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THE IMPROVEMENT OF THE AUTOMATED MONITORING SYSTEM FOR ATMOSPHERIC AIR QUALITY IN THE CITY OF ZAPORIZHZHIA

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The article substantiates methodological approaches to determining the location of observation posts (in accordance with the requirements of EU Directive 2008/50/EC and CMU Resolution No. 827 of 14 August 2019) based on the results of an inhalation risk assessment for public health. This made it possible to identify the locations of the highest levels of pollution, taking into account the links to the areas of the highest population density. Calculations of non-carcinogenic risk (HQ) levels in Zaporizhzhia were made. Zaporizhzhia when assessing chronic inhalation impacts for individual pollutants and in total from 8 priority chemicals on the health of the exposed population showed that the hazard coefficients exceed safe levels ($HQ \geq 1$) and the risk to the health of the exposed population is unacceptable, in particular, from emissions of dust, sulphur dioxide, nitrogen dioxide, phenol, formaldehyde, and hydrogen sulphide. Thus, the validity of the location of the proposed automated stations, based on the results of the health risk assessment of the exposed population, showed the feasibility of their location in the above-mentioned locations identified in the State Monitoring Programme for the Protection of Atmospheric Air in the Zaporizhzhia Agglomeration for 2022–2026. Based on the results of the public health risk assessment, it is recommended to install additional indicative observation points in Zaporizhzhia at the following intersections: Yatsenko Street – Peremohy Street, Profspilok Square – Nezalezhnoyi Ukrainy Street, Istorychna Street – Fundamentalna Street, Motorobudivnykiv Avenue – Heroiv 55 Brigady Street.

In accordance with the Directive, Resolution and Order of the Ministry of Internal Affairs of Ukraine dated 21.04.2021 No. 300, it is proposed to include in the automated surveillance network in the city of Zaporizhzhia, in addition to the pollutants defined by the Pollutant Monitoring Programme (sulphur dioxide, nitrogen dioxide, nitrogen oxide, carbon monoxide, particulate matter (PM10 and PM2.5), benz(a)pyrene, ozone, formaldehyde and phenol), mandatory monitoring of hydrogen sulphide emissions at the designed fixed measurement points. In addition, it is necessary to provide for monitoring of emissions of polycyclic aromatic hydrocarbons and formaldehyde at indicative observation points located in areas of intensive traffic. *Key words:* atmospheric air, atmospheric air quality monitoring, automated observation posts, indicative observation points, average concentrations, pollutants, public health risk assessment.

Удосконалення автоматизованої системи моніторингу за якістю атмосферного повітря у місті Запоріжжі. Белоконов К.В., Мальований М.С., Проскурнін О.А.

Обґрунтовано методичні підходи до визначення місць розташування постів спостережень (відповідно до вимог Директиви ЄС 2008/50/ЄС та Постанови КМУ від 14 серпня 2019 р. № 827) на підставі результатів оцінки інгалаційного ризику для здоров'я населення. Це дозволило визначити місця найвищих рівнів забруднення, враховуючи прив'язки до місць найвищої щільності проживання населення. Проведені розрахунки рівнів неканцерогенного ризику (HQ) у м. Запоріжжі при оцінці хронічних інгалаційних впливів для окремих забруднюючих речовин та сумарно від 8 пріоритетних хімічних речовин на здоров'я експонованого населення показали, що коефіцієнти небезпеки перевищують безпечні рівні ($HQ \geq 1$) та ризик для здоров'я експонованого населення є недопустимим зокрема, від викидів пилу, ангідриду сірчастого, діоксиду азоту, фенолу, формальдегіду, сірководню. Отже, обґрунтованість щодо місцерозташування запропонованих автоматизованих пунктів, виходячи з отриманих результатів оцінки ризику для здоров'я експонованого населення, показала доцільність їх розташування у вищевказаних місцях, визначених у Програмі державного моніторингу у галузі охорони атмосферного повітря агломерації Запоріжжя на 2022-2026 роки. Рекомендовано на підставі отриманих результатів оцінки ризику для здоров'я населення встановити у м. Запоріжжі додаткові індикативні пункти спостереження на перехрестях: вул. Яценка – вул. Перемоги, майдан Профспілок – вул. Незалежної України, вул. Історична – вул. Фундаментальна, просп. Моторобудівників – вул. Героїв 55-ї бригади.

