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Strengthening Project Management to Attain Overseas Blocks with High Potential for Exploration

Abstract New overseas venture evaluation is key for oversea exploration of Chinese oil companies, whose credibility directly determine the degree of success of exploration for overseas blocks. The uniqueness of new overseas venture evaluation in short assessing cycle and limited data make project management vital. Project management includes human resource allocation, quality control and effective communication. In China National Offshore Oilfield Corporation (CNOOC), the new overseas venture evaluation system has been established. This system includes quality control system and assurance for new overseas venture evaluation, geological evaluation norms for overseas oil & gas exploration, regulations for new overseas venture evaluation and seismic interpretation methodology and procedure for new overseas venture evaluation. Directed by the new overseas venture evaluation system, three-level quality control and management of data-room visit are strictly reinforced, which guarantees the efficiency and quality of new overseas venture evaluation. As a result the new overseas venture evaluation boosts the development of young explorationists and leads to breakthroughs in exploring potential target areas of CNOOC and in the discovery of giant oil and gas fields, which underpins the development of overseas business in CNOOC.

Keywords: new overseas venture evaluation, exploration, project management, quality management, assessing system

1 Introduction

China's economic development heavily depends on import of oil and gas. Before 1907, China had no petroleum industry. On September 10, 1907, with the help of Japanese engineers, oil pay zone was penetrated by Yan-1 well in Yanchang County, Shaanxi Province, signaling the beginning of China's petroleum industry (Qiu & Gong, 1999). In

1939, Yumen Oil Field was discovered and exploited by an exploration team, including Wen-hao Weng, Jia-rong Xie and Jian-chu Sun. However, despite the discovery of oil field, China still imported oil. After the founding of People's Republic of China, to boost the economic development, the founding fathers made the decision to invest more in petroleum industry.

There were three options to mitigate the crisis of oil & gas demand. On October 29, 1907, Kelamayi Oil Field, the first giant oil field, was discovered. In 1959, the world famous oil field, Daqing Field was discovered by Si-guang Li, Ji-qing Huang and Jia-rong Xie, ending China's history of importing oil and gas. Unfortunately, although new oil fields were discovered continuously in offshore areas and western China, the import of oil and gas still exceeded export, and thus China rejoined the family of petroleum-importing countries in 1993, due to the high demand of oil and gas by the burgeoning economy. After that, the rapid development of manufacturing industry and real estate industry boomed oil import year after year. In 2003, the amount of oil import, 91.13×10^6 tons, put China in the first place in the list of oil-importing counties in Asia and second all over the world. In 2009, the amount of oil import surpassed that produced domestically, marking the external dependence of oil and gas in China exceeding 50%. In 2015, oil and gas produced in China were 215×10^6 tons, a 1.7% increase compared to those of 2014. In contrast, the amount of oil and gas imported in 2015 is 334×10^6 tons, 8.8% higher than that of 2014, pushing the external dependence of oil and gas in China to a historical high of more than 60%, much higher than the security level of 50%.

Three options are available to mitigate the crisis of external dependence of oil and gas for China. The first one is investing more to discover giant oil and gas fields in areas with relatively low exploration activities and to find more oil and gas to improve the reserve replacement ratio in well explored areas, which is very hard because the yet-to-find resources in China is already limited. The second option is speeding up the development of techniques to improve the recovery rate of oil and gas. The third option, and the effective one for the decades to come, is

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strengthening implementing the strategy of overseas exploration and exploitation for oil and gas to acquire more reserves to counteract the shortage of domestic resources.

With the underpinning of national strategy, oil giants in China started overseas exploration and exploitation with some achievements in the last decades. In CNOOC, since the initiation of overseas section for petroleum exploration and exploitation in 2004, the investment has been in an ever rising trend. In order to attain overseas high quality blocks with or without discoveries of oil and (or) gas, speedy evaluation should be implemented for the target blocks. This evaluation is called new overseas venture evaluation. New overseas venture evaluation is the most important part of the overseas strategy for oil companies which, if badly conducted, can undermine the company itself in two ways. For example, if the blocks without potential of exploration and exploitation are overvalued, and this will cost the company arms and legs for unworthy assets. On the other hand, if the blocks of high potential are undervalued, the company will miss great opportunities to grow.

