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PROVIDING A SHIELD AGAINST THE AIR THREAT

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PROVIDING A SHIELD AGAINST THE AIR THREAT

AIM

1. Currently the Canadian Armed Forces (CAF) does not have a Ground Based Air & Missile Defence (GBAMD) capability. However, the CAF did have a Ground Based Air Defence (GBAD) capability that was completely divested in 2012. This service paper will examine the requirement for the CAF to have a tactical GBAMD capability.

INTRODUCTION

2. Defending against air attack has been around since man decided to use air machines for military purposes. The earliest reported use of GBAD employment in the form of Anti-Aircraft-Artillery (AAA) guns was in World War I (WWI) by the United Kingdom (UK).[1] It was during World War II (WWII) when GBAD, in the form of networked, enabled AAA coupled with air surveillance radars with command nodes to counter impending air attacks by fix wing aircraft became a viable defence to air threats. The UK with her allies created an integrated air defence network that was able to fend of the Germans Luftwaffe and win the Battle of Britain.[2] With the end of WWII the GBAD requirement waned again. However, the Cold War would re-invigorate the GBAD requirement to counter the new Soviet air threat. The Soviet air threat was initially based on long range aircraft flying nuclear weapons and jet-engines. Again a networked approach to air defence with GBAD was needed. However, the advent long range missiles and stand-off weapons quickly negated the requirement of GBAD. This dictum held true until yet again technology was able to counter the range of missiles and their stand-off with early detection and employment of surface-to-air guided missiles capable of super-sonic speed. What

[1] I.V. Hogg, Anti-Aircraft: A history of Air Defence, 1978 29.

[2] N.W Routledge, Brigadier. History of the ROal Regiment of Artillery: Anti-Aircraft Artillery 1914-55. London: Brassey's (UK)1994, 94

had driven GBAD technology from 1975 to the late 20th century was the ability of GBAD to have effective guided missile technology. With the end of the Cold War, the tactical GBAD requirement was not required as a near peer did not exist in opposition to Western Allies.

3. However, technology has bounded yet again, along with new threats that require tactical GBAMD response. Technology that was only available to State actors are now available to Non-State Actors. Technology like indirect artillery, rockets, missiles, Unmanned Air Vehicles, Drones, helicopters, and Fixed Wing Aircraft are increasingly available to non-state actors. The attack of the World Trade Center Towers in New York on September 11, 2001 along with the 2006 Lebanon War between Israel and the non-state entity, Hezbollah have re-invigorated the requirement of GBAMD. Canada needs to determine what tactical GBAMD capability is best suited counter these threats from the air in order to provide protection domestically to protect Canadian sovereignty and CAF Task Forces on expeditionary operations as required.

DISCUSSION

4. The doctrinal role of air defence artillery "is to prevent the enemy from interfering from the air with friendly force operations on the ground".[3] Air Defence doctrine further recognizes that the role "encompasses many aspects, from protection of the force through passive measures to the protection afforded by the destruction of the enemy's air assets".[4] In essence air defence artillery in the Canadian context is the backstop for any air threat. The Royal Canadian Air Force (RCAF) is primarily responsible for interdicting any air threat infringing on Canadian sovereignty. However, surface-to-air capabilities are the responsibility of the Canadian Army.

[3] Canada. Department of National Defence. Air Defence Doctrine – B-GL-372-001/FP-001, 3-1. Kingston: Department of National Defence, 1999. 1.

[4] Ibid,…, 2.

5. Current doctrine has not kept pace with the increasing threat to land forces from rocket, artillery and mortar (RAM), munitions from unmanned aerial systems (UAS), and missiles, both cruise and air to ground. The CAF's last generation GBAD equipment of the Air-Defence Anti-Tank System (ADATS), Twin 35mm Gun & Sky-Guard System, and Javelin Man-portable AD System were optimized to engage aerial platforms and but were incapable of defeating munitions.[5]

6. An effective GBAMD capability includes the ability to provide detection and early warning, identification and interception, and engagement of the target (if necessary). These abilities include the integration of all Joint, Allied, and/or Coalition air defence assets in a given theatre of operations and include air defence sensors, a command and control and reporting system, and engagement systems. All these systems and capabilities must be linked (networked) by an effective communications system.

7. In a theatre of operations with a combination of fighter aircraft, High/Medium Air Defence (HIMAD) and Low Level Air Defence (LLAD) systems: aircraft and HIMAD systems provide large area air defence, (i.e. the theatre of operations);[6] LLAD systems provide protection to land manoeuver forces, vital elements and installations, and critical lines of communication – these latter tasks fall into the army's area of responsibility. Area, route and point air defence tasks tend to be resource intensive in terms of people and systems. As with any resource, there will rarely be sufficient assets to cover all the requirements.

