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Article

Capabilities of the Armed Forces of the Republic of Poland in the area of decontamination – selected aspects[1]

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Abstract

This article analyses the capabilities of the decontamination subsystem of the Polish Armed Forces in the context of contemporary security challenges, with particular emphasis on chemical, biological and radioactive (CBRN) threats. The author characterised the decontamination subsystem, discussed its structure and operating conditions, and compared it with the subsystems in Germany and the US. The results of the analysis indicate technological, organisational, and doctrinal limitations that impact the subsystem's effectiveness. Proposed solutions include equipment modernisation, procedure standardisation and strengthening cooperation between armed forces and non-military entities. The author emphasises the need to adapt the subsystem to NATO requirements and contemporary hybrid threats.

[1] The article is based on a doctoral dissertation entitled *Zdolność podsystemu likwidacji skażeń Sił Zbrojnych Rzeczpospolitej Polskiej do podjęcia działań* (Eng. The ability of the decontamination subsystem of the Armed Forces of the Republic of Poland to take action), defended at the War Studies University. The dissertation was awarded in the 14th edition of the Head of the Internal Security Agency competition for the best doctoral, master's or bachelor's thesis on state security in the context of intelligence, terrorist and economic threats.

Keywords

decontamination, Polish Armed Forces, CBRN, operational capabilities, security

Introduction

The hazards associated with the use of weapons of mass destruction (WMD) remain one of the significant challenges to national security in the context of both potential terrorist acts and armed conflicts. This is evidenced by incidents of this type recorded over the last 30 years:

- 1995 – the Aum Shinrikyo cult carried out an attack in the Tokyo subway, spraying sarin, which killed 13 people and poisoned several thousand[2];
- 2006 – in London, Alexander Litvinenko, a former officer of the Russian Federal Security Service (FSB), was poisoned with the radioactive substance polonium-210 administered in tea, which led to his death from radiation sickness within three weeks[3];
- 2015 and 2017 – Russian politician and journalist Vladimir Kara-Murza, known for his criticism of the Kremlin, has twice been the victim of suspicious poisonings, which led to multiple organ failure and coma. In both cases, Russian hospitals and foreign tests confirmed poisoning with an unidentified chemical substance[4];
- 2018 – in Salisbury, Great Britain, the chemical agent Novichok was used in an attempt to poison Sergei Skripal, a former Russian military intelligence officer, and his daughter Yulia. The substance,

[2] *Rozproszenie gazu sarin w Tokio* (Eng. The sarin gas attack in Tokyo), Terroryzm!com, 26 XII 2006, http://www.terroryzm.com/rozproszenie-gazu-sarin-w-tokio/ [accessed: 25 VII 2025]; K. Pletcher, *Tokyo subway attack of 1995*, Britannica, 8 V 2025, https://www.britannica.com/event/Tokyo-subway-attack-of-1995 [accessed: 25 VII 2025]; T. Okumara et al., *Report on 640 Victims of the Tokyo Subway Sarin Attack*, "Annals of Emergency Medicine" 1996, vol. 26, no. 2, pp. 129–135. https://doi.org/10.1016/S0196-0644(96)70052-5.

[3] *Alexander Litvinenko: Profile of murdered Russian spy*, BBC News, 21 I 2016, https://www.bbc.com/news/uk-19647226 [accessed: 26 VII 2025].

[4] *Vladimir Kara-Murza Tailed by Members of FSB Squad Prior to Suspected Poisonings*, Bellingcat, 11 II 2021, https://www.bellingcat.com/news/2021/02/11/vladimir-kara-murza-tailed-by-members-of-fsb-squad-prior-to-suspected-poisonings/ [accessed: 1 VIII 2025].

which was applied to the door handle of their home, led to the serious poisoning of the Skripals and police officer Nick Bailey, as well as the death of Dawn Sturgess, who had accidental contact with an abandoned vial containing the poison[5];

– 2020 – Russian opposition leader Alexei Navalny was poisoned with the chemical agent Novichok during a flight from Tomsk to Moscow, which led to his hospitalisation. The poison was applied to his clothing (probably his underwear). The presence of the substance was confirmed by five laboratories certified by the Organisation for the Prohibition of Chemical Weapons (OPCW)[6];
– 2017 – Kim Jong-nam, the brother of North Korea's leader, was attacked at Kuala Lumpur airport with the paralytic-convulsive agent VX, which was applied to his face by two women[7].

Incidents involving the poisoning of Russian citizens are attributed to the FSB unit specialising in toxic substances and are linked to the activities of the Russian secret services aimed at eliminating Vladimir Putin's political opponents[8].

Due to their deliberate nature and the use of prohibited substances against civilians, these events can be classified as acts of terrorism. The use of chemical weapons in contemporary armed conflicts was of a different nature, despite the existence of the Chemical Weapons Convention[9]:

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[5] S. Morris, *UK believes Putin personally authorized Salisbury novichok attack, inquiry told*, The Guardian, 14 X 2024, https://www.theguardian.com/uk-news/2024/oct/14/salisbury-novichok-poisonings-inquiry-sergei-skripal-vladmir-putin [accessed: 25 VII 2025].

[6] F. Gardner, *Navalny 'Novichok poisoning' a test for the West,* BBC News, 2 IX 2020, https://www.bbc.com/news/world-europe-54003014 [accessed: 1 VIII 2025]; *OPCW Issues Report on Technical Assistance Requested by Germany*, OPCW, 6 X 2020, https://www.opcw.org/media-centre/news/2020/10/opcw-issues-report-technical-assistance-requested-germany [accessed: 1 VIII 2025]; D. Steindl et al., *Novichok nerve agent poisoning*, "The Lancet" 2021, vol. 397, no. 10270, pp. 249–252. https://doi.org/10.1016/S0140-6736(20)32644-1.

[7] *Kim Jong-nam killing: 'VX nerve agent' found on his face*, BBC News, 24 II 2017, https://www.bbc.com/news/world-asia-39073389 [accessed: 26 VII 2025].

[8] *The Lab: How FSB chemical weapons experts tried to poison Alexei Navalny*, The Insider, 14 XII 2020, https://theins.ru/en/politics/262611 [accessed: 1 VIII 2025]; *Zabójstwo Aleksandra Litwinienki* (Eng. The murder of Alexander Litvinenko), in: Konsorcjum Mall-CBRN, *Podręcznik zapobiegania i reagowania na zdarzenia CBRNE w centrach handlowych*, https://www.uni.lodz.pl/fileadmin/Projekty/MALL-CBRN/Materials_available_for_download_/Mall-CBRN-Handbook-PL-1.0.pdf, pp. 24–25 [accessed: 2 VIII 2025].

[9] *Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, drawn up in Paris on 13 January 1993.* Compliance

– between 2013 and 2018 in Syria, the OPCW confirmed at least 85 cases of chemical weapons use[10], mainly sarin and chlorine. These actions are unofficially attributed to Bashar al-Assad's regime[11]. The use of dangerous substances resulted in hundreds of deaths and thousands of casualties[12];
– since February 2022 in Ukraine, the OPCW has recorded reports of more than 3000 cases of the use of toxic substances, including chloropicrin. OPCW technical inspections during site visits have gathered evidence of the use of these substances and secured relevant traces. However, from a procedural point of view, the evidence is insufficient and requires further investigation to conclusively determine that these incidents were caused by Russian forces[13].

The use of WMD by an adversary (state, organisation, assassin) poses a serious operational hazard to military operations, and a significant security threat to state authorities in the context of crisis management in the broad sense, but also to civilians who are unprepared for such attacks.

