity of spare parts should be held to ensure the continuous availability of the service.

CHAPTER 7. Ambulance and Medical Service

Ambulance service should be provided in the airport. Civil Aviation Office shall arrange to have sufficient medical supplies, available on or in the vicinity of the airport to treat the passenger and crew capacity of the largest aircraft normally using the airport. The availability of ambulance and medical services should form part of the AirportEmergency Plan (AEP) established to deal with aircraft accident/incident. As the city ambulance and medical service takes time to reach airport or accident/incident site, airport rescue and fire service station shall be provided with ambulance and medical service for the establishment of initial triage and delivery of basic life supportuntil the arrival of city medical service.

Ambulance team should be qualified in basic life support. The extent of these facilities shall be determined on the basis of type and density oftraffic. Ambulance should be able to operate under off-road conditions and also in the terrain in the vicinity ofairport.

Depending upon the frequency and volume of traffic movement, as a measure of economy, the vehicle used for other purposes may be used as ambulance (in domestic airports) provided such use will not interfere with its availability in the event of need. But such vehicle must be suitably modified to permit the carriage of stretchers and other necessaryequipment.

The provision of portable lighting should be considered for illuminating an accident scene, particularly for triage and casualty handling areas.

Ambulances used to transport casualties who may have a serious communicable disease or are contaminated with a toxic agent (chemical or radioactive material) require additional consideration. Designated equipment may be necessary and personnel involved should receive additional training and be provided with necessary personal protective equipment.

CHAPTER 8. Extinguishing Agents Characteristics

Principal extinguishing agent should be a Foam which meets either performance level A or B or C. The principal extinguishing agent should be aqueous film forming foam or fluoroprotein foam or film forming fluoroprotein foam or protein foam or synthetic foam or a combination of these agents. The complementary extinguishing agents shall be any combination of Dry Chemical powder and gaseous agents with proven low environmental impacts like CO_2 or any other agent which demonstrates equivalent performance. The minimum quantities and types of extinguishing agents required for each RFF Category are set out in Table 3-4. It is a mandatory requirement.

8.1 Principal Extinguishing Agents

Foam is used to provide an air excluding blanket which prevents volatile flammable vapours from mixing with air or oxygen. To achieve this objective fire fighter shall follow the following guidance:

- Foam must flow over the fuelsurface
- Must resist disruption due to wind or exposure to heat or flame
- Should be capable of resealing any ruptures caused by disturbances of an established blanket.

a. Method of foam production: Foam solution is produced either in pre-mixed forms or by the use of a proportioning system, which are delivered at a pre-determined pressure to nozzle which induce air to aspirate the solution. The pressure may be created by a pump or, with vehicles of smaller capacity, by a compressed gas source usually either dry nitrogen or dry air. In all cases the system will produce an acceptable foam only if the solution is delivered in the appropriate volume and in the correct pressure range to the aspirating nozzle or nozzles.

b. Quality of Foam: The quality of foam produced by a rescue fire fighting vehicle using any of the concentrated type will significantly affect the control and extinguishment times of an aircraft fire. Any foam concentrates to be used in aircraft rescue and fire fighting vehicle should meet or exceed the criteria in given below specifications, so as to achieve the performance level A and B, asappropriate.

8.1.1 Foam Specifications

- The pH value of foam concentrate should be as neutral as possible and should register between the values of 6 and 8.5.
- The viscosity measurement of a foam concentrate when at its lowest temperature should not exceed 200 mm/s.

  When a foam concentrate is tested by the centrifuge method, foams should contain no greater than 0.5 per cent of sediment.

8.1.2 Foam Performance Acceptance Test
Foam Performance Acceptance Test should be carried out to ensure that foam production by an RFF vehicle is of an acceptable standard. Such test should be carried out when:

a) When RFF vehicle is first acquired for operational use at an aerodrome

b) When significant maintenance, refurbishment or component replacement has been undertaken. Only those parts of the system that could have been affected by the work undertaken need to be tested.

The Foam Performance Acceptance Test should confirm the following:

a) The induction percentage for all foam-making devices
b) The expansion ratio from all foam-making devices
c) The jet range of the main monitor
d) The spray pattern of the main monitor

8.1.3 Fire Test Method

Functional fire tests shall be carried out to determine the suitability of foam concentrate in the airport environment. Test shall be conducted to evaluate the ability of a foam concentrate to:

a. Extinguish a fire of 2.8m^2(Performance Level A)or 4.5 m^2(Performance Level B) or 7.3 m^2 (Performance Level C) asappropriate
b. Resist burn back due to exposure to fuel andheat.

Equipment required for the test:

a. A circular fire steel tray of 2.8m^{2}or 4.5 m^{2}or 7.3 m^2. The vertical wall shall be200mm;
b. Equipment or access to facilities to enable accurate recordings of air temperature, water temperature and windvelocity;
c. Fuel: 60 L of Avtur (Jet A) for performance level A tests; 100 L of Avtur (Jet A) for performance level B tests; 157 L of Avtur (Jet A) for performance level Ctests;
d. Branch pipe, straight stream, air aspiratingnozzle;
e. Suitable stop watch
f. Circular, burn back pot, measuring 300 mm (Internal diameter), 200 mm high, 2 L of gasoline orkerosene;and
g. Protective screen between tray and equipment for protection against radiant heat.

Preferable testing conditions:

a. Air temperature(degree Centigrade)	>=	15
b. Foam solution temperature(degree Centigrade)	>=	1.5
c. Wind velocity (m/s)	<=	3

d. The test shall not be carried out in conditions of precipitation, if outdoors.

Test procedure:

i. Position the chamber holding the premix foam upwind of the fire with the nozzle ("Uni 86" foam nozzle) horizontal at a height of 1 m above the upper edge of the tray and at a distance that will ensure that the foam will fall into the centre of the tray.
ii. When testing performance level A foam, place 60 L of water and 60 L of fuel into a 2.8 m^2 tray;
When testing performance level B foam, place 100 L of water and 100 L of fuel into a 4.5 m^2 tray; and
When testing performance level C foam, place 157 L of water and 157 L of fuel into a 7.32 m^2 tray.
iii. Position the protective screen, if required.

iv. Test the foam apparatus to ensure a nozzle pressure of approximately 7 bar (700 kPa) and a discharge rate of 11.4 l/min.
v. Record the air, kerosene, water and foam premix temperature and check it is in the correct range.
vi. Record the wind velocity and check it is in the correct range.
vii. Ignite fuel and allow 60 seconds pre-burn from full involvement.
Note 1: full involvement shall be obtained in less than 30 seconds after the beginning of ignition.
Note 2: ignition method shall forbid putting solid or liquid substance into the kerosene, for example ignition with a gas burner is acceptable.
viii. Apply foam continuously while maintaining the nozzle pressure and an application rate of 11.4 l/min for 120 seconds.
ix. Record extinction time.
x. Place burn back pot in centre of fire tray.
xi. Ignite burn back pot 120 seconds after end of application of foam.
xii. Record when 25 per cent of the fuel area is re-involved with fire.

Test performance requirements:
For each performance level, a foam concentrate is acceptable if:

a) The time extinguish the fire from the overall surface of the tray is equal to or less than 60 seconds and
b) The re-ignition of 25% of the tray surface is equal or longer than 5 minutes.

Also, minute flames (flickers) visible between the foam blanket and the inner edge of the tray at the 60 seconds time are acceptable if:

a) They do not spread in a cumulative length exceeding 25% of the circumference of the inner edge of the tray and
b) They are totally extinguished during the second minute of foam application.

8.1.4 Operational considerations

- Adequate clear water supply should be arranged for foam production. Corrosion inhibitors or any other additives should not be used in the water without prior approval of the foam concentrate manufacturer.
- Foam can be applied to fires in two distinct forms: Solid streams, and Dispersed patterns. Solid streams are used where range of application is essential or where the stream may be deflected from a solid object to distribute it in the fire area. Solid streams must be employed with care at an aircraft accident where survivors are evacuating the aircraft and escape slides may be in use. Dispersed patterns may be employed to deliver foam at shorter ranges to a fire area, combining greater coverage with the more effective surface application of the foam. Dispersed patterns are particularly valuable in protecting fire fighters from radiated heat.
- Equipment such as High Reach Extendable Turrets (HRET) and low-level High-Performance Monitors can provide the operator with greater flexibility in directing the foam stream. HRET can be defined as a device, permanently mounted with power-operated boom(s), designed to supply a large-capacity, mobile, elevated water stream or other fire extinguishing agents, or both. The extendable turret places the nozzle well forward and below the operator, thus eliminating foam overspray and providing a clearer view of the effectiveness of agent application. The ability to position the nozzle nearer to, or in alignment with the target allows more precise aiming, reduces disruption from wind and helps to conserve agent.

- RFF vehicles equipped with HRET may incorporate penetrating technology that provides the vehicle operator the ability to deliver extinguishment agent through an adjustable nozzle or rigid probe in and around the aircraft and into the passenger or cargo compartments. Such technology provides the ability to pierce through the fuselage or aircraft components affords the operator greater flexibility when it comes to the strategies and tactics of aircraft interior firefighting. The piercing action of the rigid tip allows agent application to the seat of the fire that may be inaccessible to handline operations such as in the case of cargo aircraft, tail-equipped aircraft engines, and auxiliary power units (APUs).
- Other suitable manual or hand-held penetrating technologies mayinclude the following:
  a) manual piercing or hand-held penetrating nozzles, given a safe working platform and proper protection, can deliver many of the same firefighting tactics and strategies described for HRET;
  b) handheld Skin Penetrating Agent Applicator Tool (SPAAT) is also a manual penetration tool; and
  c) ultra-high pressure water streams have been developed using a narrow-gauge water stream to "cut" a small hole through the aircraft skin to apply agent into the interior of an aircraft. The ultra-high pressure water streams pierce the outer structure with high pressure water and aggregate enabling an exterior attack on the involved structure. Once the outer structure is penetrated, the ultra-high-pressure mist into the thermal layer cools the interior dropping temperature from 800 °C to 100 °C in a matter of seconds. This technology allows the operator to attack fire from a safe exterior position without the firefighter entering the interior of a structure.
- The use of penetrating technology to suppress aircraft interior fires should be carefully evaluated as there are concerns regarding its efficacy and safety, in particular to passengers. Where provided, adequate training including standard operating procedures should be provided to RFF personnel involved in the use of such equipment.

8.2 Complementary agents

Complementary agents have the capability of rapid-fire suppression but offer a transient control and are particularly used on concealed fire such as engine fire, fire in aircraft freight holds and beneath the wings where foams may not penetrate and on running fuel fire situation on which foams are ineffective.

It is also necessary to apply a principal agent simultaneously or at least before flashback can occur in order to achieve permanent control.

It should be noted that when a large quantity of complementary agents is discharged a dense cloud of the agent may affect aircraft evacuation or rescue operation by limiting the visibility and affecting the respiration to those exposed to the effects.

a. Dry Chemical Powder

Dry chemical powder is finely divided powder of sodium bicarbonate or potassium bicarbonate or mono-ammonium phosphate etc. which are combined with additives to improve their performance.In aircraft RFF operations, dry chemical powders are normally of the "BC" type, since they are effective against fires involving flammable liquids and those of an electrical origin. Dry chemical powders should comply with the specifications of the International Organization for Standardization (ISO 7202).

It can provide rapid knockdown of flammable liquid fire and some protection to operatives from radiated heat when used with foam in dual agent attack and delivered at suitable rate.The successful use of dry chemical powder is strongly dependent on the technique of its application. The application of dry chemical powder is also significantly affected by wind speed but use may be made of wind to augment the range of a powder stream and to influence its pattern of distribution. When selecting dry chemical powder for use with a foam as a dual agent attack, care must be exercised to ensure its compatibility with that foam.

b. Carbon Dioxide(CO_2)

Used as a means of rapid knockdown for small fire or a flooding agent in reaching concealed fires in areas inaccessible to foam. Carbon dioxide should comply with the specifications of the International Organization of Standardization (ISO 5923).

It should not be used on fires involving flammable metal. It may be used as complementary agent in a dual-agent attack with a foam.CO_2 is most effective at high rates of delivery, achieved through low pressure system.

Carbon dioxide installation types:

- High Pressure System: Consists a series of cylinders manifold together, containing CO_2 gas at 5900kPa pressure at an ambient temperature of 21 Degree Celsius.
- Low Pressure System: Where carbon dioxide is contained in an insulated pressure vessel at a controlled low temperature usually -18 Degree Celsius. At this temperature the storage pressure is 2100 kPa and the delivery system can provide discharge rates up to 1100kg/min giving a long throw to a great volume ofgas.

8.3 Conditions of Storage of Extinguishing Agents

Section 3.6 indicates that a reserve supply of foam concentrates and complementary agents equivalent to 200 percent and 100 percent respectively of the quantity mentioned in Table 3-5 should be maintained at the airport. The reserve of extinguishing agents shall be stored in the fire station and the conditions of storage should be:

a. Foam concentrate: Avoid extreme temperature and direct exposure to sunlight. Replace and seal the caps of any partly-usedcontainers
b. Dry chemical powder: Maintain stock, replace and seal the caps of any partly-used containers

The stocks of fire extinguishing agents should be stored and used in a consistent manner in accordance with manufacturers' guidance. Consideration should be given to avoid prolonged or extreme storage conditions. It should be inspected and tested in regular basis. This may require the keeping of log books and records of test to be assured of continual fitness for purpose. Inspector from the Aerodrome Safety and Standards Department of Civil Aviation Authority of Nepal, may require to examine any evidence of this assurance from time totime.

