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ORIGINAL ARTICLE  
PRACA ORYGINALNA

## ENERGY INFRASTRUCTURE OBJECTS OF UKRAINE AS A PUBLIC HEALTH THREAT: CRIMINOLOGICAL ANALYSIS

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### ABSTRACT

**Introduction:** There are currently a number of energy infrastructure objects in Ukraine, including nuclear power plants whose failure or destruction due to various factors, including criminogenic ones, can have serious and even irreversible negative consequences not only for the state's national security but also for public health and environment as a whole at local, regional, national and even interstate levels. In the context of the recent criminal violence's escalation that has been observed in Ukraine, such objects can be deliberately harmed, which will inevitably lead to an environmental disaster. Therefore, it is obviously necessary to conduct criminological monitoring of threats for public health related to possible disruptions in operation of critical infrastructure in the energy sector.

**The aim:** of this research is to assess the risks for public health resulting from the critical infrastructure's operation in the energetical field of Ukraine by criminological analysis of certain crime types and propose measures to minimize their negative impact on public health.

**Materials and Methods:** The study is grounded on dialectical, historical, comparative, logical, analytical, synthetic, statistical comprehensive and cartographic research methods. The calculations and mapping were done using Adobe Photoshop CS6, Microsoft Excel 2016, Microsoft Word 2016 and QuickMap 2.2. The sources of the study are the statistical reports of Ukrainian law enforcement agencies, analytical materials of the Organization for Security and Co-operation in Europe, specialized literature on medicine and law.

**Results:** The country's energy system, including its nuclear, gas and oil pipelines, belongs to the country's critical infrastructure, since any disruption to their operations or their destruction will inevitably lead to a number of negative consequences, including damage for public health in a large area as a result of environmental pollution. The analysis of criminological statistics shows that the real threat to the functioning of such objects in Ukraine is currently represented by criminal acts, which can lead to disruption of the analyzed objects (terrorism, cases of illegal handling of weapons, ammunition, or explosives, creation of non-statutory paramilitary or armed formations, etc.). At the same time, it has been established and clearly demonstrated by the mapping method that there is an increased level of violence and auto-aggression (suicide) in the areas of nuclear energy facilities deployment. This fact does not exclude the negative impact of energy infrastructure functioning on public health.

**Conclusion:** By the time that critical energy infrastructure facilities operate fully and in a normal mode, it is extremely dangerous to conduct any large-scale military operations in Ukraine. Even a minor disturbance in the normal operation of such facilities is a potential danger for public health over a large area. The danger of such objects being violated is also emphasized by the fact that under normal rating their impact on public health is evident, which is confirmed by statistics, in particular, on suicides among local community, level of pre-meditated murders on the territories of relevant regions, etc. In addition, such objects are a potential target for acts of terrorism, the results of which can also be catastrophic. In this regard, the development of measures' system of minimizing the negative impact on mental and physical health of people living in the territory of critical infrastructure's location is particularly relevant.

**KEY WORDS:** cancer, health protection, public health, psychosocial disabilities, sickness, X-ray

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### INTRODUCTION

Modern society is a very complex social organism, in which it is possible to distinguish certain links, elements, sectors, systems, resources or networks, from which life's quality of the whole society depends directly on uninterrupted and safe functioning. Therefore, any abnormalities and deviations from the normal functioning of these entities, in particular as a result of criminal acts, can lead to serious and even irreversible negative consequences for both public health and environment at local, regional, national and interstate levels. Currently, such entities are commonly referred to as critical infrastructure.

For the first time in the world, such objects began to be mentioned on the European continent in the late 1990s, due

to the threat of numerous terrorist challenges. Following the tragic events of the terrorist attacks in New York on September 11, 2001, the issue of the need to protect critical infrastructure has gained new relevance and global scope. The National Strategy for the Physical Protection of Critical Infrastructures and Key Assets was introduced in the United States in early 2003 [1].

Critical infrastructure objects are enterprises and institutions (regardless of ownership) of such sectors as energy, chemical industry, transport, banks and finance, information technology and telecommunications (electronic communications), food, health, public services are strategically important for the functioning of economics

and security of state and society [2]. Therefore, failure or destruction of objects in these industries can have very negative consequences for the national security and defense capability of a state, its natural environment, public health, etc. Thus, as a result of the notorious accident at the Chornobyl NPP, which happened due to criminal negligence, the entire ethnocultural region was destroyed, as 350,000 residents of the surrounding areas were evacuated from the radiation contaminated area. In addition, due to late evacuation, people was affected by doses of radiation that ten times higher than the allowable limit. Approximately 600,000 people who eliminated the catastrophe's effects also affected by huge doses of radiation [3]. However, it is still unknown how many of them have died or have health deviations. There are no relevant researches have been conducted in medical, ecological or any other related aspects.

As we can see, a direct object of critical infrastructure - the country's energy system, including the nuclear, as well as gas and oil pipelines is recognized as a special priority. By the way, in any country that is concerned with the protection of critical infrastructure, the energy system is classified as such [4, p. 9; 5]. As correctly defined in the literature, effective identification of critical assets enables protection programs to prioritize asset lists (C. Izuakor and R. White, 2016) [6]. Detailed risk assessment can then be limited to key assets, such as those whose disruptions could have debilitating effects on security, national economic security, national public health and safety, or any their combinations [7].

