MALDIVES CIVIL AVIATION AUTHORITY
Republic of Maldives

AIR SAFETY CIRCULAR
ASC 139-16

Rescue and Fire Fighting Services (RFFS)

Issue 1.00, 15 June 2025

Foreword

The Air Safety Circular (ASC) 139-16 titled *"Rescue and Fire Fighting Services (RFFS)"* is issued by the Maldives Civil Aviation Authority (CAA) to support the continuous enhancement of aerodrome emergency preparedness and operational safety.

Rescue and Fire Fighting Services are a critical component of the aerodrome safety management framework, providing immediate response capabilities in the event of aircraft emergencies and other life-threatening incidents on the aerodrome. This ASC provides guidance and acceptable means of compliance to meet the requirements prescribed under MCAR-139 Aerodrome Rules and complements the aerodrome standards set out in ASC 139-5, with a specific focus on RFFS as required by ICAO Annex 14, Volume I, Chapter 9. It addresses essential elements such as the level of protection to be maintained, training of RFFS personnel, equipment necessary for complex environments, and facility requirements to ensure operational readiness and resilience.

This circular reflects the State's commitment to fostering a responsive and capable emergency response framework across all certified aerodromes.

This circular will be subject to regular review and updated as necessary to reflect changes in international standards, national requirements, and operational practices.

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Chapter 1 — General

1.1 Introduction

1.1.1 This Air Safety Circular (ASC 139-16) sets forth guidance related to the planning, implementation, and oversight of Rescue and Fire Fighting Services at certified aerodromes.

1.1.2 The circular shall be applicable from 15 June 2025 at 0000 UTC.

1.2 Definitions

1.2.1 Definitions of the terms and abbreviations used in this Circular, unless the context requires otherwise, are in MCAR-1 Definitions and Abbreviations.

1.3 Purpose

1.3.1 The purpose of ASC 139-16 is to provide recommendation and guidance to ensure that aerodrome Rescue and Fire Fighting Services (RFFS) are planned, structured, and maintained in accordance with applicable regulatory requirements and best practices.

1.3.2 This circular aims at supporting aerodrome operators in achieving and sustaining an adequate level of emergency response capability proportionate to the aircraft operations at each aerodrome.

Specifically, it establishes expectations regarding:

a) Minimum training standards for RFFS personnel.

b) Required level of protection based on aerodrome category.

c) Provision of rescue equipment suitable for difficult or challenging environments, and

d) Infrastructure and facility requirements necessary to support RFFS operations effectively.

1.4 Applicability

1.4.1 This Air Safety Circular (ASC 139-16) applies to all certified aerodrome operators within the Maldives that are required to provide Rescue and Fire Fighting Services (RFFS) in accordance with MCAR-139 Aerodrome Rules and the national standards outlined in ASC 139-5.

1.5 Effective Date

1.5.1 This Air Safety Circular is effective from 16 June 2025.

1.6 References

a) Air Safety Circular 139 – 5 Aerodrome Standards

Chapter 2 — Administration

2.1 General

2.1.1 The rescue and firefighting service at an aerodrome should be under the administrative control of the aerodrome management, which should also be responsible for ensuring that the service provided is organized, equipped, staffed, trained and operated in such a manner as to fulfil its proper functions.

2.1.2 In drawing up the detailed plan for the conduct of search and rescue operations in accordance with 4.2.1 of ICAO MCAR 12 - Search and Rescue, the aerodrome management should coordinate its plans with the relevant rescue coordination centres to ensure that the respective limits of their responsibilities for an aircraft accident within the vicinity of an aerodrome are clearly delineated.

2.1.3 Coordination between the rescue and firefighting service at an aerodrome and public protective agencies, such as local fire brigade, police force, coast guard and hospitals, should be achieved by prior agreement for assistance in dealing with an aircraft accident.

2.1.4 A grid map of the aerodrome and its immediate vicinity should be provided for the use of the aerodrome services concerned. Information concerning topography, access roads and location of water supplies should be indicated. This map should be conspicuously posted in the control tower and fire station, and available on the rescue and fire-fighting vehicles and such other supporting vehicles required to respond to an aircraft accident or incident. Copies should also be distributed to public protective agencies as desirable.

2.1.5 Coordinated instructions should be drawn up detailing the responsibilities of all concerned and the action to be taken in dealing with emergencies. The aerodrome operator should ensure that such instructions are promulgated and observed.

Chapter 3 — Personnel

3.1 General Requirements

3.1.1 The total number of personnel, whether regular or auxiliary, required to deploy and operate the RFF service should be determined so as to meet the following criteria:

a) the RFF vehicles should be staffed so as to ensure their ability to discharge at their maximum designed capability extinguishing agents, principal or complementary, both accident/incident; and effectively and simultaneously, at an aircraft

b) any control room or communications facility operated by, and serving, the RFF service can continue to provide this service until alternative arrangements to undertake this function are initiated by the airport emergency plan.

