About expediency of construction of power plants on associated gas of oil fields of the Middle Volga region

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Abstract. An analysis of the resource base of gas deposits in a number of areas of the Middle Volga region has been carried out, it is shown that small power plants can be built on the basis of these deposits. The analysis of technical characteristics of internal combustion engines and gas turbines of low power is carried out. The variants of the power plant construction depending on the gas flow rate of the field are substantiated. It is stated that it is possible to build a power plant with a capacity of 1.2 – 1.9 MW on the basis of the Yuzhno-pervomajskoe field, 16.0 – 24.0 MW on the basis of the Perelyubskoe field and 10.0 – 13.4 MW on the basis of the Zapadno-Vishnevskoe field. Based on the methodology of project financing, the efficiency of the construction of power plants using low-power internal combustion engines and gas turbines has been determined. An analysis of the risks and sustainability of the solutions obtained was carried out. It is stated that the construction of power plants based on internal combustion engines with a unit capacity of 630 kW and 1,400 kW provides the cost of electricity production in the amount of 0.40 – 0.51 rubles / kWh, depending on the initial technical and economic factors. The construction of power plants based on a gas turbine with a unit capacity of 2.5 – 20.0 MW provides the cost of electricity production at 0.31 – 0.545 rubles / kWh. The results obtained can be used for design studies of construction and decision-making on financing the construction of the power plant.

Preliminary development of an investment project for the construction of an autonomous energy source on the basis of associated gas was carried out for three fields: Yuzhno-pervomajskoe (well No. 10), Perelyubskoe (well No. 2) and Zapadno-Vishnevskoe field (well No. 2) in the Saratov Region.

The initial data on the composition and gas flow rate for calculating the economic efficiency of the power plant construction on associated gas are given in table 1.

Table 1. Estimated data on production rates and composition of associated gas.

| Deposit                  | Debit, million m³/year | Propane-butane | Nitrogen | CO₂ | H₂S | CH₄ |
|--------------------------|------------------------|----------------|----------|-----|-----|-----|
| Yuzhno-pervomajskoe     | 6.0                    | 4.38           | 1.4      | 1.87| –   | 92.23 |
| Perelyubskoe            | 70.0                   | 3.34           | 0.1      | 1.17| –   | 95.39 |
| Zapadno-Vishnevskoe     | 45.0                   | 1.5            | 0.55     | 1.29| –   | 96.66 |

Gas turbines and internal combustion engines are considered as the main equipment for a power station on associated gas. The main characteristics of power gas turbines are shown in table 2.
The gas turbine power plant can be located both indoors and outdoors. It has a block-transportable design and is transported to the construction site in parts – blocks and separately transported elements. Installation of units and elements is carried out directly at the site of construction of a gas turbine power plant.

On the example of a gas turbine power plant based on an engine with a capacity of 2500 kW produced by JSC “Aviadvigatel” in Perm, we will give a description of its main technical solutions.

The Ural-2500 gas turbine power plant is designed to produce and supply electricity to industrial and household consumers. The generation of electrical energy AC is made by using synchronous three-phase turbine generators GTU-2,5-2RUHLZ driven gas turbine GTU-2,5P, which is based on engine D-30EU-1 and reducer R-45. The gas turbine power plant can be used as a main or backup power source, independently, in parallel with other sources of electricity or in parallel with the power system. It is possible to utilize the heat of the exhaust gases in the boiler-utilizer for the production of hot water or steam. The gas-turbine power plant operates on gaseous fuel.

Table 2. Main characteristics of power gas turbines.

| Characteristics                     | GTE-1.5 | GTE-2500 | GPU-2,5P | GTU-4P | GTG-6 | NK-14E |
|--------------------------------------|---------|----------|----------|--------|-------|--------|
|                                      | NPO     | Mashproekt | Aviadvigatel | Mashproekt | SKBM  |
|                                      | Klimov, S-Pb | Nikolayev | Perm   | Nikolayev | Samara |
| Rated power, MW                     | 2.85    | 2.5      | 4.0      | 6.7    | 9.5   |
| Effective efficiency, %             | 28.5    | 21.8     | 24.7     | 31.5   | 29.1  |
| Degree of pressure increase         | 12.0    | 6.0      | 7.1      | 16.6   | 9.5   |
| Gas temperature after combustion chamber, °C | 688    | 816      | 1000     | 1023   |       |
| Gas temperature after turbine, °C   | 385     | 448      | 420      | 435    |       |
| Air consumption, kg / s             | 15.0    | 26.2     | 30.4     | 31.0   | 32.1  |
| Possible heat output, MW            | 5.0     | 7.8      | 11.1     | 9.8    | 14.1  |

