

Oil and Gas Reservoirs Management Principles: Challenges and Strategies for Optimal Preservation of Hydrocarbon Reserves in the Common Fields

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Abstract

Management Repository is an interesting way to raise the profitability of the oil companies; in fact, reservoir management is a key to success during the life of the reservoir from the exploration to abandonment stage. To achieve optimal operation of a vessel, in addition to proper methods for recovery, it is necessary to evaluate the economic aspects. In fact, the optimal harvest is meant to protect oil reservoirs. Unfortunately, the lack of knowledge of the science of management and safeguard the withdrawal of reservoirs cause the production of these huge resources to be faced with challenges and to be decreased in the short term. Today, one of the challenges posed for the oil and gas producing countries is the state of production from common fields in terms of the number of wells, the place of the drilled well, the amount of production and application of EOR and optimal methods appropriate with the physical conditions of the reservoir. Using the literature, this paper is to examine the management of oil and gas reservoirs and by discussing the challenges facing the preservation of hydrocarbon reserves in the common fields, presents recommendations to optimize recovery and preserve these resources.

Keywords: Management and Preservation, Oil and Gas Reservoirs, Hydrocarbon Reserves, Common Fields.

1. Generalities of Research

1.1. Introduction

Oil exploration which started nearly 150 years ago can be considered as a starting point for the industrialization of human life. Large underground reserves of oil, easy access to them, being liquid and the easy transportation functionality, considerable energy which can be used directly, has converted the oil and gas industry to the high-risk and profitable industry which has exposed the financial and managerial storm of internal and external factors. The life of an oil reservoir starts with searching and exploration actions and continues with determining the characteristics of the reservoir. Meaning that is presented from it today, is a process based on trial and error which simulation of reservoir and production engineering are only two components of it (Ghavam, A.S., 2004). One of the most important assets of any oil companies is the amount of hydrocarbon reserves which is under the control of the company. Protecting the hydrocarbon reserves and the proper methods of exploiting of the oil and gas reservoirs are the pivotal policies of *Islamic Republic Oil Ministry* in keeping the national power and economic growth in country. Nowadays one of the challenges posed for oil and gas producing countries is how to produce from shared reservoirs which are common in terms of the number of wells, location of wells, the amount of production and the application of methods for increasing and optimizing the harvest with the physical conditions of the reservoir (Mohammadi, F., 2010).

1.2. Defining the Issue

With considering the reducing of hydrocarbon reserves and pressure drop of oil and gas reservoirs, each day the role of production process optimization in maintenance and increasing the power of production appear more significant than before. Increasing the size of reserve and production efficiency have been always the major concerns of the countries which have petroleum sources and oil companies. Protection of reservoirs means the optimization exploiting. Protection of reservoirs means that with careful studies, use of different technologies and good planning the maximum amount of available hydrocarbon being extracted (Rafiee, I., 2007).

The knowledge of management and preservation of reservoirs has been an issue in line with protection of underground reservoirs which is considered along with the ending of the natural production period of reservoirs (Najafpour, M., & et.al., 2008). Common field of oil and gas with considering the available and harvested fluid characterization are threatening with this fact that if they were not harvested in time from the shared field and the exploiting of the opposite side continued, the available oil and gas in the part under the control of a country migrated to the neighbor countries and being harvested by them (Saifzadeh, H., Roshandel, G., 2002).

1.3. Importance and Necessity of Research

Hydrocarbon reservoirs are the most important energy resources of the world but with considering the limitation of these resources, planning and performing necessary actions for optimizing the exploitation from them are vital matters because of this nowadays management and preservation of reservoirs have been more important. For optimal exploiting of the reservoirs, we should investigate the economic aspects of it (Churchill, R., Allen, L., 1988).

