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Edited by
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AIEP EDITORE

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НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ ЦИВІЛЬНОГО ЗАХИСТУ УКРАЇНИ

NATIONAL UNIVERSITY OF CIVIL DEFENCE OF UKRAINE

Edited by Roberto Mugavero, Volodymyr Andronov, and Maksym Kustov

Kharkiv - Rome, 2023

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LIST OF ABBREVIATIONS

AAD	Anti-Aircraft Defence
AFU	Armed Forces of Ukraine
AFPS	Automated Fare Payment Systems
ATTT	Automation and Telecontrol of Train Traffic
CF	Charitable Fund
CFYSS	Centres of Family and Youth Social Services
CPU	Communication Point of the Unit (fire department)
CS	Chief of Staff
CZ	Combat Zone
DPS	Diesel Power Station
EO	Explosive Objects
ES	Emergency Situation
ESS	Substation
FES	Fire extinguishing substances
FRU	Fire and Rescue Units
FRV	Fire and Rescue Vehicle
HAPP	Hydro-Accumulating Power Plant
HFE	Head of Fire Extinguishing
HPS	Hydroelectric Power Station
HR	Head of the Rear
ID	Input Device
IDD	Input and Distribution Device
IHE	Institution of Higher Education
IP	Iodine Prophylaxis (iodine blocking of the thyroid gland)
MDB	Main Distribution Board
MSOMS	Metro Station Operation Management System
NPP	Nuclear Power Plants
OCC	Operational Coordination Centre
OP	Operative Precincts
ORSCP	Operational and Rescue Service of Civil Protection
RCOP	Radiation and Chemical Observation Posts
RII	Radioactive Isotopes of Iodine
SES	State Emergency Service
SDPP	State District Power Plant
SwG	Switchgear
TD	Territorial Defence
TPP	Thermal Power Plant
UAVs	Unmanned Aerial Vehicles
UCPS	Unit of Continuous Power Supply
WOOP	Warehouses of Oil and Oil products

INTRODUCTION

The hostilities, which originated in eastern Ukraine in 2014, escalated into a full-scale war on February 24, 2022, following the invasion by the Russian Federation. Hundreds of cities and towns across nearly all state regions were targeted by rocket and artillery fire. The most intense fighting occurred in Luhansk, Donetsk, Kharkiv, Sumy, Chernihiv, Kyiv, Kherson, Mykolaiv, and Odesa regions. Over 5 million Ukrainian citizens were compelled to evacuate to secure locations in western Ukraine, Europe, and beyond. On February 24, 2022, the President of Ukraine, Volodymyr Zelensky, signed Decree No. 64/2022, "On the introduction of Martial Law in Ukraine".

The Ukrainian civil protection system had to work in the new realities. After all, rescuers, by their vocation, are always close to those who need help and provide salvation to people regardless of the circumstances around them. The city of Kharkiv was in the active combat zone from the first hours of the invasion and the beginning of hostilities, and employees of the National University of Civil Defence of Ukraine, like all the rescuers of the country, accepted the challenge and started actively rearranging their work in conditions of constant shelling.

The dangerous working conditions of rescuers demanded new, unique approaches to solving Civil Defence problems during martial law. The main task is the rescuers' safety when facing challenges during firefighting at critical infrastructure facilities. In the zone, chemically dangerous objects and radioactive substances are located during hostilities. In addition, the potential threat of using chemical or nuclear weapons has significantly increased. Of course, the entire area of hostilities, which amounts to hundreds of thousands of square kilometres, has been polluted by various explosive objects, so the main work in the liberated territories is demining and removing flammable objects. The enemy's powerful strikes on the energy infrastructure have led to large-scale blackouts throughout the country, with the consequences of which we constantly have to fight. Fortunately, volunteer organisations have become widespread in such difficult conditions, supporting all sections of the population, from the military at the front to babies in hospitals. The misfortunes experienced by millions of people could not leave an imprint on their psychological health, which will require a long rehabilitation period for many years to come. Indeed, working in such difficult conditions also harms the rescuers' morale, and professional work with each individual can reduce the adverse effects and internal reserves.

Unique experiences of rescuers have been compiled in this collective monograph, which focuses on the organisation of Civil Defence and the protection of the population amidst hostilities. All the materials presented herein are the outcomes of collecting, processing, and analysing real-life practical interventions by various rescue services and university personnel operating within conflict zones in Ukraine. Weaknesses have been scrutinised, accompanied by recommendations to enhance the organisational aspects of certain activities.

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CHAPTER 1

EMERGENCY RESPONSE UNDER MILITARY ORGANISATION EMERGENCY STATE

1.1 General concepts and terms

Civil Protection (CP) is a state function aimed to protect the population, territories, environment and property from disasters by preventing such situations, eliminating their consequences and providing assistance to victims in peacetime and in times of emergency (Article 4 [1]).

Civil protection is carried out with the aim of guaranteeing the safety and protection of the population and territories, material and cultural values, and the environment from emergencies, fires and elimination of their dangerous consequences in peacetime and in special periods.

Performing tasks that ensure the implementation of state policy in the field of civil protection is carried out by the Unified State System of Civil Protection.

The Unified State System of Civil Protection (USSCP) is a totality management bodies, forces, and means of central and local executive authorities, local self-government, enterprises, institutions, and organisations, providing state policy in the field of civil protection in peacetime and during a particolar period.

The **USSCP consists of**:

- management bodies;
- forces assigned to perform civil protection tasks;
- funds of financial, medical, and material and technical resources;
- communication, notification, and information support systems;
- man-made and natural safety monitoring system and forecasting emergencies;
- training system for personnel, management and specialists in the field of civil protection, and training of the population in emergencies;
- system of scientific support of civil protection activities.

The direct supervision of the USSCP activities is entrusted to the central executive body in the field of civil protection, which ensures the implementation of state policy measures - the State Emergency Service of Ukraine (SES of Ukraine).

The USSCP operates at the state, regional, local and facility levels depending on the scale and features of emergency situations, functions in the following modes:

1. daily functioning;
2. heightened readiness;
3. emergency situations;
4. state of emergency or martial law.

The mode of daily functioning of the USSCP is established under conditions of normal production and industrial, radiation, chemical, seismic, hydrometeorological, man-made and fire conditions, hydrogeology, for absence of epidemics, epizootics, etc.

The mode of heightened readiness of the USSCP is established within the limits of the specific territory in the event of significant deterioration of industrial, radiation, chemical, epidemic, seismic, hydrometeorological conditions, if available the threat of an emergency.

The regime of an emergency situation of the USSCP is established in case of occurrence of an emergency, depending on the scale, in a specific area.

The mode of operation of the USSCP under the conditions of a state of emergency is established in accordance with the Law of Ukraine *"On the Legal Regime of the State of Emergency"*. Peculiarities of the functioning of the USSCP under martial law are defined by the Law of Ukraine *"On the Legal Regime of Martial Law"* and *"On mobilization training and mobilization"*.

A civil protection system is created at each industrial facility.

The head of the facility - director, chief, rector, etc. - is responsible for the constant readiness of its forces and means, who is also the head of civil protection of the object.

Civil protection services are established at business facilities according to a standard plan, taking into account the specifics of the facility:

1. notification and communication;
2. medical;
3. radiation and chemical protection;
4. protection of public order;

5. fire protection;
6. power supply and light masking;
7. emergency and technical;
8. warehouses and shelters;
9. transport;
10. material and technical supply, etc.

Organisation of public training in emergencies

According to Article 34 of the Law of Ukraine "On the Protection of the Population and Territories from Man-Made and Natural Disasters", all categories of the population are required to learn the basic methods of protection against the effects of man-made and natural disasters, methods of providing first aid to victims, rules for using protective equipment, and to observe safety measures.

1.2 Structure and principles of building the national security system of Ukraine

The territory of Ukraine as a system with territorial and temporal distribution parameters of vital activity (Fig. 1.1) in the process of its functioning and development creates prerequisites for the occurrence of dangers that are negative, affecting the state of the natural-ecological, economic-technical, and socio-political balance on its territory.

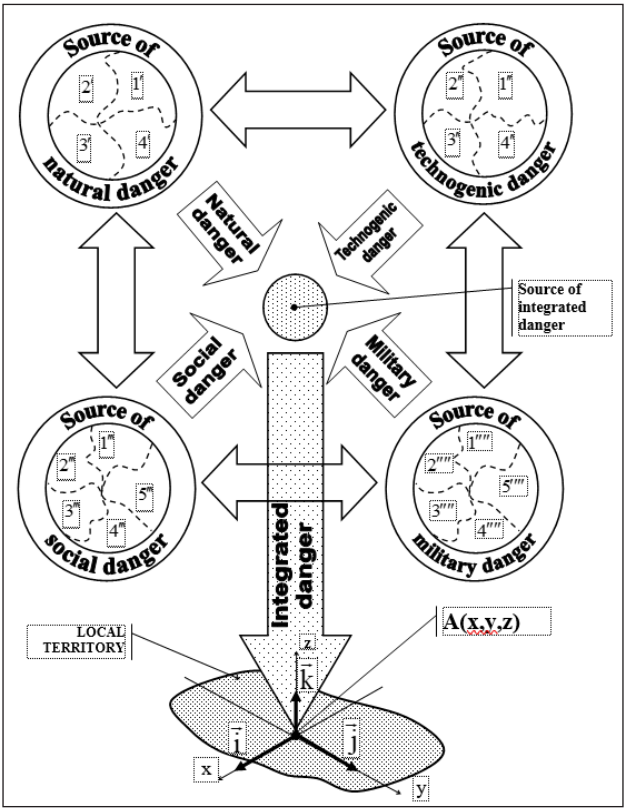

Fig. 1.1. Model representation of the processes of emergence of disaster sources of different origin on the local territory of Ukraine

According to Fig. 1. 1, the source of integral hazard at a point *A (x,e,z)* of the territory nonlinearly combines sources of natural hazard: 1'- processes in the atmosphere;2' - processes in the biosphere; 3'- processes in the lithosphere;4' - processes in the hydrosphere; sources of man-made hazard: 1'' - accidents at industrial facilities and transport; 2''- explosions;3'' - fires;4'' - release of other types of energy; sources of social hazard: 1''' - psychological peculiarities of a person and peculiarities of upbringing; 2'''- unfavourable position of a person; 3'''- social injustice; 4'''- tension in intergroup, interfaith and interethnic relations; 5'''- negative social processes leading to the destruction of ethical principles, social stability of a person and law-abidingness; sources of military danger: 1'''' – the existence of acute contradictions that can be resolved only with the use of military force; 2'''' - availability of a sufficient number of military forces and means for one of the parties to resolve the dispute in its favour or the ability of the state to create such forces in the future; 3'''' – leaders or governments have the political will and determination to use force, the ability to use armed forces to resolve a possible conflict; 4'''' – availability of reliable allies among states, their coalitions or other subjects of military-political relations; 5'''' – favourable geopolitical conditions and the real (or predicted) political and military situation for military actions.

An important condition for countering the main threats to Ukraine's national security is to create an effective national security system.

The protection of Ukraine's national interests involves activities to identify, prevent and eliminate threats to the national security in all important areas of life.

The national security of Ukraine as an integral phenomenon encompasses the following types of security (see Figure 1.2): political, economic, state, social, information, economic, humanitarian, military, civilian, fire, environmental, etc.

Threats to the national security of Ukraine and relevant priorities of the state policy in the areas of national security and defence are defined in the National Security Strategy of Ukraine, the Military Security Strategy of Ukraine, the Cybersecurity Strategy of Ukraine, and other documents on national security and defence, which are approved by the National Security and Defence Council of Ukraine and approved by decrees of the President of Ukraine.

The Security and Defence sector of Ukraine consists of four interconnected components: security forces; defence forces; defence industrial complex; citizens and public associations voluntarily participating in ensuring national security. The functions and power components of the Security and Defence sector are determined by the legislation of Ukraine.

The Security and Defence sector includes Ministry of Defence of Ukraine, Armed Forces of Ukraine, State Special Transport Service, Ministry of Internal

Fig. 1.2. The main directions of the functioning of National Security system of Ukraine

Affairs of Ukraine, National Guard of Ukraine, National Police of Ukraine, State Border Service of Ukraine, State Migration Service of Ukraine, State Emergency Service of Ukraine, Security Service of Ukraine, Department of State Security of Ukraine, State Service of Special Communication and Protection of Information of Ukraine, Apparatus of the Council of National Security and Defence of Ukraine, Intelligence Agencies of Ukraine, the Central Body of Executive Power, which provides formation and implementation on state military-industrial policy.

Other state bodies and local self-government bodies carry out their national security functions in cooperation with the bodies that make up the security and defence sector. The Ministry of Defence of Ukraine is the main body in the system of central bodies of executive power that ensures the formation and implementation of the state policy on national security in the military, defence and military construction sectors in peacetime and in a special period.

The powers of the Ministry of Defence of Ukraine include the organisation of defence planning activities in the defence forces, determination of the principles of military, military personnel and military-technical policy in the field of defence, coordination of the activities of state bodies and local self-government bodies regarding the preparation of the state for defence in accordance with the established procedure.

The Ministry of Defence of Ukraine is a central executive and military command and control body that is subordinate to the Armed Forces of Ukraine and the State Special Transport Service.

According to the Constitution of Ukraine, the Armed Forces of Ukraine are a military formation that is responsible for the defence of Ukraine, protection of its sovereignty, territorial integrity and inviolability. The Armed Forces of Ukraine provide deterrence and repulsion of armed aggression against Ukraine, protection of the airspace of the state and underwater space within the territorial sea of Ukraine, in cases determined by the law, participate in measures aimed at combating terrorism.

The Ministry of Internal Affairs of Ukraine is a central executive body that ensures the formation and implementation of state policy in the following areas:

1. ensuring the protection of human rights and freedoms, interests of society and the state, countering crime, maintaining public safety and order, as well as providing police services;
2. protection of the state border of Ukraine and sovereign rights of Ukraine in its exclusive (maritime) economic zone;
3. Civil Defence, protection of the population and territories from emergencies and prevention of their occurrence, elimination of emergencies, rescue, firefighting, fire and industrial safety, activities of emergency services, and hydrometeorological activities;
4. migration (immigration and emigration), in particular, counteracting illegal migration, citizenship, registration of individuals, including refugees and other categories of migrants defined by law.

The activities of the National Police of Ukraine, the National Guard of Ukraine, the State Border Guard Service of Ukraine, the State Emergency Service of Ukraine and the State Migration Service of Ukraine are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Internal Affairs of Ukraine.

The National Police of Ukraine is a central executive body that ensures public safety and order, protection of human rights and freedoms, interests of society and the state, combating crime, as well as provides services to assist persons who need such assistance because of personal, economic, social reasons or as a result of emergencies.

The National Guard of Ukraine is a military formation with law enforcement functions designed to perform tasks on protection and defence of life, rights, freedoms and legitimate interests of citizens, society and the state against criminal and other illegal encroachments, public order and public security, as well as in cooperation with other bodies - for ensuring the state security and protection of

the state border of Ukraine, cessation of terrorist activities, illegal paramilitary or armed groups, organised criminal organisations.

The State Border Guard Service of Ukraine is a specialized body that implements the state policy in the field of security of the state border of Ukraine and protection of Ukraine's sovereign rights in its exclusive (maritime) economic zone.

The State Emergency Service of Ukraine is a central executive body that implements state policy in the fields of civil protection, population and territory protection from emergencies, prevention of their occurrence, elimination of the consequences of emergencies, rescue operations, firefighting, fire and industrial safety, operation of rescue services during accidents, and hydrometeorological activities.

The State Migration Service of Ukraine is a central executive body that implements state policy in the areas of migration (immigration and emigration), including combating illegal migration, citizenship, registration of individuals, including refugees and other categories of migrants defined by law.

The Security Service of Ukraine is a special-purpose state body with law enforcement functions that ensures state security by carrying out, with strict observance of human and civil rights and freedoms, the following: countering intelligence and subversive activities against Ukraine; combating terrorism; counterintelligence protection of state sovereignty, constitutional order and territorial integrity, defence and scientific and technical potential, cyber security, economic and information security of the state, critical infrastructure facilities; protection of state secrets.

Intelligence bodies of Ukraine are state bodies or structural subdivisions within them authorized by law to carry out intelligence activities in order to protect the national interests of Ukraine from external threats.

In accordance with the law, the State Security Administration of Ukraine provides state protection of state bodies of Ukraine, security of officials and protection of objects defined by law.

The State Special Communications Service of Ukraine is a state body designed to ensure the functioning and development of the state system of governmental communications, the National System of Confidential Communications, the formation and implementation of state policy in the areas of cyber defence of critical information infrastructure, state information resources and information required to be protected by law, cryptographic and technical protection of information, telecommunications, use of the radio frequency resource of Ukraine, postal communications, paramedic communications, as well as other tasks in accordance with the law.

1.3 Features and chronology of the introduction of the legal regime of military or state of emergency

The content of the legal regime of the state of emergency, the procedure for its introduction and termination, peculiarities of the activities of state authorities and bodies of local self-government, enterprises, institutions and organisations in conditions of state of emergency, observance of human and citizen rights and freedoms, as well as the rights and legitimate interests of legal entities and liability for violations of requirements or failure to comply with measures of the legal regime of emergency are defined in the Law of Ukraine *"On the Legal Regime of the State of Emergency"*.

A state of emergency is a special legal regime that may be temporarily introduced in Ukraine or in some of its regions in the case of man-made or natural emergencies of no lower than the national level that have led or may lead to human and material losses, posing a threat to the life and health of citizens, or in the case of an attempt to seize state power or changes in the constitutional system of Ukraine through violence and provides for the provision to the relevant bodies of state power, the military command and local self-government bodies in accordance with this Law of the powers necessary to avert the threat and ensure the safety and health of citizens, normal functioning of the national economy, state authorities and local self-government bodies, protection of the constitutional system, and also allows temporary, due to the threat, restrictions on the exercise of constitutional rights and freedoms of a person and a citizen, and rights and legal interests of legal entities with an indication of the period of validity of those restrictions.

The purpose of imposing a state of emergency is to eliminate the threat as quickly as possible, especially liquidation of severe man-made or emergency situations due to natural disasters, normalization of the situation, restoration of law and order at attempts to seize state power or change the constitutional system through violence, to restore the constitutional rights and freedoms of citizens, likewise rights and legitimate interests of legal entities, creating conditions for normal functioning of state authorities and local self-government bodies, and other institutions of civil society.

The legal basis for introducing a state of emergency is the Constitution of Ukraine, the Law of Ukraine *"On the Legal Regime of the State of Emergency"*, other Laws of Ukraine and the Decree of the President of Ukraine on the introduction of a state of emergency in Ukraine or in its individual localities, approved by the Verkhovna Rada of Ukraine.

A state of emergency is introduced only if there is a real threat to the safety of citizens or the constitutional system, the elimination of which by other means is impossible.

A state of emergency can be imposed in the event of:

1. the occurrence of particularly severe emergencies of anthropogenic and natural nature (natural disasters, catastrophes, especially large fires, the use of weapons, pandemics, panzootics, etc.), which pose a threat to the life and health of significant segments of the population;
2. the implementation of mass terrorist acts, accompanied by the death of people or the destruction of particularly important objects of life support;
3. the emergence of interethnic and interfaith conflicts, blocking or seizure of certain particularly important objects or areas, which threatens the safety of citizens and disrupts the normal activities of state authorities and local governments;
4. the emergence of mass unrest, accompanied by violence against citizens, limiting their rights and freedoms;
5. attempts to seize state power or change the constitutional order of Ukraine through violence;
6. mass transition of the state border from the territory of neighboring states;
7. the need to restore constitutional law and order and the activities of public authorities.

A state of emergency in Ukraine or in certain of its localities is introduced by the Decree of the President of Ukraine, which must be approved by the Verkhovna Rada of Ukraine within two days from the date of the President's request.

Before the introduction of a state of emergency on the grounds provided for in paragraphs 2-7 of the second part of Article 4 of this Law, the President of Ukraine addresses through the mass media or in any other way groups of persons, organisations, institutions that are initiators or participants of actions that may be a reason for the introduction of a state of emergency with a demand to stop their illegal actions within the time limit set in the address and warns of the possibility of the introduction of a state of emergency.

Under conditions that require urgent measures to save the population or prevent the death of people, a state of emergency can be introduced without warning.

Proposals for the introduction of a state of emergency in Ukraine or in certain

of its regions are submitted to the President of Ukraine by the National Security and Defence Council of Ukraine. In case of necessity to introduce a state of emergency on the grounds provided for in clause 1 of the second part of Article 4 of this Law, proposals for its introduction are submitted by the Cabinet of Ministers of Ukraine.

Introducing a state of emergency on the territory of the Autonomous Republic of Crimea or in some of its localities may be initiated by the Verkhovna Rada of the Autonomous Republic of Crimea.

In the Decree of the President of Ukraine on the introduction of a state of emergency are noted:

1. justification of the need to introduce a state of emergency, respectively to Article 4 of this Law;
2. borders of the territory where the state of emergency is introduced;
3. the time from which the state of emergency is introduced and the period for which it is introduced;
4. the list and limits of emergency measures, an exhaustive list of constitutional rights and freedoms of a person and citizen that are temporarily restricted in connection with the introduction of a state of emergency, as well as a list of temporary restrictions on the rights and legitimate interests of legal entities, indicating the duration of these restrictions;
5. state authorities, military command bodies and local self-government bodies, which is entrusted with the implementation of the state of emergency measures and the limits of their additional powers;
6. other issues arising from this Law.

After signing the Decree on the introduction of a state of emergency, the President of Ukraine applies to the Verkhovna Rada of Ukraine for its approval.

The appeal of the President of Ukraine is considered by the Verkhovna Rada of Ukraine as a matter of urgency.

Decree of the President of Ukraine on the introduction of a state of emergency, approved by the Verkhovna Rada of Ukraine, is immediately announced through the mass media or in any other way.

A new precedent in the modern history of independent Ukraine was set on February 23, 2022. The President of Ukraine issued Decree No. 63/2022 "On the introduction of a state of emergency in certain regions of Ukraine". The reason was the recognition of the independence of the self-proclaimed LPR and DPR by the Russian Federation on February 21, 2022, and the decision to deploy armed

forces of the Russian Federation to the temporarily occupied territories of Donetsk and Luhansk regions.

Such actions are a continuation of the Russian Federation's policy of escalation armed aggression against Ukraine, imposition of separatism, provocation inter-ethnic and inter-confessional conflicts, mass disturbances, which threatens the safety, life and health of citizens, state sovereignty, constitutional system and territorial integrity of Ukraine.

The subversive activities of the special services of the Russian Federation, the activities of separatist forces, criminal and illegal military groups in the occupied territories of Donetsk and Luhansk regions, and their terrorist activities have become an armed confrontation and threaten to spread to other regions of Ukraine.

With the aim of normalizing the situation in the State, ensuring the protection of internal territories and state borders, combating crime, maintaining public order and security, creating conditions for proper functioning of bodies state power, local self-government and other civil institutions, preventing of attempts to seize state power or change the constitutional system of Ukraine by means of violence, guided by points 5 and 6 Part 2 of Article 4 of the Law of Ukraine *"On the Legal Regime of Emergency State"* – based on the proposal of the National Security and Defence Council of Ukraine and in accordance with Clause 21 of Article 106 of the Constitution of Ukraine, the President of Ukraine decrees:

1. Introduce on the territory of Vinnytsia, Volyn, Dnipropetrovsk, Zhytomyr, Zakarpattia, Zaporizhzhia, Ivano-Frankivsk, Kyiv, Kirovohrad, Lviv, Mykolaiv, Odesa, Poltava, Rivne, Sumy, Ternopil, Kharkiv, Kherson, Khmelnitsky, Cherkasy, Chernivtsi, Chernihiv regions, and Kyiv City the state of emergency from 00 hours 00 minutes on February 24, 2022, for a period of 30 days.

2. Heads of regional and Kyiv City state administrations to form operational staffs, headed by the heads of regional and Kyiv City governments administrations, to coordinate actions of executive authorities, local authorities, self-government bodies , enterprises, institutions, and organisations for the introduction and the implementation of measures of the legal state of emergency - which include representatives of the Security Service of Ukraine, central authorities of the Executive Power - ensuring the formation and implementation of the state policy in the field of protection and protection of the state border, public order and Civil Defence, the Military Service of Law and Order in the Armed Forces of Ukraine, the State Agency of Ukraine for Exclusion Zone Management, local executive bodies and local self-government bodies.

3. The Security Service of Ukraine, the Ministry of Internal Affairs of Ukraine, the National Guard of Ukraine, the National Police of Ukraine, the State Emer-

gency Service of Ukraine, the State Border Guard Service of Ukraine, the Armed Forces of Ukraine, the Military Law Enforcement Service of the Armed Forces of Ukraine, central executive authorities subordinated to military formations established in accordance with the laws of Ukraine, according to their powers, to provide assistance in the implementation of measures of the legal regime of the state of emergency.

4. The following measures are introduced on the territory defined in Article 1 of this Decree:

- establishment of a special regime of entry and exit (if necessary);
- restriction of vehicle traffic and their inspection (if necessary);
- strengthening the protection of public order and facilities that support the life of the population and the national economy;
- prohibition of mass events, except for events that are banned by a court (if necessary);
- prohibition of strikes;
- temporary or irrevocable evacuation of people from dangerous places, with mandatory provision of permanent or temporary housing;
- introduction of a curfew (prohibition to be on the streets and in other public places without specially issued passes and identity cards during fixed hours of the day, if necessary);
- verification of citizens' documents, and, if necessary, personal examination, inspection of things, vehicles, luggage and cargo;
- prohibition for conscripts, persons liable for military service and reservists to change their place of residence without the knowledge of the relevant territorial recruitment and social support centre, the Central and/or regional office of the Security Service of Ukraine, and the relevant unit of the Foreign Intelligence Service of Ukraine;
- prohibition of production and distribution of information materials that can destabilize the situation;
- prohibition of amateur radio transmitters and radio emitting devices for personal use;
- special rules for using communications and transmission of information through computer networks (if necessary).

The implementation of measures to introduce and maintain the state of emergency provided by this Decree is entrusted to executive authorities, local self-government bodies and relevant military commands in accordance with the Law of Ukraine "On the Legal Regime of the State of Emergency".

5. To provide funding to the Cabinet of Ministers of Ukraine and use it within

the limits of the powers of other measures related to the introduction of the legal regime of the state of emergency in the territory specified in Article 1 of this Decree.

6. To notify the Ministry of Foreign Affairs of Ukraine via of the UN Secretary General to the States participating in the International Pact on Civil and Political Rights, on restrictions on human rights and freedoms of citizen, which are a deviation from the obligations under the International Covenant, and about the limit of these deviations and the reasons for making such a decision.

7. This Decree entered into force simultaneously with the entry into force of the Law of Ukraine "On Approval of the Decree of the President of Ukraine "On the Introduction of the State of Emergency in Certain Regions of Ukraine".

The content of the legal regime of martial law, the procedure for its introduction and cancellation, legal basis of activity of state authorities, military command, military administrations, local self-government bodies, enterprises, institutions, and organisations in conditions of martial law, guarantee of rights and human and citizen freedoms, rights, and legal interests of legal entities.

Martial law is a special legal regime introduced in Ukraine, or in some of its localities, in case of armed aggression or threat of attack, danger to state independence of Ukraine or its territorial integrity, and provides provision to relevant state authorities, military command, military administrations and local self-government authorities, necessary for averting the threat, repelling armed aggression and ensure national security, eliminating the threat of danger to state independence of Ukraine, its territorial integrity, as well as temporary, caused by the threat of limitation of the constitutional rights and freedoms of a person and citizen, likewise the rights and legal interests of legal entities, with an indication of the period of validity of those restrictions.

The legal basis for introducing martial law is the Constitution of Ukraine. The Law of Ukraine *"On the Legal Regime of Martial Law"* and the Presidential Decree of Ukraine on the introduction of Martial Law in Ukraine, or in some of its localities, is approved by the Verkhovna Rada of Ukraine.

The Military Command, which is granted the right under this Law together with executive authorities, military administrations, the Council Ministers of the Autonomous Republic of Crimea, and local self-government bodies to introduce and carry out measures of the legal regime of martial law, is Commander-in-Chief of the Armed Forces of Ukraine, Commander of the Joint Forces of the Armed Forces of Ukraine, commanders of types and separate branches of troops (forces) of the Armed Forces of Ukraine, commanders (heads) of military bodies management, commanders of formations, military units of the Armed Forces of Ukraine and other military formations formed in accordance with the Laws of Ukraine.

The decision to introduce martial law in 10 regions of Ukraine for 30 days from 26 November 2018 was first made on November 26, 2018, in connection with the act of armed aggression of the Russian Federation in the Kerch Strait against the ships of the Naval Forces of the Armed Forces of Ukraine, the existing threat of a large-scale invasion of Ukraine by the armed forces of the Russian Federation.

In conjunction with another act of armed aggression by the Russian Federation that took place on November 25, 2018, in the area of the Strait of Kerch against ships of the Naval Forces of the Armed Forces of Ukraine, with heavy consequences - other aggressive actions of the Russian Federation in Azov and the Black Seas perpetuate the existing threat of a large-scale invasion of Ukraine by the armed forces of the Russian Federation. Against the background of the occupation of the Autonomous Republic of Crimea and parts of the regions of Donetsk and Luhansk, the danger for state sovereignty, independence of Ukraine and its territorial integrity persists, so as to create the conditions for implementation, by the State authorities, military command, local self-government bodies, enterprises, institutions, and organisations authorized by them, the necessary actions to repel armed aggression and ensure national security. On the basis of the proposal of the National Security and Defence Council of Ukraine, in accordance with paragraph 20 of the first part of Article 106 of the Constitution of Ukraine, the Law of Ukraine "About Legal Regime of Martial Law" President of Ukraine Petro Poroshenko decreed:

1. To introduce Martial Law in Ukraine from 2:00 p.m. on November 26, 2018, for a period of 30 days until 2:00 p.m. on December 26, 2018.

2. Military Command (General Staff of the Armed Forces of Ukraine, the command of the types of the Armed Forces of Ukraine, the operational management commands, commanders of military formations, units of the Armed Forces of Ukraine, State Border Service of Ukraine, State Special Service of Transport, State Service for Special Communications and Information Protection of Ukraine, National Guard of Ukraine, Security Service of Ukraine, Foreign Intelligence Service of Ukraine, Office of State Security of Ukraine) together with the Ministry of Internal Affairs of Ukraine, other executive authorities, local self-government bodies to introduce and implement measures provided by the Law of Ukraine *"On the Legal Regime of Martial Law"* and the powers necessary to ensure the defence of Ukraine, the protection of security population and state interests.

3. In connection with the introduction of Martial Law in Ukraine temporarily, for the period of effect of the legal regime of Martial Law, constitutional rights may be limited, and human and citizen freedoms provided in Articles 30–34, 38,

39, 41–44, 53 of the Constitution of Ukraine as well as introducing temporary restrictions on rights and legalities interests of legal entities within the limits and scope necessary for provision the possibility of introducing and carrying out measures of the military legal regime, especially conditions provided by the first part of Article 8 of the Law of Ukraine *"On the Legal Regime of Martial Law"*.

4. To the Cabinet of Ministers of Ukraine:

- to implement a plan for the introduction and enforcement of the legal regime of martial law in Ukraine;

- to ensure the supply of material and technical resources and property to the Armed Forces of Ukraine and other military formations, provision of services and their financing in the amounts necessary for the effective performance of their tasks during the special period.

5. The State Emergency Service of Ukraine, together with regional state administrations, other state bodies, institutions, enterprises, organisations of all forms of ownership, urgently bring the designated objects of the unified state civil protection system, its functional and territorial subsystems into readiness to perform assigned tasks during the special period with the introduction of the FULL READY status.

6. Regional, Kyiv city state administrations and local self-government bodies should establish defence councils and provide assistance to the military command in the implementation of martial law measures.

7. To provide information to the Ministry of Foreign Affairs of Ukraine according to the established procedure of the UN Secretary General and officials of foreign States on the introduction of Martial Law in Ukraine, on the restriction of rights and human and citizen freedoms, which is a deviation from obligations under the International Covenant on Civil and Political Rights and their limits deviations and reasons for making such a decision.

8. This Decree entered into force simultaneously with the entry into force of the Law of Ukraine "On Approval of the Decree of the President of Ukraine "On the Introduction of Martial Law in Ukraine".

February 24, 2022, in connection with the military aggression of the Russian Federation against Ukraine, Martial Law was introduced by Decree of the President of Ukraine No. 64/2022, at 05 hours 30 minutes on February 24, 2022, for a period of 30 days.

Based on the proposal of the National Security and Defence Council of Ukraine, in accordance with Clause 20 of the first part of Article 106 of the Constitution of Ukraine, the Law of Ukraine *"On the Legal Regime of Martial Law"* President of Ukraine Volodymyr Zelensky has decreed:

1. Introduce Martial Law in Ukraine from 05:30 on February 24, 2022, for a period of 30 days. Subsequently, the term of martial law in Ukraine was extended:

- from 05:30 on March 26, 2022, for a period of 30 days in accordance with Presidential Decree No. 133/2022 of March 14, 2022;
- from 05:30 on April 25, 2022, for a period of 30 days in accordance with Presidential Decree No. 259/2022 of April 18, 2022;
- from 05:30 on May 25, 2022, for a period of 90 days in accordance with Presidential Decree No. 341/2022 of May 17, 2022;
- from 05:30 on August 23, 2022, for a period of 90 days in accordance with Presidential Decree No. 573/2022 dated August 12, 2022;
- from 05:30 on November 21, 2022, for a period of 90 days in accordance with Presidential Decree No. 757/2022 dated November 7, 2022.

2. Military Command [General Staff of the Armed Forces of Ukraine, the Command of the United Forces of the Armed Forces of Ukraine, the command types, separate types of troops (forces) of the Armed Forces of Ukraine, management operational commands, commanders of military formations, units of the Armed Forces of Ukraine, State Border Service of Ukraine, State Special Transport Service, the State Service of Special Communication and Protection Information of Ukraine, the National Guard of Ukraine, the Security Service of Ukraine, Foreign Intelligence Service of Ukraine, State Security Office of Ukraine] together with the Ministry of Internal Affairs of Ukraine, other executive bodies, authorities, local self-government bodies to implement measures provided by the Law of Ukraine *"On the Legal Regime of Martial Law"* and the powers necessary to ensure the defence of Ukraine, the protection of security population and state interests.

3. In connection with the introduction of martial law in Ukraine, the constitutional rights and freedoms of man and citizen provided for in Articles 30-34, 38, 39, 41-44, 53 of the Constitution of Ukraine as well as temporary restrictions on the rights and legitimate interests of legal entities within the limits and to the extent necessary to ensure the possibility of introducing and implementing measures of the legal regime of martial law provided for in part one of Article 8 of the Law of Ukraine "On the Legal Regime of Martial Law" can be restricted temporarily, for the period of martial law.

4. To the Cabinet of Ministers of Ukraine urgently:

- to implement a plan for the introduction and provision of legal measures of the Martial Law regime in Ukraine;
- to provide funding and take other measures within the scope of authority, related to the introduction of the legal regime of Martial Law in the territory of Ukraine.

5. The State Emergency Service of Ukraine, in cooperation with regional and

Kyiv city state administrations, other state bodies, institutions, enterprises, organisations of all forms of ownership, immediately prepare the unified state civil protection system, its functional and territorial subsystems for performing assigned tasks during the special period.

6. Regional, Kyiv city state administrations and local self-government bodies to establish defence councils and ensure assistance to the military command in the introduction and implementation of martial law measures.

7. To provide information to the Ministry of Foreign Affairs of Ukraine, according to the established procedure of the UN Secretary General and officials of foreign States on the introduction of Martial Law in Ukraine, on the restriction of rights and human and citizen freedoms, which is a deviation from obligations under the International Covenant on Civil and Political Rights and their limits deviations and reasons for making such a decision.

1.4 Peculiarities of interaction between services in the field of prevention and response to emergencies, fires, and dangerous events

The direct organisation and coordination of work on the elimination of the consequences of emergencies, fires and dangerous events are carried out in accordance with Articles 76 and 80 of the Civil Protection Code of Ukraine and Order of the Ministry of Internal Affairs of Ukraine No. 1406 dated 26 December 2014 "On Approval of the Regulation on the Emergency Response Headquarters and Types of Operational, Technical and Reporting Documentation of the Emergency Response Headquarters", registered with the Ministry of Justice of Ukraine on January 16, 2015 under No. 47/26492.

