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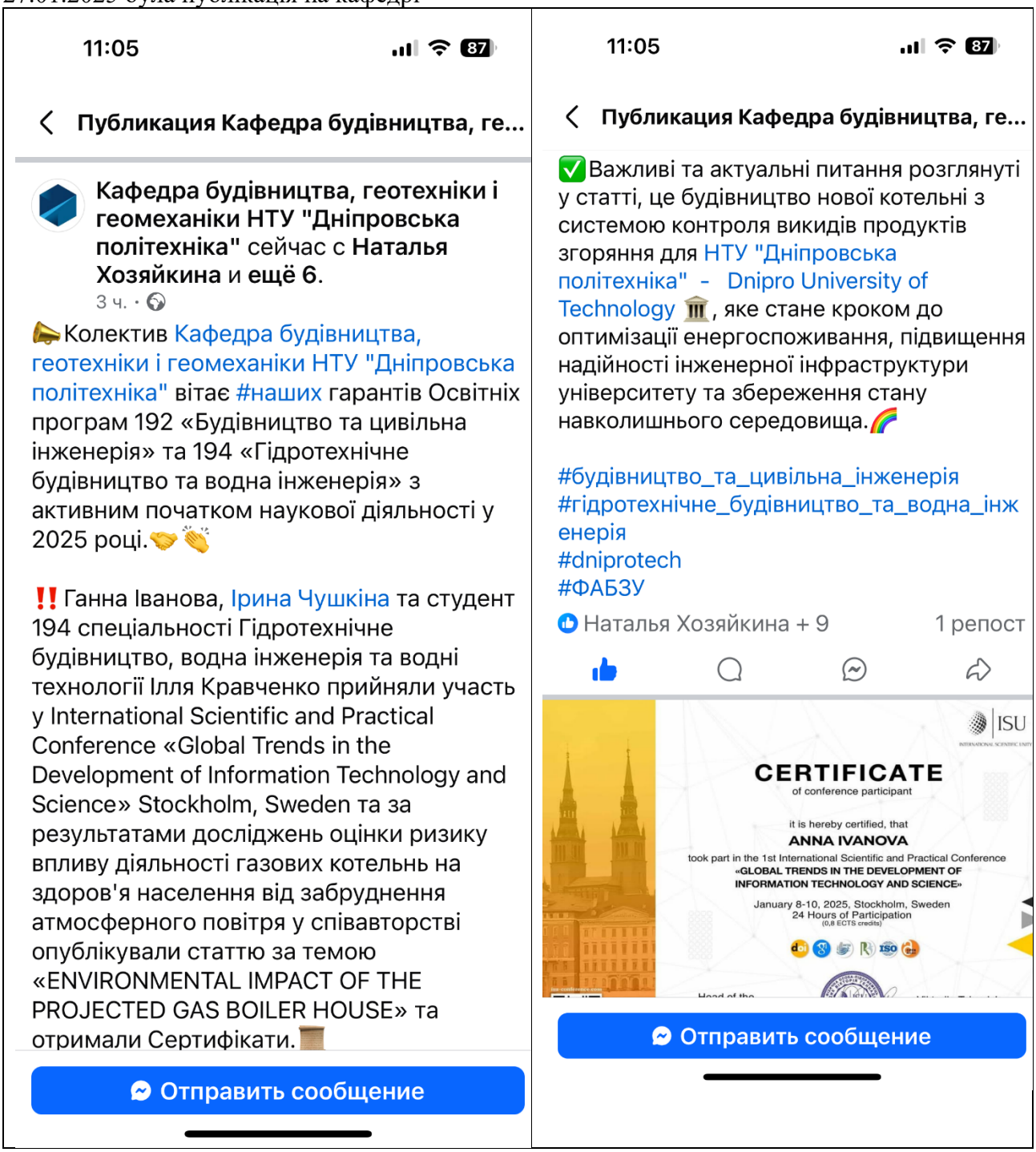

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SECTION: ARCHITECTURE AND CONSTRUCTION

ENVIRONMENTAL IMPACT OF THE PROJECTED GAS BOILER HOUSE

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In modern conditions, ensuring reliable heat supply is a task for the effective functioning of buildings and structures. Dnipro University of Technology is one of the leading educational institutions of Ukraine, located in the center of the city of Dnipro, which requires a high-quality and stable heating system to maintain proper working and learning conditions.

Currently, the heat supply of the university buildings is created through a heating main from the existing boiler house of the National Metallurgical Academy. However, due to physical and moral wear and tear of the equipment, as well as insufficient quality of the coolant, there was a need to create a new, modern boiler house to provide heat supply to the educational buildings and office premises of Dnipro University of Technology.

