



The Development of Poland's Air Defense System: The Operational Context

Eugeniusz CIEŚLAK

Siedlce University of Natural Sciences and Humanities, Siedlce, Poland;
eugeniusz.cieslak@uph.edu.pl, ORCID: 0000-0002-6476-3643

DOI: <https://doi.org/10.37105/sd.44>

Abstract

This article discusses the operational context for the development of Poland's air defense system. This assessment focuses on air defense operations in high intensity conflict. Recommendations include setting a realistic level of ambition in the field of air defense and increasing operational capabilities through the modernization of its combat assets. The priority proposed for Poland's air defense system is to introduce a new generation of short range surface to air missile systems and then develop medium range air and missile defense capabilities.

Keywords: air defense, operational context, development, Poland, defense

1. Introduction

This article attempts to provide a brief assessment of the operational context of Poland's air defense system development. Due to the unclassified nature of the article, the discussion is limited to public documents, media and academic work. The discussion of doctrinal fundamentals

serves as an introduction to further considerations related to air defense and the air defense system. Then, the article offers an assessment of the current capabilities of Poland's air defense system and confronts them with prospective air threats to propose improvements. The assessments and opinions contained in this article reflect the author's personal views only. Due to the nature and limited scope of the ar-

ticle, the discussion is limited to the problems of the air defense operations during a high intensity conflict.

2. Doctrinal fundamentals of air defense

The study of the operational aspects related to the development of Poland's air defense system needs direct references to the relatively universal doctrinal assumptions and decisions adopted in relation to this system in long-term strategic concepts. Air defense, which aims at the protection of friendly forces from enemy air and missile attacks, is seen in the military doctrine through the prism of active and passive defense. Active air defense activities include the use of airborne and surface based air defense assets to destroy missile and air threats or reduce the effectiveness of their employment. After some simplification, it can be assumed that active air defense is focused on direct kinetic and non-kinetic actions against air and missile threats. On the other hand, passive air defense includes all the measures that reduce the effectiveness of an enemy air attack by increasing the survivability of defended assets through early warning, camouflage, concealment, deception, hardening, dispersion and reconstitution (NSA, 2010). An assessment of any air defense systems requires a detailed examination of its capability to perform essential functions. That is especially relevant for those functions enabling active air defense. Integrated detection, identification, assessment, interception and engagement of air and missile threats is essential to active air defense operations. The implementation of those functions requires an air defense system to have specialized components that are usually referred to as subsystems. The essential

components of active air defense are: airborne and surface based combat assets, surveillance assets and command and control elements. NATO doctrine identifies weapon systems, and surface environment, which is subsequently divided into control and reporting agencies together with sensors, communications systems and data processing facilities as well as contributing systems supporting air defense operations (NSA, 2010). In general, relatively universal rules for the establishment, operations and development of air defense systems focus on the requirements related to their optimization in relation to the essential air threats, as well as the complementarities of the means used to eliminate the limitations of individual weapon systems.

In an assessment of Poland's air defense system, reference to its interrelationships within the NATO Integrated Air and Missile Defense System is necessary. This applies above all to the degree of the "independence" and "self-sufficiency" of the national air defense system, but, as a consequence, also to the scope of international cooperation in the field of air and missile defense and the scope of operational capabilities, which will be developed only in the alliance dimension (JAPCC, 2017).

From the point of view of Poland's development of the national air defense system, it seems important to refer to two basic options for the employment of air defense assets. The allied doctrine and a number of references in related scientific work point at an option of minimizing the damage sustained by own forces and facilities and an option of inflicting maximum attrition on the enemy (NSO, 2016). Depending on national priorities, the air defense system may be developed to achieve one of these aims or a compromise of them. In the context of military threats from the Russian Federation, both of these options should be considered in the

light of the cultural approach of the potential adversary to their own losses (Cieślak, 2018). Taking into account the above theoretical assumptions and doctrine, an attempt can be made to assess the current state of Poland's air defense system.