An analysis of the events mentioned above highlights the enormous costs that must be incurred in order to eliminate or at least minimise the negative effects of contamination resulting from the use of chemical,

with the provisions of the Convention is monitored by the OPCW, based in The Hague, as the executive body.

[10] A report by the public broadcaster BBC indicated that between September 2013 and spring 2018, there were 106 cases of chemical weapons use in Syria. Neither this report nor any of the official reports of the United Nations or the OPCW explicitly identified the perpetrator of the use of prohibited substances. See: *Syria: BBC Investigation Reveals Widespread Chemical Weapons Use*, BBC, https://www.bbc.co.uk/programmes/w172w25d6yyjrc0 [accessed: 25 X 2018].

[11] Inspections conducted by the OPCW in Syria confirmed the use of prohibited toxic agents, but the evidence gathered and secured did not allow for a clear identification of the entity responsible for their use. At the same time, given that the victims of the attacks were so-called rebels and the community supporting them, it is highly likely that the agents were used by forces loyal to the President's regime.

[12] *Syria: BBC Investigation Reveals*...

[13] The use of prohibited weapons in the Russian-Ukrainian war resembles the actions in Syria. A common feature in both cases is the lack of evidence enabling the perpetrator of the use of WMD to be clearly identified. See: *OPCW issues report on third Technical Assistance Visit to Ukraine following an incident of alleged use of toxic chemicals as a weapon*, OPCW, 26 VI 2025, https://www.opcw.org/media-centre/news/2025/06/opcw-issues-report-third-technical-assistance-visit-ukraine-following [accessed: 26 VI 2025].

biological, radiological and nuclear (CBRN) agents[14]. This includes the need to possess and develop the ability to carry out broadly understood decontamination, both internal (when contaminants have entered the human body through the skin or digestive system) which is carried out by qualified health care units, as well as external (surface) contamination, which is neutralised by other services, most often forces detached from the resources of the State Fire Service (PSP) or the Armed Forces of the Republic of Poland (SZ RP).

The decontamination capabilities achieved by individual services must be sufficient to remove (or destroy) contamination resulting from both terrorist acts and military operations. In this context, it is necessary to take into account, above all, human resources and procedures that are as unified as possible, as well as the specific nature of potential tasks, the time and place of activities, infrastructure and logistics. It seems reasonable to have a coherent system at the national level for the interoperability and cooperation of individual services, depending on the operation being conducted.

The article presents selected aspects of the capability of the Polish Armed Forces' decontamination subsystem as part of the defence system against weapons of mass destruction (OPBMR)[15] in the process of achieving the capability to take action. The subsystem comprises the indicated organisational structures of the Polish Armed Forces, equipment and gear appropriate for the specific nature of the tasks, proven operating procedures, as well as relations between the management structures, those carrying out decontamination measures and the troops undergoing this process. This subsystem can also be seen as a set of unique capabilities. Achieving them affects the potential capabilities of individual subunits, troops, organisational structures or entire systems.

[14] In the United Kingdom, nearly 800 soldiers from the chemical regiment were involved in the operation to identify contamination, take multiple samples and, above all, decontaminate buildings and land after the attempted poisoning of Sergei Skripal and his daughter in 2018. The operations, which resulted in the infrastructure being declared fit for use again, lasted almost a year and cost millions of pounds. See: *Salisbury declared decontaminated after Novichok poisoning*, BBC, 1 III 2019, https://www.bbc.com/news/uk-england-wiltshire-47412390 [accessed: 10 III 2019].

[15] This system is part of the functional system for the survival and protection of troops, which, like other functional systems, was established on the basis of Decision No. 56/Org./P5 of the Minister of National Defence of 24 December 2013 on the Organisers of Functional Systems of the Polish Armed Forces (unpublished).

This article aims to present the capabilities of the Polish Armed Forces' decontamination subsystem, identify its weaknesses and indicate directions for development. The analysis is based on the literature on the subject, NATO doctrinal documents, the author's research forming the basis of his dissertation, and examples. The dissertation sought to identify the factors that determine the capabilities of the Polish Armed Forces' decontamination subsystem and ways to improve it in the face of contemporary CBRN threats[16]. An interdisciplinary approach was used, combining historical, comparative and systemic analysis. The analysis of existing and desired capabilities was carried out in accordance with the DOTMLPFI criteria[17] adopted by NATO, as a fully functional capability must take into account not only technical and technological aspects[18], but also all other factors that influence it.

The article may serve as a starting point for discussion and further research on the need for a coherent, inter-ministerial decontamination system at the national level, capable of responding to both terrorist incidents and the combat use of prohibited weapons.

Structure and role of the Polish Armed Forces decontamination subsystem

The decontamination subsystem[19] in the Polish Armed Forces is one of the key subsystems of the OPBMR system. Contamination elimination, also referred to as decontamination, aims to ensure the safety of people, facilities or areas. It involves the sorption, destruction, neutralisation, rendering harmless or removal of chemical or biological contaminants, or the removal of radioactive substances from them or their surroundings.

[16] The research question in the dissertation was: 'What requirements should the Polish Armed Forces' decontamination subsystem meet and what capabilities must it achieve in functional and structural terms in order to be fully ready to perform its tasks, and how should it be organised in times of peace and war?'.

[17] DOTMLPFI is an acronym formed from the first letters of each component of capability: doctrine, organisation, training, material, leader, personnel, facilities, interoperability. This type of analysis allows for a holistic view of capability.

[18] Equipment and technical ability to use it.

[19] See: *NATO Glossary of Terms and Definitions* AAP-6(2014), p. 129; *NATO Glossary of Terms and Definitions for Chemical, Biological, Radiological and Nuclear Threats* AAP-21(B), p. 18; NO-01-A006:2010 *Defence against weapons of mass destruction. Terminology*, p. 17.

General characteristics of the subsystem

The main tasks of the decontamination subsystem in the Polish Armed Forces include:

- neutralisation of chemical, biological and radiological contamination in order to protect personnel and equipment,
- multi-level decontamination of personnel, uniforms, equipment, including sensitive equipment (SE), and the area,
- support for military and civil operations in crisis situations, such as terrorist incidents or industrial and natural disasters.

A soldier's ability to carry out decontamination procedures is developed as early as the basic training stage, as one of the skills enabling survival (saving one's own life or that of another soldier) and creating conditions for the continuation of the assigned task. Decontamination is therefore present and perfected at every organisational level (from the soldier to the Armed Forces component – Figure 1), and thus at every organisational level – from tactical to strategic.

The broadest scope of activities in this area has been assigned to soldiers from decontamination units that are part of the chemical forces, and they have the best training in this regard. Until recently, decontamination was even considered at the political and strategic level in civilian state structures[20]. The higher the organisational or command level, the broader the scope of tasks performed, which in military doctrine is generally described as (...) *creating conditions for the armed forces to perform their tasks in situations of contamination and contamination threats*[21].

In any case, as part of the task, operation or mission planning process, the appropriate scope of decontamination is taken into account, which is a function of variables such as:

- organisational level,
- command level,

[20] Paragraph 16(8)(f) of the repealed *Regulation of the Council of Ministers of 27 April 2004 on the preparation of the national security management system* indicated that the preparation of command posts for individual public authorities included the preparation of **points for special measures**. Meanwhile, the *Regulation of the Council of Ministers of 25 March 2025 on the preparation of the national security management system*, which repealed the previous executive act, generally specified that protective and rescue measures are carried out in relation to the main command post, without specifying the contractor or the scope of these measures.

[21] *Defence against weapons of mass destruction in combined operations* DD/3.8(A), Training 869/2013, p. 14.

