VERSATILITY, ADAPTABILITY AND FLEXIBILITY OF HELICOPTER ARMAMENT VARIANTS

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Abstract: *The article will analyze the types of missiles that can be attached to the IAR 330 Puma SOCAT helicopter, compatible with its modern avionics and armament system. The key element is the presentation of the missiles that Rafael has designed, compatible with this type of helicopter, and finally a multi-criteria analysis will be performed based on their characteristics. The study will highlight the best existing constructive variant of the missiles that are compatible with the SOCAT system.*

Keywords: *multicriteria analysis, integration, smart munitions, various weapons, agility.*

1. INTRODUCTION

The SOCAT system (optoelectronic anti-tank reconnaissance and combat system) has an avionics architecture with armament systems, developed for the IAR Puma 330 helicopter at an advanced level foldable for the national specifics.

The SOCAT system has advanced technology regarding display, operation, armament and man-machine connection methods.

Thanks to this system, crews intended and trained on the Puma SOCAT are capable of performing attack and assault missions with a high probability of achieving the intended purpose, also benefiting from an increased survivability in a hostile environment (Fig.1).

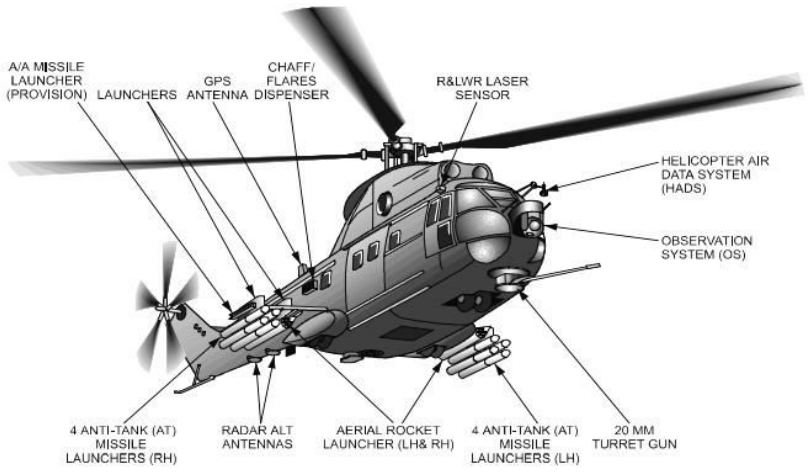

FIG.1 Weapons layout on the helicopter [4]

The increased performance and combat capabilities resulting from the modernization of the IAR-330 helicopters upgraded with the SOCAT system are summarized in general terms as follows[1,2,3]:

– safe and precise air navigation over long distances, with the possibility of flying at low altitude and in areas with difficult terrain geography, both day and night, in difficult weather conditions;

– communication and research data transmission systems with increased resistance to jamming, on the trajectory of the tactical field to ground-based equipment and to other combat aircraft, in real time;

– the advanced HOCAS- Hands on Collective and Stick concept (the concept in which the pilot metaphorically plays the piano) the use of onboard weapons without the pilot taking his hands off the flight controls;

– discovery capacity, high resolution for identifying and combating enemy targets from long distances and with increased precision;

– protection and self-defense systems that increase the survivability on the battlefield.

The IAR 330 Puma SOCAT helicopter, in general, we can recall the following from the armament line:

- Onboard cannon: 1 × 20 mm GIAT THL20 turreted cannon;
- Unguided missiles: PRND S-5K/M, 57 mm caliber;
- Guided missiles: 8 × anti-tank missiles. [1,2,3]

The following will be presented the types of missiles that are compatible with the SOCAT system [4,5,6]:

X-5 missile

The X-5 missile is a wire-guided, anti-tank missile, capable of destroying armored ground targets or fortifications. The X-5 system automatically ensures the activation of the CHECK mode. This mode is the system status reporting mode when it reports to the operating system the current status of the missiles loaded on the launchers.[6]

X-8** missile

The X-8** anti-tank missile has the same specifications as the X-5 missile, the same operating mode, the only significant difference between the two missiles would be the length of the wire through which information is transmitted to the missile, this being up to 9 km, therefore the range is between 400 m and 9000 m. [6,7]

