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EFFICIENT PLANNING OF GASIFICATION OF SOUTHERN REGIONS

(using the example of the northern and northwestern districts of the city of Shymkent)

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The article presents an analysis of the gasification process in remote areas of Kazakhstan, with special attention to the northern and northwestern regions of Shymkent, which are actively being built up. The study is based on data from the national gasification program and includes an overview of existing infrastructure, plans to improve it, and proposals to improve access to gas in less affluent areas.

The key results of the study show that consistent infrastructure improvements significantly expand access to natural gas. This, in turn, stimulates economic growth and improves the quality of life of the population. Gasification initiatives create new jobs and stimulate economic activity.

Recommendations for more efficient use of gas resources, including the latest technologies to minimize environmental impacts and the transition to cleaner energy sources, are also presented. Ways to reduce greenhouse gas emissions and integrate sustainable technologies into the industry are proposed.

The study highlights the importance of a comprehensive approach to gasification, which covers the technical side, economic planning and active participation of local communities. As practical steps, it is proposed to develop preferential tariffs for new gas users and strengthen environmental protection measures.

The conclusion focuses on the possibilities of gasification as a way to solve problems of energy security, economic efficiency and environmental sustainability, suggesting specific measures to accelerate this process and promote sustainable development of the energy sector in the region

KEY WORDS: *pipeline gas transportation, gasification, trunk gas pipeline, green energy.*

ЭФФЕКТИВНОЕ ПЛАНИРОВАНИЕ ГАЗИФИКАЦИИ ЮЖНЫХ РЕГИОНОВ

(на примере северного и северо-западного районов города Шымкент)

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В статье представлен анализ процесса газификации отдаленных районов Казахстана, с особым вниманием к северным и северо-западным районам Шымкента, которые активно застраиваются. Исследование основано на данных из национальной программы по газификации и включает обзор существующей инфраструктуры, планов по ее улучшению и предложений для улучшения доступа к газу в менее обеспеченных районах.

Ключевые результаты исследования показывают, что последовательные улучшения инфраструктуры значительно расширяют доступ к природному газу. Это, в свою очередь, стимулирует экономический рост и повышает качество жизни населения. Инициативы по газификации создают новые рабочие места и стимулируют экономическую активность.

Также представлены рекомендации по более эффективному использованию газовых ресурсов, включая новейшие технологии для минимизации экологического воздействия и переход к более чистым источникам энергии. Предложены пути снижения выбросов парниковых газов и интеграции устойчивых технологий в индустрию.

Исследование подчеркивает важность всестороннего подхода к газификации, который охватывает техническую сторону, экономическое планирование и активное участие местных сообществ. В качестве практических шагов предлагается разработать льготные тарифы для новых пользователей газа и усилить меры по охране окружающей среды.

Заключение акцентирует внимание на возможностях газификации как способе решения проблем энергетической безопасности, экономической эффективности и экологической устойчивости, предлагая конкретные меры для ускорения этого процесса и продвижения устойчивого развития энергетической отрасли региона.

КЛЮЧЕВЫЕ СЛОВА: *трубопроводный транспорт газа, газификация, магистральный газопровод, «зеленая» энергетика.*

ОҢТҮСТІК ӨҢІРЛЕРДІ ГАЗДАНДЫРУДЫ ТИІМДІ ЖОСПАРЛАУ

(Шымкент қаласының солтүстік және солтүстік-батыс аудандарының мысалында)

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Мақалада Қазақстанның шалғай аудандарын газдандыру процесіне талдау жасалып, Шымкент қаласының солтүстік және солтүстік-батыс аудандарына ерекше назар аударылады. Зерттеу ұлттық газдандыру бағдарламасының деректеріне негізделген және қолданыстағы инфрақұрылымға, оны жақсарту жоспарларына және аз қамтылған аудандарда газға қол жетімділікті жақсарту бойынша ұсыныстарға шолу жасайды.

Зерттеудің негізгі нәтижелері инфрақұрылымды дәйекті жақсарту табиғи газға қол жеткізуді айтарлықтай кеңейтетінін көрсетеді. Бұл өз кезегінде экономикалық өсуді ынталандырады және халықтың өмір сүру сапасын арттырады. Газдандыру бастамалары жаңа жұмыс орындарын ашады және экономикалық белсенділікті ынталандырады.