2. Concepts and Theoretical Principles of Research

2.1. Preservation of hydrocarbon reserves and optimal production from oil and gas field of country. Optimal use and preserve strategic underground oil and gas energies determining the successful prospects of sustained economic of *Islamic Republic* in the up-stream sector of oil and gas (Navazeny, B., Nojourni, A., 1999). Preservation of the oil and gas reserves is one of the major challenges facing the oil industry and oil management. Studies show that 75% of the actions related to protection of production capacity realize with performing the development programs and removing the operational obstacles and restrictions and only 25% of these actions related to the new exploration of oil (Karimi, S., Jabbari, N., 2006). In the production processes from an oil reservoirs in order to have optimal production, understanding the production mechanism or mechanisms is essential and this understanding cannot be achieved unless the real performance of the reservoir is understood and with the knowledge of the actual mechanisms, a reservoir engineer can perform proportional simulation to the fact and continue to produce from the field and finally the share of each mechanism is determined and the producing is done properly (Turkan, A., Aboutalebi, Z., 2010).

2.2. The necessity of adopting development strategy and a production strategy from the country's hydrocarbon reserves. Strategy is a guide to move from the present situation to the ideal situation. Success or failure of each organization in achieving the desired status or its prospects depends on the organizations ability in defining an effective strategy to achieve the determined targets. One of the most noticeable natural talents in Iran is the existence of huge hydrocarbon resources. Therefore one of the most important missions of the oil ministry in order to achieve the national goals is to design a strategic management system in order to discover how to convert this natural talent into tangible and effective functionality in the national economy and even in the region economy to make the Iran's move towards becoming the regional prime power easier (Turks, A., and et.al., 2011).

2.2. Reservoir Management Process

Most of the people know the management reservoir as a synonym with reservoir engineering that in the early 1970 reservoir engineering was proposed as a most important technical aspect of reservoir management (Dvirty, G., and et.al., 2004). Emerge the better methods and technologies, the progress of science and achieve the accurate and safer

information about the conditions and characteristics of reservoirs, the beneficial role of interconnected computer networks and personal computers in performing large operations on data, management, data storage and documentation, etc., the effective role of software in calculating and evaluating the past performances and predicting the future performance of the reservoir, the necessity of applying the team approach and attention to coordination between scientific and operational sections associated with reservoir and etc. Caused significant progress in the reservoir management during the recent 20 to 30 years. Reservoir management as a key for success in the longevity of a reservoir management is to adopt and implement the best possible decisions which make the exploit oil and gas companies to achieve their predetermined goals and commitments about the production (Ghalehbani, A., 2010). All reservoir management process consists of three stages:

1. Reservoir description;
2. Reservoir model argument;
3. Reservoir performance, well performance and field development (Khajavi, A., 2009).

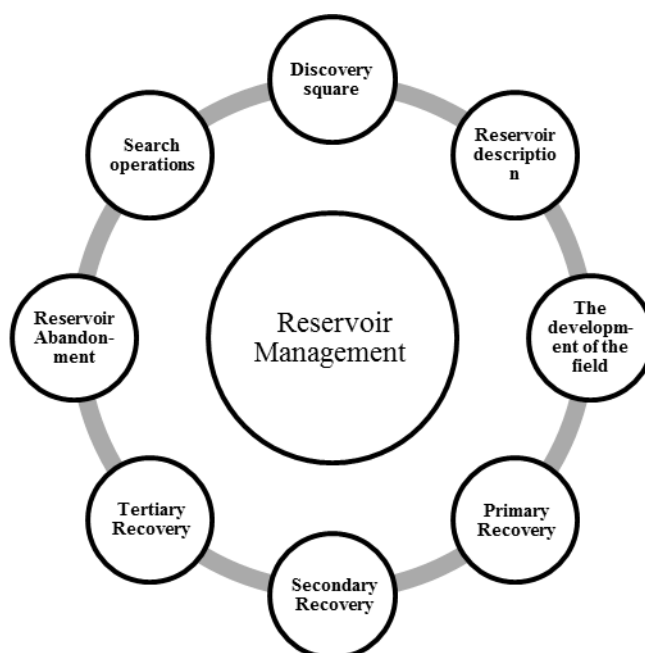


Figure 1. Reservoir management as the key to success in the life of a reservoir.

