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INVESTIGATION THE NON-PRODUCTIVE TIME AND RELATED DRILLING CHALLENGES IN AZAR OIL FIELD

A.S. Rahmati[1], S.R. Shadizadeh[2]
[1]Corporate Planning Department, NIOC, Tehran, S.RAHMATI777@GMAIL.COM
[2]Petroleum Engineering Department, PUT, SHADIZADEH@PUT.AC.IR

Abstract: Non Productive Time (NPT) is the principle reason of drilling project delays. There are various occurrences or situations that lead to stoppage of drilling operations or marginal reduction in advancement of the drilling progress. These occurrences are either observable or unobservable and may be due to the physical characteristics of the well, geology, drilling parameters of the well, operator experience, wellbore quality, equipment downtime, well planning and execution, team communication, management, or project management abilities. Non Productive Time is directly proportional to drilling cost and if it becomes out of control could result in escalation of costs sometimes beyond budgetary allocation. The purpose of this paper is to perform an evaluation on the Non-productive time experienced while drilling wells in Azar oil field. The Azar field is one of the most complicated and challenging for drilling operation in the west Karoun. It has excessive and low pressure layers that are very close to each other. The drilling process can take more than a year, not because of depth but the complex nature of formations. The analysis showed two factors of stuck pipe that leads to fishing operation and low rate of penetration (ROP) had the most influence on creating waiting times. In this study, effective factors hindering the process of drilling operations as well as the related NPT are investigated. Finally, some solutions are presented.

Keywords: NPT, drilling cost, challenging drilling operation, stuck pipe, fishing, low ROP.

1. INTRODUCTION

As time goes on, the human civilization demands more and more sources of energy. Nowadays, the main sources of energy are oil and gas [1]. This propels the companies to drill deeper to produce more petroleum. Due to variable characteristics of deep layer the drilling operations encounter more problems, which needs more time for handling. Non-productive time is defined as the time through which the drilling operation is stopped or the rate of penetration is very low [2]. Time spent on pipe stuck, fishing, tool transportation, tripping in/out, and lost circulation as well as lost time due to bad weather are considered as NPT [3]. Regarding project management, the drilling operations should be coinciding with the defined schedule and budget. Some drilling problems as well as some technical and untechnical lost time result in digression from the schedule. In such cases, more time should be spent on drilling operation, which is not desirable for drilling contractors in financial point of view. Total drilling time comprises of conventional drilling time and reducible and irreducible NPT. Recognizing reducible NPTs and reducing them has a key role in drilling operations. This can be done through an integrated management plan [4].

Drilling is one of the most critical, complex, and costly operations in geothermal resource development projects. While drilling costs are responsible for nearly half of the well expenditures, less than half of the total drilling time is spent on actual drilling operations but rather on dealing with problems associated with the drilling operations, rig movement, equipment breakdowns, and waiting periods for materials [5]. From project management point of view, drilling operation should always be on schedule and on budget. Occurrences of drilling problems, which cause delays often, push drilling operation behind schedule.

During the drilling process, there are numerous occurrences or eventualities that cause stoppage of drilling operations or marginal reduction in advancement of the drilling progress. Such occurrences are classified as non-productive time (NPT).

Non-Productive Time (NPT) is defined as time which drilling operation is stopped or penetration rate is very low; for example, time spent on fishing, stuck pipe, waiting on equipment repairs, tool transportation, lost circulation and tripping in/out [6]. Non Productive Time (NPT) is the main cause of drilling project delays and huge costs overruns in drilling projects due to standby charges and penalties on equipment and personnel [7].

2. AZAR OIL FIELD

Azar structure is an asymmetric anticline located in the Anaran exploration block in the foreland basin of the Zagros fold and thrust belt along the Iran-Iraq border. Total length of the field (on top of Ilam formation) is more than 36.5 km including the extension in Iraq and approximately 13.5 km on the Iranian side. The development plan is designed to produce 65,000 BOPD of which 30,000 BOPD will be reached in the first stage (early production). The development plan totally consists of drilling 19 wells. This field Shared with Iraq's Badra, along Iran-Iraq borders in the southwest of Ilam, between two cities of Mehran and Dehloran. The field is one of the most complicated hydrocarbon fields in the region.

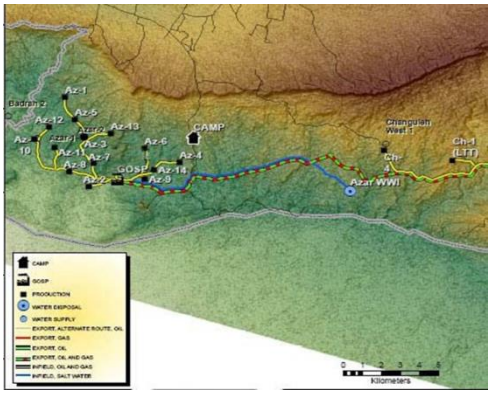

Figure 1 Map of the Azar oil Field

3. DRILLING CHALLENGES

Drilling in the Azar field had so far proven to be very challenging. The main drilling challenges were:

- Two high-pressure zones with a weak zone between them;
- Well control issues in the Gachsaran, Pabdeh, and Gurpi formations – influx of high pressure water;
- Narrow drilling window – small difference between gain and loss situations;
- Salt in Gachsaran and Kalhur formations;
- Potential for mud losses in nearly all sections;
- Cementing operations in high mud weight, adding to the wells complexity; and
- Slow ROP in Agha Jari and Gachsaran formations.

