



**GOVERNMENT OF INDIA
CIVIL AVIATION DEPARTMENT
OFFICE OF DIRECTOR GENERAL OF CIVIL AVIATION**

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AERODROME ADVISORY CIRCULAR

**SUBJECT: MANPOWER REQUIREMENTS FOR AERODROME RESCUE AND
FIRE FIGHTING OPERATION**

1. Introduction

The effectiveness of any fire fighting system depends on quality of equipment and competency & adequacy of manpower deployed for the purpose. Para 9.2 of CAR Section 4, Series B, Part-I specifies the requirements for ARFF equipment and para 9.2.45 recommends the aerodrome operators to carry out task resource analysis for determining the minimum number of fire fighting personnel required for their aerodrome.

This circular is issued for the purpose of providing guidance to the aerodrome operators regarding methodology to be adopted for carrying out the task resource analysis for ascertaining the minimum manpower requirements for aerodrome rescue and fire fighting.

It is important to note that this circular on its own does not change, create, amend or permit deviations from regulatory requirements, nor does it establish minimum standards.

The minimum requirements should be established including minimum number of RFFS vehicles and equipment required for the delivery of the extinguishing agents at the required discharge rate for the specified ICAO RFFS category of the airport.

It is also to be documented in aerodrome manual. In case, it is required for the RFFS to attend structural incidents and road traffic accidents in addition to aircraft incidents/accidents, additional resources should be allocated for the same and robust procedures shall be established by aerodrome operator so that it does not have any impact on the response time as per the declared fire category of the aerodrome.

Note: ICAO Doc 9137-AN/898 Airport Services Manual Part 1 Rescue and Fire Fighting may be referred in this regard for detail guidance.

2. General Information.

Human Factors

The Task Resource Analysis (TRA) should observe human factor principles to obtain optimum response by all existing agencies participating in emergency operations. The principles should include the effects of human performance for example workload, capabilities, functions, decision aids, environmental constraints, team versus individual performance and training effectiveness. The examples given are illustrative and not exhaustive.

- (a) A Task and Resource Analysis consists of the following:-
 - (i). A scenario for analysis.
 - (ii). Identification of the tasks that need to be carried out for that scenario.
 - (iii). A time line, identifying when individual tasks are to be carried out.
 - (iv). The number of persons required to carry out individual tasks (due account should be taken of fatigue, health and safety issues etc.).
 - (v). All the tasks identified within the scenario.

Every airport is unique in that the location, environment, runway and taxiway configuration, aircraft movements, airport infrastructure and boundary etc. may present specific additional risk, hence it is imperative to consider these factors in Task and Resource Analysis. This process should be undertaken for a number of different scenarios. It may be useful to run the process as a table top exercise, involving a number of disciplines.

- (b) The following elements should be taken into the consideration for The scenarios and analysis should take into consideration of following elements including:
 - (i). Aircraft types using the aerodrome;
 - (ii). The RFFS vehicle(s) and
 - (iii). The use of self-contained breathing apparatus (SCBA);
 - (iv). Hand lines;
 - (v). Ladders; and
 - (vi). Other rescue and fire-fighting equipment provided at the aerodrome associated with aircraft RFFS operations.
- (c) Identify the types of aircraft commonly in use at the airport as the type of aircraft and its configuration has a direct bearing on the resources required in meeting Phase 1 below, 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.

Example:

