ENIRONMENTAL IMPACT STATEMENT (EIS)
INFRASTRUCTURE CONSTRUCTION OF
KHAUZAK-SHADY AREAS OF DENGIZKUL FIELD

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«Khauzak and Shady of Dengizkul deposit Construction» Statement on Environmental Consequences
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TERMS AND DEFINITIONS

ARTESIAN WATER– confined subsurface water spurting out when opened.

SUBSURFACE WATER BUDGET – a quantitative ratio between elements which determine feeding, subsurface water-supply consumption and changes within specified time.

IRREVOCABLE WATER CONSUMPTION – water consumption without water return to water body.

NONARTESIAN WATER – subsurface water with free surface of the pressure equal to the atmospheric one.

WATER CONDUIT – hydraulic works to feed and discharge water in the preset direction.

WATER INTAKE – water collection from a water reservoir, channel or subsurface water source.

WATER WELL – a well to collect subsurface water, as a rule. Fitted with well casing and filter.

AQUIFER – a system of water-bearing beds alike in formation conditions and geology and hydrologically interconnected.

WATER FOR DRINKING WATER SUPPLY – effluent from waste water treatment plant (waterworks), flowing into water intake facility or control tank.

MINERALIZED WATER – water containing a considerable amount of mineral matters. Low-(0,5 – 5 g/dm³), medium-(5-30 g/dm³) and high-salt water (over 30 g/dm³ of soluble salts) are distinguished.

FRESH WATER – water with mineralization up to 1g/dm³.

INDUSTRIAL WATER – water, resources and components composition of which are sufficient to extract these components industrially.

WASTE WATER – water disposed after use in household and industrial human activities.

INDUSTRIAL WASTE WATER – water after industrial process.

HOUSHOLD WASTE WATER – water discharged from human settlements.

ATMOSPHERIC AIR – 1) natural gas mixture formed during Earth evolution; 2) air outside residential and production premises.

ACCIDENTAL EMISSION – pollutants emission into the environment as a result of breakdown in process or accident.

SMOKE FUMES – fumes produced from mineral and vegetal fuel combustion.

WASTE GAS – combustion products discharged to chimney flue.

SUBSURFACE WATER – ground water of the permanent aquifer that is the first to the ground surface and is located on the first aquifuge to the surface.

GAS CONTENT – 1) considerable concentrations of hazardous and explosive gaseous substances in the air; 2) considerable increase in concentration of any gas in the air (including gases typical for the atmosphere) against the accepted norm.

POLLUTION – emission or emergence of new, atypical physical, chemical, information and biological agents in the environment or exceeding of natural mean annual level during the time considered.
ATMOSPHERIC POLLUTION – emission into the air or formation of physical and chemical agents and organisms in it, unfavorably affecting the environment and damaging material values.

WATER POLLUTION – pollutants, microorganisms and heat inflow into the water body.

LOCAL POLLUTION – contamination of a small area (normally around an industrial enterprise, human settlement and etc.). Point contamination from single chimney or fugitive source is also distinguished.

WATER POLLUTION RATE – water contaminating pollutants, microorganisms and heat content that causes violation of requirements to water quality.

SPECIAL NATURE RESERVE – a plot of land within the limits of which particular types of economic activities are prohibited (permanently or temporarily) to secure one or many living species, ecosystems, one or several ecological components or protected area nature as a whole.

DUST CONTENT (of air) – fine solid (dust) particles of natural or anthropogenic origin in the air.

AERATION ZONE – Earth crust top layer between its surface and groundwater table. It contains hygroscopic, film and capillary water; occasionally gravitational water emerges there.

WATER PROTECTION ZONE – territory allocated to protect subsurface and surface water from contamination; economic activities are as a rule prohibited or limited there and such territory is reforested.

HARMFUL SUBSTANCES (pollutants) CONTENT CONTROL - estimation of pollutants amount in the air, water, soils, food products and record of deviations from the stated norms.

MAXIMUM PERMISSIBLE EMISSION – atmospheric emission set for each air pollution source provided that ground level concentration of these substances will not exceed the maximum permissible concentration (MPC).

MAXIMUM PERMISSIBLE CONCENTRATION (MPC) IN THE AIR – legislatively enacted standard for quantitative content of harmful substance in the air. There is maximum one-time MPC of chemical substance in the air of residential areas. This concentration shouldn’t cause reflex (including subconscious) phenomena in the human body (m.p. MPC) by inhalation during 30 min.

ANTHROPOGENIC LOAD – extent of direct and indirect human impact and their economic activities on the nature as a whole or its separate environmental components and elements (landscapes, natural resources, fauna species and etc.)

WASTES – raw materials unsuitable to produce this product, its non-utilizable remains or (solid, liquid and gaseous) substances formed during process flows and energy not subject to utilization in the taken production (including agriculture and construction). Hazardous wastes have to be neutralized. Unreclaimable scrap turns into wastes.

WASTE PROCESSING – mechanical, physical-chemical and biological transformation of industrial and household (municipal) wastes to neutralize harmful components or extract useful substances from wastes, which can be used anew.

STRATAL WATER – water from aquifer, one or several lithologically homogeneous layers containing gravitational water and characterized by strong hydraulic interaction. Vaporous condensate water in gas beds, which transforms into liquid during gas recovery, also belongs to stratum water.

SURFACE WATER – water represented by different water bodies on the land surface.
SUBSURFACE WASTE WATER DISPOSAL – waste water pumping to deep lying lost circulation horizons of subsurface water through wells.

FILTRATION FIELDS – territories intended (usually specially constructed) for soil waste water biological treatment to remove pollutants and, as a rule, are not used for other purposes.

MAXIMUM PERMISSIBLE CONCENTRATION OF SUBSTANCES IN WATER (MPC) – substances concentration in water, exceeding of which makes water unsuitable for one or several kinds of water use.

NATURAL RESOURCES – natural sites and phenomena used for direct and indirect consumption to create material values, sustain humanity’s existence conditions and improve products quality.

EVAPORATION POND – artificial pond for industrial polluted water change from liquid or semi-solid state into gaseous by evaporation from water surface.

HAZARDOUS EMISSIONS DISPERSION – physically stipulated (air flow, gas diffusion) decrease in pollutant concentration in the atmosphere, normally as the distance from emission source increases.

RECLAMING – artificial restoration of fertility and vegetative cover after anthropogenic damage to a natural site (open cast mining and etc.).

LAND RECLULTIVATION – range of works to restore disturbed land productivity and economical value as well as improve environmental conditions in compliance with society interests. Land recultivation should be an integral part of process technology at operating enterprises associated with land disturbance.

SOOT – solid product of incomplete combustion or thermal hydrocarbons decomposition.

DISCHARGE – water or waste water discharged from a waste water treatment plant, industrial enterprise or settler.

CHIMNEY FLUE – a drafting facility to discharge combustion products from ovens and boilers into the atmosphere. Increase of chimney height reduces ground level pollutant concentration but enlarges its dispersion area, thus eventually intoxicating a much larger area than a lower chimney could do.

INDUSTRIAL WASTE RECYCLING – industrial wastes use as secondary raw materials, fuel, fertilizers and etc.

FLARE – cone divergent gas or liquid flow. Flare can be vertical, horizontal and ground (on the ground surface), movable, emerging during start-up and/or tripping of thermal generating or technological unit as well as discontinuously operating source and stationary one.

BACKGROUNd CONCENTRATION OF POLLUTANT – amount of pollutants in anthropogenically affected natural environment unit.
<table>
<thead>
<tr>
<th>Abbreviation</th>
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<td>AO</td>
<td>Joint-Stock Company</td>
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<tr>
<td>ISB</td>
<td>Inlet Threads Block</td>
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<td>BOD</td>
<td>Biological Oxygen Demand</td>
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<td>HVL</td>
<td>High-Voltage Line</td>
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<tr>
<td>GWC</td>
<td>Gas-Water Contact</td>
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<td>SRC</td>
<td>State Reserves Committee</td>
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<td>GCD</td>
<td>Gas-Condensate Deposit</td>
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<td>GPP</td>
<td>Gas Processing Plant</td>
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<tr>
<td>ICE</td>
<td>Internal Combustion Engine</td>
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<tr>
<td>BCS</td>
<td>Booster Compression Station</td>
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<tr>
<td>DPS</td>
<td>Diesel Power Station</td>
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<td>EIS</td>
<td>Environmental Impact Statement</td>
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<tr>
<td>I&amp;A</td>
<td>Instrumentation and Automation</td>
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<td>PTL</td>
<td>Power Transmission Lines</td>
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<td>MGPP</td>
<td>Mubarek Gas Processing Plant</td>
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<td>OGCD</td>
<td>Oil-Gas Condensate Deposit</td>
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<td>OLR</td>
<td>Oil Loading Rack</td>
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<td>NHC</td>
<td>National Holding Company</td>
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<td>OAO</td>
<td>Open Joint-Stock Company</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<td>NE</td>
<td>Natural Environment</td>
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<td>PP</td>
<td>Pilot Production</td>
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<td>PAP</td>
<td>Potential Atmospheric Pollution</td>
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<td>CP</td>
<td>Collecting Point</td>
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<td>TEG</td>
<td>Triethylene Glycol</td>
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<td>TES</td>
<td>Technical and Economic Substantiation</td>
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<td>UE</td>
<td>Unitary Enterprise</td>
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<td>GS</td>
<td>Gathering Station</td>
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<td>HPF</td>
<td>High Pressure Flare</td>
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<td>LPF</td>
<td>Low Pressure Flare</td>
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<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
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<td>EP</td>
<td>Electrochemical Protection</td>
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INTRODUCTION

Designing is based upon: production sharing agreement (PSA) as of 16.06.04, license for the right to use subsurface areas No 001 as 28.07.04, mining allotment act No 634 as of 11.10.04, annual work program and “Khauzak and Shady of Dengizkul deposit field development process flow diagram” with addenda to the field development process flow diagram.

During the engineering of the facility “Dengizkul deposit Khauzak and Shady Sites Construction” environmental impact assessment (EIA) procedure was analyzed.

Draft Environmental Impact Statement (draft EIS) was approved by the State Environmental Expertise under the State Environmental Committee of the Republic of Uzbekistan as of April, 11 2005 No 18/113z (Note: Programmatic Environmental Impact Statement to the Addenda to the field development process flow diagram). Later on a draft EIS for “Addenda to Khauzak and Shady of Dengizkul deposit field development process flow diagram” was developed, which also received a positive expert review as of June, 27 2007 No18/213z.

The Directorate-General for State Environmental Review gave a favorable conclusion for the work performed (EIS) as of November, 28 2005 No 18/394z. EIS tasks are admitted to have been performed. The facility under design is supposed to settle such important challenges as:

- placing on production Dengizkul deposit sites preserved for a long time;
- increase in hydrocarbon (gas) production up to 3,0 bln m³ per year;
- attraction of foreign investments;
- stable provision of Mubarek gas processing plant with raw materials for a long period of time.

Besides these goals achievement certain measures shall be performed under the project to preserve natural complexes in the region including border territories of Turkmenistan in accordance with the requirements of “Environmental Protection Law”.

According to the State Environmental Expertise Review development of the II stage of EIA procedure - Environmental Impact Statement (EIS) was required as ecological support.

The number of issues considered in the work was determined with regard to the design specifications set upon consideration of the “draft EIS”.

At the final stage of design complementary solutions have been made, which can change work influence on the environment to a certain degree. A necessity thereupon emerged to specify and adjust design solutions as well as develops norms of harmful substances emissions into the atmosphere (MPE), water bodies and solid wastes (MPW).

To settle these issues “Statement on Environmental Consequences of Khauzak and Shady of Dengizkul deposit Construction” was drawn up and is presented in this work.

According to the applicable regulations the Statement on Environmental Consequences has to include:

- design solutions adjustment and other measures taken in accordance with draft Environmental Impact Statement review by the State Environmental Committee authorities;
- environmental standards regulating expertise facility operation;
requirements to works arrangement and measures performance under the environmental supporting documents to the facility operation;

− main conclusions on a possibility to conduct economic activities.

Thus the challenges of the present work are addenda, specification of environmental and other information as well as new information record when designing the facility and conducting environmental expertise.

Methods of works performance are based upon the methods of EIA procedure adopted in the republic and include peculiarities of the facility considered.

Design and fund materials, books as well as “Regulation on State Environmental Expertise” approved by the order of the Cabinet of Ministers of the Republic of Uzbekistan as of December, 31 2001 No 491 regulating the “draft EIS” structure and scope and other applicable regulations on environmental protection were used in the present work.

The document agreed upon in State Environmental Committee authorities of the Republic of Uzbekistan is to be further submitted by the Customer to the review committee for commissioning the facility. Statement of Environmental Consequences sets norms to control current activities of users of natural resources by the State Environmental Committee territorial authorities of the Republic of Uzbekistan to prevent from violations of environmental norms and rules.
1 TARGET AND NECESSITY TO IMPLEMENT TARGETED ACTIVITIES

In the Republic of Uzbekistan great attention is paid to industrial potential development, and primarily to fuel and energy complex being the foundation of economic growth and strengthening its energy independence. Oil and gas industry – one of the country major heavy industries – is prioritized. Significant work has been made within a short period of time:

- Natural gas production has been increased including enriched gas, which makes it a valuable raw material for gas processing;
- Oil and gas condensate production has been increased;
- New gas and oil facilities have been put into operation;
- Natural gas processing system have been reconstructed;
- New high-technology facilities for oil and gas condensate processing and liquefied gas production have been put into operation.

These results were facilitated by high technologies introduction alongside with the attraction of foreign companies and financial institutions.

Considerable hydrocarbon reserves were discovered in the country, the development of which is hampered by certain difficulties (remoteness and inaccessibility, high concentration of hydrogen sulfide and etc.), which explains the necessity to cooperate with foreign investors to attract high technologies and extra financing.

Over the last years know-how in the construction of environmentally friendly facilities of oil-gas industry supported by foreign capital have been accumulated. A favorable investment climate to attract all kinds of investments has been created.

The analyzed project of Khauzak and Shady construction confirms the above. These sites are planned to be operated with the attraction of Russian investments.

Oil field capacity will make up 3 bln m³/year

The set of start-up complex facilities is determined upon the terms that the first phase of Khauzak construction shall be commissioned since 2007.

Priority construction facilities include:

- Khauzak external power supply;
- Access roads to Khauzak;
- Khauzak water supply;
- 8 wells from multiple well platforms and 2 wells from individual lines;
- Four collectors from well platforms to GS;
- Gathering Station (GS) including:
  - Inlet Threads Block;
  - Gas separation plant;
  - Condensate stabilization (preparation) facility;
  - Degassing and stratum water disposal unit;
High and low pressure flare platform;  
Operator’s room;  
Power supply facilities;  
Gas- and fire-safety support facilities;  
- Gas-pipe from GS to the Dengizkul-MGPP gas-pipeline tie-in point with lease automatic custody transfer;  
- Condensate line from GS to the tie-in point with lease automatic custody transfer;  
- Fuel gas pipeline with fuel gas skids and lease automatic custody transfer;  
- Some facilities of field base and human settlement.

In future the number of wells will increase up to 37 units, 9-10 well platforms will be made, a human settlement and a field base will be developed, a booster compression station (BCS) will be started when pressure in deposits drops.

The project is implemented by LUKOIL Uzbekistan Operating Company OOO.

Project implementation will cause jobs creation and stimulate infrastructure and transportation network development in the area.

3 bln m³ of sour natural gas shall be fed to MGPP for processing annually. After recovery treated and dry natural gas will be supplied to the main gas pipe lines of the republic and further to the consumers, according to the PSA.

On a national scale, construction and extra gas recovery from gas condensate is one of the actions to create stable raw materials base to provide population and industry with gas fuel and oil products, chemical raw materials in planned amounts.

Wide industrial and household gas consumption has considerably decreased atmospheric air pollution in the republic as a whole. Export of produced gas brings money specifically allocated to solve social problems.

First-aid posts in field camps and workshops allow arranging systematic medical supervision of workers’ health, and administer timely aid where necessary.

Besides, the workers of large enterprises enjoy benefits, when trade union tickets to get preventive treatment in sanatoriums and preventoriums of the industry and the republic as well as travel tickets to summer camps for worker’s children and etc. are allocated.

Thus the target and necessity to put Khauzak and Shady of Dengizkul deposit into operation is stipulated by requirements to the long term economic development of the Republic of Uzbekistan as well as social aspects enhancement and welfare increase of service personnel represented by the inhabitants from the adjacent settlements of Kashkadarinsk and Bukhara oblasts.

The above puts environmental security and control during gas and oil field operation in priority.

2 GENERAL CHARACTERISTICS

2.1 ACTUAL STATE OF ENVIRONMENT IN THE CONSTRUCTION AREA

2.1.1 Existing sources of anthropogenic influence
According to the field development process flow diagram 37 wells will be constructed within 12 years. Slanted recovery wells make up most of them.

Within the borders of Alat district Bukhara Oblast, in the region considered, intensive economic activity of other industries hasn’t been observed.

High and low pressure flares at CGPP (complex gas processing plant), industrial and household boiler pipes, pump pits and etc. anthropogenically affecting the environment to different extents are the main sources of hazardous emissions at Dengizkul and Urtabulak operating fields.

It should be noted that each of the two (Dengizkul and Urtabulak) fields emits almost equal quantity of pollutants. Dengizkul CGPP emits 683,458 t of pollutants into the atmosphere per year and Urtabulak – 603,94 t/year.

On the whole, 7 pollutants (nitrogen dioxide, nitrogen oxide, carbon oxide, sulfur dioxide, soot, hydrocarbons and hydrogen sulfide) have been detected in the considered industrial district for the time being. Other substances constitute the minor part in the total gross emission. Hence we can conclude that sulfur dioxide (1141,4503 t/year) is the prevailing ingredient in industrial emissions.

During explorations in course of well construction natural objects in the deposit area were mechanically affected. Taking into account temporality of these works, no environmental degeneration in the deposit area is observed since a number of preventative measures to secure maximally environmental integrity of nature objects were performed.

At the present moment the wells in Dengizkul and Urtabulak deposits are operated, that is connected with hydrocarbon material extraction.

Though motor transport affects air, soil, road-side vegetation condition, the average content of nitrogen oxides, sulfur and carbon as well as soot does not, however, violate sanitary norms because of low traffic.

The operating Dengizkul and Urtabulak gas producing fields are the only industrial water consumers. Amu-Bukhara channel is the water supply source for these gas fields. Water is pumped to the fields through the water conduit from “Hamza” pump pit.
Figure 1 – Khauzak and Shady site plan
During treatment of industrial waste water from Urtabulak and Dengizkul solid wastes, oil sludge mainly, are produced. Oil sludge generation norm is 0,19 t. year. Wastes are disposed at Dengizkul deposit. To collect wastes a special metallic tank was made. In practice, a small amount of wastes and terms of their disposal do not really affect the environment.

Besides, solid wastes of consumption are produced, such as: metal scrap, fluorescent and filament lamps, construction waste from repairs, household wastes (50 kg per one worker per year). Wastes are temporarily stored at specially equipped CGPP sites. Metal scrap goes to “Vtorchermet” organizations, specialized recycling enterprises get fluorescent lamps. Waste quantity is not considerable.

High and low pressure flares and stratum waster water at Dengizkul and Urtabulak are the most significant existing sources of anthropogenic impact.

2.1.2 Climate and atmospheric air

The whole of irrigated zone of Bukhara oblast is located in desert area, in its central and south sub-areas.

The climate of this territory is extremely continental with low precipitation and high summer and low winter temperatures. All these as well as low relative air humidity and often winds increase moisture evaporation from soil layer and promote soil salinization. Low winter temperatures cause upper soil layer freezing that deteriorates its hydrophysical properties and hampers processing and washing.

Average annual temperature fluctuates in the range of 14,4-16,4°C, average monthly temperature of the hottest month July makes up 28,4-29,4°C, in the daytime the maximum air temperature reaches 43,4-46,0 °C, while the minimum temperature during the strong fall in winter (December) drops to –15,2-24,9 °C, with monthly average of –4,8-5,5°C. Average daily temperatures: maximum ones are in late July and early August, minimum – in January-December.

Average annual temperature of soil fluctuates in the range of 19,0-19,5°C, maximum average annual temperature being 37,6-37,8°C, minimum - 7,5-8,2°C. Soil surface temperature in summertime is very high and absolute maxima reach 70-71°C this time of the year. In wintertime it, however, drops to –18-20°C, annual amplitude fluctuations of soil temperature being 45,2-49,2°C.

Average annual amount of precipitations falling in Bukhara and Karakul oases makes up 208,6 mm and 162,0 mm, correspondingly, out of which 114,9 and 76,8 mm, respectively, fall at night and 93,7 and 85,2 mm, correspondingly - in the daytime. According to “Bukhara” and “Karakul” weather stations, maximum amount of precipitations during two days make up 23,1 and 18,8 mm or 66,6 and 39,4% of the average monthly norm, respectively. Maximum precipitations occur in spring (42,5-52,6%), 30,7-57,1% fall in winter, 1,4-16,1% in autumn, while summer is practically rainless (0,5-3,1%).

Average snow cover is 4-5 cm in depth, as a rule, it is loose and unstable and often melts, while in severe winters it can become dense, which causes soil freezing up to 50-60 cm.

Average annual relative air humidity is marked by wide fluctuations in the range of 52-55% at “Karakul” up to 59-61% at “Bukhara” weather station. Winter months are characterized by the highest relative air humidity at the level of 74-85% and summer months by the lowest - 33-45%.

Little precipitations, high air temperature, intensive solar radiation, high relative air humidity cause strong evaporation in the oases.

Annual evaporation makes up 1750-2040 mm. Over 80% of moisture evaporates during the warm six months. Moisture deficit makes up 1580-1770 mm. In summertime the amount of evaporating moisture exceeds atmospheric precipitations 40-45 times approximately, which, in its turn, promotes intensive soil salinization.
According to the wind rose by Karakul weather station northern winds most evidently prevail during summer months, wind direction in wintertime is roughly the same, excluding south-western winds.

As to the air pollution potential (set of meteorological factors stipulating the level of possible air pollution from the sources in this geographic area), Khauzak and Shady territory - Kyzyl Kum desert – is situated in the area of moderate air pollution potential.

Environmental audit was held on the territory of contract sites in late 2004 – early 2005.

Sites atmospheric air was sampled by 22 sampling stations. In some spots high maximum occasional dust content was detected, which can be explained by Kyzyl Kum desert (with Khauzak and Shady located on its territory) referring to the nature resources of atmosphere dustiness. 3-4-fold increase in MPC level of atmospheric air dustiness is observed in the southern and, in particular, in the south-eastern part of the examined territory. Maximum dust concentrations have been observed at the rate of 2,778 mg/m$^3$ (5,6 MPC), minimum ones - at the rate of 0,429 mg/m$^3$ (0,9 MPC).

In all samples collected on the sites methane was found, though its concentration does not exceed approximately safe level of impact (ASLI – 50 mg/m$^3$). Maximum methane concentration in the samples is 2,743 mg/m$^3$. Carbons C$_2$-C$_6$ were not detected there.

Oxygen content in all analyzed samples was a little lower as compared with clean air. No carbon dioxide was found in the samples.

High concentrations of the following components have been observed:
- nitrogen dioxide – from 1,29 MPC to 7,94 MPC;
- nitrogen oxide – from 1,12 MPC to 2,35 MPC;
- ammonia – from 1,07 MPC to 40,835 MPC;
- xylol – from 4,22 MPC to 5,46 MPC;
- toluol – from 2,76 MPC to 4,17 MPC.

As to the rest examined components (carbon oxide, sulfur dioxide, benzol) no MPC exceeding was detected. Sample maximum concentrations made up:
- carbon oxide – 2,3 mg/m$^3$ or 0,46 MPC;
- sulfur dioxide – 0,488 mg/m$^3$ or 0,98 MPC;
- benzol – 0,477 mg/m$^3$ or 0,32 MPC;

2.1.3 Surface and subsurface water

There’s no constant hydrographic network at Khauzak and Shady, except for a well developed drainage system and a discharge collector. The largest of them is South-Dengizkul discharge collector, the flow of which varies from 0,31 to 1,4 m$^3$/c, correspondingly. Collector-drainage water salinity ranges from 10,9 to 13,7 g/l.

Dengizkul lake is situated in Alat district of Bukhara region and originates from a spring. Eastern part Bukhara-Hivinsk area is a downfold zone as compared with Central Kyzylkum. Dengizkul depression (the former lake) is one of such downfolds. Nowadays this depression represents a large saliniferous basin for drainage water collection; it’s total area is 267 km$^2$ and the capacity is $2723,4 \times 10^6$ m$^3$. 
At the present moment the main arm of the Zaravshan river – Taikir, as well as several waste and drainage water channels flows into lake Dengizkul situated in the lower reach of the Zaravshan river in the deepest area of a big tectonic depression. Dengizkul lake is of a closed type.

The area and depth of lake varies constantly: in high-water years the lake surface reached 110-120 thous. ha with the water volume of 3-3.5 bln. m³ and the inmost depth of 25-30 m. At the present moment its area is 50-60 thous. ha. The water is very salty; its bottom is covered with 4-6 cm of salt. According to the data of the Main office of water economy of the Republic of Uzbekistan the estimated water level in lake Dengizkul makes up 184,2 – 184,4 m.

Only 150-230 mln. m³ of water flew into the lake in 1993-2003 instead of 480-550 mln. m³ of water inflow in the years 1985-90. This amount of inflow water doesn’t cover evaporation losses and the water volume decreased by 60%. As a result, the lake area reduced almost twofold and stripped a salted lakeshore line. Water mineralization increased approximately 5-8-fold, including: 8-fold in chlorides, 26-fold in sulphates, 7-fold in nitrates, 6-fold in biological oxygen demand (BOD) content.

25-30% of lake area is covered with rush and bush, which is considered to be favourable for fish reproduction and growth. In spring and autumn birds flyways run through the lake, some of the birds stay for the winter. The lake is an ornithological reserve and is included into the International list of objects of Ramsar Convention on the Wetlands of International Importance especially as wildlife habitat and has a universal importance.

Lake Dengizkul is the largest wintering area for swimming birds (over 50 species) in Uzbekistan, over one hundred species of avifauna use the lake as a flyway in spring and autumn.

In accordance with the art.5 of the Republic of Uzbekistan Act On Specially Protected Natural Areas, “Dengizkul” special nature reserve refers to the territory for natural objects and complexes conservation, reproduction and restoration. It was created by Uzbekistan Government regulation No 530 in 1973 and then prolongated by Bukhara Regional Executive Committee resolution (No 157/11 as of 26.09.90). This special nature reserve is used to protect wildlife and its habitat and conduct scientific researches. Hunting, fishing and plants gathering are prohibited.

According to the regulation No 174 as of 07.04.92 by the Cabinet of Ministers of the Republic of Uzbekistan “On the approval of regulation on the water-protective zones of water reservoirs and other water bodies, rivers and main channels and collectors as well as sources of drinking and domestic water and medicinal and health-improving water in the Republic of Uzbekistan” a sanitary conservation zone of 500 m was established around the lake within the distance of which no disposal sites, industrial waste dumps, chemicals and etc. are allowed.

Civil, dredging and blasting works, mining operations, laying of pipes and other communications as well as other works are performed only upon agreement with Nature Conservation Authorities.

During the Environmental audit conducted at Khauzak and Shady sample analyses were made separately for three groups: water collected from open water reservoirs, ground water and drinking water. In total, 22 water samples were collected on the sites, including 10 samples from surface water reservoirs, 6 ground water samples and 6 drinking water samples.

The analyses results showed the following:

Sulfate and magnesium water predominates in Lake Dengizkul, its mineralization being 20-25 g/l, which manifold exceeds the set MPC level. As the distance of the discharge collector inflow point to the lake increases, water mineralization goes up and exceeds 25 g/l at a small distance from the discharge collector, i.e. Lake Dengizkul belongs actually to the category of saltish water. Though biological and chemical oxygen demands exceed the allowable MPC level on the whole lake surface, but as the distance of the discharge collector inflow point to the lake increases, their
values grow 3 and 15-fold, respectively. BOD and COD are maximum in the south-eastern shore of Dengizkul lake (up to 70 and 50 MPC, correspondingly).

The average amount of dissolved oxygen in the lake makes up 0.5 mg/l, which is 8 times lower than the minimum limit set for the fishery bodies of the 2nd category. At the same time the amount of dissolved air in the discharge collector water corresponds to the value set for the fishery bodies of the 1st category.

The amount of phenol in Lake Dengizkul goes up as the distance of the discharge collector inflow point increases and its concentration exceeds the set MPC in the middle of the lake water surface, its maximum concentrations being detected on the north-eastern lakeshore of Dengizkul.

Comparison of phenol allocation in Dengizkul water and atmospheric air testifies to the fact that the increase in phenol concentration as the distance to the north-eastern lakeshore decreases (approximately in the mining allotment area located in the middle of the lake) is logical.

Benzol and oil products in the ground water have been detected at all sampling stations, however, their concentrations do not exceed the set MPC.

All over the ground water suspended solids and dry residue exceed the allowed MPC 25 times (from 25 to 48 MPC), total water mineralization – 27.5 times (from 9,18 to 47.8 MPC), BOD and COD (from 4.29 to 41.2 MPC), BOD₅ (from 3.07 to 29.4 MPC). Ammonium, nitrites and carbonates ions haven’t been found in the ground water. High concentration of Xylol - from 3.4 to 105 MPC was detected there.

Ammonium, cadmium, copper, nickel, lead, iron and zink were found in the drinking water but their concentrations are considerably lower that the allowed MPC. Not all these substances exceeded MPC: cadmium (from 3 to 10 MPC), aluminium (2.3 times more than MPC) with practically no concentrations of it in artesian wells. Pesticides in the drinking water were not found either. Benzol and oil products were detected but their concentrations in the drinking water was considerably lower than the MPC. Water from artesian wells used on the site as drinking water is mineralized, its mineralization exceeding MPC 6.6-7.2 times. According to sanitary and bacteriological characteristics water from only one artesian well meets the set norms.

Microorganisms capable to reproduce due to oxidation of oil hydrocarbons are found in all water samples (excluding discharge water collector) and bottom silts. In most samples their number is in the range of 10⁷-10⁹ cells per 1 ml.

According to subsurface water difference in age and lithologic deposits on the considered territory, the following hydrogeological elements can be distinguished: aquiferous, locally aquiferous, water permeable, but waterless and water-proof complexes, crack aquiferous zones.

The examined plot for the planned construction belongs itself to the Bukhara-Karshinsk artesian basin. According to the surveys, quaternary deposits aquifer system is the closest to the ground surface. Groundwater depth is 10 meters and more.

Subsurface water mineralization is over 3g/l. Water type changes from hydrocarbonate calcium to sulphate chloride water. Water is salty and can be used only as utility water; subsurface water is fed through filtration of discharged surface water from the main collector and partly by means of precipitants infiltration.

Subsurface water is opened for the period of geological engineering survey at the depth of 0.6-2.1m in the area of highway construction near the frontier post and on the territories adjacent to lake Dengizkul (bordering on Turkmenistan).

2.1.4 Soils
Soil cover consists mainly of grey-brown poor-developed, desert sand soils. These are automorphous soils of the desert zone, referring to relatively postmature surfaces. As to the mechanical makeup, soils and subsoils are basically light granulated: loamy sand, sand, more rarely loam. Medium and heavy loam layers are also found. Fine dust particles (0,1-0,05 mm) prevail among the soil fractions. These soils contain a small amount of humus (0,4-0,8%), nitrogen, phosphor and potassium. Their formation occurs at the close ground water level to the ground surface (1,5-2m).

All soils and subsoils of the site subject to salinization, the degree of which varies from slight to strong, this being stipulated by the macro-and micro relief of the terrain, hydrogeological conditions and subsoils mechanical content. As to the chemical nature of salinization, the soils and subsoils are mostly sulphate-chloride, more rarely chloride-sulphate.

Soils (subsoils) sampling during the environmental audit at Khauzak and Shady, conducted at 22 sampling stations (0,3-6 m in depth) and 6 sampling stations near the formerly drilled wellheads showed the following:

At some spots of Khauzak site oil products content in soils (sampling depth up to 0,3 m) 5-6-fold exceeds their concentration in the subsoils (sampling depth up to 6 m), which can be explained by fraction composition of the soil, dominated by fine dust particles preventing from oil products “penetration” in the soil depth. Nowadays soils pollution caused by anthropogenic activities, for instance, well drilling, is therefore observed mainly in the surface layer.

Out of organic matters in the bottom silts, xylol, phenol as well as synthetic surfactants have been found. Benzpyrene is the main representative of multiring aromatic hydrocarbons detected in bottom silts. However, its content in bottom silt samples is low and it brings no carcinogenic risk to the environment.

Khauzak and Shady are distinguished by high hydrocarbon content in soil and bottom silts, with maximum number of oil- and phenol-oxidizing bacteria found in Khauzak as a whole and in single spots of Shady (near the north-eastern shore of Lake Dengizkul), which, in turn, correlates with phenol allocation in the atmospheric air, water and soil.

The number of microorganisms in the single samples of the soil and bottom silts of the considered territory reaches $10^5-10^6$ of cells per 1 g.

As to the subsoils, according to the engineering-geological researches and on the basis of physical and mechanical properties of subsoils, three geotechnical elements (GTE) have been singled out. The most details description of subsoils parameters, with a view to implementation of industrial construction upon the materials of engineering-geological researches, was given in the EIS.

2.1.5 Flora and Fauna

The nature of soils and their wetting degree determines vegetation cover development.

Vegetation in this region is represented mainly by mixed herbs and shrubs on the sand.

The following plant associations have been found out: ephemer-wormwood and amber-black brown. The prevailing plants are: alhagi (camel's-thorn), asparagus, calligonum, Salsola Richteri and other species of saltworts (Salsola arbuscula, Salsola gemmascens). Saxaul, several species of “suzerain”, sandhill wattle, aristida (pictures 8-11). Takyrlic soils are characterized by different types of wormwood: with psammophyte shrubs, ephemer and Calligonum. On saline lands saltwort-ephemer plants are widespread.

Large areas of channel- and lakeshores are covered with tamarisk brushwood with some alhagi and saltworts. Poplars (P. pruinosa and P.diversifolia) and horsetail (Equisetum
rmosissimum) grow along the water basins. Reed, blackamoor, meakin, bladderwort and etc. grow in the water basins.

The flora is represented by 13 endemic species and 3 red-listed species, 14 rare and 19 scanty species on the whole.

To the present moment 30% of soil is covered with vegetation. Plants have morphological changes but they are minor (mainly necroses). Vegetation is very thin; there are spots with no vegetation at all.

The Fauna is represented by 27 species of mammals, 17 species of reptiles, over 160 species of birds, out of which 3 species of mammals, 24 species of birds, 2 species of reptiles and 7 species of arthropoda are red-listed.
The lesser white-toothed shrew and piebald shrew are widespread on the territory considered. They are active mainly at night in autumn, sometimes in the daytime. The species population varies.

The long-eared hedgehog is widespread on the whole territory. It lives in holes and eats different food: ground beetle, scarabs, acridoid grasshoppers, butterfly caterpillars, beetles and etc. It also eats vertebrates (lizards, small birds) and plants. The Brandt's hedgehog is less common than the long-eared hedgehog and lives in the same conditions as the long-eared hedgehog. Red-listed. The European free-tailed bat is a red-listed vulnerable rare species of bat.

The tolai hare, long-clawed ground squirrel, Severzov's Jerboa, southern jird, Libyan jird, giant day jird are the typical faunal forms of these region.

Fox is a bit smaller and lighter here than in other places.

The Caffre cat living in some habitats is relatively small by size. Marbled polecat is a numerically insignificant species. Steppe polecat is a very rare species on this territory.

The goitered gazelle used to be wide-spread in the desert of the considered territory. Intensive desert land development and animal breeding as well as poaching caused rarity of the goitered gazelle as species and it was red-listed.

Researches of the avifauna showed that there are over 160 species of birds inhabiting the territory, about 40 species are nesting there. 24 species are red-listed. A lot of bird species visit the area during seasonal migrations. Typical inhabitants: sky lark, fringillidae family, chats, sand grouses, small predatory birds, besides the lake is also inhabited by aquatic and semi-aquatic birds. To protect the birds an ornithological reserve was created on the territory of Lake Dengizkul in 1973 and exists till nowadays. The lake is inscribed into Ramsar Convention as a wetland having international importance in the quality of aquatic bird’s habitat.

The birds of pray are represented by a great many of falcon and goshawk species.

Besides, many other species of birds are found on the sites: corvidae family, coraciiformes, starlings, fringillidae family, sky larks, wagtails, warblers, the Turdinae and other.

The territory of the area considered is inhabited by many reptile species, which, due to their biology, can be rare and numerous: toad agama, sunwatcher, plate-tailed gecko, racerunner, Eremias lineolata, Eremias intremedia, Eremias grammica, Coluber karelini, corn snake (Elaphe guttata), Psammophis lineolatus and etc.

The steppe tortoise inhabits loess-like, sandy-loam and sandy areas of the plain and foothills. A lot of tortoises used to be found everywhere.

The steppe agama is a widespread common species on this territory.

The desert monitor is a scanty red-listed species.

The Tartar sand boa inhabits sandy areas fixed and semi-fixed sands.

The Central Asia cobra was sometimes found. Red-listed.

From the amphibia the green toad and lake frog inhabits the area considered.

The ichthyofauna of lake Dengizkul is basically known for its commercial fish species: European carp, pikeperch, zherekh, fresh-water catfish, shemaya, carpbread and snakehead. There
are other fishes in the lake; they don’t have any commercial value but constitute an integral part of the water body ichthyofauna and are particular valuable in biological diversity.

To determine physical and chemical conditions impact of the territory NE on the physiological state of living organisms and vegetation within the Environmental audit, ecotoxicological researches on microelements and pesticides accumulation in local plants tissue were pursued.

Their results showed that physical and chemical conditions of the sites Khauzak and Shady are, on the whole, unfavorable and produce a negative effect on the physiological state of flora and, subsequently, fauna, though it is local.

Liver dysmorphology, hepatocyte necrobiosis and dissection of muscle fibres (myopathy) is mainly true for the rodents eating tree roots than those eating fruit, which have comparatively less manifested functional disorders only in liver tissue.

Liver dysmorphology, partial hepatocyte necrobiosis and dissection of muscle fibres (myopathy) are mainly true for herbivorous fishes. No visible histopathological changes in predatory fish have been detected in any of the examined tissues (muscles, liver, gonads).

The above noted negative impact on flora and fauna is local.

2.1.6 Landscape

According to the ecological map of the Republic of Uzbekistan the ecological situation intensity is moderate in this region, i.e. no big anthropological impact has been made on the landscape.

The construction site is defined as a hilly sand plains landscape with wormwoods and kandynamik on desert sand soils, barchan sands spots with pioneer-psammophyte aggregations.

Cultural and historical monuments haven’t been recorded in Khauzak and Shady area.

Economic land development and construction and operation of gas producing and gas-transport facilities have increased the anthropogenic pressure to a certain extent.

However, negative impact on the flora and the fauna as well as landscape is, on the whole, weak due to the dispersal of industrial facilities.

2.2 HEALTH STATE OF PERSONNEL

There’s no standard residential population in the construction area, excluding personnel maintaining the prospective production and frontier post military personnel.

Gas-condensate deposits exploitation causes hazardous substances emission into the atmosphere, the main of them being combustion and natural gas underburning products at the existing sources as well as the components of natural gas itself.

Thus, the chemical matters – sulfur dioxide, nitrogen oxide and dioxide, carbon oxide, hydrogen sulfide, methane, oil products in water, volley compound discharges - $\text{CH}_4+\text{H}_2\text{S}+\text{RSH}$ – are health hazardous (in industrial and living conditions). These factors can promote development of occupational diseases, such as chronic and acute poisoning, chronic toxic bronchitis, pneumosclerosis and etc.

Air salinity and dustiness can cause certain diseases, such as chronic dust bronchitis, bronchial asthma, pneumonia and etc.
Personnel temporarily staying on the facility site can, supposedly, have typical diseases true for the residents of Bukhara oblast: hepatitis, diseases of the digestive apparatus, diseases of respiratory apparatus, cardiovascular disease – which can be prevented by preliminary and systematic medical examinations of personnel, medical service arrangement, and compulsory vaccination of personnel as well as teaching personnel the main rules of hygiene and sanitation.

Negative impact of hazardous industrial and natural factors on the personnel’s health will be minimized by means of preventive measures oriented at prophylaxis of general and occupational morbidity and health protection of personnel.

2.3 CONCISE DESCRIPTION OF CONTRACT AREAS

Administratively Khausak and Shady sites are situated in Alat district Bukhara oblast the Republic of Uzbekistan.

The closest settlement is the city of Alat located 60 km to the north-west. 8-10 km to the east of the deposits the settlement of Dengizkul is situated, and the district center Mubarek (Kaga-Karshi railroad) is 120 km to the east. 20 km to the south-east of the deposits Urtabulak gas field is situated.

Exploratory drilling at Khauzak-Shady was commenced in 1967. Drilling of the well 1 on Khauzak site in 1968 revealed industrial gas presence in the upper jurassic carbonate deposits. The main exploratory works in this area were finished in 1974, though supplementary exploration of its single spots continued up to 1993. In total, 20 exploratory and one observation well were drilled in Khauzak area.

Most of them (16 wells) was drilled during 1967-74 and closed down as having been fully recovered. Nowadays practically all these wells are flooded by Lake Dengizkul. Two more exploratory wells 301, 301 and one monitor well 242 were drilled in 1988-93; as of 01.10.2001 they belong to the monitor wells fund (to my opinion, they still belong to it as far as they are not in the LUKOIL balance).

Shady located to the north of Khauzak was first preliminary drilled in 1972. Industrial gas presence in the jurassic carbonate deposits was detected during the testing of the well 1 in this area in 1974, which was confirmed by the testing of the exploratory wells 2 and 3. The drilling results of the exploratory wells 4,5 and 5 and testing prospecting wells allowed concluding that Shady together with Khauzak is a single, large-scale gas-condensate deposit. In total, 8 exploratory wells were drilled at Shady. In recent years a range of seismic exploration works have been performed.

The peculiarities of geographical location of Khauzak and Shady of Dengizkul deposit are:

- sites location in a desert zone, pretty distantly from human settlements;
- no drinking water supply sources in this area;
- Khauzak and Shady location comparatively closely to other important facilities of oil-gas industry;
- facilities dislocation in extremely continental climatic zone;
- location in the area with poor-developed road system and infrastructure.

Khauzak XY horizon productivity was detected as a result of exploratory wells testing. In terms of lithologic-geophysical properties and formation conditions XV horizon carbonate deposits are conventionally subdivided into 3 formations (from bottom to top): subreef (SR), reef (R), above-reef (AR).
The lower part of the horizon (XVSR) was determined as unpromising. During XVP horizon testings at Khauzak commercial gas inflow with an output from 140 to 450 thous. m³/day was produced. During XV-HP horizon testings commercial gas inflow with an output from 28 to 381 thous. m³/day was obtained. Thus, resulting from the tests, commercial gas presence was detected in XV- P, XV-HP horizons. Besides, in the lower XV-HP horizon in the south-east of Khauzak area (wells 14, 5, 12) a fissile stratigraphic equivalent of Khauzak reef knolls is distinguished. Reef bed is multipay. Its size is 1.3-2.3 x 2.7-3.5 km, the height ranges within 18-12 m. GWC of the reef bed is detected at 2332 m; of the lower above-reef bed – at 2336 m. The above-reef bed is multipay-common contact, lithologically screened from the east. Bed size is 29 x 12-14 km, height 40-150 m (pictures 7 and 8).

Gas bed is covered with sulphate-halogen Kimmeridgium-Tithonian deposits, the capacity of which ranges from 200 to 506 m. Gas-water contact was detected at 2332 m. Strata pressure made up 277,3 kg/cm², temperature – 98 °C.

Khauzak and Shady blanket gas composition is as follows: methane – 88,15%, ethane – 1,38%, propane – 0,32%, butane – 0,17%, pentane plus – 0,52%, hydrogen sulfide – 4,25%, carbon dioxide 4.3%, nitrogen – 0,31%, density – 0.769 kg/m³. Deposits gas is methanic and dry. One cubic meter of gas contains 56,6 g of sulfur.

Deposits condensate is heavy, high-sulfur and basically is composed of benzene and kerosene fractions. By hydrocarbon group content of benzene fractions condensate is of methane-aromatic-naphthenic type (table 1).