3.1.2 In addition, in determining the minimum number of RFF personnel required, a task resource analysis (see Chapter 7) should be completed and the level of staffing documented in the Aerodromes Manual. During flight operations 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.

3.1.3 Consideration should also be given for personnel to use handlines, ladders and other RFF equipment normally associated with aircraft RFF operations. The responding vehicles should provide at least the minimum discharge rates specified in the tables. The remainder of the vehicles may be staffed by personnel not necessarily employed in close proximity to their vehicles but able to respond when the alarm sounds so as to reach the scene of the accident no more than one minute after the first responding vehicles so as to provide continuous foam application.

3.1.4 All personnel (regular and/or auxiliary) provided for aircraft RFF duties, should be fully trained in the performance of their duties and under the direction of a designated chief of emergency crew (Chief Fire Officer). Selected personnel should receive special driving instructions in cross-country and soft-ground techniques. Where the response area of

the RFF service includes water, or other difficult terrain and suitable rescue equipment and procedures are provided for these locations, the personnel designated to respond should be adequately trained and exercised to provide a prompt and effective service.

3.2 Selection of Personnel for RFF Duties

3.2.1 Personnel recruited for RFF services should be resolute, possess initiative, competent to form an intelligent assessment of a fire situation and, above all, must be well trained and fully qualified. Ideally, every individual should be capable of sizing up changing circumstances at an aircraft accident and taking the necessary action without detailed supervision. Where the available staff displays limited capacity to use initiative, the deficiency must be corrected by the provision of additional supervisory staff of a superior grade who will be responsible for exercising control of their crews. The officer responsible for the organization and training of the RFFS should be a well experienced, qualified and competent leader. The capabilities of this officer should be proved by training at a recognized and MCAA approved RFFS training establishment and measures should be taken to ensure the officer's continuing proficiency.

3.2.2 Due regard should be given to the arduous nature of RFF duties and personnel selected for this work should be free from any physical disability which might limit their performance, or which might be aggravated by a high level of exertion. Particular care should be taken in selecting personnel as wearers of respiratory protection equipment, where psychological factors are significant, in addition to physical suitability.

3.3 Management of RFF personnel

3.3.1 Full-time RFF personnel may be assigned other duties, provided that the performance of these does not impair their ability to respond immediately to an emergency, or restrict their performance of essential training, inspections and equipment maintenance. These subsidiary duties could include fire prevention inspections, fire guard duties or other functions for which their equipment and training makes them particularly suitable. Arrangements must exist for their immediate mobilization in the event of an emergency and, wherever possible, a crew assigned to subsidiary duties should travel in the RFF vehicle to which they are appointed, maintaining constant contact with the fire station by radio.

3.3.2 The airport emergency plan should provide for the alerting of all personnel who may contribute to the effective performance of post-accident operations in a support role to the RFF crews.

3.4 Physical and Medical Fitness Assessments for RFF Services

3.4.1 As the nature of RFF operations involves periods of intense physical activity, all RFF personnel have to possess a minimum level of physical fitness and medical fitness to be able to perform the tasks associated with these operations. Physical fitness and medical fitness are often described as the overall physical condition of the body, which can range from peak condition for performance at one end of the spectrum to extreme illness or injury at the other. The key fitness components for RFF are generally aerobic fitness, anaerobic fitness, flexibility and medical fitness. Optimum physical fitness and medical fitness for RFF personnel would mean that a firefighter is able to carry out RFF activities safely, successfully and without undue fatigue.

3.4.2 **Aerobic fitness** is the ability to continue to exercise for prolonged periods of time at low to moderate or high intensity. This is typically what limits the ability to continue to run, cycle or swim for more than a few minutes and is dependent upon the body's heart, lungs and blood to get the oxygen to the muscles (CO2) providing the sustained energy needed to maintain prolonged exercise. Typical aerobic activities include walking, jogging, cycling, rope skipping, stair climbing, swimming, or any other endurance activities.

3.4.3 **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 weightlifting, running up several flights of stairs, sprinting, power swimming, or any other rapid burst of hard exercises.

3.4.4 **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. Flexibility is best developed using slow controlled stretching exercises.

3.4.5 **Physical fitness** assessment should be catered to the components mentioned above. 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 assessment should also be conducted at least once a year. The physical fitness assessment should be conducted for pre-employment entry as a firefighter as well as ongoing physical fitness assessments for existing RFF staff to ensure they are maintaining their level of physical fitness.

3.4.6 **Medical fitness** assessments specific to RFF services should be developed. The medical fitness assessments should be conducted for pre-employment entry as a firefighter as well as ongoing medical fitness assessments for existing staff. The frequency of medical fitness assessments should be determined by each agency. The medical fitness assessments should be used to identify any underlying medical conditions, which may pose a risk to the individual firefighter during physically demanding activities.

