INNOVATIVE TECHNOLOGY DEVELOPMENT

KMG Engineering

KMG Engineering is a scientific research centre of KMG (previously – KazMunayGas Research and Development Institute of Production and Drilling Technologies). It was founded in 2014 to provide comprehensive scientific and engineering support for exploration, production, and drilling of KMG's hydrocarbon resources. KMG Engineering has its head office in Astana and two branches: Atyrau Branch LLP in Atyrau and KazNIPImunaygas LLP in Aktau, which provide direct real-time support for KMG's assets.

Objectives of KMG Engineering LLP and its branches

In order to achieve objectives and initiatives set out in the KMG Development Strategy for 2022–2031, as well as address challenges identified earlier, KMG Engineering has defined strategic goals for its own development programme cascading them as follows:

- R&D advancement and new technology implementation to develop resource base;
- R&D support for reliable and efficient field operation;
- implementing advanced technologies as part of digital transformation;
- developing hydrogen energy projects and competencies;
- creating a continuous improvement system for KMG subsidiaries based on lean production methods and project management aimed at minimising losses and improving efficiency;
- maintaining and improving management systems based on unified rules and regulations.

To deliver against its strategic goals, KMG Engineering focuses on addressing end-to-end objectives in the areas of technology development, digitalisation, business process optimisation, IT, HR and risk management.

In order to achieve these objectives, KMG Engineering develops and implements competitive technologies and procedures conventional for the global industry, provides expert support to the use of these technologies and procedures across KMG's fields portfolio.

2022 results

Exploration

Following a series of regional studies, the Company developed five promising projects for running seismic surveys as part of subsoil exploration at Mugodzhary, Northern Ozen, Berezovsky, Zharkyn, and Bolashak. It also drafted a promising exploration project for Karazhar. KMG Engineering prepared oil and gas system parameters to evaluate exploration opportunities in unexplored Shu-Sarysu, Aral, Syr Darya, Balkhash and Ili sedimentary basins. We keep looking for ways to expand our resource base.

In order to draft geological reports for production and exploration projects, KMG Engineering conducted a comprehensive study of geological and geophysical data and prepared reports on four potential M&A projects, as well as express opinions and recommendations on 13 current objectives.

KMG Engineering completed a dynamic analysis of 3D seismic data for the Bekturly Vostochny, Asar and Akshabulak projects with detailed well description, AVO analysis and seismic inversion, which helped mitigate uncertainties with reservoir anisotropy and risks related to prospective target identification. Work continues to conduct a similar analysis for the Uzen-Karamandybas project with a view to further updating its seismic and geological model.

KMG Engineering completed geological and geophysical studies to reprocess and reinterpret seismic data for the Laktybai and Airantakyr projects. Similar studies continue for the Al-Farabi project.

As part of further exploration of production assets, KMG Engineering analyses, interprets and integrates geological and geophysical data to find opportunities for resource base expansion. It has identified a number of potential non-structural traps and prepared recommendations for exploration, developed and updated detailed further exploration programmes for 2022–2024 for Ozenmunaigas and Kazgermunai. Additional studies are conducted to add details to the seismic and geological model for the Uzen and Karamandybas fields.

KMG Engineering provided R&D assistance in the drilling, core sampling and testing of 15 appraisal, two exploration and eight production wells with further exploration functionality (including current declining wells from 2021), namely nine appraisal wells and one production well with further exploration functionality of Mangistaumunaigaz, one exploration and two appraisal wells of Embamunaigas, one prospecting and exploration well of Becturly Energy Operating, three production wells with further exploration functionality of Ozenmunaigas, three appraisal wells of Kazgermunai, one appraisal well of Kazakhturkmunay, and four production wells with further exploration functionality of Karazhanbasmunai.

KMG Engineering developed a total of 17 reports on reserves reestimation, increase and conversion, of which 12 have successfully been approved by the State Commission on Mineral Reserves of Kazakhstan and the remaining five await approval in 2023. Proved recoverable oil reserves from fields grew by 40.3 mln tonnes in total (net of reserves attributable to KMG). KMG Engineering continues developing 13 more reserves reports that will move to 2023.

An exploration plan for the Turgai Palaeozoic block has been developed and approved by the Central Commission for Exploration and Development of Mineral Reserves of Kazakhstan. Report on the supervision of exploration at Zhenis has been drafted and filed with the Ministry of National Economy of Kazakhstan. Post-subsoil use remediation plan for the Dead Kultuk (Ustyurt) block has been developed and reviewed by state supervisory authorities.

