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The strategic relevance of a conventional nuclear-powered submarine for the Brazilian state

La relevancia estratégica de un submarino convencional de propulsión nuclear para el Estado brasileño

Abstract: The choice of the Brazilian State for the construction and operation of the Conventional Nuclear Propulsion Submarine (CNPS) has been criticized and questioned by civil society and international actors. This work aims to verify the legitimacy of the CNPS project, analyzing its relevance at the political and strategic level. By the exploratory-descriptive qualitative method, the CNPS project is approached from the strategic perspective, exposing technical and academic grounds and arguments. The research reveals that only with the CNPS the country will have the ability to undertake effective deterrence by denial in its strategic environment. Its unique characteristics will mainly guarantee the sovereign right to preserve territorial integrity, the protection of the resources involved in Brazilian Jurisdictional Waters (BJW) and the Blue Amazon, as well as the protection of maritime communication lines in terms of the constitutional purpose of the Brazilian Navy. The authors conclude that the CNPS is compatible and adequate to the strategic vision of Brazilian national defense.

Keywords: National Defense; Strategy; Nuclear Technology; CNPS; Blue Amazon.

Resumen: La decisión del Estado brasileño de construir y operar el Submarino Convencional de Propulsión Nuclear (SCPN) recibe críticas y cuestionamientos de la sociedad civil y de los actores internacionales. Este trabajo tiene como objetivo verificar la legitimidad del proyecto SCPN, analizando su relevancia a nivel político y estratégico. Utilizando el método cualitativo exploratorio-descriptivo, se aborda el proyecto SCPN desde una perspectiva estratégica, exponiendo fundamentos y argumentos técnicos y académicos. La investigación expone que solamente con el SCPN el país tendrá la capacidad de emprender una disuasión efectiva mediante la negación de su entorno estratégico. Sus características únicas garantizarán principalmente el derecho soberano a preservar la integridad territorial, la protección de los recursos incluidos en Aguas Jurisdiccionales Brasileñas (AJB) y la Amazonia Azul, así como la protección de las líneas de comunicación marítimas de acuerdo con el objeto constitucional de la Marina de Brasil. Los autores concluyen que la SCPN es compatible y adecuada a la visión estratégica de la defensa nacional.

Palabras clave: Defensa Nacional; Estrategia; Tecnología Nuclear; SCPN; Amazonia Azul.

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1 INTRODUCTION

With approximately 5.7 million square kilometers (km^2) — equivalent to about half the continental area of the Brazilian territory —, the Blue Amazon[1], defined in the Navy's Doctrine Command (*Doutrina Militar da Marinha*, DMN) (Brazil, 2017b) as the region that encompasses the surface of the sea, the waters that overlay the seabed, and the marine soil and subsoil within the Atlantic expanse expanding the shore up to the outer limit of the Brazilian Continental Shelf, gained significance on the global stage after the discovery of attested reserves of oil and natural gas in the depths of its subsoil. This discovery has propelled the growth of the Brazilian energy sector, positioning Brazil as a potential major player in global oil and natural gas production.

This perspective aligns with the Naval Policy, a guiding document for the strategic planning of the Brazilian Navy (*Marinha Brasileira* - MB), emphasizing that:

> The inherent Brazilian maritime calling is underpinned by its expansive coastline, waterways, the scale of its maritime trade, and the indisputable strategic and economic significance of the South Atlantic. This region includes the "Blue Amazon," encompassing the substantial potential for both living and non-living resources, including the largest oil and natural gas reserves in Brazil. (Brasil, 2019, p. 13)

Given this extensive coastline teeming with vast biodiversity, mineral, and energy resources, a Navy commensurate with these assets and equipped with naval assets capable of monitoring the Brazilian Jurisdictional Waters (AJB) is indispensable so it can fulfill its mission, as mandated by Article 142 of the Constitution of the Federative Republic of Brazil of 1988 (CF/88). This mission includes the defense of the Homeland, the guarantee of constitutional powers, and upon the initiative of any of these powers, the maintenance of law and order.

The concept of maritime strategy was initially defined in 1911 by Corbett (2004) as the governing principle for wars in which the sea plays a pivotal role that aims to influence events on land. This strategy guides the use of naval power, encompassing all activities conducted by the Navy concerning the sea and considering the maritime power of a nation. In a broader sense, maritime power involves all activities related to the use of seas and oceans, including those intended for purposes other than military ones.

As one of the components of maritime power, according to Speller (2008), naval power constitutes the military expression of maritime power, encompassing all resources and activities carried out by the Navy, extending even to administration on land. These resources exceed the confines of naval warfare, covering aspects such as technical cooperation, exchange with other

1 The concept of the Blue Amazon distinguishes itself with that of the Brazilian Jurisdictional Waters (*Águas Jurisdicionais Brasileiras*, BJW) (Brasil, 2017b). During peacetime, it primarily focuses on a deterrence strategy, which entails a well-equipped Naval Power. The maintenance of national military assets capable of immediate and efficient deployment contributes to deterring potential aggressors, thus inhibiting the risk of armed conflicts. This is the best way to avoid such threats. In the Blue Amazon, the boundaries of the BJW consist of imaginary lines on navigation charts and have no physical form. Sovereignty, sovereign rights, and jurisdiction within these areas are upheld only by the presence of monitoring ships (Brasil, 2017a).

Navies, solo or joint naval exercises with other nations, prestige, and the preservation of traditions and international agreements promoting good order at sea and freedom of navigation.

Moura (2014) advocates that the Brazilian naval strategy, grounded in the National Defense Strategy (*Estratégia Nacional de Defesa*, END) and the Brazilian Navy Articulation and Equipment Plan (*Plano de Articulação e Equipamento da Marinha do Brasil*, PAEMB), unfolds into two key aspects. The first refers to defending the Brazilian coast and AJB, protecting the Blue Amazon against potentially stronger adversaries, focusing on prioritizing the use of submarines employing both nuclear and conventional propulsion with a strategic emphasis on denying the use of the sea. The second involves safeguarding maritime trade and participating in expeditionary operations abroad, covering the expanse of the South Atlantic and occasionally extending to other oceans. This encompasses the adjustments in the Brazilian naval strategy as outlined by the END and its associated documents, particularly in the MB projection for developing and operating six nuclear attack and 15 conventional submarines. Establishing a comprehensive submarine force comprising both conventional and nuclear submarines has been an ongoing developmental project for the MB Submarine Force since the late 1970s, an initiative that persists up to this despite the budgetary restrictions faced by the Naval Force.

