

Standard Operating Procedure for Firefighting of Fire Helicopters in China

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Abstract: Disasters like disastrous fire and earthquake have made disaster relief efficiency a major concern of the public, firefighters and government. Helicopters can play a huge role in those complex disaster environments. According to the performance parameters of fire helicopter and relevant laws and regulations, this paper studies the dispatch and application procedures of fire helicopter. A standard operating procedure (SOP) for China fire department has been developed, to ensure the safety and efficiency of fire helicopters rescue operations.

1. Introduction

Fire is one of the most-deadly disaster in peacetime all over the world. Over the 10 years from 2006 to 2015, USA had an annual average of 1,398,000 fires resulting in 3,180 civilian deaths. Especially in China, the firefighting of high-rise building is still a major problem. For example, in 2010, a fire destroyed a 28-story high-rise apartment building in the city of Shanghai, killing 58 people and injuring more than 70 others, which exposed the inadequacies of fire forces on ground. If aerial firefighting had been effectively applied, a lot of casualties could have been avoided.

In view of the complexity in different fire environment, the application of fire helicopter could meet the demand of emergency management department in China. The new cooperation mode combined with aerial firefighting and ground rescue would be a mainstream trend to respond to disasters. Due to the large space of flame combustion distribution, the conventional firefighting methods can't effectively work in a high-rise building fire. Therefore, Establishing SOP for firefighting of fire helicopters is of great significance for setting up a multi-machine cooperative firefighting method in severe fires.

The significance of SOPs for ensuring standards of each field has long-since been acknowledged. SOPs establish a systematic method of work operations and ensure that work is done consistently by all persons who are required to do the same task. They must be well written in order to provide an effective control and prevent errors from occurring. In order to standardize the firefighters' rescue operation procedures and develop safety consciousness into the habitual behavior of firefighters, SOPs in the field of firefighting should also be concerned. This article will establish the corresponding standard procedures in the dispatching and firefighting procedures of fire helicopters. It must be appropriately modified.

2. Establishment of Standard Operating Procedure

2.1 Basis for Standard Operating Procedure

In order to regulate the deployment and use of fire helicopters for China fire department, it is necessary to refer to related laws and industry standards. According to Law of the People's Republic of China on Civil Aviation, Technical regulations of forest fire suppression, Firefighting regulations for fire forces and Regulations for police helicopters in Shanghai public security bureau, this article established the standard operating procedure combined with the actual situation.

