Strategic analysis of the aviation capacity for the Integrated Management System of Rural Fires in Portugal from 2025

Análise estratégica da capacidade de aviação do Sistema de Gestão Integrada de Fogos Rurais em Portugal a partir de 2025

FORÇA AÉREA PORTUGUESA

AUTORIDADE NACIONAL DE EMERGÊNCIA E PROTEÇÃO CIVIL

AGIF AGÊNCIA PARA A GESTÃO INTEGRADA DE FOGOS RURAIS

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Preamble

1.1 Project sponsors

This paper is the main report of a project established to conduct a high-level review and strategic analysis of Portugal's aerial fire management capacity, with a focus on capabilities required for aerial firefighting beyond 2025.

The project is sponsored primarily by the Autoridade Nacional de Emergência e Proteção Civil (Civil Protection Authority, ANEPC) and the Força Aérea Portuguesa (Portuguese Air Force, FAP) and facilitated on behalf of all stakeholder agencies by the Agência para a Gestão Integrada de Fogos Rurais (Agency for Integrated Rural Fire Management, AGIF).

1.2 Observations, Findings, Recommendations and Suggestions

This report includes Observations, Findings and Recommendations:

Observations

are important points that were considered to be worth highlighting to stakeholders and readers. In some cases, Observations provide guidance for developing subsequent Findings and Recommendations. Observations do not necessarily require further action.

Findings

are important conclusions synthesised from evidence evaluated by the project, but do not necessarily require specific action by stakeholders.

Recommendations

provide consolidated advice, proposals or suggestions for addressing important issues, for consideration by stakeholders.

Nature of Recommendations

Recommendations are advisory only, and are made for consideration by the relevant agency(s) or institution(s). These agencies and institutions will need to consider Recommendations in the context of their overall responsibilities and priorities. No obligation on any agency or institution to endorse, adopt or implement the Recommendations of this report should be inferred.

This report also includes "Suggestions" regarding operational and technical matters in Appendix 1. (Refer to paragraph 1.5 "*Technical and operational matters*", on the next page.)

1.3 Limitations of consultation

Aerial firefighting in Portugal has a large and very diverse range of stakeholders. Many organisations and individuals are in a position to offer valuable contributions and insights. As far as practicable, the project consulted with a representative group of stakeholders, however it was not practical for all stakeholders to be directly consulted. Some interest groups also declined to be consulted.

1.4 Nature of report

This report is not intended to be a scientific paper. It includes reference to material that has not been formally published or peer reviewed, and also references some research that was conducted through informal consultation and discussion.

1.5 Technical and operational matters

The project covered by this report is intended to focus on strategic matters, however a number of issues of a technical or operational nature that would benefit from further consideration by the relevant agencies and institutions were identified during the information gathering phase. These issues have been communicated to stakeholders in an interim Supplementary Report for their information and consideration.

A summary of the technical and operational matters identified in the Supplementary Report is provided in Appendix 1 to this report.

The summary in Appendix 1 includes “Suggestions”:

Suggestions:

are only relevant to technical and operational matters, and are suggested options for addressing the issues raised. Suggestions are mainly based on feedback from respondents, or experience with similar issues in other jurisdictions. They are suggestions only, for consideration by the responsible agencies. The responsible agencies may be aware of other options for resolving these issues.

1.6 Confidential information

The project adopted the principle that, as far as practicable, relevant information should be in the public domain, and that the need to treat any information as confidential should be minimised. However, for commercial reasons, some information provided to the project has been treated as confidential (for example: pricing information and proprietary technical information). In addition, some people and organisations provided information on the condition that they not be identified in project reports or that the information provided be treated as confidential.

Where appropriate, some information supplied to the project team has therefore necessarily been regarded as confidential. Confidential information, and any related observations, findings or recommendations, has been provided directly to the project sponsors in auxiliary reports.

1.7 Language

This report was originally written in the English language, as the primary international language of aviation. Most consultations were conducted in English. Care should be taken when reading or interpreting versions of this reports in languages other than English. The definitive version of this report is the original English language version.

1.8 Conflict-of-interest

The project utilised the services of the consultancy business *Avtract* (Australian Business Number 38 707274543) to assist with information gathering, analysis and preparation of reports.

Avtract has declared that to the best of its knowledge, there is no conflict-of-interest in relation to the project or the preparation of this report. Avtract has no beneficial interest in any products or solutions canvassed or recommended.

1.9 Acknowledgements

The project team would like to gratefully acknowledge the many people who provided information and gave their time freely to participate in interviews and respond to questions.

The project also acknowledges and extends thanks to suppliers of images and illustrations used in project reports.

1.10 Version

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Terminology and definitions

2.1 Respondents

Any person, agency or institution that provided verbal or written information to the project team, whether through interview, discussion or responding to a written project questionnaire is referred to in this report as a ***respondent***.

2.2 Key terms

Terms and definitions used in aviation are often open to interpretation. Different sectors and countries tend to use some terms in different ways. Translations between languages may increase the risk of mis-interpretation. The following list explains how certain key terms are used in this report:

Aerial fire management: refers to any use of aerial means to support prevention, mitigation, response or recovery activities associated with landscape fires, including planned fires

Aerial firefighting: is a subset of **aerial fire management** and refers to the use of aerial means to support response to unplanned landscape fires. Aerial firefighting includes direct attack and indirect attack, supervision, command, intelligence gathering, imaging, mapping, transport and other related operations

Aerial attack or **air attack:** is a subset of **aerial firefighting** and refers to the dispensing of suppressants or retardants from aircraft to directly or indirectly assist with controlling landscape fires or to protect assets from landscape fire

Aircraft: refers to any air vehicle and includes rotary-wing aircraft and fixed-wing aircraft; and includes remotely piloted or optionally piloted air vehicles

Aeroplane: refers to conventional fixed-wing aircraft; and does not include remote or optionally piloted air vehicles unless stated otherwise

Helicopter: refers to conventional rotary-wing aircraft; and does not include remote or optionally piloted air vehicles unless stated otherwise

Foam: refers only to water with an added Class A surfactant foaming solution (refer also to the Water, Foam, Gel, Retardant table at Section 2.4)

Retardant: refers only to a slurry of water combined with a commercial fire-retardant product, that acts to chemically retard the fire (refer also to the Water, Foam, Gel, Retardant table at Section 2.4)

Coordination: refers to the organisation of different elements of a complex activity so as to enable them to work together effectively

Supervision: refers to overseeing the performance of an act or function. Supervision may involve providing direction to a person or agency

Leased: means the services of an aircraft are provided by an Air Operator under contract, on a full-service basis. The term is interchangeable with “contracted”.

2.3 Abbreviations and Definitions

The following Table sets out Abbreviations and Definitions as they are used in this report. For convenience, the Table below also includes some abbreviations and definitions that are not used in the report, but may appear in related documents or references.

Refer also to the table of Aircraft Categories at Section 2.5

Esp = Spanish term
En = English term

Term	Meaning in Portuguese	Meaning in English	Additional explanation
AAO	Área de Apoio Operacional (CMA)	[See CMA]	
AFF (En)	*(Seguimento automatizado de voo)*	Automated Flight Following	National, multi-agency system for aircraft tracking and event recording in U.S.A.
AFOCELCA	Agrupamento Complementar de Empresas do Grupo and The Navigator Company e Grupo ALTRI	Complementary Group of Companies of The Navigator Company Group and ALTRI Group	Joint venture of forestry companies to provide resources
AGIF	Agência para a Gestão Integrada de Fogos Rurais	Agency for the Integrated Management of Rural Fires	
ANAC	Autoridade Nacional da Aviação Civil	National Institute of Civil Aviation of Portugal	Portuguese Civil Aviation Authority
ANEPC	Autoridade Nacional de Emergência e Proteção Civil	National Emergency and Civil Protection Authority	
ARENA (En)	*(Sistema nacional multi-agências para a gestão e utilização de dados sobre aeronaves)*	National multi-agency system for managing and using fire and emergency aircraft data in Australia	
ATA	Ataque Ampliado	Extended Attack	
ATI	Ataque Inicial	Initial Attack	
ATU (En)	*(Unidade de Telemetria Automatizada)*	Automated Telemetry Unit	An add-on to AFF in the U.S.A.; to provide aircraft event data
AVB	Avião Bombardeiro Aviões Bombardeiros	Bomber plane Bomber planes	Fixed-wing firebomber Fixed-wing firebombers (refer to Section 2.5)
BHATI	Brigada Helitransportada de Ataque Inicial	Heli transported Initial Attack Brigade	Heli-transported brigades of 8-12 firefighters, with captain/leader (see also EHATI)
BRIF (Esp)	*(em espanhol) Brigadas de Refuerzo de Incendios Forestales*	Forest Fire Reinforcement Brigades	Specialist air-transported forest firefighting units (Spain)
CATE	Companhia de Ataque Estendido	Extended Attack Company	
CB	Corpo de Bombeiros	Fire Department	

Term	Meaning in Portuguese	Meaning in English	Additional explanation
CBS (En)	*(Simulação em computador)*	Computer-Based Simulation	
CMA	Centro de Meios Aéreos Centros de Meios Aéreos	Air Means Centre Air Means Centres	Air base Air bases
AAO	Área de Apoio Operacional	Operational Support Area in a CMA	Airbase operations centre
ZOA	Zona de Operações de Aeronaves	Aircraft Operations Zone in a CMA	Ramp, movement area
CDOS	Comando Distrital de Operações de Socorro	District Operations Command	
CNEPC	Comando Nacional de Emergência e Protecção Civil	National Emergency and Civil Protection Command	Also used to refer to the Command Centre
COCO (En)	*(Propriedade do Contratante, Operado pelo Contratante)*	Contractor-Owned, Contractor-Operated	Aircraft owned and operated by a commercial third party
CODIS	Comandante Operacionais Distritais	District Operational Commander	
CONEPC	Comandante Nacional de Emergência e Proteção Civil	National Commander of Emergency and Civil Protection	
COPAR	Coordenador de Operações Aéreas	Coordinator of Air Operations	Air Attack Officer or Air Attack Supervisor
COPAR-Ar	Coordenador de Operações Aéreas - Aéreo	Airborne Coordinator of Air Operations	
COPAR-T	Coordenador de Operações Aéreas - Terra	Ground-based Coordinator of Air Operations	
COS **COS(OS)**	Comandante de Operações de Socorro	Operations Commander or Relief Commander	
DECIR	Dispositivo Especial de Combate a Incêndios Rurais	Special Rural Fire Fighting Device	Integrated firefighting assets and organisation for rural fires
DIROP	Diretiva Operacional	Operational Directive	[see also DON]
DON	Diretiva Operacional Nacional	National Operational Directive	
DON-DECIR	Diretiva Operacional Nacional n.º 2 –DECIR	National Operational Directive no. 2 - DECIR	
EASA (En)	*(Agência Europeia para a Segurança da Aviação)*	European Aviation Safety Agency	
EHATI	Equipa Helitransportada de Ataque Inicial	Heliborne Initial Attack Team	Heli-transported team of usually 5 firefighters (see also BHATI)
ENB	Escola Nacional de Bombeiros	Portuguese National Fire School	National fire training college
EU (En)	*(União Europeia)*	European Union	
FAP	Força Aérea Portuguesa	Portuguese Air Force	

Term	Meaning in Portuguese	Meaning in English	Additional explanation
FDI (En)	*(Índice de perigo de incêndio)*	Fire Danger Index	
FEPC	Força Especial de Proteção Civil	Special Civil Protection Force	Technical Force of Civil Protection
FWI (En)	*(Índice meteorológico de incêndios)*	Fire Weather Index	
GIPS	Grupo de Intervenção, de Proteção e Socorro	Intervention, Protection and Relief Group of GNR	GNR specialist firefighting force
GIS (En)	*(Sistema de Informação Geográfica ou Plataforma de Informação Geográfica)*	Geographic Information System	
GNR	Guarda Nacional Republicana	Republic National Guard	
GPIAAF	Gabinete de Prevenção e Investigação de Acidentes com Aeronaves e de Acidentes Ferroviários,	Agency for Prevention and Investigation of Aircraft and Railway Accidents	Transport safety bureau
HEB	Helicóptero Bombardeiro Helicópteros Bombardeiros	Bomber helicopter Bomber helicopters	Rotary-wing firebombing aircraft (refer to Section 2.5)
ICNF	Instituto da Conservação da Natureza e das Florestas	Institute for Nature Conservation and Forestry	National Forestry and Conservation department
IFAWG (En)	*(Grupo de trabalho internacional sobre combate aéreo a incêndios)*	International Fire Aviation Working Group	A committee of the UN International Strategy for Disaster Reduction
ICS (En)	*(Sistema de Controlo de Incidentes or Sistema de Comando de Incidentes)*	Incident Control System	Sometimes refers to Incident *Command* System See also SGO
IFR (En)	*(Regras de voo por instrumentos)*	Instrument Flight Rules	
ISR (En)	*(Informações, Vigilância e Reconhecimento)*	Intelligence, Surveillance and Reconnaissance	
LAT (En)	*(Aerotanque de grande porte)*	Large Airtanker	Type 1 or Type 2 airtanker in the U.S.A. Interagency Airtanker Board classification system
MAA	Monitorização Aérea Armada	Armed Air Monitoring	Loaded patrol
MAFFS (En)	*(Sistema Modular Aéreo de Combate a Incêndio)*	Modular Airborne Fire Fighting System	Proprietary roll-on roll-off drop system using pressuried flow
MAI	Ministério da Administração Interna	The Ministry of Internal Administration	Home Affairs Ministry
MAPA (Esp)	*(em espanhol) Ministerio de Agricultura, Pesca y Alimentación*	Ministry of Agriculture, Fisheries and Food	Spanish Ministry, previously responsible for Forest Fire. See also MITECO
MDN	Ministério da Defesa Nacional	Ministry of Defence	

Term	Meaning in Portuguese	Meaning in English	Additional explanation
MITECO (Esp)	*(em espanhol) Ministerio para la Transición Ecológica y el Reto Demográfico*	Ministry for Ecological Transition and the Demographic Challenge	Spanish Ministry responsible for Forest Fire
NAC (En)	*(Coordenador Nacional de Operações Aéreas)*	National Aircraft Coordinator or National Air Operations Coordinator	
NADAIR	Núcleo de Apoio à Decisão para a Análise de Incêndios Rurais	Decision Support Center for the Analysis of Rural Fires	
NAFC (En)	*(Centro Nacional de Combate a Incêndios Aéreos, Austrália)*	National Aerial Firefighting Centre, Australia	
NPIRFM (En)	*(Plano Nacional de Gestão Integrada de Fogos Rurais)*	National Plan for Integrated Rural Fire Management	
NVG (En)	*(Óculos de visão nocturna)*	Night Vision Goggles	See also NVIS
NVIS (En)	*(Sistema de visão nocturna)*	Night Vision Imaging System	See also NVG
OMS (En)	*(Sistema de Gestão de Operações)*	Operations Management System	See SGO an ICS
OPA	Operador Aéreo Operadores Aéreos	Air Operator Air Operators	
OPAR	Oficial de Operações Aéreas	Air Operations Officer	Aircraft Officer Air Support Group Manager
RADS (En)	*(Sistema de queda aérea retardant)*	Retardant Aerial Delivery System	Proprietary gravity drop system using longitudinal doors. Later versions offer computer controlled constant flow
RescEU (En)	*Um subprograma do Mecanismo de Protecção Civil da UE para criar capacidade de reserva*	*A reserve of European capacities*	A sub-program of the EU Civil Protection Mechanism
RPA (En)	*(Aeronave pilotada remotamente)*	Remotely Piloted Aircraft	UAV/Drone See also UAV and UAS
SADO	Sistema de Apoio à Decisão Operacional	Operational Decision Support System	Situation reporting and information system
SGIFR	Sistema para a Gestão Integrada de Fogos Rurais	System for the Integrated Management of Rural Fires	
SGIFR UI	Sistema para a Gestão Integrada de Fogos Rurais Unidade de Intervenção	System for the Integrated Management of Rural Fires Intervention Unit	
SGO	Sistema de Gestão de Operações	Operations Management System	ICS-type management system

Term	Meaning in Portuguese	Meaning in English	Additional explanation
SIOPS	Sistema Integrado de Operações de Proteção e Socorro	Integrated System of Protection and Relief Operations	Management, command and control structure
SOCO (En)	*(Propriedade do Contratante, Operado pelo Contratante)*	State-Owned, Contractor-Operated	Aircraft owned by the State and operated by a commercial third-party (Sometimes known as GOCO)
SOSO (En)	*(Propriedade do Estado, Operado pelo Estado)*	State-Owned, State-Operated	Aircraft owned and operated by the State (Sometimes known as GOGO)
TC	Tribunal de Contas	Portuguese General Accounting Court	Contract approval tribunal
TRM (En)	*(Gestão dos recursos da equipa)*	Team Resource Management	An extension of Crew Resource Management
UAV (En)	*(Aeronave pilotada remotamente)*	Un-crewed Aerial Vehicle	UAV/Drone See also RPA
UAS (En)	*Sistemas de Aeronaves não Tripuladas*	Un-crewed Aerial System	UAV/Drone plus ancillary systems
VCI	Veículo de Combate a Incêndio Veículos de Combate a Incêndios	Fire Fighting Vehicle Fire Fighting Vehicles	Fire engine, fire truck Fire engines, fire trucks
ZOA	Zona de Operações de Aeronaves (CMA)	[see CMA]	

2.4 Water, foam, gel (water enhancer) and retardant

Air attack is normally conducted by dispensing either water, foam, gel or retardant. However, these terms are sometimes used interchangeably or may be mis-used. The following Table describes how the terms are used in this report, and provides some additional information.

More detailed information is available through the U.S. Department of Agriculture's Wildland Fire Chemicals System[1].

English term	Description	Action	Other information
Water	Plain water, no additives	Suppressant	Includes fresh water, sea water, salt water and brackish water unless specified otherwise Usually low cost
Foam (often referred to as *Class A Foam* or *Bushfire Foam*)	Water with the addition of liquid concentrate surfactant which causes bubbles to form when exposed to shearing action of airflow Usually not coloured	Suppressant Improves the action of water by increasing surface area, reducing evaporation and helping water to stick to ground or elevated fuels Sometimes (incorrectly) referred to as *short-term retardant*	Available as liquid concentrate; usually used at a concentration between 0.4% and 1.0% Concentrate may be added to the water from a concentrate tank on-board the aircraft or may be added to the water when filling on the ground Concentrate must be tested and approved for use in aircraft Relatively low cost
Gel (often referred to as *Water Enhancer*)	Water with the addition of a polymer which increases viscosity Sometimes coloured blue	Suppressant Improves the action of water by increasing viscosity, improving drop characteristics and reducing evaporation Allows water to remain effective for longer periods than foam Sometimes (incorrectly) referred to as *short-term retardant*	Available as a powder or as liquid concentrate If liquid concentrate is used, it may be added to the water from a tank on-board the aircraft or may be added to the water when filling on the ground If powder is used it must be mixed and loaded on the ground Concentrate or powder must be approved for use in aircraft Medium cost
Retardant	Slurry of water mixed with pre-prepared commercial product, usually consisting mainly of ammonium or sulphate salts and gum (glue) Usually coloured red	Retardant Chemical reaction retards fire. Water is a carrier only and the product is still effective when water has dried out Often referred to as *long-term retardant*	Available as liquid concentrate or powder Requires specialised mixing and loading equipment Ground loaded only (for helicopters the prepared slurry can be hover-filled from an open tank) Product must be approved for use in aircraft Relatively high cost

[1] https://www.fs.usda.gov/rm/fire/wfcs/wildland-fire-chemicals.php

2.5 Aircraft categories

The following Table briefly describes the categorisation of aircraft currently used for aerial firefighting in Portugal (refer also to Section 9.6):

Abbreviation	Description	English
HEBL	Helicópteros Bombardeiros Ligeiros	Firebombing helicopter – light (normally complemented by 5 person firefighting team)
HEBM	Helicópteros Bombardeiros Médios	Firebombing helicopter – medium (normally complemented by 8-12 person firefighting team)
HEBP	Helicópteros Bombardeiros Pesados	Firebombing helicopter – heavy
HERAC	Helicóptero de Reconhecimento, Avaliação e Coordenação	Coordination and reconnaissance helicopter
AVBM	Aviões Bombardeiros Médios	Amphibious firebombing aeroplane - medium
AVBP	Aviões Bombardeiros Pesados	Amphibious firebombing aeroplane – heavy
AVRAC	Aviões de Reconhecimento, Avaliação e Coordenação	Coordination and reconnaissance aeroplane

2.6 Operational Periods

The following Table describes the Operational Periods (Phases) that are normally used in Portugal to define response and resourcing levels during each calendar year:

Phase	English	
Nivel I	Phase I (“permanent”)	January 1st through May 14th
Nivel II	Phase II	May 15th through May 31st
Nivel III	Phase III	June 1st through June 30th
Nivel IV	Phase IV	July 1st through September 30th
Nivel III	Phase III	October 1st through October 15th
Nivel II	Phase II	October 16th through October 31st
Nivel I	Phase I (“permanent”)	November 1st through December 31st

03

Executive Summary

Aerial means provide valuable support for the management of rural fire in Portugal. Aerial firefighting is critical to meeting the Vision of the National Plan for Integrated Rural Fire Management: *Portugal protected from severe rural fires.*

Portugal is well-placed to deliver a cohesive and effective aerial fire management capacity. There is a strong, legislated strategic framework for integrated fire management, including aerial components, which has recently been revised and renewed. The legislative framework sets out clear responsibilities around the engagement and utilisation of aerial means.

As the threat to communities and to the environment and the economy from rural fires evolves over coming decades, it will be imperative to ensure that the aerial capabilities and capacities engaged by Portugal are appropriate to the fire risk, and are effective and represent value-for-money.

The National Emergency and Civil Protection Agency (ANEPC) and the Portuguese Air Force (FAP), with support from the Agency for Integrated Management of Rural Fires (AGIF) therefore sponsored a strategic analysis of the planned aviation capacity for the Integrated Management System of Rural Fires in Portugal. The analysis principally focussed on the period beyond 2025.

The strategic analysis project undertook an inventory of the aerial firefighting resources that were available in Portugal during the different fire risk periods (Phases) for 2022, to use as a reference point ("baseline") against which plans for future years could be compared. During the peak summer fire season (Phase IV) of 2022, principal aerial firefighting means that were immediately available to be deployed were:

		Primary Role	S	L	A*	Total
HEBL	Light firebombing helicopter with 5 firefighters	ATI	3	23	3	29
HEBM	Medium firebombing helicopter with 8-12 firefighters	ATA and ATI		12		12
HEBP	Heavy firebombing helicopter	ATA		3		3
AVBM	Medium firebombing aeroplane	ATA and ATI		14		14
AVBP	Heavy firebombing aeroplane	ATA		2		2
HERAC	Light reconnaissance and coordination helicopter		1			1
AVRAC	Light reconnaissance aeroplane			2		2
	TOTAL (including AFOCELCA)		4	56	3	63

*S=State-owned; L=Leased; A=Leased by AFOCELCA

These primary resources are complemented by UAVs (drones) used for surveillance and, in emergencies, can be supplemented by other FAP means or by resources from other countries.

The main trends planned to be implemented for future seasons, subject to availability and subject to prevailing market and financial considerations are:

- increase the number of HEBL and AVBM, to further strengthen the initial attack system
- commission up to six FAP owned and operated medium-heavy helicopters (UH-60A Black Hawks)

- decrease the number of leased HEBM, to be offset by the increased number of more cost-effective HEBL, and by the introduction of FAP owned and operated medium-heavy helicopters
- retire two piston-engined, leased AVBP in favour of turbine-engined aeroplanes
- commission two FAP owned and operated AVBP in partnership with the RescEU program
- increase the number of HERAC, initially to a total of two.

In addition, business cases are currently being prepared or considered for:

- commissioning additional FAP-owned and operated medium-heavy helicopters; and
- commissioning additional FAP-owned and operated AVBP.

The strategic analysis project concluded that the current and planned aerial firefighting capacity in Portugal, is generally fit-for-purpose and is appropriate to the present and forecast situation (provided that it can be successfully implemented in current and future markets), but there are opportunities to consider some further improvements and adjustments.

A significant proportion of Portugal's aerial firefighting capacity is dedicated to rapid initial attack of incipient fires. This is appropriate, and the initial attack organisation is world-class. Prioritising allocation of resources to effective initial attack should continue. Some refinements to the initial attack system are recommended, especially to improve options to increase weight-of-attack in initial response.