According to Moura (2014), the choice of the Brazilian naval strategy is significantly influenced by the imperative of defending the coast, rooted in the paradigm of the Coastal Defense. This focus is complemented, though to a lesser extent, by the control of maritime areas, in line with concepts of traditional naval warfare. Nuclear attack submarines play a decisive role in both the aforementioned strategic components, whereas conventional submarines are mainly related to the first objective. When analyzing states without an antagonistic conception of Coastal Defense as a component of their naval strategy, a comparative analysis of political-strategic characteristics indicates a substantial similarity between Brazil and Russia, which extends to the use of submarines.

The naval strategic models Brazil pursue closely align with those of Russia and India—two fellow state members of the BRICS group with continental dimensions. The Brazilian envisioned pattern for submarine use closely aligns with the Russian approach. On the other hand, the India naval strategy significantly emphasizes controlling maritime areas, particularly prioritizing the security of its maritime traffic. In this context, the Brazilian national project to enhance military power, especially by operating conventional nuclear-powered submarines (SCPN) and a substantial fleet of conventional submarines powered by diesel-electric propulsion, seems compatible with its strategic objectives.

Another noteworthy aspect expressly outlined in the 2012 END refers to prioritizing the strategic task of denying the use of the sea:

> The foremost priority is to secure the means to deny the use of the sea to any concentration of enemy forces approaching Brazil by sea. Keeping the enemy out of Brazilian waters is the foundational principle that shapes the Brazilian maritime defense strategy, taking precedence over other strategic objectives. This prioritization has profound implications for the reconfiguration of naval forces. (Brasil, 2012a, p. 20)

To achieve the objective of denying the utilization of the sea, the country must uphold a substantial submarine naval force, comprising both conventional and nuclear-powered submarines. Furthermore, it should retain and enhance the capacity to design and manufacture both conventionally powered submarines and those with nuclear propulsion. Although the 2012 END assigned such precedence, its 2016 iteration did not explicitly establish this priority, instead, limiting itself to the recommendation that

> To fulfill the imperative of denying the utilization of the sea, Brazil shall establish a comprehensive submarine naval force, consisting of both nuclear-powered and conventionally powered submarines. Efforts will be directed towards attaining autonomy in cyber technologies essential for guiding submarines and their weapon systems, which should enable seamless collaboration within networks comprising other naval, land, and air forces. (Brasil, 2012a, p. 27)

Regarding this point, it is necessary to clarify the meaning of the expression 'denying the use of the sea.' The DMN defines it as the primary objective of naval power, which involves preventing an opponent from utilizing or controlling a maritime area for their purposes over a specific period without requiring the direct presence of Brazilian forces. If the desired outcome involves destroying or neutralizing hostile forces, it necessitates actions such as attacking enemy Sea Lines of Communication[2] (SLOC) and potentially conquering land areas. The latter enables the domination of transit zones or the establishment of support bases that are crucial for protecting Brazilian SLOC. Classic alternatives for executing these tasks include attacks, amphibious operations, reconnaissance, mining operations, and the use of submarines.

Unlike terrestrial scenarios, in which the territory often constitutes a hegemonic factor in actions, lines of communication emerge as the core strategic objective in maritime settings. The ability to disrupt or maintain control over SLOC forms the basis of maritime interactions, establishing sea control not only as a fundamental means of achieving maritime supremacy but also as a decisive factor influencing the outcome of conflicts. Unlike terrestrial scenarios, the inhospitable nature of the marine environment fully prevents any attempt to establish ownership of maritime territories, excluding those close to the coastline. Thus, lines of communication configure the prominent objectives at stake in the oceans, in addition to being common to adversaries. Hence, the primary objective of maritime warfare refers to controlling SLOC, rather than territorial occupation, as in land conflicts (Corbett, 2004).

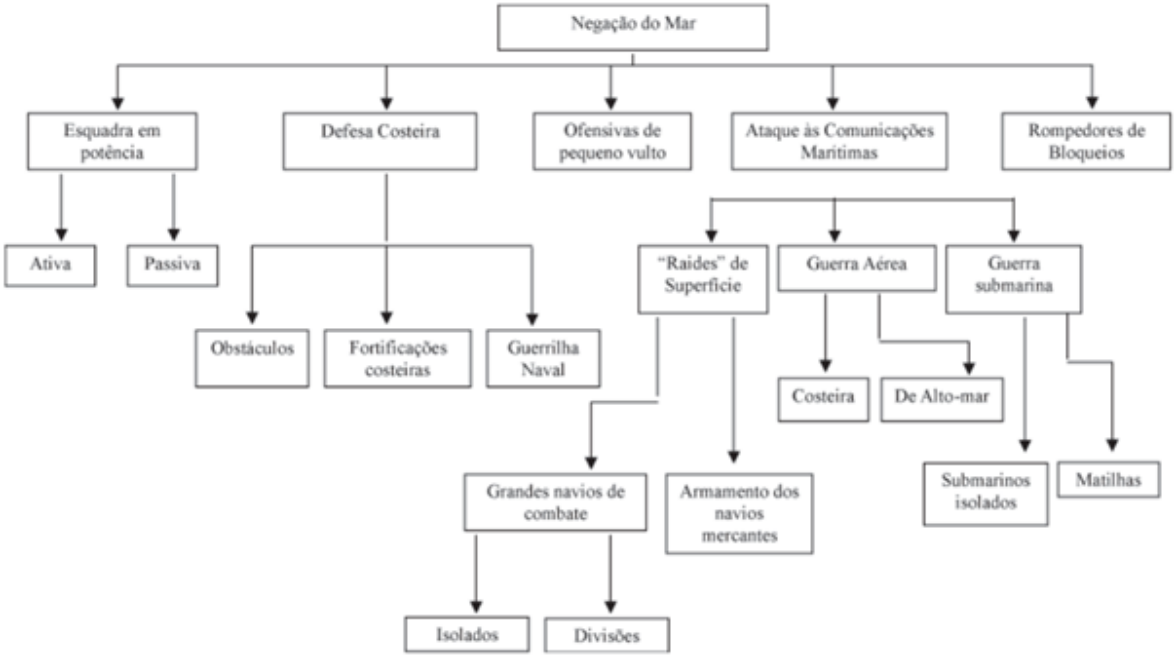
The control of the sea aims to achieve dominance over communication flows. In other words, it involves the capability to freely maneuver at sea and prevent the effective

2 The term "Sea Lines of Communication," abbreviated as SLOC, in this context, refers to the primary maritime routes between ports of interest used for trade between states and/or major cities. These lines are particularly sensitive at specific focal points such as straits, channels, and bottlenecks. They also serve as vital connection points between land and sea. Given these peculiarities, SLOC hold significant strategic value, especially concerning the flow of logistical supply lines, including the transport of natural and energy resources (Rucks, 2015).

use of communication lines by the adversary, which aligns with the Corbettian conception, which perceives the primary goal of naval warfare as the denial of such capabilities to the enemy. However, achieving and sustaining full command of the sea is immensely challenging. This occurs to the possibility of obtaining or fragmenting local supremacy, even with inferior means, as long as force is strategically focused to a sufficient degree (Corbett, 2004).