Сондай-ақ экологиялық әсерді азайту және таза энергия көздеріне көшу үшін соңғы технологияларды қоса алғанда, газ ресурстарын тиімдірек пайдалану бойынша ұсыныстар берілген. Парниктік газдар шығарындыларын азайту және салаға тұрақты технологияларды біріктіру жолдары ұсынылды.

Зерттеу техникалық жағын, экономикалық жоспарлауды және жергілікті қауымдастықтардың белсенді қатысуын қамтитын жан-жақты газдандыру тәсілінің маңыздылығын көрсетеді. Практикалық қадам ретінде газды жаңа пайдаланушылар үшін жеңілдікті тарифтерді әзірлеу және қоршаған ортаны қорғау шараларын күшейту ұсынылады.

Қорытынды энергетикалық қауіпсіздік, экономикалық тиімділік және экологиялық тұрақтылық мәселелерін шешу тәсілі ретінде газдандыру мүмкіндіктеріне назар аударады, бұл процесті жеделдету және аймақтың энергетика саласының тұрақты дамуын ілгерілету үшін нақты шараларды ұсынады.

ТҮЙІН СӨЗДЕР: *газ құбыры тасымалдау, газдандыру, магистральдық газ құбыры, «жасыл» энергетика.*

Introduction. Compared to other modes of transport, pipeline transport has an advantage for the transportation, distribution of gas, oil and oil products. The main advantage lies in the convenience of laying the pipeline itself, in those areas where there is no access to water, road transport, for example, marshy places, high-altitude areas, underwater, underground passages. Also, the advantage of pipeline transport is the low cost of transported products, while for water and rail transport for the transportation of gas, oil and oil products, the cost of transportation is quite high. Due to the fact that pipeline transport, especially gas pipelines, has high requirements for tightness, the quality of the transported products is ensured. There is no danger of evaporation of light hydrocarbon components. Such high tightness requirements are typical for trunk gas pipelines and oil pipelines. Transportation of gas, oil and oil products by gas and oil pipelines requires minimal capital investments during construction. When transporting hydrocarbons by gas and oil pipelines, it is possible to maximize the automation of processes, control leaks, pressure, etc., which can completely eliminate the negative impact on the environment. Pipeline transportation of gas, oil and petroleum products is also not without drawbacks, the main drawback of this type of transport is the narrow orientation of the operation of gas and oil pipelines.

All possible problems and prospects for pipeline transport are what currently excites oil and gas professionals. To solve possible problems, at present, several projects for the construction of pipeline transport systems have been developed and are currently being implemented in our country, which would expand the list of tasks to be solved in the oil and gas industry. **The issue of development of the gas industry and gasification of regions** – one of the important areas on the agenda of our country. Today, the level of gasification of the country is about **47,4%**. more **1300** settlements have access to gas. About **13 billion** tenge is allocated annually from the republican budget for gasification of the country.

Materials and methods. According to the gasification plan, the issues of designing a gas pipeline branch to provide gas to the regions of the city of Shymkent were considered. The situational diagram (*Figure 1*) shows the general situational diagram of the entire

facility being designed, including the gas pipeline branch "KU-45 MGP" BBSH "-Automated Gas Distribution Station (AGDS)-3," AGDS -3 "Shymkent," two distribution gas pipelines R-1.2 MPa AGDS -3 "Shymkent" - Gas control points block "GCP block" - 51 "and" AGDS -3 "Shymkent" - GCP block "Yntymak," as well as GCP block "Yntymak".