| Characteristics                     | GTE-10/95 | GTU-12PE | GTD-15 | GTD-16 | GTU-16PE | AD-31ST |
|--------------------------------------|-----------|----------|--------|--------|----------|---------|
|                                      | Motorostroytel, Ufa | Aviadvigatel, Perm | Mashproekt, Nikolayev | Aviadvigatel, Perm | Saturn-Lyulka, Moscow |
| Rated power, MW                     | 12.0      | 15.8     | 17.5   | 16.0   | 20.0     |
| Effective efficiency, %             | 35.0      | 31.0     | 35.0   | 37.5   | 36.5     |
| Degree of pressure increase         | 16.9      | 15.8     | 19.6   | 19.6   | 21.0     |
| Gas temperature after combustion chamber, °C | 870    | 1076     | 1143   | 1250   |         |
| Gas temperature after turbine, °C   | 365       | 432      | 466    | 520    |         |
| Air consumption, kg / s             | 51.0      | 98.0     | 72.0   | 57.0   | 61.0     |
| Possible heat output, MW            | 17.5      | 27.3     | 26.5   | 21.9   | 26.9     |
The gas turbine power plant is operated from a general station operator's console. If necessary, it is possible to organize the management of a gas turbine power station from a separate remote control panel, based on a PC. Binding of a gas turbine power plant on the terrain is carried out by designing and subsequently building the necessary complex of facilities and devices that ensure the operation of a gas turbine power plant.

Table 3 presents the main parameters and technical characteristics of a gas turbine power plant (at \( p = 760 \text{ mm Hg}, T = +15 ^\circ \text{C} \)) at rated operating conditions. Fuel and start-up gas are natural gas according to OST 51-40, GOST 5542, net calorific value – 119.58 kcal / kg.

**Table 3.** The main characteristics of a gas turbine power plant based on an engine with a power of 2500 kW (JSC “Aviadvigatel” Perm).

| General information                                                                 |       |
|-------------------------------------------------------------------------------------|-------|
| Rated power at the generator terminals                                               | 2.5 MW|
| Thermal output power at \( t = 110 ^\circ \text{C} \)                                | 5.89 Gcal / h |
| Rated frequency of electric current                                                  | 50 ± 0.5 Hz |
| Rated voltage of electric current                                                    | 6 300/10 500 V |
| Nominal power factor                                                                 | 0.8   |

| Indicators of quality of electricity                                                |       |
|-------------------------------------------------------------------------------------|-------|
| 1 Steady-state deviation of the voltage in the steady-state thermal state with an   | ±1.0  |
| unchanged symmetrical load (10 ... 100)% of the rated power, %                      |       |
| 2 Steady-state deviation of the frequency in the steady-state thermal state with    | ±0.4  |
| unchanged symmetrical load (10 ... 100)% of the rated power, %                      |       |
| 3 Transient voltage deviation at the reset-throw of a symmetrical load of 50% of    | ±5    |
| the rated power, %, not more; recovery time, s, not more                             | 5     |
| 4 Transient frequency deviation when reset-sketch of the symmetrical load 50% of    | ±8    |
| the rated power, %, not more; recovery time, s, not more                             | 5     |
| 5 Transient variation of the voltage during the reset of the symmetrical load of the | ±10   |
| nominal mode to 100...200 kW, %, not more; recovery time, s, not more                | 30    |

| Operating characteristics and parameters                                           |       |
|-------------------------------------------------------------------------------------|-------|
| Efficiency at generator terminals                                                  | 20.61%|
| Efficiency on the shaft of the power turbine                                       | 21.55%|
| The degree of pressure increase in the compressor                                  | 5.9   |
| Gas temperature before turbine                                                     | 676 \text{ °C} |
| The temperature of the gas behind the power turbine (on the exhaust)               | 367 \text{ °C} |
| Gas consumption behind the power turbine (on the exhaust)                          | 25.3 \text{ kг/ч} |
| Specific fuel consumption                                                          | 0.349 \text{ kg / kWh} |
| Total fuel utilization factor at \( t = 110 ^\circ \text{C} \)                       | 77.1% |
| Excess air factor in exhaust gases                                                 | 5.9   |

Starting gas parameters:

- consumption; not more 1.5 kg / s
- pressure (excessive); 4...5 kgf / cm²
- temperature range; 50 °C

Fuel gas parameters before GTES:

- pressure (excessive); 10...12 kgf / cm²
- temperature range; 50 °C

Rated rotor speed of generator

- 3 000 rpm

Emissions of \( \text{NO}_x \) (at \( 15 \% \text{O}_2 \)), no more

- 50 mg / Nm³

Equivalent sound level, not more

- 80 dB

The resource of the gas turbine:

- before overhauling; 25 000 h
- general technical; 100 000 h
The main characteristics of power plants based on ICE are shown in table 4. For more detailed technical data on one of the 500 kW electric power engines, see table 5.

