Analysis of Cabin Emergencies and the Countermeasures

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***Abstract*—Based on the analysis of different categories of cabin emergencies, this paper expounds the present situation and forming factors of the cabin emergencies, and accordingly explores relevant countermeasures to strengthen the handling of cabin emergencies. Cabin safety is very important for the development of airlines, so improving the ability to deal with emergencies deserves airlines' attention.**

Keywords—cabin, emergencies, factors, countermeasures

I. INTRODUCTION

Civil aviation is the most commonly used mode of transportation at present, which is regarded as a kind of transportation with the highest safety coefficient. Cabin is an important bridge between passengers and airline companies. The cabin space is limited, with a variety of passengers together, often there will be some unexpected emergencies such as disputes among passengers and flight attendants, or other security incidents, which are possible of making the cabin full of uncertainties, affecting the flight safety of the aircraft.

The causes of these emergencies are various, and these events will have a negative impact on cabin safety. According to ICAO SMS (Safety Management System), safety is a state in which the risk of personal injury or property damage is reduced and maintained at an acceptable level or minimized through continuous hazard identification and risk management processes. Airlines need to pay attention to how to effectively solve cabin emergencies and ensure the flight safety of aircraft.

II. AN OUTLINE OF CABIN EMERGENCIES

A. Categories of Cabin Emergencies

The categories of cabin emergencies can be classified according to the causes of emergencies, which mainly include human factors, irresistible factors and aircraft mechanical failures. With the development of science and technology, accidents caused by aircraft mechanical failures have been greatly reduced, but unexpected events caused by human factors have increased. Human factors include passengers who do not comply with flight safety regulations, physical discomfort, and unprofessional operations of flight attendants. The irresistible factors are mainly caused by unfavorable weather conditions such as strong wind, snow, ice and other severe weather. The main cause of mechanical problems is the failure of the aircraft engine, the long service life of the aircraft, or the negligence of mechanical personnel.

B. The Importance of Enhancing Emergency Handling

1) Protecting the flight safety

Civil aviation has an eternal development theme, that is, safety. On May 7, 2002, on the CJ6136 plane flying from Beijing to Dalian, passenger Zhang ignited in the cabin, resulting in a large-scale longitudinal movement of the passengers on the plane. The cockpit crew were unable to pull the aircraft up which led to airplane crash. All the passengers on board were killed. This event is called "Dalian 5.7 Air Disaster". This incident has aroused national concern about the safety of aircraft flight. If the cabin crew can remain calm when encountering emergency situations, judge and deal with emergencies in a timely and professional manner, it is possible to eliminate the threat of these events in the bud, and the safety of the cabin will be certainly guaranteed as well as flight safety[1].

2) Comforting passengers' mood

When there is an emergency in the cabin, the passengers are easy to be nervous. When the mood of the passengers are not stable, they are likely to act excessively. If their mood is not properly handled, it will probably lead to more serious cabin safety incidents.

Cabin emergencies caused by passengers' psychological factors are often related to the out of control of their anxiety state and the its rapid conduction. When the anxiety of the passengers is not relieved, they will produce adverse reactions such as nervousness and complaints. In severe cases, they may even induce sudden illness during the flight[2]. If the cabin emergency can be handled in time, the passengers can have a full sense of security, which is conducive to flight safety.

3) Maintaining cabin order

The cabin order is closely related to the safe flight of the aircraft. Reducing the risk event is to use effective measures to eliminate the possibility of emergencies at the beginning as much as possible, and prevent it from happening. Therefore, the effective use of risk management in the safety management of civil aviation cabin can better improve the cabin order and create a safe cabin environment for passengers[3].When encountering an emergency, if it can be handled quickly and professionally, eliminating the negative impact, the cabin order can be maintained and the safety of life and property of passengers can be assured.

III. STATUS QUO AND FACTORS OF CABIN EMERGENCY

At present, the airlines have a series of complete disposal measures, which can help better handle cabin

accidents and emergencies in the first time, and eliminate the effect of sudden incidents.

