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Pneumatic tents as possible instruments for collective protection

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Collective protection is an important task in defence against weapons of mass destruction, and using only stationary constructions is not enough for its practical accomplishment. In addition to the mobile collective protection devices (e.g. in tanks, APCs – armoured personnel carriers), it is necessary to assure collective protection of HQs, command-posts and medical support subunits. A pneumatic tent equipped with additional facilities is suitable for this task along with other possible devices. The authors give an overview on the possible ways of pneumatic tent applications in collective protection – analyse their advantages and describe the valid NATO STANAG directives in collective protection. Based on practical experiences they present the conception developed at the HDF 93 Petőfi Sándor NBC Battalion for equipping and application of pneumatic tents for collective protection.

Importance of the collective protection

The collective protection (COLPRO) is a very important part of the global NATO doctrine, especially when it comes to the consideration of the CBRN[i] defence family.[1]

Although this seems like an elementary and evidential statement, this was not always alike. The position and the conditions of usage of COLPRO systems and equipment have changed significantly in the past decades. This introductory brings up some important questions: What is COLPRO truly mean? What are the threats that need to be dealt with COLPRO? Why is it so important?

The collective protection can be described as follows:

"*Protection provided to a group of individuals in a CBRN environment, which permits the lack of individual CBRN protection*."

or

"*Integrated systems that provide contamination-free, environmentally-controlled surroundings for personnel to perform their missions.*"

[i] Chemical, biological, radiological, nuclear.

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Or we can be simpler than that, when we say that basically it is a tent pressurised with clean air. But this would not consider several other possible COLPRO types and installations that serve the same purpose, these will be specified below in the article.

There are several hazards on the modern battlefield that needs to be avoided by military personnel and be countered by commanders. In our point of view these are the remains and effects of the usage of chemical, biological, radiological and nuclear weapons or devices, secondary hazards arising from counter-force targeting or release of toxic industrial material (TIM) remains. Protection against these hazards can be achieved via individual protective equipment (IPE) or using COLPRO. The usage of IPE may result unacceptable mental and physical degradation and may allow the enemy to shape the battlefield to his advantage.

The importance of COLPRO is evident, when we consider the necessity of the operation of command posts or medical-surgical installations in contaminated environment. The only possible solution for effective accomplishment of these tasks is COLPRO, when we take the fact into account that these duties are not executable wearing IPE. Besides these dimensions of usage, there are others which need the comfort and working space offered by a COLPRO instalment, like logistic and maintenance functions of precision instruments. And last but not least, probably the most important feature of COLPRO systems is the assurance of rest and relief of personnel operating on the contaminated battlefield. The evasion or displacement of personnel from the contaminated terrain would be the most desirable solution, but often it is not a suitable option for the situation, neither it is always possible. In modern warfare it may be necessary to cross, occupy and remain in contaminated terrain.[2] This could be a key feature in a complex battleplan. Although every unit can be equipped, trained and conditioned to fight under such conditions, it must be considered that individual efficiency and morale may decrease with time and relief from the IPE gear is inevitable. The heat build-up, physical exertion, breathing resistance, reduced mobility and flexibility, thirst and hunger causing personnel to seek refuge in a clean environment.[3] The best relief method is rotating the soldiers and this is the least expensive in terms of manpower and logistical support.[4] However the tactical situation not always allows this method to be practised. These situations need the advantages the COLPRO can provide, because not withstanding the threat can come to a point at which the user would be tempted to weight the risk of subjecting himself to CBRN contamination to attend to several matters like eating, hydrating or urinating/defecating, but that could lead to an unnecessary loss in manpower and fighting strength.[5]

So it would seem that the COLPRO of nowadays has only advantages, so it would be foolish not to use it in every situation where CBRN protection is required. For a time

now the most remarkable objection was that COLPRO systems were expensive, because it was manpower-intensive to install and operate them. It was demanding a lot of power, operating space, transportation and storage so it did not seem a top candidate for the leading solution against CBRN hazards.[6] This has changed for today as these systems became to have much more reasonable price and logistical burdens are reduced to an acceptable level. Now security forces are viewing it as a vital component of their CBRN strategies.

