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AERONAUTICAL SEARCH AND RESCUE (ASAR) IN THE LAND AREA OF THE REPUBLIC OF POLAND

Adam WETOSZKA*

* *Aeronautics Faculty, Polish Air Force Academy, e-mail: wetoad@op.pl*

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Abstract:

The article presents some aspects of functioning of the SAR system in the land area of the Republic of Poland. It describes those who are responsible for conducting the operation depending on the location and type of event. The characteristic of the SAR system includes legal and structural aspects, procedures and technical equipment which are essential components of the whole body. The final section contains some conclusions of the SAR system functionality as well as forecasts of its reorganization in the context of changes in the aviation law and legal documents.

Keywords: *air rescue system ASAR, helicopter rescue, emergency services, rescue missions.*

INTRODUCTION

The safety of flights is an essential element of aviation operations. Any negligence in this area can lead directly to a loss of human lives or serious material losses. Aviation incidents[1] damage confidence in air transportation, especially when mass media inform about aviation accidents usually characterised by a large number of casualties. The possibility of providing first aid to the injured by emergency services in such a situation depends on a number of factors, e.g. time between the accident and receiving information about it, local terrain conditions, climate, etc.

[1] Aviation incidents are divided into the following categories depending on their consequences:
a) aviation accidents;
b) aviation incidents – *Flight Safety Manual of the Armed Forces of the Republic of Poland*, MON, SZGWP, 2004.

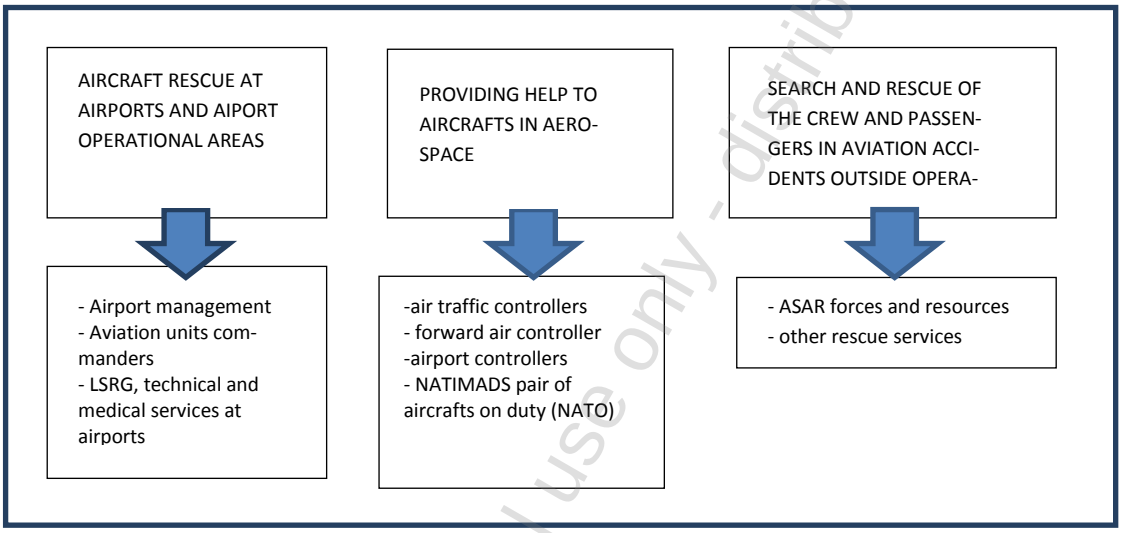
1. SYSTEM SOLUTIONS

The solutions currently used in civilian and state aviation ensure the quickest possible help depending on the place where an accident took place and the Flight Safety Analysis indicates that aviation incidents can occur in three places:

- Airports and airport operational areas;
- Aerospace;
- Outside airport operational areas.

Depending on the place where an aviation accident happened, appropriate services presented in Table 1. Take responsibility for providing help to the crew and passengers.

Table 1. Division of responsibility for rendering help to aircrafts depending on incident location



Source: Author's own study on the basis of: J. Nowak, B. Grenda, The system of search and rescue in Poland, scientific conference:
Tactics and command in SP, KTiU, Dęblin 2014.

In airport operational areas[2] the responsibility for help provided to aircraft crew and passengers is held by airport management and Airport Rescue and Firefighting Services. In the aerospace the responsibility is taken by air traffic controllers, forward air controllers and airport controllers. An especially important task of rendering help to aircrafts in the air is carried out by a pair of aircrafts on duty on the Air Policing mission in the NATINANDS.

[2] Airport operating area – the area of an airport and its surroundings where airport services and other units defined in PDSZ (Action Plan in Dangerous Situations) within the radius:
a) 8000 m – certified airport;
b) 3000 m – airport with a limited airport certification or exclusive use airports – from an airport reference point – Ordinance of the Minister of Transport, Civil Engineering and Water Management of 4 April 2013.

Air Policing is a special kind of air operations conducted by fighter aviation during peace or a crisis aiming at guarding NATO air borders inviolability, protection of people and armed forces from airstrikes and help for aircraft in danger. The pair on duty can take the following actions with reference to an aircraft in the air:

- visual identification – interrogation – actions undertaken in an attempt to define the affiliation of a plane which violated aerospace or to follow a given aircraft;
- intervention – actions undertaken to force the violator to accept required flight conditions. In such situations standard signals defined by ICAO *(International Civil Aviation Organization)* are used. The goal of intervention is removing the captured aircraft from the NATO controlled aerospace or forcing it to land at an indicated airport;
- engagement – in the situation when the previous actions do not work, an authorised person can take a decision to use arms to the capture, hostile aircraft (violator);
- other tasks – which among others encompass help in danger, assistance (help) in aircraft hijack or escorting a VIP aircraft. The pair on duty can also render help to aircrafts in the air, e.g. in the case of losing geographical orientation or inspection of external damage to an aircraft in the air so as to assess risk during emergency landing.

