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UAS ALBATROS IN ACTIVITIES FOR DEFENCE AND SECURITY ON SEA WATERS

Together with publishing, by the Armament Inspectorate of Ministry of National Defense, the tactical program UAS *Albatros* of short range, vertical take-off and landing, for the Navy, employees of the Polish Naval Academy (PNA) with the staff of the Lublin University of Technology (LUT) began the analytical and conceptual phase. The result was development of UAS usage assumptions in activities for the Navy in the field of reconnaissance as well as creating a picture of the situation in the marine area (*Maritime Situational/Domain Awareness* MSA/MDA). As part of extended applications, the so-called *dual use* was indicated for other representatives of maritime state services (mainly the Border Guard) and commercial entities (*Lotos Petrobaltic S.A.*), as potential recipients of UAS (as part of conducting protection of marine critical infrastructure facilities CI).

The impact potential of the Navy significantly increased in recent years. It is a result of obtaining modern controlled anti-ship missiles, both mounted on the decks of warships (missile RBS-15 Mk 3 on the warship decks of 660 project), and included in Marine Rocket Unit, MRU (2 Coastal Combat Squadrons CCS – equipped with *Kongsberg* NSM rockets). What is important from the usage of combat abilities point of view, range of both types of rockets of about 200 km significantly exceeds the range of detection of mediums at the disposal of ships (carriers of rockets) as well as MRU.

The article presents author's opinion on possibilities of usage of UAS vertical take-off operating from the decks of warships and coasting in the Navy. The increase in the ability to conduct the diagnosis (RADINT, SIGINT, ELINT/COMINT) should be considered as key issue, also realization of tasks as part of extending the possibilities of using UAS by other services.

Keywords: Unmanned Maritime Systems, Unmanned Aircraft Systems, UAS, Albatros.

1. INTRODUCTION

The Navy carries out tasks in sea areas in accordance with assigned tasks of Peace (P), Crisis (C) and War (W) time and allied commitments. Character of the tasks is determined by specific area of the Navy activities: In the national defense system we distinguish:

- Defense zone of the Navy, which is the main area of operational activity of the Navy and an area of approximately 32 500 km². It covers the area of Polish sea internal waters, territorial waters, adjacent zone and exclusive economic zone (operationally divided into coastal defense zone – covering lane of width of 20 nautical miles along

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the coast and sea defense zone – covering waters from N border of coastal defense zone to external border of the Naval Defense Zone);

- Area of Operational Navy Interest (AONI), covering waters and airspace of the Baltic Sea, zones of the Baltic Straits, and also east and north part of the North Sea, the countries lying above these waters and the armed forces and their operational deployment.

In the alliance defense and crisis response system the Navy forces affect the land, air, and North Atlantic sea area on N from the Tropic of Cancer. However, during stabilization and humanitarian international actions the area of operation of naval forces covers any geographical area.

2. UAS PROJECTS – PRESENT STATUS

In 2016 the Armament Inspectorate announced start up, as additional, of program of the UAS tactical short range destined for the Navy. Project named *Albatros* covers acquiring unmanned aircraft system (UAS) of vertical take-off and landing (Plan Modernizacji Technicznej, 2014). Requirements specified in the request for information (RFI) determine destination of UAS for the realization of reconnaissance actions (Ogłoszenie, 2016, IU):

- reconnaissance of enemy forces over land;
- reconnaissance of enemy forces at the sea and coastline;
- searching for the shipwreck survivors at the sea
- continuity of action 24/7 h;
- enabling landing and taking off from the Navy ships;
- enabling storage on the Navy ship's decks (for this purpose, the assumptions of UAS hangars in a standard container were developed);
- enabling steering and controlling of realization of reconnaissance tasks from the Navy ship's decks (flight control and data transmission);
- enabling quick assembly of the system on the Navy ships;
- the ability to maintain buoyancy after launching.

As part of the provision of reconnaissance systems, UAS should have:

- optoelectronic warheads (infrared and visible range reconnaissance);
- radiolocation station SAR/GMTI Synthetic Aperture Radar (SAR) and Ground Moving Target Indicator (GMTI);
- radiolocation station SAR/MMTI (Maritime Moving Target Indication);
- electronic reconnaissance stations (ELINT/COMINT).