The COLPRO systems have another disadvantage which is a consequence of their purpose: they are vulnerable to dynamic impacts. Because of this, COLPRO facilities should be provided in locations that are protected from direct and indirect hostile fire, and from civil intrusion in domestic operations. Air or artillery attacks could rupture the protective membrane or damage the facility and put all occupants at risk. It is impossible for the personnel in the facility to defend themselves, so local security must be provided by adjacent elements.[7] So local protection like air and ground defence are key considerations.

Types of COLPRO systems

There are a number of standardizations of COLPRO systems. One differentiates through the mobility of the several COLPRO types. This method operates with types like fixed, mobile, transportable and hybrid CBRN COLPRO systems.

1. Fixed COLPRO systems are static facilities, which can be hardened, semi-hardened or unhardened. They can provide protection to all or a part of a fixed installation. Among the fixed facilities there can be defined those which are built with the purpose of COLPRO, besides them almost every facility can be adapted to serve more or less efficient as COLPRO shelters. Some nations require all public buildings to have COLPRO areas.[8]
2. Mobile COLPRO systems are integrated to land, sea or air platforms. They may or may not be capable of operation on the move or allowing entry and exit in the face of CBRN hazards.[9] Armoured vehicles, particularly their CBRN reconnaissance variant often feature this capacity. The “citadel” structures of naval ships are another good example.
3. The transportable COLPRO systems are stand-alone devices capable of being deployed into the area of operations. These are characteristically tents or containers.

4. The hybrid systems are internally mounted systems designed to provide augmented filtration and/or airflow to individuals operating or occupying vehicles or aircraft.

These are the basic types of COLPRO in the view of mobility. But there can be made an other differential in the aspect of the working method. This way we can create categories like ventilated-facepiece, overpressure, hybrid and total systems.[10]

1. The ventilated-facepiece systems supplies filtered air to the protective mask canisters of combat vehicle crew members or to the aircrew protective masks. These systems are rated by their airflow capacity. The filtered and pressurized air supplied by these systems extends to capacity of standard IPE equipment.
2. The overpressure system is an enclosure of pressurized and purified air. Several filters, like gas or particle filters remove the contamination from the air and than channel it to the personnel. The air pressure precludes leakage of contaminated air into the enclosure. The crew/personnel can enter and exit through a protective entrance, typically an air lock.
3. The hybrid system provides protection for personnel in combat vehicles, vans and shelters. These systems combine the positive pressure and the ventilated face mask systems. The system can be used with open hatch, using the face masks or closed hatch with the positive pressure operation. If contamination enters, the overpressure system can help to purge the interior from toxic vapours.
4. The total system is basically a hybrid system combined with some form of environmental control. This reduces the heat-stress casualties, however, it increases the logistical burden, primarily because of increased demand of maintenance.

Figure 1. Type FA 45GM collective NBC filter, which is called “octopus” by soldiers

Besides the types of COLPRO systems mentioned above, NATO standardization has developed a classification method to provide commanders with the instrument of determination of the required COLPRO system. The specific solution may include a mixture of fixed, deployable and mobile COLPRO. The classification is actually optimized for fixed COLPRO sites, so in the view of this article further specification of this theme is not necessary.

Possible usage of pneumatic tents as COLPRO and the principle of their construction

Pneumatic tents are the first idea to pop up in the head of people when it comes to discuss the COLPRO. Although they are indeed the most typical representatives of the COLPRO systems-family, they are probably the best solution to a CBRN problem in the view of mobility. They provide perfect shelter on the field, they are mobile, fast to deploy and modular in design, so they can serve as a perfect candidate for almost every upcoming task on the contaminated battlefield. They can operate as a command post, a medical facility or a workshop and, of course as relief shelter for the troops deployed, who can seek relief from their IPE in the tents.