Chapter 4 — Training

4.1 General

4.1.1 The training curriculum should include initial and recurrent instruction in at least the following areas:

a) Airport familiarization.

b) Aircraft familiarization.

c) rescue and firefighting personnel safety.

d) emergency communications systems on the aerodrome, including aircraft fire-related alarms.

e) use of the fire hoses, nozzles, turrets and other appliances required for compliance with ASC 139-5 Chapter 9, 9.2.

f) application of the types of extinguishing agents required for compliance with ASC 139-5 Chapter 9, 9.2.

g) emergency aircraft evacuation assistance.

h) firefighting operations.

i) adaptation and use of structural rescue and fire-fighting equipment for aircraft rescue and firefighting.

j) dangerous goods.

k) familiarization with firefighters' duties under the aerodrome emergency plan; and

l) protective clothing and respiratory protection.

4.2 Training and procedures manual

4.2.1 The aerodrome operator providing RFFS shall have a training and procedures manual. The training and procedures manual must include the following information:

a) General information of the organisation showing charts and posts within the RFFS, and the associated chains of responsibilities between the posts.

b) General description of the scope and training objectives of the ARFF trainings provided.

c) A description of each training course offered including the course material, training simulators, equipment and facilities to be used to comply with the requirements in this circular.

d) A description of any additional training when needed to meet the requirements of certified operator of an aerodrome.

e) A description of the standard operating procedures to ensure the safety of instructors, assessors and trainees when training is conducted.

f) A description of the assessment procedures and standards required by 4.6.

g) A description of the ARFFT organisation's training simulators, equipment and facilities, in particular training simulators for compliance with the requirements in 4.7 and 4.8.

h) A description of the duties and qualifications of the personnel designated as responsible for the planning, performing and supervising of the training in 4.6.

i) A description of the procedures used to establish and maintain the competence of instructors as required by 4.10.

j) A description of the selection process, qualifications, role and duties of the assessors designated to perform assessments as required by 4.11.

k) A description of the method used for the completion and retention of the training records required by 4.12 and 4.13.

l) The procedures necessary to ensure compliance with this chapter.

m) The procedure for notifying the CAA of changes to any training course established pursuant to 4.5, at least 2 weeks prior to the start of the course.

4.3 Control of Training and procedures manual

4.3.1 The procedures for the control, amendment and distribution of the training and procedures manual must ensure that:

a) Necessary amendments are made to the training and procedures manual to keep the information contained therein up to date.

b) Any amendments are reviewed and authorised by the appropriate personnel.

c) Any amendment to the training and procedures manual are recorded, including the reasons for the amendment.

d) The current version of the training and procedure manual is identifiable such that the use of superseded material is precluded.

e) The current version of the training and procedures manual is made available to relevant personnel at all locations where the personnel require access to the manual; and

f) All obsolete documentation is promptly removed from all points of issue or use.

4.4 Quality assurance system

4.4.1 The organisation providing RFFS training must establish a quality assurance system, acceptable to the CAA, which ensures that training and instructional practices comply with all relevant requirements.

4.4.2 The quality assurance system must include an internal audit programme to ensure compliance with the Manual.

4.5 Training

4.5.1 The organisation must establish courses with training curriculum that includes initial and recurrent instruction in the following areas:

4.5.2

a) Basic RFF training.

b) Intermediate RFF training; and

c) Advanced RFF.

4.5.3 **Basic RFF training**

a) The organisation must design and provide a basic RFF training and conduct assessments in accordance with the course syllabus.

b) The organisation must ensure that the basic RFFS training includes practical exercises involving pressure-fed fuel fires to give entry level rescue and firefighting personnel adequate exposure related to aircraft fire fighting.

4.5.4 **Intermediate RFF training**

a) The organisation must design and provide an intermediate RFF training course for fire officers and conduct assessments:

i. In accordance with the course syllabus.

ii. that will equip such personnel with the theory, principles and practices of fire station management, tactical firefighting involving various emergencies and fireground command to prepare them for their roles as airport fire officers.

b) The organisation must ensure that an intermediate RFF training includes practical exercises.

c) The ARFFT organisation must establish the qualifying criteria for entry into the intermediate RFF training course and incorporate such criteria into its training and procedures manual.

4.5.5 **Advanced RFFS training**

a) The organisation must design and provide an advanced RFF training course for senior fire officers and conduct assessments:

i. In accordance with the course syllabus.

ii. That will equip such fire officers with the theory, principles and practices of fire station management, facilities and fire safety planning, as well as command and control at aircraft crash sites to prepare them for their roles as senior fire officers.

b) The organisation must establish the qualifying criteria for entry into the advanced RFF training course and incorporate such criteria into its training and procedures manual.

4.6 Training Assessments

4.6.1 The ARFFT organisation must establish procedures and standards on the conduct of assessments and examinations connected with the courses specified in the 4.5.1.

4.7 Training facilities

4.7.1 The organisation must have or provide the necessary facilities to ensure that ARFFT and the conduct of assessments connected with RFFS training can be provided in accordance with the training and procedures manual and in a safe manner.