Table 1 - Group hydrocarbon composition of stable condensate

<table>
<thead>
<tr>
<th>Fractions, °C</th>
<th>Output, weight in %</th>
<th>Hydrocarbon content in condensate, weight in %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aromatic</td>
<td>Naphthenic</td>
</tr>
<tr>
<td>Up to 60</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>60-95</td>
<td>3.8</td>
<td>1.0</td>
</tr>
<tr>
<td>95-122</td>
<td>10.8</td>
<td>3.1</td>
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<tr>
<td>122-150</td>
<td>13.0</td>
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<td>150-200</td>
<td>15.1</td>
<td>3.3</td>
</tr>
<tr>
<td>&gt;200</td>
<td>57.3</td>
<td>12.1</td>
</tr>
<tr>
<td>100.0</td>
<td>24.0</td>
<td>29.2</td>
</tr>
</tbody>
</table>

Stratum water connected to the gas-bearing intervals has mineralization from 85 to 108 g/l within Khauzak deposits. Chloride-sodium and chloride-potassium prevail in this water. It contains high concentrations of iodine (up to 31 mg/l), bromine (up to 329 mg/l), boron oxide (not more than 102 mg/l).

The set potential condensate content is 24.3 g/m³.

Thus, the main peculiarity of these sites is high content of hydrogen sulfide and carbon dioxide in natural gases.

However, the deposits belong to complicated geological and field facilities and many parameters have to be specified. Based upon the results of production wells drilling and their operation, filtration and capacity characteristics of gas deposits and wells deliverability will be specified.
Figure 7 - Khauzak and Shady XV-HP horizon confining layer subsurface map.
Figure 8 - Pay section geologic profiles on the line of wells 302, 301, 14-X, 10-X, 13-X, 13-CD
3 ECOLOGICAL ANALYSIS OF PROCESS SOLUTIONS

3.1 DEVELOPMENT PARAMETERS

Reservoir simulation model and technological parameters design procedure are accepted on the basis of the main geological and physical peculiarities and processing factors influencing the process of development:

- two gas-bearing beds have been distinguished, the main gas reserves are accumulated in the average part of XV-HP horizon;
- different types of carbonate collectors, FCS (filtration-capacity-structure) heterogeneity in terms of area and profile have been defined;
- elevated concentrations of hydrogen sulfide (4,25%) and carbon dioxide (4,3%) in blanket gas, different initial condensate content in gas (24 g/m³ in the middle of XV-HP horizon, 37 g/m³ in XV-P + low synchronous part of XV-HP horizon), high condensate density of 0,821 and 0,823 g/cm³ in the horizons correspondingly have been detected;
- a single gas-pool outline with the adjacent Dengizkul site that have been developed since 1981;
- as far as the contract area hasn’t been yet developed, the last results of hydrodynamic research of re-activated wells from the past years and initial wells drilled within the pilot well program on the cluster No 16 as well as data and experience in the development of sites excluded from the contract area, including Dengizkul site, constitute the basic initial data to predict technological parameters;
- an anthropogenic lake above Khauzak and Shady, occupying 80% of the gas content area.

To calculate technological parameters a 3D compositional hydrodynamic model created on the basis of Schlumberger Eclipse software.

To design Khauzak and Shady contract area development, the following initial data were taken:

- Contract site reserves singled out in the “Estimation of hydrocarbon reserves on Khauzak and Shady contract site” based upon Dengizkul deposits gas, condensate and sulfur reserves by C1 and C2 categories, set by the SRC of the Republic of Uzbekistan in 1996.
- well hydrodynamic and gas-condensate research data;
- laboratory research data of physical and chemical properties of formation fluids;
- actual data on the mining sites excluded from the sites contract area, including Dengizkul, planned gas withdrawal rates on Dengizkul site.

Works earlier performed with respect to Dengizkul deposit serve as initial data sources to make process designs.

Table 2 - Geological structure for process designs

<table>
<thead>
<tr>
<th>Name</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average depth of the object bedding, m</td>
<td>2460</td>
</tr>
<tr>
<td>Parameter</td>
<td>Value</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Object dimensions (length/width), km</td>
<td>23x9</td>
</tr>
<tr>
<td>Gas content area, km&lt;sup&gt;2&lt;/sup&gt;</td>
<td>262.7</td>
</tr>
<tr>
<td>Average effective gas net pay, m</td>
<td>14.5</td>
</tr>
<tr>
<td>Average gas saturation, decimal fractions</td>
<td>0.78</td>
</tr>
<tr>
<td>Average water saturation, decimal fractions</td>
<td>0.22</td>
</tr>
<tr>
<td>Porosity, decimal fractions</td>
<td>0.13</td>
</tr>
<tr>
<td>Permeability after model adaptation, x10&lt;sup&gt;-3&lt;/sup&gt; m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>6</td>
</tr>
<tr>
<td>Stratal pressure, MPa</td>
<td></td>
</tr>
<tr>
<td>including:</td>
<td></td>
</tr>
<tr>
<td>- initial</td>
<td>26.8</td>
</tr>
<tr>
<td>- on the date of design document drawing up</td>
<td>24.4</td>
</tr>
<tr>
<td>Stratal temperature, °C</td>
<td>98</td>
</tr>
<tr>
<td>In-situ fluids properties</td>
<td></td>
</tr>
<tr>
<td>- gas density, kg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>175</td>
</tr>
<tr>
<td>- water density, kg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1100</td>
</tr>
<tr>
<td>- gas viscosity, MPaxc</td>
<td>0.023</td>
</tr>
<tr>
<td>- water viscosity, MPaxc</td>
<td>0.43</td>
</tr>
<tr>
<td>- moisture content of blanket gas, g/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>4.4</td>
</tr>
<tr>
<td>Blanket gas density at 20°C, kg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>784</td>
</tr>
<tr>
<td>Condensate density, kg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>821</td>
</tr>
<tr>
<td>Reserves of blanket gas C&lt;sub&gt;1&lt;/sub&gt;+C&lt;sub&gt;2&lt;/sub&gt;, bln.m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>107.003</td>
</tr>
<tr>
<td>Stable condensate content in blanket gas, g/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>25.4</td>
</tr>
<tr>
<td>Stable condensate reserves, thous. T</td>
<td>2797</td>
</tr>
<tr>
<td>Sulfur content in blanket gas, g/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>56.6</td>
</tr>
<tr>
<td>Sulfur reserves, thous.t</td>
<td>6147</td>
</tr>
</tbody>
</table>
Table 3 – Initial data for process designs

<table>
<thead>
<tr>
<th>Name</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtration resistance factors:</td>
<td></td>
</tr>
<tr>
<td>Khauzak site</td>
<td></td>
</tr>
<tr>
<td>A, MPa^2/(thous.m^3/day)</td>
<td>0,43537</td>
</tr>
<tr>
<td>B, (MPa/(thous.m^3/day))^2</td>
<td>0,0003192</td>
</tr>
<tr>
<td>Shady site</td>
<td></td>
</tr>
<tr>
<td>A, MPa^2/(thous.m^3/day)</td>
<td>0,303697</td>
</tr>
<tr>
<td>B, (MPa/(thous.m^3/day))^2</td>
<td>0,0005473</td>
</tr>
<tr>
<td>Drag coefficient for lifting 89 mm</td>
<td>0,035</td>
</tr>
<tr>
<td>Drag coefficient for lifting 101 mm</td>
<td>0,018</td>
</tr>
<tr>
<td>Average well flow rate on gas, thous.m^3:</td>
<td></td>
</tr>
<tr>
<td>Khauzak site</td>
<td>485</td>
</tr>
<tr>
<td>Shady site</td>
<td>496</td>
</tr>
<tr>
<td>Maximum rate limitation to well-head, m/c</td>
<td>10</td>
</tr>
<tr>
<td>Maximum permissible differential pressure drawdown, MPa</td>
<td>6</td>
</tr>
<tr>
<td>Minimum well-head pressure, MPa</td>
<td>1</td>
</tr>
<tr>
<td>O Coefficient</td>
<td></td>
</tr>
<tr>
<td>- for tubing string - 89 mm</td>
<td>0,000032</td>
</tr>
<tr>
<td>- for tubing string - 114 mm</td>
<td>0,0000672</td>
</tr>
<tr>
<td>Well operation rate, decimal fractions</td>
<td>0,95</td>
</tr>
<tr>
<td>Operating well stock reserve, %</td>
<td>15</td>
</tr>
</tbody>
</table>

Hydrodynamic model includes all main geological and physical and technological particularities of Khauzak and Shady. Bottom and edge stratum water presence, gravity force, wells placement in the area, perforation intervals, processing limits are also considered in the model.

To design digital geological and filtration models of Khauzak and Shady the following main data are used:
- coordinates, altitudes and well deviation survey;
- seismic horizons surfaces under 3D-seismicity interpretation;
- GIS data;
- wells hydrodynamic and gas-condensate research data;
- formation fluids components and its physical and chemical properties (gas, condensate and water);
- analyses data on development of Dengizkul deposit industrially-used site;
- mean values of stratal temperature and deposits pressure;
- relative permeability values.

Hydrocarbon reserves were cumulatively calculated, i.e. by summing up hydrocarbon reserves in each cell.

Discrepancy between the reserves of hydrodynamic flow network and geological model for each strata have not exceeded 0,5%. Initial stratal temperature of both productive strata equals to 98°C.
Hydrodynamic tests describe gas by composition model allowing reasonable considering of phase transformation and blanket gas properties at pressure lower than that at the beginning of condensation, as well as predicting the dynamics of recovered gas composition in the process of development.

Blanket gas actual components are: carbon dioxide, hydrogen sulfide, methane, ethane, water. Due to a relatively small amount of nitrogen in gas, it refers to methane and, similarly, propane and butanes are added to ethane.

**Table 4 - Blanket gas blend composition**

<table>
<thead>
<tr>
<th>Component No</th>
<th>Name</th>
<th>XV-HP average part</th>
<th>XV-P+ low synchronous part of XV-HP horizon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>carbon dioxide</td>
<td>4,3</td>
<td>4,3</td>
</tr>
<tr>
<td>2</td>
<td>hydrogen sulfide</td>
<td>4,25</td>
<td>4,25</td>
</tr>
<tr>
<td>3</td>
<td>methane (+ nitrogen)</td>
<td>88,58</td>
<td>88,89</td>
</tr>
<tr>
<td>4</td>
<td>ethane (+ propane + butane)</td>
<td>2,47</td>
<td>1,94</td>
</tr>
<tr>
<td>5</td>
<td>light fraction (C₅₋₉)</td>
<td>0,21</td>
<td>0,37</td>
</tr>
<tr>
<td>6</td>
<td>heavy fraction (C₁₀+)</td>
<td>0,19</td>
<td>0,25</td>
</tr>
<tr>
<td>7</td>
<td>water (g/m³)</td>
<td>4,4</td>
<td>4,4</td>
</tr>
<tr>
<td>8</td>
<td>potential C₅+ (g/m³)</td>
<td>24</td>
<td>37</td>
</tr>
</tbody>
</table>

With respect to geology concepts and data on Dengizkul site development, gas reservoir drive is assumed. Based upon this, boundary conditions have been specified in the model, corresponding to the inactive aquifer basin with a limited external boundary.

To get information on stratal pressure values, current gas-condensate characteristics of wells, formation fluids content, researches of the wells No 302, 301, 242 and 173G were pursued in late 2006 – early 2007.

During designing stratal pressure distribution in Khauzak and Shady sites was determined. In the area of the wells 242, 173G and 301 underpressure has been already detected. At the same time, the stratal pressure of the well 302 is initial.

Dengizkul deposit drained reserves are estimated at the rate of 175 bln.m³ of gas, which exceeds the site approved reserves (160.6 bln m³) by 14.4 bln m³. Accumulated gas withdrawn at Dengizkul makes up 94.97 bln m³ as of 01.01.2007, which constitutes 54.27% of the drained reserves.

Three types of field development (plus one for the long term) are considered in the process flow-chart of Khauzak and Shady contract sites, characterized by different gas recovery capacities (1.9, 3.0 and 4.5 bln m³/year) and operating well stock (23, 37 and 63 units).

Operating practices of planned wells were estimated at all considered options with regard to the following limitations:
- maximum permissible pressure drawdown - 6,0 MPa;
- maximum rate to the well-head shall not exceed 12 m/sec;
- minimum well-head pressure 1 MPa.
All the options consider the transfer of three exploratory wells No 242, 301, 302 to the operating well stock.

Upon the engineering-and-economical performance the option of an annual withdrawal rate of 3,0 bln and operating well sock of 37 units is recommended for implementation. Three earlier drilled monitor wells at Khauzak can be used as recovery wells. Most of the wells are slanted, with bottom holes under the basin of Lake Dengizkul; one well has horizontal drilling-in and vertical wells.

72.0 bln m³ of gas, or 76.8% of its initial reserves, are extracted from the gas deposit during the estimated period. Stabe condensate resources will make up 935,7 thous. t (table 5).

For the period of development 37 wells constitute the operating well stock. Constant annual gas withdrawal at the rate of 3,0 bln m³ is predicted up to the 12th year inclusively. During this period 33.7 bln m³ of gas, or 359% of its initial reserves, will be recovered and stable condensate reserves will make up 504,5 thous. t or 24.8%.

Table 5 – Gas and condensate recovery in Khauzak and Shady

<table>
<thead>
<tr>
<th>Years</th>
<th>Gas recovery for the period, bln m³</th>
<th>Gas recovery from the moment of development, bln m³</th>
<th>Stable condensate resources, thous. t</th>
<th>Withdrawal, % from IOIP</th>
<th>Operating well stock, end of the period, units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From the moment of development, bln m³</td>
<td>From the moment of development</td>
<td>Gas</td>
<td>Condesate</td>
<td>Gas</td>
</tr>
<tr>
<td>1</td>
<td>0.98</td>
<td>1.0</td>
<td>24.5</td>
<td>24.5</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>2.52</td>
<td>3.5</td>
<td>51.4</td>
<td>75.9</td>
<td>3.7</td>
</tr>
<tr>
<td>3</td>
<td>3.00</td>
<td>6.5</td>
<td>54.3</td>
<td>130.2</td>
<td>6.9</td>
</tr>
<tr>
<td>4</td>
<td>3.04</td>
<td>9.5</td>
<td>49.8</td>
<td>180.0</td>
<td>10.2</td>
</tr>
<tr>
<td>5</td>
<td>3.06</td>
<td>12.6</td>
<td>46.7</td>
<td>226.7</td>
<td>13.4</td>
</tr>
<tr>
<td>6</td>
<td>3.04</td>
<td>15.6</td>
<td>43.7</td>
<td>270.5</td>
<td>16.6</td>
</tr>
<tr>
<td>7</td>
<td>3.02</td>
<td>18.6</td>
<td>41.7</td>
<td>312.1</td>
<td>19.9</td>
</tr>
<tr>
<td>8</td>
<td>3.03</td>
<td>21.7</td>
<td>40.8</td>
<td>353.0</td>
<td>23.1</td>
</tr>
<tr>
<td>9</td>
<td>3.02</td>
<td>24.7</td>
<td>39.2</td>
<td>392.2</td>
<td>26.3</td>
</tr>
<tr>
<td>10</td>
<td>3.00</td>
<td>27.7</td>
<td>38.2</td>
<td>430.4</td>
<td>29.5</td>
</tr>
<tr>
<td>11</td>
<td>3.03</td>
<td>30.7</td>
<td>37.7</td>
<td>468.1</td>
<td>32.7</td>
</tr>
<tr>
<td>12</td>
<td>3.00</td>
<td>33.7</td>
<td>36.4</td>
<td>504.5</td>
<td>35.9</td>
</tr>
<tr>
<td>13</td>
<td>2.79</td>
<td>36.5</td>
<td>32.7</td>
<td>537.1</td>
<td>38.9</td>
</tr>
<tr>
<td>14</td>
<td>2.54</td>
<td>39.1</td>
<td>28.9</td>
<td>566.0</td>
<td>41.6</td>
</tr>
<tr>
<td>15</td>
<td>2.25</td>
<td>41.3</td>
<td>25.0</td>
<td>591.1</td>
<td>44.0</td>
</tr>
<tr>
<td>16</td>
<td>1.99</td>
<td>43.3</td>
<td>21.9</td>
<td>613.0</td>
<td>46.1</td>
</tr>
<tr>
<td>17</td>
<td>1.84</td>
<td>45.1</td>
<td>20.1</td>
<td>633.1</td>
<td>48.1</td>
</tr>
<tr>
<td>18</td>
<td>1.70</td>
<td>46.8</td>
<td>18.4</td>
<td>651.5</td>
<td>49.9</td>
</tr>
<tr>
<td>19</td>
<td>1.55</td>
<td>48.4</td>
<td>16.7</td>
<td>668.2</td>
<td>51.6</td>
</tr>
</tbody>
</table>
The chosen option has the following characteristics:

- development of production zones by natural pressure depletion with annual gas withdrawal of 3,0 bln m³ during constant mining;
- acid treatment and acid fracturing are applied here to increase wells capacity;
- brining in Khauzak wells is planned from the first year of development, Shady wells are put on production to maintain the planned gas production level commencing from the eighth year of development.

This option includes changes in the idea of contract area geology and accordingly the new wells are allocated on the area maximum uniformly (due to the peculiarities of cluster foundations allocation along the lake shoreline) in the zones of maximum gas net pay with the distance up to 1500 – 2000 m between the bottomholes of producing wells. 30 wells are situated in the southern and south-western part of Khauzak and 7 wells are in the western part of Shady (picture 9). The scheme is preliminary and approximate and is to be specified in future due to the specific patterns. The same applies to the pictures 13 and 16.
Average gas flow rate per running well of the object will make up 504,0 thous. m³/day at 4.3 MPa of pressure drawdown during the initial stage of development. Average gas flow rate will be 231 thous. m³/day at the beginning of production decline and will decrease to 44 thous. m³/day at 3 MPa in pressure drawdown by the end of the whole calculated period (65 years).
Average stratal pressure in the well drainage area will drop to 10.3 MPa at the end of constant sampling period; and to 4.4 MPa by the end of the whole calculated period (65 years). Weighted average reservoir pressure of contract area will make up 16.8 MPa by the end of the constant sampling period and 6.1 MPa—at the end of the calculated period (65 years).

In terms of a weak water drive the accumulated water production in the contract area will make up 528 thous. tons by the end of the period; and 3129 thous. tons by the end of the calculated period (65 years).

To ensure projected samplings in the first year of development, 10 recovery wells are developed at Khauzak. By the end of the period of constant sampling the operating well stock will be represented by 37 wells (30 wells at Khauzak, 7 wells at Shady).

**Figure 10 – Development parameters**

![Graph showing development parameters](image)
Figure 11 - Gas and condensate cumulative production

Figure 12 - Running well stock and average gas flow rate
Well design, namely quantity, strings dimension-type, their running depth, rock destruction tool diameters as well as to of cement (CT), cementing methods are chosen depending on mining and geological conditions.

The main requirements to the construction of gas and gas-condensate wells are:
- structural efficiency combined with casting string and cement sheath integrity in annular space;
- achievement of designed production conditions of wells;
- maximum reservoir energy consumption to transport it through infield and main pipelines.

Top of the cement behind the production string is up to the well-head on which a casing head is installed. The wellhead is fitted with a cross-type production tree made from non-corrosive material. Production tree consists of manometers, valves, nipples allowing setting process mode of operation, conducting research of wells, well killing during overhauls.

As far as gas has excessive corrosion aggressiveness (hydrogen sulfide and carbonic acid) a packer is installed at tubing strings (TS) lowered into the well for operation, and the tube space between TS and production string are filled with corrosion inhibitor solution.

Upon consideration of various alternative technical capabilities of this specific facility it was decided to use the following principle solutions:
- application of cluster drilling method;
- recovery wells will be drilled in such a way that their heads are located about 40 m away from each other in a straight line alignment;
- wells will be connected with multiple well platforms situated maximally closely (by norms) to the well-heads by specific pipelines.

By the order of the State Environmental Committee of the Republic of Uzbekistan the EIS projects on slanted and vertical wells, wells with horizontal drilling in and a rat hole were implemented separately at Khauzak and Shady contract sites, which received positive expert reviews by the State Environmental Expertise (as of August, 29 2005 No 18/227z, as of August, 29 2005 No 18/226z, as of September, 9 2005 No 18/243z, as of December, 19 2005 No 18/366z).

Based upon the lithological composition of pay deposits of Khauzak and Shady sites, boric acid solutions with elevated concentration are recommended for use to intensify gas influx during acidizing. Organic acids (acetic, citric acid and so on), as well as surfactants are recommended for use as a stabilizer preventing repeated settling-out caused by processing.

More considerable well deliverability can be reached by hydromechanical methods of bed stimulation. Beds hydrofracturing in gas-oil-condensate deposits showed that upon successfulness of this procedure productivity can increase 2-3-fold on average. When wells are selected for hydrofacturing, their structural location and, in particular, gas-water contact (GWC) position should be taken into account.

To improve “bed-well” association in pay deposits the following methods and technologies can be tried:
- powder generators of pressure and beds processing with combustible and oxidizing mixtures can be applied in gas wells to increase production;
- change of reservoir gas-dynamic fracturing by application of combustible and oxidizing mixtures;
- well deliverability development by means of explosive and pulse technologies
- utilization of influx intensifying technologies as pulse technologies during well construction; major well injection.

The amount of acid solutions and acid-rock reaction period for Khauzak and Shady deposit should be determined upon the results of industrial tests made at recovery wells during the test production period. The preliminary amount of acid is recommended at 0,5-2,5 m$^3$ per 1 m of bed thickness of a processed interval, while reaction period proceeding within 20-24 hours.

Khauzak and Shady field development process flow diagram was developed with respect to conservation of mineral resources, sustainable use of natural resources. The project fully meets up-to-date requirements and will promote a fuller and timely use of the reserves of the deposit raw hydrocarbons, having been in a long conservation.

EIS project for a process flow diagram received a positive expert review of the State Environmental Expertise under State Environmental Committee of the Republic of Uzbekistan (as of April, 11 2005 No 18/113z) as well as a draft EIS for addenda to the field development process flow diagram - expert review as of June, 27 2007 No18/213z.

3.2 CONSTRUCTION OF WELLS, PIPELINES, MULTIPLE WELL PLATFORMS AND COLLECTORS

Long-term (over 20 years) experience in Dengizkul field operation showed sufficient reliability of pipelines, collectors and CPF equipment operated at the deposit.

Gas from Dengizkul deposit is high-sulfur. Initial hydrogen sulfide fractional pressure in gas made up 1,10 MPa, carbonic acid - 1,15 MPa, which stipulated high aggressiveness of the deposit well production.

Borehole equipment was protected from corrosion by means of inhibitor solution injection into the pay bed. This method was replaced with inhibition by a small amount of inhibitor solution of elevated concentration (4 m$^3$, 10% vol.) in 1987. During the considered period of operation the following inhibitors were used: I-1-A (from the beginning of development) followed by “Sekangaz” and “Gazocheim-1”. At present corrosion inhibitors «Dodcor – 4712», «Dodcor – V 4543» (FRG) are used. “Danoh” (Japan), “Altosan” (Uzbekistan, Russia), “I-51D” (Russia) can be used.

The pursued researches and analyses data of corrosion protection at Dengizkul deposit show that during the whole period of operation the advised in the project well inhibition regime was followed. In this connection efficient inhibition of corrosion processes was secured, general corrosion rate was low (under 0,009 g/m$^2$ per hour). All applied and recommended types of inhibitors turned out to be highly efficient protectors from corrosion.

Gas was conditioned by means of absorption dehydration with high concentration diethylene glycol on two Central Processing Facilities. CPF-1 Dengizkul (4 process lines) has been operated since 1981, CPF-2 (3 process lines) – since 1984.

CPF Dengizkul has been operated without gas dehydration with high concentration diethylene glycol since 1997, i.e. gas is just separated from dropping liquid. Fully saturated gas flows to the gas pipeline Dengizkul-MGPP.

Gas pipeline Dengizkul-Mubareksk GPP 98,8 m lengthwise is designed to supply sulfurous crude gas from CPF Dengizkul to Mubareksk GPP at the operating pressure of about 5,6 MPa. During gas pipeline installation imported pipes of DN 1020 mm made from corrosion-resistant material were used.
Dengizkul-Mubareksk GPP gas-pipeline locates: piston start-up unit in the beginning of the gas pipeline; piston receiver unit for 98 km; line valve stations for 10 km, 20 km, 30 km, 40 km, 50 km, 60 km, 70 km, 90 km. At present gas from Urtabulak deposit is supplied to Dengizkul-Mubareksk GPP gas pipeline.

To protect the gas pipeline from corrosion inhibitor «Dodicor – 4543» is used. Dengizkul-Mubareksk GPP gas pipeline inhibition (100% gas humidity) is carried out once a quarter by putting in an inhibitor solution “plug” poured between the pistons.

Long operation of gas-fields at Dengizkul deposit didn’t cause any perceptible environmental change. Applied construction and operation technologies are traditional for the gas producing industry.

At Khauzak and Shady contract sites the location of recovery well-heads under the cluster method and on a vast area, natural objects availability in the deposit area (sands and lake Dengizkul dividing the single territory into two parts) as well as special features (the Republic of Uzbekistan state border proximity to Tukmenia) and remoteness from the existing gas recovery and transportation facilities complicate the designing and construction of gas collection network. Besides, Lake Dengizkul is an ornithological reserve with a water protection zone of 500 m from the shore.

When the tubing diameter was substantiated, the following factors of efficient well operation were considered:

- securing optimal pressure drop in the borehole at all stages of bed development;
- gas flow rate at the bottomhole allowing removing liquid-spray phase and basic sediments at all stages of bed development;
- rate flow limitation at the operating well-head up to 12 m/c to reduce corrosion of wellhead equipment;
- securing optimal thermodynamic well drive.

Initial gas flow rate on bed development at Khauzak and Shady of Dengizkul deposit by means of vertical and slanted wells will make up 500-600 thous. m³/day. Using horizontal wells will bring the initial flow rate to about 750 thous. m³/day. Based upon this, tubing strings of 73, 88.9, 101.6 mm in diameter are considered for slanted wells operation as well as 114.3 mm at the operation of the borehole-end wells.

Wells are recovered under the packer scheme.

Based upon the geological and technical conditions of deposit development, tubing layout of vertical and slanted wells is as follows:

- a string of smooth leak-proof tubing of 101.6 or 114.3 mm in diameter, correspondingly, from well-head to the depth 50-100 m higher than the pay bed top;
- a complex of subsurface borehole equipment manufactured either domestically or abroad, standard size - 101.6-114.3/168х35, is lower, under the pay bed top;
- Tail liner with a shear valve on the end is located under the complex, up to the bed top;

The complex should at least consist of (from the top downward): circulation valve, one tubing, packer, landing nipple with a subsurface safety valve set on it, shear valve. Besides, shear valve should be installed on the tail liner shoe. When required, telescoping joint and inhibitor valve can be installed in the complex above the circulation pump.

*Shear valve* is installed on the tail liner shoe to reduce hydroblow by packer.
Tail liner is designed to regulate lift string shoe position with respect to drilling-in interval and to transport fluid produced from the bed in the interval “shear valve-packer”.

Packer is intended to leak-proof annulus between production and lift strings. Packer should be installed 50-100 m above the pay bed top. Packer design – stationary-removable, hydralyc.

Landing nipple is designed for the installation of a subsurface safety valve in or a bridge plug to secure well-kill safety it during operation.

Subsurface safety valve is intended to shutdown lift line in emergency. Design – removable, autonomous.

Circulation valve is designed to connect annulus between production and lift strings with tube side.

Inhibitor valve is made to supply inhibitor to prevent from wells hydrating.

Telecompressing joint is designed to compensate temperature changes on the length of lift string.

Lift string is made to transport produced fluid to the surface in the interval higher than that of the packer.

Lift string is hung on a production tree installed on the surface wellhead.

The surface wellhead is designed as wellhead connection and casing hanger.

Based upon the number of casing strings, connection of vertical, slanted and horizontal borehole-end wellheads is implemented by two-unit V-casing hanger of the type OKK2-35-168x245x426, OKK2-35-178x273x426. Downhole splitter well-heads are connected by the casing hanger type OKK2-35-245x426 K1 having anticorrosive design.

Production tree is designed to connect well head and tubing hangers.

With regard to productivity of planned wells production tree type AF6-80/65 to connect vertical, slanted and horizontal borehole-end wellheads is recommended. For multibranch wells production tree type AF1a 65x35K1 with a nominal bore-hole opening of 80 mm and working lines opening of 65 mm should be used; producing pressure – 35,0 MPa, anticorrosion design.

On full development 37 wells shall be constructed. Well spacing in the area should provide full information and reasonably high control over technological parameters of the wells operation.

As to the high high-sulfur deposits, high safety degree of gas collection, treatment and transportation system is of prime importance.

Besides the production tree, the well-heads will have the following:
- a platform for lifting facility UPA-80 or A-50;
- a platform for a corner post;
- operating floor;
- tubing platform;
- platform for a kill unit;
- flare platform.

Thus, when required, repairs and works on increasing wells productivity can be performed.

In all pipelines U-compensators to compensate thermal changes within the length of pipelines are installed 14-15 m away from the well-heads. Pipelines are buried into the ground for 1 m of the top pipe and are covered with one layer of “Altene 122025NT” anticorrosion isolation with one layer of “Altene 210-25 NT” covered one the primer “Altene P16NT” or pipes protection from
soil corrosion is carried out in accordance with GOST R 51164-98, IBC (Industry Building Code) 008-88, CN&R (Construction norms and Regulations) III-42-80*.

Joints subject to heat processing (100%) and solidity testing (10%). Erection joints are examined by radiographic test (100%) and backed up by ultrasonic testing (20%), hydraulic tests are carried out.

The common and the easiest diagram of all wells connection to the GS platform by separate pipelines is unsuitable in this case because of wells remoteness up to 6 km.

By the project, cluster method of recovery wells allocation shall be used because the well-heads were about 40 m from each other in the straight line; the wells will be connected with clusters located maximally closely (by norms) to the well-heads by separate pipelines; in each cluster (collection point) the pipelines join into a general collector, through which gas flow is fed to the gathering station (GS).

With regard to the ground location of well clusters and necessity to meter gas from each cluster, radial-connection from Shady and Khauzak clusters to the GS “Khauzak” is proposed.

Gas is fed from wells to the GS “Khauzak” after decreasing well-head pressure to 7.2 MPa, with installation of safety valves of 8.0 MPa in pressure in the well-heads.

Mechanics of pipelines is based upon the estimated pressure of 8.0 MPa. At Khauzak and Shady gas-condensate fields pipelines are made from pipes of 168x17, 273x26, 325x31 mm.

Pipeline diameters are chosen with regard to pressure loss not exceeding 10-15% of the initial pressure and permitted gas rates up to 20 m/sec sufficient to remove liquid from the pipelines.

See picture 13 for the scheme of gas collection at Khauzak and Shady of Dengizkul deposit and pictures 14, 15, 16 for collector scheme (preliminary), multiple well platform flowsheet and general layout.

This project considers dam construction 500 m lengthwise across Lake Dengizkul and pipe lying on the dam from the site Shady. 7 wells from 2 multiple well platforms are supposed to be drilled at Shady. Collectors will be laid not on the lake bottom but on the dam (maybe trestle). Dam construction will minimize emergency situations and ecological risks.

Environmental assessment will be provided upon specific adopted decisions before its construction (in 7-8 years). Curved outline of the pipes in horizontal and vertical plains is stipulated by:

- welded stalks laying on the curves of natural bending radius limited by elastic yield
- application of plied pipe elbows of 20 m in radius;
- application of precast branch pipes of 5D in radius.

Cathode terminal columns at the same time serving as identification signs and included into the ECP section (Electrochemical protection) are installed each 1 km on the pipeline routes and turn angles.

Anticorrosion protection is secured by:
- three-ply preinsulation;
- heat shrinkage couplings with locks to isolate pipe welds;
- application of electrochemical protection established simultaneously with pipeline construction;

Quality and uniformity of Insulation finish is checked by cathodic polarization.
Before putting into operation the gas pipe is cleaned and tested for durability and leakage. The inside of the gas pipe is cleaned by washing with a cleaning appliance run through it. After washing the gas pipe is hydraulically tested for durability.

Pipe crossing the lake is tested in three stages:
- 1st stage – after welding on a berth or platform – for the pressure equal to 1.5 of working pressure;
- 2nd stage – after pipe laying across the lake - for the pressure equal to 1.25 of working pressure;
- 3rd stage – simultaneously with the whole gas pipe - for the pressure equal to 1.1 of working pressure;

To remove water from the inside of pipes after hydraulic tests, pipelines are purged with compressed air and treated with a cleaning piston, with further pipelines testing for leakage in terms of working pressure.

Environmental impact on this stage of project implementation will basically show up in land withdrawal for a short (pipes) and long-term use (well platforms, collection clusters, flares), hydrocarbon removal (natural gas and condensate), water resources as well as in certain atmospheric pollution through emissions from motor-transport and special equipment during the construction period and from the working blare during operation. Hazardous impact of emissions (from motor-transport, flare) will be temporal and local. Environmental impact of the produced wastes will be minimized due to their further recycling.
Figure 13 - Principal scheme of gas collection at Khauzak and Shady of Dengizkul deposit
Figure 14 – Multiple well platform flowsheet
Figure 15 – Multiple well platform general layout
Figure 16 – Collector scheme
3.3 GATHERING STATION

Specifications for gas pipe connection of Khauzak high-sulfur deposit to Dengizkul-Mubareksk GPP gas pipe do not set any requirements to water and liquid hydrocarbon dew points for gas coming from the GS. There are only three main requirements to gas flow:

- **gas temperature should not exceed 55°C.**

  According to the field development process flow diagram, gas flow temperature in the well-heads will not exceed 40.5°C even at constant well operation.

- **oxygen volume concentration in gas should not exceed 1%.**

  According to the field development process flow diagram, gas produced from the deposit does not contain oxygen.

- **mechanical impurities in 1 m³ of gas should not exceed 0.003 g.**

  High-efficiency gas treatment facility such as filter-separator allows gas flow cleaning to the required quality.

Thus, the easiest method of gas treatment in the GS is a qualitative two-stage gas treatment with adherence to the process conditions of facilities operation; the process fully meets all the requirements to gas treatment, listed in the specifications.

Upon the results of surveys and agreements with supervisory authorities it was decided to place the GS platform of Khauzak and Shady of Dengiskul deposit in the area of Khauzak site.

Produced gas and condensate treatment system for transport in the GS complex includes:

- **inlet manifold with a set of pipeline locking and control accessories to connect collectors to well clusters;**

- **gas pre-treatment system including:**
  
  - inlet plug trap;
  
  - inlet separators (multicyclon scrubbers) to treat gas flow from mechanical impurities and fluid (the 1st stage of treatment);
  
  - filter-separators for fine purification from fluid (II stage of treatment);

  - interconnecting piping of facilities with locking, control and safety valves;

  - instrumentation and automated control systems of devices, including equipment for automatic control of trapped fluid and its discharge into the collecting pit;
Figure 17 – Gathering station flowsheet
gas collection, separation and degassing and condensate stabilization system including:

- equipment of fluid separation and degassing system, including separators-degassers, segregators with accessories, interconnecting piping, lock, control and safety valves;

- equipment of condensate stabilization system, including stabilizator, reboiler, condensate cooler, other auxiliary equipment, lock, control and safety valves, interconnecting piping.

- system of condensate transport from pump pit, including:

Condensate tanks with accessories, interconnecting piping, lock and control valves; condensate transfer pumps with interconnecting piping, lock and control valves and other auxiliary equipment.

- GS flare system, including:

  - high pressure flare;
  - low pressure flare.

Flare facility is designed to collect, burn and dissipate combustion materials of hydrocarbon gaseous impurities contained in emissions from the facilities and process plants in order to neutralize these emissions in the period of: bringing plants on production; emergency discharge devices and safety valves activation as well as gas and vapor liberation from technological units on emergency; constant emissions, i.e. discontinuous emissions from technological equipment and communications at their normal operation; recurrent shutdown of processing facilities and in case of their commissioning.

Thus, to secure field failure-free operation the project envisages the construction of two flares: high pressure flare (HPF) with D -150 mm and low pressure flare (LPF) with D-500, H-35 m.

Flares are placed with regard to the prevailing wind directions and minimal length of flare collectors, mainly in the area bordering on the enterprise fence. Flares are installed on one platform that is 100 m away from the GS boundary. The distance between both flares is also 100 m. Gas resulted from blowing-out of pipelines, collectors, devices with pressure over 0.3 MPa and emissions from high pressure safety valves through separator (for fluid phase release) are fed to the HPF.

- industrial and household waste water recycling system;

- inhibitor facilities to make, store corrosion inhibitor and fill mobile units including inhibitor make-up and storage tanks; inhibitor transfer pumps; instrument gages

Application of corrosion inhibitors in wells and pipelines with hydrogen sulfide gas is in itself a nature-conservative measure since it’s oriented at decrease in accident rate. The practice of inhibitor stuff application on other fields testifies to its safety both for personnel and natural environment.

Inhibitor type for Khauzak and Shady and its application technology is determined by the general designer for specific conditions.

- measuring system of gas amount fed to the gas pipe, including:

  - metering stream on the basis of membranous devices of the required configuration; gas flow computing complex;
equipment to determine gas composition at the outlet from the GS, including continuous chromatograph also used to correct the formula of gas flow calculation, connecting piping, lock valves, fittings.

- measuring system of condensate amount fed to the condensate pipe, including:
  fluid measuring device;
  fluid flow computing system;
  interconnecting piping, accessories, fittings, I&C devices.

- compressed air system for I&C (instrumentation and automated control systems), repairs and forced air of tap air actuators, including:
  compressed air compressors of the required capacity;
  compressed air treatment and drying system;
  air receivers;
  interconnecting piping, lock, control and safety valves;

- fuel gas conditioning block, including:
  fuel gas filter-separators.

Initially the GS is designed and equipment is chosen based upon the treatment conditions of full volume of gas produced in Khauzak in the amount of 3,3 bln m³/year with regard to further change in productivity and inlet pressure of gas to the GS during the development process.

The GS territory is divided into four main zones (picture18):

- production zone;
- zone of auxiliary facilities;
- enterprise security zone;
- administrative zone.
Figure 18 – Gathering station general layout
Industrial roads secure constant transport communication between production buildings and process installation facilities. Passages and approaches provide access to fire and special engineering facilities. On-site roads layout is assumed to be of a ring-type. Roadway width of the on-site roads is estimated to be 4.5 m.

To avoid wind erosion all sites free from buildings are graveled for 8cm as well as stabilized with soil from drill-waste disposal area.

Following fire-prevention measures the following is foreseen:
- access for fire-fighting vehicles to all buildings and facilities is available;
- two fire water tanks, 300 m$^3$ each, are installed;
- fire pump plant;
- fire alarm connected to the fire department located in the field base;
- fire-proof ring with fire hydrants;
- boxes with sand and fire-alarm panel in the required quantity;
- four exits with gates 4.7 m wide;
- installation of safety signs on the GS site.

Table 6 - Indicators under GS general layout

<table>
<thead>
<tr>
<th>Total area of the site</th>
<th>5.7589 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Including:</td>
<td></td>
</tr>
<tr>
<td>Area of flare system</td>
<td>1.826 ha</td>
</tr>
<tr>
<td>Building area</td>
<td>0.9995 ha</td>
</tr>
<tr>
<td>Including:</td>
<td></td>
</tr>
<tr>
<td>Substation 110/ 10 kV</td>
<td>0.2000 ha</td>
</tr>
<tr>
<td>Administrative zone</td>
<td>0.0690 ha</td>
</tr>
<tr>
<td>Safeguard zone</td>
<td>0.0920 ha</td>
</tr>
<tr>
<td>Utilities area</td>
<td>0.0953 ha</td>
</tr>
<tr>
<td>Building density</td>
<td>28.27 %</td>
</tr>
<tr>
<td>Utilities area</td>
<td>0.5812 ha</td>
</tr>
<tr>
<td>Including:</td>
<td></td>
</tr>
<tr>
<td>Administrative zone</td>
<td>0.0690 ha</td>
</tr>
<tr>
<td>Safeguard zone</td>
<td>0.0920 ha</td>
</tr>
<tr>
<td>Utilities area</td>
<td>0.0953 ha</td>
</tr>
</tbody>
</table>

The site area is protected along the perimeter by double metallic netted fence. Total height of the fence is 2.5 m (the height of the panel – 2.0 m, including the head from barbed wire of 0.5 m). The distance between the outer and inner fence is estimated to be 8.0 m.

At this stage environmental impact shows up in land resources withdrawal for a long-term use, certain atmospheric pollution from operating flares, degasifiers, heaters, boiler, pump pits and condensate tanks as well as consumption of water resources industrially and in household, generation of industrial waste water.
3.4 HYDROCARBONS MAIN TRANSFER

Gas will be transported from Khauzak and Shady GS to Mubareksk GPP through the pipeline designed anew. It is necessary to lay the main gas pipe 711x20,6 mm in diameter and 44 km lengthwise from Khauzak GS to the tie-in point of Dengizkul-MGPP pipeline.

Conditions for pipelining and facilities construction are very hard in the desert: high summer temperatures of air and soil, loose and moving sand, low winter temperatures, spring impassability of takyrs and takyr-like soils considerably complicate pipe laying and installation of engineer facilities.

The most hazardous process is pipe blowing-out, which causes insulation damage, metal corrosion, pipe buckling and even pipe breaking. In other words, emergency situation occurs, elimination of which is very expensive. Pipe blowing-out can be prevented, if protective measures are elaborated from the moment of route selection.

To perform periodical cleaning of the inside of gas pipe during operation and defectoscope flowing through, cleaning pistons acceptance and start-up en-route units are envisaged.

Gas-pipe laying is assumed to be subsurface with bedding less than 1,0 m deep to the pipe or ballasting device top.

Passages above motor ways are made in protective casings from steel pipes with a vent stand of 5 m high. Crossing with an oil pipe and a coupling cable occurs not less than 0,35 m away from each other in the clear.

Gas pipe is protected from soil corrosion by outer precast anticorrosive coat. Welds insulation is to be secured by heat-shrinkage couplings. Valving and fittings are supplied with outer polymer coating.

Complex testing of pipe metal and welds uniformity is done by interpipe defectoscoping before putting the pipe into operation.

Gas-pipe protection from soil corrosion shall be made in accordance with the standard.

Gas-pipe insulation has to be reinforced, preferably precast. Electrochemical protection shall be made simultaneously with gas-pipelining. Gas-pipe running through rock and pebble gravel is to be insulated to protect it from damage by soft ground.

Gas-pipe tie-in point is to be from Khauzak GS to the existing Dengizkul-MGPP near the 23rd km (picture 19). Parameters of the existing gas-pipe Dengizkul-MGPP at the connection point:

- working pressure at the connection point: P = 5,4 MPa;
- top line of pipe is 1,2 m deep;
- diameter and pipe thickness DN -1020 x 21 mm;
- gas pipe is fitted with pistons acceptance and start-up units, linear valves;
- average temperature of the ground in summer is 30°C, in winter - 20°C;
- corrosion protection – inhibition once a quarter with corrosion inhibitor and electrochemical protection from soil corrosion.

Safety valves and protective holders are to be installed at the intersection of motor ways by the designed gas-pipe.
Near the piston start-up unit at the exit from Urtabulak GPF-1 a ball valve DN-700 RN~64 with a spherical end cap for further possible connection to the gas-pipe Urtabulak-MGPP is installed.

According to the specifications of the unitary subsidiary “Mubarekneftegas” gas pipeline from GS to the tying point into the existing gas pipeline Dengizkul-MGPP is about 44 km lengthwise and 28 inches in diameter (DN700) with estimated pressure 7.45 MPa, including pig receivers, connection points for mobile inhibitor device, linear and safety valves, cathodic protection devices and etc.

Due to the gas pipe length, 9 (nine) linear valve units are proposed for placement on the route.

GS safety valve is to be placed at the exit of the GS at the pipe starting point in the area where pig receiver is situated.

Installation of linear valve units and pig receivers is implemented under the standard pattern. Pig receiver will be at the end-point of the gas pipe in the area of tying into Dengizkul-MGPP gas pipe.

With respect to the transported gas composition and properties, steel with ultimate strength not more than \( 56\text{kgf/mm}^2 \) is reasonable to use as pipe material. Such materials are of an increased stability at high H2S service and considerably less liable to intergranular corrosion than steel with high ultimate strength (60 kgf/mm\(^2\) and more).

For the 1\(^{st}\) category pipe with estimated 7.45 MPa pressure, the effective wall thickness will make up 12.4 mm. With regard to corrosion allowance and rounding to the nearest standard thickness value, a longitudinal welded pipe D=720x16 mm, 56kgf/mm\(^2\) can be recommended.