The basic concept and abbreviations related to the problem of object recognition are presented in Table 1.

Table 1. Concepts of object recognition

Abbreviation	Full name
SIGINT	<i>Signal Intelligence</i>
ELINT	<i>Electronic Intelligence</i>
COMINT	<i>Communication Intelligence</i>

Source: Own elaboration based on: (AAP-6, 2014).

UAS will have to be able to fire by using on-board weapons.

In January 2017 the Kazimierz Pułaski foundation published a commentary to the realization state for the Technical Modernization Plan (TMP) for 2013-2022. Operational program “Rozpoznanie obrazowe i satelitarne” (*Satellite and imagery intelligence*) includes the purchase of unmanned systems. TMP 2013-2022 assumed acquisition of 6 UAS classes (Table 2).

The foundation commentary draws attention to the growing importance of systems of imagery intelligence operating in favor of offensive and defensive systems (Lipka, 2017). The current implementation of projects concerning the acquisition of UAS systems by the Polish Armed Forces have already recorded serious (delayed dozens of months) delays.

Table 2. list of UAS projects provided for in TMP 2013-2022

Program code	class	number	Remarks
<i>Zefir</i>	MALE ² Medium and big	4 sets	capable of transferring weapons
<i>Gryf</i>	Medium range	12 sets	Division level
<i>Orlik</i>	Short range	12 sets	Brigade level
<i>Wizjer</i>	mini	15 sets	Battalion level
<i>Ważka</i>	mini	15 sets	Vertical take-off/landing
<i>Mikro</i>	micro	6 sets	
<i>Albatros</i>	Short range	4 sets	Vertical take-off/landing

Source: (Dmitruk, 2016).



Fig. 1. View of UAS Albatros approach to landing aboard a ship

Source: Lublin University of Technology.

² MALE – *Medium Altitude Long Endurance*.

As part of the PNA's cooperation with LUT, an outline of the use of UAS in the marine environment for the development of the Polish Navy's capabilities was made. Particular emphasis has been placed on applications in the field of reconnaissance, target identification and actions for the protection of marine critical infrastructure facilities.

Think tank indicates that it is a burning issue to provide systems of imagery intelligence for the Marine Rocket Unit. There is a situation in which Coastal Rocket Squadrons do not have the opportunity to use the full combat potential of modern anti-ship missiles on their equipment (tasks under *Targeting and Over the-horizon Targeting OTH-T* and *Battle Damage Assessment – BDA*).

3. UAS ALBATROS

Basic tactical and technical data of UAS Albatros are presented in Table 3. The performance with the use of stealth technology elements (appropriate choice of construction, materials used, painting and others) is to guarantee reduction of visibility of units signature in the air. The unit's ceiling, anticipated at 5000 m, will allow reaching the range of detection of surface objects up to 150 km, and on the surface wave up to 40 km³.

Table 3. Basic Technical and tactical data of UAS Albatros

Take-off mass [kg]	200	Fuselage	Performed in <i>Stealth</i> technology
propulsion	Combustion engine	Autonomie [h]	up to 5
Mass of armament	(30% of UAS mass) up to 50 kg	Flight altitude [m]	Max 5000
RCS [m ²]	0.1	V max [km/h]	100-120

Source: Own elaboration based on information from LUT.

As the basic package of tasks possible to be implemented by UAS Albatros (while ensuring continuous performance of mission 24/7), the following are indicated:

- reconnaissance over the land;
- reconnaissance over the sea;
- searching for the shipwreck survivors, taking part in SAR/CSAR actions (fig. 2);
- indication of the target over the horizon – also radiolocation (*Over-the-horizon Targeting*, OTH-T), action as the Target Reporting Unit (TRU), including highlighting of targets;
- Battle Damage Assessment (BDA);
- immediate impact resulting from reconnaissance and analysis for immediate performance (*Time Critical Strike*, TCS);
- actions in favor of own forces as part of the protection of troops (*Force Protection*, FP), and in this creating buffer zones, also combating asymmetrical threats. Still current threats from asymmetrical means cause the need for effective protection and defense of vessels and shore infrastructure of the Polish Navy (*Force Protection*). We are talking about ships carrying out a stopover on unguarded roadsteads, anchorages or maneuvering in shallow water zones and closed water areas. The use of UAS will, firstly, improve the possibilities of detection from the recognition of threats, and secondly, it will allow them to immediately oppose them;

³ Data obtained from the Lublin University of Technology.