A. Status Quo of Cabin Emergency Handling

The safety management system refers to the establishment of a security goal and security policies, and implements a management system of security objectives through systematic management of a series of elements that are related or interacted with each other within the organization, such as organizational structure, responsibility system, resources, processes, and procedures.

China's Civil Aviation Emergency Response System has been formulated to better guide the handling of cabin emergency, which mainly covers four aspects[4]:

1) Emergency plan

It can be further classified into three levels: the first is the regional plan; the second is the special plan; and the third is the overall plan.

2) Legal management

In order to standardize the civil aviation emergency response, the Civil Aviation Administration of China has formulated a series of regulations to legalize it, such as the "Regulations for Emergency Response Management of Civil Aviation Transportation Airport Emergency".

3) Institutionalization of emergency response

In order to better cope with civil aviation emergencies, the Civil Aviation Administration of China has set up a special leading group and a regional organization to institutionalize the civil aviation emergency work.

4) Emergency mechanism

In 2016, Civil Aviation Administration of China formulated "China Civil Aviation Emergency Management Regulations" for the management system and emergency prevention, emergency response, recovery and corresponding legal responsibilities.

The current overall situation of cabin emergency handling is better than before, and most of the emergencies can be effectively solved in the first place, but some problems in the cabin emergency handling process still need the attention of airlines.

B. Main Factors of Cabin Emergencies

The following chart shows the cabin emergencies due to different factors from year 2009 to year 2013, which indicates that cabin interference has taken most account of cabin emergency[5].

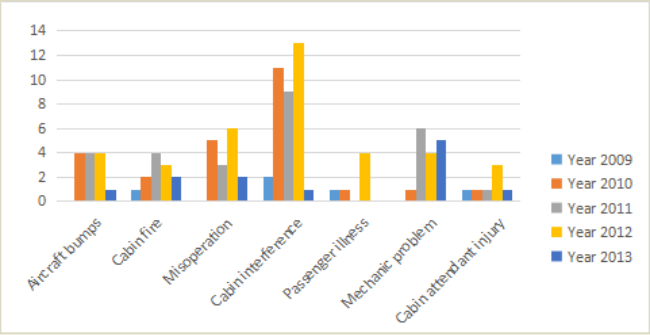

Fig. 1. Classified statistic of cabin emergency

1) Human factors

The human factors leading to the cabin accidents are mainly the lack of professionalism of the flight attendants and the lack of safety awareness of the passengers themselves.

The civil aviation illegal interference refers to behaviors that are harmful to the normal order and safety of civil aviation, such as illegal hijacking of aircraft; bringing dangerous materials into aircraft; spreading harmful or false information. In recent years, civil aviation illegal interference accidents have occurred frequently in China. For example, in 2014, about 120 illegal interference incidents including false terrorist information were handled according to the statistics of the civil aviation department[6].

2) Irresistible factors

Studies have shown that some aircraft safety accidents are closely related to the impact of bad weather. In the early morning of June 18, 2017, the flight of Eastern Airlines MU774 from Paris, France to Kunming, China, encountered a bumpy air turbulence during the flight, causing multiple passengers injuries on board. Air pressure, temperature, and atmospheric density all affect the take-off and landing distance, aircraft load and fuel consumption. Thunderstorms, haze, storms and other severe weather conditions will greatly reduce the safety of the flight.

Therefore, in the case of serious bumps, flight attendants should be vigilant in the first place. Especially wind shear is easy to cause flight accidents. It accounts for about 20% of aviation accidents. This is because of the discontinuity of the wind. It has the characteristics of short time, small scale and high strength. Force majeure caused by weather is the most difficult to handle, and it is also a test for a flight attendant to deal with such emergencies.

3) Aircraft factors

Unexpected events caused by the aircraft's own factors also cause serious harm to cabin safety. According to statistics, flight accidents caused by mechanical failure accounted for 17.8% of the total accidents. Since 1990, there have been three accidents in the United States due to aircraft fuel tank explosions, resulting in the crew members being killed. In recent years, cabin accidents caused by the aircraft's own factors are not unfamiliar, and the sudden events caused by the aircraft's own factors often have serious impacts, which are extremely unfavorable for flight safety.