Foam generating system shall be regularly checked for induction accuracy. For foam system designed to induce at 6%, induction should be in the range of 5% to 7% at the optimum working conditions. For system designed to induce at 3%, the range is 3% to 5%, and for 1% systems, the range is 1% to 1.1%.

When different types of extinguishing agents are used on the aerodrome, care must be taken to ensure that incompatible types are kept apart and care is exercised when these have to be used simultaneously against fires.

CHAPTER 9. Fire Station

9.1 Design, Construction and Location of FireStation

Properly constructed and located Fire Station may contribute the morale and efficiency of the rescue and firefighting services. In selecting the location of the fire station, prime concern is to meet the minimum response time and easy access to both the runways ends and the movement areas of the airport.

Following factors shall be considered in selecting and designing the fire station:

- The location of the fire station shall be based on minimizing response time to areas where aircraft accidents and incidents might occur. At largeaerodromes, it may be necessary to consider the provision of more than one fire station to meet the response time in optimum conditions of visibility and surfaceconditions.
- Need to deal with structuralfire
- Location strategically in relation to the runwaypattern
- Possibilities of accidents and incidents occur on or close to therunways.
- Emergency fire vehicles should have direct access to the movement area within the recommended responsetime.
- Access to the runways is direct with minimum number ofturns.
- Vehicle running distance should be as minimum as possible in relation torunways.
- Ability of vehicles to reach the stand by point withoutdelay.
- Widest possible view of airport areas from fire watchtower.
- Adequate accommodation for the housing of vehicles, and theirmaintenance.
- Domestic and personnel administrativefacilities.
- Communication and alarmsystem.
- Appropriate storage and technical supportfacilities.
- Fire station apron or manoeuvring area shall be strong enough to bear the weight of fully laden vehicles and should not be damaged when vehicles are driven awayrapidly.
- The station apron should be adequately illuminated. Lights should be mounted so as not to adversely affect driver's vision or airportoperation.
- There should be an exterior water connection or hydrant assembly for the refilling of vehicle watertanks.
- The provision of means to rapidly replenish foam concentrate tanks isdesirable.
- Installation of closed-circuit television (CCTV) cameras in the watch-room may be considered.

9.2 Firefighting Vehicle Housing

- Following facilities and infrastructure shall be made available for the housing of fire vehicles: Series of bays with sufficient space for each of the vehicle and surrounding areas for fire personnel to work around the vehicle (at least 1.2 meters clearance around each of the vehicle).
- Strength of bays floor should capable to hold the maximum weight of the vehicle. Surface should be resistant to oil, grease and foam and should be easily cleaned to avoidslippery.
- If doors are provided to the bays, they should be easily opened without delaying the

movement of vehicles. Doorways shall be wide enough to enable a quick and safe exit by vehicles giving adequate clearance to ladders obstruction lights and aerials etc. which may be fitted to vehicleroofs.

- Ceiling of the bays should be of sufficient height to the tops of vehicles so that inspection of foam tanks etc. may beconducted.
- Vehicle bay shall be provided with adequate lighting facilities. Electrical systems of appropriate design, shall be provided for engine heating, battery charging or other equipment.

9.3 Domestic and Administrative Requirements

Following facilities should be available at the fire station:

- Office room for the chief of station, second in command and other RFFpersonnel.
- Locker room for the staff for changing theirclothing.
- Mess room fitted with chairs, tables and mounted white board which could also be used as class room.
- Kitchen facilities.

9.4 Supporting Facilities

Following facilities shall be made available to the extent possible which are necessary to maintain the efficiency of the personnel, equipment and ultimately the service: -

- Well-equipped workshop for the repair and maintenance of the vehicle and theequipment.
- Hydrant and water source (may be well) for the testpurpose.
- Electric or manual pump for the transfer of foam from containers tovehicle.
- The specific area for training purposes. The area is not required to be a separate enclosed room, although this may bedesirable.
- The provision for proper exercisefacilities.
- Secondary electrical power supply to ensure the continuous availability of essential equipment andfacilities.
- Hose storage space should be provided including suitable racking andventilation.

9.5 Fire Watch Tower

Fire watch tower should be the central point for the reception of emergency calls. The watch tower should be sited in a position which enables surveillance of as much of the movement areas as possible. The importance of prompt and clear communications is paramount. Therefore, each fire station should be provision of direct communication facilities with air traffic control, RFF vehicles, crew en-route to, or in attendance at, an aircraft accident or incident. A direct telephone line to the local city fire brigade should be provided.

Double glazing and other sound proofing measures may be necessary to exclude excessive noise from aircraft. Facilities should be required to minimize the effect of direct exposure to the sun. Facilities should be provided for varying lighting intensity in the watch tower room to permit maximum external vision at night. The fire watch tower should be provided with a public address so that details of the emergency can be conveyed to crewmembers.

CHAPTER 10. Rescue and Firefighting Personnel

The total number of personnel required to deploy and operate the RFF service should be determined from a Task Resource Analysis (TRA). It should be determined such that sufficient trained and competent personnel should be designated to be readily available to ride the RFF vehicles and to operate the equipment at maximum capacity. These personnel should be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the appropriate rate can be fully maintained. The level of staffing should be documented in the respective Aerodrome Manual.

10.1 Personnel Selection

All personnel (regular and/or auxiliary) provided for aircraft RFF duties, should be fully trainedin the performance of their duties. Personnel recruited for RFF services should be resolute, possess initiative, and competent to form an intelligent assessment of a fire situation. The details on trainings that are to be provided to an RFF personnel is given in Chapter- 14.

As the nature of RFF operations involves periods of intense physical activity, all RFF personnelhave to possess a minimum level of physical fitness and medical fitness to be able to perform the tasks associated with these operations. The key fitness components for RFF are generally aerobic fitness, anaerobic fitness, flexibility and medical fitness. Physical fitness assessment should be catered to these components which are also mentioned in brief below. RFF services should develop various types of tests to ensure that these components are tested to determine if the RFF personnel has the required physical fitness level for the job. The physical fitness assessments should be conducted for preemployment entry as a fire fighter as well as ongoing physical fitness assessments for existing staff at least once every year.

- ***Aerobic fitness*** is the ability to continue to exercise for prolonged periods of time at low to moderate or high intensity. Typical aerobic activities include walking, jogging, cycling, rope skipping, stair climbing, swimming, or any other endurance activities.
- ***Anaerobic fitness*** works differently to aerobic fitness. It is an activity that requires high levels of energy and is done for only a few seconds or minutes at a high level of intensity. The term *anaerobic* means "without oxygen". Participation in anaerobic activities leads to anaerobic fitness, which may be defined as higher levels of muscular strength, speed and power. Examples of anaerobic activities include heavy weight lifting, running up several flights of stairs, sprinting, power swimming, or any other rapid burst of hard exercises.
- ***Flexibility*** refers to the ability to move the limbs and joints into specific positions at the end of their normal range of movement. Flexibility is important as it will allow the body to work in cramped positions without unduly stressing the muscles, tendons and ligaments and may reduce the risk of injury.
- ***Medical fitness*** assessments specific to RFF Services should be developed and should be used to identify any underlying medical conditions, which may pose a risk to the individual fire fighter, during physically demanding activities.

10.2 **Task Resource Analysis**

10.2.1 Introduction
The following guidance describes the stages that should be considered by an airport operator in carrying out a Task and Resource Analysis (TRA) to establish justification as to the minimum number of qualified/competent personnel required to deliver an effective airport RFF Service to deal with an aircraft incident/accident. If an airport operator requires the RFFS to attend structural incidents and road traffic accidents in addition to aircraft incidents/accidents due regard must be given to the inability of not meeting required response times, and robust procedures should be introduced accordingly.

10.2.2 Purpose
By using a qualitative risk-based approach, which focuses upon probable and credible worst case scenarios a task and resource analysis seeks to identify the minimum number of personnel required to undertake identified tasks in real time before supporting external services are able to effectively assist RFFS.

10.2.3 General Information
The airport operator should first establish the minimum requirements including: minimum number of RFFS vehicles and equipment required for the delivery of the extinguishing agents at the required discharge rate for the specified RFF category of the airport.

10.2.4 Task Analysis/Risk Assessment
A task analysis should primarily consist of a qualitative analysis of the RFFS response to a realistic, worst case, aircraft accident scenario. The purpose should be to review the current and future staffing levels of the RFFS deployed at the aerodrome. The qualitative analysis could be supported by a quantitative risk assessment to estimate the reduction in risk. This risk assessment could be related to the reduction in risk to passengers and aircrew from deploying additional personnel. One of the most important elements is to assess the impact of any critical tasks or pinch points identified by the qualitative analysis.

10.2.5 Qualitative Approach
The task analysis including a workload assessment aims to identify the effectiveness of the current staffing level and to identify the level of improvement resulting from additional staffing. A credible worst-case accident scenario should be analyzed to assess the relative effectiveness of at least two levels of RFFS staffing.

10.2.6 Quantitative Risk Assessment
This will generally be used to support the conclusions of the qualitative analysis by examining the risks to passengers and aircrew from aircraft accidents at the airport. This comparison of the risk allows the benefit of employing additional RFFS staff to be evaluated in terms of the risk reduction in passengers and aircrew lives saved. This could be expressed in monetary terms and may be compared with additional costs incurred in employing the additional personnel. However, this is of little, if any, value in determining minimum levels of personnel.

10.2.7 Task Analysis
The following items will assist in determining the basic contents of an analysis:

a) Description of aerodrome(s) including the number of runways
b) Promulgated RFFS Categories (Aeronautical Information Publication)
c) Response Time Criteria (Area, times & number of Fire Stations)
d) Current & future types of aircraft movements
e) Operational Hours
f) Current RFFS Structure & Establishment

g) Current Level of Personnel
h) Level of Supervision for each operational crew
i) RFFS Qualifications/Competence (Training Programme & Facilities)
j) Extraneous Duties (To include Domestic & First Aid Response)
k) Communications & RFFS Alerting system including Extraneous Duties
l) Appliances & Extinguishing Agents available
m) Specialist Equipment- Fast Rescue Craft, Hovercraft, Water Carrier, Hose Layer etc.
n) First Aid- Role Responsibility
o) Medical Facilities- Role Responsibility
p) Pre-Determined Attendance: Local Authority Services- Police, Fire & Ambulance etc.
q) Incident Task Analysis: Feasible Worst-Case Scenarios, Workload Assessment, and Human
Performance/Factors. To include: Mobilization, Deployment to Scene, Scene Management, Firefighting, Suppression & Extinguishment, Application of Complementary Agent(s), Post Fire Security/Control, Personnel Protective Equipment, Rescue Team(s), Aircraft Evacuation & Extinguishing Agent Replenishment. *Note: The aim is to identify any Pinch Points within the current workload and proposed workload.*
r) Appraisal of existing RFFS provision
s) Future requirements: Aerodrome development & expansion
t) Enclosures could include: Airport Maps, Event Trees to explain tasks & functions conducted by the RFFS etc.
u) Airport Emergency Plan and Procedures
Note: The above list is not exhaustive and should only act as a guide.

<u>Phase 1</u>

The airport operator must be clear as to the aims and objectives for the RFF services, and the required tasks that personnel are expected to carry out.

Table 10-1: Example for Phase 1

Aim:
To maintain a dedicated RFFS of qualified and competent fire and rescue personnel equipped with vehicles and specialist equipment to make an immediate response to an aircraft incident /accident on or in the immediate vicinity of the airport within the specified response time criteria.
Principal Objective of the RFFS:
The principal objective of an RFFS is to save lives in the event of an aircraft accident or incident. For this reason, the provision of means of dealing with an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome assumes primary importance because it is within this area that there are the greatest opportunities of saving lives. This must assume at all times the possibility of, and need for, extinguishing a fire that may occur either immediately following an aircraft accident or incident, or at any time during rescue operations.
Tasks:
a) Meet the required response time
b) Extinguish an external fire
c) Protect escape slides and exit routes
d) Assist in the self-evacuation of the aircraft
e) Create a survivable situation
f) Rescue trapped personnel

g) Maintain post fire security/control
h) Preserve evidence

Note: The above list is not exhaustive and all relevant tasks must be identified before moving to Phase 2. Each task/mission may include numerous functional activities/actions.

Phase 2

Identify a selection of representative realistic, feasible accidents that may occur at the airport, this can be achieved by a statistical analysis of previous accidents on airports and by analyzing data from both International National & Local sources.
Note: All incidents should involve fire to represent a feasible worst-case scenario that would require an RFFS response.

Table 10-2: Some Examples of realistic accidents

a) Aircraft engine failure on takeoff with a fire (aborted takeoff).
b) Aircraft aborts and overruns into the Runway End Safety Area (RESA) with fire on takeoff.
c) Aircraft into aircraft with fire (collision)
d) Aircraft into structure- terminal building(s) with a fire.
e) Aircraft leaves the runway on landing into the runway strip (full emergency evacuation).
f) Internal aircraft fire (Cabin fire, baggage hold, cargo hold, avionics bays).

Phase 3

Identify the types of aircraft commonly in use at the airport; this is important as the type of aircraft and its configuration has a direct bearing on the resources required in meeting Phase 1 above, it may be necessary to group the aircraft types in relation to common aircraft configurations for ease of analysis or identify precise aircraft type that may have a unique configuration.