Photo 1. A pair on duty (23rd Tactical Air Base) operating in NATINAMDS.

Source: [online]. Available on the Internet: *http://www.tvn24.pl/wiadomosci-z-kraju,3/polskie-mig-29-w-litewskiej-bazie-kontroluja-przestrzen-powietrzna,528401.html* [accessed on: 11.02.2015].

In the case of events taking place outside the airport operating area, the crew and passengers receive help from ASAR units and other services depending on the kind of needs. Thanks to agreements it is possible to use: Fire Brigades, Border Guards, Police,

Land Search and Rescue Groups, Medical Air Rescue, Hospital Emergency Departments and other services depending on needs (e.g. TOPR, GOPR).

Standard documents requiring to maintain and organise ASAR services on land at the international level is the Convention of International Civil Aviation, including Annex 12, and at the national level the Aviation Law Act.

The Convention of International Civil Aviation of 7 December 1944, also called the Chicago Convention, initiated all legal regulations related to civil aviation and aviation security on an international scale and it is also the basic, up-to-date source of law. At this conference ICAO *(International Civil Aviation Organization)* was established. Poland, represented by its emigration government, was one of 52 countries which signed the Chicago Convention Final Act on 7 December 1944.

Annex 12 of the Convention of International Civil Aviation standardises aeronautical search and rescue. It states that search and rescue operations are conducted on the basis of certainty or assumptions that some people are in danger and it is possible to help them. With a view to the necessity to find survivors of aviation accidents as quickly as possible, ICAO developed and negotiated the Standards and Recommended Practices which are a part of Annex 12. The Annex regulations states the requirements for member states in terms of cooperation during search and rescue operations in their territories and along coastlines, including the ones with undefined sovereignty. The issues related to the equipment of rescue teams were discussed as well along with cooperation between the rescue services of cooperating states. The requirements relates to providing necessary information to these services were included as well.

The Aviation Law Act is a document regulating the organisation of ASAR service. Art. 140a. refers to search and rescue of aircrafts in danger, rendering help to the crew and passengers of aircrafts and other victims of aviation incidents regardless of their national affiliation. According to this article these tasks fall in the scope of activity of aviation search and rescue services, later referred to as "ASAR service[3]".

In the further part of the act, item 2 and 3 one can read that: Item 2. The ASAR service ensures search and rescue services for all aircrafts in the Polish airspace and acts on land in the search and rescue area corresponding with the borders of the airspace information area.

Item 3. ASAR service responsibilities encompass actions related to searching a defined area for the purpose of establishing the location of an aircraft and victims of an aviation incident, establishing their condition and undertaking rescue activities at the location of the incident, later referred to as "search and rescue actions", retaining the rights of the Maritime Search and Rescue Service (SAR) and other specialised rescue services.

[3] Art. 140a. of the Announcement of the Speaker of the Parliament of the Republic of Poland of 13 September 2013 on the consolidated text of the Aviation Law Act.

2. THE SEARCH AND RESCUE SERVICE ON LAND IN THE REPUBLIC OF POLAND

In Poland the system of aviation search and rescue is a part of the structures of the Ministry of National Defence. The reasons for such organisational structure are historical, however, a change would require heavy expenditures. The Aviation Law Act is explicit in this respect and designates the minister of transport to organise and perform these tasks. By all appearances, sooner or later some elements of this system will function as civil-military organs[4].

In accordance with the above, Art. 140a, item 5 reads:
The ASAR service encompasses the following units:

- civil-military coordination centre of aviation search and rescue;
- aviation search and rescue teams;
- emergency points.

During rescue missions the forces and facilities of the aviation search and rescue system of the Ministry of National Defence cooperate with rescue units from other sectors of state administration.

Other documents which standardise the details of the ASAR land and maritime service are as follows:

- Aviation Rescue Instruction – reference No. WLOP 390/2008;
- Military Maritime Rescue Instruction – reference No. Mar. Woj. 1361/2012;
- Rescue Duty Plan in the Aviation and Rescue Service (ASAR) and the Maritime Search and Rescue Service (SAR) for a given year.

ASAR services are responsible for search and rescue actions in the area of FIR – Warsaw[5] in the following situations:

- Missing aircrafts;
- Aviation accident outside an airport;
- Emergency landing of an aircraft outside an airport, a landing strip and a road runway in the region of FIR – Warsaw;
- Providing aid to the crew and passengers of aircrafts which were faulty by finding the accident place, giving first aid to survivors, transporting the injured to hospitals and protection of aviation equipment, documents and an aircraft load (if necessary);

[4] J. Nowak, B. Grenda, SYSTEM POSZUKIWANIA I RATOWNICTWA LOTNICZEGO W POLSCE [Aviation search and Rescue System in Poland], scientific conference: Tactics and command in SP, KTiU, Dęblin 2014.

[5] FIR *(Flight Information Region*) is airspace of defined dimensions in which airspace information service emergency service are provided. The Polish Flight Information Region FIR EPWW (or FIR Warsaw) encompasses the airspace above Polish land, internal waters and territorial sea (Polish airspace) and this airspace above the Baltic Sea which, pursuant to international agreements, are controlled by Polish Air Transport Services (ATS). Pursuant to the Aviation Law Act FIR EPWW is divided into controlled and uncontrolled airspace.

- Providing aid to survivors of all civilian and military aircrafts regardless of their national affiliation, citizenship and nationality of people aboard and other people (the so called third parties) who are victims of an aircraft accident.

