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PILICA Anti-Aircraft Rocket-Artillery System - a V-SHROAD System

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Abstract. The PILICA Anti-Aircraft Rocket-Artillery System has been developed for the Armed Forces of the Republic of Poland. The PILICA Anti-Aircraft Rocket-Artillery System is composed of: The Command and Control station, the Radiolocating station, six Firing Units along with Artillery Tractors, two Transport Vehicles, and two Ammunition Vehicles. PILICA's task is that of detecting, recognising, and identifying objects, then automatically dividing the tasks and commands for efficient elimination. PILICA's Firing Unit has autonomous-mode target detection, identification and elimination capabilities (without cooperating with Command and Control) using equipment such as its optoelectronic head and IFF system. In the system operation mode and in cooperation with Command and Control, the Firing Unit and its subsystems ensure the reception of commands/combat tasks in its fire responsibility zone, as well as reporting statuses and the completion of the given combat tasks.

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Reporting and command reception from the Command and Control station is automated. The Firing Unit can fire using its automatic tracking system, or when operated in manual mode. The Firing unit has been equipped with a portable remote control console, providing the ability to use it remotely. In case of a power supply malfunction in the Firing Unit, it is possible to use it entirely manually, with the use of artillery weapons. The Firing Unit is equipped with a stabilised, optoelectronic day-night head that enables it to work independently of the weapons when it comes to observation and detecting, as well as identifying, objects. The head constitutes not only an element of the guidance system, but also a source of information for the entire System, as the data on the detected and observed objects is exchanged within the entire command network. PILICA is equipped with a unique formation and training system, providing capabilities for training teams on real equipment, with the use of a virtual simulation management system employing the DIS protocol.
Keywords: anti-aircraft system, anti-aircraft set, aerial defence, rocket-and-artillery set, close-range system

1. INTRODUCTION

The PILICA Anti-Aircraft Rocket-Artillery System is a V-SHROAD anti-aircraft system, and is meant to be a complement to the Polish aerial defence, ensuring the protection of strategic structures such as airports, bases, and military units.

Its prototype has been developed as a result of the evolution of that structure, thanks to application of the experience obtained by the engineers of Zakłady Mechaniczne "TARNÓW" S.A. (Tarnów, Poland) while developing and modernising the previous anti-aircraft versions of 23 mm cannons and rocket-artillery sets. The application of new technologies allowed for a significant improvement in PILICA's firing effectiveness and functional quality.

The system has capabilities allowing for shielding a single object, such as Command and Control, or a greater area, such as the site of military concentration, an aerial base, or a logistical base, from aerial attacks. An example Firing Unit arrangement in the group is presented on Fig. 1.

The PILICA prototype possesses an integrated detection, identification, combat management, and aerial, grounded and naval vehicle elimination system, permitting it to achieve a high effectiveness at eliminating objects while retaining significant mobility and low costs of use [1, 2, 3]. Thanks to its increased velocity, detection precision and airborne object tracking, PILICA is capable of destroying combat airplanes and helicopters.

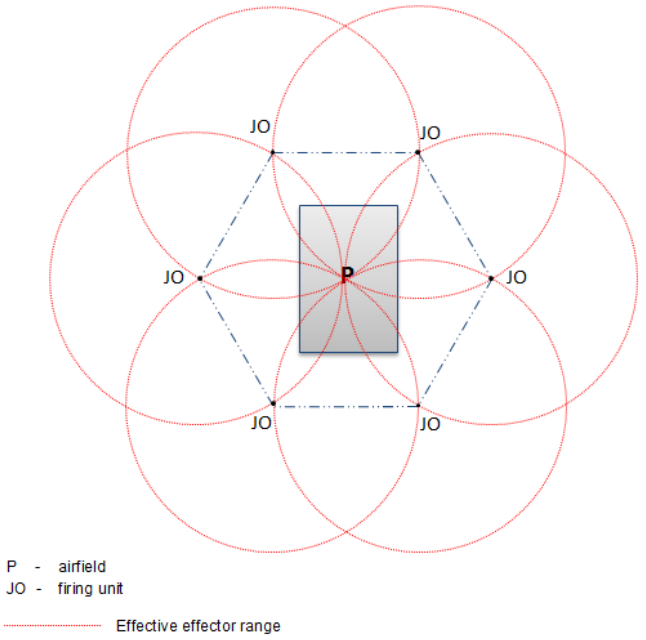

Fig. 1. Example PILICA arrangement
(Source: Zakłady Mechaniczne "Tarnów" S.A.)

