

Ministry of Ecology and Natural Resources of Ukraine

State ecological academy of postgraduate education and management of the Ministry of Ecology and Natural Resources of Ukraine

CONCLUSION N17/102 ON 27.12.2013

of the state ecological expertise of the draft of “Agreement on sharing hydrocarbons which will be extracted in the Yuzivska field between Shell Exploration and Production Ukraine Investments B.V., LLC Nadra Yuzivska and the state of Ukraine ”

The state ecological expertise of the draft of “Agreement on sharing hydrocarbons which will be extracted in the Yuzivska field between Shell Exploration and Production Ukraine Investments B.V., LLC Nadra Yuzivska and the state of Ukraine ” was made according to the Law of Ukraine "On Ecological Expertise" and under paragraph 2 of article 11 of the Law of Ukraine "On Production Sharing Agreements".

Ministry of ecology and natural resources of Ukraine had examined the environmental expert assessment of the draft of “Agreement on sharing hydrocarbons which will be extracted in the Yuzivska field between Shell Exploration and Production Ukraine Investments B.V., LLC Nadra Yuzivska and the state of Ukraine ”, which was prepared by State ecological academy of postgraduate education and managing of the Ministry of Ecology and Natural Resources of Ukraine (cover letter on 25.12.2013 N 1025), which is an integral part of this conclusion, and considered that it is possible to recognize the sufficiency of environmental substantiation and to give them positive appreciation on condition to the compliance with environmental legislation.

Annex: environmental expert assessment

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O.A.Proskuryakov

Positive conclusion is valid for three years from the date of its issuance. If during that time the realization of the decision on the project of state ecological expertise has not started, a new state ecological expertise on the project shall be conducted.

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The environmental expert assessment of the Agreement on sharing hydrocarbons which will be extracted in the Yuzivska field between Shell Exploration and Production Ukraine Investments B.V., LLC Nadra Yuzivska and the state of Ukraine

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## 1. INTRODUCTION

Ukraine is among the countries whose economic development is largely constrained by the lack of its own hydrocarbons. Therefore, in recent years, Ukraine is increasingly concerned with diversification of its energy sources.

One of the components of this process is the development of new deposits of unconventional hydrocarbons (shale gas, coalbed methane, central basin gas, etc.).

Lack of own energy resources, especially oil and gas, force Ukraine to export over 60% of the consumer gas (from 40 to 60 billion square meters per year) and more than 90% of the oil (from 26 to 28 million tons per year) on very unfavorable terms.

The problem of national energy safety has been more aggravated in the face of rising prices for oil and gas, so the issue of energy provision and energy savings is the most relevant to the economy.

Meanwhile, the country has such reserves of mineral resources that could make it not only an independent state, but also the biggest exporter of oil and gas to Europe. Increasing of own oil and gas production is a necessary condition for the sustainable development of Ukraine, its economic and political independence.

Analytical studies of the Agreement on sharing hydrocarbons which will be extracted in the Yuzivska field between Shell Exploration and Production Ukraine Investments B.V., LLC Nadra Yuzivska and the state of Ukraine, namely – the article "Rational and complex use. Guard and protection of subsoil, environment, health, labor. Safety, scope, costs and terms of the environmental protection measures" was made in order to conduct environmental expert assessment.

According to the agreement, during the operations with hydrocarbons all necessary measures will be taken to comply with the legislation of Ukraine, regulations on environmental protection and pollution prevention which are in line with international practice on activities in the oil and gas industry.

In particular, in order to ensure effective conducting of prospecting, exploration, development and extraction of mineral resources, to achieve safe and reliable level of oil and gas activities in compliance with the relevant standards of safety management system of health, labor, environment (SMS) (including avoidance of significant and unforeseen effects on human, their life and health, property, environment or subsoil), and management of oil and gas activities in accordance with acceptable standards of social responsibility, Operator is obliged to:

- to comply with available in the Operator safety management system of health, labor, environment (SMS) and standards of social responsibility (SR), which is developed in accordance with Operator's SMS and SR standards and regulatory requirements existing in Ukraine;
- to comply with the Investor's environmental obligations, contained in agreement;
- to project, build and operate all facilities for oil and gas activities in accordance with the Investor's obligations under the Agreement and in a manner that consist with the Operator's management system of SMS and SR, that are based on it;
- to comply with the regulatory acts on SMS that are used at the local level and other established by law SMS requirements.

Before the beginning of any oil and gas activity operator will conduct a study in order to determine the an initial environmental conditions of area in which such activity will be carried out, including the condition of any infrastructure on it and the actual level of pollution at the moment of beginning of such oil and gas activities.

The amount, terms and procedure of conducting a study of initial environmental conditions will be determined by the Operator and will be approved by the Ministry of Ecology and Natural Resources of Ukraine (or its legal successors).