Apart from this the system performs the following tasks:

- Accepting, analysing and conducting tasks related to information about safety threats to aircrafts flying in the Polish airspace;
- Supervision of the condition and ability to undertake search and rescue actions by the ASAR service units;
- Management of actions undertaken by the ASAR service units and coordination of these actions, particularly management of the actions of aviation search and rescue teams;
- Informing organisational units of the Navy, State Fire Department, Border Guards, Police, healthcare facilities and other units able to offer help related to aviation search and rescue which are obliged to cooperate with ASAR when performing their tasks;
- Informing the organs of air defence and air traffic services about civilian and military flights of aircrafts involved in search and rescue actions;
- Protection of aircrafts with the HEAD status, flights important from the point of view of the Ministry of National Defence and the "Air Policing" mission;
- Security of drills and trainings of Polish and NATO air forces, shooting at battle camps in the Republic of Poland and important national and international events.

It also analyses information related to:

- The condition and number of forces as well as facilities of the rescue units in FIR – Warsaw and in cross-border areas of neighbouring states;
- Distribution of aviation services bodies;
- Communications agents which can be used in search and rescue operations;
- Ways and range of information exchange with RCC of neighbouring states;
- Numbers of subscribers participating in search and rescue operations in the SRR *(Search and Rescue Region)*;
- Rescue forces and facilities from state administration sectors which can be used during search and rescue actions;
- Access to the list of lantern rescue radio-lights users working in the COSPAS - SARSAT satellite-based rescue system operating at a frequency of 406 MHz.

The structures managing the whole ASAR system encompass centres and sub-centres of search and rescue coordination, authorities cooperating with them and also Armed

Forces command organs. Executive units are designated elements of the armed Forces, including active-duty troops in the system[6].

The structure of ASAR is presented in the figure below.

Aeronautical Rescue Coordination Centre (ARCC) is located in the Component Command – Centre for Aeronautical Operations in Warsaw. It is a superior element for the forces and facilities of this system, this is why most of the above mentioned system tasks is conducted by this centre. This is also the command organ in case of rescue signal emission and starting and conducting a rescue action. Should there be any complications during a rescue action, on the basis of signed agreements, the centre can receive support from the National Centre for Coordination of Rescue Operations and Civil Protection, National Headquarters of the State Fire Service, National Headquarters of the Military Gendarmerie, Police National Headquarters, National Headquarters of the Border Guards, Polish Medical Air Rescue, civilian and military airports, aero clubs, active landing strips, Active Duty Services, operating and active-duty military services and RCC of neighbouring states.

The organisational structure of the centre is presented in the figure below.

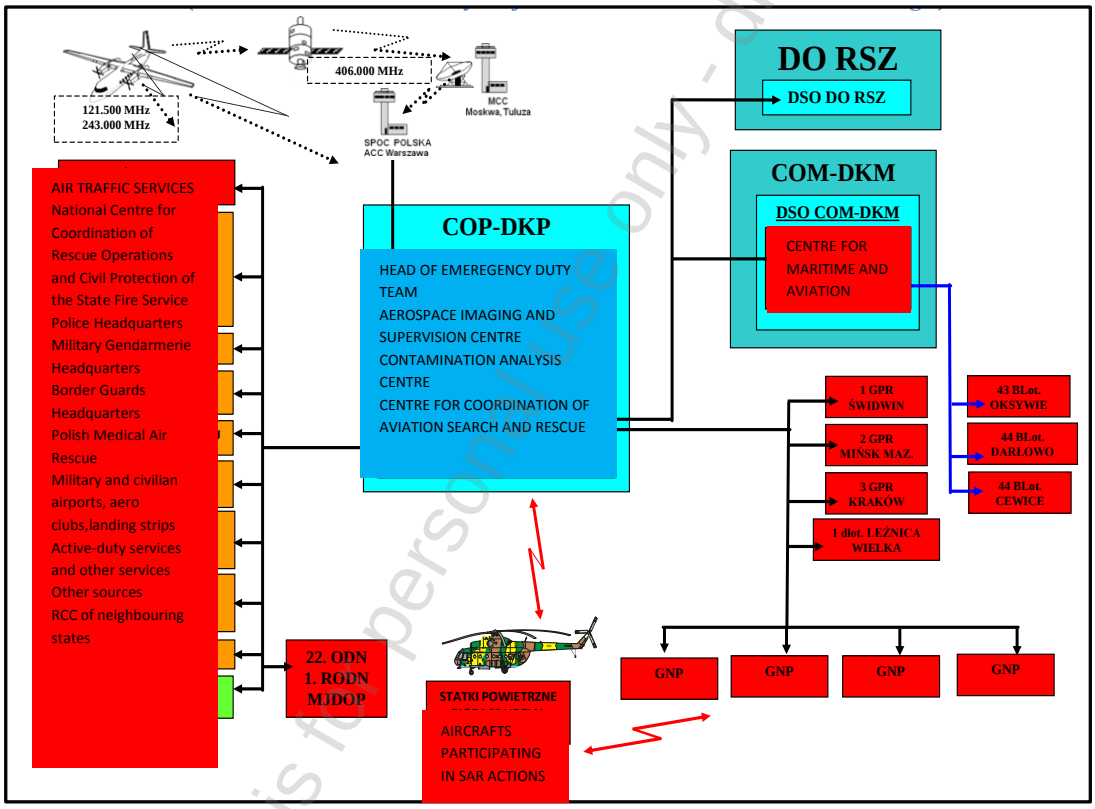


Fig. 1. The structure of the ASAR system with account for OKP and RL
(Centre for Coordination of Aviation Search and Rescue)
Source: Centre for Coordination of Aviation Search and Rescue, SAR presentation, 2014.

[6] J. Karpowicz, Aeronautical Search and Rescue (ASAR), WSOSP, Dęblin 2010, p. 73.

