**Anastasia Pedan**,
Student of Bachelor's degree of specialty 183 «Environmental Protection Technologies»,
National University of Civil Protection of Ukraine of SES of Ukraine, Cherkasy, Ukraine
pedan.anastasiia_2023b@nuczu.edu.ua
**Oleksandr Kondratenko**,
DSc(Engineering), Professor, Professor of the Department of Fire and Technogenic Safety of Objects and Technologies, Educational and Scientific Institute of Fire and Technogenic Safety,
National University of Civil Protection of Ukraine of SES of Ukraine, Cherkasy, Ukraine
ORCID ID: 0000-0001-9687-0454
kondratenkoom2016@gmail.com

# ANALYSIS OF ENVIRONMENTAL COMPONENTS POLLUTION FROM HEAT-AND-ELECTRIC POWER PLANT AS THE OBJECT OF THE NATIONAL CRITICAL INFRASTRUCTURE

**Annotation.** The study comprehensively analyzed the legislative aspects of the relevance of its topic, taking into account the industry, departmental, and geographical aspects of training applicants in specialty 183, and provided the results of the analysis of aspects of the negative technogenic impact on the environmental components of the operation of heat-and-electric power plants in one of the eastern regions of Ukraine.

**Key words:** Ecological Safety, Environment Protection Technologies, Pollutiants Emission, Heat-and-Electric Power Plant

## 1. INTRODUCTION

**Relevance of the study topic** is due to the following components. Compliance with:

- the Order of the State Emergency Service of Ukraine № 618 dated 20.09.2013 «On approval of the Regulations on the organization of environmental support of the State Emergency Service of Ukraine» (https://zakon.rada.gov.ua/rada/show/v0618388-13#Text), namely: the results of research allow achieving the goal of environmental support of the SES of Ukraine as a set of organizational and technical measures, carried out, including by higher educational institutions, namely, achieving environmental safety of all types of activities of bodies and units of the SES of Ukraine, protection of personnel and employees, material and technical means under the influence of environmentally unfavorable anthropogenic and natural factors, as well as environmental protection in the places of deployment and location of bodies and units of the SES of Ukraine, in terms of fulfilling the task of scientific support of the main tasks of environmental support of the SES of Ukraine, providing an assessment of environmental damage from the activities of bodies and units of the SES of Ukraine, implementing measures to restore the environment, complying with maximum permissible standards for emissions of harmful substances into the atmosphere, implementing measures to reduce them, reducing the toxicity of exhaust gases from equipment;
- the Decree of the President of Ukraine № 722/2019 dated 30.09.2019 «On the Sustainable Development Goals of Ukraine for the period until 2030» (https://zakon.rada.gov.ua/laws/show/722/2019#Text), namely: the results of research correspond to Goal № 3 «Ensure healthy lives and promote well-being for all at all ages», Goal № 7 «Ensure access to affordable, reliable, sustainable and modern energy for all», Goal № 11 «Ensure inclusive, safe, liveable and environmentally sustainable cities and other human settlements», Goal № 13 «Take urgent action to combat climate change and its impacts»;
- the Resolution of the Cabinet of Ministers of Ukraine № 476 dated 04/30/2024 «On

approval of the list of priority thematic areas of scientific research and scientific and technical developments for the period until December 31 of the year following the termination or abolition of martial law in Ukraine» (https://zakon.rada.gov.ua/laws/show/476-2024-%D0%BF#Text), namely: the results of research correspond to the direction of «Rational Environmental Management», namely «Modeling and Forecasting of the State of the Natural Environment, Technologies for Overcoming Negative Impacts on It», the section «Energy and Energy Efficiency», namely «Systems for Generating and Transporting Electric and Thermal Energy» and «Technologies for Developing and Using New Types of Fuel, Renewable and Alternative Energy Sources and Types of Fuel», the section «National Security and Defense», namely «Ecologically Balanced Energy Security» and «Intelligent Information and Control Technologies for Diagnostics, Operation and Repair of Military and Special Equipment»;