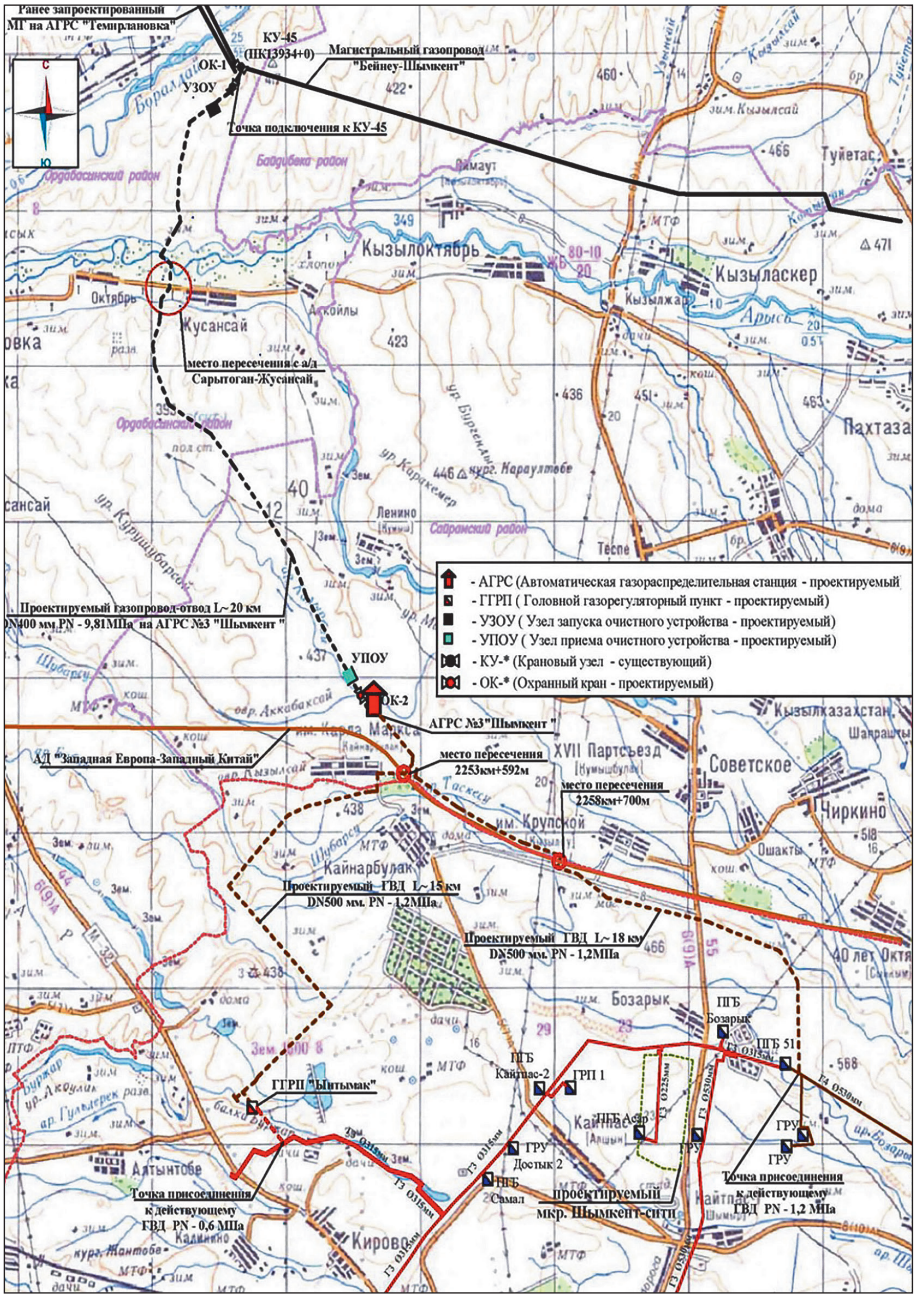

Figure 1 - **Situational diagram of connection of the designed gas pipeline branch at the AGDS -3 to the "Beineu-Bozoi-Shymkent" MGP KU-45**

The situational diagram (*Figure 2*) shows the connection diagram of the designed gas pipeline branch at the AGDS -3 to the KU-45 of the "Beineu-Bozoy-Shymkent" MGP.

