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Development of the combat sleeping bag system of the Latvian National Armed Forces

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Introduction.

National Armed Forces Republic of Latvia (NAF) has developed Combat Individual Protection System (CIPS), providing protection against artificial and natural threats soldiers face on the operation areas worldwide. National Armed Force Republic of Latvia in cooperation with researchers from Riga Technical University (RTU) have started improvement program of the CIPS. According to the recent research performed by NAF in cooperation with RTU the highest priority (first priority among natural threats) of thermal resistance was identified by passive experiment [1], expert aprior ranking and following mathematical proceeding. NAF is operational worldwide in different climates condition. Protection from the cold and thermal infrared surveillance during the low level metabolic heat rate of sleeping (40 W/m²) is the key aspect of the survivability of the soldier in combat and training operation to maintain task fulfilled. Cold weather/extreme cold weather due to its constant being on operation field within some seasons of the year in case of improper clothing system produces more casualties than artificial threats like bullets, fragments, explosion overpressure, bladed weapons and ext. Climatic category of cold climates NATO [2] divided into five categories C0 – mild cold, C1 – intermediate cold, C2 – cold, C3 – severe cold and C4 – extreme cold (Table 1).

Table 1. Summarized temperature and humidity cycles world wide

| Category | Meteorological | |
|-------------|------------------|-----------------------|
| | Temperature (C°) | Relative Humidity (%) |
| A1 | 32 to 49 | 8 to 3 |
| A2 | 30 to 44 | 44 to 14 |
| A3 | 28 to 39 | 78 to 43 |
| B1 7 days | 24 | 100 |
| B1 358 days | 23 to 32 | 88 to 66 |
| B2 | 26 to 35 | 100 to 74 |
| B3 | 31 to 41 | 88 to 59 |
| C0 | -6 to -19 | Tending to saturation |
| C1 | -21 to -32 | Tending to saturation |
| C2 | -37 to -46 | Tending to saturation |
| C3 | -51 | Tending to saturation |
| C4 | -57 | Tending to saturation |
| M1 | 29 to 48 | 67 to 21 |
| M2 | 25,5 to 35 | 100 to 53 |
| M3 | -23 to -34 | Tending to saturation |

The main task of NAF is providing territorial defence of the Republic of Latvia and providing joint military operation in Afghanistan. Both regions are within categories C0 – C1. On the basis

of the Concept of national defence, soldiers must be prepared to carry out the mission also outside these zones. Area C2 – C4 already counts as an Arctic climate, where the temperature is significantly reduced. Since 2006 Snugpak UK is exclusive source of the CIPS-Mod1-7.level-combat-jacket, CIPS-Mod1-7.level-combat-jacket-hooded, CIPS-Mod1-7.level-pants for the CIPS as the main sub-system for the protection cold/extreme cold weather of the Latvian Army. CIPS-Mod1-Snugpak-system was configured and developed in the close cooperation between Latvian Army and Snugpak UK as well as approved by Government of the Republic of Latvia (decision No.731, protocol No.47, paragraph No.44, September 27th, 2006). According to the government decision 14000 sets of the CIPS-Mod1-7.level-combat-jacket, CIPS-Mod1-7.level-combat-jacket-hooded, CIPS-Mod1-7.level-combat-pants should be delivered within year 2014. Additionally since 2006 separately three levels of CIPS-Mod1-Snugpak-combat-sleeping-bags as well as CIPS-Mod1-Snugpak-shelters, all together making combat sleeping bag system (CSBS) for needs of the Latvian Army were procured as additional parts of the CIPS-Mod1-Snugpak-system for the protection against cold/extreme cold weather. Following Government decision NAF identified the level of CIPS-Mod1-Snugpak-system to ensure its capability of the protection against cold/extreme cold weather according to the requirements of the C0 – C1 climatic region.

Methodology.

Three level CSBS were evaluated in conjunction with thirteen combinations of the combat dress uniform system of the CIPS on instrumented mannequin. There is no existing standard for the requirements of the combat sleeping bags. The evaluation was done under the modified civil standard EN 13537:2002 “Requirements for sleeping bags” [3] in the climatic chamber of the Lund University. NAF had special needs of the location of the mannequin according to the operation using and possible location of the soldier inside sleeping bag, closing mode of the sleeping bag, as well as area of the sleeping bag contact points to the ground during the combat and training. Parallel calculation method was used and the values were corrected for standard. The key importance to NAF is estimation of the protection level against extreme air temperature during four hours of exposure during combat and training exercises.