According to Coutau-Bégarie's (2010) analysis of the Classical Maritime Strategy, submarines hold a crucial advantage in that they can operate independently of war between organized forces and achieve decisive negative results by attacking SLOC (Figure 1). This enables a weaker Naval Power to conduct operations that may (although incapable of decisive outcomes) preserve its combat potential while degrading enemy resources, ensuring the denial of sea use to the adversary, even if unable to control the sea. The pursuit of naval supremacy by the most powerful adversary aims at dominating the sea. However, achieving this domination fails to guarantee such adversary the ability to retain and utilize it freely. Thus, whoever exercises control over the sea is drawn into a communications war, which evades resolution by direct clashes against the enemy organized forces. Instead, it becomes a war of attrition against a submarine enemy. In this context, submarine forces always hold the advantage of initiative, enabling them to choose the moment and place of their attacks.

Figure 1 – Control of Communications and Maritime Areas — Interdiction of the Seas



Source: Coutau-Bégarie, 2010, p. 471.

Submarine warfare is not simply a repetition of traditional corsican warfare[3], using a new weapon. The fleet tactic developed by Admiral Doenitz during World War II (1939-1945) transcends mere isolated corsairs against maritime traffic. Instead, it involves submarine squadrons coordinated and commanded by a land-based headquarters. This transformative approach marked an organic and doctrinal revolution at the time, giving rise to a new form of war that, while retaining the same objective of disrupting maritime activities, was fundamentally distinct in its means and conduct, despite remaining unchanged in its object. The disruptive technological revolution in naval operations and means of warfare occurred with the invention and construction of the first nuclear submarine, the USS Nautilus[4], in 1955, This fact led to nuclear-powered submarine weapons becoming one of the precursors of dissymmetric warfare[5].

In operational terms, the nuclear submarine could be considered simply the lord of the seas, offering the best cost/benefit ratio in naval warfare. Its decisive advantage[6] lies in its concealment capacity, which translates itself into military surprise and, strategically speaking, constitutes one of the most potent factors in any conflict. This enables these submarines to seamlessly blend in with their operational environment, preserving their stealth capabilities and tilting the situation in their favor. To achieve this, a combination of surface naval and air assets would be necessary to counter, with any chance of success, a single nuclear-powered submarine. This underscores its essential deterrent effect: what matters most is not necessarily what it will do, but what it is capable of doing. And it can do so much that its mere existence is enough to produce a good part of the desired effects of its possession (Moura Neto, 2009).

To elucidate the characteristics of each submarine type further, the following table summarizes the main operational distinctions between submarines with nuclear propulsion and those with diesel-electric propulsion.

3 "The fundamental concept of conventional private warfare involves relinquishing competition for supremacy against those wielding maritime power due to the highly uneven balance of forces. [...], it constitutes a strategy of attrition the aim of which is to hinder the dominant power from exert its supremacy and impose losses that, though restricted in absolute numbers, will prove to be substantial, perhaps even intolerable." (Coutau-Bégarie, 2010, our translation)..

4 United States Naval Nuclear Propulsion Program (2015) — "Since USS NAUTILUS (SSN 571) first signaled "UNDERWAY ON NUCLEAR POWER" over 60 years ago in 1955, our nuclear-powered ships have demonstrated their superiority in defending the country — from the Cold War to today's unconventional threats, to advances that will ensure the dominance of American seapower well into the future." (United States, 2015).

5 "Dissymmetry" may be interpreted as one antagonist seeking a pronounced qualitative and/or quantitative superiority over the opponent. It expresses a clear intention to implement an overarching strategy aiming to establish superiority in terms of means to achieve desired ends. It should not be confused with "asymmetry" (Tomé, 2005)..

6 The advantages of nuclear-powered submarines could be summarized into "seven deadly virtues (...), namely flexibility, mobility, stealth, endurance, reach, autonomy, and punch." (Till, 2018, p.159).

Chart 1 – Advantages and Disadvantages — Nuclear propulsion x Diesel-electric propulsion

Nuclear-Propelled Submarines:	
Upsides	**Downsides**
1. Nearly boundless autonomy: It operates independently of atmospheric air, enabling extended journeys without the need for frequent surfacing.	**1. High cost:** Building and maintaining nuclear submarines incur significantly higher costs due to the intricate nature of the involved technology.
2. Higher speed: They typically boast a higher maximum speed potential in comparison to diesel-electric submarines.	**2. Complex maintenance:** Nuclear submarine operations necessitate highly trained personnel and specialized facilities to maintain the nuclear reactors.
3. Reduced reliance on the surface: Remain submerged for longer periods without the need to surface to replenish their fuel, displaying superior stealth capabilities.	**3. Limitations in shallow water:** Substantial draft makes them less suitable for shallow water operations.
Diesel-Electric-Propelled Submarines:	
Upsides	**Downsides**
1. Lower cost: A more cost-effective choice in terms of construction and maintenance, rendering them a viable option for numerous navies.	**1. Surface dependence:** Must surface regularly to recharge their batteries and replenish their air, limiting their autonomy and diminishing their concealment capabilities.
2. Silent: They are quieter than nuclear submarines, endowing them with superior stealth capabilities.	**2. Limited underwater speed:** Their underwater speed is significantly inferior to that of nuclear submarines.
3. Versatility in shallow waters: Can operate efficiently in shallow waters in which nuclear submarines may face challenges.	**3. Limited submerged autonomy:** Constrained by battery capacity, they display reduced underwater autonomy.

Fonte: Elaborado pelos autores, 2023.

