PROSPECT OF RESOURCE INCREASE OF URENGOY COMPLEX

V.I. Marinin

Russia
ABSTRACT

According to JSC Gazprom’s plans of steady hydrocarbons production buildup, Urengoygazprom LLC faces the task of expanded resource base development. At the same time formation pressure decline leads to progressive water encroachment of pay horizon, which is accompanied by technological problems of hydrocarbons production, the latter have an adverse effect on economic indexes. With the change of the Urengoy oil, gas and condensate deposit into the phase of declining production in the main Senomanian and Valanzhin pay horizons, the company needs to develop new deposits.

As far as the plan of raw material base strategic development of Urengoygazprom LLC till 2030 is concerned, it has restriction on selection of new areas for prospecting works, due to the fact that big prospective objects, discovered on the adjacent territories, are located within license areas of others companies, and the joint development of Gydansky peninsula or South-Kara gas-bearing area, offered to our company, is prospective, but very capital-intensive.

The concentration of large, medium and prospective resources is distinctly seen in the central part of Nadym-Pur-Tazovskaya oil, gas bearing area, where according to Gazprom experts’ data, more than 67% of initial summary gas reserves of Western Siberia northern districts are concentrated. That’s why it is recommended to carry out the exploration work in the central part of the territory in question and also on the bents of Urengoy and Pestsovy banks in Achimov, Yurassic and Triassic deposits, which are conceivable gas-bearing on evidence of logging of СГ-7 well on En-Yahinskaya area.

Developing of deep gas-bearing horizons can be profitable in the first place in case of the complex use of their energy for increasing of gas, oil and condensate recovery ratio from Senomanian and Valanzhin payout beds.

The main way to overcome the subjective and to minimize the objective reasons of appreciation of hydrocarbon reserves increment provision could be the follows:

- Perfection of applied and implementation of new technologies in the geology-prospecting production.
- Creation of three-dimensional geological-geophysical models of prospecting objects and prospecting of hydrocarbons.

Thus our company has every reason to increase raw materials base, which will maintain hydrocarbons production on the achieved level and will ensure its growth in the presence of necessary volume of investment.
TABLE OF CONTENTS

Abstract

1. Introduction

2. Geological structure of hydrocarbons reserves on the license areas of Urengoygazprom LLC

3. The ways of resource increase of Urengoy complex

4. Prospect of resource increase of Urengoygazprom LLC

5. References

6. List of Figures
1. INTRODUCTION

Urengoygazprom LLC is a daughter enterprise of JSC Gazprom, our five license areas embrace Urengoy gas, oil bearing district situated in the central part of the North of West-Siberian oil, gas bearing region (Fig. 1). Urengoygazprom LLC is an integral part of the unified gas supplying system of Russia and is one of the leading companies as far as it provides more than 30% of gas, condensate and oil production in JSC Gazprom. Urengoygazprom LLC is a diversified enterprise, whose main activity is not only production of hydrocarbons, but also their treatment for transport and partial processing of liquid hydrocarbons to produce commodity petrochemicals for region needs [2].

Diagram 1. General map of OOO Urengoygazprom’s activities territory.
Gas reserves depletion degree of Cenomanian deposits on Urengoy and Northern-Urengoy areas exceeded by 70% and 50% accordingly. It means that the time of “easy gas” production is over and now the process of transition to the phase of declining production takes place on these objects. That’s why in accordance with general strategy of JSC Gazprom we work hard on the maintaining of annual gas and condensate production, moreover we head for energy-saving measures, increase of hydrocarbons production rate, development of new areas, growth of our own raw material base. Tab-Yahinsky area of Urengoy field, Pestsovaya area and En-Yahinskoye field have been brought into operation for the last two years. 2004 gas production amounted to 142.8 milliard cum (100.6 % from plan), condensate production amounted to 4.5 Mln t (106.9%), oil – 489 thousand t (104.1%). Later on after 2008-2010 Achimov stratum of Lower Cretaceous and Yurassic oil and gas perspective horizons will turn into one of the main developed places. This fact is proved by the results of the geological exploration works in 2004, when Urengoygazprom increased gas reserves till 92.3 bcm [2] instead of 19 bcm according to the plan, which is from deposits of Achimov stratum and Yurassic layers.

