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THE FUNCTIONING OF THE AIRPORT RESCUE AND FIREFIGHTING SERVICE DURING COVID-19 PANDEMIC

Abstract

The Airport Rescue and Firefighting Service (ARFF) is part of the civil aviation operational safety system. Failure of the ARFF to function will ultimately result in the cessation of flight operations at a particular airport, so it is crucial to ensure a continuous service. Ensuring the uninterrupted and efficient operation of the ARFF was a particular challenge during the Covid-19 pandemic. In this paper, the authors

sought to answer the research problem: How can an uninterrupted the ARFF service be ensured during a pandemic? Three example schemes for organising shift work were also presented.

Key words

Airport Rescue and Firefighting Service, civil aviation, safety, Covid-19, pandemic

Introduction

One of the key challenges for civil aviation is ensuring an adequate level of safety. The term “aviation safety” itself is an abstract concept and difficult to define. For the purposes of this article, the authors make use of the definition developed by the International Civil Aviation Organisation (ICAO), which considers safety to be a state in which the possibility of injury to person or property is reduced and maintained at or below an acceptable level through a continuous process of hazard identification and safety risk management¹. In the ICAO Safety Manual Management (SMM), under the definition of aviation safety, it is rightly stated that, despite the hierarchical elimination of all types of aviation accidents and serious incidents as the highest goal, it is impossible to achieve a state of absolute absence of hazards and risks. Human activity and the systems it has developed do not guarantee the absolute absence of operational errors and bearing the consequences of those errors occurring. Safety is recognised as a changeable and dynamically susceptible state of the entire aviation system, in which risks must be continuously reduced². As long as the level of risk is controlled and kept at an acceptable level, the entire aviation system is able

to maintain an appropriate balance between operational (profit-oriented) and safety-preserving activities. Furthermore, the airport is a critical infrastructure of the state³. This is why it is important to analyse the way in which the various airport services operate, especially in the context of the emergence of such a large-scale new threat to the operation of air transport as pandemic. In the case of aviation, it is also important to identify aviation safety and aviation security⁴. Aviation safety is primarily concerned with technical parameters and regulations relating to the manufacture and operation of aircraft, which keep the level of risk of error or malfunction and damage below the maximum acceptable level⁵, while aviation security is the combined measures and human and material resources intended to protect civil aviation against acts of unlawful interference⁶. While potential threats to civil aviation will be indicated in a later section of this article, it is important to point out that the Airport Fire and Rescue Service (ARFF) participates with varying levels of commitment in response to virtually every potential threat. In the case of the basic task of the ARFF, i.e. ensuring an adequate level of rescue and firefighting protection and thus activity in the area of aviation safety (operational safety),

¹ Doc 9859-AN/474 Safety Management Manual – Third Edition 2013, ICAO, 2.1.

² Ibidem.

³ Ł. Szymankiewicz, *The Modus Operandi of Terrorist Attacks Using Improvised Explosive Devices in Landside Zones from 2001 to 2018*, „Journal of KONBiN” 52 (3), p. 124.

⁴ E. Jasiuk, R. Wosiek, *Global Security and Safety Management in Civil Aviation in light of Annex 19 to the Chicago Convention*, [in:] E. Jasiuk, R. Wosiek (ed.), *Legal conditions of international cooperation for the safety and efficiency of civil aviation*, Warszawa 2019, p. 133.

⁵ H. Jafernik, R. Fellner, *Prawo i procedury lotnicze*, Gliwice 2015, p. 23

⁶ Ibidem.

the number of ARFF' firefighters, the number of rescue and firefighting vehicles, the number of firefighting agents and the number of specialised equipment, respectively ready for immediate use or rescue operations, should be understood as appropriate for the individual category of airport fire protection⁷. It should be emphasised that it is mandatory to provide a level of rescue and firefighting protection adequate to the operating aircraft, which makes it possible to see that the functioning of the ARFF determines the continuity of flight operations and thus the operation of the airport.