This research will be conducted by a competent contractor with an international reputation selected by the Operator. The survey results will be reported by the Operator to the state authorities and, if it will be necessary, other public authorities.

In order to identify and minimize the impact on the environment and public health before the beginning of the geological study of mineral resources, evaluation and development of hydrocarbons, the Operator will carry out assessment of the impact on environmental and social environment, and public health.

The amount of this assessment of the impact will be determined in accordance with Operator's standards, legislation of Ukraine and normative legal acts. Terms and costs of assessment of the impact will be determined by the Operator in each particular case.

During making this assessment of the impact will be provided the participation of any interested parties and its transparency.

The Operator will demand its contractors to follow the requirements of safety management system of health, labor, environment (SMS) and standards of social responsibility (SR).

The Operator, in accordance with the provisions of the Agreement, will provide to each party of the Agreement the right to audit SMS and SR at their own risk and at their own expense.

To implement the measures in health, labor, safety, environment and social sphere, the state will provide the necessary support to the Investor for effective, safe and reliable activities for oil and gas production.

## **2. DESCRIPTION**

### **2.1. Location of the proposed activities**

According to the Decree of the Cabinet of Ministers of Ukraine of November 30, 2011 № 1298 "On the competition for an agreement on the distribution of hydrocarbons extracted within Yuzivska field", Yuzivska field is located within the Kharkiv and Donetsk regions of Ukraine and is limited by such geographic coordinates:

Number of angular points	North latitude	East longitude
1	49°28'11"	36°58'15"
2	49°18'26"	37°24'24"
3	49°11'32"	37°30'28"
4	49°13'00"	37°43'55"
5	49°08'00"	37°43'30"
6	49°02'01"	37°44'45"

7	49°00'29"	37°56'38"
8	48°56'43"	38°00'11"
9	48°43'04"	38°18'07"
10	48°43'00"	37°49'40"
11	48°39'00"	37°51'30"
12	48°33'02"	37°54'29"
13	48°32'30"	37°52'34"
14	48°45'05"	37°31'10"
15	48°40'44"	37°22'17"
16	48°36'21"	37°31'08"
17	48°28'37"	37°40'40"
18	48°24'00"	37°39'58"
19	48°15'21"	37°54'24"
20	48°10'56"	37°49'39"
21	48°07'02"	37°42'44"
22	48°07'02"	37°42'50"
23	48°02'13"	37°33'25"
24	48°02'27"	37°25'50"
25	48°11'29"	37°26'12"
26	48°12'15"	37°31'26"
27	48°15'36"	37°37'37"
28	48°25'24"	37°26'50"
29	48°25'11"	37°23'13"
30	48°27'46"	37°20'30"
31	48°26'26"	37°16'08"
32	48°39'05"	37°00'58"
33	48°39'13"	36°48'33"
34	48°48'20"	36°43'16"
35	48°55'57"	36°48'34"
36	49°01'22"	36°49'19"
37	49°07'14"	36°48'34"
38	49°07'09"	36°51'09"
39	49°08'58"	36°50'26"
40	49°09'15"	36°48'17"
41	49°30'09"	36°45'31"

Except Kam'yanska subsoil area

1	49°07'16"	37°12'28"
2	49°09'52"	37°14'45"
3	49°06'45"	37°28'0"
4	49°02'10"	37°24'0"

Except PivnichnoVolovenkivske deposits

1	49°17'20"	36°47'25"
2	49°18'10"	36°49'10"
3	49°15'40"	36°52'35"
4	49°14'50"	36°51'00"

Except Spivakivske deposits

1	49°11'45"	37°04'56"
2	49°12'15"	37°05'50"
3	49°12'18"	37°08'10"
4	49°11'53"	37°11'50"
5	49°11'04"	37°12'23"
6	49°10'29"	37°11'30"
7	49°10'21"	37°08'41"
8	49°11'05"	37°05'30"

Area of contractual field is 7886 square kilometers. The area includes all sedimentary deposits located within its perimeter, and is limited by the geological foundation and depth mark of ten thousand meters below the surface, see picture 1 (For this picture see Ukrainian version of assessment).

## 2.2. General characteristics of the object of the proposed activity

Yuzivska field is located in Kharkiv and Donetsk regions. In accordance with the Law of Ukraine "On Production Sharing Agreements" draft of agreement must be agreed with the local authorities in whose territory will be located subsoil areas that is passed to the user under the agreement. On 16 and 17 January, Donetsk and Kharkiv regional council made a decision number 6/18-456 and decision number 636-VI about the approving draft of agreement.

The abovementioned questions were studied by deputies in specialized committees with involving experts in the field of geology and ecology, also was studied and analyzed the economic feasibility and possible risks to the environment.

The process of extraction of hydrocarbons precedes work on geological study, on prospecting and exploration. For each well, which will be drilled, is making the drilling project. These projects are made by specialized project institutes. Compulsory component of the drilling project is a section about assessment of impacts on the environment (hereinafter – AIE).