3. Assessment of the current state of Poland's air defense system

The current state of Poland's air defense system has been, similarly to the situation in many member states of the North Atlantic Alliance, the result of previous organizational solutions as well as trade-offs between the desired operational capabilities and the technological and financial capabilities of the state. From the perspective of two decades of Poland's membership in NATO, one can notice the lack of a long-term, realistic concept for the development of the national air defense system that would be consistently implemented (Cieślak, 2018). Due to the specific modernization needs of respective services of the armed forces and the involvement of the Polish Armed Forces in out of area combat and stability operations the development of individual components of the Polish air defense system was not fully harmonized. Some of the components of the national air defense system were modernized by purchasing new weapon systems, or modernizing legacy weapon systems. Some of the modernization decisions after 2000 were postponed because of political, economic or operational reasons. The coherence of efforts related to the development of the national air defense system were negatively affected by changes in the priorities and programs of technical modernization of the armed forces. Changes in

priorities were also the result of subsequent strategic defense reviews, including the review completed in 2017, main conclusions of which were included in the "Defense Concept of the Republic of Poland". The lack of coherence and continuity of efforts aimed at the development of the national air defense system has resulted in generation and capability gaps between the components of the air defense system and within the components. The generation gap in airborne air defense assets means that more than thirty-year old MiG-29 fighters operate along with advanced F-16 aircraft. The ground based air defense forces, both in the Air Force and the Polish Army, are equipped with surface-to-air-missile systems, which by large are obsolete and will need retirement in coming years. The surface-to-air-missile systems are capable of engaging a single aerial target at a time and their origin dates back to the seventies of the last century. The exceptions are the relatively modern man portable air defense systems Grom and their mobile versions of Poprad (Dobija, 2019). However, they both are very short-range infrared guided air defense systems. The aftermath of the Warsaw Pact doctrine and organizational solutions still results in the Polish Air Force and the Polish Army operating surface to air missile systems with similar tactical capabilities. Poland's air defense system has been optimized for combating aircraft and, to a lesser extent, helicopters. One must also note a relatively good mobility of ground based air defense systems. The air defense surveillance and target acquisition assets of the Polish air defense system are predominantly radar, some of which are mobile. Official assessments of Poland's armed forces suggest that the air defense system lacks sufficient electronic warfare capability as well as camouflage and deception capability (Roslan, 2018). This may adversely affect both active air defense operations and passive air defense measures.

4. Priorities for air defense system's development

Delays in implementing the technical modernization programs for the Polish Armed Forces over last two decades have led to a cumulative need for new weapon systems by all services of the armed forces. Realistically assessing Poland's economic potential, it should be noted that even with the current priorities for technical modernization of the armed forces until 2035, it will be impossible to acquire all planned weapon systems and achieve the declared operational capabilities (MON, 2019b). In the perspective of the next decade, and probably also in the longer perspective, it will be necessary to make choices regarding the type of capability acquired and the capacity that will be achieved. Also, in the case of Poland's air defense system, it will be necessary to answer the question about the types of operational capabilities and capacity for those capabilities. When considering the operational aspects of developing a national air defense system, one must be aware of the need to compromise between the level of ambition in air defense and the technological and financial capabilities of the state. From the perspective of the last few years, Poland's ambitions in the field of missile defense can be a good example. The cost of purchasing two PAC-3 MSE Patriot batteries in March 2018 was USD 4.74 billion (MON, 2019c). The capacity of the missile defense provided by the two batteries will probably not be sufficient to meet the needs. Acquisition costs for another six Patriot system batteries will surely expand capacity (MON, 2019b). But at the same time, it will limit the availability of financing for the remaining components of the national air defense system. Despite the urgent needs related to the modernization of ground based air defenses optimized to engage only air threats, which might be much

cheaper than missile defense systems, medium-range missile systems have become the political priority of purchases (MON, 2019c).

Assessing the changes in the security environment that have taken place in recent years in Poland's environment it can be predicted that under the conditions of the Article V collective defense operations, the national air defense system will have to combat a significant number of technologically advanced air and missile threats. Tactical ballistic missiles will be the most serious threat to facilities, such as airports and naval bases, command posts at the strategic and operational level as well as communication nodes (Fabian et al, 2019). Given the significance of that infrastructure for deployment of NATO forces to the alliance's eastern flank, it is necessary to look for effective ways for missile defense. One may consider, at least during the transition period, the implementation of this specific task by allied forces. It is also worth considering ways to degrade a threat of enemy's tactical ballistic missiles through offensive operations, including the use of unmanned aerial combat systems.