Forms of interaction:

- exchange of information on the threat or occurrence of emergencies, fires and dangerous events in different regions of the country;

- holding joint operational meetings of the Head of the State Emergency Service of Ukraine or deputies with the Head (deputies) of the National Police of Ukraine and the Commander (deputies) of the National Guard of Ukraine, heads of territorial bodies of the State Emergency Service of Ukraine with heads of territorial (including interregional) bodies of the National Police of Ukraine (hereinafter referred to as territorial bodies of the National Police of Ukraine) and operational-territorial associations of the National Guard of Ukraine;

- carrying out joint activities according to plans for interaction of management bodies and forces of Civil Defence in the event of an emergency (further interaction plans) developed at the regional and local levels;

- conducting joint exercises and trainings;
- implementation of other measures.

Interaction is carried out:

- at the state level between the apparatus of the State Emergency Service and the apparatus of the central body administration of the National Police of Ukraine and the main body of the military administration of the National Guard of Ukraine;
- at the regional level between territorial bodies of the State Emergency Service, territorial bodies of the National Police of Ukraine and bodies of the military administration of operational territorial associations of the National Guards of Ukraine;
- at the local level between units of the State Emergency Service, departments of districts, cities, districts in cities of the National Police of Ukraine and the military units of the National Guard of Ukraine.

Measures to eliminate the consequences of emergencies (fires, etc.) or dangerous events on the territory of Ukraine are carried out by civilian forces protection, including units of the Civilian Operational Rescue Service protection, with the involvement of the National Police of Ukraine and units of the National Guard of Ukraine in accordance with the tasks assigned to them.

The organisation of joint events consists of stages of preliminary preparation and operational training.

At the stage of preliminary preparation by the interacting parties, are carried out:

- development of cooperation plans at the regional and local levels;
- mutual information;
- determining the scope and sequence of joint actions during liquidation of the consequences of an emergency, fire, and dangerous event;
- coordination of the order of management and interaction of units during execution of joint tasks, as well as issues of material and technical support.

At the stage of operational preparation, the following are carried out:

- joint determination of locations, staff meetings, etc., likewise the order of implementation of joint measures related to the prevention of occurrence and liquidation of the consequences of emergency situations, fires, and dangerous events;
- assessment of the situation at the place of a threat or occurrence of an emergency situation, fire or dangerous event, state and capabilities of available forces and means;
- determination of the head of joint activities in agreement with the heads interacting parties;
- determination of the need to involve other additional forces and means of the

National Police of Ukraine and the National Guard of Ukraine before acting on prevention of emergence and liquidation of consequences of an emergency situation, fire, and dangerous event, sequence of implementation of joint measures;

- involvement of forces and means necessary for implementation of joint activities.

The State Emergency Service within the scope of its competence:

- informs the National Police of Ukraine and the National Guard of Ukraine about the threat or occurrence of emergency situations, fires, and dangerous events at the state, regional and local levels;

- carries out measures to eliminate the consequences of emergency situations, fires, and dangerous events, including, within the scope of its competence, at the facilities of the National Police of Ukraine and the National Guard of Ukraine, in accordance with developed interaction plans;

- performs emergency rescue and other urgent work;

- conducts search and rescue of people in affected targets and territories, provides emergency medical assistance to persons who are in a life-threatening condition and state of health, and, on the scene, promotes their evacuation to safety facilities;

- carries out other measures provided for by law.

The National Police of Ukraine, within the scope of its competence:

- informs the State Emergency Service at the state, regional and local levels about signs of threat or occurrence of emergencies, fires, and dangerous situations or events;

- aids services to persons with personal, economic, social reasons or as a result of emergency situations that require such assistance;

- organises and carries out, within the limits of the powers provided by law, measures to save people, ensure their safety, protect property in case of natural disasters, accidents, fires, catastrophes, and liquidation of their consequences;

- takes measures to ensure public safety and order on streets, squares, parks, stadiums, train stations, airports, sea and river ports, and other public places;

- regulates road traffic and monitors compliance with the Rules of traffic, approved by the Cabinet of Ministers of Ukraine from No. 1306 of October 10, 2001, by its participants and on the legality of exploitation vehicles on the road network;

- escorts vehicles in cases provided by law;

- uses all possible measures to provide emergency, in particular pre-medical and medical assistance to persons who suffered as a result of criminal or administrative offenses, accidents, as well as persons who find themselves in a situation dangerous to their life or health;

- carries out control, within the limits of competence defined by law, according to compliance with the requirements of the radiation safety regime in a specially defined zone radioactive contamination;

- contributes to ensuring, in accordance with the law, the legal regime of the military or state of emergency, in zones in ecological emergency situations, in case of announcement on the entire territory of Ukraine or in a separate area;

- takes measures to identify persons who are unable - due to health or age or other circumstances - to report information about yourself, or establish the identity of the person in case of an unidentified corpse;

- helps executive authorities and local authorities' self-government in the resettlement of people from places dangerous for living, evacuation of the population;

- participates in the implementation of quarantine measures during epidemics and epizootics;

- grants permission to units of the Civilian Operational Rescue Protection Service for access (in the prescribed manner) to the territory under the jurisdiction of the National Police of Ukraine to prevent the occurrence or liquidation consequences of emergency situations, fires, and dangerous events;

- carries out other measures provided by law.

The National Guard of Ukraine, within the scope of its competence:

- informs the Emergency Situation Service at the state, regional and local levels about signs of a threat or occurrence of emergency situations, fires, and dangerous events;

- aids in eliminating the consequences of natural, man-made, environmental disasters;

- participates in liquidation of the consequences of emergency or crisis situations on targets guarded by units of the National Guard of Ukraine;

- participates in maintaining and restoring law and order in the districts in the occurrence of particularly severe natural or artificial emergency situations (natural disaster, catastrophes, especially large fires, the use of means of destruction, pandemics, panzootic, etc.), which create threat to the life and health of significant sections of the population;

- grants permission to units of the Civilian Operational Rescue Protection Service for entering the territory of objects protected by the National Guard of Ukraine, to prevent the occurrence or liquidation of the consequences of emergency situations, fires, and dangerous events;

- carries out other measures provided for by law.

Material and technical support of the involved forces and means to prevention of occurrence or liquidation of an emergency situation is carried out by central bod-

ies of executive power, the main body of the military administration of the National Guard of Ukraine, under whose control they are belong to.

The exchange of information is carried out at state, regional and local level through dispatches with the aim of organising the timely implementation of operational threat response measures or the occurrence of an emergency, fire, or dangerous event:

- at the state level, between the operational service and the service of the State Emergency Management Centre of the State Emergency Service - another section of the Department of organisational, analytical and operational support – through response of the National Police of Ukraine and of the agents on duty at the Office of Command Posts of the headquarters of the Main Directorate of the National Guard of Ukraine, by phone within 5 minutes and with written confirmation e-mail or fax within 30 minutes;

- at the regional level, between the operational and coordination centres of the State Emergency Service's territorial bodies, the duty services of the National Police of Ukraine and the operational and duty services of the National Guard of Ukraine;

- at the local level, between units of the State Emergency Service of Ukraine, departments (divisions) in districts, cities, and districts in cities of the National Police of Ukraine and military units of the National Guard of Ukraine.

In order to increase the effectiveness of information and analytical support for management decision-making, interaction, coordination and control over the activities of executive authorities, law enforcement agencies and military formations in the areas of national security and defence in peacetime, as well as in a special period, including martial law, state of emergency and in the event of crisis situations that threaten the national security of Ukraine, the National Security and Defence Council of Ukraine decided:

1. To recognise the necessary expansion and further development of a unified network of situation centres, which should include the Main Situation Centre of Ukraine, the Government Situation Centre, situation centres of security and defence agencies, situation centres of central executive authorities, the Council of Ministers of the Autonomous Republic of Crimea, regional, Kyiv and Sevastopol city state administrations, as well as reserve and mobile situation centres.

2. To establish that the Governmental Situation Centre, situation centres of the security and defence sector bodies, situation centres of central executive authorities, the Council of Ministers of the Autonomous Republic of Crimea, regional, Kyiv and Sevastopol city state administrations, backup and mobile situation centres are equipped with unified software and hardware for infor-

mation and analytical support of management decision-making, which should include, particularly:

- data storage and database management system;
- data analysis and visualization tools from various sources, as well as construction of prognostic models based on them;
- module of geoinformation systems and technologies for creating and working with sets of geospatial data;
- secure video conferencing to ensure synchronous exchange of audiovisual information in real time;
- electronic communication networks to ensure information exchange, including transmission of data and audiovisual information, with varying degrees access restrictions between communication nodes, situational centres, and other subjects of information exchange;
- technical support of the hardware and software complex for provisioning interoperability, stable and continuous functioning, testing, configuration, and performance tracking, according to the defined regulation.

3. To the Cabinet of Ministers of Ukraine, the National Security and Defence Council of Ukraine, the Security Service of Ukraine, and the Foreign Intelligence Service of Ukraine provide:

- further development of the network of situational centres, using the information and analytical system of the Main Situation Centre of Ukraine;
- the possibility of deployment of reserve situational centres in reserve (urban, non-urban) control points, as well as mobile situational ones, to ensure the stability and viability of the state management system in a special period, especially in the conditions of Martial Law, in conditions of emergency state and during the emergence of crisis situations that threaten the national security of Ukraine.

1.5 Generalised features of the civil protection management system in the conditions of hostilities

1. The basis of Ukraine's national security system is a global security system, the components of which are closely interconnected and interdependent, in order to ensure the appropriate security state for the vital interests of man and the citizen, society and the state. The sustainable development of society is achieved through early detection, prevention, and neutralization of national, real and potential, threats of interest to the National Security of Ukraine, considered as an integral phenomenon covering the political, economic, state, social, informative,

humanitarian, military, civil, fire, environmental and other areas of security.

The regulatory and legal basis for the functioning of the national security system of Ukraine and its subsystems is based on the Constitution of Ukraine, the Laws of Ukraine "On the Fundamentals of National Security of Ukraine", "On Defence of Ukraine", "On the Legal Regime of Martial Law", "On the Legal Regime of Martial Law", "On Democratic and Civilian Control over the Military Organisation and Law Enforcement Agencies of the State", approved by a Decree of the President of Ukraine in accordance with the provisions of the Law of Ukraine "On the Fundamentals of National Security of Ukraine" the National Security Strategy of 2015, other laws and regulations, as well as on the basis of treaties and agreements recognised by Ukraine.

2. In the event of an emergency in Ukraine, or in some of its localities - manmade or natural situations not lower than national one's levels that have led or may lead to human and material losses, and also pose a threat to the life and health of citizens - or in the case of an attempted seize of state power or changes in the constitutional system of Ukraine through violence, by decree of the President of Ukraine (which is subject to approval by the Verkhovna Rada of Ukraine) a legal state of emergency may be temporarily introduced.

A state of emergency in Ukraine, or in some of its localities, gives provisions for relevant state authorities, military command and to local self-government bodies according to this law on powers, necessary to avert the threat and ensure citizens' safety and health, normal functioning of the national economy, state power and local self-government bodies, constitutional protection order, and also allows for a temporary, threat-driven, limitation in implementation of constitutional rights and freedoms of man and citizen, in addition to legitimate interests of legal entities, with an indication of the period of validity of those restrictions.

3. In the event of armed aggression or threat of attack, threat to the state independence of Ukraine and its territorial integrity, the President of Ukraine can temporarily introduce the legal regime of martial law by a Decree.

Martial Law in Ukraine, or in some of its localities, gives provisions for relevant state authorities, military command, military administrations and local self-government bodies, that is the necessary powers to avert the threat, repulse armed aggression and ensure national security, elimination of the threat of danger to the state independence of Ukraine, its territorial integrity, as well as a temporary restriction caused by a threat to constitutional rights and freedoms of man and citizen and rights and legitimate interests of legal entities, with an indication of the period of validity of those restrictions.

4. Measures to eliminate the consequences of emergencies, fires and danger-

ous events on the territory of Ukraine are carried out by civil protection forces, including units of the Operational Rescue Service of Civil Protection, with the involvement of the National Police of Ukraine and units of the National Guard of Ukraine in accordance with the tasks assigned to them.

Direct organisation and coordination of work on liquidation of consequences of emergency situations, fires, and dangerous events are performed by: information exchange about the threat of emergency or emergencies, fires, and dangerous events in different regions of the country; conducting joint operations meeting of the Chairman of the State Emergency Service, or his deputies, with the Chairman (deputies) of the National Police of Ukraine and the Commander (deputies) of the National Police Guards of Ukraine, heads of territorial bodies of the State Emergency Service, with leaders of territorial (including interregional) bodies of the National Police of Ukraine and operational territorial units of the National Guard of Ukraine; carrying out joint activities according to the plans for the interaction of management bodies and forces of Civil Protection in the event of an emergency, which are being developed at the regional and local levels; conducting joint exercises and trainings; implementation of other measures.

5. In order to increase the effectiveness of information and analytical ensuring management decision-making, interaction, coordination and control over the activities of executive authorities, law enforcement agencies and military formations in the spheres of national security and defence in peacetime, and also in a special period, including under Martial Law conditions in state of emergency and during threatening crisis situations, National Security of Ukraine, Council of National Security and Defence of Ukraine decided to expand and further develop a single network of situational centres, which should include the Main Situation Centre of Ukraine, Government situational centre, situational centres of security sector bodies and defence, situational centres of central executive bodies, Councils Ministers of the Autonomous Republic of Crimea, regional, Kyiv and Sevastopol city state administrations, as well as reserve and mobile situation centres.

1. About the Concept (Fundamentals of State Policy) of National Security of Ukraine: Resolution of the Verkhovna Rada of Ukraine of January 16, 1997, No. 569-r.

2. On the legal regime of the state of emergency: Law of Ukraine dated March 16, 2000, No. 1550-III.

3. On the principles of domestic and foreign policy: Law of Ukraine dated July 1, 2010, No. 2411-VI.

4. Civil Protection Code of Ukraine dated October 2, 2012, No. 5403-VI.

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5. On the approval of the Procedure for preparing actions as assigned by bodies management and Civil Defence forces: Resolution of the Cabinet of Ministers of Ukraine dated June 26, 2013, No. 443.

6. On the approval of the Procedure for training the population in the actions of emergency situations: Decree of the Cabinet of Ministers of Ukraine dated June 26, 2013, No. 444.

7. On approval of the Order of formation, tasks and functions of formations of Civil Protection: Resolution of the Cabinet of Ministers of Ukraine dated October 9, 2013, No. 787.

8. On approval of the Procedure for conducting training of the management staff and specialists, whose activities are related to the organisation and implementation of measures on issues of civil protection: Resolution of the Cabinet of Ministers of Ukraine dated October 23, 2013, No 819.

9. On approval of the Procedure for evacuation in case of threat of emergency or emergency: Cabinet Order of Ministers of Ukraine dated October 30, 2013, No. 841.

10. On the approval of the Regulation on the Unified State Civil System of Protection: Resolution of the Cabinet of Ministers of Ukraine dated January 9, 2014, No. 11.

11. On approval of standard provisions on functional and territorial subsystem of the unified State System of Civil Protection: Resolution of the Cabinet of Ministers of Ukraine dated March 11, 2015, No. 101.

12. On the National Security Strategy of Ukraine: Presidential Decree of Ukraine on the decision of the National Security and Defence Council of Ukraine dated May 6, 2015.

13. On the legal regime of Martial Law: Law of Ukraine dated May 12, 2015, No. 389-VIII.

14. On the approval of the Instruction on the Procedure for the transfer of organs of the National Police of Ukraine on the enhanced variant of official activity: Order of the Ministry of Internal Affairs of Ukraine dated December 10, 2015, No. 1560, Registered with the Ministry of Justice of Ukraine on January 5, 2016, under No. 12/28142.

15. On the Concept of the Development of the Security and Defence Sector of Ukraine: Decree of the President of Ukraine on the decision of the National Security and Defence Council of Ukraine dated March 4, 2016.

16. On the approval of the Instruction on the Procedure for interaction between the State the Emergency Situations Service of Ukraine, the National Police of Ukraine and the National Guard of Ukraine in the field of emergency prevention and response situations, fires, and dangerous events: Order of the Ministry of Internal Affairs of Ukraine dated August 22, 2016, No. 859, registered to the Ministry of Justice of Ukraine on September 14, 2016, under No. 1254/29384.

17. On the approval of the Instruction on the Order of territorial cooperation Police bodies and interregional territorial bodies of the National Police of Ukraine during response to emergency situations, in case of introduction of legal regime of Martial Law or state of emergency: Order of the Ministry of Internal Affairs of Ukraine dated October 31, 2016, No. 1129, registered to the Ministry of Justice of Ukraine on January 19, 2017, under No. 85/29953.

18. On the approval of the Strategy for reforming the State Service System of Ukraine on emergency situations: Order of the Cabinet of Ministers of Ukraine dated January 25, 2017, No 61.

19. Some issues of using protective structures of Civil Defence: Resolution of the Cabinet of Ministers of Ukraine dated March 10, 2017, No. 138.

20. On approval of the Procedure for the development of unified activity plans State System of Civil Protection: Resolution of the Cabinet of Ministers of Ukraine dated August 9, 2017, No. 626.

21. On National Security of Ukraine: Law of Ukraine dated June 21, 2018, No. 2469-VIII.

22. Regarding the improvement of the network of situational centres and the digital one transformation of the sphere of national security and defence: Decision of the Council of National Security and Defence of Ukraine from June 4, 2021, entered into force by Decree of the President of Ukraine dated June 18, 2021, No. 260

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CHAPTER 2

FIRE EXTINGUISHING IN MILITARY CONFLICT ZONES: CRITICAL INFRASTRUCTURES FEATURES

As a result of the Russian aggression, with the start of active hostilities on February 24, 2022, the management bodies and units of the ORSCP were transferred to an enhanced mode of service and began to operate under martial law. Execution of assigned tasks is carried out in extremely difficult conditions that are significantly different from peacetime conditions.

Since the beginning of the war, Ukrainian cities and regions have been subjected to constant rocket, aircraft and artillery shelling, which has led to deaths, large-scale fires, significant damage to civilian infrastructure, and destruction of critical infrastructure and logistics facilities.

The objects of critical infrastructure of Ukraine (Fig. 2.1) include enterprises and institutions (regardless of the form of ownership) of such industries as energy, chemical industry, transport, banks and finance, information technologies and telecommunications (electronic communications), food, health care, communal economy, which are strategically important for the functioning of the economy and the security of the state, society and population, the failure or destruction of which may have an impact on national security objects of critical infrastructure: government institutions, cultural sights heritage, emergency systems, assistance to the population and response to emergencies, railway stations, airports and metro, oil and gas pipelines, energy and transport trunk networks, places of mass gathering people, objects and channels high-speed and government connection, sea ports, hydrotechnical and highway structures, military facilities, energy supply systems and life support, other objects and defence, the natural environment, lead to significant material and financial losses, human casualties [1, 2].

The Law of Ukraine "On the Basic Principles of Ensuring Cybersecurity of Ukraine" uses the term "Critical Infrastructure Objects", defining them as legal entities whose activities are directly related to technological processes and/or provision

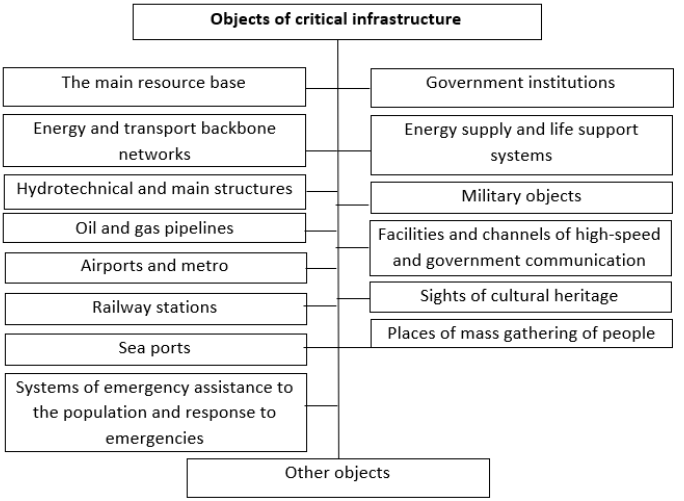

Fig. 2.1. Objects of critical infrastructure of Ukraine

of services that are of great importance for the economy and industry, functioning of society and public safety, the failure or disruption of which can have a negative impact on the national security and defence of Ukraine, the environment, cause property damage, and/or pose a threat to human life and health [3].

The European Union (EU) defines critical infrastructure as systems that are essential for the maintenance of vital social functions. A damage of critical infrastructure, its destruction or disruption as a result of natural disasters, terrorism, criminal activity or malicious behaviour, can have a significant negative impact on the EU's security and the well-being of its citizens [4, 5].

Practically all objects of critical (Fig. 2.1) and civil infrastructure of Ukraine in the zone of military conflict is under constant threat of bombing, a large part of them was destroyed. As a result of shelling occur fire, which is accompanied by dangerous factors, the death of people, destruction of material values - necessary for the ORSCP divisions, which are required to respond quickly to the elimination of possible dangerous consequences, especially clear the organisation of operational actions, ensuring the safety of both the civilian population and personnel and employees of the units of the State Emergency Service.

Considering some experience of the units of the State Emergency Service

during the military Russian aggression against Ukraine, we will conduct a brief analysis and consider the general requirements and the main features of the organisation of fire extinguishing at individual critical objects infrastructure in the zone of military conflict. In the future, after the end of hostilities and a comprehensive analysis of firefighting and the elimination of the consequences by the Emergency Services to objects damaged or destroyed as a result of bombing and terrorist acts of the armed forces of Russia, a detailed report on each industry and enterprise will be compiled, with coverage of the main actions and operational indicators.

In order to prevent the disclosure of information that allows the enemy to assess the effectiveness of shelling, in subsequent sections no specific objects are given of critical infrastructure, data on the consequences of fires, the forces and means involved, time indicators and other detailed information.

2.1 Organisation of fire extinguishing for storage facilities of petroleum products in hostile conditions

It should be noted that the most difficult part of the organisation to extinguish fires that occurred as a result of bombing in hostile conditions, is the presence of critical objects infrastructure and, in particular, oil storage companies. Below we will consider the issue of the organisation of fire extinguishing in companies of storage of petroleum products, we will perform a brief fire-extinguishing analysis during the war. Here we summarize the experience of the Emergency Response Unit of the State Emergency Service, namely the practice of extinguishing fires on enterprises of this industry in peacetime and the period of hostilities that occurred on the territory of a number of Ukrainian regions following bombing by the Russian armed forces.

As a result of the shelling, up to 80% of the facilities where oil products were stored and processed were completely or partially destroyed, leading to fuel shortages and, in the first weeks, to a virtual absence of fuel. By May 10, the total amount of direct damage caused to Ukraine by the war started by Russia exceeded $94.3 billion, with destroyed or damaged oil depots costing Ukraine $227 million.

Peculiarities of execution by the management bodies and divisions of the ORSCP of the Centre of Central Ukraine, the FRU (Fire and Rescue Units) of the State Emergency Service of Ukraine operates on sensitive targets in populated areas and territories subject to constant shelling during armed conflict. The operational activities are organised and carried out considering the situation on

the site of the dangerous event (fire), the characteristics of the emergency and the requirements imposed by the Statute on the bodies in action. Management and subdivision of ORSCP during firefighting are governed by the legislation approved by the Ministry of Internal Affairs Ordinance of 04/26/2018 No. 340, registered with the Ministry of Justice on 07/10/2018 No. 801/32253 [6] (hereafter - Charter of Actions) and other guidance documents on fire fighting.

Analysis of the organisation of firefighting at oil storage facilities that occurred as a result of shelling

During the Russian military aggression against Ukraine, which began on 24 February 2022, the enemy carried out massive bombings on oil storage companies, both in the areas of hostility and in the lower part of the country (Fig. 2.2).

The enemy uses artillery to deal damage to fire systems, aircraft, cruise missiles, and ballistics.

As a result of fire damage to the oil product storage, enterprises (oil depots and oil storage facilities, tank farms, etc.) are destroyed; there are large-scale fires, the territory of the objects is polluted by EO, there is the threat of repeated attacks.

In these difficult conditions, the State Emergency Service of Ukraine's agencies and units provide response to all fire incidents, and operational actions are organised in accordance with the requirements of regulatory acts, with mandatory consideration of the specifics of the situation at a specific time at the scene and the maximum possible observance of the safety measures for those involved in extinguishing the fire.

According to the analysis of the operational actions of the management bodies and the firefighters during the extinguishing of fires at oil storage facilities caused by rocket and artillery shelling, the State Emergency Service's management and employees acted in accordance with the specific situation at the scene, which was changing dynamically, with maximum compliance with the requirements of the Statute of Procedure and safety measures for the participants in the extinguishing.

The decision to involve units to extinguish such fires was made after exchanging information with the Armed Forces, Law Enforcement Units bodies, subdivisions of TD (Territorial Defence) and local bodies of Executive Power, clarification of information regarding possible repeated, just like clarification safe routes of movement of units to the scene of the incident.

In some cases, considering the development of the situation and the danger to personnel, first to the scene of the fire to conduct reconnaissance the next change of OCC (Operational Coordination Centre), or one operational calculation for

Regions of Ukraine	Number of hits (of shelling)				
Volynsk	1				
Dnipropetrovsk	1	1	1		
Zhytomyr	1	1	1		
Zaporizhzhia	1				
Kyivska	1	1	1	1	
Luhansk	1	1	1	1	1
Lviv	1				
Odesa	1				
Poltava	1	1			
Rivne	1	1			
Sumy	1	1			
Ternopilsk	1				
Kharkivska	1	1			
Khmelnytska	1	1			
Chernihivska	1	1			
TOTAL	32 hits				

Fig. 2.2. Damage to oil infrastructure of Ukraine (As of 04/24/2022)

FRV (Fire and Rescue Vehicle), was directed, and already based on their information, decisions were made regarding the nomination of the main forces and means to minimize possible damage to fire-rescue equipment under and during tracking, a safe distance of up to 100 m was observed between FRVs.

After the units arrived at the scene of the incident, the HFE (Head of Fire Extinguishing) conducted a fire investigation, established at the place of work the presence of EO (Explosive Objects) that could remain after shelling, determining possible shelters for personnel in case of repeated shelling. The HFE, in the majority, spoke: the senior staff of the FRU (Fire and Rescue Units) of SES (State Emergency Service), who has a permit to lead fire extinguishing, with significant experience in extinguishing fires, and senior officials from among the territorial management bodies of the State Emergency Service.

To manage the forces and resources, fire headquarters were formed, the required number of fire fighting vehicles were deployed to cool the tanks, extinguish oil products in the tanks and spilled in the dumps, the situation at the fire site was constantly observed, the threat of repeated shelling was controlled, and measures were taken to prevent injuries to personnel, including from explosive

munitions fragments that could remain after the shelling.

The replenishment of internal sources of fire water supply was carried out by pumping large amounts of water from outside, from the nearest large reservoirs, ponds, and lakes.

The main efforts of the FRU were focused on preventing the fire from growing uncontrollably and spreading to the surviving tanks by intensive cooling and reducing the intensity of burning of spilled oil products by supplying air-mechanical foam. Artificial barriers, including the use of sandbags, were installed to contain oil spills. In the case of the threat of repeated shelling, operational activities were stopped, personnel and equipment were withdrawn to a safe place and took refuge in an organised manner, or a decision was made to return to their permanent deployment locations.

In some cases, fire extinguishing was not carried out due to constant shelling and mortal threat to personnel.

Fire extinguishing at oil product storage enterprises is significantly complicated:

- the impossibility of rapidly supplying water-based paint to the fire due to the threat of repeated shelling;
- contant spillage and burning of oil products from a large number of simultaneously destroyed and punctured tanks;
- leakage of oil products from the tanks through holes caused by ammunition hits;
- overflow of oil products due to foaming due to damaged breathing valves or cracks in the upper part of the tank;
- explosions of oil product vapours in emptied tanks;
- a large fire area, high temperature, powerful heat and convective flows, and heavy smoke;
- impossibility of using fire hydrants at the facilities due to damage to pumping stations and insufficient quantity of coolant (water);
- the need to arrange for the pumping/supply of water and foaming agent, and in some cases, the poor quality of foaming agent from the facility's stocks.

Thus, the operational actions of the management bodies and units of the State Emergency Service during the extinguishing of fires at oil storage facilities that occurred as a result of shelling in the context of hostilities were correct, organised in accordance with the requirements of the Charter of Actions, taking into account the situation at a particular time at the scene and with the maximum possible observance of safety procedures for the participants in the extinguishing.

During the extinguishing of fires at oil product storage enterprises, which did not occur due to violations of fire safety rules or storage technology oil products,

and as a result of the external influence of combat weapons, it is necessary to take into account a number of additional factors, namely:

- the possibility of repeated shelling of nearby tanks with oil products and places of deployment of forces and means of the State Emergency Service;
- the possibility of simultaneous damage and burning of several tanks, including dispersed, or the entire composition of oil products;
- the possibility of burning jets of oil products that flow out under pressure from holes after tank damage;
- delay in the departure of the State Emergency Service's forces and equipment due to shelling of the oil products warehouse;
- the possibility of temporary suspension of operational activities during the fire extinguishing process to withdraw and shelter personnel due to the threat of shelling;
- lack of pressure in the fire water supply network due to damage to electrical and water networks, damage to pumping equipment;
- possible destruction of fire reservoirs and reservoirs with water supply for fire extinguishing and foaming agent storage places;
- contamination of the territory with unexploded ordnance and their explosive debris;
- the possible absence of maintenance personnel at oil storage facilities due to the threat of shelling or their hiding in shelter.

The central apparatus of the State Emergency Service of Ukraine summarized the experience of response, namely the practices of extinguishing fires at oil storage facilities that occurred in a number of regions as a result of shelling, firefighting guidelines and other sources [6-10]. Based on the work done, Methodical Recommendations on the organisation of operative actions of bodies were developed by management and units of the State Emergency Service during firefighting in warehouses oil products, occurring as a result of shelling in the conditions of hostilities [11]. Structurally, the Methodological Recommendations consist of 6 Chapters and an Appendix intended for use by SES officials in organising operational actions of the SES FRU [12].

The possible fire situation at oil storage facilities after shelling

As a result of rocket and artillery shelling of oil storage facilities (warehouses, tank farms, etc.), a significant number of tanks, structures and technological communications are destroyed and damaged, which is accompanied by large-scale fires (Fig. 2.3).

During the fire, the following situation is observed:

- destruction of tanks due to fires, spills and spread of oil products over a significant area, also due to the absence or, in some cases, collapse of tank parks;

- spillage of oil products from tanks due to heating and foaming;

- release of dark oil products from tanks due to boiling;

- the formation of zones - "pockets" in damaged reservoirs, which complicate the supply of FES (Fire extinguishing substances) due to the collapse of the tank roof;

- strong thermal radiation from the burning tank - powerful convective flows of combustion products and their direction change depending on meteorological conditions;

- rapid development of fire and spread of fire through technological trays, sewage and other systems;

- damage to tanks as a result of rocket fragments flying and leakage of oil products.

If the lining of the tank (group of tanks) is not damaged, the fire area will be limited to the lining within which the burning oil products are spreading.

If the lining of a tank (group of tanks) is damaged, the fire area will rapidly increase as oil products spread over the territory of the tank farm and pose a threat to neighboring, surviving tanks. In some cases, oil products can spread beyond

Fig. 2.3. Fire situation at the oil depot as a result of shelling

the boundaries of the tank farm and pose a threat of fire spread to neighboring facilities and settlements.

In the event of damage to railway tanks on access tracks and overpasses, the spread of burning oil products on the adjacent territory occurs.

As a result of shelling at the oil products storage facility, fire extinguishing systems, fire water supply, electricity supply, and the destruction of foam and fire rescue equipment may be damaged.

When the State Emergency Service of Ukraine is extinguishing the fire, there is a constant threat of a second attack on the oil storage facility.

Organisation of fire extinguishing at oil product storage facilities after shelling

The features of the fire fighting organisation after shelling are determined by the results of the study, prediction and assessment of the situation.

1. The decisive direction of operational actions on a fire that has occurred at oil storage facilities as a result of rocket and artillery fire should be considered the direction in which there is a danger to people, a threat of explosion, destruction of structures, a threat of fire spread to adjacent groups of tanks, buildings, structures and in which operational actions of fire and rescue units of the State Emergency Service at this time can ensure the success of fire extinguishing.

The State Emergency Service forces and means are deployed on a first priority basis in the critical area of operational actions, taking into account the situation and the threat of repeated shelling of the object's location.

2. In the case of combustion of oil products within the collapse limits due to the mass destruction of tanks due to insufficient forces and resources, the main efforts of the fire protection system should be directed to the protection of nearby tanks, survivors, not on fire. To protect surviving tanks that do not burn, powerful jets of water should be applied for their cooling and use, if available, fixed irrigation systems. At the same time, it is necessary to ensure controlled burning of spilled oil products from destroyed tanks within the bund by supplying FES from the side of neighboring surviving tanks to reduce the burning intensity and, consequently, reduce the thermal impact on them.

3. In case of damage to the tank (group of tanks) lining and spreading of burning oil products beyond its boundaries, it is necessary to arrange for additional lining and guide shafts to localize the spread of the spill or to divert it to a safe place.

To perform these engineering works, the facility's forces and means and nearby Civil Defence units should be involved.

The main efforts of the FRU should be focused both on the protection of unharmed tanks that do not burn, and on the protection of the forces and means involved in conducting engineering work for the arrangement of additional embankments and directional shafts.

In this case, the localization of the fire can be achieved, as a rule, by controlling the burnt-out of spilled oil products.

4. If possible, if there are sufficient forces and means and confidence in achieving positive results of operational actions, a foam attack should be prepared and carried out to extinguish oil products in the collapsed and intact burning tanks.

5. If oil products are located in railway tanks on the approach tracks and the overflow overpasses of the warehouse, it is necessary to organise their removal with the help of shunting locomotives to a safe place outside the affected areas.

In the case of burning railway tanks, after they are removed from the territory of the oil products warehouse, it is necessary to arrange for the uncoupling of the tanks and removal of those that are not burning to a safe place.

To locate oil spill sites, it is necessary to arrange for their embankment and the installation of guide shafts to divert spilled oil products away from the surviving tanks.

If there are sufficient forces and means available, the tankers and oil spill are extinguished. If there are insufficient forces and equipment, the main efforts are focused on ensuring controlled burnout of the oil spill and protection of the tanks.

6. During shelling, or the threat of repeated shelling of the location area facility, when there is a danger to the personnel, operational extinguishing actions fires are not carried out at oil product storage enterprises. Personal warehouse and equipment are taken to a safe place. Recovery of operational actions carried out after termination or minimization of the threat to personnel.

Management (leadership) of forces and means during fire extinguishing at oil product storage facilities after shelling.

During the organisation of fire extinguishing at petroleum product storage facilities, the HFE must:

- to find out (clarify) the presence of destruction on the routes of fire-fighting vehicles, rubble and other obstacles to the place of fire extinguishing;

- to arrange the exploration and determine the decisive direction of operational actions, establish the peculiarities of fire development, determine the methods of fire extinguishing, the need for forces and means to localise the fire or reduce the intensity of thermal radiation;

- to establish a Fire Headquarters, including representatives of the facility administration, units of the Armed Forces of Ukraine, TDs, law enforcement agen-

cies, military administration and local authorities;

- to find out the location, type and condition of fire water supply sources, and in case of insufficient water at the facility, take measures to supply or pump additional water;

- to determine the fire protection units at the work sites (objects), appoint the heads of the fire protection units, inform them of the tasks, and assign forces and means to the fire protection units;

- to create a reserve of forces and means for solving problems that arise suddenly;

- to appoint an observer who, in cooperation with representatives of military formations, should constantly monitor the danger from the air and, in case of a threat, inform the participants in firefighting;

- to appoint a person responsible for monitoring compliance with safety measures by personnel;

- to ensure timely implementation of the decision and strict compliance with safety measures by the staff.

During reconnaissance, fire extinguishing, preparation for foam attack and after the elimination of the fire, the Fire Headquarters officials (CS, HR) must organise and carry out their actions in accordance with the requirements of the firefighting management documents, depending on the situation at the fire, while maintaining appropriate safety measures.

2.2 Organisation of fire extinguishing at energy enterprises in hostile conditions

The destruction of Ukraine's energy facilities, energy supply and life support systems began from the first days of the war. The enemy has been using air-, sea- and land-based cruise missiles, ballistic missiles, anti-aircraft guided missiles and Iranian Shahed-136 drones.

Since the beginning of the full-scale invasion, the armed forces of the aggressor country have carried out 85 attacks on electricity facilities, including 51 in October (Fig. 2.4).

The most attacks on critical infrastructure facilities were made in Dnipro region - 8, Lviv - 6, Vinnytsia - 5, Sumy - 4, Kharkiv - 4, and Kyiv - 4.

At first, the occupiers attacked non-critical facilities that affected certain regions: district heating stations or thermal power plants (TPPs) that produce heat and hot water, and thermal power plants (TPPs) in the area of active hostilities.