Table 10-3: Example for types of aircrafts

a) Long wide-bodied aircraft with multiple passenger decks and multiple aisles.
b) Long narrow-bodied aircraft with single aisle, high passenger density.
c) Short narrow-bodied aircraft with single aisle, high passenger density.
d) Regional aircraft.
e) Short Takeoff and Landing (STOL) aircraft.

Phase 4

Every airport is unique in that the location, environment, runway and taxiway configuration, aircraft movements, airport infrastructure and boundary etc. may present specific additional risks.In order that the feasible accident scenario can be modeled/simulated, a major factor is to consider the probable location for the most realistic accident type that may occur.To confirm the location of the scenario it is important that a facilitator using a team of experienced fire service personnel, who have knowledge of the airport and the locations in which an aircraft accident is likely to occur evaluate the scenario.The role of the facilitator is to seek agreement in identifying the credible worst-case locations and by using a scoring system place these locations in order of relevance & priority. The team must determine why the locations have been identified and provide a rationale for each location. One methodology would be to award a weighted number, to each location, the total numbers can then be added up in relation to each identified location.

Table 10-4: An Example List of factors contributing to worst-case location

a) Response Time
b) Route to the accident site (on or off paved surfaces)
c) Terrain
d) Crossing procedures for active runway(s)
e) Aircraft congestion on route (taxiways)
f) Surface conditions
g) Communications
h) Supplementary water supplies
i) Adverse weather conditions- Low visibility Procedures
j) Daylight or darkness

An additional time delay for any of the factors listed above should be estimated and recorded & the location with the highest additional response time could be identified with the worst-case location.It is important to note that the location of an accident could have an impact on the resources and tasks that will be required to be carried out by ARFF personnel.From the above analysis a location or a number of locations could be identified, in agreement with the airport operator and the TRA facilitator.

Table 4-5: An Example List of worst-case locations

1. Taxiway Bravo: Runway Holding Position Bravo 1- leading onto Runway 06L
2. Runway 13- Runway & Service Road Crossing Point (Grid Reference A5)
3. Runway 28 Overrun RESA
4. Runway 24 Undershoot RESA
5. Aircraft Stand A33 (Alpha Apron)
6. Grid Reference A6 (Runway 06 Localiser Road)
7. Taxiway Alpha: Intermediate Taxi-Holding Position- A3
8. Aircraft Stand A5 (On taxilane).

Phase 5

This Phase combines the accident types to be examined as described in Phase 2, with the aircraft identified in Phase 3 and the locations as described in Phase 4. The accident types should be correlated with the possible location, in some cases this could be in more than one location on an airport, for which a task and resource analysis needs to be carried out. The above information is to be built into a complete accident scenario that can be analysed by experienced supervisors & firefighters for the task and resource analysis in Phase 6.

Table 5 Example of Accident Scenario

Scenario No. 1:

Accident Type: Aircraft Overrun into Runway 06 RESA- Phase 2.
Aircraft Identified: Boeing 747-400- Phase 3.
Accident Location: Runway 06 RESA- Phase 4.

The Boeing 747 400 is a wide-bodied multi-deck aircraft, its typical seating configuration can be 340 Economy, 23 Business, and 18 First Class passengers on the lower deck. On the upper deck provision is made for a further 32 Business Class passengers, giving an estimated aircraft seating capacity of 413 excluding the crew. The aircraft typically has 4 exits on both sides of the lower deck and one each side of the upper deck.

During the take-off phase the aircraft suffers a fire in the number 3 engine and the pilot decides to abort the take-off. During this phase the fire develops rapidly and impinges on the fuselage. The aircraft overruns the runway and comes to rest in the RESA. F light Deck Crew orders an evacuation.

The RFF services are informed by ATC and respond accordingly and the aerodrome emergency procedures are activated.

Phase 6

By using a TRA facilitator with teams of experienced airport supervisors & firefighters the accident scenario(s) developed in Phase 5 are subject to a task and resource analysis carried out in a series of tabletop exercises/simulations. When carrying out a task and resource analysis the principal objective should be to identify in real time and in sequential order the minimum number of RFF personnel required at any one time to achieve the following:

a) Receive the message and dispatch the RFF service (the dispatcher may have to respond as part of the minimum riding strength)
b) Respond utilizing communications, taking appropriate route and achieving the defined response criteria
c) Position appliances/vehicles in optimum positions and operate RFF appliances effectively
d) Use extinguishing agents and equipment accordingly
e) Instigate Incident Command Structure- Supervisors
f) Assist in passenger and crew self-evacuation
g) Access aircraft to carry out specific tasks if required, e.g., firefighting, rescue etc.
h) Support and sustain the deployment of firefighting and rescue equipment
i) Support and sustain the delivery of supplementary water supplies
j) Need to replenish foam supplies

The task and resource analysis should identify the optimum time when additional resources will be available to support/augment and/or replace resources supplied by RFF services (Aerodrome Emergency Plan). It can also provide vital evidence to support the level of RFF vehicles and equipment. In order to start a task and resource analysis the required category of the airport must be identified as required by the regulatory authority, this should confirm the minimum number of vehicles, and the minimum extinguishing agent requirements and discharge rates, this should also determine the minimum number of personnel required to functionally operate the vehicles & equipment.

The results of the analysis should be recorded in a table or spreadsheet format and should be laid out in a method that ensures that the following is recorded:

a) Receipt of message and dispatch of the RFF response
b) Time: This starts from the initial receipt of call and the time line continues in minutes & seconds until additional external resources arrive or the facilitator decides an end time
c) List of assessed tasks functions and priorities are achieved
d) The resources (personnel, vehicles and equipment) required for each task is defined
e) Comments to enable team members to record their findings
f) Identified Pinch points

Working Example of a Qualitative Task Resource Analysis- Scenario 1

Key to working example:

- Major Foam Tenders are identified as MFT A, B, C & D.
- Minimum numbers of personnel riding the MFTs are identified as: A1, A2, B1, B2 etc.

Major Foam Tenders:

- 4 MFTs carrying 11,00 Litres with a total water capacity of 44,000 Litres: (A, B, C & D)
- Minimum number of RFFS personnel: Total 14

Supervisors:

- Watch Commander: 1= A1
- Crew Commanders: 3= B1, C1 & D1

Firefighters:

- Total- 10.
- A2 & A3.
- B2 & B3.
- C2, C3, & C4.
- D2, D3, & D4.

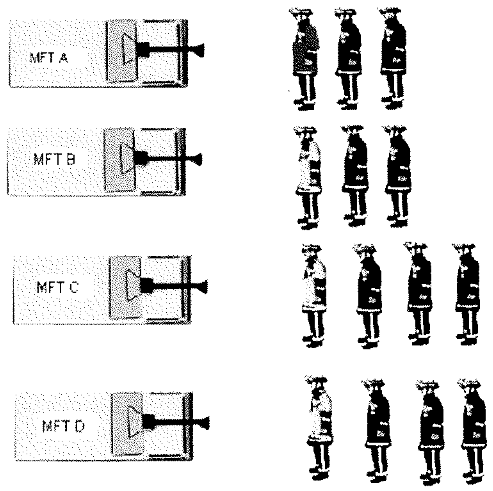

Figure 10-1: Personnel riding the MFTs

Note:

1. For this example, the RFFS is deployed from a single fire station at an airport with a single runway, designated 06-24.

2. Time has been defined in minutes and seconds.

3. For this TRA, the dispatcher is outside of the minimum number of ARFF personnel.

Stated objectives for the RFFS:

a) Instigate aerodrome emergency plan
b) Respond within the required response time
c) Select appropriate route & communications
g) Position appliances in optimum positions and operate effectively
h) Instigate Incident Command System
d) Suppress/extinguish any fires
e) Assist with self-evacuation of the aircraft
f) If appropriate extinguish any internal fire
g) If required ventilate aircraft to create survivable conditions
h) Maintain post fire control of the critical area
i) Preserve evidence

Table 10-7: Example of Task Resource Analysis

TIME	TASKS	RESOURCES	COMMENTS
00.00	Call received from ATC as aircraft accident runway 06 RESA. Boeing 747-400.	Dispatcher	Achieved
00.00	ARFF personnel mobilized by dispatcher.	Dispatcher	Achieved
00.15	Call made to operate the airport emergency plan.	ATC/Dispatcher/Operations Unit.	Achieved- ATC
00.30	Personnel donning in appropriate PPE.	Minimum riding strength	Achieved
00.40	Route selected & all appliances mobile en-route to 06 RESA.	MFTs A, B, C, & D.	Achieved- Supervisors & Drivers.
00.50	Supervisor(s) utilize appropriate communications (RTF): Discreet frequency, ATC, Local Authority etc.	Supervisor(s)	Achieved Note: Aircraft may have already instigated evacuation (Air Crew)
02.00	All appliances in position: Priority identified by Supervisor(s) to extinguish ground pool fire and fire in number 3 engine that is impinging on fuselage. A1 instigates ICS	Supervisors & Drivers. MFTs A, B, C & D. A1 Supervisor B1 Supervisor C1 Supervisor D1 Supervisor	Achieved A, B & C deploy monitors
02.15	Create and maintain survivable conditions for the passengers to reach a place of safety. Complementary agent required. D1 is Supervisor. D2 is Pump Operator. Breathing Apparatus Entry Control Officer (BAECO).	A2 A3 B1 B2 B3 C1 C2 C3 D1 D2 D3 deploy, use complementary agent donned in RPE. D4	
03.15	All external fires extinguished.	MFTs A, B, C, & D. All Crewmembers.	Achieved.
03.20	Assist with self-evacuation, and maintain survivable conditions for the passengers to reach a place of safety.	MFTs A B. B1 A2 A3 B2 B3	Achieved: Hand lines deployed accordingly
03.20	Crew prepares to enter aircraft in RPE.	MFT D D1 D3 & D2 (Pump)	Achieved D1 D3 Briefed by BAECO.

TIME	TASKS	RESOURCES	COMMENTS
03.20	Crew prepares appropriate entry point and hand line.	C1 C2 C3 C4	Achieved by use of: Specialist Vehicle/Equipment/ Ladder.
	Note: MFT A maintains post fire control.	A2 A3	Achieved
03.55	Crew enters aircraft in RPE with hand line. (BAECO).	D1 D3 D4.	Achieved
	Ladder made safe for internal crew.	C4	Achieved
	Crews assist with hand line for BA entry team	B2 B3	Achieved
04.15	Following self-evacuation of aircraft provide assistance with mustering passengers and crew to place of safety.	C1 C2 C3.	Achieved. Assistance provided by aircraft crew and additional responders from airport in accordance with the emergency procedures.
04.15	A2 remains as Monitor/Turret operator, and provides escape route protection.	MFT A	Achieved
04.30	Supervisor A1 liaises with ATC, Rendezvous Point Officer & arriving emergency services to ensure appropriate resources are brought forward to the accident site/location.	A1	Achieved
04.50	Supervisor A1 instructs Airside Operations to assist in containing exiting passengers and crew and obtaining a head count of survivors.	A1	Achieved
04.55	D1 reports 20 survivors still on board aircraft require medical aid and assistance. There is no smoke in cabin or flight deck areas and survivors are having no difficulty with breathing.	D1 A1	Achieved
05.05	External emergency services are brought forward to the accident site with additional equipment to support the removal of the remaining survivors and to transport the survivors to the appropriate safety zone.	A1 & external commanders: • Police • Fire • Ambulance • Medical	Achieved

TIME	TASKS	RESOURCES	COMMENTS
	Additional Points		
	Note 1: At this point the airport emergency plan is fully instigated and the supporting services can relieve D1 D3, provide supplementary water if required from the nearest hydrant or emergency water supply, assist in the deployment of specialist fire ground equipment and if required support the teams that are engaged in removing the survivors to a place of safety.		
	Note 2: The facilitator may decide to terminate the analysis at this point or continue with the exercise to evaluate specific elements of the emergency plan. e.g., Preservation of Evidence.		

Notes:

a) It can be seen that ten firefighters and four supervisors including the officer in charge are required to achieve the above supported by four Major Foam Tenders.

b) The time line can be further verified by the use of practical exercises & individual analysis to establish if the times are realistic and achievable for each task and function.

c) Each of the above tasks can be sub-divided into individual functions associated with the specific task performed at a particular time.

Table 6 Timeline Assessment for Personnel: Firefighters and Supervisors

Task Time	A1	A2	A3	B1	B2	B3	C1	C2	C3	C4	D1	D2	D3	D4
00.00														
00.15														
00.30														
00.40	A1	A2	A3	B1	B2	B3	C1	C2	C3	C4	D1	D2	D3	D4
00.50														
02.00	A1			B1			C1				D1			
02.15		A2	A3	B1	B2	B3	C1	C2	C3		D1	D2	D3	D4
03.15														
03.20		A2	A3	B1	B2	B3	C1	C2	C3	C4	D1	D2	D3	
03.20														
03.20		A2	A3											
03.55					B2	B3				C4	D1		D3	
04.15							C1	C2	C3					
04.15														
04.30	A1													
04.50	A1													
04.55	A1										D1			
05.55	A1													

This Table gives an indication of the time line from the above analysis and can be utilized to verify an individual task, function or identify "Pinch Points" ensuring each task is achievable effectively within the time line.