The basic structure of these tents is not too complicated, but on the one hand they must have some equipment to fulfil their purpose and the other hand standardization is of a great importance, especially at multinational HQs or aircrew, among whom there will be a great interchange of personnel. They should expect that the layout, fixtures and fittings of any equipment they encounter at any base are similar, and the procedures must be common with the one they use in their national army. Besides that a uniformised Contamination Control Procedure should be included as a part of the entry/exit process in order to preserve the integrity of the toxic free area (TFA). These procedures must be conducted in such way that the risk of cross-contamination during the process should be eliminated.[11]

Deployable COLPRO systems have one more great advantage besides mobility – they are usually modular in design, so they can be easily adopted to the characteristics of the mission.

Every module has its clearly defined function, so if the counter effect one module can provide is not needed, it can be left unused, which assures bigger flexibility. The COLPRO systems can have following various modules:

1. The most important part of a COLPRO shelter is the toxic free area (TFA). In the TFA personnel can remain without their IPE safely. It may be divided into several other areas, but it must be perfectly airtight to maintain an overpressure

without leakage. The airflow design must prevent places of stagnant air. Several control panels are desirable to be found in the TFA.

2. The air filtration unit (AFU) is probably the most important equipment the shelter is mounted with, because this is the part which will filter out all hazardous CBRN particles and vapours. It also delivers the clean air to maintain overpressure, gives the adequate purging to the airlock and sustains the needs of the occupants.
3. The environmental control unit (ECU) should maintain the air temperature and humidity within acceptable limits in the various extreme climate conditions.
4. The air re-circulation filter (ARF) should be capable of providing an extra margin of agent filtration to aid the reduction of the accumulation of low level contaminants.
5. Airlock. The airlock serves 3 main purposes:
   - It forms a compartment with two doors between the TFA and the contamination control area (CCA) or source of CRBN hazard;
   - It maintains overpressure in the TFA with a pressure gradient drop through the airlock to the CCA or the outside;
   - It provides purging so that personnel can enter the TFA without carrying through quantities of vapours or particles that could represent a hazard.
6. The contamination control area (CCA) is required before the airlock to prevent contamination entering the TFA. The design, size and complexity of the CCA will depend on a number of factors which need to be considered, for example the number of personnel occupying the COLPRO or their expected rate of entry/exit, and most importantly the types of potential CBRN hazards and the threat level. The parts of the CCA are the followings (in order from the outside to the inside):
   - Control area is designed for entry/exit control, identification and other purposes. It may have an internal TV sensor system for optical checking.
   - The monitoring points are where sensors are used for the purpose of rapid distinguishing between clean and contaminated personnel and equipment. These sensors can be operated remotely or they can be hand held monitors.
   - The liquid hazard area (LHA) may be reached through the above mentioned parts or directly from the exterior. This is where personnel decontaminate, remove and store their external equipment.
   - Changing area. In an ideal facility the personnel can move from the LHA direct to the changing area. Here the contaminated CBRN suit can be doffed or donned in relative safety due to the high airflow from the TFA.

- The particulate hazard area (PHA) is the module where particles are removed and showering or vacuuming also take place here.
- The vapour hazard area (VHA) is immediately before the airlock and where the respirator exchange may be carried out and other final items of the IPE are removed.
- Storage areas are required to store either clean-contaminated or re-supply items. They can be used in conjunction with almost every other mentioned module.
- Waste areas are like storage, only to serve the purpose of waste disposal.
- The power module is supporting the full function of the whole facility and provides electricity for lighting, heating or other needs required.

Depending on the function of the COLPRO facility and the number of personnel occupying it at a time it may be necessary to connect multiple TFAs to form a large COLPRO complex. Allowing this feature is probably the most important advantage of the modular design. But there are several extra requirements to be considered in this case.

