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METHODS OF GEOLOGICAL RISKS ASSESSMENT DURING CONDUCTION OF EXPLORATION WORKS

D. Turdiev
"Algoritm-engineering" Research institute of Science Academy of Republic of Uzbekistan

ABSTRACT

Oil and gas industry, being complex manufacturing system, is characterized by a number of specific peculiarities distinguishing it from other productive industries. The most significant of these peculiarities characterize oil and gas industry as complex, multi-staged, dynamic and semi-structured object and precondition occurrence of different risks at corresponding stages of operational lifetime. Initial stage of lifetime of examined industry is geological exploration - geological and geophysical surveys and accuracy and reliability degree of exploration defines reasonability and efficiency of subsequent stages conduction in decisive manner [1]. Therefore, identification, analysis and assessment of risk related to geological and geophysical surveys (referred to as geological risks) as well as its management in order to decrease risk extent to minimally possible and acceptable becomes extremely important and urgent [2].

UDC CODE & KEYWORDS

■ UDC: 553.9 ■ Oil exploration ■ Geological risk

INTRODUCTION

In general conduction of oil and gas operations is always related to some risks of geological, technological or economical nature during all stages of development of region, area or specific sector.

Main purpose of this research is assessment of geological risks at the stage of prospecting and exploration of proposed deposits.

Research process includes several types of geological risks combined in three groups.

First group includes following risks or regional level:

- Availability of source rocks;
- Availability of favorable thermobaric conditions for transformation into hydrocarbon;
- Availability of favorable migration routes;
- Availability of reliable seal within the block.

Second group includes local risks of the object:

- Availability of forecasted trap;
- Availability of conditions for accumulation of hydrocarbon;
- Availability of conditions for preservation of hydrocarbons accumulations;
- Information on geological abnormalities forecasting presence of deposit of hydrocarbon in this trap.

Third group includes subjective risks:

- Absence of violations of well construction and producing horizons penetration regulations;
- Absence of low-quality cementing job of casing string annulus;
- Quality of conducted geological and research works;
- Consideration of geological and research works results during interpretation of materials and violations of well construction regulations;
- Reliability of conclusion of geological and survey works;
- Adequate amount of core material covering producing part of the section;
- Taking of optimal measures for flow call;
- Optimal well construction;
- Confirmation of presence of prognosis deposit or its non-industrial nature.

Methods of geological risks assessment during conduction of exploration works

In principle, if geological risks of regional level are very high, assessment of risks of remaining levels becomes unreasonable.

Risk degree of the last group in general is defined by the performance level of the company announced as a successful bidder for specific area of production.

All mentioned type of risks were forwarded to leading specialists of Republic of Uzbekistan for conduction of expert assessment using 9 score scale. Given assessment results show that all experts assessed regional risks as minimal and possibility of presence of these criteria was assessed as maximum.

Values of export evaluations of subjective risks mostly depend on conditions of conduction of mentioned works. In case these works to be conducted with lack of logistic and personnel support, risk will be increased and should works to be conducted without lack of logistic and personnel support the degree of risk will be decreased significantly.

Described algorithm of mathematical calculation of geological risks during conduction of oil and gas works is based on hierarchy analysis method (HAM). This method is a systematic procedure for hierarchal presentation of elements defining essence of the problem of evaluation of efficiency and profitability of conduction of geological exploration works [3, 4, 5].

This method consists of decomposition of the problem into more simplified components and subsequent processing of sequence of judgments of person making decision using pair comparisons. Result may be expressed in relative degree (intensity) of interrelation (relative importance, preferences, domination) of elements in the hierarchy. Upon that evaluations of these judgments are expressed numerically. HAM includes procedure of synthesis of multiple judgments, identification of ranks (priority levels) of criteria and formation of alternative solutions. It is necessary to mention that values obtained in such way are evaluations in the relation scale of elements of adjacent hierarchies and it corresponds to so-called fixed evaluations.

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The solution of this problem is a process of staged establishment of priorities of criteria (geological risks). First stage includes identification of the most important elements of the problem, second stage includes the best way of checking of examinations, testing and assessment of elements, next stage may include development of the way of application of the solution and evaluation of this quality. The whole process should be checked and considered up to the moment of getting assurance that the process covers all important characteristics required for presentation and solving of the problem. The process might be checked in terms of sequence of hierarchies: in this case results obtained under one sequence shall be used as input data for examination of next sequence. Proposed method classifies process of solving of such multistage task as making reliable decision on conduction of geological exploration works.

During management of complex system it is constantly necessary to make difficult decisions related to consideration of many quality criteria and reserves limitations. If such decisions are made only using intuition and supervisor experience it would be difficult to make optimal decision. In this regard it is necessary to develop and implement formalized method of decision making support.

Conclusion

Currently formal mathematical models of decision making are being widely used during monitoring and management of complex objects and processes. Along with that real complex and poorly-structured objects are characterized by a number of peculiarities that are reflected in optimization of these tasks. Main peculiarities are availability of many criteria for solving of actual problems, antagonism, nonequivalence and hierarchy of particular criteria system; presence of criteria based on subjective data; operations of analyzed processes under conditions of uncertainty of different nature (stochastic, neo-stochastic). The necessity to consider abovementioned peculiarities at the same time makes it impossible to apply traditional formal models and methods.

Moreover, while solving actual practical tasks different situations occur or there is an absence of required indicators of initial data or existing measurement means don't provide required information corresponding to the process or only qualitative information is available. Such kind of situations may occur due to insufficient knowledge of the objects as well as due to participation of person or group of persons in the management. The peculiarity of such situations is that substantial part of information required its mathematic description is available in the form of qualitative conclusions, judgments and evaluations provided by the experts. In such cases usual quantitative methods of system analysis becomes of little use and non-effective. In such situations it is necessary to use modern information technologies that based on computer processing of qualitative and linguistic - uncertain information on the object and management goals allow to get required information for making decision and management. And in order to achieve that it is necessary to develop appropriate mathematic support and software.

In general defined peculiarities and situations are similar for geological works as well and it allows consideration of tasks for identification, analysis, evaluation and management of geological risks as multi-criteria tasks of optimization with uncertainties in initial information, criteria and situations.

REFERENCES

1. Provision on geological exploration works for oil and gas. Moscow. 1983, p.124.

2. Mirzadjanzade A.Kh., Khasanov M.M., Bahtizin R.N. Modeling of processes of oil production. Non-linearity, non-equilibrium, uncertainty. Moscow - Izhevsk. Institute of computer research, 2004, p.369.

3. Saati T., Vargas L. Comparison of eigenvalue, logarithmic least squares and least squares methods in estimating ratios//Mathematical Modelling - 1984 - Vol.5 - P. 303-324.

4. Shepard R.N. (1972) A Taxonomy of some principal types of data and of multidimensional methods for their analysis. R.N. Shepard, A.K. Romney and S.B. Nerlove. Eds. Multidimensional Scaling: Theory and Applications in the Behavioral Sciences 1. New York: Seminar Press, pp. 21-47.

5. Anderson N.H. (1974). Information Integration Theory: A brief survey. D.H. Krantz, R.C. Atkinson, R.D. Luce and P. Suppes, Eds. Contemporary Developments in Mathematical Psychology 2. San Francisco: Freeman.