**Table 4.** Main characteristics of internal combustion engines.

| Characteristics             | Value |
|-----------------------------|-------|
| Rated power, kW             | 200   |
| Gas consumption, m³/h       | 70    |
| Possible heat output, kW    | 200   |

**Table 5.** Technical characteristics of a diesel generator with a power of 500 kW produced by “ZAO Volzhsky Diesel Maminyh” Balakovo.

| Characteristics             | Engine oil | Value |
|-----------------------------|------------|-------|
| Rated power                 | 625/500    |
| The frequency of rotation of the crankshaft | min⁻¹ | 1500 |
| Number of cylinders         | 6          |
| Diameter/stroke              | cm         | 21/21 |
| Motor start                  | electric   |
| Fuel                         | natural gas|
| Gas consumption, no more    | Nm³/kWh    | 0.31  |
| Total oil consumption       | g/kWh      | 1.72  |
| Emissions of CO, NO₂, respectively | g/kWh | 2.5 and 7.22 |

| Characteristics             | Generator | Value |
|-----------------------------|-----------|-------|
| Voltage                     | V         | 400   |
| Stator rated current        | A         | 1140  |
| Frequency, number of phases | Hz        | 50, 3 |
| Resource to overhaul        | hour      | 40 000|
| Resource before write-off   | hour      | 118 000|
| Engine-generator weight     | kg        | 10000+150|

The basis for selecting the composition of the power equipment of the designed power plant on associated gas is its characteristics of fuel gas consumption in the mode of operation at rated power (tables 2 and 4).

Tables 6 – 8 present options for the composition of power plant equipment for each of the fields.

The above data, taken as starting data, are considered when implementing an investment project that includes the following mandatory sections:

– analysis of the market of electricity consumption (taking into account solvency of demand);
– location and capacity of the energy source, determined by the gas debit;
– project timeframe and investment conditions;
– warranty documentation (with performance agreements, purchase of electricity, transfer of land, property, fuel supplies, construction, operation and maintenance, environmental and industrial safety).

**Table 6.** Composition of the power plant equipment at the associated gas of the Yuzhno-pervomajskoe field

| Characteristics             | Dimension | GTE-1,5 | 1500 | 800 | 630 | 500 |
|-----------------------------|-----------|---------|------|-----|-----|-----|
| Unit type                   |           | GT      | ICE  | ICE | ICE | ICE |
| Number of units             |           | 1       | 1    | 2   | 3   | 3   |
| Unit power                  | MW        | 1.2     | 1.4  | 0.8 | 0.63| 0.5 |
| Installed capacity of the power plant | MW     | 1.2     | 1.4  | 1.6 | 1.89| 1.5 |
| Gas Consumption             | m³/h      | 513.4   | 525.0| 560.0| 660.0| 525.0|
| Annual gas consumption      | million m³| 4.107   | 4.200| 4.480| 5.280| 4.200|
Table 7. Composition of equipment of power plant with gas turbines at associated gas of the Perelyubskoe field

| Characteristics                        | Dimension | GTU-4P | GTG-6 | NK-143 | GTE-10/95 | GTU-12PE | GTU-16PE | GTU-16PE | AJI-31CT |
|----------------------------------------|-----------|--------|-------|--------|-----------|----------|----------|----------|----------|
| Number of units                        | –         | 4      | 3     | 2      | 2         | 2        | 1        | 1        | 1        |
| Unit power                             | MW        | 4      | 6.7   | 9.5    | 10        | 12       | 17.5     | 16       | 20       |
| Installed capacity of the power plant  | MW        | 16     | 20.1  | 19     | 20        | 24       | 17.5     | 16       | 20       |
| Gas consumption (thous. m³/h)          |           | 1.732  | 2.272 | 3.494  | 3.556     | 3.663    | 5.341    | 4.563    | 5.861    |
| Annual gas consumption (million m³)   |           | 55.424 | 54.528| 55.904 | 56.896    | 58.608   | 42.728   | 36.504   | 46.888   |

