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Ability to conduct decontamination of gas transmission infrastructure after a CBRN attack

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Abstract
The article presents the issues concerning the ability to conduct decontamination processes on selected elements of the natural gas transmission infrastructure. On the basis of research and analysis presented possibilities remove contaminations from various surfaces and technical facilities. The specificity of the gas transport equipment requires the use of specialized equipment and modern technologies. Both the fire brigade and the military have the ability to decontaminate some devices in a limited way.

Key words
decontamination, gas transmission infrastructure, CBRN attack

Introduction

Ensuring the security of the state and its citizens is one of the vital national interests of the Republic of Poland. National security means the ability of the state and its society to ensure the conditions for its survival as an institution, a community of citizens, the biological survival of the population, territorial integrity, political independence, internal stability and quality of life. This certainty is shaped by actions involving the use of opportunities, the challenges, reducing risk and eliminating external and internal threats, which will ensure survival, identity, operation and freedom of development of the state and the nation (society) [1, 5]. The main opportunities for national security must be sought in strengthening the role of the Polish in the North Atlantic Treaty Organization and the European Union as well as in building friendly relations with neighboring countries [2].

In the modern world the threat of CBRN seems relatively unlikely, however, the use of weapons of mass destruction can also have a huge impact on the gas transmission infrastructure. Both the armed forces and fire brigade as have the appropriate equipment to conduct decontamination. The problem lies in the fact that the availability of emergency services for the transmission infrastructure is very limited. On the basis of the Decision of the Council of Europe and the European Commission No. 2119/98/EC, 2000/57/EC, 2119/98/EC and 2001/792/EC - the minister responsible for health is responsible for the organization and functioning of the National Focal Point system RAS-BICHAT (Rapid Alert System for biological, Chemical, Radiation and Nuclear Threat in the European Union). The proper functioning of this system ensures efficient circulation of information about the dangers of CBRN. This system allows you to work out the decisions and recommendations for further action. In the event of threats are taken, inter alia, activities related to the removal of contaminations.

1. Characterization of selected elements of infrastructure to transport the gas

Gas distribution infrastructure, as well as other types of transport infrastructure consists of linear elements and the point elements, which are called. technical infrastructure. Technical infrastructure are: equipment, transmission networks and associated facilities providing essential and basic services for a particular business unit (housing, neighborhood, city, industrial plant, etc.) in the field of energy, providing heat, water, sewage and waste disposal, transport , telecommunication engineering, etc. Including national system has a length of 13.5 thousand. km of transmission lines, 117 thousand. km distribution network, 18 compressor stations, about 1,600 reduction stations and reduction - the measurement of high pressure and more than 3,000 gas stations the second degree. Figure 1 shows the transmission network high pressure in Poland.

