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REPAIR OF WEAPON SYSTEMS UNDER COMBAT OPERATIONS. PART 2 - MODIFICATION OF REPAIR SYSTEM BY INCLUDING EXPEDIENT REPAIRS

Abstract. Basing on the first part of the paper entitled: “Repair of weapon systems under combat operations. Part 1 – nature and principles”, the current paper presents modification propositions in the repair system under combat operations with reference to expedient (temporary, improvised) repairs taking into consideration Polish Land Forces.

Keywords: weapon systems, battlefield maintenance, expedient repair.

1. INTRODUCTION

The analysis conducted in the first part of the paper, entitled: “Repair of weapon systems under combat operations. Part 1 – nature and principles and technology”, proved that there is an urgent need to implement an expedient repair system into the Polish Armed Forces. Therefore, in the next part, some suggestions and solutions in this matter are presented.

2. AN EXPEDIENT REPAIR SYSTEM PRELIMINARY CONCEPT FOR THE POLISH ARMED FORCES

2.1. A concept of a system at the central level

The expedient repair system at the level of the Polish Armed Forces should be finally managed by some unit at a central level. The Center of Expedient/Battle Damage Repair System Coordination and Organization is a suggested name for this unit. It should function at the Inspectorate for Armed Forces Support since the mentioned staff is responsible for organization and execution undertakings and tasks of service support. The created center should not be a complex staff unit consisting of many people, but only a team of a few specialists, who will be responsible for (fig. 1):

- collecting and archiving data concerning battle and maintain damages and failures;
- collecting data with reference to applied technologies and methods of expedient repairs maintained in military units, weapon systems, as well as monitoring of their durability;
- developing doctrines, instructions, regulations and field manuals concerning expedient repair and publishing serial newsletters due to expedient repair procedures and technologies popularization;
- organizing and directing of annual training for personnel in the scope of expedient repair, which could be arranged in the Land Forces Training Center.