In a potential armed conflict, the main effort of the national air defense system should focus on protecting military forces such as tactical combat teams. It can be expected that the air threat to tactical combat teams will result from enemy tactical air forces, both aircraft and assault helicopters using non-guided and guided weapons. As operations in the Syrian conflict suggest, Russian airpower has been increasing the percentage of air strikes from medium altitudes and use of guided air munitions (Lavrov, 2018). Therefore, it may be concluded that in a high intensity conflict scenario, at least some part of the air strikes may be conducted from outside the effective range of very short range air defenses such as Grom or Poprad. This should be taken into account

in the scenarios of future air defense operations. As a consequence, the choice of weapons will be crucial for the national air defense system to engage enemy combat aircraft performing strikes from medium altitudes. Fighter aviation alone may not be sufficient for this mission, especially taking into account a threat from tactical ballistic missiles such as SS-26 Iskander to the fighter air bases in Poland (Dobija, 2019). Poland's plans to acquire F-35 fighters will probably not change that calculus in a significant way (MON, 2019a).

Future high intensity conflict at the eastern flank of NATO may see a widespread employment of enemy unmanned aerial vehicles primarily performing reconnaissance tasks in support of their own rocket and long range artillery forces. Such use of unmanned aerial vehicles significantly increases the precision of rocket and artillery fire, which was reflected, among others, in the conflict in eastern Ukraine. It can be assumed that the threat to one's own troops from the tandem of unmanned aerial vehicles, rocket and artillery troops may be greater than from the SS-26 Iskander tactical ballistic missiles. While the latter will be effective against infrastructure targets, reconnaissance data provided in almost real time by unmanned aerial vehicles may allow enemy rocket and artillery troops to attack tactical troops in an accurate and flexible way. This requires a more detailed examination of the operational aspects of countering threat of unmanned aerial systems by Poland's air defense system. For smaller and cheaper unmanned aerial vehicles, the challenge for Poland's air defense system will be to select a weapon system which is not only operationally but also economically justified. The above dilemma became apparent with all its sharpness in the Lebanese War in 2006, when Israeli armed forces were forced to defend against Hezbollah's massive unguided missiles. The answer after a few years was the Iron Dome system, in which

the cost of missiles intercepting rockets was reduced to an acceptable level while maintaining combat effectiveness (Lambeth, 2012). It is difficult to judge the final solutions for combating unmanned aerial vehicles by the national air defense system in the perspective of the next decade or later. The scale and unorthodoxy of ongoing experiments with the use of unmanned aerial vehicles, as well as in the field of countering such threat, does not allow determining with sufficient degree of certainty potential solutions. Lasers, electronic interference, kamikaze drones, anti-aircraft artillery with programmable rounds, or the use of unguided rockets - the search areas are varied and it is difficult to determine which one is most promising. Due to the relatively small costs of developing technologies needed for addressing threat of the unmanned systems, it is worth, following the example of the armed forces of other countries, experimenting, gathering experience and developing specific technological solutions on a national scale.

The assessment of the military threat posed by the Russian Federation requires that doctrinal assumptions should be made regarding the philosophy of employment of Poland's air defense system. An attempt should be made to obtain an honest answer to the question of what we expect from the national air defense system in the event of potential aggression by an aggressor. In the author's opinion, it seems unrealistic to ensure full security for defended assets due to technological and financial reasons. On the other hand, it seems advisable to consider options related to increasing the capabilities of Poland's air defense system to inflict maximum attrition on an air opponent.

Russian airpower employment in the Syrian conflict showed the massive use of unguided air munitions. That requires the penetration of air defense engagement zones by attacking aircraft or helicopters thus making them vulnerable to active air

defense operations. If the priority of the employment of the national air defense system were inflicting maximum attrition to the air opponent, the capabilities to engage aerial threats should be increased not only at low, but also at medium altitudes, i.e. above three thousand meters. Such an approach requires the introduction of new anti-aircraft missile systems, which will replace the currently operated SA-3 Nawa SC and SA-6 Kub systems. It will also be necessary to take measures to increase the survivability of ground based air defense forces through the development of radio-electronic defense and masking systems (Roslan, 2018).

