ARFF
Fire Vehicle Replacement 5

Concept of Operations

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1 Introduction

1.1 Purpose

This concept of operations document describes the operational requirements of Aviation Rescue and Fire Fighting (ARFF) fire vehicles under the proposed '*Fire Vehicle Replacement 5 (FVR 5)*' project. This project is focused on meeting ARFF's operational (fire vehicle) capability and service delivery requirements beyond the final delivery of Rosenbauer Ultra Large Fire Vehicle (ULFV) Mark 8's (Mk8), under the FVR 4 project, in approximately June 2014 through to the commencement of the ULFV Mk8 *end-of-life* fire vehicle replacement program in approximately 2020.

The FVR 4 project commenced in 2004 with an initial purchase of 18 of the current generation ULFV Mk 8 fire vehicles. A total of 86 'Rosenbauer' Panther ULFV Mk8 (6 wheel drive and 8,900 litre capacity) fire vehicles will be delivered at the completion of the Rosenbauer contract in June 2014.

Whilst these vehicles have proven to be fit-for-purpose, they have been subject to over 70 minor modifications since their introduction (see Appendix 1). Most of these modifications are attributable to changes in ARFF operational requirements, WHS improvements, heavy vehicle compliance and new firefighting equipment design or technology advancements. Accordingly, these changes are an important consideration in the development of operational requirements for FVR5.

Civil Aviation Safety Regulations (CASR) 1998, 139.710, outlines the functions of an airport rescue and fire fighting service (ARFFS) are as follows:

> 139.710 Functions of ARFFS
>
> (1) The functions of an ARFFS for an aerodrome are:
>
> (a) to rescue persons and property from an aircraft that has crashed or caught fire during landing or take-off; and
>
> (b) to control and extinguish, and to protect persons and property threatened by, a fire on the aerodrome, whether or not in an aircraft.
>
> (2) Nothing in subregulation (1) prevents the ARFFS provider for an aerodrome from performing fire control services or rescue services elsewhere than on an aerodrome, but the provider must give priority to operations mentioned in subregulation (1).

As outlined above, the primary functions of ARFF are to **rescue persons and property from an aircraft** that has crashed or caught fire during landing or take-off; and to **control and extinguish, and to protect persons and property threatened by, a fire** on the aerodrome, whether or not in an aircraft.

When performing these functions, ARFF is required to meet minimum capability requirements, including the provision of a minimum number of vehicles, specific response times and minimum usable amounts of extinguishing agents (water and complementary agent) as well as minimum fire extinguishing agent performance requirements.

The Civil Aviation Safety Authority's (CASA) Manual of Standards Part 139 H (MoS 139H) specifies minimum useable amounts of extinguishing agent and fire vehicles required per ARFF service category. MoS 139H is currently consistent with International Civil Aviation Organisation (ICAO) Standards and Recommended Practices (SARPS) therefore ARFF currently meets (or exceeds) both MoS and ICAO recommended practices in relation to extinguishing agent.

However, recently announced[1] changes to ICAO SARPS[2] are proposed to take effect from 1 January 2015,. Under these proposed changes, the minimum extinguishing agent amounts will change to align the required extinguishing agent (water) capacity with the largest aircraft in each category level rather than the current 'average' aircraft type within each category. It should be noted that where a difference exists between ICAO Standards and Recommended Practices (SARPS) and MoS 139H, the MoS prevails.

Therefore, whilst ARFF will continue to meet MoS requirements from 1 January 2015, with existing Mk8 allocations, it may not meet (nor is it currently required to meet[3]) the proposed new ICAO SARPS in relation to required minimum extinguishing agent (water) capacity. If ARFF were required to meet ICAO-level extinguishing agent (water) capacity recommendations in the future, internal modelling suggests ARFF would not meet the ICAO proposed new extinguishing agent (water) holdings at all Category 9 or 10[4] locations using existing Mk8 allocations.

In addition, sampling of international ARFF providers found may of these providers significantly exceed these new ICAO recommendations and National Fire Protection Association (NFPA) standards. Whilst NFPA codes and standards are not expressly part of ICAO or CASR requirements, they do recommend extinguishing agent (water) amounts that incorporate MoS 139H/ICAO equivalents (know as Q1

[1] November 2013.
[2] ICAO Annexe 14 6th Ed July 2013 at Chapter 9.2.13.
[3] Up to 15 January 2015 MoS 139H and ICAO SARPS, in relation to extinguishing agent (water) capacity, are aligned. It is likely a future review of MoS 139H would realign the MoS with ICAO recommendations.

and Q2 combined) and an additional allowance for interior fire fighting (known as Q3).

