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Integrated Crisis Management - Advanced CONOPs Specifications

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Abstract	<p>The present document gathers the potential integration of the innovative contributions of AF3 system in a common brand new CONOPs, which is compatible with the guidelines thorough all different emergency phases and countries. Therefore, the specific actors involved in the CONOPs may be adapted to the regulations and competencies established for each country.</p> <p>The document provides technical requirements and operational guidance for the main solutions and contributions that AF3 consortium proposes for each of the phases considered during forest fire emergencies.</p>
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ABBREVIATIONS AND ACRONYMS

Acronym	Description
AF3	Advanced Forest Fire Fighting Project
ARIA	ARIA Technologies
SES	Selex ES Spa
AFF	Advanced Fire Fighting
AAFF	Advanced Aerial Fire Fighting
ACP	Advanced Cooling Pellets
AEMET	Agencia Estatal de Meteorología (State Meteorological Agency)
ARP	Advanced Retarding Pellets
ASA	Advanced Situation Awareness
BARC	Burned Area Reflectance Classification
CECIS	Common Emergency Communication and Information System
CNVVF	Corpo Nazionale dei Vigili del Fuoco (Italian National Fire Corps)
CONOPS	Concept Of Operation
C4I	Command, Control, Communications, Computers and Intelligence
DOS	Director of Operations
EADS CASA	EADS - Construcciones Aeronauticas S.A.
EFFIS	European Forest Fire Information System
ELBIT	ELBIT System Ltd
ES	Expert Systems
ERCC	Emergency Response Coordination Centre
FFL	Fire Fighting Lab
FFP	Fire Fighting Pellet
FFT	Friendly Force Tracking
FHG	Fraunhofer-Gesellschaft Zur Foerderung Der Angewandten Forschung E.V
GIS	Geographic Information Systems
UAVs	Unmanned Aerial Vehicles
UGVs	Unmanned Ground Vehicles
UOW	The University Of Westminster Lbg
ICOM	Intracom Sa Telecom Solutions
IR	Infrared
IOCC	Integrated Operational Coordination Operational Coordination Centres
MC	Mission Computer
MIC	Monitoring and Information Centre
MOD	Ministry Of National Defence, Greece
NCSR	National Centre for Scientific Research -Demokritos
OCC	Operational Coordination Centre
SKYTEK	Skytek Ltd
SRC	Centrum Badan Kosmicznych Polskiej Akademii Nauk
POLITO	Politecnico di Torino
PYRO	Pyro Fire Extinction S.L
TRAGSA	Empresa De Transformacion Agraria S.A.
UAV	Unmanned Air Vehicle
UGV	Unmanned Ground Vehicle



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UL	Underwriters Laboratories
UPV	Universitat Politecnica De Valencia
WSN	Wireless Sensors Network
WUI	Wildland Urban Interface

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1. PURPOSE AND SCOPE

The purpose of this document is to define the overall Concept of Operations (CONOPS) and specifications for the integrated crisis management in the frame of forest fires, in order to provide a procedure that will enable efficient reaction in Forest fire emergencies, making use of advanced methodologies and technics developed and tested

With the requirements established in WP2 together with the current emergency policies and procedures as a starting point, this deliverable aims to translate requirements into a Concept of Operations and into detailed technical specification of the crisis monitoring and management architecture.

The architecture has been defined in such a way that all the information in real-time and all the requirements have been fused into a very clear picture, which will help optimizing the decision process, the command and control operation, and the use of attack methods.

The CONOPS takes into account all available firefighting technologies and resources together with advanced AF3 solutions in the system.

The principles of the EU Civil Protection Mechanism have been also considered as foundation and the Document is also aligned with the Planning for Forest fire Emergency at every level (local, regional and national).

The intended audiences of this document are:

- Entities (companies, SMEs, and Universities other bodies) involved in AF3 project for the development of new advanced firefighting resources and technologies in a way that meets end-user requirements
- End users (managers, policy makers, Public Administrations, etc.), which drive strategically the AF3 project, and which count on the knowledge about the management of firefighting emergencies as well as of the needs to be fulfilled by efficient implementation of AF3 innovative solutions.

This document focuses operational regards supposed to reach a significant improvement of efficiency and effectiveness through the application of new technologies and procedures proposed by AF3 project.

Consequently, it does not aim to change nor replace the current emergency policies but to support them through the implementation of new methods and technologies. Consequently, certain issues that are already addressed by auto-protection plans in building, infrastructures or other planning documents may not be specifically addressed in this document.

Therefore, the document intends to fully fit to the emergency management policies, avoiding incompatibilities with proposed new methodologies, both through the creation of alternatives supporting management, and the instruments for their implementation.

2. APPLICABLE DOCUMENTS

2.1 REFERENCE DOCUMENTS

Ref.	Identification	Title
R1.	SEC-2013.4.1-6	Preparedness for and management of larger scale forest fires – Integration Project
R2.	D21.1	Mission analysis report
R3.	D21.2	Requirements specification for the AF3 sensors and system
R4.	D22.2	System Architecture & Sub-system Definition

EUROPEAN REGULATION

2014/762/EU: Commission Implementing Decision of 16 October 2014 laying down rules for the implementation of Decision No 1313/2013/EU of the European Parliament and of the Council on a Union Civil Protection Mechanism and repealing Commission Decisions 2004/277/EC, Euratom and 2007/606/EC, Euratom (notified under document C(2014) 7489) Text with EEA relevance

Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a Union Civil Protection Mechanism Text with EEA relevance

Commission Decision 2010/481/EU, Euratom amending Decision 2004/277/EC, Euratom as regards rules for the implementation of Council Decision 2007/779/EC, Euratom establishing a Community civil protection mechanism

Commission Decision 2008/73/EC, Euratom amending Decision 2004/277/EC, Euratom as regards rules for the implementation of the Mechanism

Council Decision 2007/779/EC, Euratom establishing a Community Civil Protection Mechanism (recast)

Commission Decision 2007/606/EC, Euratom laying down rules for the implementation of the provisions on transport

Council Decision establishing a Civil Protection Financial Instrument (2007/162/EC, Euratom)

NATIONALS REGULATIONS

Each locality, region and nation could have its own particularities, therefore it is important to know and respect their regulations and their emergency management system. The Spanish regulations for civil protection, forest fire emergency and forest and natural environment, are given below for reference. Regulations from other countries in the frame of AF3 have been also included in the ANNEX 3. The regulations included come from the Vademecum of Humanitarian Aid & Civil Protection of the European Commission¹.

Civil Protection

Royal Decree 407/1992, of 24 April, by which the Basic Civil Protection is approved (*Real Decreto 407/1992, de 24 de abril, por el que se aprueba la Norma Básica de Protección Civil*).

Law 2/1985, of January 21, civil protection (*Ley 2/1985, de 21 de enero, sobre protección civil*).

Forest Fire Emergency

Resolution of 31st of October 2014, the Secretariat, by which the Agreement of the Council of Ministers of 24 October 2014 establishing the State Civil Protection Plan for Forest Fire Emergency, is published (*Resolución de 31 de octubre de 2014, de la Subsecretaría, por la que se publica el Acuerdo del Consejo de Ministros de 24 de octubre de 2014, por el que se aprueba el Plan Estatal de Protección Civil para Emergencias por Incendios Forestales*).

Royal Decree 893/2013, of 15 November, by which the basic guideline for wildfire emergency civil protection planning was adopted (*Real Decreto 893/2013, de 15 de noviembre, por el que se aprueba la Directriz básica de planificación de protección civil de emergencia por incendios forestales*).

Forest and Natural Environment

Law 43/2003 of 21 November, on Forests (*Ley 43/2003, de 21 de noviembre, de Montes*).

¹ The Vademecum (http://ec.europa.eu/echo/files/civil_protection/vademecum) gives a general overview of the measures taken by EU Member States as well as at EU level to deal with disasters. Disasters may be due to natural causes, such as earthquakes, landslides, forest fires, floods, snowstorms, tidal waves and/or human activity, such as in the case of accidents involving chemicals, etc. The Vademecum is a source of information for:

- professionals working in the field of civil protection at the national, regional and local level
 - volunteers and non-governmental organisations
 - interested members of the public
-

Law 42/2007 of 13 December on Natural Heritage and Biodiversity (*Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad*).

OTHER DOCUMENTATION

A. Ganteaume, A. Camia, M. Jappiot, J. San Miguel-Ayanz, M. Long-Fournel, et al.. *A Review of the Main Driving Factors of Forest Fire Ignition Over Europe*. Environmental Management, Springer Verlag (Germany), 2013, 51 (3), p. 651 - p. 662

COLOMBAROLI D., MARCHETTO A. AND TINNER W. 2007 - *Long-term interactions between mediterranean climate, vegetation and fire regime at lago di Massaciuccoli* (Tuscany, Italy). Journal of Ecology, 95:755-770.

UK Government Cabinet Office, *UK Civil Protection Lexicon version 2.1.1 (February 2013)*. MS Excel Spreadsheet

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/128797/LEXICON_v2_1_1-Feb-2013.xls , Crown Copyright.

U.S. Department of Home Security, *National Incident Management System*, Washington DC, 2008. FEMA Publication P-501 (Catalog number 08336-1) Web site: http://www.fema.gov/pdf/emergency/nims/NIMS_core.pdf

U.S. National Wildfire Coordinating Group (NWCG) *Glossary of Wildland Fire Terminology*. October 2014. Web site: <http://www.nwcg.gov/pms/pubs/glossary/e.htm>

Vademecum of Humanitarian Aid & Civil Protection of the European Commission http://ec.europa.eu/echo/files/civil_protection/vademecum

Vélez, R. (Coord.), 2000: *La defensa contra incendios forestales. Fundamentos y experiencias*, Ed. McGraw-Hill, Madrid, 1360 pp.

3. SITUATION & ASSUMPTIONS

3.1 SITUATION

Although under certain conditions forest fires may play a role in ecosystems, especially when they are natural caused and spread in vast wildland territories, uncontrolled fires in highly anthropized areas such as the Mediterranean basin usually become a hazard for citizens, properties, infrastructure and natural resources. In this sense, protection of human life is the overriding priority in firefighting.

The urban growth beyond city limits into natural areas is increasing the wildland-urban interface (WUI). Fires that occur in the WUI impact directly on lives and properties, and then become critically important. The same case is forest fires impacting critical infrastructure.

Forest fires are common in Europe and especially important in the Mediterranean basin. Human causes, both accidental and arson, are the most common ignition sources. In wildland (forest and rural areas) areas human action has resulted in the alteration of fire regimes (landscape segmentation, land use changes, etc.), and in the accumulation of heavy loads of fuel, that may affect the behaviour of fires, especially when outbreaks start under extreme weather conditions. Climate change implications and socio-economic factors such as the rural abandonment or trends in building of dwellings within, or very close to, forested areas further increases the risk that a large forest fire occurs.

Even though fires occur all over the year, they take much more importance in number, virulence and potential hazard during summer season due to drought and high temperature.

Most of forest fires are controlled during early stages so they do not evolve into large fires. Therefore, early detection and immediate response are critical for the success of firefighting tasks. There is also a direct correlation between preparedness and response. Preparedness is a key in the pursuit of successful firefighting. The exercise of this experience and expertise provides the ability to protect the lives and property of the citizens. Strategic planning and continuous training become then essential for success in the management and control of emergency events.

During the emergency, usually multiple firefighting resources (air segment, ground segment, are due to work coordinated under a previously established plan) in order to secure the area quickly and safely. It is usual that air segment resources low the flame intensity in order to make possible for the ground units to complete the fire extinction.

Furthermore, there are some conditions under which the performance of current firefighting resources becomes reduced, and the safety of some units can be threatened, e.g. air segment units cannot operate at night time. Alternative methods are included with this regard, in order to strengthen the firefighting capacities from the air segment through innovative advanced technics developed in AF3 project, intending a more accurate and effective use of water drops from aircrafts, which operation will be able to be extended during the night time in maximum safety conditions.

There is a need of new innovative technologies such as active countermeasure, passive countermeasure, early detection systems, integrated crisis management and advance training tools that are being asset in AF3. This innovative technologies intend to facilitate the difficult task of manage large firefighting operations, that involve large numbers of people and several different agencies.

3.2 ASSUMPTIONS

As stated in D2.1.2 “Requirements specification for the AF3 sensors and system”, the AF3 CONOPS must take into account all CONOPS of different countries, and it has to be flexible enough in order to be “customized” by all possible users.

For each country, National, Regional, and Local Governments have the competences in forest firefighting according to their National and/or Regional Emergency Plan for forest firefighting, that specifies protocols and plan procedures.

When an emergency event occurs, the specific emergency plan/mechanism (hereafter, the Plan) must be activated in order to attend the incident according to protocols.

The Emergency Management Coordinator (responsible for the direction of the Plan) is the individual within each political subdivision (states, regions, provinces, prefectures, municipalities) that has coordination responsibility for jurisdictional emergency management.