To successfully implement the new overseas venture evaluation (primary and detailed ones included), specialized team come into existence in the oil companies in China. Compared with the evaluation for domestic exploration projects, the evaluation for overseas ones is more challenging in working pace, research cycle and methodology, which need responding management system to guarantee the efficiency, timeliness and high evaluation quality to avoid the two possibilities, as mentioned earlier, which could undermine the company.

2 The best time for Chinese oil companies to increase investment in overseas oil and gas exploration

Considering the recent oil prices, overseas resources and technology, there is a great opportunity to look for new overseas projects and increase foreign investment in oil and gas exploration nowadays. The relationship among China's rapid economic development and oil resource and the dependence on foreign oil has been discussed briefly in the introduction. In addition, overseas, especially Africa's rich oil and gas resources, "along the way," the low oil prices and the rapid development of technology for exploration and development have provided a good opportunity for the participation or acquisition of overseas petroleum exploration blocks and properties.

2.1 Overseas rich oil and gas resources provides the material basis for China's overseas new projects

Years of petroleum exploration strategic research found that the overseas petroleum resources in some areas is

considerably rich. For instance, the African countries have abundant petroleum resources. However, these countries have poor economy and technology. They need to cooperate with foreign oil companies to find oil and gas fields.

In Africa, there are 80 sedimentary basins with a total area of 15×10^6 km². Among these basins, five super giant sedimentary basins are with exploration area over 1.0×10^6 km², 8 giant sedimentary basins with exploration area 50×10^3 – 100×10^3 km², 30 large sedimentary basins with exploration area 10×10^3 – 50×10^3 km² (Li & Jin, 2005). There are 20 oil-producing countries in the entire Africa region, with over 500 oil and gas fields found and the proven recoverable reserves of crude oil and natural gas amounted to $2,062 \times 10^{10}$ barrels and 660 Tcf, the remaining proven recoverable oil and gas reserves are $1,170 \times 10^{10}$ barrels and 540 Tcf. According to the strategic research, the oil and gas resources in the whole Africa are more than $1,600 \times 10^{10}$ barrels and 1,119 Tcf, accounting for 28% of the world's undiscovered oil and 20% of undiscovered natural gas resources, respectively. Therefore, the petroleum exploration potential in Africa is great.

The petroleum resources distribution is very uneven in Africa. The petroleum resources are mainly in a few countries and regions in North, West and Central Africa (Arthur, Macgregor, & Cameron, 2003; Xu, Wang, & Fang, 2005). North Africa region, such as Algeria, Libya and other countries, has rich petroleum resources, but the exploration degree is the highest in Africa. It is relatively difficult to find large oil and gas fields. It is necessary to focus on acquiring projects for the existing oil and gas asset and taking into account the new exploration project. For the West, East and Central Africa, it is suggested that the China's oil company focus on acquiring new exploration projects, taking into account the acquisition of existing oil and gas assets.

Taking West African coast as an example, 15 sedimentary basins were developed with varying amounts of oil and gas (Zhang, 2010). The total exploration area of the 15 basins is 3.3×10^6 km², with 0.72×10^6 km² in land, 0.591×10^6 km² in continental shelf, and 1.99 km² in deep water, which account for 21.9%, 17.9% and 60.2%, respectively. Exploration level is relatively higher in the land and shallow water region. However, the exploration level is much lower in West Africa vast deep water region. Strategic research shows that geological conditions are favorable in West African deepwater region. Multiple sets of source rocks, sandstone and carbonate reservoirs were developed in West African, where exploration layers are numerous and exploration potential is enormous (Dickson, Fryklund, Odegard, & Green, 2003). The low exploration level and the enormous exploration potential of these regions are the key areas for Chinese oil companies to obtain new exploration projects.

Most of African countries are poor with backward petroleum exploration and development technologies.

They need to introduce other countries' capital and technology to explore and develop oil industry, to obtain a win-win situation.

2.2 'The Belt and Road' strategy provides an excellent opportunity for Chinese petroleum companies to go overseas

'The Belt and Road' is a top national strategy involving 65 countries, the majorities of which have rich oil and gas resources, such as Saudi Arabia in West Asia, Kazakhstan in Central Asia, Russia in CIS, and Indonesia in East Asia. It also offers a good opportunity for China to take part in petroleum exploration and development in East Africa, which includes 11 countries, such as Tanzania, Mozambique, Sudan and Uganda. The countries have hundreds of petroleum basins. For example, there are 84 basins in 24 countries in Asia-Pacific and East Africa.