At present time and in the future prospects of resource increase of our company are connected both with additional exploration of developed deposits, and with prospecting on new areas and in the depth, where one expects to discover gas, condensate reservoirs in Achimov, Yurassic and Triassic deposits [1, 3].

2. GEOLOGICAL STRUCTURE OF HYDROCARBONS RESERVES ON THE LICENSE AREAS OF URENGOYGAZPROM LLC

There are three oil and gas columns in geological cross-section of Urengoy deposit:
- deep-laying Jura and Achimov gas, condensate and oil deposits;
- Neokom gas, condensate and oil deposits;
- Senomanian – Alb gas deposits (Fig. 2).
The reserves structure of gas, condensate and oil of commercial categories approved by state reserves committee of Russian Federation testify the wide spectrum of hydrocarbons deposits found in the license areas of the company. Convergence of hydrocarbons reserves which belong to Urengoygazprom shows maximum square and the biggest thickness of reservoirs in the Urengoy area as well as its highest degree of exploration maturity (Fig. 3).

It is evident from the suggested scheme that in the nearest future the main reserves maintaining gas production are connected with development of Neokom pay horizon on Pestsovaya and also Senomanian and Neocom horizons on West-Pestsovaya areas of Urengoy oil, gas and condensate deposit.

Formation pressure decline leads to progressive water encroachment of pay horizon which is accompanied by technological problems of hydrocarbons production; the latter have an adverse effect on economic indexes. With the change of the Urengoy oil, gas and condensate deposit into the phase of declining production in the main Senomanian and Valanzhin pay horizons, the company needs to develop new deposits. Depletion degree of hydrocarbons reserves in Senomanian and Valanshin pay horizons indicates the necessity of reserves' increase first of all on the Urengoy, En-Jahinskaya and Northern-Urengoy areas and on the adjacent territories to maintain the achieved production capacity taking into account the releasing infrastructure capacity, which are available in the company.

To maintain the achieved production capacity Urengoygazprom LLC has developed Senomanian deposits on Pestsovaja, En-Yahinskaya areas and on Tab-Yahinskaya territory of Urengoy area, and Valanzhin deposits on En-Yahinskaya field.

With modern gas production capacity current gas reserves will last for 33 years. As reservoir energy declines, gas production and gas treatment costs will increase, because these reserves are mainly at the periphery of deposits. On the whole in Urengoygazprom LLC the proportion of production capacity to reserves' increase is favourable, but the major increase volume has been obtained from
the deep horizon of Achimov and Yurassic deposits, the developing of which involves considerable investment.

At present time to fulfill the exploration work program of raw materials base replenishment, Urengoygazprom LLC has reserves of category C2 expecting their transferring into commercial category as the result of prospecting, and prospective resources of category C3 of the areas prepared for preliminary drilling, with total volume up to 2290 mln t reference fuel, what is less than 25 % of initial reserves of hydrocarbons and it is evidently not enough for the maintaining production capacity and especially for its increase, as provided for in the program of JSC Gazprom.

3. THE WAYS OF RESOURCE INCREASE OF URENGOY COMPLEX

To provide near-term outlook the company proceeds with additional exploration on the developed areas with the purpose to transfer C2 reserves into industrial category, what can increase the commercial gas reserves on 12.2%, gas condensate – by 26.2% and oil – by 128%. At the same time the volume of prospect reserves of category C3 is slender and can not provide prospecting works sufficiently, as taking into account the planned degree of reserves addition, they can last for 10-11 years (fig. 4).