On October 10 - 11, Russian terrorism reached a new level: they began to target critical energy infrastructure. The energy system has two main components: the generation of electricity and the infrastructure for its supply. In October, the

Regions of Ukraine	February	March	April	May	June	July	August	September	October	TOTAL
Vinnytsia									5	5
Volynsk									2	2
Dnipropetrovsk									8	8
Donetsk	1			1	2	4	2	4		14
Zhytomyr									2	2
Zaporizhzhia	1									1
Ivano-Frankivsk									2	2
Kyiv									4	2
Kyivska	1								3	4
Kirovohradsk									2	2
Luhansk					2					2
Lviv									6	6
Mykolayivska								1	2	3
Odesa				1					1	2
Poltava			1						1	2
Rivne									2	2
Sumy	2	2					1	4	4	13
Kharkivska								3	4	7
Khmelnytska									2	2
Chernihivska	1									1
TOTAL	5	3	1	2	4	4	3	12	51	85

Fig. 2.4. Damage to the electricity facilities of Ukraine (as of 10/24/2022)

Russians tried to destroy both components. Terrorists attacked switchgear, transformers and switches to prevent the plants from connecting to the energy grid. The enemy's key targets were Ukrenergo's high-voltage transformer substations and power generation equipment at the thermal power plants.

It is known that the situation is very complicated: after the last attack, 30 to 40% of the energy system was damaged. Why is it difficult to name an exact number? Every hour the situation changes in both directions. Power engineers and rescuers are working to repair damaged facilities around the clock, while new attacks are taking place.

As a result of Ukraine's massive rocket attacks on critical infrastructures in the energy sector, many fires broke out, which were accompanied by rapid spread, injuries and deaths, destruction of technological equipment, buildings and structures, and many other factors that influenced the operational actions of the State Emergency Service FRU.

A significant number of personnel and employees of the State Emergency Service of Ukraine, fire and rescue and special vehicles of the State Emergency Service of Ukraine, employees and emergency equipment of Ukrenergo were engaged in firefighting and emergency response.

Analysis of the operational actions of management bodies and FRU during firefighting on the territory of enterprises of the energy industry, which occurred as a result of rocket artillery shelling, indicates that the management and personnel of the State Emergency Service acted according to the specific situation at the scene, which is constant changed, with maximum compliance with the requirements of the Statute of Actions and safety measures for firefighters.

The possible situation of fires at the energy facilities is determined by the general operational and tactical characteristics, operational and tactical features of individual industries, sites, premises, structures, installations and apparatus, and the specifics of fire and emergencies development (Fig. 2.5).

The complexity of the situation at fires is caused by the advanced fuel economy, a large amount of oil-filled equipment, a significant length of cable facilities, which are combined with many premises of the main structures of the facility, as well as the presence of high-voltage power grids and installations and the presence of radiation at the nuclear power plant [13].

The fire situation at energy facilities as a result of shelling and bombing was influenced by the following:

Fig. 2.5. The situation at the fire

Fig. 2.6. The situation at the fire

- operational and tactical characteristics of the object, its type, purpose and the nature of the technological process [nuclear power plants, hydroelectric power plants (HPS), TPP, TPP, stationary diesel power plants, transformer plants substation];
- location of the facility (within the city, settlement, nearby located residential areas and other industrial one's enterprises, outside cities);
- the nature of the destruction of objects as a result of shelling, the influence of dangerous factors of fire and explosions of technological equipment;
- time of day (the effectiveness of operational actions is significantly reduced at night).
- *Extinguishing fires at energy industry enterprises as a result of shelling and bombing became much more difficult* (Fig. 2.7):

- the impossibility of rapidly supplying the extinguishing agents to the fire due to the threat of repeated shelling;
- pouring out, burning and spreading of process oils from generators, transformers and switchgear destroyed and damaged by shelling on large areas;
- combustion of lubricating fluid in the transformer housing, which is followed by its rapid boiling and ejection through the holes formed after the explosion;
- the rapid spread of fire by the combustible insulation of the cables laid in trays, tunnels and mines;
- the using of coal dust, hydrogen, nitrogen, oxygen and fuel oil in the technological process;
- high temperature, heavy smoke and the formation of toxic combustion products;
- the collapse of structural elements of machine and boiler rooms of TPPs, HAPPs and HPSs caused by shelling;
- destruction and cluttering of the territory of the facilities the metal transmission poles;
- damage to main hose lines by unstable debris structural elements of buildings and structures;
- the presence of electrical installations under high voltage;
- impossibility of using fire-fighting water supply due to damage to pumping stations, insufficient amount of FES (water) at fire stations reservoirs and special water reservoirs.

During extinguishing of fires at energy enterprises that occurred as a result of the external influence of military means of destruction, must be considered a number of additional factors, namely:

- delay in the departure of the forces and means of the State Emergency Service in connection with the shelling of the territory object;
- the possibility of repeated shelling of objects and places of deployment of forces and means of the State Emergency Service;
- the possibility of simultaneous damage and burning of several transformers, generators, including cable management;
- the possibility of electric shock to the SES personnel;
- the possibility of temporary suspension of operational activities during extinguishing fires for evacuation and shelter of personnel due to the threat of shelling;

- possibility of destruction of fire reservoirs and lack of pressure in the network of the firefighting water supply system, due to damage to the electrical and water supply lines networks, damage to pumping equipment;
- the possibility of damage and the occurrence of fires in structures and buildings adjacent to the object;
- contamination of the territory with ammunition and other unexploded explosives, and their explosive fragments;
- the need to involve a sapper unit of the Armed Forces of Ukraine or a pyrotechnic unit of the SES;
- possible absence of service personnel due to the threat of shelling or their shelter in protective structures.

Peculiarities of the organisation of fire extinguishing and management of forces and means by Emergency Services at energy industry facilities in the conditions of hostilities consisted of a clear compliance with the requirements of the Statute, safety

Fig. 2.7. Extinguishing a fire in a group of transformers as a result of shelling

and labor protection rules, guidelines documents on fire extinguishing at energy facilities of Ukraine and a clear and continuous interaction with the servicing engineering and technical personnel of energy facilities, facility and city emergency units, communal services, pyrotechnic units of the State Emergency Service, as well as from units of the Armed Forces of Ukraine, TD, Law Enforcement Agencies, military administrations and local authorities.

2.3 Organisation of fire extinguishing at civilian (urban) infrastructure facilities in hostile conditions

When considering issues of firefighting in wartime, one cannot not touch on the specifics of the operational activities of the units of the State Emergency Service at the facilities civil (urban) infrastructure.

Urban infrastructure is a set of structures, buildings, systems and services, necessary for the functioning of the city.

From the very beginning of the military aggression, the Russian occupiers have been committing acts on the territory Ukraine's war crimes, cynically shelling the civilian population. The invaders rockets and bombs are dropped on children's hospitals and maternity homes, they are shelled housing estates, schools, kindergartens, sports complexes, markets, as well as administrative buildings of local and regional administration.

Unfortunately, there are no exact statistics on the destruction, because in some regions, representatives of state administrations are unable to record the destruction due to the ongoing heavy shelling by the Russian armed forces.

However, human rights activists of the Ukrainian Legal Advisory Group have collected data on destruction of civil infrastructure from open sources (Fig. 2.8) and they speak that this is only a small fraction of the future destruction statistics.

Destruction of civilian infrastructure by the armed forces of the Russian Federation can violate the norms of International Humanitarian Law and qualify as the most serious crimes under the Geneva Conventions and the Rome Statute. By preliminary assessment, many of these attacks on civilian targets are extensive, indiscriminate, willful or reckless, are not "necessary in time of war".

The most affected regions remain territories, cities and settlements of the northern, eastern and southern parts of Ukraine, which are located in the zone of active hostilities, which were exposed to fire from the first days of the war attack by almost all means of warfare: aerial bombs, mines, missile and artillery systems of defeat, and de-occupied territories that are under constant fire. As a result,

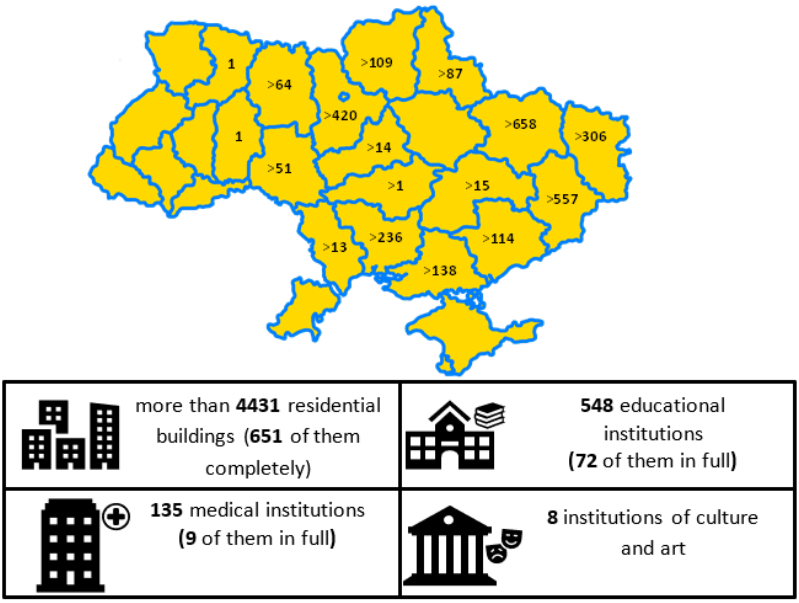

Fig. 2.8. The number of destroyed civilian infrastructure objects as a result of shelling (as of March 22, 2022)

people die, complex fires occur, significant destruction of civil facilities and infrastructure occurs - one of the largest residential areas in Kharkiv, namely Severnaya Saltivka, called the "Ghost of Kharkiv", under the rubble of which people find themselves (Fig. 2.9).

Since the beginning of hostilities, the State Emergency Service rescuers have been working at the limit of human and technical capabilities to protect the civilian population. Over this time, they have extinguished more than 15,000 fires caused by enemy shelling, defused a large number of explosive devices and mines, and rescued more than 2,000 people from the rubble.

Features of the operational and service activities of the ORSCP during the martial law period in responding to the fires and emergencies that occurred at civil infrastructure facilities.

Under the conditions of Martial Law, the ORSCP activity is carried out in accordance with tasks assigned to the service. On the ORSCP, except for extinguishing fires, there were many tasks assigned to it that in peacetime does not solve [14]. Namely: evacuation of population from dangerous territories; delivery humanitarian cargo; exhumation of bodies of killed citizens; provision power supply of critical and civil infrastructure facilities and others, depending on the situation. This list of tasks requires some changes in the organisation of service activity, first of all concentration of forces and means. For this purpose, the fire and rescue units of the SES were introduced to a special regime of duty for two days in a row, which made it possible to double the number of personnel on duty. All units have been provided with reserve vehicles and equipment. To reinforce the garrisons, the SES units evacuated from the occupied territories and the National University of Civil Defence of Ukraine, which consisted of academic and teaching staff, were also included in the operational calculation.

Fig. 2.9. Damage to civil infrastructure objects as a result of shelling, which are accompanied by fires and destruction

Considering the huge amount of work involved in fire fighting and rescue operations (during large-scale shelling, up to 50 fires broke out simultaneously), sometimes almost all personnel on duty and a significant number of fire and rescue and special vehicles were involved at the same time, which significantly strained the command and control system. In this regard, the duty units of the OCCs of the State Emergency Service were also transferred to an intensified version of service, and in the event of massive shelling and a large number of fires, the command staff of the operational groups of the State Emergency Service's main departments were additionally involved in managing firefighting and rescue operations.

Operational management of forces and means was carried out by operational headquarters, which worked around the clock in protected management points. In the course of their activities, the headquarters solved a large number of different issues, ranging from collecting information on the operational situation and responding to it to supporting the activities of SES units, organising the interaction of the FRU with support services, disaster medicine, units of the Armed Forces of Ukraine, TD, law enforcement and volunteer organisations.

The feature of the State Emergency Service unit's response is the increase in response time on call. This is primarily related to job security, namely after arriving at the place of the call, locations need to be explored to provide shelter to operational personnel in case of danger, as well as the ways of following them in case of repeated shelling, the presence at the site of the works of the unexploded EO (Explosive Objects), the return units to the places of deployment from the follow-up route, in cases of repeated ones shelling, etc. During the operational actions of the FRU, the State Emergency Service was repeatedly hit under enemy fire; in addition to situations where explosives detonated at the site of the works, what does not burst, causing the death and injury of the State Emergency Service personnel. The enemy carried out remote mining of territories, which makes much more difficult following the FRUs to the call location and increases the arrival time (from 3 to 15 minutes), generally affecting the time of fire elimination, the consequences of emergencies and efficiency of helping victims.

The main types of work on civil infrastructure facilities, which suffered from bombings and shelling, there are: evacuation and rescue of people, extinguishing fires, removing debris to remove the injured and the dead. Under the time of rescue operations and liquidation of the consequences of shelling shortage of specialists capable of carrying out rescue work and demolition of debris in the heights has been warned.

Therefore, Operational and Rescue Service of Civil Protection (ORSCP) of

the SES garrisons and additional personnel of specialists hired in the service have experience in carrying out works at heights of buildings and structures. In addition, volunteers provided considerable assistance in clearing the rubble to rescue people. The main efforts of the SES units were directed at rescue operations from buildings and structures destroyed by bombardment and shelling. (Fig. 2.10).

Many people were trapped under the rubble of the structures, asking for help. If there was even a small chance of unblocking a person quickly, rescuers would try to pull the victims out manually, using hand-held rescue tools and small mechanical equipment. In the first hours, it is very important to find every injured person, because time is of seconds. It is necessary to take a person out from under the rubble as soon as possible to provide them with help. There were also people trapped in the rubble, which required searching for them. In such conditions, the search operations involved robots and canine units, and in addition to special rescue vehicles, heavy engineering equipment was used to remove the rubble [15].

The huge amount of fire and emergency responses in combat situations requires constant updating and logistical support of the FRUs to provide fire and rescue vehicles and equipment, protective clothing, mine clearance and neutral-

Fig. 2.10. Conducting search and rescue activities in the destroyed buildings

isation equipment, etc. The central apparatus of the SES provides continuous assistance in this field. For instance, humanitarian aid from EU states and volunteer organisations, as part of the programme of assistance to Ukraine due to the Russian war of aggression, is used to replenish the State Emergency Service's park with new types of fire and rescue and special vehicles, fire hoses, fire and technical equipment, medical supplies, etc.

The analysis of the operational actions of the management bodies and the SES during the liquidation of fires and emergencies based on the study of the cards of operational and tactical actions in case of fires (COTAFs) [16] that occurred at civil infrastructure facilities and resulted from bombing and shelling, indicates that the State Emergency Service management and personnel acted in accordance with the specific situation and conditions at the scene of the fire or emergency, with the maximum observance of the requirements of the Statute of Operations and general requirements for the organisation of firefighting (operational actions) in areas of constant shelling.

The possible fire situation at civilian infrastructure facilities, such as residential and administrative buildings, is determined by the general operational and tactical characteristics of the facilities, operational and tactical features of residential and administrative buildings, and the specifics of fire and emergency development.

The complexity of the fire situation is caused by the presence of a large number of people; a large amount of combustible load; rapid spread of fire, smoke and high temperature; the number of storeys of buildings and the complexity of the layout of the premises; the presence of power grids and household communications.

The fire situation in the civilian buildings as a result of shelling and bombardment was affected and complicated:

- operational and tactical characteristics of buildings, their type and purpose (residential or administrative, rural or urban buildings, number of floors buildings and their degree of fire resistance);
- a significant number and condition of people (children, the elderly, the aged, the sick, etc.);
- season of the year, time of the day, meteorological conditions (at night, in conditions of low temperatures, strong wind speed, the effectiveness of operational actions is significantly reduced);
- nature and type of building destruction (fully or partially destroyed building, within one or more floors, by direct or oblique hit of combat weapons).

While fighting fires at civilian infrastructure facilities that occurred as a result of external attack by military means of destruction, it is necessary to consider a number of additional factors, namely:

- the delay in the departure of SES forces and means due to shelling of urban areas; the possibility of repeated shelling,
- whether on the way of the units to the scene or at the location of the SES forces and means;
- the possibility of temporary suspension of operational actions to withdraw and shelter personnel due to the threat of shelling;
- the pollution of the territory and facilities of the unexploded EOs; the need to use the SES pyrotechnic unit;
- the possibility of destruction of the fire water supply.

As well as factors influencing the conduct of the operational rescue activities:

- the presence of people who cannot leave dangerous places on their own, who are trapped in the rubble and need help in freeing them from debris of collapsed structures, and who require medical assistance in case of injuries and wounds;
- the lack of special emergency rescue equipment for conducting the operational rescue activities, means of small and heavy mechanisation for dismantling the rubble, and, during the mass evacuation, the lack of personnel of the SES units.

The peculiarities of the firefighting organisation in this conditions meant that during the fire search, extinguishing agents were simultaneously supplied, people were found and rescued, and explosive objects was detected and removed to the hazardous areas. Small fire hoses with low water supply were used to extinguish the small fires, and powerful water jets were used to extinguish the big fires.

After extinguishing the fire, all forces and resources were directed towards disassembling the rubble, unblocking the victims trapped under the debris of the construction structures, and providing them with primary medical assistance. It was carried out simultaneously removing the dead and sending their bodies for identification.

All actions of the SES of Ukraine and other emergency response units during the firefighting and rescue operations were carried out in cooperation with utilities, law enforcement agencies, units of the Armed Forces of Ukraine, TD, py-

rotechnic units, and representatives of local administrations. Volunteers, cynologists and robotics, members of the TD, law enforcement officers, workers and civilian rescue and engineering vehicles of enterprises and organisations were involved to assist the SES during mass search and rescue operations.

2.4 Features of ensuring the safety and protection of SES personnel in hostile conditions

The work safety of the staff of FRUs of the State Emergrncy Service during fire and consequences of emergencies is determined by the Statutes of Operations, occupational safety rules and instructions of the SES [17]. The responsibility for maintaining occupational safety requirements belongs to the Head Fire Extinguishing (HFE) and other officials of the SES management bodies and units who manage the units. The personnel of the FRUs must strictly observe the relevant requirements that ensure their health and safety, depending on the nature of operational actions and the conditions of the situation at the fire or in the emergency zone.

New types of dangers have appeared in connection with the hostilities, including shelling and injuries to the personnel of the SES of the EOs.

The locations of fire and rescue units of the SES are subjected to the rocket and artillery shelling by the Russian military.

During operational activities, the personnel of the State Emergency Service units comes under the enemy's shelling, including repeated ones; susceptible to damage unexploded EOs.

All these dangers are accompanied by deaths and injuries of the rescuers, damages to fire and rescue vehicles and equipment.

Requirements for personnel shelter

According to instructions from the State Emergency Service management, local and regional authorities have developed guidelines with recommendations on the fitting-out of basements or rooms with protective properties against combat bullets to protect personnel units [18].

In each garrison of the Operational and Rescue service of Civil Protection, measures were taken to determine the accommodation and shelter for staff of administrative and territorial authorities during the "Air Alert" signal, which involves specification's personnel locations during service, depending on the presence of protective structures in the territory, the subdivision and volume planning, and structural characteristics of buildings (depots) of fire and rescue units.

In order to ensure the protection of personnel, the arrangement of basements or rooms with protective properties against hazards must comply with the following basic requirements:

- be located in the basement (underground), basement or first floor;
- be provided with electricity, artificial lighting, water supply and sewerage systems;
- not have large openings in the external fencing structures, available openings (except door openings), provide the possibility of their bookmarking (with sandbags or soil, concrete blocks, brickwork, etc.);
- have at least two entrances (exits), one of which may be an emergency entrance (in case of planning a dual-purpose shelter or a simple structure with a capacity of less than 20 people, one entrance is allowed) and be closed with reinforced doors;
- the premises must be equipped with places for sitting and lying down, sanitary facilities, have forced or natural ventilation, backup artificial lighting (lanterns, candles, etc.), primary fire extinguishing equipment and medical aid, and containers with drinking and technical water.

Requirements for protection (special clothes) of personnel

Decisions were made to ensure the safety of personnel that were not prescribed in the main regulatory documents, as the work of rescuers in the centre of Europe, in the conditions of war, is not quite typical for the 21st century.

According to the requirements of the SES leadership, personnel who are involved in fighting fires and emergencies in the area of active hostilities must be provided with one hundred per cent armour protection.

Personnel performing fire extinguishing and elimination of the consequences of emergencies should wear special protective clothing; in areas with increased thermal radiation, in heat-protective fire suits, and during possible bombardments and shelling, including repeated ones, in case of possible damage and injury by explosive fragments of ammunition that could remain after shelling, use additional clothing items, such as bulletproof vests and a blue Kevlar helmet with the appropriate inscription "SES", to distinguish them from the AFU units (Fig. 2.11).

Mine risk requirements for personnel

The enemy employs nearly all available means to defeat the Russian army during this military aggression, including bombing, rocket and artillery attacks, as well as the use of remote mines on various objects and territories.

Fig. 2.11. Non-traditional protection of the FRU personnel (blue Kevlar helmet with the inscription "SES" and bulletproof vest)

Moreover, a significant number of fires occur on the territory and facilities where the hostilities are taking place (or have taken place), including those with the presence of EOs. Awareness of personnel with the types of risks posed by EOs, as well as the procedure for their detection, reduces the risk to life and health of personnel.

Under the definition of an explosive object, we should understand any device, means, or suspicious object that can explode due to certain conditions. Any attempts to de-mining yourself or any other actions with the suspicious objects are strictly prohibited! It must be remembered that careless handling of these objects (attempts to pick up or carry, take apart, make any mechanical influence, etc.) can lead to death or significant harm to health, injury to a person or group of people. Do not use your phone near mines, ammunition and other types of explosive objects!

Actions in case of detection of explosive objects at the scene [19].

If an explosive object has been discovered during fire fighting and emergencies, it is not allowed to move closer to it or permit others to do so. You should immediately stop, do not panic and calm down. If you are not moving alone, warn others, loudly report the danger and order them to stop. Check for signs of other dangerous objects around you by carefully looking without moving. Carefully walk back the way you came, to a safe distance, trying to follow your footsteps. If possible, you should take cover behind a building or other protective barrier.

Thereafter, marked the dangerous area with a visible sign of red ribbon, handkerchief, etc., that is any handmade signs, marks and other visual warnings made with available means (Fig. 2.12) and inform the pyrotechnic units of the SES, the National Police of Ukraine or military authorities or TD (Territorial Defence).

In conclusion, the war against the Russian invaders, which has been going on for more than 8 months, has resulted in civilian casualties, suffering and destruction of infrastructure. The crisis is escalating every day, and humanitarian needs are increasing. Since the beginning of hostilities, SES rescuers have been working to the limit of their human and technical capabilities protecting civilians and carrying out operational tasks to eliminate fires and the consequences of emergencies.

For reference, as of November 12, 2022, since the beginning of the active phase of the armed aggression of the Russian Federation (February 24, 2022), units of the State Emergency Service carried out 66,551 trips to elimination of the consequences of shelling, 13,141 fires were eliminated, 2,000 people were saved; psychological assistance was provided to 184,154 people.

The SES units had to eliminate the consequences of fires and emergencies in the conditions of hostilities (war). The practice and analysis of the SES FRU's operational actions have shown that the SES personnel worked in accordance with the requirements of the governing documents on which the Service's activities are

Fig. 2.12. Unofficial warning signs for dangerous places where explosive objects are found

based, showing heroism, courage, and high motivation to accomplish their tasks.

In general, the amount of work carried out with the involvement of the SES is very considerable. The ORSCP units were engaged in the following activities: extinguishing fires caused by shelling; checking the site of shelling (enemy missiles); conducting rescue operations; removing rubble and structures of damaged buildings at high altitudes; and clearing explosive ordnance. They also assisted the population, police, and public utilities, including: evacuating the population; delivering humanitarian supplies; exhuming the dead; supplying electricity to critical infrastructure; and providing psychological assistance to the victims.

Given the unusual growth in the volume and complexity of operational actions during peacetime, there was an initial shortage of specific specialists needed to carry out work in the affected areas. These specialists included high-altitude operations experts (mountaineers, climbers, etc.), sappers, EO identifiers, premedical training specialists (paramedics on guard), heads of ORA and emergency recovery operations (specialists in rubble removal), as well as experts in fixing building structures and materials (slingers).

To ensure operational actions, a shortage was noted, namely: rescue means (rescue hoods) for mass evacuation from places of damage; shelters for civilian population and personnel; sources of fire-fighting water supply in certain areas of cities and settlements; absence and impossibility use of aerial reconnaissance equipment at fire sites and conduct of emergency response.

It is very important that the rescuers do not remain alone. They receive regular support from foreign partners and the volunteer movement. For example, as part of the program to aid Ukraine due to Russian aggression, with the assistance of the leadership of the Ministry of Internal Affairs and the State Emergency Service, charitable organisations in Ukraine and allied countries ensure that the material and technical support for rescuers is constantly replenished. Specifically, the fleet of fire and rescue vehicles has been considerably upgraded; a large amount of electrical, hydraulic and pneumatic equipment, as well as powerful power plants have been received, which are used both for the needs of the units and for critical infrastructure facilities; protective clothes and equipment have been updated; sets of climbing equipment and gear have been received; and huge experience has been gained in conducting debris removal operations and extinguishing fires in hostilities.

The gained experience and substantial support will help them to carry out more efficiently their operational tasks of protecting civilians from the consequences of enemy aggression.

On the whole, the garrisons of the SES of Ukraine are well-coordinated and combat-ready, ready to perform their assigned tasks.

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CHAPTER 3.

FEATURES OF THE ORGANISATION OF RADIOLOGICAL, CHEMICAL, AND BIOLOGICAL PROTECTION IN A MILITARY CONFLICT ZONE

Given the open violation of the norms of International Humanitarian Law by the Russian occupying forces and in order to be ready to respond to emergency situations and dangerous events related to the possible application of weapons of mass destruction, posts were deployed on the basis of units of the State Emergency Service radiation and chemical monitoring – hereinafter RCOPs (Radiation and Chemical Observation Posts).

RCOPs is a non-staff specialized formation designed for implementation of periodic or permanent radiation and chemical observation in accordance with established tasks and regulations [1].

Radiation and chemical observation posts are established by decisions of the Council of Regional and City Military State Administrations and by orders of heads of state enterprises, institutions and organisations. All RCOPs have one numbering within the regions.

Provision of RCOPs with devices of radiation and chemical intelligence, weather kit, set of signs of fencing, individual means protection and communication facilities are provided at the expense of enterprises, institutions and organisations, on the basis of which they are established.

To perform individual tasks of RCOPS at the expense of the attracting entity, it can be equipped with cars, including one specially equipped.

3.1 Main tasks of the radiation and chemical observation post and functional duties of the specialists

The main tasks of RCOPs are:

- timely detection of radioactive and chemical contamination of the territory within the area of responsibility of the post;
- presentation of signals "Radiation hazard", "Chemical alarm";
- informing the manager of the object and the calculation and analytical group about radioactive and chemical contamination of the territory in the post's area of responsibility;
- designation of the boundary of the zone of radioactive and chemical contamination on terrain;
- control over changes in the dose of ionizing radiation and concentration of hazardous chemicals within the area of responsibility fasting;
- sampling of soil and water contaminated with radioactive and dangerous substances chemicals, and sending them to the laboratory;
- observation of the meteorological situation.

The composition of the RCOPs includes: the head of the post, 1-3 radiation observers and chemical environment. The following is recommended for monitoring via RCOPs equipment:

- radiation reconnaissance device - 1 set (measurement range: from background values up to 1 Sv/h. (100 R/hour);
- chemical intelligence device - 1 set (for determining dangerous substances and chemicals);
- chemical reconnaissance device - 1 set (for determining combat poisons substances);
- weather kit - 1 set (RCOPS is equipped with a weather kit, if it is absent from the next object);
- means of communication and notification (telephone, siren, gong);
- individual dosimeters - for each post specialist;
- personal protective equipment (filter gas mask with gas-tight boxes for protection against dangerous chemicals and combat poisonous substances, dust respirator, protective suit) – on each post specialist;
- means for marking zones of radiation and chemical contamination (sets of fencing signs, signal tape, etc.) – 1 set;
- sampling kit - 1.

Fig. 3.1. The meteorological station is part of the radiation and chemical station observation

The head of the radiation and chemical observation post is subordinate to the head of the facility and is obliged to:

- know the tasks, equipment and possibilities of the post;
- clarify, with the head of the facility, the limit of the area of responsibility of the post, periodicity of radiation and chemical monitoring, order of notification and communication;
- check the serviceability of radiation, chemical reconnaissance and dosimetry control equipment, communications and notification devices;
- demonstrate to the observers the limit of the area of responsibility of the post, task regarding the implementation of radiation and chemical monitoring and order notification and communication;
- organise the rotation of observers at the post;
- if necessary, organise the post's engineering equipment;
- report to the head of the facility about the start of surveillance;
- in case of detection of radioactive or chemical contamination, report to the head of the facility, inform the calculation and analytical group and organise follow-up;
- organise provision of suitable power sources and indicator tubes for devices;
- organise the special treatment of devices of radiation and chemical intelli-

gence, means of communication and means of personal protection, as well as sanitary processing of the staff of the post.

The duty observer is subordinate to the Head of the RCOPS and is obliged to:

- check the serviceability and completeness of personal protective equipment, devices for radiation, chemical reconnaissance and dosimetric control, means communication and notification;
- put personal protective equipment in the "Ready" state;
- at the beginning of the shift and within the established deadlines, determine the direction and wind speed, air temperature;
- in time with the help of reconnaissance devices, carry out surveillance of radiation and chemicals;
- in case of detection of radioactive contamination, transfer the protective devices to "Combat" status, give the signal "Radiation Hazard", promptly report to the Head;
- after the detection of radioactive or chemical contamination, as well as in the presence of sudden changes in weather conditions, carry out meteorological overtime observation;
- on the instructions of the Head of the post, take samples of soil, water, contaminated radioactive or dangerous chemical substances, sending to research in a radiometric (chemical) laboratory;
- keep records in the journal of radiation and chemical monitoring.

3.2 Procedure for the role of radiation and chemical observation post in hostile conditions

In the daily mode of operation of the Unified State System of Civil Defence with RCOPs specialists, exercises on the execution of tasks in an emergency situation are conducted. For the preparation of the RCOPS, the head of the installation on the basis of which the post was created, is directly responsible for the assigned actions [1].

When the Unified State System of Civil Defence is activated under the following conditions: high readiness, emergency, or state of emergency, as decided by the head of the facility, RCOP personnel will proceed to the designated deployment location. They will then inspect the functionality and completeness of radiation and chemical reconnaissance devices and conduct meteorological, radiation, and chemical observations within the prescribed timeframe.

In case of exceeding the power of the exposure (equivalent) dose above 0.05 mR/h. (0.5 μSv/hour) within the area of responsibility of the on-duty observer of

Fig. 3.2. Control of the air condition by the duty shift of the operational and rescue unit

the post sends the signal "Radiation Hazard" and reports to the head of the post.

In case of detection of chemical pollution of air, soil, water within the limits, the on-duty observer of the zone of responsibility gives the signal "Chemical Alert" and reports to the head of the post.

On the instructions of the head of the post, the on-duty observer takes samples of soil, water contaminated with radioactive or dangerous chemicals substances to be sent for research in a radiometric (chemical) laboratory.

The head of the post immediately reports to the head of the facility about the radiation and chemical pollution of the object's territory, informs on the instructions of the head of the facility operative on-duty territorial body of the State Emergency Service of Ukraine and the chief of calculation and analytical group,

Fig. 3.3. Data collection from radiation and chemical monitoring stations

and within 2 hours sends it to the operative next message according to the established form.

The received data on the state of the radiation and chemical situation is entered by the station observer on-duty in the radiation and chemical monitoring log.

In the future, the observer on-duty carries out, within the established time, limits monitoring of changes in the radiation and chemical environment.

RCOPS reporting documents include:

- Journal of radiation and chemical monitoring;
- Copies of notifications about the dangerous environmental pollution by chemical and radioactive substances.

3.3 Observations by dispatch Services

Radiation and chemical monitoring at enterprises having a dispatcher service with a 24-hour duty mode, radiation and chemical monitoring measures are directly carried out by the dispatcher on-duty [2].

During shift acceptance and transfer, the dispatcher on-duty must familiarize himself with the situation in the area of responsibility, records in the radiation and chemical monitoring log, as well as visually inspect the integrity of the radiation and chemical detection devices and check their operation. Each device must have instructions for use, a technical passport and a certificate of metrological verification.

In the case of establishing an exposure (equivalent) dose power of 0.05 mR/h (0.5 μSv/h) and above, the appearance of anomalous phenomena - a colored cloud or suspicious drops on the ground, plants, building surfaces - the dispatcher on-duty immediately informs the management of the enterprise by telephone, the operational on-duty management body of the territorial subsystem of the Unified State System of Civil Defence of the Central District and the operational on-duty territorial body of the State Emergency Service (hereinafter - the duty of the State Emergency Service).

After being informed, the dispatcher, with the help of radiation and chemical reconnaissance devices and by taking samples, clarifies the strength of the exposure (equivalent) dose in the area, the type and concentration of a dangerous chemical substance in the air, takes samples of contaminated soil for research in radiometric (chemical) laboratory, clarifies the meteorological data and, within one hour, sends a written message about radioactive and chemical contamination to the emergency department on-duty [2].

For additional information regarding the results of radiation and chemical observations, the findings are communicated via telephone to the on-duty management of the territorial subsystem within the Unified State System of Civil Defence, as well as to the on-duty personnel of the Emergency Department. These communications occur within the timeframes specified by the management body of the said territorial subsystem within the Unified State System of Civil Defence.

In the event of the introduction of modes of heightened alertness, an emergency situation and in a special period, the dispatcher also transmits by telephone information on the results of radiation and chemical monitoring to the RAH of the district or city of regional subordination, on the territory of which the dispatching office operates service, within the terms determined by the management body of the territorial subsystem of the Unified State System of Civil Defence.

The on-duty dispatcher enters the data on the state of the radiation and chem-

ical situation obtained by his own measurements into the radiation and chemical monitoring register [2].

3.4 Iodine prevention in case of radiation accident

In the event of a radiation accident at nuclear installations, radioactive substances may be released into the surrounding natural environment, including significant amounts of radioactive elements (131-135I).

When released, as a result of an accident at a nuclear installation, RII (Radioactive Isotopes of Iodine) enters the human body, the thyroid gland absorbs it and is exposed to radiation. If the drug KI is introduced into the body before the beginning or during the arrival of radioactive iodine, the arrival of RII is blocked, reducing or deflecting radiation exposure of the thyroid gland and also reducing the risk of negative consequences for human health. KI drugs do not protect the body from the biological effects of other radionuclides that may be contained in the radiation release.

The levels of RII accumulation in the thyroid gland depend on the age of the person and the functional state of the thyroid gland. With the normal function of the thyroid gland of an adult, it accumulates about 30% of the total amount of RII entered the human body. In children, due to higher functional activity and smaller sizes of thyroid gland, than in an adult, the accumulation of RII in the thyroid gland occurs in larger quantities, faster, which contributes to the formation of a higher absorbed radiation dose.

Thus, in children under the age of one year, the maximum absorbed doses per unit of 131 activities are formed approximately 10 times higher than in an adult. As the child's age increases, the levels of accumulation of radioactive iodine in the thyroid gland decrease and by the age of 14 correspond to the levels of its accumulation in other adults.

In women who are breastfeeding, up to 30% of the total amount of radiopharmaceuticals ingested into the breast milk is excreted during the day.

When the function of the thyroid gland is disturbed, the level of accumulation of RII is significant change: in the case of hyper function, the accumulation increases to 50%, at hypo function decreases to 15 - 25%. In conditions of iodine deficiency levels, the accumulation of RII in the thyroid gland increases.

The degree of damage to the thyroid gland depends on the absorbed dose, the age of the person and the functional state of the thyroid gland. Significant doses of radiation can cause acute damage to the thyroid gland (especially in children),

which may manifest as a violation of the function and structure of the thyroid gland (acute hypothyroidism, acute thyroiditis, acute thyrotoxicosis). Levels definitely justified urgent intervention in case of acute irradiation of the thyroid gland are determined in accordance with the resolution of the Chief State Sanitary Doctor of Ukraine dated December 1, 1997, No. 62 "On the implementation of the State Hygienic Standards "Radiation Safety Standards of Ukraine (NRBU-97)" (hereinafter - NRBU-97).