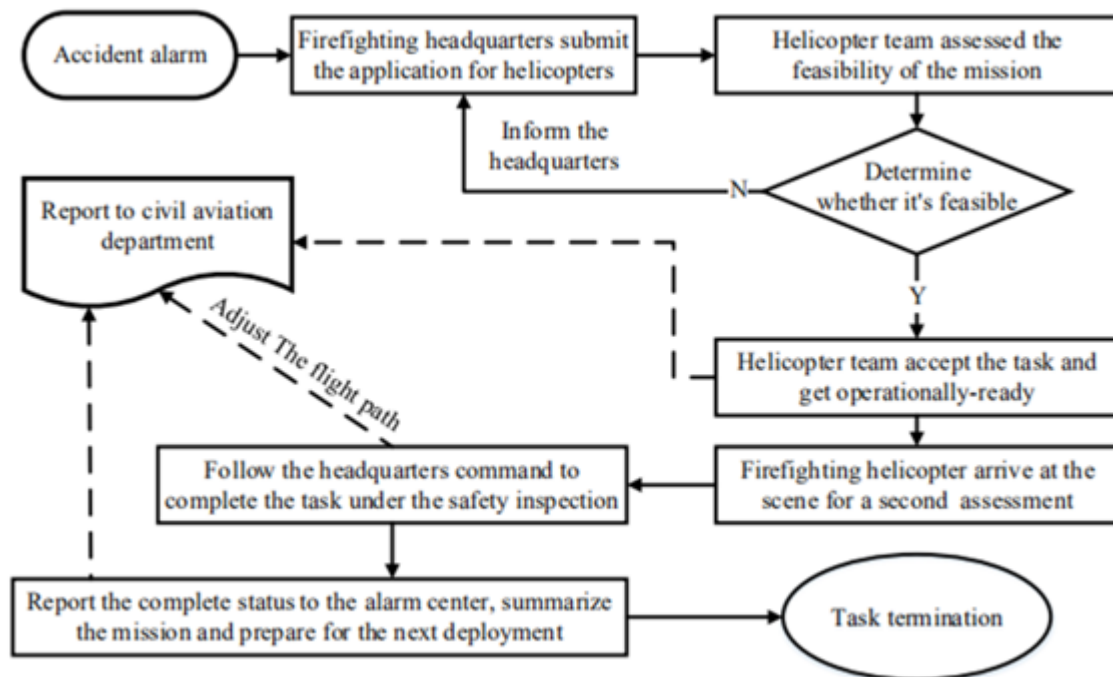


Figure 1. Deployment procedure of fire helicopter in China

2.2 Deployment Procedure of Fire Helicopter

In consideration of flight safety and low-altitude airspace management in China, the deployment of fire helicopter plays an important role in the rescue process. Fig. 1 present a deployment procedure of fire helicopter in China.

When the emergency command center of fire department receives the fire alarm information, it needs to evaluate the information at the scene of the accident and determine the need for fire helicopter support, the application should be submitted by the firefighting headquarters. After receiving the response from the emergency command center, the helicopter team should immediately evaluate the feasibility of the flight mission according to the weather, crew, airspace control, mission characteristics and other conditions on the same day. After having the condition of using fire helicopter, the emergency command center shall issue the instruction of executing flight task to the police aviation team in written form or by telephone. After the fire helicopter arrives at the scene, it is necessary to re-evaluate the disaster at the scene. The application of fire helicopter belongs to the operation of aerial firefighting, which is difficult and dangerous, and requires careful and standardized operation. Therefore, after the reassessment of the helicopter commander, the final opinion on whether to carry out the mission is proposed. When carrying out flight missions, the fire headquarters should be in unified command to organize and carry out firefighting and other flight missions on the premise of ensuring the safety of helicopter flight. After the flight mission, the helicopter team should summarize the experience and resume the duty status.

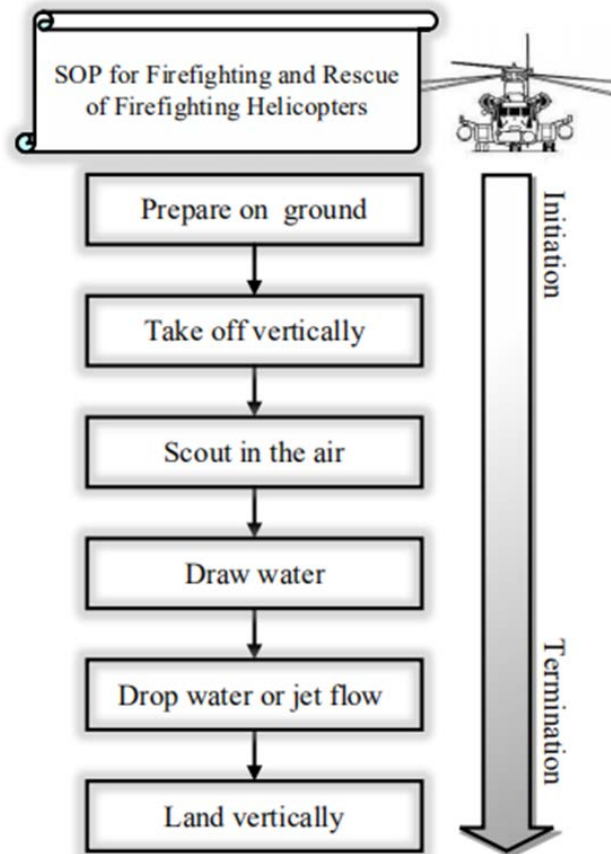


Figure 2. SOP for firefighting of fire helicopter

2.3 Standard Operating Procedure for Firefighting

Due to the characteristic of firefighting mission, it is necessary to define the scope of application of this operating procedure. It can be used for daily helicopter training, aerial reconnaissance and command of fire scene, firefighting of forest and high-rise building and so on [7]. The SOP for firefighting of fire helicopters is mainly composed of 6 major steps, shown in Fig. 2.

