25. PERSONAL PROTECTION OF DECONTAMINATION AND RESCUE TEAMS ENGAGED FOLLOWING TO TERRORIST CHEMICAL AND BIOLOGICAL STRIKES

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INTRODUCTION

Terrorist chemical and biological attacks that can be envisaged in future will bring beside extent and degree of violence also new sophisticated methods including the use of supertoxic lethal chemicals and highly contagious biological agents causing increasing number and severity of casualties including lethal cases. This itself stresses requirements on chemical and biological protection in the widest possible sense, i.e. on the complex system of physical and medical protection and rescue means and methods and in the first line on the high-level personal protection of teams engaged in all rescue and recovery actions following to such attacks. Compared to e.g. police missions at street riot control or even to rescue operations after industrial or traffic accidents with release of toxic agents, the rescue teams acting after above mentioned terrorist strikes will be more probably in a much difficult position due to a wider variety of sometimes not exactly anticipated terrorist means and methods. This is why the equipment of these teams must envisage *any* expected possibility from *low hazard* (as for the character of agents, agents only in vapour state, short-term exposition) to *high hazard* (with high amounts/concentrations of supertoxic lethal agents and/or highly contagious agents, plume of agents with droplets, extensive spills etc., long-term operations, combined attacks with explosives or incendiaries etc., work in the environment with lacking enough oxygen or extreme concentrations of agents or smoke etc.) as the extreme, but probable eventuality.

The varieties of conditions under which the rescue teams will operate need to envisage corresponding variety of protective means to be ready for use on the spot.

The aim of this paper is to present the results of the Czechoslovak and Czech R&D, production, testing and use of the new generations of protective means, introduced into the Czech Armed Forces, Czech Civil Protection, as well as for employment at Fire brigades and in chemical and nuclear industry, some of them developed specially for other rescue missions, suitable for the rescue operations after terrorist CB strikes.

Present generations of the Czech means for personal protection, as the result of own R&D, benefit from the old tradition of development of chemical defence (starting in the 1920s) that was necessary to devote attention to, due to the possibility of Czechoslovakia being probable target of use of chemical weapons during its whole modern history after its foundation in 1918. In the pre-WW-II-period, this state was surrounded by two non-friendly countries, preparing offensive chemical assets, during the Cold War was a potential battlefield due to its location, together with then two German states, on the divide between two major Alliances.

CZECH MEANS FOR PERSONAL PROTECTION AFTER TERRORIST STRIKES

Rescue teams designated to operate after terrorist chemical and biological attacks can benefit from the wide variety of modern generations of means for personal protection, ready

for deliver and use in the Czech Republic, able to cover any tactical and technical requirement stemming from the risk analysis, risk assessment and risk management of the concrete situations the terrorist attacks could pose.

The main means of personal protection are represented by a wide sets of

- protective masks (respirators) (originally developed for armed forces, civil protection and industrial safety),
- air-permeable suits (in several modifications as for the cover fabric and accessories)
- air-non-permeable (isolating) suits (in several modifications as for the breathing oxygen source),
- air-non-permeable filtroventilated suits (in several modifications as for the construction material and filtroventilating unit).

It can be stressed that beside concrete *requirements* for individual types (sets) of protective means, general requirements for construction material were applied in order to assure long-term protection against penetration of toxic agents with lowest possible inward leakage and general requirements for long-term use of means under enhanced physiological comfort.

This means in case of *respirators (protective masks)* not only widest possible field of vision and sound/voice transmission, low pressure and impact on face and lowest possible harmful space (connected with expired CO_2 increase), but also possibility of drinking in contaminated area.

In case of the new types of *protective suits*, removal of heat and vapours from the sub-suit space is understood and in some cases also possibility of urine discharge without breaking seal, assuring thus long-term wearing in contaminated area.

Following description of individual means shows the variety of possible use, indicating that actually all possible requirements meeting the demands of use by rescue teams can be fulfilled. It can be noted, that all below mentioned means have been tested under a very strict testing system, according the standards, corresponding to the EN (ISO) standards [3].

RESPIRATORS (PROTECTIVE MASKS) [2,3,4]

For military uses:

M-10M Belong to the standard equipment for all servicemen of the Czech armed force, as well as for servicemen of Rescue regiments of the Czech Civil Protection. Developed during the 1970s by considerable upgrading of the original type M-10 introduced in the late 1960s. Contains 2 upgraded filtration elements in the facepiece. Enables safe drinking in contaminated area. Its design and basic properties are comparable to that of the protective mask M-17-A1 (USA). It was produced in grey colour.