## THE AIM

The aim of this article is to assess the risks to national security, environment, public health, etc. related to critical infrastructure in the energy sector of Ukraine by conducting a criminological analysis of certain types of crime that could directly or indirectly harm such objects and those which, in turn, may be conditioned by some adverse effects of such objects' operation. However, the purpose of the article is also to draw public attention to the problems of possible interconnection of any pollution (including radioactive radiation) due to natural, man-made disasters or criminal acts with disorders of human psyche, which, in turn, can be cause of criminal acts, for example, of a violent nature.

## MATERIALS AND METHODS

This study was conducted during 2017-2019 and is based on the research's results: 1) official statistics data of the Department of Information and Analytical Support of the Ministry of Internal Affairs of Ukraine and Office of Organizational Support of the Unified Register of Pre-trial Investigations and Information and Analytical Work of Prosecutor General's Office of Ukraine; 2) analytical materials from the Organization for Security and Co-operation in Europe; 3) quantitative and qualitative indicators of crimes against life and health of a person, public safety, as well as suicides during modeling an existing situation with

these offenses in certain regions of Ukraine by visualizing the latter with the help of geographical maps and relevant tables that perform an additional explanatory function in assessing threats to public health in Ukraine in the context of protecting the state's energy infrastructure. The empirical and statistical data collected are processed, summarized, and analyzed using descriptive statistics capabilities. The article is based on dialectical, comparative, analytical, synthetic, statistical and comprehensive research methods. The calculations and mapping were done using Adobe Photoshop CS6, Microsoft Excel 2016, Microsoft Word 2016 and QuickMap 2.2. Theoretical basis of the article is specialized literature on medicine and law.

## RESULTS AND DISCUSSION

The specific literature identifies certain types (categories) of threats that should be covered by critical infrastructure protection. Such threats include: accidents and technical failures, in particular, aviation accidents, nuclear accidents, fires, accidents in energy supply systems, emissions of hazardous substances, system failures, accidents and emergencies caused by negligence, organizational errors, etc.; natural hazards, including extreme weather, forest, steppe and peat fires, seismic phenomena, epidemics and pandemics, space phenomena, hurricanes, tornadoes, earthquakes, tsunamis, floods, etc.; malicious acts, in particular, malicious acts of groups or individuals such as terrorists, criminals and saboteurs, as well as hostilities during war [4, p. 12]. As was noted, the subject of our in-depth analysis is, first, the criminological estimation of public health threats in Ukraine, primarily as a result of unlawful acts affecting critical energy infrastructure facilities and, second, disclosure of a possible link between environmental pollution that results from operation of some of these objects in regular mode, or which has occurred as accidents' results or criminal activities at these objects, and disorders of human psyche, that in the etiology of criminal behavior as a manifestation of destructive aggression in the broad sense may subsequently play some negative role.

The listed threats potentially carry an enormous risk of disruption and even collapse in uninterrupted energy supply of a state with long-term environmental consequences. In fact, they determine the likelihood of corresponding negative changes in critical infrastructure's objects. Risk is defined as the possibility of loss, damage or injury [8, p. 90]. Thus, risk is always associated with dangers' presence and threats, the likelihood of any harm to public health of a country as a whole and its regions, in particular. The criminological assessment of threats to the protection of critical infrastructure should be considered as an effective mechanism for analyzing the state of protection of Ukraine's territory from any criminogenic events. In mathematics and economics, analyzing certain types of threats, attention is always drawn to identifying potential risks based on statistics, scientific, technical and expert judgment. Such an approach we used to build the scheme and outline the main results of our research.

It is emphasized that the Organization for Security and Co-operation in Europe is in fact calling for the recognition of importance of critical energy infrastructure in the modern world, which in its Decision 6/07 on protecting critical energy infrastructure from terrorist attacks determines that critical energy infrastructure, including nuclear power plants, dams of hydroelectric power plants, oil and gas producers, refineries, transmission facilities, supply routes and facilities, energy storage facilities as well as hazardous waste storage facilities, may be vulnerable to terrorist attack [9].

Today, the energy system of Ukraine consists of comprehensive structure of such objects. Among the most valuable of them are: 1) an extensive gas transportation system extending from eastern to western and from northern to southern borders of Ukraine; 2) four operating nuclear power plants (South Ukrainian NPP – 3,000 MW; Khmelnytsky NPP – 2,000 MW; Rivne NPP – 2 880 MW; Zaporizhzhya NPP – 6,000 MW [10, p. 22]). The Chernobyl NPP is still partially operational (its capacity before the disaster was 3,200 MW) [11].

Particular attention should be paid here to those threats to public health related to nuclear power, especially when it comes to criminal events related to man-made disasters or conducting military operations in the territories of those countries where such facilities are located. As is known, the world's first nuclear reactor was built in 1942 in the United States, and Ukrainian nuclear power was started in 1977, when the first Chernobyl NPP was put into industrial operation [12]. Nowadays, nuclear power plants are operating in 30 countries. Ukraine ranks 10th in the number of nuclear reactors (power units) in the world [10, p. 21].

