ARTICLE DOI 10.52781/cmm.a090

The ASTROS system as a deterrence and presence tool

El sistema ASTROS como herramienta de disuasión y presencia

Abstract: The purpose of this article is to analyze if the ASTROS system can be used as a tool for strategic deterrence. The article draws on research from a thorough literature review focused on the Artillery Saturation Rocket System (ASTROS), strategic aspects of the Brazilian National Defense Strategy (NDS), the Land (Terrestrial) Military Strategy, and foreign nation's use of similar artillery pieces. Additionally, a key aspect of this study is the analysis of the Anti-Access Area Denial (A2/AD) strategy. This study finds that the ASTROS system can serve as a component of A2/AD, concluding on its ability to collaborate with strategic deterrent. Finally, the work explores how land forces can effectively contribute in the construction of the land military capabilities by virtue of what was established in the to the NDS.

Keywords: ASTROS system; extrarational deterrence and presence; anti-access and area denial.

Resumen: En este artículo nos proponemos analizar si el sistema ASTROS puede ser una herramienta para la estrategia de presencia y disuasión extrarregional. La investigación se desarrolló a través de una revisión bibliográfica y documental, a la luz de la literatura que aborda el Sistema de Cohetes de Artillería para Saturación de Área, centrándose en la estrategia de disuasión preconizada en la Estrategia Nacional de Defensa (END) y en la presencia señalada en la Estrategia Militar Terrestre y en cómo se lo utiliza en otras naciones, particularmente con el uso de la estrategia Anti-acceso y Negación de Área (A2/AD). El estudio tiene como objetivo presentar las posibilidades de empleo del sistema ASTROS como una herramienta A2/AD, concluyendo sobre su capacidad para colaborar con la estrategia de disuasión extrarregional y presencia. Finalmente, el trabajo es relevante para contribuir con la Fuerza Terrestre en la construcción de capacidades militares terrestres por lo establecido en la END.

Palabras clave: sistema ASTROS; disuasión extrarregional y presencia; anti-acceso y negación de área.

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Received: 04 May 2022
Approved: 12 Dec. 2022

COLEÇÃO MEIRA MATTOS
ISSN on-line 2316-4891 / ISSN print 2316-4833
http://ebrevistas.eb.mil.br/index.php/RMM/index

1 INTRODUCTION

The current National Defense Strategy 2020 (NDS) addressed that it is essential that Brazil dedicates continuous attention to its defense, given the systematic condition of instability of relationships between countries and the emergence of new threats on the international scene, presenting the strategies and strategic actions to achieve the National Defense objectives (NDO) of the National Defense Policy (NDP).

The NDS says that «deterrence should be the first strategic posture to be considered for the defense of national interests in that region» (BRASIL, 2020c, p.33) and established this posture through the Defense Strategy (DS) as DS 2, "strengthening deterrence capacity", aiming to improve and consolidate the factors that give the country conditions to discourage any hostile action against its sovereignty, interests, longings and aspirations. Two of its strategic defense actions (AED) are:

> AED-8 provide the country with modern Armed Forces, well equipped, trained and in a state of permanent readiness, capable of discouraging threats and aggression.
>
> AED-9 demonstrate the ability to counteract the concentration of hostile forces in the vicinity of borders, the limits of Brazilian jurisdictional waters and national airspace (BRASIL, 2020c, P.63).

The Terrestrial Force adopts the Army planning system (SIPLEx), which is structured in six chapters to define how the Army is organized and prepared to be employed in order to fulfill its mission, aligned with the Strategic Defense Planning System (SISPED) and having as a conceptual basis the analyzes of the current legal diplomas, with a strand called The Strategic Defense Planning **Strategic Design**, which established as the foundations of its strategy: **Deterrence** and **Presence**.