Each country has a National and/or Regional Emergency Plan for forest firefighting, that specifies protocols and plan procedures. Despite there are some differences between countries respecting the organization of firefighting units, they all share common base lines in the way they perform their work at fire emergencies. This fact allows designing a common general Concept of Operations which can be afterward adjusted to specific particularities of each territory.

Regardless the specific organization for each country, Forest firefighting competencies are performed under the competencies of Regional or National governments through their representative bodies in the territory at the level of NUTS 2 and NUTS 3 regional (Regions, Provinces, Districts, etc.)

Within the frame of European regulation, each country develops its own emergency policies according to their distribution of competencies so successive Forest fire emergency plans cover the different levels of responsibility at the different levels of potential risk (e.g. response competencies under regional bodies supported by national bodies).

According to the competencies in each country and region, Operation Coordination Centres (or simply, Coordination Centres) are established in the territory (regions, provinces, etc.), in order to assume the direction of the emergency plans and to give coordination support to the director of operations when a fire occurs. These Coordination Centres are driven by the public bodies in charge (regional government, national government bodies in the regions, etc.)

Other coordination centres (under the responsibility of different agencies, e.g. national government bodies, civil protection agencies) can also assist the regional Coordination Centres.

The forest fire emergency plans assign means to a priority area where they will rapidly operate when a fire alarm is communicated.

Each region counts on a catalogue of the units and resources available. The catalogue indicates where the means are located, number and characteristics.

An Incident Command Post (ICP) may be established in the emergency area in order to centralize the direction of operations on the field. Strategic locations are selected for the establishment of the ICP in order to optimize communication capabilities, observation of the emergency and access of support resources. The Operational Coordination Centre provides support to the ICP.

Reception Posts can also be established in order to assist arriving firefighting resources to the affected area.

Depending upon type, location, and duration of the incident, agency jurisdiction may transfer authority following the procedures established in the emergency plans and regulations.

4. SCENARIOS

Three main scenarios have been considered for the redaction of D5.1.1, in order to address the operational implications that can be derived from them in the management of Forest fire emergencies.

The mentioned scenarios were addressed in the AF3 Mission analysis report (D2.1.1), so only a brief explanation is provided.

- **Forest and bush fires.** Forest fires (bushfires, forest fires) are fires which spread out of the human control, over natural landscape. Some of the factors that characterize forest fires are related to the land on which they take place: orographic features (slopes, orientations, aspects, orographic formations), fuel characteristics (live or dead vegetal fuel with different characteristics of flammability and combustibility, different distribution patterns (horizontal and vertical continuity), fuel load and structure (size and shape, compaction, wood density), chemical composition, etc.), weather patterns (linked to the seasonality of events in each territory, and the general events, like droughts or heat waves, and local events that modify its impact), geographic and socio-economic characteristics.
- **Wild land - urban interface fires.** Wild land – urban interface scenario considers the Forest fire emergencies when affect areas where dwellings and human buildings meet or intermingled with forest and agricultural rural areas. These specific areas own some particularities related to ignition risk, hazardousness, and consequences for inhabitants that makes very important their separated consideration.
- **Critical Infrastructure in forest.** Under some circumstances, Forest fires may affect assets, systems or parts thereof that are essential for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact as a result of the failure to maintain those functions. Consequently, critical infrastructure in forest scenario, it is focus on the protection of transportation routes, power grids, pipeline etc. that are essential for the functioning of a society and economy.

5. OPERATIONAL DESCRIPTION

The CONOPS is established identifying the general technical requirements of the phases involved in the emergency management (section 5.1) and a description of each of the phases from an operational point of view (section 5.2), including stakeholders, responsibilities and procedures, and integrating the Advanced Forest Fire Fighting solutions.

The aim is to get a clear picture of how to approach the forest fire management in the three previously described scenarios (Forest Fires, Wildland Urban Interface and Critical Infrastructure), using the best suitable procedures to provide interoperability between the current planning and new AF3 technologies during forest fire emergencies.

The emergency event is structured following the main three phases described in the D2.1.1 “Mission Analysis Report” and the specific phases in the Annex I from the Description of Work document: Pre-emergency, Emergency and Post-emergency. The main phase classification from D21.1 provides a view from the sequence an evolution of emergencies, and therefore a more operative approach than the classification from D21.2 which is focus on the requirements specification. All phases are listed below under the operating phase they belong to according to D21.1:

Pre-emergency

- Fire prevention
- Readiness

Emergency

- Preventive intervention
- Fire Detection
- Monitoring and Crisis Management and Simulation
- Fire Fighting and Rescue operations

Post-emergency

- Debriefing and Feedback

5.1 TECHNICAL REQUIREMENTS

In each of the mentioned phases (pre-emergency, emergency and post-emergency), specifications and technical requirements are given for those activities involved in the AF3 project.

5.1.1 Pre-emergency (Fire prevention and Readiness.)

Pre-emergency consists of those actions and measures that are taken before the fire outbreak occurs, with the aim of reducing the likelihood of its occurrence, or limiting its consequences in case the fire has already started. In the pre-emergency, specifications and technical requirements are given for the two phases included: Fire prevention and Readiness.

5.1.1.1 Fire prevention

This phase include all the actions that are intended to avoid or reduce the incidence of unwanted human-caused forest fires and the risks they pose to life, property or resources.

Prevention actions include public-oriented sensitization and awareness actions, general training in good practises oriented to public, silvicultural measures to reduce combustibility and fuel continuity, construction of firebreaks and other infrastructures to support firefighting tasks (access roads and paths, water points, etc.), vigilance and deterrence.

These tasks are planned through forest fire prevention plans, and are executed taking into consideration the forest fire risk assessment, which is included in prevention plans.

In this frame, fire danger maps and fire risk maps are used in order to better manage by focusing actions and resources in critical areas with a high fire risk. For developing Fire Danger maps a daily Fire Danger Index is published during regular fire season. The European Forest Fire Information System (EFFIS)² generates daily maps of 1 to 6 days projected fire danger level in EU using weather forecast data. Fire danger level is assessed through the Canadian Forest Fire Weather Index (FWI) System, providing a harmonized method thorough Europe. Agencies of the different countries can also elaborate their own fire danger maps, according to the common methodology, though calibrated for each region. This provides a common method for fire weather index. In Spain FWI is provided by the State Meteorological Agency (AEMET).

Derived from the Fire Danger Index and Fire Danger Map, daily fire risk is usually assessed including information related to occurrence, causality, hazardousness derived from the fuel, vulnerability (taking into account the main values to protect: human lives, residential areas, infrastructure and facilities, economic values, ecological values, landscape values, artistic and historical heritage, values of protection against soil erosion).

In Prevention phase, AF3 is able to improve the Fire Danger Index and Map with the inclusion of new satellite image and processing technology.

In order to obtain the Fire Danger Index, the technologies have to allow an accurate prediction of Fire Danger to identify potential risk answering the next three questions:

- When? Allows defining the risk seasons.
- Where? Allows defining the risk areas.
- How? Allows organizing the extinction.

The following factors are analysed:

- Fuel (type, load, structure, continuity)
- Weather (wind, drought or rain, humidity, temperature)
- Orography (slope, orientation)
- Land (region, infrastructure, WUI)
- Ignition sources and fire history.

² <http://forest.jrc.ec.europa.eu/effis/>

Fire Weather Index depends exclusively of weather conditions and it is classified as Low, Moderate, High Very high or Extreme.

Local risk index depends on all the other factors previously mentioned, and it is addressed by the Regions through the regional plans.

AF3 systems would use daily fire risk assessment given by the public administration (FWI, risk maps, etc.) in order to strength the detection capacities of the public administrations, especially in areas with high causality.

Regarding the firefighting infrastructure, AF3 proposes the placement of extinguisher Nub-e capsules (PYRO) for securing specific values such as human premises, critical infrastructures, Wildland–Urban Interfaces areas or isolated and disperse buildings, being used as an extra tool to avoid the fire threat in case a fire is produced. This system enables the fast creation of chemical firebreaks, with an autonomous operation, a high degree of environment adaptability as well as a minimization of firefighting impacts over the environment, and a more efficient water and fire retardant agents' use.

The use of capsules can be part of pre-emergency or emergency phases depending on the moment of the placement in the field or infrastructures: before the outbreak, before the fire season or during the emergency, as a specific preventive firefighting method.

This issue will be further analysed in the emergency during Preventive intervention section.

In order to increase public awareness on fire prevention, AF3 propose the development of a social network based service integrating the use of smartphones, internet and dedicated broadcasting. This will allow engaging and communicating with public in all phases of the fire incident, especially addressing people living in high risk areas such as WUI. These new tools shall:

- Be public orientated.
- Easily accessible.
- Allow two-ways communication

5.1.1.2 Readiness

Readiness is the condition or degree of being completely ready to cope with a potential fire situation, this also includes the mental readiness to recognize changes in fire danger and act in consequence.

In order to be ready it is essential to promote activities that lead to a safe, efficient, and cost-effective fire management program in support of land and resource management objectives through appropriate planning and coordination. Activities involved include the maintenance and implementations of programs and plans; training, provision the necessary resources and infrastructure.

Despite, several measures are currently completely covered by the public administrations (e.g. location of detection and firefighting resources, construction and maintenance of fire breaks, roads, etc.), AF3 can perform an important role for supporting readiness through the implementation of advanced innovative instruments that will strength the effectiveness of current firefighting resources as well as provide new advanced firefighting methods, whose readiness must be defined and self-protection opportunities that could arise from the use of several systems by private users and communities.

Simulation Tools involved in AF3 will play a role in the qualification of firefighting staff involved in traditional and advanced Fire Fighting resources. A Fire Simulation Tool (FFL) integrating multiple models for distribution, damage and risk analysis (as well as fire propagation) will allow to carry on mission rehearsal, both once the fire has been declared, with an operative goal, and as a training activity in simulated environments.

Some models will be launched as a preventive tool in order to better understand the potential behaviour of eventual fire emergencies affecting (human settlements, critical infrastructures, etc.). The Firefighting Simulation Tool will be developed in such way that trials can be easily carried out, so specific weakness, strengths, opportunities and threats can be recognized for specific areas whose prevention plans can be propose for review.

AF3 also includes a multi environment training methodology (Virtual reality, Mixed reality and real on field training) that will enable to develop several tailored training curricula for covering the training needs/skills improvement stated by the end users by using the more suitable composition of VTEs for training each skill: FFL, VTE (UPV), 3eTRAINING (TRAGSA).

The Advanced Training Tools have to be useful for the firefighting staff both in organization and in extinction tasks and shall allow multi-environment training.

The training shall:

- Fulfil the criteria of the firefighting roles.
- Simulate real communication between firefighting staff.
- Real time interaction with other firefighting personal, the environment, fire and weather.
- Support fire and weather simulators.

Every role has a required minimum training that must be completed; some roles may also require a minimum of expertise in order to fill curricula, which allow the people involved in the emergency to count on the adequate skills for the tasks related to each position.

The different platforms, technologies and tools from the partners have to interoperate or fuse.

5.1.2 Emergency (Preventive intervention, Fire Detection, Monitoring and Crisis Management and Simulation and Fire Fighting and Rescue operations)

Emergency phase consist of those actions and measures taken when an event or situation threatens human welfare, the environment, or the security. AF3 differentiated the following phases: Preventive intervention, Fire detection, Monitoring and Crisis Management and Simulation and Firefighting and Rescue Operations. Specifications and technical requirements are given for each of them.

5.1.2.1 Preventive Intervention

In the very early stage of the emergency, when there is a reliable forecast on how the disaster will start and how much time it may occur to progress, a preventive intervention can be considered to avoid or limit the fire spreading.

As stated for prevention stage, in this phase AF3 proposed the Placement of Nub-e capsules (PYRO). The Nub-e system is detailed in the deliverable D21.2. "Requirements specification for the AF3 sensors and system". This section aims to highlight the requirements and in the section 5.2.2 its operational use.

Capsules could secure Wildland–Urban Interface and critical infrastructure or being used as a complement fuel-breaks and forest management to avoid fire spread. The requirements for the capsules are:

- The exact location and other characteristics of the capsules will be known and queryable in GIS as the rest of the preventive actions (fuel breaks, water tanks, etc.), in order to optimize firefighting strategy.
- The capsules will allow its placement in critical areas, just prior or during to the high risk season.
- The capsules will create preventive layers (fireproof barriers) that will difficult fire spread.
- Capsules can be part of the auto protection mechanism of infrastructure or be place within the forest fire plan.
- Capsules will not damage or be dangerous for the environment, civilians and first responders.
- The system should be operative for months and autonomous
- The system should be able to adapt to several kind of vegetation and fire behaviour
- The system should be compatible with other preventive measures and forest fire-fighting means
- The system should be capable to be installed at any time

5.1.2.2 Fire detection

Detection is the act or system of discovering and locating a fire. This includes realizing, communicating, and locating the fire.

For this purpose traditional methods and new methods are available. Traditional detection methods include Fire Lookouts, Forest guards, and 112 calls. Other current methods in use are smartphone applications, thermographic cameras which are usually set up to protect specific areas not covered by lookout towers. AF3 will add new detection methods such as Satellite images, or airborne sensors (Aircrafts, UAVs) that will allow earlier and more accurate fire detection. Sensors and satellite images could provide information and allow detecting ignition, smoke and hot-spots.

