THE USE OF AVIATION EQUIPMENT IN EXTINGUISHING SPREAD FIRES

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This work deals with the creation, monitoring and extinguishing fires in Slovakia and abroad. In the introduction, the fires by land, ground and crown are characterized. Furthermore, there are some fire protection characteristics in the Slovak Republic and also fire monitoring system- Forestwatch. The core of thesis presents the analysis of patrol, monitoring and extinguishing flights. There is an analysis of different types of air-crafts and their usefulness in monitoring and extinguishing of forest fires and grassland fires. At the end of the paper, the filling air-crafts and helicopters by extinguishing agent is more specified.

K e y w o r d s: Wild fires, forest fires, fire prevention, fire fighting, aviation technology

1 INTRODUCTION

The Aviation Fire Service provides fire protection in the Slovak forests. It was established in 2001. Its work has been regulated by the Ministry of Agriculture and Rural Development of the Slovak Republic and the Ministry of Interior of the Slovak Republic no. 1344/40/2003-700 air activity undertaken in monitoring and forest fires since 2003. If there is an assumption of fire danger incensement, the center will monitor the area. If any fire is recognized, the localization and subsequent announcement comes afterwards. Annually, this activity costs around € 130 000. Cooperation between the ground fire brigade (and intervening technique) and the air monitoring and fire brigade (and technology), while firefighting is coordinated by the Fire and Rescue Service. Fire flights are made with respect to the season, current meteorological situation and the risk of the fire given. The aircraft with a built-in internal tanks or helicopters with Bambi hanging bags are used for forest fires.

The aim of this thesis is to describe and analyze the ways of extinguishing of grasslands and forests fires. The contribution of this work is the clarification of some air fire services, the importance of fire prevention and the ways of extinguishing fires in the Slovak Republic.

2 CHARACTERISTIC OF FIRE

Fire is defined as any unwanted burning, which causes some damage to property or the environment, and resulting in the death or injury of an individual or a dead animal. Also, it is unwanted combustion, in which the lives or health of individuals, animals, property or the environment are endangered. The Aviation Fire Service is in the developed countries considered as essential accessory for the ground fire units. So, is it in the Slovak Republic, but the air fighting has much shorter history. Using aerospace technology for the disposal of fires, especially in forest, use so many efforts to prevent the spread of fire and eliminate it as quickly as possible. It is not impossible in some cases. The Fire Protection (PO) is currently done by ground walks, patrol (monitoring) flights or camera monitoring system.

The danger of fire is mostly influenced by meteorological conditions. At the certain period of a long-term drought, the risk of fire is significantly higher. Surface fires can be categorized according to the type of forest or grassland where the fire is spread as followed - the land, underground and crown. Depending on the speed of the fire and the flame height, the types are - light, medium and strong.

There are fires:

- ground,
- underground,
- crown.

2.1 Fire protection

From 2005 to 2011, there were 26 fires reported in the State Forests of Tatra National Park (TANAP) that destroyed more than 450 ha of forest. Fire damages for state property were more than 1.12 million euros. The most common cause of fire was smoking, grass burning and intentional burning.

Extreme year was in 2005 because it was burning 12 times in the TANAP. The largest fire was on 30th July 2005 which hit the area of 230 ha and damages overrun 565 000 €. The second largest fire affected 58 ha of a protected area Kežmarské Žľaby in April 2007, and damaged young forest stands in price more than 500 000 €.

In 2011, the scope of state forest TANAP there were four forest fires recorded. On 3rd March 201, the meadow in Stráne village bellow the Tatra Mountains in the protected area of the Tatranske Matliare burned. The fire was quickly spreading to the forest but the firefighters and foresters from Kežmarok extinguished it in time. Fire did not damage any forest cover and therefore there were no damages.

On 5rd March 2011, there was a fire in Stráne village in the Tatras again. However, this time the fire was spreading quickly in all directions. Despite the best efforts of Kezmarok firefighters, members of voluntary fire brigade Mlynceky and foresters, the fire also extended to the nearby forests. The fire damaged almost 33 hectares of forest, out of which 1.1 hectares were owned by the State Forests Tatra National Park.

On 21st April 2011 dry grass was burning near Novy Smokovec. The fire was spread to the area of 1200 m2 lately destroyed by Poprad SWAT Fire and Rescue Service Fire. Fire did not affect forest cover, thus the damage to state property was avoid.

The fourth and the last time, it burned 29th September 2011 in TANAP area near Vyšne Hagy, the property of the State Forests Tatra National Park. In an area of about 300 m2, some grass and lots of brushwood after calamity burned. Damage to the forest was none. In three cases the probable cause of fire was grass burning, in one case the grass burned because of car crash.

In 2012, there were two forest fires in the state area of TANAP recorded. The first one on 6th July 2012 in the protected area of Vyšné Hagy, and the second one on 26th August in the protected area of Dolny Smokovec.