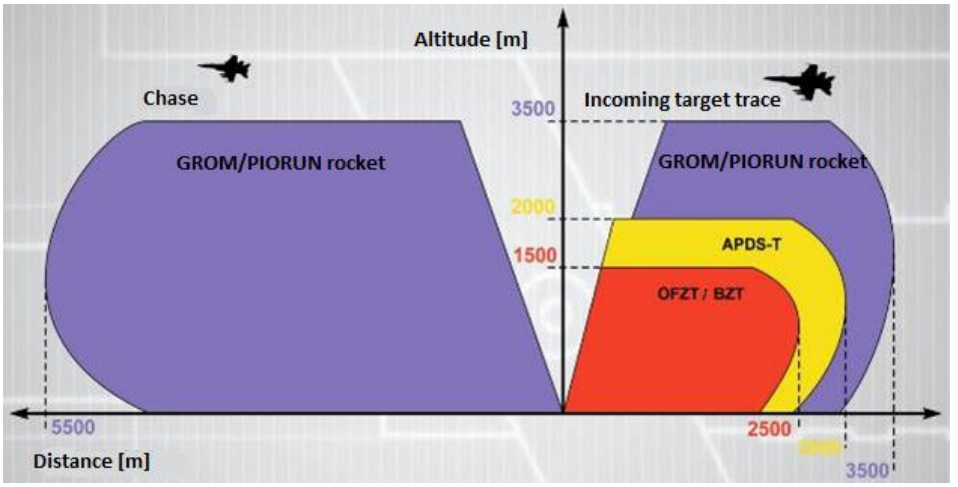

Fig. 2. PILICA's target elimination capabilities: APDS-T - a subcalibre anti-tank missile, OFZT - a cluster-demolition-ignition-track missile, BZT - an ignition-track anti-tank missile
(Source: Zakłady Mechaniczne "Tarnów" S.A.)

PILICA detects, recognises, and identifies objects, then automatically divides the tasks and commands. The PILICA Firing Unit possesses autonomous target detection, identification, and elimination (without cooperating with Command and Control) through the use of equipment such as its optoelectronic head or IFF system. In system operation mode and in cooperation with Command and Control, the Firing Unit and its subsystems ensure the reception of commands/combat tasks in its fire responsibility zone, as well as reporting statuses and the completion of the given combat tasks. Reporting and command reception from the Command and Control station is automated. The Firing Unit can be fired with the use of an automated tracking system, as well as in manual mode by the operator. The Firing Unit has been equipped with a Portable Remote Control Console, ensuring the ability to operate it remotely. Should the Firing Unit's power unit malfunction, it is possible to use the unit completely manually, with the use of artillery weapons. The Firing Unit is equipped with a stabilised, optoelectronic day-night head that enables it to work independently of the weapons when it comes to observation and detecting, as well as identifying objects. The head constitutes not only an element of the guidance system, but also a source of information for the entire System, as the data on the detected and observed objects is exchanged within the entire PILICA command network.

2. PILICA – BASIC INFORMATION

2.1. Historical background

The project was implemented in 2012-2015 by Zakłady Mechaniczne "Tarnów" S.A. Its aim was to commence PILICA Anti-Aircraft Rocket-Artillery System production, conducting research and obtaining results from the PILICA prototype, as well as elaborating the prototype's technical documentation. Within the scope of PILICA's development, the following tasks have been performed:

- works within the scope of the anti-aircraft rocket-artillery set, within the framework of the development project, have been concluded,
- the conceptual and technical analysis of the optimal way to meet the needs of the Armed Forces of the Republic of Poland,
- a preliminary system project and technical documentation have been drawn up,
- PILICA prototype unit creation and test,
- authoring of the documentation for the test batch.

2.2. Prototype and tests

The PILICA prototype tests were performed in a scope entailing both individual and collective tests regarding:

- Command and Control with command and combat management terminals (Fig. 3), means of communication as well as systems for electric power supply, Firing Unit information exchange, and master command system information exchange,

Fig. 3. Commander's station and PILICA's means of communication
(Source: Zakłady Mechaniczne "Tarnów" S.A.)

- Firing Unit (Fig. 4), ensuring the elimination of aerial means of attack using artillery and GROM/GROM-M rockets, with a TUR-2 vehicle (Fig. 5) used as the Firing Unit's artillery tractor,

Fig. 4. PILICA during night artillery shooting (Central Air Force Range, Ustka, Poland)
(Source: Zakłady Mechaniczne "Tarnów" S.A.)

- a wired and wireless communications subsystem,
- a JELCZ 442.32 vehicle as the transportation vehicle for Command and Control.

Fig. 5. TUR-2 as an artillery tractor
(Source: Zakłady Mechaniczne "Tarnów" S.A.)