There will be a detection of re-ignition.

AF3 project will focus at integration and deployment of diverse systems including satellites, airplanes, UAVs, and both mobile and stationary ground systems for the early detection of fire and for early detection and the fire spread and behaviour (flame front location, flame intensity, rate of spread, etc.), and consequences such as the propagation of smoke and toxic clouds. The regulations for the use of UAV are currently being worldwide developed, so there may be differences in the restrictions of each country. Until the regulations are completely developed and

validated the law may result particularly restrictive in order to assure the security, privacy, etc., of the citizens. Current regulations on the use of UAVs in Spain and UK are listed in the ANNEX 4.

AF3 shall:

- Apply airborne observation solutions such as UAVs and data from sensors mounted on fire-fighting aircrafts for wide area monitoring and fire detection, with emphasis on fire re-ignition detection.
- Develop swarm-operated micro-UAVs for cost-effective preventive actions including precise localized observations of high risk areas, confirmation of possible incidents (e.g. via visual smoke detection and simple IR/radiation sensors), as well as post-crisis actions including surveillance, search for survivors, assessment of damages to infrastructures, support recovery etc.
- Integrate innovative space observation competencies, using satellite image processing for purposes of monitoring and early warning on a large scale. Satellite images technology is described in the chapter 4 of the deliverable D21.2. "Requirements specification for the AF3 sensors and system".

5.1.2.3 Monitoring and Crisis Management and Simulation

Monitoring is the ordered collection, analysis, and the interpretation data to evaluate management's progress toward meeting objectives, and to identify changes in natural systems. Monitoring is also conducted on forest fires to observe fire effects, fire behaviour, or both.

Monitoring is very important in most of the fire emergency phases. It is transversal to all the firefighting process from pre-emergency to post-emergency.

AF3 project will focus at integration and deployment of diverse systems including satellites, airplanes, UAVs, and both mobile and stationary ground systems for the early detection of fire and for monitoring the firefighting operations (location of resources, status, etc.), the fire spread and behaviour (flame front location, flame intensity, rate of spread, etc., and consequences such as the propagation of smoke and toxic clouds).

In AF3 Document of Work are distinguished four different data sources. Three mayor segments of observation sources and one for social media tools that shall be further investigated. The segments are the following:

- Observation from Air Segment
- Observation from Space Segment
- Observation from Ground Segment
- Observation and Early Warning performed through ancillary data (data collected from citizens: smartphones apps, social media, etc.)

The segments have to be compatible with each other. Data for the sources of different segments will combine to obtain the desire information and maps.

The information from the sources shall:

- Allow real or near-real time monitoring of all means and resources in the field.
- Collect location and other data (status, contact data, capability, etc.) from means in the incident area and of those available for future deployment
- Control arriving time of units.
- Weather conditions are monitored using weather units from agencies or using the mobile units for communication and weather observation.
- Monitor through mobile devices, sensors, cameras, UAVs, UGVs, Lidar.
- Data is collected in real time and immediately process and send.
- Near-real time Data is shown in GIS, which includes position of units and resources (including preventive resources such as water tanks, preventive layers, etc.)
- Be compatible with actual tools and technologies.
- Build a network that allows data collection.

The Crisis Management and Simulation requires the input from monitoring systems, so interoperability between the systems is needed. Interoperability mechanisms between the technologies from the different partners must be foreseen.

Crisis management and simulation requires a Command, Control, Communications, Computers, and Intelligence (C4I) that is run for command purposes in the Incident Command Post (ICP) and for coordination and support purposes in the Operational Coordination Centre (OCC). C4I shall combine information from Data visualization, data fusion and reasoning unit and Simulation and risk analysis tools. Its objectives are:

- To control the incident activity regarding: location, mission, status, configuration, reports
- To communicate with all the operating forces based on wired & wireless communication, Telephones, Cellular and Internet, and command them
- To communicate with the public, with national, regional and municipal Authorities and local C4I posts (Police, Defence, Medical, Aerial, Naval, Airports and Harbours)
- To ensure Backup C4I infrastructure and communication

The data visualization, data fusion and reasoning unit shall be capable to:

- Combine multi-source heterogeneous data into a processed information
 - Enhance existing GIS capabilities, raising fire detection alerts with increased speed and efficiency and focusing the observation capabilities on areas of high-risk
-

- Provide a visualization tool both for command and control as well as for ground personnel and first responders
- Be part of a web 2.0 enabled portal, also intended to embed web social media information into the monitoring fusion
- Collect input from airborne observation and satellite images from cell phones, social networking and web applications inputs, to update maps on real-time
- Enable dynamic re-routing based on estimated hazards and risks resulted from the analysis of aerial photos
- Allow a preliminary and rapid mapping of alerts/disasters utilizing common smartphones (simulating any future ruggedized professional mobile terminal)

The simulation and risk analysis tools will:

- Be used for mission briefing, mission rehearsal, training, debriefing and decision support
- Identify the risks and suggest to the user the best options to cope with them
- Such an integration between simulation and expert system is an innovation itself because the user will not have to formulate queries to the system, but the simulated situation (which can also take advantage of real data) and risk analysis themselves will serve as an input
- Integrate environment, agents and risk analysis models to give to the user the most comprehensive information and prediction

Undemanding communications systems in terms of levels of coverage must be implemented in order to communicate with remote areas.

Simulations have to be accurate and provide rapid feedback

Simulation and risk analysis tools are complementary tools.

Outputs are due to be operative and user oriented avoiding high amounts of information of less use or difficult interpretation. Information must be provided in such a way that the responsibility relays in the person in charge.

AF3 shall:

- Integrate innovative space observation competencies, using satellite image processing for purposes of monitoring and early warning on a large scale.
 - Establish an efficient method to generate maps from satellite remote sensing data showing different degrees of damage affecting vegetation after a large forest fire, in order to locate priority intervention areas and plan forest restoration works.
-

- Develop an ecological UAV for monitoring the propagation of pollution and smoke during a fire together with a simulation tool that will enable to map and display the current ecological situation and predict the smoke propagation according to wind and atmospheric data.
- Increase the capacity of the emergency preparedness and response by combining advanced technologies in LIDAR remote sensing (Doppler LIDARS), UAV field measurements and advanced numerical modelling to provide the best field situation report, both in forecast and nowcast mode.
- Assess the hazardous areas according to level of trust directly depending of the on-field information (observations and in-situ measurements).
- Make information available and relevant with coupling modelling outputs and on-field measurements
- Show information in layers in a way that information is shown on demand.
- Provide sensor information, fire behaviour and simulations, orography, POI, units' location and their associated information.

5.1.2.4 Firefighting and Rescue Operations

Firefighting and Rescue Operations include all the operations and active measures that are taken to counter fire and to save human lives, livestock, environment, properties and infrastructures.

Work shifts are assigned to the units, should allow monitoring and be queried.

Ground segment operates 24h during emergency, no matter of weather conditions. On the other hand traditional air assets operate between sunrise and sunset and under certain weather conditions. Advanced Aerial Fire Fighting (AAFF) will allow air segment to operate 24h and under a more variety of weather conditions.

Air segment and ground segments operate in coordination.

The Director of Operations is the ultimate responsible of coordinating all units in the field. The DOS can name a number of responsible for the different sections or segments such as: aerial coordinator, section coordinator, or those needed.

The Coordinator of the Plan is the responsible for mobilizing all units, except for those in the automatic dispatch, which must be informed in any case.

AF3 addresses:

- New fire extinction systems.
 - Tools for improving the effectiveness, efficiency and safety of the extinction resources: ASA, Web viewer and interoperability tools for the tracking and support in decision making at each of the different steps in the chain of command; (OCULUS, EMERCARTO, C4I); tools for mobile devices (mobile phones, tablets, communication systems, etc.) for the information exchange between the command centres and the emergency area; monitoring systems for the specialists and affected population health risk
-

- Advanced Aerial Fire Fighting system using the AAFF pellets and the airborne dispenser to allow night aerial attacks and in harsh weather conditions.

5.1.3 Post-emergency. Debriefing and Feedback

Post-emergency phase is most relevant to provide to fire fighters and command centre an accurate feedback about the real situation, after firefighting operations. This information gives precious indication on how efficiently refine and “adjust” the firefighting mission and minimize the fire effect and damage.

Post mission debrief and analysis refer to methods and tools for documenting, debriefing and analysing the AF3 performance. The purpose is to have the capability to debrief each firefighting mission. The Simulation Host, makes possible to have playback, and debriefs, reviewing all the crews’ actions and the external scenario. It provides also the possibility to use real data, extracted from on board instruments as base for a real mission debriefing.

AF3 is aimed to:

- Use the simulation and analysis tools for the emergency evaluation debriefing. Uploading the data collected during emergencies and creating a comprehensive database.
- Measure and evaluate firefighting operations results.
- Create a database of lessons learnt
- Increase the system efficiency with the increased experience
- Improve training with the feedback from lessons learnt and emergency evaluations.

5.2 OPERATIONAL GUIDANCE

The operational guidance is provided, including AF3 approach.

5.2.1 Pre-emergency. (Fire prevention and Readiness.)

5.2.1.1 Fire Prevention

AF3 project addresses three main aspects: specific values protection through the placement of Nub-e capsules (PYRO); data collection for input models and fire risk assessment, and public awareness.

Placement of extinguisher capsules (PYRO)

The capsules will be placed in critical areas, just prior to the high risk season. The capsules will create preventive layers (fireproof barriers) that will difficult the fire spread.

Procedures

Decision of placement of capsules, identification of values to protect, requiring the application of specific protection measures (critical infrastructures, premises, Wildland Urban Interfaces, etc.)

As Nub-e creates long-term fire proof barriers (months or years), they can be included in prevention plans such as fuel breaks or water tanks. The Emergency Management Coordinator at each level (auto protection plans, local plans, and regional plans) is responsible for the placement of extinction capsules provided no dangers can be derived for wildlife or public. Additional measures will be taken in order to avoid hinder the movement of persons. Nub-e system will not make difficult the movement of animals and people, and neither will complicate the access to potential escape routes

The responsible of the crews placing the capsules will assume the responsibility of an adequate execution of the operations, in fulfilment with the prescriptions established by the plan director and any responsible from the public administrations.

The forest guards and any representative of the public administrations in the affected area must be aware of the deployed capsules in order to take them into account in case a firefighting intervention is planned in the area (e.g. backfires).

Capsules will be deployed by preventive ground crews with the supervision or knowledge of the public representative in the territory (forest guards in the case of forest land).

Fire Risk Assessment

AF3 will be able to support the fires risk assessment in case it is considered as convenient by the public administrations.

In any case, AF3 could be able to incorporate fire danger and risk indexes (FWI, and other local risk and vulnerability indexes and maps managed by the public administrations), in order to use them as inputs in models of risk and damage analysis.

Procedures

The responsible of the Fire Fighting Lab for each territory will be in charge of keeping updated the FWI and other daily Fire Risk Indexes in use.

It is function of the Fire Fighting Lab to incorporate any additional information related to Forest fire Risk required to run simulations and forecasts with the AF3 models.

Daily publication of Potential fire risk index forecast is useful for a proper planning of prevention in the different risk areas.

The index allows differentiating risk areas to better allocate resources. It also enables to establish work schedules for the firefighting resources according to the probability of being deployed in a potential emergency.

Inform and communicate with all stakeholders is important to prevent those activities that could cause ignition. When the fire risk forecast indicates a high fire risk, all the stakeholders should be informed.

Resources

- Very high/high resolution satellite images and Satellite data processing and methodologies That will allow developing: An efficient fast method for spread human settlements, roads, and other infrastructure detection, Fuel type map and Fire risk model. (SRC contribution)
- Risk evaluation tools for WUI (RUIMap TRAGSA)
- Weather forecast from EFFIS (spatial resolution of 10 km x 10 km) and different national meteorological agencies (e.g. AEMET in Spain provides forecast with a spatial resolution of 5 km x 5 km)

Advanced public awareness

The objective is to adapt and to improve methods, procedures and tools designed to provide public information channels during a crisis and to integrate them with the AF3 integrated crisis management system.

Procedures

Such a tool will serve to engage and communicate with public in all phases of the fire incident from prevention to firefighting, providing the relevant information and recommendations.

The Public Information Channels will be developed to alert and to better coordinate citizen evacuation, having an immediate impact due to the wide diffusion of smartphones and social network based service.

It shall allow dialogue between citizens and emergency services during large scale incidents

Advanced public information channels such as smart phones, internet and dedicated broadcasting will be integrated in the global system.

Resources

- Smart phone applications. (NCSRD and ICOM contribution)
- Social network tools (NCSRD and ICOM contribution)
- Services offered by mobile operators (ICOM contribution)

5.2.1.2 Readiness

All firefighting personnel have to be ready for a possible intervention. Prior to firefighting, the proper training is needed and therefore as previously mention, Firefighting Simulation Tool and Advanced Training Tools are implemented in AF3.