With smaller doses of radiation, the development of benign and malignant neoplasm (nodules, cancer) in the thyroid gland is possible. According to scientific publications, an increase in the frequency of thyroid cancer in persons who were children at the time of the accident at the Chernobyl Nuclear Power Plant (hereinafter - Chernobyl NPP) was observed at absorbed doses of more than 0.1 Gy (100 mGy). The increase in cases of thyroid cancer in persons who were adults at the time of the accident at the Chernobyl nuclear power plant is not confirmed by statistical data.

Iodine prophylaxis (IP) - iodine blocking of the thyroid gland - is an urgent protective measure to prevent or reduce the absorption of RII by the thyroid gland, with the help of stable iodine preparations, which is primarily aimed at protecting the thyroid gland from the accumulation of RII (131-135I), received at the initial stage of a radiation accident by inhalation. IP belongs to urgent measures aimed at preventing the negative impact of the early phase of a radiation accident.

The risk of radiation damage to the thyroid gland can be reduced or even averted with the timely appointment of IP, as such or in combination with other radiation protection measures: limiting exposure to open air, shelter, evacuation, radiation control of food products, including drinking water, etc.

IP consists in the introduction of stable iodine preparations into the human body in the event of a radiation accident and under the condition of exposure to radioactive iodine isotopes. IP is applied before the exposure to RII or within the first 6 hours after the absorption of RII by the thyroid gland.

During radiation accidents at nuclear facilities, RII can be released as a plume or "cloud" and subsequently contaminate soil, surfaces, food and water, as well as settle on human skin and clothing, resulting in external exposure.

RII deposited during external exposure can be removed with detergents. Another type of exposure with a greater risk to human health occurs in the case of internal exposure, when the RII enters the human body by inhalation or oral (consumption of contaminated food products, drinking water) and accumulates in the thyroid gland. The thyroid gland is at particular risk of RII radiation exposure

because it uses iodine to produce hormones that regulate the body's metabolism.

The effectiveness of IP is significantly reduced if the reception of KI (stable iodine preparation) is delayed even for a few hours after the beginning of the absorption of KI into the body. The 2.5- to 4.0-fold difference between the levels of delayed intervention for this measure in relation to the pediatric and adult parts of the population is due to the fact that, firstly, the doses per unit of intake in children are several times higher than in adults, and secondly, the risk of radiation-induced thyroid cancers in children per unit dose is about twice as high as in adults.

The method of pharmacological protection consists in inhibiting, or temporarily stopping, the function of the formation of thyroid hormones, which determine the activity of metabolic processes in the human body. The chemical structure of these hormones includes iodine. After reception, the preparation of stable iodine blocks the thyroid gland, which prevents the accumulation of RII in it, and their further participation in the synthesis of thyroid hormones.

Stable iodine preparations are used to protect the thyroid gland from the accumulation of RII.

The optimal effect of IP is achieved with early (preventive) reception of the drug 6 or less hours before the arrival of the RII. Taking the drug simultaneously with the intake of the "cloud", it remains effective and 6 hours after inhalation intake leads to a two-fold decrease in the dose, and after 24 hours - until there is practically no protective effect.

Generally, the use of KI- together with the control of food and drinking water - is an appropriate strategy to reduce the radiation risk of adverse health consequences for people exposed to the release of RII, as a result of a radiation accident.

The planning of the IP is carried out in accordance with NRBU-97: this Regulation, and within the framework of civil protection measures in the event of a radiation accident, takes place in the mode of operation of the Unified State System of Civil Defence.

The following limits - lower for children, 50 mGy, compared to 200 mGy for adults - have been established for IP planning in accordance with NRBU-97. Levels of unconditional justification of IP are set for children - 200 mGy, for adults - 500 mGy. Indicators of limits and levels are defined considering the expected dose in case of internal radiation of RII entering the body during the first two weeks after the start of the accident.

The main goal of planning and effective implementation of IP is ensuring the availability, as soon as possible, of KI drugs for all population groups and, especially, the children's population.

When planning the creation of stocks and reserves of KI drugs, it is necessary

to give preference to tablet forms, differentiated for the adult population and children. Quantitative substantiation of the required KI stocks, at least for one-time use, should be carried out, considering the expiration dates, storage conditions and taking into account the constant renewal.

In the case of a radiation accident, first of all, the need to conduct an environmental inspection arises in relation to the population living in satellite cities of NPPs, as well as settlements located in the monitoring zones of nuclear installations.

The population, in respect of which protective measures are expected to be carried out, must be informed immediately. At the same time, the nature of the information should be worked out in advance within the framework of training and education emergency training of various levels, with the involvement of relevant specialists - medical workers and psychologists, in such a way that, simultaneously with the necessary specific instructions on the preventive use of stable iodine preparations, stress, social panic and excessive and uncontrolled use of alternative iodine preparations can be avoided.

It is recommended to conduct periodic educational training and educational activities.

A single dosage for an adult KI is 125 mg (100 mg of iodine). In the event of a radiation accident at facilities designed for the handling of radioactive and nuclear materials and the threat of environmental pollution, the personnel of the RII should take 125 mg of KI immediately.

The population living in the territory, where there is a threat of pollution of RII, takes a prophylactic dose of the drug KI only after an official notification about the threat of release and the need to conduct an IP.

The notification takes place according to the requirements of paragraph 10 of the Procedure for the implementation of urgent iodine prevention measures among the population of Ukraine in the event of a radiation accident, approved by the Order of the State Nuclear Regulatory Inspection of Ukraine dated November 8, 2011, No. 154, registered in the Ministry of Justice of Ukraine on November 25, 2011, under No. 1353/20091.

The Regulation establishes the following age groups and dosages of stable iodine (KI): children up to 1 month (infants and children who are breastfed) - 16 mg, children from 1 month to 3 years - 32 mg, children from 3 to 12 years old - 62.5 mg, adolescents from 13 to 18 years old, adults up to 40 years old, breast-feeding mothers - 125 mg (see table 3.1).

Population group, age	Dosage* in milligrams of KI
Babies (from birth to 1 month)	~16
Children from 1 month to 3 years	~32
Children 3 - 12 years old	62,5
Children over 12 years old and adults under 40 years old	125
Pregnant women	125

*Notes: * KI is taken after meals. Table 3.1. Dosage of a single dose of KI* for adults and children for thyroid gland protection from the accumulation of RII*

To obtain the necessary dosages of KI, medicinal products currently registered in Ukraine must be used in accordance with the manufacturer's instructions.

A single dose of KI is sufficient. However, in the case of long-term or repeated negative impact, unavoidable consumption of contaminated food products and drinking water, the possible re-administration of stable iodine preparations is carried out only after official notifications in accordance with paragraph 3 of this section.

The optimal effect of IP is possible under the condition of early (preventive) administration of the drug 6 or less hours before the arrival of the RII.

The acceptable period for taking stable iodine is 24 hours before and within 6 hours after the expected onset of exposure to RII. It is also reasonable to take KI to block the thyroid gland within 8 hours of starting exposure to RII. The start of IP later than 14 hours after exposure to RII may cause more harm than the expected benefit, because it will contribute to the extension of the biological half-life of RII, which has already accumulated in the thyroid gland.

A single application of KI provides thyroid protection for approximately 24 hours. As a rule, population evacuation (when indicated) is a more effective radiation protection measure than repeated dosing of KI. If evacuation, for some reason, is delayed or impossible, then multiple (repeated) use of KI should be carried out no earlier than 24 hours after the first administration of the drug and only in the conditions or with the possibility of prolonged arrival of radioactivity in the environment.

The risk of serious side effects in children from a single dose of KI, according to the dosage specified in table 3.1, is estimated to be 1 case per 10 million of children - the experience of carrying out IP in Poland after the accident at the Chernobyl NPP.

International experience shows that the risk of side effects from use of higher doses of KI is incomparably lower than the risk of thyroid cancer in children from the influence of swarm.

Contraindications to taking stable iodine preparations:

- the presence (including in the anamnesis) of diseases of the thyroid gland, in particular hyperthyroidism of various nature;
- furunculosis;
- increased sensitivity to iodine;
- during's dermatitis herpetiformis;
- hypocomplementemic vasculitis;
- hemorrhagic diathesis;
- urticaria, pulmonary tuberculosis, nephritis, nephrosis, pyoderma.

Temporary blockade of the function of the thyroid gland and single administration iodine-containing preparations practically do not affect the health of children and adults.

Long-term blockade of thyroid gland function after repeated intake of large doses of iodine-containing drugs increases the risk of hypothyroidism (reduction of thyroid gland function). People of all ages are at risk of hypothyroidism and its consequences for the state of individual organs and systems of the body, or the body as a whole, may be different.

When prescribing large doses of iodine-containing drugs, in addition to the negative effects associated with blocking the function of the thyroid gland, a toxic side effect of iodine is possible.

1. On the approval of the Methodological Recommendations on the Organisation of Work Post of Radiation and Chemical Surveillance: Order of the Minister on issues emergency situations and in cases of protecting the population from the consequences of the Chernobyl disaster dated August 11, 2010, No. 649.

2. On the approval of the Methodology of Observations regarding the Assessment of Radiation and

Chemical Situation: Order of the Ministry of Internal Affairs of Ukraine dated November 27, 2019, No. 986.

3. On the Protection of People from the Effects of Ionizing Radiation: Law of Ukraine dated January 14, 1998, No. 15/98-VR.

4. Regulations regarding Iodine Prophylaxis in case of occurrence Radiation Accident: Order of the Ministry of Health of Ukraine dated March 9, 2021, No. 408.

CHAPTER 4

EXPLOSION PROTECTION RULES FOR RESCUERS AND CIVILIANS IN HOSTILITY ZONES

4.1 The relevance of Individual armour protection in the Combat zone actions

The Combat Zone (CZ) is characterized by an increased level of danger in case of threat of explosion, coming under fire from enemy artillery, a rocket salvo system, aerial bombardment, and radioactive contamination and poisoning by dangerous chemical substances.

The most likely danger in the CZ for civilians and units of the Operational and Rescue Service of Civil Protection during the performance of assigned tasks is damage by fragments from explosive objects, and fragments of structural elements, resulting from the explosive destruction of buildings and structures. Since the beginning of military aggression on the part of Russia, about 252,000 km2 of the territory has been contaminated – as to say, almost 2/4 of the territory of Ukraine - which is probably mined (Fig. 4.1). The most polluted territory has such areas as [7]:

- Zhytomyr,
- Kyivska,
- Chernihiv,
- Sumy,
- KharKIv,
- Luhansk,
- Donetsk,
- Zaporizhzhya,
- Kherson,

- Mykolayivska,
- the Autonomous Republic of Crimea.

Since the beginning of the large-scale military invasion of Russia on the territory of Ukraine, 5,327 civilians have been killed as of the eleventh month of 2022, from being hit by shrapnel during enemy shelling in the CZ, and 226 people have been killed among the personnel of the State Emergency Service, including:

- died - 49;
- injured - 171;
- 6 are in captivity (since the beginning of hostilities, 39 have been captured, 33 of them have been released).

The use of means of individual armour protection before the beginning of the large-scale invasion of Russia on the territory of Ukraine was regulated in accordance with the Order of the State Emergency Service [1] - the list of the equipment and means of the department of pyrotechnic works includes:

Fig. 4.1. The level of contamination by explosive objects in the territory of Ukraine as a result of Russia's aggression.

- bulletproof vest - protection class 6 or protection level IV, armoured helmet (bullet protection helmets) - protection class 1A or III-A protection level - protective apron - protection class 2 or ballistic protection level V50 - not less than 450 m/s (STANAG 2920) complete with visor (protective mask) with level protection no less than that provided by untreated polycarbonate 5 mm thick and completely covering the face and throat.

But this norm is used exclusively for assembly of pyrotechnic units, which are involved in cleaning (demining) territories contaminated by explosive objects, manually [2] in the territory of Donetsk and Luhansk regions.

Instead, the issue of the use of means of individual armour protection of the civilian population in the CZ and units of the Operational and Rescue Service of Civil Protection, which perform tasks as assigned in the CZ, is acute.

4.2 Analysis of modern means of Individual armour protection

4.2.1 Analysis of modern body armour

The most popular means of individual armour protection is a bulletproof vest, which is able to protect the body from bullet and shrapnel wounds.

Modern bulletproof vests are most often shaped like a sleeveless jacket, sometimes with a stand-up collar. Often, bulletproof vests have additional protective parts that cover the shoulders, groin, waist, and have additional elements (Fig. 4.2). First of all, the body armour is designed to protect against bullets from pistols and automatic weapons, it also copes with grenade fragments in case of explosions and other minor secondary fragments during the destruction of structural elements of buildings and structures. When choosing a bulletproof vest, first of all, you need to pay attention on:

- class;
- type of wearing body armour;
- effectiveness of the protection area;
- effective wearing time.

When designing body armour, designers observe the following conditions:

- body armour must protect the main vital parts of the body from bullets of a certain caliber and power and debris;

Fig. 4.2. Typical body armour

- armour elements must be light and, at the same time, reliably protect, not shatter into fragments during a hit;
- bulletproof vests should provide, if not good, at least acceptable ventilation of the human body;
- the vest should sit securely on the body, not restrict movement during exercise movement and performance of tasks as assigned;
- bulletproof vests must be quickly donned/removed.

But you can choose a bulletproof vest based on only one parameter, namely the class of protection.

Body armour in Ukraine is classified by protection classes, which are regulated in accordance with standards [3] and are listed in table. 4.1. The class of protection of the bulletproof vest is determined by the type (type A, type B, type C) and the characteristics of the bullet (hitting bullet), which it is designed to resist under the appropriate conditions (speed, distance, humidity).

- Soft body armour (type A) is a soft protective material that is flexible and bends in different directions. In body armour, we typically see soft armour at levels IIA, II, and IIIA [4,5] and 1, 2 [3].
- Semi-hard body armour (type B) - ballistic plates (hard armour) combined with soft armour elements (standard army body armour).

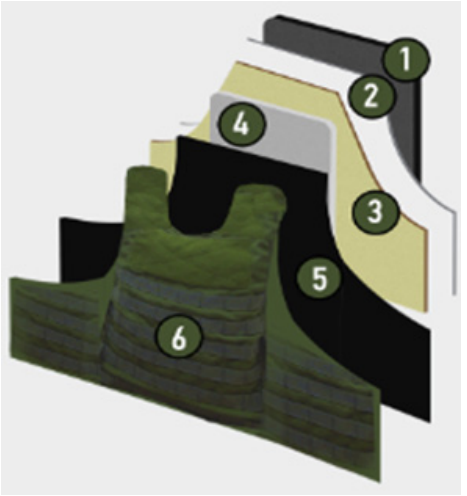

Fig. 4.3. A typical body armour structure: 1 – removable climatic damping support; 2 – depreciation support; 3 – flexible protective element - additional protection of 1 cl.; 4 – armour element of the main protection; 5 – anti-ricochet block; 6 – fabric cover.

- Hard body armour (type C) - armour plates (hard armour) based on hard elements (plate carriers). Armour plates are solid plates, often made of pressed polyethylene with a ceramic front (Al2O3, SiC, B4C) or profiled steel sheets (Armox, Ramor, Swebor). Ballistic plates in Ukraine are mostly produced in the size of 30x25 cm, flat, single or polygonal.

Structurally (Fig. 4.3), all bulletproof vests do not differ from each other, but differ in the quality of the filling material.

There are 9 classes of body armour [3]: special, 1, 1-A, 2, 2-A, 3, 4, 5, 6.

The higher the number, the higher the level of protection.

Table 4.1. Classification of body armour according to the Ukrainian standard

Class protection	Weapon	Caliber, type	Description	Mass balls, p.	Speed bullets, m/s
1	PM pistol	9mm bullet pistol cartridge 57-H-181 p	in a steel shell with a steel core	5,9	315±10
1-A	APS pistol	9mm bullet pistol cartridge 57-H-181 p	in a steel shell with a steel core	5,9	330±10
2	TT pistol	7.62 mm bullet pistol cartridge 57-H-134 z	in a steel shell with a steel core	5,5	430±15
2-A	hunting smooth-bore weapon	Breneke bullet of a 12-gauge hunting cartridge	lead without sheath	35	400±15
3	AK74 machine gun	bullet of the 5.45-mm cartridge 7N6	in a steel shell with a steel core	7,9	910±15
	AKM machine gun	a bullet of a 7.62-mm cartridge model of 1943 57- H-231	in a steel shell with a steel core	3,4	730±15
	AK-74 assault rifle	bullet of 5.45-mm cartridge 7H10s	in a steel shell with a steel core	3,6	910 ±15

4	SVD rifle	bullet of a 7.62-mm rifle cartridge 57-H-323c	in a steel shell with a steel core	9,6	850±15
5	AKM machine gun	bullet BZ (armour-piercing incendiary) 7.62-mm automatic cartridge	in a steel shell with steel core	7,4	745±15
6	SVD rifle	bullet B-32 7.62-mm rifle cartridge	in a steel shell with a steel core	9,6	850±15
Special	cold weapon	dagger, knife	according to DSTU 4104[1]	_	Impact energy -40J

It is impossible to say, unequivocally, how much body armour vest weighs. After all, there are a lot of them, and the mass, as mentioned above, is seriously different. Only approximate, data can be given - depending on the protection class:

1. First class – 1.5 - 2.5 kg.
2. Second class - 3 - 5 kg.
3. Third class - 6 - 9 kg.
4. Fourth class - 8 - 10 kg.
5. Fifth class - 11 - 20 kg.
6. Sixth grade - more than 15 kg.

The **US Standard** [4] is the newest and most advanced standard in the world.

The NIJ standard places greater demands on the product than the old standard [5] in test methods and bullet speeds. Ballistic plates are designed to stop bullets such as 7.62x51 NATO, 7.62x39 MSC, 5.56x45 SS109, 7.62x63 AP, etc. In addition to standards [5] and [4], there are also HOSDB, VPAM 2006, German Schutz class, European **PrEN ISO14876-2**, all of which have the same level of protection against high-velocity bullets.

If we consider the CZ, then 70-80% of civilians and rescuers died from shrapnel formed after explosions of cluster elements, such as 9H210, 9H235, Kobe, PTAB-2.5 type aerial bombs, etc.

[1] Editor's Note: *DSTU 4104* is the Ukrainian Standard of measuring the strength of materials for personal armour protection elements [on the point, see Savvova O., Bragina L., Voronov G., Sobol Y., Babich O., Shalygina O., Kuriakin M. (2017) *Development of Glass-Ceramic High-Strength Material for Personal Armour Protection Element*s, available on http://science2016.lp.edu.ua/chcht/development-glass-ceramic-high-strength-material-personal-armour-protection-elements].

During military operations, any elements of individual armor protection and various forms can be used. Modern protective vests can be adapted to the requirements of almost any profile and task. Body armor can provide protection against ballistic, cold, or even spiked weapons, as well as shrapnel from EO explosions.

Plate carriers should be singled out as the most popular. The wearer himself holds the armor plate or soft armor (or a combination) and then fixes them to the body. There are countless different options for armor wearers. They are the ones who make the protective vest suitable.

A plate carrier can be designed to hold front, back, and side plates, as well as soft ballistic inserts (Figure 4.4). They can also be designed to have additional fasteners, including protective soft armor for the neck, shoulders and groin.

Fig. 4.4. The size and method of wearing body armour

Correct wearing of the armor protection system is mandatory. Many people who wear armor every day have no idea that they are wearing it incorrectly, leaving themselves vulnerable. The top of the front plate should be in line with the top of the sternum. When the plate is in the correct position, it will provide the most coverage of your vitals.

The top of the back plate should be exposed approximately at the level of half of the shoulder blades. This ensures maximum front and rear coverage, ensuring maximum protection of the breastbone.

Side plates may seem unnecessary at first, but they are extremely valuable.

They should be as high as possible in the plate carrier, without restricting movements. Most modern carriers have adjustable side pockets. They rise to such a height that the plates can protect the lungs.

The hidden type of Body Armor is quite popular (Fig. 4.5). These carriers are made minimally bulky and light, but with consideration to get the job done: they

Fig. 4.5. A hidden type of body armour

keep the armor as close to the body as possible. However, this does not mean that they are low quality.

They are often used by security guards and policemen under uniform. They are effective enough for rescuers to use under the suit which, being rather bulky, makes it uncomfortable to wear the Body Armor over it.

If the MOLLE system (a modern fixation system) is used in addition to the hidden armor, the user can remove it after completing the air alarm in the CZ, and they will still have access to all the other equipment on them.

Today, Body Armor with the MOLLE system (Fig. 4.6) makes up a large percentage of the market. Some of these MOLLE vests can be so thin that they can also be hidden under clothing. Others are designed for extreme loads and are also lightweight and provide excellent mobility.

A general feature that should be considered when choosing plates for rescuers

Fig. 4.6. Body Armour quick release system

is reliable protection and quick release from it. This is because the work of rescuers during the emergency's liquidation is related to the performance in and around tight spaces, such as rubble, road accidents, and fires using fire extinguishers.

Some plates tend to be much more specialized than the ordinary ones used for bulletproof vest. They are intended for military operations in the CZ. These slabs are usually bulky and allow you to fasten the periphery (Fig. 4.7).

Most often, these bulletproof vests have protection to the shoulder, throat and groin, but the use of this type of protection by rescuers, hinders them rather than helping them.

Outside of peripheral protection, these bulletproof vests generally function similarly to other plate carriers. Outside of peripheral protection, this Body Armor generally function similarly to other plate carriers. Some models, such as the IOTV, have quick-release systems and offer improved internal support, cushioning and breathability. They also tend to offer a variety of bulky systems so that the user can customize their gear to make it comfortable and functional. The type of protection specified is sufficient for the military, but not for civilians and rescuers.

Analyzing armour and ballistic protection, you should pay attention, first of all, to what is installed - an armour plate or a soft panel. Soft armour is generally designed for smaller or more specialized threats. Plates are designed for more

Fig. 4.7. A military type of Body Armour

powerful munitions and more advanced threats. That's what actually stops the threat and can usually be quickly removed from the body armour and repositioned in another (for example if a concealed and external plate carrier is used).

Solid armour (Fig. 4.8) is able to provide protection from all but, in particular, from the most advanced ballistic threats that are common today. In addition to threats designed specifically to defeat armour protection, there are very few branded armour plates that are not designed to provide adequate protection. Given this, you must first review the comparative tables of levels of the corresponding armour protection to understand what the plates can and cannot do.

Analyzing US armour plates rated by the National Institute of Justice (NIJ) typically use Level III or IV. It is important to note that the NIJ does not support manufacturer labeling as "lightweight" or "+".

Armour plates are generally rated only at levels III and IV. Tier III stops all threats with cartridges up to 7.62 with FMJ bullets. In the case of 5.223 or 5.56 ammunition, if the bullet has a lead core, a level III plate will suffice.

Fig. 4.8. Hard Armour

If the user expects likely threats from steel-core ammunition or anything with armour-piercing bullets, level IV armour should be used. Armour-piercing bullets require ceramic or metal outer ones or internal segments to stop such bullets. Most of the Level IV labels in the NIJ-approved registry contain these features.

Armour plates can be made from a number of different materials. As long as they are on the approved registry, they are guaranteed to stop the assessed threats.

The advantages of the materials with which they are made are determined by the price per armour and its weight.

Ceramic and steel plates are relatively similar in weight per plate and can be found in Tier IV ratings. The advantage of steel plates is that they are usually much thinner than ceramic ones, and the cost is usually much smaller. The steel coating can give a ricochet fragment, which is caused by debris when it hits the plate. Fragmentation can end up harming the user as well.

Steel plates are also recommended for use with trauma backpacks, since it can help absorb the energy of a bullet hitting the armour, as well as protect against plate dents that may occur.

Ceramic plates (Fig. 4.9) have many of the same properties as steel plates, but do not ricochet or dent. Ceramic plates provide excellent protection against mul-

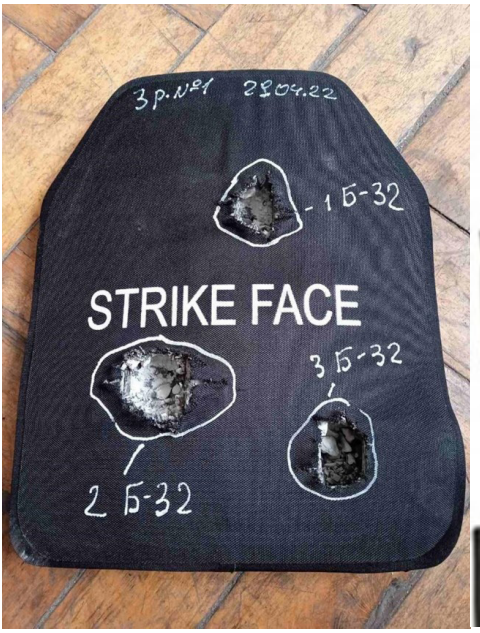

Fig. 4.9. The appearance of a ceramic plate when it is affected by a striking factor

Fig. 4.10. The appearance of Soft Armour

tiple hits, but the downside is that they do not withstand multiple precision hits in the same spot and tend to be more expensive. Considering that, in the CZ, fragments scatter randomly can hit the same point several times, this option will not be effective enough.

Kevlar plates are excellent and time-tested against ballistic threats. The downside is that Kevlar alone may not be sufficient against a level IV threat. Kevlar simply cannot withstand armor-piercing ammunition without inserts or a special coating. Kevlar is often used with plates (ICW); the advantage of this class of protection lies in lightness and resistance to fragments and debris, which in CZ are the most likely threat option.

Not to be excluded is Soft Armor (Figure 4.10), which works almost like hard armor except that it comes in flexible panels and protects against smaller threats such as pistol-caliber ammunition. Soft armor cannot be rated for protection against rifle caliber ammunition, as the highest protection for soft armour is IIIA. Flexible armour simply isn't tough enough to withstand the impact of high-powered ammunition. That being said, if the mission profile does not involve rifle-cali-

ber ammunition for an immediate threat, or if the user requires additional flexibility and mobility and lighter, flexible Soft Armour, there is no need for hard plates.

According to US standards, soft armour comes in one of three levels.

IIA is the lowest rating, followed by II and then IIIA. IIA armour is designed to stop only 9mm bullets and is actually pretty hard to find. Level II armour stops 9mm and more powerful bullets.

Tier II armour makes most IIA armour obsolete. Tier II armour doesn't cost much more than IIA and isn't much heavier. Given the choice, the extra protection of tier II armour is worth it. Level IIA armour stops pistol caliber ammunition to .357 Sig and .44 Magnum. IIIA is also sometimes found in armour plates.

Soft Armour from well-known, proven brands is usually made of materials such as Kevlar fabric, Goldflex and Twaron. Goldflex is a non-woven laminated version of Kevlar fabric, and Twaron is similar to Kevlar but is a "para-aramid" rather than the "aramid" of Kevlar[2].

Do not forget about the maintenance of the armour. Scheduled inspections and maintenance of armour and its carrier must be performed to prevent malfunctions in the field. You should make sure that the plates are checked for damage or expiration date. If the plates have visible damage or are outdated, they must be replaced as soon as possible.

In the world we live in today, armour is just as important to keep and have on hand as a firearm. First responders to a threat of all kinds must have armour protection and must understand not only how to use the armour they have, but also why each type of armour is effective at its level.

When using a bulletproof vest in civilian use and during the liquidation of emergencies by rescuers in the CZ, it should be taken into account that in the first case, too heavy armour will cause inconvenience in movement in case of long-term use, and in the second case, heavy armour will restrict work and increase the degree of fatigue, so attention should be paid on modern body armour that uses panels with soft properties (made of ballistic fabrics). For the most part, such fabrics are made of aramid fiber. If you look on aramid fiber from the point of view of chemistry, it is a compound of benzene rings united by NH Co groups. These groups form strong hydrogen bonds with neighboring molecules. This ensures the strength of the aramid fiber.

From the outside, aramid looks like thin fibers - spider webs. They are usu-

[2] Editor's Note: for more information on this point, see also Kośla, K., Kubiak, P., Łandwijt, M., Urbaniak, W., and Kucharska-Jastrząbek, A. (2022) *Fragment-Resistant Property Optimization within Ballistic Inserts Obtained on the Basis of Para-Aramid Materials*, available on https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8954709/.

ally yellow in color and other shades can rarely be found. Fibers are woven into threads, from which fabric - aramid is produced. The first fabric of aramid origin was the well-known Kevlar, which was used in body armour of various countries around the world. Note that it was first released by a chemist named Dupont. Nowadays, such fabrics are produced in different countries under different names.

Fabrics of different brands differ from each other in specific characteristics, among which, for example, tensile strength can be mentioned. The last fabric parameter can vary from 280 to 550 kilograms per square millimeter. But there is such a large spread in the indicator among Russian manufacturers. If we talk about fibers produced by Western countries (USA, Japan and Europe), they are inferior in strength to Russian ones. Based on this; we can say that it is chemists from Russia who hold the first place in terms of the strength of mass-produced aramid fiber.

Note that the tensile strength of low-carbon steel is 55–60 kilograms per square millimeter. If we talk about more privileged types of steel, then 250 kilograms per square millimeter. It should be noted that aramid is 5 times stronger than low-carbon steel. With all this, aramid is about 5 times lighter than steel, or rather, any of its grades. Of particular importance when comparing aramid and steel is their density.

Soft aramid armour provides the consumer with class 1 and class 2 protection[3] (Body Armour), in addition to some classes accepted in other countries with their corresponding designation. Speaking more generally, aramid armour protects against pistol and revolver bullets, as well as shrapnel. And it turned out to be unrealistic to make armour from fabric that would be able to protect against bullets from machine guns and rifles. But for our research, this is not necessary since the main threat in the CZ is fragments and debris. The impossibility of protecting against bullets of larger calibers is due to the fact that the bullet has a large kinetic energy, and its pointed shape promotes the spreading of fibers. And this immediately reduces the effectiveness of the armour.

But it should be noted a few more disadvantages of Soft Armour. They certainly include water-fearing and aging. Most aramid fabrics lose up to 40% of their strength when wet, but when drying, the properties of the fabric are restored. The passage of time also affects fiber strength characteristics, but, unlike the first case, the loss of useful properties is an irreversible process. Therefore, manufacturers usually provide a five-year warranty on aramid fiber vests. To protect against

[3] Editor's Note: for a correct classification of Body Armour Protection Classes according to the Ukrainian Standards and the corresponding NATO Standards, see also https://arp.co.ua/en/klas-zakhystu-bronezhyleta.-standarty-dstu-i-nato/.

moisture, armoured panels are placed in water-repellent covers or using impregnating substances that repel moisture.

The strength reserve, as well as the impregnations, allows you to protect the bulletproof vest from the effects of time. To the smallest extent, the shortcomings are expressed in modern animal fibers, microfilaments from the company "Akzo Nobel". This fiber undergoes special impregnation and processing. Such processes ensure its preservation from moisture, up to the long stay of the user in water, wearing such a bulletproof vest. The fabric warranty from these manufacturers is not 5, but 10 years. If we talk about the disadvantages of such a fiber, we can count the relatively low tensile strength among them. As shown by experiments with such vests, the ballistic properties of the fabric in question are small and the tensile strength was not affected in any way.

Summarizing the analysis of bulletproof vests, one should look at modern achievements in the field of Soft Armour, which will have a small weight, but will add protection in CZ. The specified type of Body Armour should also be used by the employees of the Central Security Service, who are in the CZ and perform actions as assigned. Apart from bulletproof vests, rescuers will have overalls that will provide additional protection against possible fragments.

4.2.2 Analysis of modern protective helmets

In addition to the bulletproof vest, you should pay attention to helmets[4] (Fig. 4.11), which protect against fragments and pistol bullets. They can be made from a combination of para-aramid, NVMPE[5] and impact-resistant plastic in different

[4] Editor's Note: in accordance with US Federal Government's definition of Ballistic Protection, Section 18 United State Code § 921(a)(35) defines the term "body armour" as *"(...) any product sold or offered for sale, in interstate or foreign commerce, as personal protective body covering intended to protect against gunfire, regardless of whether the product is to be worn alone or is sold as a complement to another product or garment."*. Therefore, ballistic helmets fall within this definition and are in no way separate from other ballistic wearables. So, for the purposes of interpreting federal law, the terms "ballistic helmets" and "body armour" are interchangeable (https://www.hardheadveterans.com/blogs/reviews/can-civilians-buy-ballistic-helmets#:~:text=The%20federal%20government's%20definition%20of%20ballistic%20protection&text=It%20is%20easy%20to%20see,%E2%80%9Cbody%20armour%E2%80%9D%20are%20interchangeable).

[5] Editor's Note: NVMPE is a component of Ballistic Protection (armour helmet, etc.) consisting of ultra-high molecular polyethylene, 5 times stronger than steel. It is very re-

Fig. 4.11. Modern typical helmets

variations. Helmets should have a cover made of fire- and water-resistant fabric. Covers are needed, because NVMPE together with plastic are flammable, so they need protection from fire, because shells explode regularly.

There are two options for classifying helmets:

1. According to the level of protection based on the NIJ designation level [4]: (I, IIa, II, IIIa).
2. According to the type of cutout in the ear area (low, medium, high).

sistant to high temperatures, and although it has the same ballistic strength as para-aramid, it is about three times lighter. For pros and cons of the NVMPE, see also https://arp.co.ua/en/yaki-buvaiut-bronezhylety/.

It's often best to keep your ears open, especially if most teams will be vocal. That's why FAST helmets with a high neckline are the choice of the majority modern armies of the world and special units. They are compatible with communication equipment and are lightweight.

Protection standards are created for ballistic helmets and body armor. But there are differences, and they are significant. To begin with, a helmet should not only protect the user's head, but also remain light and not cause spine fatigue.

Sanctioned helmets fall under the standard [4] and are even tested in various ways. While this means there are no Level IV helmets, all Level IIIa helmets are impact, bullet and shrapnel resistant.

According to the NIJ standard, a helmet should create obstacles and distribute as much force as possible. It should direct all the force back, protecting the head and neck from the impact.

NIJ I - The first level provides protection against small caliber bullets such as .22 as well as 38 Special (which is a fairly common caliber). Since the difference between levels I, IIa and full level II is quite small, II is the most popular.

NIJ II is by far the most common type of protection for helmets. Such a helmet is relatively light and can be comfortable for the user (if the size is chosen correctly). Until NIJ got the IIIa designation, this was the highest level of protection, and over the years it has become even lighter with new materials. For many "domestic" situations (for example, for civilians or rescuers), this is a sufficient level of protection, both in everyday life and in the CZ. He can endure significant blows with blunt objects, returning most of the force and dissipating the rest.

NIJ IIIa is currently the highest level of protection offered by helmets. There are models that can withstand even fragmentation grenades exploding nearby. As for bullets, the helmet can withstand a direct shot from a .44 Magnum without any injury to the user (Figure 4.12).

But the main advantage of this helmet is its protection against explosives. The layers inside will not only protect the head from any flying debris, but also from the explosion itself. Namely, it acts as a blunt object under the pressure of the air due to the explosion.

This rush can be so strong that it crushes bones. In many ways it is worse than a grenade fragment.

Bullets and all kinds of debris that can be scattered after an explosion will fly, impact, and penetrate differently. Although the fragments are slower than bullets, they can be much larger and often irregularly shaped to penetrate as deeply as possible. Unlike bullets fired from a rifled barrel, fragments have strange shapes, and it is impossible to predict where they will fly.

Fig. 4.12. The appearance of the helmet after being hit by fragments 3 cm in diameter

But when it comes to other explosive devices, the contents inside can be even more deadly. A good helmet will not only protect against such penetration, but also cushion the impact to prevent stun.

Other (non-explosive) debris includes debris that can start flying. This applies to any collapse of buildings or other objects that begin to move under the influence of the blast wave. The helmet protects against them without any problems. Yes, it will be damaged (most likely), but it will do its job function: protect against death. If a head injury is received, it is relatively minor. In uncertain situations, this is very relevant in the air defence system, because the threat of shelling during an air alert is constant.

When testing ballistic helmets, a gold standard called V50[6] is used. We are talking about testing helmets with the smallest fragments that fly at a speed of up to 670 meters per second. Although each part individually does not carry much

[6] Editor's Note: "V-50" or" Velocity-50%" is a ballistic test where bullets are fired at higher and higher velocities until they start penetrating. The velocity of the bullets where 50% of the bullets DON'T penetrate, and 50% of the bullets DO penetrate is the V-50 rating for that ballistic protection. So, V-50 is a good measure of the UPPER limit of protection, or the "breaking point" for armor. For a detailed explanation of V-50 Ballistic Testing, see also https://www.hardheadveterans.com/blogs/reviews/v50-ballistics-testing.

force due to the light weight of 1.1 grams, there can be dozens of these parts hitting the helmet at the same time.

Although the helmet may be damaged after an explosion to achieve a V50 value, the wearer underneath must be fully protected.