> Deterrence
>
> In the global context, Brazil is not the strongest State, nor the weakest. Thus, it must be shown to the possible aggressors, that the response will be so violent and effective, that their victory will be very unlikely and, even in this case, their losses would be priceless.
>
> Deterrence is the first combat, avoiding crises and allowing Brazilian society to resist pressures from any actor.
>
> Presence
>
> It is characterized under two fundamental aspects:
>
> • first, directed to the military expression, in which the military presence, in the national territory, aims to fulfill the constitutional destination, being made effective by the careful articulation of military organizations in the territory and the ability to quickly deploy troops to any region of the country, characterizing strategic mobility. (grifo nosso)
>
> • in the second aspect, directed to psychosocial and political expressions, it is based on the development of the defense mentality and the integration of military expression into society. The strategies of deterrence and presence are mutually linked, that is, the success of one contributes to the success of the other (BRASIL, 2019d, p.8).

The Land Military Policy/2019 (PMT/2019), held at SIPLEx, presents goal number 1. "CONTRIBUTE TO EXTRAREGIONAL DETERRANCE", saying it will be obtained with the qualification and preparation of material and human resources, endowing them with mobility and elasticity with the capacity to discourage any military aggression, thus maintaining alignment with the defense documents (NDP and NDS).

To achieve objective No. 1 of PMT/2019, the Brazilian Army (EB) has built strategies and strategic actions, aligned for the development of Military Land Capabilities (CMT) and the EB adopts the generation of forces through Capability-Based Planning (CBP), which will be achieved by the Strategic Programs of the Army (PrgEE).

Silva (2020) explains that the CBP was adopted in 2013 by the EB, as a methodology to guide the generation of forces to face uncertain threats, as it aims to raise future capabilities, adding seven determining factors, interrelated and inseparable: Doctrine, Organization (and/or processes), Training, Material, Education, Personnel and Infrastructure - forming the acronym DOAMEPI, which are the so – called operational capabilities (OC).

It should be noted that a group of OC with functional links brought together, to develop and enhance the capabilities of a force to fulfill a certain task within an established mission, constitute a Ground Military Capability (CMT).

It should be noted that, also in 2013, the Army General Staff (EME) selected the capabilities to be developed for the Ground Force. Among them is the Ground Military Capability of Superiority in Confrontation and Fire Support OC.

Superiority in Confrontation, which according to the catalog of capabilities EB20-C-07.001 (BRASIL, 2015c), is defined as being able to fulfill the assigned missions, using the available means to impose their will on the enemy, defeating him.

OC Fire Support is defined as being "capable of supporting the operations of friendly forces with powerful, deep and precise fires, seeking the destruction, neutralization or suppression of objectives and enemy forces" (BRASIL, 2015b, p.10).

The Missile and Rocket Artillery System (ASTROS) represents, very well, the OC Fire Support and directly contributes to CMT superiority in the confrontation, being developed and operationalized by the ASTROS 2020 Strategic Program.

The present work is a bibliographic and documentary research that intends to address the ASTROS system as a tool of extraregional deterrence and presence, passing through the strategy of anti-access and area denial, being divided into a theoretical debate on anti-access deterrence and area denial (A2/AD); the ASTROS system; the ASTROS system as a means of extraregional deterrence and; final considerations.

2 THEORETICAL DEBATE ON ANTI-ACCESS DETERRENCE AND AREA DENIAL (A2/AD)

The concept of the anti-access and area denial strategy (A2/AD) was developed by American analysts from the 1990s, after the first Gulf War (1990-1991), presenting a revolution in Military Affairs and emerging the concept of" A2/AD" in 2003, in the *Center for Strategic and Budgetary Assessments, Meeting the Anti-Access and Area-Denial Challenge*.

> If anti-access (A2) strategies are aimed at preventing the entry of US forces into a theater of operations, then Area Denial (AD) operations are aimed at preventing their freedom of action in the narrowest boundaries of the area under the direct control of an enemy. Thus, AD operations include actions by an adversary in the air, on land, and under the sea to contest and prevent joint US operations within its defended battle-space (KREPINEVICH; WATTS; WORK, 2003, p. ii).

This strategy arose to reduce the military capabilities of the opponent (troops, combat platforms and means of transport) in the air, on land or on water, dissuading from entering a certain region, for fear of losing their means.