The AIE contain information about the necessity of mining, analyze of the ways of implementation and their alternatives, about characteristics of the environment where drilling will be conducted, about assessment of possible risks and environmental safety measures.

Approbation of drilling project, including the AIE, is carried out by the competent public authorities in accordance with the laws of Ukraine, including the State Sanitary-Epidemiological Service, Environmental Services, State Service of Mining Supervision and Industry, Fire Safety Authorities and with involving the those local community on whose territory activities will be conduct.

In order to implement environmental risk assessment of planned activities and ways to prevent harmful impact on the environment and human health before the start of the drilling, subsoil user should get special permits from specially authorized by state bodies. Among them: permit for the emission of pollutants into the air from stationary sources, special water usage permit, permit for the generation and disposal of waste, and so on.

For the purpose of proceedings oil and gas activities, the operator, in the manner provided in current legislation of Ukraine and Agreement, must receive in use land, which is necessary for the oil and gas activities, and to provide during such use land reclamation and observance of legislative requirements on the protection of cultural heritage and land management, which provides holding archaeological expertise, sampling soil for agrochemical analysis, implementation of geodesic and geological engineering surveys.

The construction of wells precedes village council approval of the placement on its territory oil and gas activity's objects.

After successful conducting of geological study, exploratory and prospecting works, preparation of appropriate projects and confirmation of mineral resources for them, getting other permits in accordance with the laws of Ukraine, you can start commercial development of field.

In the case of industrial production of hydrocarbons, investor must obtain a mining allotment for needs connected with the use of mineral resources in accordance with the current legislation of Ukraine. In addition, if it is necessary, to obtain the conclusion of research organization about the utilization of harmful substances, wastes or wastewater treatment.

In the case of using chemicals for hydraulic fracturing, subsoil user must follow the rules that guarantee the safety of public health and the environment and to obtain permission to use them.

In case of occurrence danger to life and health or to the environment, investor's right to use subsoil may be limited, temporarily banned or stopped by the Cabinet of Ministers of Ukraine.

In accordance with the current legislation the public has right for getting the accurate information about the environment within the project implementation under the Agreement, and the right of local communities to participate in decision-making on project during the permitting process stages is guaranteed by the current legislation of Ukraine.

### **2.3. Assessment of impacts on the environment during the operations**

Any human activity harms the environment. Even hiking trails cause the relocation of some species of flora and fauna.

Therefore, the planned activities within the drilling platforms and other oil and gas activity distracts the soil, increases the emission of harmful substances into the air from construction equipment, increases the level of electromagnetic radiation, noise impact (all within the sanitary zone).

Large-scale production of shale gas is being carried out for less than 20 years. Furthermore new technologies that reduce the need for water, reduce the use of reagents and generally reduce the impact of work related to shale gas on the environment are constantly emerging.

Some interaction with the environment is inevitable, and mitigation measures of it's consequences should be integrated into ordinary work.

At present we are talking only about the potential risks of impact on the environment, since the question of the commencement of extractive activities remains open.

Extraction of natural gas from conventional or unconventional sources is associated with risks and threats to the environment and human health.

There are such risks of extracting gas from unconventional sources:

- air pollution;
- Excessive use of water;
- Use of chemicals for hydraulic fracturing (HDF);
- possible presence of natural radioactivity of rocks;
- Problems of processing, treatment and recycling of used water;
- potential contamination of surface water and drinking water layers;
- technological seismology.

Environmental threats include:

- proximity to protected areas;
- impact on local biodiversity;
- the balance of greenhouse gas emissions.

#### **2.3.1. Hydraulic fracturing technology**

Typically, gas-saturated layers that need conducting hydraulic fracturing, occurring at depths greater than 2 km from the level of potable groundwater. Aquiferous horizons and the area of formation of cracks are sharing kilometers thickness of impermeable rock. The low permeability of these rocks prevents migration of hydrocarbons (including gas) and any technological liquids that are pumped into a layer to the aquifer.

The Operator must apply measures to protect groundwater by complete sealing of wells (cementing by quality materials and putting several layers of strong steel tubes) that comply with all regulatory requirements.

The liquid for fracturing is pumped through wells in the gas-saturated layers that has low porosity, and which usually occurs much deeper than the last freshwater aquifer and which is separated from it by thickness of impermeable rocks. Accordingly, the fracturing liquid remains in the destination horizon, or is pumped back through the hole, in any case it is completely isolated from drinking groundwater, see picture 2 (in Ukrainian version of assessment).

The wells are projected and tested for tightness in accordance with the most stringent specifications which were developed with taking into account the local environment. The upper sections of the well, which pass through aquifers, are strengthened to prevent the ingress of gas or industrial liquids in these layers. Wells are strengthened with steel pipes and are cemented to the surface from horizons that lie much deeper (300 meters or more) than aquifers.

