Artigo recebido em fevereiro de 2014 e aceite para publicação em maio de 2014

ARMAMENTS NON-PROLIFERATION:
THE CASE OF CRUISE MISSILES

NÃO-PROLIFERAÇÃO DE ARMAMENTOS: O CASO DOS MÍSSEIS DE CRUZEIRO

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Abstract

This article is intended to present an overview of cruise missiles produced by several States and their vertical and horizontal proliferation, especially in what concerns Land Attack Cruise Missiles (LACM), using publicly-available information only. The analysis was limited to LACM capable of delivering a payload of at least 500 kilograms (kg) to a range of at least 300 kilometers (km), or non-conventional weapons.

A characterization of those missiles will be made and a brief historical overview presented, as well as an analysis of the technologies involved, a description of world cruise missile programs and of non-proliferation issues (detailing two multilateral mechanisms in use). The Portuguese aspects of non-proliferation will be addressed, including some proposals for a better addressing of this issue in the appropriate Portuguese fora.

We conclude that the issue of cruise missile proliferation involves multiple technological, political, military and commercial aspects, being an issue of concern for several actors of the International System.

Keywords: Cruise Missiles, Military Technologies, Non-proliferation.

Resumo

Com o presente artigo pretende apresentar-se uma panorâmica sobre os mísseis de cruzeiro produzidos por diversos Estados do mundo e respetiva proliferação horizontal e vertical, especialmente no respeitante aos Land Attack Cruise Missiles (LACM), utilizando essencialmente informação pública. Delimitou-se a análise aos LACM capazes de

Como citar este artigo: Mira, J., 2014. Armaments Non-Proliferation: The Case of Cruise Missiles. Revista de Ciências Militares, maio de 2014, II (1), pp. 245 - 267.
Disponível em: http://www.iesm.pt/cisdi/index.php/publicacoes/revista-de-ciencias-militares/edicoes.

transportar uma carga útil de pelo menos 500 quilogramas (kg) a pelo menos 300 quilómetros (km), ou cargas não-convencionais.

Serão caracterizados aqueles tipos de mísseis e apresentada uma breve resenha histórica, sendo focadas, sucintamente, as tecnologias envolvidas na sua conceção. Serão focados os programas de produção de mísseis de cruzeiro, abordando-se a capacidade de produção, por diversos Estados, de LACM e tecendo-se alguns comentários sobre cada um dos países e mísseis abordados. Tecer-se-ão considerações sobre a área da não-proliferação, particularizando-se dois importantes mecanismos multilaterais de controlo da proliferação. Apresentar-se-ão ainda alguns aspetos respeitantes à abordagem nacional à não-proliferação, identificando-se os principais atores nacionais neste campo e propondo-se algumas medidas para um melhor acompanhamento desta temática nos fora nacionais apropriados.

Conclui-se que a temática da proliferação de mísseis de cruzeiro encerra múltiplos aspetos tecnológicos, políticos, militares e comerciais, sendo motivo de preocupação para vários atores do Sistema Internacional.

Palavras-chave: Mísseis de Cruzeiro, Tecnologias Militares, Não-Proliferação.

Introduction

In the American military operation designated as "Iraqi Freedom" that took place in the Persian Gulf in 2003 and which end state was the fall of Saddam Hussein's regime and the occupation of Iraqi territory, it was noticed that the expected use of ballistic missiles (of the type generically known as SCUD)[40] by Iraqi forces had a different result from the one of the previous operation "*Desert Storm*", of 1991: on this date, several SCUD surpassed the defensive systems, both of Saudi Arabia and Israel, while in 2003 nine SCUD launched by Iraq were shot down in flight by Patriot anti-aircraft systems (*Global Security, 2013*).

The same did not happen to another type of missile, with media exposure lower than the one of its ballistic counterparts: at 01H45 on Saturday 29th of March of 2003, an Iraqi surface-surface cruise missile, type CSS-C-3/SEERSUCKER made in China, reached the harbor in Kuwait City, after a 80km low-level flight, missing a popular shopping centre (Foltzer, 2003). This undetected attack, using a conventional military payload41 in the missile caused two injuries. A worst scenario could have occurred if the military payload used was of a non-conventional type.

The described occurrence, associated to a situation of sensitive proliferation of cruise missiles at the level of state actors of the International System, stresses out this subject as reason of concern, particularly for those feeling threatened by the existence of those missiles in neighboring States or by the possibility of non-state actors getting them.

Considering the relative lack of national knowledge on this matter, the present article aims at the presentation of an overview concerning cruise missiles produced by several

[40] Concerning ballistic missiles and their technologies, development programs and countermeasures, we suggest consulting (Mira 2012).

[41] Warheads may be conventional (high explosives) according to the definition of (NATO, 2013, p. 2-C-14) or nuclear, radiological, biological or chemical, the last four cases being "weapons of mass destruction".

States worldwide and respective horizontal and vertical proliferation, particularly in what concerns Land Attack Cruise Missiles (LACM), that is to say, cruise missiles conceived to attack land targets, generally targets of high tactical or even strategic value (High Value Targets)[42]. Using mainly analysis of public scope documents, this approach will be limited to LACM covered by Missile Technology Control Regime (MTCR)[43] criteria, that is to say, able to carry a payload of at least 500kg for at least 300km, or non-conventional weapons. The qualitative analysis presented will be carried out after the present introduction, according to sections focusing on the involved technologies, the production programs of those missiles, the issue of their proliferation and the Portuguese approach to their non-proliferation, ending with some conclusions.

According to the Allied Publication AAP-6 (2013), a missile is "A self-propelled munition whose trajectory or course is controlled while in flight"[44]. A cruise missile is defined by the government of the United States as an "unmanned, guided, expendable, weapon delivery vehicle that is continually self-propelled and sustains flight through the use of aerodynamic lift."[45]

Cruise missile Technology (like ballistic missiles´) exists since the end of World War II included in Hitler's German program of "wonder weapons" (*wunder waffen)*. In fact, at the end of the first decade of the forties of the last century, the III Reich tried to develop weapons and equipment that could invert the imminent defeat. Fighters, bombers and large submarines were developed, as was an attempt of a military nuclear program. Among the weapons, Nazi Germany invested resources in two programs for missile development, one of which was the "flying bomb" Fieseler Fi.103, which received the propaganda designation of *Vergeltungswaffe Eins* (V-1) or "Retaliation Weapon 1". Operated by the Air Force *(Luftwaffe),* with aerodynamic lift and pulse-jet enginejet propulsion, this surface-to-surface missile could reach hundreds of kilometers per hour and was launched from long, fixed, sloping land ramps. Although several "buzz bombs" (the nickname given by the Allies) were destroyed by British Royal Air Force and US Air Force fighters, they caused large damage in their targets in England and in the continent.