Згідно з Директивою, Постановою та Наказом МВС України від 21.04.2021 р. за № 300 пропонується включити до автоматизованої мережі спостережень на території м. Запоріжжя, окрім визначених Програмою моніторингу забруднюючих речовин (сірки діоксид, азоту діоксид, азоту оксид, вуглецю оксид, тверді частки пилу (PM10 та PM2.5), бенз(а)пірен, озон, формальдегід та фенол) обов'язковий моніторинг за викидами сірководню на запроєктованих пунктах з фіксованими вимірюваннями.

Крім того, необхідно передбачити на індикативних пунктах спостережень, що будуть розташовані на ділянках інтенсивного руху автотранспорту, моніторинг за викидами поліциклічних ароматичних вуглеводнів та формальдегіду. *Ключові слова:* атмосферне повітря, моніторинг якості атмосферного повітря, автоматизовані пости спостережень, індикативні пункти спостережень, усереднені концентрації, забруднюючі речовини, оцінка ризику для здоров'я населення.

General statement of the problem and its connection with important practical tasks. Considering the current trends in Ukraine's external policy regarding the implementation of the EU regulations and recommendations (EU Directives 2008/50/EC and 2004/107/EC), the problem of organising, developing and improving the air quality monitoring system is extremely relevant [1, 2]. Despite the adoption of the Resolution of the Cabinet of Ministers of Ukraine dated 14.08.2019 No. 827 and the Order of the Ministry of Internal Affairs of Ukraine dated 21.04.2021 No. 300, the main direction of further development in the field of atmospheric air monitoring should be the consistent harmonisation of the activities of the relevant entities (elements) of air monitoring networks [3, 4]. At the same time, in order to ensure the implementation of the basic principles of the state environmental monitoring system, it is necessary to involve the existing potential of all monitoring entities, primarily on the basis of consistency and progressiveness of the regulatory, legal, methodological and technical support of observation networks.

The above implies mandatory fixed (reference) measurements for areas and agglomerations where long-term objectives or assessment thresholds for pollutants exceed the norms (EU Directive 2008/50/EC). In addition, the information obtained from fixed measurements can be supplemented by modelling techniques and/or indicative measurements to provide valid data on the spatial distribution of pollutants and air quality. The use of additional assessment methods will also provide an opportunity to reduce the required minimum number of fixed sampling points.

According to the CMU Resolution No. 827 of 14.08.2019 and EU Directive 2008/50/EC, fixed/standard measurements are measurements carried out at fixed air pollution observation points on a regular basis or by random sampling to determine the levels of pollutants using the assessment methods specified in paragraph 4 of Annex 3 of the Resolution or in Section A and Section C of Annex VI of the Directive. Indicative measurements are those that meet data quality requirements that are less stringent than those for fixed measurements.

It should also be noted that sampling points must be located in compliance with certain requirements set out in EU Directive 2008/50/EC and Order of the Ministry of Internal Affairs of Ukraine of 21.04.2021 No. 300 [4]. For example, points intended to protect public health should be located in such a way as to provide data on: areas within zones and agglomerations where the highest concentrations occur, which are likely to directly or indirectly affect the population for a period that is significant compared to the averaging period of the limit value.

Relevance of the research. Zaporizhzhia is the fourth largest industrial centre in Ukraine with developed machine building, ferrous and non-ferrous metallurgy, chemical and construction industries. The territory of the city belongs to the regions with an increased natural potential for air pollution and unfavourable conditions for dispersing emissions into the atmosphere [5, 6].

Given Zaporizhzhia's strong industrial potential, climatic features and existing buildings, one of the main environmental problems is air pollution from industrial and motor vehicle emissions.

At present, the state monitoring of air quality in Zaporizhzhia is carried out by the following monitoring entities: State Institution Zaporizhzhia Regional Centre for Disease Control and Prevention of the Ministry of Health of Ukraine and Zaporizhzhia Regional Centre for Hydrometeorology [7]. Public monitoring of atmospheric air quality, implemented on the platforms of active NGOs, has also gained wide popularity in the city, which certainly contributes to the development of the state air monitoring system, but unfortunately, the stations have sensor devices that do not meet the requirements of methods for assessing pollutant levels during fixed measurements in accordance with the Resolution of the Cabinet of Ministers of Ukraine of 14 August 2019 No. 827 [3].