OM-90 The newest model under current introduction. The facepiece possesses extraordinary resistance to penetration of toxic agents (bromobutyl rubber), design of a sealing gasket and low respiration resistance ensure longtime endurance of the mask with the canister made of high-resistant plastic. Computer-optimized field of vision (general field of vision 71 %), design enables correction of dioptrical defects and compatibility with basic military optical devices including the noctovisor CLARA. Hardened glass of visors is highly resistant to damage and scratching. The mask enables safe drinking in contaminated area. Built-in diaphragm assures easy communication and audibility. Screw filter canister with 40x1/7" thread can be fitted on both right and left side. Rubber-textile clamping system

assures optimum position on the user's head. Materials warrant their resistance to wear and damage, enable complete decontamination of the set and simply maintenance.

Main technical data:

Facepiece (produced in black colour) 500 g (average - 3 sizes). Pressure loss (30 ltr/min) - inhalation max 20 Pa, exhalation max 60 Pa. Plastic filter canister OF-90 250 g. Dimensions 110 x 80 mm, pressure loss at 30 ltr/min max 130 Pa. Coefficient of penetration KP 0.0001 %.

Producer of military protective masks: *Gumarny (Resin works) Zubri Co,* CZ-756 54 Zubri, Czech Republic.

For Civil Protection and other civilian (industrial uses) .

The R&D of the modern series of the protective masks proceeded in the same main organisations, in the first case subordinated to the Ministry of Defence (Czechoslovak NBC Defence R&D Establishment bearing various depictions in its history, the latest two being Research Institute 070 and now Military Technical Institute of Protection) and in the second case subordinated to the Ministry of Industry (Research Institute of Resin and Plastics Technologies). Similarly, also the production was carried out in the same factory, built in the 1950s for manufacturing the oldest post-WW-II protective mask according to the Soviet-originated model BSS-MO-4u. It was therefore possible to use not only R&D, as well as the material and technological experience and skill, but to apply directly some construction elements, originally designed for modern military masks (mainly for M-10 produced on quite new resin technology) for civil protection and other civilian (industrial) masks. It can be seen, that e.g. visors, resin valves, internal „half-masks" fitted with additional valves, sound/voice transmitting element, drinking device and some construction details were applied as such (material, construction, form, size). This was the reason, why the civilian applications were introduced very quickly, following as the successors of the original military design and why one can observe many similar features on the first view. There is, of course, one exception: The civilian applications, even if derived from the M-10 (M-10M respectively) were designed in all cases with the central filter canister. Reasons for it were not only economic (e.g. the form for manufacturing the facepiece of M-10 with two filtration elements by the transfer moulding was extremely complicate containing altogether 13 parts) but also technical, to enable beside common CBW filter using other special filters against industrial toxic agents.

CM-4 is the basic type of the protective mask for the mass use in Civil Protection, introduced in the early 1970s for the whole general adult population of Czechoslovakia. It was produced, (like all other civilian protective masks) in grey colour and sufficient number (3) of sizes, reflecting the anthropometry of Czechoslovak male/female adult population

CM-4M as upgraded previous type was introduced in the 1980s. It was necessary to overconstruct the original plastic part containing the exhaust valves and air inlet to fit the mask with the drinking device. This upgrading have led to the up-to-date protective mask for general use. This type is widely available.

CM-4K is the modification of CM-4 for industrial use to be connected by means of a hose to the remote air delivery from the external source.

CM-5 is a typical industrial protective mask, derived from the CM-4. It was introduced in the late 1980s and belongs to the most modern civilian protective masks for general use. It is marked by its single wide panoramic visor. It is therefore extremely suitable for industrial operations under various conditions where good sight is required.

CM-5M is the latest model of civilian protective mask, being derived from both CM-4M and CM-5 combining the advantages of both types, i.e.single wide panoramic visor and

ability to drink in contaminatred area. It is therefore very welcomed for long-term work under heavy-duty conditions.

It is quite clear from this overview that the whole set of civilian protection masks, produced in huge quantities (actually for the whole 15 mlns of citizens of Czechoslovakia) is available in enough volume to be used for the purposes consistent with the title of this paper.

As it was stated above, there is a single producer of both military and civilian masks in the Czech Republic, named under the military protection masks.

AIR-PERMEABLE PROTECTIVE SUITS [1]

The R&D, started in the Czechoslovak NBC Defence R&D establishment in the late 1960s.

The main achievement was the adsorption fabric, based on tiny-particle sorbent pneumatically scattered and fixed on the multilayer non-vowen system of randomly oriented polymer fibers.