Potential future gaps in planned capability mainly centre around (i) providing sufficient *weight*-of-attack in initial attack and extended attack; and (ii) accessing suitable aerial resources for aerial attack on large fires and intense fires; and (iii) ensuring sufficient suitable platforms for airborne co-ordination. The analysis recommends further evaluating the costs and benefits of various options for engaging larger capacity aircraft, such as fixed-wing airtankers and heavy helicopters. Enhancing specialist capabilities such as those used for airborne surveillance and information gathering is also recommended.

The project identified some risks to the provision of aerial firefighting capabilities, particularly over the next three to five years, which is essentially a period of transition to the planned long-term arrangements. Some of these risks are associated with current aviation market conditions; some relate to potential delays in fully commissioning planned new capabilities. Individually, these risks are considered to be manageable, but if several adverse events happened to occur concurrently, the effect on Portugal's overall aerial firefighting capacity could be very significant. Contingency options should be considered and carefully planned.

Delivery of aerial fire management in Portugal is a joint enterprise, involving several key agencies. Successful, safe, effective and efficient aerial firefighting depends entirely on inter-agency collaboration and coordination. The main agencies and institutions involved in aerial firefighting in Portugal are highly competent and have clear responsibilities. However, some enhancements to formal governance arrangements are recommended in order to minimise the risks that are inevitably associated with multi-agency enterprises and to ensure that governance remains robust in the future. Major Recommendations include the formation of a multi-agency governance committee or Board, and the formation of an interagency technical committee. Strengthening of relevant formal relationships with Spain is also recommended.

The project also recommends the establishment of clear Principles, and the preparation of a National Aerial Firefighting Strategic Plan, to guide operation and further development of aerial firefighting capabilities; and to help ensure that all actors have common understanding of

strategic directions. These should be in the form of simple, straightforward publicly available documents. It is recommended that maintaining a high standard of safety is a key guiding Principle.

Importantly, the analysis identified two transformational opportunities that have the potential to significantly enhance aerial fire management in Portugal. Progressing these two initiatives is likely to generate the greatest improvements in safety, efficiency and effectiveness, and the greatest returns on investment:

1. Further development of the coordination and supervision (COPAR) function for aerial means at fire operations.

   This would include increasing the capacity for aerial supervision and routinely using airborne coordinators in a wider range of circumstances. Formal qualifications or micro-qualifications for aerial and ground coordinators would be introduced, along with increased opportunities for training and skills maintenance. Use of Computer-Based Simulation will also improve training outcomes.

2. Improving the systems for collecting, storing, using and analysing aircraft tracking and event data.

   High-quality data automatically collected from aircraft serves a wide range of purposes. This data will be used to streamline management of aerial resources, and improve accountability. In the future, the data will underpin economic analysis and empirical resource allocation tools, and will be critical to robust evaluation of effectiveness.

The strategic analysis also recommends the initiation of a long-term economic study to closely evaluate and quantify the benefits and costs of using aerial means. Outcomes of an economic study will greatly assist future resource allocation decisions, and decisions regarding the overall level of investment in aerial means.

Finding 1 (Principal finding):

Aerial fire management arrangements in Portugal are generally sound, and heading in the right direction.

Broadly speaking, the current and planned aerial firefighting capacity in Portugal is fit-for-purpose and is generally appropriate to the present and forecast situation. However, there are opportunities to consider some improvements and adjustments. There are also risks to the continued or planned provision of some capabilities in the short to medium term (1 to 5 years).

04

Introduction

4.1 General

Portugal has a landscape and climate that is conducive to serious unplanned fires occurring in the rural environment. Timely and effective mitigation and response is required to assure the protection of people and communities, protection of community assets and the natural environment, and to maintain economic security.

Portugal also uses fire on a planned basis to manage landscape fuels and maintain the health of fire-dependent ecotypes.

There is evidence that the frequency and severity of unplanned fires are likely to increase in coming years in Portugal and other European States, mainly as a result of global climate change. Fire seasons will be longer, with the potential for damaging fires to occur at times of the year outside of the customary fire season. Climate change will also increase the probability of serious fires occurring in ecosystems and vegetation types that were previously regarded as less susceptible. In some circumstances, landscape fires will be more difficult to control, with increased propensity for spotting (projection) and lower effectiveness of natural barriers such as water courses and damp forests.

The climate-related issues are compounded by factors such as shifting rural population, rural abandonment and increasing forest-urban interface. The potential economic and social impacts of forest and rural fires are likely to increase.

Following a series of damaging rural fire events in 2017, and recognising the escalating threat from rural fires, the Portuguese government implemented a program of legislative change and developed a National Plan for Integrated Rural Fire Management (NPIRFM) for 2020-2030. The development of the National Plan followed wide consultation and detailed analysis of the factors that were contributing to severe rural fires.

The NPIRFM is enabled by national legislation through resolution by the Council of Ministers and aims to draw on all available national capacities, including aviation, to reduce the occurrence of rural fires and to reduce the resulting damage, from an environmental, social and economic perspective in accordance with the overall Vision: *Portugal protected from severe rural fires.* The NPIRFM also establishes the System for the Integrated Management of Rural Fires (SGIFR).

Aerial firefighting is an important component of the SGIFR and aerial means are critical to delivering the outcomes required by the National Plan and its associated Strategies and Action Plans.

4.2 Aerial firefighting

Portugal has a long and proud history of using aerial means to support the management of planned and unplanned rural fires; and to provide support to firefighters and protect

communities from wildfires. Portugal also has a strong record of innovation in aerial fire management.

Aviation can play many valuable and diverse roles in the management of rural fires. Aircraft offer speed and weight of attack that can be crucial to preventing spread of wildfire and protecting communities, assets and the environment. Aircraft provide perspective and critical information for local communities and for the teams that are planning combat of fires.

Aerial firefighting is, however, highly specialised, and requires particular skills, as well as high-quality planning, management, coordination, supervision and support in order to operate safely, effectively and efficiently. Relatively small adjustments in an aerial operation, or single factors such as the selection of aircraft type for a particular task, can make large differences in effectiveness and efficiency. Proper integration with ground operations is imperative.

Aviation can be relatively expensive, and often has a high profile. It has been observed in many countries that great care must be taken to ensure that a focus on aviation does not distract or divert funds from other activities that may have been more effective in preventing and mitigating unplanned rural and forest fires. This caution was consistently reinforced by many respondents during consultation for this strategic analysis project.

Safety of air and ground personnel is a major issue for aerial fire operations. Around the world, the safety record for aerial firefighting is far from optimum, and Portugal has seen a number of fatal crashes and losses of airframes in recent years. Rigorous, best-practice safety and risk management is required, including specialised training.

Significant advances in aerial fire management technology have been made in recent years. Good quality data is now available and is becoming crucial to decision-making and resource allocation. Best-practice approaches to management, supervision and support of specialised aerial assets are more sophisticated and have now been well-proven. Airborne remote sensing technology and the ability to integrate sensor outputs with agency information systems has also markedly improved. Relatively new capabilities such as Remotely or Optionally Piloted Aircraft (RPA, OPA or UAV or “drones”) are having a major impact. There have also been significant improvements in training methods for personnel involved in managing and supporting aviation, with simulation technology now playing an important role.

4.3 Strategic analysis project

As the nature of rural fires changes in coming years, demand for specialised aerial support is likely to increase. Communities will have increased expectations of the responsible government agencies and the aviation industry to provide appropriate capabilities and to ensure that aerial fire management adapts to the changing circumstances, and is safe, efficient and effective.

The responsible agencies are also conscious of developments that are occurring around the world in aerial firefighting and in the application of aerial means for fire and emergency management. Implementing and deploying specialised aviation requires careful, advance planning. There are often long lead-in times to make changes or to introduce new aviation capabilities.

Against this background, a project was established to conduct a high-level, strategic review and analysis of Portugal’s aerial fire management capacity. The project principally aims to:

1. identify the aerial capabilities and capacity that will provide optimum support to Portugal’s firefighters and rural communities in the future; and:

2. support and guide the responsible agencies to optimise the way in which aerial capabilities are provided and utilised.

As aerial *firefighting* in the rural areas is by far the major component of *aerial fire management* in Portugal, the strategic analysis project focusses mainly on the aerial means that are required for supporting response to unplanned wildfires.

In Portugal, aerial firefighting is a joint effort involving a number of entities, as well as private companies. In legislation, the National Emergency and Civil Protection Agency (ANEPC) is designated as the main "user" of aerial means for firefighting. The Portuguese Air Force (FAP) is designated as the main "provider" of airborne means for aerial firefighting.

The strategic analysis project is therefore overseen jointly by FAP and ANEPC. Support and facilitation for the project is provided by the Agency for Integrated Management of Rural Fires (AGIF).

The overall purpose of the strategic analysis is to provide the stakeholder agencies with resources and information that will enable those agencies to develop strategies and plans to optimise Portugal's aerial fire management capability, supporting firefighters and protecting communities.

As processes are currently in place to arrange appropriate aerial capabilities in Portugal until 2025, the strategic analysis project focussed primarily on optimising aerial firefighting arrangements that will apply from 2026 and onwards. However, the project also considers some selected shorter-term issues that were identified by respondents during the information gathering phase.

To support the analysis and to assist the stakeholder agencies to identify international best-practice, the project engaged an external organisation, Avtract[2]. Avtract has substantial international experience and expertise in utilisation of specialised aerial resources, and specifically in aerial firefighting.

4.4 Project scope

With minor exceptions*, the aerial strategic analysis project only considered aerial fire management capability applicable to Continental (mainland) Portugal. The responsible entities will continue to liaise with the Administrations of the Autonomous Regions of Portugal regarding appropriate arrangements for the Regions.

*Exceptions relate to considering the ability to provide emergency aerial support in the Autonomous Regions when selecting appropriate aerial capabilities for Continental Portugal.

4.5 Project methodology

Portugal has considerable experience and expertise in aviation management and aerial firefighting and across multiple agencies. The project drew mainly on information and expertise that already exists within the relevant agencies and institutions.

The project proceeded in two main phases:

1. an inventory of capabilities, as at the summer season of 2022, to use as a reference point or "baseline"; along with analysis of documentation of planned capabilities for 2023 and onwards; and

[2] ABN 38 707274543 Email: admin@avtract.com

2. a conventional Strengths, Gaps, Opportunities, Problems-to-solve (SGOP) analysis.

   Information on strengths, gaps, opportunities and problems-to-solve was gathered from a wide range of sources including via:

   - review of existing documentation and literature
   - structured interviews with stakeholders and interest groups, and
   - written questionnaires for selected stakeholders.

As noted earlier, it was not practicable to consult with all interested parties, however the project team was able gather information from a representative range of stakeholders.

During the analysis, capabilities, resources, resourcing levels and aerial firefighting procedures were compared with relevant practices in other jurisdictions. International partners and organisations were consulted to assure that the findings and recommendations appropriately reflect best-practice.

A list of agencies and organisations directly consulted is provided at Appendix 2.

4.6 Key characteristics

The project identified some key characteristics of the environment in Portugal that are important to consider when designing optimum aerial fire management arrangements. Identifying these characteristics also helps to ascertain situations where it may be appropriate for Portugal to adopt different approaches to aerial fire management from those that are routinely applied in other jurisdictions. Important relevant characteristics of Portugal include:

Geopolitical

- westernmost country of Europe
- bordered by Spain to the north and east; the only land borders are with Spain
- includes the Atlantic archipelagos of the Azores and Madeira as Autonomous Regions (note: only Continental Portugal is specifically considered in this project)
- full Member of the European Union; active participant in RescEU.

General

- area: 92,212 / 89,015km^2 (total / Continental Portugal)
- population: 10.3 million (total, at the 2021 census)
- main language: Portuguese, with some local dialects. English, French and Spanish are common second languages, especially in tourist areas, but are not universal (see also Aviation environment, on the next page)
- very high proportion of land is privately owned (85.5% is private, 2.7% belongs to the State, 11.8% belongs to local communities), with a high degree of ownership fragmentation
- abandonment of forests and traditional agricultural practices with consequent increase in biomass and combustible material is a significant, ongoing issue
- notable population shift (especially younger demographics) from rural areas to urban and urban fringe areas (based on figures to 2021)
- increasing amount of wildland or forest to urban interface.

Geophysical and biophysical

- bordered by the Atlantic Ocean to the west and south

- mainland Portugal is effectively split by the River Tagus. North of the Tagus is characterised by mountains rising to 2.000 metres, high plateaus and deep valleys, with large areas of forest; south of the Tagus tends to be flatter, with more broad-scale agriculture
- significant Protected Areas, with high conservation values, but only one formal National Park (Peneda-Gerês National Park)
- Protected Areas often include privately-owned land
- highest proportion of forest area in Europe (38 %)
- about 25% of the world's natural distribution of Cork Oak (*Quercus suber*). Portugal provides approximately half the world's production of cork products; these are very significant economically
- significant area of softwood (mainly *Pinus spp*) and hardwood (mainly *Eucalyptus globulus var)* plantation. Plantation products are also very significant economically.

Fire climate

- classic Mediterranean climate with a high-temperature, summer wildfire season; although Atlantic and continental influences create local and regional effects and complicate climate and weather modelling and predictive services
- fire risk periods often align with neighbouring countries, increasing competition for resources
- propensity of wildfires to project embers ("spotting") appears to be increasing
- annual period in which damaging wildfires can occur appears to be growing.

Aviation environment

- full Member State of EASA, EASA regulations apply; national civil aviation regulations apply in some circumstances
- flight under Visual Flight Rules is permitted
- large areas of civil and military controlled airspace relative to the size of the country
- heavily laden vertical obstruction environment; wires pose a very significant hazard and potentially limit opportunities for low visibility and night operations. Reliable databases and maps of wires are not always readily available or comprehensive
- runways for fixed-wing aircraft are mostly relatively short and/or have relatively low pavement strength; some longer runways are available but are generally used for international Regular Public Transport or are at military installations
- there is generally good availability of water, compared to many countries, for hover-filling and for fixed-wing scooping. However, availability of water along the Atlantic coast cannot be assumed, due to typical sea-state conditions
- high temperatures, and high density altitudes (low air density) prevail during times of highest wildfire risk; effects of density altitude on aircraft performance need to be considered
- Portuguese language is routinely used in general aviation in Portugal; English is not necessarily spoken. Language barriers can create some risks in operations. The need to communicate in Portuguese language may affect overall availability of experienced flight crews (as they may not have the necessary skills).

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Governance

5.1 Enabling legislation and regulation

In any jurisdiction, it is crucial that aerial fire management is enabled by appropriate legislation and that aerial firefighting activities are appropriately authorised by the State.

In Portugal, three general areas of law are directly relevant:

1. law enabling the management of fires that occur in the rural environment and providing for the use of aerial capabilities to support rural fire management;
2. law that underpins the role of the Portuguese Armed Forces to provide and operate aerial capability for civilian activities in the rural environment; and
3. law that governs the operation of civil aviation in Portugal.

There is also a need to consider laws that may govern or affect international aviation operations.

Law pertaining to management of rural fires

In recent years, Portugal has comprehensively reviewed, revised and renewed the legislative framework for management of fire in rural areas. New, updated legislation governs rural fire management. In turn, this legislation, alongside relevant Resolutions of the Council of Ministers, sets out responsibilities of the various agencies and institutions and enables the production of approved plans and strategies for management of rural fire, most notably the National Plan for Integrated Rural Fire Management (NPIRFM). The NPIRFM specifically refers to and authorises the appropriate use of aerial capabilities to support rural fire management as part of an integrated approach – the Integrated Management System for Rural Fires (SGIFR).

The project did not identify any specific issues or gaps in the overall enabling legislation and regulations that authorise the use of aerial capabilities to support management of rural fires in Portugal.

Finding 2:

In general terms, use of aerial capabilities to support management of rural fires in Portugal is appropriately authorised by the State and is enabled by appropriate, modern legislation, resolutions and regulations.

Law relating to the role of Portuguese Armed Forces

The NPIRFM specifically assigns responsibilities for some aspects of aerial firefighting to Portuguese Armed Forces. These responsibilities are mostly delivered by the Portuguese Air Force (FAP) and exercised through:

i. provision of the services of aircraft that are owned and operated by FAP, including un-crewed aircraft (UAVs or “drones”);

ii. provision of the services of aircraft that are owned by the Portuguese State and operated by the FAP (note: it is understood that ownership of relevant aircraft previously owned by other State agencies has now been transferred to FAP, or will soon be transferred);

iii. procurement and management of the services of civilian organisations to operate aircraft that are owned by the Portuguese State or FAP; and

iv. procurement and management of the services of civilian organisations to provide and operate aerial capabilities.

It is worth noting that, in the past, various other countries have identified issues with laws that may authorise their armed forces to become involved in civil fire management.

The legislation that enables and empowers the Portuguese Armed Forces, and the FAP specifically, is complex, and has been subject to various amendments over time. It was considered beyond the scope of the strategic analysis project to comprehensively analyse this legislation. A brief examination did not identify any aspects of the legislation that would clearly conflict with the objectives of supporting civil fire management, standing-up aerial capabilities specifically for rural fire management or of procuring and utilising civilian aviation services for the purpose of rural fire management.

Finding 3:

The project was not made aware of any aspect of the legislation that establishes and empowers the Portuguese Armed Forces, and specifically the Portuguese Air Force, that conflicts with the current roles in supporting rural fire management.

Observation 1:

Although no obvious issues regarding the provision of support for rural fire management were identified in legislation that establishes and empowers the Portuguese Armed Forces, it would be worthwhile for a suitable expert to comprehensively examine the relevant legislation to “double-check” that it contains appropriate and unambiguous provisions (assuming such an examination has not already been recently performed).

Law pertaining to civil aviation in Portugal

Portugal is a full Member State of the European Aviation Safety Agency (EASA). In simple terms, civil aviation in Portugal is therefore principally governed by European civil aviation laws administered by EASA. However, in some circumstances and for certain operations, Portuguese national civil aviation legislation and regulations may apply. Portuguese civil aviation legislation is administered by the Portuguese Civil Aviation Authority, or Autoridade Nacional de Aviação Civil (ANAC). As an example, the operation of dropping of water by civilian aircraft is still governed, at least in-part, by Portuguese civil aviation regulations, whereas EASA regulations cover activities such as high-level aerial surveillance and mapping of wildfires.

It is also worth noting that aviation accidents are investigated by the Agency for the Prevention and Investigation of Aircraft and Railway Accidents, or Gabinete de Prevenção e Investigação

de Acidentes com Aeronaves e de Acidentes Ferroviários (GPIAAF), while navigation and air traffic services are provided by Navegação Aérea Portugal (NAV).

Further, it should be noted that aircraft owned and operated by FAP for firefighting are regarded as military aircraft and are generally not subject to civil aviation regulations.

The fact that EASA regulations are applicable to some aerial firefighting activities, while Portuguese civil aviation regulations are applicable to other activities is not necessarily an inherent problem. Mostly it is the responsibility of Air Operators to be aware of the regulations that apply to the operations that they are conducting and to comply accordingly. Also, ANAC acts as a delegate of EASA within Portugal. However several respondents did raise the potential for confusion about which regulations applied in some circumstances, and also the potential for inconsistent standards to apply to different types of operation. One example that was raised by several respondents was the possibility of differing requirements around aircrew language skills for different operations.

Observation 2:

EASA regulations apply to some aspects of civil aerial firefighting operations in Portugal, whilst Portuguese national civil aviation regulations apply to other aspects. This is not necessarily an inherent problem, but does increase the risk of confusion about which specific regulations may apply in some circumstances, and may increase the risk of having inconsistent standards for different aerial operations. Multiple sources of regulations may also complicate contract management audit and due diligence.

ANAC is the agency that is best positioned to provide advice on the civil aviation regulatory environment as it applies in Portugal at any point in time.

ANEPC and FAP do currently maintain active liaison with ANAC regarding aviation legislation and regulations and other related matters, and have progressively developed an ongoing working relationship. There would now be benefit in formalising this partnership, with scheduled meetings and a register of issues and actions.

Recommendation 1:

ANEPC, FAP and ANAC establish a formal, joint aerial fire management liaison committee, with regular scheduled meetings, with a formal agenda and an action register.

Note: the recommended liaison committee could be a sub-committee of the Strategic Coordination Committee or Board recommended in Section 5.3 of this report.

International operations

As the threats posed by landscape fire increase, there is likely to be an increase in demand for international sharing of aviation reources, either to provide immediate short-term assistance in emergency situations, or as part of longer term bi-lateral or multi-lateral mutual support and partnership arrangements.

In-principle, sharing of high-cost, specialised aerial resources through international collaborative arrangements is sensible. It provides economic efficiencies and added protection for communities. Aerial resources are often the first or only choice to provide additional support for neighbouring countries in developing emergency situations. Europe is, in many ways, ideally positioned for effective sharing of aerial firefighting resources.

Potentially this may involve:

i. Portuguese-based civil aircraft operating in other countries

ii. Portuguese military aircraft operating in other countries

iii. foreign civil aircraft, from EASA and non-EASA Member States, operating in Portugal

iv. foreign military aircraft operating in Portugal.

The regulatory situation for international aviation operations is complex. Great care must be taken to ensure that the operation of Portuguese aircraft in other countries is in accordance with applicable Portuguese, EU and foreign laws; likewise great care must be taken to assure that operation of any foreign civil or military aircraft in Portugal is in accordance with applicable laws. To be clear, there is no suggestion that this has not been the case in the past. However, the aviation regulatory environment is increasingly complex and dynamic, and exercising appropriate due diligence is therefore increasingly important.

Observation 3:

International aerial firefighting operations pose increased risks around regulatory compliance. Great care should be taken to ensure that any international operations are conducted in accordance with relevant laws.

5.2 Clear accountabilities and responsibilities

A key requirement for safe, effective and efficient aerial firefighting in any jurisdiction is to ensure that the responsibilities and accountabilities of all agencies and institutions involved are completely clear. As aerial firefighting in Portugal is a true multi-agency enterprise, this is particularly important.

Portugal is currently in the fortunate position of having recently reviewed and revised the principal legislation governing rural fire management. This legislation enables the NPIRFM and SGIFR. The NPIRM sets out specific responsibilities for the respective SGIFR agencies and institutions.[3] The critical responsibilities directly related to aerial fire management may be summarised as:

Entity	Summarised key responsibility
Armed Forces (through FAP)	Provide and manage appropriate aerial support resources
ANEPC as Coordinating Entity	Utilise aerial support resources for response and recovery
GNR (mainly through GIPS)	Utilise aerial support resources for surveillance (fire detection)

Put simply, FAP is the key *supplier* of aerial resources, ANEPC is the key *user* of aerial resources; and GNR has some specific responsibilities for use of aerial resources for fire detection.

[3] National Plan for Integrated Rural Fire Management 2020-2030, published by AGIF and approved by Resolution of the Council of Ministers 45 A/2020 16 June 2020; page 82 and summarised on pages 42-44

ANEPC, FAP and GNR, along with other SGIFR entities, also have other relevant supporting and consulting roles. These are fully described in the NPIRFM.

Other relevant primary responsibilities to highlight include:

Entity	Summarised responsibility
ANEPC as Coordinating Entity	Pre-position aerial support resources at national and regional level according to fire risk and priorities
ANEPC as Coordinating Entity	Request logistics support (pre-response and response)
ANEPC as Coordinating Entity	Dispatch (and release) local, regional and national resources to Initial Attack and Extended Attack
ANEPC as Coordinating Entity	Assign missions to aerial support crews
ANEPC as Coordinating Entity	Monitor the progress and behaviour of the fire
ANEPC as Coordinating Entity	Request additional resources, including international (foreign) resources

The allocation of fundamental responsibilities for key aerial firefighting functions to FAP, ANEPC and GNR is clear and well documented.

The allocation of agency responsibilities has been reviewed relatively recently, through the post-2017 process of examining all rural fire management legislation and arrangements in Portugal, and the development of the NPIRFM for 2020-2030. It would be fair to say that while not all respondents agreed with the current arrangements, the project did not identify any compelling reasons to reconsider the allocation of responsibilities in the short to medium term. As a matter of good governance, the allocation of fundamental responsibilities related to aerial fire management should be reviewed at regular intervals in the future. This regular review could be a function of the proposed Strategic Coordination Committee or Board as recommended in Section 5.3 of this report.