Fire Fighting Lab simulation tool

A new technology proposed by SelexEs in AF3 consisting of a complete System (HW and SW) will be designed to satisfy end-user needs in the firefighting activities. FFL has a role in Readiness supporting training and in Crisis Management and Simulation supporting decision making.

Procedures

When training is possible and there are not incidents to attend to (usually during low risk season) FFL can be used for training purpose.

Regardless that outputs from FFL must be integrated with C4I through the required interfaces, teams of analysts might be appointed to operate the FFL.

The Firefighting lab will work with real or simulated data in order to run simulations oriented to training and better understand the operation proceedings to face eventual emergencies.

Mixed on field and virtual trials will be enabled through the interoperation with mixed and virtual training environments (UPV, TRAGSA), and location and situation awareness systems.

The Emergency Management Coordinator will decide on the provision of real data coming from any awareness system and devices carried by fire fighting resources involved in an emergency.

Resources

- Model of forest fire propagation and extinguishing
- Model of crisis management
- Fire Fighting Lab simulation tool core

Advanced Training Tools

AF3 project proposes the creation of a multi environment training methodology for improving the new training needs and current skills of both first responders and commanders in charge of fighting large fires in Europe. This improvement will be achieved by providing to the target end users new training tools and realistic scenarios used in three different Virtual Training Environments (VTE) going beyond to the capabilities offered by their current training curricula. In addition, AF3 will develop innovative training curricula according to the new training needs expressed by the end users in order to face new challenges and threat scenarios.

These innovative training curricula will be composed by several combinations of different scenarios played in some of the three VTEs proposed by AF3 training methodology. This way the end users skill acquisition and practice will be improved for facing new situations in a more realistic manner.

Training programs are established by the Regions in the stages of implementation, or maintenance of the Forest Fire Emergency Plan (update or review). Training methodologies can be found in *D5.3.1 – Training methodologies specification*.



Procedures

Tutor. Training actions will be carried out under the supervision of specialized staff, related to the firefighting mechanism of each Region.

Training actions will be plan in a flexible way, providing multi-environment training curricula, but also enabling to perform partial training exercises using separated modules or a combination of them.

Trainees. The Advanced Training Tools proposed by AF3 will cover the whole command chain and both air and ground segment units, being possible to train crews in their specific role, but also playing different roles in order to deeper understand the complexity of different positions and to train different skills more efficiently.

Resources

- Mixed Reality VTE: UPV
- Virtual training tool: 3eTRAINING (TRAGSA contribution)
- Visualization modules for simulation and image generator: VIR3X (SES contribution)
- Online training and learning management systems (SKYTEK contribution)

5.2.2 Emergency (Preventive intervention, Fire Detection, Monitoring and Crisis Management and Simulation and Fire Fighting and Rescue operations)

5.2.2.1 Preventive intervention

AF3 propose the Nub-e system as a passive counter measure system. Nub-e system consists in the construction of fireproof barriers by means of the deployment of polymeric capsules that release extinguishing agents (water and retardant agents) on the vegetation before fires reach them.

The capsules will be placed in critical areas, just prior to the high risk season. The capsules will create preventive layers (fireproof barriers) that will difficult fire spread. Location and characteristics of deployed capsules will be available through communication and information systems developed in AF3.

Procedures

People in charge of directing the forest fire emergency plans jointly with the managers of the involved areas or infrastructures (at each scale, auto-protection plan, local plan, regional plan) identifies in the plan, critical areas to be protected through Nub-e system, and includes any prescription for its use (replacement period, environmental and logistical considerations).

When there is a forest fire emergency, the Direction of Operations could decide to place capsules in strategic places, such as fire breaks, WUI or critical infrastructures.

The Director of operations and units deployed in the emergency area must know the location of nub-e system capsules through cartography or viewers and situation awareness tools.

Resources

- -Nub-e capsules system (PYRO)

5.2.2.2 Fire Detection

Fire detection is the first stage in the activation of Forest Fire Emergency Plans, and it consist of actions taken to warn of the existence of a fire close to the time of its start, so that the extinction means are mobilized immediately.

It implies the notification to the Operation Centres of date and hour of the communication, identification of the referring and receiver bodies, origin of the information, literal content of the information, effects (current and foreseen) and instructions and observations.

Fire detection is very important for early extinction, and therefore to reduce fire effect over citizens, properties and environment.

Fire detection systems are established by each region and defined by Forest Fire Emergency Plans, through the annual Catalogue of Resources and Means.

Procedures

In case the information does not come from the 112 service, the Regional Centre of Operations must alert the 112 Emergency Assistance Service.

Innovative detection systems will have to be included in the regional catalogue of firefighting means, with indication of its priority area, technical requirements and limitations. The use of any detection system will remain under the responsibility of the Emergency Management Coordinator.

AF3 propose the use of several technologies with the aim of supporting fire detection through the use of UAVs swarm-operated micro-UAVs and space observation and firefighting aircrafts.

Once a forest fire has started and detected by AF3 detection systems, related information will be sent to the Operation Coordination Centre and 112 Emergency Assistance System, as well as to the Fire Fighting Lab which will launch simulations according to the input data and models included.

Resources

- Public awareness application (ICOM, NCSR)
- UAVs (several contributors) including the use of multiple micro-UAVs for detection and monitoring (UOW contribution)
- Very high/high resolution satellite images and Satellite data processing and methodologies for Hot spots and burn area detection system. (SRC contribution)
- Mobile tools for monitoring, decision support and situation awareness (UPV, TRAGSA: viewers, augmented reality tools, etc.)
- Location and tracking systems

5.2.2.3 Monitoring, Crisis Management and Simulation

As mentioned before, monitoring applies to most of firefighting process. There are monitoring resources that are used since the pre-emergency phase and therefore it is not required a mobilization or call for its use. On the other hand there are other resources that are incorporated to the incident management in posterior phases and could need a proper mobilization or call.

For those resources that need a call to be implemented in the emergency, the normal procedure except for those indicated a specific one, is as follows: The DOS will request the resource or suggest its use to the Direction of the Plan. Then the Direction of the Plan will evaluate the convenience of the resource (simulation, experts, etc.) and then mobilize it or not, and inform the DOS about the decision and the incorporation process.

Other way of operate the resources is that the Direction of the Plan suggest to the DOS the mobilization of the resource. Them after been advised by the DOS the Direction of the Plan take the decision about mobilizing or not and inform the DOS as before.

In general terms, all monitoring technologies have to be compatible with each other. The outcomes will be put together to facilitate comprehension, visualization and therefore decision making.

Procedures

AF3 proposes the use of multiple technologies from ground, air and spatial segments for detection and monitoring. The data obtained from these sources shall be sent directly to the FFL/C4I. The FFL shall utilize the data for mission simulation and rehearsal, feeding the C4I for supporting decision making.

For this to happen, C4I will be operated from the ICP, by the DOS or the responsible by him appointed.

The Coordination Centre can also make use of FFL and C4I to assist the DOS providing information required by the Director of Operations placed in the Incident Command Post (ICP).

In those areas where a sensor network is installed (data from ground sensors, wireless sensor network, etc.), the emergency monitoring shall be uninterrupted through them.

Any dispositive in the emergency has been previously assigned to the operative of the Emergency Plan for Forest fire and shall operate under the responsibility of the Direction of the Plan.

The FFL shall implement services for the data exchange with other existing platforms in arrange of the standards that shall be defined.

The use of unmanned aerial vehicles shall take place in areas with no aerial intervention, out of their manoeuvring area and according to the law restrictions, and they shall be retired once aerial means are mobilized.

The unmanned aerial vehicles working out of the scope of aircrafts and helicopters shall remain regardless their mobilization, and those AUVs that have been retired due to incompatibilities with air segment operation shall re-join the operations when aircrafts and helicopters have abandoned the area (e.g. during night), by previous command from the DOS or the responsible designated by him (Aerial Coordinator).

Resources

Observation from Air Segment

- Advanced real time electro-optical system all bands: sensors integration to UAV and light aircrafts (ELBIT contribution).
- “PEGASUS” UAV platform, standards and regulatory framework, UAV & plane safety implications (MOD)
- Multiple micro-UAVs for visual/N-IR detection and monitoring (UOW contribution)

Observation from Space Segment

- Very high/high resolution satellite images and Satellite data processing and methodologies. That will allow developing: An efficient fast method for spread human settlements, roads, and other infrastructure detection, Fuel type map, Hot spots and burn area detection system, Fire risk model. (SRC contribution)
- Generate maps from satellite remote sensing data showing different degrees of damage affecting vegetation after a large forest fire, in order to locate priority intervention areas and plan forest restoration works. BARC maps (SRC contribution)
- Satellite communications and C2 during a crisis REACT (SKYTEK contribution)

Observation from Ground Segment

- UGV and manned vehicles requirements and demonstration/deployment planning (POLITO contribution)
 - Health risks and Damages monitoring (NCSR, ICOM and TRAGSA)
 - Real-time fire monitoring and surveillance of burned areas for fire re-ignition detection. (TRAGSA contribution) including micro-UAV based N-IR observation (UOW)
 - Mobile/fixed cameras, laser rangefinder, relaying techniques (UPV contribution)
-

-
- Wireless Sensor Network: Low-cost WSN-based integrated platform (NCSR D contribution) and Dropped/spread micro sensors, flexible communication protocols (UOW contribution)
 - Mobile tools for monitoring, decision support and situation awareness (UPV, TRAGSA: viewers, augmented reality tools, etc.)
 - Location and tracking systems
 - DSS systems: viewers, resource management modules.,
 - LIDAR system. This data allows developing meteorological forecast system and simulation tool (ARIA contribution)

Observation and Early Warning performed through ancillary data (smartphones, social media)

- Public awareness application (ICOM, NCSR D)
- Mobile tools for monitoring, decision support, situation awareness, and location and tracking of the deployed units (UPV, TRAGSA: viewers, augmented reality tools, etc.)

A Command and Control System will be implemented. For this purpose the technologies previously mention for data capture and processing, and the technologies from this section will merge to allow a crisis management system and simulator.

Crisis Management and Simulation needs: Data visualization, data fusion and reasoning unit and Simulation and risk analysis tools. The data from the monitoring and detection is also used in this phase.

Data visualization, data fusion and reasoning unit:

Data visualization, data fusion and reasoning unit will be able to combine multi-source observation data with results from fire prediction techniques, algorithms and models, returning feedback to detection mechanisms for focused observation in areas of high-risk.

This unit need to integrate the technologies from partners and/or allow them to interoperate.

- The Advanced Situation Awareness (ASA) system will be designed to collect all relevant real time data from all sources (UPV contribution)
- Tactical Display and Synthetic Environment. “SYENA” (SES contribution)
- Data fusion and mediation component, GIS and online knowledge extraction system & visualization: OCULUS (NCSR D) and EMERCARTO-SIGUEME (TRAGSA contribution)
- Integration with crisis management systems, data fusion of airborne sensors of 6.1 (ELBIT contribution)
- Semantic web based tools (SKYTEK contribution)

- Day and night optical data analysis algorithms, data fusion techniques for sensor nodes (UOW contribution)

Simulation and risk analysis tools

The simulation and risk analysis tools will be used to predict how the situation is about to develop in time with and without fire-fighting operations. Decision makers, before ordering actual actions, will be able to have a prediction of the impact of various actions (firefighting brigades, preventive intervention, aerial firefighting, etc.) based on the DS simulation tools.

- Risk analysis software tool for firefighting with pellets.(FHG contribution)
- Software tool for real time risk analysis, preventive risk analysis, and ex-post risk analysis (FHG contribution)
- Visualization module for risk analysis (FHG contribution)
- Fire Fighting Lab, (SES contribution)
- Mobile visualisation (rugged PDA), direct visualisation from UAVs (UPV contribution)
- Simulation environment (ELBIT contribution)
- C4I stations: (ELBIT contribution)
- Decision support system iPV (SKYTEK contribution)
- Web Semantic data mining and fusion expertise (SKYTEK contribution)
- Integration and interfacing of crisis management systems to UGV and manned ground vehicles (ELBIT contribution)
- Risk evaluation tools for WUI (RUIMap TRAGSA)

5.2.2.4 Fire Fighting and Rescue operations

Fire Fighting and Rescue operations phase includes all the operations and active measures that are taken to counter fire and to save human lives, livestock, environment, properties and infrastructures. During the operations, each fire is identified based on the stage of attack. The stages are identified as: First attack, Extended attack, General attack and Full attack and they are described below.

First attack

Forest fire that can be controlled by firefighting resources foreseen by the Plan as automatic dispatch resources. It is characterized by a rapid response after the notification of the emergency.

It has an easy operational structure, sometimes even with direct orders from the Director of Operations to the crew. The operational structure is represent in Figure 1.