The development of ground based air defense forces seems justified, when one takes into account the lessons learned during recent conflicts, in which parties with diverse air potential clashed. One of the telling examples may be the operations of Serbia's air defense system during Operation Allied Force. The use of NATO airpower against Serbia in 1999 indicated that in conditions of air defense operations against an enemy with technological and quantitative advantage, the most vital element of the air defense system were a mobile surface to air missile systems. Air defense fighters were relatively quickly blocked at airbases, and fixed elements of the surveillance and command and control system were successfully attacked. The ability of the Serbian surface to air missile forces to pose a threat to NATO airpower throughout the Allied Force Operation significantly limited the freedom of use of the alliance's airpower and forced an unfavorable apportionment decisions. One should also notice the low effectiveness of attacking Serbian forces in Kosovo by a NATO airpower, which was caused, among others, by the presence of credible air to surface missile threat. It may be concluded that from an operational point of view, it would be desirable for Poland to operate mobile surface to air

missile systems capable of operating in a decentralized and autonomous manner.

Lessons learned from the armed conflicts of others cannot predetermine specific solutions for the development of Poland's air defense system. In the case of an extremely unfavorable turn in the international situation, Poland may become a victim of aggression not only by air, but also by land. Due to the above, the length of defense activities and the ability to maintain key areas and facilities within the country may determine the options of allied assistance. Therefore, the national air defense system's ability to inflict maximum attrition on an air opponent may be a factor in military deterrence that strengthens alliance guarantees (Roslan, 2018). Taking into account the possible operational scenarios of a potential high intensity conflict, it can be hypothetically assumed that the priority of air defense should be the protection of troops and facilities crucial for the Polish Armed Forces, and then allied forces' defensive operations. Considering the above-mentioned assumptions, an attempt can be made to articulate recommendations regarding the composition and size of individual components of the national air defense system desirable from the point of view of operational requirements.

The last decade has not seen any significant improvement in the state of Poland's air defense system. The situation is particularly acute in terms of ground based air defenses, in particular small and medium range anti-aircraft missile systems (Cieślak et al, 2011). Due to the fundamental changes in the security environment that took place after 2014, the priority in the development of the national air defense system should be to take urgent measures leading to the modernization of, above all, ground-based air defenses. Currently, the only modern class of anti-aircraft weapon system in Poland's air defense system are very short-range anti-aircraft missile systems (VSHORAD),

which are effective against air threats at distances of about five kilometers and altitudes of just over three kilometers. Poland's air defense system lacks advanced short-range surface to air missile systems capable of engaging air threats at distances of around thirty kilometers and altitudes of up to several kilometers, as well as medium-range systems. Legacy surface to air missile systems such as SA-3 Nawa SC, SA-6Kub and SA-8 Osa do not guarantee effective engagement of air threats not only because of the archaic nature of technological solutions, but also because the potential enemy has extensive knowledge about their weaknesses and limitations (Dobija, 2019).

In the long term, the operationally desirable solution for Poland's air defense system would be to have very short, small and medium range surface to air missile systems. However, in the short term, mainly because of economic reasons, it will be necessary to make the inevitable choice which capability to introduce or modernize first. In the next few years, it will be necessary to start replacing the currently used legacy radar guided surface to air missile systems with a new generation of air defense systems capable of autonomous or distributed operations against advanced air threats. Despite the obvious needs in this regard, which have been articulated by the military for over a decade, there has been no satisfactory action at political levels that would translate into tangible results soon.

Doctrinal patterns of potential opponent forces, to include the role of airpower in hypothetical armed aggression against Poland, makes it rational to acquire short range surface to air missile systems. The technology offered by the short-range surface to air missile systems available on the market seems adequate in relation to the nature of prospective air threats. At the same time, the lower costs of short-range surface to air missile systems may allow purchasing more fire modules than those

of medium range systems. Short-range surface to air missile systems may offer a rapid and significant increase in the operational capacity of Poland's air defense system to inflict maximum attrition on the potential aggressor airpower. Giving priority to the acquisition of medium range surface to air missile under the first stage of WISLA program, may delay the procurement of short range systems and create a generation gap after the retirement of SA-3, SA-6 and SA-8 missile systems. A new generation of short-range surface to air missile systems might allow Poland's air defense ground based air defenses utilizing older generation systems through operations in air defense clusters. However, when choosing new short range surface to air missile systems, their ability to operate in a network-centric environment should be taken into account. The capability of simultaneous engagement of several air threats by a single anti-aircraft combat vehicle within a radius of up to thirty kilometers and at altitudes of up to several kilometers seems to be achievable in both technological and economic terms. High mobility, obtaining information about the air situation from external sources and having, in addition to radar, also passive detection systems, should ensure the survivability of small range surface to air missile systems at modern battlefield.

