

## TECHNICAL AND ORGANIZATIONAL ASSUMPTIONS FOR MODULAR PLATFORM TO DECONTAMINATION

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### TECHNICKÉ A ORGANIZAČNÉ PREDPOKLADY PRE MODULÁRNE PLATFORMA PRE DEKONTAMINÁCIU

#### ABSTRAKT

Článok prezentuje problém dekontaminácie, ako jeden z najdôležitejších aspektov obrany proti zbraňam hromadného ničenia. Vozidlá, ktoré sú v súčasnej dobe majú jednotky CBRN vyžadujú modernizáciu, aby sa lepšie prispôbili aktuálnym potrebám, aby bola zaistená bezpečnosť. Článok prezentuje výsledky štúdie týkajúce sa technických a funkčných cieľov a organizačnej platformy modulov pre dekontamináciu. Na základe analýzy rizík, ktoré môžu nastať v dôsledku ozbrojených konfliktov, prírodných katastrof a teroristických útokov civilizácie so zbraňami hromadného ničenia alebo uvoľňovaní toxických (nebezpečných) látok - vyvinuté rôzne funkčné modely pre účinné odstránenie kontaminantov. Návrh technických a organizačných riešení viacstupňovej dekontaminácie, vybavenia a technických zariadení v rôznych variantoch. Výsledkom tejto štúdie je navrhnúť stavebný panel, ktoré umožňujú účinnú dekontamináciu chemických, rádioaktívnych a biologických látok. Moderný dizajn spĺňa štandardy NATO a EÚ.

**KLúčové slová:** dekontaminácia, modulárny platforma pre dekontamináciu, technológia dekontaminácia

#### ABSTRACT

This article presents the problem of decontamination, as one of the most important aspects of defense against weapons of mass destruction. Vehicles that are currently equipped troops CBRN require improvements in order to better adapt to the current needs to ensure the safety. Article presents the results of studies concerning the technical and functional objectives and organizational a modular platform to decontamination. On the basis of the risks analysis that may occur as a result of armed conflicts, natural and anthropogenic disasters and terrorist attacks with weapons of mass destruction or release of toxic (hazardous) substances - developed various functional models for effective removal of contaminants. Proposals technical and organizational solutions of multi-stage decontamination, equipment and technical facilities in different variants. The result of the study is to propose building a panel that allows for effective of chemical, radioactive and biological decontamination. Modern design meets the applicable standards and the standards of NATO and the EU.

**Keywords:** decontamination, modular platform to decontamination, technology of decontamination

#### INTRODUCTION

The total decontamination is carried out at decontamination points, which consist of decontamination squares of equipment and weapons, and of the personnel decontamination square. It also organizes the elements needed to ensure the smooth conduct decontamination: a distribution point, the road maneuver, control point, the point of leadership and management, point of collecting contaminated clothing and individual equipment, decontamination effectiveness of the control point. Depending on the requirements and capabilities available to the subdivision rescue develops one or more squares decontamination equipment and supplies. The decontamination square for people develop one or two sets of tents for decontamination.

Theoretical considerations for the effective removal of contamination that may occur as a result of armed conflicts, natural disasters and civilization and the impact of terrorist groups tend to bring the thesis that today, both military and specialized chemicals as the non-military formations not fully prepared for effective decontamination. The complicated situation after the contamination tends to make the discussion of a new system of organizational and technical knowledge about decontamination. Analysis of the needs of rapid and effective decontamination in all conditions tends to search for solutions to develop a modern platform for effective decontamination of toxic and hazardous substances. Attempted a holistic analysis of the advantages and disadvantages of different solutions (military and civilian) in relation to the potential needs [1,2].