4.7.2 The facilities must include training simulators (including the essential simulators in 4.8, a training ground, equipment for practical training, aircraft mock-up and lecture rooms suitable for classroom teaching.

4.7.3 The organisation must provide office accommodation for instructors and assessors of a standard that will ensure that an instructor or assessor can prepare for his or her duty without undue distraction.

4.8 Essential training simulators

4.8.1 The organisation must have access to the following essential simulators:

a) breathing apparatus simulator.

b) civil aircraft fire simulator.

c) pressured-fed fuel fire simulator.

d) flashover simulator.

e) confined space simulator

f) airport foam tender simulator.

4.8.2 A simulated fire using the simulators mentioned in (4.8.1)(b), (c), (d), and (e) must include a pit fire or a fire with an aircraft mock-up or similar device using enough fuel to provide a fire or smoke intensity which simulates realistic firefighting conditions.

4.8.3 Any training simulator, equipment or facility that is unserviceable must be repaired or rectified as soon as reasonably possible, and an alternative or replacement be made available to ensure that training and standards provided by the organisation will not be compromised.

4.9 Personnel requirements

4.9.1 The organisation must directly employ or have on secondment such number of fully qualified individuals as ARFF training instructors and assessors to deliver the ARFF training and perform the assessments of ARFF training, or both, in accordance with the training and procedures manual.

4.9.2 The organisation must not appoint an individual as an instructor or assessor unless the individual meets the selection criteria mentioned in 4.10.

4.9.3 An individual may carry out any combination of the roles of an instructor and assessor in relation to any ARFF training, only in accordance with the selection criteria and duty statements referred to in 4.2.

4.9.4 The organisation must state in its training and procedures manual, selection criteria and duty statements for its instructors or assessors, which specify standards (including, but not limited to, the qualifications and experience in paragraph 4.10 for the initial appointment of and maintaining the competency of its instructors or assessors.

4.10 Qualification of instructors

4.10.1 Instructors who are appointed to provide basic RFF training and intermediate RFF training must meet the following requirements:

a) Have a minimum of 5 years' experience with a rescue and firefighting service provider.

b) Have leadership exposure in operations with a rescue and firefighting service provider.

c) Pass the intermediate RFF training course.

d) Pass the Breathing Apparatus Operations Training Course or equivalent.

e) Possess relevant instructional techniques.

f) Possess effective communication skills.

g) Be able to conduct theoretical and practical assessments.

h) Possess a valid Medical First Aid certification.

i) Have knowledge of the Standards and Recommended Practices in Annex 14 to the Chicago Convention, Procedures for Air Navigation Services Aerodromes Doc 9981, Airport Services Manual Doc 9137 and other applicable documents issued by ICAO, where relevant.

j) Are trained in knowledge and skills related to human performance including team coordination which can be found in the Human Factors Training Manual under ICAO Doc 9683; and

k) Are assessed as competent to conduct classroom lessons, practical simulator training and assessment of student competence.

4.10.2 Instructors who are appointed to provide the advanced RFF training course must, in addition to the requirements in 4.10.1, have undergone and passed the advanced RFF training course conducted by an ARFFT organisation.

4.10.3 Every instructor must complete the initial and recurrent training appropriate to their assigned tasks and responsibilities.

4.10.4 The organisation must ensure that all personnel engaged by it to augment the training conducted by instructors are assessed to be competent and qualified.

4.11 Qualification of assessors

4.11.1 The organisation must designate such number of assessors to perform assessments or examinations of ARFF trainings in accordance with the training and procedures manual.

4.11.2 Every assessor conducting the assessment for basic RFF training, intermediate RFF training or advanced RFF training courses must meet the same set of criteria as applicable to an instructor providing the corresponding training.

4.12 Records of training

4.12.1 The organisation must, for each trainee undergoing ARFF training

a) Keep a written record of all ARFF trainings and any assessment undertaken by the trainee on or after the date of commencement of this circular; and

b) Ensure that every record required by this paragraph is legible and in a permanent form, is clear and accurate, and is in a readily accessible format.

c) The organisation must keep, and have ready access for the CAA to, a copy of every record required by 4.12.1 for 5 years from the date of completion of the ARFF training or assessment to which the record relates.

d) This section applies to every ARFF training or assessment that commences on or after 1 October 2025.

4.13 Control of training courses records

4.13.1 The organisation must keep records of all training courses conducted on or after the date of commencement of this Circular, including the training plan, the instructors who conducted the courses and course materials used.

4.13.2 The organisation must keep records of any course variation made as a result of course reviews, together with the reasons for the course variation and when the CAA was notified of the variation.

4.13.3 A record mentioned in sub-paragraph (4.13.1) or (4.13.3) must be kept by the organisation for at least 5 years from the date of completion of each course to which the record relates.