Most importantly, although the responsibilities and accountabilities of the relevant agencies are currently clearly allocated and well documented, they are not always fully understood by secondary agencies and other actors (including some Air Operators) and the public. There would be a benefit in producing a simple, publicly available guide or web-page that summarised and described the main responsibilities. This summary could also form part of a published National Aerial Firefighting Strategic Plan, as described in Section 6.2 of this report.

Finding 4:

The key responsibilities and accountabilities of the relevant agencies and institutions in relation to aerial firefighting are appropriate and clearly defined in the relevant legislation and underpinning strategies and plans, but are not always understood by other actors and the public.

Observation 4:

The key responsibilities and accountabilities of the relevant agencies and institutions in relation to aerial firefighting should ideally be regularly reviewed in the future.

Note: future review of agency and institutional responsibilities in relation to aerial firefighting could be a function of a Strategic Coordination Committee or Board or equivalent governance arrangement.

Recommendation 2:

A simple, publicly available, summary guide to the main current responsibilities and accountabilities related to aerial firefighting in Portugal should be produced and published.

Note: this guide could form part of a wider National Aerial Firefighting Strategic Plan.

ANEPC advises that publication of the textbook: *Aerial Means in Rural Fire Fighting* in the near future will assist in educating other parties. ANEPC also proposes that a simple flowchart with the attributions of the different actors be placed on ANEPC's website. This can then be linked from, or reproduced on, other websites.

5.3 Inter-agency coordination and collaboration

As in many countries, aerial fire management in Portugal is a joint enterprise. There are many agencies and institutions involved, and many stakeholders. Successful delivery of aerial support for firefighting relies on effective, high-level inter-agency collaboration, co-operation and communication. Efficient, collaborative forward planning and strategic decision-making is also required, along with clear, consistent guidance and priority setting for agency staff who are assigned to implement aerial firefighting programs.

There is also a fundamental need in any joint enterprise to ensure that all agencies involved, whether they are in Coordinating, Responsible Entity or Support Entity roles, are working to a set of agreed common principles, plans, goals and priorities.

To be completely clear, any suggestions regarding overall governance and inter-agency coordination in this section are intended to cover only high-level, joint enterprise management and planning; it would be inappropriate for high-level inter-agency coordination arrangements to have any direct role in operational coordination, control or command of aerial resources during actual wildfire events.

Collaboration between the main agencies involved in aerial firefighting in Portugal is generally good at management level. However, although this is working well at the moment, it relies to some degree on existing relationships and there are no readily identifiable formal structures for ongoing collaboration. This situation presents potential future risks, particularly if there are changes to organisational structures or key personnel. Risks would be reduced by formalising some aspects of interagency collaboration and cooperation.

The project carefully considered whether there was a need for a formal interagency governance and coordination mechanisms specifically for aerial means, or whether this should be accommodated within other high-level national governance arrangements. On balance, it was concluded that arrangements specifically for aerial means were justified, considering factors such as:

- multiple, large agencies and institutions involved
- multiple stakeholders, including international stakeholders and the EU
- complexity of the regulatory environment
- significant operational risks and requirements for specialist risk management
- high public profile and increasing public expectations
- very significant public expenditure.

It is worth noting that it has been found in many other countries that formal coordination mechanisms, such as inter-agency coordination committees and technical committees often significantly improve collaboration and communication by simply enhancing working relationships between the respective agencies and institutions.

High-level, strategic coordination and collaboration

Formal, high-level inter-agency governance and coordination committees are normal practice in countries where successful delivery of aerial capabilities depends on multiple agencies with differing responsibilities. Some countries have adopted the concept of a "Board" to provide high-level governance for jointly-delivered aerial fire management in their jurisdiction, and to provide a formal avenue for ongoing collaboration and cooperation. The Governance Board model has some important characteristics that are useful in joint enterprises. Notably, although the members of the governing Board of a multi-agency enterprise may be nominated by an individual agency, they do not necessarily represent the interests of that agency, but have a responsibility to act in the best interests of the enterprise overall. This "Board concept" has been found to work well, in other countries, for governance of joint enterprises such as multi-agency aerial capability.

Typically, a high-level, inter-agency governance arrangement such as a Coordinating Committee or Board would, for example:

- provide a formal, quality-assured mechanism for communication between relevant agencies on high-level strategic matters, planning and other issues relating to aerial capability
- agree on underlying Principles for utilising aerial capabilities to support rural fire management
- agree on strategic directions for aerial capability and ensure that appropriate, agreed plans for future capability are developed
- maintain, approve and publish the "National Aerial Firefighting Strategic Plan" (see Section 6.2) or equivalent document
- agree on high-level priorities for the joint enterprise
- provide advice to government and key stakeholder agencies regarding priorities and funding
- identify needs for strategic research and monitor progress of research
- periodically review agency responsibilities and accountabilities and provide advice to government
- establish and oversee sub-committees on technical and operational matters.

A high-level Strategic Coordinating Committee or Board would typically:

- include senior nominees from all relevant agencies and institutes

- meet regularly, with a formal agenda, and maintain registers of issues and agreed actions

Technical coordination and collaboration

In aerial fire management it is also crucial that all actors work to common, agreed technical standards and operational procedures. Standards for training of personnel who supervise and support aerial operations should also be aligned.

In Portugal, multiple entities have an interest in technical standards, operational standards and training standards relating to aerial operations. Again, while interagency collaboration is generally good regarding these matters, there would be benefit in establishing a formal, ongoing structure for interagency communication and collaboration on technical and operational matters and procedures.

Most countries with multiple agencies involved in delivering specialised aerial capabilities establish a formal inter-agency Technical Committee or similar group. In many instances, this Technical Committee is a sub-committee of the high-level Coordinating Committee or Board or equivalent referred to above. A typical example would:

- identify needs for common technical standards, procedures and training standards
- coordinate or arrange the development of agreed, common technical standards, procedures and training standards
- agree on common, inter-agency technical standards, procedures and training standards
- advise the high-level Coordinating Committee or Board regarding priorities for development of standards and procedures
- provide technical advice to the high-level Coordinating Committee or Board, and to key stakeholder agencies.

A Technical Committee would typically:

- include senior technical experts from the relevant agencies
- meet regularly, with a formal agenda; with formal meetings supplemented by additional informal and subject-specific meetings; and maintain a register of agreed actions.

Recommendation 3:

Establish a formal, high-level, interagency Aerial Means Strategic Coordination Committee or Board to provide overall governance of the joint, multi-agency enterprise that delivers and deploys aerial capabilities to support rural fire management in Portugal.

Note: it is suggested that:

- a Strategic Coordination Committee or Board should have clearly defined, agreed Terms of Reference that set out, at a minimum:
  - roles of the Committee
  - scope of operation
  - membership, and responsibilities of members
  - meeting procedures

[continues on next page]

[Recommendation 3 continued]

- a Strategic Coordinating Committee or Board should meet at least four times per year, with a formal agenda, and should maintain a register of issues and a register of agreed actions
- a high-level Strategic Coordination Committee or Board would logically be convened by AGIF, with membership from ANEPC, FAP, GNR, and appropriate representation of Fire Brigades. Involvement of representatives of ANAC, MDN and other government institutions, such as ICNF, should also be considered
- appropriate non-government institutions such as AFOCELCA could be observers, or could participate in relevant sub-committees.

Recommendation 4:

Establish a formal interagency Technical Committee for aerial capabilities that support rural fire management.

Note: it is suggested that:

- a Technical Committee should have clearly defined Terms of Reference that set out, at a minimum:
  - roles of the Committee
  - scope of operation
  - membership, and responsibilities of members
  - meeting procedures
- the Technical Committee be established as a sub-committee of the Strategic Coordinating Committee or Board, and provide regular progress reports
- the Technical Committee should meet at least four times per year, with a formal agenda, and should maintain a register of issues and a register of agreed actions
- the Technical Committee would logically be convened by either ANEPC or FAP (possibly in rotation) and include, at a minimum, nominees of ANEPC, ANEPC-FEPC, FAP and GNR-GIPS, and appropriate representation of Fire Brigades. Involvement of representatives of other relevant government and non-government institutions should also be considered
- development of agreed standards for training of personnel who manage, supervise and support aerial capabilities could be included in the responsibilities of the Technical Committee, or it may be preferred that a separate mechanism be established for this purpose.

5.4 International collaboration - Spain

Spain, including the Autonomous Regions of Spain, is a critical partner in aerial fire management in Portugal.

Whilst also acknowledging the importance of EU coordinating mechanisms, such as the Civil Protection Mechanism and its RescEU sub-program, there are some existing and potential direct relationships between Portugal and Spain that justify special attention:

- the entirety of mainland Portugal's land border is with Spain (the longest continuous land border between two countries in the EU)
- there is an existing, bi-lateral agreement for provision of mutual support in the land border zone (25km either side of the land border). This agreement needs to be closely managed and monitored, due to the significant safety and legal implications
- Spain is the country most likely to be a supplier of surge aerial resources for Portugal when additional capacity is required in an emergency; and vice-versa. Sharing of aerial resources between Portugal and Spain is likely to occur more often in the future. It is important that mechanisms for sharing of resources are carefully pre-planned. Ideally the arrangements, including agreed operational procedures, should be formalised in a bi-lateral agreement
- there are potential opportunities to partner with Spain, in the future, for routine or "mainstream", joint provision of specialised aerial firefighting resources. As a simple example, Portugal and Spain could possibly collaborate to routinely share high-cost resources such as large fixed-wing airtankers or heavy helicopters
- there will be significant benefits in aligning technical standards for aviation activities between Portugal and Spain, where this is appropriate and practical. Common or closely aligned standards and operating procedures underpin the ability to safely and successfully share resources; and generate efficiencies in other areas – such as safety management, data collection and contract management, and training.
- there are significant opportunities to closely collaborate with Spanish agencies institutions on matters such as training initiatives. Aligning training in aviation ICS roles has the potential to generate significant benefits.

Whilst good communication and collaboration with appropriate Spanish agencies and institutions does currently occur, and there are already a number of joint initiatives, there are also some gaps. As an example, the formal Portugal-Spain land border mutual support agreement has been recently revised, with some significant changes, however many respondents reported that they were not aware of some of the more important changes.

Many respondents considered that there would be considerable benefit in further formalising the Portugal-Spain collaborative partnership arrangements regarding aerial fire management.

Collaboration needs to occur at different levels, ranging from strategic to technical. It is suggested that a high-level, international oversight committee be established to coordinate collaboration between Portugal and Spain regarding aerial fire management. This Portugal-Spain oversight committee should:

- consider drafting and approving a simple, agreed Charter or similar document, committing Spain and Portugal to collaboration, cooperation and communication regarding aerial fire management, and describing the agreed arrangements and processes
- coordinate collaboration between Portugal and Spain regarding aerial fire management
- monitor relevant bi-lateral agreements, identify requirements or opportunities for new agreements, or requirements for revisions to existing agreements
- identify and consider opportunities for further bi-lateral sharing of resources between Portugal and Spain, including the possibility of routine or "mainstream" provision of shared specialised resources

- identify and consider other opportunities for enhancing collaboration between Portugal and Spain, particularly in activities such as training for aviation-related ICS roles and associated micro-qualifications
- identify other areas of collaboration requiring attention, and prioritise development of solutions
- elevate matters to appropriate EU coordination mechanisms when required
- ensure that coordination processes and agreements are communicated as required
- establish and oversee joint sub-committees or working groups as required, for example: on technical and operational matters.

A Portugal-Spain collaboration oversight committee would:

- comprise appropriate high-level representatives of relevant agencies and institutions from Portugal and Spain
- hold regular meetings, at least twice per year, with a formal agenda
- maintain an agreed action plan.

To be clear, any suggestions regarding overall governance and coordination of international collaboration in this section are intended to only cover activities such as strategic management, planning and preparation, and development of joint initiatives. While it is not uncommon for management of international operational activities to be enhanced through the working relationships that are established as a result of collaborative mechanisms, it would be inappropriate for the proposed collaboration oversight arrangements to have any direct role in operational coordination, control or command or directing the sharing of aerial resources during actual wildfire events or emergencies. These operational roles are covered by other mechanisms.

Observation 5:

Many respondents indicated that they were not aware of some important aspects of the current land border mutual support agreement between Portugal and Spain, following the most recent revisions. For example, many respondents were not aware that the agreement now applies within 25km of the border.

Note: This issue is also included in the Supplementary Report on Technical and Operational matters (refer to Appendix 1).

Observation 6:

Some respondents also expressed concern regarding aspects of the land border mutual support agreement between Portugal and Spain. Most concerns related to different operational procedures, especially communication procedures, that applied along sections of the border, associated with differing requirements of the respective adjacent Autonomous Regions of Spain.

Note: it is understood that Spanish national authorities are aware this matter, and have initiated a project to align procedures where appropriate.

This issue is also included in the Supplementary Report on Technical and Operational matters (refer to Appendix 1).

Recommendation 5:

That Portugal proposes to the appropriate agencies or institutions in Spain that a formal arrangement, such as a high-level oversight committee, be convened to govern, coordinate and promote collaboration regarding aerial fire management between Portugal and Spain.

Note: it is suggested that:

- A collaboration oversight committee should have clearly defined Terms of Reference that set out, at a minimum:
  - roles of the Committee
  - scope of operation
  - membership, and responsibilities of members
  - meeting procedures
- the Committee should meet at least twice per year, with a formal agenda; and should maintain a register of issues and a register of agreed actions
- the Committee would logically be convened by AGIF and MITECO (possibly in rotation) and include, at a minimum, nominees of ANEPC, FAP and appropriate Spanish agencies and institutions. Involvement of representatives of other government and non-government institutions should also be considered.

Recommendation 6:

Consideration be given to the possibility of entering into a consolidated, comprehensive bi-lateral agreement with Spain for routine sharing of aerial resources for between Portugal and Spain, for fire and emergency management purposes.

This bi-lateral agreement would be intended to provide for situations that are not covered by the existing 25km land border mutual support agreement.

Note: It is acknowledged that a bi-lateral agreement may not be necessary if wider EU resource sharing procedures and standards are sufficiently comprehensive in the future. However, it is considered that there would be value in establishing a consolidated PT-ES bi-lateral agreement in the meantime.

It is critical for safety in bi-lateral resource sharing that appropriate, clear operational procedures are agreed and published.[4] Any bi-lateral agreement should include agreed operational procedures.

[4] Guidance on the format and content of bi-lateral agreements for international sharing of aviation resources is provided at http://www.ifawg.net/ifawg-fire-aviation-guidelines-part-2-new/co-7-1-international-deployments/

06

National strategy

6.1 Guiding principles

A strategic approach to aerial resource management in any jurisdiction is normally based on some form of established guiding principles. These underpinning principles then provide consistent direction for the selection of appropriate capabilities and for development of appropriate doctrine such as plans, strategies, training programs and Operational Directives. Agreed, cross-agency guiding principles are effectively imperative in a multi-agency enterprise such as aerial fire management in Portugal.

The main principles underpinning aerial fire management in Portugal are generally already agreed and understood between the main agencies and institutions. However, there would be additional benefit in formalising and publishing these implied principles.

As an example, one of the key principles guiding the development of aerial firefighting capability in Portugal is clearly that rapid initial attack of nascent fires is a primary focus. This principle has guided the development of the aerial firefighting fleet towards higher numbers of smaller, more responsive air attack aircraft, that are well spaced around the country during high fire risk periods. This is a logical and sensible approach, but it would be useful to clearly document and publish this principle so that all agencies and their personnel, and the aviation industry, understand the factors that are driving the selection of capabilities.

In a multi-agency environment, the actual process of defining and agreeing on guiding principles is also very valuable, and will improve shared understanding of the factors that each partner agency needs to consider in delivering their responsibilities.

Agreed principles would ideally also form part of the published National Aerial Firefighting Strategic Plan that is recommended at Section 6.2.

It is important that Portugal develop and agree its own underpinning principles for aerial fire management, although it is suggested that the principle of prioritising safety should be always be the first guiding principle for any jurisdiction.

The following are illustrative examples of typical guiding principles that have been adapted from or adopted in other jurisdictions:

- Safety on the ground and in the air is always the highest priority
- Planning and deployment of aerial capabilities will be driven by the needs of the community
- Rapid Initial Attack will the primary focus of aerial firefighting
- Aerial operations will be fully integrated with ground operations
- Financial, human and physical resources for aerial operations will be deployed in a manner that is sustainable and based on assessment of risk
- Aerial capabilities will be optimised through cooperation and collaboration, including with industry partners and internationally

- Decisions regarding the application of aerial capabilities will be made on the basis of evidence
- Aerial fire management will be conducted and supported to high standards
- Aerial fire management programs will incorporate continuous improvement through ongoing evaluation and review, training, research and innovation.

Recommendation 7:

The relevant agencies and institutions formally agree and publish the basic Principles that guide the development and operation of aerial firefighting capability in Portugal.

Note: ideally the agreed, approved Principles would form part of a wider, published National Aerial Firefighting Strategic Plan.

Ideally the Principles would be drafted under the auspices of a high-level, interagency Aerial Means Strategic Coordination Committee or Board, who would appoint one agency or institution to lead the drafting process. This governance committee would then jointly approve the agreed Principles, and arrange for periodic review.

6.2 National Aerial Firefighting Strategic Plan

As is the case in most countries, aerial f*irefighting* is by far the major component of aerial *fire management* in Portugal. As previously noted, responsibilities for aerial firefighting functions in Portugal are clearly laid out in the NPIRFM and associated plans and sub-plans, however they are not always well understood by some agencies and by some third-parties such as Air Operators, and the public.

Likewise the main guiding principles that drive the selection and operation of aerial capabilities are implied and are generally understood by the main agencies involved, but are not necessarily clearly documented or communicated to other agencies and institutions and to the aviation industry and the public.

Other countries have also found that providing some guidance to the supplier industry regarding planned future developments and directions has generated significant benefits. Long lead-in times are often required in the aviation industry to deliver changes in aviation capability and capacity and to provide appropriate ongoing sustainment. Advance notice allows the aviation industry to plan and prepare to provide the capabilities and capacity required, and to make appropriate investments.

It is therefore suggested that the main agencies involved in aerial firefighting in Portugal, collaborate to produce and publish a simple and straightforward, agreed document that brings together and summarises:

- the overall governance arrangements for aerial firefighting
- the relevant components of the NPIRFM and SGIFR and plans and sub-plans
- responsibilities of the main agencies and institutions regarding aerial firefighting
- key principles that guide the development and operation of aerial firefighting capability
- anticipated future developments and strategic directions

- other factors driving capability selection and capacity and fleet planning.

The document should also provide a very brief background to aerial firefighting in Portugal, describing its history and development and why it is an important component of the SGIFR that requires significant public investment; as well as summaries of current and planned capabilities.

It is also suggested that the document clearly emphasise that the following doctrine underpins fleet selection and operation in mainland Portugal:

- the primary considerations for aerial firefighting fleet selection in Portugal are:
  - only capabilities that can operate safely and legally will be selected
  - ensuring effective rapid initial attack to any part of Portugal or community that is threatened by landscape fire; and
  - ensuring that there is access to sufficient, appropriate aerial means to support extended attack and response to large fires.

The proposed document is referred to here for convenience as *a "National Aerial Firefighting Strategic Plan"*, but the relevant agencies may prefer an alternative title.

The National Aerial Firefighting Strategic Plan, if adopted, should be regularly reviewed.

Recommendation 8:

The main agencies involved in aerial firefighting in Portugal collaborate to produce and publish a brief, straightforward "National Aerial Firefighting Strategic Plan" or equivalent document.

Ideally the Strategic Plan would be drafted under the auspices of a high-level, interagency Aerial Means Strategic Coordination Committee or Board, who would appoint one agency or institution to lead the drafting process. This governance committee would then jointly approve the Plan, and arrange for periodic review.

07

Operational command, coordination and supervision

7.1 National aircraft coordination and support

Use of aerial resources is inevitably high-profile and can be expensive. Effective, specialised high-level coordination and command protocols are required. Careful planning is required to ensure appropriate operational readiness at a national level, and to use aerial resources efficiently. Aviation also involves certain risks that require active and specialised management.

Rural fire and emergency response operations in Portugal are coordinated from the National Emergency and Civil Protection Command (CNEPC) Centre which is physically located in the ANEPC Headquarters at Carnaxide, Lisbon.

In simple terms, the CNEPC commands the resources of the Special Rural Fire Fighting Device (DECIR) which is in-effect the pooled resources of all participating agencies and institutions. The DECIR includes all relevant aerial resources, including those made available by organisations such as AFOCELCA.

The Command system is detailed in a series of Operational Directives issued by the National Emergency and Civil Protection Commander, in particular Diretiva Operacional Nacional n.º 2 (DON No. 2 – DECIR). On a daily basis, operational decisions regarding national deployment of resources, including aerial resources, are made by a rostered delegate of the National Emergency and Civil Protection Commander. The rostered delegate is normally a Deputy Commander.

Recent changes (January 2023) in ANEPC organisational structure have seen some delegation of coordination and command responsibilities to regional or sub-regional centres. It is understood that this will generally not affect high-level coordination and command of aerial resources, at least in the short term. Most respondents agreed that it is important that CNEPC maintains a national picture of the situation of aerial means and that aerial resources should continue to be considered as national resources and strategically coordinated from the national CNEPC Centre.

Observation 7:

Most respondents reinforced that aerial resources should be considered as national resources and continue to be strategically coordinated nationally.

Note: this is not intended to mean that ATI resources could not be dispatched or commanded by regional or sub-regional Commands.

The permanent ANEPC Cell that is responsible for general management of aerial means for civil protection is also located in the Carnaxide building.

It is worth noting that it has been observed in many countries that co-location of the permanent management cell for aerial means with the operational coordination and command centre (which usually also includes a resource dispatch function) can have advantages and dis-advantages. Co-location means that the command centre has ready access to expert advice. On the other hand, if the management cell is constantly required to support urgent operational situations, personnel can be distracted from delivering important ongoing management functions that are necessary to ensure reliable and timely availability of aerial means.

Normally these issues are managed by:

i. ensuring that there is a clear separation of functions and duties between the management cell and the operational command; and

ii. ensuring that the operational command function has guaranteed access to sufficient and appropriate aviation expertise on a rostered basis.

National operational coordination and readiness

In Portugal, key **operational command and coordination** functions that need to be performed by CNEPC in relation to aerial means include:

- maintaining overall national situational awareness of aerial means
- providing briefings and situation reports to the chain-of-command
- assessing medium-term national weather and fire danger forecasts (say 3 to 7 days in advance) and making decisions about readiness of resources and engagement of additional resources, or reducing resources, to match the forecast situation
- assessing the overall demand for aerial assets on a daily basis and making appropriate adjustments to the numbers and types of aircraft that are available and where they are located
- repositioning aerial resources in accordance with fire activity and forecast activity, including moving resources between CMA's and districts to meet operational needs and forecast risks
- assessing and prioritising requests for aerial resources
- approving Armed Air Monitoring (Monitorização Aérea Armada or MAA) patrol when required
- approving or pre-approving dispatch of ATA resources to ATI situations
- approving or pre-approving retention of ATI resources at fires that have extended into ATA
- monitoring support systems (for example: the status of CMAs) and making adjustments to the positioning of aircraft as required
- providing advice to regional and local commanders, and incident commander regarding optimal use of air means
- liaising with other agencies and institutions as required
- managing aircraft emergency situations that may arise
- activating and coordinating international assistance when required.

Clearly, optimal performance of these functions requires a detailed understanding of the applications and limitations of different types of aerial resources; and of the requirements for effective management, coordination and support. It is crucial that access to appropriate expertise is available.

There would be advantages in further formalising and streamlining the provision of expert operational aerial firefighting support to CNEPC and ensuring that sufficient expert support is available at all times.

Many countries with a similar scope of aerial firefighting operations to Portugal establish a National Aircraft Coordinator (NAC) or equivalent position in the central command centre to support their national command. The NAC position is usually staffed on a rostered basis by appropriately qualified personnel with aviation expertise. Often the staff who fill the rostered NAC position will be sourced from the aerial means management cell, but the roster could include suitably qualified expert personnel from other units or agencies, for example: FEPC, GIPS or FAP.

It is beyond the scope of this study to provide detailed advice on CNEPC structures and resourcing, but it is suggested that ANEPC consider whether it is appropriate to formally designate a rostered NAC or equivalent role.