#### CBRN decontamination

Technology decontamination equipment installation using the IRS. Implementation of the installation of IRS-2C equipped with a high pressure washer caused a change in technology decontamination of single stage to multi-stage variant. Chemical decontamination solution instead of an aqueous calcium hypochlorite disinfectant introduced powder applied to the contaminated surface with the dispersion lance. Until 2011 units of decontamination were equipped with special high-performance devices WUS-3 (vehicle with mounted turbojet). Decontamination using these devices was conducted using a gas or gas-droplet. The method was based on the interaction of a gas stream of hot exhaust gases to the toxic agent, and the gas-drop method for the mixing of hot exhaust gas with an aqueous solution of calcium hypochlorite. Installation bottling IRS-2 is designed for decontamination of chemical and radioactive weapons, military equipment, transport facilities engineering and construction, and land and roads. Plants can also be used to disinfect and conducting decontamination people. Additional tasks for which potent be used for this installation are:

- hot water in the tank (to 60 ° C);
- preparation and distribution solutions to eliminate contamination and disinfection;
- pumping liquid from one container to another without the tank installation;

- pumping of liquids from drums and other containers (up to 3.5 m<sup>3</sup>);
- transport of water and extinguishing fires.

Introduction to the Armed Forces after 2003 bottling plant IRS-2C technology changed decontamination and deactivation of weapons and military equipment. So far the removal of contamination from the surface of the vehicles or weapons done with aqueous solutions that were applied to contaminated surfaces with brush nozzles. In the process of reprocessing aqueous solutions of calcium hypochlorite. The concentration of the solution depends on a contaminated object, and from the center, which has been contaminated. The rescue operations can also be used other substances to produce a disinfectant such as sodium hypochlorite (commonly used in the industry). Normally radioactive decontamination is used 0.15% solution of the surfactant SF-M. Possible to replace it with other commonly used measures surfactants. Decontamination of people use a clean, preheated to a temperature of 36-40°C water and soap (approximately 15 g/person).

Installation of IRS-2C is a component of decontamination. The installation uses a new method based decontamination of the working media feeding water under high pressure (up to 9.0 MPa) or in the form of dispersed systems. With the additional equipment it is possible to carry out decontamination processes paved surfaces, infrastructure and interiors of vehicles and buildings. The use of new technology increases the efficiency and effectiveness of decontamination. Installation bottling IRS-2C is a modernization of the IRS-2. In addition to the visible changes in the construction of the installation (smaller tank, retrofitting high-pressure devices) changed decontamination technology, which consists of four stages:

STAGE 1 - Prewash - initial hot wash contaminated surface (60°C) water with a surfactant from the system IRS-2 by means of nozzles jet to remove debris from the surface contamination of equipment, in particular mud.

STAGE 2 - Application of disinfectant - applying to the surface of the powder contaminated equipment decontamination agent (disinfectant powder in the form of an aqueous dispersion) with lances SANIJET GUN with high pressure (60°C).

STAGE 3 - Disinfectant response time - the time required for the reaction of disinfectant with a poisonous agent. During this time, drivers of vehicles without devices join and filter to eliminate contamination inside the vehicle using hydraulic equipment - air spaced at positions of anticipation, and separated from IRS-2C. The maximum response time is 30 minutes.

STAGE 4 - Disinfectant swill - wash with warm water (60°C) for active substances from the surface undergoing decontamination using jet nozzles using IRS-2 installation.

Due to the fact that the device based SANIJET winding of the new system is difficult to determine its capabilities, without taking into account other elements of the system (Fig. 1). It can be estimated that the use of a pair of devices autonomously enable decontamination of chemical or radioactive from 6 to 12 vehicles / h. This device can also be used as a heating device in the bath field - tent, maintaining the existing possibilities bath (96 persons / h). Conduct decontamination in multistage variants requires the involvement of a large number of people to use. Not yet been clearly defined how many units of standard equipment can be decontaminated in one hour. We still are working on fixing them. However, during exercise developed national and international standards, which as of today is assumed for the calculations (other than those specified by the manufacturer of equipment). During the one hour can remove contamination of 6 - 12 units of equipment. At first, the second and fourth step is envisaged of 10 - 15 minutes for the two vehicles, and the third stage - 30 minutes (reaction time disinfectant). It depends on the type of military equipment. More time is required decontamination vehicle high and large overall dimensions (it is necessary to input the ladder to wash and application of disinfectant to the upper part of the vehicle).