SPIKE ER Missile

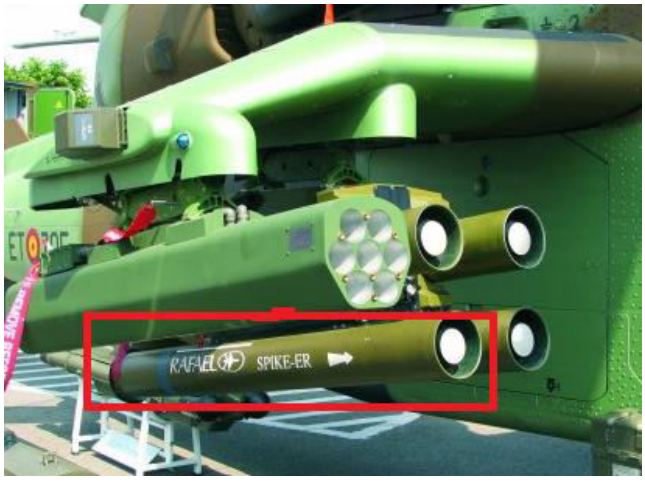

FIG.2 *SPIKE ER Missile* [11]

The Spike ER missile is an anti-tank missile with a range of 8 km, which can be guided by laser or radar. It has an electro-optical guidance system, compatible with the IAR 330 Puma SOCAT helicopter's target acquisition, search and targeting system (fig.2). It has two cameras, one CCD, used during the day, and one IIR with infrared that can be used at night with a viewing accuracy of the CCD. [7,8,]

The technical-tactical characteristics and specifications of the missiles are presented in table no. 1.

Table no. 1

Characteristic	**Performance**	**Rocket**
Distance	400m - 6 km	**X-5**
Flight time	36 s	
Flight speed	150 m/s	
Image sensor type	Channel/IR channel;	
Guidance modes	Fire and forget -Fire, observe and correct	
Blow mass:	32 kg	
Blow length	1.67m	
Blow diameter:	171mm	
Distance	400m to 9000m	**X-8****
Flight time	40	
Flight speed	225 m/s	
Image sensor type	channel or IR channel	
Guidance modes	Fire and forget -Fire, observe and correct	
Blow mass	32 kg	
Blow length	1.67m	
Blow diameter:	171mm	
Distance	400m to 8000m	**Spike ER**
Flight time	50s	
Flight speed	160-180m/s	
Image sensor type	channel or IR channel	
Guidance mode	Fire and forget -Fire, observe and correct	
Blow mass	34 kg	
Blow length	1.450m	
Blow diameter	150mm	

2. MULTICRITERIA ANALYSIS

To prepare a multicriteria analysis of the main characteristics of the presented missiles, it will be carried out with the model largely [9].

The calculation will be carried out in the following stages:

Establishment of criteria:

The actual values of the characteristics of the systems that we compare. In table 4, the following notations will be used:

- ✓ C1 – criterion 1 – maximum firing range [km] – maximum;
- ✓ C2 – criterion 2 – flight speed [m/s] – maximum;
- ✓ C3 – criterion 3 – flight time [s] – maximum;
- ✓ C4 – criterion 4 – strike mass [kg] – maximum

The three criteria were established in accordance with the common characteristics of the aircraft analyzed previously.

Criterion 1 is an important characteristic because the possibility of launching a missile from a greater distance significantly increases the chances of survival of the crew.[8]

The following two criteria are missile performance characteristics that influence the chances of hitting targets, are presented in table no.2.

Table no.2

Rocket	C_1	C_2	C_3	C_4
X-5	7	150	36	32
X-8**	9	225	40	32
Spike ER	8	180	50	34

Ince the importance of the criteria differs, a table is established as follows:

- If, when comparing criterion "i" with criterion "j", criterion "i" is more important, the value 1 is entered in the table next to criterion "i";
- The summation is made, obtaining a value for each criterion;
- The weight coefficient for criterion "i" results from the relationship [9,10]:

$$p_i = \frac{\sum_j M_p(i,j)}{\max_k \sum_j M_p(k,j)} \quad (1)$$

Table no.3 presents the weight matrix, Mp, and in the last row the values of the weight coefficients for the criteria are given.