The North American handbook *Joint Operations-JP 3-0*, 2017, presents in its concepts the term long range linked to A2 and short range with AD, which can direct the tools to be used in the execution of these tasks:

> **Anti-access**. Action, activity, or ability, usually to **long range**, designed to prevent the advancing enemy force from entering an area of operation. Also called A2. (Approved for inclusion in the DOD Dictionary.)
>
> **Denial of the area. A**ction, activity, or capability, usually short-range, designed to limit the freedom of action of an enemy force within an operational area. Also called AD.
>
> **A2 capabilities**, usually long-range, prevent or inhibit an advancing force from entering an operational area (OA). If a force is able to overcome an enemy's A2 capabilities, additional AD capabilities can limit a force's freedom of action within an OA.

The Field Manual Anti-Aircraft Artillery Group, EB70 MC 10.365, also introduces the doctrinal concepts of anti-access and area denial (A2/AD):

> Anti-access (anti-access - A2) the action aimed at slowing the deployment of enemy forces in a theater, reducing freedom of maneuver, or causing forces to operate at greater distances from the site of the conflict. Anti-access (A2) affects movement to a theater.
>
> Area denial (AD) is the action aimed at preventing operations in areas where an adversary cannot have access. The intention is to create an area in which the enemy cannot operate without extreme risk. Area denial affects maneuvers within a theater (BRASIL, 2021a, p.14-1).

The concepts presented in these manuals on A2/AD reveal that the A2 aims to prevent or delay the entry of an enemy force into the theater of operations, reaching the enemy means from as far as possible, and that AD seeks to reduce the freedom of action and maneuverability of the opposing force after entering the area of operations, that is, the means developed for this purpose must have these basic requirements.

According to Ferreira (2011, p. 62), these are examples of anti-access capabilities:

> [...] **missiles ballistic** and **cruise ship**, launched from the air, from **surface** or submarines; long-range surveillance and reconnaissance systems; nuclear submarines; and cyber and space attack systems. Area denial capabilities are: integrated naval, air and ground forces; anti-aircraft defense systems; **anti-ship** missiles of **medium and short range**, launched from the air, sea or land; diesel submarines; smart munitions; electronic warfare systems; and attack boats (emphasis added).

The Dictionary of security and defense, organized by Héctor Luis Saint-Pierre and Marina Gisela Vitelli, corroborates Ferreira›s idea that ballistic missiles can be used as anti-access means, as well as in area denial (A2 / AD):

> Anti-access capabilities include those that **prevent the access of the opponent** to the theater of operations, consisting basically of **ballistic missiles** anti-ship, anti-satellite weapons (Asat), nuclear or air-independent propulsion (AIP) submarines, long range anti-ship missile, and naval mines. Area denial capabilities, in turn, aim to **deny freedom of action within the theater of operations**, and consist of anti-ship cruise missiles, smart mines, surface-to-air missiles (SAMs), Joint Direct Attack Munition (JDAM), **theater ballistic missiles** and **coastal artillery**. Due to the fact that these capabilities have very similar tactical systems, eventually interchangeable, the concept of A2/AD was created to reference them together (SAINT-PIERRE; VITELLI, 2018, p.362, emphasis added).

In this way, the missile system is an important tool to contribute to A2/AD, meeting the proposed requirements and in the different spaces of the battlefield.

From 1980, Mearsheimer (1983) presented the concept of conventional deterrence and Teixeira Júnior (2020) links the deterrent posture, the conventional modality, by the denial method, through a system/capacity of anti-access and area denial (A2/AD), within a multi-domain environment.

The Dictionary of security and defense links the term deterrence to A2 / AD, for fear of losing expensive means of combat:

> [...] deterrence refers to the use of means that are less costly but potentially protect countries from possible hostilities. In this case, it is worth highlighting the adoption of A2 / AD, an acronym that means *antiaccess*, AA or A2 and *area-denial*, AD. This concept comprises a set of asymmetric military means, cheaper and preferred by ascending powers, which would potentially be used to confront the projection capacity of US forces, the A2/AD is an asymmetric response, since, instead of using capabilities similar to those of the attacker (the aircraft carrier, for example), less expensive means are used to avoid defeat, instead of guaranteeing an absolute victory. The countries that currently invest the most in these technologies are China, Iran and Russia (SAINT-PIERRE; VITELLI, 2018, p.362, emphasis added).