Gas-pipe materials are selected in the same way both for condensate pipe and fuel gas pipe.
Figure 19 – Gas pipeline connection diagram
Figure 20 – Condensate pipe connection diagram
Figure 21 – Fuel gas connection diagram
Condensate pipe from Khauzak deposit is to cut into the oil pipe “Northern Urtubulak- OIR ‘Northern factory’” on the 2nd km of the pump station Northern Urtubulak (picture 20). Parameters of the existing oil pipe Northern Urtubulak OIR “Northern factory” in the connection point:

- working pressure in the oil pipe - 3.0 MPa
- diameter and pipe thickness 219 x 6 mm,
- top line of pipe is 1 m deep;
- T-type tie-in 219x10 mm;

Safety valves and holders are to be installed at the crossing of the designed condensate pipe and motor ways.

According to “Mubarekneftegaz” specifications, condensate pipe with stable condensate from the GS to the oil pipe Northern Urtubulak- OIR “Northern factory” tie-in point is approximately 4 inches in diameter (DN 100mm), working pressure 3.5 MPa, and it includes linear and safety valves, cathodic protectors and so on. Based upon the approximate length of the condensate pipe making up 44 km, 9 (nine) linear valve units are supposed to be installed on the route.

Fuel gas pipe tie-in point at Khauzak GS is to be at the line valve station of “Southern Kemachi-MGPP” gas pipeline on the 26,1 km, 3 m away from the last linear valve (picture 21). It has to be a T-type tie-in. Parameters of the existing gas pipe at its connection to the fuel gas pipeline:

- working pressure P= 5.5 MPa;
- diameter and pipe thickness D 720x18 mm,
- top line of pipe is 1 m deep;

There should be a fuel-gas measuring unit before tie-in.

Gas pipe diameter must be set based upon the total amount of supplied gas, including gas for CP and GS as well as prospective start-up of BCS. In case of maximum consumption, gas pipe diameter will be approximately 6-8 inches (DN 150-200 mm) at working pressure of 5.5 MPa.

Due to the fuel gas pipeline length of 50 km, 10 (ten) linear valve units are supposed to be installed on the route.

Besides the mentioned pipes the designed motor way, HVL and communication cable (FOL) will run along the pipeline.

Pipe laying will cause temporary withdrawal of land resources, which are to be recultivated after construction is completed. Areas under the motor way will be permanently allocated. During construction engineering machinery will emit fuel combustion products from the BCS into the atmosphere, suspended materials concentration can increase.
3.5 BOOSTER COMPRESSION STATION

When wellhead pressure drops, booster compression station (BCS) has to be started before the gas dehydration plant. To avoid sediments and dropping liquid to the compressors, filter-separators have to be installed.

Units with the capacity of 4MW, gas turbine drive and centrifugal blower are to be installed in the BCS.

Blower design has to secure various capacities and compression ratios due to air-gas channels made at the level of pressure increase from 1,25 to 3,0 MPa.

BCS design operation modes and the required quantity of GCU with regard to gas extraction at the rate of 3,0 bln m³/year are included in the table.

Putting BSC into operation will be required on 7th year of development in 2013. All units are proposed to be reconnected to allow sequential operation under the pattern (2x2)+2 commencing from 17th year of development (2023).

BCS flow sheet provides for the following basic processes: gas compression; gas cooling in air cooler; fuel, starting and pulse gas treatment; oil supply for compressor sections.

Table 7 - Design duty of BCS according to gas extraction pattern of 3,0 bln m³/year

<table>
<thead>
<tr>
<th>Year of development</th>
<th>Q, mln.m³/day</th>
<th>Pressure at the entrance of BCS, MPa</th>
<th>Pressure at the exit of BCS, MPa</th>
<th>compression ratio in BCS</th>
<th>GCU quantity N=4MW (oper.+res.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013…2022</td>
<td>9.07…5.98</td>
<td>5.25…2.18</td>
<td>5.50</td>
<td>1.05…2.52</td>
<td>4+2=6</td>
</tr>
<tr>
<td>2023…2031</td>
<td>5.53…2.73</td>
<td>1.89…1.05</td>
<td>2.91…5.24</td>
<td>2x2+2=6</td>
<td></td>
</tr>
<tr>
<td>2032…2041</td>
<td>2.55…1.41</td>
<td>1.05…0.90</td>
<td>5.24…6.11</td>
<td>1x1+4=6</td>
<td></td>
</tr>
</tbody>
</table>

Dry gas measuring unit is to be installed at the exit before its feeding into the main gas pipe.

As far as BCS is to be constructed in the far future, no environmental assessment is provided in the present work, however, by analogy with the operating BCS (for example, at Shurtan) we can assume that environmental impact will be moderate (mainly, atmosphere and land resources will be affected). Based upon the experience, an additional draft EIS during engineering of BCS is developed.

Construction of field base and field camp, infrastructure facilities (power-, water supply and communication and etc) is required for maintenance personnel.

3.6 FIELD BASE AND FIELD CAMP

Field base and field camp for the servicing personnel are situated 1,2 km to the south-east of the GS.

Field base facilities are designed to house administrative offices, store houses for equipment storage and keeping, materials for the construction period, repair shops to maintain construction equipment and machinery, storage of fuels and lubricants and so on.
Field camp facilities are to accommodate servicing personnel operating Khauzak deposits. Operation is supposed to be arranged as shift work.

Field base area is divided into four zones (picture 22):

1. Residential and household area.
2. Waterworks area.
3. Production and storage area.
4. Fire emergency and gas rescue service area.

Residential and household area.

In the residential and household area the whole complex of residential and household buildings and facilities, required to create maximally comfortable living conditions for workers and servicing personnel out of shift work, has been designed.

Residential area is situated in the northern, the remotest part from the entrance; it consists of 4 hostels 20 beds each and a cottage.

The site southern part houses:
- dining-room with 50 seats;
- social amenities;
- gym with sauna;
- sports ground.

All buildings are accessible for pedestrians and favorably interconnected. To facilitate servicing at lunch a parking lot is designed in front of the dining hall. Buildings are placed with regard to insolation and ventilation conditions. Hostel windows face west and east, thus allowing maximum insolation in the morning and in the evening.

Waterworks area.

Waterworks area is intended to supply the whole field with utility and drinking water; it consists of the following facilities:
- pump station above artesian well;
- water treatment facilities;
- clean water tank;
- potable water pumpit;
- utility water tank;
- pumps control building.

Waterworks area is marked and fenced with a metal grating 2,5 m high.
Figure 22– Field base and housing settlement general layout
Production and storage area.

Production and storage area is designed to repair equipment and machinery as well as to store repair equipment and materials to secure failure-free operation of field; it consists of the following facilities:

- store house;
- equipment minor repair unit with a welding station;
- vehicle shed;
- platform to store materials and equipment.

Besides, the industrial zone has a boiler, a transforming station, a fire pump house and 2 fire water tanks.

Following fire-prevention measures the following is foreseen:

- access for fire-fighting vehicles to all buildings and facilities is available;
- two fire water tanks, 200 m³ each, are installed;
- fire pump plant;
- fire alarm connected to the fire department;
- fire-proof water conduit with fire hydrants;
- boxes with sand and fire-alarm panels in the required quantity;
- four exits with gates 4.7 m wide;
- smoking-rooms.

To observe fire safety measures smoking-rooms are to be arranged in the field camp.

Residential and accessory buildings have to be frame-panel and fitted with life support systems (lightning, heating, ventilation, air conditioning, water-supply, sewerage, a required set of furniture).

Building elements are supposed to be delivered to the site for further installation on ready-made foundations and assemblies.

Medical station is arranged in the field camp in accordance with sanitary regulations and standards 0054-96 «Engineering, construction and operation of medical institutions».

<table>
<thead>
<tr>
<th>Table 8 - Indicators under field base general layout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site total area</td>
</tr>
<tr>
<td>Building area</td>
</tr>
<tr>
<td>Building density</td>
</tr>
<tr>
<td>Utilities area</td>
</tr>
<tr>
<td>Paving area</td>
</tr>
<tr>
<td>Landscape area</td>
</tr>
<tr>
<td>Land use coefficient</td>
</tr>
<tr>
<td>Landscape coefficient</td>
</tr>
</tbody>
</table>

Field base impact on the NE will be limited to the term of deposit development.

During the construction atmospheric air will be short-term affected by the operating construction equipment; during operation – by the boiler chimney flue and fuels and lubricants store house. Over 3 ha of land will be withdrawn for a long-term use. Field fire-
prevention will be secured by water intake from the artesian well as well as household and industrial water for the base, GS and other field parts will be provided by water-desalinating plant. Industrial waste water will be produced as well as production and consumption wastes.

3.7 SOME INFRASTRUCTURE FACILITIES

Power supply for Khauzak deposit is to be provided from the designed substation 110/10 kV located on the GS platform.

As to the degree of power supply safety, GS power consumers refer to the I,II category consumers. There are power consumers at the GS of the specific group of the I category, their backup power source being diesel power station.

To receive and distribute electric power the sites are to be equipped with:
- the GS – with a two-transforming station built into the control building;
- the field base – with a self-standing two-transforming station.

The project provides for the following types of lightning: outdoor and security lightning of the territory, indoor – working, emergency and repair lightning.

Outdoor and security lightning is secured by lamps with mercury lamps DRL-250 on iron supports at the height of 8 m. Types of lamps are chosen in accordance with premises characteristics and environmental conditions.

Mercury arc lamp DRL contains mercury. Broken lamp has to be replaced. Waste lamps DRL refer to 1st hazard class and require special measures for safe storage and recycling.

The project provides for the following electrical safety actions:
- electrical equipment grounding at all voltage levels in accordance with the requirements of the operational code for electrical installations;
- lightning protection, grounding, ESP of explosion hazard zones in accordance with the guidelines;
- electrical equipment and wiring selection with respect to the environment.

The project envisages electro-chemical protection of the main process facilities as anti-corrosion measure.

ECP stations are made in blocks and designed to protect site pipeline network, installed in the same block. Block-boxes are protected from vandalism.

The installation will have reinforced concrete supports for the designed aerial transmission line of 10 kV. Cross-over poles are designed for crossing with engineering utilities.

To avoid dangerous proximity of birds to the upper part of energized insulators, the project provides for anti-bird nets serving also as corrosion protection from bird dung for air line metallic structures.

No hazardous industrial wastes polluting the atmosphere, soil and water are produced during operation of the air line and other power-supply facilities.

Thus, when choosing a route and developing external power supply design for Khauzak GS, environmental requirements and land law principles of Uzbekistan are taken into account.
The designed buildings and facilities of the GS site have their own heat supply source that is a designed boiler. General heat demand (including losses) will make up 0,2137 Gcal/h.

Based upon the heat loads, a block transportable automated boiler type KBT-0,3Gn with three water boilers type MKVa-0,1Gn and capacity 0,1 Gcal/h each is to be installed. Total installed capacity of the boiler will make up 0,3 Gcal/h.

Hot water of T=95-70°C serves as a heat-transfer agent for heating and ventilation systems. Additional raw water softening is to take place on permanent magnets UVPM-1 in water treatment plants.

Low pressure natural gas is assumed to be boiler fuel. Hourly gas flow per boiler is 27,1 m³/hour. Annual gas flow estimates to 43825 m³.

Designed auxiliary boiler is also heat supply source for the designed buildings and facilities of the field base.

General heat demand will make up 0,55 Gcal/h.

A block transportable automated boiler type KBTa-1,7Gn with three water boilers for heating, type MKVa-0,5Gn and capacity 0,5 Gcal/h each, and two water boilers for hot water supply, type MKVa-0,1 with capacity 0,1 Gcal/h each are to be installed. General installed capacity of the boiler will make up 1,7 Gcal/h.

Hot water of T=95-70°C serves as a heat-transfer agent for heating and ventilation systems, water of T=65°C is needed for hot water supply. Additional raw water softening is to take place on permanent magnets UVPM-1 in water treatment plants.

Low pressure natural gas is assumed to be boiler fuel. Hourly gas flow per boiler is 85,0 m³/hour. Annual gas flow estimates to 147550 m³. Boiler staff is represented by 3 persons, 1 person per shift.

Heating system, heat-transfer-agent type and parameters, heater type in production, administrative, living and auxiliary premises, proved by the project secure explosion and fire safety during operation.

The main premises of the designed buildings and facilities are to have balanced natural or mechanical ventilation system. Spots of harmful emissions are isolated and locally exhausted.

To create comfortable conditions in the living premises, rest-rooms, library, air conditioning by channel-type split-systems with fresh air feed combined with hot water calorifer and necessary control valves and automatic devices have been designed. Air conditioning by split-systems with one outer block and several inner blocks is envisaged for studies, rest-rooms, billiard room and dining hall.

Ventilation system followed in the design secures meteorological conditions and air purity in working and service areas of premises, required by norms.

To ensure transport communication between deposit facilities and outer road network as well as constant inspection of communication line, construction of special motor way from the existing motorway Mubarek-Urtabulak to the GS platform and field base. Motor way is 34.682 km lengthwise.

Besides, access roads to the well clusters (about 15 km) are to be built from the GS platform.
Levels of motor way original surface vary in the range from 183,5m (Khauzak deposit area) to 250,00m (GPF-1 Urtabulak area). Present-day quaternary deposits and upper Neogene bottomset beds form geological structure.

Motor way route runs along the communication line (motor way, Power Transmission Lines of 6 kV and gas pipe). It runs across the existing earth bed from PK123+00 to PK155+00.

Due to poor traffic the designed road belongs to V technical grade.

No water supply GPF-1 Urtabulak to the GS and field base has been approved by the design (high costs for water conduit construction), but a decision was made to use subsurface water at Khauzak contract site.

Turonian- Palaeocene deposits are the most prospective aquifer system. It is widespread throughout the contract site Khauzak. Water from the complex is pressure water, which water-head height comes up to 115-255 m. Piezometric levels are set from 21,9-34 m deep and below the day surface to 5-16 m higher than the latter. Wells flow at discharge during limestone sampling made up 3-6 l/sec (specific yield – up to 1,3 l/sec), sands and sandstone sampling showed 4-16 l/sec (specific yield – up to 0,8-1,1 l/sec).

Thus, water supply for the complex facilities is to be done from the pump station above the artesian well by pump ECV8-25-100M e=25 m³/h; H=100 m; with electromotor PEDV 11-180; N=11 kW; ds=2850 rpm - 2 pcs (1 oper., 1 reserved.).

Water will be fed for household, industrial use and fire-prevention, for green zone wetting and watering, therefore corresponding systems have been designed at the platforms.

As far as the main drinking water consumers are situated in the field camp and base, water treatment units (water-desalinating plant E4LE-11000-ECH-5 (1.75 m³/h) are to be treated in the field camp. Plant capacity (42 m³/h, 32,79 m³/day of potable water) fully covers the demand. Waste water will be fed to the waste water treatment facilities and evaporation ponds.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Before treatment, mg/l</th>
<th>After treatment, mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total BOD</td>
<td>up to 500</td>
<td>3</td>
</tr>
<tr>
<td>SS</td>
<td>up to 500</td>
<td>3-5</td>
</tr>
<tr>
<td>Ammonia N</td>
<td>up to 20</td>
<td>0,5</td>
</tr>
<tr>
<td>Surfactants</td>
<td>up to 6</td>
<td>0,5</td>
</tr>
<tr>
<td>Oil products</td>
<td>up to 25</td>
<td>0,05</td>
</tr>
</tbody>
</table>

Industrial waste water from the GS site flow into the industrial waste water treatment plant.

To treat industrial waste water a settler with a trapped oil tank of the capacity 12,5 m³ and a sludge collection tank of the capacity 12,5 m³ is designed on the site of waste water treatment facilities. In the settler industrial wastes will be mechanically treated from floating wastes, suspended solids and oil products. Designed capacity of the plant is 15 m³/h or 360 m³/day.
After appropriate treatment waste water is fed to moisture-proof evaporation ponds.

Household waste water is pumped from the GS and field base sites into household waste water treatment facilities consisting of 2 bioreactors by appropriate sewerage stations.

**Automation system.**

Automation system of Khauzak site of Dengizkul deposit includes:

- primary elements, measuring transducers, actuating device and local indicating instruments (field instrumentation and automation);
- fire alarm system;
- gas alarm system;

Field instrumentation and automation, automatic control local systems and telemecanics systems form in total an automatic process control system created on the basis of PLC+SCADA and process flow visualization software package Genesis32.

In its turn, automatic process control system consists of a distributed control system and an emergency protection autonomous (dedicated) system.

Creation of automatic process control system is targeted at:

- obtaining reliable information from processing facilities to secure improved oil-gas fields development and operational control and production, transport, treatment and ready-products registration process management;
- optimization of operational modes of gas production, gathering, transport and gas treatment process facilities;
- increase in accuracy and measurement efficiency of technological process parameters;
- introduction of new mathematical methods of technological processes and gas recovery facilities control and management;
- facilitating control over gas recovery technological processes;
- higher production safety, emergency situations prevention, environmental improvement in oil-gas production region

Autonomous ESD has reserved modules securing appropriate reliability and infallibility of ESD operation.

The project also provides for a fiber-optic communication line 35 km lengthwise to the GPF-1 Urtabulak; installation of digital ATS for 100 numbers at Khauzak GCF communication center, arrangement of trunked radio system to provide personnel with mobile radio communication.

Technical security equipment system (TSE) is provided to secure reliable protection of the facility.

To receive timely information from the outposts of the restricted area, the following communication modes have been designed:

- installation of telephones
- alarm system
- video surveillance.
4 turning video-cameras are to be installed for video surveillance all around the restricted zone. The cameras are installed on metallic supports 5 meters high in the line-of-sight.

During infrastructure facilities construction NE (atmospheric air, land resources) will be affected by operating construction equipment. Operation of these facilities leads to land use, subsurface water removal from artesian wells, harmful substances emissions, though minor, into the atmosphere when boilers work.
3.8 SOCIO-ECONOMIC ASPECTS

Uzbekistan is situated in the central part of the Eurasian continent. Its territory is 447,4 thous. km$^2$, 95,1 % out of which are covered by land and 4,9% constitute water basin. About 60% of the territory is covered by deserts and semideserts.

Uzbekistan having considerable natural energy resources – oil, gas, hydropower resources and coal reserves – is of great importance for the republic’s economy development.

The main traffic arteries connecting the countries of the region, Eastern and Western states run across the territory of the republic. Uzbekistan rail road network is the biggest in Central Asia. Rail roads of the country stretch for about 7 thous. km. Over 80 thous. km of motor roads have been built and operated, most of them being hard-surface roads.

Uzbekistan boasts a well-developed gas-pipe system allowing gas exporting to all neighboring states of the CIS (Turkmenistan has its own big gas reserves). Besides, powerful gas-pipes run from the republic to Chelyabinsk, Yekaterinburg and European Russia.

At present Uzbekistan population is over 26 mln. people and in this respect the republic is the biggest in Central Asia and the third in the CIS. Most of people live in the countryside and are occupied mainly with farming. At the labor market employment of people wanting a job proceeds.

The territory of Alat district, Bukhara oblast, where the site is located, is 3,2 thous. sq.km., which constitutes approximately 0,7% of the country territory. Population as of January, 1 2004 numbers 74,8 thous. people (0,3% of the country population). Population density is 24,6/sq.km, About 16,7% of the district population (12,5 thous.) live in the district center – the city of Alat.

Uzbeks are the main natives. Demographic trends remain at a high level. Birth rate per 1000 people, for a district on average, is 20,2; mortality rate is 4,4, population growth – 15,8 people.

Migration is low at present, not more than 4-5 families leave the country per year, and there are hardly any immigrants.

Road network of the district is moderately developed. International roads stretch for 26 km, asphalted road are 212 km lengthwise.

The case with gas-supply is the most satisfactory, with its coverage of 98%.

Alat district stands out for adherence to ancient customs. Wedding and other ritual ceremonies are still observed. Local population is said to be very religious.

Industrial facilities of Khauzak cluster of fields are situated far away from human settlements. The closest to them is a comfortable field camp “Urtabulak-Dengizkul”. There are three hostels, canteen, swimming-pool, bath-house, two boilers, sports complex, medical post, administrative building and garage in the camp. Planted land area is 1,5 ha.

Implementation of the planned activities will increase natural gas, sulfur and gas condensate production. Thus, gas production expansion, liquid hydrocarbons production will decrease gas and, in particular, liquid hydrocarbons scarcity in the country.

Gas-oil products (gas, petrol, oils and so on) are used both in industry, construction, transport and in household (individual motor transport owners), i.e. they are intended to
satisfy population needs. Thus, the projected construction will produce a considerable social effect on a republican scale together with an economic impact.

In case of emergency situations, the risk of affection for the population is minimal, that is stipulated by considerable remoteness of settlements from industrial facilities.

Gas wide-use in industry and household has significantly decreased air pollution in the republic as a whole. Export of produced gas brings revenues which are used, in particular, to solve social problems.

Enterprise operation has to be based upon safety measures to people and natural components, i.e. during implementation of the planned activities technical and environmental requirements have to be mandatory observed.

It should be pointed out, that the prospected industrial activity is closely related to implementation of the set of actions on environmental protection, on a conceptually new technological design, construction and operation basis, with application of resource saving technologies. Facility operation in the area with low environmental pollution potential will produce high economic and environmental effect.

To avert emergency situations, well operating personnel has to be highly qualified and have modern equipment.

As a rule, industry development brings benefits from socioeconomic incentives caused by enterprise operation to the population living in the areas adjacent to the developed territory.

Implementation of the planned activities will bring the following positive results:
- (additional) jobs creation;
- infrastructure and transport network development;
- boosting employment of local population;
- higher education level of local population (possibility to study and improve skills);
- preventive health care due to periodic health examinations of the personnel, medical service and so on.

At the same time, higher hazardous impact on the population is hardly expected from construction because there are no residential areas on the considered territory. Human settlements are considerably remote, poorly populated, and climatic conditions facilitate good dispersion of harmful substances in the atmospheric air.

A field camp with a service base to be built 1,2 km to the south-west of the GS Khauzak is designed in the research area.

The plot of land for the field camp was chosen on the basis of technical and economic assessments on transportation costs minimization, operating personnel transfer to the GS site and in view of the terrain relief and possibility of land allotment.

All passages and grounds will be asphalted. Territory landscaping with trees and bushes is supposed. To protect the camp from winds and sand, the project provides for sanitary protection zones, 100 km long, around the territory as for the facilities of the IV class. All area free from buildings and roads will be landscaped with trees and bushes.

Table 10 - Technical and economic indicators
Medical post in the field camp will allow arranging periodic health examination for the workers and administering first-aid when required. Besides, workers of such large enterprises enjoy benefits when trade union trip tickets for preventive treatment in sanatoriums and preventoriums of the industry and the republic as well as tickets to summer camps for workers’ children and so on are allocated.

On-site application of safe modern equipment will prevent from quality deterioration of environmental objects.
4 NORMATIVE AND METHODICAL DEVELOPMENT BASIS FOR ECS ON KHAUZAK AND SHADY CONSTRUCTION

The base of normative and legal base for preparation of the 3rd phase of EIE - ECS – procedure are instructive and methodical documents, which determine strategic frames for observance of internal republican requirements and carrying out of ecological direction.

The main purpose of ECS preparation consists of evaluation of the adopted design decisions to give estimation of the approved design decisions for their stability and safety, and their ecological influence should be confirmed by ecological norms on basic elements of natural environment.

So the ECS procedure includes informative material, in which the possibility of unfavorable consequences and advantages of realization of the planned activities and also the development of ecological norms of MPE (maximum permissible emissions); MPW (maximum permissible wastes), PSW (Permission on special water use); MPNW (maximum permissible norms of waste formation), establishing limits for environmental pollution: emissions, wastes and placement of wastes in operation of the objects which are the subjects of ecological control over enterprise activity are fully depicted.

4.1 Lawful base for atmospheric air protection in Uzbekistan is concluded in a joint state and public measures directed at preservation of air field from pollution, depletion of its oxygen reserves, rational use of air in economic purposes in the interests of sanitation and improvement of environment.

Content of legal protection of atmospheric air includes system of warning, control and other measures directed at preservation of optimal quality of atmosphere.

Normalization of emissions and concentrations of harmful substances and industrial enterprises effects are carried out in order of standardization of atmospheric basin quality. In the field of atmospheric air protection there are three types of standards:

− Maximum permissible concentration of harmful substances (MPC);
− Maximum permissible emissions of harmful substances (MPE);
− Maximum permissible grades of physical influence.

The degree of atmospheric air pollution is determined as per MPC excess ratio with regard to danger class, summation of biological effect of air pollution and MPC excess frequency.

4.2 Lawful base for water protection takes an important place among water sources protection from pollution and includes totality of legal means aimed at preservation, restoration and improvement of natural water resource condition use and protection which are subject to legal regulation.

A number of legal norms aimed at preservation of water is contained in fish farm legislation where in interests of water protection it is prohibited to drop untreated water in a water source.

Special protection measures from pollution are set by legislation for subsurface water where the use of dead wells should be secured by reliable isolation of the above water horizons from pollution.
In order to reduce intake of surface and subsurface water there should be adopted measures insuring water economic use by introducing advanced technological processes and normalization of water consumption.

4.3 Legislation of Uzbekistan adopted norms of protection of environment from harmful wastes of production used for development of building construction projects sections, expansion, and reconstruction of economy objects. Nowadays the real account of production wastes, their qualitative and quantitative content and also ways of their disposal and methods of utilization are hampered.

Wastes are the special form of emission which during their lifespan may change their nature and location because they are transported and treated before burial affecting air, soil and water. That is why the main mission of the enterprise is to use the production technologies providing for minimization of harmful (toxic) waste formation.

Systematization and classification of waste is done, their volumes for further control over waste movement and potential danger when handling them are determined.

It is supposed to carry out works on inventory of production and consumption waste at a stage of enterprise designing, on collection and analysis of data on production waste formation in each subunit of enterprise, standardization of the supposed production waste and setting limits for their location.

Carrying out assessment of consequences of construction of Khauzak and Shady on the basis of qualitative and quantitative indices is required for controlling bodies and initiator of economic activity.
5 ENVIRONMENTAL STANDARDS

5.1 MAXIMUM PERMISSIBLE ATMOSPHERIC EMISSIONS

Normative literature


3. WD 39-0148306-413-88 «Methodical instructions on emission calculation from unorganized gas producing enterprises».

Sources of influence on atmospheric air during operation of Khauzak-Shady field will be:

- Flares of gathering station (GS) and multiple well platform;
- Technological reservoirs for condensate;
- Chimneys of technological furnaces (boiler house);
- Technological site (hardware yard) of GS;
- Sewage works (ponds open surface);
- Welding equipment and machines;
- Exhaust pipes of ICE.

Below is the description of stationary sources of effect on atmospheric air during operation of Khauzak-Shady field objects in the period of maximum volume of production and preparation of gas condensate raw material.

Source No.1. Multiple well platform 16 flare

Flare standpipe at multiple well platform 16, is designed to utilize (burn) hydrogen sulfide containing gases when blowing wells besides for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

Sources of release of polluting substances are the wells connected to multiple well platform 16 during blowing.

Source of emission – organized, flare. According to design the height of flare is 30m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant throughout the year that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

Polluting substances emissions calculation when burning gas on flares is carried out according to [2] by formula:
\[ M_i = K_i \times B, \quad (2.1) \]

where: \( M_i \) – substance mass emission, g/d;
\( K_i \) – experimentally established coefficient, equal to:
\[ K_{CO} = 0.057; \quad K_{CH4} = 0.03; \quad K_{NOx} = 0.002. \]

Quantity of NO\(_2\) is designated as 0.8, and NO – 0.2 from total quantity of NO\(_x\).

Emissions of SO\(_2\) are determined by formula:
\[ M_{SO2} = 1.88 \times [H_2S] \times B \times 10^{-2}, \quad (2.2) \]

where: \( M_{SO2} \) – emission mass SO\(_2\), g/sec;
\([H_2S]\) – content of hydrogen sulfide content of gas, g/m\(^3\).

In case of presence of \( C_{5}H_{12}^{+}\)\(_{\text{max}}\) fraction in burned gas, calculation is carried out by formula:
\[ M_{\text{black}} = 0.03 \times V \times \alpha \times \rho \times 10^{-2}, \quad (2.3) \]

where: \( V \) – gas volume supplied to flare, m\(^3\)/sec;
\( \alpha \) – fraction share of \( C_{5}H_{12}^{+}\)\(_{\text{max}}\) in burned gas, (%);
\( \rho \) – fraction density \( C_{5}H_{12}^{+}\)\(_{\text{max}}\) is adopted as 3.457 kg/m\(^3\).

According to adopted development variant considered in a supplement to Technological diagram, average gas output for one operating well during the initial period of development will be 504.0 thousand. m\(^3\)/day.

Taking into account practice of operation of gas condensate field blowing of one well is fulfilled in 2-3 cycles with total duration up to 3 hours, minimum number of one well blowing is 1 time per month or 12 times a year, therefore total time of bleeding off gas to flare from one well will be 36 h/year.

Taking into account average output and bleed off time, gas volume supplied to flare from one well will be:
\[ V = \frac{504000}{24} \times 36 = 756000 \text{ m}^3/\text{year} \]

Four wells (173, 162, 171, and 1025) are connected to multiple well platform; therefore, total volume of burned stratum gas on flare of multiple well platform 16 will be 3024000 m\(^3\)/year. Content of hydrogen sulfide in stratum gas is 4.25 %, fraction \( C_{5}H_{12}^{+}\)\(_{\text{max}}\) – up to 0.52 g/m\(^3\), average density – 0.9 kg/m\(^3\).

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m\(^3\)/h or 87,600 m\(^3\)/year.

So total volume of gas burned on flare will be 3111600 m\(^3\)/year or 0.0987 m\(^3\)/sec (average model of flare operation in constant condition) or 88.80137 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.3) and will be:
\[ M_{CO} = 88.80137 \times 0.057 = 5.061678 \text{ g/d} = 159.625080 \text{ t/year} \]
\[ M_{NO2} = 88.80137 \times 0.002 \times 0.8 = 0.142082 \text{ g/d} = 4.480704 \text{ t/year} \]
\[ M_{NO} = 88.80137 \times 0.002 \times 0.2 = 0.035521 \text{ g/d} = 1.120176 \text{ t/year} \]
\[ M_{CH4} = 88.80137 \times 0.03 = 2.664041 \text{ g/d} = 84.0132 \text{ t/year} \]

Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m\(^3\), therefore, sulfur dioxide emissions equal to:
\[ \text{M}_{\text{SO}_2} = 1.88 \times 60.714 \times 0.0987 = 11.262216 \text{ g/d or } 355.165243 \text{ t/year} \]

Content of \( C_{5+ \text{max.}} \) fraction in burned gas is 0.52\%, therefore, black emissions equal to:

\[ \text{M}_{\text{black}} = 0.03 \times 0.0987 \times 0.52 \times 3457 \times 10^{-2} = 0.053211 \text{ g/d = 1.678061 t/year} \]

Gas air mixture outlet on flares is calculated by formula:

\[
V = 10 \times V_1, \text{ m}^3/\text{sec} \quad (2.4)
\]

where: \( V_1 \) – volume of burned gas on flare, m\(^3\)/sec

Therefore, volume of smoke fumes will be:

\[ V = 10 \times 0.0987 = 0.987 \text{ m}^3/\text{sec} \]

Outlet gas air mixture velocity is determined by formula:

\[
w = \frac{(4 \times V)}{(3.14 \times d^2)}, \text{ m/sec} \quad (2.5)
\]

where: \( V \) – smoke fumes outlet volume, m\(^3\)/sec

\( d \) – emission source orifice diameter, m

Smoke fumes outlet velocity will be:

\[ w = \frac{(4 \times 0.987)}{(3.14 \times 0.42)} = 7.58 \text{ m/sec} \]

**Source No.2. Multiple well platform 19**

Flare standpipe at multiple well platform 19 is designed to utilize (burn) hydrogen sulfide containing gases when blowing wells besides, for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

**Sources of release of polluting substances are the wells connected to multiple well platform 19 during blowing.**

**Source of emission** – organized, flare. According to design the height of flare is 30m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

**Calculation of gross output emissions from source**

The volume of gas supplied from one well is calculated by analogy with source No. 1 and will be 756000 m\(^3\)/year. Four wells (18, 21, 302, and 17) are connected to multiple well platform; therefore, total volume of burned stratum gas on flare of multiple well platform 19 will be 3024000 m\(^3\)/year. Content of hydrogen sulfide in stratum gas is 4.25 \%, fraction \( C_{5+ \text{max.}} \) – up to 0.52 g/m\(^3\), average density – 0.9 kg/m\(^3\).

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m\(^3\)/h or 87,600 m\(^3\)/year.

So total volume of gases burned on flare will be 3111600 m\(^3\)/year or 0.0987 m\(^3\)/sec (average model of flare operation in constant condition) or 88.80137 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\text{M}_{\text{CO}} = 88.80137 \times 0.057 = 5.061678 \text{ g/c = 159.625080 t/year} \\
\text{M}_{\text{NO}_2} = 88.80137 \times 0.002 \times 0.8 = 0.142082 \text{ g/d = 4.480704 t/year} \\
\text{M}_{\text{NO}} = 88.80137 \times 0.002 \times 0.2 = 0.035521 \text{ g/d = 1.120176 t/year} \\
\text{M}_{\text{CH}_4} = 88.80137 \times 0.03 = 2.664041 \text{ g/d = 84.0132 t/year} 
\]
Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[ M_{SO_2} = 1.88 \times 60.714 \times 0.0987 \text{ m}^3/\text{sec} = 11.262216 \text{ g/d or 355.165243 t/year} \]

Content of \( C_{5+}^{\text{max}} \) fraction in burned gas is 0.52%, therefore, black emissions equal to:

\[ M_{\text{black}} = 0.03 \times 0.0987 \times 0.52 \times 3457 \times 10^{-2} = 0.053211 \text{ g/d} = 1.678061 \text{ t/year} \]

Therefore, volume of smoke fumes outlet will be:

\[ V = 10 \times 0.0987 = 0.987 \text{ m}^3/\text{sec} \]

Smoke fumes outlet velocity will be:

\[ w = \left(4 \times 0.987 \right) / \left(3.14 \times 0.4^2 \right) = 7.858 \text{ m/sec} \]

**Source No.3. Multiple well platform 9**

Flare standpipe at multiple well platform 9 is designed to utilize (burn) hydrogen sulfide containing gases when blowing wells besides, for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

Sources of release of polluting substances are the wells connected to multiple well platform 9 during blowing.

**Source of emission** – organized, flare. According to design the height of flare is 30m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

**Calculation of gross output emissions from source**

The volume of gas supplied from one well is calculated by analogy with source No. 1 and will be 756000 m³/year. Five wells (102, 1011, 1010, 1009 and 1008) are connected to multiple well platform; therefore, total volume of burned stratum gas on flare of multiple well platform 9 will be 3780000 m³/year. Content of hydrogen sulfide in stratum gas is 4.25 %, fraction \( C_{5+}^{\text{max}} \) – up to 0.52 g/m³, average density – 0.9 kg/m³.

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m³/h or 87,600 m³/year.

So total volume of gases burned on flare will be 3867600 m³/year or 0.12264 m³/sec (average model of flare operation in constant condition) or 110.376712 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[ M_{CO} = 110.376712 \times 0.057 = 6.291473 \text{ g/d} = 198.407880 \text{ t/year} \]
\[ M_{NO_2} = 110.376712 \times 0.002 \times 0.8 = 0.176603 \text{ g/d} = 5.569344 \text{ t/year} \]
\[ M_{NO} = 110.376712 \times 0.002 \times 0.2 = 0.044151 \text{ g/d} = 1.392336 \text{ t/year} \]
\[ M_{CH_4} = 110.376712 \times 0.03 = 3.311301 \text{ g/d} = 104.425200 \text{ t/year} \]

Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[ M_{SO_2} = 1.88 \times 60.714 \times 0.12264 \text{ m}^3/\text{sec} = 13.998504 \text{ g/d or 441.456837 t/year} \]

Content of \( C_{5+}^{\text{max}} \) fraction in burned gas is 0.52%, therefore, black emissions equal to:

\[ M_{\text{black}} = 0.03 \times 0.12264 \times 0.52 \times 3457 \times 10^{-2} = 0.066139 \text{ g/d} = 2.085766 \text{ t/year} \]

Volume of smoke fumes outlet will be:
Smoke fumes outlet velocity will be:

\[ w = \frac{4 \times 1.2264}{3.14 \times 0.4^2} = 9.764 \text{ m/sec} \]

Source No.4. Multiple well platform 11

Flare standpipe at multiple well platform 11 is designed to utilize (burn) hydrogen sulfide containing gases when blowing wells besides for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

Sources of release of polluting substances are the wells connected to multiple well platform 11 during blowing.

Source of emission – organized, flare. According to design the height of flare is 30m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

The volume of gas supplied from one well is calculated by analogy with source No. 1 and will be 756000 m³/year. Four wells (1015, 1012, 1013, and 1018) are connected to multiple well platform; therefore, total volume of burned stratum gas on flare of multiple well platform 11 will be 3024000 m³/year. Content of hydrogen sulfide in stratum gas is 4.25 %, fraction \( \text{C}_5^{+}\text{max} \) – up to 0.52 g/m³, average density – 0.9 kg/m³.

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m³/h or 87,600 m³/year.

So total volume of gases burned on flare will be 3111600 m³/year or 0.0987 m³/sec (average model of flare operation in constant condition) or 88.80137 g/sec.

The source is not equipped with gas and dust cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
\text{M}_{\text{CO}} &= 88.80137 \times 0.057 = 5.061678 \text{ g/d} = 159.625080 \text{ t/year} \\
\text{M}_{\text{NO}_2} &= 88.80137 \times 0.002 \times 0.8 = 0.142082 \text{ g/d} = 4.480704 \text{ t/year} \\
\text{M}_{\text{NO}} &= 88.80137 \times 0.002 \times 0.2 = 0.035521 \text{ g/d} = 1.120176 \text{ t/year} \\
\text{M}_{\text{CH}_4} &= 88.80137 \times 0.03 = 2.664041 \text{ g/d} = 84.0132 \text{ t/year}
\end{align*}
\]

Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[ \text{M}_{\text{SO}_2} = 1.88 \times 60.714 \times 0.0987 \times 11.262216 \text{ g/d} = 355.165243 \text{ t/year} \]

Content of \( \text{C}_5^{+}\text{max} \) fraction in burned gas is 0.52%, therefore, black emissions equal to:

\[ \text{M}_{\text{black}} = 0.03 \times 0.0987 \times 0.52 \times 3457 \times 10^{-2} = 0.053211 \text{ g/d} = 1.678061 \text{ t/year} \]

Volume of smoke fumes outlet will be:

\[ V = 10 \times 0.0987 = 0.987 \text{ m³/sec} \]

Smoke fumes outlet velocity will be:

\[ w = \frac{4 \times 0.987}{3.14 \times 0.4^2} = 7.858 \text{ m/sec} \]

Source No.5. Multiple well platform 14
Flare standpipe at multiple well platform 14 is designed to utilize (burn) hydrogen sulfide containing gases when blowing wells besides, for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

Sources of release of polluting substances are the wells connected to multiple well platform 14 during blowing.

Source of emission – organized, flare. According to design the height of flare is 30m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

The volume of gas supplied from one well is calculated by analogy with source No. 1 and will be 756000 m³/year. Four wells (1016, 1014, 1017, and 1020) are connected to multiple well platform 14; therefore, total volume of burned stratum gas on flare of multiple well platform 14 will be 3024000 m³/year. Content of hydrogen sulfide in stratum gas is 4.25 %, fraction C₅₊max. – up to 0.52 g/m³, average density – 0.9 kg/m³.

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m³/h or 87,600 m³/year.

So total volume of gases burned on flare will be 3111600 m³/year or 0.0987 m³/sec (average model of flare operation in constant condition) or 88.80137 g/sec.

The source is not equipped with gas and dust cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
M_{CO} &= 88.80137 \times 0.057 = 5.061678 \text{ g/d} = 159.625080 \text{ t/year} \\
M_{NO_2} &= 88.80137 \times 0.002 \times 0.8 = 0.142082 \text{ g/d} = 4.480704 \text{ t/year} \\
M_NO &= 88.80137 \times 0.002 \times 0.2 = 0.035521 \text{ g/d} = 1.120176 \text{ t/year} \\
M_{CH_4} &= 88.80137 \times 0.03 = 2.664041 \text{ g/d} = 84.0132 \text{ t/year}
\end{align*}
\]

Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[
M_{SO_2} = 1.88 \times 60.714 \times 0.0987 \text{ m³/sec} = 11.262216 \text{ g/d or 355.165243 t/year}
\]

Content of C₅₊max. fraction in burned gas is 0.52%, therefore, black emissions equal to:

\[
M_{black} = 0.03 \times 0.0987 \times 0.52 \times 3457 \times 10^{-2} = 0.053211 \text{ g/d} = 1.678061 \text{ t/year}
\]

Volume of smoke fumes outlet will be:

\[
V = 10 \times 0.0987 = 0.987 \text{ m³/sec}
\]

Smoke fumes outlet velocity will be:

\[
w = \frac{(4 \times 0.987)}{(3.14 \times 0.4^2)} = 7.858 \text{ m/sec}
\]

Source No. 6. Multiple well platform 5

Flare standpipe at multiple well platform 5 is designed to utilize (burn) hydrogen sulfide containing gases when blowing wells, besides, for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

Sources of release of polluting substances are the wells connected to multiple well platform 5 during blowing.
Source of emission – organized, flare. According to design the height of flare is 30m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

The volume of gas supplied from one well is calculated by analogy with source No. 1 and will be 756000 m³/year. Five wells (1019, 1021, 1022, 1023 and 1024) are connected to multiple well platform; therefore, total volume of burned stratum gas on flare of multiple well platform 5 will be 3780000 m³/year. Content of hydrogen sulfide in stratum gas is 4.25 %, fraction C₅₊max. – up to 0.52 g/m³, average density – 0.9 kg/m³.

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m³/h or 87,600 m³/year.

So total volume of gases burned on flare will be 3867600 m³/year or 0.12264 m³/sec (average model of flare operation in constant condition) or 110.376712 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
M_{\text{CO}} = 110.376712 \times 0.057 = 6.291473 \text{ g/d} = 198.407880 \text{ t/year}
\]

\[
M_{\text{NO}_2} = 110.376712 \times 0.002 \times 0.8 = 0.176603 \text{ g/d} = 5.569344 \text{ t/year}
\]

\[
M_{\text{NO}} = 110.376712 \times 0.002 \times 0.2 = 0.044151 \text{ g/d} = 1.392336 \text{ t/year}
\]

\[
M_{\text{CH}_4} = 110.376712 \times 0.03 = 3.311301 \text{ g/d} = 104.425200 \text{ t/year}
\]

Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[
M_{\text{SO}_2} = 1.88 \times 60.714 \times 0.12264 \text{ m}^3 / \text{sec} = 13.998504 \text{ g/d} \text{ or } 441.456837 \text{ t/year}
\]

Content of C₅₊max. fraction in burned gas is 0.52%, therefore, black emissions equal to:

\[
M_{\text{black}} = 0.03 \times 0.12264 \times 0.52 \times 3457 \times 10^{-2} = 0.066139 \text{ g/d} = 2.085766 \text{ t/year}
\]

Volume of smoke fumes outlet will be:

\[
V = 10 \times 0.12264 = 1.2264 \text{ m}^3 / \text{sec}
\]

Smoke fumes outlet velocity will be:

\[
w = (4 \times 1.2264) / (3.14 \times 0.4^2) = 9.764 \text{ m/sec}
\]

Source No. 7. Multiple well platform 7

Flare standpipe at multiple well platform 7 is designed to utilize (burn) hydrogen sulfide containing gases when blowing wells besides for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

Sources of release of polluting substances are the wells connected to multiple well platform 7 during blowing.

Source of emission – organized, flare. According to design the height of flare is 30m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

The volume of gas supplied from one well is calculated by analogy with source No. 1 and will be 756000 m³/year. Two wells (1026, 1027) are connected to multiple well platform
7; therefore, total volume of burned stratum gas on flare of multiple well platform 7 will be 1512000 m$^3$/year. Content of hydrogen sulfide in stratum gas is 4.25 %, fractions C$_{5+\max}$ – up to 0.52 g/m$^3$, average density – 0.9 kg/m$^3$.

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m$^3$/h or 87,600 m$^3$/year.

So total volume of gases burned on flare will be 1599600 m$^3$/year or 0.050723 m$^3$/sec (average model of flare operation in constant condition) or 45.650685 g/sec.