In 1986, Ukraine suffered the tragic consequences of NPP failure, extent and depth of which cannot yet be fully determined. Only immediately after the accident in clinical cases of mild acute radiation sickness (hereinafter–ARS) (1st degree of severity, radiation dose is 0.8–2.1 Gy) the patients were diagnosed with vascular dystonia and neurotic disorders, in cases of moderate ARS (2nd degree of severity, 2–4 Gy) also vegetative vascular dystonia was diagnosed; with severe ARS (3rd degree of severity, 4.2–6.3 Gy) – acute radiation and radiation-toxic encephalopathy, acute psychosis with visual and auditory hallucinations, brain edema, and with very severe ARS (4th degree of severity), 6–16 Gy) – acute radiation and radiation-toxic encephalopathy, subarachnoid-parenchymal hemorrhage, marked edema and swelling of the brain were diagnosed [13, pp. 48–52]. The situation is complicated by the fact that emergency radiation is necessarily connected with: 1) non-radiation factors, especially psychological and social stress, and 2) lack of objective baseline (before exposure) data on human health [14]. Among those who suffered the most from the Chernobyl accident, 600 thousand liquidators of this accident. Mental disorders in them are detected twice as often as in the rest of population, and suicides among them were 20 times more; many of them need psychiatric treatment [15].

Interesting data are provided by K. Loganovsky and co-authors. They have conducted standardized psychiatric interviews using the Composite International Diagnostic

Interview with 295 clean-up workers and 397 controls 16–18 years after catastrophe and report on common psychiatric disorders, suicide ideation and severe headaches. So, clean-up workers had significantly higher rates of depression (18.0% vs. 13.1%) and suicide ideation (9.2% vs. 4.1%) after catastrophe, but not alcoholism or intermittent explosive disorder. In the year preceding the interview, depression rates (14.9% vs. 7.1%), PTSD (4.1% vs. 1.0%), and headaches (69.2% vs. 12.4%) were elevated (Loganovsky et al. 2008) [16].

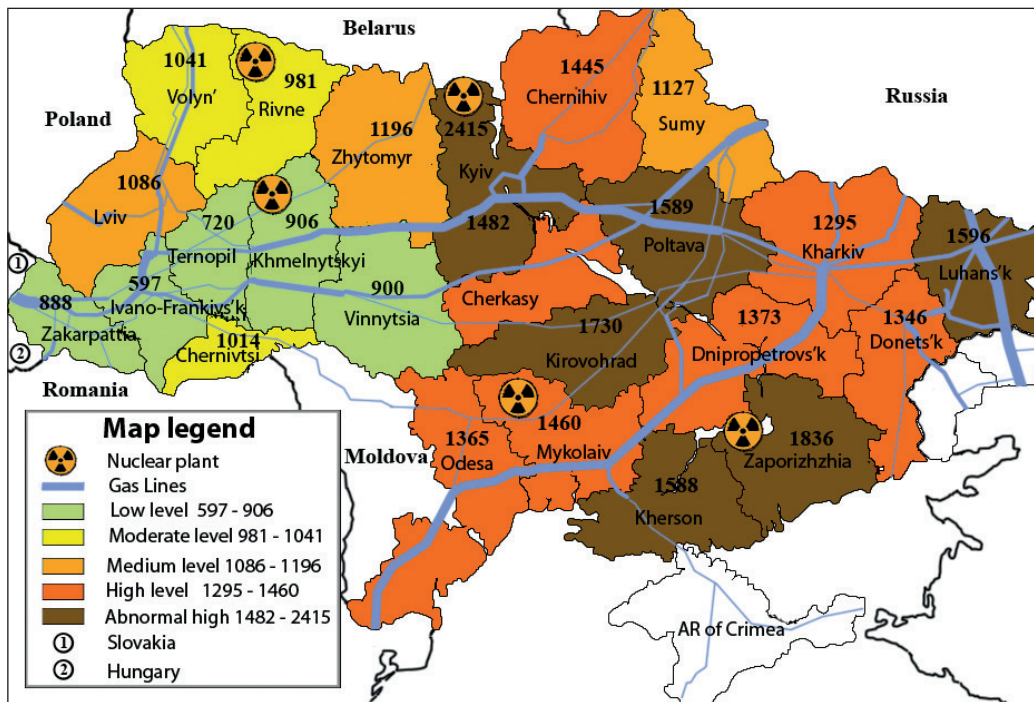
Since 1990, the Ukrainian Institute of Social and Forensic Psychiatry has conducted a survey of liquidators, which has led to the hypothesis that high doses of radiation lead to dementia and give rise to mental illness such as schizophrenia [15]. In this regard, it is not for nothing that the long-term mental health consequences have been recognized by the UN Chernobyl Forum and supported by further evidence-based International Studies as one of the major medical and social problems of the Chernobyl catastrophe aftermath [17, p. 22].