Post war and before the preponderance of ballistic missiles in the strategic (nuclear) deterrent between the superpowers ("balance of terror"[46]), cruise missiles had an important role. For example, the Northrop Aircraft B-62 / SM-62 Snark cruise missile became the first

[42] Other cruise missiles exist, conceived to attack surface ships. We will not cover these missiles in this occasion, despite the fact that many LACM are modified versions of those ASCM (Anti-ship Cruise Missiles). To conclude the references to ASCM (Anti-ship Cruise Missiles), let us mention that, in specific Theatres of Operations, some may perform near-strategic missions. For example, by interdiction of a maritime strait to commercial navigation, particularly the transport of crude oil.

[43] The Missile Technology Control Regime (MTCR) agreement was "Created in 1987, with the objective of preventing the proliferation of missiles and unmanned air vehicles, if capable to carry a payload of 500kg at 300 or more km, or non-conventional weapons that may employ weapons of mass destruction and their equipment and linked technologies, it currently includes the participation of 33 countries. Portugal is part of the Regime since 1992" (DGAED, 2006). MTCR will be covered in detail later on.

[44] As defined in (NATO, 2013, p. 2-M-8).

[45] As mentioned in (U.S. Government, 2000, p. 7).

[46] The subject of deterrence may be detailed by reading, for example (Dougherty e Pfaltzgraff, 2003, p. 439).

American operational missile with intercontinental range on 18th of March of 1960, when the 702nd Strategic Missile Wing placed this type of missiles on alert at Presque Isle AFB, Maine (Anderson, 2004, p. 78). At the tactical level, within the nuclear scope, US Air Force projected in the same period cruise missile units to Asia and Europe[47], armed with TM-76 Mace[48] and afterwards B-61/TM-61 Matador. In the naval scope, SSM-N-8 Regulus armed five American submarines, the first nuclear deterrent of the United States of America (USA) at sea (Whitman, 2013). Regarding aircraft weapons, the AGM-28 Hound Dog was the first operational cruise missile on B-52 bombers, more than half a century ago, with the British using in the sixties the Blue Steel missile from the Vulcan, from its bomber V-Force. In the Warsaw Pact, Soviet Union Tu-95/BEAR bombers used the Kh-20M (NATO[49] code: AS-3/KANGAROO).

According to the above mentioned MTCR, the fundamental difference between cruise and ballistic missiles relies on flight altitude. Cruise missiles fly at a lower altitude (below 30km) using aerodynamic lift to gain and keep altitude. Generally, they have lower cost and smaller dimensions than ballistic missiles, these being propelled by rocket engines for a suborbital ballistic trajectory, usually being guided during the ascent phase. Ballistic launch is easier to detect than cruise missiles (MTCR 2010). While the main military advantage of ballistic missiles is their very high speed, cruise missiles have the capability of maneuvering at very low heights above the terrain, using relief for concealment.

Physically, a cruise missile is very similar to a small plane, without a pilot. Its aerodynamic surfaces may be always visible (fixed surfaces) or only after the missile is launched (extensible surfaces). It is launched using land platforms (Ground-Launched Cruise Missiles - GLCM), from surface fixed facilities (not often used nowadays, that include storage hangars, support buildings and launching ramps) or from warehouses for specific heavy vehicles for transport and launching, normally road vehicles, which mobility represents an advantage in military terms. In other cases, those weapons may be launched from submerged submarines, surface ships or aircraft. Cruise missiles launched from a submarine are known as Submarine-Launched Cruise Missiles (SLCM). In the particular case of air operations, the great advantage granted by cruise missiles (Air-Launched Cruise Missiles - ALCM) is the so-called standoff distance, enabling the possibility to launch missiles out of range of enemy air defences, increasing the probability of survival of the launching aircraft.

The most recent military operations carried out by alliances of western countries has been initiated by salvos of cruise missiles launched from ships, submarines and aircraft, essentially aiming at enemy command and control centers ("decapitation" attacks), airfields, air Defence systems and other high value targets. During the recent operation in Libya more than 100 LACM[50] were fired.

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[47] In the eighties, American cruise missiles were again on the agenda, when the American Administration decided to deploy in Europe the Tomahawk GLCM (and the ballistic Pershing II) as counterpoint to the presence of the Soviet SS-20. Such a decision gave birth to several protests of European pacifists, as many readers will remember, with the famous sentence "better red than dead".

[48] A picture of a Mace may be seen, at the time, in (Mais Alto, 1959, 12).

[49] North Atlantic Treaty Organization.

[50] (Goure, 2013, p. 14), with other sources stating a total of 112 Tomahawks launched against air defense targets by American ships and a Trafalgar-class British submarine.

1. Technologies

Using as main guide (U.S. Government, 2000), we hereinafter briefly cover the technologies involved in the design and production of cruise missiles. We start by stating that technologies used in cruise missiles and those used for the development of aircraft are similar, excluding those associated to warheads. For example, the ex-USSR ALCM KS-1 (code NATO: AS-1/KENNEL) was derived from the MiG-15/FAGOT fighter (Donald, 2002, p. 52).

On the other hand, it is also certain that technologies for cruise missiles and ballistic missiles occasionally present overlapping areas (with particular attention in the case of solid propellant cruise missiles[51]) which leads to the reference in the next paragraphs of technological aspects similar to those covered in texts concerning ballistic missiles, such as (Mira, 2012).

Cruise missile flight phases may be as follows:

- Launch or release;
- Cruise;
- Terminal or attack.

A cruise missile may be considered as being composed mainly by the following systems:

- Body or fuselage;
- Propulsion system;
- Guidance or navigation system;
- Stabilization and control system;
- Payload.

Besides those constitutive systems, there are other means necessary to the production and operation of these missiles: manufacturing and testing equipment, support launching tools and mission planning systems.

We will briefly cover each one of the systems.

Body or fuselage. As already mentioned, it is very similar to an aircraft´s, particularly when the aerodynamic surfaces are visible. The Fuselage is constituted by a front section ("nose"), usually enclosing the guidance or navigation system, a central section, containing the payload, fuel and wings attachments, and a rear section containing a propulsion system and stabilizer attachments.

Cruise missiles fuselages are built in light metallic alloys (aeronautical) including aluminum, some types of steel and/or composite materials. Currently, shape and materials follow low observability criteria (LO-Low Observability, usually called stealth) besides the mandatory aerodynamic and structural resistance criteria.

[51] Propellant is the English translation for the Portuguese "Propergol" (Frota, 1995). A propellant includes fuel and oxidizer, the rocket engine dispensing with atmospheric oxygen, as mentioned hereinafter, which is not obviously the case of common turbojets.