The source is not equipped with dust gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
M_{\text{CO}} &= 45.650685 \times 0.057 = 2.602089 \text{ g/d} = 82.059480 \text{ t/year} \\
M_{\text{NO}_2} &= 45.650685 \times 0.002 \times 0.8 = 0.073041 \text{ g/d} = 2.303242 \text{ t/year} \\
M_{\text{NO}} &= 45.650685 \times 0.002 \times 0.2 = 0.018260 \text{ g/d} = 0.575856 \text{ t/year} \\
M_{\text{CH}_4} &= 45.650685 \times 0.03 = 1.369521 \text{ g/d} = 43.189200 \text{ t/year}
\end{align*}
\]

Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m$^3$, therefore, sulfur dioxide emissions equal to:

\[
M_{\text{SO}_2} = 1.88 \times 60.714 \times 0.050723 \text{ m}^3/\text{sec} = 5.789639 \text{ g/d} = 182.582055 \text{ t/year}
\]

Content of C$_{5+\max}$ fraction in burned gas is 0.52%, therefore, black emissions equal to:

\[
M_{\text{black}} = 0.03 \times 0.050723 \times 0.52 \times 3457 \times 10^{-2} = 0.027354 \text{ g/d} = 0.862651 \text{ t/year}
\]

Volume of smoke fumes outlet will be:

\[
V = 10 \times 0.050723 = 0.50723 \text{ m}^3/\text{sec}
\]

Smoke fumes outlet velocity will be:

\[
w = (4 \times 0.50723) / (3.14 \times 0.4^2) = 4.038 \text{ m/sec}
\]

**Source No.8. Flare of well 242**

**Source No.7. Multiple well platform 7**

Flare standpipe at well 242 is designed to utilize (burn) hydrogen sulfide containing gases in well blowings, besides, for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

Source of release of polluting substances is well 242 during blowing.

Source of emission – organized, flare. According to design the height of flare is 30m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

The volume of gas supplied from one well is calculated by analogy with source No. 1 and will be 756000 m$^3$/year. Flare is supplied from well No. 242 only; therefore, total volume of burned stratum gas on flare will be 756000 m$^3$/year. Content of hydrogen sulfide in stratum gas is 4.25 %, fractions C$_{5+\max}$ – up to 0.52 g/m$^3$, average density – 0.9 kg/m$^3$.

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m$^3$/h or 87,600 m$^3$/year.
So total volume of gases burned on flare will be 843600 m³/year or 0.0267504 m³/sec (average model of flare operation in constant condition) or 24, 0753425 g/sec.

The source is not equipped with dust gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
M_{CO} &= 24.0753425 \times 0.057 = 1.372295 \text{ g/d} = 43.276680 \text{ t/year} \\
M_{NO_2} &= 24.0753425 \times 0.002 \times 0.8 = 0.038521 \text{ g/d} = 1.214784 \text{ t/year} \\
M_{NO} &= 24.0753425 \times 0.002 \times 0.2 = 0.009630 \text{ g/d} = 0.303696 \text{ t/year} \\
M_{CH4} &= 24.0753425 \times 0.03 = 0.722260 \text{ g/d} = 22.777200 \text{ t/year}
\end{align*}
\]

Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[
M_{SO_2} = 1.88 \times 60.714 \times 0.0267504 \text{ m}^3/\text{sec} = 3.053350 \text{ g/d or 96.290461 t/year}
\]

Content of C_{5+max} fraction in burned gas is 0.52%, therefore, black emissions equal to:

\[
M_{black} = 0.03 \times 0.0267504 \times 0.52 \times 3457 \times 10^{-2} = 0.014426 \text{ g/d} = 0.454947 \text{ t/year}
\]

Volume of smoke fumes outlet will be:

\[
V = 10 \times 0.0267504 = 0.267504 \text{ m}^3/\text{sec}
\]

Smoke fumes outlet velocity will be:

\[
w = (4 \times 0.247504) / (3.14 \times 0.42) = 1.971 \text{ m/sec}
\]

**Source No. 9. Flare of well 301**

Flare standpipe at well 301 is designed to utilize (burn) hydrogen sulfide containing gases in well blowings besides for non failure operation fuel gas is constantly supplied to the flare to maintain duty fire.

Source of release of polluting substances is well 301 during blowing.

Source of emission – organized, flare. According to design the height of flare is 30 m; diameter at head is – 0.4 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

The volume of gas supplied from one well is calculated by analogy with source No. 1 and will be 756000 m³/year. Flare is supplied from well No. 301 only; therefore, total volume of burned stratum gas on flare will be 756000 m³/year. Content of hydrogen sulfide in stratum gas is 4.25 %, fractions C_{5+max} – up to 0.52 g/m³, average density – 0.9 kg/m³.

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, volume of fire 10 m³/h or 87,600 m³/year.

So total volume of gases burned on flare will be 843600 m³/year or 0.0267504 m³/sec (average model of flare operation in constant condition) or 24, 0753425 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
M_{CO} &= 24.0753425 \times 0.057 = 1.372295 \text{ g/d} = 43.276680 \text{ t/year} \\
M_{NO_2} &= 24.0753425 \times 0.002 \times 0.8 = 0.038521 \text{ g/d} = 1.214784 \text{ t/year} \\
M_{NO} &= 24.0753425 \times 0.002 \times 0.2 = 0.009630 \text{ g/d} = 0.303696 \text{ t/year} \\
M_{CH4} &= 24.0753425 \times 0.03 = 0.722260 \text{ g/d} = 22.777200 \text{ t/year}
\end{align*}
\]
Hydrogen sulfide content in burned gas is 4.25% or 60.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[ \text{MSO}_2 = 1.88 \times 60.714 \times 0.0267504 \text{ m}^3/\text{sec} = 3.053350 \text{ g/d or 96.290461 t/year} \]

Content of C₅₊ fraction in burned gas is 0.52%, therefore, black emissions equal to:

\[ \text{Mblack} = 0.03 \times 0.0267504 \times 0.52 \times 3457 \times 10^{-2} = 0.014426 \text{ g/d or 0.454947 t/year} \]

Volume of smoke fumes outlet will be:

\[ V = 10 \times 0.0267504 = 0.267504 \text{ m}^3/\text{sec} \]

Smoke fumes outlet velocity will be:

\[ w = \frac{4 \times 0.247504}{3.14 \times 0.42} = 1.971 \text{ m/sec} \]

**Source No. 10. Flare of safety valve of the GS**

For venting of gas during operation of safety valves on collectors at inlet to GS there is a flare for non failure operation of which fuel gas is constantly supplied to maintain duty fire.

Source of release of polluting substances are the safety valves on collectors.

Source of emission – organized, flare. According to design the height of flare is 30m; diameter at head is \( \frac{0.6}{\text{m}} \). Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

**Calculation of gross output emissions from source**

Volume of gas supplied to the flare in operation of safety valves does not have any constant value and is determined by specific situation that is why it cannot be uniquely calculated. Complete absence of discharge from safety valves is possible for a long period of time.

Taking into account the above circumstances in this operation the emissions from flare are calculated from only permanent volumes of fuel gas to maintain duty fire at a volume of 15 m³/h (3 pilot burners) or 131400 m³/year. At average density of fuel gas of 0.82 kg/m³ its weight consumption will be 3.4167 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[ \text{MCO} = 3.4167 \times 0.057 = 0.194750 \text{ g/d or 6.141636 t/year} \]
\[ \text{MNO}_2 = 3.4167 \times 0.002 \times 0.8 = 0.005467 \text{ g/d or 0.172397 t/year} \]
\[ \text{MNO} = 3.4167 \times 0.002 \times 0.2 = 0.001367 \text{ g/d or 0.043099 t/year} \]
\[ \text{MCH}_4 = 3.4167 \times 0.03 = 0.102500 \text{ g/d or 3.232440 t/year} \]

Hydrogen sulfide content in fuel gas according to specifications is not more than 0.12% or 1.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[ \text{MSO}_2 = 1.88 \times 1.714 \text{ g/m}^3 \times 0.004167 \text{ m}^3/\text{sec} = 0.013426 \text{ g/d or 0.423413 t/year} \]

Content of C₅₊ fraction in fuel gas is practically absent, therefore, there will not be black emissions from a flare.

Volume of smoke fumes outlet will be:

\[ V = 10 \times 0.004167 = 0.04167 \text{ m}^3/\text{sec} \]

Smoke fumes outlet velocity will be:
\[ w = (4 \times 0.04167) / (3.14 \times 0.6^2) = 0.147 \text{ m/sec} \]

**Source No. 11. Low pressure flare**

Low pressure (stabilization) flare at GS site is designed for burning degassing gases and stabilization of condensate, as well as all discharges from GS technological line with low pressure (less than 1 MPa), besides, for non failure operation of flare system fuel gas will be constantly supplied to maintain duty fire.

Sources of release of combustion products will be GS condensate stabilization system, dump valves of GS technological line.

Source of emission – organized, flare. According to design the height of low pressure flare is 30 m; diameter at head is – 0.15 m. Outlet temperature of gas and air mixture is 700 °C. Low pressure flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

**Calculation of gross output emissions from source**

According to design the largest design volume of gas flow at LPF is 249.7973 kg/h or at average density of gases of 1.549 kg/m³ is 161.2636 m³/hour or 0.0448 m³/sec. Hydrogen sulfide content in degassing gases according to design calculations is 35.395 % mol., fraction \( C_{5+} \text{max.} \) – 0.559 % mol.

Besides, flare equipped with two pilot burners will be supplied with fuel gas to maintain duty fire, at a volume of 10 m³/h or 0.0028 m³/year. So total volume of gases burned on flare will be 0.0476 m³/sec or 73.7324 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

- \( M_{CO} = 73.7324 \times 0.057 = 4.202747 \text{ g/d} = 132.537823 \text{ t/year} \)
- \( M_{NO_2} = 73.7324 \times 0.002 \times 0.8 = 0.117972 \text{ g/d} = 3.720360 \text{ t/year} \)
- \( M_{NO} = 73.7324 \times 0.002 \times 0.2 = 0.029493 \text{ g/d} = 0.930090 \text{ t/year} \)
- \( M_{CH_4} = 73.7324 \times 0.03 = 2.211972 \text{ g/d} = 69.756749 \text{ t/year} \)

Hydrogen sulfide content in burned gas is 35.395% mol. or 505.643 g/m³, therefore, sulfur dioxide emissions equal to:

- \( M_{SO_2} = 1.88 \times 505.643 \times 0.0476 \text{ m³/sec} = 45.248981 \text{ g/d or 1426.971858 \text{ t/year} } \)

Content of \( C_{5+} \text{max.} \) fraction in burned gas is 0.559%, therefore, black emissions equal to:

- \( M_{\text{black}} = 0.03 \times 0.0476 \times 0.559 \times 3457 \times 10^{-2} = 0.027596 \text{ g/d} = 0.870254 \text{ t/year} \)

Volume of smoke fumes outlet at LPF will be:

- \( V = 10 \times 0.0476 = 0.476 \text{ m³/sec} \)

Smoke fumes outlet velocity at LPF will be:

- \( w = (4 \times 0.476) / (3.14 \times 0.15^2) = 26.95 \text{ m/sec} \)

**Source No. 12. High pressure flare**

High pressure flare at GS site is designed for burning vented gases from GS technological line with pressure exceeding 1 MPa, besides, for non failure operation of flare system fuel gas will be constantly supplied to the flare to maintain duty fire.
Sources of release of combustion products will be apparatus system, communications, and dump valves at GS technological line.

Source of emission – organized, flare. According to design the height of high pressure flare is 35m; diameter at head is – 0.6 m. Outlet temperature of gas and air mixture is 700 °C. High pressure flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

Calculation of emissions from HPF is also carried out in maximum volume of condensate preparation. According to design the largest design volume of gas flow at HPF is 343.6841 kg/h or at average density of gases of 1.354 kg/m³ is 253.8288 m³/hour or 0.0705 m³/sec. Hydrogen sulfide content in degassing gases according to design calculations is 9.038 % mol., fraction C₅₊max. – 0.216 % mol.

Besides, flare equipped with three pilot burners will be supplied with fuel gas to maintain duty fire, at a volume of 15 m³/h or 0.0042 m³/sec. So total volume of gases burned on flare will be 0.0747 m³/sec or 101.1438 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Calculation of emissions of polluting substances of gases burned on flares is determined by formulae (2.1-2.5) and will be:

\[ M_{\text{CO}} = 101.1438 \times 0.057 = 5.765197 \text{ g/d} = 181.811240 \text{ t/year} \]
\[ M_{\text{NO}_2} = 101.1438 \times 0.002 \times 0.8 = 0.161830 \text{ g/d} = 5.103473 \text{ t/year} \]
\[ M_{\text{NO}} = 101.1438 \times 0.002 \times 0.2 = 0.040458 \text{ g/d} = 1.275868 \text{ t/year} \]
\[ M_{\text{CH}_4} = 101.1438 \times 0.03 = 3.034314 \text{ g/d} = 95.690126 \text{ t/year} \]

Hydrogen sulfide content in burned gas is 9.038% mol. or 129/114 g/m³, therefore, sulfur dioxide emissions equal to:

\[ M_{\text{SO}_2} = 1/88 \times 129.114 \times 0.0747 \text{ m}^3/\text{sec} = 18.132254 \text{ g/d} \text{ or } 571.818753 \text{ t/year} \]

Content of C₅₊max. fraction in burned gas is 0.216%, therefore, black emissions equal to:

\[ M_{\text{black}} = 0.03 \times 0.0747 \times 0.216 \times 3457 \times 10^{-2} = 0.016734 \text{ g/d} = 0.527718 \text{ t/year} \]

Volume of smoke fumes outlet at HPF will be:

\[ V = 10 \times 0.0747 = 0.747 \text{ m}^3/\text{sec} \]

Smoke fumes outlet velocity at HPF will be:

\[ w = (4 \times 0.747) / (3.14 \times 0.6^2) = 2.643 \text{ m/sec} \]

Sources No.13-14. Heat transfer agent heater

Two heat transfer agent heaters (1 working, 1 – in reserve) are designed for heating of heat transfer agent flow circulating in a closed system of heating condensate in reboiler condensate stabilization column. The fuel for heaters is fuel gas supplied from fuel gas preparation unit.

Source of release of combustion products will be heater combustion chamber.

Source of emission – organized, chimney. According to design the height of chimney is 5.6; diameter is 0.49 m. Outlet temperature of gas and air mixture is 400 °C. Heater operation mode is daily, in turns that are 24 h/d or 3,960 h/year.

Calculation of gross output emissions from source
Calculation of emissions from heater is carried out according to [2] by formula:

\[ M_{CO} = 1.5 \times G \times 0.001 \]  
\[ M_{CH4} = 1.5 \times G \times 0.001 \]  

where: G – fuel consumption, g/d.

Calculation of emission numbers of nitrogen oxides (NO\textsubscript{2}) is determined by formula:

\[ M_{NO2} = V_g \times C_{NOx} \]  

where: \( V_g \) – volume of combustion products, m\textsuperscript{3}/c, determined by formula:

\[ V_g = 7.84 \times \alpha \times V \times \Theta, \]  

where: \( V \) – volume of gas supplied for burning, m\textsuperscript{3}/c;  
\( \alpha \) - excess air coefficient;  
\( \Theta \) – calorific fuel equivalent;  
\( C_{NOx} \) – nitrogen oxide concentration in terms of NO\textsubscript{2}, g/m\textsuperscript{3}.

Nitrogen oxide concentration (\( C_{NOx} \), g/m\textsuperscript{3}) when burning fuel in furnaces is determined by formula:

\[ C_{NOx} = 1.073 \times (180 + 60 \times b) \times \frac{Q_d}{Q_p} \times \alpha^{0.5} \times \frac{V_{c.e.}}{V_{w.e.}} \times 10^{-3} \]  

where: \( Q_d \) and \( Q_p \) – actual and designed heat output, MJ/h (assume that \( Q_d = Q_p \), then \( Q_d / Q_p = 1 \));  
\( b \) – mass fraction of liquid fuel, because accompanying gas is used as fuel, then \( b = 0 \).  
\( \frac{V_{c.e.}}{V_{w.e.}} \) - ratio of dry and wet combustion products volumes in outgoing smoke gases (at \( \alpha = 1.1 \); \( \frac{V_{c.e.}}{V_{w.e.}} = 0.82 \)).

According to design data fuel gas consumption as per heater is 170 m\textsuperscript{3}/h or 0.0472 m\textsuperscript{3}/sec. At average fuel gas density of 0.82 kg/m\textsuperscript{3} its weight consumption will be 38.704 g/c.

Volume of smoke gases output will be:

\[ V = 7.84 \times 0.0472 \times 1.1 \times 1.62 = 0.6594 \text{ m}^3/\text{sec} \]

With regard to temperature mixture output volume will be:

\[ V = 0.6594 \times (273 + 400) / 273 = 1.6256 \text{ m}^3/\text{sec} \]

Nitrogen oxides concentration in smoke fumes will be:

\[ C_{NOx} = 1.073 \times 180 \times 1 \times 1.1^{0.5} \times 0.82 \times 10^{-3} = 0.1661 \text{ g/m}^3 \]

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release and will be:

\[ M_{NO} = 1.6256 \times 0.1661 \times 0.2 = 0.054002 \text{ g/d or 0.769853 t/year} \]
\[ M_{NO2} = 1.6256 \times 0.1661 \times 0.8 = 0.216010 \text{ g/d or 3.079439 t/year} \]
\[ M_{CO} = 1.5 \times 38.704 \times 10^{-3} = 0.058056 \text{ g/d or 0.827646 t/year} \]
\[ M_{CH4} = 1.5 \times 38.704 \times 10^{-4} = 0.005806 \text{ g/d or 0.082770 t/year} \]

Hydrogen sulfide content in fuel gas according to specifications is not more than 0.12% or 1.714 g/m\textsuperscript{3}, therefore, sulfur dioxide emissions equal to:
Gas and air mixture outlet velocity will be:

\[ w = 4 \times 1.6256 \div (3.14 \times 0.492^2) = 8.625 \text{ m/d} \]

**Sources No.15-18. Condensate reservoirs**

For temporary accumulation of stable condensate outgoing from stabilization column 4 horizontal reservoirs of \(160 \text{ m}^3\) equipped with respiration valves with fire barriers are used.

Sources of release of hydrocarbons will be condensate reservoirs (4 pcs.).

Source of emission – organized, respiratory valves. According to design the height of sources is 4.0m; diameter is 0.15 m. Outlet temperature of gas and air mixture is 30 °C. Reservoirs operation mode is daily, year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from sources

Annual losses of hydrocarbons from individual reservoir or group of one purpose reservoirs are calculated by summing up quarterly losses which are determined by formula:

\[
P_{\text{res, qtr}} = V_{\text{qtr}}^i \cdot \frac{\rho_{\text{hPa, sat}}}{\rho_{\text{hPa, atm}}} \cdot \frac{1}{\rho_{\text{hPa, av}}} \cdot \prod K_i \cdot 10^{-3}, \text{t} \]

where:

- \(V_{\text{qtr}}^i\) - volume of oil product going into reservoir or group of one purpose reservoirs for appropriate quarter, \(\text{m}^3\);
- \(\rho_{\text{hPa, sat}}\) - pressure of saturated vapors of hydrocarbons in reservoir gas space at quarterly average temperature of reservoir gas space, mm Hg;
- \(\rho_{\text{hPa, atm}}\) - average barometric pressure in reservoir gas space (it approximately equals to atmospheric pressure), mm Hg;
- \(\rho_{\text{hPa, av}}\) - average density of oil products vapors in reservoir gas space or quarterly average gas space temperature, kg/m³;
- \(K_1\) - experimental coefficient characterizing specific losses of hydrocarbons with regard to quarterly average reservoir turnover;
- \(K_2\) - coefficient taking account of presence of technical means, reduction of losses from evaporation and reservoir operation mode;
- \(K_3\) - coefficient taking account of climatic conditions influence on evaporation.

Quarterly average turnover \(n\) equals to:

\[
n = \frac{V_{\text{qtr}}^i}{V_{\text{res}}} \]  \hspace{1cm} (2.12)

where: \(V_{\text{res}}\) – volume of reservoir or group of one purpose reservoirs.

Value of quarterly average of reservoir gas space temperature \(t_{\text{hPa, av}}\), necessary to determine saturated vapors pressure \(P_{\text{hPa, sat}}\) is adopted for I and IY quarters

\[
t_{\text{hPa, av}} = (t_0 + t_a) / 2, \text{°C} \]  \hspace{1cm} (2.12)

for II and III quarters

\[
t_{\text{hPa, c}} = 0.7t_0 + 0.3t_a, \text{°C} \]  \hspace{1cm} (2.13)

where:

- \(t_0\) – quarterly average oil product temperature in reservoir, °C
- \(t_a\) - quarterly average atmospheric air temperature, °C
Saturated vapors pressure of oil products is taken as per CPL of enterprises which carry out periodical determination of oil products saturated vapors pressure as per GOST 1756-52 (Reid bomb) to certify commercial oil products. According to schedule $P_{\text{satHPA}} = f(t)$ initial values of SVP ($P_{(38)\text{sat}}$) are brought to quarterly average gas space temperature. Hydrocarbons vapors density is determined by formula [2]:

$$p_{\text{hPa \ atm \ To}} = \frac{M \cdot P_{\text{hPa atm To}}}{22.4 \cdot P_0 \cdot T_0 + t_{\text{hPa av}}}, \ \text{kg/m}^3 \quad (2.14)$$

where: $M$ is molecular weight of oil products, $P_0 = 760 \ \text{mm Hg}$, $T = 273 ^{\circ}\text{K}$

According to design data nominal volume of stable condensate produced at Khauzak-Shady field is 50 thousand t/year. Condensate intake to reservoirs during year are conditionally taken over as uniform and proportional to each reservoir, thus, annual turnover of one reservoir will be 12,500 t/year or at average stable condensate density of 0.694 t/m³ (as per design calculations) – of the order of 18,012 m³/year. The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release.

**Calculation of hydrocarbon emissions for Ist and IYth quarters.**

During cold period of year 9006 m³ of condensate will be turned over. Quarterly average temperature of the product is +20 °C, atmospheric air is +5.6 °C. Let’s determine average temperature of reservoirs gas space:

$$t_{\text{hPa av}} = \frac{20 + 5.6}{2} = 12.8 \ ^{\circ}\text{C}$$

Condensate saturated vapors pressure at $t_{\text{hPa av}} = 12.8 \ ^{\circ}\text{C}$ is 92 mm Hg. Molecular weight of condensate vapors is 66.6. Condensate vapors density at reservoirs gas space quarterly average temperature and average barometric pressure will be:

$$p_{\text{hPa av}} = \frac{66.6 \cdot 760 \cdot 273}{22.4 \cdot 760 \cdot 273 + 12.8} = 2.84 \ \text{g/m}^3$$

Quarterly average reservoir turnover equals to:

$$n = 9006: 160 = 56.3$$

Coefficient $K_1$, depending on quarterly average turnover is 1.55. Reservoir is not equipped with any technical means to reduce losses and is operated as «buffer reservoir», therefore, $K_2 = 0.1$. Coefficient $K_3$ for I and IY quarters equals to 1.0. Atmospheric hydrocarbons emissions during cold period will be:

$$P_{\text{res \ qtr}} = 9006 \cdot (92 : 760) \cdot 2.84 \cdot 1.55 \cdot 0.1 \cdot 1 \cdot 10^{-3} = 0.479906 \ \text{t}$$

**Calculation of hydrocarbon emissions for IInd and IIIrd quarters.**

During warm period of year 9006 m³ of condensate will be turned over. Quarterly average temperature of the product is +35 °C, atmospheric air is +23.3°C. Quarterly average temperature of reservoirs gas space will be:

$$t_{\text{hPa av}} = 0.7 \cdot 35 + 0.3 \cdot 23.3 = 31.5 \ ^{\circ}\text{C}$$

Condensate saturated vapors pressure at $t_{\text{hPa av}} = 31.5 \ ^{\circ}\text{C}$ is 230 m Hg. Molecular weight of condensate vapors is 66.6. Condensate vapors density at reservoirs gas space quarterly average temperature and average barometric pressure will be:
66.6 760 273
\[ P_{av}^{\text{hPa}} = \frac{66.6 \cdot 760}{273} = 2.666 \text{ g/m}^3 \]

Coefficient \( K_1 \), depending on quarterly average turnover is 1.55. Reservoir is not equipped with any technical means to reduce losses and is operated as «buffer reservoir», therefore, \( K_2 = 0.1 \). Coefficient \( K_3 \) for II and III quarters equals to 1.72. Atmospheric hydrocarbons emissions during warm period will be:

\[ P_{\text{res}}^{qtr} = 9006 \times (230:760) \times 2.666 \times 1.55 \times 0.1 \times 1.72 \times 10^{-3} = 1.37164 \text{ t} \]

Annual losses of hydrocarbons from one reservoir are calculated by summing up quarterly losses and will be:

\[ P_{\text{CH}_4} = 0.479906 + 1.937164 = 2.41707 \text{ t/year or 0.076645 g/sec} \]

Hydrogen sulfide emissions from one reservoir are determined by formula (3.8) and will be:

\[ P_{\text{H}_2\text{S}} = 0.08 \times 2.41707 \times 10^{-2} = 0.001934 \text{ t/year or 0.000061 g/sec} \]

For estimation of gas air mixture volume from reservoir \( V_1 \) there is ratio:

\[ V_1 = \frac{W_{\text{CH}}}{d_{\text{CH}}} \]

where: \( d_{\text{CH}} \) – density of emitted hydrocarbons \( \text{g/m}^3 \), which is determined by formula:

\[ d_{\text{CH}} = \frac{(m_{\text{CH}} : 22.4) \times (P_{\text{CH}} : P_0) \times 273}{(273 + t_{\text{CH}})} \]  \hspace{1cm} (2.15)

where \( m_{\text{CH}} \) - molecular weight of emitted hydrocarbons, \( \text{g} \)
\( P_{\text{CH}} \) - emitted hydrocarbons pressure, \( \text{mm Hg} \)
\( P_0 \) - atmospheric pressure, \( \text{mm Hg} \)
\( t_{\text{CH}} \) - emitted hydrocarbons temperature.

At condensate molecular weight of 66.6 \( \text{g} \) vapors density equals to:

\[ d_{\text{CH}} = \frac{(66.6 \times 22.4) \times 1 \times 273}{(273 + 30)} = 2.679 \text{ g/m}^3 \]

Mixture volume in unit time will be:

\[ V = 0.076706 / 2.679 = 0.0286 \text{ m}^3/\text{sec} \]

Mixture outlet velocity in unit time:

\[ W = (4 \times 0.0286) / (3.14 \times 0.152) = 1.619 \text{ m/sec}. \]

**Sources No.19-21. Condensate pumps**

For stable condensate pumpover from accumulation reservoirs to condensate pipeline design provides for 3 centrifugal high pressure pumps (2 working, 1 – reserve).

Sources of release of hydrocarbons will be centrifugal pump.

Source of emission – unorganized. According to [1] the height of this unorganized source is 2 m, section square is 0.25 \( \text{m}^2 \). Gas mixture outlet velocity equals to weight average wind speed in this area and is 3.4 m/sec. Outlet temperature of gas and air mixture for unorganized sources according to [1] equals to monthly average temperature of dislocation area during hot period of the year and is 36.9 \( ^\circ \text{C} \). Pumps operation mode is daily, in turns (taking into account connection of stand-by pump) that are 24 h/d or 5,840 h/year.

Calculation of gross output emissions from source
Hydrocarbons emissions calculation in centrifugal pumps operation is carried out according to [2] taking into account boiling temperature of the pumped product. For centrifugal pumps (with stuffing box seal) pumping condensate hydrocarbons escape is 0.039 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, hydrocarbon emissions (per methane) from the source equals to release and will be:

\[ M = 0.039 \text{ g/sec} \times 3600 \times 5840 \times 10^{-6} = 0.819936 \text{ t/year} \]

**Source No.22. GS boiler house**

Source of heat supply of buildings and installations of GS technological site provides for block boiler house, type KBTa-0,3Gn with three hot-water boilers, MKVа-0,1Gn type, and total power of 0.3 MW. Fuel for boiler house is fuel gas supplied through GAS REGULATORY STATION.

**Source of release** of combustion products will be hot-water boilers.

**Source of emission** – organized, chimney. According to design the height of chimney is 15m; diameter is 0.219 m. Outlet temperature of gas and air mixture is 180 °С. Boiler house operation mode is daily, season that is 24 h/d or 3,600 h/year.

**Calculation of gross output emissions from source**

Calculation of emissions from heater is carried out according to [2] by formulae:

\[ M_{co} = 0.001 \times C_{co} \times B \times (1 - q_4/100) \]

where:
- \( B \) – fuel consumption (t/year, thousand cubic m/year, g/d, l/d);
- \( C_{co} \) – carbon oxide output when burning fuel (kg/t) is determined by formula:
  \[ C_{co} = q_3 \times R \times Q_{ir} \]

where:
- \( q_3 \) – heat losses due to chemical fuel combustion incompleteness;
- \( R \) – coefficient taking account of fraction of losses due to chemical fuel combustion incompleteness conditioned by presence of carbon oxide in combustion products. For solid fuel \( R = 1 \), for gas \( R = 0.5 \), for fuel oil \( R = 0.65 \);
- \( Q_{ir} \) - lowest heat of natural fuel combustion (MJ/kg, MJ/m³);
- \( q_4 \) – heat losses due to mechanical fuel combustion incompleteness (%).

If there are no operation data, values \( q_3 \), \( q_4 \) for fuel gas are accepted equal to 0.5.

Quantity of nitrogen oxides (in terms of NO₂), emitted in unit time (t/year, g/d), is determined by formula:

\[ M_{NO2} = 0.001 \times B \times Q_{ir} \times K_{NO2} \times [1 - \beta] \]

where:
- \( K_{NO2} \) – parameter characterizing number of nitrogen oxides formed for 1 GJ of heat (kg/GJ);
- \( \beta \) - coefficient depending on degree of reduction of nitrogen oxides emissions due to use of technical decisions, \( \beta = 0 \).

Value \( K_{NO2} \) is determined by formulae for different types of fuel depending on nominal load of boiler units. For gas and fuel oil:

\[ K_{NO2} = 0.0059 \times \ln(Q_n) + 0.0552 \]

where: \( Q_n \) – nominal power (kW) of boiler units.
With hydrogen sulfide present in fuel calculation of emissions of additional quantity of sulfur oxides in terms of SO\textsubscript{2} is carried out by formula:

\[ M_{\text{SO}_2} = 1.88 \times [\text{H}_2\text{S}] \times B \] (2.20),

where: \([\text{H}_2\text{S}]\) – hydrogen sulfide content of fuel (g/m\textsuperscript{3}).

Design consumption of fuel gas for boiler house operation is 29.2 m\textsuperscript{3}/h or 0.0081 m\textsuperscript{3}/sec. Weight consumption of fuel gas for boiler house with regard to its average density of (0.82 kg/m\textsuperscript{3}) is 6.642 g/sec. Hydrogen sulfide content of fuel gas according to specifications is not more than 0.12% or 1.714 g/m\textsuperscript{3}.

Calculation of boiler house polluting substances emissions is carried out by formulae (2.16-2.20). The lowest heat of fuel gas combustion (per methane) is 33.41 MJ/m\textsuperscript{3} or 40.74 MJ/kg, therefore:

\[ C_{\text{CO}} = 0.5 \times 40.74 \times 0.5 = 10.185 \text{ kg/t} \]
\[ M_{\text{CO}} = 0.001 \times 10.185 \times 6.642 \times (1-0.5/100) = 0.067311 \text{ g/sec or 0.872351 t/year} \]
\[ K_{\text{NO}_2} = 0.0059 \times \ln(320) + 0.0552 = 0.0892 \]
\[ M_{\text{NO}_2} = 0.001 \times 6.642 \times 40.74 \times 0.0892 \times (1-0) = 0.024137 \text{ g/sec or 0.312816 t/year} \]
\[ M_{\text{SO}_2} = 1.88 \times 1.714 \times 0.0081 = 0.026101 \text{ g/sec or 0.338269 t/year} \]

Calculation of smoke fumes outlet is determined by formula (2.21):

\[ V = 7.84 \times 0.0081 \text{ m}^3/\text{sec} \times 1.1 \times 1.62 = 0.1132 \text{ m}^3/\text{d} \]

With regard to temperature volume of mixture outlet will be:

\[ V = 0.1132 \text{ m}^3/\text{d} \times (273 + 180) / 273 = 0.1878 \text{ m}^3/\text{sec} \]

Gas and air mixture outlet velocity will be:

\[ w = 4 \times 0.1878 / (3.14 \times 0.2192)^{1/2} = 4.988 \text{ m/d} \]

**Source No.23. Standby diesel power station**

Automated standby diesel-generator, power of 512 kW is provided as emergency power supply source at GS site. Fuel for diesel generator is diesel fuel supplied from reservoir included in a complete delivery.

**Source of release** of combustion products will be diesel-generator itself.

**Source of emission** – organized, exhaust pipe. According to design the height of fume stack is 3.7 m; diameter is 0.15 m. Outlet temperature of gas and air mixture is 120 °C. Standby diesel-generator operation mode is daily, in emergency situations; annual operation life is considered equal to 30 days or 720 h/year.

**Calculation of gross output emissions from source**

Calculation of polluting substances emissions when burning fuel in ICE was carried out according to [2] on the basis of release multiples for fuel unit by formula:

\[ M_i = B \cdot K_i \cdot 10^{-6}, \] (2.21)

where: \(M_i\) – quantity of substances emitted to atmosphere in exhaust gases of ICE, t/year

\(B\) – fuel consumption, kg/year,

\(K_i\) – average operational specific emission of \(i\)-th component, g/kg of fuel [2].

Multiples of polluting substances release when burning diesel fuel in ICE is (t/t):
Average specific fuel consumption for diesel-generator of 512 kW power is 245 g/kW*h, thus, summarized diesel fuel consumption for diesel power station will be:
\[ B = 245 \times 500 \times 720 \times 10^{-6} = 88.2 \text{ t/year} \]

Gross emissions during diesel power station operation will be:
- Carbon oxide: \( \text{M}_{\text{CO}} = 0.1 \text{ t/t} \times 88.2 \text{ t} = 8.82 \text{ t/year} \) or 3,402.7778 g/sec
- Methane: \( \text{M}_{\text{CH}_4} = 0.03 \text{ t/t} \times 88.2 \text{ t} = 2.646 \text{ t/year} \) or 1,020.8333 g/sec
- Nitrogen dioxide: \( \text{M}_{\text{NO}_2} = 0.04 \text{ t/t} \times 88.2 \text{ t} = 3.528 \text{ t/year} \) or 1,361.1111 g/sec
- Sulfur dioxide: \( \text{M}_{\text{SO}_2} = 0.02 \text{ t/t} \times 88.2 \text{ t} = 1.764 \text{ t/year} \) or 0,680.5556 g/sec
- Black: \( \text{M}_{\text{black}} = 0.016 \text{ t/t} \times 88.2 \text{ t} = 1.4112 \text{ t/year} \) or 0,544444 g/sec

Average operation value of gas and air mixture at exhaust pipe outlet with regard to temperature equal to 120° will be 25.458 m³/kg [2]. Volume of gas and air mixture outgoing from exhaust pipe of ICE will be:
\[ \text{Vt} = 88200 \text{ kg} \times 25.468 \text{ m}^3/\text{kg} : (720 \times 3600) = 0.8666 \text{ m}^3/\text{d} \]

Mixture outlet velocity in unit time equals to:
\[ \nu = 4 \times 0.8666 \text{ m}^3/\text{d} : (3.14 \times 0.152) = 49.064 \text{ m/d} \]

Source No.24. GS hardware yard

At GS hardware yard theoretical leakages are possible in sealings and connections of technological apparatus and units, pipelines, shut-off and control valves. In leakings through shut-off and control valves gates vapor gas mixture goes to flare collector that is why leakage at GS hardware yard are possible only through flange connections. In order to prevent leakage through flanges the design provides for multilayer insulation coating but according to [3] (WD39-0148306-413-88) in process of long operation of technological equipment there is a possibility of leaking occurrence.

Source of release of hydrocarbons will be flange connections.

Source of emission – unorganized. According to [1] the height of this square unorganized source is considered equal to 2m, dimensions 220x 160m. Gas and air mixture outlet velocity equals to weight average wind speed in this area and is 3.4 m/sec. Outlet temperature of gas and air mixture for unorganized sources according to [1] equals to monthly average temperature of dislocation area during hot period of the year and is 36.9 °C. Source operation mode is daily, year round that is 24h/d or 8,760 h/year.

Calculation of gross output emissions from source

Calculation of polluting substances in unorganized emissions from GS technological site is carried out according to [3].

Total number of flange connections at GS site as per design data is 526 pcs. According to annex 1 data leakage is observed for flows light hydrocarbons (two phase flows) for 5% of total number of flanges, therefore, is subject to account in calculation:
\[ N = 526 \times 0.05 = 26.3 \text{ flanges} \]
Value of leakage of light hydrocarbons during period of 10 year term of operation through one flange is 0.00027 kg/h or of the order of 0.00000005 m³/sec. Thus, summarized possible volume of hydrocarbon leaking (per methane) through all GS flanges may amount to:

\[ M_{CH} = 26.3 \times 0.00027 = 0.007101 \text{ kg/h or } 0.001973 \text{ g/sec or } 0.062221 \text{ t/year} \]

Average content of hydrogen sulfide of produced raw material is 4.25% or 60.86 g/m³, therefore, hydrogen sulfide emissions from GS hardware yard may amount to:

\[ M_{H2S} = 60.86 \times 0.00000005 \text{ m³/sec} \times 26.3 = 0.000008 \text{ g/d or } 0.002523 \text{ t/year} \]

**Source No.25. Field base boiler house**

Source of heat supply as well as hot water supply of buildings and installations of field base and dwelling town provide for block boiler house, type KBTa-1.7Гн with five hot-water boilers, total power of 1.7 MW. Fuel for boiler house is fuel gas supplied by GAS REGULATORY STATION from block boiler house.

Source of release of combustion products will be hot-water boilers.

Source of emission – organized, chimney. According to design the height of chimney is 15m; diameter is 0.377 m. Outlet temperature of gas and air mixture is 180 °C. Boiler house operation mode is daily, year round that is 24 h/d or 8,760 h/year.

**Calculation of gross output emissions from source**

Design fuel gas consumption for operation of boiler house is 78.5 m³/h or 0.0218 m³/sec. Weight consumption of fuel gas for boiler house with regard to its average density of (0.82 kg/m³) is 17.876 g/sec. Hydrogen sulfide content of fuel gas according to specifications is not more than 0.12% or 1.714 g/m³.

Calculation of boiler house polluting substances emissions is carried out by formulae (2.16-2.20). The lowest heat of fuel gas combustion (per methane) is 33.41 MJ/m³ or 40.74MJ/kg, therefore:

\[ C_{CO} = 0.5 \times 40.74 \times 0.5 = 10.185 \text{ kg/t} \]
\[ M_{CO} = 0.001 \times 10.185 \times 17.876 \times (1-0.5/100) = 0.181157 \text{ g/sec or } 5.712967 \text{ t/year} \]
\[ K_{NO2} = 0.0059 \times \ln(320) + 0.0552 = 0.0892 \]
\[ M_{NO2} = 0.001 \times 17.876 \times 40.74 \times 0.0892 \times (1-0) = 0.064962 \text{ g/sec or } 2.048642 \text{ t/year} \]
\[ M_{SO2} = 1.88 \times 1.714 \times 0.0218 = 0.070247 \text{ g/sec or } 2.215309 \text{ t/year} \]

Smoke fumes outlet volume will be:

\[ V = 7.84 \times 0.0218 \text{ m³/sec} \times 1.1 \times 1.62 = 0.3046 \text{ m³/d} \]

With regard to temperature mixture outlet volume will be:

\[ V = 0.3046 \text{ m³/d} \times (273 + 180) / 273 = 0.5054 \text{ m³/sec} \]

Gas and air mixture outlet velocity will be:

\[ w = 4 \times 0.5054 / (3.14 \times 0.377^2) = 4.53 \text{ m/d} \]

**Source No.26. Minor repair block**

In order to carry out minor repair of the field equipment minor repair block equipped with different metal removal machines is constructed of the Base territory. Machines will be located in a closed room with exhaust ventilation.
Sources of release of polluting substances will be metal removal machines (3 pcs.) – 1 bench-type drilling machine, 1 band cutting-off machine, 1 sharpener and grinding machine.

Source of emission – organized, ventilation well. According to design the height of well is 6m; section size is 0.25 m². Emissions from this source are considered to be isothermal and according to [1] the outlet temperature of gas and air mixture from source 36.9 °C. Capacity of ventilation system is 18 m³/h. Machines operation mode is periodic – 2h/d, 6 days a week that is 624 h/year.

Calculation of gross output emissions from source

Multiples of release of abrasive-metal dust during metal removal machines operation (without cooling) are accepted according to [1] and are:

- for drilling machines – 0.002 g/sec;
- for cutting-off machines – 0.014 g/sec;
- for sharpener and grinding machines (⌀ wheel 150 mm) – 0.033 g/sec.

Thus summarized release of abrasive metal dust during machines operation will be 0.049 g/sec.

Since there is no cleaning of emissions in repair block abrasive and metal dust emission to atmosphere by ventilation well will be equal to release and will be:

\[ M_{dust} = 0.033 \times 3600 \times 624 \times 10^{-6} = 0.074131 \text{ t/year} \]

Gas and air mixture outlet velocity from source will be:

\[ w = 4 \times 18 / (3600 \times 3.14 \times 0.25) = 0.025 \text{ m/d} \]

Source No.27. Electric welding unit

For minor repair of equipment the electric welding unit will function on the territory of field Base.

Source of release of polluting substances will be electric welding unit itself.

Source of emission – unorganized. According to [1] the height of this square unorganized source is considered equal to 2m, section size is 0.25 m². Gas and air mixture outlet velocity equals to weight average wind speed in this area and is 3.4 m/sec. Outlet temperature of gas and air mixture for unorganized sources according to [1] equals to monthly average temperature of dislocation area during hot period of the year and is 36.9 °C. Welding unit operation mode is periodic – 2 h/d, 6 days a week that is 624 h/year.

Calculation of gross output emissions from source

Quantity of polluting substances emitted during electrode welding is calculated with regard to consumed welding electrodes and specific release of ingredients as per formula [1]:

\[ M = K \times B \times 10^{-6}, \text{ tons} \]  \hspace{1cm} \text{(2.22)}

where:

- \( M \) – total quantity emitted harmful substances;
- \( K \) – specific index of harmful substances emission for 1 kg of welding materials are accepted according to [1];
- \( B \) – welding material consumption, kg

Planned consumption of electrodes (AHO-6 grade) for the needs of minor repair is 1 ton, therefore, release of polluting substances will be:

\[ M_{Fe_2O_3} = 14.35 \text{ g/kg} \times 1000 \text{ kg} \times 10^{-6} = 0.01435 \text{ t/year or 0.006388 g/sec} \]
Use of gas-operated welding appliance is provided on the territory of field Base for minor repair.

**Source of release** of polluting substances will be gas-operated welding appliance itself.

**Source of emission** – unorganized. According to [1] the height of this square unorganized source is considered equal to 2m, section size is 0.25 m². Gas and air mixture outlet velocity equals to weight average wind speed in this area and is 3.4 m/sec. Outlet temperature of gas and air mixture for unorganized sources according to [1] equals to monthly average temperature of dislocation area during hot period of the year and is 36.9 °C. Appliance operation mode is periodical – 2 h/d, 6 days a week that is 624 h/year.

**Calculation of gross output emissions from source**

Quantity of nitrogen oxides emitted during gas welding using propane-butane mixture is calculated with regard to specific emissions and according to [1] equaling to 15 g/kg of mixture.

Planned demand in propane-butane mixture for the needs of minor repair is 1 ton, therefore, release of nitrogen oxides during gas welding will be:

\[
M_{NO_2} = 15 \text{ g/kg} * 1000 \text{ kg} * 10^{-6} = 0.015 \text{ t/year} \text{ or } 0.006677 \text{ g/sec}
\]

**Source No.29. Welding unit**

Mobile ICE operated welding unit will be used for carrying out repair works. Fuel for welding unit is diesel fuel.

**Source of release** of products combustion will be internal combustion engine of the welding unit.

**Source of emission** – organized, exhaust pipe. According to design the height of exhaust pipe is 2.5m; diameter is 0.08 m. Outlet temperature of gas and air mixture is 120 °C. Welding unit operation mode is periodical, 2 h/d, 6 days a week that is 624 h/year.