2.3.1 Prepare on Ground

The procedure of preparing on ground s mainly include two aspects: training ground preparation and ground preparation before the emergency mission.

The usual ground preparation is to conduct on-the-spot investigation of the fire helicopter training area, to grasp the topographical features in the area, the distribution and changes of the obstacles. The crew members should also be familiar with the distribution of firefighters on the ground and the airspace command liaison procedures. The ground preparations before the fire helicopters perform the mission are mainly to check the condition of the fire helicopters on the day, to eliminate safety hazards, such as releasing fuel deposits, checking and confirming the fuel quality, checking the hydraulic giant engine, the water tank door, and the suction pump. The helicopter pilot then conducts a mission assessment based on the specific weather conditions of the mission to determine the execution of the mission.

2.3.2 Take-off Vertically

After the fire helicopter is ready on the ground, the pilot will take the helicopter to take off vertically with the consent of the safety manager, so that the helicopter will slowly and vertically leave the ground. When the helicopter is 1 m to 2 m off the ground, under the command of the rear cabin mechanic, the pilot maneuver the helicopter slowly to the left to make the suction pipe close to the vertical ground, and then manipulated the helicopter to hover at a height of 10m. After checking

the working status of the helicopter, the pilot maneuver it to take off at an increasing speed. The helicopter should approach the work area at a speed of 160-200 km/h and a height of 200-300 m.

2.3.3 Scout in Air

Due to the difficulty of flying flight operations and the complex geography and mission environment, aerial reconnaissance is required before drawing water and firefighting. The height of the reconnaissance flight should be 50 to 100 meters higher than the flame or smoke, and avoid the thermal effects of the fire and other obstacles. The content of reconnaissance is mainly divided into the following five aspects:

- (1) Wind direction and wind speed.
- (2) Sun rays and illumination angles.
- (3) The geographical environment of the water intake point and the fire site and the distribution of obstacles.
- (4) The positional relationship between the water intake point and the fire field.
- (5) The fire distribution and development trend of the fire.

2.3.4 Draw Water

Fire helicopters should determine the direction of hovering, the weight of water withdrawal and the direction of speed increase according to the location of the water intake point, geographical environment, obstacle distribution, wind direction, wind speed, helicopter weight, etc. [8]. When it is over the water intake point, it is generally hovered at a height of 10 meters. The shore reference object is selected, and the height is slowly lowered. Under the command of a mechanic or a safety manager, it descends to a stable distance of 3 m from the water surface. After the helicopter has been hovering stably, press down on the suction pump switch door and the suction pump starts to work. At this time, pay attention to correcting the height and position of the helicopter. Especially when the helicopter's load weight changes, the helicopter is easy to drop the height and the danger occurs. Therefore, the total distance should be raised in time to keep the helicopter at the same height. When the mechanic reports that the water intake is completed, the driver releases the suction pump switch, lifts the height of the helicopter to disengage the suction pump from the water surface, and adjusts the direction of the take-off growth. The operation for drawing water of fire helicopter as shown in Fig3.

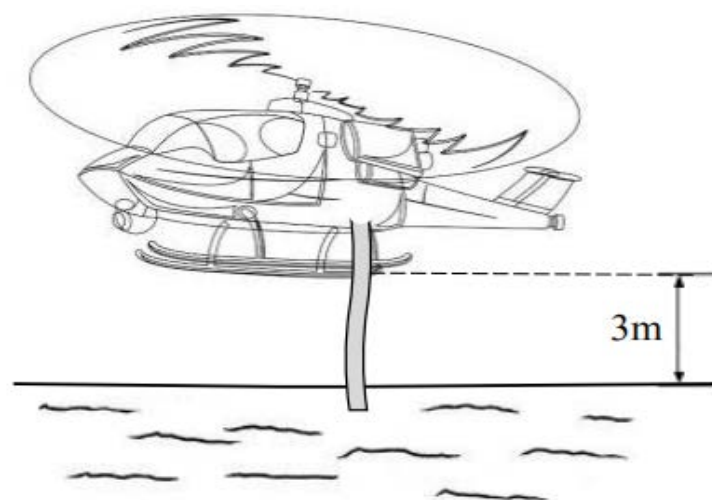


Figure 3. The schematic diagram of fire helicopters for drawing water

2.3.5 Sprinkling Water or Jet Flow

Sprinkling water in flight has a relatively high maneuverability, and it can be divided into several flying patterns such as level flight sprinkling, turning sprinkling, zooming sprinkling, and falling sprinkling. The height of the helicopter when sprinkling is usually about 30 meters, therefore the

thermal effect of the fire at this height has less impact on the fire helicopter. If the sprinkling height is too high and the water falls too long in the air, the chances of water being atomized will increase, which will affect the fire extinguishing effect. The range and falling time of objects with airdrops of 30 kg at different altitudes and different speeds are shown in Table 1.