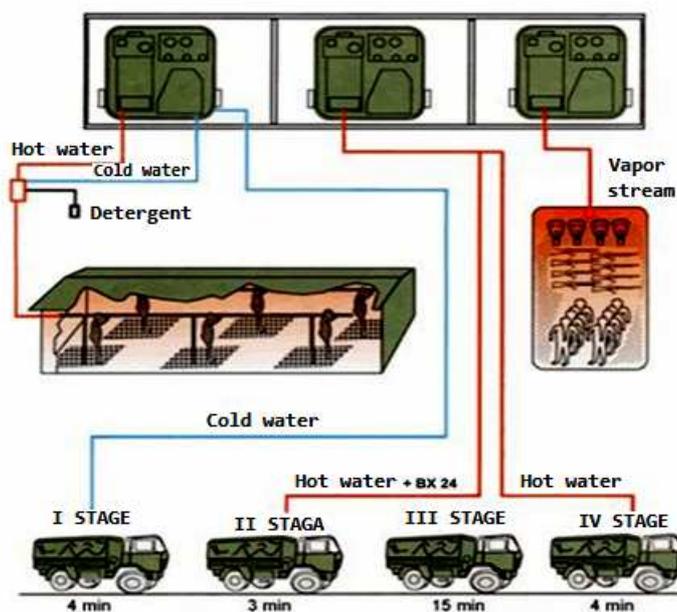


Figure 1. Point of decontamination based on SANIJET C

Source: <http://www.cristanini.it>

High decontamination unit WUS-3 was used for the decontamination of chemical, radioactive and disinfection:

- the outer surfaces of the rigid transportation equipment buildings;
- stationary objects;
- roads and squares hardened;
- runways.

Furthermore, it can be used for:

- extinguish burning buildings;
- other works exhaust gas energy-using turbojet engine.

This device consists of a motor, turbo-jet mounted on the chassis cargo - off-road Star-266 (Fig. 2). The engine is mounted so that its movement in the vertical plane (from + 15 ° to - 25 °) and horizontal (from + 90 ° to - 90 °). Service provides two soldiers: the driver of the vehicle and the operator of the turbo-jet engine. To allow a smooth and without collisional conducting decontamination, the most commonly used devices in pairs, and the center of decontamination is a stream of hot (up to 66°C) exhaust gas turbo-jet engine [4].



Figure 2. High decontamination unit WUS-3 in marching position with a protective tarp removed and mounted cab

Source: Archive MOD

The term bath-tent field-LPN is understood set of devices aimed at securing the elimination of chemical and radioactive contamination and disinfection of the large number of people. An essential element of LPN is a string of three tents: undressing, bath, dressing room (under low temperature conditions added two more tents so-called adaptive). Distribution and heating is performed using a heating device, but the installation can also be used IRS-2 or IRS-2C. Square, which is organized steam, is divided into two parts: the contaminated and uncontaminated. The boundary between the parts is between the tent-bath, and a tent-dressing room. The uncontaminated part of the set container with a supply of clean water to the boiler (if you cannot collect water directly from the source). Depending on your needs and develops 1-2 strings tents. It is recommended to organize bath on the basis of the existing sanitary infrastructure and residential buildings or businesses. Water tanks are filled with this situation directly from a well or water supply.



Figure 3. Bath-tent field-based Milagro pneumatic tents with heating device UG-72 and an open water tank

Source: Archive MOD

## Legal aspects of the new platform decontamination

According to Polish law - for research purposes had to be considered: Standards Defense - generically consistent with the specificity of equipment, the Act of 20 June 1997, the Law on Road Traffic (Dz.U.05.108.908 as amended. ), Decree of the Minister of Infrastructure of 31 December 2002 on the technical conditions of vehicles and their scope of necessary equipment (Dz.U.03.32.262), Regulation of National Defense and Minister of Internal Affairs and Administration of 9 June 2005 on the technical conditions of special vehicles and vehicles used for special purposes (Journal of Laws No. 116, item. 974), Polish Standard PN-V-25000 Protection of military equipment against corrosion and aging. Painting military equipment being supplied army. General requirements [5].