Collaborating with the above concept, Mitchell (2015) presents that one way to deter an enemy is to make it difficult for them to achieve their goal (deterrence by denial), generating fear and damage to the attacking military, but also, fear of the costs that will be inflicted during aggression. To function, the defender needs to have sufficient lethal capacity to demonstrate that victory will be impossible or difficult to obtain.

According to Joshi (2019), countries such as Russia, India and China have been using the A2/AD strategy to deter potential enemies or threats to try to harm their interests, through conventional forces, particularly with missile or rocket forces.

Other important concepts are those of operations and the multi-domain task force:

> **Multi-domain operations (MDO):** operations conducted across multiple domains and contested spaces to overcome an adversary's (or enemy's) strengths by presenting them with several operational and/or tactical dilemmas through the combined application of calibrated force posture; employment of multi-domain formations; and convergence of capabilities across domains, environments, and functions in time and spaces to achieve operational and tactical objectives.
>
> **Multi-Domain Task Force (MDTF):** new Army formation able to execute multi-domain operations, designed to deliver long-range precision joint strike as well as integrate air and missile defense, electronic warfare, space, cyber, and information operations in both competition and conflict to provide the Joint Force and coalition with new capabilities to enable the defeat of adversaries' anti-access and area denial strategies. (UNITED States, 2021, p.32, emphasis added).

With the concept of multi-domain, the strategy of A2/AD was expanded, which began to operate in all fields: space, cyber, land, air and sea. In this way, seeking to deny the enemy access over areas of interest, from as far as possible, acting by layers of concentric circles.

For Teixeira Júnior (2020), only with the development of structures, doctrines and operational concepts will A2/AD capabilities be achieved, and it is necessary to obtain defense products that allow producing a multi-domain layered defense system.

Taulois (2016) argues that the A2/AD strategy is a layered defense, in which the outermost ones use cybernetic and space systems, acting in the air, land and sea dimensions, hindering coordination, command and control of operations. In the innermost layers, weapons systems of the available naval, air and land means, particularly missiles, are applied.

General Rocha Paiva (2014) presented in the text *Dissuasão Extrarregional, assim é só Discurso* (Extraregional Deterrence, that›s just a Speech) that, for Brazil, the areas that are likely to use this strategy are: the oil basins of the Southeast and South, the northeastern salient and Roraima, in addition to the mouth of the Amazon River that are regions that can suffer influence or access from extraregional powers. However, for such a strategic system to be effective, it is necessary to have a cohesive defense set consisting of functional monitoring; ready forces; cyber and electronic warfare capabilities; anti-aircraft defense; long-range air, ground and sea missile systems; and manned or unmanned strategic mobility platforms.

Figure 1– Possible means of A2 / AD Brazil

Source: adapted from Google Earth (2022).

Gen Rocha Paiva (2016) wrote on EBlog, *A Defesa Precisa de Integração Estratégica*(Defense needs Strategic Integration), that Brazil should develop a Joint Anti-Access and Area Denial Defense System (SCDANA):

> The SCDANA, properly speaking, would frame Cybersecurity subsystems; Territorial, Maritime and Aerospace Monitoring and Control, integrated and with Brazilian satellite; Anti-aircraft Defense; **Missiles** Long-range, ballistic and **cruise ship**, **launched from land-based mobile platforms**, naval and air Forces; and Joint Defense and Power Projection Forces, with a high level of readiness, as well as others to be completed by mobilization. The **subsystems with greater deterrent effect** would be those of Cyber Security, Anti-aircraft Defense and Strategic Missiles (ROCHA PAIVA, 2016, n. p., emphasis added).

Evidence shows that the A2/AD strategy is being used by emerging powers with lower-cost weapons and ammunition to deter forces with more powerful weapons and equipment. At first, a combined long-range system is used, seeking not to allow the enemy access to the theater of operations (TO), from as far as possible, in the most diverse spectra of the battlefield: space, cyber, command and control, air and sea. On a second stage, acting to deny area, within the TO, limiting the freedom of action of the opponent, with integrated weapons systems by land, air and sea: anti-ship, anti-aircraft, strategic, ballistic and cruise missiles; precision guided munitions; surface ships, small vessels and submarines, in this way, restricting enemy actions.