Due to the broad scope of the checks concerning the particular elements of PILICA, the tests of the systems have been divided into three stages:

- stationary tests on the premises of Zakłady Mechaniczne "Tarnów", entailing i.a. checks of the particular subsystems,
- dynamic tests on the Chrcynno flying club's airfield (Fig. 6). They were dynamic tests encompassing attempts at capturing and tracking the target,
- range tests conducted at the Central Air Force Range in Ustka, concluded with artillery shooting.

Fig. 6. PILICA during the dynamic tests
(Source: Zakłady Mechaniczne "Tarnów" S.A.)

As a result of the tests conducted, it has been determined that the particular elements of PILICA, i.e. Command and Control, the Firing Unit, and the wired and wireless means of communication were found to conform to the requirements determined in the Tactical and Technical Guidelines elaborated by Zakłady Mechaniczne "Tarnów" S.A. for PILICA.

3. THE "PILICA" SYSTEM FOR THE ARMED FORCES

The PSR-A PILICA consortium, made up of Polska Grupa Zbrojeniowa S.A., Zakłady Mechaniczne Tarnów S.A., PIT-RADWAR S.A., and PCO S.A., has signed a contract for the delivery of 6 PILICA systems to the Polish Armed Forces. The first stage of the contract is the Executive Project, determining the scope in which the product created by Zakłady Mechaniczne "Tarnów" S.A. should be adapted to suit the needs of the Polish Armed Forces. The PSR-A PILICA consortium has concluded the first stage, i.e. the elaboration of the Executive Project; the submitted project has been approved by the Armament Inspectorate of the Polish Ministry of Defence.

The MoD-approved PILICA configuration is shown in Figure 7. The approval on the Executive Project has launched the PILICA production and delivery phase.

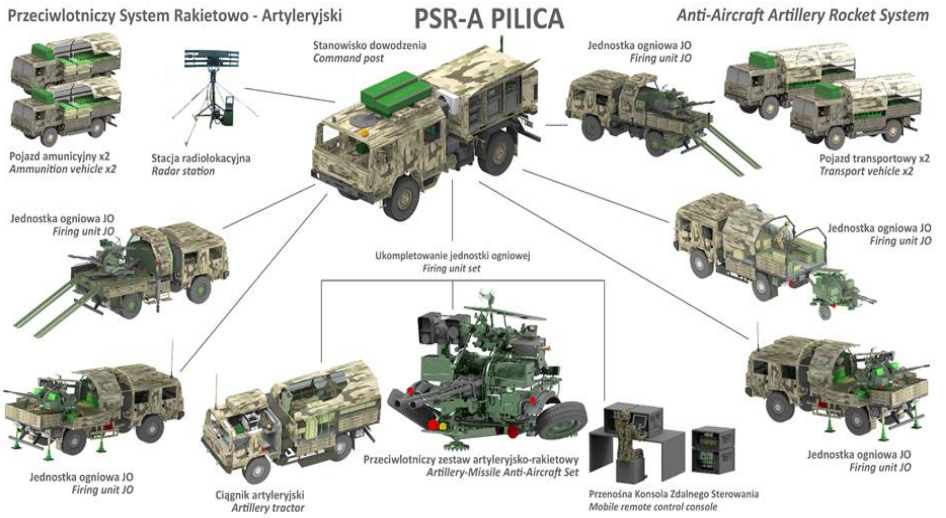

Fig. 7. PILICA configuration
(Source: Zakłady Mechaniczne "Tarnów" S.A.)

As an anti-aircraft system, PILICA is made up of the following elements:

Command and Control stations (SD) – made up of: a medium-sized truck with a dedicated operator's console, auxiliary work station, unit powering subsystem, and means of communication. The communications and power supply units are found in the container mounted on the cargo box, while the operator's console and auxiliary station are found in the vehicle's cabin. PILICA's composition includes one Command and Control station.

Radiolocation Station (SR) – the mobile radiolocation station is connected with the Command and Control station using wired and wireless data connections ensuring the system's situational awareness in the airspace. PILICA's composition includes one Radiolocation Station.

Firing Unit (JO) – this is a key component of PILICA, making up its weaponry. A PILICA Firing Unit is made up of an Anti-Aircraft Rocket-Artillery System (PZR-A), being a modified version of the 23 mm towed ZU-23-2 anti-aircraft set used by the Polish Armed Forces. The set's weaponry is two 2A14 cannons, and a launching set for two GROM/PIORUN missiles. Each Firing Unit is connected with the Command and Control station via either a wired or wireless connection. The aiming subsystem is integrated with the IFF interrogator and tracking system.

Apart from the Anti-Aircraft Rocket-Artillery System, JO includes: a portable remote control console, an autonomous power supply system, as well as the necessary communications systems. PILICA's composition includes six Firing Units.