The designed gas boiler house is a separate building made of sandwich panels. It is designed to provide heat to the heating and ventilation system of the university.

The project provides for a level of process automation that ensures economical, safe operation of the boiler house without constant presence of service personnel. Automatic regulation, control of operating parameters and the presence of a safety system contribute to the effective operation of the equipment and compliance with environmental standards.

The construction of a new boiler house will be a step towards optimizing the energy consumption of Dnipro University of Technology and increasing the reliability of its engineering infrastructure.

The main element of the environment that the future gas boiler house at Dnipro University of Technology may affect is emissions that pollute the environment. The sources of this impact are boilers that emit nitrogen oxides, carbon and gases that contribute to the greenhouse effect into the atmosphere.

The planned activity will not have a significant impact on the climate and microclimate, since the release of heat, greenhouse gases and moisture will be insignificant. It is expected that the number of emissions of substances that pollute the atmosphere from the sources of the heating boiler house will be approximately

13,5 tons per year, while its operation will not lead to significant changes in the surrounding environment.

To reduce emissions into the atmosphere, developed countries are constantly installing systems for controlling emissions of combustion products. Control over the content of exhaust gases is being strengthened, and a fine is imposed for exceeding the norms. The location of the source of emission of pollutants on the map-scheme is shown in Fig. 1

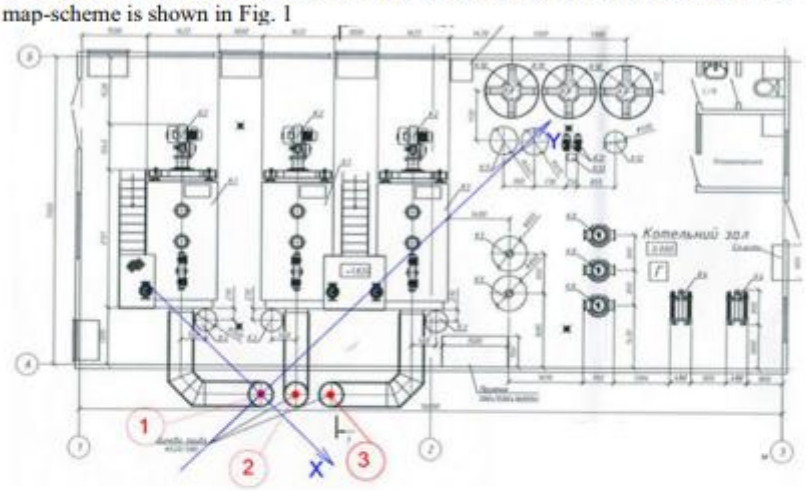

Figure 1. Location of the source of pollutant emission:
- Sources of pollutant emissions into the atmosphere

The list and characteristics of sources of emissions of pollutants emitted into the atmosphere are given in Table 1.

Table 1. List and number of pollutants emitted into the atmosphere

Name of pollutants	Maximum permissible concentrations), average per day	Hazard class	Emissions of pollutants	
			g/s	t/year
1	2	3	4	5
Pollutants				
Nitrogen oxides converted to NO_2	0,2	3	0,264	3,018
Carbon monoxide	5,0	4	0,267	10,473
Mercury	0,0003	3	0,00000072	0,0000042
Total			0,53100072	13,4910042
Substances that have a greenhouse effect				
Carbon dioxide				2340,963
Methane				0,042
Nitrous oxide				0,0042
Total				2341,0092

Thus, 13,491 t/year of pollutants and 2,341 t/year of greenhouse gases will be emitted into the atmosphere from the boiler house.

The maximum emissions of pollutants from the boiler house will be observed in winter on days with the lowest temperature at maximum boiler load: a short time, therefore the actual concentrations of pollutants that are products of fuel combustion are expected to be lower than the calculated ones. Nitrogen dioxide in emissions from the boilers is 80%, therefore the actual concentrations of nitrogen dioxide are expected to be lower than the calculated ones.

It should also be noted that all emission sources are not those for which concentrations of nitrogen oxides and carbon are standardized, since gross emissions of nitrogen oxides and carbon are significantly lower than the regulatory values of 5000 g/hour and only g/s are standardized for them. The calculation of gross emissions was performed according to the method [1].

UNICAL 2200 boilers are equipped with FBR burners with a reduced output of nitrogen oxides and carbon oxides, and an automatic gas/air ratio system, which allows for the practical elimination of fuel underburning. Maximum natural gas consumption is 256,5 m^3/hour. Annual natural gas consumption is 414,443 thousand m^3/year. Calculations were performed according to the method [1]. Mass fuel consumption per year is 299,642 kg. Calculations were performed for one boiler (Table 2).