In addition, in accordance with the requirements of the Resolution of the Cabinet of Ministers of Ukraine of 14.08.2019 No. 827 and the Order of the Ministry of Internal Affairs of Ukraine of 21.04.2021 No. 300, the State Monitoring Programme in the field of atmospheric air protection of the Zaporizhzhia agglomeration for 2022-2026 was approved, which proposes, in addition to the existing stations of the Zaporizhzhia Regional Centre for Hydrometeorology and the State Institution «Zaporizhzhia Regional Centre for Disease Control and Prevention» of the Ministry of Health of Ukraine, the installation of four new stations for monitoring air pollution (automated fixed measurements), namely [8]: the Kommunarskyi district, 32 Chumachenko St. (near the district administration of the Zaporizhzhia City Council for the Kommunarskyi district); the Shevchenkivskyi district, 91 Ivanov St. (territory of the pumping station of the 3rd lift «Shevchenko» of the Municipal Enterprise «Vodokanal»); the Zavodskyi district, 91 Myroslava Symchyha St. (Lyubov Kovalska St.). Myroslava Symchyha (Liza Chaikina) Street, 56 (near the district administration of the Zaporizhzhia City Council for Zavodskyi District); the Dniprovskyi District, 2 Shchaslyva Street (territory of the municipal institution «Zaporizhzhia Specialised Boarding School of II-III Degrees «Kozatskyi Lyceum»») of the Zaporizhzhia Regional Council). It is proposed to mon-

itor the following pollutants at the specified (proposed) observation points: sulphur dioxide, nitrogen dioxide, nitrogen oxide, carbon monoxide, particulate matter (PM10 and PM2.5), benzo(a)pyrene, ozone, formaldehyde and phenol.

It is also planned to carry out indicative measurements in an automated mode at the main five traffic intersections, namely: Sobornyi ave. to Metallurgiv ave.; Sobornyi ave. to Ukrainska str.; Sobornyi ave. to Vyacheslav Zaitsev str. (Lermontov str.); Vintera Blvd. – Hrebelna St.; Motorobudivnykiv ave – Ivanova str.

Analysis of recent research and publications. It is well known that the main responsibility for organising and conducting air monitoring in zones and agglomerations (taking into account the main provisions of the Cabinet of Ministers of Ukraine Resolution of 14 August 2019 No. 827), is entrusted to the Ukrainian Hydrometeorological Centre of the SES of Ukraine and partially to: laboratory centres of the Ministry of Health of Ukraine (in rural, recreational, industrial (on the border of the sanitary protection zone) areas and upon complaints from the public) and the State Environmental Inspectorate, which carries out selective control at emission sources of industrial facilities [9]. In recent years, the development of the environmental monitoring system (in particular, of atmospheric air) in Ukraine has been gaining momentum. This involves the creation of observation networks in large industrial centres using automated observation posts to supplement the existing stationary posts. Such projects have already been implemented by regional state administrations in Dnipro and Kyiv regions and are being developed in other regions of Ukraine [10]. Public monitoring, implemented mainly on the platforms of active NGOs, is also gaining popularity, which undoubtedly contributes to the development of the state air monitoring system in Ukraine. Today, there are more than 700 public monitoring stations, mostly equipped with sensor devices, which, unfortunately, do not meet the requirements of methods for assessing pollutant levels during fixed measurements, according to the CMU Resolution of 14 August 2019 No. 827 [11]. Identification of previously unsolved parts of the overall problem. In the existing Soviet-era observation systems, the collection and processing of information is based on laboratory methods of analysing atmospheric air samples and is used not so much for operational management decisions as for statistical analysis [12]. The use of indicative measurements or modelling is not sufficiently covered by the regulatory framework. As a result, the existing monitoring system is imperfect, limiting data on the state of air pollution throughout the territory and the long-term dynamics of indicators. The locations of the monitoring stations, which were determined on the principle of territorial commonality in accordance with the requirements of the RD 52.04.186-89, currently do not meet the contemporary realities regarding the validity of their installation in the context of rapid urbanisation and uncontrolled urban planning decisions in almost all

regions of Ukraine. The issue of determining the content of particulate matter (with a diameter of less than 10 microns – PM10 and less than 2.5 microns – PM2.5) and ozone remains unresolved, as their state monitoring has not yet been introduced at the national level [9].

In accordance with EU Directive 2008/50/EC, CMU Resolution No. 827 of 14.08.2019 and Order of the Ministry of Internal Affairs of Ukraine No. 300 of 21.04.2021, the justification for the installation of automated monitoring stations should be based on forecasting the levels of air pollution in the study areas, which allows to assess the inhalation risk to public health from pollution sources (industrial enterprises, vehicles) throughout the city. This approach is appropriate in the context of the realities of Ukraine ('chaotic' location of posts) in order to save public funds, which will help harmonise the existing observation network and increase the validity of management decisions to improve air quality [9].