– task, operation or mission,
– theatre of operations, taking into account terrain conditions and even climate zones,
– availability of terrain infrastructure in the area of operations,
– logistics system,
– degree of detail of reconnaissance preparation of the battlefield,
– the enemy, its CBRN[22] capabilities and potential impact,
– CBRN threat level,
– forces and resources allocated to the task/operation/mission,
– meteorological conditions.

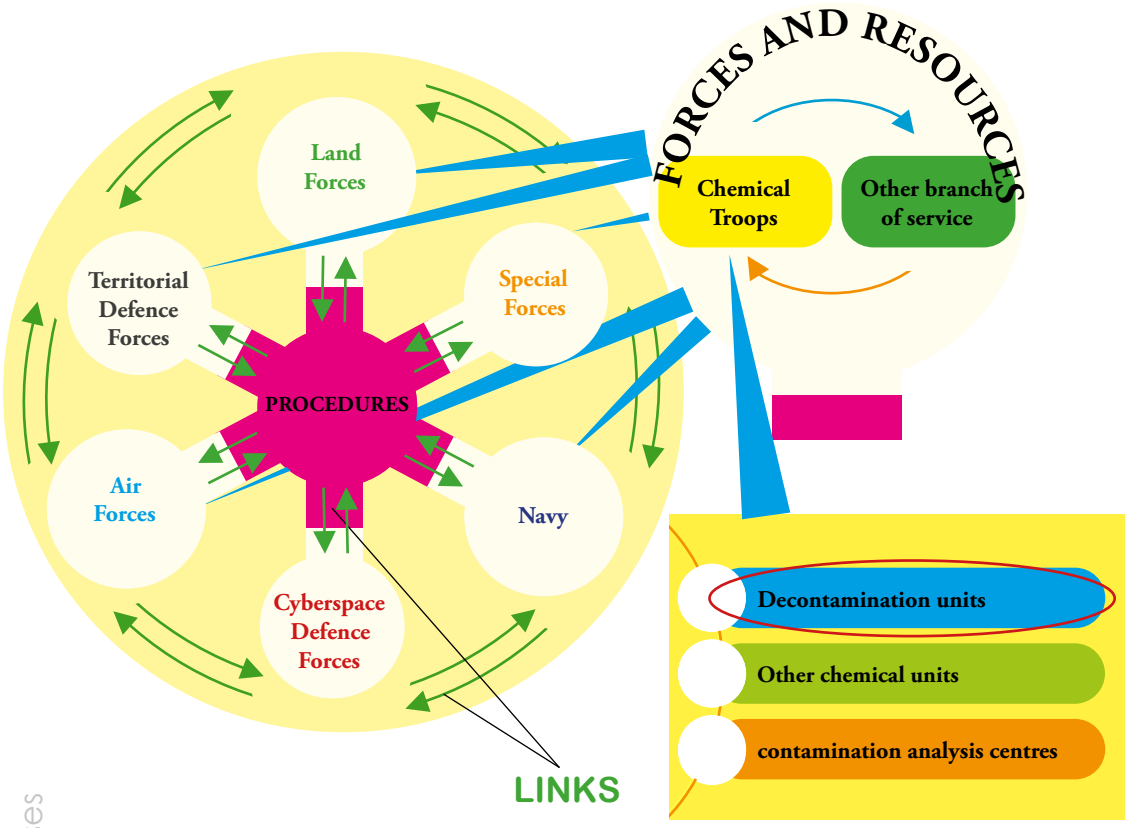

Figure 1. General structure of the Polish Armed Forces decontamination subsystem.

Source: own elaboration.

[22] OPBMR issues outside Poland have been described as 'CBRN' - (translator's note).

The last factor plays a particularly important role, which is why the impact of natural forces on contamination without human intervention has been treated as a form of contamination remediation (so-called passive decontamination)[23]. The weather, or more precisely selected meteorological parameters, is taken into account in the planning process. Since humans have no influence on these conditions, only human-dependent issues can be considered when modelling or optimising the functioning of the system. In the Polish Armed Forces, these are treated as active contamination removal.

Contamination removal carried out by the Polish Armed Forces for the military includes classification based on:

1) the agent causing contamination:
   – decontamination – exposure to chemical agents (C),
   – deactivation – action against radioactive agents (R, N),
   – disinfection – action against biological agents (B),
2) the entity affected (for which decontamination is carried out):
   – people – both those who are contaminated but still able to perform tasks after treatment, and those who are injured, for whom treatment is a preliminary stage allowing for further treatment and rehabilitation,
   – individual soldier equipment,
   – combat equipment (land, aircraft and ships) and armaments,
   – electronic, optical and optoelectronic equipment considered sensitive (SE),
   – facilities,
   – terrain.

Mechanical, physical and chemical methods are used in the decontamination process[24]. The choice of method depends on the contaminant and the time elapsed since contamination. Chemical contaminants should be removed as quickly as possible using the best

[23] Passive decontamination, known as natural decontamination or weathering, is a natural process of decontamination that does not require the use of forces or resources. Objects left for passive decontamination should be isolated and marked as hazardous. See: *Defence against weapons of mass destruction in combined operations* DD/3.8(A)..., p. 50.

[24] Various approaches to this issue can be found in the literature on the subject. This article adopts the most commonly used nomenclature contained in the manual *Special treatments for terrain and field defensive structures*, Ref. No. 1984 Chem. 321, Warszawa 1985, and in: A. Leosz, S. Sawczak, *Sprzęt likwidacji skażeń* (Eng. Decontamination equipment), WSO–TK internal 57/96.

available methods. The principle of 'as quickly as possible' is crucial in OPBMR.

Subsystem structure

The decontamination subsystem consists of (Figure 2):

- **organisational structures** (some OPBMR projects are carried out by all soldiers, and therefore each soldier is part of the subsystem),
- **equipment** used to carry out tasks,
- **measures** directly affecting contamination,
- **procedures** and **relationships** defining the performance of tasks and rules of cooperation.

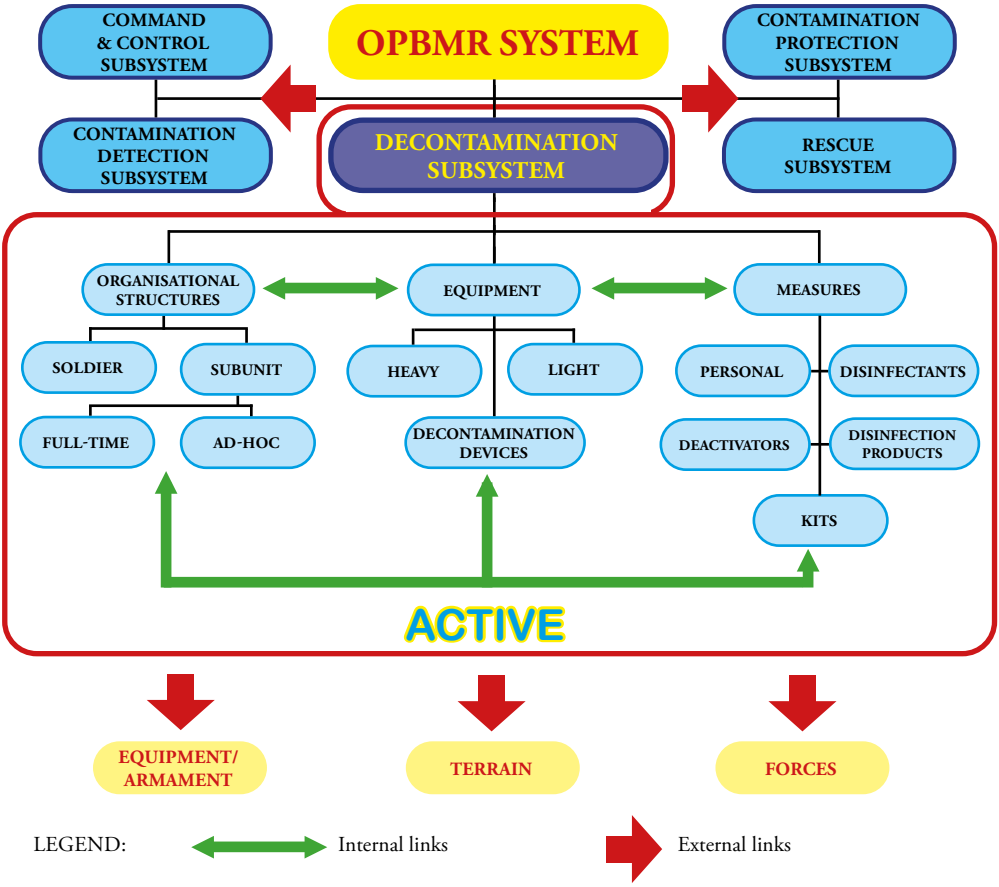

Figure 2. Components of the Polish Armed Forces decontamination subsystem.