With consideration to extinguishing agent (water) usage in operational responses (aircraft crash/fires), the higher NFPA-level extinguishing agent requirements are more 'operationally realistic' of water usage, although these amounts are also considerably less than actual water amounts used in operational responses.

Reflecting the above discussion, ARFF's *Fire Vehicle Replacement 5 (FVR5)* strategy is focused primarily on meeting two core objectives:

1. Providing new fire vehicles to meet known (future) services requirements between 2014 and 2020; and
2. Increasing extinguishing agent (water) capacity, particularly at Category 9 and 10 locations.

Noting 10 years have passed since the procurement of the current ULFV Mk8 vehicles, and during this time fire vehicle technology and capabilities have advanced, secondary considerations to the *Fire Vehicle Replacement 5 (FVR5)* strategy include:

3. Increasing operational capability via the introduction of new technologies, such as High Reach Extendable Turret (HRET) and Compressed Air Foam System (CAFS) capabilities;
4. Reducing fire vehicle response times, offered by newer and faster vehicles
5. Physical limitations of existing infrastructure, including fire station design, training ground size and maintenance facilities.

On the basis of the above two core objectives, the Fire Vehicle Replacement 5 (FVR5) strategy identifies two fire vehicle options: a large capacity (8x8) fire vehicle or a medium capacity (6x6) fire vehicle, noting a minimum of two5 of either vehicle size would need to be introduced to establish extinguishing agent capacity holdings above proposed ICAO recommendations at Category 9 and 10 locations.

[4] Excluding Sydney which has an additional Mk8 vehicle online.
[5] This approach assumes one vehicle could be offline at any one time for maintenance.

It is recommended that two new fire vehicles be introduced at each of the Category 10 fire stations (Brisbane, Melbourne, Perth and Sydney), one[6] fire vehicle be introduced at Category 9 locations (Adelaide) and one fire vehicle be introduced at the Learning Academy to support operational training requirements.

This approach would require an initial purchase of eight to ten new fire vehicles with the need for additional fire vehicles dependant on future new services requirements and category upgrades. Accordingly, provision for the purchase of additional fire vehicles is recommended.

1.2 Scope of the Project

This project will provide Airservices with new fire vehicles to meet known (future) services requirements between 2014 and 2020 and increasing extinguishing agent (water) capacity at Category 9 and 10 locations. Increased water capacity is of particular importance given the proposed implementation of changes to ICAO extinguishing agent (water) capacity recommendations from 1 January 2015 and, additionally, the potential for MoS 139H to reflect the proposed changes either within the planned delivery period of these vehicles (2014-2020) or within the 15-20 year operational life of these new fire vehicles.

As outlined above, this project would enable the release of eight to ten Mk8 vehicles in the medium term from Category 9 and 10 locations to provide for known fire vehicle requirements associated the commencement of new ARFF services and to replace refurbished Mk 7's that may be still in service.

The *Fire Vehicle Replacement 5 (FVR 5)* strategy recommends that the new fire vehicles also be fitted with new technologies: High Reach Extendable Turret (HRET) with penetration and dual agent capability that allows for fuselage penetration and defensive fire fighting operations and a more conventional ARFF design with an aspirated primary monitor either in roof or bumper mounts with a smaller secondary monitor in support. This fire vehicle would use standard around the pump foam proportioning systems or positive displacement foam pumps to

[6] The allocation of only one larger vehicle at Category 9 locations would mean the location would not meet ICAO-level extinguishing agent holdings if the vehicle was offline at anytime (assuming ICAO-level holdings are adopted within the MoS 139H).

induct or inject foam into the vehicles water pumps and discharge it through aspirated monitors.

It is intended that the 'non HRET' vehicles would use Compressed Air Foam Systems (CAFS) as their primary agent delivery through their monitors, with a conventional foam proportioning system or foam pumps available as a back up system should the CAFS fail.