Notes:
From the above Table it can be seen that a potential Pinch Point exists with Firefighters A2 & A3. However, the tasks that they are performing are achievable as A2 & A3 are already utilizing a foam hand line to maintain the evacuation route and maintaining Post Fire Control. This is considered logical and an achievable process for this crew.

Conclusion

A task analysis can be as detailed as necessary. The aim is to itemise the knowledge and practical skills involved in carrying out the task or function effectively and to the correct standard of competence based on a qualitative analysis. Having gathered the appropriate data and agreed the outcome, the TRA should enable an RFFS to confirm and subsequently provide the correct level of vehicles, equipment and personnel. It would also enable the RFFS to develop a training specification and a learning programme can then be designed around role and task. When planning a TRA, the following questions are to be asked:

a) What is done?
b) Why is it done?
c) When is it done?
d) Where is it done?
e) How is it done?
f) Who does it?

It is often difficult to assess the overall effectiveness of a complete unit by observation only. However, observation/demonstration does allow you to assess the effectiveness of individual units and any element(s) of the emergency arrangements. Documentary evidence relating to previous accidents or exercises may also assist in establishing if the current RFFS is staffed at an appropriate level. The overall objective is to be satisfied that the RFFS is organized, equipped, staffed, trained and operated to ensure the most rapid deployment of facilities to maximum effect in the event of an accident. The above process can also be used to identify equipment shortages and training needs for personnel required to deal with identified tasks.

CHAPTER 11. Emergency Organization

11.1 Airport Emergency Plan

Airports should establish an emergency plan to deal with aircraft emergency situations. The plan should include a set of instructions dealing with the arrangements designed to meet emergency conditions and steps should be taken to see that the provisions of the instructions are periodically tested. In responding to aircraft and airport emergencies including fire emergencies, Airport Rescue and Firefighting Services should follow Airport Emergency Plan(AEP) of the concerned airport.

Airports should prepare detailed grid map(s) for locating any accident site in minimum time. It is recommended that two grid maps be prepared: one map depicting confines of airport access roads, location of water supplies, rendezvous points, staging areas, highways, difficult terrain etc. (example in Figure 11-1), and the other of surrounding communities depicting medical facilities, access roads, rendezvous points etc. within a distance of approximately 8 km from the centre of the airport (example in Figure 11-2). The grids in the two maps should not conflict and must be easily identifiable. Copies of the map(s) should be maintained at the air traffic control tower, the airport operations office, the airport fire station, the fire watch tower, local police stations, local hospitals, local fire stations, and other similar emergency and information centres in the area. Copies of map(s) should also be available on all RFF vehicles and other supporting vehicles in the airport. Instruction classes on the use of such maps should be held periodically.

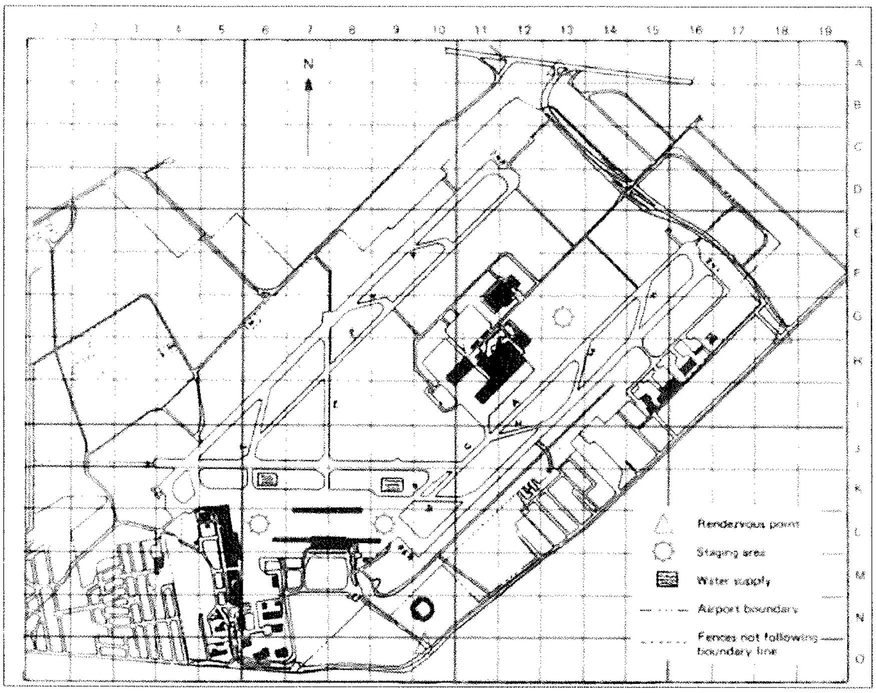

Figure 11-1: Sample Grid Map: Airport

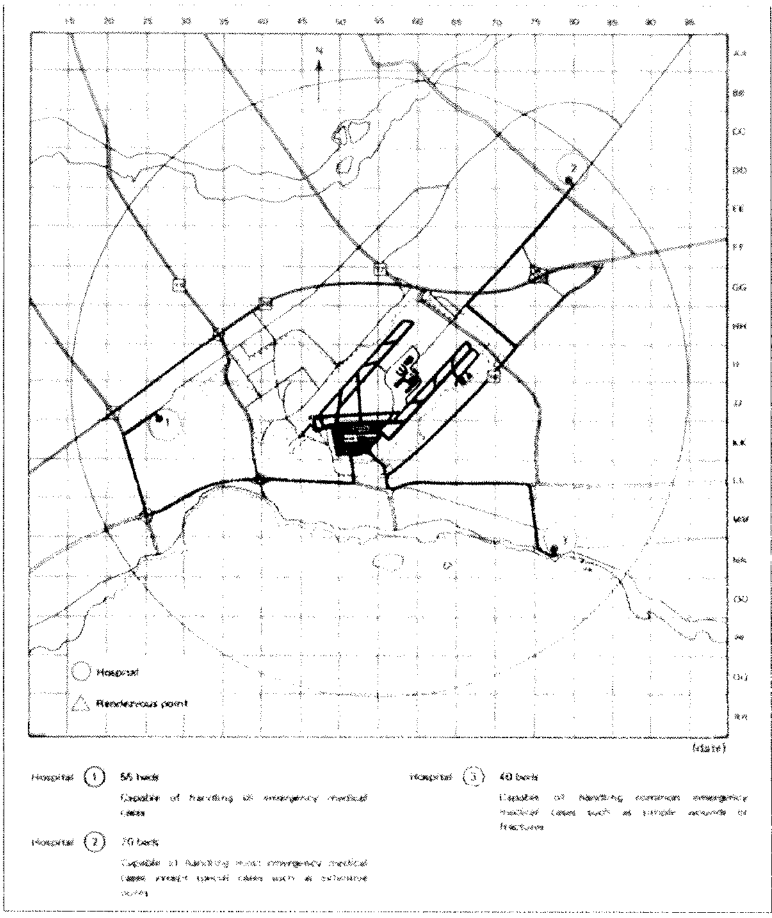

Figure 11-2: Sample Grid Map: Airport Vicinity

11.2 Types of Emergency Situation

ALERT – 1, Aircraft Accident (On Airport)

ALERT – 2, Aircraft Accident (Off Airport)

ALERT – 3, Full Emergency (Airborne Aircraft)

ALERT – 4, Unlawful Interference

ALERT – 5, Bomb Threat – to Aircraft

ALERT – 6, Bomb Threat – to Building

ALERT – 7, Ground Incident

ALERT – 8, Structural Fire

ALERT – 9, Local Stand by

ALERT – 10, Weather Stand by

ALERT – 11, Natural Disaster

ALERT – 12, Public Health and Medical Emergency

ALERT – 13, Chemical, Biological, Radiological, Nuclear and Hazardous Materials Emergencies

11.3 Aircraft Emergency for which Services may be Required

Aircraft emergencies for which services may be required can be classified as:

a) *aircraft accident* — an aircraft accident which has occurred on or in the vicinity of the airport;
b) *full emergency* — to be instituted when it is known that an aircraft approaching the airport is, or is suspected to be, in such trouble that there is danger of an accident; and
c) *local standby* — to be instituted when an aircraft approaching the airport is known or is suspected to have developed some defect but the problem is not such as would normally involve any serious difficulty in effecting a safe landing. This includes bomb threats and other incidents.

11.3.1 Aircraft accident

Notify the RFF service, providing information on the location of the accident and all other essential details. These details should as a minimum include:

- type of aircraft;
- type of accident/incident; and
- time and (grid) location of the accident/incident.

Subsequent calls may expand this information by providing details on the number of occupants, fuel on board, aircraft operator, if appropriate, and any dangerous goods on board, including quantity and location, if known.
Initiate the calling of the police and security services and the aerodrome authority in accordance with the procedure in the airport emergency plan, giving grid map reference, rendezvous point and/or staging area and, where necessary, airport entrance to be used.

11.3.2 Full emergency

Notify the ARFF service, if applicable, to stand by at the predetermined standby positions. These details should ideally include:

- type of accident/incident;
- type of aircraft;
- fuel on board;
- number of occupants, including special occupants: handicapped, immobilized, blind, deaf;
- nature of trouble;
- runway to be used;
- estimated time of landing;
- any dangerous goods on board, including quantity and location, if known.

Initiate the calling of the mutual aid/responding agencies in accordance with the procedure laid down in the airport emergency plan, giving where necessary the rendezvous point and airport entrance to be used.

11.3.3 Local standby.

Call the ARFF service to stand by, if applicable, at the predetermined standby positions. Provide all essential details. These details should be included:

- type of accident/incident;
- type of aircraft;
- fuel on board;
- number of occupants, including special occupants - handicapped, immobilized, blind, deaf;
- runway to be used;
- estimated time of landing;
- aircraft operator, if appropriate; and
- any dangerous goods on board, including quantity and location, if known.

The responsibility on the scene for dealing with the emergency rests with the ARFF service charge who is normally responsible for assuring that there is no further need for the ARFF service before returning to the station. Should another emergency occur before the previous one is finally dealt with, the air traffic control officer may be responsible for notifying the ARFF service so that redeployment of resources can be made, and for all other action as set out for each type of emergency.

Air traffic control, where available, should have facilities to maintain continuous communication with as well as to inform the officer-in-charge of the ARFF service of last-minute changes in the distressed aircraft's flight plan or emergency conditions existing. When advised of the situation, aid to the extent needed or judged desirable should be put into effect by the officer-in-charge of the ARFF service. Air traffic control should then notify the pilot of the aircraft in distress of the precautionary action being taken at the airport.

11.3.4 Collection Area and Triage Area

Location of collection area and medical triage area depend upon the site of accident/incident. Collection area will be established by RFFS. Casualties from accident site will be transferred by RFF personnel in the collection area. This area should be safe for casualties. The triage area should be located at least 90 m upwind of the accident site to avoid possible exposure to fire and smoke. If necessary, more than one triage area may be established.

There should be a care are according to the priority base. A transportation area should be established for the recording, dispatching and evacuation of survivors. This area should be located between the care area and the egress road.

Fire Chief/Senior fire office of rescue and firefighting service in coordination with medical team and security agencies shall establish medical triage area and care area as required.

CHAPTER 12. Aircraft Firefighting and Rescue Procedures

12.1 Features Common to All Emergencies

Upon notification from air traffic control announcing an aircraft emergency, the required equipment is dispatched to the scene of the accident or to the predetermined standby positions. Once the call has been received, all subsequent ARFF action will be the responsibility of the airport ARFF service chief.

Response by ARFF equipment to off-aerodrome accident(s) should be done in accordance with airport emergency plan (Alert-2) and existing mutual aid agreement(s). Communication should be maintained between ARFF vehicles, the fire station and air traffic control. Wherever possible, mutual aid resources should monitor predetermined frequencies.

All the operational activities should be carried out under the command, control and supervision of shift in-charge, whereas overall command remains with the chief of fire station.

12.2 Emergency Response Procedures

12.2.1 Common features to all emergencies

Following factors and conditions are some common elements applicable to all types of emergency situation:

- Constant observation of all flights and apron activities by airport fire station watchtower.
- Observation of taxiing of aircraft, ground observation of engines
- Availability of access routes
- Effect of weather conditions as a possible restriction on movement of emergency vehicle
- On receipt of information from control tower announcing an aircraft emergency the required equipment shall be dispatched to the scene of the accident or incident to the determined sand-by positions applicable to the runway.
- If the information is received other than ATS Tower, in that case ATS tower must be informed and verification of information is necessary.
- Rescue and firefighting vehicles shall be positioned to provide the best possible coverage of the potential crash area.
- For emergencies involving gear malfunctioning and tire difficulty, there is possibility of aircraft veering off the runway and possibility of hitting the emergency equipment. In that case as precaution emergency equipment are to be located in touch down point.
- Broken fuel, hydraulic fluid, alcohol and oil lines should be plugged or crimped when possible to reduce the amount of spill and extent of fire.
- Use of aircraft windows for rescuing an dventilation

12.2.2 Aircraft Fire Classification

For the effectively responding and extinguishing the aircraft fire, some aircraft fire has been classified as follows: -

i. Class A fires:

Fires involving cargo, upholstery and similar solid combustibles are Class A fire which requires cooling and quenching for extinguishing. If no flammable liquids are involved, water preferably water fog can be used.

ii. Hot breaks and wheel fires:

Heating of aircraft wheels and tires presents a potential explosion hazard greatly increased when fire is present. Extra precaution should be taken to be protected from these dangers. Normally hot breaks will be cooled down themselves without using extinguishing agents. Fire fighters should approach the wheels with extreme precaution, never from the side in line with the axle.