The acquisition of more medium-range surface to air missile systems capable of defending against tactical ballistic missiles will require more detailed considerations. In professional discussions among air defense specialists, the argument of the proportion of costs incurred in relation to the expected operational effects is raised. It is difficult to say with full conviction that Poland will be able (at least in economic terms) to create a missile defense system that will be fully effective against a barrage of the tactical ballistic missiles of a potential aggressor. If the effectiveness is not high enough, does it

justify maintaining such a high political priority of missile defense among the activities for the development of the national air defense system? Full use of the surface to air missile sets capable in ballistic missiles defense requires the possession of satellite reconnaissance means that provide sufficient early warning. Medium range surface to air missiles may be used to engage air threats, but they cannot perform missile and air defense tasks simultaneously. Due to the acquisition costs, medium-range surface to air missile systems will generate a heavy burden on the state budget. This creates potential problems in the event of disruptions in the financing of the technical modernization program of the armed forces. The purchase of medium-range surface to air missile systems before small-range ones may cause lack of sufficient financial resources for the latter ones or at least a delay in procurement. Such a scenario may affect the capability of Poland's air defense system to inflict maximum attrition to an air opponent, and consequently reduce the ability to effectively deter against a potential aggressor. If in the perspective of the next decade the national air defense system does not have a new generation of short range surface to air missile systems of the new generation, then two batteries of medium-range surface to air missile systems will not be a credible potential for military deterrence against hypothetical armed aggression directed against our state. The national air defense system would then not be able to provide effective protection for key forces and infrastructure, or to inflict maximum attrition on an air opponent. Therefore Poland's air defense system should have in the long term both small- and medium-range surface to air missile systems. Nevertheless, due to the state's ability to finance the technical modernization program in the time horizon of the next decade, it seems rational to shift focus to small-range surface to air missile systems. Subsequently, a second

phase of acquiring medium-range surface to air missile systems might increase to capacity of ballistic missile defense. Such an approach will ensure a faster increase of the operational capabilities of the national air defense system in the field of engaging air threats and reduce the risk of delays associated with the technological immaturity of missile systems.

The concentration of efforts on the modernization of short and medium-range surface to air missile systems should not stop the development of the other components of Poland's air defense system. The fighter component of the national air defense system should be assessed as satisfactory. However, over the next few years, midlife upgrade will be needed for F-16 aircraft and replacement for MiG-29 seems inevitable. Some of these activities are already being undertaken, e.g. the purchase of new AMRAAM air-to-air missiles, but in the coming decade there will be requirement to replace on-board radar with an active electronically scanned array (AESA) one. Such an approach, combined with increasing the survivability of fighter bases, appears to be a desirable course of action with regard to the airborne assets of the national air defense system. The development of the surveillance and command and control subsystem of Poland's air defense system should take into account making it more passive and non-cooperative. Plans to introduce Integrated Air and Missile Defense Battle Command System may result in a networked architecture that will enable any sensor best shooter philosophy in active air defense operations. Aside from improvement to ground radar systems, some improvements to optoelectronic and electronic surveillance and target acquisition should be made. Poland's air defense system needs substantial improvements in the field of passive air defense. Electronic warfare systems allowing for effective disruption of enemy aircraft on-

board weapons control systems, communications as well as navigation systems. It is necessary to increase the use of multi-spectral deception and camouflage systems in and to hardening of selected infrastructure of air defense system. In parallel with the acquisition of new generations of surface to air missile systems, Poland's air defense system needs electronic warfare systems for electronic defense and electronic attack to be able to nullify the effectiveness of enemy anti-radiation missiles and disrupt enemy communications and navigation needed for support of air operations