When delving into this subject and in line with the aforementioned perspective, the National Defense Policy (*Política Nacional de Defesa*, PND) stipulates, in its 2020 version, that:

> The Amazon, as the South Atlantic, stands as an area of geostrategic interest for Brazil. [...] Deterrence must be the foremost strategic posture to be contemplated for the defense of national interests in that regio.
>
> [...]
>
> The Country must be able of conducting surveillance, control, and defense of Brazilian jurisdictional waters and of its territory and airspace, encompassing both continental and maritime areas. It must also ensure the security of maritime lines of communication and air navigation routes, particularly in the South Atlantic, to reinforce its status as an area of peace and cooperation. (Brasil, 2020, p. 33-34)

The concept of *deterrence* involves the ability of a state to prevent undesirable actions solely based on its recognized power or a history of similar reactions that induce

unfavorable responses from entities considering such actions (Freedman, 2005). According to Pape (1996), both coercion and deterrence aim to influence the opponent's decision-making process, but deterrence seeks to maintain the *status quo* by dissuading the opponent from changing their behavior. In contrast, coercion endeavors to compel the opponent to change their conduct. The author defines coercion as efforts to modify the behavior of a state by manipulating costs and benefits (Pape, 1996).

While coercion is perceived as the flip side of deterrence, both can be closely interconnected in practice. Coercion is thus portrayed as the counterpart to deterrence, serving the purpose of dissuading a specific behavior on the part of an adversary by manipulating costs and benefits. In essence, coercion aims submission, where as deterrence, at intimidation or detain. Although states often employ economic, diplomatic, or other non-military means of coercion, military coercion or the use of military instruments to influence the behavior of an opponent, merits special attention due to its prevalence when vital interests are at stake and its effective use entails significant physical and normative consequences.

Freedman (2005 apud Herz; Dawood; Lage, 2017, p. 340) explains that the strategy proposed by MB authorities would resemble "deterrence by denial." This form of deterrence aims to create a situation in which a specific course of action is no longer a viable choice. Thus, SCPN would prevent a swift victory for a potential adversary, which would only be obtained by incurring irreparable losses, entailing high costs by acting at odds with Brazilian interests in the South Atlantic. It would constitute a Pyrrhic victory, a type of triumph that inflicts so much damage on the victorious side that it is essentially equivalent to defeat. For a better comprehension, it is also worth highlighting that the "framing of the South Atlantic as a strategic area is a fundamental feature, justifying the nuclear-propelled submarine project."[7](Herz; Dawood; Lage, 2017, p. 339). Deterrence by denial would be implemented with the use of non-nuclear weapons. Thus, the intended deterrence is classified as conventional, rather than as nuclear deterrence, which relies on the threat of using nuclear weapons—an option Brazil, as a *non-nuclear weapon state* (NNWS), neither possesses nor contemplates. In short, and according to the authors, nuclear-powered submarines are deemed a tool for strategic flexibility and surveillance, contributing to safeguarding the security interests of Brazil, including the control of natural resources in the South Atlantic and the denial of access to the AJB by external actors.

7 In this region, Antarctica holds strategic relevance due to commercial routes crossing the Drake Strait and the Cape route as due to its environmental impact (Mattos, 2014, apud Herz; Dawood; Lage, 2017, p. 339). "The strategic interest in the Antarctica also justifies the investment in nuclear propelled submarines. According to Leonardo Faria de Mattos, the threat lies in the possibility of disrespect of the Antarctic Treaty, and nuclear submarines have a role to play in deterrence in this respect, particularly in the parts of the continent of interest to Brazil, i.e. those facing the South Atlantic." (Mattos, 2014, p. 186, apud Herz; Dawood; Lage, 2017, p. 339). In other words, concern about Antarctica is intricately linked to concern regarding the South Atlantic. "In sum, the framing of the South Atlantic as a strategic area is a fundamental feature of the justification for the nuclear propelled submarine put forward by the Brazilian ruling elites." (Herz; Dawood; Lage, 2017, p. 339)..

In a similar interpretative context, the authors posit that the concept of deterrence, as formulated by the Brazilian ruling elites[8], materializes a necessary response to address the strategic significance of the South Atlantic. The following passage reinforces this perception:

> We contend that the Brazilian strategy can be understood in terms of a general and conventional deterrence strategy, that is, when no specific targets are clearly stipulated and no nuclear weapons are used. In addition, Brazilian authorities argue that the submarines deny potential enemies the possibility of an easy victory against Brazil, and this is the very characteristic of deterrence by denial. (Herz; Dawood; Lage, 2017, p. 344)

Indeed, the strategy grounded in 'deterrence by denial' could be further elucidated, drawing upon classical literature, as follows:

> Deterrence by denial strategies seek to deter an action by making it infeasible or unlikely to succeed, thus denying a potential aggressor confidence in attaining its objectives—deploying sufficient local military forces to defeat an invasion, for example. At their extreme, these strategies can confront a potential aggressor with the risk of catastrophic loss. Deterrence by denial represents, in effect, simply the application of an intention and effort to defend some commitment. A capability to deny amounts to a capability to defend; "deterrence and defense are analytically distinct but thoroughly interrelated in practice." (Mazarr, 2018, p. 2)

The 2016 National Defense White Paper (*Livro Branco de Defesa Nacional*, LBDN) emphasizes that "The possession of a submarine with nuclear propulsion will contribute to the defense and preservation of national interests in water, particularly in the South Atlantic." Among other characteristics, Lana (2014) highlights that:

> Given its exceptional mobility and nearly limitless autonomy, nuclear-powered submarines challenge today's most advanced detection systems and is thus regarded as one of the most effective naval assets for deterrence. (Lana, 2014, p. 175, our translation)

The analysis of the distribution of submarines worldwide finds a complete concentration of nuclear-powered units within the possession of major powers in the Northern Hemisphere. These distinctive features of mobility and autonomy are endorsed in two sections of the DMN (2017b), which states:

> **Opposing or adversarial forces must be halted or, preferably, deterred, extending well beyond the confines of Brazilian maritime spaces.** [...]

8 "The ruling elite refer to those in control of strategic decision-making processes in society. The ruling elite changes constantly and includes actors that have access to economic, military, political, and cultural resources that allow for a significant impact in the way a given society is governed." (Herz; Dawood; Lage, 2017, p. 345)..

> Naval Power must leverage the attributes of **mobility, permanence**, versatility, and flexibility. **Mobility signifies the capability to move swiftly and cover vast distances while maintaining a high level of readiness for immediate deployment. Permanence denotes the capacity to operate continuously, autonomously, and for extended durations, spanning distant and expansive areas.** (Brasil, 2017b, p. 1-5, our translation, emphasis added)

Specifically addressing naval nuclear propulsion, Yu (2020) explains that, in comparison to conventional reactors, marine nuclear reactors distinguish themselves by the extremely high energy density of their nuclear fuel, delivering continuous high-power energy production that dispenses with oxygen and ship fuel. Yu further emphasizes that leveraging the technological expertise gained from utilizing nuclear energy in submarines, several countries have consistently expanded its application to various marine platforms such as aircraft carriers, destroyers, frigates, submersible vehicles, and icebreakers[9].