2.2.1. Reservoir Description

One of the most important stages of reservoir management is reservoir description, this stage is to identify and present a model for describing the reservoir which its behavior and answer be similar to the actual behavior of the reservoir as much as possible. Reservoir description is a dynamic process which is repeated as soon as receiving the new information. Reservoir model is yield from integrating the interpret models of different types of information and by engineering software (Sajjadiyan, V.A., 2011).

2.2.2. Reservoir Model Argument

The aim of reservoir description is to define a reservoir model which shows the dynamic and static information of the reservoir. As soon as the reservoir model is constructed its coordination and compatibility with available interpretative data and information must be proved. In the proving stage, the respond of the reservoir should be computed and evaluated by different simulators such as seismic, well logging, flow and reservoir in order to prove the ability to reproduce the information and data which are mentioned above (Fahimpour, G., and et.al., 2009).

2.2.3. Reservoir Performance, Well Performance and Field Development

After the model was confirmed, this model can be used for predicting the future behavior of the reservoir in different development scenarios. Reservoir production behavior such as pressure, flow rate, fluid saturation percentages are calculated by using the flow adjusted simulators. For predicting the field behavior considering the entire system (reservoir, wells and well head facilities) is necessary and all of these should be studied together. For example, at any point of the system flow rate is determined by the balance of inflows and outflows and by the effects which are applied on the input flow and output flow the flow rate reach the optimal and economical status (Asadzadeh Farkhan, B., 2010).

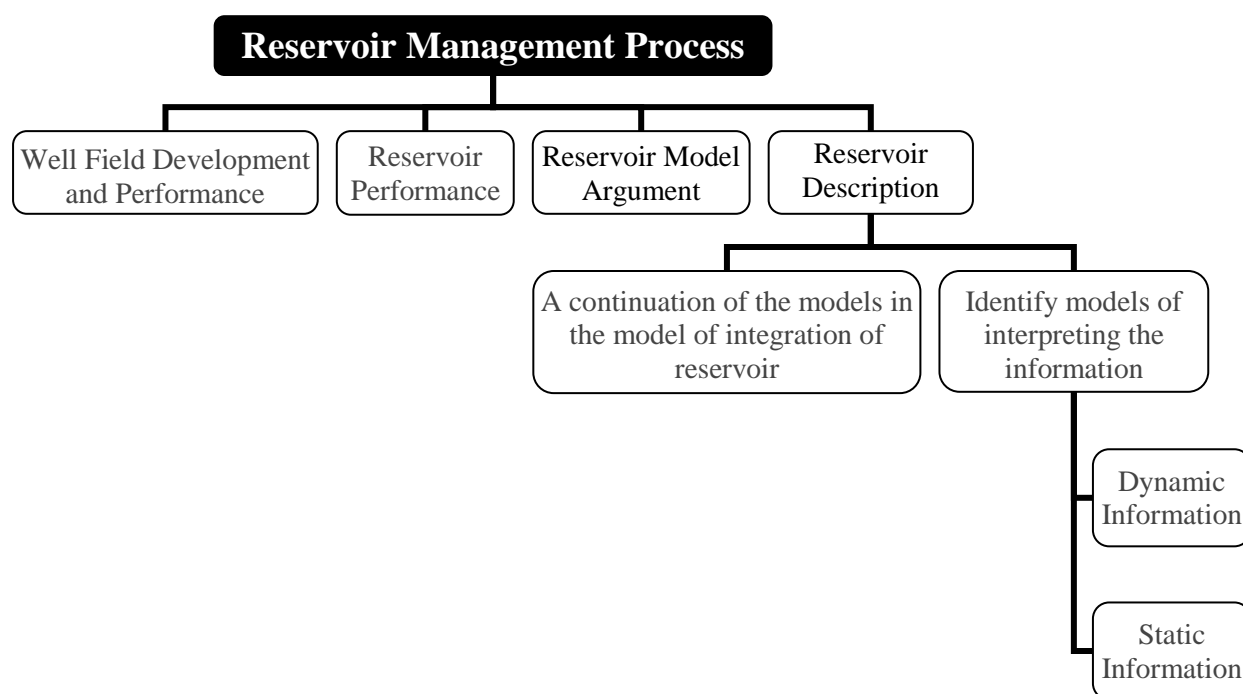


Figure 2. Reservoir Management Process.