Source: own elaboration.

Although only chemical decontamination subunits are capable of performing the full range of tasks related to this subject area[25], it is vital for every soldier to take immediate and appropriate remedial action after potential contact with a contaminant. The selection of equipment and gear is also related to the scope of assigned tasks. Soldiers of decontamination subunits have specialised devices and means for decontamination, while soldiers of other types of troops are equipped with the equipment and means necessary to carry out immediate[26] and/or operational[27] decontamination, depending on the organisational level, needs and capabilities.

Capability requirements for the subsystem

The concept of operational capability in the Polish Armed Forces was introduced by Decision No. 95/MON of the Minister of National Defence of 27 February 2007 on guidelines for the Operational Requirements Review[28]. In 2014, the decision was amended to include the DOTMLPFI model. These capabilities are described in the Catalogue of Capabilities of the Polish Armed Forces[29], in area P – survival and protection of troops, in which the decontamination subsystem is a key element of the OPBMR

[25] Decontamination subunits perform Level III tasks, i.e. thorough decontamination, mainly at decontamination points (PLSk). PLSks perform a full range of tasks, i.e. in relation to contaminated people and combat equipment. In the case of decontamination carried out in military formations (in areas where troops are deployed), the procedures mainly concern equipment. The decontamination of people takes time and is too sensitive a process to be carried out close to the line of contact between troops (within range of the enemy's basic firepower).

[26] Each soldier undertakes immediate decontamination as soon as contamination is detected. The procedures for which they use their individual protective kit, mainly the IPP-95 individual anti-chemical kit and the IPLS-1 individual decontamination kit, are applied to exposed parts of the body, uniforms, and parts of weapons and equipment essential for further use.

[27] These procedures are primarily performed by decontamination teams from OPBMR units at the company level (equivalent sub-unit) and full-time personnel operating combat equipment such as tanks, combat vehicles and motor vehicles. The procedures are carried out using PZLS-1 contamination decontamination kits and instruments included in the combat equipment, e.g. the DK-4 ejector kit, ZOd-2, ZO-E, ZO-1 or ZO-2 decontamination kits.

[28] *Decision No. 95/MON of the Minister of National Defence of 27 February 2007 on the introduction of the 'Guidelines for Conducting an Operational Needs Review'*.

[29] Classified document. The catalogue is one of the tools for planning the development of the Polish Armed Forces.

system. The author has identified four main capabilities for decontaminating people (personnel), equipment, facilities and terrain (Figure 3).

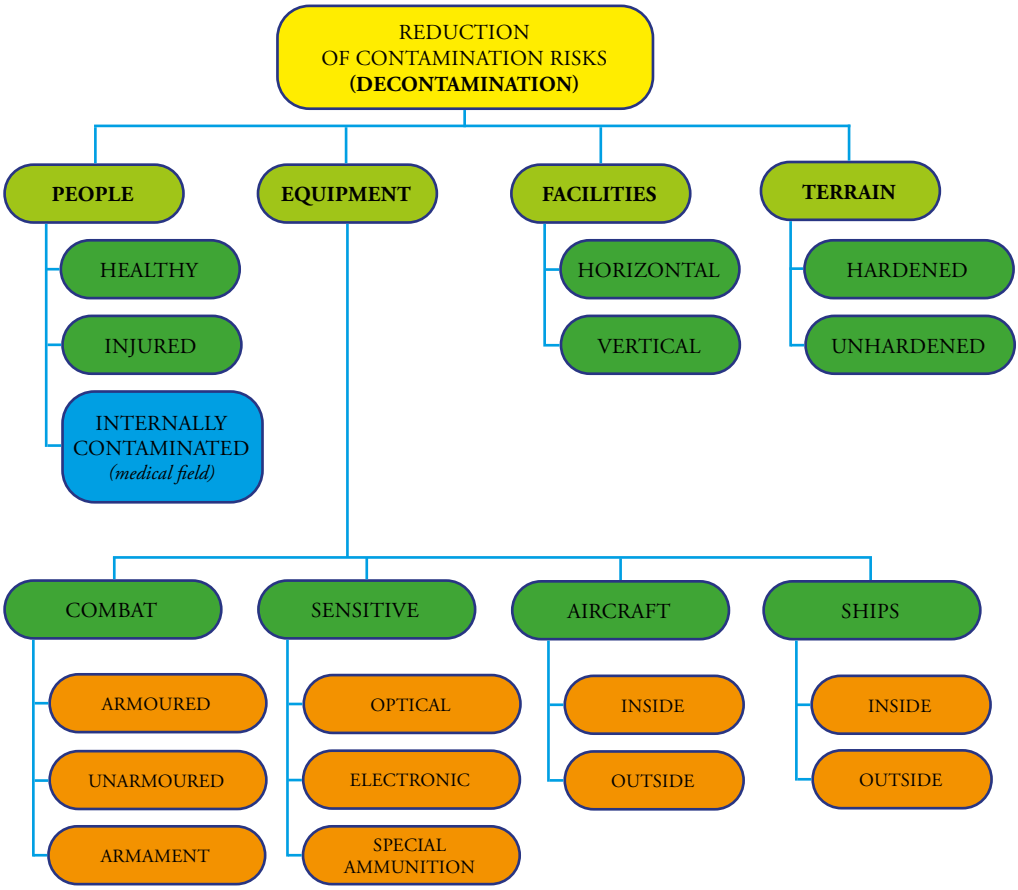

Figure 3. Capabilities of the OPBMR system decontamination subsystem.

Source: own elaboration based on the Catalogue of Capabilities of the Polish Armed Forces.

The ability to decontaminate people includes procedures for soldiers and civilians, with wartime and peacetime procedures, including support during possible contamination during mass events (inspired by the security measures taken during EURO 2012), being unified[30].

[30] The planning, organisation and conduct of decontamination in the Polish Armed Forces, including the decontamination of people, are essentially defined by the following documents: *Regulations for chemical forces of the land forces*, DWLąd. Internal 183/2011 and *Sanitary and special treatments of weapons and combat equipment*, Chem. Instruction 278/79.

Systems for decontaminating people can be field-based (in tents, containers, vehicles) or stationary, while meeting the following requirements: specific throughput (number of people/hour depending on the level), communication routes eliminating contact between contaminated and clean persons, separation of clean and dirty zones, securing water and decontamination agents, water heating, collection of contaminated waste generated after treatment, contamination control, medical stations and separate routes for women and men.

The ability to treat people who have been internally contaminated by chemical or radioactive agents goes beyond the competence of chemical warfare units and has been assigned to health protection services. However, such patients require preliminary decontamination before they can be admitted to hospital.