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[5] Canada. Department of National Defence. Anderson, J.H.B. and Christopher, G.L, and Hull N.F. Maj, Evaluation of Candidate Low-Level Air Defence Systems, Operational Research and Analysis Establishment, Ottawa, 1985.35.

[6] Op Procedures

8. Doctrinally, categories of Air Defence Artillery weapons include those required to cover the HIMAD and LLAD roles. LLAD coverage is further divided into Short Range Air Defence (SHORAD) and Very Short Range Air Defence (VSHORAD). Historically, however, the CA's focus has been in the LLAD category. Up until 2012, legacy systems including ADATS, GDU XXX (Twin 35mm), Javelin man portable shoulder launch system, and the Skyguard Radar were the mainstays of the CA's air defence capability.[7] In order to distinguish from the full range of GBAD capabilities available to support HIMAD through to VSHORAD, the term GBAMD is used to describe the future capability sought to function in the LLAD environment. The reasoning for this is that in accordance with army doctrine, army force development and line of operation 3, the army will only deployed a CA Brigade Headquarters with a Battle Group and enablers. This would predicate the need to have a sub-unit worth of GBAMD capability in order to provide the necessary force protection for this element.[8]

9. The future security environment (FSE) will see an increase in the quantity and quality of air threats. Threats and threat potential in the lower airspace (ground to 3000m) have changed significantly over the past 15 years. During this period missile-based FGB systems continued to gain in performance in terms of velocity, effective range and agility in order to combat the conventional threat of the Cold War era. However, one major constraining factor did remain fairly constant and this was the ever high cost of missile-based GBAD shooters.[9] These threats will be supported by advanced technologies including, cyber, EW, stealth, etc. There are several emerging trends and threat capabilities:

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[7] Canada. Department of National Defence. Air Defence Doctrine – B-GL-372-001/FP-001, 3-1. Kingston: Department of National Defence, 1999. 1.

[8] Canada. Department of National Defence. Toward Land Operations 2021: B-GL-310-001/AF-001, Kingston: Department of National Defence, 2009. P 6-11.

[9] Fabian Oschner, The Renaissance of Gun=Based Air Defence. Military Techonolgy; Apr 2007; 31- 42.

a. UAS will become more prolific in the future battlespace and will have a multi-role capability. Payload capacities will increase relative to size and power allowing for grater lethality. Payloads may include explosives, CBRN, SIGINT, sensor suites, etc. or a mix thereof. The range of systems will allow for autonomous, semi-autonomous, and 'fire-and-forget' operations. UAS will employ anti-radiation homing capabilities, provide target designation, and conduct EW missions. They will employ sophisticated counter-measures and make use of stealth technology. Attack profiles may include individual platforms, pairing platforms with manned platforms, and or 'swarming' platforms.[10]

b. Rocket, artillery and mortar (RAM) threats will be the primary threats to land forces in the near future. RAM munitions will become increasingly accurate and will possess on-board guidance ability (GPS, INS, PGK, etc.) Payloads may include explosives, CBRN, EW, etc. Attack profiles will range from a single projectile being fired or launched to dozens being fired or launched simultaneously.[11]

c. Cruise Missiles (CM) will see a reduction in size relative to payload and power. Payloads may include a similar variety as those identifies for UAS. Reduced signatures will be a function of size and the use of advanced materials. They will employ sophisticated counter-measures and make use of stealth technology. As well, their speed (Mach 3+) and lower operating altitude will provide inherent protection. Increased accuracy will result from improvements in guidance systems, including

[10] Canada. Department of National Defence. Toward Land Operations 2021: B-GL-310-001/AF-001, Kingston: Department of National Defence, 2009. P 2-16.

[11] *Ibid*…, p 2-13.

INS, GPS, and terrain mapping. Attack profiles may include thermal and radiation homing, and the delivery of sub munitions.[12]

d. Attack Helicopters (AH) will see improvements in their night and poor weather operations, as well as increases in their payload capability. AH signatures will be reduced and stand-off ranges increased. Attack profiles will include 'pop-up' engagements employing fire and forget missiles making use of mast-mounted sights and off-platform designators. They may operate as single platforms, in teams, and paired with UAS.[13]

e. Fixed Wing (FW) aircraft will see improvements in speed and stealth, as well as night and poor weather operations. They will have an increased payload capability and greater stand-off capability. Attack profiles may include individual platforms, teams, and pairing manned-platforms with unmanned platforms. As stand-off capabilities of manned air platforms increases, overflights with these platforms become unnecessary. In all but the rarest cases, this will place these platforms out of the range of LLAD systems.[14]

f. Unconventional aircraft include the uses of civilian aircraft to conduct attack missions by the enemy. These aircraft can range in size and capability from ultra-lights, crop-dusters, aerobatic, private planes through to commercial transporters or airliners. The range and flexibility of payloads is limitless. These aircraft may be used as platforms