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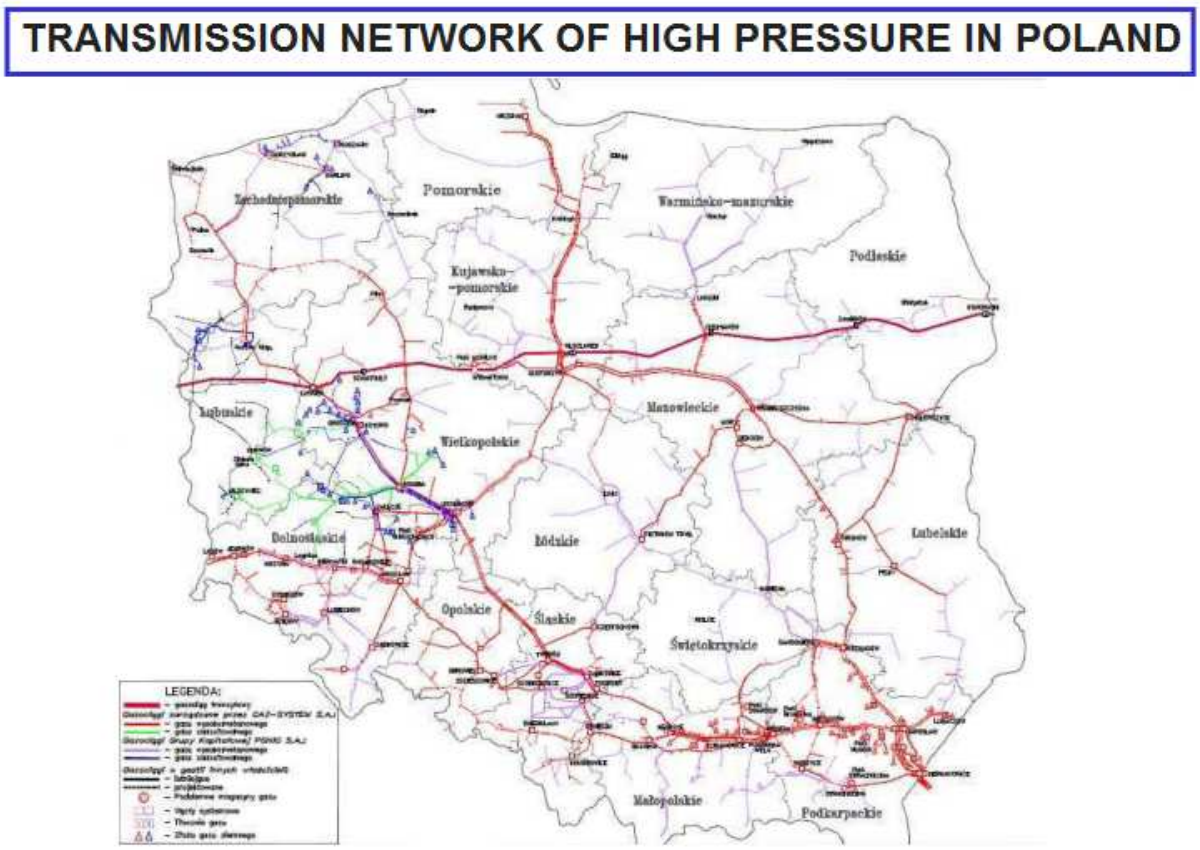

Fig. 1. Source: based on [1, 6]

Gas transmission infrastructure (fig. 2) - technical devices and systems technology, providing the necessary and basic services for the gas in the transmission and distribution of gas. This infrastructure includes:

- pipelines,
- stations,
- compressor stations,
- gas storage.

Linear infrastructure gas transmission network formed pipelines - pipelines, which, together with the connections and equipment, arranged outside the object extracting, producing, storing or consuming gas, serving the transmission and distribution of gas fuels. The basic elements of point-gas transport infrastructure, the existence of which is necessary for proper functioning are:

- gas stations,
- compressor stations,
- stores and gas reservoirs,
- nodes of gas
- unit valve stations (UVS),
- steam traps,
- odorizing stations.

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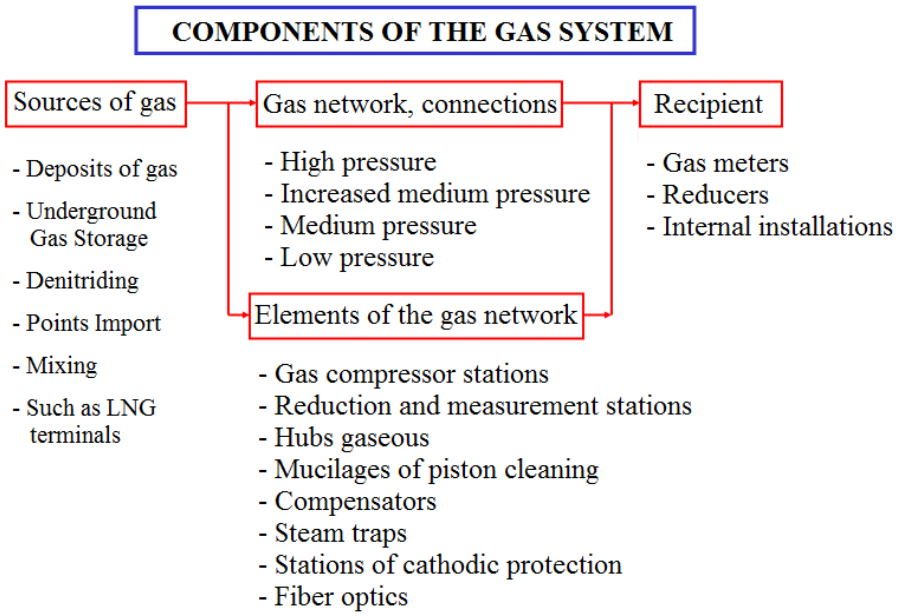