Chapter 5 — Level of protection to be provided

5.1 General

5.1.1 In accordance with ASC 139-5 Chapter 9, 9.2, aerodromes should be categorized for rescue and firefighting purposes and the level of protection provided should be appropriate to the aerodrome category.

5.1.2 ASC 139-5 Chapter 9, 9.2.3, permits a lower level of protection to be provided for a limited period where the number of movements of the aeroplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months. It is important to note that the concession included in ASC 139-5 9.2.3 is applicable only where there is a wide range of difference between the dimensions of the aeroplanes included in reaching 700 movements.

Chapter 6 — Rescue equipment for difficult environments

6.1 General

6.1.1 Suitable rescue equipment and services should be available at an aerodrome where the area to be covered by the service includes water, swampy areas or other difficult environment that cannot be fully served by conventional wheeled vehicles. This is particularly important where a significant portion of approach/departure operations takes place over these areas.

6.1.2 The rescue equipment should be carried on boats or other vehicles such as helicopters and amphibious or air cushion vehicles, capable of operating in the area concerned. The vehicles should be so located that they can be brought into action quickly to respond to the areas covered by the service.

6.1.3 At an aerodrome bordering the water, the boats or other vehicles should preferably be located on the aerodrome, and convenient launching or docking sites provided. If these vehicles are located off the aerodrome, they should preferably be under the control of the aerodrome rescue and firefighting service or, if this is not practicable, under the control of another competent public or private organization working in close coordination with the aerodrome rescue and firefighting service (such as police, military services, harbour patrol or coast guard).

6.1.4 Boats or other vehicles should have as high a speed so as to reach an accident site in minimum time. To reduce the possibility of injury during rescue operations, water jet-driven boats are preferred to water propeller- driven boats unless the propellers of the latter boats are ducted. Should the water areas to be covered by the service be frozen for a significant period of the year, the equipment should be selected accordingly. Vehicles used in this service should be equipped with life rafts and life preservers related to the requirements of the larger aircraft normally using the aerodrome, with two-way radio communication, and with floodlights for night operations. If aircraft operations during periods of low visibility are expected, it may be necessary to provide guidance for the responding emergency vehicles.

6.1.5 The personnel designated to operate the equipment should be adequately trained and drilled for rescue services in the appropriate environment.

Chapter 7 — Task Resource Analysis

7.1 Introduction

7.1.1 A Task Resource Analysis (TRA) should be completed to establish justification as to the minimum number of competent personnel required to deliver an effective airport rescue and Firefighting Services (RFFS) 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 the aircraft incidents/accidents, due regard must be given to the inability of not meeting required response times and robust procedures should be introduced accordingly.

7.2 Purpose

7.2.1 By using a qualitative risk-based approach, which focuses upon probable and credible worst-case scenarios, a task and resource analysis should be done 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.

7.2.2 Consideration should be given to the types of aircraft using aerodrome, as well as the need for personnel to use self-contained breathing apparatus, handlines, ladders and other RFF equipment provided at aerodrome associated with aircraft RFF operations.

7.3 General Information

7.3.1 The airport operator should first establish the minimum requirements including minimum numbers 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.

7.3.2 The TRA should observe human factors principles to obtain optimum response by all existing agencies participating in emergency operation. The principles should include all the effect of human performance due to workload, capabilities, functions, decision aids, environmental constraints, team versus individual performance, and training effectiveness.

7.4 Task analysis / risk assessment

7.4.1 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.

7.5 Qualitative Approach

7.5.1 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 analysed to assess the relative effectiveness of at least two levels of RFFS staffing.

7.6 Quantitative risk assessment

7.6.1 This assessment will generally be used to support the conclusion of the qualitative analysis by examining 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.

7.7 Task analysis

7.7.1 The following items will assist in determining the basic contents of a TRA:

a) Description of the aerodrome(s) including the number of runways.

b) Promulgated RFFS categories (Aeronautical Information Publication).

c) Response time criteria (area, times and number of fire stations).

d) Current and future types of aircraft movements.

e) Operational hours.

f) Current RFFS structure and establishment.

g) Current level of personnel.

h) Level of supervision for each operational crew.

i) RFFS qualifications/competence (training program and facilities).

j) Extraneous duties (to include domestic and first aid response).

k) Communications and ARFFS alerting system including extraneous duties.

l) Appliances and extinguishing agents available.

m) Specialist equipment: (i.e.: fast rescue craft, hovercraft, water carrier, hose layer, extending boom technology and high reach extendable turret technology).

n) Initial emergency medical aid - role and responsibility.

o) Medical facilities: role and responsibility.

p) Pre-determined attendance - local council authority services, police, fire and ambulances, etc.

q) Incident task analysis - feasible worst-case scenarios, workload assessment, human performance/factors. It should include:

   i. Mobilization

   ii. Deployment to scene

   iii. Scene management

   iv. Firefighting

   v. Suppression and extinguishment

   vi. Application of complementary agents

   vii. Post fire security/control

   viii. Personal Protective Equipment (PPE)

   ix. Rescue teams

   x. Aircraft evacuation

   xi. Extinguishing agent replenishment (note: the aim to identify any pinch points within the current workload and proposed workload).