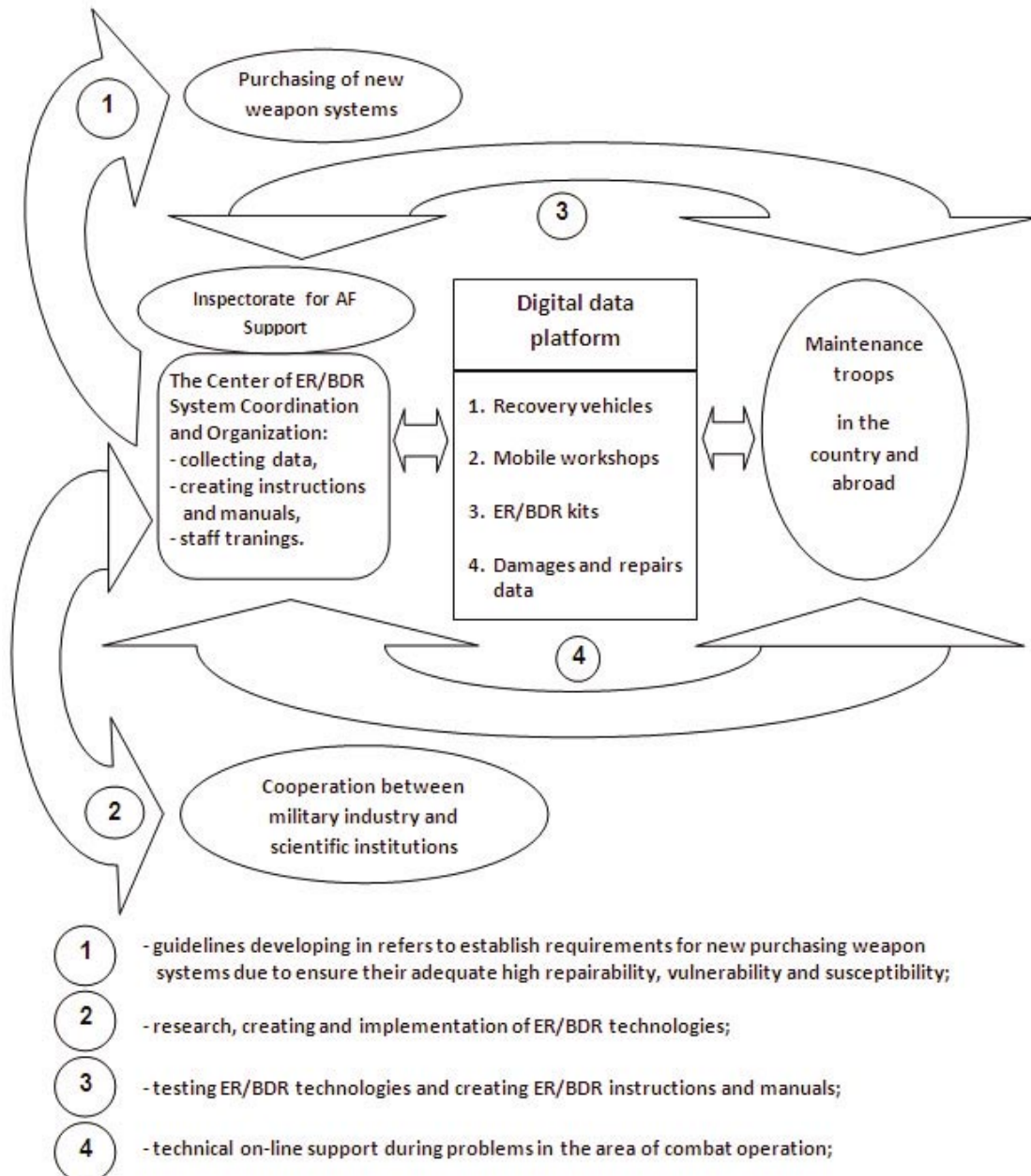


Fig. 1. Ideological scheme of ER/BDR functional system in the Polish Armed Forces

A digital platform of data exchanging should be the main component of the system which ensures proper creation of knowledge and experience concerning using and disseminating issues in the scope of expedient/battle damage repair. It should be a functional element of integrated computer system which is being currently created for support logistics services in The Polish Armed Forces. Additionally, it should operate in a computer net and be accessible; not only for the center, but also for military staff, maintainers and cooperating units which would be responsible for system creation. The information resources of the platform would be increased with every new experience concerning temporary repairs. What is more, in the future, it might be some kind of a computer tool to support logistics staff, maintenance units, recovery teams, and even single mechanics in solving technical problems, which could occur during combat operations in remote battle areas.

The mentioned support could be executed on-line by modern communication technologies such as sat voice and picture transmission. To sum up, the computer tool would be created to support new trends in remote technical objects managing called "telemaintenance" (fig. 2) [16].



Fig. 2. The concept of telemaintenance system in German Land Forces to support expedient repairs during combat operations [11]

The Center of ER/BDR System Coordination and Organization should cooperate closely with maintenance units deployed in the area of Poland and in foreign countries. On the one hand, the mentioned cooperation would concern development and testing of the newest technologies (methods, tools and stuff), which allow to execute expedient repairs in currently used weapon systems in order to put them into practice. At the same time, maintenance staff would be engaged in developing new instructions and procedure of expedient repair. On the other hand, the Center should be able to provide some kind of on-line technical support in the future, especially for those units which would execute combat operations in remote battle areas. A feedback should be created between the Center and maintenance units that would encouraged units to initiate new ideas and solutions, which would be after submission included in formal documents and digital data platform.

The crucial task for the Center would be guidelines developing with reference to established requirements for purchasing new weapon systems in order to ensure their adequate high maintainability, vulnerability and susceptibility. The Center should cooperate closely not only with maintenance units but also with entities of military industry and scientific institutions to properly formulate the mentioned requirements. The cooperation would also concern conducting research in order to work out and implement technologies of expedient and battle damage repairs for currently maintained and future weapon systems.