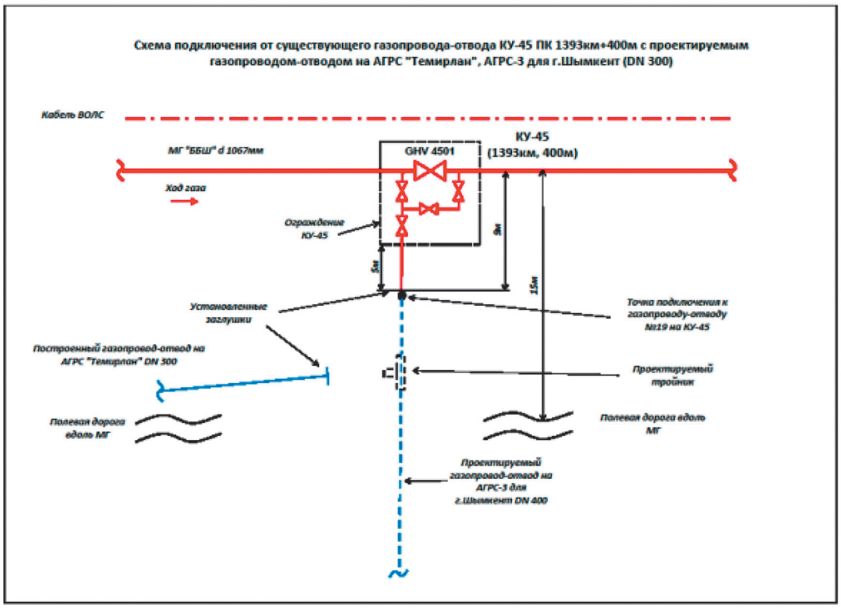

Figure 2 - **Situational diagram of connection of the designed gas pipeline branch at the AGDS -3 to the "Beineu-Bozoi-Shymkent" MGP KU-45**

Basic provisions. The main provisions of this work are the analysis of the existing gas transportation system in the Republic of Kazakhstan, having problems in this area and ways to solve these problems. Consideration of ways to solve problems is characterized by the example of a company dealing with gas transportation and distribution. The relevance of this study lies in solving significant problems of gas transportation, as well as gasification of the southern regions of the country. According to the 'Rules for determining the general procedure for classifying buildings and structures as technically and/or technologically complex objects', approved by the order of the Minister of National Economy of the Republic of Kazakhstan dated February 28, 2015, No. 165 (as amended), the designed pipeline branch 'KU-45 MG "BBSH" to AGDS-3 "Shymkent" PN 9.8 MPa DN 426x10÷12 mm made of steel pipes according to GOST 20295-85 (K60) is classified as a technically complex object of Level I (increased) responsibility.

The gas pipeline runs through the lands of the Ordabasy and Sairam districts of the Turkestan region.

Connection of the gas pipeline branch to the AGDS-3 for Shymkent is planned to the crane assembly of the Beineu-Shymkent KU-45 located on the territory of the Shubar rural district of the Ordabasyn district of the Turkestan region.

The route of the gas pipeline branch from the connection point passes through the territory of this area mainly in a southerly direction, bypassing archaeological sites and burials along its entire length, and a separate agricultural facility (winter hut). At the same time, on the PK1 and PK6 of the gas pipeline branch there are sites of the OK-1 security crane and the Unit for launching the UZOU cleaning device. The route of a gas pipeline branch crosses on the site of PK-54+66 ÷ of PK-56+54 the river Arys and on PK-65 the

highway of regional "Badam-Shubar-Akkoyly-Kyzylasker-Karabulak-Tyulkubas" KH-63 value (33 km +500) on the site between settlements of Rusangsai and Sarytogan by method of the horizontally directed drilling (HDD), then the land plots of agricultural purpose.

Further, the gas pipeline section follows the eastern border of the agricultural land mass. Upon completion of this section of the gas pipeline branch at PK97 + 41, the gas pipeline route turns to the southeast and passes to the territory of the Sairam district of the Turkestan region, following the Arys River tributary on the west side, approaching the inflow channel up to 1.5 km in the area of Kumysh settlement.

In this section, the route of the gas pipeline branch runs in a southeast direction towards the village of Kainarbulak (Karl Marx) with the completion of the route at the site of the designed AGDS-3. The total length of the gas pipeline branch from the Beineu-Bozoi-Shymkent KU-45 to the AGDS-3 site is 19,750 km. The branch gas pipeline also includes a branch to the Temirlan AGDS with a length of 5 m, mounted at the point of connection of the planned branch gas pipeline to the BBSH MGP KU-45. Along the entire length, the gas pipeline route bypasses many archaeological graves and monuments.

Challenges and prospects. Brief description of the area and construction site. Geomorphologically, the site and the linear structure are located on the floodplain terraces of the Arys River. The topography of the ground has a general slope from south to north. Ground elevation varies from 327.00 m to 430.00 m.

The geological and lithological structure of the site and linear structures includes alluvial-proluvial, Middle-Upper Quaternary deposits, represented by sandy loam and gravel, everywhere covered by a topsoil layer, 0.2 m thick.

Groundwater is penetrated on the river banks at a depth of 1.2-1.3 m from the ground surface. The seasonal amplitude of groundwater fluctuations ± 2.0 m.