Relevant authorities of the Chinese Government organize PetroChina, Sinopec, CNOOC to study cooperation in oil & gas sector under the framework of 'The Belt and Road' to obtain more and better projects and blocks.

2.3 Low oil prices force the overseas oil companies to transfer interests of exploration blocks and oil & gas assets

Since the 1960s, there have been two major oil price fluctuations, which was near \$40 a barrel in 1980, dropped to about \$10 in 2000, and then climbed up to a maximum of nearly \$150 in 2008, after frequent fluctuations finally back to \$30 now. The price is not enough to cover the cost of exploration and development, with a \$10 loss for producing a barrel of crude oil. Several oil companies or agencies holding exploration blocks face great difficulties under this situation. Recently many news reports of oil company mergers, acquisitions and layoffs have burst out. Many companies have serious problems in cash flow breaking so that they have to transfer interests of exploration blocks and oil & gas assets at low prices, especially small companies. Chinese oil majors should make full use of the opportunity to acquire projects and blocks overseas.

2.4 Rapid technological advances of petroleum exploration and development provide strong support for Chinese oil companies to go abroad

Chinese petroleum exploration and development technologies have been greatly developed over the past 30 years. Seismic acquisition and processing technologies for desert, mountain, plateau, loess wall have been mature (Fang, 2006). Deepwater exploration will be hotspot in the next 30 years. Deepwater drilling and seismic exploration technologies have made considerable progress by innovation. China already has the ability to drill in ultra-deep water. Also, deepwater seismic acquisition and processing technologies, subsalt seismic processing technologies,

complex carbonate and deepwater sandstone reservoir prediction technologies have been improved significantly. Technological advances provide strong support for Chinese oil companies to find petroleum abroad.

3 Overseas project evaluation has its own particularity

3.1 Projects increase each year

Overseas projects evaluated by CNOOC increased each year between 2004 and 2015. 29 projects were evaluated in 2004, the number up to 43 in 2009, 67 in 2010 and 51 in 2015. These projects are mainly from Africa (especially West Africa), America (mainly in South America) and Asia-Pacific, a small amount from the Middle East and the former Soviet Union countries.

3.2 Great randomness

Evaluation task is done by Management Department of CNOOC Ltd., which is responsible for collecting bidding information of overseas upstream oil & gas projects, contracting tender side, and gathering relevant technical, legal and fiscal terms and other information, then issuing geological evaluation mission statements to overseas project evaluation teams. Normally, it is random for the management department to issue missions so that overseas project evaluation teams generally do not know when it will come and must always be at preparing state.

3.3 Multiple departments involved

Overseas project evaluation teams should communicate and cooperate with multiple parties, including Exploration Department, International Affairs Department and other administrative departments, relevant departments and teams in CNOOC Research Institute, and also the tender side involving host countries and their national oil companies, the oil companies bidding.

3.4 Many parallel projects

Because of the influences of financial crisis and oil price fluctuation, bidding opportunities for overseas petroleum projects have been numerous in recent years. Particularly in the period of 2008–2009, Africa, Asia-Pacific, the former Soviet Union countries, South America, even North America, have offered many bidding opportunities. CNOOC Ltd. may be targeting at several overseas projects simultaneously, so that one overseas project evaluation team usually has to evaluate several projects at the same time, even 6 projects at most in parallel evaluation, resulting in heavy workload and complicated management.

3.5 High timeliness

Overseas project evaluation requires a high timeliness. A new project usually has to be completed within 5 to 15 days. The time is very limited in terms of the workload, especially for asset assessment projects. How to complete the projects timely with high quality is a key issue.

3.6 The diversity of project types

The types of overseas New Ventures include pure exploration projects, asset evaluation of discovered oil and gas fields, and the combination of exploration projects and asset acquisition. The evaluation ideas, methods and processes are different for different projects. Due to the lack of technical personnel, technical personnel must be skilled in evaluating different types of projects and capable of versatile technology. For young staff, the difficulty and pressure can be imagined.

3.7 The diversity of key geological problems

All over the world, there are nearly 600 sedimentary basins of various types from tensional and extensional ones to compressional ones. For different types of basins, the tectonic and sedimentary evolution background, basin structure, sedimentary strata and hydrocarbon accumulation conditions are quite different. The different types of basins where projects need to be evaluated located have different key geological problems to be solved. Based on the past experiences, the team of overseas New Venture evaluation came across lots of different geological problems every year, which need different methods and technologies.