It seems that implementation of the suggested concept for The Polish Armed Forces at the central level would concentrate the work on its improvement in one center subordinated to the Central Logistics Staff. The proposed Center of System Coordination and Organization would be responsible for the long-term policy of system creation and development and also for a link which would join all its functional components.

2.2. A concept of system organization under combat operations

According to the current logistics doctrines [4], [5] battlefield maintenance at the brigade level is organized from full-time maintenance elements, that is maintenance company and additional supporting elements from a maintenance battalion of higher level. There are organized 1-2 mobile recovery- repair sections (GER), technical reconnaissance team (PRTech) and evacuation team (GET). The other forces are included into unit maintenance collection points (UMCP) (fig. 3).

The reconnaissance- recovery team (PRiPT) is the first chain of battlefield maintenance which is based on the evacuation squad of a fighting company. It is located at 500-700 m from forward enemy battle area in case of conducting attack and 800-1200 m in case of conducting defense. The operating time (available time) of PRiPT should be as short as possible not to let this team fall behind in relation to the supported company [9]. It is assumed that maximum operating time should not exceed 0.5 hours. The main tasks of this team are as follows [16]:

- permanent observation of weapon systems of supported unit;
- rapid removal of disabled, mired and abandoned equipment and returning it to operation;
- providing first aid to crews and operators;
- retrieving equipment for repair and return to the user;
- prevention from enemy capture of equipment;
- maintaining permanent communication with recovery-repair section and reporting about technical situation.

A mobile recovery-repair section (GER) is organized on the basis of a maintenance platoon of a logistics company of fighting battalion. The section can be strengthened with forces from the maintenance company of a brigade. In the case of an attack the section is moving at the distance of 1.5-2 km from fighting companies and in the case of defense 3-4 km from forward enemy battle area. An operating time (available time) of GER section should not be longer than 1-2 hours. The main tasks of this section are as follows [9]:

- location of the damaged equipment on the battlefield and assessment of damage extent and required recovery, repairs or evacuation;
- spare parts and technical materials supplies to the damaged weapon systems;
- providing first aid to crews and operators;
- technical support in negotiating water obstacles;
- exchange of information about technical situation between reconnaissance-recovery teams and command post of battalion or brigade.

An evacuation team (GET) is an element that is created temporarily by means of forces and resources of maintenance company of brigade. It depends on the type and intensity of combat operation. The main tasks of an evacuation team include evacuation and movement of damaged weapon systems to designated areas, unit collection points or stationary workshops as well as retrieval of units and parts from broken equipment and evacuation of enemy equipment, which can be used to support own forces [15].