- the Specialty Passport of 21.06.01 «Ecological Safety», approved by Resolution of the Presidium of the Higher Attestation Commission of Ukraine № 33-07/7 dated 04.07.2001 (https://zakon.rada.gov.ua/rada/show/va7_7330-01#Text), namely: the results of research correspond to the directions of «Development of scientific methods for research of complex assessment and forecasting of the impact of technogenic pollution on the environment and humans» and «Improvement of existing, creation of new, environmentally safe technological processes and equipment that ensure the rational use of natural resources, compliance with the standards of harmful impacts on the environment. Environmental audit, environmental management»;

- the Law of Ukraine № 3769-IX dated 04.06.2024 «On Amendments to Some Laws of Ukraine Regarding the Mandatory Use of Liquid Biofuels (Biocomponents) in the Transport Sector» (https://zakon.rada.gov.ua/laws/show/3769-20#Text), namely: in Article 1, part «sustainability criteria - requirements that liquid biofuels (biocomponents) and biogas intended for use in the transport sector meet, in particular indicators of greenhouse gas emission reduction from the use of these types of biofuels and the prohibition of the use of certain land plots to obtain raw materials necessary for the production of such types of biofuels» and Section II «Liquid biofuels (biocomponents), which are taken into account to comply with the regulatory mandatory share in the sales of automotive gasoline in the customs territory of Ukraine, must meet sustainability criteria from June 1, 2025»;

- the Standard of Higher Education in Specialty 183 «Environmental Protection Technologies» of the Third (Educational and Scientific) Level in the Field of Knowledge 18 «Production and Technologies», approved by Order of the Ministry of Education and Science of Ukraine № 1427 dated 23.12.2021 (https://mon.gov.ua/static-objects/mon/sites/1/vishcha-osvita/zatverdzeni%20standarty/2021/12/24/183-Tekhn.zakh.navk.seredovyshcha-dokt.filos.pdf.), namely: the Integral Competence «The ability to produce new ideas, solve complex problems in the field of research and innovation in the field of environmental protection technologies, which provides for a deep rethinking of existing and creation of new holistic knowledge and/or professional practice, to carry out own scientific research, the results of which have scientific novelty, theoretical and practical significance; to apply modern methodologies of scientific and scientific-pedagogical activity» and Special Competence «SC03. Ability to identify weaknesses and shortcomings in environmental protection systems, set appropriate scientific tasks and solve them using engineering, modeling, statistical, expert and other scientific research methods» and also Program Education Result «PER07. Develop, implement and evaluate the effectiveness of innovative environmental technologies and equipment in production to reduce the man-made burden on the environment and improve the ecological state of industrial regions»;

- the Topics of Scientific Research and Scientific and Technical (Experimental) Developments for 2025-2029, approved by Order of the Ministry of Internal Affairs of Ukraine № 326 dated 21.05.2024 (https://mvs.gov.ua/normativno-pravovi-akti/nakaz-mvs-

vid-21052024-326-pro-zatverdzennia-tematiki-naukovix-doslidzen-i-naukovo-texnicnix-eksperimentalnix-rozrobok-na-2025-2029-roki), namely: in the Point 25 in part «Modeling and forecasting the state of the natural environment, technologies for overcoming negative impacts on it» and the Point 27 «Development of aviation, water and other types of transport of bodies and units of the Ministry of Internal Affairs system under the legal regime of martial law and the post-war period»;

- the Civil Protection Code of Ukraine in its current version dated 12.09.2025, Article 108 «Civil Defense Service Oath» (https://zakon.rada. gov.ua/laws/show/5403-17#Text), namely: «I swear to courageously and resolutely protect the lives and health of citizens, the property of Ukraine, and its natural environment from emergencies».

**Purpose of the study.** To analyze aspects of pollution of environmental components from a heat-and-electric power plant as the object of the national critical infrastructure.

**Object of the study.** Negative technogenic impact on environmental components from a heat-and-electric power plant as the object of the national critical infrastructure.