National operational support

Where a national command centre has responsibility for receiving requests for air means and for dispatching and actively monitoring aerial resources, it is usual to also establish an **aerial means support function**. Often this is referred to as a National Air Dispatch Centre or a national "AirDesk" or equivalent, and is staffed by specially trained, rostered operators. Key roles of the aerial means support function usually include:

- managing and providing data and information to support the CNEPC and its operational command and coordination function for air means as outlined above
- dispatching national aircraft
- dispatching support resources
- providing flight-following (real-time monitoring for safety purposes) for national aircraft
- monitoring national availability of specialist personnel for supporting and supervising aerial operations and making adjustments to the availability and location of personnel as required
- monitoring aerial firefighting activities to ensure that resources are released back to their home CMA when no longer required
- supporting management of aircraft emergency situations.

Whether or not a formal AirDesk or equivalent is established, it is crucial to ensure that sufficient fully trained personnel are always available to perform aviation support functions in the command centre, including receiving requests and dispatching and flight following for aerial resources. There is also a need to ensure access to surge personnel, that is trained personnel who can attend at short notice to supplement rostered personnel when there are unusually high levels of activity.

Again, it is beyond the scope of this study to provide detailed advice on command centre structures and resourcing, but it is also suggested that ANEPC consider the whether it is appropriate to adopt a defined "AirDesk" to consolidate aerial support functions in the CNEPC Centre.

Recommendation 9:

ANEPC review organisational structures and staffing levels in the national Command Centre to ensure that sufficient expertise in aerial means is always available to support CNEPC, and that sufficient trained, specialist staff are always available to support aviation operational functions in the Centre.

Note: it is suggested that the ANEPC review consider whether there is value in establishing a position of National Aircraft Coordinator or equivalent within the CNEPC; and/or consider consolidating aviation support positions into an AirDesk or equivalent.

7.2 Aerial coordination and supervision

A transformational opportunity

High quality on-site operational coordination and supervision of aerial firefighting at fire situations is crucial to success. This has been evidenced by experience over many years in many countries around the world. These countries have consistently found that implementing high-standard operational coordination and supervision of aircraft has resulted in the greatest improvements in safety, effectiveness and efficiency of aerial firefighting. Almost all jurisdictions that routinely use aerial firefighting now define a role to actively co-coordinate and supervise air operations at emergency incidents. This aerial supervision role is normally included in each country's version of the Incident Command System (ICS), and is referred to as, for example: *Air Attack Supervisor*, *Air Attack Officer*, *Air Coordinator* or *Air Tactical Group Supervisor*.

There can some confusion in terminology used to refer to coordination and supervision in fire and emergency management around the world. In part this is due to the fact that, in aerial firefighting, an aerial supervisor or coordinator role normally encompasses some elements of both operational coordination and supervision of aircraft.

To be clear, the role does not extend to air traffic control (active direction of aircraft for separation purposes) although an aerial supervisor or coordinator may assist pilots in maintaining separation. Active direction of aircraft to maintain separation would require air traffic control or pilot qualifications.

Key elements of the role normally include:

- advising Incident Commanders on aerial tactics and strategy and the most appropriate use of aircraft
- advising Incident Commanders on the most appropriate type of aircraft to employ to meet incident control objectives
- advising Incident Commanders when aerial resources are ineffective or no longer required
- integrating aerial fire control operations with ground fire control operations
- interpreting fire control objectives and developing aerial tactics to meet incident objectives
- communicating aerial tactics to pilots

- ensuring that aerial operations are efficient and effective; monitoring and adjusting operations
- identifying hazards and potential safety issues; resolving safety issues where appropriate
- identifying water sources
- providing overall situation awareness to relevant ICS roles on the ground, including Incident Commanders
- communicating between ground crews and aircraft
- assisting pilots to maintain separation of aircraft, providing advice regarding procedures to enhance separation
- assessing effectiveness of aerial operations, keeping records and providing appropriate feedback and reports
- verifying use of aircraft for accounting, payment and record-keeping purposes.

In general terms, the role may be performed from an airborne platform or from the ground. Although ground-based operational coordination of aerial assets is useful for relatively simple operations, airborne supervision and coordination has been found to be most effective in the majority of situations. Airborne coordination also provides additional benefits, such as improved overall situational awareness, obtaining incident intelligence, identifying preferred water sources and providing an additional layer of safety for ground crews and communities.

The aerial supervision and coordination role requires a very good knowledge of rural fire control strategy and tactics and aerial firefighting tactics, as well as specific knowledge of aircraft and their limitations. A good understanding of relevant regulations is required. High quality communication skills are necessary. Any person undertaking the role requires significant training and must practice and maintain skills after initial qualification. Most countries require some form of qualification or micro-qualification for persons performing aerial coordination and supervision.

Portugal is very much aware of the potential benefits of high-quality coordination and supervision for air operations and is well advanced in implementing air and ground coordination (COPAR-Ar and COPAR-T[erra]) programs for aerial firefighting. A number of COPAR-Ar and COPAR-T have been trained and appointed. A manual of coordination procedures, the *Manual for the Coordination of Aerial Operations in Rural Fires*, has been prepared by ANEPC and is due to be published in the near future.

DON-DECIR currently prescribes that a COPAR-T should be appointed at an incident which has more than two aircraft assigned; and a COPAR-Ar should be appointed, to work with the COPAR-T, whenever four or more aircraft are operating in the same operational theatre. These directives do not prevent COPAR being assigned to incidents with fewer aircraft involved, provided that sufficient trained COPAR are available. Most countries that regularly deploy aerial assets for firefighting now aim to have *airborne* coordination and supervision (that is, equivalent to COPAR-Ar) in place for all air attack operations. Exceptions may apply where the pilot-commander of the air attack aircraft has been specifically trained and approved for un-supervised air attack – this in turn requires a level of additional training for the aircrew similar to that required for COPAR.

Most respondents strongly reinforced the value of having high-quality coordination and supervision at rural fires in Portugal. Many respondents also indicated that a significant increase in capacity for airborne coordination was required, to ensure that sufficient COPAR-Ar are available.

Increasing the number of trained COPAR-Ar also requires making available additional suitable coordination aircraft. Currently COPAR-Ar mostly operate from a limited number of Agusta 119 Koala HERAC (light helicopters) provided and operated by FAP, and occasionally from AVRAC (fixed-wing reconnaissance) aircraft. For 2023, it is planned that the number of dedicated HERAC will be increased from one to two, however additional capacity will be required as more trained COPAR-Ar become available. On occasions, it will be possible to also utilise AVRAC, or even HEBL, as coordination and supervision platforms, without compromising ATI capacity (for example: by utilising an ATI resource based in a region where the fire risk is low).

Some respondents considered that there appeared to be somewhat variable standards of COPAR-T across the country. This is concerning, and poses potential safety risks. Even if COPAR-Ar capacity is increased, maintaining a high standard of COPAR-T will still be important, as it will not be practical or sensible to allocate COPAR-Ar to all incidents requiring COPAR.

Continuing to improve the standard, and increasing the capacity of COPAR overall should be regarded as a transformational opportunity for Portugal, and is worthy of significant priority and effort. As previously mentioned, other countries have reported dramatic improvements in safety, effectiveness and efficiency of aerial firefighting operations by implementing high quality coordination and supervision. There are also a number of additional benefits, for example:

- an effective increase in availability and capacity of aerial resources (this arises, in-part, because coordinators ensure that aircraft are released from situations when they are no longer being effective)
- reduction in the overall cost of using aerial means, as a result of improved safety, effectiveness and efficiency
- greatly improved accountability for public expenditure on aerial means
- increased public confidence in agencies and institutions involved in aerial firefighting.

Increasing the standard and improving the capacity of COPAR will require close collaboration between key agencies, including ANEPC, FAP, GNR-GIPS, Fire brigades and AGIF, as well as with institutions such as the National Fire Service School (ENB). Liaison with relevant Spanish and EU agencies would also be beneficial, with a view to aligning standards and procedures where appropriate, and collaborating on training.

There would be considerable benefit in initiating a formal joint-agency project to manage the process of further developing Portugal's coordination and supervision capacity for air operations. Key steps in the project would include:

- finalise appropriate, agreed standards for aerial coordination and supervision in Portugal
- finalise agreed training standards for COPAR including:
    - requirements for formal qualifications or micro-qualifications
    - requirements for maintaining ongoing proficiency.
- determine the numbers of COPAR-Ar and COPAR-T ultimately required to ensure optimum aerial supervision and coordination in Portugal; and set appropriate targets for training and proficiency programs.

It is important to note that most countries have experienced that there is a need achieve a balance between having appropriate numbers of qualified COPAR (or equivalent position) and those COPAR having sufficient opportunities for gaining experience and practicing skills. Recent developments in low-cost computer-based simulation technology can assist with maintaining skills (refer to Section 9.7).

- develop an agreed joint agency plan to ensure that Portugal continues to implement appropriate, best-practice aerial coordination and supervision arrangements; and to ensure that the capacity for high quality coordination and supervision of air operations is significantly increased.

It will necessarily take some years to establish appropriate standards and gradually increase the capacity for best-practice coordination and supervision. In the meantime, some incremental improvements can be made. It is suggested that immediate efforts be directed to:

- increasing the availability of airborne coordinators (COPAR-Ar) and ensuring that they can be deployed to as many incidents that involve multiple aircraft as is practical (ANEPC advises that they are currently working to increase the number of trained COPAR-Ar)
- publishing the *Manual for the Coordination of Aerial Operations in Rural Fires*

Note: refer also to Section 9.3 regarding ICS.

Finding 5:

Improving the capacity and standard of operational coordination and supervision of aerial means is a transformational opportunity for Portugal.

Observation 8:

Care should be taken if it is planned to increase the number or complexity of air attack aircraft in the future. The ability to provide adequate coordination and supervision for air attack operations should be one of the considerations in making decisions about air attack capabilities and capacity.

Recommendation 10:
A transformational opportunity

Portugal formally commits to a high priority objective of transforming the safety, effectiveness and efficiency of aerial firefighting by:

i. continuing to implement appropriate, best-practice aerial coordination and supervision arrangements; and

ii. increasing the capacity for high quality coordination and supervision of air operations.

Note: this commitment would logically be arranged through the formal, high-level, interagency governance arrangement such as the Aerial Means Strategic Coordination Committee or Board recommended at Section 5.3.

Recommendation 11:

A formal joint-agency project be initiated, with the mission of:

i. defining appropriate best-practice aerial coordination and supervision standards and arrangements; and

ii. developing agreed implementation plans.

Note: the joint project would ideally be commissioned by the high-level, interagency governance arrangement such as the Aerial Means Strategic Coordination Committee or Board recommended at Section 5.3; and would logically be led by ANEPC with involvement from AGIF, FAP, GNR-GIPS, Fire Brigades and ENB.

Recommendation 12:

The *Manual for the Coordination of Aerial Operations in Rural Fires* developed by ANEPC should be published as a matter of priority.

Recommendation 13:

Formal qualifications or micro-qualifications and appropriate formal training courses and competency-based certification should be established for COPAR-Ar and COPAR-T.

Note: it is suggested that aligning training standards and qualifications with Spain, and collaborating with Spain to provide COPAR training, also be considered.

Recommendation 14:

Training exercises and other opportunities to develop and maintain skills after initial qualification should be routinely provided for COPAR-Ar and COPAR-T.

Recommendation 15:

Pending further direction from the joint project proposed at Recommendation 11, in the meantime Portugal should increase the number of light helicopters (and aeroplanes, if appropriate) that are available for COPAR-Ar.

Note: it is suggested that a minimum of 3 suitable light helicopters should be available during Phase IV.

Recommendation 16:

Pending further direction from the joint project proposed at Recommendation11, in the meantime, the range of situations where it is intended that COPAR-Ar be routinely deployed should be expanded, as sufficient trained and qualified COPAR-Ar become available.

Note: currently a COPAR-Ar is required when four or more aircraft are present in an operating theatre. It is suggested that Portugal should ideally aim to have COPAR-Ar at any situation involving multiple air attack aircraft.

7.3 Training for users of aerial means

It has also been found in many countries that providing appropriate training in the proper use of aerial means to all "users" of aerial firefighting trained provides significant improvements in effectiveness and efficiency.

This means that any person who is likely to occupy an ICS position equivalent to crew leader, sector commander, division commander or incident commander should receive an appropriate level of training in effective use of aerial means. This training could also be extended to planning chiefs and logistics chiefs, and to district relief commanders who may be involved in dispatch or strategic coordination of aerial resources.

Training does not have to be complex or time consuming, but should include, at a level appropriate to the trainee's role:

- basic aviation safety
- basic regulatory considerations
- aircraft type recognition
- limitations of aerial means
- appropriate tactical applications for different types of aircraft and dispensing systems
- characteristics and uses of water, foam, gel and retardant
- communication procedures
- integrating aerial firefighting tactics and strategy with ground tactics.

ANEPC has advised that it is currently intended that all elements with functions within the Operations Management System (SGO) receive an adequate level of training on the use of aerial means.

A textbook of aerial firefighting in Portugal, *Aerial Means in Rural Fire Fighting* is currently being finalised by ANEPC. This document will provide a good basis for designing and delivering appropriate training, and should be published as soon as practical. (Note: to be clear, this is a different document from the *Manual for the Coordination of Aerial Operations in Rural Fires* referred to in Section 7.2.)

As is the case with training for aerial coordination and supervision, training of "users" can potentially be delivered, at least in part, through on-line modules and relatively simple simulation technology.

Recommendation 17:

The *Aerial Means in Rural Fire Fighting* textbook drafted by ANEPC should be published as a matter of priority.

Recommendation 18:

At a minimum, formal training regarding appropriate deployment and utilisation of aerial resources should be provided for:

i. any person who may occupy Operations Management System (SGO) roles equivalent to incident commander, division commander, sector commander or crew leader, or planning chief or logistics chief, at rural fires; with training for incident commanders as the highest priority;

ii. district relief commanders who may be involved in dispatch or strategic coordination of aerial resources.

In due course, completion of the respective air operations training module should become a requirement for Incident Commander certification or qualification.

Note: ANEPC has advised that it is currently intended that all elements with functions within the (SGO) receive an adequate level of training on the use of aerial means, supported by a specific module. There is also a plan to create a relevant Massive Open Online Course (MOOC). This Recommendation is intended to reinforce the priority and necessity of continuing to provide appropriate training to users of aerial means.

08

Aerial capabilities

8.1 Determining capability and capacity

As described earlier, Portugal recognises that the most effective use of aerial resources for firefighting is in rapid initial attack, to help prevent incipient fires from becoming larger. In-principle, Portugal therefore focusses aerial firefighting effort on rapid initial attack. This clear focus received strong support amongst respondents.

Determination of the appropriate aerial means for Portugal in terms of typology, numbers, placement and availability is therefore essentially based around the following underlying guidance, considered alongside the available funding:

1. Rapid Initial Attack
    i. during Phase III and Phase IV, there should be sufficient resources to "triangulate" an incipient fire with Initial Attack (ATI) resources, at any time during daylight hours, ideally:
        - with dedicated Initial Attack resources located within approximately 40km of potential fire starts in those parts of Portugal that present a conjunctural (combined) fire risk of High or Very High (mainly this occurs north of the Tagus River and in the Algarve region)
        - with dedicated Initial Attack Resources located within 80km km of potential fire starts in other areas.

    ii. during Phases I and Phase II, sufficient resources should be maintained to provide reasonable Initial Attack response, in accordance with the prevailing fire risk

    iii. during all Phases, sufficient resources designated for Extended Attack should be available to reinforce Initial Attack resources when required and appropriate.

    Initial Attack means are mostly:
    - HEBL (light helicopters with short-line bucket and 5 person EHATI crew), or
    - in some locations, may be HEBM (medium helicopters with short-line bucket and with 8-12 person BHATI crew).

2. Extended Attack (ATA)
    i. during all Phases there should be sufficient resources, in accordance with the prevailing fire risk, to provide reasonable response to any fire that escapes Initial Attack (usually regarded as extending beyond 90 minutes since detection).

    Extended Attack means are essentially:
    - HEBM with short-line buckets and 8-12 person BHATI crew, if not designated for Initial Attack, and
    - HEBP (medium helicopters with long-line bucket), and
    - AVBM (medium amphibious aeroplanes), and
    - AVBP (heavy amphibious aeroplanes).

3. Specialist support means
    i. during all Phases there should be sufficient aerial resources for coordination, supervision, command, intelligence gathering and mapping.

    Specialist support means are essentially:

    - HERAC (light helicopter for coordination, supervision and reconnaissance); and
    - AVRAC (light aeroplane for specialist intelligence gathering and reconnaissance).

As stated earlier, the guidance listed above is appropriate, but it would helpful to have the underpinning Principles clearly summarised and published, ideally as part of a National Aerial Firefighting Strategic Plan or equivalent.

Illustration: AS350B3 HEBL on standby at CMA helipad, Algeriz, Vale de Cambra

Illustration: AS350B3 HEBL with bucket on hook

Image: HeliBravo

Illustration: Agusta Westland AW119 Koala HERAC

Image: FAP

Illustration: Air Tractor AT802F Fireboss AVBM

Image: Carlos Miguel Seabra

Baseline resources

The strategic analysis project used the aerial means component of DECIR for 2022 as a “baseline” or reference point for analysis of capacity in future years.

Applying the guidance listed above, within available budgets, resulted in a DECIR national aerial firefighting fleet for 2022 that can be summarised as follows:

Type	Operation	Phase					
		I	II	III	IV	III	II
		Permanent All year	Shoulder 15/05-31/05	Shoulder 01/06-30/06	Peak 01/01-30/09	Shoulder 01/10-15/10	Shoulder 16/10-31/10
Special purpose:							
HERAC	SOSO		1	1	1	1	
AVRAC	COCO		2	2	2	2	2
Air Attack:							
HEBP	COCO			3	3	3	
HEBM	COCO		12	12	12	12	12
HEBL	SOCO	3	3	3	3	3	3
HEBL	COCO	7	11	23	23	23	11
AVBP	COCO		2	2	2	2	
AVBM	COCO	4	6	14	14	14	12
TOTAL		**14**	**37**	**60**	**60**	**60**	**40**
[Total State-Owned]		3	3	4	4	4	3

SOSO: State Owned, State Operated; “State” includes FAP
SOCO: State Owned, Contractor Operated
COCO: Contractor Owned, Contractor Operated

The following aircraft contracted by AFOCELCA may be considered as part of the DECIR:

		I	II	III	IV	III	II
HEBL	COCO				3		

The following aircraft are also available:

Medium UAV	SOSO	Up to 12 UAVision OGS42 for long range fire detection and surveillance
Small UAV	SOSO	Various small UAV owned and operated by GNR-GIPS and ANEPC for local surveillance
Other	SOSO	Other Armed Forces aircraft when required in emergencies, including P3 Orion for broad area surveillance

Illustration: UAVision OGS42 medium UAV

The spatial distribution of DECIR aircraft during Phase IV may be illustrated as follows:

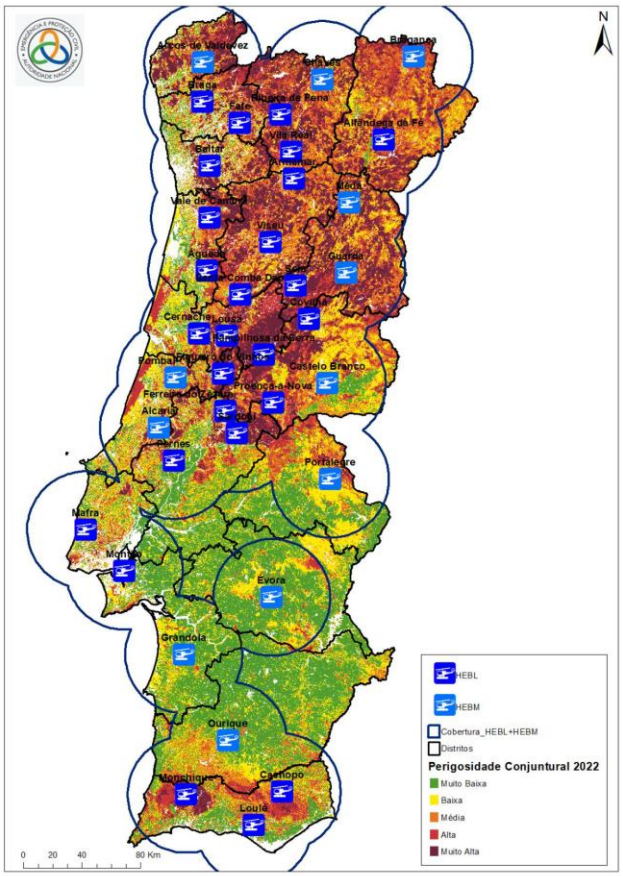


Illustration:

Base locations and area of influence, HEBL and HEBM during Phase IV

Source: ANEPC, reproduced from DON-DECIR 2022

Colours represent the conjunctural (combined) fire risk over the period.
Baixa = low (green-yellow)
Alta = high (red-dark red)

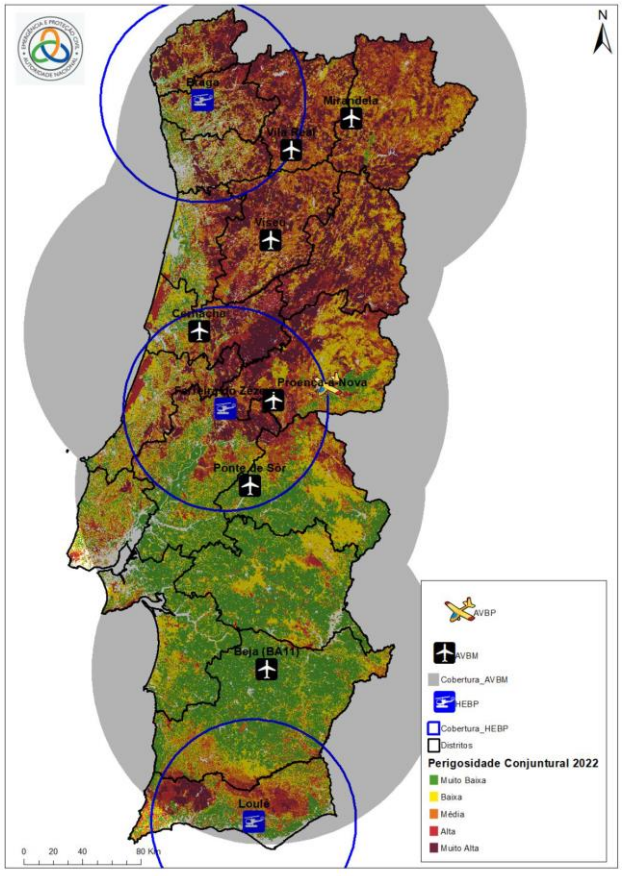


Illustration:

Base locations and area of influence, HEBP, AVBM and AVBP during Phase IV

Source: ANEPC, reproduced from DON-DECIR 2022

Planned trends

In summary, over the two to four years from 2022, subject to market conditions, availability and budget considerations, Portugal generally aims to:

i. increase the number of leased HEBL (light helicopters for air attack) dispersed around the country, to further enhance rapid initial attack, particularly during Phases III and IV.

   It is planned that the cost of increasing the number of HEBL will be at least partly offset by reducing the number of leased HEBM (medium helicopters for air attack), as light helicopters that are capable of dispensing a maximum of around 900 to 1000 litres are often more cost effective than medium helicopters that carry a maximum of around 1300 to1400 litres

ii. reduce the number of leased HEBM (medium helicopters) in favour of increasing HEBL capacity

iii. commission and then increase the number of State-Owned HEBM/HEBP (medium-heavy firebombing helicopters, specifically the UH-60, or Black Hawk, type)

iv increase the number of leased AVBM (medium amphibious aeroplane bombers) to improve the options to provide increased weight-of-attack in initial attack, and to provide additional, flexible resources for extended attack

v. transition contractor owned and operated piston-engined AVBP (heavy amphibious aeroplane bombers) to turbine-engined AVBP or AVBM

vi. evaluate the possibility of adding “super-heavy” HEBP to the national fleet

vii. evaluate the possibility of adding large fixed-wing airtankers (LAT) to the fleet

viii. increase the number of HERAC (light helicopters for reconnaissance and co-ordination)

ix evaluate possibilities for expanding the use of UAS (un-crewed aircraft).