The estimated maximum level of groundwater, taking into account the amplitude of fluctuations in the level of groundwater, the influence of irrigation networks during irrigation (May-July), floods, the period: the first - the end of February, the beginning of March, and the second end of March, the beginning of April, as well as atmospheric precipitation, was taken at an elevation of 328.70м.

Type of construction site soil conditions by seismic properties II (second). Seismic hazard index of the construction site is 7 (seven) points.

Construction category of soils by difficulty of development according to SN RK 8.02-05-2002 for sandy loam 1/1 (manual/excavator).

According to the "Rules for determining the general procedure for classifying buildings and structures as technically and (or) technologically complex objects," the Western and Eastern branches belong to technically complex objects, II (normal) level of responsibility. Both of the above gas pipelines, after leaving the designed AGDS-3, run through the territory of the Sairam district of the Turkestan region, and then enter the territory of Shymkent and connect to the existing gas distribution network of the city.

The routes of the Western and Eastern branches are provided in the corridors defined by the General Plan of the city of Shymkent, and agreed by the State Institution "Department of Architecture and Urban Planning of the city of Shymkent".

The western branch starts from exit No. 1 of the Shymkent AGDS-3 and consists of an underground HP GP 1.2MPa 16.862km long made of steel pipe D530x7mm. (with

long-term extension D325x7 mm 10m long) according to GOST 10704-91 in factory very reinforced insulation, hydraulic fracturing "Yntymak" with a capacity of 50 thousand m3/h (on the branch of HP GP 1.2MPa with a length of 0.071 km from steel pipe D325x7 mm in factory very reinforced insulation) and underground HP GP 0.6MPa from PE pipe D315x28.6mm PE100 SDR11 0.367km long for tie-in to the 0.6MPa HP distribution gas pipeline passing in the area of Yntymak microdistrict, in accordance with the specification of the SCPP of KTG Aimak JSC No. 604/2 dated 09.02.2018.

The capacity of the Western branch is 130 thousand m3/h, including 50 thousand m3/h through the Yntymak hydraulic fracturing and 80 thousand m3/h for connecting promising residential areas along the Western branch (Dostyk, Kainarbulak microdistrict) through the Dy300 branch provided for at a PK129 of + 89 m according to the letter of GU EI Management Housing and Utilities of South Kazakhstan Region "No. 23-07-08/2806 dated 12.06.2018, and other promising facilities after the creation of a new bypass gas pipeline from the AGDS-1 (after the removal of the AGDS outside the city). Linear crane units are provided on the West branch: 5 pcs. DN500 (on PK0 + 25, PK23 + 00, PK72 + 00, PK121 + 99 and PK168 + 54 of the gas pipeline linear disconnecting devices KU-1 ÷ KU-5 are installed) and 2 pcs. DN300 (on branches to PK129 + 89, PK168 + 40.5) - ball valves, PN 1.6 MPa, with an extended rod under the carpet.

The 'Yntymak' Gas Regulating Station (GRS) is connected at the input to the Western branch via a branch of steel gas pipeline with a working pressure of 1.2 MPa and dimensions of D325x7 mm with a length of 0.071 km, and at the output via a PE gas pipeline with a working pressure of 0.6 MPa and dimensions of D315 mm with a length of 0.367 km to the existing high-pressure gas distribution pipeline of 0.6 MPa and dimensions of D315x28.6 mm in the Yntymak district area. The volume of gas passing through the 'Yntymak' GRS, amounting to 50,000 m³/h, is intended to create additional gas backpressure and eliminate the gas deficit in the existing pipeline that supplies the industrial zone in the Badam area, where industrial facilities of companies such as LLP 'Adelya', LLP 'Batsu', JSC 'Agro-5', LLP 'Karlskrona', and others are located.

The eastern branch starts from exit No. 2 of the Shymkent AGDS-3 and consists of an underground HP GP 1.2MPa D530x7mm with a length of 21.999km (with a long-term branch D325x7 mm, 10 m long) from a steel pipe according to GOST 10704 in factory very reinforced insulation is connected to the existing bypass distribution gas pipeline HP 1.2 MPa D530 mm at the entrance to the current PGB-51, in accordance with the technical specifications of the SCPP JSC KTG Aimak No. 604/1 dated 09.02.2018.