**Subject of the study.** Qualitative and quantitative indicators characterizing the object of the study.

## 2. RESULTS OF THE STUDY

Kharkiv region, as a region with developed industry and heat and power industry, faces significant environmental challenges associated with pollution of all components of the environment. The largest sources of pollution are enterprises of the heat and power industry, oil and gas and mining sectors. It has been established that H&E PP emit sulfur oxides, nitrogen oxides, carbon monoxide, heavy metals, as well as products of incomplete combustion, including soot and benzopyrene, into the air, which have a negative impact on human health, cause respiratory diseases, destroy infrastructure, cause acid rain and reduce the transparency of the atmosphere [1,2].

Such energy-generating facilities are included in the list of critical infrastructure facilities, the aspects of ensuring their protection are regulated [3-7]:

- Law of Ukraine № 1882-IX in the current version dated 21.09.2024 «On Critical Infrastructure»;
- Resolution of the Cabinet of Ministers of Ukraine № 1109 of September 09.09.2020 «Some issues of critical infrastructure facilities» (as amended by Resolution of the Cabinet of Ministers of Ukraine № 48 of 16.01.2024);
- Law of Ukraine № 389-VIII in the current version dated 14.05.2025 «On the legal regime of martial law»;
- Law of Ukraine № 1550-III in the current version dated 18.05.2024 «On the legal regime of the state of emergency»;
- Law of Ukraine № 1932-XII in the current version dated 09.07.2025 «On the Defense of Ukraine».

In addition, the introduction of modern technologies, such as reheating of steam, regenerative heating, the use of scrubbers to capture sulfur oxides and reduce the formation of nitrogen oxides through optimization of the combustion process, allows to significantly reduce the negative impact on the environment. Particular attention should be paid to the situation that has developed as a result of a full-scale war. The destruction of industrial facilities, a decrease in production volumes and the relocation of enterprises led to a temporary decrease in the level of industrial pollution. However, explosions, fires and shelling caused new environmental threats, including air pollution by combustion products and the destruction of infrastructure. Under martial law, assessing the real level of pollution is complicated by the limited ability to monitor and provide official reporting.

## CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

This study analyzed qualitative and quantitative indicators characterizing the negative technogenic impact on environmental components from a heat-&-electric power plant as the object of the national critical infrastructure.

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## REFERENCES

1. Research of Properties and Rational Composition of Ecosafe Building Materials with Ash-and-Slag Waste from Masute Fuel And Coal Combustion / O. Kondratenko, V. Koloskov, H. Koloskova, V. Babakin // Key Engineering Materials. – 2023. – Vol. 935, pp. 85–97. – DOI: 10.4028/p-RwzP9p.

2. Research of Technical and Economic Properties of Material of Porous Fuel Briquettes from the Solid Combustible Waste Impregnated with Liquid Combustible Waste / O. Kondratenko, V. Koloskov, S. Kovalenko, Y. Derkach // Materials Science Forum, 2021, № 1038, pp. 303–314. – DOI: https://doi.org/10.4028/www.scientific.net/msf.1038.303.

3. Law of Ukraine № 1882-IX in the current version dated 21.09.2024 «On Critical Infrastructure». URL: https://zakon.rada.gov.ua/laws/show/1882-20#Text

4. Resolution of the Cabinet of Ministers of Ukraine № 1109 of September 09.09.2020 «Some issues of critical infrastructure facilities» (as amended by Resolution of the Cabinet of Ministers of Ukraine № 48 of 16.01.2024). URL: https://zakon.rada.gov.ua/laws/show/1109-2020-%D0%BF.

5. Law of Ukraine № 389-VIII in the current version dated 14.05.2025 «On the legal regime of martial law». URL: https://zakon.rada.gov.ua/laws/show/389-19#Text.

6. Law of Ukraine № 1550-III in the current version dated 18.05.2024 «On the legal regime of the state of emergency». URL: https://zakon.rada.gov.ua/laws/show/1550-14.

7. Law of Ukraine № 1932-XII in the current version dated 09.07.2025 «On the Defense of Ukraine». URL: https://zakon.rada.gov.ua/laws/show/1932-12#Text.