There are three commonly used tests to obtain the V50 designation:

1. The NATO standard is STANAG 2920.
2. US standard - Mill STD 662 E.
3. The British standard is UK / SC / 5449.

There are alternative ballistic helmet designs, but they usually just look like outdated models. Modern helmets can be divided by design into High, Mid and Low cut. Each of them has its advantages and disadvantages.

In each case, the goal is to balance the protective ability and durability of the helmet with size, weight and rationality in use with special equipment and protective clothing. Each type has its place and works best in different situations.

The high-cut FAST helmet (Fig. 4.13) is designed to be light (up to 1.6 kg), strong, and leave enough space for additional equipment (usually for communication). Most often, such helmets are used by special units. The main advantage of this design is its weight and ergonomics. But the specified helmet will be better suited to the military than to civilians and rescuers.

Helmets of medium length are losing popularity, but not for civilians and rescuers (Figure 4.14).

Such a helmet will have good protective properties and will not burden the user.

The design of helmets with a low neckline, on the one hand, provides maximum protection (because it covers the ear area and partly the neck). On the other hand - forces the user to use only internal communicators and carry a considerable weight on the neck.

This weight will become inconvenient during long-term work on the liquidation of emergency situations or personal movement in the CZ.

Therefore, a helmet is one of the main elements of protective equipment for any dangerous tasks. But when it comes to choosing between different types of ballistic helmets, we need to know what they are designed for as well as what they will be used for.

Although they will protect against bullets, their main purpose is to protect against flying debris. Comfort and the possibility of long-term wear are also important. These factors are unmatched by FAST helmets that are made in Canada.

Fig. 4.13. FAST high neck helmet

Thus, after analysing materials in the field of individual armour protection and considering the realities of Ukrainian life since the large-scale military invasion by the Russian Federation, the necessity of utilizing individual protection emerges as a critical criterion for mitigating tragic consequences. This applies to the civilian population and appointed rescue operations within the combat zone.

Fig. 4.14. Helmets of medium length

Fig. 4.15. Items that look like explosives

The sphere of individual armour protection is quite saturated with various types and classes, but, looking at the peculiarities of their use for civilians and rescuers who eliminate emergencies in the CZ, there is still a risk of repeated shelling, where the main striking factor is fragments and debris from artillery shells, cluster and other ammunition.

Therefore, for the protection of civilians and rescuers, one should stop at Body Armour of type "B" with soft armour of class 2A and protective helmet of medium length of level II.

4.3 Algorithm of actions in case of detection of explosive objects

4.3.1 Procedures following the detection of an explosive-like object

- immediately stop all work at the place of discovery of the object;
- quickly move to the maximum safe distance (at least 100 meters), while moving back along your tracks;

- mark the location of the object, if possible, fence it off;
- if possible, if photographic means are available, photograph the object and its location;
- do not panic and keep calm;
- immediately inform the operational services, providing information about the characteristic features of the object (place of its location, date and time of discovery and the person who discovered it).

IT IS STRICTLY PROHIBITED:

- touch and move towards EO;
- smoking near the EO, building a bonfire (these actions can trigger an explosion);
- fall asleep or bury in the ground, hide, or try to somehow cover EO;
- independently try to neutralize EO;
- beat, cut or roll EO - explosives are poisonous and sensitive to mechanical influences and heat

4.3.2 Characteristic features of masked explosive objects:

- the item is in a crowded place or in an unattended vehicle, box, box, backpack, suitcase, bag, etc.;
- a structure similar to a EO or an improvised explosive device;
- the presence of ropes, wires, threads on the product extended from the object;
- presence of antennas, clock or electronic timers, accumulators or batteries;
- the presence of unusual, suspicious sounds, for example, the ticking of a clock, periodic signals;
- suspicious smell (of chemicals or fuel, gas, etc.);
- the presence of uncharacteristic parts that are not intended for that subject.

4.3.3 Recognition of explosive objects

The most frequently detected munitions are artillery shells, engineering ammunition, grenades and grenade launcher shots, mortar mines, aerial bombs, detonators for various ammunition and cartridges.

Fig. 4.16. Homemade Explosive

Fig. 4.17. Demining area in the event of EO detection

Initiating devices (concentrated charges and blast charges) – a large amount of explosive substance placed in one place or in boxes, cylinders, containers, which can be initiated both remotely and detonated after mechanical action on it or clock mechanisms. Charges on the exhaust are characterized by tension wires or the bed that led to them; the task of such EO is to injure people.

Fig. 4.18. Concentrated charges and charges on stretch marks

A mine trap is a specialized mechanism, which looks like an ordinary object, but has an initiating detonator installed in it, which activates the VR (input device). They are usually disguised as everyday items, designed to kill or injure. Initiation occurs suddenly when some manipulation of the mine trap takes place.

Fig. 4.19. A sample of a mine trap

Anti-personnel mine[7] is an engineering ammunition designed to destroy the enemy's manpower from the action of an explosive substance and fragmentation damage. Depending on the modification, the mine can hit several people and has a different radius of fragmentation.

Fig. 4.20. Anti-personnel mines (PMN-2, OZM-72, POM-2)

Anti-tank mines are engineered ammunition designed to disable or destroy enemy vehicles, both light and armoured. Such mines are activated, usually, when hitting it. Initiation occurs from a pressure action of at least 150 Kg.

Cluster munitions (artillery shells, aerial bombs, munitions from rocket salvo systems such as "HAIL", "HURRICANE", "SMERCH", "TORNADO") are a special element of armament, because cluster munitions are equipped with various explosive objects, and the cluster element itself represents a small amount of an

[7] Editor's Note: as regards on landmines used in Ukraine since the full-scale Russian invasion began on February 24, 2022, see also Human Rights Watch (2022) Background Briefing on Landmine Use in Ukraine, available on https://www.hrw.org/news/2022/06/15/background-briefing-landmine-use-ukraine.

Fig. 4.21. Anti-tank mines (TM-62, PTKM-1R)

Fig. 4.22. Cassette elements (PTAB-2.5, 9H24/210/235, PFM-1)

explosive substance in the case; most of them contain a self-destructor that activates after the expiration date, resulting in an explosion (VERY DANGEROUS).

Grenade is designed to damage manpower and lightly armored enemy equipment with shrapnel, a shock wave or a cumulative jet.

By purpose, hand grenades are divided into offensive, defensive, and special (smoke, lighting, signal, etc.), and anti-tank grenades are divided into high-explosive and cumulative.

Combat ammunition is an element of armament for small arms, intended for firing from combat weapons. The main task is to destroy manpower. There are large-caliber, automatic, pistol, revolver and rifle cartridges.

Artillery ammunition is intended for firing from artillery guns and howitzers, launchers. By definition, there are fragmentation, high-explosive fragmentation, smoke, illuminating, armour-piercing, incendiary, concrete-piercing, etc. Artillery ammunition is also divided by caliber:

Fig. 4.23. Hand grenades (RGD-5, F-1, RGN, RGO)

- small caliber - up to 70 mm;
- medium caliber - from 70 to 155.5 mm;
- large caliber - more than 155.5 mm.

A **mortar mine** is a type of artillery weapon intended for flanking fire on enemy personnel located in target shelters, as well as for the destruction of field fortifications. A characteristic feature of this type of EO is the teardrop shape and feathers on the tail part, where the firing pin is located. Their blasters are very sensitive to mechanical impact.

Fig. 4.24. Ammunition for small arms


Fig. 4.25. Artillery ammunition


Fig. 4.26. Mortar mines

4.3.4 Marking, with improvised means, places of detection of explosive objects

The following improvised means can be used to mark the place where an object similar to an explosive was discovered:

- a pile of stones;
- packages;
- bottles;
- fabric tapes;
- stuck sticks;
- other signs, obstacles.

Taking into account the analysed materials in the realm of individual armour protection and considering the realities of Ukrainian life since the large-scale military invasion by the Russian Federation, the utilization of personal protective gear emerges as a critical criterion for mitigating tragic consequences. This pertains to both the civilian population and the rescuers executing their designated duties within the combat zone.

Fig. 4.27. Marking of the area when a suspicious object is detected

The sphere of individual armor protection is quite saturated with various types and classes but, looking at the specifics of their use for civilians and rescuers who eliminate emergencies in the CZ, the risk of repeated shelling remains, where the main impressive factor is fragments and debris from artillery shells, cluster and other ammunition. Therefore, for the protection of civilians and rescuers, you should stop at type "B" body armor with soft armor of class 2A and a protective helmet of medium length of level II.

The main thing that the population needs to know is that it is impossible to approach and touch unfamiliar objects that are not typical for this area, because they can be explosive and carry a danger that will lead to injuries and fatal consequences. We should also not forget about warning markings in the form of a "white and red" tape or signs of mine danger, which warn us that a dangerous area awaits us further.

1. On the introduction of changes to the norms of rostering, costs and terms of operation of fire-rescue, technological and garage equipment, tools, individual weapons and equipment, repair and maintenance materials of units of the State Emergency Service of Ukraine: Order of the State Emergency Service of Ukraine from 24.02.2020 No. 157.

2. On approval of SOP 09.10/DSNS. The procedure for manual cleaning (demining) of territories contaminated by explosive objects by Civil Defence Bodies and Units: Separate Order of the State Emergency Service of Ukraine dated September 4, 2019, No. B-127.

3. DSTU 8782:2018 Unified Standard for the classification of classes of Ballistic Protection.

4. NIJ 0101.06. Ballistic Standard. USA.

5. NIJ 0101.04. Ballistic Standard. USA.

6. Shevchuk O.R. & Govorukha R.O. (2022) Analysis of the use of explosives by Pyrotechnic Units to destroy explosive objects: materials of the International Scientific and Practical Conference "Fire Safety Issues 2022". Kharkiv, NUCD of Ukraine, p. 329-331.

CHAPTER 5

FUNCTIONING OF THE CIVIL PROTECTION SYSTEM UNDER BLACKOUT CONDITIONS

An accident in the power supply system is a violation of normal mode of the entire energy system or a significant part of the energy system, associated with damage to equipment, temporary unacceptable deterioration of electricity quality, accompanied by an interruption in the supply of electricity to consumers. Accidents in energy systems are often called the word "blackout" [1].

5.1 World history of blackouts in the 21st century

The world history of blackouts in the 21st century is summarized in Table 5.1

Table 5.1. History of blackouts of the civilized world in the 21st century

Date	**Country**	**Cause and effect**
02.01.2001	India	As a result of an accident at a power plant in Uttar (Pradesh) more than 200 million residents of the north of the country remained without electricity
18.01.2001	USA	1 million Californians living in and around San Francisco were left without electricity
06.2001	Nigeria	Between 30 and 50 million residents lived without electricity for several days as a result of a power system failure in the east of the country
24.11.2002	Argentina	In the capital of Argentina, Buenos Aires, there was an accident on a high voltage line. About 2 million people remained without electricity

03.02.2003	Algeria	The whole of Algeria with a population of 32 million people was left without electricity for several hours due to an accident at the central power plant
22.07.2003	Spain	More than 350,000 residents of Barcelona and the Balearic Islands were left without electricity after an accident caused by an overload
22.07÷14.08. 2003 Big Blackout 2003	USA, Canada	About 10 million people in Canada (about a third of the population) and 40 million in the USA were left without electricity. Many airports closed, including Pearson International Airport in Toronto and all airports in New York. In many cities, including Toronto and New York, the subway stopped working. Passengers stuck in the subway had to be evacuated. There were water outages in some cities, in particular in Detroit. Cell phones worked very poorly, with major outages, but landlines continued to function. The reasons for the blackout are as follows: due to high electricity consumption, power lines in Cleveland, Ohio heated up, sagged (due to thermal expansion of the wires) and touched trees (which were not trimmed in time). Due to an error in the computer system, as well as the actions of personnel, other control centres were not notified in time. There was a cascading shutdown of about 100 other power plants.
18.08.2003	Georgia	The whole of Georgia remained without electricity. The reason was the emergency shutdown of Inguri HPP - the country's largest HPP (produces almost half of the electricity). After that, the entire energy system of Georgia was turned off. There was no electricity even at life support facilities, the subway stopped working, tens of thousands of passengers were stuck in train cars and at stations. Water supply has stopped in most Georgian cities. The central TV tower in Tbilisi did not work for 20 minutes.
28.08.2003	Great Britain	In the capital of Great Britain, London and some areas in the southeast of the country, a large-scale power outage occurred in the evening. Approximately two-thirds of the metro and part of the trams stopped running, streetlights and signal lamps in the areas of power failure went out, chaos was observed in city transport. The reason for the power outage was an accident in the transformer system. There were about 250,000 people in the London subway who were evacuated from trains that stopped in the tunnels. Electricity supply was restored 34 minutes after its outage
23.09.2003	Sweden, Denmark	The storm knocked out power lines, causing power outages in southern Sweden and eastern Denmark. 5 million people remained without electricity for a whole day

28.09.2003	Italy	The emergency power outage affected the entire territory of Italy, with the exception of the islands of Sardinia and Elba, for 12 hours, as well as parts of Switzerland in the Geneva area for 3 hours. The falling tree caused a blackout on the Mettlen-Livorno transmission line, which stretches from Switzerland to Italy. This caused a 110% overload on the second Swiss line, Sils-Soazza. 20 minutes after the events began, the Italian side reduced the volume of electricity imports due to an increase in domestic production. But this did not sufficiently relieve the San Bernardino line, which failed. The outage of this line caused a series of cascading outages on the remaining Swiss lines. The complete loss of the Swiss lines caused overloading of the power transmission lines stretching to Italy from France. The French lines were out of action. In the next few seconds, the lines going to Italy from Austria and Slovenia were de-energized. After a series of power outages connecting Italy to the continent, generators in northern Italy also failed due to excessive load, leading to a complete blackout. 56 million of consumers remained without electricity. The subway stopped working, 110 trains stopped on the railways. As a result of the power outage, four people died - one man and three women. A man was hit by a car at an unlit intersection, a woman suffered multiple burns when a candlestick fell on her; two more elderly Italian women fell down the stairs
07.11.2003	Chile	As a result of the heat, an accident occurred at the central power plant in Chile. 600,000 residents of the city of Santiago remained without electricity for four hours
22.01.2004	Turkey	The entire European part of Istanbul was without electricity due to the snowstorm
12.07.2004	Greece	As a result of the accident at the power plant, 6 million residents of the city of Athens and the southern part of the country remained without electricity for two hours.
09-10.08.2004	Jordan	The power supply system of the region with a population of about 5.8 million people was completely paralyzed for a period of up to three hours
22.11.2004	Poland	An accident in the power system in Warsaw. In the evening, as a result of a sudden power outage, three districts of the city of Warsaw ("Mokotów", "Polyuwa" and "Wola"), a quarter of the city's where 1.5 million people live, were left without electricity. Due to the lack of power supply, Frederic Chopin International Airport was closed for an hour and a half, as a result of which at least 12 planes were diverted to other airports, several flights were delayed. According to the city's Fire Service, passengers of the capital metro were not injured. During the blackout, by a happy coincidence, all the trains ended up in subway stations and not in tunnels
23.01.2005	Canada	Due to the flood, the city of Toronto remained without electricity for about 12 hours

14.08.2005	Japan	The reason was a break in the high-voltage cable. The lifting crane, which was on the ship, broke one of the main power transmission lines stretched over the Edogawa River. More than a million apartments in Tokyo remained without electricity, as well as in the cities of Kawasaki and Yokohama. In Tokyo, the subway stopped for 30 minutes, traffic was completely stopped on several lines of ground trains. About three hundred traffic lights went out on the capital's roads. The fire department received more than 20 calls from people stuck in elevators. The ATMs were turned off. The attractions of Tokyo Disneyland remained without electricity
04.11.2006	Germany	When the passenger liner, built at the shipyards in the city of Papenburg, entered the sea along the Erms River, a scheduled disconnection of the 380-KIlovolt line was carried out for the passage of the liner under it. However, during the redistribution of electricity flows, the automatic protection system of one of the neighboring lines was triggered, which caused a wave of blackouts in Germany, the Benelux countries, France, Spain, Portugal, Italy, Morocco, Austria and Croatia
09.11.2009	TajiKIstan	As a result of the accident on the "Nurek - Regar" transmission line, almost all of Tajikistan's hydroelectric power plants, including the country's largest Nurek hydroelectric power plant, stopped producing power, which led to the disruption of electricity supply to about 70% of the territory of Tajikistan. The accident occurred at 4:35 a.m. local time and, according to the press secretary of the "Barqi Tojik", was eliminated in an hour and a half. Specialists of " Barqi Tojik " associate the accident with the autonomous operation of the Tajik power system outside the United Power System of Central Asia, due to the lack of transit electricity from Uzbekistan and Turkmenistan
10.11.2009	Brazil	According to the main version, the cause of the event was the damage of the LEP, connecting the dam of "Itaipu" with the Brazilian power system, which made it impossible to release the power of the NPP. Power outages affected more than 50 million people living in Brazil; there were also power outages in Uruguay. The power outage occurred at 8:15 p.m. local time, power was restored at 0:37 a.m. on November 11
31.07.2012	India	The power crisis began after four northern states - Rajasthan, Haryana, Punjab and Uttar Pradesh - exceeded the power consumption quota. After that, the outages spread to neighboring areas. The problems in the power supply system began around 2:30 a.m. local time. Hospitals and schools remained without electricity. More than 600 million people in India experienced problems in energy supply, which affected 19 states in the north and east of the country. The Northern, Eastern and North-Eastern power supply system's worked with interruptions. Electricity supply in Delhi has fallen from 4,000 MW to 40 MW. All six lines of the Delhi Metro were not working, passengers were taken out of the stations. The system of city traffic lights worked with violations. More than 500 railway depots were suspended in northern India. By the morning of the second day, it was possible to completely restore the power supply of the northern and western regions of the country

24.09.2012	Kazakhstan	In the city of Almaty, there was an emergency disconnection of all 220 kV connections at the "Almaty-500" substation. The reason was a short circuit on the RU-220 bus section, which arose due to erroneous actions of the personnel. As a result, the entire city and the Almaty region were left without electricity, including such large facilities as the subway and the city's airport
20.11-08.12.2015	Ukraine	As a result of the undermining of power transmission line supports from mainland Ukraine to the Autonomous Republic of Crimea, energy supply to the peninsula was completely stopped. For two weeks, the activists prevented the restoration of the pylons and the restoration of electricity supply to Crimea. A state of emergency was introduced in Crimea and fan shutdowns began
03.07.2018	Azerbaijan	The cause of the accident was the failure of a transformer on one of substations of the Azerbaijan TPP, as a result of which an opening occurred, which, in turn, disrupted the normal operation of the entire power plant. These problems were caused by abnormal heat and increased electricity consumption. As a result of the accident, the power supply was stopped in 39 cities and regions of Azerbaijan, including Baku and Ganja. The operation mode of the enterprises of the State Oil Company of Azerbaijan (SOCAR) was violated: the operation mode of land industries was violated, the compressor stations of the Gas Export Administration, as well as the Baku Refinery, the enterprises of the production association "Azerkhimiya" and the Azerbaijan Gas Processing Plant were stopped in emergency mode. JSC "Azerenerzhy" appealed to neighboring countries about the import of electricity. Azerbaijan temporarily suspended exports electricity to Iran
09.08.2019	Great Britain	A massive power outage occurred in the evening in some areas of London and south-east Britain due to the failure of the country's national energy system. The company "Transport for London", which operates the transport system of the British capital, reported that the bankruptcy affected the work of street lighting and traffic lights, and also caused disruptions in the work of rail transport. National Rail reported that trains on some lines were briefly stopped due to a power outage, but power was later restored. The interruption affected railway lines operated by Thameslink, Southern and Gatwick Express, as well as some London Underground lines
09.01.2021	PaKIstan	Power outages across the country (114 cities) were caused by a sudden drop in frequency in the power supply system
25.01.2022	UzbeKIstan, Kyrgyzstan, Kazakhstan	As a result of a significant emergency imbalance in the power system of Central Asia (Uzbekistan, Kyrgyzstan), there was an increase in the power transit capacity of 500 kV "North-East-South of Kazakhstan"

28.09.2022	Cuba	Cuba's power generation system completely shut down due to Hurricane Ian. A tropical hurricane passed through Cuba on the night of September 27. Wind gusts reached 123 km/h. Generation in the energy system is zero (there is no energy supply throughout the country). The failure was detected in the west, in the central part and in the east
Starting from 10.10.2022	Ukraine	Blackouts in various regions of Ukraine caused by a full-scale military attack by the Russian Federation

The analysis of the data presented in Table 5.1 shows that military actions are not the main cause of blackouts.

On February 24, 2022, at 3:40 a.m., an open military attack by the Russian Federation on Ukraine began. Campaign strikes have begun throughout the territory of Ukraine. Russian troops invaded Ukraine near Kharkiv, Kherson, Chernihiv, and Sumy, entering from Russia, Belarus, and Crimea, which was temporarily occupied by Russia in 2014.

After the successful September counteroffensive of the Armed Forces of Ukraine in the Kharkiv region, the systematic destruction of Ukraine's energy system by the Russian Federation began on October 10, 2022. The longest blackouts occurred after massive shelling of Ukraine on October 10, October 31, November 15, and November 23, 2022 [2-4].

On October 10, 2022, at approximately 8:15 a.m., Russian forces launched the largest missile attack on the entire territory of Ukraine since the start of the full-scale invasion [about 100 missiles and Unmanned Aerial Vehicles (UAVs) were launched]. The missile attack is associated with the September failures of the Russian occupying forces at the front and the damage to the Kerch bridge on October 8, 2022. Missile launches were carried out in several waves from the regions of the Black and Caspian seas, including Tu-95MS and Tu-22M3 aircraft. 84 missiles were used in the strikes. Air Defence Forces managed to shoot down 43 missiles. Russia used Kh-101, Kh-555, Kalibr, Iskander, S-300 and Tornado missiles. Russia also used 24 UAVs, of which 13 were Iranian "Shahed-136" from the territory of Belarus and Crimea. Three cruise missiles fired from the western part of Crimea violated the airspace of Moldova. As of 11 a.m. on October 10, 11 important infrastructure facilities in 8 regions and the city of Kyiv were damaged as a result of the strikes. Some regions were cut off. In total, on October 10 and during less intense shelling on the following two days, 28 objects of Ukraine's energy infrastructure were damaged by missile strikes.

In Kyiv, hits were recorded in 4 districts of the city: Shevchenkivskyi, Sviatoshynskyi, Holosiivskyi and Desnyanskyi. As a result of the impact, 5 objects of critical infrastructure were damaged. All metro lines were stopped in the city.

Only in the afternoon, the Syretsko-Pecherska line of the Kyiv Metro, from the Syrets station to the Chrevyn Khutir station, resumed traffic. Damage to critical infrastructure led to the introduction of temporary restrictions on the supply of electricity to consumers (fan outages).

Fig. S.1. Consequences of the rocket fire in Kyiv on October 15, 2022

Russia launched 15 missiles in the Lviv region, some were shot down by air defence forces, others damaged energy infrastructure facilities. According to the statement of the deputy mayor of Lviv, Andriy Moskalenko, as of 2:20 p.m., approximately 90% of the city's electricity was cut off, and the movement of trams and trolleybuses was temporarily suspended. Also, 80% of the traffic lights do not work. By 11:00 p.m., electricity was restored in the city. A total of four electric substations were destroyed in the Lviv region after the missile attacks on October 10 and 11, which not only supplied the region, but also exported energy abroad. Moreover, two of them were hit again on October 11.

At least 3 strikes were recorded on Kharkiv energy infrastructure facilities. In some areas, water and electricity have disappeared.

As a result of the shooting on the evening of October 10, 1307 people were killed.

On October 27, 2022, Russian military personnel struck critical infrastructure facilities in the Kyiv region, causing an even greater shortage of electric power than on October 10, 2022. Power grid operators were forced to introduce longer emergency consumer disconnections in the city.

On October 31, 2022, the Russian military carried out several waves of missile attacks on objects of critical infrastructure of Ukraine.

A total of 78 missiles and UAVs were launched. 55 Kh-101 cruise missiles and one Kh-59 cruise missile were fired from the Tu-95 and Tu-160 strategic aviation missile-carrying aircraft from the north of the Caspian Sea and from the Volgodonsk region (Rostov region); 44 cruise missiles were destroyed by air defence forces and means; 22 missiles from the S-300 complex were also struck, and 5 UAVs were used. Strikes by Russian missiles were recorded in Kyiv, Kirovohrad, Zaporizhzhia, Chernivtsi, Cherkasy, Kharkiv regions, and Vinnytsia region.

As a result of the attacks, 18 (mainly energy-related) facilities in 10 oblasts were damaged; power was cut off to railway sections as well as hundreds of settlements in seven oblasts of Ukraine. Rocket attacks were carried out on the Dnipro Hydroelectric Power Station (HPP), the Dniester Hydroelectric Power Station and the Kremenchuk Hydroelectric Power Station. As a result of the strikes in critical infrastructure in the Kyiv region, around 80% of consumers in the city of Kyiv were left without water and power outages were experienced.

Cruise missiles violated the airspace of Moldova. Debris of one downed rocket fell near the Dniester hydroelectric power plant, windows were blown out in many houses. On the same day, the Ministry of Foreign Affairs of Moldova summoned the Russian Ambassador and declared one employee "persona non grata".

Fig. 5.2. The intensity of emergency power outages in Ukraine due to massive shelling of infrastructure from October 10 to November 3, 2022 [according to (5)]

According to data [5] in Ukraine, from October 10 to November 3, the northern and central regions, in particular, Zhytomyr, Chernihiv, Cherkasy, Kyiv oblasts, as well as Kyiv itself, were most affected by emergency power outages (excluding stabilization ones). It is noted that, in accordance with the data of "Ukrenergo" - the regional energy and military administrations - the Sumy, Kharkiv, Poltava, Dnipropetrovsk, Kirovohrad and Zaporizhia regions also suffered significant losses from emergency shutdowns. It is noted that the eastern and western regions of Ukraine, in particular Kherson, Mykolaiv, Odesa, Vinnytsia, Khmelnytskyi, Ternopil, and Chernivtsi regions, were the least affected.

On November 5, 2022, the Russian military carried out another massive shelling of the critical infrastructure of Ukraine which, in terms of the number of missiles fired - 96 air and sea-based cruise missiles X-101, X-555, "Kalibr" , and guided air missiles X-59 - surpassed the shelling on October 10 with 84 pcs.

In addition, in the morning four strikes were made from C-300 complex on the outskirts of Zaporizhzhya, and during mass shooting with cruise missiles, six more strikes from P-300 were launched in Kharkiv and Chuguev district. The Ukrainian anti-aircraft forces managed to shoot down 75 of 96 launched cruise and sea-based missiles (X-101, X-555, "Kalibr"), two controlled aircraft missiles X-59, as well as 10 submarines of Iranian production "Shamed-136/131", one UAZO "Orion" and one "Orlan-10".

As a result of the attack, 15 energy objects were damaged and over 7 million subscribers were disconnected from power consumption. Attacks on the energy system of Ukraine on November 15 caused a breakdown in the operation of the high-voltage line Vulcanesti- Isakcha - MGRES, which supplies electricity from Romania to Moldova, led to temporary loss of power supply to consumers of electricity in Moldova. The impact on energy infrastructure has affected the operation of nuclear power plants. Thus, the IAEA on the basis of the information received from the Ukrainian authorities, reported that Khmelnitsky NPP lost full access to the electricity network and temporarily switched to standby power supply from diesel generators. Both reactors had to be stopped. Rivne NPP lost communication with one of the 750 kV transmission lines. It was possible to reduce the power of the station, one of the four units was automatically switched off.

As of November 16, Kyiv Oblast, Kyiv, Ivano-Frankivsk, Rivne, Odesa, Cherkasy, Chernivtsi and Chernihiv regions have fully restored energy supplies; Lviv, Ternopil, Volyn, Khmelnytsky and Kharkiv regions – by 95%, Ternopil regions – by 90%.

The Zhytomyr and Sumy regions continued to work on reconstruction electricity supply.

On November 23, 2022, at about 15:00, Russian Federation once again caused a massive missile attack on critical objects infrastructure of Ukraine. Being unable to overcome the Armed Forces of Ukraine, the enemy is waging war against peaceful citizens, power plants, medical institutions, etc.: 67 launches of cruise missiles (X-101, X-555) and sea bases ("Kalibr"), as well as UAVs were carried out.

By the forces of the UPO of Ukraine 51 missile cruise rockets and 5 UAVs "Lancet" were destroyed; 30 rockets were fired at the city of Kiev alone, 20 of which were destroyed.

As a result of the attack, the longest blackout occurred during the entire war. All NPPs of Ukraine stopped working. At 24:00 on November 23, 11 regions of Ukraine were without electricity supply. The energy system of Ukraine managed to be unified only around 4:00 a.m. on November 24.

5.2 General information on the production and supply of electric energy to consumers

Electricity supply is called provision of consumers electric energy [6].

A consumer of electrical energy is an electrical energy receiver (electrical receiver) or a group of electronic receivers, united by a technological process, located in a certain territory.

An electrical energy receiver is an apparatus, unit, mechanism designed to convert electrical energy into another type of energy.

Receivers of electrical energy are divided into power (in particular, electric motors), lighting and special (civilian purpose, located in explosive and fire-hazardous zones, electrothermal, electric welding, etc.).

Electric energy is produced at power stations and is transmitted through electric lines to consumers.

A power plant is a combination of installations, equipment and apparatus used for the direct generation of electricity by converting other types of energy, as well as the necessary facilities and buildings located on a certain territory.

More than half of electricity in Ukraine is produced at Nuclear Power Plants (NPP). The rest of the electric energy is produced at thermal power plants (about 35%), hydro- and hydro-vacuum power plants (about 5%) and non-conventional (alternative) power plants (about 7%).

Nuclear Power Plant (NPP) is a complex of technical facilities intended for the production of electric energy by means of the use of energy allocated in the

controlled nuclear reaction. The first Nuclear Power Plant built in Ukraine is the Chernobyl NPP, the first power unit of which was put into operation in 1977. The Chernobyl NPP ceased its work on December 15, 2000. In Ukraine there are four nuclear power plants – Zaporozhskaya (the largest in Europe, generates the fifth part of the annual energy production of Ukraine and half of the production of all Ukrainian power plants), Yuzhno-Ukrainska, Rivne (originally called Western Ukrainian) and Khmelnytskyi.

Thermal Power Plant (TPP) is a power plant that produces electricity by converting the chemical energy of fuel into mechanical energy to rotate the shaft of the electric generator. They allocate boiler-turbine, gas-turbine and steam-gas TPPs. Boiler turbines TPPs are divided into condensing power plants (DRES) and thermal power plants (TPPs). In Ukraine, the first Central TPP of the common use has started to operate in Kyiv City in December 1890. The electric station provided a current for lighting the city theater, Khreshchatyk Street and private houses. It was located in a stone building on Teatralna Square, where the National Opera of Ukraine named after Taras Shevchenko is located now. The power plant had an insulated boiler house, machine compartment and distribution unit. Three steam boilers were installed in the boiler house, which worked on wood. Water came from the city water. The boilers produced steam for three dual-cylinder steam engines of 44,1 kW each. These machines were driven in motion dynamometer Siemens. In addition, for power of 14 arc lanterns, installed on the street Khreshchatyk, two dynamometers with power of steam machines, power of 14,7 kW were allocated. The Power Plant was about 110,3 kW. The largest TPPs of Ukraine are Burshtyn, Vugleghirska, Dobrotvirska, Zmiivska, Kryvorizka, Kurakhivska, Myronivska, Prydniprovska, *Starobeshievska,* Trypilska.

State District Power Plant (SDPP) is a thermal condensing power plant that produces only electrical energy. Shterovska *SDPP*, located in the village of Shtergres (today Miusynsk, Luhansk region), is considered the first *SDPP* built in Ukraine. Construction of the Power Plant began in 1922, the first generator was launched on October 8, 1926, the plant was fully commissioned in 1931, and closed in 1983. The initial installed capacity of the power plant was 157 MW. Worked on anthracite. Over time, the term " *SDPP* " lost its original meaning ("district") and in the modern sense means a condensing power plant of large capacity (thousands of MW) operating in a combined power system along with other large power plants.

Thermal Power Plant (TPP) is a type of power plant that produces not only electrical energy but is also a source of thermal energy in centralized heat supply systems (in the form of steam and hot water) to provide heating and hot water

supply for residential and industrial objects. As a rule, the *TPP* works according to the schedule, that is, the production of electrical energy depends on the production of thermal energy.

Gas Turbine Thermal Power Plant is a modern high-tech installation that generates electricity and thermal energy. It is based on one or more gas turbine engines mechanically connected to the electric generator and integrated control system in a single energy complex. In the gas turbine plant, the gas-like products of fuel combustion are turned. Both natural gas and oil industry products (oil, diesel fuel) can serve as fuel. On one shaft with a turbine there is a generator, which by means of rotation of the rotor produces electric energy.

Steam-Gas Thermal Power Station is a station for the production of thermal and electrical energy. It differs from the Gas Turbine Thermal Power Plant by its increased efficiency. The steam-gas unit consists of two separate units: gas turbine and steam power. The first generator is connected to the gas turbine unit. Passing through the gas turbine unit, combustion products give it only a part of their energy and at the outlet of the gas turbine have a sufficiently high temperature. From leaving the gas bin, the products of combustion get into the boiler-recovery steam-power unit, where the water vapor is heated. The temperature of the combustion products is sufficient to bring the steam to the condition required for the rotation of the steam turbine (temperature about +500 °C and pressure 80 kPa). A second generator is connected to the steam turbine.

Hydroelectric Power Station is a power plant that uses water flow energy as an energy source. It is usually built on rivers by constructing dams and reservoirs. The first Hydroelectric Power Station in Ukraine can be considered the one built in 1890 by Count Schönborn in the village of Kolchyno (near Mukacheve, Zakarpattia) on the Vyznytsia River. The station had a capacity of 200 kW and operated until 1961. The most powerful stations of Ukraine include the Dnipro cascade- that is, Kyiv, Kaniv, Kremenchutsk, Serednodniprovska (originally called Dniprodzeržyns'k) , Dniprovska, and Kakhovka.

Pumped-Storage Hydroelectric Power Plant (PSHPP) is a hydroelectric power plant used to equalize the daily unevenness of the electrical load. In its work, *PSHPP* uses either a set of generators and pumps, or reverse hydroelectric units, which are capable of operating both in generator mode and in pump mode. During the nighttime decrease in electric power consumption, *PSHPP* receives cheap electricity from the power grid and uses it to pump water into the so-called upper beef (pumping mode). During the morning and evening increase in electricity consumption, the *PSHPP* discharges water from the upper reservoir to the lower reservoir and produces peak electricity, that is fed into the power grid (gen-

erator mode). There are three Pumped-Hydro Power Plants operating in Ukraine: Kyiv, Tashlyk, and Dnestrovsk.

Non-traditional (alternative) Power Plants are considered, first of all, solar, wind and biogas power plants. Solar power plants are power plants transforming solar radiation into electric energy.

Wind power plants transform kinetic wind energy in electrical energy. Biogas power plants are thermal power plants using organic fuel received from waste of plants, animals or agriculture or industrial production. These include alcohol mixtures, air, bio-oil, various gas combinations, etc. As of June 30, 2021, the total capacity of non-conventional power plants in Ukraine was 8044 MW [solar – 6351 MW (79,0%), wind – 1593 MW (19,8%), biogas – 100 MW (1,2%)] [7]). The largest number of non-conventional power plants are located in Zaporizhzhia, Kherson and Mykolaiv regions.

Electric energy is produced at the power plant in the form of three-phase alternating current. Direct current - required for industries such as electrochemistry, electrometallurgy, electrified transport, etc. - is obtained by converting three-phase current into direct current at conversion stations using rectifiers. The *Energy System* is a combination power plants, electric and thermal networks, connected together and connected by the common regime in continuous process of production, transformation and distribution of electric energy and heat at the joint management of this regime.

Rational distribution is possible in the energy system - the load between power plants, as a result of which fuel consumption is reduced due to the most complete use of nuclear power plants and reduction of the cost of electric energy.

Generators of electric stations produce, as a rule, electricity energy with a specified value of line voltage - 6.6 kV, 11 kV, 15 kV, 30 kV etc. - depending on the type of installed generator. This is to say because power plant generators are not connected to the power transmission line directly, but through transformer substations. The voltage of the line for the transmission of electrical energy must be selected in such a way that the energy transfer takes place with small losses for the lowest cost of transmission and the lowest consumption of cable products.

The active power transmitted along the three-phase current line is determined by the formula [8]:

$$Ð = \sqrt{3} \cdot U_1 \cdot {}^2{}_1 \cdot \tilde{n}\hat{i}s\ \varphi, \text{ [W]}. \qquad (5.1)$$

Power losses in electrical wires of a three-phase network can be determined by the Joule-Lenz Law:

$$Q = I^2 \cdot R \cdot t\,, [\text{J}], \tag{5.2}$$

where Q is the amount of heat, [J]; I – current strength, [A]; R – conductor resistance, [Ω]; t is time, [c].