Results.

Summary of the results as well as sets of the combat dress uniform system in conjunction with different levels of the CSBS are showing in Table 2.

Table 2. Summarized of the CSBS evaluation

| CIPS set No. | | I_{tot} , parallel | I_{tot} , serial | I_{tot} , standard | $I_{t,r}$, local (5) clo | $I_{t,r}$, local (1) clo | $I_{cl,r}$ local (5) m^2K/W | $I_{cl,r}$ total (1) m^2K/W | Extreme temperature C^0 |
|--------------|--|-------------------------|-----------------------|-------------------------|------------------------------------|------------------------------------|--|--|---------------------------------|
| 1 | 1.level-combat-underwear 2.level-combat-underwear 3.level-combat-underwear 5.level-combat-jacket 5.level-combat-pants 7.level-combat-jacket 7.level-combat-pants | 1.159 | 1.296 | 1.034 | 8.36 | 7.48 | 1.189 | 1.060 | -23 |

| | | | | | | | | | |
|--------|--|-------|-------|-------|------|------|-------|-------|--------------|
| | combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 1.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | | | | | | | | |
| 2 | 1.level-combat-underwear 2.level-combat-underwear 3.level-combat-underwear 5.level-combat-jacket 5.level-combat-pants 7.level-combat-jacket 7.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 1.level-combat-sleeping-bag 2.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | 1.294 | 1.434 | 1.126 | 9.25 | 8.35 | 1.327 | 1.195 | -27.3 |
| 3 | 1.level-combat-underwear 2.level-combat-underwear 3.level-combat-underwear 5.level-combat-jacket 5.level-combat-pants 7.level-combat-jacket 7.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 2.level-combat-sleeping-bag combat-sleeping-bag-mat (2.type) | 1.171 | 1.329 | 1.056 | 8.58 | 7.56 | 1.222 | 1.072 | -24.3 |
| 4 | 1.level-combat-underwear 2.level-combat-underwear 3.level-combat-underwear 5.level-combat-jacket 5.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 2.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | 1.139 | 1.273 | 1.019 | 8.21 | 7.35 | 1.166 | 1.040 | -22.5 |
| 4 A | 1.level-combat-underwear 2.level-combat-underwear 3.level-combat-underwear 5.level-combat-jacket 5.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 3.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | 1.304 | 1.425 | 1.121 | 9.20 | 8.41 | 1.319 | 1.205 | -27.5 |
| 5 | 1.level-combat-boxers Tref-combat-shirt 4.līmenis-kaujas-bikses | 0.824 | 0.881 | 0.758 | 5.69 | 5.32 | 0.775 | 0.725 | -9 |

| | | | | | | | | | |
|----|---|-------|-------|-------|-------|-------|-------|-------|--------------|
| | combat boots (summer) combat socks (summer) combat gloves (3.level) 2.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | | | | | | | | |
| 6 | 2.level-combat-underwear 7.level-combat-jacket 7.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 2.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | 1.247 | 1.356 | 1.074 | 8.75 | 8.04 | 1.249 | 1.148 | -25.0 |
| 7 | 2.level-combat-underwear 7.level-combat-jacket 7.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 3.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | 1.399 | 1.516 | 1.181 | 9.78 | 9.03 | 1.410 | 1.300 | -30.5 |
| 8 | 2.level-combat-underwear 7.level-combat-jacket 7.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 2.level-combat-sleeping-bag ¹ combat-sleeping-bag-mat (1.type) | 1.409 | 1.547 | 1.202 | 9.98 | 9.09 | 1.440 | 1.310 | -31.1 |
| 9 | 2.level-combat-underwear 7.level-combat-jacket 7.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 2.level-combat-sleeping-bag ² combat-sleeping-bag-mat (1.type) | 1.169 | 1.352 | 1.072 | 8.73 | 7.54 | 1.246 | 1.070 | -25.0 |
| 10 | 2.level-combat-underwear 7.level-combat-jacket 7.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 2.level-combat-sleeping-bag ³ combat-sleeping-bag-mat (1.type) | 1.220 | 1.321 | 1.051 | 8.52 | 7.87 | 1.214 | 1.121 | -24.0 |
| 11 | 2.level-combat-underwear 7.level-combat-jacket 7.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 2.level-combat-sleeping-bag | 1.612 | 1.819 | 1.383 | 11.74 | 10.40 | 1.713 | 1.514 | -40.2 |

