Economic and Mathematical Model of Development and Industrial Operation of Offshore Oil and Gas Fields

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INTRODUCTION

When evaluating the economic efficiency of developing offshore oil and gas fields on the Arctic shelf of Uzbekistan, it is necessary to consider an integrated system for the production and transportation of oil or gas over a significant period of time, from exploration to the elimination of the field.

For this purpose, an economic and mathematical model (EMM) was developed, taking into account the following features of the Aksholak and industrial exploitation of offshore oil and gas fields. The first is a long billing period planning, including the stages of field development (pre-operational period), production (operational period) and liquidation of the field (liquidation period). The second is the complex structure of the system, which uses heterogeneous technical means (TS), which there is a need to take into account and optimize the interaction of technical means in the process of jointly solving problems related to providing a deposit supply and transport of oil or gas to markets. The third is to take into account various economic and non-formalizable indicators when optimizing technical and organizational solutions. Fourth - seasonal changes in natural conditions and, accordingly, the duration of the circular voyage of ships transporting minerals.

In the general case, the model takes into account production platforms, subsea and onshore pipelines, onshore or built-in oil or gas storage, a gas liquefaction plant, an offloading device (terminal), terminal ships (icebreaker or duty ship), shuttle tankers with ice reinforcements, liner icebreakers, transshipment base, auxiliary vessels and tugs, liner tankers or gas carriers, supply vessels. For the conditions of a particular field, individual structural elements may be absent.

The model consists of six blocks: "Initial data", "Capital costs", "Credits", "Operating costs", "Dynamics of production and income" and "Calculation of cash flows and key economic and investment indicators". The "Initial data" block contains information on the rates of taxes and duties taken into account in the EMM, on the level of prevailing world prices for mined minerals, the estimated prices for their sale on the sales market, the standards for calculating the annual operating costs on the structural elements of the production and transport system and other initial data. In the same block, The calculation of the export duty rate is based on the accepted level of prevailing world prices.

The "Capital Expenses" block provides information on capital costs for field development: prospecting and exploration operations, construction of structural elements of the production and transport system, as well as equipment for production and injection wells. Capital expenditures are given in dynamics by years of the calculation period. The "Credits" block provides information on the financing scheme for the field development project: the amount of own and borrowed funds, bank interest, deferral and repayment period of loans. Using these data, as well as taking into account the dynamics of capital expenditures from the "Capital expenditures" block, the need for borrowed funds by years of the billing period, bank interest payments and loan repayments are determined.

In the "Operating costs" block, operating costs are determined by years of the operating

period. Calculations are carried out for all structural elements cops of the production and transport system. Also, calculations are made for the delivery of platform crews and drilling crews, supply cargo (drilling cargo, fuel, drinking water, food), environmental protection and project management costs to the field. For the correct calculation of the tax on the extraction of minerals, the costs of the transport system are highlighted as a separate item. In the liquidation period, the costs for the liquidation of the fishery are determined. The block "Dynamics of production and income" provides information on the planned extraction of minerals by years of operation period, as well as the calculation of income is carried out taking into account the planned prices in the sales market specified in the "Initial data" block. The EMM provides for the possibility of separate accounting of extracted minerals, which differ in their physical and technical properties, quality and, accordingly, the selling price.

In the block "Calculation of cash flows and main economic and investment indicators", export-duty, mineral extraction tax (MET), capital costs, taking into account maintenance and the dynamics of repayment credits, the amount of operating costs, property tax, taking into account the depreciation of fixed assets in accordance with their average standard service life, taxable profit, taking into account benefits for repayment of losses of previous years, income tax and net income by years of the billing period.

Final economic indicators (capital costs, taking into account loan servicing, operating costs,taxes and duties, general expenses, volume of extraction of minerals, unit costs for extraction and transportation to markets, net income, net present value for a given discount rate, internal rate of return, payback period, and maximum negative cash flow) are tabulated. An essential advantage of EMM is the simplicity of carrying out variant calculations to assess the sensitivity of economic and investment indicators to changes in input data, such as capital costs, operating cost standards, selling price of minerals on the market. For this purpose, the model uses a number of correction factors that allow recalculation of the initial data. As a rule, calculations are performed for the base case (correction factors equal to 1), pessimistic (with correction factors for capital and (or) operating costs - 1.2, for prices - 0.8) and optimistic (with a coefficient for capital and (or) operating costs - 0.8, for prices - 1.2) EMM provides for the possibility of calculating the economic efficiency of deposits developed under the terms of a production sharing agreement (PSA). All input data required for PSA settlements (capital and operating costs, loans and revenues) are taken from the respective blocks.

Variant calculations are provided with varying the percentage of compensation payments and the share of the investor's profitable products. The model has been tested in a number of works carried out by the institute to justify investments in the development and commercial operation of offshore oil and gas fields.

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