The throughput capacity of the Eastern branch is 120 thousand m3/h and provides for the possibility of gas supply to the areas of prospective development of the Northern planning area of Shymkent (according to the General Plan for the Development of the City), incl. Microdistrict Bozaryk-2, Bozaryk-3 through the Dy300 branch provided for at PK124 + 25 m in accordance with the letter of the State Institution "Department of EiZhKKH South Kazakhstan Region" No. 23-07-08/2806 dated 12.06.2018, microdistrict Shymkent City, Asar-2, etc , as well as elimination of the gas shortage in the northwestern segment of the city's gas distribution network (microdistrict Asar, Kaitpas-2, etc.) arising during the heating period. Linear valve stations are provided on the gas pipeline: 6 pcs. DN500 (at PK0 + 25, PK31 + 00, PK73 + 00, PK124 + 26, PK174 + 34, PK219 + 81)

of the gas pipeline linear disconnecting devices KU-1 ÷ KU-6) and 1 pc are installed. DN300 (on the branch to PK125 + 57) - ball valves, PN1,6 MPa, with an extended rod under the carpet.

Results and discussion. Transportation of gas volumes required to supply Shymkent consumers is planned with connection to the Ø325x9.5 gas pipeline from the outlet of the valve station of the KU-45 of the Beineu-Bozoy-Shymkent Main Gas Pipeline R-9.8 MPa according to TU No. 1.41 dated 18.01.2018, issued by Beineu-Shymkent Gas Pipeline LLP.

The demand for natural gas for the population and other consumers of Shymkent was determined on the basis of the materials of the General Development Plan of Shymkent, as well as the existing shortage of gas volumes for consumers in the northwestern segment of the city, provided for by the Technical Conditions of the South Kazakhstan Production Branch of KazTransGas Aimak JSC for connection to existing gas distribution networks No. 604/1 (to the high-pressure gas pipeline 1, 2 MPa at the PGB-51 inlet) and No. 604/2 (to the high-pressure gas pipeline 0, 6 MPa in the area of Yntymak) dated 09.02.2018.

The Shymkent AGDS-3 capacity is 250.0 thousand Nm3/hour in accordance with the above Technical Specifications of GBSH LLP and UKPF of KTG Aimak JSC, the design gas pressure at the inlet to the AGDS is Pinlet = 9.8 MPa.

The diameters of the branch and distribution gas pipelines are determined by hydraulic calculation in the Software System for Computer Modeling of Gas Pipelines GazTrans, version 1.4, based on the condition of ensuring gas supply to all consumers during the hours of maximum gas consumption at permissible pressure drops.

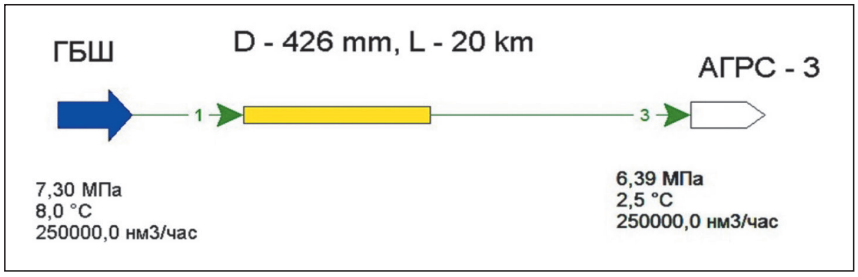

Figure 3 - **Diagram of hydraulic calculation of gas pipeline branch "KU-45 MGP" BBSH "- AGDS-3" Shymkent "**

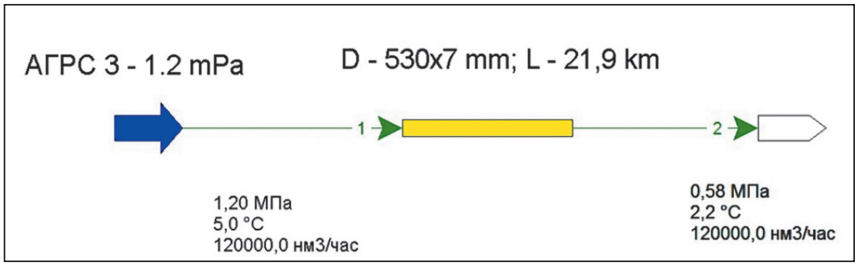

Figure 4 - **Diagram of hydraulic calculation of the distribution gas pipeline HP 1.2 MPa "East Branch"**