This enabled to develop and manufacture a large series of various modifications of air-permeable protective suits according to the customer's desire. The adsorption layer is the medium function part, fitted from inside by a light permeable linen and from outside by a cover textile fabric. Various modifications of suits differ mainly in the properties of the outer cover fabric. For the standard military use, it is designed as the oversuit and the cover fabric possesses a camouflage print and additionally also impregnation against moisture, fatty dirt, fire and light impulse of the nuclear explosion.

According to the desire of the customer, the material of the cover textile can be changed and all mentioned impregnations can be ommitted which significantly increases the air permeability. This is very important e.g. for the hot climate. So, e.g. for the Czech UNSCOM missions a special very light white cover textile was applied, what was admired by the members of all other inspecting teams operating in hot Iraq climate.

The standard Czech air-permeable protective suit POO and its properties has been already presented at various opportunities. It is available and suitable for the purposes discussed here under situations connected with low to medium risk operations.

Producer of the air-permeable protective suits: *BOIS-Filtry Ltd.*, Brno, Czech Republic

AIR NON-PERMEABLE FILTROVENTILATED PROTECTIVE SUITS [2,3,4]

The most progressive and reliable means for high-risk operations are represented by already a set of hermetic heavy-duty protective suits, derived from the basic type OPCH-90.

OPCH-90 is worldwide the first type of protective suit for military specialists, equipped with the filtroventilation unit FVJ-90 supplying enough regulated filtered air stream into respirator (protective mask) (60/120 ltr/min) and into the undersuit space (up to 300 ltr/min), continuously changing the microclimate, removing heat and water vapours, assuring thus overpressure (overpressure exhaust valves) and cooling, preventing overheating and inward

leakage. This suit, together with the Czech-made masks (M-10M, CM-4M, CM-5M and the new OM-90) enables drinking, assures the protection of respirator and the inward leakage index up to 99.99953 %, medium hard work (below 20° C) up to 6 hrs. It was tested for wearing up to 24 hrs. This is achieved thanks to fitting with a special urine-discharge device, consisting from a special suspensor with discharge hose and a container, enabling the urine discharge in contaminated area without breaking seal. The material is highly CWA-resistant.

OPCH-90-PO is the civilian (Civil Protection respectively) modification made fromanother material resistant against industrial chemicals, produced in signal yellow, with modified form of the filtroventilation unit to enable entering narrow spaces.

There are several modifications of the above mentioned types, amended with various types of breathing devices, carried either ouside (for fire brigades and rescue teams) or also under the suit (for the use in heavy duty industrial operations in corrosive environment.

Any of those suits are suitable for the use following the terrorist attacks. They are envisaged for such purposes.

Producer: *EcoProtect, Ltd*, Zlín, Czech Republic.

SUMMARY

Contemporary Czech protective means, suitable for equipment of rescue teams engaged following the terrorist CB attacks are presented. They include in the first line *respirators (protective masks)* originally designated for armed forces (M-10M, OM-90) and for civil protection and industrial uses (CM-4, CM-4M, CM-4K, CM-5, CM-5M). They are further represented by *air-permeable suits* for lower risk level (POO) produced in several modifications (as for the properties of the cover fabric for different climate and other requirements, such as colour, camouflage, impregnation against water, fire, oil products etc.) and with various accessories, i.e. types of gloves, boots and overboots. The last element of the triad are the *air-non-permeable filtroventilated suits* for high risk level (OPCH-90 and OPCH-90-PO) providing with extremely high physiological comfort and long-term use (tested for up to 24 hrs wearing due to enabling drinking and urine discharge in contaminated area without breaking seal). Modifications of these suits are described as well. Experience from several decades of R&D, production, testing, training, peaceful applications in chemical and nuclear industries, as well as from Persian Gulf operations (1990-1991) and UNSCOM missions (the 1990s) is presented. All means have been tested in a strict system using EN (ISO) standards.

KEY WORDS

CB-terrorism, rescue operations, personal protection, respirators, protective masks, air-permeable protective suits, air-non-permeable filtroventilated protective suits

REFERENCES

1. Matousek, J., Obsel, V.: Technologies for air-permeable protective suits. 5th International Sympos.on Protection against CBW Agents, Stockholm 1995, Proc., vol.2, pp.
2. Matousek, J., Slabotinsky, J., Obsel, V.: New trends in the personal protection. International Symposium NBC Defence 97, Hyvinkää 1997, Proceedings, pp 126-129.
3. Matousek, J., Slabotinsky, J., Bradka, S.: System of testing means of personal protection against CBW agents. 6th International Symposium on Protection aganits CBW Agents, Stockholm 1998, Proceedings, vol.1, pp.255-256.
4. Matousek, J., Slabotinsky, J.: Filtroventilated non-permeable protective suits. International CW Demil Conference, Vienna 1999, Conference Abstracts, p.63