| | | | | | | | | | |
|----|--|-------|-------|-------|------|------|-------|-------|--------------|
| | 2.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | | | | | | | | |
| 12 | 2.level-combat-underwear 3.level-combat-underwear 5.level-combat-jacket 5.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 2.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | 1.062 | 1.120 | 0.917 | 7.22 | 6.85 | 1.013 | 0.963 | -17.3 |
| 13 | 2.level-combat-underwear 3.level-combat-underwear 5.level-combat-jacket 5.level-combat-pants combat cap (winter) combat boots (winter) combat socks (winter) combat gloves (3.level) 3.level-combat-sleeping-bag combat-sleeping-bag-mat (1.type) | 1.265 | 1.347 | 1.068 | 8.69 | 8.16 | 1.240 | 1.167 | -25.0 |

- 1 – blanket mode
- 2 – seating
- 3 – not fully zippered

Discussion.

Physiological model for calculation of extreme temperature of the standard EN 13537:2002 “Requirements for the sleeping bags” utilizes 25 years old female with weight of 60 kg, height of 1.60 m, and body area of 1.62 m². NAF average soldier’s corresponding parameters are male, 24 years old, weight 81 kg, height 1.81 m and body area 2,0 m² [4]. Difference between physiological model of the standard EN 13537:2002 and LNAF soldier should be evaluated during the field trial under the life weather condition. Customization of the physiological model of the standard EN 13537:2002 according to the NAF soldier physiological model and following making of the field trial limits NAF of using an open type of the procurement model, because of standard testing methods should be applied in open procurement. Field trial should be provided according to the appropriate NATO STANAG [5]. Customization of the evaluation is stabilizing procurement logistics system of the NAF in long term, providing constantly soldier with necessary CSBS and ensure its compatibility with combat dress uniforms system. Table 2 showing results of the CSBS evaluation in the same time providing exclusive specification and unique combinations of combat dress uniform system in conjunction with CSBS corresponding only to the layering as well as layering materials of the CIPS. Development of such system specification should be a regular norm of the logistics officials work in order to stabilized procurement logistics. Given that the NAF, held by the material and the elements must be unified, standardized and interoperable, if necessary, to change certain elements of the other, preserving the function and thus the protection abilities, new protection layers and their support technologies should be interchangeable with existing layering systems, providing the necessary quality functions and thus full spectrum protection capability. Such logistics approach is fully compatible with the requirements of the Law on Public Procurement Republic of Latvia [6], Clause 63, part 1, section 2 and Clause 63, parts 2, section 2. Same Law Clause 3, part 3, section 2 – state interests can be applied for such kind of the military goods, providing

protection of the soldier in combat and training. Logistics officials should be considered that CSBS, being a system of military nature, formally is not included in the list of military goods according to the Law on procurement for defence and security needs of the Republic of Latvia [7] Clause 3, part 1, section 1.

Conclusions.

CSBS fully complies with the requirements of NATO AECTP-230 "Climatic conditions" cold climate categories C0 – C1, representing actual climatic conditions of the Republic of Latvia, as well as ISAF operation region. It was identified that increasing the number of layers does not provide an adequate increase of the air temperature a soldier is exposed to, due to compressing of the layers and decreasing amount of the static air. Simply providing an additional sleeping bag to the existing sleeping bag, increasing the exposure temperature, is very limited. High protection level, providing less pressed layers of the 7-level-combat-jacket-hooded and 7-level-combat-pants in conjunction with different levels of the CSBS. These facts should be taken into consideration in the development of the supplying norms for CSBS as well as the standard operation procedure of using CSBS during combat and training. Soldiers of NAF carrying out their duties in special operation units as well as reconnaissance units can be supplied with 1 and 2 level of the sleeping bags, providing the ability of using either 1 or 2 level combat sleeping bag according to the requirements of the task and decreasing weight and volume of the equipment loading. Regular infantry soldiers should be supplied with 3 level combat sleeping bag, providing physiological protection to the soldier during combat and training according to the requirements of the C0 – C1 climatic category.

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