3.8 Great responsibilities of the evaluation team

Responsibilities of the team for overseas New Venture evaluation are very important. If the technical team evaluated a very good project with a negative viewpoint, CNOOC would lose the opportunity of bidding and miss a large oil or gas field. For a bad project, if the technical team made a positive evaluation conclusion and recommend CNOOC to bid, CNOOC might suffer huge economic loss.

4 Continuously strengthen the management of overseas new venture evaluation, provides technical support for acquisition of overseas good exploration blocks

There are various topics in project management, including scope management, time management, cost management, procurement management, risk management, integrated management, communication management, human resource management and quality management. According

to the characteristics of overseas New Venture evaluation, there are three important aspects in project management: project quality management human resources management, and project communication management. The latter two serve for the first. This paper mainly focuses on the quality management in New Venture evaluation.

4.1 The establishment of a scientific new venture evaluation system

In recent years, under the support of leaders of all levels, measures were taken to establish a coordinated and scientific overseas New Venture evaluation system, which is the summary of our experience more than ten years. The system provides a strong guarantee for the New Venture evaluation quality.

4.1.1 The construction of overseas New Venture evaluation quality assurance and quality control system

'Overseas New Venture evaluation quality assurance and quality control system' was established, published, and carried out in 2009. The system is relatively complete. It includes the quality assurance and quality control system. The quality objectives have been defined in New Venture evaluation for the first time. The system provides detailed instructions for start-up phase, planning phase, operation phase, evaluation reports, backup and archiving of research results, the quality assurance and quality control measures in the closeout phase. The focus is the quality assurance and quality control in the operation phase, including: (1) the identification and selection of the reliability, authenticity and availability of data; (2) the establishment of the basic database for overseas evaluation; (3) quality control in the process of overseas adventure evaluation. Specific measures, implementation processes or technology roadmaps are established for each phase. Based on the operation of the system for more than a year, satisfied results have been achieved.

4.1.2 The establishment of overseas oil and gas exploration and geological evaluation norms

From 2013 to 2015, the New Venture evaluation and the exploration research of contract block of CNOOC basically followed the domestic version of oil and gas exploration and geological evaluation norms. In fact, overseas exploration and domestic exploration are different in many aspects. First, the types of overseas exploration research include the geological evaluation of block contract, and a large amount of New Venture evaluation. Second, the study period is different. Third, information basis is different. Fourth, the research depth is different. Fifth, the research platform is different. Thus, overseas exploration could not be guided well by the domestic