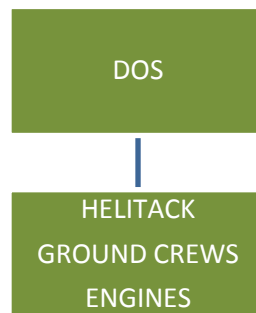


Figure 1: Example of a First Attack structure

Procedures

Fire detection → First attack means mobilization → Identify requirements and request means → (reconnaissance, evaluation and plan attack (strategy, tactics, and schedule))

The Director of Operations is performed by the most senior command present in the affected area, in order of arrival (usually a Forest Agent or the leader of the first unit arriving, e.g. a helitack chief), or a person delegated by him/her.

The Emergency Management coordination is performed by the person in charge of the OCC.

Firefighting means are localized using positioning tools; send information through situation awareness tools, monitoring and supporting decision (mobile viewers, send positioned images and videos, points of interest and events).

In case there is a sensor network deployed, it shall keep sending data.

In case the helitack is not able to respond to the fire, because of proximity to sunset or lack of operability; the Emergency Management Coordinator together with the Director of Operations could allow monitoring using UAVs and micro-UAVs.

In case the first attack means are not able to answer the emergency during early stage due to fires simultaneity, the Emergency Management Coordinator could allow the AAFF intervention, after proper mission analysis with FFL simulations.

Resources

- Radio, communication systems
 - First response resources: vehicles, engines, helicopter (helitacks).
 - Suppression tools (hand tools, mechanical tools, hose lays, retardants, etc.)
-

- Pre-existing, preventive intervention means (Nub-e system capsules), fire prevention infrastructure (water points, fire breaks, roads, hydrants, etc.).
- Data and voice communication systems.
- Situation Awareness, monitoring and decision support tools for portable devices Smartphones/tablets
- Sensors (if previously existing in the affected area or held by first responders): UAV, Satellite, wireless sensor networks, etc.)
- AAFF, UAVs (if available, when required)
- Monitoring, management and decision support systems (OCC, C4I)
- Data visualization, data fusion and reasoning unit.

Extended Attack

Fire that could not be controlled in the initial attack therefore requires the incorporation of more than one intervention team. New means for which the fire is in their priority area get involved in extinction.

The change from the initial to the extended attack will occur under request of the Director of Operations, attending to the current and predicted fire behaviour and effectiveness of the work in progress. The request has to be approved by the Emergency Management Coordinator and he/she will mobilize the new means.

The operational structure gets a bit more complex as different units arrive. It is still an easy operational structure, sometimes even with direct orders from the Director of Operations to the crew. A general operational structure is shown in the Figure 2; in green colour are represent the new responders for this phase while in blue those that were previously established.

Procedures

Re-evaluation and re-planning → Request new resources from priority area.

If the fire evolution suggest than the fire could not be control with the means from first attack, the Director of Operations will re-evaluate the situation and decided with the Emergency Management Coordinator the mobilization of the resources and means and re-design the plan.

The DOS is the same person as in Initial Attack unless Direction of the plan designates a new one from the reinforcement.

The Direction of the Plan is performed by the person in charge in the OCC, namely the duty technician, the director of the environmental/forest service or the most range representative of the competent body (regional forest fire service, regional civil protection service, or other depending on the country and region).

Sensor network deployed shall keep sending data.

It is function of the Director of Operations to ask for operation of coordination aircrafts or helicopters, as well as other support and monitoring resources such as sensors born by UAVs and/or UGVs. The OCC will take the decision of mobilization of such resources according to the information provided by the DOS, and other needs in the region (fire simultaneity).

After the corresponding simulations, AAFF could be mobilized in case there are not enough means for fire suppression because of simultaneity of incidents.

It is function of the Director of Operations to apply for AAFF measures, which will be approved by the OCC.

In case there are many units involved of different segments, the DOS could designate an aerial coordinator and a ground operation coordinator or divided the area of intervention in sectors and name a sector chief for each of them. The units then will be assigned to the corresponding chief or coordinator.

New resources

- Booster resources: vehicles, engines, helicopter (helitacks), heavy machinery, cargo helicopters, aircrafts.
- Simulation and risk analysis tools
- Sensors UAV, Satellite, wireless sensor networks, etc. (if activated and not present in the previous stage)
- AAFF, UAVs (if activated and not present in the previous stage)
- Monitoring, management and decision support systems (OCC, C4I)
- Data visualization, data fusion and reasoning unit (if activated and not present in the previous stage).

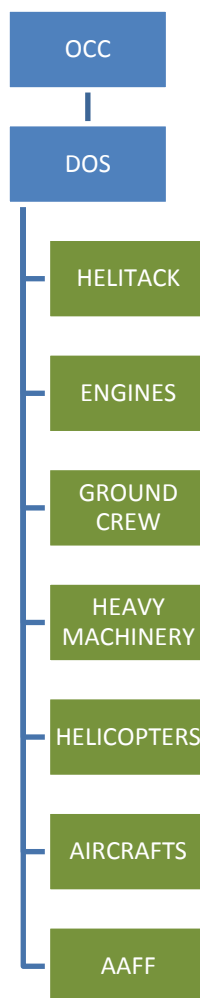


Figure 2: Example of an Extended Attack structure

General Attack

Fire that could not be controlled in the extended attack may require the intervention of other regional air assets and / or helitacks.

The operational structure is now complex with many intermediate Commands. Civil protection enters in the picture and the incident area is sectorized. In Figure 3 a General Attack structure is illustrated, representing in green colour the new incorporations from the previous attack

Procedures

Re-evaluation and re-planning → Request new resources assigned in the regional plan

A new re-evaluation and re-planning shall be considered, studying the convenience of AAFF attack at day or night, deployment of new monitoring system such as LIDAR, UAVs, micro-UAVs, UGVs, etc.

The Incident Command Post is established by the DOS. The ICP is formed by: the Director of Operations and the leaders of the action groups.

The Director of Operations can divide the area of intervention in sectors (operational zones) and designates a sector chief for each. The Sector Chief is in charge of the activities and means in the sector. The security groups, health group and support and logistics group are established and the leaders of each of them are part of the Incident Command Post.

The reinforce means are assigned to sectors or stay under DOS control (if ground segment: UGVs, LIDAR and other ground assets) or to the aerial coordinator (if aerial segment: aircrafts, helicopters, AAFF, UAVs, micro-UAVs) and task are assigned to them.

All personnel and units are localized and send data through communication systems (mobile devices, radio, other). The level of data that a unit sends depends on the type, but at least all shall send position.

The aerial coordinator is designated and takes charge of the aerial segment. The aerial coordinator coordinates and assigned tasks to the air units. Aerial coordinator could suggest and request to the DOS the use of UAVs and AAFF when convenient. After sunset or in harsh weather conditions, all traditional air assets shall be out of the incident. UAVs and AAFF shall keep firefighting when required, unless weather conditions do not allow their safe and effective operation.

The Aerial Coordinator and the Sector Chiefs shall keep informed the DOS, and act under his coordination. Aerial attack and ground attack shall be perfectly coordinated, in order to assure a safe intervention and optimize the extinction, so the aerial segment could suppress the fire and ground could mop up.

The Direction of the Plan in accordance with the DOS could deploy the LIDAR for monitoring and better predict the fire behaviour.

C4I shall continue receiving data and communicating.

New resources

- AAFF
- UGVs
- UAVs
- LIDAR

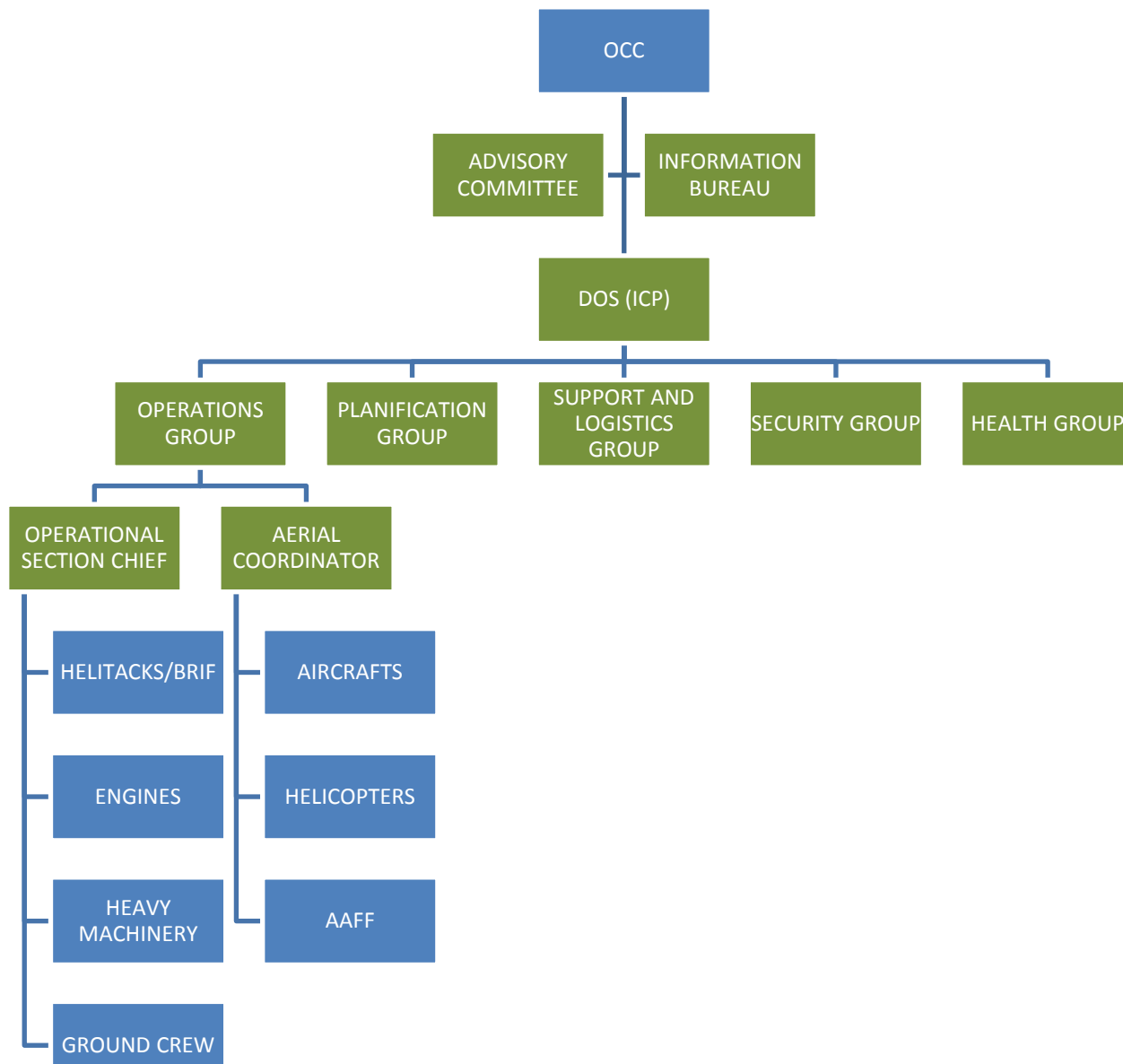


Figure 3: Example of a General Attack structure

Full Attack

Fire that could not be controlled in general attack may require the maximum deployment of the provincial mechanism. New regional assets foreseen in the region’s wildfire plan incorporate to the emergency.

Its control requires the mobilization of large number of means coming from far. The operative structure, and command chain is complex. In Figure 4 the structure is represented and the differences with the previous attack level are highlighted in green.

Procedures

Re-evaluation and re-planning→Request new national or international resources

It is possible that the state declare the incident as an incident of national importance (level 3), and that military units intervene in the incident. In this case a National Coordination Committee will form the Direction of the Plan and the DOS will be the military unit commander

As in the previous attack, everything and everyone in the incident area has a direct responsible (the person operating it), and an ultimate responsible following the command chain.

Aerial Coordinator is the responsible of air assets coordination, while ground assets that operate in a sector are under the responsibility of the Sector Chief. Any other mean or resource not assigned to them is under DOS control or whose he/she could have designated. The DOS is always the ultimate responsible for everything in the incident area. Director of Operations can be assisted by a Security Officer, a Liaison Officer and/or an Information Officer.

Additional posts may be establish for receiving new arriving resources to the intervention area, or for providing information to media.

C4I keeps receiving data from sources and transmitting it.

As for the previous phases, it is function of the DOS to establish the Extinction Plan, which establishes the strategy, tactics and schedule for the operations, and which may include the use of AAFF when recommended by the simulations launched by the FFL-C4I, and provided the security of ground units and people and infrastructures are not compromised. The last decision of using AAFF remains in the DOS.