Methodology

The aim of the study is to present exemplary models of ARFF functioning during a pandemic on the example of ARFF operating at Polish airports, taking into account the basic assumption – uninterrupted service provision. The research problem was formulated in the form of the question: How can uninterrupted ARFF service be ensured during a pandemic? The following research methods were used to answer the research problem: the institutional-legal method and the systems method. The institutional-legal method aims to analyse the basic legal acts defining the rules of the ARFF; the systemic method is used to analyse the practical models for the functioning of firefighter shifts employed at the ARFF.

Basic legal acts for the functioning of the ARFF

The legal acts which regulate the aspect of the establishment and operation of ARFF within the European Union can be divided into three categories:

- International Conventions,
- EU regulations,
- National laws and regulations.

As regards international conventions, the Convention on International Civil Aviation, signed in Chicago on 7 December 1944, should be mentioned first and foremost, indicating first of all Annex 14 “Aerodromes”, where ARFF is dedicated to chapter 9.2. Also relevant are the two Airport Services Manuals: part 1 Rescue and Firefighting⁸; part 7 Airport Emergency Planning⁹. Already in the introduction to section 9.2 it is pointed out that the primary objective of the rescue and firefighting service is to save human lives, in the event of an aircraft accident or incident occurring on or in the immediate vicinity of an airport. The rescue and firefighting service therefore exists to create and maintain survivable conditions, to provide evacuation routes for those on board the aircraft and to take rescue action for those unable to evacuate without assistance.

At the EU level, it is important to point out Commission Regulation (EU) No 139/2014 of 12 February 2014 laying down requirements and administrative procedures for airports in accordance with Regulation (EC) No 216/2008 of the European Parliament and of the Council

⁷ § 2, Regulation of the Minister of Infrastructure of 1 February 2022 on the preparation of airports for emergency situations and airport rescue and firefighting services. Acts. U. 2022 item 453.

⁸ Doc 9859-AN/474 Airport Services Manual Part 1 – Rescue and Firefighting, Fourth Edition, 2015, ICAO.

⁹ Doc 9137-AN/898 Part 7 Airport Emergency Planning, Second Edition 1991, ICAO.

Acts. In the case of national legislation, two laws and a regulation can be identified, using Poland as an example:

- The Act of 3 July 2002 Aviation Law¹⁰;
- The Act of 24 August 1991 on fire protection;
- Regulation of the Minister of Infrastructure of 1 February 2022 on the preparation of airports for emergency situations and airport rescue and firefighting services.

The functioning of ARFF

The ARFF is an airport service. Airport operational services may be or-

ganisational units and services organised or provided by the airport operator whose tasks are related to aerodrome operations, including i.e.: Duty Services, Airport Area Control Team, ARFF, Airport Security Service¹¹. It is the responsibility of the airport operator to establish, organize and ensure the functioning of the ARFF¹². For the types of emergency situations, it is possible to indicate aircraft-related, non-aircraft-related, medical emergency situations and combinations of these situations. The types of threats are presented in Table 1.

Table 1. Types of emergency situations

Aircraft-related emergency situations	Non-aircraft related emergencies situations	Combined emergency situations
1. aircraft accident at the airport	1. fire (airport infrastructure)	1. aircraft accident: at or near an airport (operational area)
2. aircraft accident outside the airport (on land, on water)	2. sabotage (also threat of bombing)	2. full operational readiness – an aircraft approaching an airport has, or is suspected to have, problems causing an immediate risk of accident
3. aircraft incident in the air (severe turbulence, decompression, structural failure), aircraft incident on earth	3. act of unlawful interference	3 local state of readiness: an aircraft approaching an airport has, or is suspected to have, some defect, but this does not cause problems that would normally cause any serious difficulty in making a safe landing

¹⁰ In the case of Polish legislation, the authors translated the titles of laws and regulations themselves.

¹¹ § 2, Regulation of the Minister of Infrastructure of 1 February 2022 on the preparation of airports for emergency situations and airport rescue and firefighting services. Acts. U. 2022 item 453.