## Technical assumptions about usability platform decontamination

Platform to conduct decontamination should allow: keeping the partial and total elimination of radioactive contamination of chemical and biological weapons and equipment and infrastructure, people, personal equipment, aircraft and ships; decontamination facilities through the use of new, more efficient and less aggressive compared to environmental disinfectant; decontamination by lowering the level of contamination and infrastructure to the degree of allowing their use without the need for personal protection against contamination up to the levels defined as maximum concentration (the NDS). Platform decontamination should provide decontamination irrespective of: season; time of day, weather conditions, climatic conditions. Equipment should allow: keeping the partial and total elimination of radioactive contamination through the removal or reduction of radioactive weaponry and equipment and infrastructure; conduct partial and total elimination of chemical and biological contamination by removing, reducing or neutralizing chemical and biological substances from equipment and infrastructure; running total and partial decontamination of contaminated people by removing them. Installation should allow rapid deployment of mobile equipment that will ensure all tasks running by decontamination crews. This equipment is a portable decontamination equipment.

Decontamination platform should enable continuous liquidations contamination for 12 hours in 24 hours (this requirement does not apply disinfectant, water, fuel and ammunition, which can be replenished). Platform decontamination should be equipped with independent water tank with a capacity of at least 3 000 dm<sup>3</sup> with the insulation system heat loss, water heating system allows the heating to 40° C operating temperature (regardless of the ambient temperature). Warm-up time should not exceed two hours regardless of weather conditions and terrain.

During the design and construction should seek to maximize the use of assemblies, sub-assemblies of parts and pieces of equipment that have already been tested in qualifying and placed on the equipment as part of the equipment in the bundling of other products, which should ensure compatibility.

Calendar life of the chassis should be:  $T_p = 30$  years. The probability of an airworthy condition chassis lifetime and use should not be lower than  $P(T_p) = 0.9$ . The platform should be adapted for use with an intensity of 24 h / day in periods of periodic service intervals. Resurs between the main landing gear overhauls shall not be less than 100 000 km. The warranty period shall be not less than 5 years in storage, or two years, and 20 000 km and 500 hours of work equipment (whichever comes first) to use the platform of decontamination, including 10 years in the paint. The warranty period does not apply to sources of electricity. The warranty on the shell does not apply to their mechanical damage occurring during operation. Guaranteed lifetime of the device specialist portable decontamination should not be less than 10 years (including not less than 2 years of operation). Major repairs of the equipment should be performed in specialized workshops. It should be possible to perform running repairs in the field [6].

Social facilities should provide the crew the ability to perform tasks, resting and preparing meals while performing tasks continuous period of not less than 3 days. The interior should have a place for the submission of personal equipment of the crew. Platform decontamination should be equipped with handles for entry / exit to / from the vehicle. Equipment installation platform decontamination should not result in mutual collisions mechanical. Design solutions and individual pieces of equipment shall meet the requirements of ergonomics and aesthetics technical support. Construction and layout of the control and regulation equipment and instruments shall be ergonomically designed, including to enable the execution of tasks related to the use of the equipment, Portable Computer: freezing temperatures with gloves and full uniform, in the contaminated area (individual means of protection against contamination). Used in the production technologies should guarantee the safe and reliable operation. Used in the production technology should minimize the need for specialized equipment [3].

## Composition and equipment specialized rescue team in the field of decontamination

Assumed structure of the team decontamination platoon equipped with a new chemical decontamination platform is based on three lorries with trailers. The team will include: team leader, two commanders section 8 operators and 4 drivers. The proposed team structure chemical decontamination platoon is shown in Figure 4.