One of the primary characteristics of the continuous development of nuclear propulsion refers to its robust support from the national defense strategy of a country that has opted to research and develop this innovative technology. As an example, the *United States Navy Reactor Program* conducted a specialized study on marine reactors, giving priority to technology development. Furthermore, it ensured adequate long-term financial support with an emphasis on implementing medium- and long-term development plans while establishing and maintaining fundamental nuclear capabilities in science and technology.

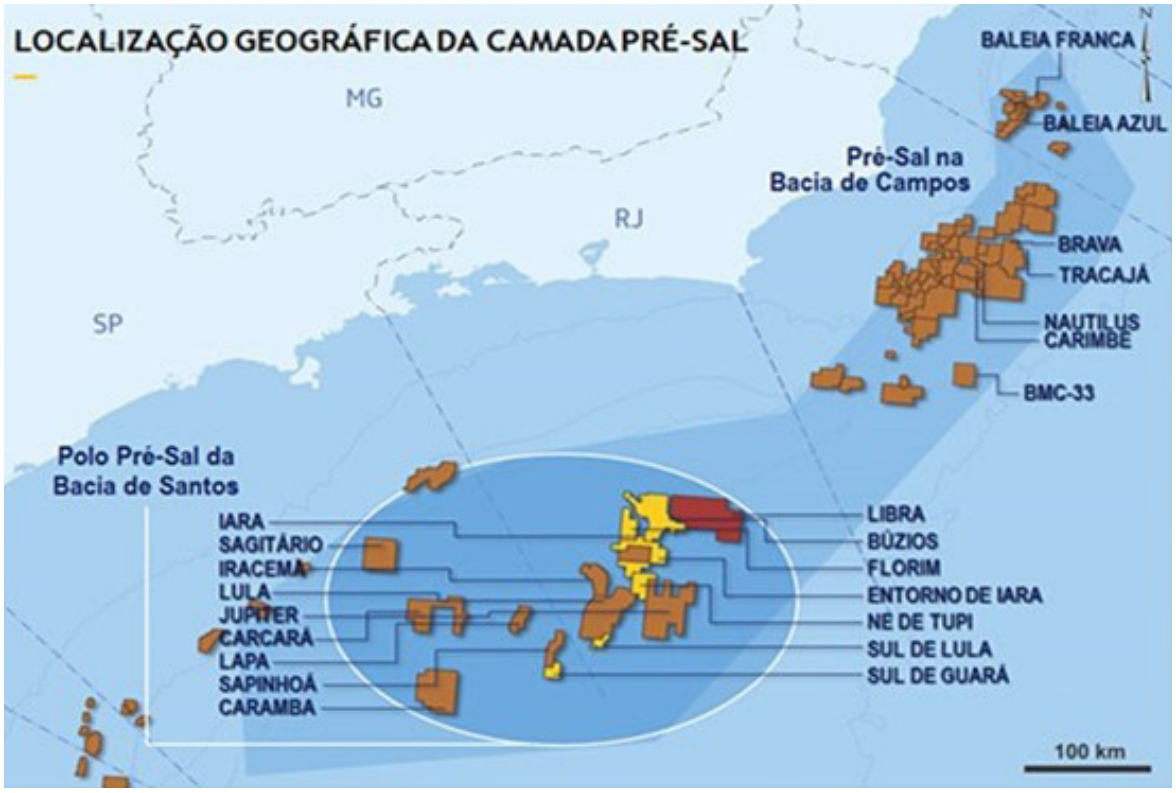
In addressing the strategic considerations for defending the Brazilian marine heritage, Lana (2014) underscores the approximate locations of mineral reserves, including those of gold, diamonds, iron, nickel, tin, cobalt, copper, and phosphates, spanning the entire length of its coast and continental shelf. The soil of the Blue Amazon is also rich in carbonates and phosphorites, highly valuable as fertilizers in agriculture. In 2006, amid research to identify the extension of the continental shelf, Brazil announced the discovery of several pre-salt oil fields stretching 800 kilometers from the coast of Espírito Santo to Santa Catarina and covering a strip approximately 200 km wide. The area encompasses nearly 150 thousand square kilometers, hosting a significant concentration of oil platforms exploring oil and natural gas reserves at depths exceeding seven thousand meters.

Fixed platforms, as illustrated in Figure 2, are inherently susceptible to potential enemy attacks, posing a risk not only to the number of extracted barrels but also to the level of reserves within the national territory. In alignment with this perspective, Moura Neto (2009) points out the potential negative consequences of leaving the coast and, therefore, the sea lines of communication unprotected, emphasizing that over 95% of the Brazilian foreign trade rely on maritime transportation[10].

9 Russia recently commissioned the first floating nuclear power plant in the world to provide electrical energy to remote areas while avoiding the environmental costs of carbon (Power Technology, 2020)..

10 Brazil's oil provinces contribute to over 82% of national oil production, with 93% of total oil reserves and 75% of total natural gas reserves

Figure 2 – The pre-salt province



Source: Petrobras, 2014.

Beyond the aforementioned issues within the Brazilian context, it is imperative to address specific concerns regarding latent threats in the South Atlantic, manifested by the presence of extra-regional powers. This exclusive group of countries possesses sufficient military capacity to exert a certain (albeit relative) degree of control over a geographic area distant from their home territories. This understanding encompasses nations with bases or overseas territories in the South Atlantic, exercising jurisdiction and sovereignty in specific locations within this region.

Among these, only three states seem to demonstrate to some extent the military capacity to ensure their presence in the South Atlantic: The United States, the United Kingdom, and, to a lesser extent, France. Such capacity is rooted not only in the political and economic influence of these countries but primarily in their substantial military capabilities, especially their sophisticated naval assets requiring advanced technological mastery. Even the United Kingdom serves as a traditional provider of surface naval assets for Brazil, and France is characterized as a partner in the Brazilian Submarine Program (PROSUB), which aims to transfer technology to produce four conventional

situated offshore. The estimated total pre-salt reserves amount to 35 billion barrels, signifying a potential shift in the country's global economic standing (Brazil, 2017a)..

submarines and manufacture SCPN. It is also essential to note that the Navy Strategic Plan (*Plano Estratégico da Marinha*, PEM 2040) (Brasil, 2020) underscores that the END focuses on two maritime areas across the vast maritime expanse under the Brazilian national jurisdiction of the Blue Amazon: the strip between Santos and Vitória and the maritime area around the mouth of the Amazon River, as highlighted in Figure 3. These areas merit a closer examination concerning the imperative to control maritime access to Brazil.