One of them is the airflow management. In large scale complexes it is essential to ensure adequate airflow through all sections of the complex to prevent dead air spaces. Although one AFU may be appropriate for one TFA, a 1:1 ratio may not be necessarily be appropriate in a large complex.[12]

Another important task that needs to be organized in a larger complex is the entry/exit and the migration of the personnel. The soldiers must complete a number of entries/exits to fulfil their mission. Besides that there may be some items of their equipment, which are too big or contaminated, so these can not be stored in the TFA section of the facility. These need an extra storage in order to prevent contamination from breaching the border of the TFA. Pneumatic tents can have external and integral integrated entrances, which can contain either a single, or a two-stage air lock-system in order to ensure bigger safety.[13]

Since we are discussing the usage of a mobile COLPRO system, it is a factor that these tents need to be set-up before they can provide cover against CBRN hazards. It is up to the consideration of the commander to decide the number and variability of the needed COLPRO installations. Timely intelligence of CBRN hazards will enable the commander to utilise the COLPRO resources available to the maximum potential. The selection of the type being used is largely depends on the commander's intend and the facilities available from national/host nation sources.[14]

Some pneumatic tents have the advantage of a really rapid deployment thanks to their basic construction. These use a specialised skeleton structure of "air beams", which is pumped up with simple air, making the setup of the assembly a simple matter.[15]

When setting up a pneumatic tent the followings should be considered:

- Location of the shelter.
- General climate of the environment.

To decontaminate the area around the entrance (and before set-up on the future place of the tent) one of the following methods ought to be used:

- Turn over about 10 cm of soil.
- Remove the top layer of the soil containing any liquid agent. Detectors should be used to check the area after top soil removal to ensure complete removal of the agents.
- Add several cm of clear soil or sand to the ground.
- Mix STB (super tropical bleach) into the soil to make a shuffle pit.[16]

Chemical detection equipment must be used to check for the presence of contamination on individuals, their equipment or weapons. During operations, periodic checks of the atmosphere should be made within the shelter. These checks should be made with chemical agent detector kits or an alarm system to prevent and determine whether there is agent penetration.

The golden rule of operating in a toxic environment is: ***Never open both outer and inner doors of the air locks at the same time!***[17]

The design and shape of the COLPRO tents should facilitate its use and readiness, and reduce its logistical burden. The pneumatic tents must protect of course against CBRN hazards such as all practical field challenges of toxic chemical and biological substances. For military use, camouflage design is appropriate and the tents should be resilient against the following typical battlefield conditions:

- It should provide a protective barrier that is impermeable to humidity and petrol, oil and lubricants;
- It should resist to the contaminated environment for extended periods without fading or a decrease in protection;
- It should be maintainable and repairable by individuals whilst wearing IPE;
- It should resist to mechanical shocks or vibrations and it should be resistant to flame.

The mobile COLPRO must be easily transportable with almost every kind of vehicle. Modular design and compatibility, interoperability are also considerable features and requirements for a modern COLPRO pneumatic tent.

Practical experiences at the HDF 93 Petőfi Sándor NBC Battalion during the usage of COLPRO equipment

The HDF 93 Petőfi Sándor NBC Battalion received 1 kit of COLPRO-300 and 1 kit of HTN 6-300 type collective protection equipment (see Figure 2) at 13. 12. 2006. The NBC support company of the Battalion has recce, decon and COLPRO capabilities.[18]

Figure 2. Type HTN 6-300 collective protection equipment

The main difference between the two types: the main part of the COLPRO-300 is a rigid frame and the type HTN 6-300 is a pneumatic tent. During the training of the operators, the battalion staff worked out a conception relating to the installation and operation of the equipment. The usage of the tents as collective protection equipment in command posts and field medical centres is the most necessary issue. Several problems made the execution of the conception (that was worked out by the battalion staff) difficult. Furniture and other equipment that fits for the special requirements of the pneumatic tent were unavailable. The preservation of the soundness and the protective ability of the tent are significant. Furniture and other equipment must not contain projecting or barbed parts which are able to cut the tent out or during long term usage they can fray it. The fixtures of the tent must be simply and fast deployable, and the usage should not require special knowledge. Lightweight, small volume and massive construction are the characteristics of the ideal equipment. Field furniture which is available at present doesn't match these requirements. This is the reason why necessary to cover the floor of the tent with the rubber carpet of the FMG-68 decontamination truck. In long term as a matter of course the production or acquisition of fixtures is necessary that meet the requirements mentioned above.