If extinguishing agents is required to be applied, then apply it in area to the break from wheel

iii. Rocket engine fires:

I fire surrounds around the engine of an aircraft equipped with rocket engine, precaution should be taken I approaching the area. No attempt should be made to extinguish the engine if they should ignite. Water or foam may be used effectively to control the fire around the rocket motors, but they cannot be extinguished because of theself-containedoxidizerinthepropellant.Theyburnveryintenselyforashortduration, however they will normally not contribute significantly to the damage, since their chambers are so well insulated that it takes several minutes of very intense heat to ignite them. This heat will normally have done irreparable damage or caused fatalities before ignition of the rocket engines occurs.

I fire does not occur; igniters and ignition cables should be removed from unexpended rocket engines on the crashed aircraft as soon as possible to reduce the possibility of inadvertent ignition from stray voltage entering the ignition wiring

iv. Confined engine fires(piston):

If engine fire confined within the nacelle cannot be controlled by the aircraft extinguishing system, dry chemical powder or halon should be applied first as these agents are more effective than water or foam inside the nacelle. Foam or water should be used externally to keep adjacent aircraft structure cool. The propellers should never be touched even when at rest.

v. Confined turbine engine fires(jet):

From the viewpoint of aircraft evacuation and other safety consideration the best way of controlling the fire confined to the combustion chambers of turbine engines, if the flight crew is in a position to keep the engine turning over. Fire fighters shall stand clear of the exhaust but may have to protect combustibles from exhaust flames.

Fire outside the combustion chambers of turbine engines and confined within the nacelle is best controlled with the aircraft built-in extinguishing system. If the fire persists after the built-in system has been expended and the turbine is shut down, halon or dry chemical may be used to extinguish the fire.

Foam should not be used in the intake or exhaust of turbine engines unless fire is not extinguished by using other agents and appears to be danger of spreading. Foam or water spray should be used externally to keep adjacent aircraft structure cool.

RFF Personnel should stay at least 7.5 meters away from the intake of an operating turbine engine to avoid being sucked in, and 45 meters away from the rear to avoid being burned from the blast.

vi. Titanium fires:

If titanium parts of aircraft are ignited, fire cannot be extinguished with the use of conventional agents available to aircraft rescue and firefighting crews. If these fires are contained within the nacelle, it should be possible to allow to burn out without seriously threatening the aircraft itself as long as there are no external flammable vapor air mixtures which could be ignited by the flames or hot engine surface; and foam or water spray is available to maintain the integrity of the nacelle and surrounding exposed aircraft structures.

vii. Fire situation involving rear mounted aircraft engines:

Problem may arise in extinguishing the fire of aircraft engine which is mounted on the rear fuselage associated with vertical stabilizer, because of the height of the engine above ground level. In this case provision of ladders, elevated working platforms and extensible applicators for delivering suitable extinguishing agents may be required.

viii. Magnesium fires:

- Use extinguishing agents specifically designed for flammable metal fires.
- Apply large volume of coarse water stream if large mass of magnesium is involved.
- Attack of water stream is undesirable where the primary fire control technique is with foam as the water stream would damage the foam blanket.

12.3 Rescue Tactics and Associated Equipment Requirements

12.3.1 Rescue Tactics

i. First Phase:

- Identify the task to be performed
- Activities outside the aircraft may include: -Firefighting, blanketing of fuel of wetted areas adjacent to the aircraft, assistance in the effective use of emergency escape equipment deployed from the aircraft and the provision of lighting to expedite the evacuation.
- Entry to the aircraft should not be made by any route used by escaping occupants during evacuation.
- Rescue of all aircraft occupants may be considered as the primary objective; the overall requirements is to create conditions in which survival is possible and in which rescue operations may be conducted. For this reason, it may be essential to commence firefighting before attempting rescue any one of the occupants.
- It should also be considered that evacuation from the aircraft and any operation within fuselage may not be conducted effectively if fire situation exists in fuselage.

ii. Second Phase:

- Arrangements shall be made to provide personnel and the equipment to rescue those occupants who are unable to make their escape without assistance.
- Maintain fire security inside and outside the aircraft which may entail the periodic restoration of the foam blanket on any fuel wetted areas.
- Delivery of air within the fuselage may be required to provide a repairable atmosphere and for the provision of localized fire protection to rescue operations involving the use of hand or powered tools.

iii. Third Phase (Fire Protection and Maintenance of Fire Safety):

Rescue and Firefighting must be taken together even if there is no initial fire, possibility of a sudden and disastrous outbreak cannot be ignored. Following precautions should be taken:

- Blanketing of fuel wetted areas.
- Protection must be available when opening doors and windows of aircraft for entry or evacuation purpose to guard against the ingress of fire and to maintain escape paths if there is a sudden outbreak.

iv. Ensuring the extinguishing Agents:

- Primary requirement is to ensure the availability of adequate quantity of highly efficient firefighting agent and from the current range of foams, dry chemical powder and halogenated hydrocarbons, foam is most suitable.
- Number of crew in first vehicle should be sufficient to ensure the operation of the firefighting or fire suppression equipment and to provide some assistance at escape slides or other exit routes if evacuation is inprogress.
- After arrival of other vehicle, the crew of the first vehicle will become available to assist in other duties as demanded by the existing situation.
- After the major fire situation has been controlled or critical area around the occupied portion of the aircraft has been secured, it is essential fire rescue team, each team consisting of two persons to assist occupants from the aircraft, to provide firefighting equipment within the aircraft capable of extinguishing or cooling cabin trim and furnishing materials which nay have become involved as well as to provide lighting and ventilation equipment within the aircraft.

v. Post-Accident Ventilation:

After the fire inside aircraft cabin has been controlled, aircraft cabin may be filled up with smoke, it is necessary to create serviceable environment within the cabin. For this, effective ventilation is essential to create serviceable environment. Whenever ventilation is introduced, there will be the risk of promoting fire in any smouldering materials within the aircraft or at any point external to the aircraft where there is an accelerated airflow. Personnel equipped with charged hose lines terminating in hand-controlled water-spray nozzles must be available to meet any sudden outbreak of fire.

vi. Mechanically-induced Ventilation:

The limitations of natural ventilation are that there may be smouldering materials outside the aircraft on the upwind side which will contaminate the air flow to the aircraft. A similar situation may arise where there are fuel-contaminated surfaces on the upwind side or where concurrent fire suppression activities are employing dry chemical powder or vaporizing liquid agents. Mechanically-induced ventilation can overcome these problems in most cases. A suitably designed unit can be sited at a point where it receives clean air which is then delivered to the aircraft. Portable fans (smoke ejectors) may be carried on RFF vehicles. There are several types of equipment which may be used for mechanically induced ventilation, including exhaust or eject or devices, some driven by electric motors or gasoline-powered engines. Some of these have to be suspended in doorways or at windows by means of an adjustable bar.

vii. Rescue Equipment Requirements:

- Adequate quantity of highly efficient firefighting agents preferably a foam
- Lighting equipment – operated by portable generator, flood lights, smaller lighting equipment.
- Power Operated tools –Rotary saw, other cutting devices,
- Hand tools- wire and bolt cutters, screw drivers, crowbars, hammers, axes
- Forcing Equipment- hydraulic operated for bending and lifting operations

which may be tubular shaft.

- Respiratory equipment- breathing apparatus
- Communications equipment- radiotelephone units, loud speakers,hand-held megaphones for crowd control
- Miscellaneous items- wedges, plugs for fuel lines, shovels, grab-hook or pike pole, ladders, etc.
- Equipment capable of delivering water spray within aircraft fuselage.
- Equipment capable of delivering a fresh air supply probably by means of powered fan unit.
- Medical first kits, Stretchers, Spine boards, foil blankets, carrying sheet setc.

viii. Coordination with flight crew:

An effective coordination and understanding between flight crew and RFF personnel is necessary to reduce confusion on the part of all personnel concerned and their role in the handling of aircraft accidents or incidents on or near an airport.

It is important that both flight crew members and RFF personnel must be aware with each other's duties and responsibilities in case of emergencies.

Role and responsibilities of flight crew members in emergencies:

- Pilot in command is responsible to declare an emergency, its type or alert number in accordance to AEP (for the purpose determining the necessity of firefighting service, PIC also to indicate the nature of emergency such as power plant fire, bomb threat, cabin fire, and plan of coping with incident
- Each of the pilots is familiar with the regulations and procedures of the airports to be used.
- Flight crew should be trained and be aware with their duties in to perform in cases of an aircraft accident or incident including emergency evacuation of aircraft occupants and directing them to a safe distance from the scene of the accident or incident. (Flight crew are responsible to make the final determination to evacuate from the aircraft and the manner in which the evacuation shall be carried out)
- Maintain personnel contact with ARFF personnel.
- Be aware in case of fire following an accident or incident is of the dangers associated with the indiscriminate opening of doors or emergency exits which might permit entry into the fuselage of flames or noxious fumes or which might promote the progress of the fire to other parts of the aircraft,
- Ensure the availability of emergency equipment such as emergency evacuation slides and ropes and be aware to use this equipment. Also make sure the availability of lightweight steps or stairs as these are often required where the aircraft equipment has failed to operate or evacuation from the leading edge of the wing is necessary

Role of RFF Personnel:

- RFF personnel should not disturb aircraft evacuation slides in use unless they have been damaged by use or fire exposure.
- RFF personnel should stand by at the foot of the slides to aid exiting persons to their feet and direct them to a safe distance from the scene.
- Provide assistance to evacuees using over viewing exits for evacuation will

normally slide off the rear edge of the wing or down the wing flaps to prevent leg injuries and direct them to a safe distance from the scene.

- Establish direct contact with flight crew members for the coordination of better evacuation procedures. Two-way radio equipment is preferred to use forcontact.
- Assist crew members in any way possible
- Since crew member visibility is restricted, RFF personnel should make immediate appraisal of the external portion of the aircraft and report unusual condition to crew members.

ix. Communication:

To establish an effective coordination between fight crew members and RFF personnel, communication equipment such as radios and intercoms should be made available. In some situations, the RFF personnel in charge may need to report to the left side of the aircraft nose and establish direct voice communication with the pilot or flight crew using portable voice amplifiers. It may also be necessary to use hand and arm signals to relay information.

x. Aircraft fire warnings:

Since it is often impossible for the crew members to make an accurate appraisal of aircraft fire warning indicators, it is advisable to bring the aircraft to a complete stop and allow the RFF personnel to inspect the area involved, prior to parking This inspection can usually be greatly enhanced by the use of thermal imaging equipment without having to open aircraft compartment doors.

xi. Engines running:

It may be necessary to keep at least one engine operating after the aircraft has come to a stop in order to provide lighting and communications aboard the aircraft. This will hamper rescue operations to some extent and consideration should be given to this problem. On reciprocating and turbo-propeller engines extreme care must be exercised by personnel on the ground to remain clear of the propeller arc. On turbo-jet engines extreme care must be exercised in the immediate area ahead and for a considerable distance behind the engine.

xii. Evacuation:

Most engines, wheel assembly, and other minor exterior emergencies, can be controlled by RFF personnel without threatening the aircraft occupants' safety and hence, evacuation may be unnecessary at times causing additional risk of injury to the evacuees. The Pilot in command should communicate with RFF personnel on the situation at hand and take the final call regarding the need for evacuation.

Nearly all aircraft are equipped with emergency evacuation equipment and the crew members should be competent in the use of this equipment. Some of the RFF personnel carry emergency aircraft evacuation stairs and, in such cases, the crew members should be informed of the availability of these stairs. Where evacuation slides are in use, they should not be disturbed unless they are damaged. If they have not been activated, or if they have been damaged, evacuation stairs should be placed in use. These stairs could also prove beneficial in evacuation off wing surfaces where the distance from the wing to the ground is excessive. Normal evacuation routes may include both over wing window exits and available doors. The use of over wing exits presents hazards if the aircraft is in the normal position with gear extended or collapsed. The distance to the ground from the wing surfaces may be excessive and cause serious injury to the evacuees. Leading edge wing evacuation should be considered where fire may block the normal evacuation off the trailing edge of the wings. It is recommended that only the aircraft doors equipped with stairs or slides be used where immediate life safety is not a factor.

12.4 Accident involving Dangerous Goods

Both the passengers and the cargo flights may carry dangerous goods, which are marked and packed in accordance to the requirements of *Dangerous Goods Handling Requirements* and *Technical Instruction for the Transportation of Dangerous Goods by Air* (Doc 9284). These dangerous goods are classified in the following nine classes reflecting the type of hazard they present:

Class 1	Explosives
Class 2	Gases: compressed, liquefied dissolved under pressure or deeply refrigerated
Class 3	Flammable liquids
Class 4	Flammable solids: Substances liable to spontaneous combustion, substances which in contact with water, emit flammable gases.
Class 5	Oxidizing substances; organic peroxides
Class 6	Poisonous (toxic) and infectious substances
Class 7	Radio active materials
Class 8	Corrosives
Class 9	Miscellaneous dangerous goods; that is articles or substances which during air transport present a danger not covered by other classes. Examples: magnetized materials; acetaldehyde ammonia; expandable polystyrene beads.

Communication of hazards presented by dangerous goods:

Packages of dangerous goods are required to be marked with the "proper shipping name" of the dangerous goods, as listed in *Technical Instruction (Doc 9284)*, and with the corresponding 4-digit "United Nations (UN) Number", used to identify the substance. The package is also required to bear one or more hazard labels in the form of 100 mm x 100 mm square with a distinctive symbol and colour.