[12] *Ibid*…, p 8-1.
[13] *Ibid*…, p 8-1.
[14] *Ibid*…, p 8-1.

to launch munitions or as a manned/unmanned 'cruise missile'. Attack profiles may include single or multiple aircraft.[15]

10. The range of air-attack vectors available to an enemy in the FSE is limitless. With a more sophisticated (peer) adversary, a greater range of capabilities may be employed – including those used by unconventional forces (hybrid threat). The unconventional adversary (non-state actor, insurgent, terrorist, criminal, etc.) will likely be less sophisticated and employ a smaller range and volume of vectors. However, their actions will be more difficult to anticipate and detect. Technology will allow for greater miniaturization, reduced costs, and global communications and surveillance; these factors translate to the availability of airborne platforms to any adversary. The defeat of this broad range of enemy and threat abilities will necessitate a broad range of capabilities. Not all these capabilities must be resident within the CA; however, army capabilities should be able to respond to as many threats as possible while providing protection to land manoeuver forces, vital elements and installations, and critical lines of communication.[16]

11. Canada will often pursue its objectives through deployment of coalitions and alliances. Regional conflicts may involve coalitions that could be different from longstanding, familiar alliance structures. This implies the need for flexibility and interoperability, as well as the ability to accommodate allied or coalition, capabilities, objectives, and policy constraints. Maintaining cohesion and unity of effort requires understanding and adjustment to the capabilities, perceptions, and objectives of coalition members. Synergy in the joint, coalition, and combined

[15] Routledge, N.W., Brigadier. History of the ROal Regiment of Artillery: Anti-Aircraft Artillery 1914-55. London: Brassey's, 1994.

[16]

arena results from sound doctrine, proper training, and the mutual application of joint force relationships and procedures.

12. The CA's air defence priorities should concentrate on defeating enemy aerial threats operating in the LLAD bands. These threats include: UAS, munitions, missiles, helicopters, and any fixed-wing aircraft. By 2021, a single system capable of defeating this varied threat will not exist. Therefore, the future GBAMD system will require a mix of various types of sensors and engagement platforms.

13. Air defence for the army of tomorrow includes a capability focused on the prevention of aerially delivered enemy effects upon friendly forces. Its primary role will be to defeat the munition in flight, while retaining a degree of capability to engage the threat of aerial platforms. Furthermore, it will offer a distinct improvement in force protection by integrating sensors and sharing target data amongst a wide range of engagement systems. FADC will offer greater detection and engagement capabilities against a range of threats including air breathing manned and unmanned aerial threats, rocket, artillery and mortar munitions, and missiles. An affordable and realistic AD system must be developed with consideration to the most dangerous and most likely force employment models; it must have the agility to transition across the spectrum of conflict (mass, mix, mobility, integration). Notwithstanding the fact that CA elements will 'always' be employed in a Joint, Allied, and/or Coalition environment, there is a clear requirement for an AD capability at the manoeuver level. This includes the combat team, BG, Bde, and Div levels where deployed. Joint assets will increase in their importance and in their ability to deliver close and long range precision air defence effects. These effects are

complementary and taken into consideration, but they do not preclude the need for a comprehensive ground based air defence capability.

14. With the advent of autonomous and semi-autonomous systems, consideration for tactics and techniques development has to be given with respect to: command and control, positive and procedural control, auto-engagements, collateral damage, policy, etc. Given the current and anticipated future resource limitations, as well as the future threat environment it is unrealistic for the army to peruse the development of a HIMAD capability as HIMAD is the responsibility for the RCAF. The army, therefore, will limit its capability development efforts to LLAD while being fully integrated in overall Joint, Allied, and Coalition air defence strategies.

CONCLUSION

15. Current and short term developments in air defence capabilities make it impossible to defend each dismounted soldier or platform from the effects of all types of munitions, UAS, and aircraft all the time. However, with integration of Joint, Allied, and/or Coalition assets ranging from space-based to ground-based sensors, the ability to provide early warning should be possible. Designs considerations for the future GBAMD should include: reduced personnel to operate the system; manned and unmanned groupings; active and adaptive protection; modularity of components for ease or repair and upgrades; advanced energy management and distribution systems; multiple effects capability; mobility (strategic and tactical lift as well as battlefield mobility); multi-spectral (band/type); self-healing networked connectivity.

16. Advances in directed energy weapons (DEW) and rail-gun technology may allow for greater engagement ranges and rates of ‘fire’ effectively allowing a future system to be employed in the HIMAD and LLAD roles. However, an AD system must focus on the LLAD threats.

Though high energy weapons theoretically would be advantageous, the cost of development, manufacturing, employing, and maintaining them would be cost prohibitive compared to guns or missile systems. Guns systems and/or missile systems with early warning and cueing would provide the best cost/benefit for the CA future GBAMD capability.

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