Note: *This aim to identify any pinch points within the current workload and proposed workload.*

r) Appraisal of existing RFFS provision

s) Future requirements-aerodrome development and expansion

t) Enclosure could include – airport maps, event trees to explain tasks and functions conducted by the RFFS.

u) AEP and procedures.

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

7.8 Phases of conducting TRA

7.8.1 Phase 1

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

Example:

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.

Principle objectives of the RFFS:

The principle 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 assume primary importance because it is within this area that the greater 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 routs

d) Assist in the self-evacuation of the aircraft

e) Create a survivable situation

f) Rescue trapped personnel

g) Maintain post fire/security control; and

h) Preserve evidence.

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

7.8.2 Phase 2

Identify a selection of representatives realistic, feasible accidents that may occur at the airport. This can be achieved by a statistical analysis of previous accidents of airports and by analysing data from international, national and local sources.

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

Examples:

a) Aircraft engine failure on take-off with a fire (aborted take-off)

b) Aircraft aborts and overruns into the runway end safety area (RESA) with a fire on take-off.

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); and

f) Internal aircraft fire (cabin fire, baggage hold, cargo hold, avionics bay(s).

7.8.3 Phase 3

Identify the types of aircraft commonly in use at the airport. This is important as the types of aircraft, and its configuration has been a direct bearing on the resources required in meeting Phase 1. 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:

a) Long wide-bodied aircraft with multiple passenger decks and multiple aisles.

b) Long narrow-bodied aircraft with single aisle, high passenger density; and

c) Short narrow-bodied aircraft with single aisle, high passenger density.

A representative aircraft type then can be chosen, i.e. Airbus A380, Airbus A330, Airbus A320, Boeing 747, Boeing 777, Boeing 737, ATR 42, ATR 72, Dash 8-300, Dash 8-Q400, Dash 6-300, etc.

7.8.4 Phase 4

a) Every airport is unique in that the location, environment, runway and taxiway configuration, aircraft movements, airport infrastructure and boundary, etc., may represent specific additional risks.

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 type that may occur.

c) To confirm the location of the scenario, it is important that a facilitator using a team of experienced fire service personnel, who have the knowledge of the airport and the locations in which an aircraft accident is likely to occur, evaluate the scenario.

d) The role of facilitator is to seek agreement in identifying the work-case locations and, by using a scoring system place, these locations in order of relevance and priority. The team them determine why the locations have been identified and provide rational for each location. One methodology would be to award a weighted

number to each location, then total number to each location, then total the numbers in relation to each identified location.

Example:

The team may have identified that the following contributed to a worst-case location:

i. Response time
ii. Route to the aircraft accident site (on or off paved surfaces)
iii. Terrain
iv. Crossing procedures for active runway(s)
v. Aircraft congestion on route (taxiways)
vi. Surface conditions
vii. Communications
viii. Supplementary water supplies
ix. Adverse weather conditions – low visibility procedures; and
x. Daylight or darkness.

e) An additional time delay for any of these factors listed above should be estimated and recorded, then the location with the highest additional response time could be identified as the worst-case location.

f) 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 RFF personnel.

g) From the above analysis, a location or a number of locations could be identified, in agreement with the airport operator and the TRA facilitator.

7.8.5 Phase 5

a) Phase 5 combines the accident types to be examines as described in Phase 2, with the aircraft identified in Phase 3 and the locations as described in Phase 4. The accident type should be correlated with the possible location. In some case this could

be in more than one location on an airport, for which a task and resource analysis needs to be carried out.

b) The above information is to be built into a complete accident scenario that can be analysed by experienced supervisors and firefighters for the task and resource analysis in the Phase 6.

Example: Scenario 1:

Accident type: Aircraft overrun into RWY 18 RESA (Phase 2)

Aircraft identified: B 777-300ER (Phase 3)

Accident Location: Runway 18 RESA (Phase 4)

c) The Boeing 777-300ER is a wide-bodied twin-engine long-range aircraft. Its typical seating configuration may include 10 First Class, 50 Business Class, and 300 Economy Class passengers, resulting in an estimated seating capacity of approximately 360–400, excluding the crew. The aircraft features eight main cabin doors (four on each side), with additional emergency exits located over the wings.

d) During the take-off roll, the aircraft suffers a fire in engine number 2 (right engine). The flight crew immediately initiates a rejected take-off procedure. However, the engine fire escalates rapidly and begins to impinge on the fuselage, triggering structural and internal damage. The aircraft overruns the runway and comes to a stop within the Runway 30 RESA (Runway End Safety Area). The flight deck crew initiates a full evacuation of passengers and crew.

e) The Rescue and Fire Fighting (RFF) services are notified by Air Traffic Control (ATC) and respond without delay. The aerodrome emergency procedures are activated in accordance with the airport's Emergency Plan, and coordination with mutual aid agencies is initiated as necessary.