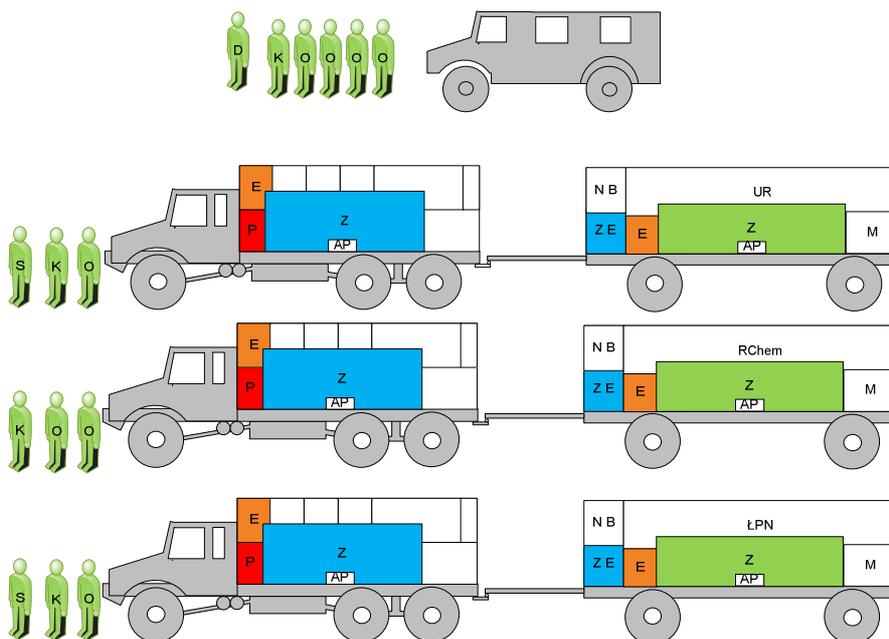


Figure 4. The proposed structure and equipment for specialized decontamination team

Source: own

**Legend:** People keys: D - decontamination team leader, S - section leader, O - disinfectant, K - driver, equipment Car: Z - tank, AP - Autopompe, E - generator, P - water heater, trailer equipment: Z - tank, AP - Autopompe, E - generator, ZE - flexible tank, M - High pressure washing machine (washer), UR - device framework Rescue team - rescue equipment, chemical and environmental, LPN - tents and equipment bath-field-tent, NB - tent household.

### The proposed technology decontamination equipment and supplies

Based on the recently adopted four-step decontamination equipment is proposed to follow the use of new platforms. According to the current guidelines of the process of decontamination equipment (vehicles), in particular the decontamination process should consist of four successive stages: pre-wash, applying disinfectant, disinfectant left on cleaned surface and wash the residue after disinfection. On Fig. 5-6 presents a proposal for the organization of four-step decontamination using the new team structure and proposed decontamination platforms. For the duration of the decontamination team leader assigns to the first section of the two operators.

In the first stage, pre-wash, will be used for one vehicle and equipment removed from the trailer: flexible tank and two high-pressure equipment. It is expected that the total pre-washing will be from 5 to 10 minutes.

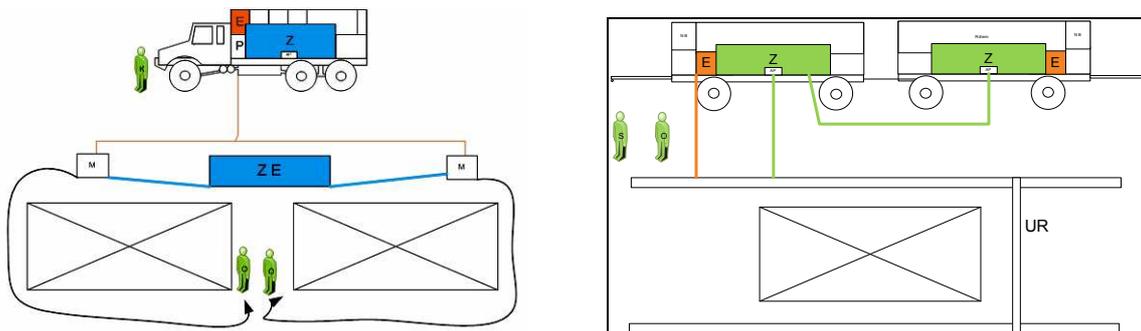


Figure 5. The proposed structure and equipment for specialized decontamination team