Within the decontamination subsystem, the equipment undergoing this process is divided into the following groups: combat, sensitive, ships (external and internal treatments, at sea or in port) and aircraft (external and internal treatments). The methods used vary depending on the design and purpose of the equipment, taking into account its different surfaces.

The ability to decontaminate facilities includes buildings up to 15 metres high, stationary infrastructure (offices, schools) after floods or pandemics, as well as paved surfaces, roads and squares.

In accordance with NATO requirements, the ability to decontaminate the area requires subunits to be self-sufficient for three days and to maintain the capacity to transport 90 m^3 of water and purify 240 m^3/day[31].

Conditions for the functioning of the Polish Armed Forces decontamination subsystem

The functioning of the Polish Armed Forces' decontamination subsystem is determined by operational, doctrinal, technological, financial, organisational and training conditions.

[31] *BI-SC Capability Codes and Capability Statements*, 26 I 2016, https://www.scribd.com/document/382349178/Capability-Codes-and-Capability-Statements-2016-Bi-sc-Nu0083, p. 304 [accessed: 2 VIII 2025].

Operational conditions

The operational conditions of the decontamination subsystem in the Polish Armed Forces determine its organisation and functioning, taking into account anticipated threats, the type of mission and the balance of forces in national and allied operations. At the same time, the modern battlefield has become an extremely complex and demanding area of operation due to the integration of systems used in cyberspace and robotics using artificial intelligence. There is more and more electronics in the equipment, which forces the search for increasingly advanced decontamination technologies (e.g. the use of vacuum, vaporised hydrogen peroxide, nanosorbents, enzymes or cold plasma) and their replacement with universal equipment. The Polish Armed Forces must be able to respond skilfully to various scenarios involving CBRN threats, both at home (during armed conflict or terrorist incidents) and abroad. The analysis of threats converted into scenarios influences the planning of countermeasures appropriate to the situation, which often involves the acquisition of newer equipment and technologies. These are, of course, examined and verified during testing, but reality verifies the correctness of the implemented solutions and exposes any shortcomings and errors. The incident in Salisbury in 2018, in which the chemical agent Novichok was used, revealed shortcomings in the capabilities of civil services and the military, such as difficulties in decontaminating the civilian environment and the need for them to work together. It took almost a year to restore the contaminated area to public use, as the procedures carried out there were at the highest i.e. level IV clearance decontamination[32]. At the time of writing, no such procedures were in place in the Polish Armed Forces. Furthermore, the decontamination agents used by the Polish military had not been tested for their effectiveness against Novichok-type agents.

Furthermore, while the interoperability of the Polish Armed Forces with Alliance forces is achieved at various levels of integration[33], as well

[32] Level IV treatments involve the elimination of contamination to achieve complete safety from CBRN contamination. See: *Defence against weapons of mass destruction in combined operations* DD/3.8(A)...

[33] Interoperability, as defined by NATO, is the ability to operate coherently, effectively and efficiently to achieve Alliance objectives. Its level depends on the degree to which different systems and forces can work together. There are three levels of interoperability: commonality – when all forces involved in a joint operation use the same doctrines, procedures and equipment; interchangeability – the ability to use a specific product, process or service in place of another to meet the same requirements; compatibility –

as at the equipment, organisational, doctrinal, procedural and training levels[34], it is difficult to speak of common standards of conduct between the Polish Armed Forces and civil services in the area of decontamination. Interoperability is one of the challenges in building the readiness of the decontamination subsystem to perform specialised tasks.

Doctrinal considerations

The doctrinal conditions of the decontamination subsystem in the Polish Armed Forces are shaped by a hierarchical system of operational standardisation documents, including:

- doctrines (as level 1 documents),
- doctrinal documents (level 2),
- supplementary documents (level 3).

Issues related to OPBMR, and thus the decontamination subsystem, are addressed in dozens of publications. The most important of these is the periodically updated doctrinal document *Defence against weapons of mass destruction in combined operations* DD/3.8[35], which in its current version (B) introduces a three-pillar approach to CBRN defence, comprising prevention, protection and recovery. This document standardises the planning, execution and support of operations in conditions of WMD threat or use. The changes introduced in version (B) reflect, among other things, an active threat response model inspired by American solutions[36].

The following documents are also important from the point of view of creating a decontamination subsystem: the DD/3.14 *Protection of military*

the suitability of products, processes or services for use in specific conditions to meet requirements without causing unacceptable interactions between them.

[34] Requirements in this area have been specified in standardisation documents (STANAGs), planning documents (e.g. *BI-SC Capability Codes and Capability Statements*...), training documents, doctrines and regulations.

[35] *Defence against weapons of mass destruction in combined operations* DD/3.8(A)... is the equivalent of a document: NATO Standard AJP-3.8 *Allied joint doctrine for chemical, biological, radiological, and nuclear defence,* Edition A Version 1, 2012 https://assets.publishing.service.gov.uk/media/5bf40787ed915d18301589b4/archive_doctrine_nato_cbrn_defence_ajp_3_8.pdf [accessed: 2 VIII 2025]. During the research, version DD/3.8 (A) was in force, and since 2018 – version DD/3.8 (B).

[36] M.F. Kelly, *United States Army Chemical, Biological, Radiological and Nuclear Corps Capability for Combating the Contemporary Weapons of Mass Destruction Threat*, Master's Thesis, Fort Leavenworth, Kansas 2012, https://apps.dtic.mil/sti/tr/pdf/ADA563129.pdf, pp. 67–69 [accessed: 2 VIII 2025].

forces doctrine document[37], which specifies the rules for protecting personnel, equipment, infrastructure and operational capabilities in combined and multinational operations, treating OPBMR as a component of protection; *The combat systems integration manual* DD/7.1.2[38], which sets out the rules for integrating the decontamination subsystem during training and exercises, and the *Regulations for chemical forces of the land forces*[39], which standardises the planning and implementation of tasks, including support in various forms of combat operations.

In NATO, medical aspects of CBRN defence are regulated by CBRN Medical Publications: AJMedP-7 (medical support in CBRN operations),[40], AMedP-7.1[41] (CBRN casualty management) and AMedP-7.3[42] (CBRN medical training), which focus on decontaminating casualties.

The procedures for decontamination in the Polish Armed Forces are generally consistent with NATO standards, with the exception of clearance decontamination.

Technological constraints

The technological conditions of the subsystem have implications resulting from Poland's membership in NATO, such as allied standards, meeting the requirements of the armed forces' objectives, and achieving full interoperability in tactical and operational activities, procedures, and technology. Meanwhile, equipment designed in the 1970s and 1980s and used by the Polish Armed Forces is unable to meet certain requirements and limits the subsystem's capabilities in terms of neutralising contamination from CBRN agents. The lack of modern technologies in this area is compensated for by the Alliance's capabilities in allied operations. However, it is necessary to consider what the consequences of these

[37] DD-3.14 (A) *Military protection*, Training 915/2015.

[38] Classified document.

[39] *Regulations for chemical forces of the land forces*...

[40] NATO Standard AJMedP-7 *Allied Joint Chemical, Biological, Radiological and Nuclear (CBRN) Medical Support Doctrine*, Edition B Version 1, 2022, https://www.coemed.org/files/stanags/02_AJMEDP/AJMedP-7_EDB_V1_E_2596.pdf [accessed: 28 VII 2025].

[41] NATO Standard AMedP-7.1 *Medical Management of CBRN Casualties*, Edition A Version 1, 2018, https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.1_EDA_V1_E_2461.pdf [accessed: 28 VII 2025].

[42] NATO Standard AJMedP-7.3 *Training of Medical Personnel for Chemical, Biological, Radiological, and Nuclear (CBRN) Defence*, Edition A Version 1, 2016, https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.3_EDA_V1_E_2954.pdf [accessed: 28 VII 2025].

shortcomings will be in the case of national operations or crisis response activities.