As far as the plan of raw material base strategic development of Urengoygazprom LLC till 2030 is concerned, it has restriction on selection of new areas for prospecting works, due to the fact that big prospective objects, discovered on the adjacent territories, are located within license areas of others companies, and the joint development of Gydansky peninsula or South-Kara gas-bearing area, offered to our company, is prospective, but very capital-intensive.

Reserves addition of hydrocarbons planned in exploration work Program of Urengoygazprom LLC changes within 23,5-35,0 mln t. of standard fuel and amounts to less than one fourth of annual gas production, what is obviously not enough not only for maintenance of achieved production
capacity, but also for its growth provided by strategy of JSC Gazprom. To increase the addition of hydrocarbons reserves till the level provided in the Program of gas industry raw material base development for the period till 2030, approved in the Resolution of Board of Directors of JSC Gazprom № 7122-кт of the 23rd of October 2002, it is recommended not only to increase well-boring financing, but also to perfect applied technologies and to introduce new technologies of prospecting.

Our company carried out the Program of raw material base development since 2002 till 2005. The results of exploration work, carried out by the company, were the following: a gas condensate field in South-Pestsovaya area and a new oil pool in the Ach30 bed in the Northern dome of Urengoy oil, gas, condensate field were discovered, oil fringe presence of Ach 3-4 bed and industrial oil-and-gas content of Yurassic deposits on the west slope of Central rise of Urengoy oil, gas, condensate field and on Pestsovaya area were approved.

At the same time the comparison of Program’s effectiveness and actual effectiveness of the exploration work for the long period of time from 2001 till 2030 indicates that every year it is getting more and more difficult to keep the achieved level because of some objective and subjective reasons:

- Quantity reduction of not discovered shallow and big deposits of hydrocarbons within our license territories.
- Increased occurrence depth of oil, gas prospective horizons.
- Increased complexity of geology and heterogeneity of natural reservoirs of deep horizons.
- Insufficient information content of applied methods and geological-geophysical methods of prospecting.
- Using inadequate geological-geophysical models of prospecting objects.

The main way to overcome the subjective and to minimize the objective reasons could be the follows:

- Perfection of applied and implementation of new technologies in the prospecting.
- Creation of three-dimensional geological-geophysical models of prospecting objects and prospecting of hydrocarbons.

4. PROSPECT OF RESOURCE INCREASE OF URENGOYGAZPROM LLC

The concentration of large, medium and prospective resources is distinctly seen in the central part of Nadym-Pur-Tazovskaya oil, gas bearing area, where more than 67% of initial summary gas reserves of Western Siberia northern districts are concentrated.

That’s why it is recommended to carry out the exploration work in the central part of the territory in question and also on the bents of Urengoy and Pestsovy banks in Achimov, Yurassic and Triassic deposits, which are conceivable gas-bearing on evidence of logging of СГ-7 well on En-Yahinskaya area.

Developing of deep gas-bearing horizons can be profitable in the first place in case of the complex use of their energy for increasing of gas, oil and condensate recovery ratio from Senomanian and Valanzhin payout beds. Taking into account this circumstance, it is recommended to carry out pilot works on controllable intrawell bypass effectiveness for the sake of keeping back the selective water encroachment, introducing cycling process and maintaining formation pressure, what is especially urgent in connection with methanoic-nitrile composition of deep gas and formation pressure reaching 1200 atmosphere in accordance with the drilling results (Fig. 5).

The most important data proving gas occurrence in Yurassic and Triassic deposits are the follows:

- Content of sandstone is more than it was supposed earlier both in Yurassic deposits, and in Triassic deposits;
- Penetration of sandstone and conglomerate into the underlying argillite making hydrodynamic “windows” and combining separate reservoir-beds into big volume reservoirs was fixed in the core of Yurassic and Triassic deposits;
- Sandstone with porosity up to 20% was found in the core of Jurassic deposits, cavities partly filled with quartz were found in the core of Triassic deposits. These facts prove that forming process of secondary pore system in reservoirs is going on;
- Togurskaya formation member, which consists of loam, changes into sandstone on the northern slope of Pestsovoye bank making lithologic screened natural gas reservoir;
- 20% increase registration of mud logging till well bottom and formation of increased loam crust during Triassic deposits deepening.