Source: own

In the second stage, lasting up to 10 minutes working solution will be applied to the surfaces of contaminated equipment. This process will be automated by using a device equipped with a frame with sets of nozzles and sensors that monitor the shape of the object. In the event of liquidation of chemical contamination will be applied disinfectant powder or organic, in the case of radioactive contamination - a solution of surfactants (active foam).

The third stage involves directing a vehicle (equipment) on one of the three double fields (Fig. 6), on which the disinfectant for 30 minutes will come into chemical reaction with a hazardous substance or a surfactant, will be "removed" radioactive contamination. In addition, there is the possibility of applying the disinfectant / active foam on the other (contaminated) equipment vehicles. This will be possible thanks to the use of portable sprayers, which are transported on trailers 1 and 2

Decontamination additional equipment will require the participation of soldiers assigned to the platoon for the duration of the chemical decontamination. It is estimated that in the case of four-step decontamination will be from 2 to 6 operators.

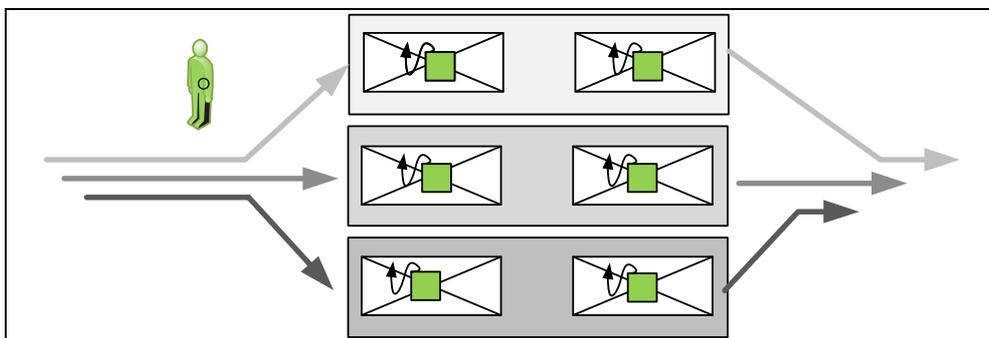


Figure 6 Stage III - leave for 30 minutes working solution on contaminated equipment surfaces

Source: own

Full-time service of the third phase will be the only one operator, whose task will be to control the movement of the fields expectation. Another of his task may be to supervise the use of the spray by soldiers assigned to contaminated vehicles or drivers. The fourth stage decontamination involves the removal of residues of poisonous and working solution of the entire surface of the equipment. The organization of the work is analogous to the first stage and is based on vehicle No. 1 (Fig. 7). Support are two operators and drivers.

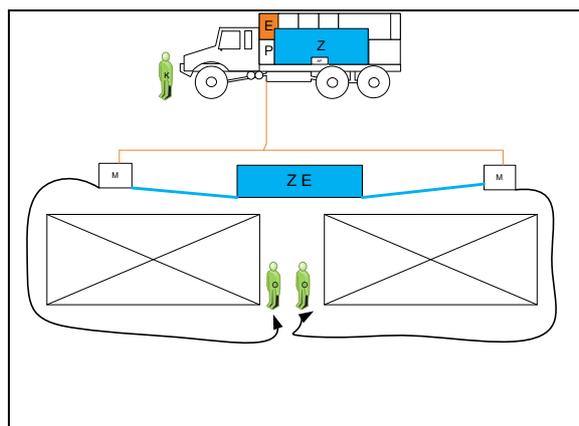


Figure 7 Stage IV - wash the residue after decontamination.