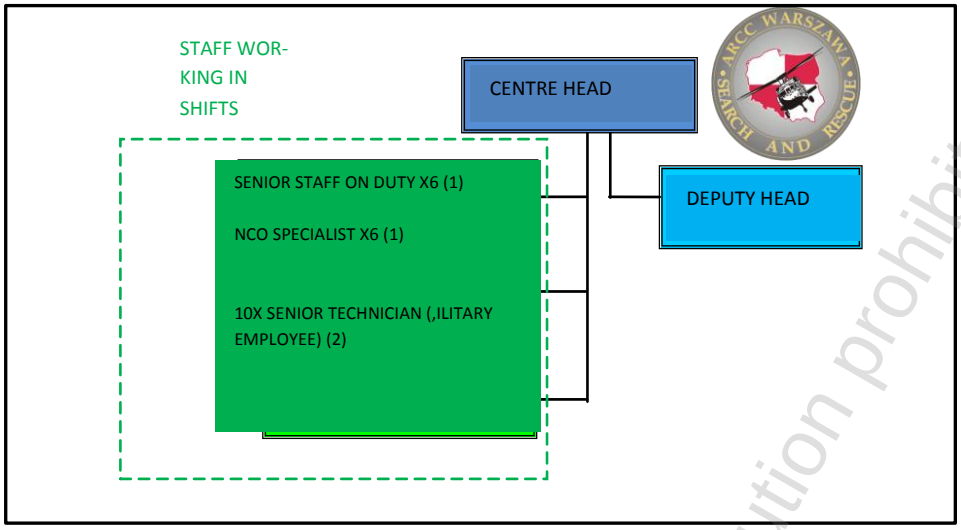


Fig. 2. Organisational structure of OKP and RL
(Centre for Coordination of Aviation Search and Rescue)
Red numbers denote the number of staff on duty.
Source: Centre for Coordination of Aviation Search and Rescue, SAR presentation, 2014.

2.1. Aviation structure of the system

The aviation structure of the system consists of four search and rescue teams distributed in the aviation units the Armed Forces of the Republic of Poland.

- 1. SRT Świdwin;
- 2. SRT Mińsk Mazowiecki;
- 3. SRT Kraków;
- 1. Air squadron in Leźnica Wielka.

A search and rescue team (SRT) is an independent military unit performing search and rescue tasks using rescue helicopters on the land of the Republic of Poland and SAR tasks in cross-border areas of neighbouring states. The organisational structure of SRT is presented in a diagram below on the basis of 2.SRT.

Basic SRT tasks encompass:

- Maintaining readiness of forces and facilities in the Polish Medical Air Rescue by Rescue Duties;
- Designating air rescue forces and facilities in situations of threat to security within the European Union in the area of Europe;
- Participation of forces and facilities separated from air rescue forces in crisis situations (floods, fires) in the Republic of Poland.

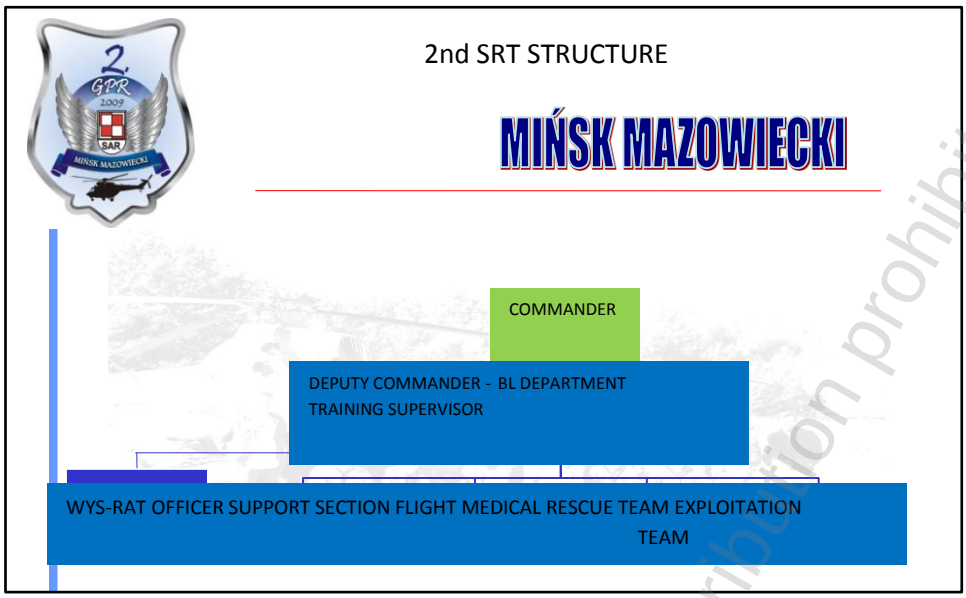


Fig. 3. SRT organisational structure
Source: Conference materials: Medical rescue and rendering of medical aid from the air in the state security system, Dęblin 14-15.05.2014.

Apart from this SRT team are also responsible for:

- Aviation training of the department flight crew;
- Trainings for technicians and rescuers from other units;
- Participation in the support of battle camps;
- Participation of rescue helicopters with their crews during shows;
- Participation in operational exercises with troops, tactical and special exercises as part of crisis management;
- Interim duties to secure air shows.

Search and rescue teams are equipped with W-3 RL, Mi-8 RL, Mi-2 RL helicopters. Helicopter equipment encompasses:

- helicopter standard equipment;
- medical equipment;
- rescue equipment;
- evacuation equipment;
- specialist equipment;
- individual equipment[7].

The dislocation of SRTs with SAR elements in sea areas and the tactical operation radius of helicopters are presented in the figure below. In the case of an aviation incident in a region outside the tactical operation radius of rescue helicopters OKPiRL co-

[7] Conference, *Medical rescue and rendering of medical aid from the air in the state security system,* Dęblin 14-15.05.2014, Presentation 2. SRT Mińsk Mazowiecki.

operates with such institutions as: State Fire Service, Military Gendarmerie, Police, Border Guards, Helicopter Emergency Rescue Service.