7.8.6 Phase 6

a) By using a TRA facilitator with team of experienced airport supervisors and firefighters the accident scenario(s) developed in phase 5 is subjected to a task resource analysis carried out in a series of a tabletop exercise/simulations.

b) When carrying out a task resource analysis, the principle objective should be to identify in ream 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 RFF service (the dispatcher may have to respond as part of the minimum riding strength).

   ii. respond utilizing communications, taking appropriate route and achieving the defined response criteria.

   iii. position appliances/vehicles in optimum positions and operate RFF appliances effectively

   iv. use extinguishing agents and equipment; accordingly,

   v. instigate incident command structure - supervisors.

   vi. assist in passenger and crew self-evacuation.

   vii. access aircraft to carry out specific tasks if required, e.g. firefighting, rescue.

   viii. support and sustain the deployment of firefighting and rescue equipment.

   ix. support and sustain the delivery of supplementary water supplies; and

   x. need to replenish foam supplies as needed.

c) 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.

d) In order to start a task and resource analysis the required category of the airport must be identified as required by the CAA. 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 and equipment.

e) 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:

i. receipt of message and dispatch of the RFF response

ii. time - this starts from the initial receipt of call and the timeline continues in minutes and seconds until additional external resources arrive or the facilitator decides an end-time

iii. list of assessed tasks, functions and priorities achieved

iv. the resources (personnel, vehicles and equipment) required for each task should be defined.

v. Comments to enable team members to record their findings; and

vi. identified pinch points.

7.9 Conclusion

7.9.1 A task analysis can be as detailed as necessary. The aim is to itemize the knowledge and practical skills (doing) involved in carrying out the task or function effectively and to the correct the standard of competence based on a qualitative analysis. Having gathered the appropriate data and agreed to 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 task and resource analysis, ask the following questions:

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?

7.9.2 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 the 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 8 — Facilities

8.1 General

8.1.1 The provision of special telephone, two-way radio communication and general alarm systems for the rescue and firefighting service is desirable to ensure the dependable transmission of essential emergency and routine information. Consistent with the individual requirements of each aerodrome, these facilities serve the following purposes:

a) direct communication between the ATC and the aerodrome fire station in order to ensure the prompt alerting and dispatch of rescue and firefighting vehicles and personnel in the event of an aircraft accident or incident.

b) direct communication between the rescue and firefighting service and the flight crew of an aircraft in emergency.

c) emergency signals to ensure the immediate summoning of designated personnel not on standby duty.

d) as necessary, summoning essential related services on or off the aerodrome; and

e) maintaining communication by means of two-way radio with the rescue and firefighting vehicles in attendance at an aircraft accident or incident.

8.1.2 The availability of ambulance and medical facilities for the removal and after-care of casualties arising from an aircraft accident should receive the careful consideration of the aerodrome operator and should form part of the overall emergency plan established to deal with such emergencies.

Chapter 9 — Preventive maintenance of vehicles and rescue equipment

9.1 General

9.1.1 The principal objective of an airport RFFS is to "save lives in the event of an aircraft accident or incident". The most important aspects bearing on effective rescue in a survivable aircraft accident or incident is the training received and the effectiveness of the fire vehicles and associated rescue equipment, and the speed in which personnel and equipment can be deployed.

9.1.2 The ASC 139-5, requires that a maintenance programme, including preventive maintenance where appropriate, shall be established to maintain facilities in a condition which does not impair the safety, regularity or efficiency of air navigation.

9.1.3 Due to the increasing complexity of specialized aviation fire vehicles and their associated rescue equipment a programme of regular and ongoing preventive maintenance is paramount to ensure availability and reliability. A robust maintenance programme would also maximize the lifecycle of both fire vehicles and rescue equipment.

9.2 Preventive Maintenance

9.2.1 To ensure ongoing reliability and peak performance of any fire vehicle or rescue equipment is maintained, and to ensure that RFFS are provided at the required levels, all RFF vehicles and rescue equipment need to have regular preventive maintenance conducted on them.

9.2.2 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.

9.2.3 A maintenance programme should take into account the following activities:

a) original equipment manufacturer (OEM) maintenance recommendations.

b) local environmental conditions, for example tropical heat versus heavy rains.

c) National Regulatory requirements - e.g., certification of pressure vessels, hoses, roadworthiness certificates; and

d) regular performance testing.

9.3 Personnel

9.3.1 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 organizational Safety Management Systems.

9.3.2 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.

g) knowledge of regulatory requirements pertaining to the provision of RFF; and

h) knowledge of operators SOP pertaining to maintenance activities.

9.3.3 Specialist training should be initially provided by the OEM with the delivery of the first type of fire vehicle or item(s) of rescue equipment.