Summary

The decisions related to the development of Poland's air defense system require an honest assessment of the operational context, as well as financial and economic conditions necessary for fulfillment of planned changes. Such a comprehensive approach is needed to propose well-reasoned operational, organizational and technical solutions. The development of Poland's air defense system should not be seen in terms of a one-off undertaking that will result in a state of the art system, but rather as a long-term process that needs both stability and flexibility of approach. Due to the changes in the security environment resulting from the aggressive policy of the Russian Federation in recent years, the urgency of increasing operational capabilities of Poland's air defense system seems warranted. By doing so, Poland will be able to increase its military security and make its military deterrence more credible. Development of Poland's air defense system needs a realistic definition of the level of national ambitions and the consistent implementation of approved concepts and plans through

the long-term process of technical modernization. In the short term the priority should be given to modernization of ground-based surface to air missile systems, primarily to the short-range ones. In longer term, the harmonization of modernization efforts will be needed to prevent generation gaps within the national air defense system. The modernization requirements of Poland's military must be carefully confronted with the financial capabilities of the state. It calls for a reassessment of the priorities for specific operational capabilities. This applies primarily to the modernization of the missile defense capability. While in the long term it is desirable, in the shorter timeframe, priority should be given to capabilities related to defense against air threats, and, consequently short-range surface to air missile systems should be given due attention. Poland's air defense system also needs substantial efforts to improve capabilities related to passive air defense to complement active air defense operations.

References

1. Cieślak E. (2019). Poland's armed forces in NATO. Two decades of transformation. *Polské ozbrojené síly v NATO. Dvě desetiletí transformace. Defence and Strategy, Volume 1/2019*, 23-38.
2. Cieślak, E. (2018). Operacyjne aspekty rozwoju narodowego systemu obrony powietrznej. In K. Dobija, S. Maślanka and D. Żyłka (Eds.), *Wyzwania i rozwój obrony powietrznej Rzeczypospolitej Polskiej obronność RP XXI wieku* (pp. 38-54). Warszawa: Akademia Sztuki Wojennej.

3. Dobija, K. (2019). *Uwarunkowania rozwoju system obrony powietrznej Polski*. Warszawa: Akademia Sztuki Wojennej.
4. Fabian B. et al. (2019) Strengthening the Defense of NATO's Eastern Frontier. Washington D.C: Center for Strategic and Budgetary Assessments
5. Joint Air Power Competence Center (2017). *Joint Airpower following the 2016 Warsaw Summit. Urgent Priorities*. Kalkar: Joint Air Power Competence Center.
6. Koncepcja obronna Rzeczypospolitej Polski, Ministerstwo Obrony Narodowej (2017).
7. Lambeth B. S. (2012). Israel's War in Gaza Benjamin A Paradigm of Effective Military Learning and Adaptation. *International Security, Volume 37 No. 2*, 81-118.
8. Lavrov, A. (2018). *The Russian Air Campaign in Syria. A Preliminary Analysis*. Moscow: Centre for Analysis of Strategies and Technologies.
9. Ministerstwo Obrony Narodowej. Coraz bliżej zakupu samolotów F35. 11.09.2019. Available online <https://www.gov.pl/web/obrona-narodowa/coraz-blizej-zakupu-samolotow-f35>, 12.12.2019.
10. Ministerstwo Obrony Narodowej. Modernizacja techniczna SZ RP. 1.03.2019. Available online <https://www.gov.pl/web/obrona-narodowa/modernizacja-techniczna-szrp>, 30.11.2019
11. Ministerstwo Obrony Narodowej (MON). *System PATRIOT*. 26.03.2019. Retrieved from <https://www.gov.pl/web/obrona-narodowa/system-patriot>, 04.12.2019.
12. NATO
13. Standard Document AJP-3.3 Allied Joint Doctrine for Air and Space Operations Edition B version 1, NATO Standardization Office (NSO) (2016).
14. NATO Standard Document AJP-3.3.1(B) Allied Joint Doctrine for Counter Air, NATO Standardization Agency (NSA) (2010).
15. Roslan, G. (2018). *Obrona powietrzna. Militarne aspekty bezpieczeństwa powietrznego Polski*. Gdynia: Wydawnictwo BP.