Fig. 2. Source: based on [1, 6]

A significant part of the gas transmission infrastructure is above ground surface and exposed to the direct impact of CBRN agents. This includes the key elements related to the control and the control of gas flow (point-gas transport). All of these elements are exposed to the direct impact of factors destruction of weapons of mass destruction. In most cases, service of gas appliances require direct human contact (engineer, technician, operator ...). A significant part of aboveground device is located in the towns and villages, where people are [fig. 3]. Contamination of surface facilities and equipment can cause serious threat to human life or health.

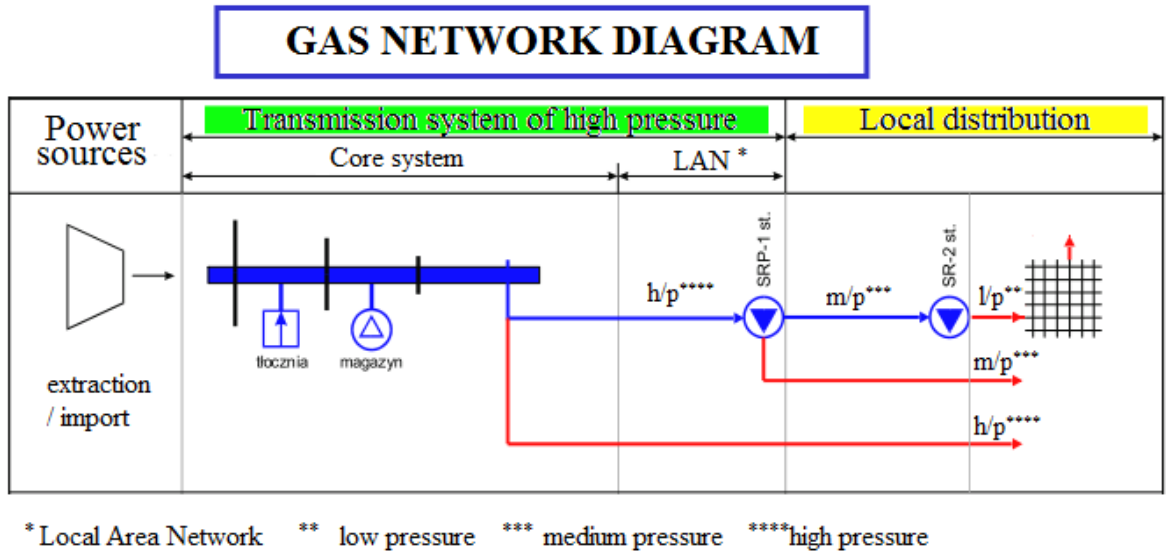

Fig. 3 Source: based on [1, 6]

3. Description of CBRN threats

Despite the ongoing process of normalization of relations between the countries signed a number of agreements and conventions, the threat of the use by the warring parties weapons of mass destruction and other hazardous chemicals, radioactive and biological seems to be quite real. The experience of recent years has shown that these measures can also be used in acts of terrorism.

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The term contamination mean unwanted presence of chemical, radioactive and biological material on the surface or in the volume of objects that are dangerous to living organisms.