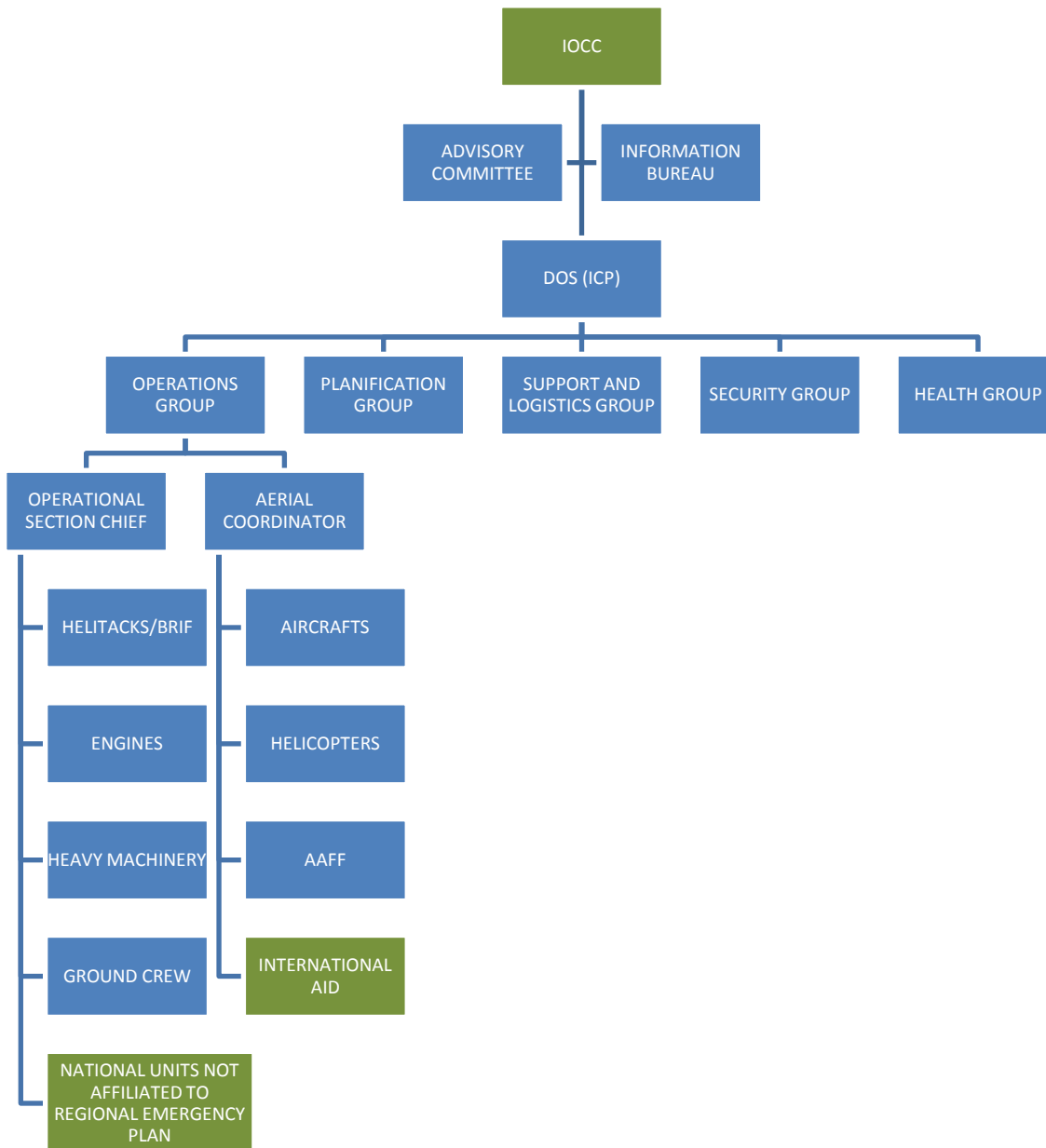


Figure 4: Example of a Full Attack structure

New resources

- Health risks and Damages monitoring (NCSR, ICOM and TRAGSA)
- Wireless Sensor Network: Low-cost WSN-based integrated platform (NCSR contribution) and flexible communication protocols (UOW contribution)

5.2.3 Post-emergency. Debriefing and Feedback

The Simulation Host allows having playback, and debriefs, reviewing all the crews actions and the external scenario. The purpose is to have the capability to debrief each firefighting mission shortly after is finished and extract lessons for future emergencies.

Lessons learnt can be implemented through training. There should be a data base with all lesson learnt that shall be share with partners, in order to improve all the AF3.

Resources:

- Simulation and risk analysis tools
- Data visualization, data fusion and reasoning unit:
- Training and simulation tools

6. ROLES AND RESPONSABILITIES

The activities described in the chapter 5 Operational description are performed by a person and/or have a responsible for it. In this title the main roles of the actors involved in forest fire emergencies are identified. In order to identify the actors' role, a distinction is made between those actors performing coordination functions, those in the execution and other participants.

6.1 EMERGENCY MANAGEMENT COORDINATION (DIRECTION OF THE PLAN)

The emergency management coordination team is host in the Coordination Centre and is responsible of the corresponding emergency plan. Their duties include supporting and coordinating first responders, other means and resources. The main roles in this group are: the Emergency Management Coordinator, the Advisory Committee and the Information Bureau.

Emergency Management Coordinator

The Emergency Management Coordinator is the head of the Operational Coordination Centre (OCC), centres consisting of the necessary resources to manage the Plan: coordination and meetings room, information bureau and broadcast centre, equipped with the required means of communications and computing.

For Potential Gravity Levels 0-1 the Emergency Management coordination is performed by the corresponding Operational Coordination Centre boss, unless the Director of Regional Service with the competencies in forest fire emergencies decides to take the responsibility.

When fire is affecting more than one province (or district, i.e. NUTS III) within the same Region (i.e. NUTS II), the direction of the plan will be assumed by the Director of Regional Service with the competencies for forest fire emergencies (forest fire service, civil protection service, or other, depending on the country or region), namely the maximum regional responsible for Forest fires emergencies issues in each Region or the one he/she appoints.

For Potential Gravity Level 2: Direction Committee will be established.

Formed by:

Representative of the Region: Emergency management coordination (direction of the plan)

Representative of the State: reinforcements 'coordination

When fire is affecting more than one Province:

Director of Environmental Service: Operations direction

Representative of the Region

Representative of the State: Plan's direction

Responsibilities

- Declare Potential Gravity Level, unless declaration of level 2, in which case it is suggested by the Direction of the Plan and declared by the appointed political representative.
- Decide actions to be taken to protect people, properties, infrastructure, environment and extinction personnel. Nub-e capsules prescription.
- Mobilize resources, security group, health group, support and logistics group
- Ask for support from regions, states or any other aid.
- Determine and coordinate the release of civil information.
- Declare end of emergency and demobilization
- In case level 2 is declared, establish Direction Committee
- Inform national and international organism involved
- Continuous monitoring
- Communications
- Coordination and resource allocation between simultaneous incidents.

Advisory Committee

For Potential Gravity Levels 0-1: Number of experts needed.

For Potential Gravity Level 2: Number of experts needed and the responsible of the government in the areas involved.

Responsibilities

- Advice to the direction of the plan about most likely fire evolution, consequences, countermeasures and needed resources.
- Study and propose modification for better effectiveness.

Information Bureau

Regional or Provincial Government Press Office.

Responsibilities

- Centralize, coordinate and prepare general information about the emergency.
- Release it to the press once approved by Direction of the Plan.
- Inform to stakeholders

6.2 EXECUTION OF THE PLAN

In this section it has been separated those agents performing their duties from the Incident Command Post, and those other actors which are included in the possible different functional sections established for a more efficient management of the disaster (operations/intervention group, security group, health care group and support and logistics).

In cases that the management of the incident requires the participation of different agencies, such as law enforcement and police, rescue, or medical aid, the representatives of these agencies will be integrated in the a Unified Command Post, in order to coordinate their respective functions. The representatives of these agencies will be responsible for the tasks of the different units under their respective competencies.

6.2.1 Incident Command Post (ICP)

The Incident Command Post is the place where the Director of Operations (DOS) performs his/her functions, and from where the actions of task forces are coordinated. Representative from different agencies may be also included, together with responsible staff in charge of separated functional sections, such as, planning, logistics, or administration and finances sections.

Incident Command Post may further include a Post for Forest Fires Analysis, appointed officials of the Task Forces present in the emergency (intervention, health, security, logistical support), and emergency management technical staff.

Director of Operations (DOS)

Person appointed by the Direction of the Plan, meanwhile no one has been appointed the role is performed by the most senior command present in the intervention area, in order of arrival (usually a Forest Agent or the leader of the first unit arriving, e.g. a helitack chief, a firemen lieutenant), or a person delegated by him/her.

The Incident Command Post is the place where the Director of Operations (DOS) performs his/her functions, and from where the actions of task forces are coordinated.

Incident Command Post may further include a Post for Forest Fires Analysis, appointed officials of the Task Forces present in the emergency (intervention, health, security, logistical support), and emergency management technical staff.

The DOS, or those officer in whom he/she delegates, uses the FFL-C4I for the analysis of alternatives and decision making.

The Director of Operations has the following responsibilities, which will carry on from a Incident Command Post in case it is established.

Responsibilities

- Reconnaissance and assessment (fire behaviour, threaten values, forecast, etc)
 - Design the Operations Plan (strategy, tactics and schedule)
 - Decide the fire suppression activities
 - Define operative orders from the plan strategy and guarantee the orders transmission to the different operation groups
 - Coordinate the units and actions groups
 - Means and resources deployment over the field
 - Identify requirements
 - Inform and suggest the OCC about extinction: fire evolution, necessary countermeasures such as: evacuation, road closures, etc
 - Request resources and units to OCC
 - Define: the area of intervention, the base area and the relief area
 - Establish the Incident Command Post when required (during General Attack)
 - Supervise means inclusion in the operative
 - Coordinate air assets till Aerial Coordinator is designated
 - Designate aerial coordinator
 - Establish fire sectors and name Sectors Chiefs for each
 - Simulations
-

Public Information Officer

The Public Information Officer is responsible for interfacing with the public and media and/or with other agencies with incident-related information requirements. The Public Information Officer may also perform a key public information-monitoring role.

Whether the command structure is single or unified, only one Public Information Officer should be designated per incident. Assistants may be assigned from other involved agencies, departments, or organizations.

The DOS must approve the release of all incident-related information.

Responsibilities

- Determine, according to direction from IC, any limits on information release.
- Develop accurate, accessible, and timely information for use in press/media briefings.
- Obtain the Incident Command's approval of news releases.
- Conduct periodic media briefings.
- Arrange for tours and other interviews or briefings that may be required.
- Monitor and forward media information that may be useful to incident planning.
- Maintain current information summaries and/or displays on the incident.
- Make information about the incident available to incident personnel.

Liaison Officer

The Liaison Officer is Incident Command's point of contact for representatives of other governmental agencies.

Under either a single-Incident Command or a Unified Command structure, representatives from assisting or cooperating agencies and organizations coordinate through the Liaison Officer.

Agency and organizational representatives assigned to an incident must have the authority to speak for their parent agencies or organizations on all matters, following appropriate consultations with their agency leadership.

Responsibilities

- Act as a point of contact for Agency Representatives.
- Maintain a list of assisting and cooperating agencies and Agency Representatives.
- Assist in setting up and coordinating interagency contacts.
- Monitor incident operations to identify current or potential interorganizational problems.
- Participate in Planning Meetings, providing current resource status, including limitations and capabilities of agency resources.
- Provide agency-specific demobilization information and requirements.

Safety Officer

The Safety Officer monitors incident operations and advises the DOS on all matters relating to operational safety, including the health and safety of emergency responder personnel.

The Safety Officer has immediate authority to stop and/or prevent unsafe acts during incident operations.

It is important to note that the agencies, organizations, or jurisdictions that contribute to joint safety management efforts do not lose their individual identities or responsibility for their own programs, policies, and personnel. Rather, each contributes to the overall effort to protect all responder personnel involved in incident operations.

Responsibilities

- Identify and mitigate hazardous situations.
- Create a Safety Plan.
- Ensure safety messages and briefings are made.
- Exercise emergency authority to stop and prevent unsafe acts
- Initiate preliminary investigation of accidents within the incident area.
- Participate in Planning Meetings to address anticipated hazards associated with future operations.

Section Chief

Designate by the DOS when required. The main sections identified according to the Incident Command System are operations, planning, logistics, and finances.

Responsibilities

- Coordinate section unit and resources
- Assign tasks to units
- Define section actions
- Inform and request what needed to DOS

6.2.2 Operations section/Group

Consist of mechanical and human resources whose main priorities are the performance of operations within the disaster area. The operations to perform are coordinated by the DOS, or by the appointed Operations Section Chief. In cases that emergency requires the joint participation of different agencies; different branches can be established by the chief of operations section (Branch 1, Police; Branch 2, Firemen; Branch 3, Medical Assistance; etc.)

In the case of fire suppression operations, the operations group will be constituted by the mechanical and the human resources whose main priorities are firefighting operations. It comprises: troops-brigades, regional air resources, air resources allocated by the State Government, heavy machinery, pump trucks, provincial and local extinction means, and human and material resources, including volunteers working in the local and provincial plans of action. These unites can work either as individual units, or task forces (temporary groups of individual units), or strike teams (including a specific number of units of the same type).

These actions are performed by:

Units in short distance from the fire (in Spain around 50km and 20 minutes of arriving time) during the first attack.

Mobilized Units which priority area includes the intervention area (extended attack). The priority area is defined for each unit in the Forest fire Emergency Plans.