9.3.4 It is essential that personnel working on this type of equipment to be licensed.

9.4 Maintenance Procedures

9.4.1 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 RFFS are minimized. E.g., 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 OEM e.g., visual check, inspections & measurements.

d) activities to be undertaken at each type of maintenance service as recommended by Operators SOP.

e) arrangements for technical support from the OEM or the OEM's local agent (if applicable).

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

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

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

i) tire replacement requirements.

j) environmental procedures including appropriate disposal procedures for old parts as well as used lubricants and coolants.

k) 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/gases; and

l) the method of reporting and documenting any defects that have been identified with the fire vehicles or rescue equipment by operational and maintenance personnel.

9.5 Maintenance Work Areas / Special Tools

9.5.1 Provision of a work area for maintaining RFF 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 bunding.

c) lifting/jacking equipment.

d) wheel lifters/tire changing cages; (v) storage areas for lubricants, spare parts and tools.

e) storage of technical documentation; and

f) storage of maintenance records.

9.5.2 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) a ventilated area for operating engine-powered tools, for example, portable saws or hydraulic rescue units; and

d) ventilation for charging batteries.

9.5.3 Modern day RFF 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. E.g.:

a) Multimeters

b) liquid flow meters.

c) tension wrenches.

d) pressure gauges; and

e) air quality testing for breathing apparatus.

9.5.4 To comply with requirements, some workshop equipment used by maintenance personnel may require regular safety certification by an accredited certifying body. Some examples are:

a) lifting/jacking equipment such as cranes, pulleys, slings, chains, and shackles.

b) workshop air receivers.

c) pressure test equipment, such as hoses and fittings; and

d) electrical test and tagging of alternating current (AC) equipment, such as power tools, electrical cables, and workshop machines.

9.6 Performance Testing – Fire vehicles

9.6.1 While an RFFS 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 RFFS 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.

9.6.2 Records of any performance tests undertaken should be retained, as it is a record of the fire vehicle continuing to meet the specifications, and allows future review if performance starts to deteriorate. Where multiple fire vehicles of the same type are stationed at the same location or operated by the same service provider, it allows prediction of when the same performance deterioration may occur on other fire vehicles.

9.7 Rescue Equipment Requirements

9.7.1 The maintenance requirements for rescue equipment should be in accordance with OEM requirements. However, due to the nature of firefighting, equipment can sometimes unknowingly become damaged. Consequently, it is essential to check the following:

a) all items - regular daily or weekly checks to ensure functionality.

b) breathing apparatus sets - maintained after every use and checked regularly when not used for safe operation.

c) BA air quality - regularly checked to ensure air quality is constantly met.

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 six-monthly basis to ensure that the hoses do not 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. Under high forcing loads, damaged components can be very dangerous if they fail

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 toolbox - checked to ensure all tools are present.

9.8 Maintenance Documentation

9.8.1 A complete set of maintenance documentation should 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; (vii) tolerances, specifications and capacities

g) illustrations and exploded views

h) schematic drawings e.g., electrical wiring circuits, pneumatic circuits, chassis air circuits or hydraulic circuits

i) special tools needed for repairing and adjusting; and (xi) spare parts catalogue providing exploded views of the entire fire vehicle.

9.8.2 It is important that the technical documentation is in a format that can be easily read, understood and followed.

9.8.3 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. As a minimum, all drawings should be of A1 size or similar. 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. Electronic copies of all schematic drawings is required.

9.9 Maintenance Record Keeping

9.9.1 A comprehensive set of maintenance records should be kept for each fire vehicle.

9.9.2 Keeping individual sets of maintenance records is also beneficial for each of the larger and more complex 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.

9.9.3 Keeping such documentation has several benefits:

a) provides a historical record of the maintenance of the fire vehicle/equipment, which may be an organizational requirement for legal or compliance reasons

b) provides evidence for any warranty claim that may be made against the OEM.

c) can be referred to in the future (if a similar fault occurs); and

d) provides evidence for any surveillance audit that may be undertaken for regulatory compliance.

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

9.10 Protective Clothing

9.10.1 Protective clothing normally includes, but is not limited to, turnout suits (jackets, overalls complete with suspenders), firefighting boots, gloves and helmet as a minimum. The proper care and preventive maintenance is normally the responsibility of the firefighter and the RFFS.

9.10.2 Protective clothing needs to be inspected for serviceability on a regular basis:

a) by the wearer prior to commencing duty.

b) after use; and (iii)

c) as required.

9.10.3 There are three levels of cleaning - routine, advanced and specialized:

a) routine cleaning is performed after any fire-ground use where soiling has occurred and may involve brushing debris from the clothing, rinsing it with water and/or applying spot cleaning as required.

b) advanced cleaning is more thorough with a frequency dependent on the use and condition of the clothing.

c) specialized cleaning may need to be conducted by an external agency; and

d) any cleaning should consider and comply with the manufacturer's instructions.

9.10.4 Minor repairs may be conducted at 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.

9.10.5 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.

For the Civil Aviation Authority

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