Supersenomanian sandstone-aleurolitic beds of Berezovskaya bed series are considered to be the object of study on the Urengoy gas, oil and condensate deposit (Fig 6). Their gas-bearing capacity is proved by productivity of Supersenomanian deposit on Southern-Russian, Zapolarnoye and Nadymskoye fields. That’s why it is recommended to include in well abandonment plan on Urengoygazprom’s territory trials in sandstone-aleurolitic beds of Berezovskaya bed series in view of the fact that their collecting properties change on the area and it is difficult to determine the filtration-capacitive quality and the saturation on evidence of survey. Moreover, it is planned to carry out the works for quick definition of criterions for gas saturated intervals determination as a result of these trials.

As far as the near-term outlook is concerned, the company is required to carry out the exploration work in Tyumenskaya measure on the Central Raised Zone and western slope of Urengoy bank, and also in Achimov and Jurassic deposits on En-Yahinskoye and Pestsovoye fields, and later on these deposits but on Osenney, Eastern-Toyahskoi and Dalney areas. However by TyumenNIIgiprogas’ estimate the total annual gas production from these areas will not exceed one third of today’s annual gas production in Urengoygazprom LLC.

During the first five years of the period from 2011 till 2030 the maximum growth of reserves addition is planned for Urengoygazprom LLC, the company must develop all prospective reserves of hydrocarbons located on its territory during that period of time.
In accordance with recommendations of VNIIGAS after 2010 the company shall move to eastern districts of Pur-Tazovskaya oil, gas field and after 2020 – to Yamal.

It is reasonable to suggest that the main part of initial prospective resources is located in the zones of many-stored gigantic fields; Big Urengoy is one of these fields. That’s why these deep Yurassic and Triassic horizons are considered to be one of the most effective directions of raw material base growth for the company.

Prospect assessment of this district is based on the calculations made for the company on the base of investigations of VNIIGAS LLC. Obviously, the maximum concentration of hydrocarbons is in the central northern part of complex. And it is proved by the fact that almost the half of reserves concentrates on the two of six big fields (Urengoy and Yamburg), leaders of West-Siberian region.

Based on prospects of Western-Siberian oil, gas bearing complex cited in the last VNIIGAS’ publications and with average thickness of sedimentary cover 3.67 km, the average density of initial geological reserves will make 13 636 t of standard fuel / km$^3$. With such density the initial geological reserves must not exceed 519,01 Mio t of standard fuel on 1 km$^3$ taking into account the volume of sedimentary rock in Urengoy oil, gas region to the depth of 3700 m.

Practically, only proved gas reserves of the categories B+C1+C2 to the depth of 3700 m make 12200 Mln t of standard fuel (based on publications of VNIIGAS). Then based on our calculations, the density of initial geological reserves in Big Urengoy makes more than 350529.67 mln t of standard fuel/km$^3$. In other words it is 25 times as much as average density in Western-Siberian oil, gas bearing region. And taking into account that the formation pressure grows with the depth (based on the results of ultradeep well No 7), there are prospective raw material base replenishment sources.
Thus our company has every reason to increase raw materials base, which will maintain hydrocarbons production on the achieved level and will ensure its growth in the presence of necessary volume of investment.
5. REFERENCES


6. LIST OF FIGURES

1. Fig 1. General map of OOO Urengoygazprom’s activities territory.


4. Diagram 4. Dynamics of potential C3 hydrocarbon resources on licensed areas of OOO Urengoygazprom.


6. Diagram 6. Over-Cenomanian silt sandstone horizons of Berezovsky measure, as one of the prospective oil-gas-bearing objects to-be-studied on Big Urengoy.