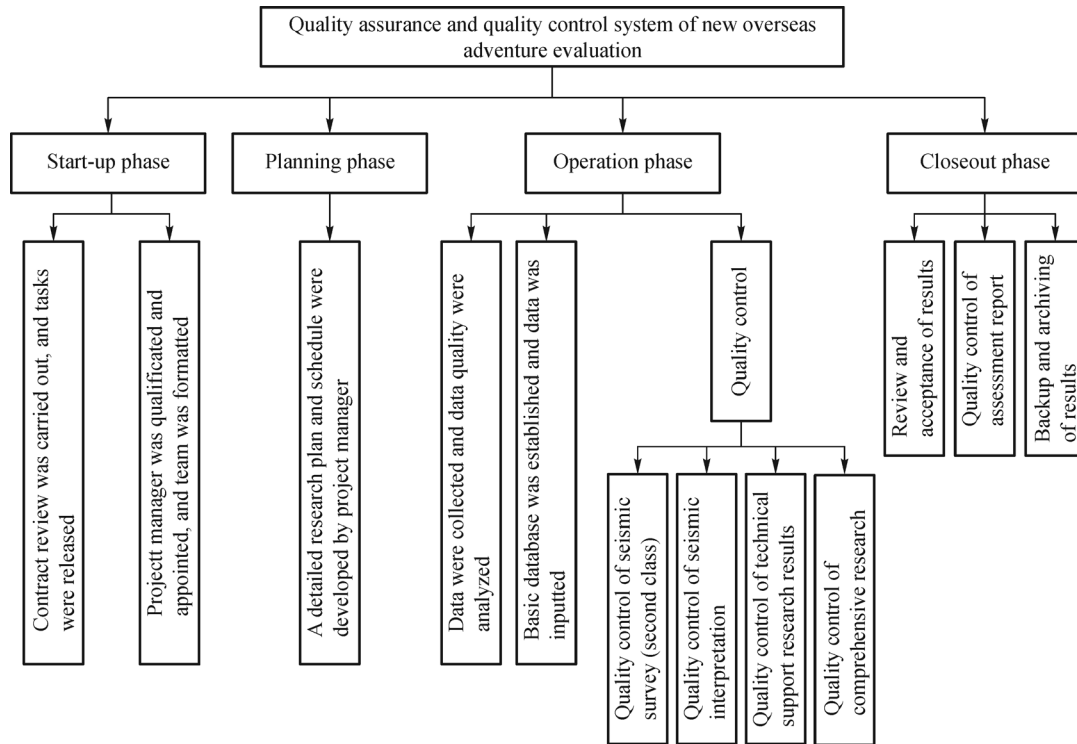


Figure 1. Quality assurance and quality control system for overseas New Venture evaluation.

version of oil and gas exploration and geological evaluation norms, especially for New Venture evaluation. Then, overseas oil and gas exploration and geological evaluation norms were established by CNOOC Research Institute in 2015. Three topics, including geological risk analysis, potential resource calculation and economic evaluation, which are quite different with domestic research, were completed carefully. It is believed that the overseas oil and gas exploration and geological evaluation norms will play major roles in the evaluation of the overseas New Ventures.

There are three highlights in the geological risk analysis of overseas exploration. First, it has a very clear hierarchy which contains three gradually deeper levels: geological risk analysis of initial evaluation phase of the New Venture, geological risk analysis of detailed evaluation phase of the New Venture, and geological risk analysis of targets evaluation in exploration blocks. In the initial evaluation level, only the risk analysis of the region where blocks are located are needed, while in the detailed evaluation level, the risk of the exploration targets (traps) have to be analyzed. Second, the methods and ideas of the geological risk analysis are much more comprehensive and more internationalized. The probability methods are used for the risk analysis in initial evaluation phase, while matrix approaches are responsible for the risk analysis in detailed evaluation phase. During the analysis, the resources and the geologic risk are always linked together. Third, the whole process is very feasible. The scoring matrix tables of the

risk are produced for every geologic risk factor, and the geologic features are clearly defined for different risk factor score segment, which is a good reference and is convenient for the evaluators.

There are two highlights in the criterion of resource calculation for the overseas exploration. First, the rock volume method is used for the resource calculation. Second, 'five probability distributions and three methods' are first proposed by CNOOC. The five probability distributions include Normal distribution, lognormal distribution, beta distribution, triangle distribution, and uniform distribution. The three methods for determining values include statistic simulation method (for the case of large sample size), statistic compare method (for the case of small sample size), and empirical model method (for the case of zero sample size).

4.1.3 The establishment of evaluation criterion for overseas exploration projects

The evaluation criterion for overseas exploration projects was established by CNOOC Research Institute in 2015. This criterion regulates specific processes for the initial and the detailed phase of evaluation as the production process in the factory, which tells people how to carry out the work for every step. Even for those overseas exploration technicians who will join the work soon, they can improve

their working efficiently, avoid detours, and obtain high quality research results, as long as they follow this criterion during work.

4.1.4 The establishment of the methods and processes of the rapid seismic interpretation for the new venture

There is huge seismic interpretation work during the detailed evaluation of overseas exploration. But very limited time, usually a few days to ten days (considering usually six months to one year is needed in the domestic evaluation), is left to complete the work. In order to pass on the experience to the young seismic interpreters, different rapid interpretation processes are established according to the different types and different phases of the New Venture. Those processes, which provide good research ideas and roadmaps, are good references for the young technicians.

4.1.5 The strict implementation of three-level quality control system

The quality control work for the project team of overseas New Venture evaluation is strictly implemented according to the three-level quality control system. The three-level quality control includes the QC of project manager, the QC of the chief engineer of the department, and the QC of superior chief engineer. The project manager, responsible for the first level of QC, has a great responsibility in the whole QC process. Every step of the research work has to be controlled and technically guided by the project manager. The chief engineer of the department is responsible for reviewing the key issues and guiding the key benchmarks for the project.

4.2 Strengthen the early, middle and late stage management of visiting data room

Going abroad to visit the data room of counterpart is usually required for detailed evaluation of overseas New Venture. Visiting data room is a kind of knowledge. It is a thinking and researching-worth topic of how to improve the quality of New Venture evaluation at the greatest extent through visiting data room. For a decade, the experiences were repeatedly groped and a set of early, middle and late stage management measures of visiting data room were collected. The implementation is favorable.