The tents were set up and equipped as a command post first time during the summer field NBC exercise in 2007.

As a result of the theoretical and practical research, the layout on Figure 3 seems to be expedient.

Comment:

1 – weapon storage place
2 – storage place for individual equipment
3 – decontamination site for protective overboots
4 – collecting place for IPE
5 – entrance airlock
6 – collecting place for gasmasks
7 – decontamination place
8 – NBC detector
9 – medical doctor
10 – IPE outlet place
11 – air condition unit
12 – mobile toilet
13 – curtain
14 – NBC filtration and ventilation unit
15 – workplace for ongoing operation control team
16 – workplace for planning team
17 – workplace for support team
18 – storage place for water, food etc.
19 – gasmask outlet
20 – resting area
21 – checkpoint
22 – exit airlock
23 – individual equipment outlet place
24 – weapon outlet
moving direction

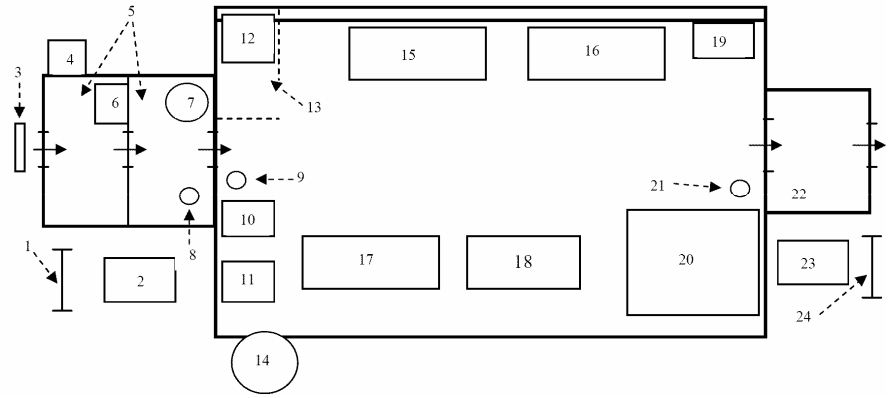

Figure 3. Recommendation layout of the HTN 6-300 collective protecting equipment in use

On one hand the tent contains workplaces which necessary to the continuous operation of a command post, on the other hand it contains the special duty places that are important for the operation of the collective protection equipment.

The first question: When should a tent be set-up? If the tent is built in intemperate weather conditions in favour of the rest of the personnel, or for their more effective work, then it had to be built at the same time with the other elements of the command post. If it is used to ensure the continuity of the C2[ii] in an environment where chemical or radiological contamination is possible, then the furnituring and the work begins according to the commander's decision that was based on the result of vulnerability analysis. In this case the commander nominates soldiers from the personnel of the main command post to deploy it as alternate command post in protected environment. This alternate command post has to possess accurate and up-to-date information as important requirement because it is necessary for the C2 take-over.

In case of chemical or radiological contamination of the main command post, the alternate command post – deployed in a collective protection tent – takes the C2 over by the decision of the commander. The organization of the reserve commanding post is similar to the main post but works with fewer personnel.

Ongoing operation control team leads the subunits that conduct actual tasks. This team receives the reports of the subordinates and modifies the tasks if it is necessary.