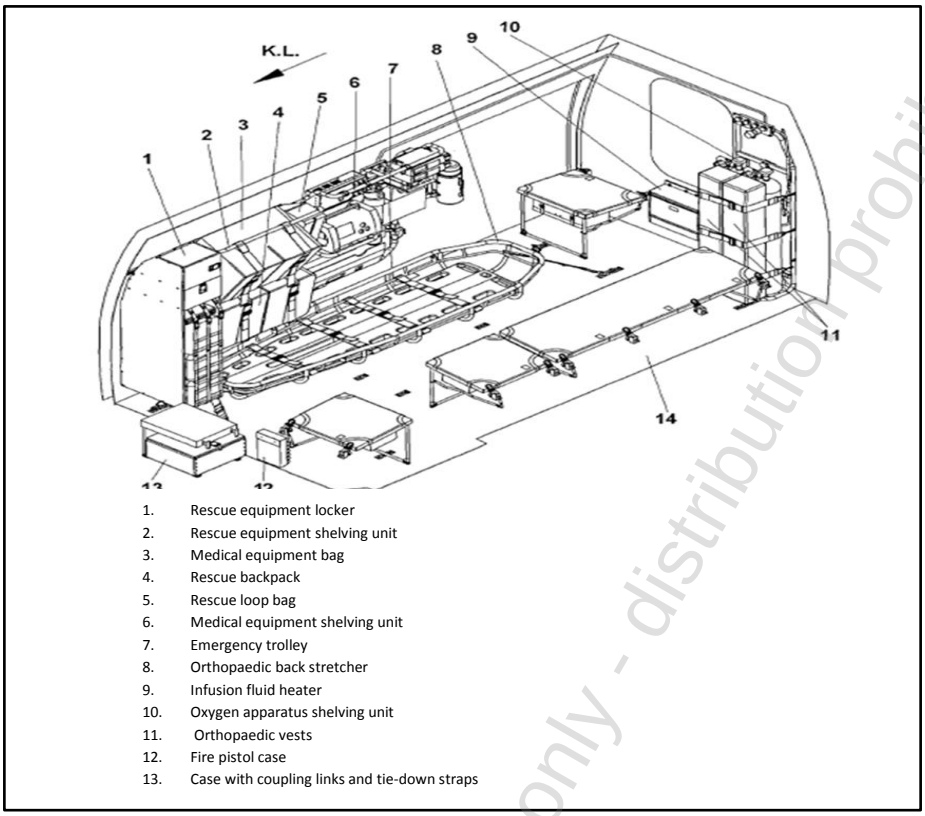


Fig. 4. Helicopter equipment W-3 WA SAR
Source: Conference materials: Medical rescue and rendering of medical aid from the air in the state security system, Dęblin 14-15.05.2014.

Missions conducted by the Search and Rescue System are divided into:

Search and rescue missions:

a. Missions above land:
   - searching for missing aircrafts with no radio communication;
   - searching for aircrafts which reported a fault and had to conduct emergency landing / crashed but maintained radio communication;

b. Missions above water bodies and inland waters:
   - searching for missing aircrafts with no radio communication;
   - searching for aircrafts which reported a fault and had to conduct emergency landing / crashed but maintained radio communication.

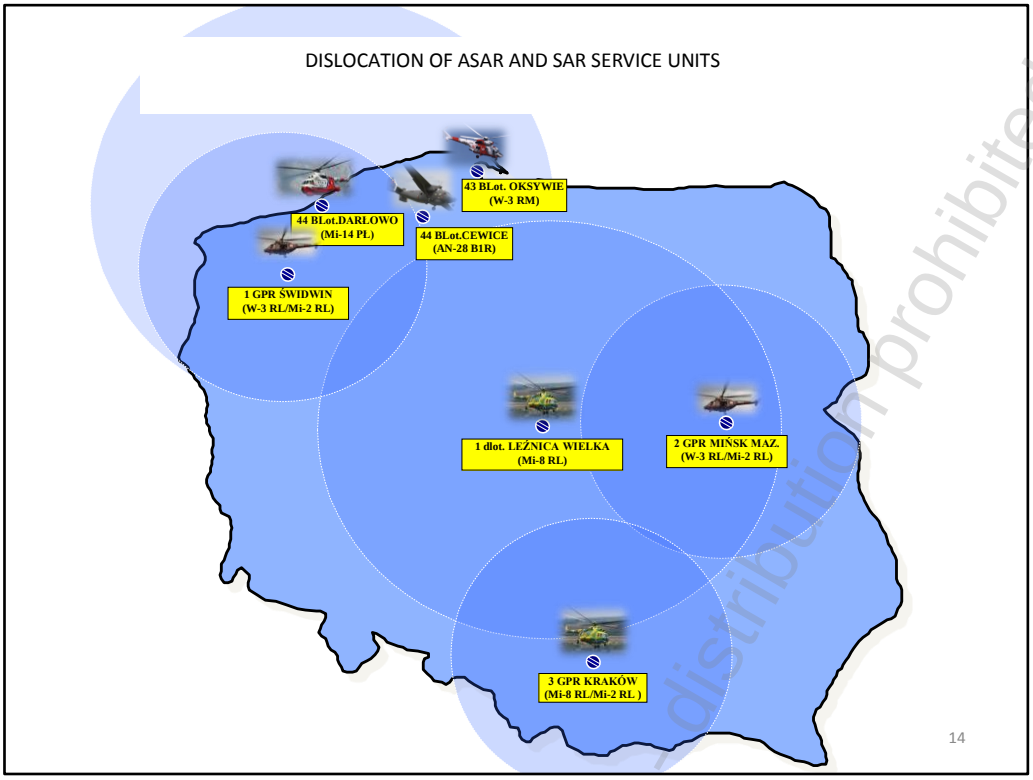


Fig. 5. Dislocation and tactical radius of Search and Rescue Teams
Source: Centre for Coordination of Aviation Search and Rescue, SAR presentation, 2014.