The purpose of the article. The main purpose of the study is to assess the respiratory risk to public health from sources of pollution (industrial enterprises, motor vehicles) throughout the city of Zaporizhzhia, especially in the streets with the highest population density, and to provide proposals for improving the automated system of observation (monitoring) of atmospheric air quality in the city of Zaporizhzhia.

Novelty. Methodological approaches to determining the locations of observation posts were substantiated based on data from the assessment of inhalation risk to public health, which made it possible to determine the areas of the highest levels of pollution, taking into account the links to the places of the highest population density.

Presentation of the main research material. Analysing the above, in order to provide proposals for improving the automated system of observation (monitoring) of atmospheric air quality in Zaporizhzhia, as envisaged by the State Monitoring Programme in the field of atmospheric air protection of the Zaporizhzhia agglomeration for 2022-2026, additional studies were conducted to assess the inhalation risk to public health from industrial enterprises and vehicles in residential areas, especially on streets with the highest population density.

The calculations were based on the general procedure of the Human Health Risk Assessment methodology developed and recommended by the US Environmental Protection Agency, which involves four interrelated stages: hazard identification, dose-response assessment, exposure assessment and risk characterisation, and the Guidelines «Assessment of Carcinogenic and Non-Carcinogenic Risk to Public Health from Chemical Air Pollution» [13, 14].

The following gradation of risk levels for non-carcinogenic effects was used in the study: extremely high (HQ/HI > 10, mass complaints, chronic diseases); high (HQ/HI = 5-10, there is a risk of adverse effects in the

majority of the population); medium ($HQ/HI = 1-5$, there is a risk of adverse effects in particularly sensitive subgroups of the population (unacceptable for the general population, acceptable for production conditions)); low ($HQ/HI = 0.1-1.0$, the risk of adverse effects is negligible); minimal ($HQ/HI \leq 0.1$, no risk of adverse effects) [15].

In order to determine the list of priority potentially harmful chemical compounds from industrial enterprises, the most complete list of all chemicals that can affect humans in the study area was first compiled. The following criteria for selecting priority pollutants were taken into account: assessment of the toxicity of pollutants that can affect public health; analysis of data on hazard parameters and dose-response relationships (reference concentrations; carcinogenic potential factors; current national standards: maximum permissible concentrations for maximum one-time and average daily concentrations (MPCm.s, MPCa.d.), estimated safe exposure levels (ESLs)); assessment of the direction of impact on organs and systems of the human body.

Considering the criteria for selecting priority pollutants emitted into the air by stationary sources of industrial enterprises, a list of priority pollutants for 2023 was formed, which is necessary for further research on risk assessment for public health. The list includes 8 chemical compounds, including hydrogen sulphide, phenol, formaldehyde, and carbon disulfide, which are classified as hazard class 2 (highly hazardous substances); nitrogen dioxide, sulphur dioxide, and suspended solids, which are classified as hazard class 3; and carbon monoxide, which is classified as hazard class 4 [16].

Regarding the direction of action and the impact of priority substances on public health (organs and systems), it can be noted that non-carcinogenic substances cause a wide range of human health disorders caused by various forms of toxic effects that are recorded at the molecular, cellular, tissue, and population levels. The constant pressure of polluted air on public health is reflected in the morbidity and mortality rates. First and foremost, it is an increase in chronic respiratory diseases

caused by chemicals such as nitrogen dioxide, sulphur dioxide, hydrogen sulphide, phenol, and substances in the form of suspended particulate matter; cardiovascular diseases caused by carbon monoxide, phenol, sulphur dioxide, and substances in the form of suspended particulate matter; and diseases of the central nervous system caused by carbon monoxide and phenol.

The averaged levels of annual concentrations of pollutants for 2023, which form exposure loads on the health of the population of residential areas of Zaporizhzhia, were provided by the State Institution «Zaporizhzhia Regional Centre for Disease Control and Prevention» of the Ministry of Health of Ukraine. Based on the calculated exposure levels, the risk characteristics for residential areas from air pollution caused by emissions from industrial enterprises and motor vehicles were established, including non-carcinogenic risks (hazard coefficients for individual substances (HQ) and total hazard indices (HI).