- activities in the common architecture of UAS-USV-UUV, including mainly retransmission of signals and data transmission in the relation of the drones-command post.



Fig. 2. View of the UAS Albatros, SAR version

Source: Lublin University of Technology.

4. DEFINED RECIPIENTS AT THE TACTICAL LEVEL

Impact rocket potential, designed to combat naval targets and selected land targets of the Navy, is created by a Marine Rocket Unit (two Fire Squadrons) with platforms in the form of missile ships of project 660 (*Orkan*). Marine Rocket Unit, equipped with Norwegian missiles (Table 4) – *Naval Strike Missile* (NSM) – is designed mainly to combat the opposing naval forces of the enemy.

Table 4. Characteristics of the NSM missiles

NSM (IR seeker)		
	Range [km]	>200
	Combat warhead [kg]	Equivalent of 100 TNT
	Missile mass [kg]	407
	Speed [Mach]	0.7-0.95
	Length [m]	3.96

Source: (KONGSBERG).


Its other tasks include the cover of the main Naval Bases (NB), Landing Points (LP), areas convenient for landings of amphibious warfare as well as important military and industrial facilities located on the Polish coast.

MRU is characterized by high maneuverability and high fire efficiency. MRU has the ability to cooperate with the naval forces of the Navy in defense of the sea coast, shielding

of maritime transport lines as well as support for the activities of the Navy and Land Forces (LF) in defense operations.

Modern Swedish missiles, the RBS-15 Mk3, are used to equip the three remaining missile vessels OORP Orkan, Piorun, and Grom. These are defense missiles capable of maneuvering and changing the direction of a flight on a previously planned route (*waypoints*).

Table 5. Characteristics of the RBS-15 Mk3 missiles

RBS-15 Mk3 (Active radar seeker)		
	Range [km]	>200
	Combat warhead [kg]	200
	Missile mass [kg]	630
	Speed [Mach]	0.9
	Length [m]	4.35

Source: (SAAB).

5. ONBOARD STATIONING

Only the warships of certain types have the potential for taking (take-off and landing) the UAS (table 6). In 2016, there was information about the underestimation of expenses related to the implementation of the plans of “Plan Modernizacji Technicznej Sił Zbrojnych RP w latach 2013–2022” (*Plan for the Technical Modernization of the Polish Armed Forces in 2013–2022*), based on which “Program Operacyjny – zwalczanie zagrożeń na morzu w latach 2013-2022/2030” (*Operational Program – fighting threats at the sea in 2013–2022 / 2030*) is implemented. Originally, it was assumed to acquire for the Navy three patrol vessels with the function of fighting mines – Czapla (2015–2026), and the same number of the coast defense vessels – Miecznik (2014–2026). In practice, this means that the issue of obtaining new warships by the naval armed forces is questionable. Their acquisition is dictated by an urgent operational need.

The *Strategic Concept of National Security of the Republic of Poland* (“Strategiczna koncepcja bezpieczeństwa narodowego Rzeczypospolitej Polskiej”) published in February 2017 indicates the key role of frigates, which for years have been considered as “workhorses of navies” in opposition to contemporary threats (Strategiczna koncepcja, 2017). This fact is also confirmed by the general tendency to increase the number of large ships by the navies of the Baltic states (increase from 18 to 22 in comparison with the state from 1978 and 2015 with a reduction in the number of ships remaining in the classes). What is important for the future usage of UAS Albatros, units of this class absolutely must have the ability to base or at least receive (landing and take-off) on-board helicopters. Thus, it is obvious to maintain and develop the possibility of using UAS on the units of these classes. The specialization of frigate ships (anti-submarine combat, escorting, combating air assault agents) is not important. Because all frigates need to improve their ability to strike and point targets at non-horizontal ranges. Equipment at UAS will naturally lead to greater opportunities.