- (i) Long wide-bodied aircraft with multiple passenger decks and multiple aisles. e.g. Airbus A380, Boeing 747, etc.
 - (ii) Long narrow-bodied aircraft with single aisle, high passenger density. e.g. Airbus A 320, Boeing 737, etc.
 - (iii) Short narrow-bodied aircraft with single aisle, high passenger density. e.g. ATR
- (d) The minimum requirements should be established including minimum number of RFFS vehicles and equipment required for the delivery of the extinguishing agents at the required discharge rate for the specified ICAO RFFS category of the aerodrome. (**ref. CAR Section 4, Series B, Part-I, Table 9-2 and 9.2.41**).
- (e) One of the most important elements of a TRA is to identify and assess the impact of any critical tasks or pinch points identified by the analysis. The nature of the analysis will differ depending on whether it is an assessment of the existing RFFS deployment at the aerodrome or planning for future requirements.
- (f) The assessment should examine the workload and identify the effectiveness of the staffing level. Where shortfall(s) or pinch point(s) are found the analysis should identify the additional staffing or equipment required to address them.
- (g) The following items will assist in determining the basic contents of an analysis:
- (i) Description of aerodrome(s) including the number of runways.
 - (ii) Promulgated RFFS Categories (Aeronautical Information Publication).
 - (iii) Response Time Criteria (Area, times and number of Fire Stations).
 - (iv) Current and future types of aircraft movements.
 - (v) Operational Hours.
 - (vi) Current RFFS Structure and Establishment.
 - (vii) Current Level of operational crews.
 - (viii) Level of Supervision for each operational crew.
 - (ix) RFFS Qualifications/Competence (Training Programme and Facilities).
 - (x) Extraneous Duties (To include Domestic and First Aid Response).
 - (xi) Communications and RFFS Alerting system including Extraneous Duties.
 - (xii) Appliances and Extinguishing Agents available.
 - (xiii) Specialist Equipment- Fast Rescue Craft, Hovercraft, Water Carrier, Hose Layer,
 - (xiv) Extending Boom Technology.
 - (xv) First Aid- Role Responsibility.
 - (xvi) Medical Facilities- Role Responsibility.

- (xvii) Pre-Determined Attendance: Local Authority Services- Police, Fire and Ambulance etc.
- (xviii) Incident Task Analysis. (Feasible Worst Case Scenarios) (Workload Assessment) (Human Performance/Factors). To include: Mobilisation, Deployment to Scene, Scene Management, Fire Fighting, Suppression and Extinguishment, Application of Complementary Agent(s), Post Fire Security/Control, Personnel Protective Equipment, Rescue Team(s), Aircraft Evacuation and Extinguishing Agent Replenishment.

Note: The aim is to identify any Pinch Points within the current workload and proposed workload.

- (xix) Appraisal of existing RFFS provision.
- (xx) Future requirements (Aerodrome development and expansion).
- (xxi) Enclosures could include: Airport Maps, Event Trees to explain tasks and functions conducted by the RFFS etc.).
- (xxii) Airport Emergency Plan and Procedures.

Note: The above list is not exhaustive and should only act as a guide.

3. Task and Resource Analysis Team

- (a) It is important to identify a facilitator who will manage the TRA exercise. In the planning stage, the role of the facilitator is to seek agreement that the worst-case scenario is credible and an adequate test of the RFFS response.
- (b) To carry out the TRA a team of experienced fire service personnel to evaluate the scenario needs to be established. They need to have knowledge of the aerodrome and the locations in which an aircraft accident is likely to occur. The team should include all levels of the RFFS organisation.
- (c) For some scenarios, it may be useful to include one or two non-RFFS personnel in the exercise (possibly experienced operational or ATC staff) to check and challenge the validity of any assumptions that may arise during the TRA.

4. Task and Resource Analysis Methodology

- (a) A Task and Resource 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. A Task and Resource Analysis may be structured in three phases:

- (i). Phase 1 – Aims and Objectives
 - (ii). Phase 2 – Scenario development
 - (iii). Phase 3 – Task and Resource Analysis
- (b) Guidance on the content of each Phase, including examples, is provided below. Clearly, each aerodrome will need to establish and design its TRA to suit its particular environment and operation. The following phases are not exhaustive, nor are they a rigid framework. However, they provide an outline of the type of content that may be expected in a TRA.

5. Phase 1 – Aims and Objectives The aims and objectives of the RFFS must clearly identify the required tasks that personnel are expected to carry out.

- (a) **Aims.** 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 aerodrome within the specified response time criteria.

To identify any pinch points within the current workload and proposed workload. For small RFFS units, identified pinch points may have to be covered by alternative resources.

(b) **Tasks Objectives**

- (i). Meet the required response time
- (ii). Extinguish an external fire
- (iii). Protect escape slides/ exit routes
- (iv). Assist in the self-evacuation of the aircraft
- (v). Create a survivable environment
- (vi). Rescue trapped personnel
- (vii). Maintain post-fire security/control
- (viii). 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 activities/actions.