The key geological problems and the difficult problems of the blocks must be selected by the technical personnel according to the limit data in hand before visiting data room. The blocks were queued according to the difficulty and criticality. The key geological problems and the difficult problems must be confirmed by the project manager, director and chief engineer after determined by the technical personnel.

The number of technical personnel for data viewing needs to be further confirmed after the determination of data volume and key geological problems and the difficult problems. The tour list is arranged according to the principles of new and old collocation, professional collocation. The senior technical staff have rich experience, and can make decisions decisively in a few days' visiting time, and lead the visit team avoid detour as much as possible. On the other hand, young technicians response and think quickly, and would operate the professional software skillfully, and can get started on new softwares or technologies quickly. The collocation of new and old personnel not only reduces the pressure on the new and old employees, but also improves the efficiency and effectiveness.

The works must be carried out according to the specific division strictly by the professional and technical personnel during the period of visiting data room. The team needs to make good use of the conveniences that the foreign side provides, adequately collect and quickly digest the data and research results of the foreign side, distinguish the truth and falsity at the greatest extent, and identify the excessive packaging of the foreign side. Under special circumstances, the technical personnel must inform the head of the team.

The technical personnel must finish the data sorting within the prescribed time of various New Venture projects after visiting the data room. Technical personnel need to digest the collected data, the middle and the final research results of foreign side, and then, further absorb the right viewpoints and rule out the false ideas or exaggerated ones. A rapid evaluation should be carried out according to the collected basic data. Then petroleum accumulation conditions of the main exploration targets in the block need to be studied and analyzed, and the favorable accumulation conditions and geological risks of the major exploration targets need to be clarified. Finally, the technical personnel need to determine the exploration potential of the block realistically, and put forward specific evaluation suggestions to provide more solid technical basis for the decisions of company.

4.3 Strengthen the exploration strategy research of key basins in key areas, and lay a good technical basis for the New Venture evaluation

A large number of overseas exploration strategic researches are not carried out in the first few years of overseas New Venture evaluation due to various reasons. Therefore, a lot of time had to be spent on collecting regional geological data, studying the tectonic and sedimentary evolution of the basin, and studying the basic petroleum geological conditions of the basin and the zone where the blocks are located. Usually, the technical staff could not grasp the core geological problems of the New Venture evaluation in a very short time since time, personnel and information are limited. During the past five years, a certain number of

technical personnel were drafted to carry out the exploration strategic research of the key basins in each region, favorable zones were also optimized and future exploration direction is analyzed in some basins, which make the driving force of New Venture evaluation and procurement transformed from opportunity to strategy. Of course, strictly speaking, New Venture evaluation and procurement are driven by both opportunity and strategy. Practice has proved that a large number of exploration strategy researches provide favorable conditions for the rapid, efficient, and high-quality accomplishments of New Venture evaluation.

5 Efficient and strict management of overseas New Venture evaluation contributes to continuous overseas oil & gas discoveries

Overall, effective, strict but humane management of New Venture evaluation obtains satisfactory results and achievements as follows:

(1) Creatively establish the project management system, evaluation quality system and scientific evaluation system, which ensures sustainable development of overseas exploration.

In project management, the experience of technical experts is fully utilized. The project team, for the first time, creatively drew up and developed a complete project management system, New Venture evaluation quality system and scientific evaluation system. These systems have already played a huge role in the evaluation of overseas New Venture. With the deepening conduct of evaluation, systems above will be further improved.

(2) Effective and orderly management is achieved and a large number of New Venture evaluation tasks are successfully completed, which provide strong technical support and assurance to overseas investment opportunities

of CNOOC Ltd. All technical suggestions about New Venture evaluation are accepted by CNOOC Ltd. and CNOOC International Ltd.

(3) Great oil and gas fields are discovered in several blocks acquired by overseas New Venture evaluation.

Great oil and gas discoveries are obtained in several blocks selected and acquired in hundreds of evaluated New Ventures, such as Congo (Brazzaville) project, Algeria project, Gabon Project, Uganda project. These oil and gas discoveries lay the resource foundation for establishing overseas oil and gas exploration base of CNOOC and make indelible contributions to the completion of annual new replacement reserve.

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