3 THE ASTROS SYSTEM

The development of ASTROS (*Artillery Saturation Rocket System*) was started in 1981, by the company AVIBRAS, with rockets of different calibers and different types of heads, being exported to several countries and used in combat successfully in the Persian Gulf region (AVIBRAS, 2021a).

From 1990, the ASTROS II system was incorporated into the Brazilian Army and, in 1991, another batch of the material, already proven in combat, was produced and exported (AVIBRAS, 2121a).

According to the Manual Experimental Artilharia De Campanha de Longo Alcance (Experimental Manual of Ling Range Artillery Campaign, BRASIL, 2017B, p.1-2), ASTROS is composed of launch vehicles of the system and use the SS-30, SS-40, SS-60 and SS-80 area saturation rockets, also using the TS-09 70 training rocket, 70 mm, for training garrisons through live simulation, being composed of MK3M (modernized) and MK6 vehicles, all capable of launching SS-40G guided rockets and the Tactical Missile (MTC-300).

The vehicles are all of the same type, the basic vehicle (VBA/T2B - TRATA chassis) of military characteristics, armored, 6X6, payload of 10 t, capable of running on any terrain, with integrated tracking system, of different versions: Universal Multiple Rocket Launchers vehicle (LMU) – line of fire; Mobile Weather Station vehicle (MET) – meteorology; Battalion level Command vehicle (VCC) and Battery level Command vehicle (PCC) – Communications and direction; Ammunition Resupply vehicle (RMD) and Field repair/workshop vehicle – logistics; Radar Fire Control vehicle (UCF) – Direction and Coordination and Tracking vehicle (STREV) – monitoring the trajectory of rockets and missiles.

Figure 2 – ASTROS System

Source: AVIBRAS (2021B).

The ASTROS system is part of Field Artillery, as prescribed in manual EB70-MC-10.224 (BRASIL, 2019a, P. 2-2), "Field Artillery, according to its nature, is classified as motorized, armored, mechanized, paratrooper, AirMobile, Jungle, Mountain and **Missiles and Rockets**»(BRASIL, 2019a, p.2-2, emphasis added).

The Artillery Manual: Fires, EB20-MC-10.206 (BRASIL, 2015b, P.2-14) states that Field Artillery is a system composed of subsystems: Line Of Fire; Observation; Target Search; Topography; Meteorology; Communications; Logistics; and Direction and Coordination. It operates in a systemic way, comprising a set of people, processes and means that integrate the function of fighting Fires. Thus, the ASTROS system is also organized in this way.

Currently, the ASTROS system has the ability to launch rockets and missiles, being developed and manufactured by the Brazilian company AVIBRAS since the 1980s, possessing characteristics of multi caliber, high mobility, to launch rockets at long distances, thus, conceived as a strategic weapons system with great deterrence power.

The ASTROS 2020 strategic project aimed to provide the ground force with means capable of providing long-range and high-precision fire support, resulting in several subprojects, such as the guided rocket and the tactical missile (TM).

The SS-40G guided rocket is being developed based on conventional rockets, which rely on fire calculation for ballistic trajectory. This ammunition receives the coordinates of the target and uses actuation systems with lateral jets in the propulsion phase and mobile aerodynamic surfaces, in the configuration called "canard", which in the diving phase to the target, contribute to the reduction of the Circular Error Probability (CEP), decreasing the area hit and increasing saturation in the area effectively hit by a burst.

The MTC-300 missile is an ammunition with the purpose of being launched from the LMU platform, with the possibility of carrying 200 kg of conventional warhead at a distance of up to 300 km with accuracy in CEP less than or equal to 30 m, producing minimal collateral damage and being able to hit strategic targets, giving the ground force a greater capacity for extraregional deterrence.

The transformation of the project into a program increased the possibilities of work development, ensuring continuity and constancy of the flow of resources.

PrgEE ASTROS 2020 now has in its scope a fort (Fort Santa Barbara, which brings together several military artillery organizations), an artillery command (C Art Ex), an administration and support Base (B Adm Ap), two missile and rocket groups (6th GMF and 16th GMF), an instruction center, a logistics center, a target search battery, with the development of SS-40G and MTC-300 guided rockets, among other projects.