In the longer term (beyond 2026), it is aimed to:

i. increase the number of State-Owned AVBP, in collaboration with the RescEU program

ii. further increase the number of State-Owned HEBM/HEBP, subject to developing an appropriate business case.

These trends are discussed further at sections 8.3, 8.4 and 8.5.

Matching resourcing levels to risk

Ideally, all countries that use aerial means in fire management would implement rigorous, empirical systems and tools to guide and assist decisions on the selection of types, numbers, availability levels and optimum locations of aerial resources in accordance with the threat posed by fires.

However, most countries around the world have found that implementation of empirical resource-to-risk decision support systems can pose significant challenges. Issues usually encountered include:

- lack of suitable historical records and data on fire occurrence and on the use of aerial means
- lack of reliable data on effectiveness of aerial means, and lack of consistent approaches to measuring effectiveness
- incompatibilities between datasets

- difficulties in the attributing the fire control effects to aerial means, versus other means (particularly when aerial means often work in support roles, such as assisting ground crews)
- fire control objectives may not always be clearly stated, making it difficult to assess effectiveness against objectives
- taking into account the range of roles and tactics in fire control that can be undertaken by aircraft
- taking into account the range of factors that can affect efficiency and effectiveness of aerial fire control (including quality of coordination and supervision)
- taking into account the range of different aircraft types that are used.

Despite the difficulties, some good progress in developing resource-to-risk models has recently been made around the world. Data collection has improved as a result of the introduction of automated systems. Data management techniques have improved dramatically, while the cost of storing required data has reduced. Recent advancements in computer modelling of fire spread and damage now allow more rigorous desktop evaluation of different fire control options. Rapidly developing Artificial Intelligence (AI) technology will also certainly feature in resource-to-risk decision support systems and tools in the near future.

At this stage, however, it is fair to say that the use of structured, empirical resource-to-risk decision support systems is necessarily limited, although it is certainly highly desirable to continue to develop these tools.

In these circumstances, some degree of expert judgement will be required to determine the capabilities and capacities required to address landscape fire risks, and to determine appropriate the resourcing and availability levels.

Portugal has evaluated, and continues to explore, the possibility of implementing structured resource-to-risk decision support systems for aerial means. A number of academic papers have also studied interactions between resourcing and availability of aerial means and the risks posed by landscape fire in Portugal. Due to the constraints discussed above, generally these have been limited to examining selected aspects of the aerial means resourcing situation, however they have provided important knowledge that will contribute to structured decision support systems in the future.

Given the limitations of currently available empirical resource-to-risk systems and tools, most countries have adopted some form of a system based on a “model-of-cover”. Usually these systems combine expert judgement about the effects of different resources with measures such as response times (usually the elapsed time for a specified resource to arrive at a fire location). In-effect, this is the approach currently applied in Portugal.

Some countries apply a two-level approach to their model-of-cover systems. Typically this would be along the following lines:

- Level 1: Initial attack

  Determine the resources required for Initial Attack based on setting objectives such as response times (*standards of cover*) that are appropriate to the prevailing risk levels; plus

- Level 2: Extended attack and campaign fires

  Determine the resources required for extended attack and campaign fires through application of *critical incident analysis*.

Critical incident analysis involves the use of historical data to create hypothetical scenarios of concurrent, compounding serious fire situations, combined with simultaneous initial attack situations, and examines the total resources that would be needed to allocate appropriate resources to all fires in that critical scenario.

Finding 6:

The current methodology used in Portugal to determine the aerial means capabilities and capacities required to address landscape fire risk, and the typology, location and availability levels of those capabilities, is generally appropriate, given the available data and the limitations of alternative or complementary approaches. The current methodology relies to some degree on expert judgement.

Recommendation 19:

Portugal should continue to research and develop structured, empirical resource-to-risk systems and tools to support making decisions about aerial means capabilities and capacities and the disposition and deployment of those capabilities.

Note: immediate efforts should be directed towards identifying data required, so that appropriate data collection can commence in the meantime.

It is suggested that Portugal also maintain close liaison with other countries that are exploring the development use of empirical resource-to-risk tools and systems for aerial means.

8.2 Opportunities for savings

An important part of any strategic analysis is always an examination of the opportunities to make cost savings, which would in turn allow funds to be deployed to activities which more efficiently or effectively addressed mitigation of risks associated with rural fires.

Some respondents expressed a view that there were situations in Portugal where the number of aerial means, or the level of availability of aerial means, could be reduced without adversely affecting the effectiveness of response. Examples that were cited include:

- requirements for some aircraft to be available (on immediate standby) for all daylight hours, even in periods during the day of relatively low fire risk (for example: early morning), or in the evening when a deployment would not be practicable given remaining daylight
- requiring some contracted aircraft to continue to be available on days when the forecast or actual fire risk is relatively low.

Some respondents also expressed a view that the total number of aircraft required to be available during Phase II and III could possibly be reduced, especially if there was more flexibility to move aircraft closer to any areas of relatively high fire risk. Not all respondents supported this view, however, with come citing the risk associated with lengthening fire seasons and an apparent increase in the number of fires occurring outside the traditional fire season. There may also be contractual impediments to temporarily moving some aircraft to higher risk areas.

It is important to note that reducing aircraft availability does not necessarily result in reduced prices or cost savings. Many of the costs incurred by Air Operators in making aircraft available

are fixed. If the financial returns on the contractor's investment are reduced, contracts may not be viable for some Air Operators. In turn, this may reduce competition in the market.

However, even if there are no cost savings, there are usually other potential benefits in ensuring that aircraft are not required to be immediately available when they are unlikely to be deployed, for example: improved fatigue management for pilots, AMC crews and GIPS crews.

Although the potential for cost savings is not completely clear, there are a number of alternative contracting models that may generate in savings. These models should at least be explored and, if appropriate, tested in the market.

Most contractor-owned-contractor-operated aerial fire management services in Portugal are currently provided through some form of contract that commits the aircraft and crew to be immediately available to be dispatched on each day during a defined continuous period in each year (specified as a minimum number of days). This type of contract would normally be referred to as "Exclusive Use" or "Absolute Availability" in other countries.

One option that could be examined is a type of contract sometimes known as Partial Availability. Usually Partial Availability contracts adopt a two-tiered availability system, which allows the Air Operator to undertake other work with the aircraft or pilot at times of relatively low fire risk, provided that they remain available to be placed on immediate standby for fire response when justified by the fire risk. Normally a three-tiered payment system applies: a "retainer" payment, plus a payment per day for the days when the aircraft is required for immediate standby or for actual fire firefighting, plus a payment for each hour of actual operation.

Again, it is important to note that Partial Availability may not necessarily reduce total contract costs. Partial Availability contracts are often attractive to locally-based Air Operators; however this type of contract is less likely to appeal to contractors who bring aircraft into the country solely to provide contracted aerial firefighting services. There is also an additional management overhead cost associated with determining the required availability of each Partial Availability aircraft on a daily basis.

Other contracting models may also potentially provide some cost savings, such as "Call-When-Needed" contracts; or "included hours" contracts, where in-effect the Air Operator amortises the cost of a certain number of flying hours into the standby charges.

Recommendation 20:

FAP works with ANEPC and GNR-GIPS to identify opportunities for cost savings through closely managing daily availability of aerial means.

Recommendation 21:

FAP market tests alternative contracting models by providing options in future procurement processes for tenderers to offer services on a Partial Availability or similar basis, or to offer other added-value propositions, such as included hours.

8.3 Initial attack resources

As previously noted, Portugal recognises that the most effective use of aerial resources is in rapid initial attack (ATI), to prevent nascent (incipient) fires from becoming large.

The strategic review project formed the view that the initial aerial attack system in Portugal is as well-structured as anywhere in the world.

Some respondents considered that there are minor gaps in coverage of the initial attack system, including in the north west of the country. In most instances these gaps can be covered with sensible use of other nearby aerial resources. ANEPC is aware of possible gaps and aims to adjust positioning of the fleet as opportunities arise. The project did not identify any clear requirement to increase total ATI resourcing beyond that already planned for beyond 2025.

There was a very strong common theme amongst respondents that the initial attack system could be further enhanced by earlier use of resources that are currently designated for extended attack (ATA), such as AVBM, AVBP and HEBM (medium) or HEBP (heavy) helicopters, when appropriate. This would provide valuable additional weight-of-attack in the early stages of a fire. Processes are currently implemented to allow this to happen, and there is evidence that deployment of designated ATA resources to ATI situations is occurring more regularly. However, central approval for these deployments is required. In some instances, this may act as a cultural barrier for local fire commanders to request appropriate additional resources when additional weight-of-attack is warranted.

Many respondents also suggested that there would also be benefits in providing greater flexibility for ATI helicopters to remain at fires, where appropriate, beyond the 90-minute initial attack period. There was not universal agreement on this point, some respondents preferred to maintain the integrity of the initial attack system to deal with any further outbreaks of fire. In reality, it is likely that there will certainly be individual situations where it is appropriate for the ATI resources to remain at an incident beyond 90 minutes, and there will be situations where it will be preferable that they return to ATI mode at the end of the 90-minute period. Again, processes are currently implemented to provide this flexibility, but some respondents expressed the view that they had still observed situations where it would have been beneficial for the ATI aircraft to remain, yet they were required to return to their CMA. This may, in-part, be due to existing legal, contractual and logistical constraints.

Improving the overall capacity for airborne coordination and supervision will assist in resolving this type of situation, as trained COPAR-Ar will be able to provide definitive, expert advice regarding optimum deployment of resources.

Implementation of a National Aircraft Coordinator or equivalent role, and ensuring adequate expert aviation support for the CNEPC would also assist with rapid assessment of situations where ATA resources should be used to support ATI, or where ATI resources should be considered for ATA. A NAC or equivalent would also arrange appropriate “backfill” when required, for example: moving an ATI helicopter and crew from a CMA in an area of relatively low fire risk, to replace an ATI helicopter that is being used for ATA.

Finding 7:

The system for rapid initial attack of nascent landscape fires with aerial means in Portugal is comprehensive and well-structured, and generally represents best-practice. The priority given to initial attack is appropriate.

Recommendation 22:

ANEPC continue to promote and refine existing procedures that allow for early dispatch of ATA resources to initial attack situations when appropriate, or retention of ATI resources beyond the initial attack period; and that ANEPC work with FAP to reduce, as far as practical, any legal, contractual and logistical constraints on such deployments.

Initial attack – light helicopters and medium helicopters

Several respondents raised concerns regarding the trend to prefer leasing HEBL (light helicopters) rather than HEBM (medium helicopters) for air attack.

Both categories, HEBL and HEBM, cover a wide range of possible aircraft makes and models, with different capacities. The HEBL models most often engaged in Portugal are largely variants of the Aerospatiale AS350B3 (later models are known as the Airbus H125). This model is regarded as one of the more capable light helicopter options. When used with a typical bucket, in moderate conditions, it is reasonable to plan on dispensing at least 700 to 800 litres of water on each lift. An AS350B3 will also carry 5 firefighters plus pilot in most conditions, with a reasonable load of fuel. In recent years, the HEBM models most often engaged in Portugal have been variants of the Bell 212 or Bell 412. Lifting capacities can vary considerably between the different models of Bell medium helicopters, and even between individual aircraft of the same model. Depending on the fuel carried and the basic weight of the particular aircraft being used, it is reasonable to generally plan on HEBM dispensing somewhere between 900 and 1350 litres per lift, or carrying at least 8 firefighters plus pilot.

Directly comparing the effectiveness and efficiency of different models of HEBL and HEBM is not simple, and needs to take into account a wide range of factors. It is also necessary to understand the fire control objectives. For example: if aircraft equipped with underbelly tanks are favoured due to local conditions such as the nature of water sources, HEBM may be preferred. There is a wider range of tanks available for HEBM, and for most HEBM, the weight of the tank will form a lower proportion of the aircraft operating weight, compared to a HEBL with tank.

Illustration: Bell 412 HEBM

Image: Carlos Miguel Seabra

If there is no requirement to carry passengers, this may also open up the possibility of using other makes and models of HEBM, with more attractive cost profiles.

Any comparison also needs to take into account other capabilities that may be available in the aerial firefighting fleet. For example: the need for leased HEBM may be reduced if other, heavier, air attack helicopters are readily available.

In very general terms, the contract leasing costs for a capable HEBL, such as an AS350B3 will most likely be significantly less than for a typical HEBM such as a Bell 212 or Bell 412. The cost per litre of water dispensed, or firefighter delivered, is also likely to be lower for the HEBL in most circumstances, although this will depend on the particular situation.

The lower daily availability costs for leased HEBL mean that it is possible to make more HEBL available in total, therefore reducing response times in initial attack.

In these circumstances, it is reasonable, in-principle, to substitute appropriate models of HEBL, such as the AS350B3 or H125, for HEBM. However, there are a range of factors to be considered, and each instance needs to be carefully evaluated. Risks associated with having a high proportion of the ATI fleet being provided by a single aircraft model should also be considered.

Observation 9:

Substituting higher total numbers of capable HEBL for HEBM is, in -principle, a reasonable strategy, provided sufficient high-quality HEBL and pilots are available, and provided that relative market costs continue to favour HEBL.

However, each instance should be closely evaluated and considered on its merits, and should be considered in the context of the desirable mix of capabilities and capacities in the overall aerial firefighting fleet. Over the next 3 to 5 years, selection decisions should also consider the possible risks associated with continued availability of heavier helicopters for air attack (for example: the leased KA32Ts).

8.4 Extended attack resources

Note: although this section discusses specific resources under the heading of extended attack, there is no reason why these resources cannot be used in initial attack, when appropriate, and this should be encouraged. Successful initial attack in some situations will often rely on *weight*-of-attack (that is, the total amount of suppressant or retardant dispensed in the initial attack period) as well as the speed of attack.

Extended attack - heavy amphibious aeroplanes

The Canadair CL series aircraft are well-suited to Portugal and are interoperable with other European countries. It is appropriate for Portugal to retain access, if possible, to heavier scooping aircraft (AVBP) to deal with higher intensity and larger fires. Most respondents agreed that Portugal should ideally, in the future, have access to immediate response from four to six heavy scooping aircraft, at least during Phase III and Phase IV.

Currently, two Canadair reciprocating engine CL-215s are leased. Two, new DHC-515 turbine-engined aircraft, to be state-owned, have been ordered. Introduction to service of the DHC-515 is expected around 2027, however there are risks associated with meeting this timeline. Planned production of the DHC-515 aircraft should be carefully monitored.

Illustration: De Havilland (Canadair) CL-215 AVBP

Image: Carlos Miguel Seabra

The leased CL-215 aeroplanes are ageing and have significant limitations. They have limited effectiveness in some situations and are compromised by maintenance downtime, relatively low dispatch reliability and, at times, limited access to Avgas fuel. This situation is not likely to improve. It is desirable to establish a path for retirement of the CL-215s in favour of appropriate turbine-engined AVBM or AVBP.

Recommendation 23:

The two leased CL-215 AVBP be replaced with suitable turbine-engined, leased AVBP or AVBM, ideally CL-215T or CL415-EAF, or CL-415. This should be implemented as soon as possible, subject to funding.

Note: it is understood that FAP is currently evaluating options to progress this Recommendation; and is also currently evaluating options to increase the total number of AVBP available to Portugal in the longer term.

Extended attack - large airtankers

In very general terms, large fixed-wing airtankers (LAT) are likely to have limited applicability in Portugal.

LATs are normally most cost-effective compared to smaller aircraft when:

- there are relatively long distances between the relevant loading (filling) base and the fire, or
- indirect attack is required, or
- where additional weight-of-attack is required, usually in the case of large or intense or fast-moving fires.

LATs are usually most effective if used to dispense retardant for indirect attack. In some circumstances, with proper supervision, they can be effective for direct attack with foam or gel. It is rarely useful to dispense plain water from LATs.

Use of LATs requires significant pre-planning and preparation, including, for example:

- developing safe operating procedures and integration procedures
- training specialist COPAR
- providing suitable aerial platforms for COPAR (including lead-planes, if required by the operating procedures)
- identifying and preparing suitable CMAs (operating bases)
- establishment of specialist infrastructure at CMAs, including for storing, mixing and loading retardant or gel or foam.

Portugal has relatively few runways that are suitable for LATs. Those runways that are suitable for LATs in terms of length and pavement strength are mainly used to service regular public transport (airline) operations or are part of military installations. Having said that, most LATs are relatively fast, so having to travel longer distances to re-fill is not necessarily a major disadvantage.

Illustration: C-130Q (equivalent to C-130H), large airtanker, with RADS dispensing system

Given current predictions, there will certainly be some situations in Portugal, in the future, where use of LATs could be advantageous. The question is

whether providing dedicated LAT capability to fill that niche will justify the cost.

Options to reduce the cost and improve the economic viability of providing LAT capability could include:

- sharing LAT capability and costs with another country, such as Spain, through bi-lateral agreement, or through a suitable EU mechanism
- using suitable multi-role large aeroplanes, so that costs are offset against other roles. This could be:
    - civil aircraft, that can also undertake other tasks when not required for firefighting, such as passenger transport, medical transport, Search and Rescue, or servicing Portugal's Autonomous Territories.

      Examples of multi-role, civil LATs include the Conair Q400MR and the Coulson 737 Fireliner.
    - military aircraft that normally undertake other military tasks, but can be configured for aerial firefighting when required.

      FAP currently operate a number of aircraft types that can at least be hypothetically converted for firefighting missions, including the CASA 295, C-390 and C-130.

      Whether or not it would be appropriate, viable or cost effective to utilise FAP aircraft as LATs requires detailed further investigation. Considerations include, for example:
        - effect on the ability to deliver other FAP responsibilities
        - residual value of airframe and engines
        - cost of conversion
        - cost of other modifications required (for example: C-130s may require wing box replacement or strengthening)
        - cost and effort of sustaining the capability, including training of pilots and maintaining pilot skills
        - effect on service life of airframes and components
        - additional maintenance requirements.

Illustration: C-390 with MAFFS dispensing system
Image: MAFFS

Recommendation 24:

Portugal initiate a specific project to:

i. closely evaluate the costs and benefits of having a large fixed-wing airtanker (LAT) capability available for aerial firefighting; and

ii. identify viable options for making available a LAT capability, using either military or civil aircraft.

Note: this project would ideally be conducted under the auspices of the high-level, interagency governance arrangement such as the Aerial Means Strategic Coordination Committee or Board recommended at Section 5.3; and would logically be led by FAP.

It understood that FAP has already commenced preliminary work on a project to evaluate LAT options.

Extended Attack – super-heavy helicopters

Some respondents considered that it was important for Portugal to have access to a "super-heavy" helicopter capability for ATA, at least during Phase IV. (Super-heavy or "high-volume" bombing helicopters are usually regarded as those with a capacity to dispense 7000 litres or more, for example: Boeing CH47 Chinook, Erickson S64 Aircrane or similar).

Not all respondents agreed on this topic, some considered that super-heavy helicopters were not necessary in the Portuguese situation.

Illustration: example of super-heavy helicopter, Erickson S64 Aircrane, seen here in scooping mode.

It has been found from experience around the world that there are certainly situations where super-heavy helicopters can be more effective compared to smaller aircraft. Mostly this is for direct attack or for direct protection of property, under conditions of extreme fire behaviour. Super-heavy helicopters have also proven to be critical in some initial attack situations, especially when the fire is rapidly spreading. These types of situations are forecast to occur in Portugal more often in the future. However, having super-heavy helicopters readily available is usually relatively expensive.

As with LATS, in the future there will certainly be some situations in Portugal where very heavy helicopters will be useful. As with LATs, there is a question of whether providing a super-heavy helicopter capability will justify the cost.

Options to reduce the cost and improve the economic viability of providing a super- heavy helicopter capability for air attack could include:

- sharing the capability and costs with another country, such as Spain, through bi-lateral agreement, or through a suitable EU mechanism
- using suitable multi-role super-heavy helicopters, so that costs are offset against other roles. This could be:

- civil or military aircraft that can undertake other missions when not required for firefighting.

  For example: a CH47D Chinook equipped with a Coulson RADS tank offers this possibility. The firefighting tank can be quickly removed and the aircraft returned to passenger or cargo configuration. Alternatively, many super-heavy helicopters can be used for commercial heavy lifting and construction tasks.

  Of course, these alternative roles are only economically helpful if there is sufficient demand from either military or civil users for such missions.

It is worth noting that in many circumstances, two UH-60 Black Hawk helicopters (see below) or similar medium-heavy helicopters such as the AS322 (H215), will deliver a similar total volume of water or foam as one super-heavy helicopter. The UH-60 is well suited to the Portuguese situation and two medium-heavy helicopters would provide greater mission flexibility than one super-heavy helicopter. This suggests that Portugal should at least consider increasing the number of UH-60 or equivalent helicopters available for firefighting, as an alternative to purchasing or leasing a super-heavy helicopter capability. Another option to consider is investigating commercial contract arrangements to provide a super-heavy helicopter capability only when required by the forecast fire risk, for example: only for fire seasons that are forecast to be more severe than normal.

Observation 10:

Providing a super-heavy helicopter capability for air attack in Portugal should be considered. Whether it is viable to provide a capability will largely depend on the cost. There may be options to at least partially offset costs against other uses, or to share costs with an international partner. Another option to explore is to manage the capability so that costs are only incurred when the capability is most likely to be required.

Increasing the number of medium-heavy helicopters available for firebombing, such as the UH-60 Black Hawk or equivalent, could be considered as an alternative to providing a super heavy helicopter capability. (UH-60s are more likely to be a viable alternative to super-heavy helicopters only if higher performance models of the UH-60 are utilised, such as the UH-60A+ or UH-60L, preferably with firebombing tanks).

Providing heavy or super-heavy helicopter capability should not occur at the expense of ATI (initial attack) capacity. ATI is still the most efficient and effective use of aerial means in most circumstances.

Extended Attack – Medium-Heavy Helicopters

From 2007, Portugal utilised up to six State-owned Kamov KA32A HEBP for firefighting, initially operated by the State Corporation, Empresa de Meios Aéreo (EMA) and subsequently operated by private contractors. Although variants of the KA32 are capable firefighting helicopters, and are well suited the aerial firefighting environment in Portugal, the KA32A helicopters proved to be difficult to maintain, resulting in relatively low availability and low dispatch reliability. A shortage of qualified mechanics and issues in obtaining approved spare parts were central factors. Maintenance and repair problems were exacerbated by pandemic-related supply-chain issues in 2020 and became critical in 2022 due to the world political situation. In March 2022, EASA suspended European type certification for the KA32 type. Supply chain issues are expected to continue. Under this combination of circumstances, it has become impractical to continue to operate the State-owned KA32As, and there is now little likelihood of them being able to reach operational readiness for firefighting. In October 2022, the Government of Portugal therefore agreed to make the six (unserviceable) KA32A airframes available to the Government of Ukraine. All respondents who commented on this issue agreed that, given the prevailing circumstances, this is a sensible resolution.

Illustration: Kamov KA32A, former HEBP

Image: Media of Portugal

Finding 8:

It would not have been practical to return the State-owned Kamov KA32A HEBPs to operational readiness in the foreseeable future. The decision to decommission the KA32As from consideration for inclusion in the DECIR is logical and sensible.

In mid-2022 Portugal entered into a contract for the purchase of six UH-60A Black Hawk helicopters, primarily to provide medium-heavy firebombing capability for ATA. The aircraft are due to be delivered progressively from 2023 to 2026. The possibility of purchasing additional Black Hawks is under consideration.

As well as air attack, the Black Hawks are likely to be suitable platforms for future implementation of "BRIF" or "Helitack" specialised, airborne forest firefighting crews. The Black Hawks are also likely to be well-suited to other FAP and ANEPC roles, such as winch rescue.

The Black Hawk type is considered appropriate to the Portuguese situation. There is a significant body of experience around the world in using Black Hawks for firefighting, and the type is now well proven as a capable, reliable firefighting resource in other countries.

Illustration: Military UH-60 with bucket on hook in the U.S.A.

Image: U.S. Department of Defence

The strategic analysis project identified a number of potential risks regarding implementation of the Black Hawk in Portugal, however, including:

- there is a worldwide shortage of Black Hawk pilots with appropriate firefighting experience. Careful attention to recruitment, and to a program of pilot training that also allows pilots to gain appropriate experience will be required. This may possibly extend the planned timelines for full operational readiness of the Black Hawks
- the model of Black Hawk that is currently scheduled for delivery to FAP is the UH-60A, with "-700" engines. Operating Black Hawks with -700 engines may pose some challenges in the future. Although very capable at lower altitudes, the performance of Black Hawks powered by -700 engines can be limited under the "hot-and-high" conditions that are typically encountered in fire-prone regions of Portugal during summer
- the model of UH-60A Black Hawk that is currently scheduled for delivery is a version that limits external loads carried on the hook to 3628kg (8000 lbs).