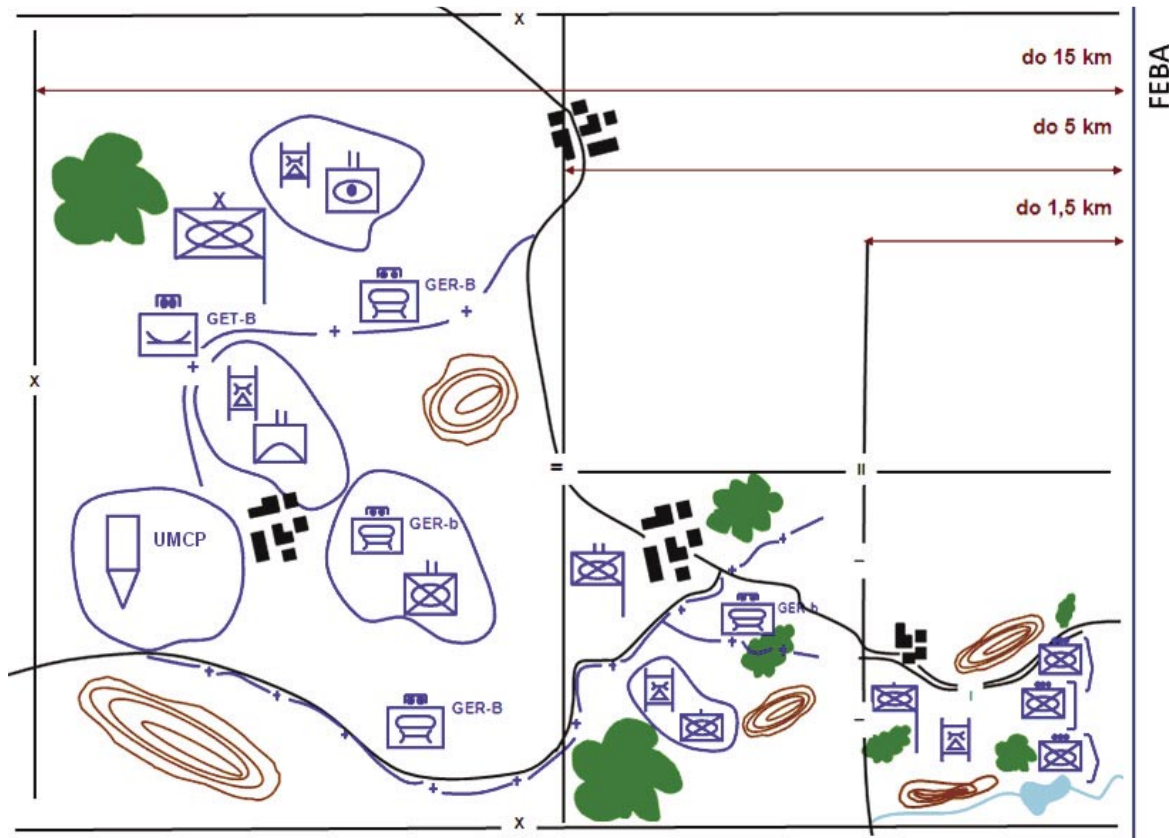


Fig. 3. Technical support system at the mechanized brigade level

Unit maintenance collection point (UMCP) is a place where field repairs are executed. It is deployed by the main forces and means of maintenance company of logistics battalion and should be created with the use of stationary technical infrastructure near logistics roads of evacuation. It is located at the distance of 8-10 km from forward enemy battle area in case of attack and 12-15 km in case of defense.

The history of recently conducted armed conflicts has shown that the losses could reach almost 100% in an extremely unfavorable coincidence. However, among the damaged weapon systems only a part will be irreparable. The rest will qualify to different levels of repair with regard to repair effort [1], [2]. Considering repair capabilities of current deploying mobile maintenance elements it is assumed that PRiPT will not be able to conduct any repair but only recovery tasks, GER will conduct 1st level repairs of low repair effort (2-4 hours) and maintenance companies which while deploying UMCP will execute the 1st level repairs of average repair effort (to 12 hours). The 2nd levels repair will be executed only by maintenance battalions deployed at the division levels [2].

The conducted analysis proved that maintenance units and mobile support elements deployed by them are neither prepared nor able to carry out expedient (improvised) repairs of weapon systems considering their special repair equipment, guidelines and instructions for combat operations as well as trainings programs for logistics specialists [8], [10], [14]. In terms of research mentioned in previous chapters, it was noticed that a lack of such solutions in the current battlefield maintenance system significantly reduced its repair capacities and elasticity and thus it resulted in abilities to recover and restore combat power of fighting units. Additionally, there is evidence that some of the damaged equipment can be rapidly restored to combat with the use of improvised methods [1], [3], [6], [7], [12], [13], which will result in extending the fighting unit abilities to carry out operation and; therefore, lead to advantage over

the opponent. The system of an expedient repair is also indispensable in the case of conducting operation at a long distance from their own logistics support and supply sources (peacekeeping operations and reconnaissance or sabotage operations, etc.).