Source: own

### Technology decontamination of the personnel

Technology decontamination of the personnel carried out using a new platform fully meets the current procedures (Fig. 8). The essential element is the field-steam-tent, which is currently equipped subunits decontamination. The heating device UG-72 has been replaced by the installation on the car, the possibilities are much greater. Another advantage of this solution is the ability to replace a vehicle No. 3 by the vehicle 1 or 2. A problem associated with the necessity of supplying pure water into the bath tank in the event of a vehicle does not occur. This is due to the fact that the tank is transported only water and surfactants are added to the stream of water from the reservoir through auto-pump. In the case of installations on vehicles to eliminate contamination in the area by clean, it will be necessary to carry out only a few rinses clean with water. This is better than the current solution, in which the water tanks at the fishing bath provided a tent using IRS installation. Differences of application platforms rely primarily on the efficient organization of the region of initial decontamination of protective clothing and decontamination area (deactivation) of individual equipment. The second section has for this purpose two high-pressure devices, a flexible reservoir with water and in the case of chemical contamination auto-pump tank trailer containing disinfectant or an organic powder. For the application of the working solution to equip the individual planned to use spray. Activities related to the decommissioning of individual equipment soldiers carry contaminated before entering the LPN, and the proper execution of all the activities exercised commander of the second section [7].

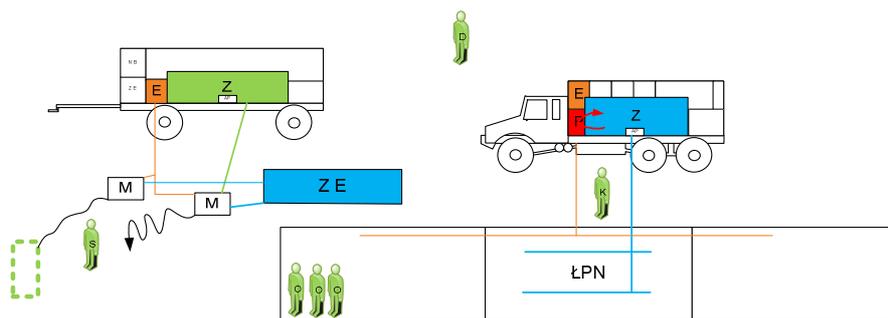


Figure 8 Organization and Equipment Liquidation Square Contamination U.S. Personal developed by section 2 based on the new platform for decontamination. *Source: own*

### Summary and conclusions

The research literature and made on the basis of conceptual analysis allows to draw the following conclusions. Equipment platforms should be carried on cargo-terrain vehicle with a trailer biaxial. Decontamination platform should allow conducting the liquidation of nuclear, chemical and biological equipment, facilities engineering (including aircraft and ships) and persons and their equipment. The proposed technical solution provides the ability to conduct decontamination whatever the season, time of day, weather conditions and climatic conditions. Body decontamination platform should enable rapid deployment of equipment and getting ready for action. Means of communication and navigation should ensure that radio communications between vehicles during the execution of tasks. Decontamination platform should be able to comply without refueling, march over a distance of 500 km on paved roads and 300 km in the wilderness. Decontamination platform should be equipped with hardware and equipment for the organization of the rest - tents, air conditioners, etc. Preparation time variant of specialist equipment to work should not exceed two hours regardless of weather conditions.

From the data presented in the article will clearly show that the new platform to eliminate the contamination may have greater potential than the currently used systems and equipment decontamination. Attention should also be paid to the small number of people laid to operate. In conclusion, in the context of research, significant assumptions specified technical and organizational platform for decontamination. It has been shown theoretically, the ability to perform the tasks at a high level of efficiency and in accordance with the standards of NATO and the EU.

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### RECENZIA TEXTOV V ZBORNÍKU

Recenzované dvomi recenzentmi, členmi vedeckej rady konferencie. Za textovú a jazykovú úpravu príspevku zodpovedajú autori.

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