**Calculation of gross output emissions from source**

Quantity of polluting substances emitted during ICE fuel burning is calculated according to [2] depending on multiples of release per unit of fuel by formula (2.21) similarly to source No. 23:

Planned diesel fuel consumption for welding unit is 8 l/h or 6.4 kg/h (4 t/year). Thus gross emissions will be:

\[
\begin{align*}
M_{CO} &= 0.1 \text{ t/t} * 4 \text{ t} = 0.4 \text{ t/year or } 0.178063 \text{ g/sec} \\
M_{CH_4} &= 0.03 \text{ t/t} * 4 \text{ t} = 0.12 \text{ t/year or } 0.053419 \text{ g/sec} \\
M_{NO_x} &= 0.04 \text{ t/t} * 4 \text{ t} = 0.16 \text{ t/year or } 0.071225 \text{ g/sec} \\
M_{SO_2} &= 0.02 \text{ t/t} * 4 \text{ t} = 0.08 \text{ t/year or } 0.035613 \text{ g/sec} \\
M_{black} &= 0.016 \text{ t/t} * 4 \text{ t} = 0.064 \text{ t/year or } 0.028490 \text{ g/sec}
\end{align*}
\]

Average operational value of gas and air mixture volume when leaving exhaust pipe with regard to temperature equal to 120° will be 25.458 m³/kg [2]. Gas and air mixture volume leaving ICE exhaust pipe will be:

\[
V_t = 4000 \text{ kg} * 25.468 \text{ m}^3/\text{kg} : (720 * 3600) = 0.0453 \text{ m}^3/\text{d}
\]

Mixture outlet velocity in unit time equals to:
Mobile ICE operated compressor will be used for carrying out repair works. Fuel for compressor is diesel fuel.

**Source of release** of products combustion will be internal combustion engine of the compressor.

**Source of emission** – organized, exhaust pipe. The height of exhaust pipe is 2.5m; diameter is 0.08 m. Outlet temperature of gas and air mixture is 120 °C. Compressor operation mode is periodical, 2 h/d, 6 days a week that is 624 h/year.

**Calculation of gross output emissions from source**

Quantity of polluting substances emitted during ICE fuel burning is calculated according to [2] depending on multiples of release per unit of fuel by formula (2.21):

Planned diesel fuel consumption for compressor is 8 l/h or 6.4 kg/h (4 t/year). Thus gross emissions will be:

\[
\begin{align*}
M_{CO} &= 0.1 \, t/t \times 4 \, t = 0.4 \, t/\text{year or } 0.178063 \, g/\text{sec} \\
M_{CH4} &= 0.03 \, t/t \times 4 \, t = 0.12 \, t/\text{year or } 0.053419 \, g/\text{sec} \\
M_{NO2} &= 0.04 \, t/t \times 4 \, t = 0.16 \, t/\text{year or } 0.071225 \, g/\text{sec} \\
M_{SO2} &= 0.02 \, t/t \times 4 \, t = 0.08 \, t/\text{year or } 0.035613 \, g/\text{sec} \\
M_{black} &= 0.016 \, t/t \times 4 \, t = 0.064 \, t/\text{year or } 0.028490 \, g/\text{sec}
\end{align*}
\]

Average operational value of gas and air mixture volume when leaving exhaust pipe with regard to temperature equal to 120° will be 25.458 m³/kg [2]. Gas and air mixture volume leaving ICE exhaust pipe will be:

\[
V_t = 4000 \, kg \times 25.468 \, m^3/kg : (720 \times 3600) = 0.0453 \, m^3/d
\]

Mixture outlet velocity in unit time equals to:

\[
\nu = 4 \times 0.0453 \, m^3/d : (3.14 \times 0.08^2) = 9.017 \, m/d
\]

**Source No.31. Lighting installation**

Mobile ICE operated lighting installation will be used for carrying out repair works. Fuel for lighting installation is diesel fuel.

**Source of release** of products combustion will be internal combustion engine of the installation.

**Source of emission** – organized, exhaust pipe. The height of exhaust pipe is 2.5m; diameter is 0.08 m. Outlet temperature of gas and air mixture is 120 °C. Installation operation mode is periodical, 2 h/d, 6 days a week that is 624 h/year.

**Calculation of gross output emissions from source**

Calculation of polluting substances emissions during ICE fuel burning is carried out according to [2] depending on multiples of release per unit of fuel by formula (2.21):

Planned diesel fuel consumption for lighting installation is 8 l/h or 6.4 kg/h (4 t/year). Thus gross emissions will be:

\[
\begin{align*}
M_{CO} &= 0.1 \, t/t \times 4 \, t = 0.4 \, t/\text{year or } 0.178063 \, g/\text{sec} \\
M_{CH4} &= 0.03 \, t/t \times 4 \, t = 0.12 \, t/\text{year or } 0.053419 \, g/\text{sec} \\
M_{NO2} &= 0.04 \, t/t \times 4 \, t = 0.16 \, t/\text{year or } 0.071225 \, g/\text{sec} \\
M_{SO2} &= 0.02 \, t/t \times 4 \, t = 0.08 \, t/\text{year or } 0.035613 \, g/\text{sec}
\end{align*}
\]
M_{black} = 0.016 \text{ t/t} \times 4 \text{ t} = 0.064 \text{ t/year} or 0.028490 \text{ g/sec}

Average operational value of gas and air mixture volume when leaving exhaust pipe with regard to temperature equal to 120° will be 25.458 m³/kg [2]. Gas and air mixture volume leaving ICE exhaust pipe will be:

V_t = 4000 \text{ kg} \times 25.468 \text{ m³/kg} : (720 \times 3600) = 0.0453 \text{ m³/d}

Mixture outlet velocity in unit time equals to:

\nu = 4 \times 0.0453 \text{ m³/d} : (3.14 \times 0.082) = 9.017 \text{ m/d}

**Source No.32. Pond-evaporators of OC**

Waste water from GS and field Base sites after purification at mechanical and biological treatment are dispose to hydro insulated ponds-evaporators. Open surface (useful area) of ponds-evaporators is 100 m x 78 m (2 maps)

Sources of release of hydrocarbons will be open surface of the pit (sump).

Source of emission – unorganized square hydrocarbon emissions. According to [1] the height of source is considered equal to 2m, summarized dimensions of ponds area are 100x156 m. Gas and air mixture velocity equals to weight average wind speed in this area and is 3.4 m/sec, temperature equals to monthly average temperature during hot period of the year and is 36.9 °C. Source operation mode is daily, year round that is 24 h/d or 8,760 h/year.

Calculation of gross emissions from source

Calculation of hydrocarbons emissions (summarized) during evaporation from open surfaces is carried out according to [2] by formula:

\[ M = 0.28 \times (4+0.4 \times V) \times (0.7518 \times P_{S(38)} \times K_5) \times K_{10} \times (C : S)^{0.1} \times S \times K_{11} \times 10^{-2}, \text{ g/sec (2.23)} \]

where:

- \( V \) – annual average wind speed, m/sec;
- \( P_{S(38)} \) – oil products saturated vapors pressure at 38° C (\( P_s = 1.6 \text{ hPa} \));
- \( C \) – oil products concentration in waste water, mg/l;
- \( S \) – evaporation surface area, m²;
- \( K_5 \) – coefficient depending on \( P_{S(38)} \), at 1.6 hPa \( K_5 = 0.29 \);
- \( K_{10} \) – coefficient depending on \( P_{S(38)} \), at 1.6 hPa \( K_{10} = 0.25 \);
- \( K_{11} \) – coefficient depending on evaporation surface cover degree, open surface - \( K_{11} = 1 \)

Oil products concentration in purified waste water disposed to ponds is 25 mg/l according to design documentation for purification installations. Evaporation surface area is 15600 m². Thus, hydrocarbons emissions will be:

\[ M = 0.28 \times (4+0.4 \times 3.4) \times (0.7518 \times 1.6 \times 0.29) \times 0.25 \times (25/15600)^{0.1} \times 15600 \times 1 \times 10^{-2} = 10.727271 \text{ g/d} \]

or 10,727271 g/d * 3600 * 8760 * 10^{-6} = 338,295,218 t/year

**Source No.33. Scraper station starting-up unit flare**

For venting of gas during operations at scraper station starting-up unit there is a flare, for non failure operation of which fuel gas is constantly supplied to the flare to maintain duty fire.

Source of release of polluting substances is scraper station starting-up chamber on the gas pipeline of commercial gas.
Source of emission – organized, flare. According to design the height of flare is 35m; diameter at head is – 0.7 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

Volume of gas supplied to the flare in operations of starting-up does not have any constant value and is determined by specific situation that is why it cannot be uniquely calculated. Complete absence of venting of gas to flare for a long period of time is possible.

Taking into account the above circumstances in this operation the emissions from flare are calculated from only permanent volumes of fuel gas to maintain duty fire at a volume of 15 m³/h (3 pilot burners) or 131400 m³/year. At average density of fuel gas of 0.82 kg/m³ its weight consumption will be 3.4167 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
&M_{\text{CO}} = 3.4167 \times 0.057 = 0.194750 \text{ g/d} = 6.141636 \text{ t/year} \\
&M_{\text{NO}_2} = 3.4167 \times 0.002 \times 0.8 = 0.005467 \text{ g/d} = 0.172397 \text{ t/year} \\
&M_{\text{NO}} = 3.4167 \times 0.002 \times 0.2 = 0.001367 \text{ g/d} = 0.043099 \text{ t/year} \\
&M_{\text{CH}_4} = 3.4167 \times 0.03 = 0.102500 \text{ g/d} = 3.232440 \text{ t/year}
\end{align*}
\]

Hydrogen sulfide content of fuel gas according to specifications is not more than 0.12% or 1.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[
&M_{\text{SO}_2} = 1.88 \times 1.714 \text{ g/m}^3 \times 0.004167 \text{ m}^3/\text{sec} = 0.013426 \text{ g/d or 0.423413 t/year}
\]

Content of C₅⁺ max. fraction in fuel gas is practically absent, therefore, there will not be black emissions from a flare.

Volume of smoke fumes outlet will be:

\[
V = 10 \times 0.004167 = 0.04167 \text{ m}^3/\text{sec}
\]

Smoke fumes outlet velocity will be:

\[
w = \frac{4 \times 0.04167}{(3.14 \times 0.7^2)} = 0.108 \text{ m/sec}
\]

Source No.34. Scraper station flare

For venting of gas during operations at scraper station there is a flare, for non failure operation of which fuel gas is constantly supplied to the flare to maintain duty fire.

Source of release of polluting substances is scraper station receiving chamber on the gas pipeline of commercial gas.

Source of emission – organized, flare. According to design the height of flare is 35m; diameter at head is – 0.7 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

Volume of gas supplied to the flare in receiving operations does not have any constant value and is determined by specific situation that is why it cannot be uniquely calculated. Complete absence of venting of gas to flare for a long period of time is possible.

Taking into account the above circumstances in this operation the emissions from flare are calculated from only permanent volumes of fuel gas to maintain duty fire at a volume of
15 m³/h (3 pilot burners) or 131400 m³/year. At average density of fuel gas of 0.82 kg/m³ its weight consumption will be 3.4167 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
M_{\text{CO}} &= 3.4167 \times 0.057 = 0.194750 \text{ g/d} = 6.141636 \text{ t/year} \\
M_{\text{NO}_2} &= 3.4167 \times 0.002 \times 0.8 = 0.005467 \text{ g/d} = 0.172397 \text{ t/year} \\
M_{\text{NO}} &= 3.4167 \times 0.002 \times 0.2 = 0.001367 \text{ g/d} = 0.043099 \text{ t/year} \\
M_{\text{CH}_4} &= 3.4167 \times 0.03 = 0.102500 \text{ g/d} = 3.232440 \text{ t/year}
\end{align*}
\]

Hydrogen sulfide content of fuel gas according to specifications is not more than 0.12% or 1.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[
M_{\text{SO}_2} = 1.88 \times 1.714 \text{ g/m}^3 \times 0.004167 \text{ m}^3/\text{sec} = 0.013426 \text{ g/d or 0.423413 t/year}
\]

Content of C₅⁺ fraction in fuel gas is practically absent, therefore, there will not be black emissions from a flare.

Volume of smoke fumes outlet will be:

\[
V = 10 \times 0.004167 = 0.04167 \text{ m}^3/\text{sec}
\]

Smoke fumes outlet velocity will be:

\[
w = (4 \times 0.04167) / (3.14 \times 0.72) = 0.108 \text{ m/sec}
\]

**Source No.35. ПК5+13 block valve station flare**

For venting of gas from block valve station with two-way blowing at ПК5+13 of gas pipeline of commercial gas there is a flare system provided, for non failure flare operation of which fuel gas is constantly supplied to the flare to maintain duty fire.

**Source of release of polluting substances** is block valve station with two-way blowing on the gas pipeline of commercial gas.

**Source of emission** – organized, flare. According to design the height of flare is 35m; diameter at head is – 0.7 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

**Calculation of gross output emissions from source**

Volume of gas supplied to the flare does not have any constant value and is determined by specific situation that is why it cannot be uniquely calculated. Complete absence of venting of gas to flare for a long period of time is possible.

Taking into account the above circumstances in this operation the emissions from flare are calculated from only permanent volumes of fuel gas to maintain duty fire at a volume of 15 m³/h (3 pilot burners) or 131400 m³/year. At average density of fuel gas of 0.82 kg/m³ its weight consumption will be 3.4167 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
M_{\text{CO}} &= 3.4167 \times 0.057 = 0.194750 \text{ g/d} = 6.141636 \text{ t/year} \\
M_{\text{NO}_2} &= 3.4167 \times 0.002 \times 0.8 = 0.005467 \text{ g/d} = 0.172397 \text{ t/year} \\
M_{\text{NO}} &= 3.4167 \times 0.002 \times 0.2 = 0.001367 \text{ g/d} = 0.043099 \text{ t/year} \\
M_{\text{CH}_4} &= 3.4167 \times 0.03 = 0.102500 \text{ g/d} = 3.232440 \text{ t/year}
\end{align*}
\]
Hydrogen sulfide content of fuel gas according to specifications is not more than 0.12% or 1.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[ M_{SO_2} = 1.88 \times 1.714 \frac{g}{m^3} \times 0.004167 \frac{m^3}{sec} = 0.013426 \frac{g}{d} \text{ or } 0.423413 \frac{t}{year} \]

Content of C_{5+max} fraction in fuel gas is practically absent, therefore, there will not be black emissions from a flare.

Volume of smoke fumes outlet will be:

\[ V = 10 \times 0.004167 = 0.04167 \frac{m^3}{sec} \]

Smoke fumes outlet velocity will be:

\[ w = \frac{4 \times 0.04167}{3.14 \times 0.72} = 0.108 \frac{m}{sec} \]

Source No.36. PIK108+48 block valve station flare

For venting of gas from block valve station with two-way blowing at PIK108+48 of gas pipeline of commercial gas there is a flare system provided, for non failure flare operation of which fuel gas is constantly supplied to the flare to maintain duty fire.

Source of release of polluting substances is block valve station with two-way blowing on the gas pipeline of commercial gas.

Source of emission – organized, flare. According to design the height of flare is 35m; diameter at head is – 0.7 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross output emissions from source

Volume of gas supplied to the flare does not have any constant value and is determined by specific situation that is why it cannot be uniquely calculated. Complete absence of venting of gas to flare for a long period of time is possible.

Taking into account the above circumstances in this operation the emissions from flare are calculated from only permanent volumes of fuel gas to maintain duty fire at a volume of 15 m³/h (3 pilot burners) or 131400 m³/year. At average density of fuel gas of 0.82 kg/m³ its weight consumption will be 3.4167 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[ M_{CO} = 3.4167 \times 0.057 = 0.194750 \frac{g}{d} = 6.141636 \frac{t}{year} \]
\[ M_{NO_2} = 3.4167 \times 0.002 \times 0.8 = 0.005467 \frac{g}{d} = 0.172397 \frac{t}{year} \]
\[ M_{NO} = 3.4167 \times 0.002 \times 0.2 = 0.001367 \frac{g}{d} = 0.043099 \frac{t}{year} \]
\[ M_{CH_4} = 3.4167 \times 0.03 = 0.102500 \frac{g}{d} = 3.232440 \frac{t}{year} \]

Hydrogen sulfide content of fuel gas according to specifications is not more than 0.12% or 1.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[ M_{SO_2} = 1.88 \times 1.714 \frac{g}{m^3} \times 0.004167 \frac{m^3}{sec} = 0.013426 \frac{g}{d} \text{ or } 0.423413 \frac{t}{year} \]

Content of C_{5+max} fraction in fuel gas is practically absent, therefore, there will not be black emissions from a flare.

Volume of smoke fumes outlet will be:

\[ V = 10 \times 0.004167 = 0.04167 \frac{m^3}{sec} \]

Smoke fumes outlet velocity will be:
w = (4 * 0.04167) / (3.14 * 0.7^2) = 0.108 m/sec

**Source No.37. ПК219+75 block valve station flare**

For venting of gas from block valve station with two-way blowing at ПК219+75 of gas pipeline of commercial gas there is a flare system provided, for non failure flare operation of which fuel gas is constantly supplied to the flare to maintain duty fire.

**Source of release** of polluting substances is block valve station with two-way blowing on the gas pipeline of commercial gas.

**Source of emission** – organized, flare. According to design the height of flare is 35m; diameter at head is – 0.7 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

**Calculation of gross emissions from source**

Volume of gas supplied to the flare does not have any constant value and is determined by specific situation that is why it cannot be uniquely calculated. Complete absence of venting of gas to flare for a long period of time is possible.

Taking into account the above circumstances in this operation the emissions from flare are calculated from only permanent volumes of fuel gas to maintain duty fire at a volume of 15 m^3/h (3 pilot burners) or 131400 m^3/year. At average density of fuel gas of 0.82 kg/m^3 its weight consumption will be 3.4167 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

- \( M_{CO} = 3.4167 \times 0.057 = 0.194750 \text{ g/d} = 6.141636 \text{ t/year} \)
- \( M_{NO_2} = 3.4167 \times 0.002 \times 0.8 = 0.005467 \text{ g/d} = 0.172397 \text{ t/year} \)
- \( M_{NO} = 3.4167 \times 0.002 \times 0.2 = 0.001367 \text{ g/d} = 0.043099 \text{ t/year} \)
- \( M_{CH_4} = 3.4167 \times 0.03 = 0.102500 \text{ g/d} = 3.232440 \text{ t/year} \)

Hydrogen sulfide content of fuel gas according to specifications is not more than 0.12% or 1.714 g/m^3, therefore, sulfur dioxide emissions equal to:

- \( M_{SO_2} = 1.88 \times 1.714 \text{ g/m}^3 \times 0.004167 \text{ m}^3/sec = 0.013426 \text{ g/d or 0.423413 t/year} \)

Content of \( C_{5+}^{max} \) fraction in fuel gas is practically absent, therefore, there will not be black emissions from a flare.

Volume of smoke fumes outlet will be:

\( V = 10 \times 0.004167 = 0.04167 \text{ m}^3/sec \)

Smoke fumes outlet velocity will be:

\( w = (4 \times 0.04167) / (3.14 \times 0.7^2) = 0.108 \text{ m/sec} \)

**Source No.38. ПК328+35 block valve station flare**

For venting of gas from block valve station with two-way blowing at ПК328+35 of gas pipeline of commercial gas there is a flare system provided, for non failure flare operation of which fuel gas is constantly supplied to the flare to maintain duty fire.

**Source of release** of polluting substances is block valve station with two-way blowing on the gas pipeline of commercial gas.
Source of emission – organized, flare. According to design the height of flare is 35m; diameter at head is – 0.7 m. Outlet temperature of gas and air mixture is 700 °C. Flare operation mode is constant and year round that is 24 h/d or 8,760 h/year.

Calculation of gross emissions from source

Volume of gas supplied to the flare does not have any constant value and is determined by specific situation that is why it cannot be uniquely calculated. Complete absence of venting of gas to flare for a long period of time is possible.

Taking into account the above circumstances in this operation the emissions from flare are calculated from only permanent volumes of fuel gas to maintain duty fire at a volume of 15 m³/h (3 pilot burners) or 131400 m³/year. At average density of fuel gas of 0.82 kg/m³ its weight consumption will be 3.4167 g/sec.

The source is not equipped with dust and gas cleaning equipment, therefore, emission from the source equals to release. Emissions of harmful substances to atmosphere are determined by formulae (2.1-2.5) and will be:

\[
\begin{align*}
M_{CO} &= 3.4167 \times 0.057 = 0.194750 \text{ g/d = 6.141636 t/year} \\
M_{NO_2} &= 3.4167 \times 0.002 \times 0.8 = 0.005467 \text{ g/d = 0.172397 t/year} \\
M_{NO} &= 3.4167 \times 0.002 \times 0.2 = 0.001367 \text{ g/d = 0.043099 t/year} \\
M_{CH_4} &= 3.4167 \times 0.03 = 0.102500 \text{ g/d = 3.232440 t/year}
\end{align*}
\]

Hydrogen sulfide content of fuel gas according to specifications is not more than 0.12% or 1.714 g/m³, therefore, sulfur dioxide emissions equal to:

\[
M_{SO_2} = 1.88 \times 1.714 \text{ g/m³} \times 0.004167 \text{ m³/sec} = 0.013426 \text{ g/d or 0.423413 t/year}
\]

Content of C₅⁺ₜₐₓ fraction in fuel gas is practically absent, therefore, there will not be black emissions from a flare.

Volume of smoke fumes outlet will be:

\[
V = 10 \times 0.004167 = 0.04167 \text{ m³/sec}
\]

Smoke fumes outlet velocity will be:

\[
w = \frac{4 \times 0.04167}{(3.14 \times 0.72)} = 0.108 \text{ m/sec}
\]

Thus, in the result of inventory of emission sources of Khauzak-Shady area of Dengizkul field 38 sources of atmospheric air pollution were disclosed as per corrected design decisions. Inventory forms of the sources are represented in Tables 12-15. From registered atmospheric emission sources it is planned to receive 10 names of pollutants. List of pollutants is represented in Table 11.

### Table 11 – List of pollutants

<table>
<thead>
<tr>
<th>Ingredient name</th>
<th>MPC, mg/m³</th>
<th>Class of danger</th>
<th>Established quota (fraction of MPK)</th>
<th>Max concentration in fraction of MPC</th>
<th>Corresponder to established quota (+/-)</th>
<th>Percent of contribution to emissions</th>
<th>Totally emitted to atmosphere, t/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfide anhydride</td>
<td>0.500</td>
<td>3</td>
<td>0.33</td>
<td>0.29</td>
<td>+</td>
<td>62.2872</td>
<td>4689.386207</td>
</tr>
<tr>
<td>Carbon oxide</td>
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Development possibilities

In prospect two multiple platform at Shady structure are subject to construction on Khauzak-Shady area. Number of connected wells, their flow rate, piping as well as methods of connection to existing collectors will be corrected and specified in detail after Project of development of Khauzak-Shady areas of Dengizkul field preparation.

The construction of BCS is also planned in the beginning of declining production on Khauzak-Shady area. Placement of BCS is designed not far from GS but parameters of compressor units, their quantity and operation mode are not known at present. Determination of above characteristics will be carried out later on during ecological endorsement of Khauzak-Shady project.

When BCS is in operation the sources of atmosphere pollution will be exhaust wells of compressor units, their technological stalks, stalks of oil plant, chimneys of technological furnaces of auxiliary structures (unit of fuel gas, impulsive gas preparation, etc.).

Summarized volumes of area emissions will be corrected as per received results. At present time detailed calculation of emissions from the above objects is not possible.

Within the limits of mining allotment of Khauzak-Shady area the following objects are already designed under construction:

- landfill of temporary storage and utilization of drilling wastes;
- gas filling station;
- entry check point No.1;
- entry check point No.2;

Designing and construction of the above objects passed independent ecological estimate (including ECS development), that is why sources registered on these sites were not counted in this work.

In future after putting in operation of all designed objects it will be necessary to carry out detailed updated inventory of emission sources throughout Khauzak-Shady area as a whole. Implementation of this work is expedient to be carried out during 2009-2010, after preparation of the Project Khauzak-Shady area development, putting in operation firm wells, in conditions of stable operation of preparation objects and gas and condensate transport, upon which to carry out repeated standardizing of emissions of fully functioning field.
Facilities of the Khauzak-Shady area of the Dengizkul Field (well clusters, gas treatment facility, power supply units, effluent treatment plants, linear part)

OOO LUKOIL Uzbekistan Operating Company

Tashkent, A. Khodzhaev Street 1, Floor 9, phone: 140-40-40

OOO EKOTEXPROEKT ENGINEERING
### Table 12. – Section 1. Pollution Sources

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<th>Operational unit, workshop, site</th>
<th>Pollution Source</th>
<th>Product or operation performed</th>
<th>Operating time of the pollution source, hours per day</th>
<th>Pollutant</th>
<th>Quantity of pollutants generated by the pollution sources Average, mg/m³</th>
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«Khauzak and Shady of Dengizkul deposit Construction» Statement on Environmental Consequences
Table 13. – Section 2. Pollution Sources

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### Table 13 continued

<p>|   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|   | Flare of cluster 5 | Flare stack | 8760 | 6 | 30 | 0,4 | 1,2264 | 9,764 | 700 | 5050 | 4000 | - | - | - | Carbon oxide | 6,291473 | 5130,0334 | 198,407880 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Nitrogen dioxide | 0,176603 | 144,0011 | 5,569344 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Nitrogen oxide | 0,044151 | 36,0005 | 1,392336 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Hydrocarbons | 3,311301 | 2700,0171 | 104,425200 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Sulfur dioxide | 13,998504 | 11414,3053 | 441,456837 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Soot | 0,066139 | 53,9294 | 2,085766 |
|   | Flare of cluster 7 | Flare stack | 8760 | 7 | 30 | 0,4 | 0,5072 | 4,038 | 700 | 3000 | 5000 | - | - | - | Carbon oxide | 2,602089 | 5130,3017 | 82,059480 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Nitrogen dioxide | 0,073041 | 144,0083 | 2,303424 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Nitrogen oxide | 0,018260 | 36,0016 | 0,575856 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Hydrocarbons | 1,369521 | 2700,1597 | 43,189200 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Sulfur dioxide | 5,789639 | 11414,9034 | 182,582055 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Soot | 0,027354 | 53,9314 | 0,862651 |
|   | Flare of well 242 | Flare stack | 8760 | 8 | 30 | 0,4 | 0,2675 | 1,971 | 700 | 8200 | 3700 | - | - | - | Carbon oxide | 1,372295 | 5130,0746 | 43,276680 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Nitrogen dioxide | 0,035821 | 144,0037 | 1,214784 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Nitrogen oxide | 0,009630 | 36,0000 | 0,303696 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Hydrocarbons | 0,722260 | 2700,0374 | 22,777200 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Sulfur dioxide | 3,053350 | 11414,3925 | 96,290461 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Soot | 0,014426 | 53,9290 | 0,454947 |
|   | Flare of well 301 | Flare stack | 8760 | 9 | 30 | 0,4 | 0,2675 | 1,971 | 700 | 3150 | 3500 | - | - | - | Carbon oxide | 1,372295 | 5130,0748 | 43,276680 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Nitrogen dioxide | 0,035821 | 144,0037 | 1,214784 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Nitrogen oxide | 0,009630 | 36,0000 | 0,303696 |
| Gas Treatment Facility (GTF) | Flare of safety valves at the inlet of the GTF | Flare stack | 8760 | 10  | 30 | 0.6 | 0.0417 | 0.147 | 700 | 8100 | 3300 | - | - | - | Carbon oxide | 0.194750 | 4670.2638 | 6,141636 |
| | | | | | | | | | | | | | | | Hydrocarbons | 0.722260 | 2700.0374 | 22,777200 |
| | | | | | | | | | | | | | Sulfur dioxide | 3.053350 | 11414.3925 | 96,290461 |
| | | | | | | | | | | | | | Soot | 0.014426 | 53.9290 | 0.454947 |
| | Flare stack | 8760 | 11 | 30 | 0.15 | 0.476 | 26.95 | 700 | 8250 | 3300 | - | - | - | Carbon oxide | 4,202747 | 8829.3004 | 132,537823 |
| | | | | | | | | | | | | | Hydrocarbons | 2.211972 | 4647.0000 | 69,756749 |
| | | | | | | | | | | | | | Sulfur dioxide | 45.248981 | 95060.8845 | 1426,971858 |
| | | | | | | | | | | | | | Soot | 0.027596 | 57.9748 | 0.870254 |
| | Flare stack | 8760 | 12 | 35 | 0.6 | 0.747 | 2.643 | 700 | 8250 | 3200 | - | - | - | Carbon oxide | 5.765197 | 7717.8005 | 181,811240 |
| | | | | | | | | | | | | | Hydrocarbons | 1.179792 | 247.8403 | 3,720360 |
| | | | | | | | | | | | | | Sulfur dioxide | 0.029493 | 61.9601 | 0.930090 |
| | | | | | | | | | | | | | Hydrocarbons | 0.161830 | 216.6399 | 5,103473 |
| | | | | | | | | | | | | | Sulfur dioxide | 0.040458 | 54.1606 | 1,275868 |
| | | | | | | | | | | | | | Soot | 0.016734 | 22.4016 | 0.257718 |</p>
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|   |     |    |                           |    |    |    |    |    |    |    |    |    |    |    |    |        |      |      |     |
|   |     |    | Thermal liquid heater     |    |    |    |    |    |    |    |    |    |    |    |    | Carbon oxide | 0.058056 | 35.7136 | 0.827646 |
|   |     |    | No.2                      |    |    |    |    |    |    |    |    |    |    |    |    | Nitrogen dioxide | 0.216010 | 132.8802 | 3.079439 |
|   |     |    | Smoke stack               |    |    |    |    |    |    |    |    |    |    |    |    | Nitrogen oxide | 0.054002 | 33.2197 | 0.769853 |
|   |     |    |                            |    |    |    |    |    |    |    |    |    |    |    |    | Hydrocarbons | 0.005806 | 3.5716 | 0.082770 |
|   |     |    |                            |    |    |    |    |    |    |    |    |    |    |    |    | Sulfur dioxide | 0.152094 | 93.5618 | 2.168252 |

|   |     |    | Condensate tank 160 m³   |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.076645 | 2679.8951 | 2.417070 |
|   |     |    | No.1                      |    |    |    |    |    |    |    |    |    |    |    |    | Hydrogen sulfide | 0.000061 | 2.1329 | 0.001934 |
|   |     |    | Breather valve            |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.076645 | 2679.8951 | 2.417070 |
|   |     |    |                            |    |    |    |    |    |    |    |    |    |    |    |    | Hydrogen sulfide | 0.000061 | 2.1329 | 0.001934 |

|   |     |    | Condensate tank 160 m³   |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.076645 | 2679.8951 | 2.417070 |
|   |     |    | No.2                      |    |    |    |    |    |    |    |    |    |    |    |    | Hydrogen sulfide | 0.000061 | 2.1329 | 0.001934 |
|   |     |    | Breather valve            |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.076645 | 2679.8951 | 2.417070 |
|   |     |    |                            |    |    |    |    |    |    |    |    |    |    |    |    | Hydrogen sulfide | 0.000061 | 2.1329 | 0.001934 |

|   |     |    | Condensate tank 160 m³   |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.076645 | 2679.8951 | 2.417070 |
|   |     |    | No.3                      |    |    |    |    |    |    |    |    |    |    |    |    | Hydrogen sulfide | 0.000061 | 2.1329 | 0.001934 |
|   |     |    | Breather valve            |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.076645 | 2679.8951 | 2.417070 |
|   |     |    |                            |    |    |    |    |    |    |    |    |    |    |    |    | Hydrogen sulfide | 0.000061 | 2.1329 | 0.001934 |

|   |     |    | Condensate pump            |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.039000 | 45.8824  | 0.819936  |
|   |     |    | Fugitive                   |    |    |    |    |    |    |    |    |    |    |    |    | Hydrogen sulfide | 0.000061 | 2.1329 | 0.001934 |
|   |     |    |                            |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.039000 | 45.8824  | 0.819936  |
|   |     |    |                            |    |    |    |    |    |    |    |    |    |    |    |    | Methane | 0.039000 | 45.8824  | 0.819936  |

«Khauzak and Shady of Dengizkul deposit Construction» Statement on Environmental Consequences
<table>
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<tr>
<th>Source of Emissions</th>
<th>Type of Emissions</th>
<th>Concentration (mg/m³)</th>
<th>Volume (m³)</th>
<th>Flow Rate (m³/h)</th>
<th>Emission Rate (kg/h)</th>
<th>Emission (kg)</th>
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Table data includes concentrations of various pollutants in milligrams per cubic meter (mg/m³), volumes of emissions in cubic meters (m³), flow rates in cubic meters per hour (m³/h), emission rates in kilograms per hour (kg/h), and total emissions in kilograms (kg). The table covers emissions from different sources and types of emissions, including smoke stacks and exhaust stacks from boiler houses and emergency diesel power stations, as well as fugitive emissions from the instrument center of the GTF. The pollutants listed include carbon monoxide, nitrogen dioxide, sulfur dioxide, hydrocarbons, soot, methane, and hydrogen sulfide.
Table 13 continued

|    | 1    | 2                  | 3                  | 4     | 5  | 6  | 7     | 8     | 9     | 10   | 11   | 12   | 13   | 14   | 15   | 16             | 17  | 18  | 19  |
|----|------|-------------------|--------------------|-------|----|----|-------|-------|-------|------|------|------|------|------|----------------|-----|-----|-----|
| 17 | 18   | 19               |                    |       |    |    |       |       |       |      |      |      |      |      |                 |     |     |     |
| 20 | 21   | 22               |                    |       |    |    |       |       |       |      |      |      |      |      |                 |     |     |     |
| 23 | 24   | 25               |                    |       |    |    |       |       |       |      |      |      |      |      |                 |     |     |     |
| 26 | 27   | 28               |                    |       |    |    |       |       |       |      |      |      |      |      |                 |     |     |     |
| 29 | 30   | 31               |                    |       |    |    |       |       |       |      |      |      |      |      |                 |     |     |     |

- **Boiler house KHTa-0.75 Henry**
  - Smoke stack
  - Carbon oxide: 0.181157
  - Nitrogen dioxide: 0.064962
  - Sulfur dioxide: 0.070247

- **Minor repair block**
  - Ventilation shaft
  - Abrasive metal dust: 0.049000

- **Electric arc welding machine**
  - Fugitive
  - Ferrous oxide: 0.006388
  - Manganese dioxide: 0.000868

- **Gas-operated welding machine**
  - Fugitive
  - Nitrogen dioxide: 0.006677

- **Welding unit**
  - Exhaust stack
  - Carbon oxide: 0.178063
  - Nitrogen dioxide: 0.071225
  - Hydrocarbons: 0.053419
  - Sulfur dioxide: 0.035613
  - Soot: 0.028490

- **Compressor**
  - Exhaust stack
  - Carbon oxide: 0.178063
  - Nitrogen dioxide: 0.071225
  - Hydrocarbons: 0.053419
  - Sulfur dioxide: 0.035613
  - Soot: 0.028490

- **Lighting system**
  - Exhaust stack
  - Carbon oxide: 0.178063
  - Nitrogen dioxide: 0.071225
  - Hydrocarbons: 0.053419

«Khauzak and Shady of Dengizkul deposit Construction» Statement on Environmental Consequences
### Treatment facilities

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<th>Area</th>
<th>Emission Source</th>
<th>Sulfur dioxide</th>
<th>Soot</th>
<th>Sulfur trioxide</th>
<th>Methane</th>
<th>Carbon oxide</th>
<th>Nitrogen dioxide</th>
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### Linear part

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<th>Area</th>
<th>Emission Source</th>
<th>Sulfur dioxide</th>
<th>Soot</th>
<th>Sulfur trioxide</th>
<th>Methane</th>
<th>Carbon oxide</th>
<th>Nitrogen dioxide</th>
<th>Nitrogen oxide</th>
<th>Hydrocarbons</th>
<th>Sulfur dioxide</th>
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Table 13 continued

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<td>Nitrogen dioxide</td>
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<td>131,0313</td>
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<td>Nitrogen oxide</td>
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<td>0,172397</td>
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<td>32,7818</td>
<td>0,043099</td>
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<td>Hydrocarbons</td>
<td>0,102500</td>
<td>2458,0336</td>
<td>3,232440</td>
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<td>Sulfur dioxide</td>
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<td>0,423413</td>
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</table>

«Khauzak and Shady of Dengizkul deposit Construction» Statement on Environmental Consequences
Table 14. – Section 3. Indicators of dust and gas trapping (decontamination) units operation

<table>
<thead>
<tr>
<th>Pollution Source No.</th>
<th>Dust and gas trapping (decontamination) unit</th>
<th>Contaminant trapped</th>
<th>Concentration of substance, mg/m³</th>
<th>Plant efficiency, %</th>
<th>Utilization Factor (%)</th>
<th>Characteristics of the state of dust and gas trapping units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before treatment</td>
<td>After treatment</td>
<td>Design</td>
<td>Actual</td>
<td>Standard</td>
<td>Actual</td>
</tr>
</tbody>
</table>
| No dust and gas trapping units available

«Khauzak and Shady of Dengizkul deposit Construction» Statement on Environmental Consequences
Table 15. – Section 4. Total pollutant emissions

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Quantity of pollutants generated by all pollution sources, tpa</th>
<th>Including</th>
<th>From those received for treatment</th>
<th>Total air emissions, tpa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emitted without treatment, tpa</td>
<td>Received for treatment, tpa</td>
<td>Captured and decontaminated</td>
<td>Actual, t/year</td>
</tr>
<tr>
<td>Total</td>
<td>7528,646682</td>
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<td>-</td>
<td>-</td>
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<tr>
<td>Including solid ones:</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Abrasive-metal dust</td>
<td>0,074131</td>
<td>0,074131</td>
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<td>-</td>
</tr>
<tr>
<td>Soot</td>
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<td>-</td>
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</tr>
<tr>
<td>Ferrous oxide</td>
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<td>Manganese dioxide</td>
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<td>-</td>
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<td>Gaseous and liquid ones:</td>
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<td>Carbon oxide</td>
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<td>Methane</td>
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<td>-</td>
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<tr>
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<td>-</td>
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<tr>
<td>Sulfur dioxide</td>
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<td>4689,386207</td>
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<td>-</td>
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</tbody>
</table>
**Development of MPE Standards**

In accordance with Resolution No. 491 of the RU Cabinet of Ministers dated December 31, 2001 On the Approval of the Provision on the State Environmental Impact Audit in the Republic of Uzbekistan, the infrastructure facilities of the Khauzak-Shady area refer to the 1st category. Taking into account the category of the facilities, and on the basis of the qualitative and qualitative properties of the pollutant discharges into the atmosphere, the calculation of ground level concentrations of contaminants was performed using the *Ecolog* Standardized Software for Air Pollution Calculation.

The characteristics and coefficients defining the conditions of spreading the pollutants in the atmosphere in the area of construction (the Bukhara weather station) are provided in Table 16.

**Table 16 – Atmospheric Characteristics and Coefficients**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Designator</th>
<th>Dimension</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Coefficient depending on the atmospheric stratification</td>
<td>A</td>
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</tr>
<tr>
<td>Terrain relief coefficient</td>
<td>η</td>
<td></td>
<td>1,0</td>
</tr>
<tr>
<td>Average air temperature at 1 pm:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of the warmest month</td>
<td>Tw</td>
<td>°C</td>
<td>+36,3</td>
</tr>
<tr>
<td>of the coldest month</td>
<td>Tc</td>
<td>°C</td>
<td>-2,4</td>
</tr>
<tr>
<td>Wind velocity, probability of the increase of which per year is 5%</td>
<td>U*</td>
<td>mps</td>
<td>8,0</td>
</tr>
<tr>
<td>Average annual wind velocity</td>
<td>Wav</td>
<td>mps</td>
<td>4,2</td>
</tr>
<tr>
<td>Average annual frequency of wind directions by bearings:</td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td>7,0</td>
</tr>
<tr>
<td>NE</td>
<td></td>
<td></td>
<td>19,0</td>
</tr>
<tr>
<td>E</td>
<td></td>
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<td>34,0</td>
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<tr>
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<td></td>
<td></td>
<td>10,0</td>
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<td>S</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>no wind</td>
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<td></td>
<td>12,0</td>
</tr>
</tbody>
</table>

Based on the results of calculating the maximum ground level concentrations the standards of pollution emissions were defined taking into account the allowed quotas [1]. For the Bukhara area the MPC quotas are as follows:

- Substances of the 1st hazard class: 0.18 MPC
- Substances of the 2nd hazard class: 0.25 MPC
- Substances of the 3rd hazard class: 0.33 MPC
- Substances of the 4th hazard class and substances with the Safe Reference Levels of Impact (SRLI): 0.50 MPC

Standardization was performed by the values of ground level concentrations beyond the borders of cluster sites with flare systems, gas treatment facilities, field base and treatment facilities. It should be noted that in order to ensure that the maximum concentrations of pollutants from the sources of the gas treatment facilities meet the requirements of the established quotas, the sanitary protection zone of 1000 meters from the borders of the gas treatment unit was established for the gas treatment unit site in accordance with the Sanitary Rules and Standards.
For other sites not sanitary protection zones need to be established because of small values of ground level concentrations beyond their borders. In order to estimate the emissions from flare stacks on the linear section of the communication corridor a conditional reference area was adopted, the size of which is 500x500 meters. The standard emissions calculated for this reference area are fair for all block valve stations and pig launchers/receivers because of the similar composition and parameters of their emissions. The results of calculating the maximum ground level concentrations from the facilities of Khauzak-Shady demonstrated the following (Fig. 23-32):

**Carbon oxide**

The maximum concentration beyond the site limits is achieved in the point with the coordinates of $X=9500$ m, $Y=3000$ m and amounts to 0.06 MPC. This concentration is formed with the wind velocity at 0.5 mps and the wind direction of 333° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 1 (0.02 MPC) and N 12 (0.01 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.5 MPC, it is advisable to assign the MPE status to the emission parameters.

**Nitrogen dioxide**

The maximum concentration beyond the site limits is achieved in the point with the coordinates of $X=9500$ m, $Y=3500$ m and amounts to 0.25 MPC. This concentration is formed with the wind velocity at 2.0 mps and the wind direction of 353° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 11 (0.11 MPC) and N 12 (0.12 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.25 MPC, it is advisable to assign the MPE status to the emission parameters.

**Nitrogen oxide**

The maximum concentration beyond the site limits is achieved in the point with the coordinates of $X=9500$ m, $Y=3000$ m and amounts to 0.004 MPC. This concentration is formed with the wind velocity at 0.5 mps and the wind direction of 41° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 5 (0.001 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.33 MPC, it is advisable to assign the MPE status to the emission parameters.

**Methane**

The maximum concentration beyond the site limits is achieved in the point with the coordinates of $X=9500$ m, $Y=3000$ m and amounts to 0.001 MPC. This concentration is formed with the wind velocity at 0.5 mps and the wind direction of 55° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 29 (0.001 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.5 MPC, it is advisable to assign the MPE status to the emission parameters.

**Sulfurous anhydride**

The maximum concentration beyond the site limits is achieved in the point with the coordinates of $X=7500$ m, $Y=4000$ m and amounts to 0.29 MPC. This concentration is formed with the wind velocity at 0.5 mps and the wind direction of 244° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 11 (0.1 MPC) and N 12 (0.13 MPC). Since the maximum ground level concentration beyond the
site limits does not exceed the established level of 0.33 MPC, it is advisable to assign the MPE status to the emission parameters.

**Soot**
The maximum concentration beyond the site limits is achieved in the point with the coordinates of \(X=7500\) m, \(Y=2500\) m and amounts to 0.12 MPC. This concentration is formed with the wind velocity at 1.9 mps and the wind direction of 325° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 23 (0.05 MPC) and N 12 (0.03 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.33 MPC, it is advisable to assign the MPE status to the emission parameters.

**Hydrogen sulfide**
The maximum concentration beyond the site limits is achieved in the point with the coordinates of \(X=9500\) m, \(Y=3000\) m and amounts to 0.002 MPC. This concentration is formed with the wind velocity at 6.0 mps and the wind direction of 61° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 18 (0.002 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.25 MPC, it is advisable to assign the MPE status to the emission parameters.

**Metal dust**
The maximum concentration beyond the site limits is achieved in the point with the coordinates of \(X=7500\) m, \(Y=2500\) m and amounts to 0.18 MPC. This concentration is formed with the wind velocity at 6.0 mps and the wind direction of 247° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 26 (0.18 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.33 MPC, it is advisable to assign the MPE status to the emission parameters.