Table 2. Gross emissions

Annual emissions					
NO_2, t	CO, t	CO_2, t	Hg, t	CH_4, t	N_2O, t
1,006	3,491	780,321	0,0000014	0,014	0,0014

Currently, in order to reduce emissions of pollutants into the atmosphere, many "ecological" burners with insignificant emissions of NO_2 and CO have been developed. Therefore, annual CO emissions are determined by the calculation method and may differ significantly from the actual ones. Due to different weather conditions, natural gas consumption during different heating seasons, the load on boilers will be different, which has a significant impact on the number of gross emissions of CO and other pollutants.

The main ingredient in emissions into the atmosphere of installed boilers for which the risk assessment is calculated is nitrogen dioxide.

The risk assessment of the impact of the planned activity on public health from atmospheric air pollution was carried out based on calculations of the risk of non-carcinogenic effects in accordance with the amendment [2].

The risk of developing non-carcinogenic effects is determined by calculating the hazard index:

$$H{\cdot}I = \sum H{\cdot}Q_i, \quad (1)$$

where $H{\cdot}Q_i$ is the hazard coefficient for individual substances, which is determined by the formula:

$$H{\cdot}Q_i = C_i / (R_f \cdot C) \quad (2)$$

where Ci is the calculated average annual concentration of the i-th substance,

and is taken according to the calculation of average annual surface concentrations.

The greatest impact on the nearest housing of the boiler house will occur with a northerly wind, which is 17,8% per year (according to the climatic characteristics of the area).

The calculation of the average annual concentration of a pollutant for a specific wind direction is carried out according to the formula:

$$C_i = (C_м \cdot P) / 125 \quad (3)$$

where C_i - average annual surface concentration, mg/m^3;

$C_м$ - maximum single surface concentration, mg/m^3 [2];

P - wind recurrence frequency from the enterprise to the calculation point, %.

$$C_i = (0,03552 \cdot 17,8) / 125 = \sim 0,0051 \text{ mg/m}^3$$

0,03552 mg/m^3 – maximum calculated concentration of nitrogen dioxide in residential areas;

$R_f \cdot C_i$ - reference (safe) concentration of the i-th substance, for nitrogen dioxide $R_f \cdot C_i\, NO_2 = 0,04$ mg/m^3;

$H \cdot Q_i = 1$ - maximum permissible risk:

$$H \cdot I = 0,0051/0,04 = \sim 0,13 < 1,0,04$$

Thus, the risk of non-carcinogenic effects is insignificant.

Conclusion: Keep daily records of the operating time of stationary sources of pollutant emissions into the atmosphere.

Equip sampling points of organized stationary emission sources to measure gas-dust flow parameters in order to monitor compliance with approved standards and permits for emissions of pollutants into the atmosphere by stationary sources.

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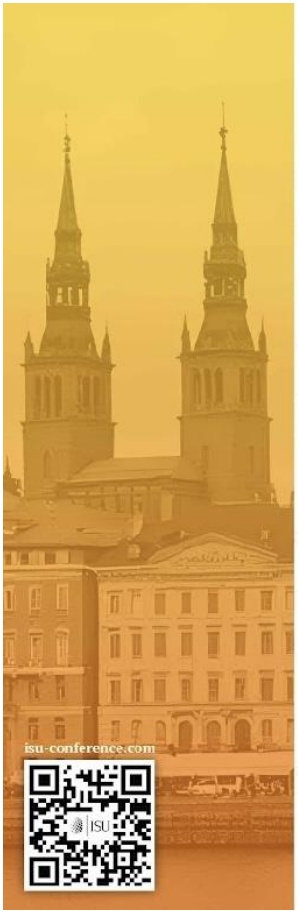

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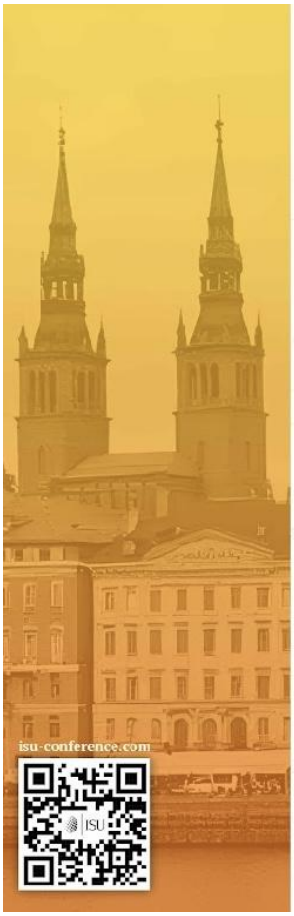

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