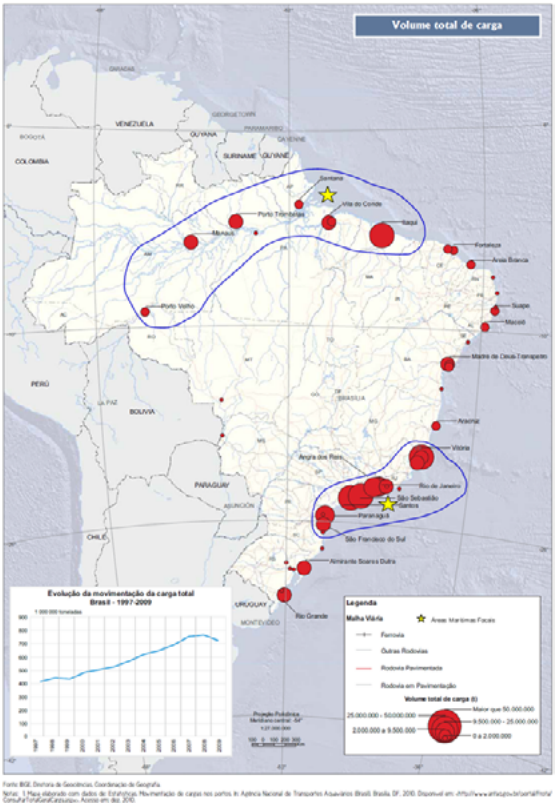
Figure 3 – Extra-regional powers within the Brazilian strategic environment

Source: Poder Naval, 2010; França 2016 (Modified by the authors).

Thus, the existence of these two distinctive focal points is substantiated as, despite the abundance of natural resources with high economic potential, a scrutiny of the maritime flow of imports and exports within these two designated zones shows heavy merchant traffic bringing about a substantial volume of cargo movement. Visually depicted in Figure 4, these commercial movements encompass significant imports and exports of cargo in the order of millions of tons. A potential disruption of these supply lines, impacting the two crucial concentration areas, could hold the potential to substantially impair the sustainment of the combat power of the

Brazilian Armed Forces as a whole. This could degrade the logistics chain responsible for maintaining the supply of essential items, directly impacting not only the pace of military operations but also the most vulnerable sectors, especially critical infrastructures and the civilian population. This would significantly contribute to generating strategic paralysis, potentially leading to economic suffocation for a country in a short space of time. It is essential to note that the strategic paralysis effect mentioned above is closely tied to the concept of the center of gravity (CG). Similarly, these concepts aim to exploit the vital points and vulnerabilities of an opponent. In Warden's (1988) perspective, the concept of an enemy center of gravity (CG) refers to the point at which it is most vulnerable and against which a potential attack would be most likely decisive. According to the author, determining these points configures the primary critical step in planning and conducting military operations. Strategic paralysis, on the other hand, is characterized as a non-lethal intention to incapacitate the enemy both physically and mentally, inducing disorientation and moral collapse. While this non-lethal intention fails to necessarily exclude destructive actions or avoid fatal results, its objective is, on the contrary, to minimize negative outcomes as much as possible (Fadok, 1995).

Figure 4 – Total cargo volume in Brazilian ports



Source: Adapted from IBGE, 2011, p. 148.

In the specific case of the United States, the IV Fleet, reactivated in 2008, is responsible for the security of the South Atlantic, deploying ships, submarines, and aircrafts to defend the area

under the responsibility of the United States Africa Command (US AFRICOM), founded in 2007 (Maclay *et al*., 2009). The IV Fleet collaborates with US AFRICOM and holds responsibility for the Latin American region (Vaz; Migon, 2013). The United Kingdom, on the other hand, exercises a degree of control over actions in the South Atlantic given its ownership of a group of islands stretching from the Falkland Islands to Ascension Island, as shown in Figure 3.

Ascension Island, in particular, stands out for its characteristics and strategic location in the South Atlantic. With 91 km2 of mountainous terrain with a highest point at 859 meters (m), it lacks a port but boasts an aerodrome with a runway of around 3000 m that can accommodate large aircrafts, making it useful for the task of force projection. Further south, the Saint Helena and Tristan da Cunha islands, although small with challenging living conditions, can serve as support bases for Unmanned Aerial Vehicles (UAVs) and antenna installations, contributing to surveying and securing the South Atlantic. Finally, the Malvinas archipelago allows for force projection over the Drake Passage and the Strait of Magellan, serving as a legal argument for territorial claims over Antarctica (Neves, 2015).

Despite its smaller influence compared to the USA and the United Kingdom, the French presence in the South Atlantic holds significance. For instance, starting in 2002, the country conducted interventions in Côte d'Ivoire, culminating in 2011 with the fall of former president Laurent Gbagbo in Chad. Moreover, numerous interventions were carried out in the Central African Republic, Libya (in cooperation with the North Atlantic Treaty Organization - NATO - and the USA), and Mali. Official documents from the French government (France, 2016) confirm operational contingents of 350, 600, and 450 soldiers in the territories of Senegal, Côte d'Ivoire, and Gabon, respectively.

France also participates in peacekeeping missions led by the United Nations (UN) in Côte d'Ivoire and the Democratic Republic of Congo, maintaining a permanent military base in Gabon and another in Senegal. Almost half of the French troops outside the European continent are deployed in Africa (Borba *et al*., 2013).

In addition to these interests and the French presence in Africa, France also holds a position in the South Atlantic by its jurisdiction in French Guiana. There it maintains a force of 2,100 men and women. The territory used to be a French colony until 1946 when it became a French overseas department and region. Its most prominent activity is the presence of the Kourou Space Center, the launch site of the European Space Agency, strategically relevant due to its privileged latitude – very close to the Equator. This feature simplifies satellite handling and reduces operating costs for launch rockets.

Hence, Figure 3 illustrates a comprehensive arrangement of forces formed by the presence of the three aforementioned main extra-regional powers and distributed around Brazil along the entire length of the South Atlantic.

This perception is validated by the text published in Política Naval, which states:

> **South America, the South Atlantic, Antarctica, and the African countries bordering the South Atlantic hold substantial reserves of scarce natural resources**

> **worldwide. This scenario could potentially lead to conflicts in which the use of force becomes a predominant factor, necessitating support for the imposition of political and economic sanctions. In the South Atlantic, external powers have intensified their activity and presence, even acquiring territories in the area.** As a result, expressions of National Power must be effectively equipped to defend national interests whenever necessary. (Brasil, 2019, p. 14, our translation, emphasis added)

From this perspective, Brazil (2020, p. 31) claims that it is plausible to perceive its strategic surroundings, including the South Atlantic, as an environment in which our sovereignty and maritime interests are susceptible to conflicts with other states. This is corroborated, as previously mentioned, by the presence of extra-regional powers in the region possessing sufficient military capacity to Brazilian disrupt maritime traffic, supply lines, and trade.