Table 1. Range and drop time of airborne 30 kg objects at different altitudes and speeds.

| Height(m) | Sprinkling range at 60km/h flight speed(m) | Sprinkling range at 100km/h flight speed(m) | Falling time(s) |
|-----------|---|--|-----------------|
| 30 | 34 | 40 | 2.5 |
| 60 | 50 | 56 | 3.5 |
| 100 | 70 | 90 | 5 |
| 150 | 80 | 118 | 7 |
| 200 | 97 | 130 | 9 |

It can be analyzed from Table 1 that when a fire helicopter sprinkles water using a water tank, the flying speed should be about 70 km/h. If the speed is too small, the maneuverability of the helicopter will be worse. If the speed is too large, the waterline will become longer, which will affect the accuracy of the water tank sprinkler.

Since it takes a certain amount of time to flow out of the water tank, the water spilled from the tank in flight is affected by the air resistance, and the range of the fire extinguishing may be smaller [9]. The pilot should pre-adjust the direction, position and sprinkling timing according to the wind direction and wind speed at that time so that it can be accurately sprinkled to the fire position during the first sprinkler. Taking KA-32A fire helicopter as an example, the sprinkler coverage of the fire area at different flight altitudes, flight speeds and wind speeds is shown in Table 2.

It can be seen from the above table that when the fire helicopter extinguishes fire by sprinkling water of trans-abdominal water tank, it is necessary to flexibly select the appropriate flight height and flight speed according to the specific conditions of the fire field. Reducing the helicopter's flying height will result in a larger effective sprinkler range and improved firefighting efficiency.

2.3.6 Land Vertically

In order to prevent damage to the carrying suction pipe, the fire helicopter should return to the base and hover at a height of 10 meters above the landing site. Under the command of the mechanic and the safety manager, the pilot is supposed to manipulate the displacement of the helicopter so that the suction pump slowly descends towards the fixed position on the ground. After the suction pump is grounded, the helicopter continues to descend to a height of 2m to 3m from the ground, and the pilot then manipulates the helicopter to the right. The helicopter should be grounded slowly without dragging the suction pump, then lowered to the bottom and finally turned off.

Table 2. Performance parameters for sprinkling water of KA-32A fire helicopter trans-abdominal water tank

| Topography | flight speed (km·h ⁻¹) | flight altitude(m) | load carrying ability(kg) | wind speed (m·s ⁻¹) | action area (length × width) (m) | |
|--------------------|------------------------------------|--------------------|---------------------------|---------------------------------|----------------------------------|----------------|
| | | | | | maximum area | effective area |
| Flat ground | 60 | 30 | 3000 | 3 | 110×25 | 65×15 |
| | 80 | 30 | 3000 | 5 | 120×24 | 105×20 |
| | 90 | 30 | 1500 | 3 | 115×20 | 75×10 |
| Mountainous Region | 40 | 25 | 1500 | 8 | 70×30 | 45×21 |
| | 60 | 25 | 3000 | 8 | 75×40 | 50×24 |
| | 80 | 25 | 3000 | 8 | 105×40 | 70×24 |

3. Conclusion

In the future, fire helicopters would gradually become the main force of firefighting in many types of fires. This paper has collated information on deployment and firefighting procedures of fire helicopters, analyzed the necessity of applying the SOP to advance the rescue efficiency of fire helicopters and established a standard operating procedure of fire helicopters. If the SOP can be used and improved in practice at fire scene, fire helicopters will have more ability to avoid the spreading of fire and its losing.

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References

- [1] UFSA. Fire in the United States 2006-2015 19th Edition, December 2017.
- [2] Smith, J., 1998. The book, The publishing company. London, 2nd edition.