Search and rescue missions:

Rescue missions above land:

- searching for missing aircrafts with no radio communication, taking victims and survivors aboard, rendering medical aid to them;
- searching for aircrafts which reported a fault and had to conduct emergency landing / crashed but maintained radio communication, taking victims and survivors aboard, rendering medical aid to them.
- Rescue missions above water bodies and inland waters:
- searching for missing aircrafts with no radio communication, taking victims and survivors aboard, rendering medical aid to them;
- searching for aircrafts which reported a fault and had to conduct emergency landing / crashed but maintained radio communication, taking victims and survivors aboard, rendering medical aid to them.

Each of the above mentioned missions can take place during the day and in the night, above land surface, in mountainous regions and above inland waters.
SRT combat readiness before start:

- Combat readiness No. 1 – time to start 5 min.;
- Combat readiness No. 2 – 15 / 20 minutes (water / summer);
- Combat readiness No. 3 – 50 / 1h10 min (water / summer).

Another element of the ASAR system are Ground Search Teams (GST). They are allocated to render help to the crews and passengers of aircrafts which reported a fault by finding the place of accident, rendering help to the crew and other people/victims of the aviation accident, they also secure evidence and protect possessions and equipment in the aircraft. Additionally GSTs are responsible also:

- rescuing survivors from aircraft wrecks;
- accepting survivors from inaccessible regions;
- releasing (photo) crews after parachute landing from buildings, trees and other high obstacles;
- putting down fires;
- providing survivors with basic supplies (food and drink, other items necessary for survival). GST combat readiness before setting off;
- Combat readiness No. 1 – time to start 5 min.;
- Combat readiness No. 2 – 15 / 20 minutes (water / summer);
- Combat readiness No. 3 – 50 / 1h10 min (water / summer).

The dislocation of the Ground Search Teams are presented in the figure below.

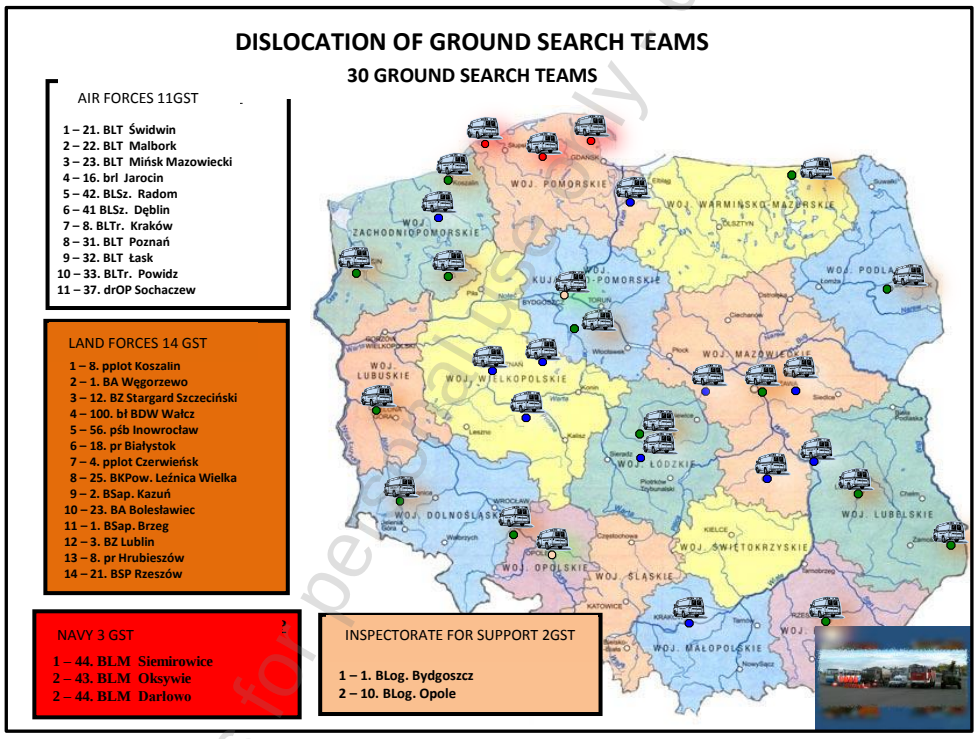


Fig. 6. Dislocation of GST
Source: Centre for Coordination of Aviation Search and Rescue, SAR presentation, 2014.

1.2. Technical elements of the system

The information about any extraordinary condition of an aircraft is received from a satellite system called COSPAS *(Cosmicheskaya Sistyema Poiska Avariynich Sudov)* SARSAT *(Search and Rescue Satellite-Aided Tracking).* It is an international satellite sys-

tem for land, air and maritime rescue. It was established by the Soviet Union (COSPAS system) and in 1979 it was supplemented by a system set up by the USA, Canada and France (SARSAT) – hence the name COSPAS-SARSAT. On 25 April 2005 the Council of Ministers granted its consent for Polish accession to the COSPAS-SARSAT programme and in May 2005 the Note on the Accession of the Republic of Poland to the International Programme COSPAS-SARSAT as a User State was issued. On 30 December 2005 the Government Declaration on the binding force of the Note on the Accession of the Republic of Poland to the International Programme COSPAS-SARSAT as a User State was issued. Thus pursuant to the signed agreements, Poland participates in this system.