Table 6. Warships of Republic of Poland which can take UAS

Class	Project	Number	Name	Mission
Training ship	888	1	ORP Wodnik	FP
Rescue ship	570	2	OORP Lech, Piast	SAR, CSAR
Spy ship	863	1	ORP Nawigator	ISR, OTH-T, BDA
ZOP Frigate	OHP	2	OORP Gen. K. Pułaski, Gen. T. Kościuszko	ISR, FP, OTH-T, DBA
Logistic support ship	890	1	ORP Adm. X. Czernicki	ISR, FP
Sum (current state)		7	Planned units	
Project <i>Gawron</i> (in construction)			ORP Ślązak	
Project <i>Miecznik</i>		3	-	ISR, FP, OTH-T, BDA
Project <i>Czapla</i>		3	-	ISR, FP, OTH-T, BDA

Source: own elaboration.

6. UAS ARMAMENT

One of the elements to be assessed and variant when carrying out conceptual work on UAS operating in the marine environment is the ability to transfer weapons. The main limitation in this respect is the UAS load capacity and the maximum mass of weapon systems of 50 kilos indicated by the LUT.

Performance of offensive actions within the framework of TCS obviously requires UAV (*Unmanned Aerial Vehicle*) equipped with weapons able to affect marine objects. While the tactical UAV intended for the implementation of missions over sea areas is not capable of transferring agents capable of combating ships of any class, one should not forget about the ability to attack small targets (boats and pontoons), which can be implemented, for example, using onboard HMG.

Advanced Precision Kill Weapon Systems are already being created (APKWS on board of MQ-8B *Fire Scout*). The query of materials concerning fire-fighting measures of UAS global structures indicates that they are equipped with:

- anti-tank guided missile (AGM 114 *Helfire* – mass of the missile, about 45 kg, in case of UAS MQ-1 Predator);
- laser-guided bomb GBU-12 *Paveway II*, UAS or bombs GBU-38 (MQ-9 *Reaper*);
- anti-radiation missiles.

Development of the attack system will be the challenge for UAS Albatros. Additional analyze requires the development of modular variants of suspended rocket sets (guided missiles and unguided missiles). Anti-tank sets can be the example here. Mass of the whole system of ATM *Spike* is about 26 kg and it is an element worth researching on the use of this type of weaponry on UAS decks. HMG, bombs and non-lethal weapon systems⁴ are

⁴ This type of weaponry includes Long Range Acoustic Devices, flamethrower and flashlight grenade launchers, laser blinders.

also taken into account. At the current level of development of UAS, one of the key elements becomes acquiring the ability to combat. We are talking about intercepting and disabling and destroying systems of UAS. One example of this is the light weight (weight of a set of 12 kg) *SkyWall 100 Drone Defense System*.

It is destined to combat UAS systems in a distance from 10 to 100 m in the range of the speed of movement of the target up to 15 m/s (approaching target) and up to 12 m/s (target moving along). The temperature range of the set operation is between -5°C and +50°C. The cartridge containing the incapacitating net and weights weighs 760g. The outspread net covers the surface of about 8m² and moves at a speed of about 3 m/s (OPENWORKS).

7. DEFENCE ONLY?

The above-mentioned areas of using UAS for state defense do not fully cover the potential of such systems. As regards the implementation of the mission for safety, with particular emphasis on the state's maritime security, the following range of activities has been identified:

- ecological monitoring (compliance with exhaust emission directives, observation of periodic blooms of water, spills of petroleum substances, etc.);
- combating maritime terrorism;
- protection of sea objects of the critical infrastructure (off-shore platforms, wind farms, sea ports);
- monitoring of situations within the framework of combating crisis situations (natural disasters, humanitarian aid, damage assessment).

Potential receivers of the UAS systems can be services and institutions responsible for safety on Polish sea areas. The main services that are part of the naval forces of the state include:

- Sea Border Guard Unit;
- Water Police;
- Services subordinate to Maritime Offices;
- Companies involved in the exploitation of energy resources (oil, gas);
- Maritime Search and Rescue Service.