¹² Article 84, The Act of 3 July 2002 Aviation Law Acts. U.2002, No. 130, item 1112 consolidated text.

Aircraft-related emergency situations	Non-aircraft related emergencies situations	Combined emergency situations
4. aircraft incident on earth	4. dangerous materials	
5. incident – sabotage, including the threat of a bomb attack	5. medical emergency situations	
6. incident – unlawful seizure of an aircraft		

Source: Authors’ own elaboration based on ICAO Doc 9137, part 7 Airport emergency planning, p. 7.

Emergency situations not related to the aircraft:

- fire (airport infrastructure),
- sabotage (also threat of bombing),
- act of unlawful interference,
- act of terror,
- natural disaster and technical failure,
- dangerous materials,
- medical emergency situations¹³.

Complex emergency situations:

- aircraft / object (structure),
- aircraft / fuel refueling device,
- aircraft / other aircraft¹⁴.

All of the above emergency situations may occur at any time during an aerodrome operation, including i.e.: take-off, landing, pushback, refuelling, de-icing, engine testing and other operations involving aircraft on the movement area¹⁵.

In accordance with the methodology of rescue and fire protection at the airport, a concept has been developed based on the existence of a critical area that is subject to protection in any fire situation

arising from an aircraft accident¹⁶. ARFF must continuously take into account the possibility of fire and the need to fire-fight it¹⁷. For example, such a fire may occur during take-off or landing; occur immediately after an aircraft incident or accident; or occur at any time during rescue operations¹⁸. An important issue that cannot be ignored is the primary purpose of ARFF which is considered to be the protection of life in the event of an aircraft accident or incident occurring on or in the immediate vicinity of an aerodrome. This service is provided to create and maintain survivable conditions, to provide evacuation routes for persons on board the aircraft and to initiate rescue operations for those persons who cannot escape from the aircraft without direct assistance¹⁹. It therefore legitimises the need to keep the ARFF in constant operational readiness. A problematic issue for the ARFF is the organisational aspect. In practice, the ARFF needs

¹³ A. Musiał, *Planning Actions in Threat Situations in an Airport as one of the Elements of the Crisis Management Process*, “Security Forum” vol. 4, no 1/2020, pp. 47-48.

¹⁴ Ibidem.

¹⁵ § 2, Regulation of the Minister of Infrastructure of 1 February 2022 on the preparation of airports for emergency situations and airport rescue and firefighting services. Acts. U. 2022 item 453.

¹⁶ Doc 9859-AN/474 Airport Services Manual Part 1 – Rescue and Firefighting, Fourth Edition, 2015, ICAO.

¹⁷ Ibidem.

¹⁸ Ibidem.

¹⁹ Ibidem.

to operate not only uninterruptedly but also efficiently, which should be reflected in quick response times. In accordance with point 2.7 Airport Services Manual Part 1 – Rescue and Firefighting reaction time should be 2 minutes, not to exceed 3 minutes to the end of each runway and each part of the movement area (time to be taken into account with good track condition and optimum visibility)²⁰. However, in addition to ensuring adequate response times, an adequate

number of forces and resources, both personnel and technical, including vehicles, should also be provided. The provision of an adequate level of protection should be based on the dimensions of the aircraft that use the airport, taking into account the frequency of operations²¹. For this purpose, each airport maintains an airport category for rescue and firefighting. Table 2 presents the minimum number of rescue and firefighting vehicles for each category of airport.

Table 2. The minimum number of firefighting and rescue vehicles

Aerodrome category	Rescue and firefighting vehicles
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	3
9	3
10	3

Source: Annex 14 – Aerodromes – Volume I – Aerodromes Design and Operations – 8th edition, July 2018, p. 9-9.

In order to determine the minimum number of firefighters per shift, the ICAO and the European Union Aviation Safety Agency (EASA), recommends that during the flight operations there should be appropriately trained and competent personnel at the airport, ready to conduct rescue and firefighting

vehicles and to operate the equipment with maximum efficiency. A minimum response time and continuity of extinguishing agents should be ensured, for which it is necessary to maintain at least a minimum number of personnel on the shift²². In order to determine the minimum staff shift status (for each category

²⁰ Ibidem.