The results of calculations of hazard coefficients for assessing inhalation impacts of pollutant emissions from industrial enterprises and vehicles under chronic exposure in 2023 indicate that safe levels ($HQ > 1$) are exceeded in some places of measurement of receptor points and the risk to the health of the exposed population is unacceptable almost throughout the city of Zaporizhzhia, as shown in Table 1.

In the Shevchenkivskiy district, the average values of the hazard coefficients for chronic inhalation exposure in 2023 exceed the permissible level for all substances except carbon monoxide and are at the level: for formaldehyde and hydrogen sulfide – at a high level; for dust, sulfur dioxide, nitrogen dioxide, phenol – at an average level, carbon monoxide – at a low level.

The most polluted streets in the Shevchenkivskiy district are Magistralna-Porady, Peredatna, Porady, Porady-Vyrobnycha, Vyrobnycha, Koryshchenko, Motorobudivnyky, Kharchova, Porady-Kharchova, Ivanova.

In the Voznesenivskiy district, the average values of the hazard coefficients for chronic inhalation exposure in 2023 exceed the permissible level for all substances,

Table 1

Comparison of calculations of hazard coefficients for chronic exposure in the studied areas of Zaporizhzhia city for 2023

The name of the substance	Shevchenkivskiy district	Voznesenivskiy district	Zavodskiy district	Dniprovskiy district
Suspended substances	3,950	4,060	3,790	4,8
Sulfur dioxide	1,225	1,613	1,838	2
Nitrogen dioxide	2,100	1,863	1,490	1,375
Phenol	2,283	1,517	1,317	1,27
Formaldehyde	8,333	7,667	9,333	6,433
Carbon monoxide	0,870	0,995	0,850	0,87
Hydrogen sulfide	-	9,500	7,500	4
Carbon sulfide	-	0,066	0,073	0,076

except carbon monoxide and carbon disulfide, and are at the level: for formaldehyde – at a high level; for dust, sulfur dioxide, nitrogen dioxide, phenol and hydrogen sulfide – at an average level, carbon monoxide – at a low level, carbon disulfide – at a minimum level.

The most polluted streets in the Voznesenivskiy district are Nakhimova, Matrosova, Yatsenka, Peremohy, Antenna-Tambovskaya, Sedova, Viacheslav Zaitseva (Lermontova) Street, Nezalezhnoi Ukrainy Street.

In the Zavodskiy district, the average values of the hazard coefficients for chronic inhalation exposure in 2023 exceed the permissible level ($HQ > 1$) for all substances, except carbon disulfide and carbon monoxide, and are at the level: for formaldehyde and hydrogen sulfide – at a high level; dust, sulfur dioxide, nitrogen dioxide, phenol – at an average level; carbon monoxide – at a low level, carbon disulfide – at a minimum level.

The most polluted streets of the Zavodskiy district are Finalna, Fundamentalna, Morflotska, Electriczna, Istorichna.

In the Dniprovskiy district, the average values of the hazard coefficients for chronic inhalation exposure in 2023 exceed the permissible level for all substances, except carbon disulfide and carbon monoxide, and are at the level: for formaldehyde and hydrogen sulfide – at a high level; for dust, sulfur dioxide, nitrogen dioxide, phenol – at an average level, for carbon monoxide – at a low level, for carbon disulfide – at a minimum level.

The most polluted streets in the Dniprovskiy district are Metallurgiv Ave., Sobornyi Ave., Winter Boulevard, Hrebina, Yeniseyska, Verkhnya.

The results of calculations of total hazard indices when assessing chronic inhalation effects of pollutant emissions from industrial enterprises and motor vehicles indicate the presence of excesses of safe levels ($HI > 1$) and are at an extremely high level in 2023: in the Zavodskiy district: $HI = 26.190$; in the Voznesenivskiy district: $HI = 27.279$; in the Shevchenkivskiy district: $HI = 27.362$, Dniprovskiy district: $HI = 20.824$.

Calculations of non-carcinogenic risk levels (HI) in the city were carried out. Zaporizhzhia, when assessing chronic inhalation effects for individual pollutants and a total of 8 priority chemicals on the health of the exposed population, showed that the hazard coefficients exceed safe levels ($HQ \geq 1$) and the risk to the health of the exposed population is unacceptable, in particular, from emissions of dust, sulfur dioxide, nitrogen dioxide, phenol, formaldehyde, hydrogen sulfide.