Means dispatched from other location in the same the region provided the intervention area is outside their priority area (General Attack).

Units which are not assigned to the regional Plan (e.g. units transferred from other regions or national support units not assigned to the regional plan) and international aid (full attack).

The Operations Group involves different actors with different levels of responsibility, and different skills requirements, according to the position they must cover during the emergency. The overall responsibilities are identified for the whole section:

- Assess, reduce and extinguish forest fires (fire suppression)
- Rescue people threatened by forest fire
- Finishing tasks and securing the perimeter.
- Send and receive information through mobile devices.

Sector Chief

The Sector Chief is the responsible of an operational zone (sector) and is appointed by the Director of Operations when is required due to complexity, to the extension of the affected area, or due to other factors. The Sector Chief is in charge of the activities and units in the sector assigned.

Responsibilities

- Direction and coordination of extinction actions for the units in charge, following the instructions from the DOS or the person appointed by him.
- Direction of the extinction, including aerial coordination of the assigned sector.
- Design assessment and attack in the assigned sector.
- Communication with ground and air assets.
- Objectives definition for aerial assets.

Air operations Director

The Operations Section Chief may separate the management of ground segment and the air segment units, when the complexity of air operations requires additional support and effort. A Director for air operation will be designated for this purpose.

Aviation safety is a paramount concern in complex operations, and a separated Air Operations management ensures the safe and efficient use of aviation resources.

The Air Operations Director will coordinate both the aerial firefighting operations and the support required by the aerial units (helibases, airports, fuel and rest supply, etc). Separated supervisor may be designated for these respective tasks.

Responsibilities

- Coordinate aerial units (traditional aerial units, AAFF and UAVs) involved in firefighting tasks
- Coordinate the required support and assistance to the aerial units (helibases, airports, etc). Establishes, maintains and operates helibases and heliports, during the emergency.
- Assign task to the air segment
- Inform the Director of Operations
- Maintains required liaison with off-incident fixed-wing bases.

Middle rank commanders in the operations section

The Operations section can include different middle rank commanders in charge of units, task forces and strike teams. Staff responsible the reception and departure of units attending the emergency area from the established centres are also included in this command rank.

A list of actors for the Spanish scene is given below:

- Reception-departure centre chief
- Helitack chief
- Brigade chief
- Strike Team Leader Engine
- Heavy machinery chief
- Chief of the Extinction and detection mobile unit
- Safety and health specialist
- Aerial Coordinator

6.2.3 Security Section/Group

Form by members of the Security forces (Civil Guard), Local Police and Forest Rangers not involved in the firefighting tasks, under the command of the most characterized member of the first body.

This group will be established at the proposal of the Director of Plan and always in case of level-2 forest fires.

Responsibilities

- Public safety
 - Access control and traffic control
-

- Driving firefighting resources to the areas indicated by DOS
- Notify and carry out the evacuation and shelter of the population threatened by the fire
- Investigation of criminal conduct and reporting of the alleged perpetrators.

6.2.4 Health care Section/Group

Formed when required by situation, and always in Level-2 fires, under the direction of the Director of the nearest Health Centre to the Operation area, with the medical staff of the Centre and ambulances concerted and / or Red Cross located in that area.

6.2.5 Planning Section

The Planning Section is responsible for collecting, evaluating, and disseminating operational information pertaining to the incident. This Section maintains information and intelligence on the current and forecasted situation, as well as the status of resources assigned to the incident. The Planning Section prepares and documents Incident Action Plans and incident maps.

The Planning Section may include: Resources Unit, Situation Unit, Documentation Unit and Demobilization Unit, Fire Behavior Analysts.

Responsibilities

- Prepares the Incident Action Plan for each operational period.
- Evaluate the situation and forecast requirements for additional personnel and equipment
- Make certain that all assigned personnel and resources have checked in at the incident.
- Keep track of the current location and status of all assigned resources and maintains a master list of all resources committed to incident operations.
- The Situation Unit collects, processes, and organizes ongoing situation information; prepares situation summaries; and develops projections and forecasts of future events related to the incident.
- Maintains accurate and complete incident files, including a complete record of the major steps taken to resolve the incident
- Develop an Incident Demobilization Plan that includes specific instructions for all personnel and resources that will require demobilization.

6.2.6 Support and Logistics Section

The Logistics Section is responsible for all service support requirements needed to facilitate effective and efficient incident management, including ordering resources from off-incident locations.

This Section also provides facilities, security (of the incident command facilities and personnel), transportation, supplies, equipment maintenance and fuel, food services, communications and information technology support, and emergency responder medical services.

When the incident is very large or requires a number of facilities with large numbers of equipment, the Logistics Section can be divided into Branches, usually two branches: Service Branch (communications, medical and food) and Support Branch (supply, facilities and ground support). Each of the branches with their corresponding branch director.

Responsibilities

- Provide all facilities, transportation, communications, supplies, equipment maintenance and fueling, food, and medical services for incident personnel, and all off-incident resources.
- Manage all incident logistics.
- Identify anticipated and known incident service and support requirements.
- Request additional resources as needed.
- Ensure and oversee development of Traffic, Medical, and Communications Plans as required.

6.2.7 Administration and finances Section/Group

A Finance/Administration Section may be established when there is a specific need for financial and/or administrative services to support incident management activities.

Responsibilities

- Manage all financial aspects of an incident.
- Provide financial and cost analysis information as requested.
- Ensure compensation and claims functions are being addressed relative to the incident.
- Develop an operational plan for the Finance/Administration Section and fill Section supply and support needs.
- Ensure that personnel time records are completed accurately and transmitted to home agencies.

6.3 OTHER PARTICIPANTS

Meteorological institutions

National or international institutions that provide weather forecast or fire weather forecast: State Meteorological Agency (AEMET) in Spain

The European Forest Fire Information System (EFFIS),

Responsibilities

- Provides forecast for risk season
-

Regional Organism for Forest fire

Agency in charge of forest fire issues in any of the different regions.

Responsibilities

- Provides classification of the vulnerable areas.
- Implement index
- Take action depending of the risk index forecast

Other entities

Other entities providing support or means.

Responsibilities

- Assure the self-sufficiency of their means or resources
- Act under the command of the Director of Operations and the Emergency Management Coordinator.

7. EMERGENCY SEQUENCE AND FLOW

The general emergency procedure is summarized according to the stage of the emergency and the actors involved in each one. A sequential approach has been taken regarding the hypothetical increment of threat from the outbreak to the most critical situation (national threat).

7.1 EMERGENCY SEQUENCE

1) Fire event.

2) **Detection & Reporting** to Operational Coordination Centre (OCC) -> Fire lookout, forest guards, mobile watcher, aircraft, 112 private calls, satellite images or sensors.

First attack

3) **Mobilization of the first response resources** (Automatic-Dispatch)

4) Identify requirements; suggest incident level and Communicate to OCC -> Director of Operations.

5) Declare Potential Level-> Direction of the Plan.

POTENCIAL GRAVITY LEVEL 0

Extended Attack

6) Request resources in priority area to OCC -> Direction of Extinction.

7) Mobilize resources in priority area -> Direction of the Plan.

8) Declare end of emergency and demobilization -> Direction of the Plan or Declare new Potential Gravity level -> appointed political representative by request from the Emergency Management Coordinator.

POTENCIAL GRAVITY LEVEL 1

General Attack

9) Request new resources included in the regional plan -> Director of Extinction

10) Mobilization of new resources and operations groups included in the regional plan -> Emergency Management Coordinator.

11) Constitution of the **Incident Command Post** (ICP) -> Director of Operation.

ICP: leaders of operation groups and DOS.

12) Declare end of emergency and demobilization -> Emergency Management Coordinator or Declare new Potential. Declare Potential Gravity level 2 -> Declaration by the appointed political representative, request by the Emergency Management Coordinator.

POTENCIAL GRAVITY LEVEL 2

Full Attack

13) Establish **Integrated Operational Coordination Centre** (IOCC).

14) Request new resources from other regions and countries -> Direction of Extinction.

15) Mobilization of new resources from other regions and countries -> Direction of the Plan.

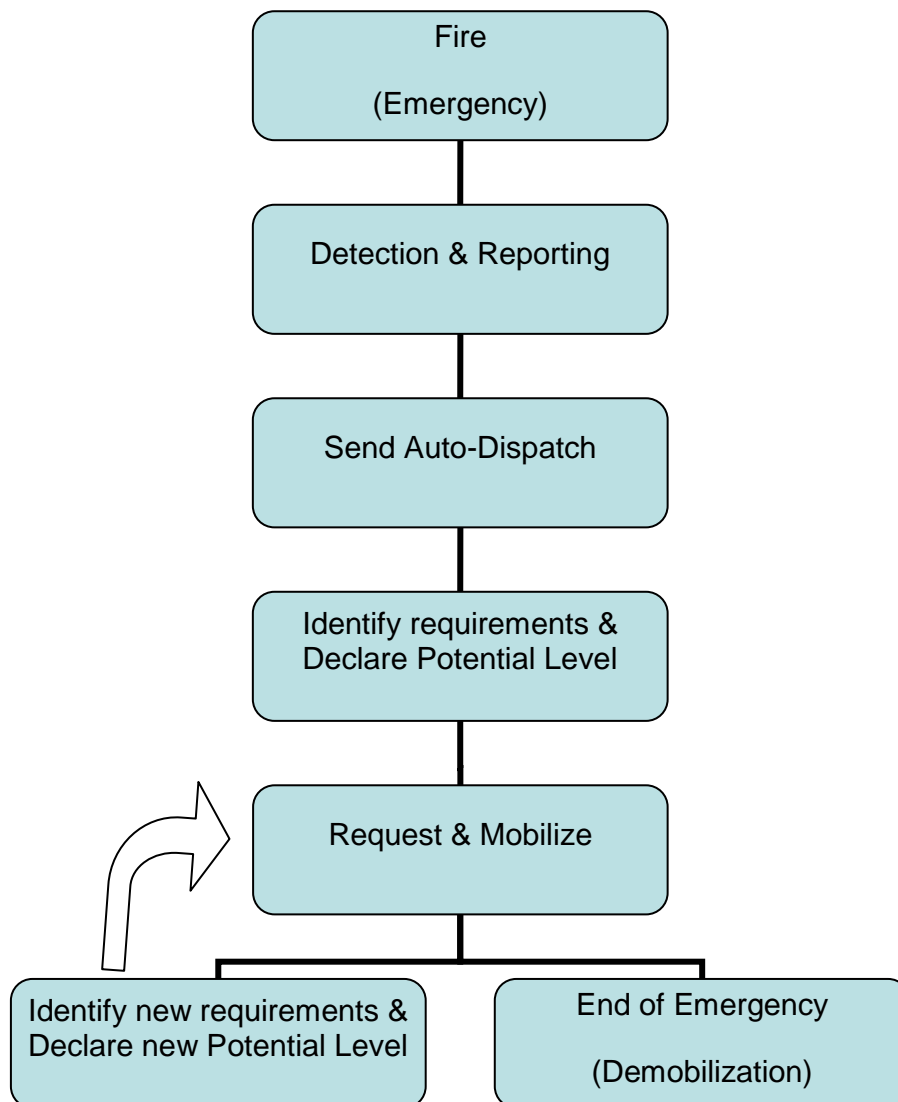
17) Declare end of emergency and demobilization -> Direction of the Plan.

18) Declare Potential Gravity level 3 -> Ministry of Interior by request from Direction of the Plan.

POTENCIAL GRAVITY LEVEL 3

19) National Plan. Control is taken by the state administration.

7.2 EMERGENCY FLOW DIAGRAM



8. CONCLUSION

The competent authority for forest fire emergency management could be either a national, a regional or a local organism depending on the magnitude of the incident, and on the administrative particularities of the country where the incident occurs.

Despite there are several operative differences in emergency management across countries, there are also shared guidelines for emergency management and command and control (e.g. Incident Command System, European regulation, etc.) This fact makes possible to establish a general CONOPs, which each country could adapt taking into account their particularities.

The present document gathers the potential integration of the innovative contributions of AF3 system in a common brand new CONOPs, which is compatible with the guidelines through all different emergency phases and countries. Therefore, the specific actors involved in the CONOPs may be adapted to the regulations and competencies established for each country.

The CONOPs identifies and describes the main solutions and contributions that AF3 consortium proposes for each of the phases considered during a forest fire emergency: Pre-emergency (Fire prevention, Readiness), Emergency (Preventive intervention, Fire Detection, Monitoring and Crisis Management and Simulation and Fire Fighting and Rescue operations) and Post-emergency (Debriefing and Feedback).