When transport of dangerous goods is requested, the shipper must provide the operator with required transport document which contains information such as the proper shipping name, hazard class or division number, UN number, and subsidiary risk of the goods. From such document, the operator should prepare a notification to Pilot-in-command that provides the information on the hazards of the dangerous goods aboard as well as the location in the aircraft where the dangerous goods have been loaded. Such notification must be provided before departure and must be readily available in flight.

In case if emergency occurs in flight, Pilot-in-command (PIC) should inform the appropriate air traffic services unit for the information to RFF services of any dangerous goods on board. If situation permits,the information provided should include the class, type and quantity of dangerous goods as well as the location where they are stowed aboard the aircraft. If situation does not permit PIC to furnish all the details, these details shall be obtained from concerned airlines ground personnel.

Emergency actions:

Firefighting personnel should determine the extinguishing agent to be used in depending on the respective nature of dangerous goods. Firefighting personnel should wear protective clothing including breathing apparatus. As far as possible, ARFF personnel should stay upwards, out of smoke, fumes and dust. ARFF personnel should take following precautions to respond fire associated with following classes of dangerous goods:

- Explosives: This division only refers to the explosive articles or substances which present no significant hazard in the event of accidental ignition or initiation during transport (i.e., explosives classed in Division 1.4, compatibility group "S"). If situation permits, effort should be made to obtain the information about the classification of explosives aboard the aircraft, since in certain cases explosives of other than Division 1.4 which could pose a risk of mass detonation in a fire may be carried under an exemption.
- Gases: The risk of failure of gas cylinders allowed to be carried as cargo would be no greater than that posed by oxygen cylinders typically installed in aircraft. They pose a significant risk only if they rupture or are exposed to direct fire contact.
- Flammable Liquids: Typically, flammable liquids will cause bigger fire than flammable gases as they are more concentrated. Methods used to extinguish fires involving jet fuel can be similarly used for flammable liquid.
- Flammable Solids: Most of these materials may react violently with water or air, ARFF personnel must be cautious when using water as an extinguishing agent.
- Oxidizing Substances, Organic Peroxides: These substances can be sensitive to heat, shock, impact or friction, react dangerously with other substances, i.e., may cause an explosion when mixed with jet fuel.
- Poisonous (toxic) and Infectious Substances: If these substances are present at the scene of fire, the firefighting activities should be conducted from as maximum distance as possible as it is more of a health hazard than a fire hazard. Food or drinking water which may have come into contact with poisons or other infectious substances should not be used. Public health and veterinary authorities should be notified. Any person exposed to these dangerous should be removed from the scene of the occurrence and transported for decontamination as soon as possible to medical facilities.
- Radioactive Materials: Foam, water or chemicals used to suppress fire, air current and fire itself can spread radioactive materials around the site. RFF personnel should wear utilize suitable personal protective equipment (PPE)and receive appropriate level of decontamination immediately after their duties are completed. Injured persons should be wrapped in blankets or coverings and immediately transported to medical facilities and medical personnel including ambulance drivers or attendants should be informed that the injured persons may be radioactively contaminated. Military authority should be notified immediately as they may be able to respond with a radiological team.

- Corrosives: PPE should be worn by all RFF personnel when these substances are presented at the scene of fire as these substances can damage living tissues severely.
- Miscellaneous Dangerous Goods: This comprises of substances and articles which present a danger not covered by other classes.
- Spills and Leaks: Dangerous goods if damaged by aircraft fire or leaking on accident site may pose a risk or injury or adverse health effects to aircraft occupants and ARFF personnel. Once initial rescue operations are completed, special precautions should be taken with packages containing such goods and if possible, pre-identified trained personnel should be assembled to deal with the problems involved.

Chemical, biological and radioactive threats (unknown substances):

For scenarios where unknown dangerous goods or substances are unlawfully released in an aircraft or within aerodrome premises, ARFF services may want to equip their personnel with equipment to detect the nature of such substances along with training to personnel to operate such equipment. These include chemical, biological or radioactive detectors.

CHAPTER 13. Rescue Operation in Difficult Environments

13.1 Rescue Operation

- At airports where a significant proportion of aircraft arrivals and departures takes place near swampy areas or other forms of difficult terrain in the immediate vicinity of the airport and where conventional ARFF vehicles may not be capable of an effective response, the aerodrome operator should ensure the availability of special procedures and equipment to deal with incidents or accidents which may occur in these areas. These facilities need not be located on, or be provided by, the airport if they can be made immediately available by off-airport agencies as part of the airport emergency plan. In all cases, the aerodrome operator should determine and specify in advance the response area for which it undertakes to provide a rescue service.
- In producing its detailed plan, the aerodrome operator should have regard to the services and facilities already provided by the search and rescue organization in accordance with 4.2.1 of CAR-12 Search and Rescue, to ensure that the separate responsibilities for an aircraft accident in the vicinity of the airport are clearly delineated. All operations, and any exercises conducted to test operational efficiency, should involve the relevant rescue coordination centre, to ensure the effective mobilization of all resources.
- The objectives of each operation should be to create conditions in which survival is possible and from which the total rescue operation can succeed. This concept anticipates that the initial, rapid response attendance may have to provide a preliminary level of succour while awaiting the arrival of a larger rescue force. The first stage would have as its objective the removal of immediate hazards to survivors, their protection, including the first-aid treatment of injuries, and the use of communications equipment to identify the locations to which additional rescue forces must respond. The emphasis will be on rescue and need not include any firefighting capability.
- If a fire situation has occurred in the impact stage of an accident, the inevitably extended response times of the first vehicles are likely to preclude effective firefighting operations. The scale of provision of rescue equipment should be related to the capacities of the larger aircraft using the airport.
- The types of difficult terrain for which special rescue facilities may be required include:

  a) Rivers or large bodies of water adjacent to the airport;

  b) swamps or other similar surfaces, including the estuaries of tidal rivers;

  c) mountainous areas; and

  d) locations which are subject to heavy seasonal snowfalls.

- The equipment to be deployed in effecting a rescue operation will vary with the environment in which the operation is to be conducted. The training required by the personnel delegated to these duties will similarly reflect the terrain conditions. In all situations the basic equipment may include:

a) communications equipment, which may include equipment for visual signals. Ideally the use of a transmitter on the distress frequency will provide a link with air traffic control and the emergency operations centre;

b) navigation aids;

c) medical first-aid equipment;

d) life-support equipment, including life-jackets, shelter, foil blankets and drinking water;

e) lighting equipment; and

f) lines, boat hooks, megaphones and tools, e.g. wire cutters and harness knives

- The types of vehicle available for rescue operations in difficult terrain will include:

a) helicopters;

b) hovercraft;

c) boats, of a number of types and capacities;

d) amphibious vehicles;

e) tracked vehicles; and

f) all-terrain vehicles, including those employing ground-effect to minimize wheel-loadings.

National Civil Aviation Security Programme (NCASP) of Nepal and Airport Emergency Plan of respective Airports require Nepal Army to carry out Search and Rescue operation in such areas.

CHAPTER 14. Training

Personnel whose duties consist solely of the provision of ARFF services for aircraft operations are infrequently called upon to face a serious situation involving lifesaving at a major aircraft fire. They will experience a few incidents and a larger number of standbys to cover movements of aircraft in circumstances where the possibility of an accident may reasonably be anticipated but will seldom be called upon to put their knowledge and experience to the test. It follows, therefore, that only by means of a most carefully planned and rigorously followed programme of training can there be any assurance that both personnel and equipment will be capable in dealing with a major aircraft fire should the necessity arise. The core training programme can be organized into nine faculties as follows:

a) fire dynamics, toxicity and basic first aid;
b) extinguishing agents and firefighting techniques;
c) handling of vehicles, vessels and equipment;
d) airfield layout and aircraft construction;
e) operational tactics and manoeuvres;
f) emergency communication;
g) leadership performance;
h) physical fitness; and
i) auxiliary modules (e.g. rescue in difficult terrain, response to biological/chemical threats, etc.).

14.1 Types of Training

Following types of trainings should be included in ARFF Training Programme:

Types of Training	Subjects to be included
Basic	• Fire and fire extinction • Types of extinguishing agents • Handling of equipment • Care of equipment • Local topography • Aircraft familiarization • Medical First Aid • Rescue operation • Practical exercises
Advanced Training/ Operational Tactics	• Brief introduction of all the subjects contained in Basic Training • Approach Positioning of Equipment
RFF Management	• Subjects included in basic and operational tactics • RFF Station Management- Managing Personnel, managing equipment, logistics, preparing budget.
Refresher	• Refresher of short duration on basic, advanced and management training

14.2 Curriculum

Following areas shall be included in curriculum at minimum:

- Airport Familiarization
- Aircraft Familiarization
- RFF Personnel safety
- Emergency communication system including aircraft fire alarm
- Use of appliances – hoses, nozzles, turrets, monitor, ladder
- Application of the types of extinguishing agents.
- Emergency aircraft evacuation assistance
- Firefighting operation
- Use of structural rescue and firefighting equipment for aircraft rescue and firefighting
- Knowledge and extinguishing dangerous goods fire
- Role and responsibility as stipulated in respective AEP
- Use of protective clothing and respiratory equipment.

CHAPTER 15. Communication and Alarm Requirements

15.1 System Facilities

Communication and alarm system is significant for efficiency of an ARFF service. Consistent with the individual requirements of each airport there should be provision for:

a) direct communication between air traffic control and the airport fire station to ensure prompt dispatch of ARFF vehicles in the event of an emergency
b) communication between air traffic control and the ARFF crews en-route to, or in attendance at, an aircraft accident/incident
c) communication between the fire station and the ARFF vehicles
d) communication between the ARFF vehicles, including where necessary, a system to provide inter-communication between the crew members of ARFF vehicle; and
e) emergency alarm systems to alert auxiliary personnel and appropriate organizations located on or off the airport.

Additionally, a direct communication may be provided between the ARFF services and the flight crew of an aircraft in emergency on the ground.

15.2 Fire Station Communications

In considering the scope of fire station communications two important factors need to be considered. The first is the extent of the workload to be carried in the watch room when an aircraft accident or incident occurs. The range of communication facilities will naturally be related to this workload and if some part of the emergency mobilization can be undertaken elsewhere, at the airport telephone exchange room or emergency operations centre, for example, then the fire station watch room can be more effectively equipped and operated in its primary role. The second consideration relates to those airports operating more than one fire station. Where two or more stations are provided it is usual to designate one as the main station and its watch room as the master watch room, which is continuously staffed. A satellite station may also have a watch room with fewer facilities commensurate with its subordinate role and usually staffed only until the satellite's vehicles respond to a call. In discussing fire station communications, it is essential to differentiate between the minimum requirements in main and satellite fire stations and to identify the systems which can serve both.

Calls to the airport fire station(s) for attendance at an aircraft accident/incident normally originate from air traffic control. The air traffic control should be linked with the main fire station by a direct telephone line not passing through any intermediate switchboard so as to avoid delays. This line is usually provided with a distinctive buzzer in the watch room and is safeguarded against buzzer defects by a warning light. This line can be linked to the alarm bells in the main and satellite fire station(s) so that the initiation of a call by air traffic control simultaneously alerts all personnel. The alarm system may also be used to activate ARFF vehicle room doors. A separate switch for activating the alarm bells should be provided in each fire station watch room. Fire stations should be provided with a public address system so that details of the emergency, giving location, type of aircraft involved, preferential routing for ARFF vehicles, can be conveyed to crewmembers. Control of this system would normally be located in the master watch room, which would also have a switch for silencing the alarm bells to avoid any interference with the effective use of the broadcast facility. Some calls for emergency services may reach the main fire station from the airport telephone switchboard and it is usual to have a special telephone circuit for these priority calls. Some of these calls will be of lower priority than that associated with an aircraft accident/incident, e.g. response to fuel spills, special services, etc., it is not necessary to link this circuit with the alarm bells. The alerting and directing of these responses can be controlled from the master watch room. A separate telephone circuit, for calls of a non-emergency nature, should also be provided in each watch room. Where the master watch room is required to mobilize off-airport support services for aircraft related or other emergency situations, direct telephone circuits with appropriate priority indications should be provided to the appropriate control centres.

Satellite fire station watch rooms should be linked to the master watch room by a direct telephone line. The satellite fire station should be served by the public address and alarm system operated by the master watch room as well as having the ability to activate the alarm and make public address broadcasts within its station. A grid reference map(s) should be displayed. In many instances the master fire station watch room tends to become overloaded with alarms, switches, buzzers, coloured lights, radio equipment, public address system, etc. The watch room should be designed in such a way as to minimize the workload on the watch room attendant during an emergency call. The objective should be to set out the watch room in such a manner that a call can be received and dealt with by a minimum of movement on the part of the watch room attendant. Grid reference maps, etc., should be placed directly in front of the watch room attendant's position. All telephone and radio equipment in each watch room should be regularly monitored for its service-ability and arrangements should exist for emergency repair and maintenance of this equipment. The continuity of electrical supplies to fire stations should be ensured by connection to secondary power supplies.