Observation 11:

The UH-60 Black-Hawk type is generally well-suited to aerial firefighting in Portugal from a number of perspectives; and potentially fills a capability gap for a medium-heavy helicopter that can also carry firefighters.

Implementation of a new aircraft type such as the UH-60 is a complex process. A conservative approach is appropriate to manage risks and ensure safety. The capability is likely to take some years to reach full operational readiness, including provision of properly experienced flight crews. This risk should be taken into account when making decisions regarding other capabilities in the aerial firefighting fleet.

Recommendation 26:

It is recommended that the FAP closely liaise with other firefighting operators of Black Hawks around the world regarding best-practice in training of UH-60 firefighting pilots.

Recommendation 27:

FAP evaluate the possibility of powering state-owned Black Hawks with variants of the "-701" engine, and equipping the aircraft with upgraded powertrain components.

8.5 Resourcing risks

Fleet diversity

Several respondents noted that a large proportion of helicopters used in aerial firefighting in Portugal are of a single make and model: the AS350. HEBL used for ATI are mostly AS350B3 (or the later model, known by the current market designation of Airbus H125). Similarly, all leased AVBM aircraft are the Air Tractor AT802F model.

An adverse event such as an urgent Airworthiness Directive that prevented or restricted operation of a specific aircraft make or model could therefore seriously compromise Portugal's aerial firefighting capacity.

While the risks associated with such an event could be reduced by including a range of other aircraft types in the fleet, this is likely to add extra cost and could reduce overall efficiency. It also potentially introduces additional risks.

The models of aircraft used in Portugal are well-proven and are well supported by the respective manufacturers or their agents (with one current exception relating to the KA32 type. Refer to "*other key resourcing risks*", over the page). While some form of broad, temporary or ongoing restriction on the operation of a specific model of aircraft is possible, it is considered to be at a relatively low likelihood of occurrence. However the consequences of such an event could be catastrophic. Accordingly it would be prudent to prepare appropriate contingency plans.

Observation 12:

An event that will prevent or restrict operation of all aircraft of a specific make or model is considered to be a low likelihood of occurring, but the consequences could be catastrophic and could seriously compromise Portugal's aerial firefighting capacity. Increasing the diversity of aircraft makes and models in the fleet could be considered, but this is likely to introduce other issues.

Recommendation 28:

FAP, in collaboration with ANEPC, continue to closely monitor the risks associated with a lack of diversity of makes and models of DECIR aircraft, within a risk management (likelihood and consequence) framework; and implement risk mitigation strategies, including contingency plans, when and if required.

Operator diversity

Several respondents also noted that a large proportion of leased aircraft used in aerial firefighting in Portugal are provided by a relatively small number of Air Operators. An event such as a corporate failure, insolvency or the withdrawal of Air Operator certification could prevent a contractor from supplying aviation services. Again, this could seriously compromise Portugal's aerial firefighting capacity.

Having a relatively small number of suppliers providing the majority of services can have other disadvantages. Some other countries have observed that it can reduce competition in the market and potentially can stifle innovation. On the other hand, there are potential advantages in economies of scale, efficiencies in contract administration, and improved standardisation.

Some respondents suggested that there would be merit in limiting the number of firefighting aircraft that could be supplied by an individual Air Operator. While this would increase the diversity of Air Operators, and reduce the risks associated with non-availability of an Air Operator who was supplying a large number of aircraft, it is likely to increase total costs and to introduce other risks. Limiting an Air Operator's eligibility to supply aircraft services would also complicate procurement processes, introducing selection considerations other than price and value-for-money.

On balance it is considered that the most appropriate primary mitigation is to minimise the likelihood of occurrence of non-availability of contracted Air Operators. This can be achieved through rigorous financial and operational due diligence of potential contractors during

procurement processes, and ongoing monitoring of contractor performance during the contract period.

While due diligence processes will minimise the risk of occurrence, the failure of an Air Operator to provide multiple aircraft services during a contract period is still possible, and the consequences of such an event could be serious. Accordingly it would be prudent to prepare appropriate contingency plans.

Observation 13:

An event that will prevent or restrict a single Air Operator from supplying multiple leased aircraft services is considered to be a relatively low likelihood of occurring, but the consequences could be serious and could significantly compromise Portugal's aerial firefighting capacity. Limiting the number of DECIR aircraft permitted to be supplied through a single Air Operator could be considered, however this is likely to introduce other issues and could potentially compromise fair procurement. Exercising comprehensive due diligence on Air Operators, to minimise the likelihood of an adverse event, is the preferred mitigation strategy, at least in the short to medium term.

Recommendation 29:

FAP, in collaboration with ANEPC, continue to closely monitor the risks associated with a small number of Air Operators supplying a relatively high proportion of the DECIR aerial firefighting fleet, within a risk management (likelihood and consequence) framework; and implement appropriate risk mitigation strategies, when and if required. Risk mitigation strategies should include:

i. a high degree of technical and financial due diligence on potential contractors during procurement processes; and

ii. a high degree of technical and financial due diligence on contractors during the contract supply period; and

iii. contingency planning.

Other key resourcing risks

A number of other potentially important resourcing risks were identified during the strategic analysis project. Mostly these can be mitigated to some degree, or contingency arrangements can be implemented. However, Portugal's aerial firefighting capacity could be significantly affected if several adverse events happened to coincide, resulting in non-availability of multiple aircraft of the same type, or multiple types of aircraft. The possibility of multiple adverse events occurring is most likely in the period 2023 to 2028. This is a period when Portugal will be transitioning to some new supply arrangements and implementing new capabilities, but is also likely to be a period of high-competition and uncertainty in the market for some categories of aerial firefighting resources.

As an illustrative, purely hypothetical example: if there were delays in achieving full operational readiness of FAP UH-60 Black Hawks, and the leased KA32T HEBP became unavailable at the same time, Portugal would have no access to HEBP capacity or to long-line bucket capability, unless appropriate contingency arrangements had been made.

As such, all resourcing risks should continue to be closely monitored, and where appropriate, contingency plans should be developed.

Resourcing risks include:

i. Availability of suitable HEBL pilots

There is some possibility that Air Operators will not be able to provide sufficient high-quality HEBL pilots with appropriate firefighting experience and Portuguese language skills during coming European summers. This is mainly due to current market conditions, which are likely to continue for some years.

ii. Availability of HEBP and long-line bucket capability

Three leased Kamov KA32T helicopters currently provide an important ATA capability, and are currently the only aircraft in the fleet capable of operating with a bucket on a long-line. There is some possibility that the Air Operator may not be able to supply or maintain these aircraft due to the world political situation and interruptions to the supply-chain for required spare parts.

Illustration: Kamov KA32T HEBP

Image: Daniel Silva

iii. Commissioning of UH-60 Black Hawks

The planned, progressive commissioning of FAP owned and operated UH-60 Black Hawks from 2023 will provide an important and necessary increase in Portugal's ATI and ATA capacity.

In addition, in coming years, Portugal aims to decrease the number of medium helicopters (for example: Bell 212, Bell 412) in favour of increased numbers of high-capacity light helicopters (for example: AS350B3). As discussed earlier, this is considered to be a reasonable strategy, as greater numbers of high-capacity HEBL will provide improved coverage and will likely deliver equivalent amounts of water at a lower cost. To some degree the loss of medium helicopter capacity for ATA and ATI will also subsequently be offset by the introduction of the UH-60 Black Hawks.

As outlined above, UH-60s have been ordered, but there are timing risks with introducing and commissioning the UH-60 capability. Some of these risks relate to ensuring appropriate pilot training and experience. It is appropriate to take a conservative approach, and it may take some years for the UH-60s to reach full operational readiness.

iv. Availability of leased AVBM aircraft

The AT802F Fireboss aeroplanes are well suited to Portugal and are interoperable with other European countries. The aircraft type is well suited to Initial Attack and Extended Attack. Portugal intends to increase the number of AVBM available during Phases III and IV in each year. There is also a possibility that AVBM could substitute for AVBP, should there be delays in commissioning turbine-engined AVBP, or new AVBP.

During the 2022 and 2023 northern hemisphere summers, there has been a very strong market around the world for provision of leased AT802F aircraft services, and significant inter-country competition. This market situation is expected to continue for the foreseeable future. In this market, Air Operators may face some difficulties providing required numbers of leased AVBM.

v. Availability of suitable AVBM pilots

There is some possibility that Air Operators will not be able to provide sufficient Fireboss pilots with appropriate firefighting experience and Portuguese language skills during the coming European summers. Again, this is mainly due to market conditions, as well as limited opportunities to train firefighting pilots. This market situation is expected to continue for some years.

vi. Access to AVBP

As outlined above, Portugal currently maintains access to 2 leased CL-215 AVBP and it is desirable, if practical, to replace these aircraft with suitable turbine-engined aircraft. This will increase capacity and improve reliability. FAP is currently evaluating options to progress the replacement.

Portugal has also ordered 2 additional new De Havilland DHC-515[5] AVBP, due to be delivered after 2027, and is evaluating the possibility of ordering additional AVBP.

The current world market for turbine-engined AVBP is "tight", there are very few suitable aeroplanes available and long lead times to supply. Delivery of new AVBP from the DeHavilland DH-series relies on re-commencement of the Canadian production line. Timely re-commencement of production of any aircraft always carries risk.

There is a reasonable possibility that there will be delays in commissioning new AVBP.

Other manufacturers intend to bring alternative AVBP to the market (for example: AVIC AG600, ShinMaywa US-2). While any suitable aircraft should be always be evaluated, neither of these examples has yet been proven in firefighting configuration and it appears that there is a low probability that they will provide viable options in the short to medium term.

Finding 9:

There are risks to the introduction or continued availability of some important aerial resources. Portugal's aerial firefighting capacity could be significantly affected if several adverse outcomes happened to coincide, resulting in non-availability of multiple aircraft of the same type, or multiple types of aircraft. The probability of multiple adverse events occurring, and the potential consequences, is considered to greatest over the next five years or so, from 2023 to 2028.

Recommendation 30:

FAP, in collaboration with ANEPC, continue to closely monitor the key risks associated with the introduction or continued availability of aerial means for rural firefighting, within a risk management (likelihood and consequence) framework; and implement appropriate risk mitigation strategies, when and if required. Risk mitigation strategies should include identification of contingency options and preparation of contingency plans, where appropriate.

[5] DHC-515 is an evolution of the Canadair CL-415

8.6 Special capabilities

Night air attack

Around the world, air attack of landscape fires is mostly limited to daylight hours due to legal and practical considerations. Many countries aspire to provide a capability to attack fires at night using aircraft. Aerial attack at night can take advantage of the cooler conditions and milder fire behaviour that usually prevail.

Recent advances in night vision technology, combined with comprehensive mapping of vertical obstructions have seen several countries implement limited night aerial firefighting programs, mainly using helicopters with underbelly tanks. A small number of AT802 fixed-wing bombers have also been used.

Respondents were very much divided on the subject of whether Portugal should develop a night aerial firefighting capability. Some respondents strongly supported the proposition, others were strongly of the view that it would be impractical to safely deliver a night capability, mainly due to the flying environment being heavily laden with wires and other vertical obstructions. Certainly the wire-laden environment in Portugal is a significant issue for safe air operations at night.

Night aerial firefighting can also be relatively expensive, due to requirements for extensive additional pilot training and recurrent skills maintenance. High-cost, high-maintenance specialised equipment, such as nigh vision goggles (NVG or NVIS) is also necessary.

Illustration: trial night firebombing operations, Victoria, Australia using NVG in a Sikorsky S61N

Image: Peter Norman

On current trends and forecasts, Portugal is likely to see more landscape fires at night, and will experience increased fire behaviour and threats to communities at night. In the future it is highly likely that the community will expect that a night aerial attack capability is available.

In the absence of a more detailed investigation, it would be reasonable to surmise that the most likely possibility for Portugal to implement a safe effective and cost-efficient night aerial attack capability would be to extend and adapt the proposed, FAP-operated UH-60 Black Hawk fleet. Although FAP has existing NVIS capability to draw on, this would still be a major project, and would most likely require that the UH-60s be fitted with underbelly tanks instead of using underslung buckets.

On balance, it is suggested that Portugal should aspire to eventually introduce a night air attack capability, however this should be the result of a very carefully planned, long-term project. In any case, night air attack on rural fires should not proceed until wires and other vertical obstructions in the target areas and along transit routes are comprehensively recorded and mapped, and this information is able to be presented to pilots in an easily accessible and usable form.

Observation 14:

It is logical that Portugal should aim to eventually introduce a night air attack capability for rural fires, however this should be the result of a very carefully planned, long-term project.

Introduction of night air attack on rural fires will also require comprehensive, reliable recording and mapping of wires and other vertical obstructions.

Retardant

As fire seasons change and as the likelihood of concurrent severe events increases, there will clearly be some benefits in having a capability to dispense long-term retardant in Portugal for indirect attack during ATI and ATA on rural fires. Retardant will be especially valuable in situations where there may be delays in arrival of sufficient ground firefighters, where it is dangerous to deploy ground crews due to terrain and/or fire behaviour, or where spotting (projection) is likely to occur.

Most respondents considered that it was important for Portugal to be in a position to dispense long-term retardant in appropriate situations. Providing a long-term retardant capability requires careful planning. Specialised storage, mixing and loading facilities are required. Aeroplanes (or helicopters) can only be filled on the ground (or in a hover). It will be necessary to implement a system for approving, managing and handling the chemicals. Different aerial tactics and application techniques are required, and pilots and COPAR must be appropriately trained.

Large fixed-wing airtankers (LATs) are most effective when used to dispense retardant (refer also to Section 8.4). If Portugal intends at any time to utilise a LAT capability, even if temporarily or only in emergency situations, an appropriate arrangement for the supply of suitable retardant must also be considered.

Existing AT802F Fireboss AVBM can very effectively dispense retardant. However, most models of land-based (wheeled) AT802s will normally carry a greater load of retardant and will be significantly more efficient for retardant dispensing operations from land aerodromes.

It is worth noting that some countries very effectively employ portable equipment (often mounted on a trailer) for mixing and loading long-term retardant, especially for medium-sized (for example: Air Tractor AT802) bombing aircraft. This alleviates the need to establish permanent infrastructure at CMAs, and allows retardant mixing and loading capability to be moved to a CMA closer to the theatre of operation, if required.

Overall it is suggested that Portugal closely evaluate the options for providing a capability to dispense long-term retardant, and develop a body of experience in the logistics and use of retardant products. This would be logically achieved through a series of trials. Trials should include comparisons of the effectiveness and efficiency of land-based and amphibious AT802s for dispensing retardant in the Portuguese situation.

Gels (sometimes known as Water Enhancers) may provide a viable, lower cost alternative to long-term retardant in the Portuguese situation. This will require further evaluation. Gel dispensing trials could be conducted alongside retardant dispensing trials.

Recommendation 31:

Portugal should conduct an operational trial and evaluation of the use of long-term retardant and gel.

Note: ideally the trial would include evaluation of the use of portable or mobile equipment for mixing and loading retardant.

Tech-aided intelligence gathering and mapping

Aircraft can provide critical information for incident management teams to plan fire control strategy and tactics and for communities that are threatened by rural fires.

An airborne capability that has been employed very successfully in some countries is a light helicopter equipped with gimballed, high resolution infra-red and visible spectrum sensors, along with automated onboard georeferencing and mapping systems. The image processing and mapping system is coupled with a communication system (usually based on bonded 4G or 5G cellular phone channels) that can transmit digitised images and metadata to the ground. Processed images can then easily be incorporated into existing agency GIS and incident command and control information systems, or used directly by firefighters on the ground to plan fire response. The images are also displayed in the aircraft for use by a COPAR-Ar or an air observer. In some case images or derived information products are also transmitted to firebombing aircraft.

To be clear, it is the onboard image processing and mapping capability that makes this type of system so useful. This allows the data gathered to be integrated with other data to generate information products that are hugely valuable to a wide range of users.

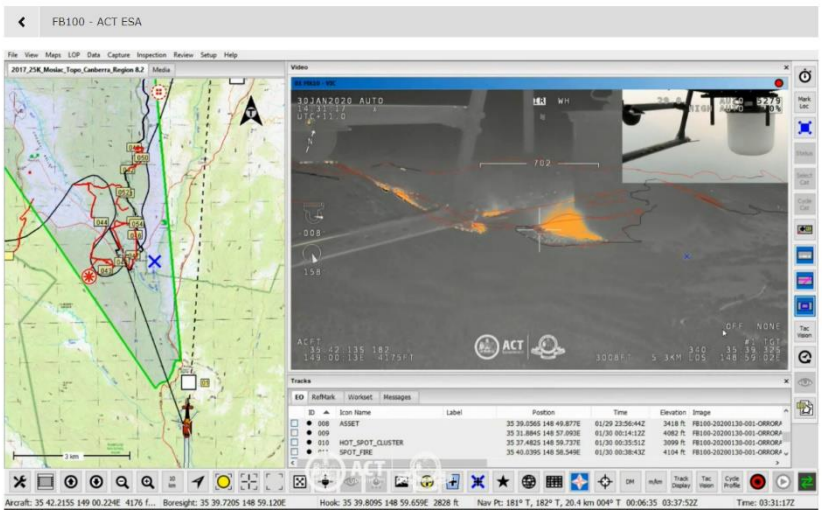


Illustration: example of ground display of intelligence transmitted from light helicopter equipped with gimballed sensor and image processing system.

Image: ACT ESA, Australian Capital Territory

UAVs or light fixed-wing aircraft can certainly also be used as a platform for gimballed sensors. Indeed the FAP UAVision UAVs are used in this mode, particularly to support GNR-GIPS in surveillance (fire detection). However it has been found that the flexibility offered by light helicopters, along with the ability to accommodate sophisticated onboard image rectification and processing, makes the light helicopter the preferred platform for this type of tech-aided intelligence gathering during actual response to rural fires.

In the Portuguese situation, a tech-aided intelligence gathering system could be incorporated onto an existing HERAC, or a light helicopter could be dedicated to the task. This capability would complement the other airborne tech-aided information gathering aircraft: AVRAC with a downward looking sensor for broad-area mapping and surveillance, and the UAVision UAVs for surveillance (fire detection).

The information gathered by tech-aided aerial platforms, and the efficient transmission of information products to a range of users, has been found to be so valuable that it is not unusual for jurisdictions around the world to dedicate one or more light helicopter solely to this task.

Note: tech-aided information gathering is discussed further at Section 10.2

Recommendation 32:

Portugal should initiate a specific project to closely evaluate the benefits and costs of having available a dedicated tech-aided intelligence gathering capability (gimballed sensors plus image processing plus communication) in an appropriate light helicopter.

Note: this project would ideally be conducted under the auspices of the high-level, interagency governance arrangement such as the Aerial Means Strategic Coordination Committee or Board recommended at Section 5.3; and would logically be led by ANEPC.

09

Support systems and processes

9.1 Safety and safety culture

Safety of persons in the air and on the ground during aerial fire management is crucial. Accidents and safety-related incidents increase costs and reduce capacity. Injuries and loss of life and should be regarded as unacceptable.

Maintaining a safe working environment in aerial firefighting is feasible, but presents some challenges, and requires specialised risk management. Challenges include, for example:

- inherently hazardous air and ground environment
- operations often conducted during extremes of weather
- dynamic, continuous risk assessment is required
- lower margins of error than in other aviation activities
- the work is highly stressing and fatiguing
- changes, diversions and distractions are normal
- highly variable levels of activity, including long periods of inactivity
- members of the broader team may be outside of the aircraft and may not be aviation professionals
- high expectations of aerial assets during emergency situations
- often single-pilot operations.

It can be difficult to analyse aerial fire management incident and accident statistics around the world, as records are not comprehensive and are often kept in incompatible databases. Analysis of available data, and comparison to other industries, does however suggest that it is reasonable to conclude:

- worldwide, aerial firefighting has a poor safety record overall, compared to other aviation sectors
- human factors are causal or contributing factors in the majority of serious accidents and incidents, therefore these accidents could be regarded as avoidable.
- experienced firefighting pilots are over-represented in serious incidents and accidents.

Portugal is no exception. There have been a number of fatal or serious aerial firefighting accidents in the past decade, most involving experienced pilots. Most respondents expressed some concern regarding the safety of aerial fire management. Several respondents expressed the view that, at times, a culture of machismo or “emergencyitis” may contribute to safety-related incidents and accidents. Actual and perceived pressure to continue unrealistic

tasks, or to continue tasks in adverse conditions was also cited as possible contributing factors. This is concerning.

It is important that Portugal continues to place a very high priority on improving safety in aerial fire management.

Actioning a number of the recommendations in this report will contribute to improving safety outcomes. These include, for example:

- adopting safety as the most important guiding Principle for developing and maintaining aerial fire management capability (refer Section 6.1 and Recommendation 7)
- improving and increasing capacity for aerial coordination and supervision (Recommendations 10 and 11)
- improving training, especially through the use of simulation (Recommendation 40)
- improving data collection and management (Recommendation 34)
- a rigorous system for processing lessons learned (Recommendation 37)
- progressing the resolution of safety-related technical and operational matters, including communication issues, as raised in the Supplementary Report (refer to Appendix 1).

A number of other productive actions are already in place, including:

- the requirement for Air Operators to have in place tailored Safety Management Systems (while noting that in some other countries it has been found that it is also necessary to ensure that Air Operators commit to actively using their Safety Management System).

Other actions that could be considered include:

- establishment of a cross-agency safety committee or safety promotion committee including representatives of ANAC and Air Operators, to identify safety issues and co-ordinate resolution
- regularly publishing safety promotion material
- implementing a confidential reporting mechanism for safety issues
- periodically reminding all relevant agencies and institutions, Air Operators and individual pilots of their obligations to maintain a safety culture, and reminding them that pilots are not obliged to accept taskings that they consider to be unsafe
- structuring contract payments to minimise financial incentives to fly in unsafe conditions.

Finding 10:

The safety record for aerial fire management in Portugal is not ideal. All relevant agencies, institutions, Air Operators and individuals must continue to place very high priority on improving safety and maintaining a safe working environment.

Recommendation 33:

Portugal should develop a cohesive multi-agency action plan of definitive actions to promote a safety culture in aerial fire management and to reduce the number of accidents and safety-related incidents.

Note: the preparation of the proposed action plan would ideally be conducted under the auspices of the high-level, interagency governance arrangement such as the Aerial Means Strategic Coordination Committee or Board recommended at Section 5.3; and would logically be led by ANEPC and FAP, with appropriate input from ANAC.

9.2 Data and data management

A transformational opportunity

High quality information regarding the use of aerial means is crucial for effective management of aircraft in fire and emergency management.

Quality data regarding the activity of individual aircraft is important for purposes such as:

- safety, and managing aircraft emergencies
- teamwork and inter-agency collaboration, where all actors use the same high-quality information
- providing situational awareness for efficient fleet management
- efficient selection and dispatch of aerial resources
- identifying water sources
- supporting water replacement programs for owners of water sources used in firefighting operations
- forecasting and scheduling aircraft maintenance and crew rotations
- providing incidental intelligence regarding fire or other emergency situations
- accountability for use of high-cost resources
- performance measurement against objectives
- evaluating efficiency and performance of various aircraft types
- accounting, validation of invoices and accounts
- fraud prevention
- research, including economic evaluation
- accident and incident investigation
- continuous improvement.

In the future, quality historical data will also be required to inform Artificial Intelligence systems that will be used to support short, medium and long-term resource allocation decisions.

Considerable advances have been made recently in the technology for real-time tracking of aircraft, and for automatically recording key events such as engine-on, take-off, firebombing drop locations, amount dropped, landing, and engine-off.

In many countries this event data is now automatically transmitted in near-real-time and fully integrated with other agency GIS and information management systems, and finance and accounting systems. Data is also stored for future uses such as performance analysis and research.

FAP currently maintains a basic tracking system for DECIR aircraft. Although this system has been extremely useful, it is not easily integrated with other information systems and does not currently transmit or record event data that would be valuable for many purposes, for example: the location and amount of water dispensed.

AFOCELCA currently maintains an automated system that transmits and records position and event data for aircraft leased by AFOCELCA.