2.3. A look at the Challenges of Managing the Country's

Oil and gas reservoirs development process and production process of country's oil and gas reservoirs consist of complex variables which systematic controlling and intelligently planning lead to true and maximal exploitation of them. Some people consider the management of this process as the reservoir engineering and the successful management of a field as a successful engineering of it (Sajjadiyan, V.A., 2012). But some others believe that reservoir management consists of some external and environmental variables which take it beyond the reservoir engineering. Another important point is inappropriate mechanisms for decision-making and policy-making in this area. The mechanisms of decision-making and policy-making should have changed along with the changes and the necessities of this industry. Policy-making has been made up of three parts:

1. Identifying the current situation;
2. Identifying the possible and desirable future;
3. Identifying the methods of reaching the possible and desirable future from the current situation.

Policy-making is a very complex and sensitive matter and developing the appropriate policies need an organized thought which can create new and deep idea through gathering information and analyzing them (Riazi, M.R., 2007).

2.4. The Meaning of Common Fields

In international laws, because of ownership of more than one country on a shared reservoir the basis of technical definition of shared reservoir in international laws is the technical-legal agreement between the countries which are owner of the reservoir (Navazeny, B., and Nojoumi, A., 1999). The definition of shared reservoir in international laws based on technical principals is a geological structure or reservoir which passes from one side of an agreed boundary line and can be exploited and extracted in the other side of boundary line partially or completely (Rebecca, V., 2003),.

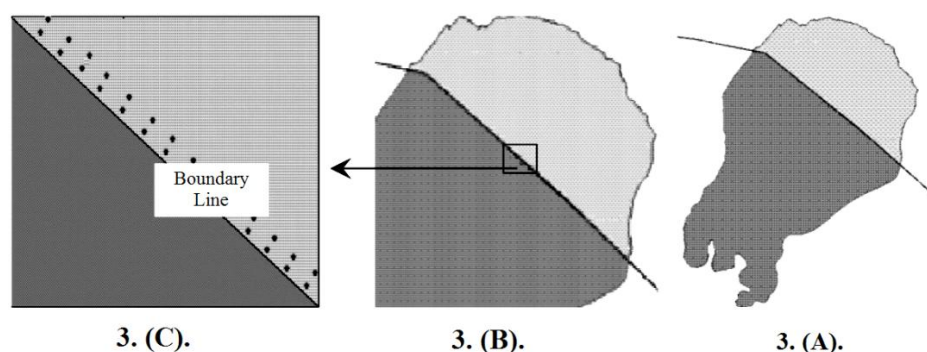


Figure 3. The scheme of a shared reservoir.

3. (A). All the parts of reservoir building

3. (B). Part of the reservoir on both sides of the border

3. (C). Location of two rows of production wells parallel to the boundary line

(Source: *Technical and Specialized Exploration and Production Magazine*, Issue 90)

2.4.1. Indicators of Management for Harvesting from the Common Reservoirs

The pattern which is known as a legal-pattern of management is applied about the reservoirs which are under the sovereignty of two or more independent countries (Honarpour, M.M., and Nagarajan, N.R., 2006).

2.4.2. Advanced Recovery in Common Reservoirs

In the recent years in terms of technical and general policy of optimal management of reservoirs it is recommended that advanced recovery is planned and implemented from the first steps of reservoir development because it is possible that with passing the time the noticeable amount of reservoirs hydrocarbon become unprocurable (Sanday, B., Tjomsland, T., 2007). One of the important methods of advanced recovery which has been implemented successfully in national oil company of Iran for interior reservoirs is stabilize or even increase the reservoir pressure through injecting gas into the gas cap or water into the water driven reservoir (Elk, J.V., Gupa, R., Wann, D., 2008).

2.4.3. Optimal and Scientific Development of Common Reservoirs

The most scientific method of shared reservoirs management is the formation of management joint committee for these reservoirs, this matter not only makes optimum production from the reservoir, but also provides the nations long term benefits. About these cases may be the most efficient method is to deposit the expansion of the reservoir to an international company with clear experience in expanding the reservoirs (Satter, A., Thakur, G.C., 1994).