These barriers help to keep liquid for hydraulic fracturing and, given the depth at which fracturing is conducting, do not allow them to mix with drinking water.

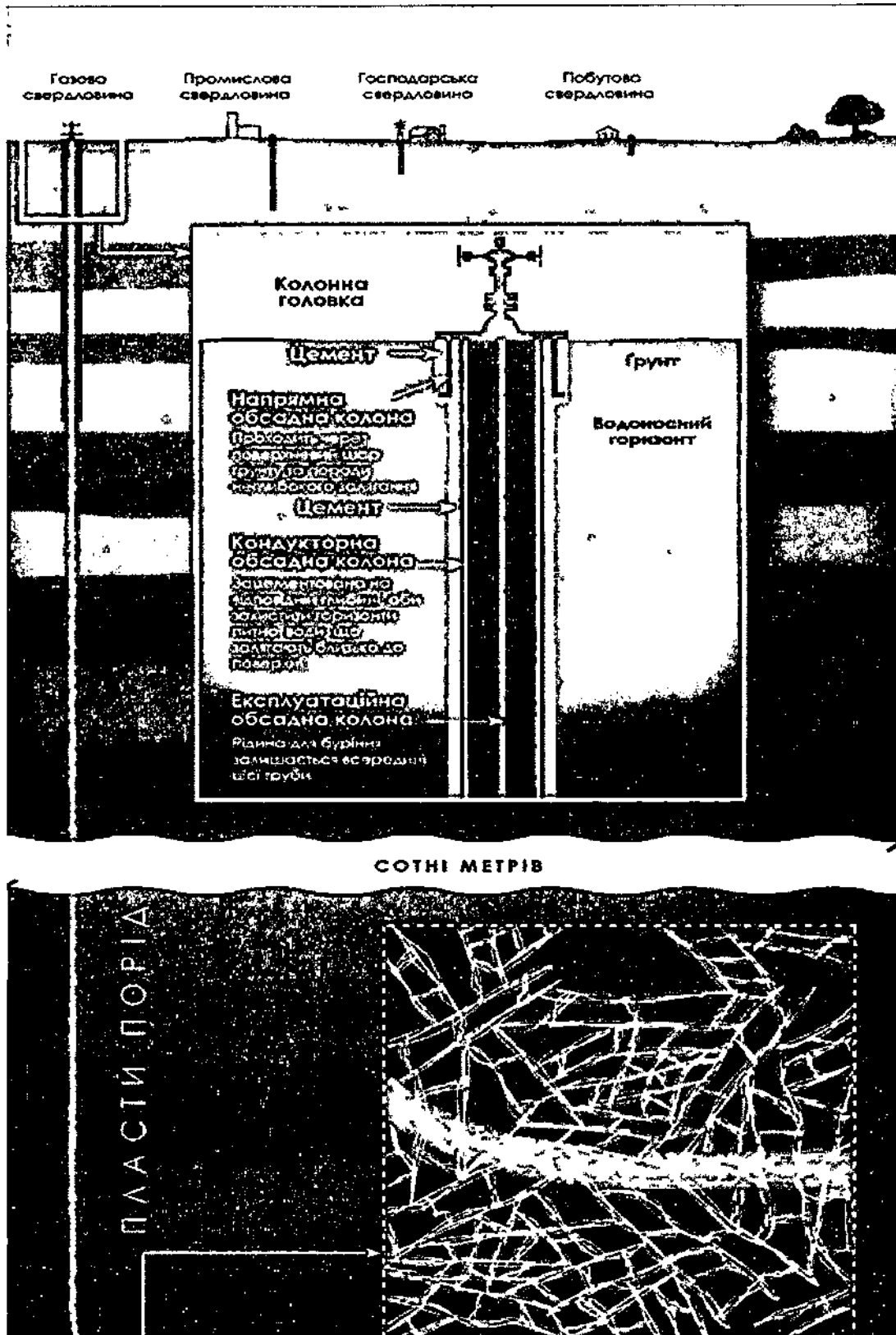
During and after hydraulic fracturing wells are monitored (by using pressure sensors), and their integrity is controlled. The operator periodically monitors the spread of cracks and liquids by applying macroseismic studies for mapping layer that helps to optimize extraction, to make it the most out and to protect the environment.

Liquid for hydraulic fracturing is mainly composed of water. The operator adds chemical impurities that are typically about 1% of the total liquid for hydraulic fracturing, they warn heating pipes, reducing friction and prevent the formation of sludge and bacterial growth.

Some of these chemical impurities can be dangerous if they are not used correctly. The operator must carefully approach the use of chemical additives in liquid for hydraulic fracturing and comply with the requirements of normative legal acts regarding handling of dangerous substances.