The potential introduction of HRET and CAFS capabilities into a small fleet of eight to ten vehicles would enable ARFF to utilise both technologies operationally for up to four years before potentially including the technologies in the end-of-life replacement of approximately 90 Mk8 fire vehicles from 2020.

Finally, whilst this project does not expressly include facility considerations, it is acknowledged that some modification to existing facilities, such as fire stations bays and maintenance facilities would likely be required to accommodate either the 6x6 or 8x8 fire vehicles.

1.3 Acronyms, Definitions, Stakeholders and Consultation

Table 1: Acronyms

Acronym	Description
ConOps	Concept of Operation
ULFV	Ultra Large Fire Vehicle (usually followed by a Mark number)
ASV/IAV	Aerial Specialist Vehicle (current acronym for the Morita vehicles 'only used in the ARFF'). Internal Access Vehicle new acronym accepted through NFPA for air stairs.
AFF	Aviation Fire Fighter
FC	Fire Commander
SO	Station Officer

Acronym	Description
ARFF	Aviation Rescue and Fire Fighting
MAV	Major Attack Vehicle: North American term for a ULFV.
HRET	High Reach Extendable Turret. A monitor attached to an extendable hydraulic arm that can also have a penetrating nozzle for piercing into the fuselage of an aircraft and controlling internal fires. Sometimes referred to as a Snozzle.
CAFS	Compressed Air Foam System. A system used to create foam for firefighting utilising compressed air from either a compressor or from a bank of storage cylinders. Noted by ICAO as being at least 30% more efficient than standard aspirated foam systems.
TIC	Thermal Imaging Camera
FLIR	Forward Looking Infra Red camera.
DCP	Dry Chemical Powder; potassium based chemical, in fine powder form, used to extinguish fires in engines and undercarriage components. Sometimes referred to by the brand name Purple K.
ICAO	International Civil Aviation Organisation
NFPA	National Fire Prevention Association (USA)
FAA	Federal Aviation Administration (USA)
CASA	Civil Aviation Safety Authority
ATSB	Air Transport Safety Bureau
BITRE	Bureau of Infrastructure, Transport and Regional Economics
MOS 139H	Manual of Standards part 139 H
PCA/TCA	Practical Critical Area and Theoretical Critical Area.
DEVS	Drivers Enhanced Vision System
A-SMGCS	Advanced-Surface Movement Guidance and Control System (VELO)

Table 2: Definitions

Term	Definition
Life cycle	Evolution of a system, product, service, project or other human-made entity from conception through retirement
user	Any person or group who interacts with the solution.
operator	Any person or group who operates the solution in its intended usage

Term	Definition
	environment
policy	Specific internal limitations which may limit decision-making freedom.
constraint	Specific externally-imposed limitations placed upon the operations of the capability or solution.
assumption	A condition taken to be true.
Airstairs/Rescue stairs	A fire vehicle based on a set of motorised aircraft stairs used to support internal firefighting, rescue operations, access to heights, precautionary disembarkation, access to APU fires etc.
Turret	A North American term for a fire vehicle monitor.
Monitor	A vehicle based, usually roof mounted, operator controlled water cannon that projects a stream or spray of water or foam agent long distances, used for controlling major fires. Primary monitor.
Bumper Monitor	A smaller version of the vehicle based monitor but mounted lower on the vehicle bumper bar. Can also be a large primary monitor also mounted on this bumper bar location, sometimes referred to as a Rhino monitor/turret.
Dual Agent branch/monitor	A monitor or branch that can supply either DCP, Halotron, water or foam either singularly or together in a combined fire attack.
Aspirated Foam	A system where the movement of agent through a nozzle entrains atmospheric air through ports into the water/foam mixture usually provides a 10 times plus expansion ratio to the bubble structure, making it more effective as a fire fighting agent.
Non Aspirated	A system where the foam solution is simply mixed with the water and relies on the agitation of the pump, water stream and contact with the object or ground to produce a bubble structure.
Under body sprays/protection	A system of plumbing and discharge nozzles under a vehicle that can be activated to protect the vehicle from fuel spill or running fuel fires.