Propulsion System. Cruise missiles propulsion system does not need to have an exo-atmospheric capability (independence of atmospheric oxygen) since cruise missiles evolve in the atmosphere. Most of the cruise missiles are propelled by jet engines (to be hereinafter detailed) However, there are cases (some supersonic missiles) using solid propellant or liquid propellant rocket engines. In all previous cases, propulsion is obtained as a reaction to a gas flow in a nozzle of adequate configuration. Solid propellant rocket engines are of more complex manufacture, however having advantages during storage time, in the prevention of accidents and in the lower period of time necessary for missile launching. Another characteristic is the fact that once functioning, they cannot be shut down until the total consumption of propellant. Liquid propellant rocket engines have an easier manufacture. However, the different compounds (fuel and oxidizing/oxidant) are toxic, corrosive, unstable and sometimes can only be supplied to the missile a short time before being launched, which increases the preparation time and consequently its vulnerability to attacks (Mira, 2012). Liquid propellant rocket engines functioning may be interrupted at any time of the flight.

Regarding jet engines, the most used propulsion in LACM may be of the following types:

- Pulsejet engine;
- Turbojet engine;
- Turbofan;
- Ramjet;
- Scramjet.

The pulsejet engine used in the V-1, is not currently used. Turbojet engines are similar to those of airplanes, although smaller. A turbofan is a turbojet engine with a fan upstream the compressor, similar to those used in aviation. Both previous jet engines are used in subsonic or supersonic missiles until Mach 2. A ramjet does not have any mobile parts. However it needs initial speed to function provided by a carrier aircraft or by solid propellant rocket engines (boosters). It is used above Mach 2, as are scramjet for missiles that reach higher speeds, approximately Mach 5.

Guidance or navigation system. These systems[52] are based on accelerometers, gyroscopes and/or reception of information by satellite (Global Positioning System – GPS, or others), using computers for the necessary calculations, complemented by any other type of sensors for the terminal phase.

Preferably, navigation systems should be independent from external sources of information to prevent interferences[53]. Besides the above mentioned systems, many advanced missiles use in the cruise phase navigation systems based on the comparison of the land overflown with data stored in memory, derived from a previous collection of geographic data by aircraft or satellite. It is the case of the American systems Terrain

[52] "A system which evaluates flight information, correlates it with target data, determines the desired flight path of a missile and communicates the necessary commands to the missile flight control system". (NATO, 2013, p. 2-M-8).

[53] GPS and Russian and Chinese similar systems are subject to interferences as apparently happened with the former in South Korea, in April of 2012 (McDowall, 2012, p. 14).

Contour Matching (TERCOM) and Terrain Profile Matching (TERPROM). However, other producing powers use similar systems. In order to permit the safe identification of the target in the terminal phase, for high precision missiles, the methods used are those such as Digital Scene Matching Area Correlation (DSMAC), radar, television or Imaging Infra-Red (IIR), image generated by infra-red sensors. As in any other guided ammunition, a crucial parameter in the technical analysis of a cruise missile is the respective CEP[54], granted by its navigation system. The lower the CEP value, the higher the precision of the missile (this indicator may not be very significant if the missile is used as a psychological, or terror, weapon, or if it possesses a nuclear warhead).

Stabilization and control system[55]. It is very similar to an aircraft´s, particularly in the case of subsonic missiles. It is constituted by aerodynamic lift surfaces (wings), stabilization and control (rudders), which induce the movement around the longitudinal, transversal and vertical axis and consequent change of trajectory, in response to the command of the navigation system.

Payload. Payload[56] is the effective component of a missile and includes its warhead[57], already mentioned. Conventional warheads, multiple or unitary, include blast or fragmentation, cluster (containing sub ammunitions) or penetrating loads, for damage of reinforced or underground structures. According to the specialized publisher *Jane's*, the maximum payload that can be transported by most cruise missiles is approximately 400kg, approximately 30 to 40% of the launch mass of a subsonic cruise missile. As for ballistic missiles, non-conventional payloads may be maintained separately from missiles, under supervision of special units[58], until the last moment before launching or arming of shooting platform. It is important to refer that it is easier to adapt nuclear warheads to the cruise missile, if compared with ballistic missiles, considering the greater thermal and mechanical requirements of a ballistic flight[59].

Support equipment for manufacturing, testing and launch. The adequate construction and exploration of cruise missiles requires, besides the technical knowledge and the necessary materials, a significant set of means and equipment such as, among others, machine tools of high capabilities, vibration test systems, thermal test chambers, engine test benches, radars for flight tracking, naval or air platforms and, for GLCM, fixed launch structures or heavy vehicles for transporting and launching missiles, which provide mobility to these weapons.

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54 CEP (Circular Error Probable): "An indicator of the accuracy of a missile/projectile, used as a factor in determining probable damage to a target. It is the radius of a circle within which half of the missiles/projectiles are expected to fall.". (NATO, 2013, p. 2-C-5).

55 "A system that serves to maintain attitude stability and to correct deflections". (NATO, 2013, p. 2-M-8).

56 Defined in (NATO, 2013, p. 2-P-2) as "In a missile or rocket, the warhead, its container and activating devices"

57 Defined in (NATO, 2013, p. 2-W-1) as "That part of a missile, projectile, torpedo or any other munition, intended to inflict damage."

58 For example, in the former USSR, units of the KGB or in France the Gendarmerie de Securité des Armements Nucléaires (Gendarmerie Nationale, 2013).

59 The process of adapting a nuclear device to its delivery vehicle (weaponization) is one of the so-called technological bottlenecks in a LACM programme, just as it is in a ballistic programme.

It is also important to refer that for the adequate use of cruise missiles mission planning systems are necessary, which allow the definition of a flight profile for the missiles, from its launch platform (air, surface or sub-surface) to the target, considering the contour of the terrain in order to deceive anti-air defences, among other operational constraints.

2. Programs for cruise missile production

The current section[60] intends to cover the capability of production, by several States, of Land Attack cruise missiles, real or potentially capable of carrying a 500 or more kilos payload, at 300 or more kilometers[61], commenting on each country and missile covered. The intention is not to present missile orders of battle for States worldwide, informing on who has what in the inventory. That is, the number of countries possessing cruise missiles is higher than those mentioned in the table, which are those producing cruise missiles and, in many cases, exporting them. This leads us to cover hereinafter the proliferation phenomena. Neither is it our intention to analyze the hypothetical willingness of those possessing the missiles to use them and against whom. Therefore, we will not evaluate any threats allegedly placed by the States hereinafter mentioned, neither will be used expressions such as rogue states or equivalent. However, it is important to mention that several of the States mentioned are allied and partners of Portugal for security issues, while several others are not. It is also important to mention that some of the States include LACM in their orders of battle, in GLCM, ALCM and/or SLCM versions together with panoplies of ballistic missiles, which grants them high operational flexibility with very significant financial costs. In a final note regarding the following table, we clarify that the designations used for the missiles are simplified (basic type), not detailing models and versions of each one.