Therefore, the justification for the location of the proposed automated points, based on the results of the risk assessment for the health of the exposed population, showed the feasibility of their location in the above-mentioned places, specified in the Monitoring Program.

In addition, it is recommended to replace the designed indicative point at the intersection of Sobornyi Ave. – Metallurgiv Ave. with a reference one with fixed measurements to validate the obtained data

on pollutant concentrations from observation post No. 9 (at 2 Rekordna St., located at a distance of less than 500 m). Also, according to previous scientific studies on the impact of motor vehicles on atmospheric air pollution in the city, it is recommended to install additional indicative points at the intersections: Yatsenka St. – Peremohy St., Maidan Profspilok – Nezalezhnoi Ukrainy St., Istorichna St. – Fundamentalna St., Motorobudivnyk Ave. – Heroiv 55-i brigadi St. According to EU Directive 2008/50/EC; 2004/107/EC, Resolution of the Cabinet of Ministers of Ukraine dated 14.08.2019 No. 827 and the Order of the Ministry of Internal Affairs of Ukraine dated April 21, 2021 No. 300, as well as taking into account the results of instrumental and analytical studies, we consider it necessary to include in the automated network of observations on the territory of the city of Zaporizhzhia, in addition to the pollutants specified by the Monitoring Program (sulfur dioxide, nitrogen dioxide, nitrogen oxide, carbon oxide, particulate matter (PM10 and PM2.5), benz(a)pyrene, ozone, formaldehyde and phenol), mandatory monitoring of hydrogen sulfide emissions at designed points with fixed measurements. In addition, to provide for monitoring of emissions of polycyclic aromatic hydrocarbons and formaldehyde at indicative observation points that will be located in areas of intensive vehicle traffic in order to assess and take into account the impact on the health of the city's population of possible risks caused by their emissions.

Conclusions and suggestions. As a result of the conducted research, methodological approaches to determining the locations of observation posts (in accordance with the requirements of EU Directive 2008/50/EC and Resolution of the Cabinet of Ministers of Ukraine No. 827 of August 14, 2019) were substantiated based on data from the assessment of inhalation risk to public health. This made it possible to determine the areas of the highest levels of pollution, taking into account the links to the places of the highest population density.

Calculations of non-carcinogenic risk levels (NQ) in the city were carried out. Zaporizhzhia, when assessing chronic inhalation effects for individual pollutants and a total of 8 priority chemicals on the health of the exposed population, showed that the hazard ratios exceed safe levels ($HQ \geq 1$) and the risk to the health of the exposed population is unacceptable, in particular, from dust emissions ($HQ = 3.95 \div 4.8$), sulfur dioxide ($HQ = 1.225 \div 2$), nitrogen dioxide ($HQ = 1.375 \div 2.1$), phenol ($HQ = 1.27 \div 2.283$), formaldehyde ($HQ = 6.433 \div 9.333$), hydrogen sulfide ($HQ = 4 \div 9.5$).

The results of the calculations of the total hazard indices when assessing the chronic inhalation effects of pollutant emissions from industrial enterprises and motor vehicles indicate the presence of excesses of safe levels ($HI > 1$) and are at an extremely high level in 2023: in the Zavodskiy district: $HI = 26.190$; in the Voznesenivskiy district: $HI = 27.279$; in the Shevchenkivskiy district: $HI = 27.362$, Dniprovskiy district: $HI = 20.824$.

According to the calculations, it is recommended to provide for the installation of additional indicative points at the intersections: Yatsenka st. – Peremohy st., Maidan Profspilok – Nezalezhnoi Ukrainy st., Istorichna st. – Fundamentalna st., Motorobudivnyk ave. – Geroiv 55-i brigadi st.

According to the EU Directive 2008/50/EU; 2004/107/EU, Resolution of the Cabinet of Ministers of Ukraine dated 14.08.2019 No. 827 and Order of the Ministry of Internal Affairs of Ukraine dated 21.04.2021 No. 300, as well as taking into account the results of

instrumental and analytical studies, we consider it necessary to include mandatory monitoring of hydrogen sulfide emissions at designed points with fixed measurements in the automated observation network on the territory of the city of Zaporizhzhia. In addition, it is recommended to provide for monitoring of emissions of polycyclic aromatic hydrocarbons and formaldehyde at indicative observation points located in areas of intensive vehicle traffic in order to assess and take into account the impact on the health of the city's population of possible risks caused by their emissions.

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