The development of modern technologies, including optoelectronic systems and equipment packed with electronics, requires innovative decontamination methods that exclude traditional wet methods, which can damage the decontaminated equipment and reduce its combat capability. Contemporary solutions in the field of decontamination are replacing older technologies to enable the treatment of modern equipment[43]. Technological trends are therefore influencing the need for organisational changes, tactics and operating procedures, forcing the restructuring of specialist subunits and the acquisition of new capabilities.

Financial and organisational conditions

The global trend of increasing defence spending is mainly due to the implementation of modern technologies. This also applies to Poland. Meanwhile, the funds allocated to the development of the Polish Armed Forces' decontamination subsystem are far from sufficient and mainly concern the maintenance of decontamination supplies. Expenditure on technological development remains close to zero[44]. In the area of acquiring new OPBMR technologies, the scale of this expenditure will not change significantly until 2026[45].

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[43] NATO, Science and Technology Organization, *TR-HFM-233, Sensitive Equipment Decontamination*, 2017, https://publications.sto.nato.int/publications/STO%20Technical%20Reports/STO-TR-HFM-233/$$TR-HFM-233-ALL.pdf [accessed: 2 VIII 2025].

[44] The technical modernisation plans of the Polish Armed Forces (PMT) are classified documents, but their implementation is subject to control. One such control was carried out by the Supreme Audit Office (NIK) in 2017 in the area of the implementation of the state budget in 2016 in the part concerning national defence. See: Supreme Audit Office, Department of National Defence, *Information on the results of the audit of the implementation of the state budget in 2016 in part 29 – National Defence and the implementation of the financial plans of the Armed Forces Modernisation Fund and the Military Property Agency*, https://www.nik.gov.pl/plik/id,14141.pdf [accessed: 20 VII 2025]. The data from this report indicate that the level of funding for the entire area of Survival and Protection of Troops is 0.07% of the budget allocated for technical modernisation (item 11.1.5. Survival and Protection Capability, p. 33). This area includes purchases of equipment for the entire OPBMR system, which includes the decontamination subsystem. The data for 2016 in this regard does not differ significantly from the data for the years preceding and following the report.

[45] The modernisation priorities adopted by the Ministry of National Defence are publicly available. See: Ministry of National Defence, *Technical Modernisation Plan until 2026. Selected*

A report by the Ministry of National Defence from 2010–2011 emphasised the need to strengthen decontamination capabilities as an element of survival and protection of troops, and provided for improvements in equipment by 2018[46].

An analysis of the organisational conditions of the subsystem showed that while there were periods of prosperity during the years of transformation in the Polish Armed Forces, in most cases the chemical forces were subject to reductions.

An analogy can be found in planning processes. While in the 2009 Defence Strategy of the Republic of Poland, developed on the basis of the National Security Strategy of the Republic of Poland 2007, OPBMR was identified as one of the main functional systems[47], in 2011, in the Strategic Defence Review[48] OPBMR was classified as an element of survival and protection of the armed forces. On the basis of the 2012 Concept of Functional System Organisers and Decision No. 56/MON of 2013[49] responsibility for the OPBMR system was divided among various organisational entities of the Polish Armed Forces, without simultaneously indicating mechanisms for preparing personnel for the needs of the system[50]. This introduced organisational chaos, which hindered the development of the system, technology and integrated training.

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issues, https://www.wojsko-polskie.pl/u/e1/aa/e1aa4b89-1045-4d1c-8a5c-7ffd4026e8d5/plan_modernizacji_technicznej_do_2026_r.pdf [accessed: 28 VII 2025]. The description refers to the period of the research. Since then, expenditure on technical modernisation has increased significantly, but this has not translated into technological development of the analysed subsystem.

[46] Ministry of National Defence, *Strategic Defence Review. Professional Armed Forces of the Republic of Poland in a modern state. Report*, Warszawa 2011, https://gdziewojsko.wordpress.com/wp-content/uploads/2011/05/raport_spo_14042011.pdf, p. 15 [accessed: 2 VIII 2025].

[47] *National Security Strategy of the Republic of Poland 2007*, https://www.bbn.gov.pl/ftp/dokumenty/SBN_RP.pdf [accessed: 2 VIII 2025]; Ministry of National Defence, *Defence Strategy of the Republic of Poland. Sectoral strategy for the National Security Strategy*, https://mkuliczkowski.pl/static/pdf/strategia_obronnosci.pdf, point 94, p. 19 [accessed: 2 VIII 2025].

[48] Ministry of National Defence, *Strategic Defence Review* ..., p. 93.

[49] General Staff of the Polish Armed Forces, Concept for the Establishment of Functional System Organisers approved by the Minister of National Defence on 19 October 2012 (unpublished); *Decision No. 56/Org./P5 of the Minister of National Defence of 24 December 2013 on Functional System Organisers of the Armed Forces of the Republic of Poland* (unpublished).

[50] General Staff of the Polish Army, Concept for establishing Organisers..., pp. 22–23.

In addition, the last decade has seen a growing trend towards the creation of expeditionary and multifunctional structures, such as task forces and chemical companies. In the case of the latter, this has not increased their existing specialist capabilities, but rather had a negative impact on the combat capabilities of the subunits.

Comparison of the Polish Armed Forces decontamination subsystem with NATO solutions

A comparison of the capabilities of the Polish Armed Forces' decontamination subsystem with similar subsystems of the armed forces of selected NATO countries reveals differences in technological, organisational and doctrinal approaches, as well as in the ability to cooperate with civil services in crisis response.

Germany

The main effort of the army

The Bundeswehr's efforts focus on providing comprehensive defence against CBRN threats in allied (NATO, European Union) and national operations, with an emphasis on crisis response, civil protection and support in stabilisation missions.

The ABC-Abwehrkommando der Bundeswehr, the command responsible for the OPBMR system in the German army, focuses on rapid detection, decontamination and neutralisation of threats, including asymmetric ones such as terrorism or industrial incidents. This reflects the resilience and interoperability emphasised in Germany's national defence strategy. The army supports authorities at the municipal, district, city, state and federal levels[51] in CBRN emergencies by integrating military capabilities with civilian structures.

Similarities between the German and Polish decontamination systems

The similarities stem from NATO membership, which requires compliance with the standards set out in the CBRN doctrine, i.e. a three-pillar approach

[51] See: H. Wyligała, *Uwarunkowania systemu zarządzania kryzysowego w Republice Federalnej Niemiec* (Eng. Conditions of the crisis management system in the Federal Republic of Germany), "Rocznik Bezpieczeństwa Międzynarodowego" 2011, vol. 5, pp. 133–154. https://doi.org/10.34862/rbm.2011.9.

and a focus on protecting personnel and equipment. In both countries, the decontamination subsystem is part of OPBMR, with an emphasis on the ability to secure troops in combined operations. Decontamination points are being developed in both armies. Although there are differences in the tactics used to develop them, the role of training troops in the procedures involved is emphasised, particularly at levels I and II, i.e. immediate and operational decontamination.

Differences between the German and Polish decontamination systems

- Organisational and functional – ABC-Abwehrkommando der Bundeswehr has centralised command in the area of OPBMR, which enables effective management of subordinate forces and development of the system[52]. Germany divides OPBMR capabilities into seven sub-areas[53], within which individual tasks are carried out at three levels of advancement: I – basic, II – advanced, III – qualified or specialised.
- Technological – Germany uses advanced decontamination systems, some of which integrate robotics and system automation.
- Doctrinal – in the German doctrine HDv 330/100[54], the OPBMR area has been integrated with civil protection, taking into account an active approach to decontamination (three phases: preliminary, operational, in-depth), and NATO guidelines (AJMedP-7) on the treatment of contaminated and infected casualties have been implemented.