It should be noted that in addition to the obvious impact on individual health (leukemia, thyroid cancer, breast cancer, other cancers, cataract, mental health) [18, etc.], man-made disasters such as Chernobyl or Fukushima (Japan) also have obvious but not recognized implications for public health. Among the latter: loss of territories for residence and territorial redistribution of population, degradation of population structure of radioactively contaminated territories, mortality in population of radiologically contaminated territories and mortality victims of catastrophes, demographic losses, disability, non-cancer health effect etc. [19] The most likely emergency scenarios in Ukraine at present are: 1) nuclear and radiological accidents and incidents (any event related to transportation, storage and use of radioactive materials and radiation sources [above all, NPPs and nuclear reactors], including the loss and theft of radiation sources and detection of hostile sources); 2) nuclear terrorism (first of all capture of a nuclear power plant or other civilian object working with radioactive materials, its mining and explosion); 3) use of tactical and/or strategic nuclear weapons [20, p. 5].

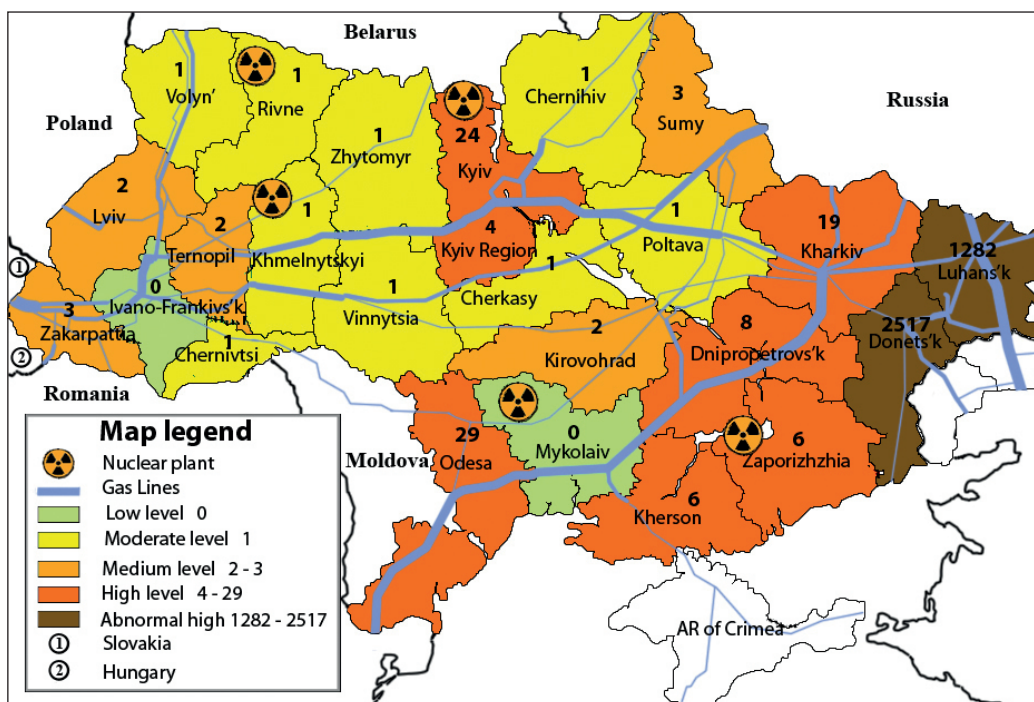
Modern humanity is in a symbolic closed circle: energy infrastructure objects have a negative impact on population's health (especially in satellite cities of NPPs, TPPs, etc.), which does not exclude outbreaks of unlawful excesses related, in particular, to aggression and auto aggression. However, while this assumption still requires serious medical and psychological research, the impact of criminal actions aimed at work's disrupting of the analyzed objects is quite obvious as they always leads to accidents and contamination of the environment and therefore irreparable damage to public health.

An analysis of the geography of major critical energy infrastructure facilities' location in Ukraine which are of high risk indicates that they are predominantly located in the areas of increased criminogenic threats (Fig. 1). Even where the crime area is relatively "favorable" as a whole, since the level of criminal threats is not high but the energy infrastructure of the critical infrastructure is located on its territory, the corresponding indicators still tend to reach the maximum limit of criminal intensity's level inherent