**Manganese and its compounds**
The maximum concentration beyond the site limits is achieved in the point with the coordinates of \(X=7500\) m, \(Y=2500\) m and amounts to 0.05 MPC. This concentration is formed with the wind velocity at 0.5 mps and the wind direction of 54° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 27 (0.05 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.25 MPC, it is advisable to assign the MPE status to the emission parameters.

**Ferrous oxide**
The maximum concentration beyond the site limits is achieved in the point with the coordinates of \(X=7500\) m, \(Y=2500\) m and amounts to 0.05 MPC. This concentration is formed with the wind velocity at 0.5 mps and the wind direction of 54° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 27 (0.05 MPC). Since the maximum ground level concentration beyond the site limits does not exceed the established level of 0.33 MPC, it is advisable to assign the MPE status to the emission parameters.

**Linear section**
The results of calculating the maximum ground level concentrations from the sources on the linear section of the communications corridor demonstrated the following (Fig. 33-37):
**Nitrogen dioxide**

The maximum concentration beyond the site limits is achieved in the point with the coordinates of X=350 m, Y=350 m and amounts to 0.01 MPC. This concentration is formed with the wind velocity at 0.5 mps and the wind direction of 225° with the OX axis. The main contribution in the formation of the maximum ground-level concentration beyond the site limits is made by sources N 33 (0.01 MPC). Since the maximum ground level concentration in the points of the reference site does not exceed the established level of 0.25 MPC, it is advisable to assign the MPE status to the emission parameters.

For other ingredients emitted from the flares of the linear section of the communication corridor the maximum concentrations do not exceed the values of 0.001 MPC in all points of the reference area, and therefore meet the values of the established quotas, and for this reason it is advisable to assign the MPE status to all emission in the linear section.

Therefore, all emissions resulting from the operation of facilities at Khauzak-Shady area outside the process facilities (for the Gas Treatment Facility – outside the Sanitary Protection Zone) are forecast to comply with the allowable emission threshold. Therefore, on the basis of the above detailed analysis of the mass and structure of pollutants, as well as taking into account the calculated level of air pollution, it is proposed to establish the regulatory status of maximum permissible emissions for each of new air pollution sources at the level of nominal calculated emissions (Tables 17-18). The regulatory status of the maximum permissible emissions of pollutants to the atmosphere in total by ingredients is recommended to be adopted in accordance with the data provided in Table 19.
Figure 23 – Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field
Carbon oxide, quota – 0.50 MPC (4th class of hazard)
Обустройство участков Хаузак и Шады Денгизкульского месторождения.

Заявление об экологических последствиях.

Figure 24. Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field.

Nitrogen dioxide, quota – 0.25 MPC (2nd class of hazard).
Figure 25 – Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field
Nitrogen oxide, quota – 0.33 MPC (3rd class of hazard)
Figure 26 – Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field
Methane, quota – 0.50 MPC (4th class of hazard)
Figure 27 – Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field
Sulfur dioxide, quota – 0.33 MPC (3rd class of hazard)
Обустройство участков Хаузак и Шады Денгикульского месторождения. Заявление об экологических последствиях
Figure 29 – Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field
Hydrogen sulfide, quota – 0.25 MPC (2nd class of hazard)
Figure 30 – Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field
Abrasive-metal dust, quota – 0.33 MPC (3rd class of hazard)
Figure 31 – Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field
Manganese dioxide, quota – 0.25 MPC (2nd class of hazard)
Figure 32 – Maximum concentrations of pollutants in the atmosphere from the pollution sources of the Khauzak-Shady area of the Dengizkul field
Ferrous oxide, quota – 0.33 MPC (3rd class of hazard)
Figure 33 – Maximum concentrations of pollutants from flares in the linear section of the communication corridor of the Khauzak-Shady area of the Dengizkul field (block valve stations, pig receiver)
Carbon oxide, quota – 0.50 MPC (4th class of hazard)
Figure 34 – Maximum concentrations of pollutants from flares in the linear section of the communication corridor of the Khauzak-Shady area of the Dengizkul field (block valve stations, pig receiver)
Nitrogen dioxide, quota – 0.25 MPC (2nd class of hazard)
Figure 35 – Maximum concentrations of pollutants from flares in the linear section of the communication corridor of the Khauzak-Shady area of the Dengizkul field (block valve stations, pig receiver)
Nitrogen oxide, quota – 0.33 MPC (3rd class of hazard)
Figure 36 – Maximum concentrations of pollutants from flares in the linear section of the communication corridor of the Khauzak-Shady area of the Dengizkul field (block valve stations, pig receiver)
Methane, quota – 0.50 MPC (4th class of hazard)
Figure 37 – Maximum concentrations of pollutants from flares in the linear section of the communication corridor of the Khauzak-Shady area of the Dengizkul field (block valve stations, pig receiver)
Sulfur dioxide, quota – 0.33 MPC (3rd class of hazard)
Table 17 – Pollutant emissions to the atmosphere at present, at the projected point of full development of the enterprise and at the
projected point of MPE achievement (by sources)

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<th>Pollutant emissions</th>
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Note: The table entries include pollutant names, operational units, source numbers, actual and projected pollutants emissions in G/SEC and TPA, and the year of MPE achievement.
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| Nitrogen oxide | Cluster sites | 1 | - | - | - | - | - | 0.035521 | 1.120176 | 0.035521 | 1.120176 | 2007 |
| Nitrogen oxide | Cluster sites | 2 | - | - | - | - | - | 0.035521 | 1.120176 | 0.035521 | 1.120176 | 2007 |
| Nitrogen oxide | Cluster sites | 3 | - | - | - | - | - | 0.044151 | 1.392336 | 0.044151 | 1.392336 | 2007 |</p>
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<td>12</td>
<td>13</td>
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<td>Pollutant emissions</td>
<td>MPE</td>
<td>Above level emission</td>
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<td>tpa</td>
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<td>tpa</td>
<td>g/sec</td>
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<td>468,938,6207</td>
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</tr>
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<td>1,175,377,822</td>
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<td></td>
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<td>0,074,131</td>
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<td>-</td>
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<td></td>
<td></td>
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<td>0,000,0324</td>
<td>0,010,259</td>
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<td></td>
<td></td>
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<td></td>
</tr>
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<td>0,000,868</td>
<td>0,001,950</td>
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<td>-</td>
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<td><strong>752,864,682</strong></td>
<td><strong>246,896,408</strong></td>
<td><strong>752,864,682</strong></td>
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<td>-</td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>
Actions aimed at controlling and maintaining the level of pollutant emissions

In order to maintain the emission level at the established (calculated) level, as well as for the purpose of the systematic control over emissions, OOO LUKOIL Uzbekistan Operating Company needs to carry out air protection activities on a regular basis. The proposed list of activities is provided in Table 20.

**Table 20 – Plan of Air Protection Activities.**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Efficiency</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring of atmospheric air</td>
<td>Obtaining reliable information about the state of the atmospheric air</td>
<td>Regular, quarterly</td>
</tr>
<tr>
<td>Operational control over the emission sources</td>
<td>Control over the emission volume on the basis of instrumental measurements and material balance</td>
<td>Regularly, quarterly</td>
</tr>
<tr>
<td>Provision with the stationary gas sensors in the site of the gas treatment facility</td>
<td>Automatic control over the concentrations of pollutants in the working area of the gas treatment facility</td>
<td>On an ongoing basis</td>
</tr>
<tr>
<td>Nondestructive testing and corrosion monitoring of the equipment of the gas treatment facility and linear section</td>
<td>Leakage control and process loss control</td>
<td>On an ongoing basis</td>
</tr>
<tr>
<td>Establishment of the sanitary protection zone (SPZ) of 1 km around the gas treatment facility</td>
<td>Decrease in the concentrations exceeding the established standards</td>
<td></td>
</tr>
</tbody>
</table>

**Activities connected with unfavorable meteorological conditions**

Depending on the degree of weather deterioration (from the point of view of spreading the contaminants in the atmosphere) and the expected level of air pollution, three groups of activities may be used at the facilities of the Khauzak-Shady field and adjacent territory in order to reduce the air pollution level.

The first group includes organizational activities not requiring any significant costs and not impacting the scheduled course of operational processes. The second group includes the activities related to the creation of additional treatment facilities and development of special operational modes of process equipment. The third group integrates the activities connected with the reduction of volumes of production through the full or partial shutdown of operations. The activities of the second and third groups shall be implemented only in the event of a hazardous air pollution. The information about the occurrence of hazardous weather conditions shall be received from the local authorities of the State Environmental Committee.

The special feature of work carried out in the Khauzak-Shady facilities is the impossibility of a full shutdown of the process equipment of the gas treatment facility. In the event of unfavorable meteorological conditions there can be a short-run (until the weather is stabilized) shutdown of operations connected with gas flaring on well clusters, block valve stations of the linear sections of the communication corridor, pig launchers and receivers and auxiliary processes (heating, minor repairs).

The action plan for reducing the air emissions for the period of unfavorable meteorological conditions is provided in Table 21.
Table 21 - Activities for reducing the pollutant emissions in the period of unfavorable meteorological conditions

<table>
<thead>
<tr>
<th>Mode No. of unfavorable meteorological conditions</th>
<th>Item No.</th>
<th>Activity</th>
<th>Emission source number</th>
<th>Ingredient</th>
<th>Atmospheric emissions</th>
<th>Level of efficiency of reducing the emissions, %</th>
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<tr>
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<td></td>
<td></td>
<td>Before the activity</td>
<td>In unfavorable meteorological conditions</td>
</tr>
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<td>mg/m³</td>
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<td>Hydrocarbons</td>
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<td>2699,1297</td>
</tr>
<tr>
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<td>11410,5532</td>
</tr>
<tr>
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</tr>
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<td></td>
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<td>143,9534</td>
</tr>
<tr>
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<td>35,9889</td>
</tr>
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<td>2699,1297</td>
</tr>
<tr>
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<tr>
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</tr>
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Table 21 - Activities for reducing the pollutant emissions in the period of unfavorable meteorological conditions

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Table 21 - Activities for reducing the pollutant emissions in the period of unfavorable meteorological conditions

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Control over emissions

Control over the observance of the developed MPE standards shall be mainly executed at the stationary source of emissions, which at the Khauzak-Shady facilities include flare stacks, smoke and exhaust stacks of process furnaces, boiler houses and diesel units, as well as breather valves of tanks.

According to [1] the emissions of ingredients creating ground level concentrations in the atmosphere below 0.1 MPC shall not be controlled. As it was identified as a result of calculations, the values of maximum ground level concentrations exceeding 0.1 MPC shall be observed with regard to the following ingredients:
- nitrogen dioxide;
- soot;
- sulfur dioxide.

In order to control the emissions in the Khauzak-Shady area, it has been planned to carry out the industrial environmental monitoring, which will help establish the control over the sources of polluting emissions in accordance with the effective regulatory documents of the Republic of Uzbekistan, as well as internal standards of the enterprise.

The main methods of control shall be instrumental and laboratory tests in direct proximity to the main sources of emissions, the data of the field chemical analytical laboratory, as well as the actual material balance of the enterprise.

The control over the observance of the MPE standards shall be executed by the enterprise itself or by another organization engaged by the enterprise on a contractual basis. Table 22 provides data on the recommended sources and ingredients to be controlled.

A more detailed program of control shall be developed by the enterprise after commissioning the field facilities taking into account its technical opportunities and material resources.
<table>
<thead>
<tr>
<th>Operational facilities</th>
<th>Controlled sources</th>
<th>Emission source number</th>
<th>Pollutant</th>
<th>Allowable emission, g/sec</th>
<th>Sampling location</th>
<th>Type of control</th>
<th>Frequency of control</th>
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<td>Sampling location</td>
<td>Type of control</td>
<td>Frequency of control</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------</td>
<td>------------------------</td>
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<td>---------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
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<tr>
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<tr>
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<tr>
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<tr>
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<tr>
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<td>On a quarterly basis</td>
</tr>
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</tr>
<tr>
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<tr>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>Sulfur dioxide</td>
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</tr>
<tr>
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<td>Soot</td>
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Table 22 continued

<table>
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<tr>
<th>Operational facilities</th>
<th>Controlled sources</th>
<th>Emission source number</th>
<th>Pollutant</th>
<th>Allowable emission, g/sec</th>
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<th>Type of control</th>
<th>Frequency of control</th>
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<td>On a quarterly basis</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Sulfur dioxide</td>
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<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
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<td></td>
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<tr>
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<tr>
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<td></td>
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<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Soot</td>
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<tr>
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<td>Linear section</td>
<td>Pig launcher flare</td>
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<td>Close to the flare (500 m)</td>
<td>Instrumental measurement (a balance method is possible)</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>On a quarterly basis</td>
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<tr>
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<td>Pig receiver flare</td>
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<td>Nitrogen dioxide</td>
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<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sulfur dioxide</td>
<td>0,013426</td>
<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
<td></td>
<td>Flare of block valve station PK5+13</td>
<td>35</td>
<td>Nitrogen dioxide</td>
<td>0,005467</td>
<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sulfur dioxide</td>
<td>0,013426</td>
<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
<td></td>
<td>Flare of block valve station PK108+48</td>
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<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sulfur dioxide</td>
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<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
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<td>Flare of block valve station PK219+75</td>
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<td>Nitrogen dioxide</td>
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<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
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<td>Sulfur dioxide</td>
<td>0,013426</td>
<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
<td></td>
<td>Flare of block valve station PK328+35</td>
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<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sulfur dioxide</td>
<td>0,013426</td>
<td></td>
<td></td>
<td>On a quarterly basis</td>
</tr>
</tbody>
</table>
5.2 STANDARD OF WATER CONSUMPTION AND WATER DISPOSAL

Reference and regulatory documents

It is planned to use 2 artesian wells as a source of the potable and technical water supply of the Khauzak field. One of them will be operating and the other one - on standby. The well depth is 550 m. The water producing formation (Turonian and Paleocene) lies at the depth of 480-550 m (see the expert opinion attached). Underground waters are mainly brackish and salty. The data on the composition of water from well No. 1X of the Khauzak field are attached hereto (the results of analysis of May 25-26, 2007). The specific production rate of one well is 3.5-1.1 dm³/sec. The borehole pumps are high pressure electrical centrifugal pumps ETsV-8-25-100. The zones of the sanitary protection of the wells have been established as follows: the zone of strict sanitary conditions with the radius of 30 meters; the zone of the second belt – 151 meters and the zone of the third belt – 715 meters from the wellheads.

A water supply source is usually selected taking into account its sanitary safety and opportunity to obtain potable water meeting the requirements of O’zDst 950:2000. If the quality of the water from a source does not meet the requirements of the standard, the water can be used upon agreement with the sanitation-and-epidemiological authority subject to the availability of the methods of processing, the reliability of which is confirmed with special process and hygienic tests. The volume of permitted water usage (fresh water intake) is 390 m³/day or 142.3 thousand m³/annum; including 250 m³/day for operational purposes and 50 m³/day for household and drinking needs.

The following water supply systems have been designed in the site.
- utility and potable;
- firefighting.

The system of firefighting water supply has been envisaged for the internal and external firefighting of the buildings and structures of the gas treatment facility and field base; for this purpose fire water storage tanks are envisaged in the sites, as well as the motor pump premises and fire water pipeline. No special requirements are set for the fire water quality and therefore, no water treatment is needed for these purposes. Fire extinguishing in the sites of the gas treatment facility and field base shall be performed by using mobile systems.

The system of the operational water pipeline is envisaged for flushing process vessels and process sites.

The system of utility and potable water supply includes potable water tanks, absorbing filters, pump station and on-site utilities. In order to bring the water quality to the level meeting the requirements of the standard, a water treatment unit is envisaged. Since the main potable water consumers are in the site camp and field base, the water treatment block is planned to be built in the camp.
The preliminary water treatment will be performed using mechanical cleaning filters for removing oxidized iron and various suspended matter with the size up to 5 micron from the water, as well as removing taints, smells, color, organochloride and other organic compounds. A reverse osmosis plant (desalinating plant) with the capacity of 1.75 m³/hr will be used for water demineralization.

The water treatment system will provide for the reduction of the total mineralization of the influent water, its total hardness, iron, fluorine, bacteria and virus content to the standard level stipulated in O’zDst 950:2000. The standards of utility and potable water consumption were calculated in accordance with KMK 2.04.01-98. The water consumption rates are established for main consumers.

**Water Consumption Rate Calculation**

The requirements for the operational personnel for servicing the facility have been defined on the basis of the necessity of the round-the-clock maintenance of the main equipment of the facility using the rotational team method.

**Operational Needs**

1. The water demand for operational needs is conditioned by the demand for flushing the equipment. The largest volume of water per day will be required for flushing the tanks and will amount to 36 m³/day; the flushing will be performed on an as-needed basis, usually during repairs, not more often than once a year. The calculation of the demand for water was performed on the assumption of flushing 5 tanks per year.

\[
W_{\text{year}} = W_{\text{day}} \times T /1000
\]

\[T \text{ is the planed quantity of working days per year, 365 days} \]

\[W_{\text{year}} = 36 \times 5 /1000 = 0.18 \text{ thousand m}^3/\text{year} \]

**Demand for utility and potable water**

1. Demand for potable water for the nonmanual workers of the gas treatment facility:

\[
W_{\text{day}} = N \times r /1000,
\]

where: \(N\) is the potable water consumption standard per shift, 12 dm³/man;
\(r\) is the quantity of people – 2 people

\[
W_{\text{day}} = 12 \times 2 /1000 = 0.024 \text{ m}^3/\text{day}
\]

\[T \text{ is the planed quantity of working days per year, 365 days} \]

\[W_{\text{year}} = 0.024 \times 365 /1000 = 0.009 \text{ thousand m}^3/\text{year} \]

2. Demand for potable water for the workers of the gas treatment facility:

\[
W_{\text{day}} = N \times r /1000,
\]

where:
\(N = 25 \text{ dm}^3/\text{man}\) is the potable water consumption standard;
\(r\) is the headcount, \(r = 18\) people;

\[
W_{\text{day}} = 25 \times 18 /1000 = 0.45 \text{ m}^3/\text{day}
\]

\[T \text{ is the planed quantity of working days, } T = 365\ \text{days.} \]

\[
W_{\text{year}} = W_{\text{day}} \times T /1000 = 0.45 \times 365 /1000 = 0.164 \text{ thousand m}^3/\text{year.} \]

3. Demand for utility and potable water of the employees working in administrative buildings in the field base:

\[
W_{\text{day}} = N \times r /1000,
\]

where: \(N\) is the potable water consumption standard per shift, 12 dm³/man;
\(r\) is the quantity of people – 33 people

\[
W_{\text{day}} = 12 \times 33 /1000 = 0.396 \text{ m}^3/\text{day}
\]

\[T \text{ is the planed quantity of working days per year, 365 days} \]
W year = 0.396 *365 /1000 = 0.145 thousand m³/year

4. Demand for utility and potable water of the workers in the field base:

Wday = N * r /1000,

where: N is the potable water consumption standard per shift, 25 dm³/man
r is the quantity of people – 47 people

Wday = 25 * 47/1000 = 1.175 m³/day

T is the planned quantity of working days per year, 365 days
W year = 1.175 *365 /1000 = 0.429 thousand m³/year

3. Watering of the territory

W = N * S * n /1000,

where: N is the water quantity spent for 1 watering – 0.5 dm³/m²
S is the area of watering, S = 6000 m²
n is the planned quantity of waterings per day; n = 1.

Wday = 0.5 * 6000 * 1/1000 = 3.0 m³/day

T is the planned number of days of watering, 200 days.
W year = 3.0 *200 /1000 = 0.6 thousand m³/year

Accommodation area of the field base

It is planned that the personnel of the gas treatment unit will live in the site camp located in the accommodation area of the field base. It is also planned to place the personnel of contracting and service companies and trainees in the site camp. Thus, up to 330 people may live in the camp.

The water consumption is adopted at the rate of 85 dm³/day per person according to KMK 2.04.01-98.

1. Demand for utility and potable water of residing personnel:

Wday = N * r /1000,

where: N = 85 dm³/man is the potable water consumption standard
r is the quantity of people – 330 people

Wday = 85 * 330/1000 = 28.05 m³/day

T is the planned quantity of working days per year, 365 days
W year = 28.05 *365 /1000 = 10.238 thousand m³/year

2. Canteen.

Wday = N * /1000,

N is the water consumption rate for cooking; 12 dm³ of water is required for cooking one conditional dish.

r is the quantity of conditional dishes.

According to KMK 2.08.02-96 the quantity of cooked dishes U per hour shall be defined using the following formula:

\[ U = 2.2*n*m \]

Where m*n is the quantity of people having meals during an hour.

For 330 people the quantity of cooked conditional dishes with three meals daily will amount to:

\[ U = 2.2*330 *3 = 2178 \text{ cond. dishes} \]
The water consumption of the canteen will be as follows:

\[ W_{\text{day}} = 12 \times \frac{2178}{1000} = 26.136 \text{ m}^3/\text{day}. \]

\( T \) is the planned quantity of working days, \( T = 365 \) days

\[ W_{\text{year}} = W_{\text{day}} \times \frac{T}{1000} = 26.136 \times 365/1000 = 9.54 \text{ thousand m}^3/\text{year}. \]

3. Watering of the territory

\[ W = N \times S \times n \times 1000, \]

where: \( N \) is the water quantity spent for 1 watering – 0.5 dm\(^3\)/m\(^2\)
\( S \) is the area of watering, \( S = 10600 \text{ m}^2 \)
\( n \) is the planned quantity of waterings per day; \( n = 1 \).

\[ W_{\text{day}} = 0.5 \times 10600 \times 1/1000 = 5.3 \text{ m}^3/\text{day} \]

\( T \) is the planned number of days of watering, \( T = 200 \) days.

\[ W_{\text{year}} = 5.3 \times 200 /1000 = 1.06 \text{ thousand m}^3/\text{year}. \]

4. Watering the planted land

\[ W_{\text{day}} = N \times S \times K \times T/1000, \]

where:
\( N \) is the standard consumption rate for watering the planted land, \( N = 4 \text{ dm}^3/\text{m}^2 \);
\( S \) is the area of watering, \( S = 13574 \text{ m}^2 \);
\( K \) is the planned quantity of waterings per day; \( K = 1.0 \);

\[ W_{\text{day}} = 4 \times 13574 \times 1/1000 = 54.296 \text{ m}^3/\text{day} \]

\( T \) is the planned number of days of watering, \( T = 180 \) days.

\[ W_{\text{year}} = W_{\text{day}} \times T /1000 = 54.296 \times 180/1000 = 9.773 \text{ thousand m}^3/\text{year}. \]

Water disposal

The generated waste waters are of two categories: utility water and industrial sewage water. In addition to the equipment flushing effluents, the industrial sewage water also includes formation water and flushing effluents of the water treatment unit and boiler house.

Tank flushing effluents are equal to the water consumption and will amount to 36 m\(^3\)/day, 0.18 thousand m\(^3\)/year.

The effluents of the water treatment unit are equal to 45-50% of the water consumption and will amount to 21 m\(^3\)/day, 7.665 thousand m\(^3\)/year.

The volume of formation water production will be as follows: 2008 – 22.9; 2009 – 33.1; 2010 – 38.5 thousand m\(^3\).

The effluents of the boiler house amount to 2 m\(^3\)/day, 0.14 thousand m\(^3\)/year.

The operating mode of the unit is continuous. The unrefined natural gas represents a multicomponent mix of hydrocarbons and an insignificant amount of non-hydrocarbon components. The non-hydrocarbon components also include water (associated or formation water). In the course of the gas treatment water is separated.

Formation water of the Khauzak and Shady fields is characterized with the salinity of 90644.0 mg/dm\(^3\). In the ion and salt composition chlorine dominates over magnesium: 53848.5 mg/dm\(^3\) and 820.8 mg/dm\(^3\) respectively. The content of sulphates and hydrocarbonates is 2060.6 mg/dm\(^3\) and 164.8 mg/dm\(^3\) respectively.
Water of all samples refers to the calcium chloride type (according to V.A. Sulin); the specific weight at 20 °C \( \gamma = 1.067 \); \( \text{pH} = 6.95 \).

The assumed formation water composition is provided in the Attachment.

In order to treat the industrial waste water, a settling chamber has been designed in the site of treatment facilities with a 12.5 m\(^3\) tank for collected oil and a 12.5 m\(^3\) sludge tank. The settling chamber will perform the mechanical cleaning of industrial effluents from floating waste, suspended particles and petroleum products. The rated output capacity of the unit is 15 m\(^3\)/hr or 360 m\(^3\)/day. After cleaning the industrial effluents will flow to the waterproof evaporation ponds. In accordance with SNiP 2.04.02-84, the specific daily average utility water disposal is taken to be equal to the specific daily average water consumption net of the water spent for watering the territory and planed land.

The domestic effluents are pumped to the domestic effluent treatment facilities consisting of the KUTM-60 packaged unit (bacterial treatment with advanced treatment in the block of thin-layer modules and subsequent disinfection). The nominal output of KUTM-60 (according to the nameplate data) is 60 m\(^3\)/day. After cleaning the domestic effluents will flow to the waterproof evaporation ponds.

In order to meet the environmental requirements and requirements for rational water usage, it is proposed to use the domestic effluents after the biotreater for watering in summer and to flow them to the evaporation ponds in winter.

In connection with the fact that within the influence area of the designed facility there are no water courses into which treated industrial effluents may be discharged or into which pollutants may get in the case of emergencies, the Industrial Environmental Monitoring of only underground waters shall be organized.

The Industrial Environmental Monitoring of the status and possible pollution of underground waters is carried out through the network of special observation wells located at the border of the possible pollution focus along the flow of underground waters. In each well the underground water level and water temperature are measured 4 times a year and the water samples are taken for full chemical analysis with the same frequency. The most often controlled parameters of underground waters are pH, nitrates, nitrites, phosphorus, nitrogen (ammonium nitrogen, nitrate nitrogen and nitrite nitrogen), permanganate oxygen consumed, total ferrum, petroleum products, heavy metals, etc. The main target of observation will be the evaporation ponds accumulating the insufficiently treated effluents.

The calculation of the water consumption and disposal standards is provided in Table 23.

The results of the calculations provide the enterprise with the opportunity to apply for the permit for special water usage.
<table>
<thead>
<tr>
<th>Water consumers</th>
<th>Unit of Measure</th>
<th>Quantity of water consumers</th>
<th>Number of hours of operation per day</th>
<th>Working days per year</th>
<th>Water consumption</th>
<th>Water disposal</th>
<th>Description of waste water receiver</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
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<td>36,0,18 Evaporation ponds</td>
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<td>365</td>
<td>-</td>
<td>-</td>
<td>105,48</td>
<td>38,5 -//--</td>
</tr>
<tr>
<td>Boiler house needs</td>
<td>m3</td>
<td>70</td>
<td>6</td>
<td>0,42</td>
<td>2</td>
<td>0,14</td>
<td>-//--</td>
</tr>
<tr>
<td>Water treatment unit</td>
<td>m3</td>
<td>24</td>
<td>365</td>
<td>-</td>
<td>-</td>
<td>21,7,665</td>
<td>-//--</td>
</tr>
<tr>
<td><strong>Total operational needs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II Domestic needs of operational personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas Treatment Facility (GTF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic and potable needs of non-manual workers</td>
<td>person</td>
<td>2</td>
<td>24</td>
<td>365</td>
<td>12</td>
<td>0,024</td>
<td>0,009</td>
</tr>
<tr>
<td>Domestic and potable needs of workers</td>
<td>person</td>
<td>18</td>
<td>24</td>
<td>365</td>
<td>25</td>
<td>0,45</td>
<td>0,164</td>
</tr>
<tr>
<td>Field base</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic and potable needs</td>
<td>person</td>
<td>33</td>
<td>24</td>
<td>365</td>
<td>12</td>
<td>0,396</td>
<td>0,145</td>
</tr>
<tr>
<td>Water consumers</td>
<td>Unit of Measur e</td>
<td>Quantity of water consumer s</td>
<td>Number of hours of operation per day</td>
<td>Working days per year</td>
<td>Water consumption Standard dm³/ unit of measure</td>
<td>Water consumption m³/ day</td>
<td>Water consumption m³/ year</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------</td>
<td>----------------------------</td>
<td>-------------------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------</td>
<td>--------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>1 of non-manual workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic and potable needs of workers</td>
<td>person</td>
<td>47</td>
<td>24</td>
<td>365</td>
<td>25</td>
<td>1,175</td>
<td>0,429</td>
</tr>
<tr>
<td>Watering of the territory</td>
<td>m²</td>
<td>6000</td>
<td>2</td>
<td>200</td>
<td>0,5</td>
<td>3,0</td>
<td>0,6</td>
</tr>
<tr>
<td>Accommodation area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residents of the dormitory</td>
<td>person</td>
<td>330</td>
<td>24</td>
<td>365</td>
<td>85</td>
<td>28,05</td>
<td>10,24</td>
</tr>
<tr>
<td>Canteen</td>
<td>cond. dishes</td>
<td>2178</td>
<td>3</td>
<td>365</td>
<td>12</td>
<td>26,14</td>
<td>9,54</td>
</tr>
<tr>
<td>Boiler house needs</td>
<td>m³</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td>7,63</td>
<td>0,534</td>
</tr>
<tr>
<td>Watering the planted land</td>
<td>m²</td>
<td>13574</td>
<td>2</td>
<td>180</td>
<td>4</td>
<td>54,3</td>
<td>9,773</td>
</tr>
<tr>
<td>Watering of the territory</td>
<td>m²</td>
<td>10600</td>
<td>2</td>
<td>200</td>
<td>0,5</td>
<td>5,3</td>
<td>1,06</td>
</tr>
<tr>
<td>III. In total for utility, domestic and operational needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>168,45</td>
<td>7</td>
</tr>
<tr>
<td>IV. For irrigation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y. For the needs of the subsidiary husbandry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YI. Water provided to other enterprises</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Water consumption

<table>
<thead>
<tr>
<th>Water consumers</th>
<th>Unit of Measure</th>
<th>Quantity of water consumers</th>
<th>Number of hours of operation per day</th>
<th>Working days per year</th>
<th>Water consumption</th>
<th>Water disposal</th>
<th>Description of waste water receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YII. Accepted effluents from other enterprises</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>YIII. Total for the enterprise</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>168,45</td>
<td>7</td>
</tr>
</tbody>
</table>

The calculations were performed in accordance with the KMK standards (SNiP).
Request
for Special Water Usage

1. Name of the enterprise, its departmental affiliation (ministry, department, main division, association):

   OOO LUKOIL UZBEKISTAN OPERATING COMPANY

2. Postal address and telephone number of the water consumer:

   Republic of Uzbekistan, Tashkent, 100027, A. Khodzhajeva Str., bldg. 1.

   Phone: (+998-71)140-40-40, fax (+998-71)140-40-41.

3. Productive capacity, personnel headcount, number of working days per year, level of available public services and amenities and population of the settlement (if the permit is requested for the water supply of a human settlement):

   The field capacity is 3.0 BCMA of natural gas; the total quantity of the field personnel is 201 people; rotational team method of operations; the number of working days per annum is 365.

4. Water usage purpose (water supply, effluent discharge, etc.):

   Water consumption: utility and potable, operational and fire-fighting needs.

   Water disposal: evaporation ponds

5. Name and location of the water body or its section, where the water usage is performed (water supply, effluent discharge, etc.):

   Two artesian wells No.IX (one on a standby) located in the Khauzak area to the south of the Dengizkul Lake in the territory of the field base.

6. Characteristics of surface water used as a source of water supply and for disposal of effluents:

   No water intake or discharge to the surface water bodies is performed.

7. Control water abstraction point (by whom established and distance from the point of effluent discharge point):

   Not required.

8. List and capacity of the facilities for surface water intake, m³/sec: Facilities for surface water intake are not available.
9. List of wells used for water supply:

<table>
<thead>
<tr>
<th>Well location</th>
<th>Well No.</th>
<th>PRODUCING WATER-BEARING FORMATION</th>
<th>Well depth, m</th>
<th>WELL PRODUCTION RATE, m³/HOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN THE TERRITORY OF THE FIELD BASE</td>
<td>1</td>
<td>480-550</td>
<td>550</td>
<td>16,25</td>
</tr>
<tr>
<td>IN THE TERRITORY OF THE FIELD BASE</td>
<td>2</td>
<td>480-550</td>
<td>550</td>
<td>16,25</td>
</tr>
</tbody>
</table>

10. Availability of fish protection structures and their design (in fishery water bodies).

*Not required*

11. A protective sanitary zone of water intake facilities used for utility and potable water supply for population:

None.

12. Water consumption characteristics

<table>
<thead>
<tr>
<th>№№</th>
<th>INDICATORS</th>
<th>WATER CONSUMPTION</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>STANDARD AND ESTIMATED</td>
<td>M³/DAY</td>
<td>THOUS. M³/ YEAR</td>
</tr>
<tr>
<td>1</td>
<td>Water intake, total</td>
<td>168,5</td>
<td>33,09</td>
<td></td>
</tr>
<tr>
<td></td>
<td>including:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>from surface waters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>from underground waters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>from the water supply pipeline of the city or another enterprise</td>
<td>168,5</td>
<td>33,09</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Use for own needs.</td>
<td>168,5</td>
<td>33,09</td>
<td></td>
</tr>
<tr>
<td></td>
<td>including:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for utility and potable needs</td>
<td>126,5</td>
<td>32,49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of them underground</td>
<td>126,5</td>
<td>32,49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>other enterprises</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for operations</td>
<td>42,0</td>
<td>0,6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of them underground waters</td>
<td>42,0</td>
<td>0,6</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Water provided to other enterprises</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>of them underground</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Water spent in the recirculated water systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Water spent in the systems of recovery (multistage) water supply.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
13. Water disposal characteristics (standard and estimate / actual)

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Water disposal volumes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m³/hr (max.)</td>
<td>m³/day</td>
</tr>
<tr>
<td>1. Quantity of effluents discharged to a water body, name of the water body including: polluted ones, of which untreated ones, meeting the standards not requiring any treatment and treated to meet the standards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Quantity of discharged effluents:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>to evaporation ponds in 2008</td>
<td>7,52</td>
<td>180,471</td>
</tr>
<tr>
<td>to evaporation ponds in 2009</td>
<td>8,68</td>
<td>208,416</td>
</tr>
<tr>
<td>to evaporation ponds in 2010</td>
<td>9,3</td>
<td>223,211</td>
</tr>
<tr>
<td>3. The quantity of discharged effluents to the city sewerage or to the sewerage of another enterprise</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4. Methods of effluent treatment and rated capacity of the treatment facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacterial treatment of domestic effluents. Rated capacity – 2.5 m³/hour.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical treatment of industrial effluents. Rated capacity – 15 m³/hr.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Qualitative characteristic of effluents for each type of discharge

<table>
<thead>
<tr>
<th>NAME OF POLLUTANT OUTLETS AND INDICATORS</th>
<th>MG/DM³</th>
<th>G/HR</th>
<th>TPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERE IS NO OUTLET TO AN OPEN WATER BODY</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. Methods of accounting for water taken in and discharged (type and model of water measuring devices and place of their installation, organization of laboratory control over the operation of treatment facilities and accounting for pollutants discharged with effluents)

At the gat treatment facility there are meters in the demineralizing plant, and a water metering device is envisaged in each pump station over each artesian well.
15. Planned actions for protection and rational use of water:

PLAN OF ACTIONS FOR PROTECTION OF WATER RESOURCES

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Activity</th>
<th>Timing</th>
<th>Expected effect of water protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Organization of a sanitary zone of a water well</td>
<td>2007</td>
<td>Water source protection</td>
</tr>
<tr>
<td>2</td>
<td>Organization of control over the composition of potable water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Organization of accounting for water intake in the form of the POD 11 log book</td>
<td>2007</td>
<td>Accounting for water flow rate</td>
</tr>
<tr>
<td>4</td>
<td>Timely repair of plumbing fittings</td>
<td>On an ongoing basis</td>
<td>Rational water usage</td>
</tr>
<tr>
<td>5</td>
<td>Presentation of the actual statistic reports on the company as a whole</td>
<td>On an ongoing basis</td>
<td>Accounting for water flow rate</td>
</tr>
<tr>
<td>6</td>
<td>Control over the composition of water in treatment facilities</td>
<td>On a quarterly basis</td>
<td>Environmental protection</td>
</tr>
<tr>
<td></td>
<td>Using treated effluents for watering the territory and planed land</td>
<td>Summer period</td>
<td>Rational water usage</td>
</tr>
</tbody>
</table>

16. Scheme of water supply and channeling of waste and storm water mentioning the water intake and effluent discharge points in relation to the nearest water usage points. Attachment 2.

17. Calculation of the maximum permissible discharge (MPD) of pollutants getting in a water body with waste waters.

There is no discharge to open water bodies. No MPD required.
5.3 **MAXIMUM ALLOWABLE WASTE**

Reference and regulatory documents:


9. Federal Classification Catalogue. Approved by Order No. 786 of the RF Ministry of Natural Resources on 02.12.02, Moscow.


11. Law "On Waste" approved by Resolution No. 363-II of the Oliy Majlis (Parliament) of the Republic of Uzbekistan on 05.04.05.


The legislation on waste generation does not cover the relations connected with the emissions and discharge of pollutants to the atmospheric air and water bodies.

According to Article 15 of this law, as well as RD O’zRH 84.3.15:2005, enterprises, irrespective of their form of ownership and departmental affiliation, which generate production and consumption waste in the course of their operations shall carry out waste inventories and develop standards of waste generation and waste limits.
Regulatory documents O’zRH 84.3.15:2005- O’zRH 84.3.19:2005 specify the standardization of waste for the following purposes:

− organization of accounting for facilities generating production and consumption waste;

− identification of types and specific quantity of actually generated production and consumption waste;

− uniform collection and systematization of available information about physical-chemical, physical-mechanical, sanitary and consumption properties for each type of waste;

− waste certification.

In accordance with clause 3.4 of regulatory document [2], the report on production and consumption waste inventory shall include only the data (including those about various properties of the waste), which the enterprise has as of the moment of inventory.

Since the enterprise is new, the document provides the available approved design solutions and data of reference documents.

The Khauzak-Shady areas of the Dengizkul field departmentally report to OOO LUKOIL Uzbekistan Operating Company, the principal activity of which is aimed at the infrastructure construction and commissioning of these areas.

The infrastructure construction of the Khauzak and Shady areas located in the Bukhara Region includes the elements of principal and auxiliary units (Fig. 38).

The principal units include the following:

− gathering stations;

− gas treatment facility (GTF);

− a 43 km gas pipeline from the gas treatment facility to the tie-in point to the Dengizkul-Mubarek Gas Plant pipeline;

− a 44 km condensate pipeline from the GTF to the tie-in point to the North Urtabulak NNR Sernyi Zavod.

The auxiliary units directly depend on the principal units and were created for supporting the principal units.

The field base with the site camp are auxiliary units.

The approximate headcount is 201 people and consist of engineering staff, clerks, workers and supporting personnel. At any one time the headcount of workers will amount to 100 people.

The construction and development of the areas will be carried out by contracting and servicing organizations with the headcount of 260 people. Number of personnel of one rotation 130. In addition to the principal working personnel it is planned that 20 people per month will come for the purpose of traineeship for 1-2 months.

Thus, on the basis of the provided data, 250 people will be present in the site at any one time, including the following:

− Gas Treatment Facility Site - 20 people

− field base - 80 people

− site camp - 250 people
Around-the-clock work on a rotational basis. The output goods shall be the natural gas production from the Khauzak-Shady areas of the Dengizkul Field described in Attachment E. In accordance with forecast data, the field capacity will reach 3 bcm over 12 years. Information about the occupied areas is provided in the mandatory Attachment B.

**Attachment B**

**Information about Occupied Areas**

<table>
<thead>
<tr>
<th>№</th>
<th>Branches</th>
<th>Unit of measure, ha</th>
<th>Amount</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total area, including:</td>
<td>ha</td>
<td>8,88</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Gas Treatment Facility area</td>
<td>ha</td>
<td>5,27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- field base and field camp area;</td>
<td>ha</td>
<td>3,61</td>
<td></td>
</tr>
</tbody>
</table>

**Attachment D**

**Enterprise Codes**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-Russian Classifier of Businesses and Organizations (OKPO)</td>
<td>All-Russia Classifier of Types of Activity (OKONKH)</td>
<td>State Classifier of Type of Economic Activities (OKED)</td>
<td>Government Agency Code System (SOOGU)</td>
<td>Indications System of Administrative-Territorial Formation s (SOATO)</td>
<td>Form of Ownership Code (KFC)</td>
</tr>
<tr>
<td>19577541</td>
<td>11231</td>
<td>11100</td>
<td>641-4</td>
<td>1726277</td>
<td>163</td>
</tr>
</tbody>
</table>
Figure 38 – Enterprise Structure
Principal Units
Gas Treatment Facility Site

The GTF performs the preliminary treatment of gas received from the wells of Khauzak-Shady to the common manifold of the block of inlet pipelines. After the block of inlet pipelines the gas goes to the separators for separating condensed moisture, which consists of water and condensate. The liquid from the separators goes to the condensate treatment block and the gas goes to the system of regeneration and further treatment.

The final product – condensate is pumped to the warehouse and then via the condensate pipeline goes to the tanks of Serniy Zavod to be shipped to the consumer by railway, and the gas is transported through the existing Dengizkul – Mubarek Gas Plant gas pipeline.

The process of preliminary gas treatment is not conductive to the generation of industrial waste.

The main types of waste in the site are solid domestic waste and sweep classified as nontoxic domestic waste.

Waste Generation Source No.1
Gas Treatment Facility Site

Waste:
- solid domestic waste (SDW)
  Generated as a result of the life activity of the GTF personnel. The GTF headcount is 20 people in one rotation.
  According to Sanitary Rules and Standards No. 0068-96 of the Republic of Uzbekistan, the standard of SDW generation per person is 83 kg per year.
  The annual standard of the SDW generation will be as follows:
  \[ N = 83 \text{ kg} \times 20 \text{ people} = 1600 \text{ kg} = 1.66 \text{ tons}. \]
  The domestic waste will be put in special containers and as soon as the containers are full, the waste will be transported to the disposal site of OOO Olotbod under a contract.

Waste:
- sweep
  Generated in the course of sweeping the paved territory of 6000 m².
  According to the Resolution of the Bukhara Regional Khomiyat (administration), the standard quantity of sweep from 1 m² of paved area for the Bukhara Region is 21 kg.
  The annual standard quantity of the waste is as follows:
  \[ N = 21 \text{ kg} \times 6000 \text{ m}^2 = 126000 \text{ kg} = 126 \text{ tons}. \]
  In accordance with the architectural and construction solutions, there is no planted land in the GTF site, therefore the actual quantity of sweep will be much smaller.
  The sweep will be collected and loaded manually. Temporary placement in containers together with the SDW. As soon as its accumulated, it will be transported to the disposal site of OOO Olotbod under a contract.

Linear section of the gas pipeline from the Khauzak GTF to the tie-in point
The gas pipeline from the GTF to the point of tie-in to the existing Dengizkul—Mubarek Gas Plant gas pipeline in accordance with the TU-UDP Mubarekneftegas is approximately 43 km long with the diameter of 700 mm, including pig receivers and launchers, connection points of the mobile inhibitor unit, line and safety valves, cathodic protection devices, etc.

Pig receivers and launchers are installed at the beginning and at the end of the pipeline respectively, and their purpose is to clean the inner surface of the gas pipeline from mechanical impurities, water and condensate. Gas pipeline pigging is performed for enhancing its throughput.

The pig receivers and launchers are comprised of the following equipment:
- pig trap stations;
pipelines, fittings and vent stacks;
- point of collection and discharge of purgings;
- pig extraction, transfer and storage mechanisms;
- pig signalers;
- pigging station control panel;
- stabilizing device for protecting from possible longitudinal movements of the gas pipelines, from the impact of temperature differences and internal pressure.

The gas pipeline pigging results in the production waste in the form of sludge. According to the standards, for removing the sludge resulting from pigging a gas pipeline there should be a manifold manufactures of the same pipe that the gas pipeline at the sections of the 1st category. The volume of the gathering manifold shall be as calculated depending on the level of gas impurity and established pigging cycle, but no more than 300 m³. The gathering manifold for collecting the sludge from the gas pipeline is located in the distance of no more than 15 m from the gas pipeline and the pigging station.

Since the pigging of a gas pipeline is performed on an as needed basis, the sludge gets in the gathering manifold from time to time. The gathering manifold is not intended for long-term storage, since after solidification the sludge is hard to remove.

Waste Generation Source No.2
Pig receiver

Waste:
- sludge resulting from gas pipeline cleaning

Generated from time to time as a result of necessary pigging of the 700 mm gas pipeline. The waste represents dirt consisting of mechanical impurities, condensate and water. The quantity of the waste depends on the level of the transported gas impurity and humidity and is defined by experiment.