Table 8. Composition of equipment of power plant with gas turbines at associated gas of the Zapadno-Vishnevskoe field

| Characteristics                        | Dimension | GTU-4P | GTG-6 | GPU-2,5P | GTE-10/95 | GTU-12PE |
|----------------------------------------|-----------|--------|-------|----------|-----------|----------|
| Number of units                        | –         | 3      | 2     | 4        | 1         | 1        |
| Unit power                             | MW        | 4      | 6.7   | 2.5     | 10        | 12       |
| Installed capacity of the power plant  | MW        | 12     | 13.4  | 10      | 10        | 12       |
| Gas consumption (thous. m³/h)          |           | 1.732  | 2.272 | 1.226   | 3.556     | 3.663    |
| Annual gas consumption (million m³)   |           | 41.568 | 36.352| 39.232  | 28.448    | 29.304   |

Figure 1 shows a scheme for assessing the overall effectiveness of future costs and benefits for associated gas plant projects.

Table: System assessment of the efficiency of investment projects for the construction of power plants on associated gas

| Types of efficiency                  | Performance indicator | Conditions for evaluation of costs and benefits |
|--------------------------------------|-----------------------|-----------------------------------------------|
| Socio-economic (social), environmental, etc. | NPV – Net Present Value | Acceptance of risk degrees |
|                                      | \( \text{NPV} = \sum_{i=1}^{n} \left( B_i - C_i \right) - \frac{1}{(1+E)^i} \) | The duration of creation, operation and liquidation of project facilities |
| Commercial efficiency                | ID – Profitability Index | Service life of the main technological equipment of deposits |
| Efficiency of participation in the project: | \( \text{ID} = \frac{1}{K} \sum_{i=1}^{n} \left( B_i - C_i \right) - \frac{1}{(1+E)^i} \) | Investment scheme and specific requirements of the investor |
| – for participating companies        | IRR – Internal Rate of Return | Setting of price indicators, current, forecast, escalation |
| – for shareholders–participants      | \( \sum_{i=1}^{n} B_i - C_i = \sum_{i=1}^{n} \left( 1 + \text{IRR} \right)^i \) | Discount factors for equipment and construction |
| – regional (national economic)       | Payback period          |                                              |
| – sectoral                          | Risk analysis and management |                                              |
| – budgetary (of all levels)         | Analysis of the stability and sensitivity of indicators |                                              |

Figure 1. Scheme for assessing the overall effectiveness of future costs and benefits for associated gas plant projects.
Performance indicators in figure 1 are self-explanatory, they are well-known and are used when selecting investment projects. Let us explain, however, that their mathematical record in the case of a given degree of inflation should reflect neither nor decrease in delayed effects (both income and cost), neither nor an increase in these effects in connection with inflation expectations of rising prices for various products, and for investments in replaceable technical equivalent equipment. If this equipment, together with the rise in price, has some positive properties (increase in the available working resource, increase in productivity, etc.), it is necessary to allocate the operating component of the price increase, and to make corrections in the formulas (figure 1) (corrections for the escalation component).

In the scheme of Figure 1: $B_t$ – the results achieved at the t-th step of the calculation; $C_t$ – the costs incurred at the same step; $T$ – calculation horizon (equal to the step number of the calculation, at which the object is liquidated); $E$ – discount rate – the profitability of the invested capital minimally acceptable for the investor with alternative and affordable risk-free investments; $B_t - C_t = R_t$ is the effect achieved at the t-th step.

The formula for calculating the NPV is shown in figure 1 and expresses the difference between the sum of the net cash flow and the capital investments ($K_t$), reduced to the same instant of time. If the NPV > 0, then the project in question is effective.

The profitability index is the ratio of the sum of the effects to the amount of capital investment (as in figure 1). The profitability index is closely related to NPV: if NPV is positive, then ID > 1, and vice versa. If ID > 1, the project is effective if ID < 1 is inefficient.

The internal rate of return is the rate of discount at which the magnitude of the reduced effects is equal to the capital investment. In other words, the IRR is the solution of the equation in figure 1. If the internal rate of return is equal to or greater than the rate of return on capital required by the investor, the investment in this project option is justified. Otherwise, investments are not advisable. If the comparison of options for NPV and IRR leads to opposite results, then NPV is preferred.