15.3 RFF Vehicle Communications

When ARFF vehicles leave their fire stations and enter the manoeuvring area, they come under the direction of air traffic control. These vehicles must be equipped with two-way radio communications equipment, through which their movements can at all times be subject to direction by air traffic control. The choice of a direct air traffic control/fire service frequency, monitored in the master watch room, or a discrete airport fire service frequency, relaying air traffic control instructions and fresh information, will be a matter for the airport or appropriate authority to determine, based on local operational and technical considerations. A discrete frequency minimizes the extent to which fire service activities involve an air traffic control channel at a busy airport. It is important to provide the fire service with the facility to communicate with flight crew members in certain types of incidents, particularly where undercarriage situations are involved or aircraft evacuation may be proposed. Technical solutions are available to permit both a discrete frequency and an aircraft "talk-through" facility, subject to air traffic control approval. All transmissions should be recorded once an emergency situation has been declared.

The radio equipment on ARFF vehicles should accommodate communication between vehicles, en-route to, and in operation at, an aircraft accident. Within individual vehicles there should be an intercommunication system, particularly between drivers and monitor operators, to optimize the deployment of the vehicles at an incident/accident sites. The provision of a communication facility within an appliance must recognize the likelihood of high noise levels and this may require the use of noise-cancelling microphones, headsets and loudspeakers for effective inter communication. The ARFF vehicles should be provided with communication equipment capable of communicating directly with an aircraft in a situation of emergency using an aeronautical radio frequency. The aeronautical radio frequency should permit the ARFF service and the aircraft to communicate with each other directly allowing the ARFF crew to issue critical information regarding the exact nature of, and the hazards associated with, an emergency in progress along with recommendations for actions. Where provided, the aeronautical radio frequency may be selected by air traffic control and notified to the aircraft and the ARFF service. The requirements and responsibilities for the utilization of a radio frequency between the ARFF service and the flight crew of an aircraft in a situation of emergency should be detailed in a procedure agreed to between the air traffic services and the aerodrome operator.

Communications between the flight crew, air traffic control and the ARFF service should be maintained throughout the emergency response. Due to the critical and timely nature of the information transmitted on this frequency, transmissions should be limited to air traffic control, pilot of the aircraft and the officer-in-charge of the ARFF operations. The officer-in-charge of the RFF operations should delay transmissions to the aircraft until cleared by the air traffic control, unless the nature of the transmission is critical to emergency operations. One of the prerequisites for effective communication between the ARFF service and the flight crew of the aircraft is language proficiency.

At the accident site the officer-in-charge of ARFF operations may leave the vehicle and make observations on foot, and can then direct and inform crew members in all aspects of fire-ground operations using a portable loudhailer. This equipment may also serve a subsidiary role in communications with aircraft crew members, the occupants of the aircraft and other persons responding to the accident.

CHAPTER 16. Aircraft Fuelling Practices

16.1 Introduction

The airport authority, the aircraft operator and the fuel supplier each has responsibilities in respect of the safety measures to be taken during fuelling operations (both refuelling and defueling). Some guidance on these safety measures is given below. It is important to note that this material is not intended to replace fuel supplier operator procedures. The material includes the following subjects:

a. General precautionary measures: to be taken during fuelling operations; and
b. Additional precautionary measures: to be taken when passengers remain on board or embark/disembark during refuelling operations.

16.2 General Precautionary Measures

The following general precautionary measures should be taken during aircraft fuelling operations:

a. aircraft fuelling operations should be done outdoors
b. bonding and/or grounding should be done
c. aircraft fuelling vehicles should be positioned so that:
   - accessibility to aircraft by ARFF vehicles is not interrupted
   - a cleared path is maintained to permit rapid removal of fuelling vehicles from an aircraft in an emergency
   - they do not obstruct evacuation from occupied portions of the aircraft in the event of a fire; and
   - the vehicle engines are not under the wing.
d. all vehicles performing aircraft servicing functions other than fuel servicing (e.g. baggage trucks) should not be driven or be parked under aircraft wings while fuelling is in progress
e. open flames and lighted open flame devices should be prohibited on the apron and in other locations within 15 m of any aircraft fuelling operation. Included in the category of open flames and lighted open flame devices are the following:
   - lighted cigarettes, cigars, pipes
   - exposed flame heaters
   - welding or cutting torches, etc.; and
   - flare pots or other open flame lights.
f. cigarette lighters or matches should not be carried or used by anyone while engaged in aircraft fuelling operations
g. extreme caution should be used when fuelling during lightning and electrical storms. The fuelling operations should be suspended during severe lightning disturbances in the immediate vicinity of the airport;
h. when any part of an aircraft undercarriage is abnormally heated, the airport RFF service should be called and fuelling should not take place until the heat has dissipated; and
i. portable fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire, and personnel trained in its use shall be readily available and there shall be a means of quickly summoning the rescue and fire-fighting service in the

event of a fire or major fuel spill. It should be ensured by regular inspection and maintenance that this equipment is maintained in a fully serviceable condition.

16.3 Additional Precautionary Measures

An aircraft shall not be refuelled when passengers are embarking, on board or disembarking unless it is properly staffed by qualified personnel ready to initiate and direct an evacuation of the aeroplane by the most practical and expeditious means available.

When aircraft refuelling operations take place while passengers are embarking, on board, or disembarking, ground equipment shall be positioned so as to allow:

- the use of a sufficient number of exits for expeditious evacuation; and
- ready escape route from each of the exits to be used in an emergency.

The following additional precautions must be observed during refuelling operations while passengers remain on board or embark/disembark:

a. passengers should be warned that refuelling will take place and that they must not smoke, operate switches or otherwise produce sources of ignition
b. the illuminated "No smoking" signs and exit lighting should be switched on
c. aircraft equipped with integral stairs should have them deployed, or if aircraft stairways are used, these should be positioned at each of the main doors normally used for passenger embarkation or disembarkation which should be open or ajar and free from obstruction.
d. if, during refuelling, the presence of fuel vapour is detected in the aircraft interior, or any other hazard arises, refuelling and all cleaning activities using electrical equipment within the aircraft should be stopped until conditions permit resumption; and
e. where passengers are embarking or disembarking during refuelling their route should avoid areas where fuel vapours are likely to be present and this movement should be under the supervision of a responsible person.

CHAPTER 17. Preventative Maintenance of Vehicles and Rescue Equipment

17.1 Preventive Maintenance

CAR-14 part 1 recommends that a system of preventive maintenance of rescue and fire-fighting vehicles be employed to ensure effectiveness of the rescue vehicles and equipment (refer 9.2.33 of CAR-14, Part-1). To ensure that the maintenance can be conducted correctly, provision of the following is a necessity:

a) maintenance personnel;

b) maintenance procedures;

c) defect reporting system;

d) designated maintenance work areas;

e) tools;

f) spare parts; and

g) storage of maintenance records.

A maintenance programme should take into account the following activities:

a) original equipment manufacturer (OEM) maintenance recommendations;

b) local environmental conditions, for example hot areas versus cold/snowy areas;

c) national or local regulatory requirements; and

d) regular performance testing.

17.2 Personnel

All personnel conducting maintenance activities should be appropriately skilled, trained and equipped to undertake the designated and required maintenance activities they are tasked with in accordance with their organisational Safety Management Systems. Working on modern day RFF fire vehicles and rescue equipment requires the following skill set or, as a minimum, a good practical working knowledge of:

a) heavy vehicle mechanical trade qualifications;

b) fire pumps and foam systems;

c) complementary agent systems;

d) hydraulics / pneumatics;

e) automotive electrical training;

f) Self-Contained Breathing Apparatus (SCBA) systems/ breathing air compressors; and

g) knowledge of regulatory requirements pertaining to provision of RFF.

Specialist training should be initially provided by the OEM with the delivery of the first of type

fire vehicle or item(s) of rescue equipment.

17.3 Maintenance Procedures

Maintenance procedures should be implemented to ensure a standardized manner in which fire

vehicles are maintained. Maintenance procedures should cover:

a) activities to be undertaken to ensure that disruption to RFF services are minimized. For example, bringing reserve fire vehicles into operational service to maintain category levels, or conducting maintenance during breaks in aircraft movements where a vehicle may be taken out of service without affecting category levels;

b) the frequency of maintenance services;

c) activities to be undertaken at each type of maintenance service as recommended by the original equipment manufacturer (OEM). For example, visual check, inspections &measurements;

d) arrangements for technical support from the OEM or the OEM's local agent;

e) spare parts that should be held on site to enable regular maintenance to be conducted for example; filters, belts, drier cartridges, lubricants, coolants, wiper blades;

f) generically common spare parts should be held on site to minimise downtime. Such as switches, light globes, relays, circuit breakers, bolts, nuts, washers, O-rings and seals;

g) arrangements with OEM and local suppliers for all other parts to ensure downtime is kept to a minimum;

h) tyre replacement requirements;

i) environmental procedures including appropriate disposal procedures for old parts as well as used lubricants and coolants;

j) any special measures to ensure safety of maintenance personnel such as procedures for working at heights, confined space entry and working with high pressure liquids / gasses

k) the method of reporting and documenting any defects that have been identified with the fire; and

l) vehicles or rescue equipment by operational and maintenance personnel.

17.4 Maintenance Work Areas/ Special Tools

Provision of a work area for maintaining RFF fire vehicles should have due consideration to the following:

a) a sufficiently large enough area to work on and around the vehicle;

b) environmental protection such as trade waste interceptor pits or bonding;

c) lifting/ jacking equipment;

d) wheel lifters/ tyre changing cages;

e) storage areas for lubricants, spare parts and tools;

f) storage of technical documentation; and

g) storage of maintenance records.

Provision of a work area for maintaining rescue equipment should have due consideration to the following:

a) a clean area to work on breathing apparatus (BA) sets/ face masks;

b) testing capability for fire hoses;

c) ventilated area for operation of engine powered tools, for example, portable saws or hydraulic rescue units; and

d) ventilation for charging batteries.

Modern day RFF fire vehicles/ rescue equipment have the need for specialist diagnostic and test equipment. It should be noted that some tools require regular calibration to ensure that they are measuring correctly. Some examples are mustimeters, liquid flow meters, tension wrenches, pressure gauges, and air quality testing for BA.

17.5 Performance Testing of Fire Vehicles

Whilst ARFFS fire vehicle may pass its initial acceptance test for compliance against its specification, there is no guarantee that it will continue to do so throughout its service life. All ARFFS fire vehicles have parts that wear with time and as a result performance is lost. To ensure that the fire vehicle continues to have the ability to respond, and discharge firefighting agents at the required amounts, regular performance testing should be undertaken including quantitative checks of:

a) 0-80 km/h acceleration;

b) braking;

c) flow rate from high and low flow deliveries;

d) foam admixing percentages;

e) monitor throw; and

f) compressed air foam systems.

Records of any performance tests undertaken should be kept. Appendix B of this manual presents a format for the same.

17.6 Rescue Equipment Requirements

The maintenance requirements for rescue equipment should be in accordance to original equipment manufacturer (OEM) requirements. However, due to the nature of firefighting, equipment can sometimes unknowingly become damaged. So, it can also be beneficial to check the following:

a) all items: regular daily or weekly checks to ensure functionality;

b) Breathing apparatus (BA) sets: maintained after every use and checked regularly when not used for safe operation;

c) BA air quality: regularly checked;

d) short lines/ long lines (rescue lines): not frayed and are in good repair;

e) portable fire extinguishers: full and charged with pressure;

f) fire hoses: inspected and pressure checked on an annual or 6 monthly basis to ensure that the hoses don't leak and the couplings are functioning and securely fitted;

g) nozzles/ foam branches: inspected for damage;

h) rescue tools: inspected to ensure that there is no damage to components;

i) general tools: inspected to ensure handles are not broken or damaged;

j) first aid kits: inspected at least weekly to ensure that items are maintained at the correct stock levels; and

k) rescue tool box: checked to ensure all tools are present.

17.7 Maintenance Documentation

A complete set of maintenance documentation should be requested to be delivered with the fire vehicle and rescue equipment during the procurement process. As a minimum this should include:

a) operating procedures;

b) maintenance procedures;

c) fault diagnosis and troubleshooting;

d) adjustment procedures;

e) removal / replacement of parts and repairable assemblies;

f) instructions for disassembly and reassembly of repairable components;

g) tolerances, specifications and capacities;

h) illustrations and exploded views;

i) schematic drawings;

j) circuits or hydraulic circuits;

k) special tools needed for repairing and adjusting; and

l) spare parts catalogue providing exploded views of the entire fire vehicle.

It is important that the technical documentation is in a format that can be easily read, understood and followed. Any schematic drawings should be a sufficiently large enough size to enable them to be easily read. This is very important for fault diagnosis whereby any circuits can be traced. It is a good idea to laminate these so that they can be kept clean of grease and still be read at a later time.

17.8 Maintenance Record Keeping

A comprehensive set of maintenance records should be kept for each fire vehicle. Keeping individual sets of maintenance records is also beneficial for each of the larger and more complex items of rescue equipment. Like items of rescue equipment, for example hoses, can be grouped together, however each item of equipment should be readily identifiable via a unique numbering system. Keeping such documentation has several benefits:

- provides a historical record of the maintenance of the fire vehicle/ equipment – which may
- be an organizational requirement for legal or compliance reasons;
- provides evidence for any warranty claim that may be made against the OEM;
- can be referred to in the future (if a similar fault occurs); and
- provides evidence for any surveillance audit that may be undertaken for regulatory

compliance.

Maintenance and calibration certificates should be maintained in a register for all special tools and test equipment.

Appendix D of this manual presents a format for keeping daily maintenance records.