Table I – Programs for production of LACM real or potentially capable of carrying a payload of at least 500kg for least at 300km

Producing state	Missile	Range (Km)	Propulsion	Launch Plataforms
Germany	Taurus KEPD 350	350+	Turbojet	Aircraft Tornado IDS
Brasil	AV-TM300	300	Turbojet	Trucks
USA	AGM-84H SLAM-ER	280+	Turbojet	Aircraft F-18
	AGM-86 ALCM	1100	Turbofan	Aircraft B-52
	AGM-158 JASSM	320-800	Turbojet	Aircraft B-1, B-52, F-16
	RGM-109 Tomahawk	1250-2500	Turbofan	Ships
	UGM-109 Tomahawk	1250-2500	Turbofan	Submarines

[60] Author's construction, having as main sources (Zaloga, 1996), (Armada International, 2001), (Hewson, 2007a), (Hewson, 2007b), (AIR FORCE Magazine, 2013), (Hardy, 2013).

[61] We say "real or potentially capable" since there are occasional cases where range is lower than 300km. Such inclusion is due to the possibility of raising the range beyond that limit, if necessary, the lower present range being the result of reasons to explain in the section devoted to proliferation.

Table I – Programs for production of LACM real or potentially capable of carrying a payload of at least 500kg for least at 300km

(Continued)

Producing state	Missile	Range (Km)	Propulsion	Launch Plataforms
France	ASMP-A	400+	Ramjet	Aircraft Rafale, Mirage 2000N
	SCALP-EG	250+	Turbojet	Aircraft Rafale, Mirage 2000D
India	PJ-10 BrahMos	290	Ramjet	Aircraft Su-30, submarines, Trucks
	Nirbhay	1000	?	Aircraft, submarines, Trucks (confirmation req.)
Iran	Meshkat?	?	Turbofan	Aircraft, ships, Trucks (confirmation req.)
Israel	Popeye Turbo	300	Turbojet	Aircraft F-15, F-16, Submarines (confirmation req.)
Pakistan	Babur (Hatf 7)	350+	Turbojet	Trucks
	Ra´ad (Hatf 8)	350	Turbojet	Aircraft Mirage III / Mirage V
United Kingdom	Storm Shadow	250+	Turbojet	Aircraft Tornado Gr Mk.4, Typhoon F Mk. 1
Republic of Korea	Hyunmu	1000	Turbojet	Trucks
Republic of China (Taiwan)	Hsiung Feng IIE (1ª fase)	500	Turbojet	Trucks
	Hsiung Feng IIE (2ª fase)	1000	Turbofan	Trucks
China (PRC)	YJ-62 / C-602	280	Turbojet	Aircraft H-6/BADGER
	YJ-63	500	Turbojet	Trucks
	DH-10 / CJ-10	1500+	Turbojet	Trucks, H-6/BADGER
	Hong Niao-1	600	?	(confirmation req.)
	Hong Niao-2	1500	?	(confirmation req.)
	Hong Niao-3	2500	?	(confirmation req.)
Russia	3M14E Klub-S (SS-N-27/SIZZLER)	290	Turbojet	Submarines
	Kh-22N Burya (AS-4/ KITCHEN)	500	Rocket (líq.)	Aircraft Tu-22M
	3K10 Granat (SS-N-21/SAMPSON)	2400	Turbofan	Submarines
	Kh-55/Kh-555 (AS-15/KENT)	3000	Turbofan	Aircraft Tu-95, Tu-160
	Kh-101/Kh-102	5000	Turbojet	Aircraft Tu-95, Tu-160
Sweden	Taurus KEPD 350	350+	Turbojet	Aircraft Gripen (export)

Source: The Author.

Germany. Taurus is a product of German-Swedish industrial cooperation (67%-33%), equipping the German air force with 600 items acquired. Its warhead has penetrating characteristics, aiming at targets of reinforced structure. Besides its initial ALCM version, plans have been defined to develop a GLCM version for the German Army, away from German doctrine according to which artillery would reach targets up to 150km, while targets at longer distances would be attacked by the Luftwaffe. The purpose being the exportation of this missile, some success has already been achieved in this area, Spain receiving 43 missiles to arm their F/A-18 and eventually also the Eurofighter, while South Korea ordered 177 of these weapons[62].

Brazil. As one of the main aerospace powers, Brazil also applies the technology in analysis. Avibras Tactical Missile 300 (AV-TM300) is currently being developed by the company Avibras and is part of the so-called Strategic Project ASTROS 2020 of the Brazilian Army. Turbo-jet engine propelled, with solid propellant rocket engine boosting, it may equipped with unitary conventional or cluster type warhead and it will be fired from the Astros III variant Mk6 launch platform on wheels. Brazil will thus introduce a new military capability which considers an "extra-regional deterrent" based on this long range high precision fire support system (Verde-Oliva, 2012, pp. 42-47).

United States of America. As it would be expected from the world´s hyper power, the USA produces and possesses a significant panoply of these ammunitions used from several types of firing platform. AGM-84H Standoff Land Attack Missile - Extended Range (SLAM-ER) is a land attack air-surface version of Harpoon anti-ship (48 exported to Turkey[63]). AGM-86 ALCM is a strategic subsonic missile used in the B-52H, equipped with a conventional or nuclear warhead. Its guidance is inertial with TERCOM or inertial with GPS. AGM-158 Joint Air-to-Surface Standoff Missile is a LO missile, with conventional warhead, destined to reach targets at standoff distances, with inertial guidance GPS and IIR, which grants it high autonomy and precision (AIR FORCE Magazine, 2013). In what concerns naval LACM, the US Navy operates two Tomahawk versions, one fired from surface ships and another from submarines64. Regarding this last platform, it took particular relevance the conversion of four Ohio class submarines (former launchers of strategic ballistic missiles) for the transport and launching of a total of 154 tactical Tomahawk. Tomahawk is a long range subsonic LACM, with unitary conventional or cluster type warheads, inertially guided with GPS and DSMAC. Since 1991 there are no nuclear LACM on board of American naval vessels, following George Bush's (father) decision to reduce the panoply of American nuclear tactical weapons65, decision corresponded by the Russian presidency. Tomahaw has been exported to particularly supporter allies of the USA66, while missiles like SLAM-ER or JASSM have been more generally exported (for example, to States of the Persian Gulf region[67]).