On the basis of the foregoing considerations, it has been decided to propose a concept in which the current maintenance system of land forces military units will be modified and supplemented with expedient repair system during tactical operations. In this way the execution of improvised (temporary) repairs will be gained starting from a single military vehicle or other weapon system without losing opportunities to conduct standard recovery operations. The main principles and assumptions of the proposed concept are as follows:

- The expedient repair system will be set in operation of current standard maintenance system and will operate at three levels, that is the 1st level of weapon system operator/crew (for example a tank or armored military vehicle), the 2nd level of mobile recovery team (currently it is PRiPT or GER) and the 3rd level of maintenance unit conducting repairs in a unit maintenance collection point (UMCP);
- Appropriately selected tools and repair materials will be applied at each level of the expedient repair system that provide maximum versatility of their use in relation to the possible extent of damage at a given level of repair;
- In addition to the general expedient repair doctrine at the level of land forces, which should be implemented primarily, specific instruction and procedures will be developed dedicated to specific weapon systems as well as instruction regarding the use of expedient repair kits on the various levels of the system;
- A training system will be created, which will allow to train soldiers in the rules of expedient repairs and proper use of expedient repair tools and materials that will be used on their level. As a result, a course should be provided for all drivers and crews (1st level), recovery teams and mobile recovery – repair sections (2nd level) and specialists of expedient repair squads of maintenance units (3rd level);
- The expedient repair system will be flexible and modifiable in terms of taking into account changes in current tasks and equipment of troops as well as needs and comments from the system users.

3. A SYSTEM DIVISION AT THE TACTICAL LEVELS

The 1st level of expedient repair system – operator/crew of a weapon system occurs in most NATO armies. The idea of that level is to include a special set of repair tools and materials in the certain type of weapon system like armored vehicle, tank or self-propelled cannon. The dedicated expedient repair kit can be used by an operator or a crew to restore broken equipment to an operation with fast and expedient methods (fig. 4). It is assumed that the direct user of a weapon system should be preferably a skilled person with regard to its condition. The person is also the closest to the failed system; therefore, he/she should take proper measures; first of all, to restore its technical efficiency. The conditions for the effective implementation of this level are: developing of expedient repair manuals for certain weapon systems, very good knowledge of construction and operation principles by operators/crews and their additional training concerning expedient repairs with expedient repair kit as well as defining operation procedures for operators/crews regarding opportunities and limitations of applying expedient repairs in a particular military operation. The conducted exercises proved that a soldier, who knows his/her weapon system and can perform standard repairs, is able to master expedient and battle damage procedures and methods very quickly [6], [13].

The 1st level ER/BDR kit should fit in one bag or box and it should include tools and materials grouped by their purpose, such as: basic tools, regenerating taps, a repair kit for electrical and hydraulic installations, universal clamps, bands, pins and gaskets, composite adhesives of "rapid" group (curing time limited to 15 minutes) and chemical fluids for cleaning, sealing installations and loosening joints.

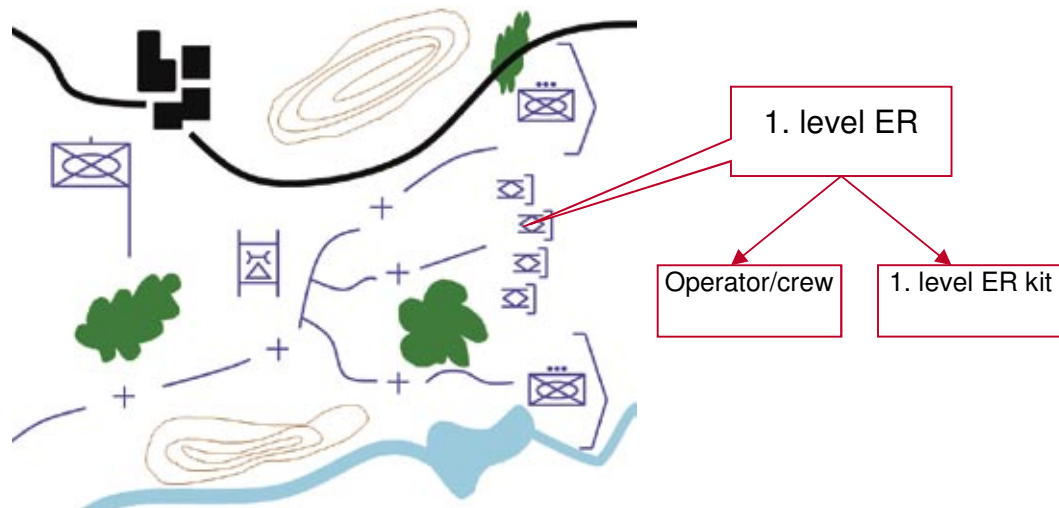


Fig. 4. The 1st level of expedient repair system

The 1st level expedient repair kit should include the following materials:

- mechanical: adhesive composite – RAPID (Belzona 1221 or Chester Metal Rapid); adhesive composite for wet surfaces (Belzona 1831 or Unirep 28); leak stop bandage; leak preventative compound; bolts; nuts; pins.
- fuel system: fuel line – 2x3.5 m 12/7 mm; fuel pipe connectors x 6; clamps x 12.
- electric: additional lights and fuses; electric wire – 2.5 mm² – 4 m; electric tape; various electric wire connectors; battery connectors.
- other: basic tools; repair tape; cable ties; adjustable drive belt.

The 2nd level of expedient repair system has a different character in various NATO armies. In some countries it is based on a recovery vehicle which is equipped with special repair kits, in the others a dedicated vehicle is used as a carrier of expedient repair tools and materials (mobile workshop with expedient repair equipment). In the proposed concept, this level will involve the inclusion of properly prepared expedient repair kits to standard equipment of currently used reconnaissance - recovery teams (PRiPT) and mobile recovery – repair sections (GER). A PRiPT means combination of a tracked or wheeled recovery vehicle as well as a special equipment to conduct recovery tasks, an expedient repair kit and a well-trained crew. The mentioned team should operate at the company level and cooperate with operators/crews of a single weapon system and mobile elements of maintenance platoon of battalion logistic company (fig. 5).

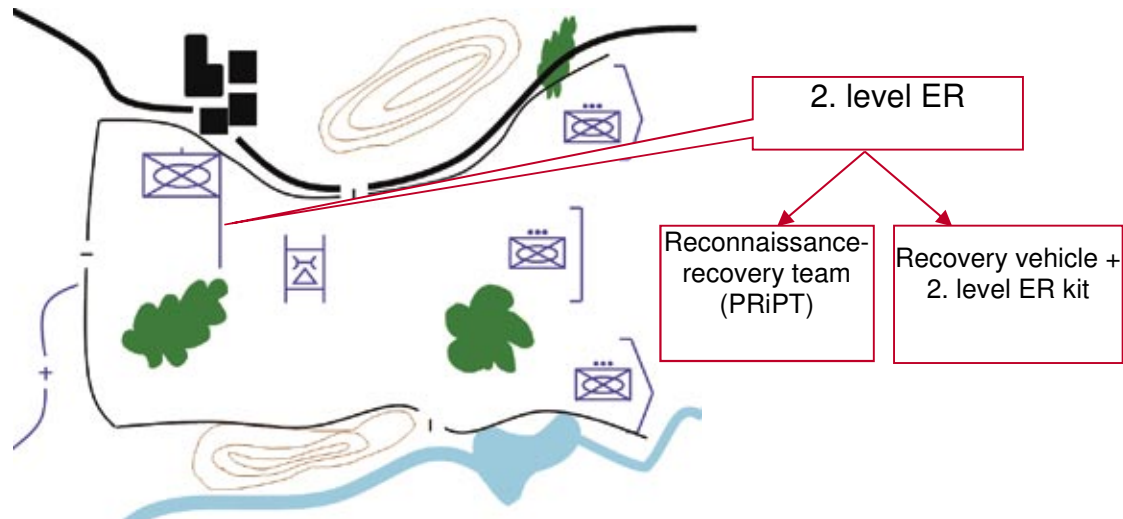


Fig. 5. The 2nd level of expedient repair system

The main advantage of this approach is that the recovery team will be able to perform the entire spectrum of rescue tasks during combat operations in a terrain which is difficult to access. The flow chart of recovery team operation is presented in figure 6.