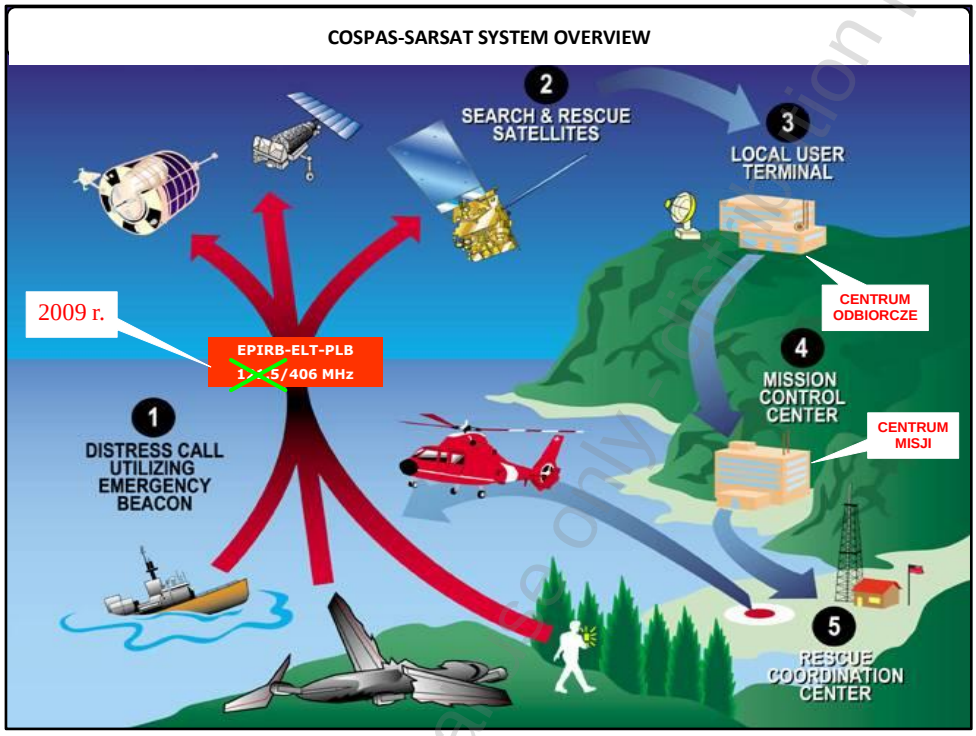


Fig. 7. COSPAS-SARSAT system
Source: [online]. Available on the Internet:
http://www.sarsat.noaa.gov/cospas_sarsat.html [accessed on: 11.02.2015].

The COSPAS-SARSAT system consists of the following elements: three types of transmitters of a distress signal, LEOSAR satellites *(Low-altitude Earth Orbit),* GEOSAR *(Geostationary Earth Orbit),* ground receivers LEOLUT I GEO-LUT, LUT *(Local User Terminals),* Mission Control Centres (MCC), Rescue Coordination Centre (RCC), Search and Research Teams (SRT), Ground Search Teams (GST).

Currently there are three types of distress signal transmitters:

a) PLB *(Personal Locator Beacon)* pilot's personal transmitter. It can be started manually or automatically, e.g. during ejection. It can be located even in pilot's watch.

b) ELT *(Emergency Locator Transmitter)* is a kind of locator beacon which is mounted on aircrafts. Transmitters of this kind facilitate the localisation of

an aircraft after a catastrophe. They shorten the time needed by SAR teams to find survivors and offer them help. Most often ELTs are located on the rear part of a plane (e.g. on a tail boom) and can be started automatically, by the pilot or when the aircraft hits ground or water.

c) EPIRB *(Emergency Position-Indicating Radio Beacon)* is a kind of radio beacon which indicates the position in emergency situations, in Polish it is also colloquially called "radiopława". It is mounted on watercrafts. This kind of equipment can be started manually or automatically every time it is flooded or during a shock when it remains on the surface of water by itself or with the help of special floating devices.

Photo 2. Three types of the described devices emitting rescue signals and pilot's watch emitting signals used in the ASAR system
Source: Author's collections

The space system is composed of satellites moving on polar orbits to ensure global coverage. The COSPAS/SARSAT system satellites is composed of:

- 5-6 Low Earth Orbiting Satellites (LEOS), orbit altitude 850/1000 km, turnaround time about 120 min;
- 5 Geo-stationary Earth Orbiting Satellites (GEOS), orbit altitude 36 000 km, turnaround time about 24 hours.

The ground segment is composed of Local User Terminals (LUT) and the Mission Control Centre (MCC) and Rescue Coordination Centre *(*RCC). All ground stations ensure complete compatibility with all other stations and each station of the system.

System operation starts with switching on a rescue transmitter. To prevent hoax alarms, when a transmitter is on it emits an acoustic beacon allowing some time for switching off (2 - 10 minutes depending on the type and place of installation). After this time it activates and sends a distress signal to COSPAS/SARSAT satellites. Radio signals are received by appropriately equipped Low Earth Orbiting Satellites (LEOSAR) moving on polar orbits. The signal received by a satellite is transmitted to a receiver at the so called Local User Terminals (LUT) where it is processed to locate signal transmitters.

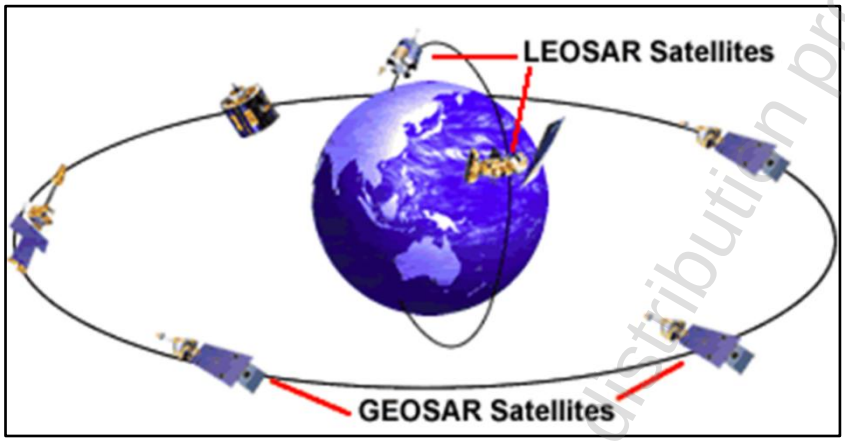


Fig. 8. COSPAS-SARSAT system
Source: [online]. Available on the Internet:
https://www.google.pl/search?q=rcc+rescue+coordination+centre&ie=utf-8&oe=utf-8&gws_rd=cr&ei=91A-VYfDHcW7ygOE3IDAAQ [accessed on: 11.02.2015].