The value of electrical resistance depends on the material from which the conductor is made, the size of the conductor, the temperature of the conductor and is determined by the formula:

$$R = \rho \cdot \frac{\ell}{S} \tag{5.3}$$

where (ρ) is the specific resistance of the conductor, (l) – conductor length, [m]; S – cross-sectional area of the conductor, [mm^2].

Then the power losses in the electric wires of the three-phase circuit will be determined by the formula:

$$\Delta Р = 3 \cdot I^2 \cdot r = 3 \cdot I^2 \cdot \rho \cdot \frac{\ell}{S} \tag{5.4}$$

From formulas (5.1) and (5.2) we get the formula:

$$\Delta Р = 3 \cdot \frac{P^2}{3 \cdot U_l^2 \cdot \cos^2\varphi} \cdot \rho \cdot \frac{\ell}{S} = \frac{P^2}{U_l^2 \cdot \cos^2\varphi} \cdot \rho \cdot \frac{\ell}{S}, \tag{5.5}$$

from which it follows that in order to transmit electrical energy over a distance with an increase in power, to reduce energy losses, it is necessary to increase the voltage.

In practice, the voltage is increased using a transformer substation, which increases the voltage to a value that depends on the amount of power being transmitted and the distance over which it is transmitted. There is certain relationship between voltage, transmission power and the length of transmission lines. For example, when transmitting power of 10÷50 MW over a distance of 50÷150 km, the line voltage increases to the value of 110 kV; 100÷150 MW and 200÷300 km – 220 kV; 150÷1000 MW and 300÷400 km – 300 kV; more than 1000 MW and more than 400 km – 500 kV, respectively.

Electric energy from the power plant to the area of consumption is transmitted via a high-voltage overhead or cable power transmission line.

An overhead power line is a facility for electricity transmission composed of wires located outdoors and fixed with the help of insulated structures and fittings or brackets and struts on engineering structures (bridges, overpasses, etc.). There are overhead power lines with voltage up to 1000 V and voltage above 1000 V (high voltage).

A cable power transmission line is a line for the transmission of electricity, or of its individual pulses, consisting of one or more parallel cables with connection, locking and end fittings and fixing parts, and for oil filled lines, in addition, with oil supply devices and pressure signaling system.

Depending on the type of current, power lines and cable lines are divided into *alternating current* and, accordingly, *direct current lines*.

After being transported by overhead line or high voltage cable to the necessary distance from the power plant to the consumption area, electricity is supplied to switchboards and substations.

Switchgear (SwG) is an electrical installation for the reception and distribution of electricity, containing switching devices, collective and connecting buses, auxiliary devices (compressors, batteries, etc.), as well as protection devices, automation and measurement devices. There are outdoor *SwG* s (the equipment is outdoor), indoor (the equipment is inside) and complete (the installation, consisting of cabinets and blocks with devices installed in them, devices for measurement, protection and automation and connecting elements, is intended for installation in premises).

A substation (ESS) is an electrical installation for the transformation and distribution of electricity, consisting of transformers or other converters of electricity, distribution devices, control devices and auxiliary facilities. There are substations of indoor transformers (*ESS*, whose equipment is located in a room or in a metal shell), attached (*ESS* closed, which has only one element in common with an adjacent room (a wall, partition or floor, which is an overlap of an adjacent

room from below), built-in (closed substation, which has two or more construction elements shared with adjacent premises), complete (substation, consisting of transformers mounted in cabinets or installed outdoors, blocks of *SwG* s and other elements, supplied in an assembled form or fully prepared for assembly), pylons (*ESS*, all whose equipment is installed on the structures or on the support of the overhead contact line simply of the sky at a height that does not require protection from the ground).

The transformer substation, as a rule, reduces the line voltage to a value of 10 kV (district transformer substation).

Next, electrical energy over the air, or power transmission cable line, goes either to high-voltage consumers, or to the transformer substation, which reduces the line voltage to the value of 380 V (object transformer substation) to ordinary consumers.

An example of a simplified single-line circuit - all conductors that are necessary for the transmission of electrical energy are depicted by a single line - supply of electrical energy from the power plant to consumers of electrical energy is shown in fig. 5.3 (the figure shows the values of line voltages).

From the facility's transformer substation to the receivers of electrical energy, electrical energy is transmitted through the electrical network.

An electrical network is a set of electrical installations for the transmission and distribution of electrical energy, consisting of substations, distribution installations, power lines overhead and cable power transmission lines operating in a certain territory. The main difference between an electric line and an electric network is that an electric line is not branched, whereas the electrical network is a branched system of conductors.

Electricity networks are open (radial and main) and closed (ring, bilateral, double main, complex, etc.). In Fig. 5.4 the principle of the construction of open electricity networks is explained, and Fig. 5.5 - that of closed electricity networks.

Residential buildings with a height of up to five floors are usually powered by a main ring circuit with a disconnected jumper (as a rule, 4 buildings are powered). Three residential buildings are normally supplied with one cable line (nominal load), and the fourth house is supplied with another cable line (a third of the nominal load). In the event of an accident, the power supply is switched to another cable.

Residential buildings with a height of up to five floors are usually powered by a main ring circuit with a disconnected jumper - as a rule, 4 buildings are powered. Three residential buildings are normally supplied with one cable line (nominal load), and the fourth house is supplied with another cable line (a third of the

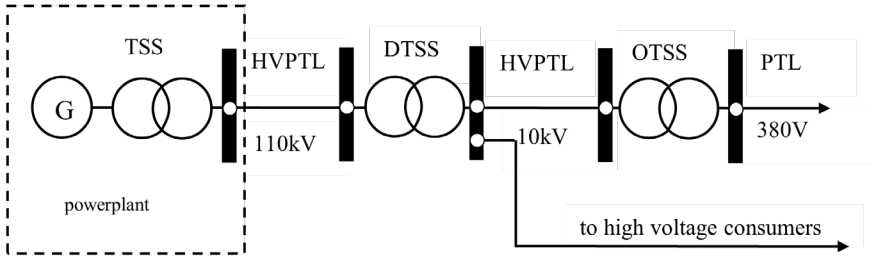

Fig. 5.3. An example of a simplified one-line scheme for the supply of electrical energy from a power plant to consumers of electrical energy G - generator of a power plant; TSS - transformer SS, which increases the voltage; HVPTL - high-voltage power transmission line; DTSS - district transformer substation that reduces the voltage; PTL - power transmission line; OTSS is an object transformer substation reducing the voltage

nominal load). In the event of an accident, the power supply is switched to another cable.

For residential buildings with a height of 5 to 16 floors, radial and trunk schemes (main circuits) with mutual redundancy of inputs are used. In this case, one of the lines is designed to supply power to the electrical receivers of residential apartments and working lighting of general construction facilities, and the second is for power lines to high voltage.

In residential buildings higher than 16 floors, electric receivers of emergency and evacuation lighting, fire extinguishers and elevators are supplied with electric energy from two independent mutually redundant power sources, and an interruption in their power supply - in the event of a disruption of the power supply

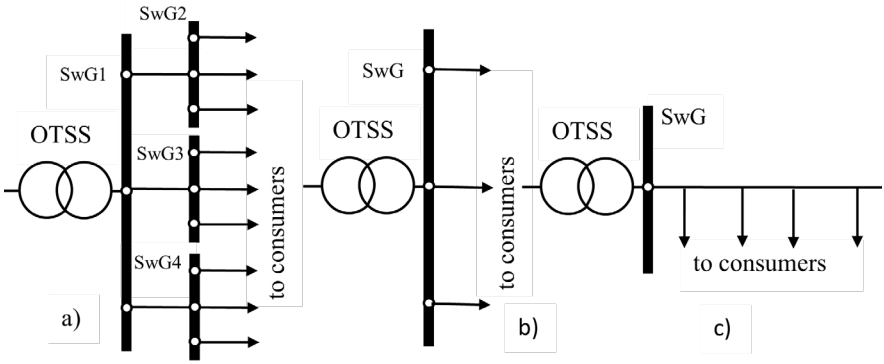

Fig. 5.4. The principle of construction of open electrical networks: a - distribution radial, b - concentrated radial, c - trunk OTSS - object transformer substation that reduces the voltage; SwG - switchgear is a distribution device

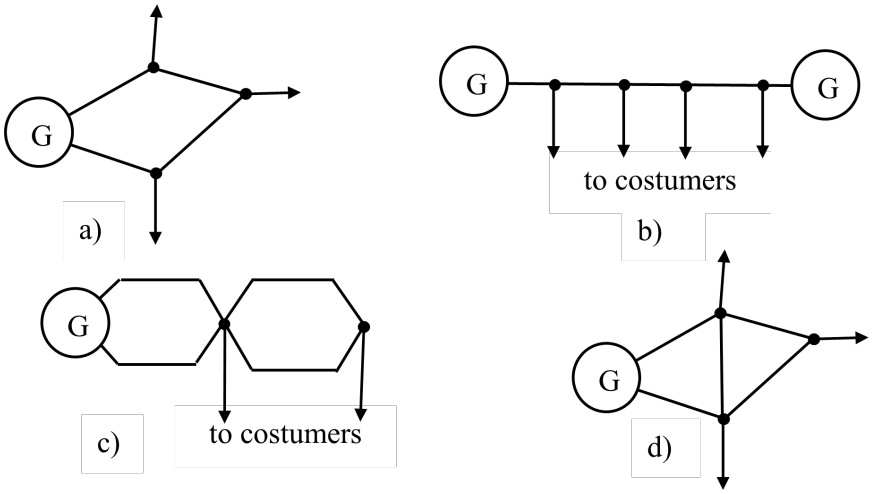

Fig. 5.5. The principle of construction of closed electrical networks: a – ring, b – bilateral, c – double trunk, d – complex closed

from one of the power sources - can be allowed only for the time of automatic power restoration.

A three-phase network with a linear voltage of 380 V is supplied to all residential buildings. For the purpose of electrical safety, only one phase with a voltage of 220 V is supplied to the apartments. A vertical distribution line departs from each input from which branches for powering individual apartments go through the floor distribution boards are located on each floor. Apartment panels with counters can be installed in apartments.

The main electricity receivers in residential buildings are lighting installations and electrical household appliances.

In public and administrative buildings, the same electricity supply scheme is used as in residential buildings. The lighting load prevails, but power electrical equipment can also be installed (electric motors for fans, pumps, refrigeration units, etc.).

As a rule, industrial enterprises are supplied with electricity from their own workshop substations. Receivers can be electric motors, electrothermal installations, electrochemical installations, lighting installations, etc.

In fig. 5.6 shows an example of a single-line diagram of a distribution radial electrical network from the object transformer substation to the receivers of elec-

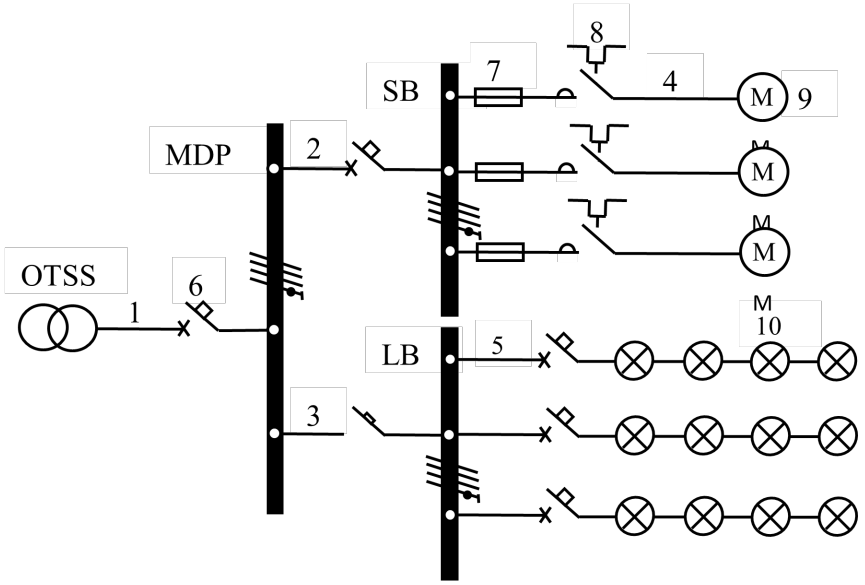

Fig. 5.6. An example of a single-line diagram of a distribution radial electrical network from the object transformer substation to the receivers of electrical energy

OTSS - object transformer substation reducing the voltage; MDP – the main Distribution Panel; SB – switchboard; LB is a lighting board; 1 – power supply network; 2 – power distribution network; 3 – distribution lighting network; 4 – branching to electric motors; 5 – group line of the lighting network; 6 – automatic switch; 7 – fuse; 8 – magnetic starter coil; 9 – electric motor; 10 – an electric lamp with an incandescent lamp

trical energy - electric motors and lamps.

Main Distribution Panel (MDP) is a panel through which electricity is supplied to the entire building or its separate part. The input and distribution device can perform the role of the *MDP* [9].

Input-Distribution Device (IDD) is an input device that also contains devices, and also devices on outgoing lines.

Input device (ID) is a set of structures, and devices installed at the input of the power line, into the house or in its separate part, powered by the *MDP*.

Accordingly, the types of electrical networks are introduced by:

- power supply network - a network from the distribution device of the PS or a branch from the overhead power lines to the input device, input-distribution device or MDP;

- distribution network - the network from the input device, input-distribution device or *MDP* to distribution devices and shields (SB, LB);

- group network - a network from switchboards and distribution devices (*MDP*, LB) to lamps, sockets and other electrical receivers.

Failure of any element of the power supply system leads to blackout. By analogy with the levels of emergency situations [10, 11], it is possible to introduce the concept of blackout by territorial coverage: state, regional, local and object level.

5.3 Standardisation of the reliability of electricity supply in Ukraine

Electric energy in Ukraine must be in accordance with the established quality standards. [12]. The standard [12] corresponds to International Standards IEC 868, IEC 1000-3-2, IEC 1000-3-3 – now obsolete. As for the quality standards of electricity, Europe is governed by the standard [13], adopted in Ukraine [14] since 2014 for confirmatory method.

According to [6], all consumers of electrical energy in Ukraine are divided into three categories of reliability, indicated by Roman numerals.

Electric receivers of category I - electric receivers, the interruption of electricity supply to which can cause danger to people's lives, significant damage to economic entities, damage to expensive basic equipment, mass shortage of products, disruption of a complex technological process, disruption of the functioning of particularly important elements of the municipal economy.

A special group of electrical receivers is distinguished from the composition of electrical receivers of the I category, the uninterrupted operation of which is necessary for an emergency shutdown of production, in order to prevent threats to human life, explosions, fires, and damage to expensive main equipment.

Electric receivers of category II - electric receivers, break the electricity supply of which leads to mass shortages of products, mass downtimes of workers, mechanisms and industrial transport, disruption of the normal activities of a significant number of urban and rural residents.

Electric receivers of category III - the rest of electric receivers that do not fall under the definition of categories I and II.

An independent power source of the receiver or group electrical receivers - a power source on which the voltage is maintained within the limits regulated by the Rules for Electrical Installations (REI) for the post-emergency mode when it disappears on another or other power sources of these electrical receivers.

Electric receivers of the first category must be supplied with electricity from

two independent, mutually redundant power sources, and interruption of their power supply in case of disruption of power supply from one of the power sources can be allowed only for the time of automatic power restoration.

For the power supply of a special group of electrical receivers of the I category, additional power supply from a third independent mutually redundant power source should be provided.

As a third independent power source for a special group of power receivers and as a second independent power source for the rest of category I power receivers, local power plants, power system power plants, special uninterruptible power supply units, batteries, etc., can be used.

If power supply redundancy cannot ensure the necessary continuity of the technological process or if power supply redundancy is not economically feasible, technological redundancy must be implemented, for example, by establishing mutually redundant technological units, special devices for non-emergency stop of the technological process, which operate in the event of a power supply failure.

It is recommended to provide electrical receivers of II category of electricity from two independent mutually redundant power sources.

For power receivers of the II category, in the event of a disruption of the power supply from one of the power sources, interruptions in the power supply are permissible for a certain time, which is necessary to turn on the backup power supply by the actions of the staff on duty or the on-site operational team.

It is allowed to power electrical receivers of the II category one at a time airline, if it is possible to carry out emergency repairs of this line in a time not exceeding one day.

For power receivers of the III category, power supply can be performed from a single power source, provided that interruptions in power supply, necessary for the repair or replacement of a damaged element of the power supply system, do not exceed one day.

Power supply of all fire-fighting devices (fire pumps, fire-stop valves with an electric drive, centralized fire alarm system, fire alarm systems, fire extinguishing, electric valves on fire-fighting water pipes, detectors of explosive concentrations of combustible gases, explosive vapors, dust, etc.) is performed, as a rule, according to the first category of reliability.

For objects of various purposes, there are departmental documents that regulate, ensuring the reliability of their electricity supply. In particular:

- residential buildings [15, 16];
- public buildings and structures [16, 17];

- medical and preventive houses and structures [16, 18];
- buildings and buildings of educational institutions [16, 19];
- houses and buildings of children's preschool institutions [16, 20];
- houses of lending, insurance and commercial institutions destination [16, 17];
- cultural, entertainment and entertainment facilities [16, 21];
- sports and physical culture and health facilities [16, 22];
- department stores, shopping centres and stores [16, 23];
- parking lots and garages for cars [16, 24];
- telephone exchanges [25-27];
- boiler rooms [28];
- subway buildings [29];
- nuclear power stations [30];
- external networks and gas supply facilities [31];
- poultry enterprises [32];
- livestock enterprises [33-37];
- buildings and structures for storage and processing of agricultural products [38-39];
- warehouses of oil and oil products [40].

The strictest requirements regarding the reliability of power supply are advanced to electric receivers of the special group I category. Therefore, such receivers are relatively rare. Of the objects listed above, the electricity receivers of the special group I category are:

- electric receivers of operating and maternity units, departments of anesthesiology, intensive care and intensive care, laparoscopy, bronchoscopy and angiography rooms and other rooms, on the smooth operation of which the life of sick medical and preventive buildings and structures directly depends [regardless of the presence of mutually redundant transformers, it is necessary to provide a diesel electric station (DES), an uninterruptible power supply unit (UPS) or accumulator batteries);
- electrical receivers of fire protection systems, elevators, emergency lighting, security alarm, gas alarm of banks and bank vaults of buildings of lending, insurance and commercial institutions;
- electrical receivers of telephone exchanges with a capacity of 3,000 or more numbers;
- traction, traction lowering and lowering substations of lines metro and electric depot, energy control points, telecontrol and remote sensing devices of the

power supply system, automation and telecontrol of train traffic (ATTT), automated fare payment system (AFPS), contact persons, devices of the station work management system metro with the use of telemonitoring (SCST), emergency (evacuation) lighting, lighting of evacuation routes for passengers and personnel from the underground buildings, dispatch centres, server buildings of the subway;

- equipment of the information and control system of the automatic fire station signaling of Nuclear Power Plants (NPP) (two independent power sources and batteries with the calculation of operation for 24 hours in standby mode and 3 hours in "fire" mode).

Less strict requirements regarding the reliability of power supply are being put forward to electric receivers of the I category. Of the objects listed above, electric receivers of the I category are:

- electric receivers of fire protection systems, gas alarm, elevators, emergency lighting (safety and evacuation lighting), light fence lights in residential buildings and dormitories, public buildings and structures higher than 16 floors (47 m) to 25 floors (73.5 m);

- electric receivers of fire protection systems, gas detection, elevators, emergency lighting, security alarm of buildings of institutions, organisations, offices with more than 2,000 employees, regardless of the number of floors of public buildings and structures;

- electrical receivers of fire protection systems, gas alarm, hospital elevators, emergency lighting, security alarm of medical and preventive buildings and structures;

- electric receivers of fire protection systems, gas alarm, emergency lighting, security alarm of buildings of educational institutions in which more than 1000 people study, buildings and structures of educational institutions;

- technical means of the automated system for managing the banking activity of buildings of lending, insurance and commercial institutions;

- electrical receivers of fire protection systems, gas alarm, emergency lighting, security alarm; the rest of the electric receivers with a total number of seats in halls of more than 800 and children's entertainment facilities regardless of the number of seats of cultural and entertainment and recreational facilities;

- electrical receivers of fire protection systems, gas alarm, emergency lighting, security alarm of indoor sports facilities;

- electrical receivers of fire protection systems, gas alarm, emergency lighting, security alarm of department stores, shopping centres and shops with sales halls with a total area of more than 2000 m^2;

- electrical receivers of fire protection and air environment control systems,

emergency lighting, security signaling of parking lots and garages for passenger cars;

- electrical receivers of telephone exchanges with a capacity of less than 3,000 numbers;

- boiler rooms of the first category (a boiler room that is the only source of thermal energy of the heat supply system and provides consumers who do not have individual backup sources of thermal energy);

- electric receivers of fire protection systems, installations of fire extinguishing and fire alarm and smoke protection, electric receivers of air support in stairwells, elevator shafts, electric dampers for smoke removal and electric motors against smoke protection, fire retardant valves with an electric drive, hermetic valves of civil protection installed in vestibule-gates, traction (contact) network 825 V, escalators, elevators and their control systems, networks of fire warning and evacuation management systems, artesian and fire pumps, ventilation shut-off equipment, duplicating sound signal of automatic fire alarm and fire extinguishing systems, water valves with electric drives, pumping water discharge systems, working station lighting and tunnels, passenger automation devices, fans for tunnel ventilation of subway facilities;

- automatic fire alarm installations for NPP premises containing systems of normal operation, important for safety, as well as for special housing, fresh fuel storage, spent fuel and radioactive waste storage, radioactive waste incineration housing, organic fuel management, cable structures, turbine compartment and installations, transformers of nuclear power stations;

- poultry farms producing eggs with a capacity of 100,000 or more hens; Poultry farms in the meat sector with the cultivation of 1 million or more broilers per year; farms for breeding flocks of chickens for 25 thousand and more heads, as well as geese, ducks and turkeys for 10 thousand and more heads;

- milk production complexes and farms with 400 or more cows; complexes for growing and fattening cattle of at least 5,000 heads; complexes for growing and fattening pigs with at least 12,000 heads;

- electrical receivers of oil pumping warehouses and petroleum products (SNN) intended for export operations, as well as stationary fire extinguishing installations (fire-fighting pumps, fittings for the supply of fire-extinguishing substances, etc.) and electric receivers of receiving stations of fire and security alarms, regardless of the category of SNN in terms of capacity.

Very often, as for the reliability of the power supply, power receivers are assigned to category II. Of the objects listed above, category II power receivers are:

- electrical receivers that do not belong to the special group I category and

I category of residential, public, medical and preventive buildings, educational institutions, buildings of lending, insurance and commercial institutions, department stores, shopping centres and shops with sales halls with a total area of more than 2000 m^2, parking lots and garages for passenger cars, subway facilities, Nuclear Power Plants;

- residential buildings with a height of up to 16 floors, including electric stoves and electric water heaters for hot water supply, with the exception of one- and eight-apartment buildings; residential buildings more than 5 stories high with stoves on natural, liquefied gas or solid fuel;
- buildings of institutions, organisations, offices with a height of up to 16 floors inclusive, with the number of employees from 50 to 2000 inclusive;
- buildings of educational institutions in which more than 200 to 1000 people study inclusively;
- electrical receivers of buildings and structures of children's preschool institutions;
- electrical receivers of stage lighting, stage mechanisms, technical hardware and sound systems with a total number of seats in the halls of more than 800; the rest of the electric receivers with a total number of seats in the halls of more than 300 to 800, including cultural, entertainment and recreational facilities;
- trade enterprises with a trading area of more than 250 m^2 up to 2000 m2 inclusive;
- boiler rooms of the second category (boiler rooms that do not belong to the first category);
- poultry farms with a lower production capacity than previously indicated for consumers of the I category (electricity interruption - no more than 3.5 hours);
- livestock farms with livestock less than specified for the 1st category (power supply interruption - no more than 3.5 hours);
- electrical receivers of buildings and structures for storage and processing of agricultural products - electric receivers of food pumping warehouses of I and II categories of SNN.

It can be concluded that a properly designed and functional power supply system for objects of various purposes should ensure the required reliability of power supply for objects of various purposes and, as a result, protect the population, the territory, the natural environment and property, in the event of emergency situations leading to the disconnection of electrical receivers from the main sources of electricity supply.

5.4 Features of ensuring the reliability of electricity supply during Martial Law in Ukraine

On February 24, 2022, the open military attack of the Russian Federation on Ukraine began. Missile strikes on the territory of Ukraine, especially after the September counteroffensive of the Armed Forces of Ukraine, led to a massive blackout.

Practically, objects of the special group I category of power supply reliability remained operational during a blackout (provided there is no direct impression and the serviceability of a third independent power source in the form of its own special uninterruptible power supply units, batteries, etc.). The above analysis shows a rather narrow list of objects of the 1st category of electricity supply reliability, which in general makes the normal life activity of a significant number of urban and rural communities impossible. Objects of the remaining categories, as a rule, remained without electricity supply, which led to a significant disruption of the normal life activity of a significant number of urban and rural communities.

Table 5.2 analyzes the possible negative manifestations of a blackout, their danger and ways to reduce it.

Table 5.2. Analysis of possible negative consequences of a blackout and ways to reduce them

Negative manifestation of blackout	The greatest danger	Ways to reduce the danger
Lack of electricity supply to residential buildings with electric stoves	Inability to cook hot food	Availability of alternative appliances for cooking (kerosene stove, traditional (tourist) stove ("fisherman's stove"), chemical heating sources, etc.
Lack of electricity supply to residential buildings	Malfunction of the water supply system	Availability of the necessary supply of drinking and technical water; arrangement of wells, water towers, use of water from available natural sources
	Inability to charge mobile phones	Each user has a Power Bank, a battery source of uninterrupted power supply, a portable electric generator, etc.

Lack of electricity supply to high-rise buildings	Failure of the elevator system, which leads to the impossibility of climbing to the upper floors, or blocking passengers inside the elevator	The use of stairwells during the announcement of an air alarm even when the elevator is operating
Lack of electricity supply to buildings with electric-dependent gas heating	Impossibility of operation of the heating system, failure of the heating system (defrosting)	Application of low-power backup sources of electricity power supply (battery source of uninterruptible power supply – provides operation during the time limited by the consumption power and battery capacity; portable electric generator – provides operation during the time limited by the liquid fuel supply; etc.)
Lack of power supply to the notification systems	Impossibility of informing the population about any dangers	Installation of backup power sources
Lack of electricity supply to medical and preventive buildings and facilities	Danger to human life during the operating room activities, the impossibility of providing medical services to the population	Electrical equipment for operational activities is assigned to a special group of reliability category I. For the rest of the consumers - installation of their own backup power sources
Lack of electricity supply to buildings and structures of educational institutions	Termination of the educational process	Evacuation, organisation of distance learning
Lack of electricity supply to children's preschool institutions	Termination of the educational process	Evacuation, temporary closure or installation of backup sources of electrical power
Lack of electricity supply to cultural spectacles and leisure facilities, sports and physical culture and health facilities	The danger caused, in particular, by the termination of the electrical lighting	Evacuation, temporary closure or installation of backup sources of electrical power

Lack of electricity supply to department stores, shopping centres and shops	Cessation of electric lighting, inoperability of cash register equipment, etc.	Evacuation, installation of own backup power sources
Lack of electricity supply to banking institutions	Impossibility of using electronic banking services; failure of the security system	Shutting down or installing backup power sources
Lack of power supply to fixed telephone exchanges	Lack of connection, inoperability of the Internet, impossibility of using electronic banking services	At telephone exchanges with a capacity of 3,000 or more numbers, it is provided for the installation of a backup source of electrical power, as a rule, an automated diesel electrical station designed for a long period of operation. Installation of backup power sources at telephone exchanges regardless of capacity
Lack of power supply to cellular base stations	Lack of cellular connection, inoperability of the Internet, impossibility of using electronic bank payments	The presence of a battery back-up source of uninterrupted power supply, a portable electric generator, etc. with automatic input of the reserve
Lack of power supply to the boiler rooms	Shutting down the heating system	Setting up your own independent power source
Lack of electricity supply to metro facilities	Suspension of transport, blocking of passengers in tunnels, on escalators, failure of the ventilation system	Most of the life support systems are assigned to the special group I category
Lack of electricity supply to poultry enterprises	The death of birds in the event of an interruption of the power supply for more than 3.5 hours	Poultry farms of large capacity are classified as I category with a power supply interruption of no more than 3.5 hours. In the case of longer interruptions, the arrangement of an independent power source
Lack of electricity supply to livestock enterprises	Death of animals due to prolonged absence	Setting up your own independent power source

Lack of electric street lighting at night	Injury to pedestrians as a result of their own carelessness	The presence of each person's own flashlight, in particular in a mobile phone, to illuminate the paths of traffic
	Pedestrian injuries as a result of traffic accidents	The use of reflective clothing elements, giving light signals to drivers using their own flashlight
Termination of electric traffic lights	Traffic accidents as a result	Personal discipline of vehicle drivers, clear
Regulation of street traffic	Unpreparedness of drivers to regulate traffic with the help of road signs and road markings	Compliance with traffic rules

It is possible to conclude that objects of special group I category, as a rule, remain able to work at emergency shutdown of electric power supply (blackout) because of presence of own (object) reserve power (supply battery backup source with uninterrupted power supply, portable electric generator, etc. with automatic backup). The rest of the facilities cannot remain operational due to damage to the main and backup (not belonging to the facility) sources of electrical power. Ensuring the operational efficiency of the object is determined by the desire and capabilities of the owner of the business entity to arrange its power supply system according to the scheme of the special group I category of power supply reliability. It is not forbidden to increase the category of reliability of the object's electricity supply above the requirement at the legislative level – in this case, economic expediency and desire to continue further work comes to the fore.

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CHAPTER 6

LOGISTICS ORGANISATION FOR UNITS IN A MILITARY CONFLICT ZONE

The logistics process of delivering operational actions by emergency rescue units before and during military conflicts differs significantly. In the context of a military conflict, this process becomes excessively complicated due to factors such as large-scale infrastructure destruction, the presence of landmines, and a high risk of coming under enemy fire from both opposing forces and the equipment of the emergency rescue units.

6.1 Provision of fuel and lubricants

Before the military conflict that began on February 24, 2022, fuel and lubricants were supplied to units by purchasing them in accordance with the procedure established by the Law of Ukraine "On Public Procurement" dated December 25, 2015 No. 922-VIII. For this, an annual procurement plan was drawn up based on existing needs, and tender documentation was also prepared. Furthermore, in accordance with the requirements of the current legislation, procurement was carried out through the procedures of open tenders, tenders with limited participation, competitive dialogue or a simplified procedure using an electronic auction. The employee of the emergency rescue unit, who was responsible for procurement according to his functional duties, considered the offers and checked their compliance with the necessary conditions and only based on the results of the evaluation determined the winner and concluded a purchase contract with him. After that, the units of the emergency and rescue formations were given coupons for a certain purchased volume of fuel, which gave them the right to refuel the vehicles under their control at gas stations specified by the contract.

After the beginning of the military conflict, large queues of cars of the local

population, who intended to evacuate to safer regions, formed at gas stations located in the regions bordering the Russian Federation, and therefore the demand for fuel and lubricants increased almost instantly. In addition, mass shelling of the facilities of the fuel and energy complex began, and the first of them to be destroyed were the enterprises of the oil and oil refining industry. These circumstances quickly caused a shortage of fuel and lubricants in the country.

According to the agreement of the heads of local military administrations with the owners of gas stations, the sale of fuel and fuel materials to the civilian population began to be limited. The restrictions consisted in the complete cessation of the sale of all or certain types of fuel and lubricants or the introduction of a certain limit of release per vehicle. These actions were aimed at preserving a certain reserve of fuel and lubricants for official vehicles, in particular, units of emergency rescue formations.

Delivery of fuel and lubricants to operational vehicles at gas stations took place outside the queue. To refuel, the driver had to present his service card and documents for a special vehicle at the cash desk. In a separate journal, the cashier entered the following information: the date, the number of the driver's official license and other personal data, the license plate of the special vehicle, the type and brand of fuel and lubricants dispensed and their quantity.

In order to avoid a shortage of fuel and lubricants for the needs of units of emergency and rescue formations, it is possible to recommend the creation of a certain reserve stock of them, which must be periodically renewed.

The need to renew fuel and lubricants is caused by the fact that during long-term storage, their operational and technical characteristics deteriorate, and this can then negatively affect the technical condition of operational vehicles that will be refueled with them. In addition, the supply of fuel and lubricants should be dispersed throughout the territory of the settlement and preferably stored in underground tanks, in order to secure it in case of enemy fire. On the other hand, if the enemy succeeds in occupying certain territories, then the stock of fuel and lubricants placed there can be used by him for his own needs. Accordingly, it is also necessary to anticipate such situations and to pre-develop a set of measures with the defence forces in order to prevent this from happening. The options of even destroying this stock either before or during the occupation of the territory by the enemy should be considered, because, as it turned out in practice, in many cases, the occupying forces prevent or even completely prevent the units of emergency and rescue formations from performing their assigned tasks, and for such conditions, the specified stock may not be needed.

6.2 Deployment of special vehicles to the designated location

At the onset of the military conflict, in an effort to impede enemy movement across the country's territory and to organise its defence, various obstacles were deployed on public roads and throughout the settlement street-road networks. These obstacles included concrete blocks, sand-filled bags, anti-tank hedgehogs, car tire piles, and other deterrents. These obstacles not only hindered movement but, in certain instances, rendered the transportation of specialized vehicles to their destinations either difficult or, in some cases, impossible. To address these challenges, roadblocks were frequently established. Defence force units would take turns manning these roadblocks, and they also conducted thorough inspections of all vehicles passing through.

A special difficulty is the process of moving special vehicles to the places of call in the dark. One of the main reasons complicating this process is the lack of street lighting in populated areas. This may be due to the deliberate switching off of streetlights during the dark hours of the day during the curfew period, which is one of the light masking measures, or in case of no electricity supply in the settlement. During this period, the movement of special vehicles on the street network is carried out, if possible, without turning on the signal and loudspeaker system and with the minimum necessary number of lighting devices.

During the day, in case of lack of electricity in the inhabited areas, the traffic lights do not work and, due to the end of curfew, the intensity of traffic on the road network increases significantly. These circumstances complicate the movement of special vehicles on the road network and increase the likelihood of road accidents. Under these conditions, while operating vehicles move to the place of call, it is necessary to turn on the signal and speaker system to attract the attention of road users and minimize the likelihood of road accidents with their involvement.

The process of planning the route of movement of units to the place of call is also complicated. This is due to the fact that the places of installation of obstacles and checkpoints can be changed by the decision of the heads of local military administrations, about which no one informs the units of the emergency and rescue formations. The reason for this is to limit access to such information by anyone not related to the formations of the defence forces. GPS navigators, which are equipped with special vehicles, are not used at all when planning traffic routes and moving special vehicles. The fact is that during their use, the enemy can track the movement of special vehicles. If it detects places of accumulation of special vehicles, fire is often applied to these places, regardless of the fact that this technique is not related to the technique of the defence forces.

In order to visually identify units of emergency and rescue formations when they were on their way to the place of call, at the beginning of the military conflict, together with the leadership of the local military administrations, recognition signs were agreed on, which were applied to special vehicles. Initially, such a recognition sign was a white A4 sheet, which was placed in the upper right corner on the inside of the windshield. After some time, changes were adopted and the letter indicated the abbreviation "DSNS" in black letters, which reflected the affiliation of a special vehicle to the relevant service. Over time, changes again took place and special vehicles of units of emergency and rescue formations began to be marked with the international identification mark of Civil Defence. The form of this identification sign is defined by the Additional Protocol to the Geneva Conventions dated August 12, 1949, relating to the protection of victims of international armed conflicts (Protocol I), dated June 8, 1977 and is an equilateral blue triangle on an orange background (Fig. 6.1). This sign must have dimensions that ensure its recognition at long distances and be made of materials that make it more visible at night or in conditions of limited visibility.

When proceeding to the designated location, all personnel travelling in special vehicles must carry documents that certify their identity. This requirement is justified because defence force formations stationed at checkpoints are authorized to halt even the special vehicles belonging to emergency and rescue units. This measure aims to conduct inspections to prevent the infiltration of subversive intelligence groups that might attempt to disguise themselves using this method.