Term	Definition
Ground Sweep	Sometimes a part of the under body protection or can be independent. It is a single nozzle or a pair of small nozzles facing forwards at the front of the fire vehicle that produce a protective foam blanket immediately in front of the fire vehicle. Used for vehicle protection and when driving through a fuel spill
Critical Area	A term defined in ICAO ASM Pt 1 that defines an area adjacent to the aircraft fuselage that needs to be controlled to create tolerable conditions for the passengers and crew to either escape or survive. The terms Practical and Theoretical critical areas are used to determine the amount of agent required by ARFF, the practical critical area (PCA) is 2/3rds of the theoretical and is derived from experimentation.
Critical Application Rate	A figure of 5.5lpm/m2 is used for B class foam agents in combination with the PCA to determine agent requirements for ARFF. Note A and C class foams have a different critical application rate based on their fire fighting performance.
Category	A size ranking between 1 and 10 used to grade airports according to the size of the aircraft that operate from them. Calculated over the 3 busiest consecutive months of the largest aircraft operations with more than 700 movements over that period.
Foam System	Round the pump proportioning or positive displacement foam pumps.

Table 3 Stakeholder Analysis

Stakeholder	Use of ConOps
Project Sponsor ARFF Executive General Manager	Understand and communicate the operational requirements. Understand and communicate the high level functions the capability will perform. Understand and communicate the standards and

	conditions under which those functions are to be achieved. Communicate direction of development. Assist in the development of management responses and support for the proposed concept. Understand and communicate the key data and control flows between the capability and users.
ARFF Operational Authority 	CFO Glenn Wood approves the operational requirements, and concept of operations.
Users/Operators ARFF Operations Staff at category 10 locations, Learning Academy ARFF Instructors. FVR 5 Focus Group	Facilitate understanding of the capability to be provided. Communicate their operational requirements and expectations of the outcome.
Project Manager (Yet to be appointed)	Understand the operational requirements of the solution. Assist in ensuring a suitable product is delivered.
ARFF Business Support Manager	Assist in developing project goals for the implementation of the program.
System Developers Airservices Engineering and ARFF Operations Support	Identify the operational usage and key operational and support requirements to allow design drivers to be identified and assessed in the light of the impact of all user needs. Facilitate understanding of the functional needs and as a basis for comparing alternative solutions. Establish the operational context. Enable understanding of operational objectives and priorities. Determine relationships of relevant development

	and user organisational structures. Enable later design decisions and trade-offs to be traced to the eventual use.
Testers Engineering and ARFF Operations Support	Facilitate understanding of operational objectives and goals to ensure correct prioritisation of test time and focus.
System Maintainers ARFF EVT's and Airservices Engineering.	Establish the potential support environment required for the resultant solution.
Business units Various	Understand and communicate the direction of change. Facilitate understanding of how the direction will impact on business delivery.
Provider	Enable understanding of the objectives and high level needs of the proposed solution.

Table 4 Consultation List

Name	Role	Business Area
ARFF FVR 5 Focus Group	**FVR 5 CONOPS**	**Various ARFF**
	Chief Fire Officer	ARFF Office of CFO
	Strategic Standards Manager	ARFF Office of CFO
	Operations Standards Manager A/g Operations Standards Manager	ARFF Office of CFO
	Fire Commander	ARFF Check & Standards

	Chief Superintendent	Operations Support Manager
	Fire Commander	Avalon ARFF
	Fire Commander	Launceston ARFF
	WHS Specialist	ARFF Operations Support
	Leading Firefighter/BCOM	UFU Branch Committee Of Management (BCOM)
	Leading Firefighter/BCOM	Townsville ARFF and UFU BCOM
	Operational Risk Specialist	ARFF Operations Support
	Chief Superintendent	Regional Manager North
	Chief Superintendent	Regional Manager Central
	Engineering Specialist Mechanical	P&E Infrastructure ARFF
	Senior Engineering Specialist	P&E Infrastructure ARFF
	Senior Engineering Specialist	P&E Infrastructure ARFF

1.4 References

The following documents are referenced and attached to the proposal as supporting product information:

Aviation Rescue and Fire Fighting Manual (AFFM) vol 5.
ICAO Airport Services Manual Part 1: Rescue and Fire Fighting 3rd Ed 1990.
ICAO Annexe 14 6th Ed July 2013
ICAO Discussion Paper 9
ARFF FVR 5 Strategy Paper 2014
NFPA 403
NFPA 414
FAA Advisory Circular AC No.: 150/5220-10E