The GMF maintains the capacity to carry out area saturation, employing both normal rockets and guided rockets, being equipped with 18 (eighteen) LMU each, collaborating with the conventional deterrent capacity.

According to manual EB70-MC-10.224 (BRASIL, 2019Aa p. 2-2, 2-3), missile and rocket field artillery can perform the following tasks:

> 2.4.11 MISSILE AND ROCKET FIELD ARTILLERY
>
> 2.4.11.1 The Missile and Rocket Field Artillery consists of the Missile and Rocket Groups, equipped with missile and rocket launchers, with the mission of conducting fire against tactical targets and targets of interest of the operational and strategic levels.
>
> 2.4.11.2 Specific Tasks
>
> 2.4.11.2.1 Missile and Rocket Field Artillery performs the following tasks:
>
> a) unleash, in a short time, a considerable mass of fires capable of saturating an area, neutralizing or destroying enemy targets;
>
> B) get in and out of position quickly;
>
> C) engage several targets simultaneously, maintaining a good mass of fire on them;
>
> d) move quickly, even through the countryside;
>
> e) perform rapid adjustment on unexpected targets;
>
> F) operate with traditional and/or automated fire direction techniques (exception of tactical missile - TM);
>
> G) operate with different types of rockets, allowing variations in range and caliber, according to the nature of the target, its location and the desired effect;
>
> H) use in their ammunition military cargo of general or special use and combine them with different types of fuze;
>
> I) engage strategic targets in the early stages of the conflict; and operational and tactical targets in the course of the maneuver; and
>
> j) be transported in three modes: air, water and land, thanks to its dimensions and weight.

In addition to the above tasks, the material can collaborate with the interdiction of an area on the battlefield. According to manual MD35-G-01, «interdiction» has the following definitions:

> INTERDICTION - 1. Act or effect of hinder or prevent, by any means, the enemy›s use of an area or in order to deprive them of the ability to provide the supplies and reinforcements to support their own forces. See INTERDICTION TASK. 2. Denomination of shots fired at an area or point to prevent its use by the enemy. 3. An administrative act by which the competent authority prohibits the use of an aerodrome, in whole or in part, for landings and take-offs, temporarily or permanently, in civil aviation. 4. See INTERDICTION OPERATION. (Brazil, 2015a, p. 150).

> INTERDICTION TASK - Task that has the general purpose of destroying or neutralizing the sources of enemy power, their supplies, forces and support structures (BRASIL, 2015a, p. 265).
>
> INTERDICTION OPERATION - Operation carried out to hinder or prevent the enemy from benefiting: from a certain region, personnel, facilities or materials. The actions carried out in this operation usually include the massive use of aerial and artillery fires, airmobile and air-ground assaults, infiltration of special troops, sabotage, barriers and guerrilla actions (BRASIL, 2015a, p.193).

The definitions of interdiction above show us that this action aims to deny an area or access to regions by the enemy, hindering or preventing the use of an area or route, existing capacity in the ASTROS system.

A counterpoint to the system is that Brazil is a signatory to the *Missile Technology Control Regime* - MTCR, since 1995. This agreement aims to prevent proliferation, limit the production and sale of complete rocket systems (including ballistic missiles, space launch vehicles and sounding rockets) and unmanned aerial vehicle systems (including cruise missile systems, targeting and reconnaissance drones) with capabilities exceeding 300 km/500 kg, range/payload limit; production facilities for such systems and; the main subsystems, including rocket stages, re-entry vehicles, rocket engines, guidance systems and warhead mechanisms (MISSILE TECHNOLOGY CONTROL REGIME, 2021).

Despite being associated with MTCR, Brazil has developed the technology and knowledge to manufacture missiles and rockets with a range of three hundred kilometers, being able to develop munitions that reach greater distances, a capacity that could be used in case of need. In this way, holding technical knowledge and production capacity also contributes to deterrence.