The payback period of the project is the period from the initial moment to the earliest time in the calculation period, after which the NPV becomes and in the future remains nonnegative. The payback period is measured in years or months. Results and costs associated with the implementation of the project can be determined with or without discounting. Accordingly, two different payback periods will be obtained.

Along with the listed indicators, in a number of cases it is possible to use a number of others: the integrated cost effectiveness, the break-even point, the simple rate of profit, etc. But none of these indicators in itself is sufficient for the adoption of the project. The decision to invest in the project should be made taking into account the values of all the above criteria and the interests of all participants in the investment project.

Preliminary analysis shows that the main economic factors that determine the economic efficiency of investment projects of power plants are capital investments in equipment, the cost of consumed fuel and tariffs for electricity sold to the consumer.

*Capital investments in equipment.* The cost of power plant equipment was determined on the basis of data provided by manufacturers. For example, the cost of a transportable power station based on gas turbines of various sizes with a capacity of 2500 kW varies in the range of 600 – 850 thousand dollars, or 240 – 340 dollars / kW. The cost of the internal combustion engine with a capacity of 1400 kW is 350 thousand dollars, or 250 dollars / kW. Internal combustion engine capacity of 500 kW ("ZAO Volzhsky Diesel Maminhy" Balakovo) in modular execution costs about 320 dollars / kW.

Considering the significant difference in the cost of the equipment, as well as the necessary costs for the construction of the power plant (auxiliary facilities, communications, transmission lines, gas transport system, etc.), the average total capital investment in this study is 350 dollars / kW. The range of investments varied between 300 – 400 dollars / kW.

When using aircraft engines used for the construction of a gas turbine power plant, especially at a relatively low operating time with a small field flow rate, in some cases, gas turbines with a low residual value, but at the same time with a low efficiency can be profitable (table 3).
Cost of fuel. The cost of associated gas, burned at the projected power plant, adopted by the upper estimate of the price of gas consumed for their own needs in extractive industry. Variation of the gas cost was carried out in the range of 400 – 500 rubles / thousand cubic meters. The cost of associated gas includes the cost of its purification and compression to operating pressures in the pre-chambers of internal combustion engines or combustion chambers of gas turbines.

The tariff for delivered to consumers energy. It is preliminarily assumed that the associated gas power plant will release the produced electricity to the network of the regional power supply organization. Since the average cost of electricity, prevailing in the system of JSC “Saratovenergo” is currently about 0.90 rubles / kWh, it is natural to assume that for an independent manufacturer the tariff will be set at the level of 0.86 – 0.88 rubles / kWh it is obvious that 0.02 – 0.04 rubles / kWh will be sent to provide dispatching services, ensure the reliability of energy supply and other system-wide costs.

When calculating the cost of production and the efficiency of investment projects, the cost of fuel and electricity tariffs throughout the adopted calculation horizon of 11 years (2016 – 2027) changed in proportion to the price of gas in the Volga region according to the Energy Strategy of Russia. The cost structure takes into account: depreciation, staff salaries with charges, maintenance costs, the cost of oil consumed, and other expenses. Property tax at the rate of 2% and income tax at the rate of 24% are taken into account when calculating the net profit. The term of construction of power plants for all options is adopted in the amount of one year, taking into account the high factory readiness and transportability of equipment.

The most important component of investment design is the most accurate risk assessment for investors. Legally substantiated division of risks between the energy campaign, lenders and buyers of energy is the most important condition for the implementation of the project. As is known, these risks can be divided into three groups: commercial, political and natural. Commercial risk arises at construction stages and is associated with changes in cost, timing and fulfillment of project requirements, completion of construction (final risk) and operational stage (operational risk) associated with the ability of the project to generate planned revenues or cash flow and meet market needs (supply risk).

Risk is defined as a measure of risk that is a multifactorial measure of the potential loss or loss of income compared to the estimated option and includes the following quantitative indicators:

– the amount of damage in the form of lost profits, up to the loss of investment;
– probability of occurrence of the specified damage due to the manifestation in real conditions of any factor;
– uncertainty of the magnitude of damage and probability.

The simplest way to minimize risks is to reduce the minimum allowable payback period of the project. Another way is to include the risk assessment in the discount rate by the formula

\[ \alpha = (1 + r + E)^{1}, \]

where E – the rate of bringing different-time costs without taking into account the risk; r – the value of the risk premium.

The most important is the calculation of the commercial risk \( r_{\text{com}} \) associated with possible changes in its determining factors in the process and at the stage of completion of construction (investment risk \( r_{\text{inv}} \)) and during operation (\( r_{\text{op}} \)). Commercial risk has an impact on the ability of an investment project to obtain calculated values of performance criteria and meet the requirements of consumers.