**Fig. 1.** Geography of Crime Rate in Ukraine per 100,000 Population in 2018



**Fig. 2.** Geography of Terrorist Acts and Creation of Terrorist Groups or Organizations (2017-2018)

**Table I.** Dynamics of Terrorist Acts (Art. 258 of the Criminal Code of Ukraine) Committed in Ukraine (2009-2018)

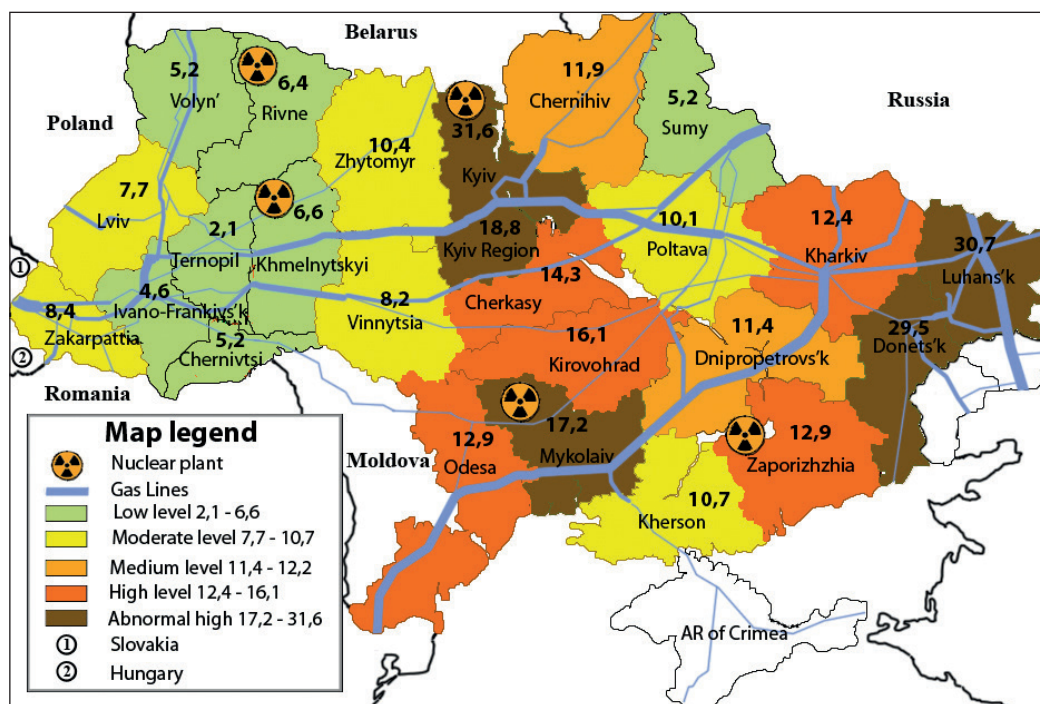
Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Quantity	-	-	-	-	4	1 499	1 295	1 865	1 385	950

in of one or another criminogenic group. This situation threatens the «transition» to the next, less favorable in terms of criminogenic, group of indicators.

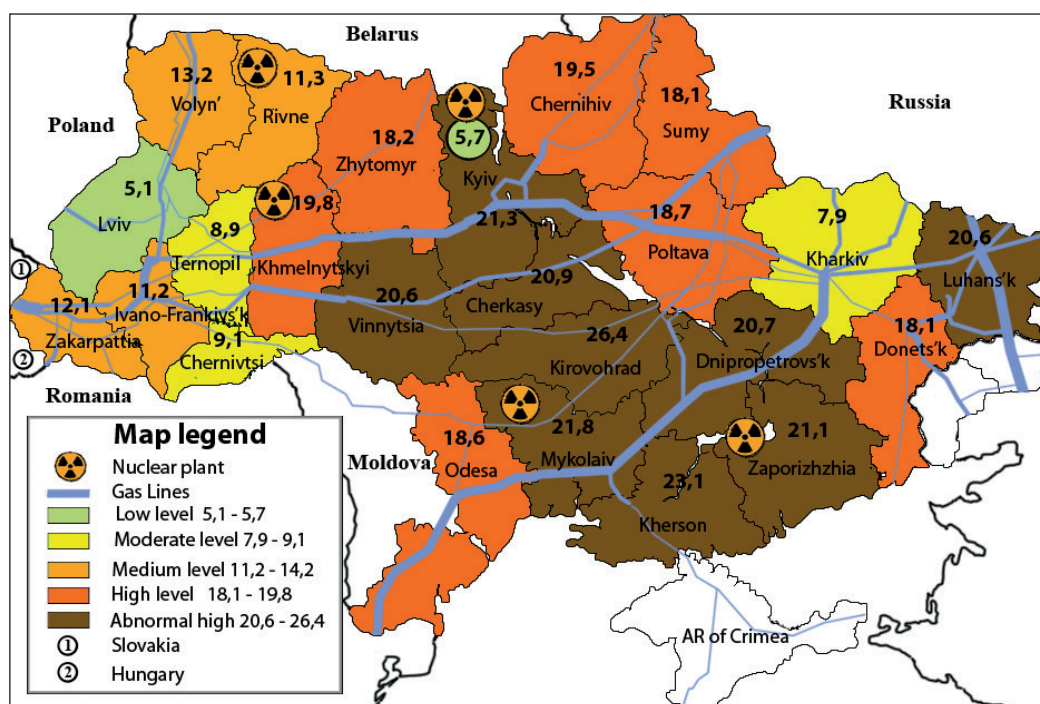
Indeed, the maps below show that many of these energy facilities, in particular nuclear and gas transportation systems and their networks, are located in regions with high levels of terrorist threat, social tension, high rates of homicide and suicide (Fig. 2, 3, 4).

Regarding crimes related to terrorism, while in 2013 only 4 facts were fixated since 2014 more than one thousand crimes have been consistently committed (Table I).