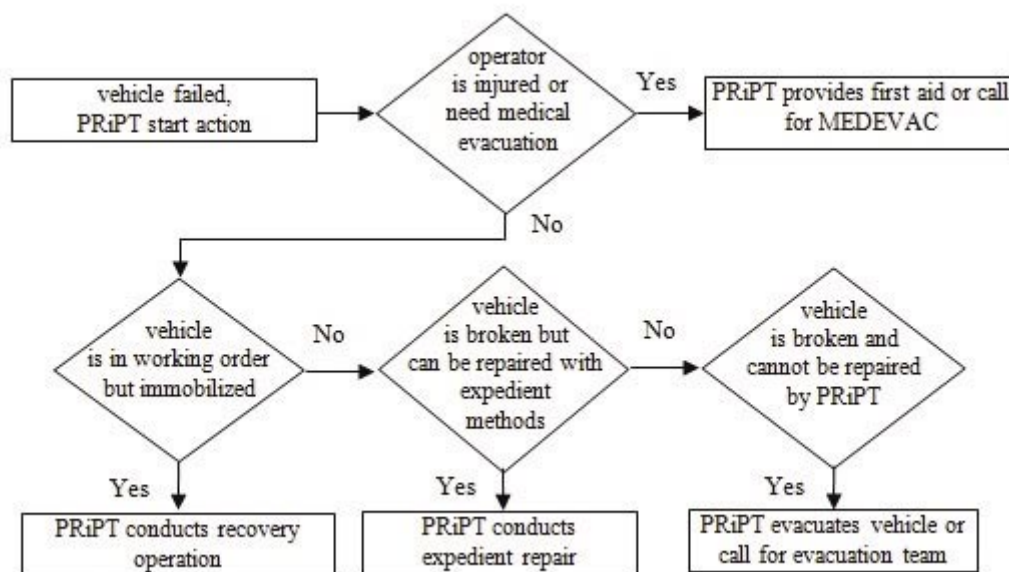


Fig. 6. Flow chart of reconnaissance-recovery team operation

The 2nd level expedient repair kit should be placed in a few bags or boxes and it should include sets similar to the 1st level kit tools and materials and additionally such sets and devices as: compressed air (e.g. lifting bags), welding and cutting (e.g. oxygen lance), auxiliary power generator, load safety equipment and composite adhesives of “rapid” and “elastomers” group (to repair rubber elements and insulation) (fig. 7).

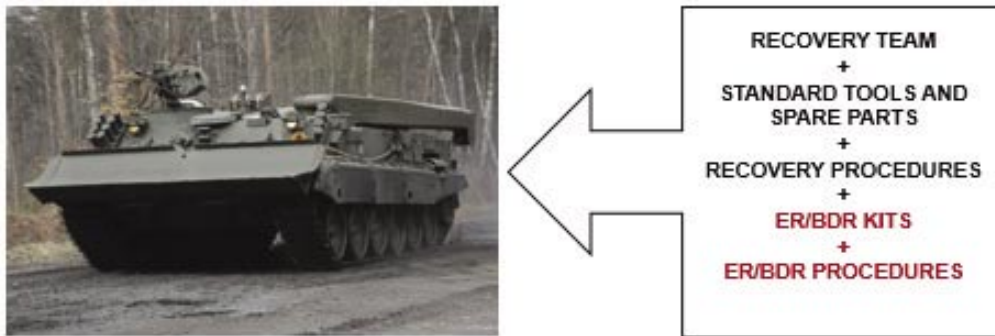


Fig. 7. Recovery team equipped with 2nd level expedient repair kit on the trucked vehicle WZT - 3

The third and last level of expedient repair system will perform its tasks at the depot level of logistic support, which is a level of a maintenance unit conducting tasks in a Unit Maintenance Collective Point (UMCP). It could be both a level of maintenance company that is included in logistic battalion of fighting brigade, and maintenance battalion which deploys its collection point at the back area of fighting division. The essence of this level would be a maintenance unit complementing an expedient repair squad or section and a container workshop with proper repair sets starting from a maintenance company (fig. 8). The expedient repair kit of this level could be more complex than at the earlier levels and it should also include composite adhesives of “super metals” group, which have better properties and longer curing time.