2.2 Prevention against fires - Forestwatch® camera monitoring system

Spring weather mostly brings increased risk of fires. Fires are for example caused by carelessness during the incineration of waste in gardens or in woods, and dry grass burning, which is a very dangerous activity prohibited by law.

Vegetation burning is strictly prohibited by law no. 314/2001 Coll fire protection. In case of a law break an individual can be fined up to € 33,1 in a block action up to € 33. Firefighters can fine a legal entity or natural person up to € 16 596.

Each village has its own municipal regulations which govern the ways how to burn waste in open air, dry grass burning or setting up a fire near the forest. Each town should do some prevention with cooperation of a department of fire volunteer; and acquaints inhabitants with the risk of fires, for example via some local radio shows.

Forestwatch ® fire system is an automatized fire monitoring system, which is based on scanning the area by cameras and subsequently evaluation of the acquired images for some signs of burning or imperilment.

It consists of:

- Cameras placed on the observation tower. It consists of a tilting mechanism, swing mechanism, autofocus, 24x optical zoom and sensitivity of 0.0005 lux.
- Industrial PC
- communication subsystem and Forestwatch ®software

Two main parts are the observation towers, where the cameras, communication subsystem, industrial computer and control center are installed. The system monitors the area 24 hours a day / 7 days a week also at night. It uses a 3D model of the terrain, so it is able to identify and locate the fire without direct visual contact i.e. over the hill. Data from the cameras are modified and send to a control center, where software receives, processes and evaluates the data. Subsequently, the operation control center is visually and audibly warned due to possible occurrence of fire. The operator can any time take control upon any of the cameras to examine the incident deeply.

3 PATROL AND MONITORING FLIGHTS

Patrol flights are conducted for the purpose of sight and location of the fire. They are performed with respect to season, weather conditions, vegetation, increased visits in forest and performing forest or other activities which are associated with increased risk of forest fires. A patrol flight can be revoked at any time according to the sudden changes in weather conditions. Aviation technology used for patrol flights should be at least two-seated because the pilot must pay attention to piloting an aircraft and another passenger watches around.

3.1 Procedure when fire is detected during a patrol flight

If fire is detected during any air patrol operation, it must be reported immediately to any LPS stand and also stand of the HaZZ region depending where the fire was located.

The message must contain at least:

- Place of fire
- Time when fire is observed
- area, type and intensity of the fire and the possibility of its further spread,
- Type of the forest,
- Other data according to requirements of the HaZZ region.

In case of any need, the pilot, who will perform the first flight to extinguish forest fire, must define the next working area from place of fire. He must notify it to the appropriate HaZZ region. To specify the place of fire or air working area, it is possible to use geographic coordinates of the place by GPS, which is on board of each fire aircraft.

3.2 Plane Zlín Z-37

The first prototype flew on 29th June 1963 and from the beginning of that tests, it was clear it will be successful. Until the end of production in 1977, more than 650 pieces had been produced from this model. Restoring of the production began again between 1983 and 1984. This airplane was also called Bumble-bee for its high-pitched engine sound like a tractor. Z 37 is single engine airplane with two-seat low-wing cantilever. Z 37 is equipped with an air-cooled nine-cylindrical radial engine, which is called M 462 - RF. The engine achieves maximum output of 232 kW. Propeller labeled as V 520 has the speed control. Fuselage is made of steel tubes

covered with canvas. Behind the cockpit there is a tank for some chemical or granular fertilizers with capacity of 650 liters. Behind this tank there is some place for a mechanic. Tail areas are classically designed. The middle part of wings has a rectangular plan. From the middle part, the wing continues trapezoidal plan. The wing flaps are of metal construction covered with canvas. Two fuel tanks are located in one wing with capacity of 125 liters. Z 37 may have two additional auxiliary tanks installed under the wings. One fuel tank has the capacity of 125 liters. A spur type of airplane chassis provides a good stability thanks to the large gauge of the main chassis.
Very high chassis ensures a safe distance between the propeller and ground which allows the landing at very low landing speed.

Pic.2 Plane Zlín Z-37

4 AERIAL FIREFIGHTING

After finding and localization of forest fire by reconnaissance or any other means, it is necessary to send ground firefight units to place of fire. Leading firefighter considering situation decides the neccessity of aerial support. His decision is based on terrain accessibility, speed of fire spreading, size of fire and also based on effectiveness of deployment of aerial support. Firefighting flights are conducted to slow down or completely stop the fire spread. In areas with difficult terrain and poor accessibility for ground troops, aviation technology is an invaluable tool for locating and extinguishing fire. Good extinguishing effect is achieved by dropping a large amount of extinguishing agent to a relatively small space. Extinguishing agent drop site depends on the extinguishing tactics chosen by the leading firefighter. Most common drop place is line of fire on front of fire.