[62] (Wezeman and Wezeman, 2014, p. 7).
[63] (Wezeman and Wezeman, 2014, p. 9).
[64] See (US Navy, 2013).
[65] Through a unilateral Presidential Nuclear Initiative (ACA, 2012).
[66] See, for example, (DSCA, 2013a).
[67] See (DSCA 2013b) and (DSCA 2013c).

France. The "*Force de Frappe*" started out by Charles de Gaulle and maintained later on by the several French presidents, has as a fundamental component (Gradella, 2008), besides four nuclear ballistic missiles launcher submarines, the Mirage 2000N or Rafale F3 and nuclear supersonic air-surface cruise missiles ASMP-A pairing. *Air-Sol à Moyenne Portée--Amélioré* is a ramjet engine propelled missile, equipped with a nuclear warhead, with a range higher than 350 km. The airplane/missile pairing of the Air Force is regularly tested through exercises, not only for operational readiness maintenance but also as a deterrent demonstration. In the same way, the Charles de Gaulle nuclear aircraft carrier may receive Rafale M aircraft equipped with ASMP-A. In the scope of conventional armament, France produces and uses the SCALP-EG high precision air-surface cruise missile, a product of Franco-British industrial cooperation and characterized by turbo-jet engine propulsion. An initial purchase of 500 of these missiles has been decided for export to Greece, with the purpose of arming Hellenic Mirage 2000-5s. The so-called Black Shaheen version, for Mirage 2000, was exported to the United Arab Emirates. Currently, plans exist for the development of the SCALP Navale version.

India. Besides the ballistic missiles of its Strategic Forces Command, this emergent power considers important to possess a high number of LACM to respond to the threats in the region. Therefore, further to the import of finished products (such as the Russian Klub) (Newton, 2002), India has developed, for a decade, in partnership with Russia, the supersonic BrahMos LACM (of Brahmaputra and Moskva rivers), an evolution of its anti-ship version. With LO characteristics, it has SLCM, GLCM (with vertical launching from a truck) and ALCM versions. The Partners intend to export this advanced missile, defending the existence of high interest from some Asian and Latin American States. Old but not confirmed statements refer the existence of plans for the development of a LACM with 1000km range, designated Nirbhay.

Iran. Iran´s order of battle for missiles with potential strategic use has been favoring ballistic devices, as opposed to eventual LACM capabilities, at least publically and at the present time. There are historical reasons for this, Iranian capabilities for cruise missiles being oriented for coastal defence and other tactical anti-ship commitments. However, the acquisition, years ago, of some examples of an advanced ALCM of ex-soviet origin[68], may lead to the development, by reverse engineering and with the possible support of foreign States, of similar weapons, requiring large bombers, which do not exist in Iran, or the transformation of commercial aircraft into cruise missile carriers[69]. That might be the case of the announced Meshkat missile.

[68] As explained in the section of this article referring to proliferation.

[69] A technical option once suggested in the western world. According to Jane´s Defence Weekly "Two industry teams will contest one of the most innovative elements of the UK's Future Offensive Air System (FOAS) programme, under which Royal Air Force (RAF) transport aircraft could receive the capability to deploy long-range cruise missiles and unmanned air vehicles (UAVs)" and "Taurus Systems has been studying schemes to make its Taurus KEPD-350 standoff missile suitable for use from transport aircraft or ground-based zero-length launchers, writes Doug Richardson. Air-launch from a transport aircraft could extend the reach of the Taurus missile."

Israel. This Middle Eastern State is known for practicing effective counter-information (and misinformation) measures on military matters. Therefore, like other aspects of its defence, such as ballistic missiles, speculation is made by specialized media on the possibility that attack aircraft and Dolphin class submarines of German manufacture are capable of firing Popeye Turbo indigenous missiles, a version with a turbojet engine of the tactical missile Popeye. Such observers also speculate about the possibility that the warheads of those hypothetical missiles are non-conventional, as well as about the possibility of the existence of another missile with a range higher than 1500km.

Pakistan. Like its regional rival, India, Islamabad increases its ballistic capability with a recent cruise missiles program. Since 2005 tests are being carried out with LACM Haft 7 (Babur) and since 2007 with Haft 8 (Ra'ad), the last fired from Mirage fighters. Articles of Pakistan press at the time of the first tests speculated that the official statement that Haft 8 could transport "all types of warheads" would imply the nuclear capability of the missile.

United Kingdom. On 21st of March of 2003, the *Royal Air Force* employed for the first time the air-surface cruise missile Storm Shadow, from Tornado fighters, in the operations of Iraq international coallition (Air Forces Monthly, 2003). It is a British version of the already mentioned SCALP-EG, propelled by a turbojet engine and armed with conventional military warheads or dispersion type. It possesses a range higher than 250km and presents last generation characteristics, notably in what concerns long range, autonomous guidance (GPS, TERPROM and IIR), low altitude flight, low observation and lifecycle low cost. This missile was also used in NATO operations in Libya in 2011, with a success in exports in 2013, being purchased in the hundreds (Wezeman and Wezeman, 2014, p. 9) by Saudi Arabia for delivery in Eurofighter Typhoon also acquired from Great Britain (Felstead, 2013).

Republic of Korea. Progress of neighbor North Korea in the evolution of a ballistic missiles program three decades old lead South Korea to develop (with previous American agreement) cruise missiles with the capability to reach any spot of North Korean territory. Such capability did not exist until a few years ago. Previously, South Korea missiles had a 180km range, a limitation imposed by bilateral agreement with the USA. In this scope, Japanese television network NHK reported, on April 2012, that Hyunmu missiles with a range of approximately 1000km had been tested on the same month. The system was afterwards present in a military parade in Seoul.

Republic of China (Taiwan). Republic of China, or Taiwan, or Nationalist China, located in an island baptized by Portuguese navigators with the name of Formosa, consideres itself to be threatened by its huge neighbor, namely by ballistic and cruise missiles systems, and is seeking to develop adequate counter-measures. Therefore, according to Taiwan's[70] press of October 2007, Taiwan would have installed a small number of Hsiung Feng IIE cruise missiles in several points of the territory. The manufacturing of 100 of these missiles by local industry in two phases is planned for the eight following years. However, the same article

[70] See (Hsu, 2007).

mentioned some difficulties to obtain American components as a result of the exports control of the USA, oriented to the non-proliferation of those capabilities.