²¹ Ibidem.

²² Annex 14 – Aerodromes – Volume I – Aerodromes Design and Operations – 8th edition, July 2018.

of aerodrome in rescue and firefighting), these organisations impose in the regulations the development of a Task & Resource Analysis (TRA) on the aerodrome operator while providing documents with the methodology for the development of the TRA. It can be noted that two aerodromes with the same category of aerodrome in rescue and firefighting may have diametrically opposed minimum personnel needs.

For ARFF operating at Polish airports, the minimum number of firefighters is specified directly in the Regulation of the Minister of Infrastructure of 1 February 2022 on the preparation of airports for emergency situations and airport rescue and firefighting services, without the development of a TRA. In terms of planning the appropriate number of staff, in

addition to the airport category, aspects such as holidays or sick leave, for example, must also be taken into account. It is impossible not to mention the very important new threat of a pandemic, which is difficult to foresee in its consequences, where practically at a moment's notice it is possible to receive information that some personnel have been infected or have to undergo quarantine – such a situation could ultimately result in the inability to carry out flight operations. What is also important is the fact that to be an ARFF firefighter requires the right qualifications, knowledge and skills – the process of recruiting, training and deploying a new employee is very time-consuming and it is practically impossible to quickly fill the shortage of staff from outside ARFF.

Table 3. The minimum number of ARFF firefighters on duty shift ready for immediate rescue operations

Aerodrome category	The minimum number of ARFF firefighters ²³
1-2	3
3-5	4
6-7	7 ²⁴
8	11 ²⁵
9-10	14 ²⁶

Source: Regulation of the Minister of Infrastructure of 1 February 2022 on the preparation of airports for emergency situations and airport rescue and firefighting services.

²³ The minimum number of ARFF firefighters does not take into account firefighters performing the duties of: manager (chief, head of emergency services) and deputy manager of the fire protection unit, specialists, inspectors, personnel of the alarm point, personnel of stations and medical rescuers.

²⁴ The minimum number of ARFF firefighters shall be increased by one firefighter from each million passengers started when handling more than three million passengers, taking into account reference 1.

²⁵ The minimum number of ARFF firefighters shall be increased by one firefighter for each million passengers started when handling more than five million passengers, taking into account reference 1.

²⁶ The minimum number of ARFF firefighters shall be increased by one firefighter for each million passengers started when handling more than seven million passengers, taking into account reference 1.

Examples of ARFF shift duty models

In any case, the work (duty) system in the ARFF unit is regulated by the Labour Code. The unit is divided into 4 duty shifts. In the absence of an epidemic threat, ARFF units in Poland work under an equivalent working time system. Under current working time regulations, 12-hour shifts are usually used. A common practice, but not mandatory, is to

start work/duty and receive equipment from the finishing shift at 7:00 a.m. and finish with the handover of equipment at 7:00 p.m. to the next shift. At the end of the day shift (7 a.m. – 7 p.m.) each firefighter has 24 hours off duty. The next duty shift starts the day after the end of the work/service at 7 p.m. After the end of the work/service at 7 a.m. the following day, each firefighter has 48 hours off. The working time schedule for duty shifts is contained in the table below.

Table 4. Example of a twelve-hour shift scheme

Day of week	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday	
	7am-7pm	7pm-7am	7am-7pm	7pm-7am	7am-7pm	7pm-7am	7am-7pm	7pm-7am	7am-7pm	7pm-7am	7am-7pm	7pm-7am	7am-7pm	7pm-7am
Shift	1	2	3	1	4	3	2	4	1	2	3	1	4	2

Source: Authors’ own elaboration.