Artillery Tractor (CA) – a vehicle fulfilling the main assumptions of a medium-load vehicle with high mobility, 4x4 drive, and enabling the Firing Unit to move in difficult terrains. The Artillery Tractor is meant for towing the Firing Unit, transporting the soldiers operating it, and transporting ammunition and equipment. The tractor has an open bodywork. PILICA's composition features six Artillery Tractors.

Ammunition Vehicle (PA) – a vehicle classified among the medium-load, high-mobility group, meant for transporting ammunition, rockets, voltaic cells, tools and equipment, supplies, and specialised equipment with a mass of at least 2000 kg – both during combat and during peacetime, in difficult terrain conditions, during the day and at night. PILICA's composition features two Ammunition Vehicles.

Transportation Vehicle (PT) – a vehicle classified among the medium-load, high mobility group, meant for transporting PILICA's equipment along with spare parts, tools and equipment, supplies, and specialised equipment with a mass of at least 2000 kg – both during combat and during peacetime, in difficult terrain conditions, during the day and at night. PILICA's composition features two Transportation Vehicles.

Means of wired and wireless communication – devices ensuring secure transmission of audio and digital information. The means of communication ensure network organisation, allowing for relaying information to every element of PILICA, as well the overarching and cooperating systems.

4. SUMMARY

The Anti-Aircraft Rocket-Artillery System based on a 23 mm cannon, popular in the Polish Army, still fulfils its function as a way to strike targets at very close range. PILICA is a modern system solution, capable of meeting the requirements of the modern battlefield. Equipping the Firing Units with modern guidance systems and tracking heads improves the effectiveness of eliminating targets using artillery means, and the integrated GROM/GROM-M rocket launchers increase the system's striking range. The modern ICT system, along with the implemented protocol, allows for integrating PILICA with the Republic of Poland's overarching anti-aircraft defence systems. The method of developing (locating) the particular elements of PILICA ensures high mobility, guaranteeing quick re-grouping and dislocation to another place.

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Przeciwlotniczy System Rakietowo Artyleryjski PILICA – system bardzo krótkiego zasięgu

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Streszczenie. Przeciwlotniczy System Rakietowo Artyleryjski PILICA opracowany został na potrzeby Sił Zbrojnych RP. W skład PSR-A PILICA wchodzą: Stanowisko Dowodzenia, Stacja Radiolokacyjna, sześć Jednostek Ogniowych wraz z Ciągnikami Artyleryjskimi, dwa Pojazdy Transportowe, dwa Pojazdy Amunicyjne. PSR-A PILICA ma za zadanie wykrywać, rozpoznawać i identyfikować obiekty, a następnie rozdzielać zadania i komendy w sposób zautomatyzowany w celu skutecznego zwalczania. Jednostka Ogniowa PSR-A PILICA posiada możliwości wykrywania, identyfikacji oraz zwalczania celów w trybie autonomicznym (bez współpracy ze Stanowiskiem Dowodzenia) poprzez posiadane wyposażenie takie jak głowica optoelektroniczna oraz system IFF. W trybie pracy systemowej, przy współpracy ze Stanowiskiem Dowodzenia, Jednostka Ogniowa oraz jej podsystemy zapewniają odbiór komend/zadań bojowych w swojej strefie odpowiedzialności ogniowej, raportowanie statusów oraz wykonania postawionych zadań bojowych. Raportowanie oraz odbiór komend i zadań ze Stanowiska Dowodzenia odbywa się w sposób zautomatyzowany.

Jednostka ogniowa posiada możliwości prowadzenia ognia z wykorzystaniem układu automatycznego śledzenia jak również w trybie ręcznym przez operatora. Jednostka ogniowa wyposażona została w przenośną konsolę zdalnego sterowania, zapewniającą możliwość obsługi zdalnej. W przypadku awarii zasilania w Jednostce Ogniowej możliwe jest jej wykorzystanie w trybie całkowicie manualnym, z zastosowaniem uzbrojenia artyleryjskiego. Jednostka ogniowa wyposażona jest w stabilizowaną optoelektroniczną głowicę dzienno-nocną, umożliwiającą pracę niezależnie od uzbrojenia w zakresie obserwacji oraz wykrywania i identyfikacji obiektów. Głowica stanowi nie tylko element układu naprowadzania, ale również źródło informacji dla całego Systemu, gdyż dane o wykrytych i obserwowanych obiektach wymienianie są w całej sieci dowodzenia. PSR-A PILICA wyposażona jest w unikalny system szkolenia i treningu, który zapewni możliwości szkolenia załóg na sprzęcie rzeczywistym z wykorzystaniem wirtualnego system zarządzania symulacją z zastosowaniem protokołu DIS.

Słowa kluczowe: system przeciwlotniczy, zestaw przeciwlotniczy, obrona powietrzna, zestaw rakietowo-artyleryjski, system bliskiego zasięgu