IV. Countermeasures for Strengthening the Handling of Cabin Emergencies

A. Countermeasures for Cabin Emergencies by Human Factors

1) Passengers' sudden illness

During the flight of the flight, if the passenger suddenly falls ill, while the plane cannot immediately land for medical treatment, it requires the cabin to have basic medical facilities that could be used at any time. There are several steps to deal with sudden illness of passengers:

First, the flight attendant should judge the passenger's illness and inform the purser. Second, cabin crew can use the public radio system to find out professional medical staff in the cabin to help the passengers get more professional treatment. Third, they can use on-board medical equipment to treat passengers with sudden illness, and make timely

decisions based on the condition. If the passenger is seriously ill, they have to report to the captain who will contact the tower to apply for a nearby landing and seek more survival opportunities for the sick passenger. Fourth, they need cooperation with other passengers in the cabin to strive for a more comfortable and quiet environment for the sick passenger. Finally, if the plane needs to return or land nearby, cabin crew need to broadcast and get understanding of other passengers on board. In some cases, timely treatment is critical to saving the patient's life.

2) Unlawful passenger interference

Unlawful interference refers to violations of aviation safety regulations that are harmful or sufficient to endanger the safety of civilian airports, aircraft operations, and the safety of the lives and property of the persons concerned. If passengers interfere unlawfully, the flight attendants need to report to the captain immediately, who is fully responsible for handling illegal interference. The captain will give instructions to the security staff. To ensure the safety of life and property of the aircraft, the security staff should take necessary measures and report back to the captain in time.

In the event of unlawful interference, the entire flight plan may be threatened and disrupted, sometimes even resulting in a serious threat to national security. In an emergency, the security staff has the right to take necessary measures before reporting to the captain to ensure the safety of the aircraft and the life and property of the personnel it carries[7]. Some flight attendants can use the trolley to block the aisle, while other flight attendants comfort the passengers in the cabin, and the captain should decide whether to return or land at an alternate airport according to the seriousness of the plot. When illegal interference occurs, the cabin crew shall report to the ground continuously and inform the latest disposal situation. When the passengers need to be handed over to the police for illegal interference, it is necessary to collect evidence in time, and coordinate with the airlines, air traffic control and airports.

B. Countermeasures for Cabin Emergencies by Irresistible Factors

1) Aircraft bump disposal

Aircraft bumps refer to phenomena such as sudden ups and downs, left and right shaking, and fuselage tremors that occur suddenly during flight. Aircraft bumps are mainly caused by the aircraft flying into the disturbance airflow zone. The aircraft bumps are related to the disturbance airflow intensity, flight speed, wing load, etc., and are usually classified into light, moderate and severe.

The following chart shows the cabin injuries caused by turbulence from year 2015 to year 2019.

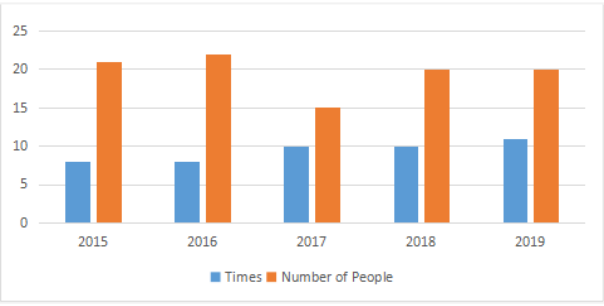

Fig. 2. Cabin injuries caused by turbulence

If there is a light bump in the cabin, when flight attendants are delivering the meal, they can continue the service carefully and remind the passenger to fasten the seat belt; if the bump is moderate, the food cart needs to be pulled back to the service compartment and fixed. If it is a severe bump, the flight attendants should immediately put the hot drink into the dining car and fix themselves immediately, and to remind the passenger to fasten their seat belt. In addition, the flight attendants should promptly appease the passengers' mood in the cabin, and inform them of the real-time situation, and take appropriate safety measures to avoid passengers being injured due to bumps.