Ability to cooperate with civil services

The cooperation between the Bundeswehr and civil services is based on constitutional provisions (German: *Grundgesetz für die Bundesrepublik*

[52] ABC-Abwehrkommando der Bundeswehr, https://www.bundeswehr.de/de/organisation/unterstuetzungsbereich/abc-abwehr-bundeswehr/abc-abwehrkommando-der-bundeswehr-in-bruchsal [accessed: 2 VIII 2025].

[53] These are: 1) individual protection, 2) collective protection, 3) medical defence against WMD, 4) contamination detection, 5) contamination removal (active), 6) specialist advice on OPBMR, 7) OPBMR technology compatibility.

[54] This is the equivalent of the Polish doctrine/regulations in the area of chemical forces command. See: *HDv 330/100 (zE) VS-NfD Führung der ABC-Abwehrtruppe*, 1999, https://www.scribd.com/document/58550605/HDv-330-100-Fuhrung-ABC-Abwehrtruppe [accessed: 3 VIII 2025].

Deutschland, GG)[55], which allows the use of the armed forces in crisis situations, e.g. during disasters, acts of terrorism, CBRN incidents, natural disasters, at the request of the federal authorities or the authorities of a given federal state. The military can carry out tasks such as decontamination (of people, vehicles and infrastructure), delivery of water and/or disinfectants, and medical and logistical support. In the Bundeswehr, interoperability is at a high level in terms of documentation, procedures (joint exercises) and equipment (compatible Kärcher equipment used by the military and civil services.

United States

The main effort of the army

The US military's efforts to combat WMD focus on global operations, expeditionary missions, counterterrorism, and support for civil authorities and services in their tasks (Defense Support of Civil Authorities, DSCA), with an emphasis on actively countering the proliferation of WMD outside the country, in accordance with the *National Security Strategy*[56].

The US 20th CBRNE Command integrates CBRN systems into joint operations, supporting the U.S. Army Forces Command (FORSCOM) and the U.S. Northern Command (USNORTHCOM)[57] in their activities.

Similarities between the American and Polish decontamination systems

Similarities include a three-pillar approach and a focus on protecting personnel and equipment. In both countries, joint operations place great emphasis on decontamination. The US Army, like the Polish Army, develops decontamination points in the field (as part of thorough decontamination) and conducts operational decontamination within six hours of contamination. It is extremely important for the military to decontaminate exposed skin (body) within one minute of contamination,

[55] See: Article 35(2) and (3) of the *Basic Law for the Federal Republic of Germany of 23 May 1949* (Grundgesetz für die Bundesrepublik Deutschland), https://biblioteka.sejm.gov.pl/wp-content/uploads/2016/02/Niemcy_pol_010711.pdf [accessed: 3 VIII 2025].

[56] *A New National Security Strategy for a New Era*, U.S. Embassy and Consulate in Poland, https://pl.usembassy.gov/pl/nss_pl/ [accessed: 11 XII 2019].

[57] USNORTHCOM is the primary military authority responsible for the defence of the continental United States, Alaska, Canada, Mexico, Cuba, the Bahamas, and adjacent waters. The command also provides support to civilian authorities within the United States. See: U.S. Northern Command, https://www.northcom.mil/ [accessed: 2 VIII 2025].

and other contaminated surfaces (e.g. weapons, personal equipment) within no more than 15 minutes[58].

Differences between the American and Polish decontamination systems

- Organisational and functional – The United States has a centralised command system in the area of CBRNE. The 20th CBRNE Command commands forces divided into the active army, reserves and National Guard. This allows for the flexible creation of task forces for expeditionary missions.

  Depending on the type of service, individual chemical warfare units and CBRN defence personnel are trained to varying degrees. The tasks of active army subunits include supporting the military in passive CBRN defence in assigned areas of responsibility (in areas of operations) and active operations to counter the proliferation of weapons of mass destruction (counterproliferation, CP[59]) and combat them (World Mass Destruction-elimination, WMD-E)[60]. In the Reserve Army, CBRNE forces are primarily prepared to carry out passive CBRN defence tasks, although they can also support operations to counter the proliferation of WMD or advise civilian services in the event of an incident involving WMD[61]. In turn, the forces comprising the National Guard are trained – like the entire armed forces – to carry out passive CBRN defence tasks, but since their main purpose is to serve within the country, this primarily involves crisis response in the broad sense. They support civil authorities within the country during events such as:
  – use or threat of use of WMD,
  – terrorist attack or threat of terrorist attack,

[58] See: FM 3-11 *Chemical, Biological, Radiological, and Nuclear Operations*, May 2019, https://irp.fas.org/doddir/army/fm3_11.pdf, p. Chapter 3 3-24 [accessed: 2 VIII 2025]; *FM 3-5, MCWP 3-37.3, NBC Decontamination*, 2000, https://www.globalsecurity.org/wmd/library/policy/army/fm/3-5/fm3-5.pdf, p. Introduction 1-3 [accessed: 2 VIII 2025].

[59] Joint Publication 3-40, *Joint Countering Weapons of Mass Destruction*, 2019, https://irp.fas.org/doddir/dod/jp3_40.pdf, p. GL-5 [accessed: 2 VIII 2025].

[60] M.F. Kelly, *United States Army Chemical, Biological…*

[61] This is handled, for example, by the 773rd Civil Support Team stationed in Kaiserslautern, Germany. See: *Army Reserve Component CBRN Units*, https://home.army.mil/wood/application/files/7315/9352/6705/UnitLocations.pdf [accessed: 2 VII 2025]; D. Friedberg, *U.S. Army North certifies the only Civil Support Team in Europe*, U.S. Army, 16 IX 2017, https://www.army.mil/article/193991/u_s_army_north_certifies_the_only_civil_support_team_in_europe [accessed: 2 VII 2025].

  - intentional or unintentional release of CBRN agents (including toxic industrial agents),
  - natural or man-made disasters that result or may result in catastrophe, loss of life or property.

  In the USA, level IV decontamination – clearance decontamination – is very well prepared in terms of planning and organisation.
- Technological – services in the USA use both older, proven technologies and modern ones, including those capable of decontaminating sensitive equipment. To this end, they use nanosorbents, enzymatic decontaminants and modern modular decontamination systems, including technology developed by Kärcher, such as the Kärcher Multipurpose Power Driven System (MPDS).

Ability to cooperate with civil services

Cooperation between the military and relevant services in the event of CBRN incidents, terrorist attacks, industrial toxic substance releases (TSP) and natural disasters involves decontamination, medical support, evacuation and logistical support (e.g. delivery of personal protective equipment). In the US, the army demonstrates a high degree of interoperability with civilian services, both in terms of documentation, procedures and equipment.

Conclusions from the comparison

Compared to Germany and the United States, the Polish Armed Forces lag behind in terms of technology, organisation and interoperability. Poland does not have integrated structures at the CBRNE command level, and its IRS-2 equipment does not meet the requirements of modern operations. The lack of regular exercises and insufficient cooperation with the civilian sector limit the capabilities of the subsystem.

Table 1. Comparison of the decontamination capabilities of Poland, Germany and the United States.

Country	Command structure/ responsibility for the system	Dominant technology	Interoperability	Cooperation with the civil sector
Poland	scattered	IRS-2, UG, Millagro	limited	weak
Germany	centralised (ABC-Abwehrkommando)	mobile kits (Kärcher Futuretech)	high	good
USA	centralised (20th CBRNE Command)	mobile kits (foam systems, unmanned vehicles)	high	very good

Source: own elaboration.