Production

To ensure stable production levels at assets under KMG supervision, the Company focuses on preventing the decline of basic production and intensifies rational recovery of residual hydrocarbon reserves. To achieve these objectives, KMG Engineering provides continuous R&D assistance in the drilling, production and treatment of recovered reserves.

The key ways to maintain basic production is to improve efficiency of production operations and economically unviable wells. This includes assessing efficiency of well interventions, identifying key factors of unsuccessful production, developing corrective measures for unsuccessful well interventions, as well as analysing and developing measures to improve efficiency of economically unviable wells.

To improve rational recovery of hard-to-recover reserves, KMG Engineering provided R&D assistance in implementing measures to enhance oil recovery and stimulate its production at low-permeable layers such as fractured carbonate deposits of the Alibekmola field, undrained reserves of low-permeability reservoirs of the Uzen field, and the Kenbay high-viscosity oil. It conducted lab studies for chemical enhanced oil recovery (EOR), made various sector production stimulation models using geological and hydrodynamic modelling and selected the best options in terms of technical and economic parameters.

To streamline approaches to and develop a single framework for applying measures to enhance oil recovery, the Company developed a Strategy for Selecting and Applying EOR Methods at Fields for KMG's Subsidiaries and Associates.

To identify production bottlenecks and hampering factors, KMG Engineering initiated and successfully implemented the Atlas of Production Bottlenecks at all KMG's Subsidiaries and Associates project. It provides a detailed description of all production bottlenecks arranged by factor and divided into technological and methodological issues. The project then studies possible solutions relying on gradual implementation of various R&D tools into the production processes. Based on identified issues, KMG Engineering developed a Review of Technological Bottlenecks and Recommended Solutions for Key Fields of KMG's Subsidiaries and Associates.

Well drilling and workover

KMG Engineering has the Online Drilling Competence Centre in place to monitor drilling and render geological and engineering support in real time. Implementation of an integrated drilling reporting system is also underway.

Drilling of new wells is one of the main ways to sustain oil production at the mature fields of KMG's subsidiaries and associates. In addition to vertical wells, the amount of horizontal wells drilled every year is increasing. The key advantages of horizontal wells include reduced total amount of wells at the fields, increased oil recovery, development of new oil reservoirs and high-viscosity oil.

In 2022, 24 horizontal wells were drilled at Embamunaigas and Mangistaumunaigaz fields, with the average reservoir penetration of 90%. 1D geomechanical models were created and updated for certain wells to optimise the drilling.

The works conducted at KMG's subsidiaries and associates resulted in the cementing strength of completed well production strings of 76% in 2022 compared to 72% in 2019–2021.

Well workover is the key to operability of the well stock.

Its efficiency is analysed by types of workovers. Well-work instructions are being developed to define the common procedure and technical requirements.

Continued efforts are taken to identify and implement advanced technologies to eliminate casing pressure and perform remedial cementing.

An audit is in progress to assess technical equipment of well workover teams working at Ozenmunaigas and Mangistaumunaigaz fields.

Major projects

Expert support for the FGP–WPMP projects in terms of checking the schedules and work fees, with recommendations provided as to the feasibility of a step-by-step launch of the Pressure Maintenance System facilities and full commissioning of the FGP sites.

Analysis of the KLPE Gas Separation Unit project FEED, with recommendations on how to improve design quality and streamline technological processes, and options for Basic Production capacity integration by TCO.

As part of expert support for Phase 2 of the Kashagan project, a study was performed comparing the location of the new plant in terms of accessible infrastructure, the length of oilfield and export pipelines with cost evaluation, and the environmental impact for further phases of field development.

When considering a matter of returning the Aktoty and Kairan fields at the meeting of the KMG Investment Committee, evaluations were made as regards the opportunity to inject raw gas from the Aktoty and Kairan fields to the Tengiz field formations, with an opinion on the fields' development prospects and a risk assessment.

A study was held and recommendations were provided regarding methanol recovery options, alternative water sources for process purposes at Karachaganak, and gas turbine suction air cooling at the gas turbine power plant of the Karachaganak Processing Complex.

Modern water insulation technologies were studied exploring possibilities to implement some of them at Karachaganak.

Assistance to operators as regards geological and hydrodynamic modelling and calculation of alternative options as commissioned by KMG, analysis and assessment of the drilling and production programme for fields of major oil and gas projects with recommendations on well trajectories and placement.