The protection of marine Critical Infrastructure (CI) facilities is of particular importance here. On the Polish coast, the role of the main transshipment ports is played by ports in Gdynia, Gdańsk and the Szczecin-Świnoujście port complex. The newly opened Gazoport in Świnoujście (in the scope of imports of liquefied natural gas LNG) and Naftport in Gdańsk (oil and petroleum products) play a key role in diversifying the supply of strategic raw materials for the country's energy security. In addition, in the area of the Exclusive Economic Zone (EEZ), continuous drilling works are run by platforms seated on the seabed and extracting crude oil and natural gas. The importance of LNG supplies by sea was noticed on the other side of the Atlantic. Gas terminals and LNG carriers serviced by them, sometimes called gas carriers, are covered with special protection on approach tracks. These tasks involve serious forces and resources (from officers to patrol boats and helicopters). Since scientists cannot agree on the effects of a potential terrorist attack on such objects, LNG terminals are treated as potential goals of this type of activity. On the other hand, gas carriers, next to tankers, are indicated by experts directly as one of the main goals of terrorist actions.

On the Polish coast there are favorable conditions for the construction of wind farms, as alternative sources for acquiring the so-called *clean energy*. Data provided by Polskie Towarzystwo Energetyki Wiatrowej (the Polish Wind Energy Association) indicate that the capacity of wind farms in Polish maritime areas is approx. 8GW.

Under the surface of the water there are dozens of undersea cables (power, telecommunications), pipelines and other facilities that enable or draw from the sea resources, or secure the process of conducting scientific research.

The development of asymmetrical threats and elements of the subliminal and hybrid war indicates a very high dynamics of dangers. Activities aimed at early detection of symptoms and opposition to threats are characterized by time deficits. UAS have several basic positive elements that characterize their activities. As a key to mention should be the dismissal of operators (crews of on-board surface and air units, or shore facilities for the benefit of which tasks are carried out) from the sources of threats. In addition, the range and speed of UAS in combination with installed ISR sensors significantly affect the possibility of early detection of threats. This creates a situation that enables the relevant services to analyze the picture of the situation (creating operational awareness of the reservoir, the region) and take action almost at the same time (provided that armed UAS is available).

Considering the issues of additional missions and potential recipients from outside the defense and security of the maritime state, it is not difficult to identify other potential UAS users. The large range of detection, good field of view, the possibility of rapid movement are features that should be considered as very beneficial from the point of view of using UAS to operate in the Police structures or services responsible for supervision and traffic control on motorways. The same factors may be used by the State Fire Service (patrolling and commanding firefighting actions of large-area forest facilities, evacuating and delivering extinguishing agents to hard-to-reach areas). The next services are the Border Guard (patrolling border regions, as well as people, as well as in inland and maritime areas), Customs Service or Road Transport Inspection.

8. SUMMARY

The dynamics of contemporary military and non-military threats forces the introduction of modern systems capable of counteracting them to the full extent. Acquiring UAS by the Navy is an urgent matter due to the nature of the operations performed (operational need) and the level expected by the crews of ships and soldiers of the shore units of the Navy. The main task of UAS operating in the marine environment (over the water areas) performing tasks from ship decks and coasting, are exploratory missions. The wide range of possibilities of modern UAS in this area allows to increase and effectively use the existing combat potential (mainly fire). It should be emphasized that UAS Albatros in the *dual use* can carry out a whole range of missions in favor of the naval services of the state. Using the potential created by the modular construction, it could easily be adapted to the specifics of the tasks of the Fire Brigade, Customs Service or the Police.

The above-mentioned "Strategic Concept (...)" in the chapter devoted to recommendations for the development of Polish naval forces, as the need indicates the acquisition of unmanned systems supporting operations in the air, on water and under water, including unmanned air systems of short and medium range. Described, in the article, examples of the use of this type of systems may be a contribution to the discussion on the role of the state security system and securing Polish interests at sea. We are talking about applications from

both the defense area of the state and the implementation of actions for the broadly understood maritime security of the state.

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