There are many options for structuring a suitable approach to data standards, collection and management. It would be relatively straightforward to tailor a system for Portugal that, as far as practical, utilised existing systems for management and display of data.

Experience with proven systems such as the Automated Flight Following (AFF) plus Automated Telemetry Unit (ATU) system in the U.S.A.; or the ARENA system in Australia, could provide useful guidance. Off-the-shelf commercial systems are also available. It is interesting to note that both the AFF system in the U.S.A, and the ARENA system in Australia allow Air Operators to select and provide their own in-aircraft tracking and event recording hardware, and to utilise the services of a range of commercial tracking providers. This will often allow the Air Operator to utilise systems that were already installed in the aircraft for the operator's own aircraft management purposes. The Air Operator simply has to supply the required data, in accordance with a data standard. The data standards for AFF and ARENA[6] are compatible, meaning that an Air Operator who operates aircraft in both countries only requires one set of in-aircraft hardware. Both AFF and ARENA also readily exchange data with other systems, for example: displaying common, high-quality aircraft position and event data in a wide variety of different command-and-control and GIS systems that were already operated by a wide range of stakeholder agencies.

A "data standards" approach, similar to that used in other countries, is likely to be approporiate in Portugal, as it will more readily accommodate, for example, aircraft that are shared from other countries in times of emergency. Interoperability of data systems across Europe should also be considered.

Because historical aircraft tracking and event data will be important for future research and evaluation projects, including economic research, it is suggested that Portugal should aim to define data requirements and arrange for acquisition and storage of appropriate data to commence as soon as practical. This will allow a repository of suitable data, in appropriate formats, to be built-up and available for analysis.

[6] https://www.nafc.org.au/wp-content/uploads/2020/11/NAFC-Standard-OPS-014-Tracking-Event-Reporting-and-Messaging-v2020.1.pdf

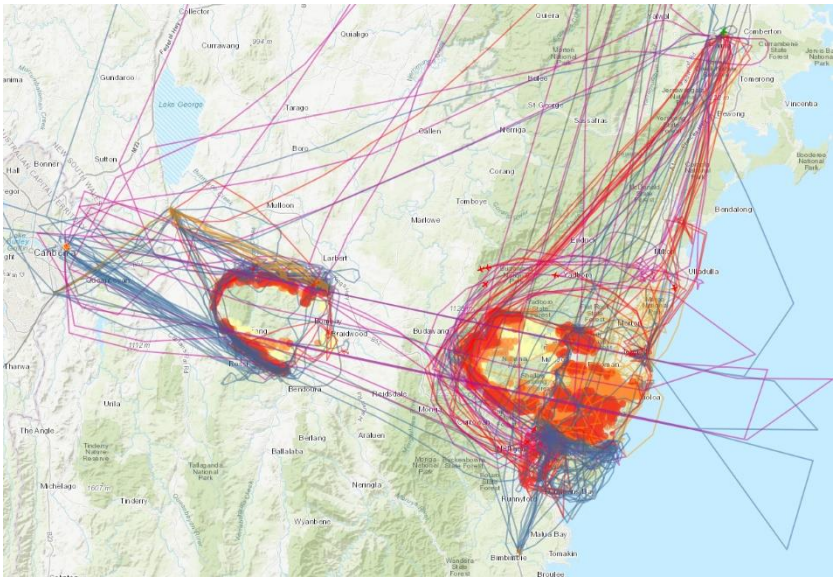


Illustration: sample screen from ARENA (Australia) showing aircraft tracks. Note the incidental information that can be easily derived regarding fire location and behaviour, and water sources.

Image: courtesy of NAFC

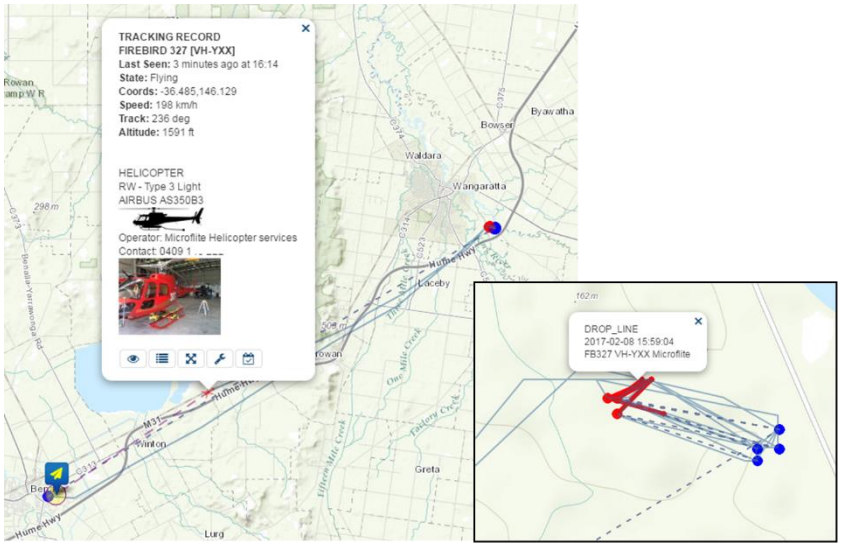


Illustration: sample screens from ARENA showing fills and drops from a single aircraft.

Image: courtesy of NAFC

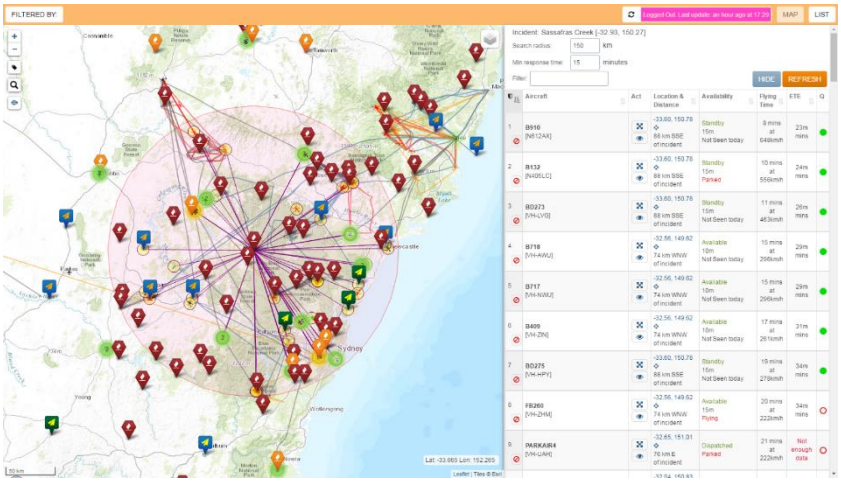


Illustration: sample screen from ARENA showing examples of dispatch and decision support tools - in this case: *"find and dispatch suitable aircraft with shortest elapsed time to arrive at fire."*

Image: courtesy of NAFC

Finding 11:

Implementation of a national approach to the collection and management of comprehensive, high quality, data on aerial fire management operations is a transformational opportunity for Portugal.

Observation 15:

Most respondents strongly supported the proposition of implementing a national, inter-agency approach to the collection and management of comprehensive, high quality, data on aerial fire management operations. Several respondents emphasised the importance of designing a system that utilised appropriate existing agency systems as far as practicable, and ensuring that data can be exchanged with existing systems. This is sensible.

Recommendation 34:

Transformational opportunity

Portugal should initiate a multi-agency project to design and implement a comprehensive, interagency approach to acquisition and management of aircraft data, that:

- provides for the collection, storage and display of near-real-time aircraft tracking and event data, to defined standards; and
- ensures that appropriate data can be exchanged with other, existing agency information systems.

This project should be commenced as soon as practical, to facilitate building a collection of data that can be utilised for future research and evaluation projects, including economic evaluation.

Note: the joint project would ideally be conducted under the auspices of the high-level, interagency governance arrangement such as the Aerial Means Strategic Coordination Committee or Board recommended at Section 5.3; and would logically be led by ANEPC and FAP, and should involve AFOCELCA.

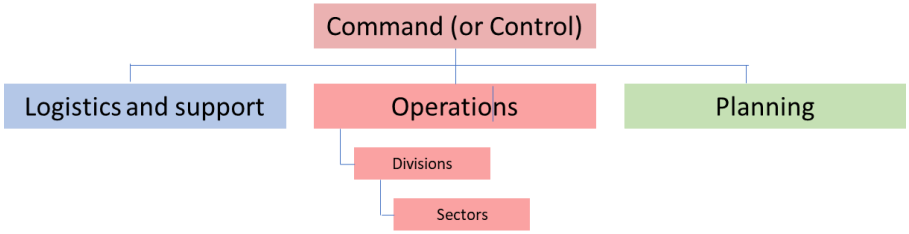
9.3 Incident Control System

Clear and effective lines of command and control are absolutely crucial to safety and effectiveness of any air operation in a fire or emergency situation, especially where multiple agencies are involved, as is the case in Portugal.

Many countries around the world now utilise some variation of an Incident Command System (ICS) to manage incidents such as wildfires. In some countries it is referred to as an Incident *Control* System, especially where the system extends beyond providing unified command of resources that are responding to an incident.

Key characteristics of an ICS normally include:

- Unified Command: the system provides for unified command of resources, irrespective of originating agency or institution
- Management by Objectives: an Incident Action Plan with clear incident control objectives is required
- Span of Control. the system expands to ensure that each unit is not overloaded by having to manage too many sub-units
- Common structure and division of responsibility - most ICS-based management systems are arranged along the following lines:



Management, supervision and support of aerial operations usually resides within the Operations line-of command, although some variants of ICS may place support functions for aerial operations in Logistics and support. Some variants of ICS place aerial intelligence gathering operations in the Planning area.

Portugal has introduced an ICS-based system, known as the Operations Management System (SGO). Implementation of SGO at incidents is scaled according to incident size and complexity, which is categorised in six Phases.

The SGO places responsibility for air operations command in the Operations line-of-command. The key roles are:

- Air Operations Officer (OPAR) who is responsible for overall management of air operations at an incident (more or less equivalent to Air Operations Manager or Air Operations Branch Director in ICS in some other countries); and
- Air Operations Coordinator (COPAR) who is responsible for on-site coordination and supervision of aerial resources, either from the air or the ground (more or less equivalent to Air Attack Supervisor, Air Attack Officer or Air Tactical Group Supervisor in some other countries).

One of the issues found with ICS in other countries is that the scale of air operations at an incident does not necessarily correlate with the scale of the incident itself – in other words it is possible to have a large and complex air operation at a relatively small (for example Phase 1 or 2) incident. Conversely it is possible to have a small air operation at a large, complex fire incident. Experience has shown that the components of an ICS system that are applicable to air operations should be implemented as soon as any aircraft are involved in an incident, and scaled according to the nature of the air operation as it escalates. This should occur irrespective of the size or complexity (Phase) of the incident. In practical terms this means that, at a minimum, an OPAR and COPAR (either COPAR Ar or COPAR-T) should be appointed for every incident where aircraft are involved. (A separate OPAR is not necessarily required for smaller operations – the role may be performed by a suitably trained person who is also performing other duties, but their responsibility for air operations must be clear.)

An important issue communicated by respondents is that although ICS is implemented in Portugal through SGO, not all actors (including some Air Operators) fully understood how it is applied, or the roles and responsibilities of the key positions in relation to air operations.

Recommendation 35:

ANEPC update relevant Operational Directives to improve clarity that the components of SGO (ICS) that apply to air operations should be implemented in all Phases of incident response, and should then be scaled according to the size and complexity of air operations, rather than the complexity (Phase) of the Incident.

Recommendation 36:

ANEPC publish a concise summary of the application of SGO (ICS) to aerial fire management in Portugal, and ensure that it is distributed to all relevant agencies, institutions and Air Operators.

Note: It is understood that ANEPC intends to soon publish the comprehensive textbook: *Aerial Means in Rural Fire Fighting*, which will include material on the application of the SGO. However it is suggested that a summary guide be published in the meantime.

Opportunity for further development of ICS for air operations in Europe

As previously mentioned, sharing of aerial resources across Europe is likely to increase in the future. This will include sharing of personnel trained in specialist aviation support and supervision roles.

Safe and effective sharing of resources must be underpinned by common and consistent command and control systems.

Implementation of ICS across Europe is variable. With a currently established ICS-based system (the SGO), there is an opportunity for Portugal to lead or to play a major part in implementing a consistent approach to ICS, at least for air operations, across Europe. As many fire-prone nations outside of Europe use ICS-based systems, this will also facilitate other international aerial resource sharing opportunities.

Observation 16:

There is an opportunity for Portugal to take a leadership role in promoting adoption of common and consistent ICS-based systems for incident management in Europe, especially for air operations.

9.4 Lessons Learned system

Experience around the world has shown that systematic approach to continuous improvement, and a culture of continuous improvement, are always essential features of safe, effective aviation activities in fire and emergency management.

Agencies involved in the SGFIR in Portugal are in fact legally obliged to adopt and apply continuous improvement strategies. A priority activity of the NPIRFM is Continuous Improvement (Priority PE3).

Continuous improvement in a muti-agency environment poses challenges. Improvements identified by one agency or institution may require action by another agency, or may require the coordinated efforts of several agencies. There needs to be agreement on improvement actions and on the responsibilities and priorities for action. Progress on improvement actions must be monitored and recorded, with relevant information available to all agencies and institutions.

Lessons-learned systems provide an important component of continuous improvement. AGIF is currently designing and implementing a cross-agency lessons-learned system for rural fire management in Portugal. This system should provide the ideal platform for sharing lessons learned across agencies and for documenting agreed improvement actions and responsibilities.

Recommendation 37:

Portugal adopt a common, interagency system for recording lessons learned for aerial fire management, including agreed corrective actions and responsibilities.

Note: the Lessons Learned system currently being designed and implemented by AGIF is expected to provide a suitable platform.

Observation 17:

Agreed actions arising from this Aerial Strategic Analysis project, including those of an operational or technical nature, could be appropriately recorded in the common Lessons Learned system, as soon as it is functional.

9.5 Procurement of commercial services

As is the case in most countries across the world, aerial fire management services in Portugal are procured from the commercial sector (from Air Operators) via publicly advertised tender or solicitation processes.

Tender processes are managed by FAP in accordance with rules and regulations laid down by Portuguese federal law governing public purchasing and procurement.

Experience in many jurisdictions has shown that, in the case of highly specialised services such as aviation, generic public tender processes do not always provide the optimum result. In particular, despite the best efforts of process designers, there can be a tendency to select providers that tender the lowest prices rather than providers who offer additional value and ultimately provide the best value-for-money. Specifying pricing “caps” (for example the

maximum total contract price that will be paid) can deter potential suppliers and reduce competition, and can make it difficult to establish true market prices for required services.

Sometimes there may also a need to meet broader objectives other than lowest price or best value-for-money, such as achieving fleet diversity or diversity of Air Operators, for risk management purposes (refer to Section 8.5).

There is no doubt that designing fair and open procurement of highly specialised aviation services such as aerial firefighting, that also meet the required legal and probity standards can be challenging. Volumes (for example: the number of flight hours expected) can be difficult to forecast. Services required can often be provided by a range of different aircraft types and operators, all with varying characteristics and advantages and disadvantages. This makes evaluation complicated. Setting technical specifications at readily achievable, minimum levels does encourage competition, but can also lead to selection of lower quality operators and can work against innovation continuous improvement. To be clear, these are lessons learned about specialised procurement from other jurisdictions, and this strategic analysis project does not suggest that minimum-standard operators have been selected in Portugal to date. However, it is a risk that needs to be considered in future procurement.

Observation 18:

Procurement of highly specialised aviation services should ideally focus principally on best overall value-for- money, acknowledging that this may have to be achieved within a budget.

Recommendation 38:

FAP work with the relevant financial agencies in Portugal to design specific procurement processes for highly specialised aviation services that:

- meet the required standards of probity, integrity and fairness
- provide best value-for-money, overall
- allow for market testing of alternative contract options, such as Partial Availability
- allow tenderers to offer added-value services and alternative means of compliance that may provide extra value
- do not necessarily specify pricing or total value caps, when appropriate
- provide some flexibility to meet wider objectives, if and when required, such as fleet diversity or operator diversity.

9.6 Aerial resources classification

The definitions for the classification of DECIR aerial resources for aerial firefighting in Portugal are:

		Definition (abbreviated from DON-DECIR)
HEBL	Helicópteros Bombardeiros Ligeiros	Light bomber helicopters, used to transport teams up to 5 persons and to discharge water from a bucket, with a maximum discharge capacity of 750 litres
HEBM	Helicópteros Bombardeiros Médios	Medium bomber helicopters, used to transport teams of 8-12 persons and to discharge water from a bucket, with a maximum discharge capacity of 1.100 litres
HEBP	Helicópteros Bombardeiros Pesados	Heavy bomber helicopters, used to to discharge water from a bucket, with a maximum discharge capacity of 4.000 litres
HERAC	Helicóptero de Reconhecimento, Avaliação e Coordenação	Helicopter used in aerial firefighting coordination missions for and, when necessary, the reconnaissance and assessment of incidents.
AVBM	Aviões Bombardeiros Médios	Amphibious medium bomber aeroplane used to discharge water or other extinguishing agents from an internal tank, with a maximum discharge capacity of 3.000 litres
AVBP	Aviões Bombardeiros Pesados	Amphibious medium bomber aeroplane used to discharge water or other extinguishing agents from an internal tank, with a maximum discharge capacity of 5.000 litres
AVRAC	Aviões de Reconhecimento, Avaliação e Coordenação	Reconnaissance and assessment aeroplane, usually with a system operator, who has knowledge of fire behavior analysis. May also be used as a platform for COPAR-Ar

Some respondents expressed concern that definitions used in the classification system may be limiting in certain circumstances, especially if used in procurement. Respondents also indicated that they were unclear whether this system was only intended to be a convenient way of describing capabilities that were already part of DECIR, or was intended to serve broader purposes (such as in tender processes).

Aircraft classification systems used elsewhere in the world normally specify minimum discharge amounts for different categories of aircraft. Specifying maximum discharge amounts may limit options to consider larger, more efficient aircraft during procurement processes. Other respondent comments included:

- there is some uncertainty about whether the classification system is intended to refer to the aircraft (for example: *HEBL* = light helicopter), or the total capability (for example: *HEBL* = light helicopter + bucket + EHATI)
- the current classifications do not appear to provide for light or medium bombing helicopters that cannot carry passengers (for regulatory reasons), should these be part of DECIR in the future
- the system does not currently explicitly provide for helicopters equipped with tanks

- the system does not currently explicitly provide for medium or large land-based (wheeled) bombing aircraft, should these be utilised in the future
- it would be useful to extend the classification system to accommodate different uncrewed aircraft (UAS) capabilities
- there may be advantages in aligning the classification system with systems that are used in other countries (such as the *"Type 1, Type 2 etc."* system used in the U.S.A. and elsewhere, while acknowledging that these systems also have some limitations).

Most importantly, it became apparent during the strategic analysis project that some agencies and institutions had, at least informally, adopted other classification systems for their internal use. As an example, some agencies refer to UH-60 Black Hawks as "medium" helicopters, others referred to them as "heavy" helicopters. This disparity has potential risks, and may lead to confusion. It is important that all agencies and institutions, and the aviation industry, have a consistent approach to classification and a common understanding of categories of aerial means.

Recommendation 39:

ANEPC and FAP collaborate to review Portugal's aerial firefighting aircraft classification, and aim to develop a common, agreed system that meets all operational and procurement needs.

Note: In the meantime, as far as practicable, a single system should be used. Logically this would be the system described in DON-DECIR, acknowledging that this may need to be supplemented for some purposes.

Note: As far as practicable, classification systems for aerial firefighting aircraft should ideally align criteria and terminology with classification systems used elsewhere in Europe and around the world.

9.7 Use of simulation

This report has previously noted the importance of ensuring the provision of sufficient competent, trained and qualified people to manage, supervise, direct and support specialist aviation capabilities such as those used for aerial firefighting. This can present a challenge for agencies and institutions involved in rural fire management. Aviation training is specialised, relatively costly and time consuming. The coordination, logistics and scheduling of aviation related training presents particular difficulties.

Provision of surge capacity for specialist aviation roles is also inherently problematic, as there is a need to balance optimum numbers of trained personnel against the costs and challenges of providing sufficient training, while also maintaining high standards.

Maintaining aviation skills presents issues for qualified personnel, with limited real-world opportunities to train and practice. Lack of skills maintenance can have a very significant effect on overall capacity.

In the past decade, there have been significant developments in training methods for specialist personnel involved in high-risk, low-task-frequency industry sectors such as aerial firefighting. Although simulation techniques have been available for some time, the advent of affordable, capable and effective computer-based simulation (CBS) is at the forefront of what can only be described as a significant shift in the way training and skills maintenance is delivered for

technical and operations-centred training in many industries. CBS offers features that can greatly enhance and streamline training for aviation specialists, as well as providing other operational benefits.

The principal advantages of employing CBS include:

- improved safety (during training and incident operations)
- overall improvements in training and in operational procedures, leading to improved effectiveness and efficiency in use of aerial means (with associated cost savings)
- the ability to train for emergency scenarios that would be unsafe to practice in the real-world
- providing an accessible way for specialists such as COPAR to practice and maintain skills at a variety of locations, without requiring use of real aircraft
- increased capacity for management and supervision of aerial means (and therefore increased flexibility to respond to large or complex events).

Properly designed CBS may be used for:

- aptitude testing and candidate selection
- initial training
- training for in-flight emergencies
- extension training, for example: large airtanker supervision
- task specialist specific training – for example: tech-aided intelligence gathering, incendiary machine operation, use of night vision equipment
- assessment
- remedial training and re-assessment
- skills maintenance and practice
- re-certification.

CBS will also provide benefits for:

- development and testing of systems, procedures (including emergency procedures), operating practices and doctrine
- interagency collaboration and cooperation including resource sharing
- preparation for international deployment
- diversity and inclusion (by making training more accessible).

A high-quality simulation capability is already available at Portugal's Escola Nacional de Bombeiros (ENB). A comprehensive, collaborative simulation capability is available at the *Sistema de Entrenamiento Integrado de Lucha Antiincendios Forestales* (SEILAF) facility in Seville, Spain. In addition, French agencies operate a variety of dedicated aviation and incident control simulation facilities, including at CESIR[7] in Valabre in France and at the Securite Civile Air Means base in Nimes.

[7] https://www.valabre.com/prestations/cesir

It is most important to recognise that high-fidelity simulation is not necessarily required. Many aviation-related training outcomes can now be provided by simple, lower cost simulation facilities that can be readily made available at locations such as agency offices, Air Means Centres and Air Operator bases, or even in private homes. This includes simulation that employs Virtual Reality (VR) technology. Simulation facilities can also be portable or mobile.

A key feature of modern simulation facilities is that they can be easily networked. As a simple example, this would allow a COPAR-Ar to practice coordination scenarios with firebombing pilots who are at completely different locations – even on the other side of the world.

High-quality off-the-shelf software, specifically designed for training and practice in aerial firefighting, is also now available.

Illustration: Securite Civile firebombing simulation and training facility, Nimes, France. This image shows the facility being used to develop and test standard operating procedures to support international resource sharing.

Illustration: example of simple, networked simulation facilities being used for COPAR training in Canada
Image: Alberta Forest Service

Illustrations: example of low-cost, portable (trailer-mounted), networked simulation facilities being used for COPAR training in Australia.

Recommendation 40:

Portugal should initiate a collaborative project to develop a cohesive plan for the appropriate incorporation of Computer Based Simulation into training and skills maintenance programs for specialists who manage, coordinate supervise and support aerial operations; and for users of aerial means.

10

Research and development

10.1 Economic research

Most respondents considered that the total level of investment in aerial firefighting in Portugal was generally in the order of magnitude that would be expected. However it would be reasonable to say that this view is based to some degree on judgement, and by comparing Portugal to jurisdictions with similar rural fire risks. These other jurisdictions also base investment decisions, at least partly, on judgement and experience. In the future, especially as the rural fire risk develops and changes, it would be advantageous for investment decisions to be underpinned by formal, targeted research into the economic costs that are incurred and the benefits that are generated through supporting rural fire management with aerial means. This type of economic research is also likely to inform related decision-making processes, such as matching resources to risk, and decisions around fleet typology, numbers and placement. Economic research will also be fundamental to the development of decision-support tools.