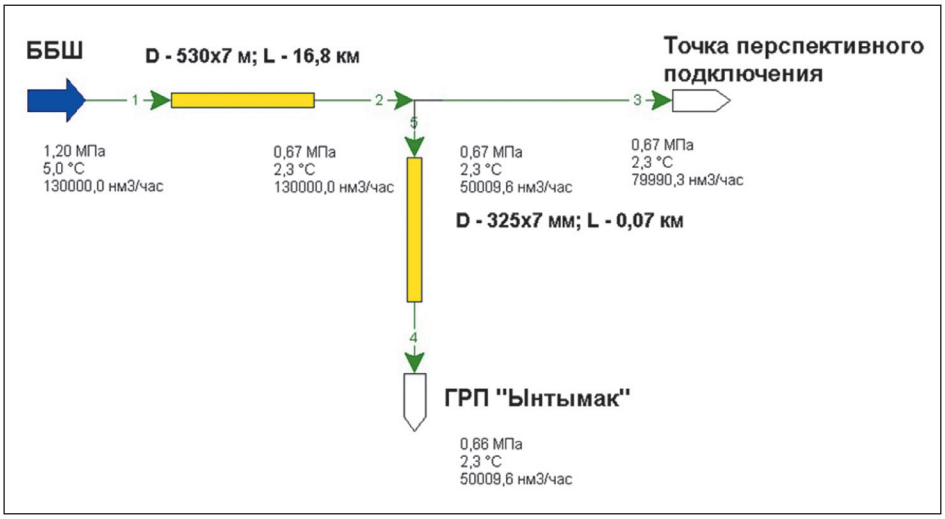

Figure 5 - **Diagram of hydraulic calculation of distribution PE of gas pipeline HP 1.2 MPa "West Branch"**

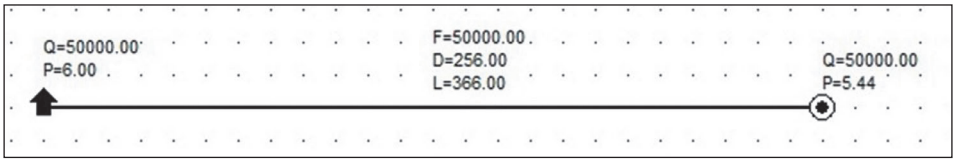

Figure 6 - **Diagram of hydraulic calculation of PE of the gas pipeline HP 0.6 MPa "Hydraulic fracturing" Yntymak "- active HP GP 0.6 MPa in Yntymak microdistrict"**

When considering the above hydraulic calculation schemes, it should be taken into account that the connection of the designed East and West branches is provided in the existing gas distribution network, i.e. in gas pipelines with existing gas overpressure. Thus, the actual pressure at the end points of the hydraulic calculation schemes - at the points of connection to the gas distribution network of the city - will be significantly higher.

Gas pipeline routes were mainly selected along existing engineering corridors.

Steel pipes in the design of the gas pipeline branch are accepted according to GOST 20295-85, distribution gas pipelines - according to GOST 10704-91 and other specifications recommended for use. The wall thickness of the pipe is adopted taking into account the strength characteristics of the designed gas pipelines.

Connecting parts of the gas pipeline branch: branches according to TU 1469-016-01395041-08, tees according to TU 1469-002-01395041-2012, diameter transitions according to GOST 17379-2001, plugs according to GOST 17379-2001, are used as for pipelines controlled by supervisory authorities.

Protection of aboveground sections of gas pipelines, as well as metal fences of sites of linear structures is carried out in accordance with SNiP RK 2.01-19-2004. Aboveground gas pipelines, including cranes and gas pipelines of AGDS, UZOU and USPOU are painted with two layers of oil paint, varnish or yellow enamel on two layers of primer intended for external work at the design temperature of external air in the construction area.

Corrosion protection of underground main and distribution steel gas pipelines is carried out in a comprehensive manner:

• insulation coatings of very reinforced type,

• cathodic polarization using cathodic protection units (CPS).

It is recommended to use steel pipes with factory or basic insulation of reinforced type based on extruded polyethylene (design number 11 GOST 9.602-2005).