For this study, it is also crucial to recognize that, when examining the recent history of conflicts in South America, the Falklands War in 1982 stands out. Vidigal (1984) argues that the British Navy significantly restricted all surface assets of the Argentine Navy during the war, confining them to the coastline and ports by destroying the cruiser *General Belgrano*, achieved by a torpedo launched from the nuclear-powered submarine *Conqueror*. As a result, the Argentine aircraft carrier *25 de Mayo* was rendered inactive upon returning to its base, and its planes were relocated to bases across the southern part of the country. This was admittedly necessary to safeguard the carrier given the inability of the Argentine Navy to effectively counter British nuclear-powered submarines.

Similarly, according to Flores (1982), this conflict shed light upon an undeniable reality: Navies "would be split into two groups—those with submarines (equipped with nuclear propulsion) and those deemed secondary as they lack such capabilities" (Flores, 1982, p. 62, our translation). The strategic and operational actions of the United Kingdom were not only decisive but also expedient, driven not only by the readiness of its surface fleet and mobilization capacity but particularly by the autonomy and speed that nuclear-powered submarines afford, which have enabled the UK to compel the withdrawal of Argentine naval forces by denying them effective use of the sea. This denial resulted in severe logistical consequences, isolating Argentine garrisons on the islands and thwarting any direct actions to disembark new troops and send essential supplies, including weapons, ammunition, and medicine.

Nuclear-powered submarines played a crucial role in determining the outcome of the conflict, exerting a disproportionate power factor in maritime confrontations. They became a decisive factor, countering the force projection capacity of aircraft carriers (even to the detriment of its force projection capabilities) by transforming it into a high-priority military target.

2 CLOSING ARGUMENTS

Considering not only the vast distance between the two previously discussed focal maritime areas (the strip between Santos and Vitória and the extension surrounding the mouth of the Amazon River, as outlined in Figure 3) but also the extensive stretch of the Brazilian coastline,

it seems reasonable to assert that even a substantial number of conventional submarines with traditional propulsion may lack the power to ensure the desired effects for an effective deterrence by denial. Simultaneously, these means alone would fail to meet the operational requirements mandated by the constitutional mission of defending the Homeland, which encompasses preserving territorial integrity, protecting the resources comprised by the AJB, and safeguarding the SLOC under the terms of the CF/88.

In this context, it should be emphasized that the presence of the SCPN would endow the national Naval Power with a genuine operational capacity to protect natural resources, dissuading potential adversarial forces from undertaking hostile actions within the AJB. This capability would enable it to confront not only another SCPN but even other more sophisticated surface assets, discouraging their use in Brazil's strategic surroundings. This feasibility is attributable to the fact that SCPN fulfill the task of denying the use of the sea to the enemy by meeting three essential conditions: (1) the ability to move great distances at high speeds (mobility); (2) the ability to continuously operate independently and for long periods in distant and large areas (permanence); and, (3) due to its great mobility and almost inexhaustible permanence, the confrontation of contemporary modern detection systems, enabling it to act stealthily (principle of surprise and permanence).

The security of a nation and its legacy, amplified by maritime spaces and their corresponding natural resources, require the use of adequately prepared and compatible defense means with the capabilities to counter possibly interfering external ambitions, thereby affecting national sovereignty.

This justification stems from the fact that armed conflicts are still employed as a power mechanism in international relations by actors and organizations to achieve objectives and safeguard their interests.

Historical events, both after the submarine threat in the two World Wars and more recently during the Falklands War, uphold ample lessons emphasizing the indispensable and continuous preparedness of the country to dissuade potential attacks on the AJB.

As elucidated earlier, in this scenario, SCPN can significantly contribute to effectively mitigate the risks of military actions along the Brazilian coast aimed at causing strategic paralysis. Hence, this crucial operational asset emerges as a suitable and steadfast instrument, primarily designed to repel sea-based attacks on national territory. It serves the key purpose of safeguarding the country against superior naval forces that could jeopardize not only energy production facilities but also prevent the easy imposition of obstacles to the Brazilian flow of maritime traffic, supply, and trade flow.

Therefore, this significant naval asset currently under construction should play a strategically monumental role in the South Atlantic not only by ensuring the preservation of the National sovereign interests but also by making a substantial contribution to the actual defense of the Homeland.

REFERENCES

BORBA, A. C. G. et al. Política Externa e de Segurança da França. *In*: MARTINS, J. M. Q. **Estudos de Caso em Política Externa e de Segurança 2012/2**. Porto Alegre: Instituto Sul-Americano de Política e Estratégia (ISAPE), 2013. p. 126-141.

BRASIL. Ministério da Defesa. **Política Nacional de Defesa**. Estratégia Nacional de Defesa. Brasília, DF: Ministério da Defesa, 2012a. Disponível em: https://www.defesa.gov.br/arquivos/estado_e_defesa/ENDPND_Optimized.pdf. Acesso em: 10 abr. 2022.

BRASIL. Ministério da Defesa. Politica Nacional de Defesa. Estratégia Nacional de Defesa. Brasília, DF: Ministério da Defesa, 2016. Disponível em: https://www.gov.br/defesa/pt-br/arquivos/estado_e_defesa/copy_of_pnd_e_end_2016.pdf. Acesso em: 02 jan. 2022.

BRASIL. Ministério da Defesa. Estratégia Nacional de Defesa. Brasília, DF, 2020a. Disponível em: https://www.gov.br/defesa/pt-br/arquivos/estado_e_defesa/copy_of_pnd_e_end_2016.pdf. Acesso em: 02 jan. 2020.

BRASIL. [Constituição (1988)]. Constituição da República Federativa do Brasil. Brasília, DF: Senado Federal, 2016. 496 p.

BRASIL. Ministério da Defesa. Comando da Marinha. **Estado-Maior da Armada**: O posicionamento da Marinha do Brasil nos principais assuntos de interesse naval EMA-322. Brasília, DF: Ministério da Defesa, 2017a.

BRASIL. Ministério da Defesa. Comando da Marinha. Estado-Maior da Armada. **Doutrina Militar Naval (DMN)**: EMA-305. Brasília, DF: Ministério da Defesa, 2017b.