2) Disposal of threats caused by environment

In the flight of the aircraft, the environment threatens aircraft safety, including the change of physical structure of the fuselage caused by heavy snow, the fire of the engine caused by the impact of the bird, and the fire of the wing tank caused by the lightning strike. These conditions will cause the aircraft to fail to fly normally. On July 23, 2014, Taiwan's Fuxing Airlines Flight GE222 crashed due to gusty weather. Therefore, in the face of these environmental hazards, the crew should comfort the passengers to remain calm, actively organize the passengers to keep in order, and if necessary, quickly evacuate the aircraft to a safe place after landing.

Moreover, in the face of such incidents, flight attendants should maintain a good psychological status, being able to handle things without fear, and solve problems wisely and rationally. Encountering unexpected situations, the flight attendants need to make an urgent decision to work with the crew to complete the emergency procedure. It also requires each flight attendant to know the structure and emergency equipment inside the cabin, including emergency exits, emergency equipment, such as oxygen cylinders, fire extinguishers, life jackets, etc. The ability to operate the emergency equipment professionally can earn more time for passengers. In addition, the flight attendants should promptly appease the frightened passengers and cooperate with the crew to carry out the evacuation procedure if needed.

C. Countermeasures for Cabin Emergencies by Airplane Factors

1) Cabin fire

The types of fires commonly found on airplanes can be broadly classified into three types: solid materials, oils, and electrical appliances. When fires occur in the cabin, the flight attendant should make a judgment on the fire source in the first place to select the correct fire extinguisher to effectively extinguish the fire.

Fires in the cabin, whether in the air or on the ground, are great a threat to personnel and property safety. The crew must cooperate and strive to extinguish the fire in the shortest possible time. The basic disposal procedure is: looking for the source of the fire and determining the nature of the fire; turning off the power; using corresponding fire extinguisher to extinguish the fire; reporting to the captain (fire extinguishing and reporting simultaneously if conditions permit); monitoring the scene to ensure that the fire is extinguished and reporting the situation to the captain all the time[8].

The flight attendant should automatically form a three-person team to be responsible for the firefighting: one

person being responsible for firefighting, one for communication, one for assistance (preparing a second fire extinguisher, or preparing a PBE, etc.). The firefighter should observe the fire and extinguish the fire in the first place. The liaison person should immediately contact the captain to report the situation (fire source, flame color, smoke concentration, smell). The third person is responsible for collecting the remaining fire extinguishers, doing the replacement work and monitoring the aftermath. Other flight attendants help to change the passenger's seat and direct the passenger to lower their body and cover their nose and mouth.

2) Cabin depressurization

Most aircrafts require pressurization to ensure that passengers in the cabin have sufficient oxygen to breathe and the cabin remains comfortable. If the aircraft is damaged or its booster system fails, the cabin pressure cannot be maintained, which will lead to the release of pressure. Cabin crew members should be proficient in the signs before pressure release, respond quickly and dispose in time.

When the oxygen mask falls off, it is necessary for the cabin crew to quickly make a reaction to depressurization, fix themselves, and pull down the oxygen mask. They should direct the passengers how to wear an oxygen mask. The cockpit crew also needs to contact the ground, quickly lower the flight altitude, and then descend to the safe height. When the aircraft reaches the safe level, the flight attendant should appease the emotions of the passengers. The purser also needs to report the damage of the aircraft to the captain in time and inform them of any other hidden dangers and passenger casualties. Subsequently, the flight attendant will patrol the cabin with an oxygen cylinder to check the passenger's injury and provide assistance.

V. CONCLUSION

Both airlines and passengers hope that every flight will be safe and smooth, but unexpected events are always unpredictable. In the face of emergencies, the cabin crew should deal with them in the first place, reducing the negative impact of the incident. The handling of cabin accidents also reflects the airline's emergency response capability, which is crucial for its future development.

This paper analyzes the status quo of cabin emergency handling, and concludes that human factors, irresistible factors, and aircraft's own factors are the main causes leading to cabin emergencies. Based on the analysis of these factors, countermeasures have been proposed to strengthen the response to cabin emergencies, prompting the airlines to comprehensively improve the ability to deal with emergencies, so as to guarantee cabin safety and flight safety.

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