Insulation of welded joints, connecting and shaped parts, mounting assemblies, points of connection of cathode terminals to gas pipelines, control and measuring points, and repair of damage to the insulating coating of pipes is carried out in the field using heat-shrinking or polymer-bitumen tapes.

When crossing natural water barriers (Arys River) and utility lines (paved roads, including category I), gas pipelines are laid by HDD, which allows maintaining the quality and hydrological state of the water body and road surface and ensuring the continuity of road operation while ensuring the necessary protection of the gas pipelines being laid from dynamic loads created by water masses or passing vehicles.

The burial depth of pipelines to the top of the pipe is assumed to be at least 0.8 m. The depth of the protective case under the road is at least 1.4 meters from the top of the road surface to the upper generatrix of the case. For mechanical protection and electrical insulation of the insulating coating of the gas pipeline on the section of the gas pipeline enclosed in a protective case, dielectric insulating rings "spacers" are installed.

Spacers provide electrical insulation between two pipes (sheath gas pipeline), are resistant to chemical corrosion, pressure, mechanical and thermal shocks. The design of the spacer ring does not have metal parts in contact with the pipeline, which eliminates the possibility of corrosion and damage to the pipeline. Spacers are installed on steel pipelines inside protective cases every meter.

The protective case end face shall be insulated with a sealing collar as per TU 2531-004-60693334-2009 with clamps to protect against harmful environmental effects. Rubber collars are designed to seal the space between the protective case and the pipeline at crossings under roads and railways, as well as other engineering structures in all climatic zones at temperatures from -40ºS to + 50ºC.

To compensate for longitudinal movements of the main pipeline, compensators-stops are provided at the launcher and pig receiver at the places where the pipeline leaves the ground, compensation for longitudinal movements is also due to the use of natural bending elbows; accepted route rotation angles are used as free movement limiters.

The design life of gas pipelines is at least 30 years. The estimated service life of AGDS is at least 30 years or 262,800 hours, taking into account the replacement of individual components with a shorter service life.

Conclusion. The designed facilities are potentially hazardous due to pollution of the environment and its individual components. Possible impact on the main components of the environment (air, water, soil, flora, fauna and humans), which is due to the toxicity of natural hydrocarbons and their satellites.

Natural gas is usually considered harmless (at low concentrations), due to the lack of carbon monoxide in it, the main danger of acute poisoning is associated with asphyxia with a lack of oxygen. Natural gas refers to substances capable of forming explosion and

fire hazardous environment. Concentration limit of its explosiveness in mixture with air at ambient temperature of 20ºS and 0.1013 MPa is 5-15.2%, dangerous concentration of oxygen is 17.8-20%.

Thus, when carrying out construction and installation works, the most dangerous works are:

• gas pipeline filling with gas with air displacement;

• electric welding of pipes,

that imposes high demands on the quality of work and the exclusion of unauthorized persons from the site of their implementation.

The construction and installation technology provides for:

1. Organization of preparatory works, including: selection and arrangement of the access road to the construction site, installation of fences that impede the movement of vehicles and unauthorized persons at the work site, installation of warning, prohibiting and prescriptive road signs, as well as light signals visible day and night, which prohibit the movement of vehicles in the blocked area.

2. Hot works during daytime only.

3. Release of natural gas from the pipeline prior to hot work, in accordance with the requirements of industry safety rules and instructions for preparing equipment for repair work.

4. Provision of the hot work area with the necessary primary fire extinguishing equipment.

The proposed technical solutions will allow:

• eliminate the existing shortage of natural gas for public utilities, industrial consumers and the population of the northern and northwestern planning areas of Shymkent;

• increase the volume of gas supplies to the industrial zone in the Badam district, which is experiencing a shortage of gas volumes;

• ensure the supply of the necessary volumes of gas to the city gas distribution networks of Shymkent for gasification of areas of promising development of the city.

The technical solutions for the construction of gas pipelines and structures on them, taking into account regulatory, environmental and fire safety requirements, are based on the following solutions: Designed gas pipelines, facilities and structures of gas trunk transportation facilities and gas distribution system will eliminate the current shortage of natural gas for utilities, industrial consumers and the population of Shymkent;

• Create conditions for gasification of promising areas of development of the northern and northwestern planning areas of Shymkent. Process parameters of gas pipelines operation are controlled at the inlet to gas reduction stations by means of I&C equipment installed locally.

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