The different types of pollution can be defined as:

- *chemical contamination* of harmful chemical pollution (toxic) surface (skin of humans and animals, clothing, means of struggle, objects, terrain, etc.) and large volumes (water, air);
- *radioactive contamination* - substances (materials containing radioactive isotopes) of the surface and a large volume;
- *biological contamination* (infection) - contamination with pathogenic regimes area and volume to induce inflammatory foci and the emergence of endemic, epidemic and pandemic among humans and (or) animals.

Such threats occur in a situation where we're dealing with aggression military (an armed conflict) or terrorism. During normal operation of gas transmission infrastructure, there are risks related to the release of toxic industrial chemicals (TIC). Flammable gases are not of natural origin characteristic odor due to which you can quickly detect their volatilization. It is therefore necessary odorization gas before entering the distribution network. Devices odorants or odorizing stations, installed in the reduction stations as freestanding objects, usually in metal cabinets, or in separate rooms of the building the station. Odorization is used for the safety of users, as flammable and explosive threat of natural gas is odorless. For safety, the gas is saturated with perfume. This process is called odorant and is mixing tetrahydrothiophene (THT) of natural gas. Tetrahydrothiophene (THT, C_4H_8S) - organic heterocyclic compound, a thiophene derivative. At room temperature it is a viscous, oily liquid with a specific smell. There is a very strong poison. Absorbed into the body through the respiratory system and the skin (it cannot be completely washed out). It is used for natural gas odorant. When working with THT caution should be exercised, because the vapors are heavier than air and may accumulate at the surface, and the vapors at a concentration of 1/3 of the form explosive mixture with air. THT ignition temperature is 19 °C.

4. Ability to conduct decontamination

Gas transmission infrastructure is a specific object for decontamination. Explosive and fire threats requires specific conditions for precautions. The sensitivity measurement and control equipment to aggressive chemicals requires the selection of appropriate methods of decontamination.
To such an action appropriate equipment and resources have firefighters and chemical troops. Their equipment and accessories allows the execution various decontamination techniques. Each type of contamination can be effectively removed.

Basics methods of disposal of radioactive contamination are shown in Table 1.

Table 1. Removal of radioactive contamination

	Methods	
Objects:	**Physical**	**Mechanical**
Devices and technical equipment	Washing of contaminated radioactive substances on a surface of the aqueous solutions of surfactants, water and solvents, and water-gas stream.	Sweeping radioactive dust or remove it from contaminated surfaces by being sucked into the vacuum tank equipment (vacuum cleaners).
Soil	Wash dust with water and stream water and gas (roads and terrain with hard cover).	Removal and disposal of contaminated ground layers. Isolation of contaminated surfaces. Blowing of dust a gaseous stream.
Protective clothing. Equipment. Means of protection against contamination	Wash of protective clothing. Washing radioactive dust with water and solutions of surfactants (shoes, accessories, etc.)	Sweeping, shaking, butting.

Since we do not have the technical capacity to stop the emission of radiation from the isotope there is only the possibility of mechanical or physical removal of contamination. Later stage consists in the transfer of radioactive wastes collected for a special landfill.

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Table 2 Elimination of chemical contamination

Methods			
Objects:	**Chemical**	**Physical**	**Mechanical**
Devices and technical equipment	Operation of decontamination solutions.	Removal of toxic substances by aqueous and solvent extraction methods. Evaporation of toxic substances in results of hot air interaction.	-
Soil	Application of decontamination solutions. Distribution (scattering) of solid decontaminants.	Evaporation of toxic substances as a result of the action of hot gases.	Stripping (removal) contaminated soil layer. Physical isolation of contaminated surfaces.
Protective clothing. Equipment. Means of protection against contamination	Cooking; action of a mixture of steam-air-ammonia; laundry.	Absorption of toxic substances by the absorbents, leaching of toxic substances in the process of solvent extraction, ventilation.	-

The total liquidation of contamination of the gas transmission infrastructure equipment contaminated with toxic chemicals can be carried out in three phases:

- *Phase I* - pre-wash contaminated surfaces dense stream of cold water,
- *Phase II* - wash contaminated surfaces with decontaminants an aqueous solution,
- *Phase III* - wash imposed measure to eliminate contamination by dense stream of cold or heated water.