BRASIL. Marinha do Brasil. **Política Naval**. Brasília, DF: Ministério da Defesa, 2019. Disponível em: https://www.marinha.mil.br/sites/all/modules/politica_naval/book.html. Acesso em: 26 fev. 2023.

BRASIL. Ministério da Defesa. Comando da Marinha. Estado-Maior da Armada. **Plano Estratégico da Marinha (PEM 2040)**. Brasília, DF: Ministério da Defesa, 2020.

CORBETT, J. S. **Some Principles of Maritime Strategy**. New York: Dover. 2004.

COUTAU-BÉGARIE, H. **Tratado de Estratégia**. Rio de Janeiro: Diretoria do Patrimônio Histórico e Documentação da Marinha, 2010. 776p.

FADOK, D. S. **John Boyd and John Warden Air Power's Quest for Strategic Paralysis**. 1995, 61 f. Tese (Dissertação de Mestrado) – School of Advanced Airpower Studies, Air University Press Maxwell Air Force Base, Alabama, 1995.

FLORES, M. C. Malvinas: uma primeira abordagem. **Revista Marítima Brasileira**, Rio de Janeiro, p. 59-70, 1982.

FRANÇA. **Les Forces françaises prépositionnées**. Paris: Ministère De La Défense, République Française, 2016. Disponível em: https://www.defense.gouv.fr/content/download/466302/7428994/DOSSIER%20-%20Forces%20pr%C3%A9positionn%C3%A9es.pdf. Acesso em: 17 fev. 2023.

FREEDMAN, L. **Deterrence**. Cambridge: Polity Press, 2005.

GILL, N. S. What Is a Pyrrhic Victory, and How Did the Term Begin? **Thoughtco**, [*s. l.*], 2 dez. 2007. Disponível em: https://www.thoughtco.com/pyrrhic-victory-120452. Acesso em: 11 dez. 2023.

HERZ, M.; DAWOOD, L.; LAGE, V. C. A nuclear submarine in the South Atlantic: The framing of threats and deterrence. **Contexto Internacional**, Rio de Janeiro, v. 39, n. 2, p. 329-350, 2017.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Atlas geográfico das zonas costeiras e oceânicas do Brasil**. Rio de Janeiro: IBGE, 2011.

LANA, L. **Submarinos**: defesa e desenvolvimento para o Brasil. Rio de Janeiro: Versal, 2014. Disponível em: https://goo.gl/gttqKf. Acesso em: 20 mar 2023.

MACLAY, J. D.; POTTER, M.; SCOTT, R. R.; SIBLEY, M. W. **The Fourth Fleet**: A Tool of U.S. Engagement in the Americas. Washington, DC: Center for Strategic and International Studies, 2009. Disponível em: http://www.voltairenet.org/IMG/pdf/The_Fourth_Fleet.pdf. Acesso em: 17 jun 2023.

MAZARR, M. J. **Understanding Deterrence**. Santa Monica: Rand Corporation, 2018.

MOURA NETO; Julio Soares de. A Importância da Construção do Submarino de Propulsão Nuclear Brasileira. **Revista Marítima Brasileira**, Rio de Janeiro, v. 129 n. 4/6, p. 9-10, 2009.

MOURA, J. A. A. **A Estratégia Naval Brasileira no Pós-Guerra Fria**: uma análise comparativa com foco em submarinos. Rio de Janeiro: FEMAR, 2014.

NEVES, A. L. V. **Atlântico Sul**: projeção estratégica do Brasil para o século XXI. Amazônia e Atlântico Sul: desafios e perspectivas para a defesa no Brasil. Brasília, DF: IPEA, 2015.

PAPE, R. A. 1996. **Bombing to Win**: Air Power and Coercion in War. Ithaca: Cornell University Press.

PETROBRAS. Blog Fatos e Dados, 2014. Produção no pré-sal bate novo recorde e ultrapassa a barreira de 500 mil barris de petróleo por dia. **Petrobras**, [*s. l.*], 2014. Disponível em: https://petrobras.com.br/fatos-e-dados/mais-uma-conquista-no-pre-sal-500-mil-barris-por-dia.htm. Acesso em: 15 jun. 2023.

PODER NAVAL. Poder Naval no Seminário da Amazônia Azul, na Escola Naval. **Poder Naval**, [*s. l.*], 2010. Disponível em: http://www.naval.com.br/blog/2010/10/16/poder-naval-no-seminario-da-amazonia-azul-na-escola-naval/. Acesso em: 17 jun. 2022.

POWER TECHNOLOGY. Russia commissions world's first floating nuclear power plant. **Power Technology**, [*s. l.*], 25 maio 2020. Disponível em: https://www.power-technology.com/news/russia-floating-nuclear-power-plant/. Acesso em: 26 jan. 2022.

RUCKS, J. T. Estreito de Ormuz: o acirramento da Competição Estratégica entre Estados Unidos e Irã (2003-2013). *In*: SEMINÁRIO INTERNACIONAL DE CIÊNCIA POLÍTICA, 1., 2015, Porto Alegre. **Anais** [...]. Porto Alegre: UFRGS, 2015.

SPELLER, I. Naval warfare. In: Jordan, D. *et al*. **Understanding modern warfare**. Cambridge: Cambridge University Press, 2008.

TILL, G. **Seapower**: A guide for the twenty-first century. 4. ed. London: Routledge, 2018.

TOMÉ, L. **A dissimetria dos EUA e a Guerra Assimétrica**. Lisboa: Universidade Autónoma de Lisboa, 2005.

UNITED STATES. Congress. House. Committee on Armed Services. Department of Energy. Department of the Navy. **The United States Naval Nuclear Propulsion Program**. Washington, D.C.: Congressional Sales Office, 2015. Disponível em: https://www.energy.gov/sites/prod/files/2017/08/f36/nuclear_propulsion_program_8-30-2016%5B1%5D.pdf. Acesso em: 8 nov. 2022.

VIDIGAL, A. A. F. Conflito no Atlântico Sul. **Revista Marítima Brasileira,** Rio de Janeiro, p. 3-29, 1984.

VAZ, C. A. M.; MIGON, E. X. F. O Brasil e as alternativas para o incremento da cooperação em segurança & Defesa na Zona de Paz e Cooperação do Atlântico Sul (ZOPACAS). **Revista da Escola Superior de Guerra**, Rio de Janeiro, v. 28, n. 56, p. 110-131, 2013.

WARDEN, J. A. **The Air Campaign – Planning for Combat**. Washington, DC: National Defense University Press, 1988. 172p

YU, J. **Marine Nuclear Power Technology**. London: Springer, 2020.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