The information about a catastrophe and the geographic coordinates of the location of the distress signal are transmitted to the Rescue Coordination Centre (RCC) or other appropriate search and rescue service to start a SAR action.

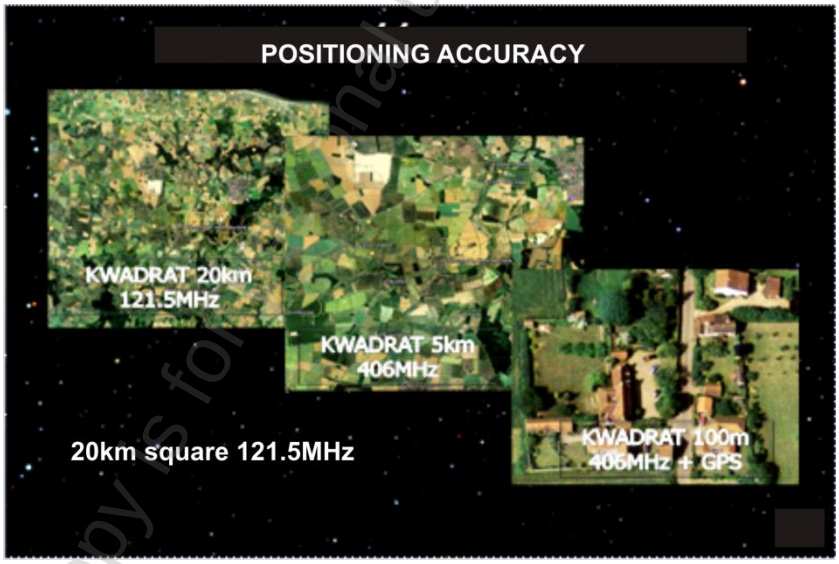


Fig. 9. Positioning accuracy using the described frequencies and GPS
Source: [online]. Available on the Internet:
https://www.google.pl/search?q=rcc+rescue+coordination+centre&ie=utf-8&oe=utf-8&gws_rd=cr&ei=91A [accessed on: 11.02.2015].

The coordinates of signal are determined on the basis of satellite measurements based on the Doppler effect of frequency change of a signal received from rescue transmitters.

Since 2009 a digital frequency of 406 MHz has been used instead of a previously used frequency of 121.5 MHz. This new signal is stronger and has a global reach. With the use of the equipment emitting this signal, it is possible to position the transmitter in increments of 100 m. The alarm time is reduced to 5 minutes and 1 satellite is sufficient for positioning.

CONCLUSIONS

The ASAR service as well as its satellite and aviation part conducts tasks related to air rescue properly. In 2014, regardless of transmitter protective devices, about 200 rescue signal emission were reported in FIR Warsaw, more than ten of them were related to actual aviation incidents starting the system. The other emissions were caused by accidental rescue radio station switching caused by human errors. However, in each case the system worked perfectly informing about an emission.

Currently the technical condition of some rescue helicopters is not perfect, however, soon there is going to attender offer for a utility helicopter, which will solve this problem in the next few years.

There are also plans to reorganise the system because pursuant to the Aviation Law Act the system should be a civilian-military organisation[8]. This is why the Ministry of Transport is working on setting up such a system on the basis of the elements of the Polish Air Navigation Services Agency, OKPiRL and the Centre for Maritime and Aviation Rescue. Its new ordinance, due to its significance, when it is implemented will be located between the Aviation Law Act and the Aviation Rescue Instruction and will signify the new quality of the system.

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[8] Art. 140a p. 5 brzmi:
W skład służby ASAR wchodzą następujące jednostki:
1) cywilno-wojskowy ośrodek koordynacji poszukiwania i ratownictwa lotniczego;
2) lotnicze zespoły poszukiwawczo-ratownicze;
3) punkty alarmowe.

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15. *Standardowe Procedury Operacyjne, SPO, Standaryzacja przygotowania oraz użytkowania sprzętu do ewakuacji medycznej oraz aparatury medycznej śmigłowca ratowniczego SAR. Zasady prowadzenia misji w lotach ratowniczych SAR dla pokładowego personelu aeromedycznego w składzie: lekarz pokładowy, pokładowy ratownik medyczny, ratownik pokładowy, Śmigłowiec W-3WA SAR [STANDARD OPERATING PROCEDURES, SOP,* [Standardisation of preparation foe use and using medical evacuation equipment and medical equipment of the SAR helicopter. Binding rules during mission in SAR rescue flights for the aeromedical crew composed of: medical doctor, medical rescue worker, rescue worker, W-3WA SAR helicopter].
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17. The Convention of International Civil Aviation (Chicago 1944).

BIOGRAPHICAL NOTE

COL Adam WETOSZKA, PhD Eng. – Head of the Department of Tactics and Armament, Polish Air Force Academy, born in Biała Podlaska, 1969. In 1992 he graduated from the Polish Air Force Academy, general staff course. In the years 2000-2002 he did a post-graduate course at the National Defence University. Working as a lecturer at the Polish

Air Force Academy, in the years 2005-2007 he completed doctoral studies at the National Defence University and in 2007 received a doctoral degree in the field of Air Forces.

His scientific interests are related to the use of air forces in a crisis response system and in particular the use of air forces in crisis situations and conflicts. The author is also interested in the issues connected with the state air security. He is an author of syllabi for aviation tactics and air forces operations courses for students and course participants at the Polish Air Force Academy. His most important publications, written individually or collectively, encompass: The Range of Applications and Tactics of Basic Types of Military Aviation in the Contemporary Environment of Crisis Response Operations (2007), Aviation Command with Direct Support of Land Forces (2009), Contemporary Threats to Air Security (2011), Selected Problems of Air Forces Command (2012), An Analysis of the Use of Armament and Military Equipment in the Persian Gulf Missions (2013), The Use of the F-16 Fighter in Combat Missions (2014). Direct support of air forces for land forces (2015).

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