People´s Republic of China. As is the case of ballistic capabilities, the GLCM of Continental China are in charge of the "2nd Artillery Corps" of Popular Liberation Army (PLA). PLA Air Force and PLA Navy both possess cruise missiles for launching from air or naval facilities[71]. The new DH-10 began to arrive in units in 2008. China is estimated to possess approximately 200-500 GLCM. The ALCM version, CJ-10, was developed to arm PLA Air Force H-6/BADGER bombers. YJ-63 seems to be guided by an inertial hybrid system, being guided in the terminal phase by an electro-optic sensor, possessing a warhead of 500kg explosives and a speed of Mach 0.68.

Russia. The old Kh-22 Burya (AS-4/KITCHEN), a technological rarity nowadays owing to the use of a liquid propellant rocket engine, still has some relevance given its nuclear warhead and high performance (speed and range). Like this missile, the ALCM types Kh-55 (nuclear) and Kh-555 (conventional) are guided by inertial systems associated to a Doppler altimeter radar that permits the comparison of the overflown terrain with the internal database of the missile, such as the American TERCOM. They both arm Russian air units of strategic bombers. These units began to receive the new high precision Kh-101 (according to British magazine Flight International of 27th of September, it possesses Russian satellite GLONASS guidance) with LO characteristics and a penetrating warhead of 400kg, Kh-102 being its nuclear version. A similar or even equivalent guidance to Kh-55 equips the SLCM type 3K10 Granat, which may arm several submarines of the Russian fleet. Concerning 3M-14EKlub, it has a 450 Kt warhead (Bedi, 2013, p. 5), reaching 290km at subsonic speeds. A GLCM version, Klub-M (M=mobile) is being considered.

Sweden. As already mentioned, Swedish Defence industry participates in the development and production of the ALCM Taurus, together with German companies. The missile was integrated with the Swedish fighter SAAB Gripen. Several test flights have been carried out. However, the Swedish Air Force has not received that ammunition yet in its inventory. It is possible that only Gripen aircraft destined to export may present an armament configuration including Taurus.

3. Proliferation and non-proliferation

As it may be deducted from the previous section about Technologies, a State or other entity capable of constructing a small jet plane may produce cruise missiles with small difficulty. In fact, the difficulty of production of cruise missiles is higher than for commercial aircraft. However it is lower than for ballistic missiles (NNSA, 2011, p. 35). Like for ballistics, the programs of those missiles evolve, partly but not totally, in the sphere of the so-called "dual-use goods and technologies", which are defined in the European Community Legislation as any products, including software and technology that may be used for civil and military purposes, including all goods that may be used for non-explosive purposes as well as for

[71] See, for example, (Tomé, 2006, p. 13), about Chinese geostrategy.

military purposes and also to support the production of nuclear weapons or other military explosive devices[72].

Besides the construction of missiles after the transfer of its technology and the necessary goods for this purpose, by legal or illegal means, another form to develop a domestic program of cruise missiles will be to obtain finished products that will be subject to reverse engineering, aiming at the creation of blueprints which permit prototyping and later series production. In this scope, some actors of the International System have shown some concern in 2005 when, according to the press (Warner, 2005), citizens of an Eastern European country, a former Soviet Socialist Republic, would have illegally exported 12 ALCM Raduga "RKV-500A" / Kh-55 (AS-15/KENT) for a regional power of the Persian Gulf and six others to a great Asian power, in both cases without nuclear warheads, previously dismounted and transported to Russia at the end of USSR. Those actors, particularly several western States, feared the production of missiles by receptor States, granting them capabilities that only a few powers have possessed. The counter-measures used to limit the proliferation of cruise missiles, as of other controlled goods or technologies considered to be, sensitive or strategic, are the performance of military operations, overt or clandestine, and the use of commercial restrictions.

Diplomacy uses several possible tools to achieve the required results. Some modalities of action derive from diplomatic action, notably the congregation of international Actors in associations of States with convergent interests that decide to adopt common procedures to the approach of a certain problem. In this area, we mention two important multilateral mechanisms for control of weapons proliferation, particularly non-conventional ones: the Proliferation Security Initiative (PSI) and the already mentioned Missile Technology Control Regime (MTCR)73.

PSI was a creation of the American administration of George W. Bush, continued with Barack Obama, aiming at the eventual interdiction of transport means (land, sea or air) of materials applicable to so-called weapons of mass destruction (as already mentioned, of nuclear, biological, chemical or radiological nature) and their delivery means. It is not, therefore, a mechanism exclusive of the scope of combat to missiles proliferation.

It is important to refer that May 2013 marks ten years of PSI creation. At the time, it was mentioned by more than 70 participant States, that this Initiative has performed an important role in the contention of weapons of mass destruction. It was also agreed that precise steps will be made to enlarge PSI in the future, for example performing more exercises; establishing international treaties legally mandatory to criminalize the traffic of sensitive goods and technologies by ships and commercial aircraft; sharing knowledge and resources to improve interdiction capabilities and expansion of the participation of the States in the Initiative.

[72] See (ATA, 2012).

[73] We must mention, in a Cold War context, an important bilateral tool (United States – USSR) in the limitation of the proliferation of this type of weapons: the Intermediate Nuclear Force (INF) Treaty that eliminated land missiles, ballistic and cruise, nuclear and conventional, with ranges between 500km and 5500km.

PSI is based, according to its promoters[74], on volunteer actions of the participant States consistent with national and international legal dispositions. By joining PSI, a State accepts the Declaration of Interdiction Principles, which encourages the participants to establish a coordinated and effective platform, aiming at the interdiction of circulation of massive destruction weapons, their delivery means and related articles. States should interdict transferences to and from States and non-state actors of concern, according to their own capabilities and legal framing; should develop procedures to facilitate the exchange of information with other States; should reinforce national legal authorities to facilitate the interdiction; should take specific actions to support interdiction efforts. These measures include, for example, the approach and survey of ships in high sea or in harbors, landing and survey of suspicious aircraft that fly in their air space and by stopping and surveying vehicles that circulate in their territory. It has been noticed, as already mentioned, that PSI is particularly oriented to the intervention on transport means, of the existent transport modes (maritime, fluvial, highway, railway and air transport).

More than 100 states joined the PSI, supporting the effort of making it a volunteer and flexible initiative oriented to improve the individual and collective capabilities to take adequate and timely actions, in the sense of containing situations of threatening proliferation.

Among the activities carried out, there are interdiction exercises[75], meetings and workshops at global level, involving military forces, police agencies, information services, customs organizations, diplomatic entities and other institutions. It is intended to involve notably the States that have the interest and the capability to interrupt the flow of sensitive items by land, sea or air and those whose ships, flags, territorial waters, air or land spaces may be used by proliferating entities.

Unlike PSI, of enlarged scope, MTCR is a tool focused on the combat to missile proliferation (and unmanned air vehicles), which is inserted in the area of the mechanism known as "export control". It may be read in an article of a previous national publication (Mira, 2011, p. 240), that such mechanism consists on legal and administrative measures that each State intents to implement, according to its internal Law, but with reflex in terms of international law, to avoid the unwanted proliferation of weapons, particularly in regions of conflict.