4.1 Mi-8 helicopter

The first flight took place 2 August 1962. Mass production of Mi-8 started in 1965. The first version of the Mi-8 was built for civilian use. It is a twin-engine, multi-purpose helicopter, with classic layout. Main rotor has 5 blades, tail rotor has 3 blades. The rotors are driven by motors TB2 -117 AG with 2x 1500 kW. The cockpit has space for two pilots and one flight engineer/navigator. The cargo cabin capacity is 4,000 kg of cargo or 24 passengers. The maximum load weight on the suspension unit is around 3,000 kg. Due to its large carrying capacity is this helicopter used for military purposes in many countries. The Slovak Republic is the helicopter used in the military and for firefighting. The chassis has three wheels. NATO codename is "Hip". Its maximum speed is 250 km/h, climb 5-8 m/s and maximum altitude 4500 m.

Pic.3 Helicopter Mi-8

4.2 Filling aerial firefighting equipment with extinguishing agent

For proper use of aviation firefighting technology to extinguish fire, we first need to choose proper land to fill equipment of aerial firefighting equipment.
If the aircrafts with integrated tank are being used for firefighting, nearest suitable water reservoir is considered as filling land. If there are no suitable water reservoirs available, aircrafts and helicopter Bambi bags need to be filled with water tank trucks.

4.3 Filling aircrafts with extinguishing agent

Such implementation is done using firefighting equipment. Filling of aircraft is done by tank trucks CAS or appropriate fire engines, but it is more complicated to transport water from water source to filling land. Filling aircraft with extinguishing agent must take place on the ground after the aircraft has landed. Therefore, we need to analyze the possibility of aircraft filling in the region, to investigate possible use of private airports, field airports and appropriate water areas. Take-offs and landings for the purpose of fire suppression can be performed on all areas that meet requirements for given type of aircraft. A final decision on the usability of the selected area is on the pilot.

For many special requirements that are placed on the filler surface is recommended to those areas to be determined in advance, to prepare the necessary documentation and determine the local fire brigade to tank the aircraft. Tactical exercises of predetermined PO units are subsequently carried out on such surfaces.

After arriving of the aircraft all members of the PO unit are obliged to obey any instructions of the pilot. Furnishing of the firefighting equipment must be carried out so as to ensure a visual contact for engineers, firemen and pilots. Firemen in the performance of the aircraft can be accessed only from the side between the wing and tail surfaces. When tanking it must be ensured that the traffic management will be distributed ahead of the aircraft. Tanking starts after pilot´s signal. Tanking from CAS to the place of tanking is secured by traffic management ,consists of 2-3 pieces of Hose B 75 with sufficient handling arc with a portable hose cap and short 5m hose B 75 to reduce the amount of excess water and avoid the dangerous waterlogged field . The filling group consists of commander, engineer and two firemen. The commander must be clearly distinguished from the firemen e.g. by red helmet or jacket. To ensure the sufficient water is needed to provide two CAS per aircraft.

4.4. Tanking of helicopter extinguishing material

Tanking of the helicopter from the water surface:

Helicopters, which are designed to put out the forest fires have the opportunity to refill the water from suitable water resources by their own. It is possible e.g from lakes, dams, rivers, artificial reservoirs or artificially prepared tanks built specially for firefighting activities. As soon as the bag reaches the water surface begins to turn and dive. This is due to the weight on one side of the bag. The amount of water in the bag depends on the speed of drawing the water from the bag. The slower it is pulled the less water it has; on the contrary, the faster it is fuller. It is caused by expansion of the material from which the bag is hanging made.

Tanking the helicopter by fire equipment:

Such performance is done in case if there is no viable water source to carry the bag hanging immersion, also in the case where such a source cannot be used for safety or other reasons or if it is far away from the fire. Tanking of the hanging bag is done by filling nozzle so-called pipes. It is designed on the basis of experience to slow down the flow of water. These nozzles are always held on the board of helicopters for fire-fighting flights.

5 CONCLUSION

In my work, I managed to clarify the current status and problems of forest fires. In Slovakia, fire protection is provided by aviation fire service in cooperation with the fire-fighting aircrafts. The use of aviation technology for the extinction of aerial and forest fires helps to eliminate fire as quickly as possible.

In the world, various aircraft equipment is used for extinguishing forest fires, for example Boing 747-273C with integrated tank volume of 80 000 liters. Because of the colossal dimensions of the aircraft and because such a large aerial fires are not common in our country, the use of this type of aircraft is not necessary or needed in Slovak Republic.

I was able to point out the efforts to prevent the occurrence of fires, whether close monitoring of forests in summer, prohibiting camp fires in the forest and its close proximity, prohibiting grass burning or burning of garbage, etc. These rules are spelled out in the Law No. 314/2001 on fire protection.

The Ministry of Interior of the Slovak Republic, the Fire and Rescue Service, Ministry of Agriculture and Rural Development of the Slovak Republic and helicopter wing of Colonel General John Ambrus in Presov are agencies in charge of fire issues in Slovak Republic.

In my work, I regard the aircraft fire services as highly justified and needed and I hope that the future of fire patrol and fire-fighting aircrafts will further develop in the right direction.

For the most part I have met my objective to clarify the current situation regarding the fires in Slovakia and worldwide, although the extent of this topic is sufficiently broad that there remained room for further development.

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