6. Phase 2 – Scenario(s) development

- (a) Identify a selection of representative realistic and feasible aircraft accidents/incidents that may occur at the aerodrome. It is also important to consider aircraft at the high end of the RFFS category to enable analysis of the upper limits of the RFFS response. This can be achieved by:
- (i). analysis of accidents around the world;
 - (ii). consideration of the accident/incident history at the aerodrome;

- (iii). brainstorming ideas using a representative team from the aerodrome;
- (iv). statistical analysis of previous accidents at aerodromes.

Note: All accidents should involve fire to represent a feasible worst-case scenario that would require an RFFS response.

Example scenarios could include:

- (i). Aircraft engine failure on take-off with a fire (aborted take-off);
 - (ii). Aircraft aborts and overruns into the Runway End Safety Area (RESA) with fire on take-off (including aircraft beyond aerodrome boundary (within response area) into water or difficult terrain);
 - (iii). Aircraft into aircraft with fire (collision);
 - (iv). Aircraft into structure (terminal buildings) with a fire;
 - (v). Aircraft leaves the runway on landing into the runway strip (full emergency evacuation);
 - (vi). Internal aircraft fire (e.g. cabin fire, baggage hold, cargo hold, and avionics bay).
- (b) In order that the feasible accident scenario can be modelled/ simulated, a major factor is to consider the probable location for the most realistic accident type that may occur, taking into account the aerodrome's particular location, environment, runway and taxiway configuration, etc., which may present specific risks.
- (c) The team may have identified that the following elements contribute to a worst-case location:
- (i). Response time;
 - (ii). Route to the accident site (on or off paved surfaces);
 - (iii). Terrain;
 - (iv). Crossing procedures for active runway(s);
 - (v). Communications;
 - (vi). Supplementary water supplies;
 - (vii). Adverse weather conditions – e.g. Low Visibility Procedures, snow/ice;
 - (viii). Daylight and darkness.
- (d) From the above analysis a location or a number of locations may be identified, in agreement with the aerodrome operator, the TRA facilitator and, if necessary, the regulator.

7. Phase 3 – Task and Resource Analysis.

- (a) Led by the TRA facilitator, the TRA team evaluates the accident scenario(s) developed in **Phase 2** in a series of tabletop exercises/simulations.
- (b) The TRA 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:

- (i). Receive the message and dispatch the RFFS (the dispatcher may have to respond as part of the minimum riding strength)
 - (ii). Respond utilising communications; taking appropriate route and achieving the defined response time
 - (iii). Position appliances/vehicles in optimum positions and operate RFF appliances effectively
 - (iv). Use extinguishing agents and equipment accordingly
 - (v). Deploy equipment accordingly
 - (vi). Instigate Incident Command Structure
 - (vii). Assist in passenger and crew self-evacuation
 - (viii). Access aircraft to carry out specific tasks if required, e.g. fire fighting, rescue etc.
 - (ix). Support and sustain the deployment of fire-fighting and rescue equipment
 - (x). Support and sustain the delivery of supplementary water supplies
 - (xi). Need to replenish foam supplies
- (c) The results of the analysis should be recorded in a table, spreadsheet or other suitable format.
- (d) Stated objectives for the RFFS
- (i). Initiate aerodrome emergency plan
 - (ii). Deploy within the required response time
 - (iii). Select appropriate route and communications
 - (iv). Position appliances in optimum positions and operate effectively
 - (v). Initiate incident command system
 - (vi). Suppress/extinguish any fire
 - (vii). Assist with self-evacuation of the aircraft
 - (viii). If appropriate, extinguish any internal fire
 - (ix). If required, ventilate aircraft to create survivable conditions
 - (x). Maintain post-fire control of the critical area
 - (xi). Preserve evidence
- (e) The TRA may be set out in a table mentioning the timings of each task and identifying the resource required for each step of the response. Table 1 is an abbreviated example to demonstrate the principles.