The official in charge of the special vehicle unit may also be required to provide a verbal password when resuming their journey to the designated location. This password is communicated daily through secure communication channels, originating from the leadership of local military administrations, and reaching the officials at the operational coordination centre for emergency and rescue units. From there, it is passed down to the unit leaders, who directly lead the trips to the

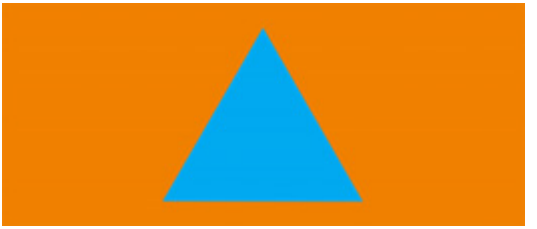

Fig. 6.1. International identification mark of Civil Defence

designated locations. As a result, these passwords remain known to a highly restricted group of individuals within the management of emergency and rescue units.

6.3 Use of communication tools during coordination of the movement of special vehicles

Before the start of the military conflict, radio communication was the main type of communication used to coordinate the movement of emergency units of rescue formations on special vehicles to the place of call. Accordingly, a single radio communication channel was established for all units of emergency rescue formations within one garrison. After the beginning of the military conflict with the capture and occupation of the first territories by the enemy, he managed to capture individual units of the emergency and rescue formations, so he had the opportunity to listen to all negotiations at once within the entire garrison, which covered the entire area. In this regard, it was decided not to use regular means of radio communication. Instead, they began to use mobile communication tools to coordinate the movement of special vehicles, as well as to send messages through closed groups in messengers. In order to coordinate the movement of special vehicles during the performance of operational tasks, when they are in a sufficiently territorially limited area, they began to use radio communication tools with a short range.

6.4 Ensuring an uninterrupted supply of water to the place of extinguishing fires

With the beginning of the military conflict to increase efficiency response during the occurrence of dangerous events and of emergency situations, units of emergency and rescue formations were transferred to an enhanced duty mode. Two regular shifts began to replace daily shifts at the same time, instead of one, as before. Due to this, it was possible to introduce additional reserve operational vehicles into the operational calculation.

Considering the fact that the subdivisions have a 100% reserve of the main fire trucks, the number of fire trucks that could be involved in the performance of operational tasks for firefighting was doubled.

In the conditions of a military conflict, pumping stations and external fire-fighting water mains are destroyed due to constant shelling.

In addition, the electric pumps of pumping stations cannot work due to the lack of electricity supply in populated areas. These circumstances greatly complicate the process of ensuring an uninterrupted supply of water to the place of extinguishing fires, because it is not possible to use fire hydrants for this as under normal conditions. Under such circumstances, when extinguishing fires, water reserves are of great importance, which are concentrated in various open water sources, namely: rivers, lakes, ponds, fire reservoirs, etc. There are even known cases of using water from the swimming pools of sports complexes destroyed by shelling, in order to fill the tanks of fire-fighting equipment and its further use for firefighting, which was not even considered before the military conflict. Quite often, such water sources are located at significant distances from the place of fire extinguishing, therefore uninterrupted supply of water to the place of fire extinguishing can be ensured by its pumping or delivery by fire tankers.

During the organisation of water supply to the fire site by means of its recirculation, schemes "from the pump to the pump", "from the pump to the tank", "from the pump to the intermediate tank" and by a mixed method can be used. In order to use the pump-to-pump scheme, the fire-fighting equipment involved in this process must be equipped with fire pumps, and in the case of using the pump-to-tank scheme, in addition, water storage tanks. The choice of an appropriate pump-

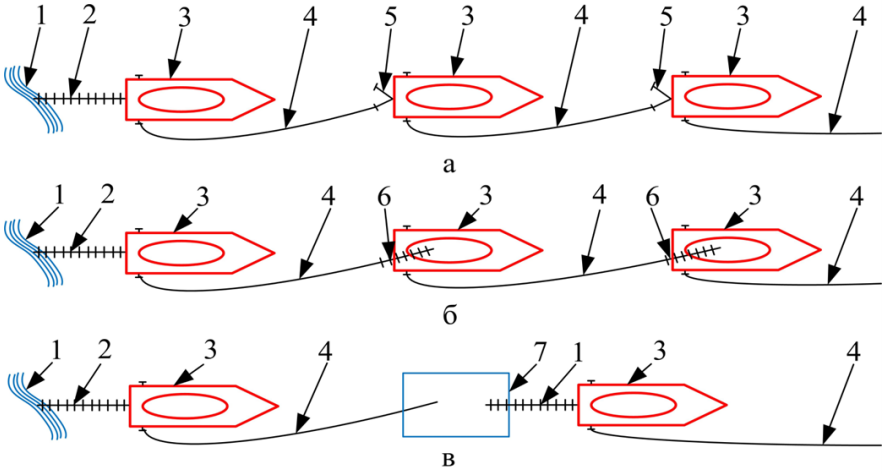

Fig. 6.2. Schemes of water pumping: a - "from pump to pump"; b – "from the pump to the cistern"; c – "from the pump to the intermediate tank"; 1 – external water source; 2 – suction fire hose; 3 – fire truck; 4 – pressure fire hose; 5 – sleeve reservoir; 6 – pressure-suction fire hose; 7 – intermediate capacity

ing scheme depends on the fire chief. For the effective use of the mentioned water pumping schemes, preliminary calculations are carried out, which are related to the determination of the required number of firefighting equipment, as well as the number of pressurized fire hoses. Schematically named water pumping schemes are shown in fig. 6.2.

In order to reduce hydraulic losses in the hose line during the assembly of water pumping schemes, it is advisable to use rubberized hoses with a large diameter if possible. Due to the pumping of water along two parallel hose lines, the distance between adjacent fire tankers can be increased four times, compared to the pumping scheme in which one hose line is used. In the pump-to-pump scheme (Fig. 6.2, a), pressure fire hoses from a fire truck, which is installed on an open water source or a fire hydrant, are connected to the suction pipe of the second fire truck through a hose collector. Hoses are laid from the pressure nozzles of the second fire truck to the place of fire or to the next fire truck, if more than two vehicles are involved in pumping. When organising water pumping according to this scheme, it is important to coordinate the work of the drivers of the car installed on an open water source or fire hydrant and the next car and maintain an excess pressure in

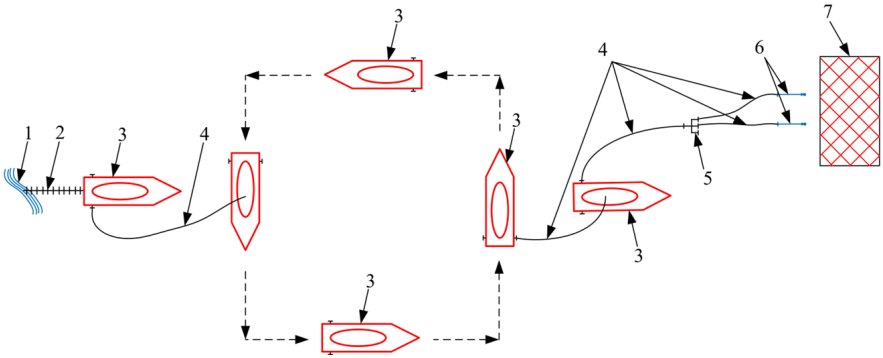

Fig. 6.3. Scheme of organisation of water delivery by fire truck tankers to the place of extinguishing the fire: 1 – external water source; 2 – suction fire hose; 3 – fire truck; 4 – pressure fire hose; 5 – three-way branching; 6 – fire barrels; 7 - place of fire extinguishing

front of the next pump of at least 0.1 MPa, which is necessary to prevent compression of the hoses of the main line.

Fig. 6.4.Hydraulic elevator

The scheme of pumping water "from the pump to the tank" (Fig. 6.2, b), compared to the previously considered scheme, is simpler and more reliable and does not require precise coordination of work between the drivers of fire tankers. In addition, considering that the water from the fire tank truck installed on an open water source or fire hydrant to the second fire tank truck, which is involved in this pumping scheme, is fed into its tank for overflow, there is no need to maintain excess pressure at the end of the main line less than 0.1 MPa. At the end of the hose line that goes to the second fire truck, it is necessary to connect a pressure-suction fire hose, fix it on the roof of the superstructure with the help of a hose delay, and lower the end of the hose into the hatch of the tank. Next, water is supplied from the fire tanker truck installed on a water source or fire hydrant to the tank of another fire tanker truck involved in this pumping scheme. After filling the tank with water, water can be supplied to the place of extinguishing the fire or to the next fire truck, if more than two are involved in the scheme. At the same time, it is necessary to monitor the water level in the tank. If the water level in the tank begins to drop, it is necessary to increase the supply of the fire pump of the vehicle installed on an open water source or fire hydrant or reduce the supply of the pump of the second fire tanker by changing the frequency of rotation of the pump shaft.

The water pumping scheme "from the pump to the intermediate tank" (Fig. 6.2, c) is a variant of the previously described scheme from the pump to the tank. The difference of this scheme lies in the fact that on the way of pumping, water can be supplied to some intermediate tank (fire reservoir, reservoir, pool or other) with a volume of at least 2-2.5 m^3. One or more fire trucks can be installed on this intermediate tank.

The combined water pumping scheme can be implemented in cases where different firefighting equipment has arrived at the fire site, as well as when there is an intermediate tank on the pumping path or directly near the fire site.

It should be noted that the possibilities of applying these water pumping schemes depend on the level of technical support of units of emergency and

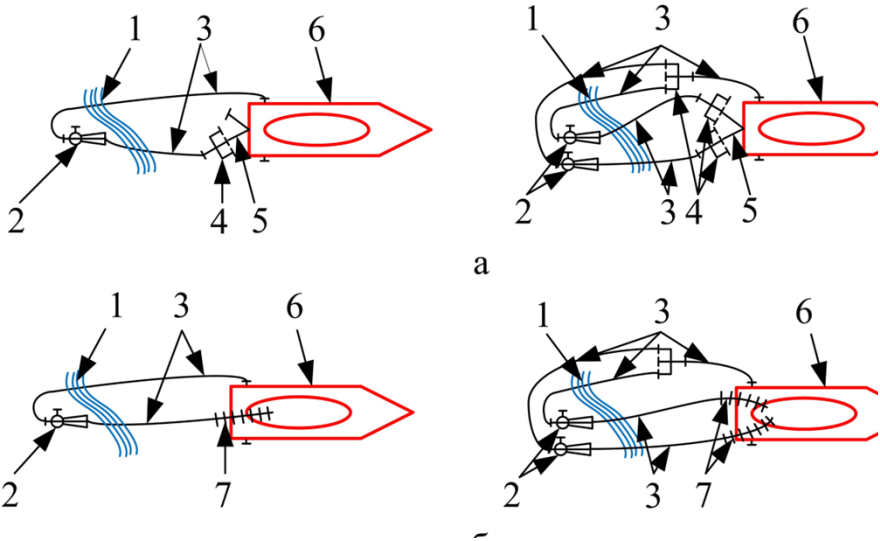

Fig. 6.5. Hydro elevator schemes: a - "hydro elevator-pump"; b - "hydro elevator tank"; 1 – external water source; 2 – hydraulic elevator; 3 – pressure fire hose; 4 – three-way branching; 5 – sleeve reservoir; 6 – fire truck; 7 – pressure-suction fire hose

rescue formations, as well as the number of pressurized fire hoses. During the practical application of these schemes, there are also often cases of destruction of pressure fire hoses due to their punctures or cuts, which also creates an additional problem in their practical application, especially in conditions where the debris of destroyed building structures and cars are scattered around. In conditions of an insufficient number of pressure fire hoses and a significant distance of external water sources and hydrants from the place of fire extinguishing, water delivery by fire tankers is used (Fig. 6.3).

At the place of refueling, the tanks of fire-fighting equipment can be filled independently or with the use of other fire-fighting equipment. After arriving at the place of firefighting, the capacity of the tank of fire-fighting equipment is replenished, from which barrels are supplied for extinguishing, as in the case shown in fig. 6.3. In addition, the supply of fire extinguishing substances by fire barrels for extinguishing can be carried out directly from the fire truck that arrived from the refueling point.

Hydraulic elevators (Fig. 6.4) and motor pumps, in particular floating fire motor pumps, were used from standard equipment to collect water from open water

sources to which there is no access for fire tankers, or when the water level in the reservoir is more than 7 m below the axis of the pump.

When using hydraulic lift systems, water can be taken from a depth of up to 20 m or from a water source up to 100 m away from the fire truck. It is possible to work with a hydraulic elevator according to two schemes: "hydraulic elevator - cistern" (Fig. 6.5, a) and "hydraulic elevator - pump" (Fig. 6.5, b).

The necessary supply of water for starting the hydraulic elevator system is determined depending on the number and diameter of fire hoses that will be used during its collection by calculation. In addition, it is also necessary to evaluate the performance of the fire pump, which affects in general the possibility of operation of the hydraulic elevator system. For a stable intake of water, the grid of the hydraulic elevator should not lie on the bottom of the water source, and the return sleeve should not have sharp bends and kinks, which can be achieved by installing the water collector on the suction pipe of the pump at an angle. The diameter of the return hose that goes from the hydraulic elevator to the fire pump or to the cistern must be larger than the diameter of the hose that connects the pressure pipe of the fire pump to the hydraulic elevator, which is one of the conditions for the operation of the hydraulic elevator scheme.

In practice, it turned out to be more effective to use fire engine pumps to fill the tanks of fire trucks, compared to the use of hydro-elevator schemes. This is explained by the fact that a lot of time is spent on assembling hydraulic lift schemes; in addition, the performance characteristic of hydraulic elevators is significantly lower than that of fire pumps.

6.5 Preservation of the integrity of fire-fighting equipment during a military conflict

During the organisation of emergency formation units' work in the conditions of a military conflict, it is crucial to address the preservation of firefighting equipment. This objective is achieved through a range of organisational and technical solutions. On-site operational activities involve dispersing firefighting equipment among emergency rescue formations to prevent accumulation in one location. Furthermore, firefighting equipment is strategically positioned behind shelters utilized by various structures such as houses or other objects whenever possible. In this manner, considerations are taken into account regarding potential directions of incoming shelling.

In the liberated territories, the movement of fire-fighting equipment must be

Fig. 6.6. A broken fire engine that was outside the garage during the shelling of the surrounding area

carried out on roads with a hard surface, thereby avoiding driving on dirt roads and roadsides. This is explained by the fact that certain sections of roads are often mined, and therefore cases of special vehicles being blown up by mines are quite common.

Driving to the place of operational work in the dark is carried out with the minimum necessary number of lighting devices switched on and, if possible, without switching on the signal and loudspeaker system.

Fire-fighting equipment, which is equipped with units of emergency and rescue formations, must be placed directly in the garages of the units, which allows protecting it at least somehow from fragments of ammunition exploding outside (Fig. 6.6). At the same time, before the military conflict, in order to minimize the time of the unit's departure, the fire-fighting equipment was placed in the front part in the direction of the gate, but, as it turned out during the shelling, the gate has less reliability and resistance to ammunition fragments than the walls, and therefore it became more expedient placement with the rear part to the gate (Fig. 6.7). Under such conditions, in the event of an explosion outside the gate, ammu-

nition fragments damage the rear part of the fire-fighting equipment; while the engine and cabin remain intact. Such a solution then allows reducing the time of bringing the damaged firefighting equipment back to working condition.

It is also a problem to ensure the operational condition of fire-fighting equipment in conditions of low ambient temperature. There is a requirement that in garages where firefighting equipment is stored, the temperature must be maintained at no lower than 10 °C. This requirement makes it possible to protect the water stored in the tanks of fire trucks from freezing, to avoid deterioration of the properties of the foaming agent as a result of its storage at a low temperature, and to ensure easy starting of the engines of fire-fighting equipment. Due to shelling of infrastructure objects, which caused damage to centralized heating systems, as well as gas and electricity supply networks, it became quite difficult to maintain the required temperature in the garages of the subdivisions. In some subdivisions, garages were divided into separate zones using curtains made of polyethylene or various fabrics, such as tarpaulin, in order to reduce the heating area (Fig. 6.8).

In the garage areas, in which heating appliances were installed, there are fire trucks and firefighting equipment, which require storage at higher temperatures. As heating appliances are used electric heaters, the power of which is carried out by autonomous electric generators, or solid fuel heaters

So:

1. With the onset of military conflict, it is recommended to limit the release of fuel and lubricants in civilian service stations. This is necessary to create a certain reserve to meet the needs of emergency rescue units, an ambulance service and emergency services of settlements and units of defence forces.
2. Movement of special vehicles by the street-road network to the place of call in the dark should be carried out as possible without switching on the signal and loudspeaker installation and with the minimum required number of lighting devices, and vice versa-in the daytime. For greater informativeness and to ensure the possibility of identification in the dark time of special vehicles of emergency and rescue units by the units of defence forces, it is advisable to notice them with special distinctive signs. GPS navigators cannot be used when planning traffic routes and moving special vehicles to a call. This is due to the fact that the enemy can thus monitor the movement of special vehicles and inflict fire exposure to places of their placement.

Fig. 6.7. The condition of the gate after the shelling of the surrounding area (the glass was replaced by corrugated board). Examples of placement of operational vehicles with the rear to the side of the gate

3. The transmission of information messages between units of emergency rescue formations must be carried out through closed communications channels. A significant radius of action cannot be used for this purpose.
4. It is possible to ensure the delivery of more water to the place of extinguishing the fire by attracting to this process of backup fire trucks, which are at equipment of emergency rescue formations. In the case of damage to water supply systems in the settlement, during the extinguishing of fires, water reserves that are concentrated in various open water sources are of great importance. In case of considerable distances from the extinguishing point of extinguishing the open water sources, it is possible to ensure uninterrupted supply of water by pumping or transporting fire trucks.
5. It is possible to protect against damage due to shelling of special ve-

hicles of emergency rescue units by adopting a set of organisational and technical measures. It is advisable to disperse special transport and avoid their accumulations at the site of the operational tasks. If possible, special vehicles should be placed on objects that can perform the shelter. In the units of emergency and rescue units, special vehicles should be stored in the garage premises with a feed part in the direction of the entrance gate; In this case, the entrance gates should be as increased as possible.

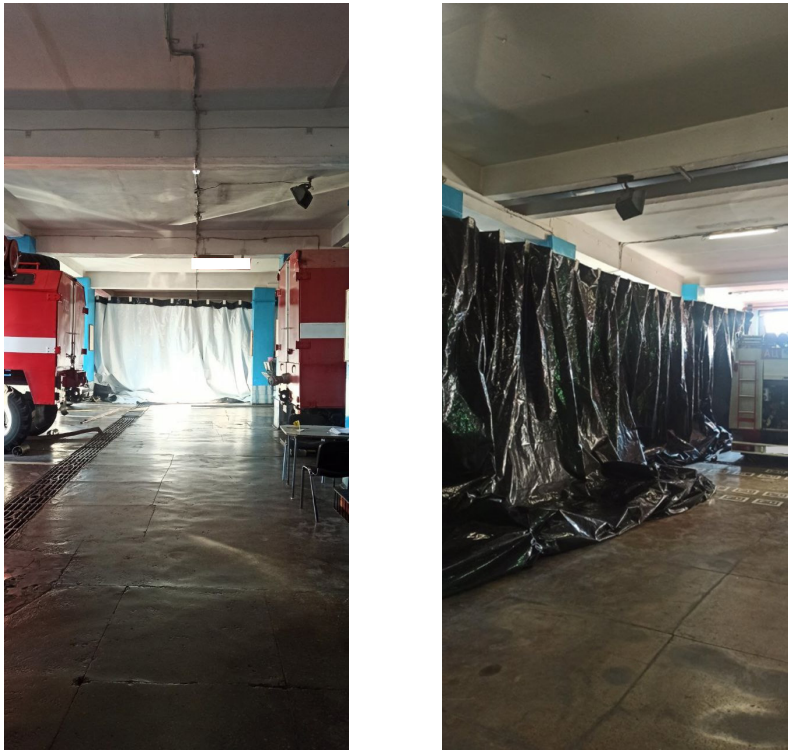

Fig. 6.8. Separation of the garage of the emergency rescue unit to minimize the heat

CHAPTER 7

PREPARATION AND COOPERATION WITH VOLUNTEERS IN HOSTILITIES

7.1 The History of the Volunteer Movement in Ukraine

Volunteer activity is voluntary, socially oriented, non-profit activity carried out by volunteers through the provision of volunteer assistance. Volunteer activity is based on the principles of legality, humanity, equality, voluntariness, free of charge, non -profit [1].

In the history of mankind, there is hardly a society that would not be inherent in the idea of voluntary and selfless help. That is, there will always be people for whom self -improvement and self -realization are possible only through work, even free, for the benefit of others.

In 2019, humanity celebrated the 160th anniversary of the Volunteer Movement. It is considered to be the beginning of 1859, when the Swiss businessman and public figure Jean Henri Dunan, impressed by the terrible consequences of one of the most bloody battles of the Austro-French war - under Solferino, on the battlefield died more than nine thousand soldiers - actually initiated the creation of the International Committee of the Red Cross, an organisation that, on a voluntary basis, would provide first medical aid to the injured. Later, Dunant became the first Nobel Peace Prize winner. The principles that he founded in this organisation have been used by active citizens in many countries of the world, and this movement has gradually adopted various types of activities, such as: assistance to the poor, orphans, the seriously ill, literacy training, struggle with drunkenness, etc. [2].

Volunteering is characterized, both in Ukraine and abroad, by some criteria determining the orientation and differences of forms of behavior of the volunteer. Let's consider some of them.

First, it is an activity that provides no financial rewards. Self-money paid by

people for work equals or exceeds the market value of the work such an activity cannot be considered voluntary. However, every volunteer has the right to legal compensation for expenses related to his activities; this is quite significant, as the volunteer activity is not a donor activity, and the person would not have to spend any funds of their own. The compensation of expenses will also ensure the participation of people whose financial resources are rather limited.

Secondly, it is an activity that is carried out of one's own free will. Human's own will is the basis of volunteer activity, but people who are engaged in volunteering rarely do it quite voluntarily. Usually as a result of peer pressure or a sense of social obligation. However, this criterion helps to distinguish the true volunteer. Activities from a situation where certain actions are caused by pressure on the individual of certain external circumstances: when, for example, at school, students require volunteers; when employees of a company, that officially implementing a volunteer program, should participate in the activities of this program.

Third, the activity benefits both the people who carry it out and society as a whole. This criterion helps to distinguish volunteering from simply leisure, for example, from sports or, for example, music (although when someone is involved in the event that raises funds for charity, it will be considered volunteer). Volunteers can help friends, acquaintances or neighbours, as well as the whole community. Only assistance to close relatives is not considered volunteer. Such a wide definition makes it possible to consider mutual assistance and participation in the activities of political parties or the election campaign as the same important forms of volunteer activity as the provision of social services.

One of the problems of determining volunteering in our country is the existence of the main forms of volunteer activity - controlled and uncontrolled. Uncontrolled volunteering is a spontaneous, unexpected assistance to friends, acquaintances, neighbors, such as childcare, courier assistance or equipment, assistance in eliminating the effects of natural disasters and emergencies, etc.

Unfortunately, the uncontrolled type of volunteer activity in Ukraine is predominant. On the contrary, controlled volunteering is dominated by public, private and public organisations and is more organised and regulated. Regulated type of volunteer activity in Ukraine is developing in the following main areas:

- voluntary work by volunteers in public and non-profit organisations; assistance to various categories of the population in all types of activities, training and development. Such leadership of volunteers, of any age, contributes to their creative and social self-realization, self-development and self-observation;

- systematic or voluntary episodic assistance to State institutions to implement social policy; assistance to educational institutions in educational work, so-

cial security institutions; work with children and young people with special needs and the elderly. This area develops into associations of children and young people. The purpose of their creation is socially useful activity, in different groups in the centres of social services of the family and young people (CSSM). Pedagogically directed volunteer activity, in fact, acts as a mechanism of development of the volunteer's personality, its socialization and spiritual formation. At the same time, voluntary activity is a consequence of creative self-development, of the training of others, but this activity is not professional [3].

In general, by 2014, the volunteer movement in Ukraine developed quite poorly compared to other countries. According to the World Giving Index (WGI) ranking, Ukraine ranked only 150 (only 5 % of the population was attracted to volunteer work); However, it is not only about money donations, but also other forms of assistance to the needy.

As a rule, the higher the country in the rating, the more there are people engaged in charity [4]. Mikhail Matyash, public figure, professor, Doctor of Medical Sciences, believes that volunteering and charity are somewhat different types of social activity. After all, charity does not provide for personal direct participation in the socially important work - does not need to alternate in shelter, bring food and medicine, and cook food. Philanthropists are usually limited to financial assistance, often counting on different benefits from the state.

After the annexation of Crimea and the beginning of the war in the Donbass, volunteering rose to the highest level of development over Ukraine's independence. In December 2014, at the request of the United Nations, GFK Ukraine conducted a nationwide study of volunteering in Ukraine. According to the research, Ukrainians have recognized the important role of the volunteer movement in social processes: 62 % recognized the role of volunteers in the political changes of 2014, 85 % believe that the volunteer movement helps to strengthen peace, and 81 % tend to consider the volunteer movement a compulsory component of civil society. Almost a quarter of Ukrainians (23 %) had the experience of volunteering, 9 % of them began to volunteer during 2014 [4]. Such data can only indicate that the volunteer movement in Ukraine has become an integral part of deep social changes in the structure of Ukrainian society.

Nile Walker, UN Coordinator in Ukraine, noted that Volunteering is an important phenomenon that helps to solve important social and economic problems. In particular, Mr. Walker said: "Volunteering is more than just one person's contribution. The basic values of volunteer work are crucial for the development of Ukraine and the construction of its future. Political will by itself is not a sufficient reason for transformation, people must also participate in this for changes.

Effective legislation is very important for the development of volunteering (...)".

A notable feature of the creation of the last institute of volunteering can be considered the increase of existing voluntary organisations and associations - among them, "Live Return", "Phoenix Wings", "Rear of the People", "SOS Army". The total financial assistance of the front provided in 2015 alone amounted to UAH 173 million. As of 2018, "Come Back Alive" and "SOS Army" provided financial assistance to the front of UAH for 131 million, and this is only in the first quarter of 2018.

7.2 Cooperation with charities that are leading Ukraine to victory

Everything changed when on February 24, 2022, citizens of a number of Ukrainian cities, in particular Kyiv, Boryspil, Kharkiv, Odesa, Mariupol, Berdiansk, and Zhytomyr, informed on their social media accounts about the sounds of explosions and shots.

President Volodymyr Zelenskyy signed Decree No. 64/2022 "On the Introduction of Martial Law in Ukraine". This document was approved by 300 votes. According to the decree, martial law was introduced from 5:30 a.m. on February 24, 2022, for a period of 30 days. This decision was made in response to the military aggression of the Russian Federation against Ukraine, based on the proposal of the National Security and Defence Council and in accordance with Ukrainian legislation.

The State Emergency Service of Ukraine was instructed to bring the unified state system of civil protection, its functional and territorial subsystems into readiness to carry out their assigned tasks during the special period, together with local state administrations and other state bodies, institutions, enterprises and organisations of all forms of ownership.

The state's efforts and financial investments at that time were not enough, so the state and its organisations required the assistance of the population, which was ready to work at a loss. In order to survive, humanity had to make and survive an important step in its history - an effective response to threats, interaction and cooperation became a part of that step. The crisis, which covered all spheres of life in the Ukrainian society, forced the volunteer movement to expand immediately and became one of the driving forces in the process of profound social change in Ukrainian society.

Under these conditions, there was a growing need for people who could come to help young people, children, and people with disabilities, retirees and families

Fig. 7.1. Provision of humanitarian aid to residents of Kharkiv

with many children. Social workers and social educators began to do a considerable work in this area. However, everyone understood that the help and support of volunteers was essential.

Assistance headquarters, foundations and platforms were created immediately to raise funds to help our army and all those affected by the war. Volunteers began to provide our military with a new type of quality service that required their intellectual efforts, knowledge, skills and abilities, such as the creation of unique command and control systems, communication systems between the military units, military training programs for personnel, development of other system software solutions, etc.

Thus, a new generation of volunteers began to actively develop along with the restoration of the traditions of charity as an essential part of independent Ukraine. Many professionals also became volunteers - rescuers, medics, lawyers, psychol-

ogists, teachers, cooks, and drivers - anyone who wanted to help like-minded people in a professional way. Dozens of volunteer initiatives and online projects appeared in a few days.

Just as tens of thousands of Ukrainians partially or completely changed their professions at the beginning of the war and became volunteers for their country, the staff of the National University of Civil Defence of Ukraine was able to quickly restructure its activities and set up rapid logistics. There was hardly any time to learn a new type of activity, as the war required quick decisions and bold steps. One of the challenges was to organise a simple and efficient logistics system that would allow for the delivery of the humanitarian aid in the shortest time possible to increase the efficiency of the intended purpose in the form of additional emergency and firefighting equipment, special equipment, generators, medicines, drinking water and food. At first, these actions were chaotic, as everyone tried to use personal contacts and even their own money to purchase everything they needed. Many questions were raised about finding transport, as public transport was no longer functioning in the early days of the war, and there were interruptions in fuel, electricity and food supplies.

Thanks to personal connections, fuel transportation was organised from such cities as Dnipro and Poltava. Fuel was needed for crews transporting humanitarian aid, as well as for TD fighters, whose actions were aimed at ensuring military security, sovereignty and territorial integrity of the state, deterring and repelling aggression, and inflicting unacceptable losses on the enemy, in view of which he will be forced to stop armed aggression against Ukraine [5]. Cooperation with TD forces was necessary because the main tasks of territorial defence included:

- participation in the protection of the population, territories, and natural environment and property from emergency situations, liquidation of the consequences of conducting military (combat) operations;
- participation in ensuring the conditions for the safe functioning of state authorities, other state bodies, local self-government bodies and military administration bodies;
- participation in the protection and defence of important objects and communications, other critically important infrastructure objects, determined by the CMU, and objects of regional, district, village, township, city importance, district councils in cities, village, townships, disruption of functioning and decommissioning of which pose a threat to the life of the population;
- participation in the implementation of measures regarding the temporary prohibition or restriction of the movement of vehicles and pedestrians near and within the zones/districts of emergency situations and/or the conduct of military

(combat) operations;

- participation in the fight against sabotage and reconnaissance forces, other armed formations of the aggressor (adversary) and paramilitary or armed formations not provided for by the laws of Ukraine;

- participation in information activities aimed at increasing the level of the state's defence capability and countering the information operations of the aggressor (adversary).

Telegram channels were created that accepted applications from citizens; own Instagram pages were also used to collect and process information. Applications were not only about food aid, but many issues were also related to the evacuation of the population, animals and property from hot spots. Another problem in the city was the issue of a shortage of medicines, especially sedatives and tranquilizers, most of the pharmacies did not work or were under constant shelling.

So, from February 24, 2022 until now, the employees of the National Centre of Ukraine are engaged in volunteer activities, of course, involving friends, relatives and acquaintances in their team. Thanks to this, already on the second day of the war, active work began to provide Kharkiv residents – which were hiding from aggression in the city's subway - with food products. Scientific and pedagogical workers of the University[8] organised and delivered humanitarian aid and provided psychological help and support to the elderly, people with disabilities, cancer patients, and children.

Volunteer scientists took on a large part of the work in the city to arrange a comfortable stay for people in bomb shelters: subway stations, basements of residential buildings, schools, kindergartens, churches, wherever it was possible to hide from the unbearable and round-the-clock bombardment by enemy shells and rockets.

They organised field kitchens, set up tents, delivered drinking water, food, medicines, personal hygiene products and warm things, and provided necessary information to city residents.

Scientists and Specialists of the University, with extensive experience of working in crisis situations, directed their efforts to conduct joint

[8] Editor's Note: hereinafter, National University of Civil Defence of Ukraine.

educational and training sessions on productive interaction during the performance of tasks assigned in martial law with representatives of the armed forces, territorial defence forces of the armed forces of the Kharkiv and Kharkiv region, patrol police department in the Kharkiv region; doctors and psychologists, residents of the city, voluntary charitable organisations; On this occasion, the algorithm of actions in the event of missile and air attacks and the announcement of the signal of "air alarm" during the performance of official tasks were shown, as well as rules for the use of means to temporarily stop bleeding (tourniquet, improvised means).

Conducted educational and training sessions on life safety in the conditions of military operations for teachers, parents of students of educational institutions, Village Councils of the Kharkiv Region, secondary education institutions of the City of Kharkiv, as well as for employees of enterprises and cities organisations: restaurateurs, employees of catering establishments, banking institutions, etc. In general, about 3,000 citizens took part in the classes. The trainings took place within the framework of information events on the safety of citizens' lives, organised at the initiative of the Department of Civil Protection of the Kharkiv Regional Military Administration and with the support of the State Emergency Service of Ukraine in the Kharkiv Region and the NUCD of Ukraine.

In extremely difficult and dangerous times, volunteers are also needed help and, especially, certain skills and knowledge for better orientation in the surrounding situation and emergency response to emergency situations. So, thanks to fruitful cooperation in the conditions of Martial Law and intensive hostilities on the initiative of the volunteer charitable organisation "1st Kharkiv Humanitarian Hub", the "Open Volunteer School" school for volunteers was opened in the summer of 2022.

As trainers and speakers, specialists of the National University of Civil Defence of Ukraine (NUCDU), the National Police of Ukraine, practicing lawyers, business trainers and experts of international organisations joined the training of volunteers. University scientists as trainers conducted educational and training classes on life safety for volunteers, and for forced migrants, and for restaurateurs

and supermarket staff, in particular, and for the newly formed School for volunteers in the city of Kharkiv.

Today, NUCD of Ukraine cooperates with many volunteer organisations, such as: UHelp, which has logistics hubs in Chelm (Poland) and Novovolynsk (Volyn region, Ukraine) and helps with transportation from all over the world through the Polish border. UHelp works in partnership with the city council, authorities of Ukraine and other verified volunteer organisations. Also, individual employees of the university established relationships with colleagues from far abroad: the Polish People's Republic, the Federal Republic of Germany, the KIngdom of Norway. According to the information of the Centre for Democracy and the Rule of Law (CDRL), which it received from the Ministry of Justice of Ukraine, 4,365 civil society organisations were registered in Ukraine between February 24 and June 30, 2022. Among those registered are 3,364 charitable and 1,001 public organisations. Some of them were new others worked informally before, and then received official status. These numbers significantly exceeded all previous indicators. For example, for the whole of 2021, 792 new charitable organisations appeared in Ukraine, and in a little more than 4 months of 2022 - more than 4 times more. CDRL experts explain this by the fact that civil society mobilized to help the Armed Forces of Ukraine and civilians [6].

The full-scale war forced many people to find themselves in a difficult situation, hundreds of thousands of people joined the volunteer movement, helping in humanitarian headquarters; children together with adults, despite constant shelling from the Russian aggressor, wove camouflage nets, purchased ammunition, and collected funds for armaments and equipping our

army. Here are some of the authoritative volunteer organisations of Ukraine, which stand at the front of humanitarian, military and tactical aid. It is they who do their best to do the impossible and provide Ukrainian soldiers and civilians with everything they need [7]:

"Come Back Alive" - This fund has been actively operating since 2014, so on the eve of the full-scale invasion, concerned Ukrainians sent UAH 48 million to its account. Since then, donating to the needs of the army has become a traditional ritual after receiving a salary. Everyone who cares actively participates in the meetings of this fund. Therefore, at the end of July 2022, the total amount of Ukrainian national aid to our army amounted to UAH 4 billion. The main activity of the fund is the purchase of tactical equipment for the soldiers of the Armed Forces: thermal imaging devices, protective equipment, quadcopters and cars, reconnaissance and fire countermeasures. Therefore, thanks to the fund, the following were in service with the soldiers of the Armed Forces of Ukraine: a TB2 helicopter with three attack drones; 25 Leka-100 unmanned systems; 20 PD-2 complexes, which include 20 drones and their ground stations.