The main factors that determine the investment risk \( r_{\text{inv}} \) are delays in implementation and increased costs for the construction of an energy facility. Operational risk \( r_{\text{op}} \) is determined by technical and operational conditions, as well as financial performance of operating activities.

The most important condition for a rational financial structure of an investment project is risk management, that is, its distribution among project participants, which requires knowledge of risk indicators and methods of its calculation. Depending on the magnitude of the losses, the following risk areas can be identified: risk-free (I), acceptable risk (II), critical risk (III) and catastrophic risk (IV).
The zone of acceptable risk characterizes the economic feasibility of the investment project, in this zone the probable losses are less than the expected income. The critical risk zone is characterized by the possibility of loss of expected income to the value of the total estimated revenue. The zone of catastrophic risk is associated with the loss of fixed assets until the complete loss of investment.

In the process of making a decision about the admissibility of risk, it is necessary to know not only the losses, but also the probability that the losses will not exceed a certain level. The values of the maximum and acceptable risks are established by the project participants. The following limit values of risk indicators are suggested:

\[ P_{II} = P\{R < R_{II}\} = 0.1; \quad P_{III} = P\{R < R_{III}\} = 0.01; \quad P_{IV} = P\{R < R_{IV}\} = 0.001. \]

At the final stage of the design, the most important section should be considered the analysis of the stability and sensitivity of the indicators of the investment project. Sensitivity analysis is carried out by assessing the influence of deviations of the determining factors from the basic values on the obtained indicators of the efficiency of the investment project.

At the stage of preparation and construction of the power plant, it is necessary to take into account an increase in the estimated cost from the base value (up to 20 – 30%). In addition, an increase in the duration of facility construction also affects the performance indicators. For the project under consideration, due to the short period of construction, the influence of this factor is insignificant.

At the stage of operation of the facility, the following factors have a decisive influence on the efficiency indicators: generation and supply of electricity, change in the cost of fuel, standards for allocations for depreciation, average tariffs for electricity and taxes.

The analysis of the effect of deviations of some economic factors on the stability of the previously obtained performance indicators for the construction of a power plants with diesel generators of 630 and 1400 kW, as well as GTU-AL-31ST-20 and other installations for a number of associated gas fields in the Saratov region showed the following.

The increase in fuel costs by 25% leads to a decrease in net discounted income by 28.9 – 43%, depending on the initial level of capital expenditure in the construction of the station. In this case, the internal rate of return of the project is reduced by 24 – 37%, and the payback period increased by 12 – 14%.

The increase in costs in the construction of a power plant by 1/3 leads to a decrease in net discounted income by 35 – 50%, depending on the cost of fuel. In this case, the internal rate of return is reduced by 63 – 81%. The payback period of investments is increased by 27 – 30%.

Thus, for the project payback period, the size of the investment has a determining effect. The cost of fuel has a determining effect on operating performance and net present value.

Conclusions

1. The main provisions for determining the economic efficiency of the investment project for the construction of a power station on associated gas from various fields of the Middle Volga Region under existing conditions have been developed.

The cost of building power plants is calculated using the data of the manufacturing plants of the main power equipment, taking into account auxiliary facilities, communications and power and electric power. For power plants based on internal combustion engines, the specific capital investments are 300 – 350 US dollars / kW. For power plants based on gas turbine units, the specific investment is 300 – 400 US dollars / kW.

The cost of electricity produced at a power plant with an internal combustion engine based on the associated gas of the Yuzhno-Pervomaiskoye field is 0.45 – 0.447 rubles per kWh of power supplied, depending on the initial technical and economic factors.

The cost price of the released electric power from the power station on the basis of gas turbine units of low power is 0.377 – 0.43 rubles / kWh, depending on the technical and economic indicators.
The indicators of economic efficiency of variants of a power station with various types of power equipment are determined. The discounted payback period for investments in the construction of power plants is 4.5 – 5.5 years, depending on the composition of equipment and investments.

2. The analysis of risks during the implementation of the investment project was carried out and the stability of the economic performance indicators in relation to the change in various factors was determined. It is established that the greatest influence on the stability of the calculated performance indicators is provided by the average system tariffs in the regional energy market, the cost of fuel and the amount of investment. It is necessary at the regional government level to establish the dynamics of prices for associated gas after its purification to a level that allows burning in internal combustion engines and gas turbines.

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