Analysis was made of 2023 production and contract plans and budgets for technical services contracts of major project operators with suggestions on streamlining and engagement of KMG Engineering branches.

Participation in consulting committees, workshops and meetings with major project partners and operators, with summarising reports and conclusions.

Works and technical services were rendered under respective contracts of the major projects.

Hydrogen energy development

KMG Engineering conducted a comprehensive analysis of global hydrogen energy development trends, studied possible applications of gas injection to produce hydrogen based on the Kashagan field, and developed an infographic guide on hydrogen energy.

As part of a memorandum of understanding between KMG Engineering and Green Spark Limited, the Company looked into technical ways to build a green hydrogen production system.

A confidentiality agreement on hydrogen transportation was signed with ERG Research and Engineering Centre.

In order to consult KMG on pilot projects in hydrogen energy, KMG Engineering together with the low-carbon development project office performed a search for potential partners on hydrogen initiatives.

As part of developing R&D cooperation in hydrogen energy, KMG Engineering held a number of meetings with both local and international organisations to attract hydrogen project financing.

It also took part in the meetings of Technical Committee for Standardisation No. 117 “Renewable Energy Sources and Alternative Energy” to discuss the hydrogen energy roadmap for Kazakhstan.

KMG Engineering employees received training under an international internship programme organised by Japan Cooperation Centre for Petroleum and Sustainable Energy and participated in two local and one international expeditions.

Organisational development and regulations

A pilot project was implemented on labour division among the operators of oil and gas production department 4 of Upstream Unit 4 at Ozenmunaigas. As a result, the level of satisfaction with work arrangement in the department grew from 18% to 95%. Thanks to the establishment of a dedicated scheduled preventive maintenance team and standardisation of maintenance and preventive repairs operations, the quality of maintenance improved, resulting in a 40% reduction in the number of repairs requests.

Representatives from each Ozenmunaigas directorate (42 people) underwent training under a four-day programme ALYP (lean production basics and project management) in order to launch individual projects on transformation and continuous improvement.

Employees of production units at Ozenmunaigas (190 people) received training in 5C workplace organisation, which helped streamline workplace environment in 18 work areas.

In line with the previously adopted internal documents, the Company developed standard drilling and development programmes and resource plans for 101 wells drilled in 2022 at the Zhetybai, Asar and Kalamkas fields.

The Company conducted express analysis of the current headcount in the following subsidiaries and associates: Kazakhturkmunay, Kazakhoil Aktobe, Kazgermunai, Mangistaumunaigaz, Embamunaigas, and Ozenmunaigas. Recommendations were prepared regarding the enhancement of the organisational structure and staff list.

Developing professional competencies of KMG Group employees

Module training programmes

In order to foster professional competencies, creative thinking and teamwork in tackling real business tasks, KMG Engineering has developed and is implementing module training programmes: Chief Geologist, Reservoir Engineer, Professional Foreman and Machine Operator. Programme participants are split into teams to work on projects of practical value for KMG’s subsidiaries and associates. Certified business couches from the CIS countries, Kazakhstan, and KMG Engineering experts are engaged in the module training. In 2022, the training was held for employees of KMG, Embamunaigas, Ozenmunaigas, Kazakhoil Aktobe, Kazakhturkmunay, Mangistaumunaigaz, and KMG Engineering.

Mandatory safety training

Since 2021, mandatory training sessions in occupational health and industrial and fire safety basics have been held on the platform of KMG Engineering. The distance learning platform offers three courses: Fire Safety Basics, Industrial Safety, and Occupational Health and Safety. The Industrial Safety course includes training in safe handling of hydrogen sulphide. The Occupational Health and Safety course covers electrical safety and first aid. In 2022, KMG Engineering obtained copyright certificates for the three courses.

Training using the distance learning platform was first launched in 2020 for Ozenmunaigas employees. Starting 2021, the platform has been used to train process managers, specialists and engineers of KMG, the head office and branches of KMG Engineering.

Student and young talent engagement

KMG Engineering has developed and is successfully implementing the KMGE School programme aimed at training qualified specialists in the most sought-after fields, supporting the education market and young talent. KMGE School provides for the selection of BA students of years three and four, who then get a special training programme consisting of at least three subjects and undergo a work experience practice at KMG Engineering. After completing the programme, its participants get jobs at KMG Engineering. In 2021, 21 KMGE School graduates were hired by KMG Engineering. In 2022, the programme took onboard 18 students from Satbayev University and Yessenov University majoring in materials science, seismology, geophysics and petrophysics, and hydrogeology.