Safe conducting of all operations with water and other liquids for drilling platforms is a priority for the Operator. The Operator has undertaken to comply with all requirements of normative legal acts concerning the storage, transportation of liquids, preventing and eliminating spills.

In order to protect potable groundwater, the Operator uses secondary protective barriers in areas of drilling sites, where he will keep containers with chemicals and will conduct operations with liquids. Barriers help to limit the spread of spill area. Containers are regularly passing to verify of the integrity and appropriate certification.



Pict.2

To protect potable groundwater Operator uses secondary protective barriers in areas of drilling sites, where he will keep containers with chemicals and will conduct operations with liquids.

Any spill that happens on drilling sites will be immediately eliminated, and the place will be cleaned and statements will be prepared in accordance with the forms and procedures established by the company and normative legal acts.

The Operator uses the multistep process of re-use of liquid that is used for the hydraulic fracturing, what will allow to reduce the overall use of fresh water. In addition, the Operator keeps pumped water in the special containers with impermeable lining, and re-uses it after primary cleaning, transports it to the



wastewater treatment plant for purification or, in extreme cases, pumps it through a special hole back in the layer.

All complexes of processing, purification and recycling, used by Operator, are previously passed through detailed environmental review in compliance with the requirements and standards established by normative legal acts and by company.

### 2.3.2. Health, labor and the environment protection (HLEP)

Operator has five basic principles of the development of oil and gas from unconventional sources. These principles provide safe conditions of work realization, protection of water, air, wildlife and the local population in the territories where activities will be conducted.

According to the Agreement (Annex 8), Operator:

- Has a systematic approach to managing SMS and SR, developed to ensure the compliance with the law and achieving continuous improvement of results;
- Set performance targets for improvement and measures, assesses the results and reports about them;
- Demands from contractors to manage SMS and SR in a manner consistent with these principles;
- Effectively communicates with communities that are affected by the activities and with external stakeholders;
- Includes results on SMS and SR in the assessment of staff and in appropriate way rewards the staff.

Operator, during making activities must: not cause damages to the population and the environment, effectively use materials, resources and energy, to report about its results, play leading role in promoting the use of best practices in the industry, manage issues of SMS and SR.

#### ***Impact on water resources and atmospheric air***

Because of the condition of its water reserves Ukraine will require from oil and gas industry to apply advanced practices to minimize water use. Reducing water use can be achieved by cleaning the water and by re-using it after the development of each well.

With the right placement and construction of wells, we can practically eliminate the chance of groundwater pollution by the drilling process and hydraulic fracturing.

Closed system is used to prevent reduction of groundwater. During the determining of water initial level is used quality testing and monitoring of groundwater for drilling and is established and ensured the compliance with appropriate standards.

On the quality of surface water influence mechanical impurities (dust), which are formed during the building of the drilling platforms and new roads. These consequences can be eliminated by placing wells and roads away from surface waters and by using best practices of protection from surface wastewater.

For a typical well drilling and multistep hydraulic fracturing is used 15000 – 25000 cubic meters of water, 10000 – 15000 cubic meters of which is used during the drilling operations and 2500 – 7500 for multistep (5–15) hydraulic fracturing.

Variation in the amounts depends on the geology and the number of hydraulic fracturing stages. At the same time the potential sources can be surface water (rivers, lakes), source of municipal water supply, treated water from the previous drilling, treated municipal wastewater.

According to the study of the Massachusetts Institute of Technology in Sila amount of using for hydraulic fracturing water is less than 1% of the total balance of its consumption in the regions of unconventional gas extraction.

To the substances that can potentially stand out in atmospheric air during the extraction of unconventional gas are referred greenhouse gases, particularly carbon dioxide, CO<sub>2</sub>, methane CH<sub>4</sub>, nitrous oxide N<sub>2</sub>O, and such pollutants as sulfur dioxide SO<sub>2</sub>, nitrogen oxides, solid particles, volatile organic compounds, carbon monoxide CO, and substances, which are used directly for hydraulic fracturing and are in the return flow water, including chemicals and naturally occurring radioactive substances washed out from geologic formations.

For drilling from 8 to 16 wells water spending are 1600 – 3800 cubic meters per day, or 200 – 400 thousand cubic meters per year. Amount of return flow water after hydraulic fracturing reaches 30-50%, and the planned recycling of this water – 70-80%. The average concentration of chemical components in pumped water is 1%, the total amount of chemical substances reaches approximately 600 – 1,200 thousand liters per year.

Basic operations with used water, which had formed as a result of drilling and development of wells, are:

- Treatment and reusing water for drilling and hydraulic fracturing (water is purified in local wastewater treatment plants for further use);

- Previous treatment at local wastewater treatment plants and additional treatment in the local municipal wastewater treatment plants of domestic wastewater;
  - Water can be filled in deep geological layers and voids.
- Aquifer, which accumulate drinking water supplies, and gas layers are separated by thick layers of sedimentary rocks.