The planning team – according to the task that determined by the commander -, works with the given orders (WARNO,[iii] OPORD,[iv] FRAGO[v]) and plans different courses of actions (COA[vi]) for the subordinate units.

Logistics, signal and administration sections work in the support group. Their tasks are: logistics support of the subunits' activities, support of the continuous information flow and accordingly support the command post's leading function.

Beyond the teams' and groups' workplaces mentioned above, other different places are set up in the tent, such as food and potable water storage, resting area (in case of the personnel have to work for prolonged time), mobile toilet (covered by a curtain), air conditioner (as part of the tent), protective clothes and gas masks distribution point, medical and NBC checkpoints.

The professional operation of the collective protection equipment is especially important to keep the C2 ability steadily. Entering and leaving are needed to keep focus on.

One of the most important rules: the number of entering and leaving has to be minimalised! On one hand despite the careful control, the danger of contamination exists, and on the other hand each entry means an extra 93M protective clothing usage. The receiving of different reports and releases of the orders have to be solved via signal instruments.

[ii] Command and control
[iii] Warning order
[iv] Operation order
[v] Fragmentary order
[vi] Course of action

Soldiers have to take their assault rifles off to the weapon stand and leave their pistols at the collecting container before each entry.

Other equipment that is worn on the protective clothes, have to be taken off into another container next to the first one. NBC soldiers decontaminate weapons and pistols then the soldiers wash their boots in a tray filled with decontamination liquid and they can enter into the first air-lock. Soldiers have to take their protective clothes off and throw it into a hole on the side of the air-lock which leads to the contaminated clothes collecting container.

The protective clothes take off has to be performed according to the rules, without touching the tent-cloth.

After soldiers enter into the second air-lock, gas-masks have to be taken off and dropped into a hole which leads to a collecting bag placed in the first air-lock.

The next step is the NBC check. If soldiers are not contaminated, they could enter into the workroom. In case of detection of contamination, they have to be decontaminated at the decontamination place and then NBC check is conducted again. This phase – if necessary – has to be repeated several times until the person will checked as clean.

A 93M protective equipment kit is given at the protective clothes distribution point in the workroom, because protective clothes – that was worn instead of the BDU[vii] – was taken off earlier.

If anybody from the personnel of the command post has to leave the collective protection equipment, he/she has to put his/her personal equipment, weapons, gasmask and the protective clothes on, in order to MOPP[viii] 4 level.

After that the duty officer of the command post checks the proper usage of the protective equipment and allows leaving through the leaving air-lock.

If a soldier is leaving that arrived from contaminated area earlier and took his/her equipment off, he/she receives a new gas mask and after leaving gets back his/her decontaminated weapons and personal equipment next to the leave air-lock.

It is important to point out that the command post that operates in contaminated environment is a temporary element of the formation. The command post's part that is set up in non-protected environment has to be evacuated from the contaminated area and set up in non-contaminated environment after decontamination. When the operational readiness is reached, C2 has to be taken off as soon as possible from the reserve command post that set up in the collective protective equipment.

[vii] Battle dress uniform
[viii] Mission oriented protective posture

The expert operation of the collective protection equipment in NBC contaminated area is decisive to keep the C2 ability steadily.

Conclusions

The advantages of pneumatics tents (simple operation, rapid relocation, mobility) make them specifically capable to the collective protection of some combat unit's elements. Essential requirements of collective protection equipment are determined by concerning NATO STANAGs. Mobile, worldwide useable equipment, that ensures the work of command group in chemical or moderate radiological contaminated environment, unfortunately is not available at the Hungarian Defence Forces. Continuous leading of subordinates is high-priority both in combat and in case of a possible disaster. Pneumatic tents with adequate additional equipment are able to ensure the conditions of commanding. The HDF 93 Petőfi Sándor NBC Battalion has used the type HTN 6-300 collective protection equipment since 2007. The protection of personnel and maintenance of continuous commanding in NBC environment are reachable with convenient setting-in, vocational and duly usage of the tent.

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