Table 1 Task and Resource Analysis

TIME	TASKS	RESOURCES	COMMENTS
00:00	Call received from ATC as aircraft accident runway 06 RESA. Gulfstream 5. RFF personnel mobilised by dispatcher	Sup	Achieved
00:15	Call made to operate the aerodrome emergency plan	ATC/Dispatcher/Operations Unit	Achieved. ATC
00:30	Personnel donning in appropriate respiratory protective equipment (RPE)	Major Fire Tenders A, B Supervisor A1 Supervisor B1 Fire-fighter A3 Fire-fighter B3	Achieved All staff, except drivers A2, B2 donning RPE
00:40	ed and appliances mobile enroute to 06 R	MFTs A, B	Achieved. Supervisors and Drivers
00:50	Supervisor(s) utilise communications (RTF); discreet frequency, ATC, Local Authority, etc.	Supervisor(s) MFTs A, B	Achieved. Note: Aircraft may have already initiated evacuation (air crew)
04:15	Following self-evacuation provide assistance mustering passengers/crew to place of safety	A1, A2, B3	Achieved. Assistance provided by aircraft crew
05:05	External emergency services are brought forward to the accident site with additional equipment to support removal of the remaining survivors and to transport the survivors to the appropriate safety zone.	A1 and external commanders: <ul style="list-style-type: none"> • Police • Fire • Ambulance • Medical • Others 	Achieved
Additional Points			
<p>Note 1: At this point the aerodrome emergency plan is fully instigated and the supporting services can relieve B3, 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.</p> <p>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.</p>			

Notes: It can be seen that four fire-fighters and two supervisors including the officer in charge are required to achieve the above, supported by two Major Foam Tenders. The timings can be further verified by the use of practical exercises and individual analysis to establish if they are realistic and achievable for each task and function.

- ✓ Each of the above tasks can be sub-divided into individual functions associated with the specific task performed at a particular time.
- ✓ Questions that may be asked as part of the TRA:
- ✓ How long does it take to don protective clothing?
- ✓ How long does it take to don self-contained breathing apparatus?
- ✓ How long does it take to slip and pitch a ladder?
- ✓ How long does it take to open an aircraft door from the head of a ladder (if required)?
- ✓ How long does it take to deploy one, two, three, etc., lengths of delivery hose?
- ✓ How long does it take to carry any item of rescue equipment over a specified distance and get to work?

8. Conclusion

- (a) A Task Resource Analysis can be as detailed as necessary. The aim is to itemise the knowledge and practical skills (doing) involved in carrying out the task effectively and to the correct standard. 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 and carrying out a TRA, following questions may be asked:
 - (i). What is done?
 - (ii). Why is it done?
 - (iii). When is it done?
 - (iv). Where is it done?
 - (v). How is it done?
 - (vi). Who does it?
 - (b) The overall objective is to be satisfied that the RFFS is organised, equipped, staffed, trained and operated to ensure the most rapid deployment of facilities to maximum effect in the event of an accident.
 - (c) The above process can also be used to identify equipment shortages and training needs for personnel required to deal with identified tasks.
9. An example for carrying out the TRA is also placed at Appendix 'A' to this circular for further guidance.
10. The manpower requirements for ARFF operation as established by Task and Resource Analysis shall be provided by the license holder and recorded in aerodrome manual. Same may be inspected during the inspections by DGCA officials.

Sd/-
(J.S. Rawat)
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Example.

Working Example of a Qualitative Task Resource Analysis - Scenario 1.

Accident Location: Runway 28 RESA

Airport Category: 10

Aircraft type: Boeing 777-300ER

Key to working example:

Major Crash Fire Tenders are identified as CFT A, B, C & D.

The personnel riding the CFTs are identified as: A1, A2, B1, B2 etc. like.

A1- Crew in-charge of CFT A

A2- Driver of CFT A

A3- Fire Fighter CFT A

A4- Fire Fighter CFT A

Major Crash Fire Tenders:

4 CFTs (A, B, C & D) against minimum requirement of 3 as per ICAO docs. Carrying 12,500 Litres with a total water capacity of 50,000 Litres to maintain the discharge rate with stipulated timeline.

Minimum number of RFFS personnel: Total 15

Supervisors:

Watch Commander: 1 = A1

Crew Commanders: 3 = B1, C1 & D1

Firefighters:

Total- 11.

A2, A3 & A4.

B2, B3. & B4

C2, C3, & C4.

D2 & D3.