However, this system is aligned with the deterrence and presence strategy, which according to the strategy manual, EB20-MF-03.106 are:

> Deterrence: it is characterized by the maintenance of military **force** sufficiently **powerful** and **ready for immediate employment**, capable of **discouraging** any **military aggression**.
>
> Presence: it is characterized by the military presence, in the national territory and its extensions, with the purpose of fulfilling the constitutional destination and subsidiary attributions. It is made effective not only by the careful articulation of military organizations in the territory, but also predominantly by the **ability to quickly travel to any region of the country**, when necessary (BRASIL, 2020b, p. 4-5, emphasis added).

The ASTROS system is extremely versatile, characterized by flexibility, adaptability, modularity, elasticity and sustainability (FAMES), as well as prompt response and lethality. The basic assumptions to meet these requirements are the strategic and tactical mobilities, foundations for the rapid concentration or dispersion of shots, thus contributing to the strategy of deterrence and presence of the Brazilian Army.

4 THE ASTROS SYSTEM AS A MEANS OF EXTRAREGIONAL DETERRENCE

The NDS, 2020, recommends that «The strategic conception of the country›s defense, in time of peace or crisis, is based on the deterrence capacity to inhibit possible threats [...]» (BRASIL, 2020c, P.33) and also states that, «Deterrence capacity, which consists not only in the availability and readiness of adequate military means, but also in the training of its personnel, is a tool of diplomacy» (BRASIL, 2020c, p. 37).

The term deterrence is defined, in the manuals Glossary of Terms and Expressions for use in the Army (EB20-MF-03.109) and Ground Military Doctrine (EB20-MF-10.102), as:

> DETERRENCE - Strategic attitude that, through means of any kind, including military, aims to discourage or divert opponents, real or potential, from possible or presumed war purposes (BRASIL, 2018d, p. 92).
>
> DETERRENCE - It is characterized by the maintenance of military forces sufficiently powerful and ready for immediate employment, capable of discouraging any military aggression (BRASIL, 2019b, p. 5-2).
>
> DETERRENCE STRATEGY- Strategy that is characterized by the maintenance of military forces sufficiently powerful and ready for immediate employment, capable of discouraging any military aggression (BRASIL, 2019b, p. 109).

The ASTROS system has availability, readiness and trained personnel to act and prevent the country from being threatened by foreign forces. In addition to being a material tested in conflicts and being purchased by many countries, as a tool of defense and extraregional deterrence. This fact proves its effectiveness and efficiency in modern conflicts.

The Military Land Policy, 2019, preaches the intention to contribute to extraregional deterrence, for this it must:

> Have military organizations with high readiness, mobility (strategic and tactical), lethality and protection (individual and collective), sufficient to discourage or divert threats, real or potential, in any expression of power, inhibit the concentration of hostile forces near the land border, contribute to deterrence in the jurisdictional waters and airspace of the country (BRASIL, 2019g, p. 6).

In this context, the EB established its strategic design, which created the Strategic Employment Forces (F Emp Estrt). Such Forces have combat power to act in situations of crisis or armed conflict, creating strategic imbalance, through deterrence, being able to act in any part of the national territory and in other areas of Brazilian strategic interest. They must have, organize or receive modules (modularity and elasticity), to be able to execute large strategic displacements.

The 6th GMF is, as a whole, one of the specialized modules that integrates the F Emp Estrt, as fire support, adding combat power to the maneuvering elements. In addition, the Strategic Conception (BRASIL, 2019d, p. 17) says that, "all MO of EB contribute to the strategy of presence and/or deterrence".

> Strategic Actuation Force - Ground forces with combat power to enable, in situations of crisis/armed conflict, strategic imbalance through deterrence, offensive and force projection (inserted in power projection). They are able to act in any part of the national territory and in other areas of strategic interest of the Brazilian State (BRASIL, 2018d, p. 122).

It should also be noted that in the conflict in Ukraine, two Mechanized Infantry Battalions were neutralized by Russian rocket artillery in the first two minutes of combat. Fact that shows the combat and deterrent power of rocket artillery and its role in combat at the tactical and area denial level.