The layers of drinking water are at the hundreds of meters depths, when the reservoir of unconventional gas - at 2500-5000 m. The cracks of HDF, depending on the density of rocks, range from several tens of meters to several hundreds of meters.

### ***Greenhouse gas emissions***

There is a risk associated with the likely release of methane, but it is estimated by the USA Environmental Protection Agency (EPA), that today in the country the methane leakage from natural gas wells is less than 2%.

EPA's Analysis in 2011 showed that the average methane emission for all wells, including oil and gas in the United States ranged from 0.7%, according to the Greenhouse Gas Reporting Program, and to 1.6%, based on data from the National Environmental evaluation.

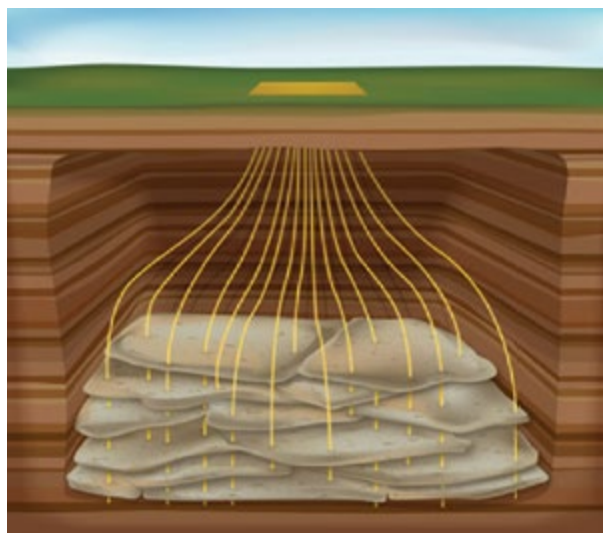
Moreover, due to the reorientation of the industry toward gas, which replaced significant amount of coal from the US domestic market, CO<sup>2</sup> emissions today had fallen to a level that was observed twenty years ago. Thus, gas from unconventional sources contributes to reduction of anthropogenic emissions of CO<sup>2</sup>.

Technology collection and utilization of liquid on the surface is quite simple and is worked out in detail, and danger of environmental pollution at this stage of work is negligible. A more likely danger of pollution by chemicals which are used in fluids for hydraulic fracturing is not during drilling but during transportation and keeping of these substances.

Therefore, Ukrainian control authorities, based on Sila experience, will develop stringent standards in this field, will conduct the necessary checkings, including on the subject of tightness of containers in which the chemicals are transported and stored.

### ***Changes in the landscape***

The picture shows multiple sloped wells for gas production from the compacted sandstone. Application by the Operator of such modern drilling technology – multiple wells from one site - automatically reduces the impact on the landscape and infrastructure load without reducing performance.



In addition, after reclamation the surface area of each drilling site can be largely renewed, in order to what it is proposed to separately keep the top layer of soil.

Company THM in order to develop unconventional gas in Hungary want to identify 160 drilling sites in an area of 1 hectare within 20 years and to remove 20-40 cm the upper soil layer and store it for reclamation.

Drilling of 8-16 wells will take from 1 to 2 years. After which 90% of the surface area of each drilling site can be changed.

Reaction to the fracturing of the geological environment, which is a key element of technology in shale gas, is mostly related not to the geological structure, but to the mechanical features of rocks (their integrity, lack of tectonic disturbances). These include, first of all, the anisotropy of strength of the gas-bearing layers, when the strength of stratification is much smaller than the thickness, which significantly increases the efficiency of hydraulic fracturing and the levels of gas recovery.

According to the legislation of Ukraine no industrial facilities, regardless of whether they are designed for gas production from unconventional sources, or for other industrial purposes, can not be located either on site of nature-protected areas or within their protection zones.

### ***The impact on local biodiversity***

Noise is a major irritant for some species, especially birds. Because of the drilling are created noise and smoke from diesel generators, which could adversely affect some biological species.

Drilling works can take up to several months, depending on the depth of the well and the type of rock. It is possible to avoid or minimize the impact on biodiversity, if the safety distances are kept (according to German experts from LBST, it is 500 m between well sites and water bodies). It is also recommended to avoid migration corridors of rare species.

Technological platforms of gas production from unconventional sources are much safer for birds, for example, than wind power sites with many high towers and moving blades of wind turbines that generate not only the danger of mechanical nature, but also are a source of infrasonic vibrations that repel birds from traditional routes of migration.