Response to emergencies

As per above guidelines, during emergencies 3 CFTs need to respond. The positioning of the CFTs as per the task given is as under:

- (a) CFT A- Near starboard side of the engine on fire and control fire
- (b) CFT B- Near Port side of the Aircraft and control fire on starboard side
- (c) CFT C- Rear side of the starboard side of the Aircraft and control fire
- (d) CFT-D- For replenishment of water to CFTs
- (e) A1- After control of Fire will assist in rescue Operation (Chute-1).
- (f) B1-After control of Fire will assist in rescue Operation (Chute-2).
- (g) C1- After control of Fire will assist in rescue Operation (Chute-3).
- (h) D1-(No separate crew in-charge required)

- (i) A2-Firefighting in the Starboard from front side
- (j) B2- Firefighting from Portside (front)
- (k) C2- Firefighting in the Starboard from rear side
- (l) D2- Replenishing of water in the CFTs
- (m) A3- Firefighting from Starboard side and create rescue path & thereafter support passenger escaping through chute(Chute-1)
- (n) B3- Firefighting from the Portside (front) and create rescue path & thereafter support passenger escaping through chute(Chute-2)
- (o) C3- Firefighting from the Starboard (rear) and create rescue path & thereafter support passenger escaping through chute(Chute-3)
- (p) D3- Assist in Replenishing of water in the CFTs
- (q) A4- Support passenger escaping through chute (Chute-4).
- (r) B4- Support passenger escaping through chute (Chute-4).
- (s) C4- Support passenger escaping through chute (Chute-5).
- (t) D4-Support passenger escaping through chute(Chute-5)