17.9 Protective Clothing

The proper care and preventive maintenance of protective clothing is normally the responsibility of the fire fighter and the ARFFS. Protective clothing needs to be inspected for serviceability on a regular basis:

a) by the wearer prior to commencing duty;

b) after use; and

c) as required.

Minor repairs may be conducted at a local level, however, major repairs may need to be conducted by an external agency so that repair activities and/or materials do not compromise the protection standards of any protective clothing.

Storage of protective clothing is also a factor to be considered:

a) storage should be away from direct light, especially sunlight;

b) avoid contact with contaminants; and

c) avoid storing near objects that could physically damage the protective clothing.

CHAPTER 18. Human Factors Principles

General

The subject of human factors is about people. It is about people in their working and living environments. It is about their relationship with equipment, procedures and the environment. Just as importantly, it is about their relationships with other people. Human Factors involve the overall performance of human beings within the aviation system; it seeks to optimize people's performance through the systematic application of the human sciences, often integrated within the framework of system engineering. Its twin objectives can be seen as safety and efficiency.

Human Factors is essentially a multidisciplinary field, including but not limited to; psychology; engineering; physiology; sociology; and anthropometry. Indeed, it is this multidisciplinary nature and the overlapping of the constituent disciplines that make a comprehensive definition of Human Factors difficult.

Human Factor Principles as per advisory circular AC/AD-14.

Appendix

Non exhaustive list, based on aeroplanes (type, series) using aerodromes in 2013. Fuselage length and width are given for information. These dimensions may vary depending on models. Please refer to type-certificate data-sheet or official manufacturer documentation for exact dimensions if necessary.

Aeroplane	*Overall length (m)*	*Maximum fuselage width (m)*
Airport Category 10	**76 ≤ L < 90**	**w ≤ 8**
Airbus A380-800	72.7	7.1
Antonov AN-225	84.0	6.4
Boeing 747-8	76.3	6.5
Airport Category 9	**61 ≤ L < 76**	**w ≤ 7**
Airbus A330-300	63.7	5.6
Airbus A340-300	63.7	5.6
Airbus A340-500	67.9	5.6
Airbus A340-600	75.4	5.6
Airbus A350-900	66.8	6.0
Antonov AN-124	69.1	6.4
Boeing 747-100, -200, -300	70.4	6.5
Boeing 747-400	70.7	6.5
Boeing 767-400ER	61.4	5.0
Boeing 777-200	63.7	6.2
Boeing 777-300ER	73.9	6.2
Boeing 787-9	62.8	5.8

Aeroplane	*Overall length (m)*	*Maximum fuselage width (m)*
Ilyushin IL-96-400, M, T	63.9	6.1
McDonnell Douglas MD 11	61.6	6.0
Airport Category 8	**49 ≤ L < 61**	**w ≤ 7**
Airbus A300 B2, B4	53.6	5.6
Airbus A300 B4-600, F4-600	54.1	5.6
Airbus A310	46.7	5.6
Airbus A330-200	59.0	5.6
Airbus A340-200	59.4	5.6
Boeing 747 SP	56.3	6.5
Boeing 757-300	54.4	3.8
Boeing 767-200	48.5	5.0
Boeing 767-300	54.9	5.0
Boeing 787-8	56.7	5.8
Ilyushin IL-62	53.1	3.8
Ilyushin IL-96-300	55.4	6.1
Lockheed L-1011 Tristar	54.4	6.0
McDonnell Douglas DC8 -61, 61F, 63, 63F	57.1	3.7
McDonnell Douglas DC10 Series 10 / Series 40 (*MD 10*)	55.6	6.0
McDonnell Douglas DC10 Series 30 (*MD 10*)	55.4	6.0
Airport Category 7	**39 ≤ L < 49**	**w ≤ 5**
Airbus A321	44.5	4.0
Boeing 707-320, 320B, 320C, 420	46.6	3.8
Boeing 720	41.5	3.8
Boeing 720B	41.7	3.8
Boeing 727-100, 100C	40.6	3.8

Aeroplane	*Overall length (m)*	*Maximum fuselage width (m)*
Ilyushin IL-96-400, M, T	63.9	6.1
McDonnell Douglas MD 11	61.6	6.0
Airport Category 8	**49 ≤ L < 61**	**w ≤ 7**
Airbus A300 B2, B4	53.6	5.6
Airbus A300 B4-600, F4-600	54.1	5.6
Airbus A310	46.7	5.6
Airbus A330-200	59.0	5.6
Airbus A340-200	59.4	5.6
Boeing 747 SP	56.3	6.5
Boeing 757-300	54.4	3.8
Boeing 767-200	48.5	5.0
Boeing 767-300	54.9	5.0
Boeing 787-8	56.7	5.8
Ilyushin IL-62	53.1	3.8
Ilyushin IL-96-300	55.4	6.1
Lockheed L-1011 Tristar	54.4	6.0
McDonnell Douglas DC8 -61, 61F, 63, 63F	57.1	3.7
McDonnell Douglas DC10 Series 10 / Series 40 (*MD 10*)	55.6	6.0
McDonnell Douglas DC10 Series 30 (*MD 10*)	55.4	6.0
Airport Category 7	**39 ≤ L < 49**	**w ≤ 5**
Airbus A321	44.5	4.0
Boeing 707-320, 320B, 320C, 420	46.6	3.8

Aeroplane	*Overall length (m)*	*Maximum fuselage width (m)*
Boeing 727-200	46.7	3.8
Boeing 737-800	39.5	3.8
Boeing 737-900ER	42.1	3.8
Boeing 757-200	47.3	3.8
Bombardier CRJ 1000	39.1	2.7
McDonnell Douglas DC8-62, 62F, 72, 72F	48.0	3.8
McDonnell Douglas DC9-50	40.7	3.4
McDonnell Douglas MD 81, 82, 83, 88	45.0	3.4
McDonnell Douglas MD 87	39.8	3.4
McDonnell Douglas MD 90-30	46.5	3.4
Tupolev TU 154	47.9	3.8
Tupolev TU 204-300	40.2	3.8
Tupolev TU 204-100, -120, -214	46.1	3.8
Airport Category 6	**$28 \leq L < 39$**	**$w \leq 5$**
Airbus A318	31.5	4.0
Airbus A319	33.8	4.0
Airbus A320	37.6	4.0
Antonov AN-148	29.1	3.4
Antonov AN-158	34.4	3.4
BAe System BAe 146 -300 / AVRO RJ 100 and RJ 115	31.0	3.6
BAe System BAe 146-200 / AVRO RJ 85	28.6	3.6
Boeing 717	37.8	3.4
Boeing 737-100	28.7	3.8
Boeing 737-200	30.5	3.8
Boeing 737-300	33.4	3.8
Boeing 737-400	36.4	3.8
Boeing 737-500	31.0	3.8

Aeroplane	Overall length (m)	Maximum fuselage width (m)
Boeing 737-600	31.2	3.8
Boeing 737-700	33.6	3.8
Bombardier CRJ 700	32.5	2.7
Bombardier CRJ 705, 900	36.4	2.7
Bombardier CS 100	35.0	3.7
Bombardier Q400 / DHC 8-400 *(Dash 8-400)*	32.8	2.7
Bombardier Global 5000	29.5	2.7
Bombardier Global Express / Global 6000	30.3	2.7
Embraer 170	29.9	3.0
Embraer 175	31.7	3.0
Embraer 190 / Lineage 1000	36.2	3.0
Embraer 195	38.7	3.0
Embraer ERJ 140	28.5	2.3
Embraer ERJ 145 / Legacy 600, 650	29.9	2.3
Fokker Fellowship F-28, MK 2000, 4000	29.6	3.3
Fokker F100	35.5	3.3
Fokker F70	30.9	3.3
Gulfstream Aerospace Gulfstream VI, G650	30.4	2.7
Gulfstream Aerospace Gulfstream V, G500, G550	29.4	2.4
Ilyushin IL-18	35.9	3.2
Lockheed L 100-20 Hercules	32.3	4.3
Lockheed Electra L-188	31.9	3.5
McDonnell Douglas DC9-10, -20	31.8	3.4
McDonnell Douglas DC9-30	36.4	3.4
Sukhoi Superjet 100-95	29.9	3.4
Tupolev TU-134A	37.1	2.7
Yakovlev Yak-42D	36.4	3.8

Airport Category 5	**24 ≤ L < 28**	**w ≤ 4**
ATR 72	27.2	2.8
BAe System BAe ATP	26.0	2.5
BAe System BAe 146 -100 / AVRO RJ 70	26.2	3.6
Bombardier CRJ -100, -200 / Challenger 800, 850	26.7	2.7
Bombardier Q300 / DHC 8-300 (*Dash 8-300)*	25.7	2.7
Convair 440 – 640	24.8	2.5
De Havilland Canada DHC-7 (*Dash 7*)	24.6	2.8
Embraer ERJ 135 / Legacy 600	26.3	2.3
Fokker F 27 *Friendship* MK -500 / -600	25.1	2.7
Fokker *Fellowship* F 28, MK -1000 / -3000	27.4	3.3
Fokker F50	25.3	2.7
Gulfstream Aerospace Gulfstream II	24.4	2.4
Gulfstream Aerospace Gulfstream IV / IV SP	26.9	2.4
Gulfstream Aerospace Gulfstream 350 / 450	27.2	2.4
NAMC YS- 11	26.3	2.7
Saab 2000	27.3	2.9
Xi'an AIC MA60	24.7	2.8

Airport Category 4	**18 ≤ L < 24**	**w ≤ 4**
Antonov AN-140	22.6	2.5
Antonov AN-24V, Srs II	23.5	2.8
ATR 42	22.7	2.8
BAe System Jetstream 41	19.3	2.0
Bombardier 415 / Canadair CL-415	19.8	2.6
Bombardier Challenger 300	20.9	2.2
Bombardier Challenger 600 / Canadair CL 600/601	20.9	2.5
Bombardier Q200 / DHC 8-100,-200 *(Dash 8)*	22.3	2.7

Cessna Sovereign (*Model 680*)	19.4	2.0
Dassault Aviation Falcon 2000	20.2	2.4
Dassault Aviation Falcon 50	18.5	1.9
Dassault Aviation Falcon 7X	23.4	2.4
Dassault Aviation Falcon 900	20.2	2.4
Dornier Fairchild 328 / 328 JET	21.3	2.2
Embraer EMB-120 *Brasilia*	20.0	2.3
Fokker and Fairchild Friendship F-27	23.6	2.7
Grumman Gulfstream I	19.4	1.9
Gulfstream Aerospace Gulfstream G200	19.0	2.3
Gulfstream Aerospace Gulfstream G250	20.3	2.3
Hawker Siddeley HS-748/AVRO 748	20.4	2.7
Raytheon Hawker 4000	21.2	2.2
Saab 340	19.7	2.3
Yakovlev Yak 40	20.4	2.3
Airport Category 3	**$12 \leq L < 18$**	**$w \leq 3$**
BAe System Jetstream 31	14.4	2.0
Beechcraft Super King Air (Series 200, 300)	13.3 to 14.2	1.5
Beechcraft 1900 D	17.6	1.5
Beechcraft 99 Airliner	13.6	1.4
Beechcraft King Air (Series 100)	12.2	1.5
Bombardier Learjet Series (23.../...75)	13.2 to 17.9	1.6
Britten-Norman Trislander	15.0	1.2
Cessna 208B Grand Caravan / Super Cargomaster	12.7	1.6
Cessna Citation (except Citation X and Sovereign)	12.3 to 17.0	2.0
Cessna CitationJet (*525 Series*)	13 to 16.3	1.6
Dassault Aviation Falcon 20	17.2	1.9
De Havilland Canada DHC 3 (*Otter*)	12.8	1.6
De Havilland Canada DHC-6 (*Twin Otter*)	15.8	1.6

Dornier Do 228-200	16.6	1.5
Embraer EMB 110 P2 Bandeirante	15.1	1.7
Hawker 1000 (*BAe 125 Series 1000*)	16.4	1.9
Hawker 400 (*Beechcraft 400*)	14.8	1.7
Hawker 800 / 750 / 900 (*BAe 125 Series 800*)	15.6	1.9
Hawker HS125 Series 3	14.5	1.8
Let Kunovice Let L-410 Turbolet / L-420	14.4	2.1
Piaggio P.180 Avanti	14.4	2.0
Pilatus PC-12	14.4	1.6
Piper PA-42 Cheyenne	13.2	1.3
Short Brothers Short Skyvan SC.7, Srs 3	12.2	2.0
Airport Category 2	**9 ≤ L < 12**	**w ≤ 2**
Aero Commander 500A	10.7	1.3
Beechcraft Duke B60	10.3	1.3
Beechcraft Baron G58	9.1	1.1
Beechcraft King Air 90	10.8	1.4
Britten Norman Islander BN2	10.9	1.2
Cessna 208A Caravan I / Caravan 675 / Cargomaster	11.5	1.6
Cessna 310, 320	9.7	1.3
De Havilland Canada DHC-2 (*Beaver*)	9.2	1.3
De Havilland Dove DH 104	11.9	1.6
Piper Navajo PA-31	9.9	1.3
Airport Category 1	**0 ≤ L < 9**	**w ≤ 2**
Beechcraft Baron Model 55	8.8	1.1
Beechcraft Bonanza 35	7.7	1.1
Beechcraft Bonanza G36	8.4	1.1
Cessna 150	7.0	1.1