Terrorism was a completely new phenomenon for Ukraine. If previously such cases were not recorded at all due to their absence, 894 terrorist acts (Art. 258 of the Criminal Code) and 427 cases of a terrorist group or terrorist organization establishing (Art. 258<sup>3</sup> of the Criminal Code) were recorded in 2014. In 2015



**Fig. 3.** Geography of Homicide Rate in Ukraine per 100,000 Population in 2018



**Fig. 4.** Geography of Suicide Rate in Ukraine per 100,000 population in 2018

it was accounted 1 295 reported terrorist acts (ie + 50%) and 849 cases of a terrorist group or terrorist organization establishment; in 2016 – 1,602 (+ 24%) and 391; in 2017 – 1,283 and 277; in 2018 – 838 and 175 crimes respectively [21; 22; 23; 24; 25; 26].

The most dangerous in this regard were the territories of Donetsk, Lugansk, Odessa, Kyiv and Zaporizhzhia regions. It should be reminded that in these territories some of the nuclear power plants and most of gas transmission system and its networks are located. Even one instance of terrorism at, or adjacent to, critical energy infrastructure in these areas may be sufficient for a major disaster.

The reality of criminological threats to energy infrastructure in our country can be amplified by the catastrophic depreciation of both one's own life and that of another person. This is clearly indicated by the high intensity of homicides and suicides in the regions of Ukraine (Map 3, 4). Again, this can be a consequence of environmental discomfort, which increases the likelihood of human acquisition, including any mental anomalies. Thus, it is possible that the influence of oil, gas transmission system, nuclear power objects etc. on public health leads to increased levels of criminal aggression in the broad sense.



This data demonstrates that the most dangerous territories for Ukraine are the cities of Kyiv (31) and Kyiv region (18.8), as well as Lugansk (30.7), Donetsk (29.5), Mykolaiv (17.2), Odessa (12.9), Zaporizhzhia (12.9) and a number of other regions of Ukraine (Fig. 3, 4). As we can see, the homicide rate per 100,000 of population in some cases far exceeds the so-called epidemiological threshold, which is equal to 7.6 cases per 100,000 of population [27]. If we combine these data of criminal statistics with the location's map of nuclear facilities, it can be seen that, with the exception of the Lugansk and Donetsk regions, in the mentioned regions or near them there are such NPPs as South Ukrainian, Zaporizhzhia (the largest in Europe) and Chernobyl. As for the Luhansk and Donetsk regions, they are naturally more violent than any other region as a result of hostilities.

Regarding suicides, in 2017, Ukraine, as in previous years, again ranked 25 countries with the highest suicide rates in the world. This figure was 15.3 cases per 100 thousand of population of the country [28], that is, six and a half thousand Ukrainians voluntarily died. In 2018, this figure was 15.8 cases per 100,000 of people [28]. In this respect, the current situation in Ukraine is alarming and does not show a stable tendency to reduce the number of such cases.

Thus, the presented results indicate that the territories of critical infrastructure locations in the energy sector of Ukraine are extremely saturated not only with so-called general crime, but also with terrorist offenses, homicides and suicides (Map 1, 2, 3, 4). Map 3 and 4 show data that our country is in a hazardous area.

## CONCLUSIONS

Power plants of various types, including nuclear, oil and gas transmission systems, are the most important types of critical energy infrastructure in Ukraine, since they are: first, the main sources of energy for internal consumption; secondly, provide electricity exports to other countries and, accordingly, profits for Ukraine; thirdly, they are the guarantors of socio-economic and political stability in some parts of the European continent. As long as critical energy infrastructure facilities are fully operational and full-time, any large-scale military operation is extremely dangerous in Ukraine. At the same time, the termination of these facilities can lead not only to economic and social, but also to political imbalances that can cause negative geopolitical consequences.

The stable functioning of power plants, in particular NPPs, oil and gas transportation system of Ukraine and, consequently, geopolitical stability in Ukraine, can be hindered by criminological threats such as: 1) high intensity of criminal manifestations in some regions; 2) terrorist crimes; 3) high inclination of certain categories of people to violence; 4) negative state of social and socio-psychological situation (high suicide rate, unemployment, social tensions, etc.); 5) geopolitical factors etc. In the case of man-made accidents, natural disasters and acts of crime (both intentional and reckless), negative impact of these objects becomes extremely dangerous for public health in large territories, taking even the magnitude of the planetary

character due to environmental pollution. Therefore, a large number of people (radiation sickness, cancer, mental disorders, etc.) always result from «incorrect» functioning or destruction of the critical infrastructure.

Analysis of quantity and geography of committing certain types of criminal acts (primarily terrorist acts) in Ukraine confirms the existence of a real threat to uninterrupted and safe functioning of nuclear facilities, oil refining and gas transportation systems. In turn, increased levels of premeditated murders and auto-aggression (suicide) cases are recorded in areas adjacent to nuclear facilities (nuclear power plants). Thus, critical energy infrastructure assets represent both a real and a potential threat to public health. In this regard, the development of a system of measures to minimize the negative impact on the mental and physical health of the population living in the territory of location of the critical infrastructure is particularly relevant.