"Prytula Charitable Fund" - On the first day of the full-scale Russian invasion of Ukraine (in February 2022), Prytula - a Ukrainian public and political figure, volunteer, TV presenter, actor, producer - together with a team of volunteers, opened a

volunteer headquarters in his office in Kyiv. The headquarters works as a coordination hub - a kind of bridge between those who bring help and those who need it. The main goal is to provide, first of all, soldiers of territorial defence and soldiers of the Armed Forces of Ukraine, who are in positions in hot spots of Kyiv and Kyiv region, maintaining the defence of the capital. Since the defence receives only weapons from the state, providing the soldiers with uniforms, body armor, helmets, food and equipment falls on the shoulders of volunteers. According to Prytula, in the early days, people brought to the headquarters everything they had at home: bags of medicine, clothes and canned food, cans of canned goods, sleeping mats and sleeping bags, binoculars, flashlights, etc. Owners of large and small businesses, in turn, brought large batches of food and supplies, hygiene, military clothing, medicines. Also, in March of the same year, the Asylum Fund collected 10 million hryvnias for a new drone in 3.5 hours [8]. In almost less than 3 months of the war, the showman collected UAH 700 million for the army [9]. On June 22, 2022, on behalf of BF Prytula, announced the collection of UAHS 500 million for three *"Bairaktars"*[9]

[9] Editor's Note: The *Bayraktar TB2* is a Medium-Altitude Long-Endurance (MALE) Unmanned Combat Aerial Vehicle (UCAV) capable of remotely controlled or autonomous flight operations. The aircraft are monitored and controlled by an aircrew in a ground control station, including weapons employment (more technical details available on https://www.military-factory.com/aircraft/detail.php?aircraft_id=1679). Manufactured by the Turkish company *Baykar Makina Sanayi ve Ticaret A.Ş.*, primarily for the Turkish Armed Forces, 12 aircraft were purchased in 2019 by the Ukrainian Government, as a part of military modernization program of its Armed Forces (on this point, "Ukraine signs agreement to procure Turkish Bayraktar TB2 drones", *The Defence Post*. 12 January 2019, now available on https://www.thedefencepost.com/2019/01/12/ukraine-turkey-bayraktar-tb2-drones/). During the 2022 Russian invasion of Ukraine, TB2 drones have been used by Ukraine's Armed Forces against Russian Forces and equipment ("Ukraine posts videos it says show Bayraktar drones blowing up Russian armor, further cementing their heroic status". *Business Insider*. 14 March 2022, available on https://www.businessinsider.com/videos-purport-to-show-ukriane-bayraktar-strikes-on-russia-vehicles-2022-3?r=US&IR=T).

for the Ukrainian Army under the name "People's Bayraktar". On June 24, the collection of funds was stopped, and the amount of collected funds amounted to more than UAH 600 million, which would be enough for four drones. The Turkish company, having learned about the promotion, decided to supply three drones for free. With the collected funds, on August 18, 2022, Serhii bought a satellite for the Armed Forces and a one-year subscription to the satellite network of the Finnish company ICEYE [10].

"Razom for Ukraine" - The Razom for Ukraine fund started its journey since the time of the Revolution of Dignity, and its founders were caring Ukrainians from the USA. Thanks to the fund, Ukrainians receive financial, volunteer and donor assistance from different parts of our planet. In five months of productive work, it was possible to collect more than UAH 2 billion. This money is directed to the purchase of technical equipment for the army, and a part is allocated to humanitarian aid.

"UNITED 24" - UNITED 24 is a one-click donation from anywhere in the world. The initiative was launched by the President of Ukraine, Volodymyr Zelenskyi. In just three months of work, it was possible to collect more than $175 million, which was directed to the following important areas: support of the Armed Forces, medical and humanitarian civilian needs, restoration of infrastructure in the regions of Ukraine.

"KSE Foundation" - The fund was founded by one of the best schools of economics in Ukraine, and they confirmed this title with a deed. Namely the art of successful fundraising. The fund participated in large-scale projects, among them: food aid to civilians, reconstruction of schools and medical institutions, management of educational initiatives, support of Ukrainian book publishing during the war.

"KOLO" - Fighter of the technological IT front for operational assistance of the Armed Forces. The team of this organisation consists of leading managers of giant companies of the Ukrainian market: Kyivstar, Readdle, Grammarly, Tumblr, Parimatch, Reface, Vimeo, LUN, Wise, Planeta Kino, etc. Good managers can make a lot of money, so the organisation has already managed to collect more than UAH 146 million, which will be used to purchase technical equipment for the Armed Forces.

"Army SOS" - The organisation began its work by helping individual battalions at the beginning of the Russian invasion in 2014. But soon it developed the original software "Nettle" - an application for artillery tablets that speeds up the work of drones with the help of intelligent maps.

"ZHRAIA " - The volunteers of this fund started their work in the East of Ukraine, and now the doors of their headquarters are open to help all of Ukraine.

The organisation cooperates with many other volunteer centres and coordinates humanitarian goods for civilians and military: medicines, equipment for doctors, tactical equipment and medicine for the Armed Forces and Law Enforcement officers on the front lines.

"Monster Corporation". For the military, the fund allocated UAH 15 million, which is used to constantly purchase drones, cars, generators, hydrators, first-aid kits, binoculars and headphones, body armor and helmets, clothes, etc. About UAH 5.5 million spent on the needs of hospitals, families in difficult situations and the elderly.

Thanks to fruitful cooperation with volunteer organisations of European countries and personal connections of university specialists, a mutual relationship was established, and humanitarian aid was received to increase the efficiency of tasks for the appointment of the staff of the NUCD of Ukraine.

Today, of the volunteer movement in Ukraine is spoken with admiration in many countries of the world, calling this phenomenon unique. According to the WGI Ukraine is ranked 20th. In an extremely difficult period, it was the volunteer

Fig. 7.2 Humanitarian aid

movement, which is 19% of the population of Ukraine, that united society, created an effective structure of public organisations, groups of people ready to take on the solution of the most urgent and painful problems of the state. At the same time, the activities of volunteers are selfless and non-profit. They do not receive a salary or any material benefit, they do everything for free. And their only reward is community recognition [11].

Considering the importance of volunteering in Ukraine as a unique, free, voluntary activity during a full-scale war, it can be noted that:

- the volunteer movement and volunteer activity are a unique phenomenon in the history of Ukraine. Indifferent people, especially in the initial period of aggression, rose to the defence of Ukraine. Now it is obvious that without volunteer battalions of military personnel and volunteers in the ranks of the Armed Forces, the very existence of the Ukrainian state was under great threat. Volunteers help our soldiers - from food to communication and equipment and technology;

– volunteers are engaged in evacuation of citizens, mainly, help comes to people who cannot leave the territory of combat actions – elderly people, sick people and children. Volunteers-zoos organise the removal of domestic animals and find homes for homeless animals;

- volunteers draw public attention to shortcomings in the work of the administrative bodies of the army and the authorities. They also make more information about the equipment of the army;

- volunteers draw public attention to shortcomings in the work of the administrative bodies of the army and the authorities. They also make it more open information on the equipment of the army.

7.3 Basic rules for each volunteer in the conditions of hostilities

So, after the start of a full-scale war in Ukraine, the culture of charity quickly gained popularity. Naturally, with popular support, the elite works of some organisations, which invent new ways to involve Ukrainians in volunteering, coordinate the funds received and guide them towards the needs of the army and the country's population [12].

With the increase in the volunteer community there have also been a number of problems, particularly through widespread stereotyping and ignorance of the basic tenets of the movement.

Anyone who wants to contribute to Ukraine's victory can volunteer. However,

to help people or soldiers in war in a qualitative and effective way, it is important to understand what volunteering is and how it works.

Working with volunteers is an organised system, which should be one whole, rather than consist of separate pieces. You should have a program to work with such a system. This will help to determine the direction of action.

The plan should start with defining the vision that this system should be and how it should work. The program of volunteerism development should include identification of the necessary roles; selection of volunteers for the required roles; orientation of volunteers; training; use of their talents and abilities; recognition of volunteers and evaluation of their success. Each of those who work should know these conditions, clearly see the goal and understand their role.

This will help prevent unnecessary deviation from the intended goal. The plan should be flexible, because the situation is constantly changing and all new information is available, especially in the conditions of the military situation.

Working with volunteers involves more than just spontaneous actions; careful considerations and thorough preparation should precede it. It all begins by identifying needs and designing a well-structured volunteer program. Drawing from their personal experiences, skills, and interests, volunteers approach tasks creatively and dedicate a significant amount of time to the organisation.

With their proactive attitude, volunteers are willing to explore new avenues, offer constructive criticism, and prevent the organisation from becoming stagnant. The primary value lies in their life experiences and their connections with consumers of social services, as well as with local self-government bodies.

Volunteers enrich the organisation by leveraging their extensive networks, which enable them to attract donations from friends, colleagues, and like-minded individuals. They raise the organisation's profile and inspire others to join volunteer initiatives. Through volunteers, organisations can enhance their client services, expand social initiatives, and contribute to overall improvements in the country's situation. First of all, it is necessary to define the organiser or coordinator. The main task of the volunteer coordinator is to plan, coordinate, monitor and improve the process of volunteer programs.

As a rule, coordination of volunteer work requires much more qualification and professionalism than management of staff. The volunteer coordinator is not just a specialist in support and counselling, he takes a proactive position between the organisation's management, staff and volunteers. Qualification of coordinator of volunteer programs means knowledge and experience of work with those who need to help, skills of organising work, authority. It should represent the interests of volunteers, and also maintain liaison with local initiative groups, other organi-

sations, authorities. Effective volunteer programs should not occur spontaneously or accidentally.

A well-prepared program depends on many factors, and the head of the volunteer program must find out a lot of questions before involving volunteers in the program. Management of the volunteer program can be seen as a mosaic - collection of individual parts in a single whole.

A successful volunteering program, which envisages the rights of volunteers or the responsibilities of the organisation with respect to volunteers, is to provide the volunteer work coordinator-rate, support, training and education of volunteer members and the right to participate in the decision-making process until reimbursement of expenses and insurance. To successfully implement the program in practice, the available financial, temporary and human resources of the organisation should be assessed in advance.

Anyone can become a volunteer, first of all, must have a sincere desire to help others. Today, requests for assistance are increasing, and thus the need for volunteerism is growing.

Research on social services working with volunteers has shown that the most active among volunteers are young people, i.e., pupils and young students (81%). Groups of volunteer activities, presented at Fig. 7.3, will help to take a closer look at the motivation of the most active and the most effective of them.

Volunteers-teenagers - For teenagers the main reason for taking part in volunteer activity is personal realization of own ambitions and aspirations, possibility to acquire new knowledge, self-assertion in a circle of peers, parents, teachers, the possibility to form their leisure, skills and skills independently. In turn, it allows to get acquainted with new friends. The main drawback of young volunteers is their low professional qualification, but there are many qualities that can be used in practical work. For example, teenagers can perform street work very well, the one that is connected with long stay on the street, turn-by-turn, trips, gathering of information in press-centres, etc. They are easily adapted to new conditions

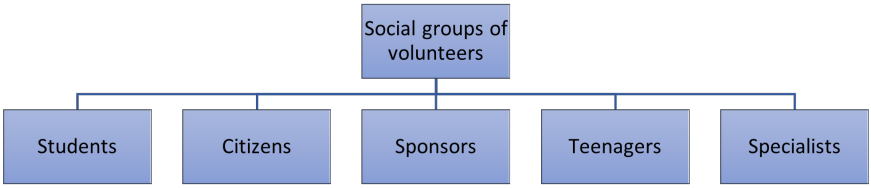

Fig. 7.3. Volunteers Groups

and have no communication problems, which makes it easy for volunteers to receive and disseminate any information to a wide range of citizens.

Volunteers-specialist - Among volunteers-specialists can meet medical workers, teacher (teacher, scientist), psychologists, lawyers, cooks, hairdressers and artists. They provide advice to social workers and other volunteers, or they provide practical assistance to different categories of citizens. For example, a doctor can provide additional free advice, an artist - speeches, a teacher (teacher, scientist) - to help in teaching, studying languages, to organise methods and means of teaching, a psychologist - to provide consultations, to conduct lectures and training sessions, cooks - to prepare for free. The specialist can be engaged for an hour and a month. It is important in this case to encourage him as a volunteer. In general, it is known that the motivation for participation of specialists in volunteer activity is realization of personal professional opportunities. Sometimes it has an exclusively altruistic character, sometimes the specialist tries to expand the circle of his interests, and he sometimes needs professional or personal self-expression. Therefore, it is very important to strengthen this motivation through encouragement (press publications, feedback, gratitude, etc.).

Volunteers-students - Students are equally active group of volunteer activities. Their motivation is distinguished by professional orientation: acquiring knowledge in a specialty, developing professional skills. Typical for this group is the focus on communication with specialists and professionals, acquaintance with new technologies, objects and methods, all that will be able to help in the future activity. Students are generally interested in the types of activities directly related to their specialty. It is excellent for the students' volunteers that the assessment of specialists is important for them, not for peers. That is, those people who are directly connected with professional activity and who promote self-assertion of the student not only as a specialist, but also as a person. However, it is in the assessment of students' professionalism that one of the main reasons for the conflict with the organisers of the volunteer movement is laid. Students mostly identify themselves as specialists, especially after the third year. In general, social service specialists are more critical about the self-confidence of young people and therefore offer them "unskilled" kinds of work, which in turn encourages them from volunteer activities. To overcome this conflict, it is necessary for a volunteer student to start working together with a professional, and then to work independently and especially under the supervision of a specialist.

Volunteers-citizens. The focus and motivation of the engagement of ordinary citizens in volunteer activities depends on individual opportunities. The main feature is that citizens' volunteers rarely come to social services at their own

discretion. Most of them still hope for help from others. Qualifications may vary and may not always be sufficient, but some of them may have an invaluable life experience of living and communication, such as in a problem family, knowledge about survival opportunities in a crisis situation, and their help is very important. Therefore, different measures should be taken to increase the number of ordinary citizens, to reveal the prospects of possible independent volunteer activity and to help not only themselves in solving the problem, but also other people who have difficulties. Only awareness of the opportunities for change for the better can encourage inclusion in volunteer activities. For the majority of citizen volunteers, the evaluation of their activities is not the main concern - the result they achieve in public activity is important to them.

Volunteers-sponsors - The principle of working with volunteer sponsors is the same as with others. It is very important to respect looking at their capabilities; it is not necessary to demand more from them than they can or want to do, it is necessary to encourage them, in particular with letters of thanks, honorary titles. Sponsors are not necessarily able to support the organisation financially. Company managers or individual entrepreneurs can provide real methodical assistance in organising work and finding finance. This option is often called "patronage of the organisation". The best way to organise patronage is to create a board of trustees at the organisation, where the trustees can be managers of various companies, well-known people in the city or country: artists, musicians, managers. The guardian will not always help with money, but his name will work, he will attract others, advise what to do. It should be remembered that the heads of many firms have higher education, vast experience in working with finance and management experience. When working with this category, you should pay attention to the nature of the work that the volunteer wants to perform.

So that volunteers can work best in these areas of voluntary activity, they must undergo training in social, psychological and pedagogical disciplines, acquire sufficient knowledge and skills to work with various groups of the population, in difficult conditions, critical situations; to do this, they must be known and organised in their actions. At the beginning of their work volunteers should take an introductory course, which is usually obligatory. The goal of the introductory course is to provide volunteers with the concept of their activities in the organisation. The introductory course facilitates the volunteer understanding of how he can apply himself, his skills and competencies in the organisation, and what rules, working technologies exist in the organisation. Volunteers should familiarize himself with the mission, tasks and obligations of the organisation. The introductory course helps to develop a sense of community with the organisation.

Components of the introductory course are:

- preparation and holding of the introductory course by the coordinator of volunteer work with the involvement of staff, board members who are already working in the organisation of volunteers and clients;
- introduction of the volunteer to the premises and equipment of the organisation;
- introduction into the social context of the organisation - the greetings of volunteers; staff and volunteers meet each other;
- information about working processes, technologies, sanitary norms and rules of safety, labor protection;
- introduction to the mission, principles, tasks and obligations of the organisation;
- transfer of basic knowledge about the target group of the organisation;
- discussion about the process and technologies of volunteer program management - the right to participate in decision-making and the right to participate in the definition of tasks from the very beginning;
- volunteer handbook, which describes the volunteer program, is published.

The purpose of volunteer's training is to prepare them for them skilled and independent work, thus providing a high quality of services rendered, meeting the interests of those in need of help. Volunteer activity is not only a useful help to others - volunteers are also interested in their benefits, namely: self-development, acquisition of new knowledge, skills and abilities, often necessary for future professional activity. Training and development also provide social aspects, namely: Getting to know other employees and developing friendly relationships between volunteers.

The entrance course is the main element in training and advanced training. It is complemented by internal organisational training, which is also a task of the coordinator of volunteer work. The purpose of organisational training and professional development is to prepare the volunteer for practical activities. In particular, the study deals with the following aspects:

- transfer of information and knowledge within the scope of tasks;
- training skills needed to perform tasks;
- reflection on personal attitude to volunteer activities.

Here is the program of one of the possible variants of the introductory course "Training of Volunteers", we need:

1. to familiarize yourself with the concept of volunteerism and its directions;
2. to learn what role volunteers play now, how to volunteer safely for themselves and the environment, how humanitarian aid works;
3. to learn to motivate yourself and your team, craft your own items and effectively help the defenders and population.

The course will be interesting for all those who want to join the volunteer movement.

Course Program / Course Structure / Course Theme.
Module 1: *"Where to Start":*
1. What is volunteering.
2. What is not volunteer activity.
3. Types and directions of volunteerism.
4. Where to start.
Module 2: "How to Act":
1. How to be safe by helping others during a war.
2. Military volunteerism.
3. Humanitarian aid.
4 Online volunteering.
Module 3: "Where to Grow"
1. Internal motivation in volunteering.
2. Prevention of volunteer training.
3. How to realize your idea to bring victory closer.

The training process should be based on the experience already available from the volunteer, for example, from professional activities or from daily life. Volunteer work coordinators and staff should understand that newcomer volunteers can offer a lot and the training should be exciting for all participants.

For this type of training, the group work method is very appropriate, which includes, among other things:

- role-playing games;
- discussion of life examples;
- discussions, expert reports;

- exchange of experiences between volunteers who have been working for a long time and/or clients;
- visiting other institutions and working in them.

In addition, it is necessary to provide for the organisation of training or training outside the organisation can be courses, seminars, trainings, master classes, conferences and other educational events.

The topics of the trainings can be different – from very specific ones, such as:

- Work in the field of HIV/AIDS;
- pre-medical assistance to victims as a result of the shooting;
- psychological assistance to people who lost loved ones as a result
- military actions;
- tools of work with shock reactions;
- how to hear complex messages, to quite general;
- computer courses;
- studying of work with youth;
- motivation courses;
- time management and delegation.

The organisation should pay for the volunteer's participation in such educational activities. The volunteer school is a necessary and quite current structure for the training of beginners. This school should focus its activities not only on training but also on the distribution of volunteers to social services, supporting them in their work and adapting them to conflict situations. Such a school allows you to define skills and successfully translate them into meaningful actions and social programs. It should conduct an advertising campaign, i.e., the promotion of volunteering, and involve citizens in volunteering activities.

Volunteer training should be clearly structured, have a theoretical and practical basis, use only the confirmed indications of volunteer training.

Every volunteer should first follow the basic rules of conduct during the fights [13]:

- we have to take care of our own safety: we have to make sure that the place where you volunteer is safe enough and that you don't feel scared;
- do not give in to panic because it prevents the organisation of the assistance process - it is always necessary to act with judgment and balance;
- do good according to what you have, i.e., you can cook delicious food

for homeless victims and military – they shouldn't be hungry!
- do you drive well, do you have your own transport? Then automotive volunteering is for you!
- we have to focus on one direction, not expect too much.
- evaluate your abilities well and remember that it is impossible to save the whole world;
- firstly, help those closest, it will probably be easier and more effective, and people will not have to look for solutions to the problem in large chats or social networks.

In the pre-war period, we couldn't even know the names of our neighbors. Today they are our main allies, ready to support and share the latter.

Here's a step-by-step reminder of how to organise voluntary assistance among neighbors. So, to help your neighbors, follow these tips:

- *Join us*: go through apartments/houses, exchange phone numbers with neighbors, or create a chat. Be in touch with your neighbors - it will help you to react in a coherent and prompt way in case of a threat, and also support you emotionally.
- *Check and record whether someone needs help, products or medicines*. Identify volunteers by specific apartments, draw up and agree among them a list. Identified people will be responsible for navigating and helping those who need it most. Find the community of your city in Telegram-channel.
- *Set up storage in your home if possible*. During active hostilities, people have to stay in shelters for days or even weeks, so make sure your common space has mattresses, warm clothes and blankets, water and food supplies, first aid kit, hygiene products, radio, batteries, flashlights. In case of lack of electricity supply, it is necessary to provide a supply of firewood and a stove.
- *Establish common security rules.* Arrange to take turns checking the entrance and the roof of the house for signs, advertising on the door (left by looters) or explosive devices. Also agree to keep the garbage can in order, because communal services can work with interruptions, and a pile of garbage on the street can mean that the owners are not at home, which can provoke looters.
- *Prepare a car, preferably with a diesel engine, with all-wheel drive, a minivan is the best option*. Determine volunteers and specific vehicles, the number of free seats in the car in case of an urgent need to leave the shelter.

Prepare the route of your departure from the city in advance so that no one remains trapped, take care of the animals. Agree on this list among neighbors.

- *Check the list of contacts in the phone book*. Identify options for contacts that can be called with questions about temporary shelter or with a request for assistance (in wartime conditions, only 10% of your contacts will be able to help in a combat situation).
- *Find out and write down the contact numbers of emergency services and addresses of volunteer organisations on humanitarian issues.*

Now your house - your main fortress. Your neighbors are your allies.

First you help each other and then you start to collect humanitarian aid or prepare food for others.

In conclusion, it should be noted that volunteer activity is the basis for building and developing a civil and democratic society. It embodies the noblest aspirations of humanity – the aspirations of peace, freedom, security and justice for all people.

Volunteer activity is a way of supporting and strengthening human values such as care and assistance to community members; the use by each person of their rights and duties as a member of a community in the course of life-long learning and development, realizing all of their human potential; interaction between people, despite all differences, for common life in a healthy stable society, for joint development of new ways of solving problems that arise.

It is undeniable that the needs of the population for social assistance, psychological support and protection grow every year, especially in the conditions of military action. Therefore, there was a need to involve several volunteer assistants in social, psychological and socio-pedagogical work. In order to increase the number of volunteers it is necessary to carry out advertising campaigns on the spread of tasks, the goals of a separate social program among the population, and especially to spread among pupils and students of educational institutions, to conduct lectures on dissemination of information. In social pedagogy, it is important not only to involve and motivate volunteers to participate in various public works, but also to properly place available volunteer assistants considering the specifics activities and personal characteristics of the volunteer. Many volunteers are now being trained in the areas in which they work, such as medicine, education, and nutrition. Others serve as necessary, for example, in response to natural disasters or to overcome the consequences of emergencies.

Today in Ukraine you can join in volunteering in several cells! This can be done in a local volunteer chat or via @Volunteers Hotline Bot.

Most useful information can be found on the TV channel, on the Ukrainian Volunteer Service's Instagram and on the Facebook page.

We keep the volunteer front and confidently move together to win!

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CHAPTER 8

PSYCHOLOGICAL ASSISTANCE TO THE CIVILIAN POPULATION AFTER SHELLING DURING THE HOSTILITIES

8.1 General features of the psychological state of the population during hostilities

Starting from February 24, 2022, immediately after the massive invasion of the Russian Armed Forces on the territory of Ukraine, the city of Kharkiv and the region suffered mass shootings from different types of weapons, as well as various types of reactive systems of salvo fire, which, in addition to the destructive effect, carry the aim of the fire. Cassette charges are used for such actions. Also used are storm troopers, working at low altitudes and spreading the panic among the population with the sounds of turbines, 500 kg of bombs, and driving the fire of unguided missiles. According to official data for the first 90 days of the war, more than 750 residents of the Kharkiv region, more than 2000 victims were killed. Six months (February – August 2022) there was no day when Kharkiv would not have been shot from all types of weapons available in the Russian army. More frequently used reactive systems of salvo fire (Grad, Uragan, Smerch), intended to damage the area and not to high-precision weapon. The maximum number of shots was 57 during the day. After every such attack on the scene there have been wounded and, sadly, killed. The victims had injuries from debris, very often these injuries took the form of amputations of limbs as a result of the explosion of shells and rockets. This shows the peculiarity of this war. After all, mainly residential areas consisting of high-rise buildings (height of buildings - from 4 to 16 floors) suffered from shelling. Those victims who were not injured and were in the epicentre of the explosions had negative psycho-emotional states. A significant number of bombings occurred in March-April 2022. This was a very active phase of the war

for Kharkiv: every day there was a maximum number of bombings, as well as the destruction caused by these bombings.

Psychological science largely pays attention to the negative effects of psycho traumatic events and the psycho emotional states of victims. It is important to form a targeted toolkit to minimize destructive impacts [3]. Despite the importance of the formation of the theoretical knowledge of professionals, a wide arsenal of effective exercises, which should be used in a short time to achieve regulation of the emotional state, is of great importance.

The problem of providing high-quality psychological assistance has become topical for the Ukrainian community with the beginning of armed conflict in the East of Ukraine since 2014 and does not lose it today. In the process of writing this Monograph, the work of T. Weber(s), M. Voitovich, Z. Kicarchuk, M. C. Kostytskoho, O. I. Kudermina, G. P Lazis, L. A. Melnik, Ya. M. Omelchenko, L. Tsarenko, V. C. Cherney have been analyzed.

When forming a complex of exercises aimed at overcoming the negative impact of the local population being under fire in the conditions of hostilities, it is appropriate to look at the state of the emotional sphere of different population groups (by age, gender, etc.) [2].

Table 8.1. Levels of severity of the psychological state of the affected population after shelling in the conditions of military operations [1–5]

Category of people	Causes (factors) of stress (experiences) as a result of extreme situations of terrorist origin			Signs and forms
	Loss of a child	Loss of a loved one	Loss of housing	
Women	A mother's reaction to the death of her own child is denial, followed by numbness. Next, anger and aggression can appear, which act as those specific emotional reactions to objective factors that prevent the mother from remaining in a state of illusory connection with the deceased child.	It is a serious mental trauma, the main consequences of which are damage to the basic structures of the personality: the picture of the world, self-perception, self-attitudes, systems of value and meaning orientations, relationships with others.	There is a loss of confidence in the future, fear for relatives and friends	There are signs of hysterical behavior prevailing
Men	They experience almost everything that women in such a situation do but show it less. Male grief differs from female grief in that it combines typical and atypical grief symptoms.	The sense of personal safety and security is destroyed	The circumstances of what happened are more interesting. In most cases, the behavior is characterized by general confusion and is due to the inability to protect loved ones and ensure their safety	Aggressive manifestations
Elderly people	The main feature of the response is an extremely severe psycho-emotional state	The experiences are mostly characterized by feelings of sadness and humility	They react with rather acute negative psycho-emotional states and reactions	Crying, numbness and panic behavior

Children pose the greatest challenge when it comes to experiencing traumatic events and receiving psychological assistance. The strength and intensity of a child's experiences are determined by a combination of objective and subjective factors that collectively influence their behaviour and psycho-emotional state.

The depth of a child's experience of the death of a loved one after shelling in the conditions of hostilities depends on the child's age. The age characteristics of a small victim determine the entire course of his experience of a psycho traumatic

event, as well as his readiness or openness to receiving help from the outside. The main subjective characteristics that determine the degree of traumatization of a child after shelling in the conditions of military operations are the age and individual typological features of the child [2]. The specified features require the use of special tools to provide children with the necessary psychological assistance.

8.2 Social and psychological training for the affected population in order to overcome the negative impact of shelling in the conditions of military operations

According to the specified conditions, a set of exercises is presented: they can be used in the development of training or separately, during individual psychotherapeutic work to overcome the negative impact of psycho traumatic situations affecting population after shelling, in conjunction with military operations.

The tasks of such a training session can be:

1. Acquaintance of the participants with the peculiarities of individual psychological reactions to war events.
2. Normalization of reactions to traumatic stress.
3. Overcoming difficulties in expressing one's thoughts and emotions.
4. Helping participants in forming a positive image of their own future.
5. Expanding the repertoire of techniques for working with intrusive images.
6. Help the participants to use the acquired knowledge, skills and abilities in the future.
7. Relief of emotional stress and help in a traumatic situation.

Target group: injured persons after shelling in wartime conditions.

Approximate age - from 16 to 65 years. Number of participants - 13 people.

We will give an example of a training session that was tested in the conditions of the Russian-Ukrainian war in the city of Kharkiv.

The host's introductory words: "Today we met because we want to experience the terrible things that happened during the war. We know that it will be difficult for us to live with the memories of the terrible things you saw or experienced.

Everyone has been affected by it, but everyone experiences it differently, there is no right or wrong way to feel anything. It is difficult to talk about war, but all of you are very brave and courageous, because you came to this class.

Today we want to show you some ways that will help you more easily survive the memories of what happened to you. Our idea is that we can help each other feel better."

Exercise 1. "Tell me about..."

Purpose: to identify the basic reasons that influenced visits to the psycho correctional group.

Duration: 30 minutes.

Exercise flow: Now that we have met you and established certain rules, we can talk about our own memories and try to learn to control them better. Try telling your story in the third person - Ivan, Pavel, Taras, who experienced the same situation as you. If someone interrupts the story to say that he or someone he knows has been in a similar situation, we provide an opportunity to speak. Ask the participants if they have been in a difficult situation - If someone refuses to support the conversation, does not comment on the story, tries to withdraw, then the presenter says that reluctance to talk about unpleasant memories is one of the manifestations of post-traumatic stress.

Reflection:

1. Was it difficult to talk about a problematic situation in a group?
2. How did the fact that the story was told from a fictional character affect you?
3. What are your impressions after hearing the stories?
4. Have you or your friends had similar situations?

Exercise 2. "Traumatic events"

Purpose: to determine what a psycho traumatic event is, to analyze what most of the participants' memories of the war are, to determine the next directions of work.

Duration: 35 minutes.

Course of the exercise: The presenter makes a list of psycho-traumatic events, which the participants of the training will talk about on a drawing board. During the conversation, the participants must answer the questions: "What do you think can cause bad memories?", " What bad things do you remember?". At the same time, you should not focus on the details of the event or the reaction of the direct participant.

After completing the list, it is worth emphasizing the specificity of traumatic events: they are sudden, stressful, pose a threat to life and health, and lead to the death of loved ones. Visual images, smells, sounds are exaggerated and terrifying,

causing feelings of fear and anxiety.

Reflection:

1. Was it easy to name traumatic events?
2. What was the most unpleasant thing to remember?
3. Do you think, from the list we compiled, is the most and the least traumatic? If so, what determines the strength of the traumatic impact?

Exercise 3. "Overcoming a traumatic situation"

Purpose: to determine what is a mandatory companion of a traumatic situation; how smells, sounds and dreams affect a person; determine prospects in further work.

Duration: 1 hour.

Course of the exercise - Leader: What memories or experiences do you experience most often? What happened to you after you experienced... (from the list of traumatic events)?

Such problems are quite natural. After experiencing something terrible, we experience it again and again. Certain sounds and smells mentally bring you back to a traumatic situation. You often have nightmares. This is a normal reaction of the body to the terrible events that you had to experience.

Reflection:

1. Was it difficult to recall smells, sounds, or nightmares?
2. Do you think they are necessary components of a traumatic situation?
3. Can their influence be reduced or completely removed?
4. How do associative smells, sounds and dreams affect your life?

Exercise 4. "Memories"

The goal: to create conditions for awareness of the factors of a psycho traumatic situation, to establish connections, which factors of traumatic events affect what.

Duration: 45 minutes

Exercise: What exactly reminds you of terrible events?

Make a general list of factors reminding of a traumatic event. After talking about the specified factors, the participants are better aware that they are also affected by certain factors. Participants who claim that nothing reminds them of the terrible events may realize during this exercise that this is not the case.

Reflection:

1. Name the factors that remind you of the traumatic event?
2. Are the factors you mentioned the only ones? Do you have similar factors with other participants of the training?

3. Have you thought about them before?
4. Was it difficult to identify and name them?
5. How did you feel when you named the factors?

Exercise 5. "Safe place"

The goal: to create a positive image of a bright, comfortable and positive reality, that should prevail over bad memories and be a source for self-help.

Duration: 25 minutes.

Course of the exercise: During this exercise, we will not return to bad memories, but on the contrary, we will try to create a new and positive image. You need to imagine a place or situation in which you are dominated by positive emotions and feelings. It can be both a real and a fictional situation or place.

Close your eyes and imagine this place. Imagine the details, the interior, the smell, the temperature as much as possible. Are you alone or are you with someone? Try to remember all the details in as much detail as possible, so that later you can restore this picture in front of your eyes.

If desired, at the end of the exercise, participants can talk about their own positive image.

Reflection:

1. Was it easy to imagine this image?
2. What was the most difficult for you in this exercise, and what was the easiest?
3. Will you be able to remember it and reproduce it in situations where you feel bad, alone, at home, in other places and circumstances?

Exercise 6. "Creating a visual image"

The goal: to teach participants to create a visual image, to control and manipulate it, to minimize the impact of memory on a person.

Duration: 45 minutes.

Course of the exercise: Our main task is to replace the image of the traumatic situation with another positive image. To do this, you need to imagine the image of a traumatic event and look at it. Imagine that you see this image on TV. What color is the image? Change the color scheme to black and white. Has the perception of the image changed? If your image is moving, try using an imaginary remote control to stop the frame. Rewind the film, look at your image in retrospect.

Slow down the film. Imagine that your TV shows poorly, the image is blurry and gradually disappears. Turn off the imaginary TV. What are your feelings?

After finishing, the presenter asks to imagine that this film is recorded on a

video disc, it is taken out and hidden in a closet.

Participants should share their own impressions, what they wanted to tell the group about, or whether something changed in their perception of the situation.

There will definitely be participants who did not feel anything, they need to be thanked and emphasized that their efforts were not in vain.

Reflection:

1. Was it difficult to create a visual image?
2. What problems did you encounter when transferring it to the TV screen?
3. What difficulties do you experience when manipulating the image?
4. Could you repeat a similar exercise individually, outside of the training group?

Exercise 7. "Projecting an image on the hand"

Purpose: to consolidate the ability to create a visual image and manipulate it to reduce psycho-emotional tension.

Duration: 45 minutes.

Course of the exercise: Participants are divided into pairs. Now the members of pairs must transfer the image to the partner's hand. At the same time, the hand moves closer and further away. Does your attitude towards the image change as the distance to it. At the end, the partner squeezes his palm into a fist and hides it behind his back. Participants talk about their impressions.

Reflection:

1. What are your impressions after performing this exercise?
2. What was easier to project - the image on the TV screen or on the hand? Why?
3. Do you think this exercise is effective?

Exercise 8. "Framework"

The goal: to consolidate the ability to work with visual images, to achieve the maximum reduction of the impact of a psycho traumatic situation on a person.

Duration: 45 minutes.

Course of the exercise: The image in the form of a photo card is placed in a frame. The participant himself determines the fragment of the image and further actions with it (keep it in memory, throw it away and tear it up).

Reflection:

1. What are your impressions after performing this exercise?
2. In your opinion, which images are easier to work with, non-moving or moving ones? Why?

Exercise 9. "Working with dreams"

The goal: to teach how to work with dreams those have a negative color, to reduce the negative impact of the image on a person and his well-being.

Duration: 50 minutes.

Exercise: If you often have nightmares, try to analyze them during the day, in a comfortable environment for you. Represent your dream in a picture, in as much detail as possible, using colored pencils.

Participants show their drawings and talk about them. The host emphasizes that the more you talk about nightmares during the day, the less likely they are to repeat them at night.

A variant of the preliminary exercise is possible - when the participant transfers the dream to the TV screen, and can do anything with the image, preferably inventing a happy ending at the end.

Reflection:

1. How do dreams affect your well-being during the day?
2. Is it appropriate to use this exercise to change the situation?
3. What are your impressions after performing this exercise?

Exercise 10. "Completion"

Purpose: to focus on positive developments, participants' understanding, setting for further cooperation.

Duration: 20 minutes.

Course of the exercise: Before starting to speak positive images, the presenter emphasizes the completion of work for today. Expresses hope for further cooperation. Expresses admiration for the participants for their courage to speak about such a difficult topic. The class ends with feedback - presenters and participants share their impressions of the class.

Reflection:

1. What were your impressions after the first day?
2. What was the easiest for you, and what was the hardest?
3. Do you see the need for such trainings?
4. Do you allow the use of acquired knowledge and skills in everyday life after completing the class or training?

8.3 Peculiarities of psychological assistance to the civilian population after shelling in the conditions of military operations

Since the provision of psychological assistance to a certain category of victims has a significant number of specific features, it is the presence of effective exercises for multi-format classes that contributes to the provision of structured assistance and the identification of a potential path for the psychological support of victims.

A significant number of victims do not want to be a separate group among consumers of psychological help, because it focuses attention on psycho-traumatic memories and leads to a significant number of sympathetic reactions from those around them. This, in turn, not only does not contribute to the improvement of the psycho-emotional state, but also leads to its deterioration. This aspect must be considered when providing psychological assistance.

The proposed training session (see subsection 8.2) is only one of many options for accompanying a victim of shelling, but its effectiveness has been proven by practical use in a city on the outskirts of which full-scale military operations are taking place. Selection feature of practical exercises allows them to be used with different age and gender groups of the population.

Since the selected issues are quite broad, in further scientific developments it is advisable to pay attention to the peculiarities of psychological counseling and various directions of psychotherapeutic work.

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