There is no doubt that economic research in the field of fire management, and aerial fire management in particular, can be difficult and may be resource intensive. Economic research into aerial firefighting in other countries has evidenced some of these challenges. Acquiring good quality, consistent data from actual events is problematic, often requiring dedicated collection teams. Measuring and attributing the effect of aerial means is not straightforward, as they often operate in support of other means. In most jurisdictions, the major costs associated with aerial means are incurred by making resources available at short notice. There is therefore an “insurance” element to the economics of employing aerial means, where the benefits can be difficult to quantify. Intangible and collateral benefits are also involved – for example: the provision of community confidence in firefighting efforts is often regarded as a benefit of deploying aerial means, whether or not they are being effective in suppressing the fire. An example of collateral benefits is that a firefighting aircraft may also provide crucial intelligence to the incident control team.

Despite the challenges for economic research on aerial firefighting, some countries have made good progress and there is now a body of literature that will help to guide appropriate data collection and research. Recent advances in automated data collection and data management are also helpful. Improvements in computer modelling of fire spread and damage now readily allow testing of different levels and types of investment in fire control measures.

Economic research requires bringing together experts from various different disciplines, and must be conducted as a collaborative exercise. In Portugal, research into the cost and benefits of aerial firefighting will necessarily be a long-term project. However it is important to commence the design of the research at an early stage, so that the data that will be required can be identified. This will also inform the proposed data collection and management project (refer to Section 9.2), and enable the appropriate data sets to be established.

Recommendation 41:

Portugal should initiate a long-term project to design and conduct economic research into the use of aerial means to support rural fire management, including a benefit-cost study.

Note: it is important that the design phase be completed as soon as practicable, in order that appropriate data acquisition can commence.

10.2 Airborne intelligence gathering

As described earlier, aircraft provide critical information for incident management teams to plan fire control strategy and tactics and for communities threatened by rural fires to make appropriate decisions regarding their safety. Information from airborne platforms can also be crucial for a range of other purposes including, for example:

- fire detection
- ensuring safety of ground firefighters
- directing resources
- regional and national situation awareness and resource allocation
- post-incident analysis, debriefing and continuous improvement
- fire cause analysis
- maintaining records, including legal records.

In simple terms, provision of good quality information is one of the most important roles that can be undertaken by aircraft. Some jurisdictions around the world now place greater emphasis on providing airborne Intelligence, Surveillance and Reconnaissance (ISR) capability for rural fires than on air attack capability.

Portugal is well aware of the importance of using aerial platforms for ISR. Current initiatives include, for example:

- equipping an AVRAC with visible and infrared sensors and automated digital image processing and mapping capability (an upgraded, downward-looking sensor is planned to be trialled during 2023)
- a simple system for routinely acquiring, transmitting and processing images of fire events from HERAC and AVRAC, via mobile (cell) phones
- use of FAP-operated Type 2 (medium) UAVs for fire detection (surveillance)
- use of a range of GNR-GIPS, ANEPC and fire brigade owned multi-rotor UAVs for intelligence gathering.

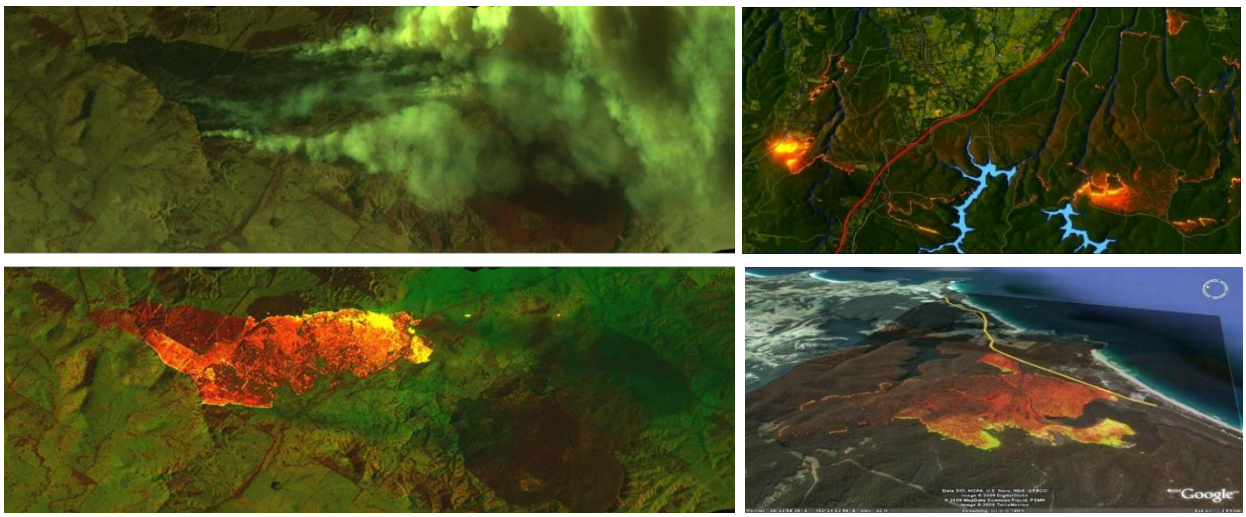
On occasions, an FAP P3 Orion with specialist sensors has also been engaged in fire surveillance and mapping.

Based on experience in other countries, further developments that could be considered, include:

- provision of gimballed infrared and visible sensors on HERAC or other dedicated light helicopters, with onboard image processing and air-ground data communication systems, to assist both with coordination of air means and to provide intelligence and information products to ground-based incident management teams and firefighters (refer also to Section 8.6)
- extending, and further automating, the existing image capture system to every aircraft ("a camera on every aircraft")
- installing broad area, downward looking infrared and visible spectrum mapping equipment in a fast, IFR (all-weather) turbine or twin-engine aeroplane to provide rapid, automated mapping of large fires or multiple fires spread around the country.

Recommendation 42:

Portugal should continue to place a very high priority on researching, developing and implementing appropriate, additional airborne Intelligence, Surveillance and Reconnaissance (ISR) capability for rural fires.



Illustrations: Simple examples of processed images of rural fires from downward looking sensors, automatically incorporated into agency information systems. The two examples on the left compare an image of the same fire from visible sensors (top) with an image from infra-red sensors (lower).

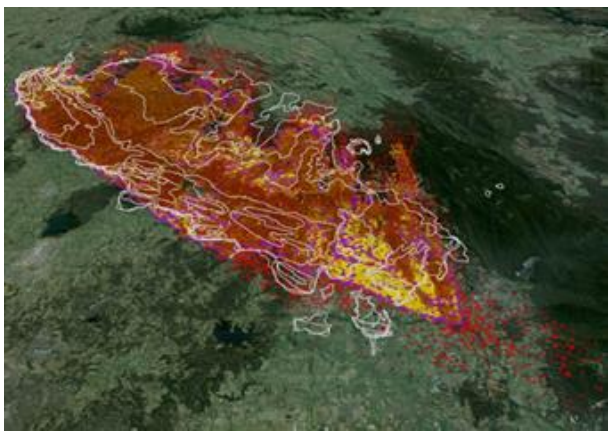


Illustration: Further example of processed images of rural fires from downward looking sensors incorporated into agency systems. In this case, the imagery has been used as a starting point to computer model anticipated fire spread.

Appendix 1
Operational and technical issues

A1.1 Introduction

A number of matters were identified during the project that were considered to be of an operational or technical nature and therefore outside the scope of the main project report. The project considered that it was important that these operational or technical issues were still recorded and presented to the appropriate agencies and institutions, in an interim Supplementary Report.

This Appendix summarises and updates the interim Supplementary Report on technical and operational issues.

It is important to emphasise that the list of operational and technical matters reported is not comprehensive or exhaustive. The strategic analysis project did not aim to identify all operational and technical issues. Only those matters that happened to be identified during the analysis project are listed.

It is suggested that the topics listed in this report could be considered for inclusion in the Lessons Learned system that is proposed in the main project report.

This report makes some ***suggestions*** for resolving the issues listed, plus some additional comments.

Suggestions:

are only relevant to technical and operational matters, and are suggested options for addressing the issues raised, mainly based on feedback from respondents and on experience with similar issues in other jurisdictions. They are suggestions only, for consideration by the responsible agencies. They are not necessarily firm recommendations. Responsible agencies may be aware of other options for resolving these issues.

A1.2 Operational and technical issues

1. Limited availability of national air-ground radio channels (safety issue)

Description:
When multiple aircraft are engaged at an incident, a national VHF-AM radio frequency is allocated for air-ground-air communications. It is understood that four such frequencies were available in 2022. However, with only a limited number of frequencies available, there is a high probability that transmissions from airborne aircraft associated with one incident will interfere with radio traffic at another incident. This may lead to confusion and has the potential to adversely affect safety.

Comment:
This issue was consistently reported by many respondents from different agencies and Air Operators.

Suggestions:

1.1 Reserve additional national VHF-AM radio channels for air-ground-air radio communications; and

1.2 Review procedures for allocation of radio channels to incidents to reduce the probability of interference. Consider national coordination of channel allocation.
(Refer also to recommendations of the main report of the strategic analysis project to consider implementation of a rostered National Air Coordination role or national AirDesk. These roles would include monitoring and national allocation of radio channels); and

1.3 Promote the use of available FM radio channels for air-ground communications, to reduce the load on each VHF-AM frequency.

Note: ANEPC has advised that due to the implementation of sub-regional commands, new procedures for frequency allocation will apply from 2023; and that authorisation to use additional VHF-AM frequencies is being sought from the relevant authorities.

2. Radio communication discipline (safety issue)

Description:
Inefficient and excessive radio traffic on VHF-AM and FM channels used for air-ground communications at rural fires.

Comment:
This issue was consistently reported by many respondents from different agencies and Air Operators. Most respondents considered that inefficient and excessive use of radio communication was significantly affecting efficiency and effectiveness of aerial operations. It may also result in safety issues, if channels are not clear to communicate regarding urgent situations.

Suggestions:

2.1 Provide additional training in radio communication best-practice for ground personnel such as: firefighters, crew leaders, local Commanders, Incident Commanders, and COPAR-terra. (Note: refer also to recommendations of the main report of the strategic analysis project regarding training and micro-qualifications for COPAR); and/or

2.2 Issue operational directives that restrict use of some radio channels to personnel that have received the relevant training or micro-qualification; and/or

2.3. Consider allocating additional, dedicated VHF-AM and FM channels for air-ground radio communications; and/or

2.4 Consider appropriate technological options for reducing communications load and interference on FM channels, for example: trunking, encoding or selective-calling.

3. Radio call-sign duplication (safety issue)

Description:
Some international aircraft that operate in border zones or as part of EU mutual aid arrangements may use the same radio call-sign as aircraft based in Portugal. This can lead to confusion and could increase the risk of aircraft collision.

Comment:
This issue was noted by several different respondents as contributing to a "near-miss" on at least one occasion. It potentially applies to aircraft sent from several European countries including France and Spain. The issue may also potentially apply to Portugal-based aircraft that are called to provide firefighting support in other countries.

It is possible that, in-part, this issue may be exacerbated by differing procedures in the different Spanish autonomous regions (refer also to Item 4).

Suggestions:

3.1 Review procedures for European international mutual aid operations to ensure that there is a process for identifying duplicate radio call-signs during briefings and information exchange before any aircraft enters Portugal, including in the PT-ES 25km border zones, or where Portuguese-based aircraft may operate in other countries[8]. Assign appropriate alternative call-signs for the relevant period of operations; and

3.2 In the longer term, collaborate within the EU to develop whole-of-Europe standards for international sharing of aerial firefighting resources, including standardising radio call-signs.

Note: refer also to recommendations of the main report of the strategic analysis project to consider enhancing formal co-operation with Spain, including the possibility of a Technical Committee or similar mechanism that would work to resolve this type of issue.

4. PT-ES Border Zone operational procedures

Description:
There is some lack of clarity about the extent of the PT-ES 25km mutual aid Border Zone, and the operational procedures that apply in that zone.

Comment
Respondents strongly supported the concept of the agreed Portugal-Spain Border Zone that efficiently allows aircraft from both countries to conduct aerial firefighting within 25km of the international border. However many respondents were not clear about the actual extent of the agreed Border Zone. Many respondents were also concerned that operational communications and coordination procedures in different parts of the Zone may be different, depending on which Spanish Autonomous Region is involved. Some respondents also expressed concern that the current procedures required each country

[8] Draft Guidelines published by IFAWG may assist with developing agreed procedures, see: http://www.ifawg.net/information/ifawg-fire-aviation-guidelines-part-2-new/co-7-1-international-deployments/

to notify the other country if their aircraft cross the international border, however these procedures were not always followed.

Suggestions:

4.1 Publish and widely distribute a clear operational directive or equivalent document (in Portuguese and English) that describes the Border Zone and the applicable, agreed procedures and responsibilities for aerial operations (refer also to Observation 5 of the main report); and

4.2 Continue to liaise with Spanish authorities regarding clarification of procedures that apply in the relevant Spanish autonomous regions.

Note: Spanish authorities are aware of different procedures applicable in Spanish Autonomous Regions and are currently working on a project that aims to align procedures within Spain.

Refer also to Recommendations of the main report of the strategic analysis project to consider enhancing formal co-operation with Spain, including the possibility of a Technical Committee or similar mechanism).

5. Operation of Mode S transponders in firefighting aircraft

Description:
Some respondents reported that although radar transponders are currently required in all firefighting aircraft, they are not necessarily required to operate in Mode S. There is a consistent view amongst respondents that operation of transponders in Mode S should be required.

Explanatory note:
All firefighting aircraft in Portugal are required to be equipped with radar transponders. When operating in Mode C, the transponder superimposes aircraft altitude data on signals transmitted from the aircraft. When operating in Mode S, the transponder superimposes additional data about the aircraft, including aircraft identification data, on signals transmitted from the aircraft. In very simple terms, this improves the functionality and reliability of collision risk reduction, traffic awareness and situation awareness systems. All modern transponders are capable of Mode C, and most are capable of Mode S. Some aircraft may require upgraded transponders if use of Mode S is mandated.

Comment:
Most other countries that routinely engage aircraft for firefighting require Mode C transmissions. Many countries have implemented a requirement for Mode S or are in the process of implementation.

Note: “firefighting aircraft” may include UAV (drones). Small, lightweight Mode S transponders are available for UAV. Requiring Mode S transponders on UAV could decrease risks of collision.

Use of Mode S may increase the visibility of aircraft to members of the public with suitable receiving equipment, and in publicly available tracking systems, for example: Flight Radar24 or FlightAware. Most countries consider that the advantages of increased electronic visibility of aircraft outweigh any possible disadvantages.

Suggestions:

5.1 At a minimum, explicitly require all aircraft involved in firefighting to be equipped with Mode C transponders and require that transponders be operated in Mode C during firefighting operations; and

5.2 FAP and ANEPC further investigate the costs and benefits of requiring Mode S transponders; and, if appropriate, implement a requirement for Mode S transponders in all firefighting aircraft, and a requirement to operate in Mode S during firefighting operations. This may necessitate providing advance notice to Air Operators to allow them time to upgrade aircraft equipment.

6. Consistent bucket-hook-up procedures

Description:
HEBL from different Air Operators have different procedures for EHATI/BHATI crews to attach the bucket to the helicopter cargo hook, or to deploy the bucket from the cargo basket. (This may also apply to HEBM, although this was not able to be confirmed).

Comment:
Training and briefing would be simplified and safety improved by having a consistent procedure. Some respondents preferred a procedure that would avoid team members standing under a hovering helicopter.

Suggestions:

6.1 In consultation with Air Operators, research and design an appropriate standard operating procedure for attaching buckets to helicopter cargo hooks, or for deploying a bucket that is already attached to the hook, from the cargo basket; and

6.2 Include the standard operating procedure in the relevant Operations Manuals and operational directives, and training programs.

7. Head protection for EHATI crew leaders (safety issue)

Description:
When aboard HEBL, normally in the front left-hand seat, the leader of an EHATI (usually GIPS personnel) is required to use a communications headset to provide intercom communication with the pilot. This requires removal of the crew leader's firefighting safety helmet during the flight. The EHATI team leader is then the only person on the helicopter that is not wearing head protection while the helicopter is operating in a relatively high-risk, low-level environment.

Suggestions:

7.1 Require relevant Air Operators to provide an additional flight helmet with integrated communications (installed microphone and headphones) in each helicopter that delivers EHATI; or

7.2 Issue all EHATI crew leaders with a suitable flight helmet that includes integrated communications.

8. Megaphones and sirens for HEBL, HEBM and HERAC

Description:
Some respondents considered that there would be benefit in equipping all HEBL and HEBM used in air attack, and HERAC, with a public address (megaphone) and siren system to:

- warn people on the ground of impending drops (using the siren); and
- improve options for communication with people on the ground, including to provide warnings or to initiate evacuations.

Comment:
This type of equipment is a standard requirement in many other countries that engage helicopters for firefighting.

Suggestion:

8.1 ANEPC and FAP investigate the feasibility, costs and benefits of requiring public address (megaphone) and siren systems on any or all of HEBL, HEBM, HEBP and HERAC; and, if appropriate, implement a requirement.

9. Use of aircraft in mopping up operations

Description:
A number of respondents expressed concern at what is perceived to be excessive use of firebombing aircraft to dispense water for “mopping-up” or “blacking out” operations, which should ideally be conducted by ground personnel.

Comment:
This issue has also been observed in many other countries. In some countries, it may be related to a lack of ground personnel available for mopping up or blacking out a fire.

Suggestions:

9.1 ANEPC consider issuing an operational directive that restricts use of aircraft for mopping-up and blacking out to those situations where aircraft are clearly more efficient or cost effective than ground personnel.
Refer also to recommendations of the main report of the to consider implementation of a rostered National Air Coordination role (NAC) or national AirDesk. These roles could include monitoring and approval of the use of aircraft for mopping-up and blacking out, when appropriate.

9.2 Ensure that the respective training programs for Incident Commanders and COPAR fully explain the costs and risks of utilising aircraft in mopping up operations.

10. Training opportunities for firefighter teams and pilots at CMA

Description:
Arrangements at some CMAs often provide little or no opportunities for EHATI/BHATI and pilots to undertake joint training exercises and to build relationships, especially at the start of a fire season or Phase, or after a change of pilot or GIPS team.

Comment:
Many respondents expressed a general desire for additional training opportunities to assist with building trust and relationships, and to maintain skills.

Structured, local pre-season or early-season training exercises could also involve and improve relationships with ATA helicopter and aeroplane pilots, COPAR and with other ANEPC personnel, Fire Brigades and ICNF personnel that are based nearby.

Pre-season or early-season training exercises could be dual-purpose, for example they could be used to identify, map and check the condition of water points, landing sites and scooping sites and to update databases.

Training exercises could also integrate with TRM training (refer to Item 11, on the next page).

Suggestions:

10.1 Design suitable standard, structured pre-season or early-season training exercises; and

10.2 Arrange helicopter contract specifications so that helicopters are required to arrive at their designated CMA some days before commencing duty, to allow for training exercises; and/or

10.3 Arrange helicopter contract specifications so that the fixed components of the contract price include provision of some operating hours for training exercises; and/or

10.4 Identify separate, dedicated funding for “live” training exercises.

11. Team Resource Management training

Description:
Several respondents commented on the value of Team Resource Management (TRM) training in improving safety and efficiency of aerial operations.

Explanatory note:
TRM is a variation of Crew Resource Management (CRM) training. CRM training normally only applies to aircraft crew, whereas TRM trains multi-disciplinary groups to work as a team and to use all available resources to assure safety and effectiveness. Topics usually covered in TRM include: Human Factors, Threat and Error Management and Effective Communication.

Comment:
TRM training has proven to be very valuable in other countries, especially for specialised firefighting crews that work directly with pilots (e.g. EHATI/BHATI) and for COPAR functions. An effective TRM training program can be delivered in less than one day.

Suggestion:

11.1 FAP, ANEPC and GNR collaborate to investigate the feasibility of introducing a requirement for TRM training for pilots, GIPS teams and all COPAR.

12. Updating of water point databases

Description:
Many respondents expressed some frustration that the database of water points that are suitable for use by helicopters was not always accurate and was not routinely updated for each summer fire season. Some respondents were not aware of procedures for providing updated information.

Comment:
High-quality, accurate prior information regarding available water can significantly improve the efficiency and effectiveness of response to fires.

Suggestions:

12.1 Implement formal procedures that require the responsible agencies and institutions to survey water points prior to each season and to submit updated data; and/or

12.2 Include surveys of water points in pre-season/early season training exercises; (refer to Item 10, above); and

12.3 Provide a simple system (e.g. a web form or App) to enable pilots and GIPS/ANEPC/Fire Brigade personnel to provide updated data and to report issues with water points.

13. Adequate water points for helicopters

Description:
Some respondents considered that there were insufficient designated, safe water points for helicopters (HEBL, HEBM, HEBP) in some regions of the country – possibly leading to longer turnaround times and inefficient delivery of water to fires.

Comment
Understanding of this issue would be improved by ensuring a current, fully updated database of water points is available (refer to Item 12 on the previous page).

Suggestions:

13.1 Ensure that the water point database is updated, and kept up-to-date; and

13.2 When the database has been updated, analyse the data to determine if there are gaps that should be addressed; and

13.3 Provide a simple system (e.g. a web form or App) to enable pilots and GIPS/ANEPC/Fire Brigade personnel to report gaps in water point coverage.

14. Notifications to ANAC or NAV

Description:
Several respondents noted that when firefighting operations are conducted in the vicinity of airports or other designated airspace, it is important that early notification is provided to ANAC and/or NAV to ensure that appropriate airspace management procedures are implemented. Early notification will minimise the risk of disruption to firefighting aircraft and commercial passenger traffic.

Comment:
This issue also arises in other countries. Most countries acknowledge that there will always be situations where it is most appropriate for the first pilot who arrives at an incident to provide an initial notification of aerial firefighting activity to relevant airspace management authorities and, if required, seek clearance to operate.

Some countries have implemented a centralised process for operational liaison with airspace management authorities, via a National Air Coordinator (NAC) or AirDesk or equivalent. A centralised process may have advantages and disadvantages, especially in the early stages of an aerial firefighting operations. In any case there is always a responsibility for all aerial firefighting pilots to ensure that they are operating with required clearances.

Suggestions:

14.1 Remind all firefighting pilots of their obligations to seek appropriate airspace clearances, if no other procedures have been implemented at the time; and

14.2 Further liaise with ANAC and NAV to define additional procedures, if required, that ensure that appropriate notification is provided to ANAC and/or NAV; and

14.3 Ensure that training for all pilots and COPAR includes identification of designated airspace, and procedures for notifying ANAC and/or NAV of aerial firefighting activity when appropriate.

15. Use of FAP P3 for surveillance

Description:
Some respondents advised that FAP has occasionally supplied a P-3 Orion for surveillance and intelligence gathering duties, during large or escalating situations. Some respondents expressed a view that, when deployed, the P-3 could be better integrated into firefighting and emergency management systems.

Suggestion:

15.1 GNR, FAP and ANEPC collaborate to develop standard procedures for deployment of the P-3 aircraft at emergency events, which ensure that:

i. information gathered is efficiently delivered into appropriate information systems; and

ii. P-3 crews are fully briefed regarding communications procedures for operating in the vicinity of rural fires and other emergencies; and

iii. other firefighting pilots are informed regarding P3 flights in their vicinity.

Appendix 2
Consultation

Aerial firefighting in Portugal has a large range and diverse range of stakeholders. Many agencies, institutions and individuals are in a position to offer valuable contributions and insights. It was not practical for all stakeholders to be directly consulted. As far as practicable, the project consulted with a representative group of stakeholders.

Some interest groups also declined to be consulted, or declined to be listed as Respondents.

Most directly consulted Respondents were interviewed by project team members. In some cases, Respondents completed a structured Questionnaire.

For some Respondents listed below, consultations have occurred with more than one representative, branch or cell of the listed agency or institution.

Also, multiple consultations may have occurred with the listed individual, agency or institution.

Respondents directly consulted include:

- MDN
- ANEPC, including FEPC
- FAP
- GNR, including GIPS
- AGIF
- ANAC
- ICNF
- Judiciary Police
- AFOCELCA
- Helibravo
- HTA Helicopters
- Shamrock
- Babcock (now Avincis) Portugal
- Babcock (now Avincis) Spain
- Agro-Montiar
- Municipality of Leiria
- Viseu Airport
- GeoTrack
- Ministry for Ecological Transition and Demographic Challenge (MITECO), Spain