Experience of work in similar fields shows that the waste quantity can be different, but does not exceed 15-20 tons per year.
According to O’zRH 84.3.15:2005 [2], the specific indicator of the waste generation represents the quantity of the waste generated when producing a unit of production or per unit of spent feedstock. The output product is the annual gas extraction, which amounts to 3000,0 Mcm per annum as per the technical and economic indicators. The specific indicator of the waste generation is as follows:

\[ n_0 = \frac{20 \text{ tons}}{3000 \text{ Mcm}} = 0.00667 \text{ tons/Mcm} \]

The temporary allocation of the waste is envisaged in the gathering manifold with further transportation with own vehicles to the drilling waste temporary storage and management site located in the Khauzak-Shady area.

Condensate Pipeline from the Khauzak Gas Treatment Facility before Tie-in

The tie-in point of the condensate pipeline from the Khauzak area to the North Urtabulak – NNE Serniy Zavod oil pipeline is located on the 2nd km from the North Urtabulak pump station. The condensate pipeline for stable condensate from the GTF to the point of tie-in to the existing oil pipeline in accordance with the specifications of the Mubarek Gas Plant has the approximate diameter of 100 mm and includes line and safety valves and cathodic protection devices. Safety valves and protection fixtures are envisaged on the pipeline crossing of motor roads in accordance with KMK.

The transportation of condensate from the GTF to the NNE Serniy Zavod does not assume generation of any production and consumption waste.
Auxiliary Units  
Field base and site camp

The territory of the field base has the facilities necessary for placing administrative premises, warehouses for storing materials for the period of construction and equipment, unit of minor repairs and a parking lot.

The field base is services by 80 workers.

The accommodation area of the site camp includes a complex of residential and domestic buildings with maximum comfortable living conditions for the personnel of the field and other contracting organizations for the period of rotation. The following facilities are located in the site:

- canteen seating 50 people;
- cultural and general block;
- workout room with sauna;
- playground.

The territory of the field base and site camp is paved and has planted land.

The life activity of personnel in the field base and in the camp is inevitably connected with the generation of solid domestic and food waste. Periodic cleaning of the territory results in the generation of sweep, and the lighting of the area leads to the generation of spent mercury lamps of the DR or LLB type and glow lamps.

Minor repairs of equipment generate metal chip waste and electrode stubs.

The types of waste from motor vehicles are spent automobile tires and tubes, waste engine oil and waste batteries, as well as wiping material (non-oily)

Waste Generation Source No.3  
Territory of the Field Base with the Site Camp

Waste:

- **solid domestic waste (SDW)**

  According to Sanitary Rules and Standards No. 0068-96 of the Republic of Uzbekistan, the standard of SDW generation per person is 83 kg per year. The headcount of the field base is 80 people, and the quantity of the camp residents at any one time is 250 people taking into account the personnel of the field, contracting and service organizations.

  Then the annual standard of the SDW generation will be as follows:

  \[
  N = 83 \text{ kg} \times (80 \text{ people} + 250 \text{ people}) = 27\,390 \text{ kg} = 27.390 \text{ tpa}.
  \]

  Domestic waste will be collected to a metal container located in a special place. As soon as the waste is accumulated, it shall be removed from the camp territory to the regional waste disposal site on a contractual basis. The collection and loading of the waste to vehicles will be performed manually.

Waste:

- **food waste of the canteen**

  According to Sanitary Rules and Standards No. № 0068-96 of the Republic of Uzbekistan, the specific standard rate of generation of food waste per one conditional dish is 0.03 kg.

  The quantity of prepared dishes subject to three meals daily and the headcount of 330 people will be 990 dishes per day:

  \[
  N_0 = 990 \text{ dish} \times 0.03 \text{ kg/dish} \times 365 = 10\,841 \text{ kg/year} = 10.841 \text{ tpa}
  \]

  The food waste will be collected in a metal container together with solid domestic waste. The waste will be collected manually.

Waste:

- **sweep**
According to the technical design, the paved area of the base and camp is 10,600 m². The standard rate of the sweep generation from 1 m² of pavement in the Bukhara Region is 21 kg as per the resolution of the regional khokimiat (administration).

The annual standard of the sweep generation will be as follows:

\[ N = 21 \text{kg/m}^2 \times 10,600 \text{m}^2 = 222,600 \text{kg/year} = 222.6 \text{tpa}. \]

Temporarily, the waste will be placed together with solid domestic waste and, when necessary, removed with the company’s vehicles to the nearest regional waste disposal site on a contractual basis.

Waste:

- **used mercury lamps**
  They are generated as a result of operating the lighting devices used in the territory of the field, base and camp. Low pressure LB type mercury lamps and high pressure DRL-type arc mercury lamps will be used for street and room lighting.

  The waste generation is calculated on the basis of the quantity of operated lamps and their service life. According to the Electric Engineering Equipment Catalogue, the average lighting hours of one LB type lamp is 8000 hours and of one DRL type lamp - 10000 hours.

  The necessary quantity of lamps for lighting the whole territory is 327 lamps, of which there are 295 LB type lamps and 295 DRL type lamps with the average duration of light emission at 10 hours per day (in winter) and 5 hours per day (in summer) with 365 working days.

  1. The operational life of one LB-type lamp will be:

     \[ 8000 : \left( (10 \times 182) + (5 \times 182) : 365 \right) = 1067 \text{ days} \]

     The standard rate of writing off LB type lamps will be: \[ 365 : 1067 = 0.342. \]

     The quantity of burnt-out lamps will be as follows:

     \[ 32 \text{ pcs} \times 0.342 = 11 \text{ pcs} \]

     The average weight of one lamp is 320 grams. The weight quantity of the spent LB type lamps is as follows:

     \[ M_1 = 11 \text{ pcs} \times 320 \text{ g} \times 10^{-6} = 0.004 \text{ tons} \]

  2. The operational life of one DRL-type lamp will be:

     \[ 10000 : \left( (10 \times 182) + (5 \times 182) : 365 \right) = 1333 \text{ days} \]

     The standard rate of writing off LB type lamps will be: \[ 365 : 1333 = 0.274. \]

     The quantity of burnt-out lamps will be as follows:

     \[ 295 \text{ pcs} \times 0.274 = 81 \text{ pcs} \]

     The average weight of one lamp is 235 grams. The weight quantity of the spent DRL type lamps is as follows:

     \[ M_2 = 81 \text{ pcs} \times 235 \text{ g} \times 10^{-6} = 0.02 \text{ tons} \]

  The total quantity of spent mercury lamps will be 0.024 tons per annum.

  The specific indicator of the waste generation will be defined as the relation of the amount of waste generation to the amount of produced product:

  \[ n_f = 0.024 \text{ ton} : 3000.0 \text{ Mcm} = 0.00001 \text{ ton/Mcm}. \]

  In order to prevent the adverse impact on the people's health and environment, the spent mercury lamps will be processed by TK SITORA in accordance with the contract using special technologies and the Selta device. There is a special place in the warehouse for the temporary storage of the waste.

Waste:

- **used incandescent lamps**
  They are generated in the course of replacing the burnt-out lamps. The average operational life of one general incandescent lamp is 1000 hours. The average weight of one lamp is 75 grams. As per the design solutions, 128 lamps are needed for lighting.
The standard rate of the waste generation is 100% of the used quantity. The weight quantity of the waste of the 4th class of hazard will be 0.0096 tpa.
The specific indicator of the waste generation will be defined per unit of produced product and will be as follows:
\[ n_f = 0.00096 \text{ ton} : 3000.0 \text{ Mcm} = 0.00003 \text{ ton/Mcm}. \]
The spent lamps will be carried manually to the place of location of solid domestic waste.

**Minor Repair Block**

Waste:
- **iron scrap**
  It is generated in the course of metalworking operations at a drilling and rough grinding machines in the minor repair block.
  Since the equipment delivered from the FSU countries is quite new, the quantity of iron scrap will not be large, about 1-2 tons per year.
  The specific indicator of the waste generation will be defined per unit of produced product and will be as follows:
  \[ n_f = 2 \text{ ton} : 3000.0 \text{ Mcm} = 0.00067 \text{ ton/Mcm}. \]
  For temporary storage of the iron scrap a metal box will be placed in the site of the block. As soon as the scrap is accumulated, it will be sent to Vtorchermet for processing.

Waste:
- **electrode stubs and remnants**
  They are generated in the course of welding operations.
  According to the technological classification of the industrial waste to the main industries the aggregative standard rates of waste generation amount to 10-15% of the used quantity of electrodes.
  Approximate electrode consumption for performing repairs will amount to 1.0 tons per annum. The standard rate of waste generation is 0.15 tpa.
  The specific indicator of the waste generation will be defined per unit of produced product as follows:
  \[ n_f = 0.15 \text{ ton} : 3000.0 \text{ Mcm} = 0.00005 \text{ ton/Mcm}. \]
  The stubs will be collected to a metal box together with the iron scrap. It will be handed over to the Vtorchermet authorities for processing.

**Parking Lot**

Thirteen (13) transportation vehicles will be used to provide transportation services in the course of operating the Khauzak-Shady field, of them
- 9 passenger cars;
- 2 special vehicles (two fire-engines);
- 2 units of earthmovers (Belarus excavators).
The maintenance of the motor transport will be carried out on a contractual basis at service stations.

Waste:
- **waste engine oil**
  It is generated as a result of replacing the engine oil in the engines of the vehicles in the course of maintenance and current repairs, which is to be carried out at service stations.
  The specific indicators of the waste engine oil generation in the course of operation and maintenance of motor vehicles per 100 liters of spent fuel is as follows [10]:
  - passenger cars – 0.56 l/year
  - tractors – 0.77 l
  The fuel consumption of passenger cars is 7704 liters and the fuel consumption of tractors amounts to 4000 liters.
  The generated quantity of the waste engine oil will be as follows:
  - passenger cars – 431.424 l/year;
  - tractors – 30.8 l/year.
The total volume of the generated waste will be 462.224 liters, or, taking into account the oil density at 0.89 t/m³, - 0.411 tpa.

The specific indicator of the waste generation is calculated as the main indicator of the motor transport, care mileage, which is 699.6 thousand km.

\[ n_f = 0.411 \text{ t : 699.6 thousand km} = 0.00059 \text{ t/thousand km}. \]

The spent engine oil shall be replaced at service stations. There will be no place of temporary storage.

Waste:

- **spent automobile tires and tubes**

Worn-out tires and tubes of the motor vehicles shall be considered spent.

In accordance with the Book of Specific Indicators of Production and Consumption Waste Generation [10], the specific indicator of the spent automobile tires and tubes per 10.0 thousand km of mileage for passenger cars is 3.7 kg and for tractors is 19.1 kg.

Proceeding from the vehicles’ mileage of 696.0 km (passenger cars) and 3.6 thousand km (tractors), the quantity of the generated waste will be as follows:

- passenger cars – 257.5 kg/year;
- tractors – 6.88 kg/year

The total volume of the waste is 264.38 kg/year.

The specific indicator of the waste generation will be defined per a thousand kilometers of mileage as follows:

\[ n_f = 0.2644 \text{ t : 699.6 thousand km} = 0.00038 \text{ t/thousand km}. \]

The spent automobile tires and tubes shall be replaced at service stations. There is no place of temporary storage.

Waste:

**Used vehicle batteries (in assembled condition)**

The operating life of batteries is 1.5 – 2 years.

The specific indicator of generation of spent batteries per 10 thousand km of mileage is as follows:

- passenger cars – 0.94 kg
- tractors – 4.18 kg

Proceeding from the vehicles’ mileage of 696.0 km (passenger cars) and 3.6 thousand km (tractors), the waste quantity will be as follows:

- passenger cars – 65.42 kg/year
- tractors – 1.5 kg/year.

The total volume of the waste is 67 kg/year

The specific indicator of the waste generation will be defined per a thousand kilometers of mileage as follows:

\[ n_f = 0.067 \text{ t : 699.6 thousand km} = 0.00009 \text{ t/thousand km}. \]

The spent batteries shall be replaced at service stations. There is no place of temporary storage.

Waste:

- **wiping rags (non-oily)**

It is generated in the course of wiping the glasses, top and inner surface of the vehicles and machines.

The specific indicator of generation of wiping rags per 10.0 thousand km of mileage is as follows:

- passenger cars – 1.05 kg
- tractors – 2.18 kg.

Based on the mileage of the vehicles, the amount of waste will be as follows:

- passenger cars – 73 kg/year
- tractors – 0.78 kg/year

The total volume of the waste is 73.8 kg/year.
The specific indicator of the waste generation will be defined per a thousand kilometers of mileage as follows:

\[ n_f = 0.0738 \frac{t}{699.6 \text{ thousand km}} = 0.0001 \frac{t}{\text{thousand km}}. \]

After repeated usage the wiping rags will be carried manually to the container for solid domestic waste. Non-oily wiping rags is the consumption waste of the 4th class of hazard.

### List of Products Generated

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Position</th>
<th>Grade, description</th>
<th>GOST</th>
<th>Code</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Natural gas</td>
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<td></td>
<td>O’zDSt 948:1999</td>
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### Information about the main and auxiliary source materials

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Position</th>
<th>Grade, description</th>
<th>GOST</th>
<th>Quantity</th>
<th>UoM</th>
<th>Code</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Gasoline</td>
<td>AI-95; AI-93</td>
<td>3120 l/year</td>
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<td></td>
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<tr>
<td>2</td>
<td>1</td>
<td>Diesel fuel</td>
<td></td>
<td>81040 l/year</td>
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<td></td>
<td></td>
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<tr>
<td>3</td>
<td>1</td>
<td>Engine oil</td>
<td></td>
<td>1140 l/year</td>
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<td></td>
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</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Electrodes</td>
<td>UONI, ANO, etc</td>
<td>1 tpa</td>
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</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Low pressure mercury lamps</td>
<td>LB-40, LD-40, etc</td>
<td>32 units per year</td>
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<td>7</td>
<td>1</td>
<td>High pressure mercury lamps</td>
<td>DRL-125 (6) DRL-250 (4)</td>
<td>295 units per year</td>
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CHARACTERISTICS OF THE WASTE LOCATION (STORAGE) PLACES

Principal Units

Gas Treatment Facility Site
Location place No. 1

Size of the area: 0.0002 ha
Waste located:
- solid domestic waste (SDW);
- sweep

A metal container for collection and temporary storage of domestic waste will be placed in the equipped paved area in the GTF site. As soon as the waste is accumulated, it will be removed from the site under the contract signed with the utility enterprise.

Time of storage – 30 days.

Linear section of the gas pipeline
Location place No. 2

Size of the area: 0.005 ha
Waste located:
- sludge resulting from gas pipeline cleaning;

According to the standards of technical design, for removing the sludge resulting from pigging a gas pipeline there should be a manifold manufactured of the same pipe that the gas pipeline of the 1st category. The volume of the gathering manifold shall be as calculated depending on the level of gas impurity and established pigging cycle. As soon as necessary, the waste shall be transported to the drilling waste disposal site.

Time of storage – 180 days.

Auxiliary Units

Territory of the Field Base with the Site Camp
Location place No. 3

Size of the area: 0.0002 ha
Waste located:
- solid domestic waste (SDW);
- food waste;
- wiping rags (non-oily);
- sweep;
- used incandescent lamps

The place of temporary storage of waste will be a special standard metal container located in the equipped area in the territory of the field base with the site camp.

As soon as the waste is accumulated, it will be transported by contractors to the authorized waste disposal site on a contractual basis.

Time of storage – 30 days.

Location place No. 4

Size of the area: 0.00001 ha
Waste located:
- used mercury lamps

According to the manual, burnt-out lamps should be stored packed in a special room and periodically transported to special places for deactivation and destruction. Glass scrap shall be buried in accordance with the Sanitary Rules of Designing the Construction and Operation of the Sites for Disposal of Non-Utilized Industrial Waste.

It is planned to define a special equipped place for the lamps in the warehouse. The lamps will be placed in boxes manually; closed boxes will be located in a special place. From time to time special enterprises will perform the centralized removal for utilization.

Time of storage – 180 days.
Location place No. 5

Size of the area: 0.0001 ha

Waste located:
- iron scrap;
- electrode stubs and remnants

The waste shall be collected in a small metal box installed in the minor repairs block. Since the equipment in the field is new, there may be no scrap during the first years of operation. The waste removal will be performed to the authorities handling recyclable materials.

Time of storage – 180 days.

The waste from amortization of motor vehicles shall not be stored in the territory of the field base, since the maintenance shall be performed at service stations on a contractual basis.

Thus, the field infrastructure construction is accompanied with the generation of traditional for the industry production and consumption waste:
- sludge resulting from gas pipeline cleaning;
- domestic waste (solid domestic and food waste, sweep);
- used incandescent lamps;
- used mercury lamps;
- waste engine oil;
- spent automobile tires and tubes;
- used vehicle batteries (in assembled condition);
- iron scrap;
- electrode stubs and remnants;
- wiping rags (non-oily).

From the listed waste items (12 items) the dominant type of waste is domestic nontoxic waste. Mercury lamps are classified as the 1st class of hazard. Used vehicle batteries (in assembled condition) are of the 2nd class of hazard. Sludge resulting from gas pipeline cleaning is the production waste of the 3rd class of hazard. The remaining waste is the waste of the 4th class of hazard.

The class of hazard was defined in accordance with the Guidelines on the Procedures of Accounting for the Generation, Usage and Storage of Toxic Waste in Accordance with Formula No. 3 – Toxic Waste (Semi-Annual, Annual).

The quantity of the generated waste is not large, and if the HSE rules are observed in the field sites and the site camp, any environmental impact is prevented.

Five (5) locations for the generated waste are defined and marked in the master plot plan of the sites.
Fig. 39 – Master Plot Plan of the GTF and Places of Waste Location
Fig. 40 – Master Plot Plan of the Field Base and Places of Waste Location
Fig. 41 – Scheme of the Gas Pipeline Connection and Places of Waste Location
### Information about the Product Output for 2004-2008

<table>
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<th>NN</th>
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<th>2005</th>
<th>2006</th>
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<td></td>
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<td>amount</td>
<td>Unit of Meas.</td>
<td>amount</td>
<td>Unit of Meas.</td>
<td>amount</td>
<td>Unit of Meas.</td>
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<td>3</td>
<td>4</td>
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<tr>
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<td>Natural gas</td>
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<tr>
<td>2</td>
<td>Condensate</td>
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</table>
## Inventory Sheet of Waste

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Position</th>
<th>Specific indicator of generation</th>
<th>Code</th>
<th>Certificate No.</th>
<th>Product code</th>
<th>Source material code</th>
<th>Note</th>
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</thead>
<tbody>
<tr>
<td><strong>Gas Treatment Facility Site</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Solid domestic waste (SDW)</td>
<td>83</td>
<td>kg/person</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Sweeping waste</td>
<td>21</td>
<td>kg/m²</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td><strong>Linear section of the gas pipeline</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Sludge resulting from gas pipeline cleaning</td>
<td>0,00667</td>
<td>t/million m³</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td><strong>Territory of the Field Base with the Site Camp</strong></td>
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<tr>
<td>1</td>
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<td>Solid domestic waste (SDW)</td>
<td>83</td>
<td>kg/person</td>
<td>2</td>
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<tr>
<td>2</td>
<td></td>
<td>Sweeping waste</td>
<td>21</td>
<td>kg/m²</td>
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<tr>
<td>3</td>
<td></td>
<td>Food waste</td>
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<td>kg/dish</td>
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<td>4</td>
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<td>Used mercury lamps</td>
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<td>Used incandescent lamps</td>
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<td>6</td>
<td></td>
<td>Iron scrap</td>
<td>0,00067</td>
<td>t/million m³</td>
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<td></td>
<td></td>
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<tr>
<td>7</td>
<td></td>
<td>Electrode stubs and remnants</td>
<td>0,00005</td>
<td>t/million m³</td>
<td>8</td>
<td></td>
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<tr>
<td>8</td>
<td></td>
<td>Spent engine oil</td>
<td>0,00059</td>
<td>t/thous.km</td>
<td>9</td>
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<td>9</td>
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<td>Used car tires</td>
<td>0,00038</td>
<td>t/thous.km</td>
<td>10</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td></td>
<td>Used vehicle batteries (in assembled condition)</td>
<td>0,00009</td>
<td>t/thous.km</td>
<td>11</td>
<td></td>
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<tr>
<td>11</td>
<td></td>
<td>Wiping rags (non-oily)</td>
<td>0,0001</td>
<td>t/thous.km</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CALCULATION OF WASTE ALLOCATION LIMIT

In order to ensure the meeting of environmental requirements stipulated in the Republic of Uzbekistan, waste allocation limits are established for users of natural resources. The limits are set on the basis of the ability of each enterprise to allocate in its area on a temporary basis the waste generated over 6 months with subsequent utilization and/or removal. [4].

The limit of production and consumption waste allocation is worked out with the following purpose:

- organization of the accounting for temporary allocation of waste generated in the Khauzak-Shady field;
- reduction in the level of impact of the generated waste on people and environment;
- improvement of the production and consumption waste management system.

In accordance with clause 1.3 of Regulatory Document O’zRH 3.16:2005, the waste allocation limits do not apply to food and other biodegradable waste, the quantities, areas and duration of allocation of which at the enterprises and the timing of removal from the enterprise territory are regulated by the regulatory enactments of the RU Ministry of Health and the Uzkommunkhizmat Agency. In this case domestic waste refers to such waste: solid domestic and food waste, sweep, spent incandescent lamps and wiping rags (non-oily).

According to the inventory results, the limits of allocation are defined for the following waste types:

- sludge resulting from gas pipeline cleaning;
- iron scrap;
- electrode stubs and remnants;
- used mercury lamps.

The source data for calculating the waste allocation limits are provided in Attachment B.

The size of the allocation limit for each type of waste (L) is calculated in accordance with the following formula:

\[ L = P_n \times n_f \times t_1 : t + K \times q_y \]  

where:

- \( P_n \) is the planned quantity of the product output, tpa;
- \( n_f \) is the specific quantity of waste generation; it is defined in the course of inventory of the waste of the enterprise, t/t, kg/t, etc.;
- \( t_1 \) is the time for which the limit is set; adopted as 180 days;
- \( t \) is the period of waste allocation considered to be temporary, \( t = 365 \) days.
- \( K \) is the coefficient of increasing the limiting quantity of waste allocation in the event of its utilization; adopted as 0.25;
- \( q_y \) is the quantity of utilized waste, tpa.

It should be noted that of the listed types of waste, for which the limits are set, the enterprise utilizes the main oil-containing industrial waste, which is the sludge resulting from gas pipeline cleaning. For other types of waste the amount of the allocation limit is defined in accordance with the following formula:

\[ L = P_n \times n_f \times t_1 : t \]  

**Location place No. 1**

The waste title as per certificate No. 2 and No. 3 is the solid domestic waste and sweep. According to clause 1.3 of Regulatory Document 1.3 waste limits do not apply to these types of waste.

**Location place No. 2**

Waste title as per certificate No.1 - **sludge resulting from gas pipeline cleaning**
Variant of temporary waste allocation – at the enterprise.
Place of temporary waste allocation – gathering manifold.
The limit shall be calculated on the basis of the planned capacity of the enterprise – \( P = 3000.0 \) Mcm/year.
The specific quantity of waste generation: \( n_f = 0.00667 \) t/Mcm.
Time for which the limit is set: \( t = 180 \) days.
Period of waste allocation considered to be temporary, \( T = 365 \) days.
Coefficient of the increase of the limiting quantity of waste allocation \( K_1 = 0.25 \).
Quantity of utilized waste: \( q_l = 20 \) t/year.
The amount of the waste allocation limit is defined by formula (1) and is as follows:
\[
L = P \times n_f \times t \times \frac{T}{365} + K_1 \times q_l = 3000.0 \times 0.00667 \times 180 \times \frac{365}{365} + 0.25 \times 20 = 14.868 \text{tons.}
\]

**Location place No. 3**

Title of waste as per certificate No. 2-4, No. 6, No. 12 – SDW, food waste, sweep, spent incandescent lamps, wiping rags (non-oily)
According to clause 1.3 of Regulatory Document 1.3 waste limits do not apply to these types of waste.

**Location place No. 4**

Waste title as per certificate No.5 – spent mercury lamps
Variant of temporary waste allocation – at the enterprise.
Place of temporary waste allocation – place in the warehouse.
The limit shall be calculated on the basis of the planned capacity of the enterprise – \( P = 3000.0 \) Mcm.
The specific quantity of waste generation: \( n_f = 0.00001 \) t/Mcm.
Time for which the limit is set: \( t = 180 \) days.
Period of waste allocation considered to be temporary, \( T = 365 \) days.
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Title of waste</th>
<th>Waste Certificate No.</th>
<th>Class of hazard</th>
<th>Specific indicator of waste generation</th>
<th>Quantity of product (feedstock) per year</th>
<th>Expected quantity of waste generation per year</th>
<th>Quantity of utilized waste, tpa.</th>
<th>Quantity of outgoing waste, tpa.</th>
<th>Quantity of stored waste, tpa.</th>
<th>Time period of allocation at the enterprise, days</th>
<th>Code of non-utilization reasons</th>
<th>Code of allocation operations</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sludge resulting from gas pipeline cleaning</td>
<td>1</td>
<td>3</td>
<td>0,00667 /million m^3</td>
<td>3000,0 million m^3</td>
<td>20,0 t</td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>Iron scrap</td>
<td>7</td>
<td>4</td>
<td>0,00067 /million m^3</td>
<td>3000,0 million m^3</td>
<td>2 t</td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Electrode stubs and remnants</td>
<td>8</td>
<td>4</td>
<td>0,00005 /million m^3</td>
<td>3000,0 million m^3</td>
<td>0,15 t</td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Used mercury lamps</td>
<td>5</td>
<td>1</td>
<td>0,00001 /million m^3</td>
<td>3000,0 million m^3</td>
<td>0,024 t</td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td></td>
<td>1-05</td>
<td></td>
</tr>
</tbody>
</table>
The enterprise does not have any waste utilization process: $K_1 = 0$.
Quantity of utilized waste: $q_0 = 0$.
The amount of the waste allocation limit is defined by formula (2):
$$L = 3000.0 \text{ Mcm} \times 0.00001 \text{ t/Mcm} \times 180 \text{ days} : 365 = 0.015 \text{ t}.$$  

**Location place No. 5**

Title of waste as per certificates No.7 and No.8 – **iron scrap, electrode stubs and remnants**.
Variant of temporary waste allocation – at the enterprise.
Place of temporary waste allocation – metal box.
The limit shall be calculated on the basis of the planned capacity of the enterprise – $P = 3000.0$ Mcm.
The specific quantity of waste generation: $n_f = 0.00067$ t/Mcm and $0.00005$ t/Mcm.
Time for which the limit is set: $t = 180$ days.
Period of waste allocation considered to be temporary, $T = 365$ days.
The enterprise does not have any waste utilization process: $K_1 = 0$.
The amount of the waste allocation limit is defined by formula (2):
Iron scrap:
$$L = 3000.0 \text{ Mcm} \times 0.00067 \text{ t/Mcm} \times 180 \text{ days} : 365 = 1 \text{ t}.$$  
Electrode stubs and remnants:
$$L = 3000.0 \text{ Mcm} \times 0.00005 \text{ t/Mcm} \times 180 \text{ days} : 365 = 0.074 \text{ t}.$$
# Limits of Allocation of Waste Generated at the Enterprise

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Waste quantity</td>
<td>area</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>amount</td>
<td>Unit of Meas.</td>
<td>amount</td>
</tr>
<tr>
<td>1</td>
<td>Waste of the 1st hazard class</td>
<td></td>
<td></td>
<td>5</td>
<td>0,015</td>
</tr>
<tr>
<td>2</td>
<td>Waste of the 3rd hazard class</td>
<td></td>
<td></td>
<td>14,868</td>
<td>0,05</td>
</tr>
<tr>
<td>3</td>
<td>Waste of the 4th hazard class</td>
<td></td>
<td></td>
<td>1,074</td>
<td>0,0001</td>
</tr>
</tbody>
</table>

## Waste of the 1st hazard class

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Used mercury lamps</td>
<td>5</td>
<td>0,015</td>
<td>tons</td>
<td>0,00001</td>
</tr>
</tbody>
</table>

**Total:** 0,015 tons

## Waste of the 3rd hazard class

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sludge resulting from gas pipeline cleaning</td>
<td>1</td>
<td>14,868</td>
<td>tons</td>
<td>0,05</td>
</tr>
</tbody>
</table>

**Total:** 14,868 tons

## Waste of the 4th hazard class

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iron scrap</td>
<td>7</td>
<td>1</td>
<td>tons</td>
<td>0,0001</td>
</tr>
<tr>
<td>2</td>
<td>Electrode stubs and remnants</td>
<td>8</td>
<td>0,074</td>
<td>tons</td>
<td>0,0001</td>
</tr>
</tbody>
</table>

**Total:** 1,074 tons

**Total:** 15,957 tons
PROPOSALS ON WASTE ALLOCATION LIMITS

When handling the production and consumption waste in the course of the field infrastructure construction, the effective environmental, sanitary and epidemiological rules and standards shall be observed, as well as technical standards and rules.

The limiting quantities of the simultaneous storage of waste, as well as the methods of their temporary storage shall be defined on the basis of the environmental safety requirements, so that the waste does not make any adverse impact on the environment and people’s health.

In the system of the operational and environmental monitoring it is necessary to observe the generation, accumulation, temporary storage, transportation and utilization of waste generated in the company.

The inventory of the waste is carried out, as well as separate accumulation and temporary storage of waste with different levels of toxicity; the waste is differentiated by the safety of transportation, its certification is performed, as well as environmental monitoring of the waste allocation places.

All types of waste generated at the Khauzak-Shady field will be removed from the territory in accordance with contracts with specialized enterprises.
### PLANNED ACTIONS FOR IMPROVING THE TEMPORARY ALLOCATION OF WASTE

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Title of waste</th>
<th>Action</th>
<th>Timing</th>
<th>Expected effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sludge resulting from gas pipeline cleaning</td>
<td>Timely removal for utilization to the waste management facility for drilling cuttings at the Khauzak-Shady area</td>
<td>2007 annually</td>
<td>Environmental protection. Environmental safety</td>
</tr>
<tr>
<td>2</td>
<td>Used mercury lamps</td>
<td>Agreement for the removal and utilization by a specialized enterprise (Sitora)</td>
<td>2007 annually</td>
<td>Environmental protection. Environmental safety</td>
</tr>
<tr>
<td>3</td>
<td>Iron scrap, electrode stubs and remnants</td>
<td>Agreement with the Vtorchermet (ferrous metal recycling) authorities for the removal and delivery of the waste for recycling</td>
<td>2007 annually</td>
<td>Decrease in the growth of accumulation and avoidance of a mess in the site of the field base.</td>
</tr>
<tr>
<td>4</td>
<td>Solid domestic waste, sweep, food waste, spent incandescent lamps, wiping rags (non-oily)</td>
<td>Contract for obligatory removal of consumption waste to the waste disposal site authorized by the controlling authorities (OOO Olotbod)</td>
<td>2007 annually</td>
<td>Decrease in the growth of accumulation, avoidance of a mess and observance of sanitary rules.</td>
</tr>
</tbody>
</table>
6 REQUIREMENTS TO WORK ORGANIZATION AND ENVIRONMENTAL ACTIONS

When operating field equipment and facilities the hazard of emergencies is conditioned by the following reasons:

- natural gas and condensate are under high pressure and high temperatures, and their properties are dangerous for people's health;
- equipment and facilities are under high pressure permanently;
- hazardous substances are used in the operational processes: corrosion inhibitors, formations of hydrates and mercury in devices;
- necessity to carry out gas-hazardous and hot works;
- necessity to maintain the equipment and facilities in any weather conditions in the open areas and at night.

Natural gas is toxic and explosion hazardous.

The main reason of fires and explosions is the violation of safety rules when working in the field. At the moment of a fire development combustibles for burning are gas, condensate, inhibitors, which are emitted to air leaking through unsealed joints. The oxidizer is the atmospheric oxygen, and the source of combustion is open fire, sparks from equipment, improper usage of tools or from application of spark hazardous tools, explosion hazardous lighting sources, and from smoking in forbidden areas, etc.

The main issue in the field is to prevent fires. Therefore the operator should know very well, understand and follow the fire safety rules in the field. It is necessary to be careful to notice danger signal, in particular the signals of gas sensors.

Fire fighting is based on the elimination of the reasons of burning. Firstly, it is necessary to block the ingress of gas, condensate and inhibitors to the combustion source. For this purpose all valves shall be closed, wells stopped, etc. Secondly, it is necessary to limit the access of oxygen to the burning area. Mechanical impact (water jets, directed explosion) is used to cut the flame from the source of combustion, and then a liberal amount of water or foam is put in this area. Fire fighting is especially effective with foaming agents. Foams can isolate combustibles from oxygen reliably and for a long time.

The gas hazardous work can only be performed by the employees who underwent special briefing and training in the techniques and methods of working in the gas hazardous and explosive environment, application of gas-protective items, who know the rules of providing help to those who have suffered from the gas impact, as well as authorized to work in rebreathers and respirators by the state of their health.

In order to prevent possible emergency situations it is necessary to strictly follow the process discipline, carefully maintain the safety devices and automatic and teleautomatic means, comply with the field safety rules in a strict manner.

The gas treatment facility is located in the single site, has a lot of principal and auxiliary equipment, structures and workshops. The environment is highly explosion and fire hazardous. The most important element of freedom from accidents is a reliable and efficient flare system. The personnel of the Gas Treatment Facility shall pay special attention to maintenance of the pre-set process parameters as well as operation of the auxiliary equipment. First of all it is necessary to monitor the following:

- inlet pressure and temperature of gas for each well and reservoir;
- outlet pressure and temperature after each cooler;
- injection (dosage) of corrosion and hydrate growth inhibitors;
- level of liquid in all process vessels;
- pressure and temperature of cooling water;
- pressure of air in air drives;
- pressure, temperature and flowrate of gas supplied to the main gas pipeline;
- pressure and temperature of condensate in the condensate gathering manifold.

When designing equipment and designing and constructing gas field facilities the safety shall be ensured using the following methods:
- the safety factors of devices and other process equipment;
- application of safeguarding equipment (valves, flares, safety automatics, etc.);
- fencing of moving elements;
- grounding of equipment and devices.

The quantitative characteristics of harmful impact are as follows:
- estimate of the amount of possible medical losses of personnel and fatalities;
- expected frequency of accidents.

The level of automation offered by the design provides for operation of equipment without the continuous presence of operating staff and for the control of field operations from the control room.

The system provides for the automated control, alarm and emergency overpressure protection for major process trains.

The process equipment installed in the field should meet the requirements of the operational rules, and thus practically fully prevent emergency situations connected with mechanical failures.

Organizational and technical failures resulting in emergencies are practically impossible, since the decrease or increase in the volume of transported gas is within the limits of established capacities. Otherwise emergency shutdown occurs automatically when protection is actuated or in a manual mode.

As for emergency situations resulting from natural disasters, in particular, earthquakes, they are hardly probable, because the GTF is located in the zone of low seismic activity and the buildings and equipment are designed taking into account high seismic activity.

It should be noted that the main safety objective in the course of operating the field is to prevent hazardous events connected with gas treatment and transportation. Natural gas in a certain concentration may form an explosive mixture with air.

Transported gas contains methane and hydrogen sulfide, which are classified as explosive materials. In connection with this, for safety purposes permanent control over the concentration of explosive materials will be executed in all operational buildings (where emission and accumulation of explosive materials is possible), as well as in open areas containing process equipment.

The hazard for gas pipelines may come both from the exposure to the environment and from development pressure. In order to reduce the accident risk it is necessary to envisage the protection of gas pipelines from corrosion using the isolation coverage and electrochemical protection (the method of cathodic polarization).

The model solutions for process pipeline envisage the following:
- passive and active corrosion protection;
- standard safety factor;
- opportunity to use intelligent pigs;
- creation of the system of leak detection providing for closing the valves in the event of an emergency.

Linear valves are planned to be located in accordance with the regulatory requirements and provide for the minimum gas leaks in the event of line ruptures.

The field infrastructure construction shall take into account the issues of sanitary and fire safety. In particular, the facility is located at the safe distance from populated areas; the correct zoning of buildings and structures was performed taking into account their purpose and other features. Emergency situations are unpredictable both from the point of view of the emission method and from the point of view of timeframe.

Analysis of the reasons of gas line ruptures results in the conclusion that they depend not only on the quality of the pipe metal and welding, but also on the quality of transported products, i.e. on the reliability of the production facilities and gas treatment facilities.

An important qualitative indicator defining the reliability of operations of trunk gas pipelines is the cleanliness of their inner part, i.e. absence of liquid and contaminants. Contaminants moving in the flow of the transported gas can be the reason of a failure of the line equipment, compressors and other equipment. Accumulations of water contribute to the development of hydrate blocks, which is especially dangerous for the transportation of high-sulfur gas, since highly active sulfur compounds may be generated.

The average frequency of emergencies for pipelines is as follows:
- trunk lines – $10^{-7}$;
- distribution lines – $10^{-6}$;

Based on this, the probability of emergencies is very low.

On the whole, the process equipment at the project meets the modern requirements to the facilities and gas pipelines.

**Fire prevention. Explosion Safety.**

Fire prevention measures were developed in full compliance with the norms and regulations. All designed buildings and structures have the II level of fire resistance with relevant categories of fire and explosion risk. The design takes into account the requirements on necessary number of fire exits; intersections of routes for people and freight were avoided. In case of explosion blast relief panels are envisaged in the explosion-hazardous premises. These panels can be either coatings or window apertures. Intrinsically safe floors are envisaged in buildings and structures of A, B, C categories.

The following systems and structures were designed for fire safety purposes:
- fire pump station;
- fire water tank (2 pcs.) for 300 m³;
- loop fire line network.

Condensate tanks are considered to be the most hazardous from the fire safety standpoint. Fire water back up equals to 260.28 cubic meters. Taking into account earthquake activities (rate 8) two tanks (300 cubic meters each) will be installed.

Fire pump station is designed for delivery of water from fire water tanks to the loop fire line network (Table 24).

**Table 24 – Equipment, installed in fire pump station**

<table>
<thead>
<tr>
<th>Pump Parameters</th>
<th>Qty, pcs</th>
<th>RPM</th>
<th>Type of</th>
<th>Power, kW</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Pump Parameters</th>
<th>Qty, pcs</th>
<th>RPM</th>
<th>Type of</th>
<th>Power, kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>fire pump station</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fire water tank (2 pcs.) for 300 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>loop fire line network</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Therefore fire safety activities proposed in the design will allow to operate the plant in a safe mode.

One of the main corrosion protection techniques to protect gas pipelines, transporting sour gas, is inhibition of pipelines by launching a pig.

This project implies cathodic protection of product pipelines, gas lines and underground utility systems for Gas treatment facilities.

Cathodic protection connection implies a joint protection implemented by connecting several pipelines to a single Cathodic protection unit through diode and resistor block.

Cathodic protection is provided through installation of switchgear for cathodic protection of UKZV, UKZN type with converters TDED-9-0.5 and deep anode beds from steel tubes having a diameter of 219x8 and a length of 75 meters. SKIP-5 instrumentation points are envisaged, which are equipped with ENES-1 reference electrodes.

Totally the facility includes: UKZV (rectifier)-6-5-1-1U1 – 1pcs., UKZN-0.22-5-2U1 – 1 pcs.

In case of a gas line accident, a faulty section of a gas pipeline is cut off at the nearest valves.

In case of failure at Gas treatment unit, an automatic protective device switches on to prevent gas delivery to Gas treatment facility, gas will be delivered through a bypass line to a gas pipeline.

Personnel that is permitted to do the work, meets the requirements set forth in an industry standard known as "Gas production companies. Operations of gas gathering, treatment and transportation facilities. Safety Requirements."

Taking into account the above mentioned requirements, personnel gets work permission only after a specific briefing both introductory and in-field training.

The following documents are put up on work places on a mandatory basis:

- regulations for maintenance and repair of equipment;
- process flow diagram for the units and specific parts indicating check, control and safety valves;
- instructions on shut down procedure for separate process line and the entire unit.

Therefore organizational and technical failures, when operating the equipment are minimized.

The most powerful impact will be made on soil and subsoil, when laying gas lines, car roads and power lines.

In order to mitigate violations of industry standards all construction and installation activities shall be carried out within the limits of right of way:

- pipes shall be distributed through permanent routes along the route roads,
- it is essential to aggregate and improve technological availability of structures and materials,
- preparation and sealing of tube ends,
- installation and insulation of inline block valves,
- cleaning and protection of inner surface of pipelines and equipment from inappropriate items, coat and mud.

In the course of construction and installation work rehabilitation of lands shall be carried out (areas allocated as permanent locations for sites, car roads, power line towers, temporary land allocations for construction of gas pipelines) to make them suitable for further use as well as to take erosion control measures, including conservation and recovery of vegetation cover. Technical phase of land reclamation is designed for conservation of fertile soil layer. Land reclamation shall be carried out in the following procedure:

1. Removal of fertile soil layer and moving it to a temporary dumping area.
2. Distribution of excess mineral ground along reclamation line, which remains after backfilling.
3. Removal of construction debris and garbage.
4. Return of a fertile soil layer from the temporary dump area and homogeneous distribution within the limits of reclamation area.

All land reclamation activities shall be carried out only within the limits of construction line, envisaged by the design. In accordance with KMK 2.01.03-96 "Construction in seismic areas" an estimated seismic activity of the construction area is 8 on Richter scale. All buildings and structures were designed with allowance for such earthquake activity: all other elements of the structure were designed on an individual basis, and the design envisaged seismicity of the area, foundations were designed with allowance for specific combination of loads, which occur due to the seismic force. Therefore earthquake prevention activities are targeted at reliable and safe operations of buildings, structures and process equipment.

Subject to the "Integrated scientific and technical program for environmental protection of the Republic of Uzbekistan", approved by the resolution of the Cabinet of Ministers of the Republic of Uzbekistan, oil and gas production companies are obliged to do their best in terms of control over the development of oil and gas production fields, improvement of natural resources utilization, prevention of air pollution and soil contamination on the field and adjacent area. Main requirements to safe well operations are associated with prevention of leakages in process lines, behind-the-casing flows and oil and mud springs. Air pollutants are represented by hydrocarbons and gas combustion products. The following actions are envisaged to protect the atmosphere:

1. All operating equipment, valves, gas and condensate pipeline shall be reliably pressurized. Closed gathering system for gas condensate shall be envisaged.
2. Gas emissions through safety valves and flash gas shall be flared or used for own needs on a mandatory basis;
3. The height of the flare shall provide for allowable concentration of gas flaring products (sulfur, carbon oxide, nitrogen oxide, soot) in the air of the operating area.

In case of emergency, when treating products from gas condensate wells of Khauzak and Shady at Gas Treatment Facility or transporting gas condensate, we do not
exclude a probability of penetration of liquid hydrocarbons and other oil products (diesel fuel, oil) to the soil, subsurface, offshore area of Dengizkul lake in transition areas.

Potential sources of oil spills include condensate tank farm, pumping station, fuel storage facility at GTS, condensate pipeline, vehicles. Precipitation that leads to intensive washing out of pollutants to the surface and underground water can be considered as a potential reason for penetration of oil products to the environment.

Assuming the complexity of an area-wide prevention from pollution of water resources and soils with oil products it is necessary to implement relevant technical and organizational preventive actions.

In case of emergency it is necessary to apply the newest technologies for decontamination of polluted areas, in particular thermally expanded graphite sorbent, which actually represents thermally split graphite. Sorbent was developed in the Russian Federation and is manufactured in Uzbekistan by EKONORDRAGMET JV.

Subject to proposed technology the sorbent is delivered to a polluted area by special equipment. Absorption period – 10 seconds. After removal of sorbent with absorbed oil products decontaminated water is pumped to a wireframe-charging filter and aluminium sulphate solution is injected. Residual content of oil products in decontaminated water does not exceed 1 mg/l. Processed sorbent is gathered in plastic barrels and delivered to the plants producing asphalt mixes.

In this context a decontamination process using thermally expanded graphite sorbent does not produce any waste.

It is well known that development control system includes control over the set of parameters, as well as registration and forecast of modification of these parameters in time. Timely, reliable and representative information, which is obtained in the process of control, gives significant impact on such indicators as reliability of well and field operations, final gas and condensate recovery, technical and economic feasibility of field operations.

In this respect prior to start-up of field surface facilities it is necessary to implement a set a investigations to specify (confirm) information assumed as initial design data. Main process parameters pertaining to field development, which require permanent control, are as follows:

- drained gas reserves;
- productivity of gas wells;
- condensate content of produced gas;
- water cuttings of gas well production.