2.5. Preservation Production from the Common Hydrocarbon Fields

One of the central policies of oil ministry of *Islamic Republic of Iran* in order to stabilize and strengthen it is position in the *Organization of Petroleum Exporting Countries (OPEC)* and the other regional and international arena is to keep and enhance the current capacity of production from the hydrocarbon reservoirs. In order to meet the objectives of the ministry of oil and the consolidation and the promotion of Iran's position as an effective country in the market of supply and energy demand, designing a comprehensive and operational strategy for optimal production and preservation of the hydro carbon reservoirs of the country is necessary (Thakur, G.C., 1980).

2.6. Necessary Actions for the Management of Common Fields

After performing the geochemical, geophysical and the petro physical tests and proving that the reservoir is in common, the following actions should be done according to the level of feeling responsibility by the other side (Elk, J.V., Gupa R., Wann, D., 2008).

2.6.1. Formation of Common Team of Reservoir Management

If the two neighbor countries form common team of reservoir management scientifically and each of them extracting from the reservoir with proper flow rate in a way that the total production rate is less than the permissible limit, then this method will include the least cost and the most advantage for the countries which are the owner of the reservoir in terms of the amount of harvestable oil (Honarpour, M.M., Nagarajan, N.R., 2006).

2.6.2. Making the Performance of Part of the Reservoir which Located in the Country Independent

With arranging the production wells, make a significant portion of the reservoirs which are in the country separate from the other reservoirs and then it will be possible to manage them with optimal production scenario as independent reservoirs (Turkan, A., Aboutalebi, Z., 2010). According to the wave theory when two wells produce near each other a point will exist

between them in which the fluid remains without moving, like pulling a rope from two sides that the resultant forces is equal to zero at a point of it (Sajjadiyan, V.A., 2011).

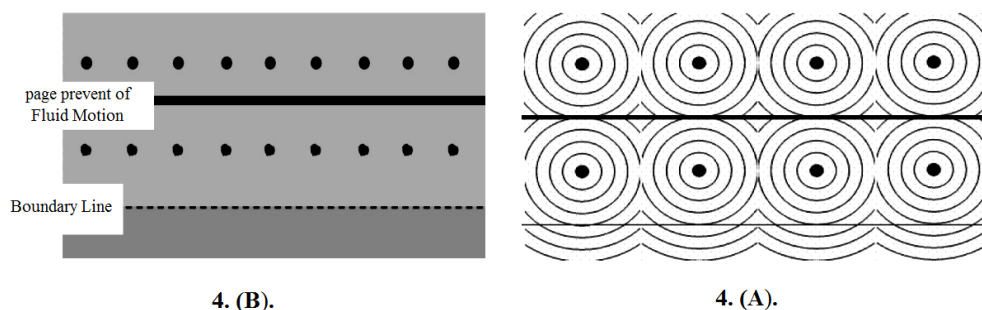


Figure 4. Digging two rows of production wells parallel to the line border:

4. (A). *View of isobaric lines around each well.*

4. (B). *The formation location of the page which prevent the parallel fluid motion to the boundary line.*

2.7. Potentials of Optimal Exploitation from the Common Fields

The thing which is obvious is that each of the 28 Common fields of Iran whether in the west of the country or in the *Persian Gulf* waters can be considered as an important challenge for the future development of oil industry of Iran but if these fields can be managed with intelligence and proper understanding the facts and parallel to, the national determination in different social layers of the country and in the various factions of the society for participating in the development process established the shared fields (Ghalehbani, A., 2010).

3. Conclusion and Presenting Suggestions

3.1. Pluralization

By passing more over 100 years since the founding of oil industry in Iran, one of the most important and oldest challenges facing this industry is focus according to the development pattern based on raw material production or exploiting. The main purpose of this pattern is to maximize the revenue from the sale of crude oil and natural gas. To overcome these challenges turning to the development pattern based on creating capabilities and technological infrastructure is necessary in order to optimal exploitation of oil and gas reservoirs. Another basic requirement is to be equipped with reservoir software systems such as reservoir simulators and field information system software and training in the use of these soft wares. Fortunately some of these simulator soft wares are used in many of the private and government companies in departments of reservoir engineering studies which they are used in the simulation and defining production scenarios.