## REFERENCES

1. The National Strategy for the Physical Protection of Critical Infrastructures and Key Assets. Available from : <https://www.hsdll.org/?view&did=1041>. [reviewed 2019.07.12]
2. Poryadok formuvannya pereliku informacijnno-telekomunikacijnih sistem ob'ektiv kritichnoi infrastrukturi derzhavi: zatv. postanovoyu Kabinetu Ministriv Ukraini vid 23.08.2016. № 563. Oficijnij visnik Ukraini. 2016. № 69. St. 2332 [Order of Formation of the List of Information and Telecommunication Systems of Objects of Critical Infrastructure of the State: approved resolution of the Cabinet of Ministers of Ukraine of August 23, 2016. No. 563]. Official Bulletin of Ukraine. 2016; 69 : 2332 [reviewed 2019.07.12] (Ua).
3. Chornobil's'ka katastrofa: yak naspravdi stalasya tragediya [Chernobyl disaster: how the tragedy actually happened]. Available from: <https://znaj.ua/society/chornobylska-katastrofa-yak-naspravdi-stalasya-tragediya> [reviewed 2019.08.20] (In Ukrainian).
4. Biryukov D.S., Kondratov S.I., Nasvit O.I. et al. Zelena kniga z pitan' zahistu kritichnoi infrastrukturi v Ukraïni [Green Book on the Protection of Critical Infrastructure in Ukraine]. Kyiv: National Institute for Strategic Studies, 2015. 35 p. (Ua).
5. Alcaraz C., Zeadally S. Critical Infrastructure Protection: Requirements and Challenges for the 21st Century. IJCIP. Elsevier Science. 2015; 8:53–66. doi: 10.1016/j.ijcip.2014.12.002.
6. Izuakor C., White R. Critical Infrastructure Asset Identification: Policy, Methodology and Gap Analysis. Critical Infrastructure Protection X: ICCIP: International Conference on Critical Infrastructure Protection (March 14-16, 2016). Arlington: Springer, 2016: 27–41. doi: 10.1007/978-3-319-48737-3\_2.
7. U.S. Government, Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA Patriot Act): Act of 2001, Public Law 107–56. Washington, DC (2001). Available from: <https://www.govinfo.gov/content/pkg/PLAW-107publ56/pdf/PLAW-107publ56.pdf>. [reviewed 2019.08.20]
8. Good Practices Guide on Non-Nuclear Critical Energy Infrastructure Protection (NNCEIP) from Terrorist Attacks Focusing on Threats Emanating from Cyberspace. Vienna: Organization for Security and Co-operation in Europe, 2013. 100 p.
9. Decision No. 6/07 Protecting Critical Energy Infrastructure from Terrorist Attack: Second day of the Fifteenth Meeting. MC(15). Journal No. 2. Agenda item 8. Available from: <https://www.osce.org/mc/29482?download=true>. [reviewed 2019.08.19]