The need to ensure the functioning of the unit became apparent with the onset of the pandemic. It became a challenge to take into account all the guidelines aimed at counteracting the spread of the coronavirus and reconciling those with working time standards. While day-to-day measures in the form of disinfection of ARFF premises and equipment were easy to implement, the question of what to do if an entire shift becomes infected and is therefore unable to work due to sick leave or an imposed quarantine had to be considered. Due to the fact that all duty shifts were in contact with each other during a handover of service, the aim was to limit it. The only way to do this was to amend the service handover regulations. Personal contact was abandoned

and doors and routes in and out of the guardhouse were designated for these purposes only. This solution required the mutual trust of ARFF personnel – during a standard handover/start of duty, any comments on the condition of the equipment and its completeness on the vehicles can be made directly, allowing the problem to be clarified immediately. When a change of service is applied under pandemic conditions, such an opportunity is lacking. However, no deficiencies were found, which confirms that this professional group is a coordinated collective that understands the seriousness of the need to keep rescue equipment in working order, a parameter that determines their safety during rescue operations. It is also clear that the aim should have been to carry

out the change of service in this form in the shortest possible time so as not to compromise operational safety conditions. The next preventive step was to change the work/service system to separate the service shifts. This solution aimed to eliminate contact between the two duty shifts and to ensure continuity of the unit in the event that one duty shift was eliminated in any way, bringing in firefighters from duty shifts with

time off in its place. Taking into account the provision of the Labour Code allowing working hours in fire protection units to be extended to 24 hours, the following working system has been established: 24 hours of work/service followed by 24 hours off, 24 hours of work/service and 120 hours off. The working time pattern on a monthly basis, for better explanation, under this system is shown in the following table.

Table 5. Example of 24-hour working schedule and 120 hours off

1 st week	Day of week	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
	Time	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am
	Shift	1	3	1	3	4	2	4
2 nd week	Day of week	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
	Time	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am
	Shift	2	1	3	1	3	4	2
3 rd week	Day of week	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
	Time	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am
	Shift	4	2	1	3	1	3	4
4 th week	Day of week	Mon.	Tue.	Wed.	Thu.	Fri.	Sat,	Sun.
	Time	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am	7am- 7am
	Shift	2	4	2	1	3	1	3

Source: Authors’ own elaboration.

With the pandemic weakened and several restrictions lifted, it was decided to change the work/service system.

Although it would seem that the accumulation of working time (48 hours in 72 clock hours) was compensated for by

a large amount of time off (120 hours) – but ARFF firefighters felt that this system was not very beneficial to their well-being by disrupting their daily rhythm.

As an alternative, a working system along the lines of the 12-hour system was introduced using the possibility of 24-hour working. Thus, work takes place

according to the rule: 24 hours work/service then 72 hours off. The advantage of this system is the isolation of the two duty shifts, which in turn makes it possible to replenish the workforce in the event of the elimination of an entire duty shift. A diagram of this system on a monthly basis can be found in the table below.

Table 6. Example of 24-hour and 72-hour interval working scheme

1 st week	Day of week	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
	Time	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am
	Shift	1	3	4	2	1	3	4
2 nd week	Day of week	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
	Time	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am
	Shift	2	1	3	4	2	1	3
3 rd week	Day of week	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
	Time	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am
	Shift	4	2	1	3	4	2	1
4 th week	Day of week	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
	Time	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am	7am-7am
	Shift	3	4	2	1	3	4	2

Source: Authors’ own elaboration.

This working system is currently used at most Polish airports. The authors’ observations show that airports that have so far been sceptical about 24-hour working are now switching to a 24-hour, 72-hour off-duty system.

Conclusion

The ARFF, by providing an appropriate level of rescue and firefighting protection, determines the maintenance of an appropriate category of aerodrome in

terms of rescue and firefighting, which in turn is a prerequisite for the assumed operation of the airport in the operational plans. In view of the above, the proper functioning of the ARFF is crucial for the implementation of air operations at an appropriate level adapted to air traffic. Preventive measures in the form of a change in the work/service system aimed at maintaining the continuity of the unit's operation, combined with the application of decontamination and disinfection guidelines, produced the desired result. In addition, the advantages of one of the work systems developed in the course of pandemic mitigation in ARFF units were recognised, adapting it for continuous use in many ARFF units in Poland.

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