We may also read in the above mentioned article that "… the control of exports aims at the prevention or at least restriction of the access, by commercial area, of certain States or non-State actors, to those goods and technologies, in order to make difficult the success of their missile programs. On the other hand, those interested in the mentioned goods and technologies use several subterfuges to obtain them, since the support of States that do not apply the established restrictions, to physical intelligence or computer operations, and also the creation of shelf companies in third countries that permit to hide the final destination of the transacted goods and technologies."

[74] See (BISN, 2013).

[75] We stress out the accomplishment in Portugal of what was, at the time, the largest PSI exercise carried out at a global level, Ninfa, 2005.

Consulting the official information of the Regime[76], we understand that MTCR is an informal and volunteer association of States that intend to prevent the proliferation of unmanned means of delivery of non-conventional weapons, coordinating national efforts for export licensing. It was originally established in 1987 by seven States (four European, two American and one Asian) and it increased to more than 30 states currently, all with equal duties and rights, being decisions obtained by consensus.

The objectives of MTCR are the restriction of missile proliferation, complete rocket systems, unmanned aircraft and technologies related with those systems capable of transporting a 500kg payload for at least 300km, as well as for systems conceived for delivery of weapons of mass destruction.

MTCR controls are applicable to certain rocket complete systems, including ballistic missiles, space launching vehicles (rockets), rocket probes, cruise missiles and unmanned aircraft, trying to control transferences of goods and technologies without damaging legitimate international trade.

In this area, MTCR Guidelines refer that MTCR is not destined to prevent national space programs neither the respective international cooperation, as long as this does not contribute to the development of delivery means of non-conventional weapons. It is important to stress out, however, that the participant States are particularly careful in transferences of goods and technologies of space launching vehicles, since most part of the applicable technologies are also applied to ballistic missiles.

With the initial focus on the Regime of the proliferating States, the events of September 2011 drew the attention to the need to be equally aware of the proliferation to non-state actors77. In both cases, it is intended to maintain surveillance over transfers of material, equipment and technologies of missiles capable of carrying non-conventional loads. This surveillance involves the abiding, by each participant State, of common guidelines for exports licensing (MTCR Guidelines), applied to a list of controlled articles (MTCR Equipment, Software and Technology Annex).

The list considers the existence of items of "Category I" and "Category II". Both cases include a wide range of goods and technologies, military and double use, necessary to the development, production and operation of the means covered by the Regime. All international transferences are considered case by case, being applied a special restriction to items of "Category I". These include rocket complete systems (including ballistic missiles, space launching vehicles and probe rockets) and cruise missiles and unmanned aircraft, with capabilities superior to the already mentioned "300km/500kg" criteria, its main production means and subsystems, as, reentry vehicles, rocket engines, guidance systems and warhead mechanisms.

"Category II" includes complete rocket systems (including ballistic missiles, space launching vehicles and probe rockets) and cruise missiles and unnamed aircraft, that are

[76] See (MTCR, 2013).

[77] If the operation and support of ballistic missiles systems is not easy for a non-state actor, some simpler cruise missiles or particularly unmanned aircraft may be used by irregular organizations in the prosecution of their goals.

not included in "Category I", with a minimum 300km range. It also includes a set of goods and technologies applicable to other equipment beyond the means covered by the Regime. Items of "Category II" are subject to more flexible rules in what concerns their international transfers.

The MTCR presidency is successively performed by the participant States, on a volunteering base, for one year. Periodically, meetings of the three operative groups of the Regime are held, ending with the annual plenary meeting, which takes place in the capital of the new country with the presidency. This meeting brings the political and diplomatic component to the groups mentioned.

Acceptance in MTCR of new participant States is obtained by consensus. A new State is accepted if it reinforces the international efforts for non-proliferation, if it demonstrates a sustained and supported commitment to non-proliferation, if it has an effective exports control system, a legal base that applies MTCR procedures and guidelines and manages and applies such controls with efficiency.

It is important to point out that decision on exports or exports denial for goods and missiles technologies are entirely a national responsibility, on a base of respect for sovereignty of the participant States and according to national legislation and practices.

One of the responsibilities of MTCR presidencies, is the international spreading of objectives and practices of the Regime carried out through one of the so-called outreach actions focused on non-participant States considered particularly relevant in this scope. These actions include the approach on subjects such as: exports control, applicable legislation, transshipment between transport means and law enforcement.

In what concerns the present article, we previously mentioned the inclusion on Table I of LACM with ranges lower than 300km, and we stressed out that this fact was due to reasons to be explained in the present section. As it has probably been understood, this lower range is due to the need of the producing States to respect MTCR exportability criteria in order to not damage eventual trade opportunities or, in other cases, the reception of technology transferred by the owners (even States not participant in the Regime voluntarily respect the criteria).

Technical capability to increase range beyond that limit, if necessary, considering the small difference between the values, lead us to include such occasional cases in the table. It is the case of the Russia-Indian BrahMos that is 7 meters long, weighs approximately 3 tons and has a 280km range. According to the Indian press (Deccan Herald, 2005), this LACM "does not break the obligations under MTCR or any of the international agreements related to proliferation and it is within 300km limit established under MTCR".

As a final remark related the non-proliferation mechanisms covered (PSI and MTCR), we may state that they both escape any subordination to the UN system of disarmament and armament control, that includes the Office for Disarmament Affairs with head office in New York and, in the particular case of missiles, the Panel of Governmental Experts constituted by Resolution of the General Assembly 55/33 A, of 20th of November of 2000, to cover the missiles subject "in all aspects". However, contacts have been established between the MTCR, for example, and entities of the United Nations Organization focused in these issues.

4. National approach to non-proliferation

The Portuguese State is not free from concerns related to the proliferation of armaments, including missiles. This area of foreign policy and Defence includes several national departments. In the scope of diplomatic action, and according to the Organic Law of Ministry of Foreign Affairs, the General Directorate of Foreign Policy of this Ministry, "(…) has the mission of ensure the coordination and decision on matters of political-diplomatic and economic nature, (…) as well as subjects in the area of security and Defence, (…)" (MDN, 2011). Functioning in the dependence of that General Directorate, the Directorate of Services for Security and Defence Affairs collects information, analyses and presents action proposals on non-proliferation matters, among others. It also follows and ensures national participation in international organisms of this area, such as the above mentioned.