It's common knowledge that gas-dynamic status of pay zones in the process of development is evaluated through the rate of decline of reservoir pressure. Productivity of gas wells in the process of operations can either improve (due to self-cleaning of bottom-hole formation area from drilling products (workover) or involvement of new productive interlayers) or decline (due to condensate dropout in the bottom-hole formation area, rock and fluid plug).

Condensate content of recovered gas is constantly decreasing due to retrograde processes taking place in the reservoir in the course of gas recovery and decline of reservoir pressure. Water production from gas wells is a natural process, which depends on well locations and gas recovery rates.
With a view to the above mentioned facts, personnel operating the field shall provide for regular studies on Khauzak and Shady to control the dynamics of main process parameters of field operations.

1. Regular (not less than once per quarter) gathering of well information and data on static pressure to evaluate the changes in reservoir pressure in pay zones being developed. It's important to note the following aspect. Based on direct (deep) measurements of reservoir pressure in wells transferred from drilling to operations, it is necessary to specify initial reservoir pressure values. An issue related to static pressure in these wells should also be clarified. Reservoir temperature shall be specified, when measuring reservoir pressure. Results of direct measurements of reservoir pressure shall be compared with design values (by using barometrical formula). In case of satisfactory compliance of results, there is no need for direct (deep) reservoir pressure measurements in operating wells.

2. Quarterly pressure survey of existing well stock.

3. Periodic (not less than once a year) well logging of gas wells to define well productivity (defining permeability and hydraulic attributes of "reservoir-well" system, identification of potential production capabilities with allowance for technology-based limits).

4. Regular (not less than once a year) studies of gas condensate characteristics of recovered gas on 8-12 wells.

5. Specific studies (hydrogeological, hydrochemical, geophysical etc.) to identify conditions for accumulation and production of fluid as well as solids from the bottom hole area and determine actual value for admissible (maximal) depression. It is necessary to arrange for regular sampling of water produced in the well together with hydrocarbon fluids and implement lab analysis of these samples.


7. Evaluation of environmental impact of the facility in the process of waste generation, forecasting the extent of pollution from production waste.

The average content of the second "sour" component (CO₂) in gas is 3.19%-4.30%. It can lead to carbon-dioxide corrosion of pipes and equipment. In this regard it is necessary to take measures for prevention or mitigation of this impact.

A set of actions associated with optimal field development is foundation stone for conservation of mineral resources, sustainable use of natural resources and environmental protection.

Industrial environmental monitoring is considered to be the most important environmental action (for more details please refer to the next chapter).

Analysis of engineering, process-related, architectural and construction solutions indicates that strict observance of operational regulations for process equipment and process regulations for facility operations, availability of professional maintenance staff, and strict observance of industrial and labor safety regulations will result in low probability of emergencies with significant environmental impact. This is confirmed by operating practices of similar production sites.
7 ORGANIZATION OF MONITORING

One of the requirements of the environmental legislation of Republic of Uzbekistan is to organize and carry out environmental monitoring of the state of the various elements of the environment.

The purpose of environmental monitoring is to assess the impact of operations on the environment in the operating area, as well as provision to all stakeholders of accurate data needed to prevent and/or reduce the impact of unfavorable consequences of changes in the state of the environment by:

− assessing the state of the elements of the environment in the Area;
− identifying trends in the changes of the elements, i.e. pollution indicators, and apply corrective actions if necessary;
− creating prerequisites for identifying actions to prevent negative situations and possible damage to the environment.

Environmental monitoring has the following objectives:

− to monitor the state of the environment in the Area and the processes taking place therein under the influence of natural factors, as well as mining and other economic activities;
− to assess the state of the environment in the Area;
− to timely identify and project the development of natural and technogenic processes that impact the state of the environment in the Area.

In accordance with Article 29 of the Law of Republic of Uzbekistan On the Protection of the Environment the Environmental Control System is comprised of the government, ministerial, operational and public control in the environmental protection area.

The main reasons for the deterioration of the state of the environment inhabited by man, disruption of the integrity of ecosystems and deletion of natural resources are anthropogenic influences on the environment which are explained by various factors, including:

− emission of pollutants into environment;
− extraction of natural resources;
− destruction of naturally developed natural structures.

Within the framework of Environmental Monitoring the objects of control in the Area are as follows:

− atmospheric air;
− surface basins and streams;
− underground waters;
− soils;
− flora and fauna;

When placing the points of control over the state of environment and defining their quantity one should proceed from the size of the Area, physical, geographical and other natural factors. The main principle of allocation is the gradual increase of the quantity of points of monitoring in the course of developing the field in order to achieve the largest coverage.

The initial environmental state of the Area was defined by the completed studies: Environmental Audit of the Territory of the Contract Area (2004) and the Departmental Environmental Monitoring in the Area (2005-2006) carried out by the GosSIAK authority of the State Environmental Protection Committee of the Republic of Kazakhstan. As a result of the field and laboratory tests performed by the GosSIAK authority of the State Environmental Protection Committee of the Republic of Kazakhstan, the state of the environmental items in the area was estimated.
The environmental monitoring network in the Area was formed from background and local stations.

The background stations are intended for estimating the natural level of environmental pollution, which depends only on the level of impact of natural conditions; the stations are placed beyond the borders of the area or far from the operational facilities. Local stations are intended for the control over the state of the environment directly in the operational areas and are placed in the territory of the operational facilities or in the immediate proximity to them.

The installed local stations of air monitoring take spot samples of air upwind and on leeward. At the same time with air sampling the observation is carried out over the following:

- main meteorological parameters: air temperature, wind direction and velocity and weather conditions. The measurements are taken every 4 hours, at 3 am, 7 am, 11 am, 3 pm, 7 pm and 11 pm;
- noise level.

In 2007 this program set the identification of the following components in the air (mg/m³):

1. Carbon oxide;
2. Nitrous oxides (as recalculated to nitrogen dioxide);
3. Sulfur dioxide;
4. Ammonia;
5. Hydrogen sulfide;
6. Methane;
7. Ethane;
8. Propane;
9. Butane;
10. Pentane;
11. Phenol;
12. Benzol;
13. Xylene;

The percentage content of the following substances is also defined in the air:

15. Oxygen;
16. Nitrogen;
17. Carbon dioxide.

As a result of the performed studies the assessment of the state of atmospheric air is carried out, which is defined by the hazard indicators of a substance, air pollution potential, critical loads and critical levels of pollutants impacting the ground vegetation and aquatic ecosystems.

In order to control the surface waters in the Area the water samples are taken in the following places:

- at the entry of the reservoir to the lake (northwestern part of the area);  
- in the Dengizkul Lake (the water area of the lake adjacent to the area of drilling).

In order to control the underground waters in the Area the water samples are taken in the following places:

- in the territory of the reservoir entering the Area (from the well drilled to the level of underground waters);  
- in the drilling sites;  
- in the sites of construction of field surface facilities;  
- in the territory of the Temporary Waste Storage and Management Facility for Drilling Cuttings and within the limits of its sanitary zone.
The monitoring shall be performed with regard to ingredients, the values of which exceed the established standards, unique pollutants characteristic for the oil and gas industry, and namely:

1. pH;
2. Suspended matter;
3. Chemical oxygen demand;
4. Mineralization;
5. Sulfides;
6. Hydrogen sulfide;
7. Lead;
8. Mercury;
9. Zinc;
10. Iron;
11. Petroleum products;
12. Benzo;
13. Xylene;
14. Toluene;
15. Phenol.

Also, when sampling the water in field conditions one should measure its temperature and define the quantity of dissolved oxygen. The samples shall be preserved in order to retain the ingredients and water properties for studying them with the help of laboratory methods. As a result of the studies, the analysis and assessment of the state of surface and underground waters shall be performed, which is defined by the indicators of chemical and biological contamination, concentrations of pollutants and preliminary estimation of the polluted area.

In accordance with the Land Code of the Republic of Uzbekistan, a user shall be liable to rationally use the land resources and prevent the aggravation of their quality.

Based on the results of soil monitoring performed in 2005-2006 the following ingredients shall be defined:

1. pH of water extract;
2. Solids of water extract;
3. Chlorides;
4. Sulfates;
5. Lead;
6. Cadmium;
7. Cuprum;
8. Iron;
9. Manganese;
10. Petroleum products;
11. Phenol

At the local stations soil sampling shall be performed taking into account the special features of emission spreading and possible impact of other sources on the environment.

Based on the results of the performed studies, the analysis of the state of soils shall be carried out, which is defined by the indicators of chemical and biological contamination; physical degradation shall be estimated, as well as phytotoxicity, biological productivity of cenosis. The monitoring of the flora and fauna in the Area will be carried out in accordance with the methods approved and used in Uzbekistan.

The organization of control in the course of monitoring consists of the following:

− inventory taking of animals and plants – establishing their species composition;
− establishing the state of flora and fauna – presence of sick animals, significant changes in the quantities of animals of certain species, etc.
– establishing the factors impacting the state of plants and animals (wildlife disturbance, pollutants – well drilling, explosion operations, industrial waste, illnesses, etc.) and addressing them. Special attention shall be paid at banning all types of operations, which can disturb animals and destruct plants, for example, explosion operations, in the territory of the state wildlife reserve;
– sampling plants and animals (organ tissues) for biochemical and histologic analysis.

The main method of gathering information about fauna is route accounting and observation and permanent base stations.

In order to carry out integrated work of controlling the state of the environment within the framework of the Environmental Monitoring, relevant preparation of the special air, water and soil sampling equipment will be performed, as well as the preparation of the necessary tools and equipment for studying the flora and fauna. Special machines and drilling equipment will be prepared for drilling small water wells, and human resources will be mobilized.

Laboratory identification of the pollutants in the air, water, soil and plant tissues will be performed in the laboratories certified by the State Committee for Standardization, Metrology and Certification of the Republic of Uzbekistan. The results of laboratory studies shall be documented with Protocols of the established format.

The results of the Environmental Monitoring shall be processed using the methods of analyzing statistic data on environmental pollution and by way of mapping the environmental situation in the area. Based on the results of performed field studies and laboratory tests Information Reports shall be prepared containing the main conclusions on the impact of oil and gas operations on environmental components.

The functioning of the Environmental Monitoring System in the Area will provide for the following:

– estimate the efficiency of operations from the point of view of current environmental requirements and compliance with the existing environmental regulatory documents;
– provide the relevant services of the Operator, as well as contractors with information about the contents of pollutants in the environment in the Area in order to implement efficient actions for eliminating or minimizing the adverse impact of specific pollution sources;
– provide the local environmental authorities and population with the online information about the state of environment in the Area.

The control shall be executed in full compliance with all stages of the complex development. By the volume of received information the period of functioning of the monitoring system can be divided into following stages:
- existing situation (background industrial environmental monitoring);
- period construction of surface field facilities;
- operational - in the course of commissioning the facilities.

The work of creating and implementing the industrial environmental monitoring system will be performed by the operational unit and specialized organizations on a contractual basis.
8 MAIN CONCLUSIONS ON THE POSSIBILITY TO CARRY OUT OPERATIONS

The integrated environmental assessment of the area of planned construction showed the following results.
The impact on soils and vegetation will be expressed in the violation of integrity of the soil and vegetation cover in the course of construction.
Emergencies shall be liquidated immediately; contaminated soil shall be removed and the area of emergency shall be fully remediated. Thus, it may be stated that the design solutions envisage solicitous attitude to soils.
After remediation the vegetation will be fully restored in a short period of time.
The landscape will retain its current look.
The risk of polluting deep underground waters is low.
Taking into account the above-mentioned impact on the health of the personnel and population, as well as in the border zone, will hardly be noticeable, and the environmental forecast is quite favorable for the planned activity.

Atmospheric air

The quantitative characteristics were calculated on the basis of specified data resulting from the engineering solutions.
In the course of operations end product of natural gas combustion, hydrocarbons and hydrogen sulfide will be emitted to the air. Additional emissions resulting from the Khauzak and Shady development will amount to 7528.646682 tpa of 10 polluting items.
The technology of the field is characterized with the continuous processes of gas and condensate treatment and transportation. In the normal course of operations the air pollution will be moderate. As it can be seen from the calculations of the maximum ground level concentrations on none of emitted ingredients will create a pollution level exceeding the established MPCs (SRLI).
Maximal values of ground level concentrations will be as follows: sulfur dioxide – 0.29 MPC, nitrogen dioxide – 0.25 MPC, metal dust 0.18 MPC – 0.33 MPC, soot – 0.12 MPC For other pollutants the maximal concentrations will not exceed 0.1 MPC.
Based on the results of calculating the state of air in the area of Khauzak and Shady development, as well as on the border with Turkmenistan, is can be concluded that the changes in the air quality will be represented by moderate values of ground level concentrations of pollutants, which provides a basis for qualifying the environmental assessment of the atmosphere as quite safe.

Water resources and waste

The water consumption and disposal standards were calculated in accordance with the existing regulatory documents.
Water supply sources were defined. The annual demand for water will be about 66.648 thousand cubic meters. Domestic and potable needs take 30.25 %.
In order to meet the environmental requirements and requirements for rational water usage, it is proposed to use the domestic effluents after the biotreater for watering in summer and to flow them to the evaporation ponds in winter.

On the basis of the defined water consumption and disposal standards the enterprise’s request for special water usage was prepared.

The construction will entail generation of electrode stubs in the amount of 0.15 tons.

The impact of waste on underground waters is prevented by the water proofing of the slurry pond.

Construction operations and operation of special machinery and vehicles is accompanied by the generation of consumption waste: construction waste, iron scrap, waste engine oil, electrode remnants, various packing materials, sludge from vessel cleaning, spent lead batteries (in assembled condition), spent tires, rubber articles, etc.

About 12 items of production and consumption waste will be generated in the site (net of drilling waste): 411.482 tons.

Where possible, the source material and resulting waste were characterized.

The rate setting was performed for the main types of waste. Actions were described for improving the waste allocation.

**Soils, flora and fauna**

The operation of the facility connected with using heavy motor transport can make changes in the physical and mechanical properties of soils. In addition to the natural soil degradation, the soil structure will be violated with the increase of fine-grained faction volume, which lead to the development of deflation processes in the form of sand storms.

The state of flora and fauna in the studied area is characterized with violations in the biocenose structures (expressed in the change of quantitative balance of various types of animals), which leads to changes in the functions of various organisms.

In connection with the observed degradation of the vegetation cover it should be noted that the loss of biodiversity results in the violation of the ecosystems’ integrity, and any type of operations can accelerate these adverse processes.

However, taking into account the land remediation and vegetation restoration actions proposed by the project by way of planting various bushes and trees, the impact of the construction on natural complexes will be insignificant and of local nature.

**Social and economic systems and health of personnel**

No social or economic changes are envisaged in the region after the project implementation due to the rotational method of work and small quantity of maintenance personnel. Therefore, the project assumed the construction of a site camp for the accommodation of the maintenance personnel ensuring comfortable living conditions. The project planned the construction of administrative and domestic buildings, cultural and recreational structures. The camp will be equipped with heating, water supply and sewerage system. The project has the plan of constructing treatment facilities.

Improvement of territory will be performed in order to ensure normal sanitary conditions. Ornamental drought-resistant and soil-tolerant trees and bushes will be planed in the territory free from buildings and utilities. The design field road network ensures access to facilities and buildings.

The analysis of the environmental impact assessment in the area of construction shows that there is no adverse impact on the personnel’s health as a result of the enterprise’s operations.

Due to the remoteness of surface fresh water bodies, no changes in their composition are envisaged.
The main conclusion of the performed analysis: this facility does not have a significant impact on the environment if it is operated with all safety precautions and in compliance with design solutions. The opportunity of developing the Khauzak and Shady areas is of current interest.
CONCLUSION

The integrated impact assessment was based on the characteristics of the current state of the environment with further interpretation of design solutions. The analysis of the current state of the area showed changes in the natural complexes common to the oil and gas industry, which is the result of the activity of the enterprises, which is expressed in the insignificant physical disfigurement of a landscape, partial degradation of the vegetation and soil cover and in the increase of the background air pollution level in the industrial area. On the whole, the integrated assessment of the current habitat conditions demonstrates its moderate state from the point of view of the environmental factor.

The procedure of the impact assessment includes the analysis of the operational facilities operation with identifying the risk connected with their further operations. The set task of reducing the risk may be resolved through the implementation of the proposed activities of stabilizing the environmental impact through the usage of modern technological and design solutions of field infrastructure construction.

The document considered the impact of gas and liquid production on the state of the environment. It has also been established that due to the integrity of the designed equipment and inlet and outlet gas pipelines, the gas production process does not have any significant impact on the environment, except for emergencies, which practically do not occur. The gas treatment process entails the emission of pollutants to the atmosphere, both in the course of maintenance and repair works and in the process of the normal operational activities.

Attention should be paid to the fact that the selected technology is quite advanced from the point of view of ensuring the stable state of the natural complexes in the region of the planned construction. This is supported by the results of the calculation of surface concentrations from the emissions of flare systems, which do not demonstrate any excess of the established standards. The document also provides for the characteristics of the types of impact, which are characterized by emissions of chemicals; and the environmental standards are provided for MPE and MPD.

The study of sources and types of impact on the environment in the course of the project implementation showed that the main types of impact are emissions at 7528.646682 tpa of 11 polluting items, the concentrations of which do not have any excessive MPC, neither on the borders of sites nor beyond their borders.

A decrease in the probability of occurrence of emergencies will be achieved through the observance of technical and environmental protection actions. Based on this, it can be stated that the performance of the project with the mentioned protective actions will not result in any adverse environmental impact.
ATTACHMENT 1  DESCRIPTION OF WASTE
Обустройство участков Хаузк и Шады Денгикульского месторождения. Заявление об экологических последствиях
Agreed upon with
(on behalf of Nature Protection Committee)

________________________

________________________

position

Full Name

“ “____________, 2007

Seal

Approved by
(on behalf of the venture)

Deputy General Director for
Operations

________________________

E.A. Chiloyants

________________________

position

Full Name

“ “____________, 2007

Seal

DESCRIPTION OF WASTE No.1

Sludge resulting from gas pipeline cleaning

waste

Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Gas production

Process/products associated with this type of waste

Khauzak-Shady  2007
**General Information about Waste**

1. **Quantity** 20 t/year  
   Waste generation, t/year

2. **Total quantity** None  
   Accumulated, thous.t

3. **Source of waste** Pipeline cleaning  
   Brief description of the process that resulted in generation of waste or deterioration of qualities of original products

4. **Type** Compound  
   Organic, nonorganic, compound

5. **Aggregate state** Spreadable  
   Solid, liquid, other

6. **View** Sludge  
   Exterior view: cuttings, slag, breakages, dust, etc.

7. **Size of fractions** 0,1-0,3  
   From to (mm, cm)

8. **Waste code** 546 015 00 04 03 0  
   Local classification

9. **Waste code** H 12  
   Basel Convention classification
Information about Properties and Composition of Waste

1. **Density** 1.02 g/cm³, t/m³

2. **Skeleton bulk weight**

3. **Humidity** 30-40 %

4. **Composition**
   Compositional/chemical analysis of waste and content of
   - **Petroleum products** - 0.05 %
     ingredients in %%
   - **Mechanical impurities-rust** - 89.95 %
     ingredients in %%
   - **Water** - 10 %
     ingredients in %%

5. **Solubility** solid part is poorly soluble
   In grams per 100 grams of water

6. **Fugacity coefficient** n/a
   Saturated-vapor pressure, mm hg/760 mm hg

7. **Toxicity class** 3
   1,2,3,4 and 5 (non-toxic)

8. **Explosion hazard** inexplosive

9. **Flammability** non-flammable

10. **High reactivity** none

11. **Content of agents of infectious diseases** none

12. **Radiation hazard** none
Agreed upon with
(on behalf of Nature Protection Committee)

________________________
position

________________________
Full Name

“ “________, 2007
Seal

Approved by
(on behalf of the venture)

Deputy General Director for Operations
(position)

E.A. Chiloyants

________________________
Full Name

“ “________, 2007
Seal

DESCRIPTION OF WASTE No. 2

Solid domestic waste (SDW)

waste
Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Activities of the venture personnel

Process/products associated with this type of waste

Khauzak-Shady 2007
### General Information about Waste

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<table>
<thead>
<tr>
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<tr>
<td>1. Quantity</td>
<td>29.05 t/year</td>
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<tr>
<td></td>
<td>Waste generation, t/year</td>
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<tr>
<td>2. Total quantity</td>
<td>No waste accumulation</td>
</tr>
<tr>
<td></td>
<td>Accumulated, thous.t</td>
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<tr>
<td>3. Source of waste</td>
<td>Activities of the venture personnel</td>
</tr>
<tr>
<td></td>
<td>Brief description of the process that resulted in generation of waste or deterioration of qualities of original products</td>
</tr>
<tr>
<td>4. Type</td>
<td>Compound</td>
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<td>Organic, nonorganic, compound</td>
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<tr>
<td>5. Aggregate state</td>
<td>Solid</td>
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<tr>
<td></td>
<td>Solid, liquid, other</td>
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<tr>
<td>6. View</td>
<td>Garbage</td>
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<tr>
<td></td>
<td>Exterior view: cuttings, slag, breakages, dust, etc.</td>
</tr>
<tr>
<td>7. Size of fractions</td>
<td>From 1 to 20 cm</td>
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<td>From to (mm, cm)</td>
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<td>8. Waste code</td>
<td>910 000 00 00 00 0</td>
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<td>Local classification</td>
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<td>9. Waste code</td>
<td>B 3020</td>
</tr>
<tr>
<td></td>
<td>Basel Convention classification</td>
</tr>
</tbody>
</table>
**Form 3**

**Information about Properties and Composition of Waste**

1. **Density** 0.77 t/year, fraction of less than 15 mm
   
   g/cm³, t/m³

2. **Skeleton bulk weight** 0.04-0.22
   
   g/cm³, t/m³

3. **Humidity** Not defined
   
   %

4. **Composition** paper, glass, polyethylene, textile, etc.

   Compositional/chemical analysis of waste and content of ingredients in %

5. **Solubility** Insoluble

   In grams per 100 grams of water

6. **Fugacity coefficient**

   Saturated-vapor pressure, mm hg/760 mm hg

7. **Toxicity class** non-toxic

   1,2,3,4 and 5 (non-toxic)

8. **Explosion hazard** inexplosive

9. **Flammability** Flammable

10. **High reactivity** None

11. **Content of agents of infectious diseases** Not tested

12. **Radiation hazard** None
Agreed upon with  
(on behalf of Nature Protection Committee)

________________________  
position

Full Name  
“ “ __________, 2007
Seal

Approved by  
(on behalf of the venture)

Deputy General Director for  
Operations

E.A. Chiloyants  
position

Full Name  
“ “ __________, 2007
Seal

DESCRIPTION OF WASTE No. 3

Sweeping waste

waste

Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Area cleaning

Process/products associated with this type of waste

Khauzak-Shady 2007
## General Information about Waste

1. **Quantity** 348.6
   - Waste generation, t/year

2. **Total quantity** No waste accumulation
   - Accumulated, thou.s t

3. **Source of waste** Area cleaning
   - Brief description of the process that resulted in generation of waste or deterioration of qualities of original products

4. **Type** Compound
   - Organic, nonorganic, compound

5. **Aggregate state** Solid
   - Solid, liquid, other

6. **View** Garbage
   - Exterior view: cuttings, slag, breakages, dust, etc.

7. **Size of fractions** From several cm to several mm
   - From to (mm, cm)

8. **Waste code** 910 010 01 00 00 0
   - Local classification

9. **Waste code category Y 46 as per the Basel Convention**
   - Basel Convention classification
Form 3

Information about Properties and Composition of Waste

1. Density  
   0.77 t/year, fraction of less than 15 mm  
   g/cm³, t/m³

2. Skeleton bulk weight  
   0.04-0.22  
   g/cm³, t/m³

3. Humidity  
   Not defined  
   %

4. Composition  
   Sand – 10-20%, dry grass, leaves and branches – 80-90%  
   Compositional/chemical analysis of waste and content of ingredients in %

5. Solubility  
   Not tested  
   In grams per 100 grams of water

6. Fugacity coefficient  
   Saturated-vapor pressure, mm hg/760 mm hg

7. Toxicity class  
   4  
   1,2,3,4 and 5 (non-toxic)

8. Explosion hazard  
   Inexplosive

9. Flammability  
   Flammable

10. High reactivity  
    None

11. Content of agents of infectious diseases  
    Not tested

12. Radiation hazard  
    None
Agreed upon with
(on behalf of Nature Protection Committee)

________________________

position

Full Name

“ “_________, 2007

Seal

Approved by
(on behalf of the venture)

Deputy General Director for
Operations

position

E.A. Chiloyants

Full Name

“ “_________, 2007

Seal

DESCRIPTION OF WASTE No. 4

Food waste

waste

Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Cooking

Process/products associated with this type of waste

Khauzak-Shady 2007
General Information about Waste

1. Quantity _______________ 10,841 _______________
   Waste generation, t/year

2. Total quantity ___________ No waste accumulation _______________
   Accumulated, thous.t

3. Source of waste ___________ Cooking _______________
   Brief description of the process that resulted in
   generation of waste or deterioration of qualities of original products

4. Type _______________ Non-organic _______________
   Organic, nonorganic, compound

5. Aggregate state ___________ solid _______________
   Solid, liquid, other

6. View _______________ Vegetable peelings, parings, remnants of food _______________
   Exterior view: cuttings, slag, breakages, dust, etc.

7. Size of fractions ___________ from 20 cm to 125 cm _______________
   From to (mm, cm)

8. Waste code _______________ 353 301 00 13 01 1 _______________
   Local classification

9. Waste code ___________ category Y 9 as per the Basel Convention _______________
   Basel Convention classification
### Information about Properties and Composition of Waste

1. **Density** 0.04-0.22 g/cm³, t/m³

2. **Skeleton bulk weight** Not defined g/cm³, t/m³

3. **Humidity** Not tested %

4. **Composition**
   - Compositional/chemical analysis of waste and content of ingredients in %
     - ingredients in %
     - ingredients in %
     - ingredients in %

5. **Solubility** Insoluble
   - In grams per 100 grams of water

6. **Fugacity coefficient**
   - Saturated-vapor pressure, mm hg/760 mm hg

7. **Toxicity class** 4
   - 1,2,3,4 and 5 (non-toxic)

8. **Explosion hazard** Inexplosive

9. **Flammability** Non-flammable

10. **High reactivity** None

11. **Content of agents of infectious diseases** Not tested

12. **Radiation hazard** None
Agreed upon with
(on behalf of Nature Protection Committee)

________________________
________________________
position

Full Name

“ “__________, 2007
Seal

Approved by
(on behalf of the venture)

Deputy General Director for Operations
(position)

E.A. Chiloyants

Full Name

“ “__________, 2007
Seal

DESCRIPTION OF WASTE No. 5

Used mercury lamps

Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Gas production

Process/products associated with this type of waste

Khauzak-Shady 2007
**General Information about Waste**

1. **Quantity** 0.024  
   Waste generation, t/year

2. **Total quantity** No waste accumulation  
   Accumulated, thous.t

3. **Source of waste** Operation of lighting equipment  
   Brief description of the process that resulted in generation of waste or deterioration of qualities of original products

4. **Type** Non-organic  
   Organic, nonorganic, compound

5. **Aggregate state** solid  
   Solid, liquid, other

6. **View** Pieces, lamps  
   Exterior view: cuttings, slag, breakages, dust, etc.

7. **Size of fractions** from 20 cm to 125 cm  
   From to (mm, cm)

8. **Waste code** 353 301 00 13 01 1  
   Local classification

9. **Waste code** H. 6.1  
   Basel Convention classification
### Information about Properties and Composition of Waste

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Density</strong></td>
<td></td>
<td>g/cm³, t/m³</td>
<td></td>
</tr>
<tr>
<td><strong>2. Skeleton bulk weight</strong></td>
<td></td>
<td>g/cm³, t/m³</td>
<td></td>
</tr>
<tr>
<td><strong>3. Humidity</strong></td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td><strong>4. Composition</strong></td>
<td></td>
<td></td>
<td>Compositional/chemical analysis of waste and content of</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>92.3% - glass; 0.15% - Hg; 1.19% - Al</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.15% - Ni; 0.03% - W; 2.11% - luminophore, etc.</td>
</tr>
<tr>
<td><strong>5. Solubility</strong></td>
<td></td>
<td></td>
<td>Almost insoluble</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In grams per 100 grams of water</td>
</tr>
<tr>
<td><strong>6. Fugacity coefficient</strong></td>
<td></td>
<td></td>
<td>Saturated-vapor pressure, mm hg/760 mm hg</td>
</tr>
<tr>
<td><strong>7. Toxicity class</strong></td>
<td>1</td>
<td></td>
<td>1, 2, 3, 4 and 5 (non-toxic)</td>
</tr>
<tr>
<td><strong>8. Explosion hazard</strong></td>
<td></td>
<td></td>
<td>Inexplosive</td>
</tr>
<tr>
<td><strong>9. Flammability</strong></td>
<td></td>
<td></td>
<td>Non-flammable</td>
</tr>
<tr>
<td><strong>10. High reactivity</strong></td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td><strong>11. Content of agents of infectious diseases</strong></td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td><strong>12. Radiation hazard</strong></td>
<td></td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>
Agreed upon with
(on behalf of Nature Protection Committee)

________________________________________
position

Full Name
“ “_________, 2007
Seal

Approved by
(on behalf of the venture)

Deputy General Director for Operations

________________________________________
position

Full Name
“ “_________, 2007
Seal

DESCRIPTION OF WASTE No. 6

Used incandescent lamps
waste
Khauzak-Shady field, Bukhara region
Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company
Branch of industry, company, etc.

Gas production
Process/products associated with this type of waste

Khauzak-Shady  2007
### General Information about Waste

1. **Quantity**  
   0,0096  
   Waste generation, t/year

2. **Total quantity**  
   No waste accumulation  
   Accumulated, thous.t

3. **Source of waste**  
   Operation of lighting equipment  
   Brief description of the process that resulted in generation of waste or deterioration of qualities of original products

4. **Type**  
   Non-organic  
   Organic, nonorganic, compound

5. **Aggregate state**  
   solid  
   Solid, liquid, other

6. **View**  
   Pieces, lamps  
   Exterior view: cuttings, slag, breakages, dust, etc.

7. **Size of fractions**  
   from 20 cm to 125 cm  
   From to (mm, cm)

8. **Waste code**  
   910 000 00 00 00 0  
   Local classification

9. **Waste code**  
   Basel Convention classification
Information about Properties and Composition of Waste

1. **Density**
   \[ \text{g/cm}^3, \text{t/m}^3 \]

2. **Skeleton bulk weight**
   \[ \text{g/cm}^3, \text{t/m}^3 \]

3. **Humidity**
   \[ \% \]

4. **Composition**
   Compositional/chemical analysis of waste and content of
   - Silicon oxide – 90%
     - ingredients in \%
   - Al – 10%
     - ingredients in \%

5. **Solubility**
   - Insoluble
   - In grams per 100 grams of water

6. **Fugacity coefficient**
   Saturated-vapor pressure, mm hg/760 mm hg

7. **Toxicity class**
   - 1,2,3,4 and 5 (non-toxic)
   - 4

8. **Explosion hazard**
   - Inexplosive

9. **Flammability**
   - Non-flammable

10. **High reactivity**
    - None

11. **Content of agents of infectious diseases**
    - None

12. **Radiation hazard**
    - None
Agreed upon with
(on behalf of Nature Protection Committee)

________________________
position

Full Name

“ “__________, 2007
Seal

Approved by
(on behalf of the venture)

Deputy General Director for Operations
position

E.A. Chiloyants

Full Name

“ “__________, 2007
Seal

DESCRIPTION OF WASTE No. 7

Iron scrap

waste

Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Gas production

Process/products associated with this type of waste

Khauzak-Shady 2007
# General Information about Waste

1. **Quantity** _______________ **2**
   
   Waste generation, t/year

2. **Total quantity** _______________ **No waste accumulation**
   
   Accumulated, thous.t

3. **Source of waste** _______________ **Repair of process equipment**
   
   Brief description of the process that resulted in generation of waste or deterioration of qualities of original products

4. **Type** _______________ **Non-organic**
   
   Organic, nonorganic, compound

5. **Aggregate state** _______________ **solid**
   
   Solid, liquid, other

6. **View** _______________ **Scrap**
   
   Exterior view: cuttings, slag, breakages, dust, etc.

7. **Size of fractions** _______________ **from 20 cm to 125 cm**
   
   From ___ to ___ (mm, cm)

8. **Waste code** _______________ **551 301 00 01 99 5**
   
   Local classification

9. **Waste code** _______________ **B 1010**
   
   Basel Convention classification
**Form 3**

### Information about Properties and Composition of Waste

1. **Density**
   
   \[ \text{g/cm}^3, \text{t/m}^3 \]

2. **Skeleton bulk weight**
   
   \[ \text{g/cm}^3, \text{t/m}^3 \]

3. **Humidity**
   
   \[ \% \]

4. **Composition**
   
<table>
<thead>
<tr>
<th>Iron</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

   Compositional/chemical analysis of waste and content of

   ingredients in %

   ingredients in %

   ingredients in %

5. **Solubility**
   
   **Insoluble**

   In grams per 100 grams of water

6. **Fugacity coefficient**
   
   Saturated-vapor pressure, mm hg/760 mm hg

7. **Toxicity class**
   
   4

   1,2,3,4 and 5 (non-toxic)

8. **Explosion hazard**
   
   Inexplosive

9. **Flammability**
   
   Non-flammable

10. **High reactivity**
    
    None

11. **Content of agents of infectious diseases**
    
    None

12. **Radiation hazard**
    
    None
Agreed upon with
(on behalf of Nature Protection Committee)

________________________________________
position

________________________
Full Name

“ “__________, 2007
Seal

Approved by
(on behalf of the venture)

Deputy General Director for
Operations

________________________________________
position

E.A. Chiloyants

________________________
Full Name

“ “__________, 2007
Seal

DESCRIPTION OF WASTE No. 8

Stub wastage and remnants

waste

Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Gas production

Process/products associated with this type of waste

Khauzak-Shady  2007
### General Information about Waste

1. **Quantity** 0.15  
   Waste generation, t/year

2. **Total quantity** No waste accumulation  
   Accumulated, thous.t

3. **Source of waste** Welding operations  
   Brief description of the process that resulted in generation of waste or deterioration of qualities of original products

4. **Type** Non-organic  
   Organic, nonorganic, compound

5. **Aggregate state** solid  
   Solid, liquid, other

6. **View** Slag  
   Exterior view: cuttings, slag, breakages, dust, etc.

7. **Size of fractions**  
   From to (mm, cm)

8. **Waste code** 314 048 00 01 99 4  
   Local classification

9. **Waste code** B 1010  
   Basel Convention classification
Information about Properties and Composition of Waste

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Density</td>
<td>g/cm³, t/m³</td>
</tr>
<tr>
<td>2. Skeleton bulk weight</td>
<td>g/cm³, t/m³</td>
</tr>
<tr>
<td>3. Humidity</td>
<td>%</td>
</tr>
<tr>
<td>4. Composition</td>
<td>Compositional/chemical analysis of waste and content of ingredients in %</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Solubility</td>
<td>Insoluble</td>
</tr>
<tr>
<td></td>
<td>In grams per 100 grams of water</td>
</tr>
<tr>
<td>6. Fugacity coefficient</td>
<td>Saturated-vapor pressure, mm hg/760 mm hg</td>
</tr>
<tr>
<td>7. Toxicity class</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1,2,3,4 and 5 (non-toxic)</td>
</tr>
<tr>
<td>8. Explosion hazard</td>
<td>inexplosive</td>
</tr>
<tr>
<td>9. Flammability</td>
<td>non-flammable</td>
</tr>
<tr>
<td>10. High reactivity</td>
<td>none</td>
</tr>
<tr>
<td>11. Content of agents of infectious diseases</td>
<td>none</td>
</tr>
<tr>
<td>12. Radiation hazard</td>
<td>none</td>
</tr>
</tbody>
</table>
Agreed upon with
(on behalf of Nature Protection Committee)

________________________

________________________

position

Full Name

“ “____________, 2007

Seal

Approved by
(on behalf of the venture)

Deputy General Director for Operations

________________________

position

E.A. Chiloyants

________________________

Full Name

“ “____________, 2007

Seal

DESCRIPTION OF WASTE No. 9

Scavenge engine oil

waste

Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Use of vehicles

Process/products associated with this type of waste

Khauzak-Shady  2007
General Information about Waste

1. Quantity __________________________ 0.411
   Waste generation, t/year

2. Total quantity ______________________ No waste accumulation
   Accumulated, thous.t

3. Source of waste _____________________ Change of engine oil in vehicles
   Brief description of the process that resulted in
   that have lost its original qualities
   generation of waste or deterioration of qualities of original products

4. Type _______________________________ Organic matter
   Organic, nonorganic, compound

5. Aggregate state _____________________ Liquid
   Solid, liquid, other

6. View _______________________________ Oily liquid
   Exterior view: cuttings, slag, breakages, dust, etc.

7. Size of fractions _____________________ Homogeneous substance
   From to (mm, cm)

8. Waste code __________________________ 541 002 02 02 03 3
   Local classification

9. Waste code __________________________ category Y 9 as per the Basel Convention
   Basel Convention classification
Information about Properties and Composition of Waste

1. Density 0,89-0,9 g/cm³, t/m³

2. Skeleton bulk weight Not defined g/cm³, t/m³

3. Humidity Not defined %

4. Composition
   Compositional/chemical analysis of waste and content of
   Petroleum oil (from petroleum) – 100%
   ingredients in %
   ingredients in %
   ingredients in %
   ingredients in %
   ingredients in %
   ingredients in %
   ingredients in %

5. Solubility Poorly soluble
   In grams per 100 grams of water

6. Fugacity coefficient
   Saturated-vapor pressure, mm hg/760 mm hg

7. Toxicity class 3
   1,2,3,4 and 5 (non-toxic)

8. Explosion hazard Inexplosive

9. Flammability Flammable

10. High reactivity None

11. Content of agents of infectious diseases None

12. Radiation hazard None
Agreed upon with
(on behalf of Nature Protection Committee)

__________________________  position

Full Name

“ “______________, 2007

Seal

Approved by
(on behalf of the venture)

Deputy General Director for
Operations

__________________________  position

Full Name

“ “______________, 2007

Seal

DESCRIPTION OF WASTE No. 10

Used car tires
waste
Khauzak-Shady field, Bukhara region
Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company
Branch of industry, company, etc.

Use of vehicles
Process/products associated with this type of waste

Khauzak-Shady 2007
General Information about Waste

1. Quantity ______________________ 0.2644
   Waste generation, t/year

2. Total quantity ______________________ No waste accumulation
   Accumulated, thous.t

3. Source of waste ______________________ Use of car tires
   Brief description of the process that resulted in
   generation of waste or deterioration of qualities of original products

4. Type ______________________ Non-organic
   Organic, nonorganic, compound

5. Aggregate state ______________________ Solid
   Solid, liquid, other

6. View ______________________ Used tires
   Exterior view: cuttings, slag, breakages, dust, etc.

7. Size of fractions ______________________ Homogeneous substance
   From to (mm, cm)

8. Waste code ______________________ 572 002 00 13 00 4
   Local classification

9. Waste code ______________________ B 3140
   Basel Convention classification
### Information about Properties and Composition of Waste

1. **Density** 0.9 g/cm³, t/m³

2. **Skeleton bulk weight**

3. **Humidity** Not defined %

4. **Composition** **Resin, rubber, metal**
   Compositional/chemical analysis of waste and content of:
   - ingredients in %
   - ingredients in %
   - ingredients in %
   - ingredients in %
   - ingredients in %
   - ingredients in %
   - ingredients in %
   - ingredients in %
   - ingredients in %

5. **Solubility** **Insoluble**
   In grams per 100 grams of water

6. **Fugacity coefficient**
   Saturated-vapor pressure, mm hg/760 mm hg

7. **Toxicity class** 4
   1,2,3,4 and 5 (non-toxic)

8. **Explosion hazard** **inexplosive**

9. **Flammability** **flammable**

10. **High reactivity** **None**

11. **Content of agents of infectious diseases** **None**

12. **Radiation hazard** **None**
Agreed upon with
(on behalf of Nature Protection Committee)

________________________
position

Full Name
“ “__________, 2007
Seal

Approved by
(on behalf of the venture)

Deputy General Director for Operations
(position)

E.A. Chiloyants

Full Name
“ “___________, 2007
Seal

DESCRIPTION OF WASTE No. 11

Used vehicle batteries (in assembled condition)
waste
Khauzak-Shady field, Bukhara region
Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company
Branch of industry, company, etc.

Use of vehicles
Process/products associated with this type of waste

Khauzak-Shady 2007
General Information about Waste

1. Quantity ____________________________ 0.067
   Waste generation, t/year

2. Total quantity ____________________________ No waste accumulation
   Accumulated, thous.t

3. Source of waste ____________________________ Replacement of batteries,
   Brief description of the process that resulted in
   that have lost their original qualities
   generation of waste or deterioration of qualities of original products

4. Type ____________________________ Compound
   Organic, nonorganic, compound

5. Aggregate state ____________________________ Solid
   Solid, liquid, other

6. View ____________________________ Items
   Exterior view: cuttings, slag, breakages, dust, etc.

7. Size of fractions ____________________________ Homogeneous substance
   From ___ to ___ (mm, cm)

8. Waste code ____________________________ 921 101 00 13 01 0
   Local classification

9. Waste code ____________________________ category Y 31 as per the Basel Convention
   Basel Convention classification
Information about Properties and Composition of Waste

1. Density ____________________________
   g/cm³, t/m³

2. Skeleton bulk weight ____________________________
   g/cm³, t/m³

3. Humidity ____________________________
   % Not defined

4. Composition ____________ Lead, plastic
   Compositional/chemical analysis of waste and content of ingredients in %

5. Solubility ____________ Insoluble
   In grams per 100 grams of water

6. Fugacity coefficient ____________________________
   Saturated-vapor pressure, mm hg/760 mm hg

7. Toxicity class ____________ 3
   1,2,3,4 and 5 (non-toxic)

8. Explosion hazard ____________ inexplosive

9. Flammability ____________ Non-flammable

10. High reactivity ____________ None

11. Content of agents of infectious diseases ____________ None

12. Radiation hazard ____________ None
Agreed upon with
(on behalf of Nature Protection Committee)

________________________
position
________________________________________________________________________
“       “____________, 2007
Seal

Approved by
(on behalf of the venture)

Deputy General Director for Operations
position
E.A. Chiloyants

________________________
position
________________________________________________________________________
“       “____________, 2007
Seal

DESCRIPTION OF WASTE No. 12

Wiping rags (non-oily)

Khauzak-Shady field, Bukhara region

Name of the venture, address, phone number, etc.

OOO LUKOIL Uzbekistan Operating Company

Branch of industry, company, etc.

Use of vehicles

Process/products associated with this type of waste

Khauzak-Shady 2007
# General Information about Waste

1. **Quantity**  
   0.0738  
   Waste generation, t/year

2. **Total quantity**  
   No waste accumulation  
   Accumulated, thous.t

3. **Source of waste**  
   wiping of vehicles  
   Brief description of the process that resulted in generation of waste or deterioration of qualities of original products

4. **Type**  
   Organic matter  
   Organic, nonorganic, compound

5. **Aggregate state**  
   Solid  
   Solid, liquid, other

6. **View**  
   Rags  
   Exterior view: cuttings, slag, breakages, dust, etc.

7. **Size of fractions**  
   Homogeneous substance  
   From to (mm, cm)

8. **Waste code**  
   549 027 00 01 030  
   Local classification

9. **Waste code**  
   Basel Convention classification
Information about Properties and Composition of Waste

1. Density  
   g/cm³, t/m³

2. Skeleton bulk weight  
   g/cm³, t/m³

3. Humidity  
   %

4. Composition  
   Compositional/chemical analysis of waste and content of

   **Fabric -100%**
   
   ingredients in %%
   
   ingredients in %%
   
   ingredients in %%
   
   ingredients in %%
   
   ingredients in %%
   
   ingredients in %%
   
   ingredients in %%

5. Solubility  
   Insoluble
   In grams per 100 grams of water

6. Fugacity coefficient  
   Saturated-vapor pressure, mm hg/760 mm hg

7. Toxicity class  
   4
   1,2,3,4 and 5 (non-toxic)

8. Explosion hazard  
   Inexplosive

9. Flammability  
   Flammable

10. High reactivity  
    None

11. Content of agents of infectious diseases  
    None

12. Radiation hazard  
    None
Обустройство участков Хауак и Шады Денгикульского месторождения. Заявление об экологических последствиях