10. Markevych K., Omel'chenko V. Yaderna enerhetyka u sviti ta Ukraini: potochnyj stan ta perspektyvy rozvytku (analytychnyj ohliad). [Nuclear power in the world and Ukraine: current state and prospects for development (analytical review)]. Kyiv: Razumkov Center, 2015, 26 p. (Ua).
11. Chornobyl's'ka katastrofa [The Chornobyl disaster]. Available from: [https://uk.wikipedia.org/wiki/Чорнобильська\\_катастрофа#Характеристика\\_AEC](https://uk.wikipedia.org/wiki/Чорнобильська_катастрофа#Характеристика_AEC). (Ua).
12. Yadernyj reaktor [Nuclear reactor]. Available from: [https://uk.wikipedia.org/wiki/Ядерний\\_реактор#cite\\_note-zeep-cstm-1](https://uk.wikipedia.org/wiki/Ядерний_реактор#cite_note-zeep-cstm-1). (Ua).
13. Torubarov F.S., Blagoveshchenskaya V.V., Chesalin P.V. et al. Sostoyanie nervnoj sistemy u postradavshij pri avarii na Chernobyl's'koj atomnoj elektrostancii (CHAES). [The State of the Nervous System of the Victims of the Accident at the Chernobyl Nuclear Power Plant (Chernobyl)]. Journal Neuropathology and Psychiatry Named by S. S. Korsakov. 1989; 2: 48–52. (Ru).
14. Loganovs'kij K.M., Zdanevich N.A. «Postradiacijnij» posttravmatichnij stresovij rozlad. Problemi radiacijnoji medicini i radiobiologii. [«Postradiation» post-traumatic stress disorder]. Problems of radiological medicine and radiobiology. 2011; 16: 138–149 (Ua).
15. Miroshnikova A. Kak na psihiku vliyaet Chernobyl? [How the mentality is influenced by Chernobyl?]. Part I. Available from: <http://www.likar.info/psihologicheskie-problemy/article-77176-kak-na-psihiku-vliyaet-chernobyl-chast-1>. [reviewed 2019.08.19] (Ru).
16. Loganovsky, K., Havenaar, J.M., Tintle, N.L. et al. The mental health of clean-up workers 18 years after the Chernobyl accident. Psychol Med. 2008; 38 (4): 481–488. doi: 10.1017/S0033291707002371.
17. Omelianets N., Bazyka D., Igumnov S., Loganovsky K., Pryszazhnyuk A., Stepanova E., Afanasev D. Health Effects of Chernobyl and Fukushima: 30 and 5 years down the line. Brussels: Greenpeace, 2016. 98 p. doi: 10.13140/RG.2.1.1188.5202.
18. Likhtarov I., Kovgan L., Vavilov S. et al. Post-Chernobyl Thyroid Cancers in Ukraine. Report 2: risk analysis. Radiat. Res. 2006; 166 (2): 375–386. doi: 10.1667/RR3593.1
19. Gun'ko N.V., Omel'yanec' M.I., Ozerova Yu. ta in. Ocinka stanu vikonannya viznachenih zakonodavstvom zahodiv protiradiacijnogo, medichnogo ta social'nogo zahistu zhiteliv radioaktivno zabrudnenih teritorij vnaslidok Chornobil's'koji katastrofi ta propozicii shchodo napryamkiv iih korekcii. [The estimation of a condition of performance of the measures, established by the legislation, of antiradiating, medical and social protection of the inhabitants of territories, is radioactive contamination in result of Chernobyl catastrophe, and offer till them correction]. Problems of radiation medicine and radiobiology. 2010; 15: 114–126 (Ua).
20. Loganovs'kij K.M., Petrichenko O.O., Morozov O.M. ta in. Ohorona psihichnogo zdorov'ya pri radiacijnih avariayah na yadernih reaktorah ta zastosuvanni "brudnoji bombi" i taktichnoji yadernoi zbroji: metodichni rekomendacii. [Protection of Mental Health in Radiation Accidents at Nuclear Reactors and the Use of "Dirty Bomb" and Tactical Nuclear Weapons: Guidelines]. Kyiv: State Institution "National Scientific Center of Radiation Medicine of NAMS of Ukraine", 2014. 26 p. (Ua).
21. Yedinij zvit pro kriminal'ni pravoporushennya za sichen'-gruden' 2018 roku [Unified Report on Criminal Offenses for January–December 2018]. Prosecutor General's Office of Ukraine, 2019. Available from: [https://www.gp.gov.ua/ua/stst2011.html?dir\\_id=113653&libid=100820&c=edit&\\_c=fo](https://www.gp.gov.ua/ua/stst2011.html?dir_id=113653&libid=100820&c=edit&_c=fo) [reviewed 2019.08.19] (Ua).
22. Yedinij zvit pro kriminal'ni pravoporushennya za sichen'-gruden' 2013 roku / [Unified Report on Criminal Offenses for January–December 2013]. Prosecutor General's Office of Ukraine, 2014. Available from: [http://www.gp.gov.ua/ua/stst2011.html?dir\\_id=112173&libid=100820](http://www.gp.gov.ua/ua/stst2011.html?dir_id=112173&libid=100820) [reviewed 2019.08.19] (Ua).
23. Yedinij zvit pro kriminal'ni pravoporushennya za sichen'-gruden' 2014 roku [Unified Report on Criminal Offenses for January–December 2014 / Prosecutor General's Office of Ukraine, 2015]. Available from: [http://www.gp.gov.ua/ua/stst2011.html?dir\\_id=112173&libid=100820](http://www.gp.gov.ua/ua/stst2011.html?dir_id=112173&libid=100820). [reviewed 2019.08.19] (Ua).
24. Yedinij zvit pro kriminal'ni pravoporushennya za sichen'-gruden' 2015 roku [Unified Report on Criminal Offenses for January–December 2015 / Prosecutor General's Office of Ukraine, 2016]. Available from: [http://www.gp.gov.ua/ua/stst2011.html?dir\\_id=112173&libid=100820](http://www.gp.gov.ua/ua/stst2011.html?dir_id=112173&libid=100820). [reviewed 2019.08.19] (Ua).
25. Yedinij zvit pro kriminal'ni pravoporushennya za sichen'-gruden' 2016 roku [Unified Report on Criminal Offenses for January–December 2016]. Prosecutor General's Office of Ukraine, 2017. Available from: [http://www.gp.gov.ua/ua/stst2011.html?dir\\_id=112173&libid=100820](http://www.gp.gov.ua/ua/stst2011.html?dir_id=112173&libid=100820). [reviewed 2019.08.18] (Ua).
26. Yedinij zvit pro kriminal'ni pravoporushennya za sichen'-gruden' 2017 roku [Unified Report on Criminal Offenses for January–December 2017]. Prosecutor General's Office of Ukraine, 2018. Available from: [http://www.gp.gov.ua/ua/stst2011.html?dir\\_id=112173&libid=100820&c=edit&c=fo](http://www.gp.gov.ua/ua/stst2011.html?dir_id=112173&libid=100820&c=edit&c=fo) [reviewed 2019.08.19] (Ua).
27. International Statistics on Crime and Justice / Edited by S. Harrendorf, M. Heiskanen, S. Malby. Helsinki: European Institute for United Nations Office on Drugs and Crime (UNODC) Crime Prevention and Control 2010. 177 p.
28. V Ukraine ozvuchili plachevnyu statistiku samoubivstv [In Ukraine deplorable statistics of suicides is read]. Available from: <https://bdzhola.com/news/v-ukraine-ozvuchili-plachevnyu-statistiku-samoubijstv> [reviewed 2019.08.19] (Ru).

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