In the area of Defence policy, the General Directorate of National Defence Policy of the Ministry of National Defence has its missions and type of internal organization defined in the Regulatory Degree nº 4/2012 of 18th of January (MDN, 2012a). Consequently, Ordinance nº 94/2012 of 4th of April (MDN, 2012b) determines the structure and establishes the maximum number of flexible organic units of the service, as well as the competences of organic units. Among them, and accordance to that Ordinance, the Directorate of Services of International Relations, proposes the necessary measures to the application, at national level, of international tools in the matter of disarmament and counter-proliferation78, contributing to the definition of the national position. Part of the same General Directorate, the Directorate of Services of Defence Strategic Planning may participate on these matters, given its responsibilities such as, among others, to follow and analyze evolution of international environment, carrying out situation studies and prospective analyses about the strategic implications in the area of security and Defence, or even to propose measures related to the military component of national Defence, including those linked to the participation of units and contingents of the Armed Forces in international missions. The activities mentioned are carried out with the commitment of other entities of the Ministry of National Defence, with the participation of national representatives in the regular meetings of entities related to non-proliferation of armaments, answers to inquiries and requests for information by international official organisms, non-governmental organizations and even private citizens, control of operations involving controlled technologies, according to the legislation, as well as the participation in international exercises of non-proliferation and counter-proliferation.

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[78] At this point, we must mention that the expression used in that legislation, "counter-proliferation", does not seem to be the most adequate, being more correct to use the expression "nonproliferation". In fact, analyzing foreign doctrines, we may consider that the latter is a non-military activity while the former is a military activity, entrusted to organizations responsible for planning, execution, command and control of military operations. Such distinction appears, for example, on page 29 of the US National Military Strategy to Combat Weapons of Mass Destruction (Chairman of the Joint Chiefs of Staff, 2006) where we may read (underlinings by the author) "Counterproliferation (CP). Actions to defeat the threat or use of weapons of mass destruction against the United States, U.S. Armed Forces, its allies, and partners." as well as "Nonproliferation (NP). Actions to prevent the proliferation of weapons of mass destruction by dissuading or impeding access to, or distribution of, sensitive technologies, material, and expertise." Such expression may be reviewed in a future modification to the legislation.

Besides the mentioned departments, other State organisms in the customs, finance, police and information areas, participate in national activities of non-proliferation.

We will not conclude the present section without a reference to the role of study and research carried out in Portugal about these matters. There is not a large national production of articles and other works on non-proliferation or on conventional and non-conventional armament control, particularly if we consider an approach on technical aspects. Some texts were already published in the Revista Militar review and in the Nação e Defesa review. Two of these articles were about export control of military technologies and goods and programs of ballistic missiles and are mentioned in the bibliographic references of this article. A work of greater extension, focusing on unnamed aircraft and remote warfare, which makes references to the control of the respective proliferation, namely through the MTCR, is also identified in the bibliographic references. There are other texts particularly concerning nuclear weapons, sometimes oriented to specific States or regions. In this area, we believe that the Centre of Research for Security and Defence (CISDI) of the Institute of Higher Military Studies (IESM) may have a role in the scope of objectives and promotion of development of knowledge in areas of particular interest to the Armed Forces and to Security and Defence. In fact, the Research Areas of the Institute consider lines of research that include the proliferation, in the areas of Conflict Research and Research of Humanitarian International Law. A simple perspective of observation of these issues and devoid of any institutional positioning, leads us to state that it is not inadequate to visualize a role of that Centre as source of knowledge on these matters to support the above mentioned entities of the Ministry of National Defence and the Armed Forces and even, if considered appropriate, of entities external to that Ministry, like the Diplomatic Institute and other foreign policy organisms or in the cooperation with civilian institutes of higher education.

We hold opinion that courses given in the Institute could benefit from a more specific approach to the subject of non-proliferation and armament control, hypothetically in the Joint Staff Course as maybe in others. In fact, since the development of a specific curricular unit for this issue is not justified, we think that a lecture on this matter would be useful for the attendants considering that tools for armament control, particularly conventional armament in the Portuguese case, may have influence in particular cases, on planning and execution of military operations, as well as implications in logistics management. Such approach could result in the submission of research themes in this area, in the scope of IESM courses.

Conclusions

The objective of the current article was to present, using public information, a view on cruise missiles produced by several States of the world and their increasing horizontal and vertical proliferations, particularly in what concerns LACM. A limit was established for the analysis of LACM covered by MTCR criteria, which is when capable to carry a payload of at least 500kg for at least at 300km, or non-conventional loads.

Those types of missiles were characterized and a brief historical review was made. Focus was given summarily on technologies involved in the conception and production of cruise

missiles, covering aspects such as flight phases (Launch or release, cruise and terminal or attack) and their generic conception by body or fuselage, propulsion system, guidance or navigation system, stabilization and control system and payload.

We then focused the production programs for cruise missiles, covering the capability by several States of production of LACM with the characteristics of payload-range mentioned above, issuing some comments on each of the countries and missiles covered and presenting a table including those programs, defined by the aspects of the producer country, produced missile, range, propulsion and launching platforms.

Based on the cruise missiles theme, global considerations were made on non-proliferation, namely focusing the definition of "dual use technologies and goods", development methods for missile programs, countermeasures employed to limit the proliferation of cruise missiles, such as diplomatic action, overt or clandestine military operations, trade restrictions, specifying two important multilateral mechanisms of proliferation control: PSI and MTCR. A mention is made to the administrative activity known as "exports control".

Regarding this area of foreign policy and Defence, some aspects were mentioned related the national approach to non-proliferation, identifying the main national departments in this area (Ministry of Foreign Affairs and Ministry of National Defence and other State organisms, customs, finance, police and information) and proposing a correction of terminology in a legal diploma and also and particularly a role in that area for the Research Center for Security and Defence of the Institute for Higher Military Studies, as a source of study, research and knowledge on these matters, as well as the addressing of the subject in courses of this Institute,

The analysis carried out in the current article permitted to conclude that the theme of cruise missiles proliferation has multiple aspects: technological, political, military and commercial, being a cause of concern to several actors of the International System, particularly to those that consider to be threatened by missile programs of other States or by the possibility that these war devices may fall in the possession of non-state actors. Particularly in what concerns Portugal, we do not consider that the National Territory is currently under direct threat of cruise missiles[79]. However, we may not exclude the possibility that deployed national forces may be under threat of those weapons, in future hypothetical Theatres of Operations. Nevertheless, this aspect was not to be detailed by this article. On the other hand, in a global perspective, in case of a conflict involving the enlarged use of these weapons, this conflict would cause obvious damages to stability and world peace, which justifies the permanent attention to the issue by entities linked to National Defence, in political, operational, information, education and research areas.

[79] Considering the "willingness" component only, given that missile-owning neighboring states are friendly, nowadays. As for the "capability" component, it does exist.

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