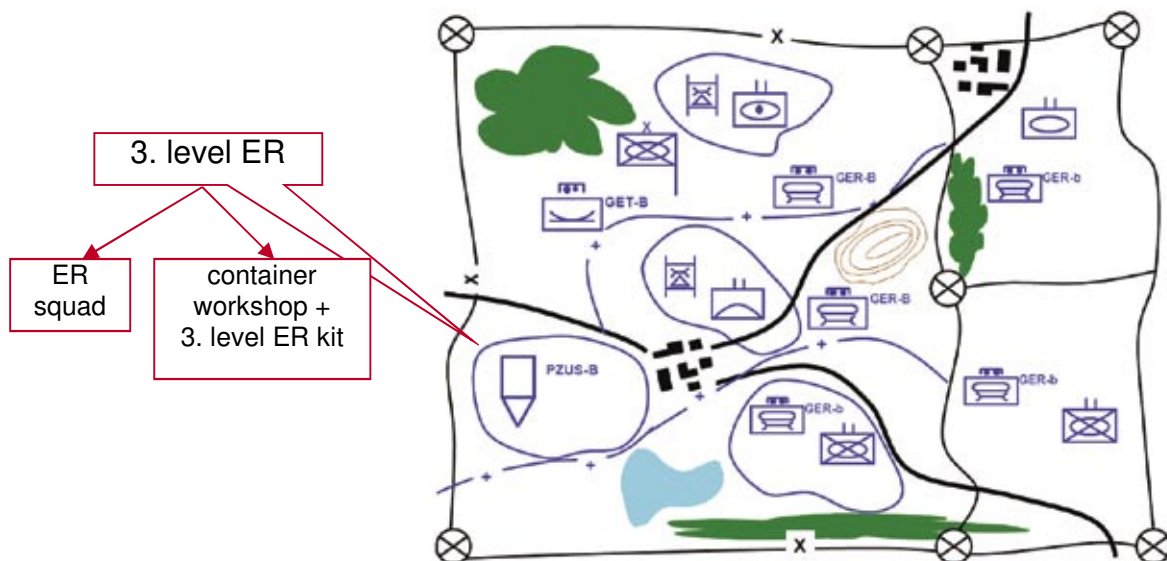


Fig. 8. The 3rd level of expedient repair system

The expedient repair section/squad would be the highest chain of expedient repair system and it should be deployed separately or in areas of unit collection points. Its main task would be professional verification of damaged weapon systems and their components in order to apply quick and improvised repairs. The mentioned repair would be conducted regarding standard repairs which are not possible due to lack of spares or too long time of its execution. This squad could act effectively during logistic support of peacekeeping operations. The U.S. troops experiences obtained during former operations have shown that many broken parts and components are unnecessarily sent back home in order to carry out standard repairs although they could be effectively repaired in the area of operation [1].

4. CONCLUSIONS

According to the conducted analysis, following conclusions can be formulated:

1. The individual armies of NATO organize expedient repair systems in a somewhat different way (they have various number of repair levels, repair time disposal, different equipment and expedient repair kits), which is caused by the size of Land Forces, specificity of tactics and weapon systems.
2. The most important elements of expedient repairs are operators or crews of military vehicles or other weapon systems, since they will be the first to decide about further actions. Therefore, it is crucial for the system that the maintenance personnel should be properly trained and have experience in expedient repair performing.
3. An essential element of expedient repairs is recording and archiving them (in a standardized form), which allows to provide further recovery actions on the broken equipment correctly and use recorded data to conduct training and support maintenance personnel in case of similar technical problems.
4. Expedient repair system dedicated for the Polish Land Forces should include three levels of repair which should be located on the following levels: operator/crew, recovery team and unit maintenance collective point.

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