Location

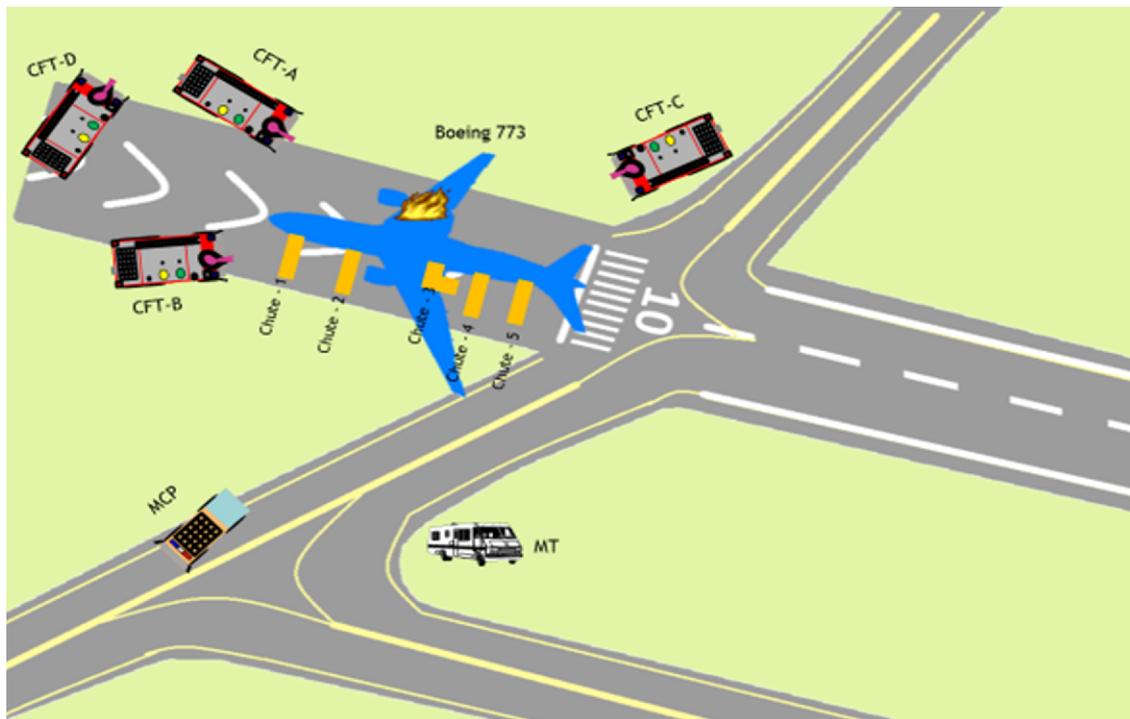


Table- Records of activities for Task and Resource Analysis

Time	Task	Resources	Comments (as per existing deployment)
0:00	Call received from ATC as accident on runway 28 RESA. Boeing 777-300	Fire Watch Tower Controller/AOCC	Achieved/ Not Achieved
0:00	ARFF personnel mobilized by FWT	FWT	Achieved/ Not Achieved
0:15	CFTs made turnout from fire station 3 & 4	OC & Crew	Achieved/ Not Achieved
0:30	Personnel donning appropriate PPE		Achieved/ Not Achieved
0:40	Route selected & all appliances mobile enroute Runway 28 RESA	OC, A1, B1,C1	Achieved/ Not Achieved
0:50	OC, CFT Communicate with ATC by VHF	OC, A1,B1,C1	Achieved/ Not Achieved
2:00	All CFTs are in position:	A2,B2,C2	Achieved/ Not Achieved
	Priority identified by OC to extinguisher ground pool fires and fire in number 2 engine that is impinging on fuselage	OC	Achieved/ Not Achieved
	OC activate Incident Command System	OC	Achieved/ Not Achieved
	Create and maintain survivable conditions for the passengers to reach a place of safety	A1,B1,C1,A3,B3,C3,D3,A4,B4,C4	Achieved/ Not Achieved
	Complementary agent (DCP) required	A2,B2,A3,B3	Achieved/ Not Achieved
3:15	All external fires extinguished	A2,B2,C2 & A3	Achieved/ Not Achieved
03:20	Assist with self evacuation and maintain survivable conditions for the passengers to reach a place of safety	A3,B3	Achieved/ Not Achieved
03:20	Crew prepares to enter aircraft with PPE (BA Sets)	All	Achieved/ Not Achieved
03:20	Crew prepares appropriate entry point and hand lines	B3, C3	Achieved/ Not Achieved
04:15	Following self evacuation of aircraft provide assistance with mustering passengers and crew to place of safety	Fire Crew	Achieved/ Not Achieved
04:15	A2,B2,C2 remains as roof turret operator and provides escape route protection.	A2,B2,C2	Achieved/ Not Achieved
04:30	OC liaise with FWT to ensure appropriate resources are brought	OC	Achieved/ Not Achieved

	forward to the accident location.		
04:50	OC instructs MCP in charge to assist in containing existing passengers and crew and obtaining a head count of survivors.	MCP in charge	Achieved/ Not Achieved
04:55	MT reports & deploys medical equipment as per the direction of medical coordinator.	MV in charge	Achieved/ Not Achieved
	A simultaneous fire in the city side area during the emergency		Achieved/ Not Achieved

Analysis of minimum manpower requirements for carrying out firefighting and rescue operations

Aerodrome Category- 10			
Sl. No.	Details of requirement	No. of person	Remarks
(a)	Drivers for CFT	4	3 For 3 CFTs and 1 for the Replenishing Vehicle. As per the standard nobody will leave the vehicle
(b)	For generation of rescue path and protection during chute use	10	2 person per chute as 777-300 have 5 chutes in both sides and during emergency only one side chute will be recommended for operation.
(c)	Assistant for the replenishing vehicle	1	Need to accompany the CFT to meet additional water requirement

Notes:

- a) *It can be seen that eleven 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.*

On the basis of above analysis and considering the concern documents the following guidelines shall be considered by all aerodrome operator:-

- a) The minimum number of RFFS vehicles and equipment required for the delivery of the extinguishing agents at the required discharge rate is to be established in accordance with CAR sec 4, Series B Part I Table 9-2 and para 9.2.41.
- b) Minimum manpower requirements should be sustained for operation of each vehicle:-
 - i. CFT - Total manpower for each CFT
 - 4 (for CFT with automated operation)
 - 5 (for CFT with manual operation)

- ii. Replenishment vehicle - Total - 3 (01 Driver + 02 Assistant)
- c) In addition as required following posts should be manned to enhance the firefighting and rescue services:-
- i. Operation Commander - 01
 - ii. Mobile command post- 02
 - iii. Fire watch tower- 01 (Based on no. of movements)