The ASTROS, a material of national manufacture, has technical capabilities to saturate the area, fire different types of rockets, quickly enter and leave position, strategic displacement throughout the national territory, to be transported by any modal, including with the support of the Brazilian Navy and the Brazilian Air Force. With the tactical missile and guided rocket in the final stages of development, further enhancing its capabilities, the ground force believes that ASTROS is an important deterrent and presence mean, collaborating with its strategic design.

With the development of these new capabilities of the system, the material can act from as far as possible, reaching targets at the strategic level, in order to hinder the movement and positioning of its troops, collaborate with strategic protection and produce a psychological effect on the adversary, dissuading from carrying out any action against the country, assessing the risk of such an attempt.

This situation contributes to the implementation of the A2/AD strategy, being able to act, as far as possible, with its missiles, jointly with cyber, marine and air means, being employed to hinder the approach of enemy forces, by air, sea and land. As well, in a second phase, to deny or interdict area within the TO, with their rockets. It should be noted that, for the A2/AD strategy to work, there is a need to integrate and form a system with capabilities that complement each other to prevent or deny the opponent from entering the Theater of Operations, a Joint System of Anti-Access Defense and Area Denial (SCDANA), which would further enhance the capacity of this material.

It is also worth mentioning the constant research and innovation of this material and ammunition, which are in the state of the art and which are also obtained by the other Brazilian Armed Forces, such as the Long-Range Cruise Missile (MICLA-BR) for the Brazilian Air Force, the National Anti-Ship Missile (MANSUP) and ASTROS battery for the Brazilian Navy. There is a real feasibility of MANSUP being able to be launched from a ground platform, by the LMU of the ASTROS system, which is a multi-caliber launch platform, being adaptable to various types of ammunition. The constant research, technological evolution and innovation in this area, in itself, is already a deterrent tool.

The material is designed to carry out interdiction or area denial operations, with its rockets, this type of operation is carried out to hinder or prevent the enemy from benefiting from a certain region, facilities or materials, making it evaluate well the cost-benefit of any hostile action.

Teixeira Júnior (2020, p. 15, emphasis added) says that:

> The ASTROS system - Artillery Rocket System for Area Saturation - is a fundamental capability for a future Brazilian conception of anti-access and area denial. With a highly mobile platform, ASTROS has the capacity for saturation fires and the use of guided rockets (BRASIL, 2018). With the recent development of tactical cruise missiles (AV-MTC) of 300 kilometers range (barrier & HUGHES, 2019), the ASTROS system could be a **cornerstone of a Brazilian A2/AD operational concept**.

The system can be present throughout the national territory and with the MTC in the final phase of development, a fact that will further expand its scope and its ability to intervene, preventing access or denying area. Thus, it is an important means of extraregional deterrence and anti-access and area denial, also allowing the development of the study of missiles and the development of new projects in this area.

5 FINAL CONSIDERATIONS

The ASTROS 2020 program is aligned with the AED-8 and AED-9 of the NDS, and provides the Armed Forces with modern means, in a state of permanent readiness, capable of discouraging threats and aggression, in addition to the ability to counter the concentration of opposing forces in the vicinity of land borders and the limits of Brazilian jurisdictional waters.

The Armed Forces, particularly the Brazilian Army and the Brazilian Navy, have 07 (seven) ASTROS batteries, which represents 42 (forty-two) launching pieces, enabling a large volume of fire, guaranteeing combat power and presenting this material with real capacity to inflict damage to possible hostile means.

The development and use of the tactical cruise missile will make it possible to contribute to the action of anti-access, acting on strategic targets from as far away as possible, with the aim of preventing and deterring the enemy from approaching and concentrating its means in the Theater of Operations.

The Brazilian missile and rocket system, ASTROS, represents an effective means of applying the strategy and concept of A2/AD, being the basis for integrating a future Joint Anti-Access and Area Denial Defense System and its continuous development and innovation process is extremely important for the future of the Brazilian deterrence and defense strategy.

Finally, it is concluded that the ASTROS system is a deterrent and presence tool, since it has strategic mobility, multi-caliber capability, the possibility of acting at the three levels of conducting operations: strategic, operational and tactical; with the possibility of reducing the enemy›s combat capability, rattling their morale, making them evaluate the risk and reducing their offensive potential.

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