**Operator notes in the Agreement (Annex 8) about environmental protection:**

- If basic equipment is connected with significant risks for the environment, it is certified by the standards of international independent environmental management measures.
- The use of energy, energy efficiency, greenhouse gas emissions are monitored, and global inventory of greenhouse gas emissions is confirmed and is subject to independent scrutiny.
- Complexes of basic equipment are projected in such way that torch burning, weathering or emissions were not always used for removing of hydrocarbons.
- Handling with emissions of sulfur oxides and nitrogen oxides, dumping and cleaning process for wastewater and produced water as well as transportation and waste disposal are realized according with international standards.
- Assessment of the risks and risk management of soil and surface water are conducted.
- In areas where water supplies are insignificant facilities are projected and operated in a manner that reduces water usage to a minimum.
- Assessment and management of potential impact of Operator activities on ecosystem biodiversity are conducted.

In Annex 9 "Environmental protection" of the Agreement are listed duties of the Operator on the protection of the environment.

Shell Exploration and Production Ukraine Investments B.V (hereinafter - Shell) undertakes during the realization of oil and gas activities to comply with the legislation of Ukraine, legal acts and " Shell global principles of activity on land."

According to the "Shell global principles of activity on land", the company undertakes duties on industrial safety.

Before starting the drilling, exploration or mining Shell conducts assessment of the risks for determination and for use of the control optimal means and for use of related measures to reduce them.

These control measures and actions are fixed in a special document ("Description OZPD") which is constantly reviewed and updated.

Shell will regularly control the production processes, will develop liquidation plans of emergency that take into account the specifics of the local environment, and all work will be conducted with the participation of qualified personnel.

***Duties on the reducing of negative impacts of industrial activities on the environment and on minimizing the area of land plots that will be used:***

- Shell, in order to reduce the negative impact of its activities, will minimize the number of drilling sites;
- During the projection of industrial facilities will be used technologies for the reducing burden on the environment, including the construction of roads, construction of drilling sites, reducing the noise level and use of light;
- For reducing the number of freight transportation of liquids will be held assess of the expediency of building pipelines and systems of gathering liquids;
- Restriction of activities will be introduce (at specific times) in aim to reduce the impact on wildlife and its inhabitants;
- The company is obliged to carry out reclamation of land plots with the use of best available techniques (planting indigenous plants and conducting monitoring).

***The obligations on the ensuring the tightness of wells:***

Worldwide, Shell uses Shell Global Drilling and Completion Standards, ground production facilities, internal technological instructions. These standards are intended to prevent violation of the integrity of wells.

During the projecting and building wells, Shell uses at least two protective barriers for isolation of drilling liquids and fracturing liquids from any connection with fresh aquifers layers.

In wells that have not been preliminary tested for impermeability under pressure, fracturing is not performed.

***The obligation on protecting water resources and reduction amount of the use of fresh water:***

- Activities on the protection of groundwater and decreased amounts of potable water will be conducted;
- Shell during the projecting, drilling and extraction oil and gas from wells, as much as possible will protect freshwater aquifers;
- Wells, where there is no complete isolation of potable groundwater, will not be used;
- During the process of the initial well construction (until the end of drilling and hydraulic fracturing), the company uses only air, water or water-based liquids for drilling through freshwater aquifers;
- Before the further drilling or hydraulic fracturing conducting, zone will be planted and cementing.
- Information about the chemicals that will be used in hydraulic fracturing will be opened (as it is permitted by its suppliers);
- To held selection of samples for analysis of drinking water near areas where fracturing will be carried out before and after development (to determine the effect on water quality). The type and frequency of monitoring depends on the specifics of the area.
- To provide purification and reusing of water and accompanying liquids, that are present in the layers, which lie in the areas of oil and gas (as far as possible in a given area).

Shell projects initial barriers (for isolation extracted hydrocarbons and drilling agents based on oil) with using containers with secondary containment in the form of an insulating layer or double walls.

During the building wells sites, company follows such distance from the protected surface water layers that is demanded by the current legislation and regulatory acts.

In addition, the company will work with local water resources management bodies and other agencies to identify other suitable sources of water.

***The obligations on minimizing of emissions:***

- During the works will be implemented measures on maximum protection of air quality and of harmful emissions control;
- Plans of development and production of hydrocarbons will be composed in order to minimize harmful emissions;
- Monitoring of production systems on the subject of harmful emissions into the air will be conduct (will be used pressure test, visual observation, infrared studies and other new technologies).

The company will use the special equipment to reduce air emissions and environmentally friendly fuel types (natural gas) at its drilling machines.

There will be conducted measurements, systematization and reporting on air emissions, in accordance with existing regulations and requirements.

Shell is working with local communities on the potential social and economic impacts that are related to its operations.

Also, the company, guiding by the principles of the global activities on land, must:

- To invest in the construction installations for water purification and treatment of sewage and other waste water during the stage of industrial development (for the water reuse);
- Maximizing the use, in terms of deposits, of unsuitable for the drinking water by drilling deep wells for the use of mineralized water, which is unsuitable for domestic use.
- On the stage of full-scale development, company will give priority for transportation of the water by pipelines, not by freight transportation, what will significantly reduce environmental impacts and security risks.
- To conduct research of the environment initial condition and comprehensive assessment of impacts on environment, social environment and health, according to international standards;
- To ensure stakeholder participation, public hearings in the aforementioned assessment, and transparency of its activities;
- To develop the detailed management plan of impact on environmental, social environment and health for minimizing negative impact on environment.