SWOT analysis of the Polish Armed Forces decontamination subsystem

SWOT analysis provides a concise overview of the strengths and weaknesses of the Polish Armed Forces' decontamination subsystem, as well as the opportunities and threats to its development. Table 2 illustrates the current capabilities and shortcomings.

Strengths

- well-educated and experienced personnel capable of cooperating in the development of modern CBRN technologies, including in the area of decontamination. Poland has, among other things, well-trained personnel in key chemical units – the Chemical Troops are well regarded among NATO partners. In this respect, Poland is one of the main pillars of NATO's CBRN defence system,
- existing infrastructure that can be adapted as stationary decontamination points (PLSk) in major garrisons,
- NATO membership, which provides access to allied experience and standards, which in turn helps to achieve interoperability, supports problem solving within the Lessons Learned system, forces the development of new capabilities, and indicates directions for the development of new technologies;

Weaknesses

- equipment and technology – outdated equipment with significant deficiencies in the required capabilities for decontaminating sensitive equipment, high-infrastructure facilities, aircraft interiors, external surfaces of large C-130 aircraft, ship interiors, contaminated casualties,
- organisational, technological and tactical inconsistencies with officially applicable manuals and instructions,
- lack of research confirming the ability of the technology used to decontaminate new-generation agents,
- lack of full compliance with NATO procedures and standards, particularly in the area of clearance decontamination,
- limited financial resources for the modernisation and development of decontamination technology,
- dispersion of the authorities responsible for the functioning and development of the OPBMR system, including the decontamination subsystem – lack of centralised command, a substantive system creator, and a decision-maker in the field of implemented and developed technologies.

Opportunities

- ability to focus efforts on acquiring key capabilities that determine the readiness of forces to take action, based on identified gaps and shortcomings,
- possibility of obtaining funds (including those from the EU) for the development and modernisation of equipment, technology and infrastructure in the area of decontamination,
- international cooperation within NATO, including participation in exercises, missions and exchange of experience in the area of technologies and tactics used,
- development of cooperation with the National Rescue and Firefighting System (KSRG) and civil services (formations) in the area of decontamination (hazard removal) in order to increase the effectiveness of response – development of solutions, including uniform standards to enable joint implementation of tasks in military operations (national and allied) and in crisis response, which will allow for the development and use of dual-use technologies and more effective management of allocated financial resources, while increasing rescue capabilities in both peacetime and wartime.

Threats

- increased hybrid threats, including the use of new-generation chemical and biological agents,
- slower pace of modernisation compared to other NATO countries in the area of decontamination,
- potential staff shortages resulting from insufficient training and inappropriate personnel policy in the chemical forces.

Table 2. Capabilities and shortcomings of the Polish Armed Forces decontamination subsystem – summary.

Survival and protection of troops Defence against WMD Contamination elimination					
Classification			**Yes**	**Yes, but with restrictions**	**No**
PEOPLE	**healthy contaminated**			– no possibility of collecting waste after procedures, – disinfectants for equipment and personal equipment do not meet environmental protection requirements	
	injured contaminated				X
EQUIPMENT	**combat**	**armoured**		– disinfectants do not meet environmental protection requirements, – inability to eliminate contamination inside the equipment	
		unarmoured		– disinfectants do not meet environmental protection requirements, – inability to eliminate contamination inside the equipment	
		weaponry		– disinfectants do not meet environmental protection requirements, – inability to eliminate contamination inside the equipment	
	sensitive	**optical**			X
		electronic			X
		special ammunition			X

Survival and protection of troops Defence against WMD Contamination elimination					
Classification			**Yes**	**Yes, but with restrictions**	**No**
EQUIPMENT	**ships**	**inside**			X
		outside		disinfectants do not meet environmental protection requirements	
	aircraft	**inside**			X
		outside		– lack of appropriate decontaminants, – lack of capacity to decontaminate large aircraft	
FACILITIES	**vertical**				X
	horizontal			disinfectants do not meet environmental protection requirements	
TERRAIN	**hardened**			disinfectants do not meet environmental protection requirements	
	unhardened				
WATER SUPPLY				no tanks with filling equipment and water pre-treatment system	
CHEMICAL RESCUE	**contamination reduction**		X		

Source: own elaboration.

Areas for improvement of the Polish Armed Forces decontamination subsystem

Based on literature, comparative analysis and examples, the author proposes the following directions for change.

1. **Technical modernisation**
   1) immediate acquisition and implementation of modern decontamination technologies in the armed forces, including for:
      – sensitive equipment,
      – aircraft,
      – ship interiors,
      – vertical facilities,
      – casualties,
   2) increasing the capacity to decontaminate personnel and essential combat equipment,
   3) introducing robotisation in the area of decontamination in order to increase personnel safety.
2. **Operational standardisation**
   1) aligning all procedures with NATO standards, including introducing clearance decontamination as an operational standard,
   2) continuously updating doctrines and doctrinal documents to include the area of OPBMR,
   3) integrating chemical warfare units into an integrated battlefield system that ensures the ability to respond to incidents in real time.
3. **Development of training programmes**
   1) implementation of regular, interdisciplinary exercises involving chemical units, civil services and NATO allies,
   2) development of specialist courses on the operation of modern decontamination systems and response to CBRN incidents in cooperation with civilian formations.
4. **Integration with the non-military system**
   1) strengthening cooperation with the National Firefighting and Rescue System, the Police, the Border Guard and other services, including the Internal Security Agency, in order to develop common standards and procedures for responding to CBRN incidents in the civilian environment and securing

NATO forces in a potential allied operation on the territory of the country,

2) establishing joint crisis response teams comprising subunits of the Polish Armed Forces (including chemical troops) and civilian formations capable of responding to incidents involving CBRN agents.

5. **Centralisation of organisational structures**
   1) creating a central command/ organisational unit to manage OPBMR, modelled on the American 20th CBRNE Command or the German ABC-Abwehrkommando der Bundeswehr, which would have the capacity to identify operational needs for the entire Polish Armed Forces, coordinate the development of the OPBMR system, including the decontamination subsystem, and the activities of chemical units in the Polish Armed Forces,
   2) optimising the deployment of infrastructure capable of functioning as stationary and mobile PLSk, to increase operational flexibility.
6. **Increasing funding**
   1) involving EU and national funds in modernisation programmes, including the purchase of new equipment and decontamination technologies, and the development of infrastructure in the field of OPBMR,
   2) prioritising the decontamination subsystem in defence budgets in order to overcome the technological slump.

Perspectives for further development

Further research on the Polish Armed Forces decontamination subsystem should focus on the following areas:

- development of technologies to neutralise new-generation chemical and biological agents, such as Novichok or modified pathogens,
- optimisation of organisational models, including the impact of centralised command on the effectiveness of operations,
- expansion of international cooperation, e.g. through joint research projects with NATO or the EU,

– analysis of the impact of climate change and local armed conflicts on potential CBRN threats, e.g. the impact of migration on the increase in biological threats.

Summary and conclusions

The Polish Armed Forces' decontamination subsystem plays an important role in countering chemical, biological and radioactive threats, but its effectiveness is limited. Factors that contribute to this and require urgent corrective action include outdated equipment, lack of full interoperability with NATO, insufficient training and limited cooperation with the civilian sector. This points to the need for comprehensive change, including:

– introduction of modern decontamination technologies,
– achievement of full interoperability with NATO forces and civil services,
– development of training programmes and cross-sector cooperation,
– centralisation of organisational structures and increased funding.

The implementation of these solutions should create conditions for increasing the operational readiness of the Polish Armed Forces, strengthening national security and more effective cooperation with allies within NATO.

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