The main Advanced Forest Fire Fighting solutions proposed and described in this document are:

- Nub-e system
- Fire Fighting Lab
- Advanced training tools
- Advanced public awareness
- Unmanned Aerial Vehicles
- Command, Control, Communications, Computers and Intelligence, C4I system
- Situation Awareness Tools
- Decision support system
- Doppler LIDAR
- Unmanned Ground Vehicles
- Advanced Aerial Fire Fighting
- Simulation and risk analysis tools
- Data visualization, data fusion and reasoning unit

ANNEX 1. GLOSSARY

Term (other terms)	Description	Other analogous terms (Es, It, En) ³
Advisory Committee	Committee supporting the direction of the plan.	Comité Asesor (Es)
Aerial Coordinator	The person responsible for management of an incident's air operations.	Coordinador aéreo (Es)
Automatic-Dispatch	Mobilization of firefighting resources which does not require a previous order from the Operational Coordination Centre, but only the awareness that an outbreak has occurred (the unit will communicate the OCC the mobilization)	Despacho automatic (Es)
Burned Area Reflectance Classification (BARC)	A satellite-derived data layer of post-fire vegetation condition. The BARC has four classes: high, moderate, low, and unburned.	Clasificación de la Reflectancia del Área Quemada (Es)
Chain of Command	A series of management positions in order of authority.	Cadena de mando (Es)
Civil Protection	Organisation and measures, under governmental or other authority, aimed at preventing, abating or otherwise countering the effects of emergencies for the protection of the civilian population and property	Protección Civil (Es)
Crew	An organized group of firefighters under the leadership of a crew boss or other designated official.	
Director of Operations; (DOS)	The nominated emergency services officer with overall responsibility for tactics and resource management at the tactical level.	Extinction Chief/Leader, Incident Commander (En) Direttore delle Operazioni di Spegnimento) (It) Director de Extinción, -DE- (Es)
Emergency Management	The individual within each political subdivision that has coordination	Director del Plan (Es)

³ Es: Spanish, It: Italian, En: English.

Term (other terms)	Description	Other analogous terms (Es, It, En) ³
Coordinator (Director of the Plan)	responsibility for jurisdictional emergency management.	
Emergency Plan	A document or collection of documents that sets out the overall framework for the initiation, management, co-ordination and control of personnel and assets to reduce, control or mitigate the effects of an emergency.	Plan de Emergencia (Es)
Engine	Any ground vehicle providing specified levels of pumping, water, and hose capacity	Pump truck (En) Autobomba (Es)
Extended Attack	Actions taken on a wildfire that has exceeded the initial response	Ataque ampliado (Es)
Fire lookout	A person designated to detect and report fires from a vantage point. A location from which fires can be detected and reported. A fire crew member assigned to observe the fire and warn the crew when there is danger of becoming trapped.	Vigilante de torre (Es)
Fire Weather Index	The Fire Weather Index (FWI) is a numeric rating of fire intensity. It combines the Initial Spread Index and the Buildup Index.	Índice de Peligro Meteorológico de Incendios (Es)
Fire Weather Station	A meteorological station specially equipped to measure weather elements that have an important effect on fire behaviour.	Mobile Weather Unit Forecast (En) Unidades Móviles de Meteorología y Transmisiones (Es)
Forest Fire	Variously defined for legal purposes (e.g. ,uncontrolled fire on lands covered wholly or in part by timber, brush, grass, grain, or other flammable vegetation). Types of fires are ground, surface, and crown.	Incendio Forestal (Es)
Forest Fire Fighter	Person whose principal function is fire suppression during forest fires.	Bombero Forestal (Es)
Health Group	Group responsible for the emergency medical and occupational health care of incident personnel.	Grupo Sanitario (Es)
Heavy Machinery	Any ground vehicle such as dozer, tractor, or other heavy piece of equipment	Maquinaria Pesada (Es)
Helicopter	An aircraft that depends principally on the lift generated by one or more rotors for its support in flight.	Helicoptero (Es)
Helitack	The utilization of helicopters to transport	Helishuttled brigade (En)

Term (other terms)	Description	Other analogous terms (Es, It, En) ³
	crews, equipment, and fire retardants or suppressants to the. The term also refers to the crew that performs helicopter management and attack activities.	Helitransportada, -BRIF, CAR, ELIF- (Es)
Information Bureau	Government Press Office in charge of the information flow to media during emergencies.	Gabinete de comunicación (Es)
Initial Attack	A preplanned response to a wildfire given the wildfire's potential. Initial attack may include size up, patrolling, monitoring, holding action or suppression.	Ataque inicial (Es)
Incident Command Post (ICP)	Any service's command and control facility nearest the scene of the incident, responsible for immediate direction, deployment and security. This might be either an Operational / Bronze or Tactical / Silver facility depending on the circumstances of the incident.	Forward Command Post (En) Posto di Comando Avanzato PCA (It) Puesto de Mando Avanzado, -PMA- (Es)
Integrated Operations Coordination Centre (IOCC)	A facility which serves as a central point for one or more agencies to use in processing information and resource requests. It may also serve as a dispatch centre.	Integrated Emergency Coordination Centre, -IEEC- (En) Centro de Coordinación Operativa Integrada, -CECOPI- (Es)
Meteorological institutions	Those Geographic Area and National-level fire weather or fire danger services and products produced by wildland fire agency meteorologists and intelligence staffs in support of resource allocation and prioritization	Agencia Estatal de Meteorología –AEMET- (Es) The European Forest Fire Information System –EFFIS-
National Coordination Committee	Coordination Committee in charge of the Direction of the Plan for level 3 emergencies (national interest)	Comite Estatal de Coordinación, -CECO- (Es)
Operations Coordination Centre (OCC)	Any facility (endowed with the required communication, computer, control and command tools) that is used for the emergency coordination from the central premises of the local, regional or national body with the competencies of firefighting response	Emergency Coordination Centre, ECC (En) Centro de Coordinación Operativa –CECOP, COR, COP- (Es) Control Centers (C&C)
Operations Group	The Group responsible for all tactical operations at the incident. Includes Branches, Divisions and/or Groups, Task Forces, Strike Teams, Single Resources, and Staging Areas.	Operational section (En) Grupo de operaciones (Es)
Operations Plan	An oral or written plan containing general objectives reflecting the overall strategy	Extinction Plan (En) Plan de extinción (Es)

Term (other terms)	Description	Other analogous terms (Es, It, En) ³
	for managing an incident. It may include the identification of operational resources and assignments. It may also include attachments that provide direction and important information for management of the incident during one or more operational periods	
Operations Section Chief	Responsible for supervising the Operations Section. Reports to the Incident Commander.	Jefe de sección (Es)
Potential Gravity Level	Classifies potential gravity of the Emergency (once detected), in order to set up the Response mechanism	Niveles de Emergencia (Es)
Security Group	The Group responsible for public safety.	
Support and Logistics Group	The Group responsible for providing facilities, services, and materials for the incident.	Logistics section (En) Grupo de Logística (Es)
WUI Wildland-Urban Interface (WUI)	The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.	Rural-Urban Interface –RUI- Interfaz urbano-forestal (Es)

ANNEX 2. COORDINATION OF EMERGENCY FOR SUCCESSIVE LEVELS OF POTENTIAL SEVERITY

POTENTIAL GRAVITY LEVEL	ATTACK LEVEL	FIRE DAMAGE (impact)	DIR. PLAN Emergency Management Coord.	DIR. OPERATIONS	RESOURCES
0	Initial attack And Extended Attack	Environment (low)	Provincial OCC	DOS	Resources within priority area
1	General Attack	Environment (medium) Properties/Infrastructure (low) People (low)	Regional OCC	ICP establish +Operational groups leaders	+Resources from the region plan
2	Full Attack	Environment (High) Properties/Infrastructure (Medium) People (Medium)	IOCC	+Civil Protection responsible	+Resources out of the regional plan
3	Full Attack	Environment (High) Properties/Infrastructure (High) People (High)	IOCC (National Coordination Committee)	+Military Commander	Maximum deployment

ANNEX 3. LIST OF NATIONAL REGULATIONS

List of regulations concerning forest fires emergencies and AF system. The civil protection regulations included bellow come from the Vademecum of Humanitarian Aid & Civil Protection of the European Commission.

GREECE

Civil Protection (Information collected from the Vademecum of Humanitarian Aid & Civil Protection of the European Commission)

Act 2344/1995: Concerns the establishment of the General Secretariat for Civil Protection (GSCP) under the Ministry of the Interior, Public Administration

Act 3013/2002: Concerns the upgrade of the role of civil protection in Greece, emphasising the importance of citizen protection and assigning roles to local authorities

Ministerial Decision 1299/2003: Regards the National Civil Protection Plan “Xenokrates”, which establish the general guidelines for emergency planning in Greece

Presidential Decree 151/2004: Concerns the organisational structure of the GSCP

Ministerial Decision 3384/2006: Refers to additions to the National Civil Protection Plan “Xenokrates” regarding the Special Plan for Human Loss Management

Act 3491/2006, Article 15: Concerns the constitution of the CBRN Incidents Support Team

Ministerial Decision 7270/2006: Regards the composition of the CBRN Incidents Support Team

Act 3536/2007, Articles 27 and 34: Concern regulations in relation to civil protection issues

Act 3613/2007: Concerns regulations in relation to the General Secretariat for Civil Protection (evacuations)

Presidential Decree 184/2009: Concerns the constitution of the Ministry of Citizen Protection and establishment of its competence

ITALY

Civil Protection (Information collected from the Vademecum of Humanitarian Aid & Civil Protection of the European Commission)

The National Service of Civil Protection was institutionalised by Act no 225 adopted on 24 February, 1992.

The Legislative Decree 112/98 has redefined the tasks of each component, considering civil protection all the more as a subject having mixed competence (the State, the regions and the local authorities).

The Legislative Decree 112/98, while respecting the general structure set by Legislative Decree no 225/92, which is still the legislative core of the system, has sensibly renewed the distributions of functions between the different levels of Government towards a stronger decentralisation and reinforcement of local powers, and assigned new tasks to the regions and local authorities (both provinces and municipalities).

Forest Fire Emergency

Legge 21 Novembre 2000 n. 353: Forest Fires Act (Official Journal 30/11/2000 n. 280)

Decreto Legislativo 18 maggio 2001, n. 227 (O.J. 15/06/2001, n. 137)

Legge 4 agosto 2006, n. 248: (O.J. 11/08/2006 n. 186 - S.O. n. 183): Art. 18 bis

Decreto del Presidente della Repubblica 5 Aprile 2013, n. 40 (O.J. 22/04/2013 n. 94)

Forest and Natural Environment

The Constitution of the Italian Republic assigns to the Regional Authority exclusive competence on Forest and Natural Environment: it is too complex to report the 20 different regional regulations

FRANCE

Civil Protection (*Information collected from the Vademecum of Humanitarian Aid & Civil Protection of the European Commission*)

The 1950 Ordinance and the 1965 Decree relating to civil defence

The Law of 22 July 1987 as amended by the Laws of 5 January 1988 and 28 November 1990 with respect to civil security

The Order of 24 August 2000 concerning the organisation and powers of the Directorate of Civil Defence and Security.

UK

Forest Fire Emergency

UK Vegetation Fire Standard: <http://www.forestry.gov.uk/fr/infd-7wkjdj>

Risk Management Control Measure: Toolkit for Practitioners and Advisors:
http://www.forestry.gov.uk/pdf/Vegetation_Fire_Risk_Management_250112.pdf

FRA2010 – Country Report, United Kingdom of Great Britain and Northern Ireland “Table T9 – Forest Fires”: [http://www.forestry.gov.uk/pdf/Table9UKReport.pdf/\\$file/Table9UKReport.pdf](http://www.forestry.gov.uk/pdf/Table9UKReport.pdf/$file/Table9UKReport.pdf)

UK Forestry Commission: <http://www.forestry.gov.uk/>

ANNEX 4. LIST OF UAV NATIONAL REGULATIONS

SPAIN

Regulations concerning the use of UAVs

Law 18/2014, of 15 October, approving urgent measures for growth, competitiveness and efficiency (*Ley 18/2014, de 15 de octubre, de aprobación de medidas urgentes para el crecimiento, la competitividad y la eficiencia*).

UK

Relevant National Regulations concerning the use of UAVs

Air Navigation: The Order and the Regulations (CAP393):

<http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=226>

UK Data Protection Act (DPA): <http://www.legislation.gov.uk/ukpga/1998/29/contents>

Unmanned Aircraft System Operations in UK Airspace – Guidance (CAP722):

<http://www.caa.co.uk/cap722>

Remote Pilot Qualification: BNUC-S™: <http://eurousc.com/services/pilot-qualifications>

EuroUSC: Airworthiness And Individual Design And Construction Assessments:

<http://eurousc.com/services/airworthiness>

EuroUSC: Operational Assessment: <http://eurousc.com/services/operations>

ITALY

Relevant National Regulations concerning the use of UAVs

Legge 17 aprile 1956, n. 561

Legge 17 ottobre 1986, n. 732

Legge 14 luglio 2004, n.178

D. Lgs. 9 maggio 2005, n. 96: Codice della Navigazione

D. Lgs. 15 marzo 2006, n. 151

Regolamento EASA (Reg. UE 965/2012)

Regolamento ENAC sui “Mezzi aerei a pilotaggio remoto” (in force since 30 April 2014)

Regolamento Enac “Regole dell’Aria” (RAIT Ed. 1 del 18.11.2014, Rev.1 del 10.12.2014)