Common hydrocarbon fields of Iran have significant volumes of extractable reserves of oil and gas. Certainly implementing such programs will have a big impact on the country's energy sector which its effects will appear in all economics sectors. along with the efforts and programs of the Ministry of Petroleum, the oil and gas common issues should be placed in the priority of country's foreign policy to in the shadow of economic, politic and international interactions with the countries of region the tendency of foreign investors for developing the common fields of the country and the possibility of obtaining the advanced technologies increased. This will undoubtedly be effective on achieving the great regional power by Iran. Some of the strategies of development and maximum production from the common fields in order to achieve the macro oil field goals are as follows:

1. Using appropriate and new patterns for attracting foreign investment.
2. The priority of allocation of internal resources to exploit from the common fields.
3. The priority of exploration program in the border areas including onshore and offshore.
4. Development and expansion of bilateral cooperation and interaction with the neighboring countries on the common exploitation from the common fields in full compliance with national interests.
5. Utilization of new technologies for increasing the production.
6. Considering the conventional models and accelerating the executive programs for developing the shared fields by using the power of domestic specialists and manufacturers.

The above issues in addition to the need for technical professionals in the oil industry need the regional overseas diplomatic efforts as well as country's macro policies.

3.2. Suggestions and Strategies

Preservation of the hydrocarbon reservoir is the function of applying the known reservoir's advanced management strategies and the principals which are mentioned below:

1. Depletion rate is considered appropriately which be in coordination with the situation of low permeable reservoir in Iran and increase the lifetime of the reservoir.
2. Gathering information and monitoring the performance of the reservoir should be done regularly in order to recognize the characteristics and mechanisms of production as well as determining the uncertainties and their effects on the forecasts scenarios.
3. Create a coherent strategy fits with the goals of preserving oil and gas reservoirs and consequently, determining the priority technological areas of the oil and gas upstream sector in the oil industry.
4. Considering the technology principals in the line with the macro policies of oil industry and attracting internal and external investments in order to preserve and optimal production from the fields.
5. New exploration fields enter the production and development circuit gradually in order to strengthen the status of Iran in the global oil and gas markets more than before.

6. Investment contracts in the part of exploration the hydrocarbon resources should be set and verified in a way which provide the possibility of presence and activity of domestic private sectors that have less financial and risk taking power than the international companies.
7. It is necessary that the academic courses which related to *Petroleum Exploration Engineering* be updated by considering these changes and the training courses for the staff of exploration section in the *National Iranian Oil Company (NIOC)* of should be planned.
8. Today country's need in the exploration section with considering the available financial priorities is to explore the hydrocarbon resources especially in the boundary regions which have the functionality of exploitation and production.

In terms of scientific attitude and with considering the available international and regional challenges, the below principals constantly should be placed in priority for all of the common reservoirs:

1. Scientific and optimal method of reservoir development obtained by technical interaction with the owners of the reservoir and implementation of optimal production scenario for the reservoir.
2. Even though for placing a reservoir in the list of the common reservoirs passing the boundary line from the last closed curve of the reservoir is essential but the extent of hydrodynamic association should be estimated by gathering static and dynamic reservoir data in order to suggest an optimal plan based on reservoirs comprehensive studies for reservoir development.
3. The most economical advanced recovery methods for the common reservoirs are the quick impact methods which act in the form of regional. According to the required recognition of the shared oil and gas fields, more investment must be done for developing these fields in medium term in order to achieve a fair share from these reservoirs.
4. Common reservoir management should be done in common in order to avoid damaging the reservoirs. Lack of optimal exploitation from the shared oil and gas reservoirs which are because of not having the reservoirs total data and lack of knowledge of reservoir management lead to reduction in production or closure of the reservoir and threaten the interests of the parties.

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