Tabel no.3 Weight matrix

	C_1	C_2	C_3	C_4
C_1	0,60	0,60	0,00	0,80
C_2	0,60	0,60	0,60	0,80
C_3	1,00	0,60	0,60	0.90
C_4	0,70	0,70	0,70	0,80
S	2,90	2,50	1,90	3,30
P	1,00	0,87	0,64	1,00

In the utility matrix (table 3) the characteristics for each criterion will be compared according to the rule: 1 the best and 0 the worst.

Since the table with the characteristics of each component contains values given in different units of measurement, it is transformed into table 4, which contains only dimensionless values:

For maximization [9,10]

$$U_{ij} = \frac{a_{ij}}{a_{ij\max}} \le 1 \quad (2)$$

For minimization [9,10]

$$U_{ij} = \frac{\min a_{ij}}{a_{ij}} \le 1 \quad (3)$$

3. PERFORMANCE MATRIX

In the performance matrix, the characteristics for each criterion will be compared according to the rule: 1 the best and 0 the worst.

The performance matrix is presented in table 4. The utility matrix is multiplied by the weight vector.

Table 4. Utilities and performance matrix

Racheta	C_1	C_2	C_3	C_4	P_1C_1	P_2C_2	P_3C_3	P_4C_4	SP_iC_i
X-5	0,66	0,66	0,72	0,66	0,76	0,59	0,46	0,46	**2,27**
X-8**	1,00	1,00	0,80	0,66	1,00	0,85	0,51	0,46	**2,82**
Spike ER	0,88	0,80	1,00	0,8	0,9	0,65	0,60	0,60	**2,75**

In this chapter, we have analyzed the compatible missiles that can be used on the IAR-330 Puma Socat helicopter, namely: X-5, X-8**, Spike ER

To prepare the ranking, the technical and tactical characteristics of each missile were presented and the important common elements were compared.

The comparison was made using three criteria, namely: C1 – maximum firing distance, C2 – maximum flight speed, C3 – maximum flight time, C4 – strike mass.

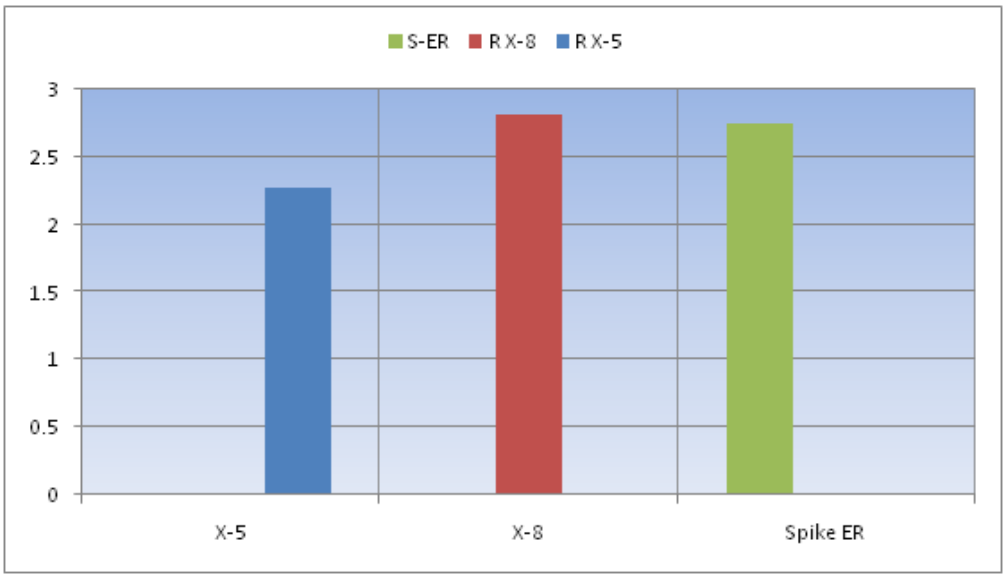

FIG.1 Rocket compatibility chart

4. CONCLUSIONS

In this article, we analyzed the missiles that can be used on the IAR-330 Puma Socat helicopter, namely: X-5, X-8**, Spike ER. We conducted a multi-criteria analysis, focusing on 4 criteria considered the most important.

The comparison was made using four criteria, namely: C1 – maximum firing distance, C2 – maximum flight speed, C3 – maximum flight time, C4 – strike mass.

From the calculations performed and presented above, we concluded that for the selected criteria, the 3 missiles have similar compatibility with a slight advantage for the X-8** missile (Fig.1).

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