For chemical decomposition of toxic substances can be (following the model of biological wastewater treatment plants) select an appropriate biological material (micro-organisms). Biological disinfectants are highly effective and have a wide application. In an emergency situation, when a gas leak into the environment, the earth is soaked in THT. To remove this very intense and unpleasant smell of the earth's surface sprayed onto a 10% solution of potassium permanganate or 5% sodium hypochlorite.

Table 3 Biological decontamination (disinfection)

Methods			
Objects:	**Chemical**	**Physical**	**Mechanical**
Devices and technical equipment	Operation of disinfectant solutions on the contaminated surface.	-	-
Soil	Sprinkling disinfectant solutions. Scattering disinfectant substances.	A stream of high temperature gases.	Removal and disposal of contaminated soil layer. Barrier isolation of contaminated surfaces.
Protective clothing. Equipment. Means of protection against contamination	Soaking in solution to decontamination.	Cooking, operation of hot air and steam-air mixture, laundry.	-

The disinfection of contaminated by microbial equipment is take place by 2% solution of calcium hypochlorite. In the case where the type is not known biological contamination, disinfection is performed with a solution with a higher concentration of calcium hypochlorite. The best results are obtained by using a stream of gas-droplet intermittent, ie alternately gas stream and gas-droplet. The gas stream is directed to the contaminated equipment. Sanitizing gas stream is conducted in this way, be exposed to the entire surface contaminated object, paying particular attention to the upper surfaces of the primary contaminations, and bottom parts the secondary and combined contaminations.

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A very important element of the service of contaminated items is the proper use of personal skin protective equipment and respiratory system. Decontamination the equipment to protect against contamination should be carried out outside the boundary contaminated area.

Summary

Poland has a certain potential, which is based on two subsystems regulations: military (army) and non-military (fire brigade), which, however, require adaptation and improvement. It can therefore be tempted to formulate a specific "philosophy" to prepare for the combined crisis response: use existing, upgraded needed to create the necessary, and the whole idea for the task. Considering this issue rational transition from the existing to the desired, should be based on all that already exists, is properly formed and can serve their experience to others.

In accordance with the legislation in force since 1991, under the Act on the State Fire Service (SFS) and the Regulation of the Ministry of Interior on detailed rules for the organization of the national rescue - extinguishing just SFS is an essential element of the non-military target in the field of chemical rescue. She was previously the domain of occupational chemical rescue station (since 1968), which form an integral part of larger chemical plants. It should be noted about the potential "military rescue", which according to the Law on crisis management can be used in certain situations in order to support non-military elements of the subsystem. National Rescue-Firefighting (NRF) has certain capabilities that may prove to be too modest for such a WMD terrorist attack with a large number of victims. Therefore, it is essential to ensure effective cooperation, or support to all departments involved in rescue and liquidation during the occurrence of contamination.

Analysis of the current challenges and threats and the resulting need to prepare adequate forces and resources in order to ensure the safety of the public, implies a desire to strengthen the capacity of national emergency based on the existing strengths and resources of the National Emergency Rescue System. In the face of new threats related to terrorist attacks using chemical, biological, radiological and even nuclear weapons, it is necessary to verify current assumptions and continuously updated action plans according to changing situations.

Currently, intensive work on developing new plans and are modified procedures for the use of forces and means of the Land Forces in crisis situations. In terms of the liquidation of feldspar chemical, biological and radioactive fire brigade is the core of these forces. Specialized equipment to carry out the liquidation ensures comprehensive feldspar: people, equipment and gas transmission infrastructure, technical buildings and terrain.

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