**3. VALUATION GENERALIZING PART**

General provisions of environmental protection:

- Protecting the environment during exploration, construction of wells, equipping and development deposits of oil and gas must be carried out in accordance with the Laws of Ukraine "On Environmental Protection", "On Air Protection", the Water Code of Ukraine, the Land Code of Ukraine, the Forest Code of Ukraine, legislation on the protection and use of flora and fauna and other legal acts relating to the protection of the environment, and in accordance with the current building, sanitary, fire and technical standards and regulations.

- Protecting the environment should include a set of organizational, technical and technological measures in aim to ensure the security of settlements, sustainable use of land, water, to prevent pollution of surface and groundwater, air, to save forests, nature reserves, protected areas, etc.

- Environment impact assessment (EIA) of enterprises business activities and organizations during the exploration, drilling and development deposits of oil and gas must be carried out in accordance with the legislation of Ukraine and performed according to the projects of the well construction and equipping projects of oil and gas deposits.

- Responsibility for environmental protection relies on heads of enterprises and organizations performing the exploration and development of oil and gas deposits.

- Control over implementation of the rules, regulations, standards on environmental protection on the exploration and development of oil and gas deposits is exercised by the competent bodies of executive power, sanitary and epidemiological service, fisheries inspections, etc.

Article 51 of the Law of Ukraine "On Environmental Protection" provides that all projects of commercial and other activities absolutely must have materials (section) assessment of its impact on the environment and human health. Development of gas from unconventional sources is no exception. Impact assessment is developed with the requirements of legislation on environmental protection, environmental capacity of the area, state of the environment in a place where it is planned to place the objects, environmental forecasts, perspectives of socio-economic development, power and types of common impact of harmful factors and objects on the environment.

Worldwide experience identifies two main types of environmental risks. First – is conservation of the land fund in subsoil area, which is granted for use. In realization of projects of studying and gas extraction from unconventional sources, special attention is paid to the reducing of land plots for development. In the world's best practice that could be applied to the Oleska area, this is achieved by drilling multiple wells from one point.

The second risk – is the depletion and pollution of water resources:

- protection of ground and surface waters from the reagents which are used for hydraulic fracturing, directly from the well during the passage of the solution under pressure, especially at the groundwater level, and during the hydraulic fracturing;

- decreasing of the water amount, which is necessary for the full cycle of shale gas extraction.

These problems are solved by modern and tested in practice technologies, based on the experience of the operator's work, and by constant control over the running of works by environmental and mining supervision state controlling bodies.

According to the report "Ukraine shale gas: environmental and regulatory assessment", prepared by an expert group of the United States Agency for International Development (USAID) in pursuance of the Memorandum of understanding between the Government of Ukraine and the Government of the United States on unconventional gas resources on 15.02.2011, approved by the Cabinet of Ministers of Ukraine on 09.02.2011 № 100-p, if the well is properly placed, built, tested and monitored, the threat of groundwater pollution by the drilling process and hydraulic fracturing will be very small.

Water from the developed wells and existing wells can be reused. Water for drilling and hydraulic fracturing can come from local wastewater treatment plants or industrial wastewater, accompanying underground (shale) water or repeatedly used technical water.

Penetration of polluted water and infection by bacteria is impossible. Near the drilling the process of water pollution is usually much lower than near the ordinary wells.

Extraction of shale gas – it is the first step to ensure the region by it's own energy resources.

Thus, in our view, the current legislation of Ukraine on production sharing agreement provides investors the conditions of successful implementation of large-scale projects of searching and extraction gas from shale and tight rocks, and the central executive bodies, local authorities and the public are provided by clear mechanisms for participation in decision-making on economic, social and environmental conditions of the production sharing agreements, as well as by control over the implementation of the investment obligations and work program.

We believe that with the right resolving issues related to extraction of unconventional hydrocarbons, we can solve the issue of gas independence. This is especially beneficial to the population-gas consumers and for large enterprises that use gas production activities.

According to the results of analytical studies of the project of the Agreement on sharing hydrocarbons which will be extracted in the Yuzivska field between Shell Exploration and Production Ukraine Investments B.V., LLC Nadra Yuzivska and the state of Ukraine, namely – the article "Rational and complex use. Guard and protection of subsoil, environment, health, labor. Safety, scope, costs and terms of the environmental

protection measures" and conducting on their basis the comparative analysis and assessment of the degree of environmental safety, planned activities comply with the requirements of current environmental legislation on environmental protection, of rational use and reproduction of natural resources, of ensuring environmental security.