4. RISK ELEMENTS APPLIED TO EACH WELL

In addition to the base times generated above for the drilling and completion activities, operational event based risks along with a probability of occurrence have been added on a section by section basis in order to generate the expected well time used in the drilling schedule. The following list is a summary of the operational event based risks that have been added to the base time and included in the drilling schedule:

- Performing a sidetrack due to drilling or coring related problems;
- Remedial cementing operations, i.e. requirement to perform a cement squeeze;
- Remedial operations caused by failures in drilling or coring equipment;
- Premature motor and/or bit failure resulting in additional Bottom Hole Assembly (BHA) trips;
- Liner hanger installation problems;
- Fishing operations;
- Curing losses observed while drilling;
- Recovering from high pressure kick incidents;
- Completion component failure observed while running the completion;
- Re-drilling the well;
- Problems related to coring; and
- Delays due to custom clearance for drilling equipment and supplies

5. TIME ANALYSIS

Through analyzing the secondary data obtained from drilling logs, daily drilling reports (DDRs) and well completion repots, the analyses of the NPT in drilling Azar wells in west Karoun was performed. DDRs include the drilling progress in a summarized format providing some information about planned start and completion dates, well details, meters drilled in the last 24 hours, current depth, and the current status. All the drilling activities are recorded in the DDRs on an hourly basis.

Among the drilled wells in this field, five wells were chosen for NPT analyses considering the following issues:

- Different drilling rigs had performed the drilling operation for each of chosen wells;
- The actual drilling duration exceeded the planned drilling duration; and
- There were at list one kilometers distance among the chosen wells.

Through the NPT analyses, a comprehensive comparison was carried out for the planned and actual drilling duration for wells Azar-003, Azar-004, Azar-005, Azar-006 and Azar-007. Every digression of the actual drilling duration from the plan was precisely investigated to find out the true cause of delay. The main source of data for this study was drilling logs and DDRs along with information gathered from interviewing with drilling personnel.

A step-by-step method was incorporated in the analyses of NPT for each well. These analyses were performed from the spud-in data (the first day) to the completion date. To provide the following inferences, the collected data were tabulated:

- What % NPT comprise the total drilling duration;
- Which is/are the main causes of NPT;
- What is the main cause of NPT in selected wells; and
- What is the main cause of problems

In the following first charts the drilling time and drilled depth (actual and planned program for each well) are shown. Then the causes of waiting time for each well are shown separately in next pages.

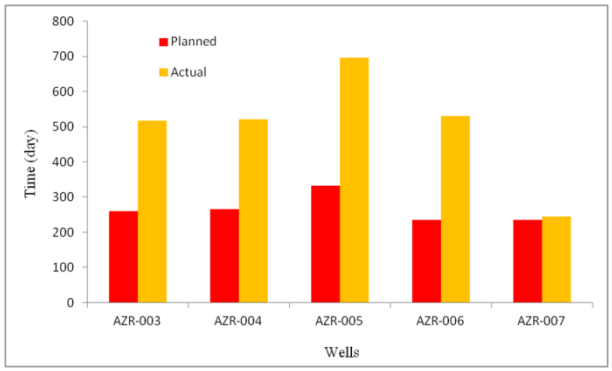

Figure 2 Actual drilling time vs. Planned for Azar oil field wells

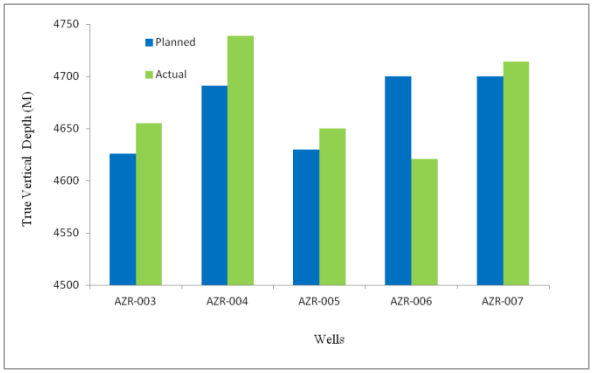

Figure 3 Actual drilled depth vs. Planned for Azar oil field wells

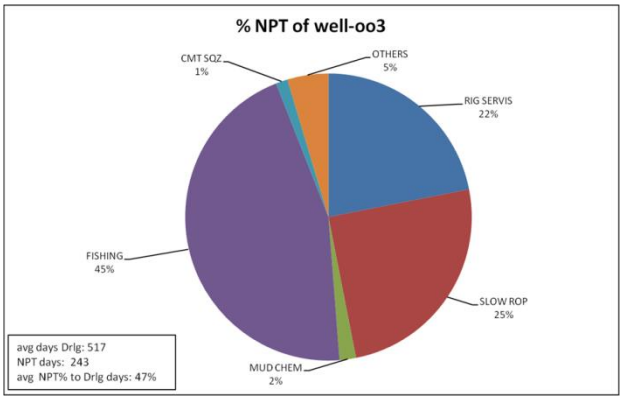

Figure 4 Fishing as a 45% of NPT for well-003

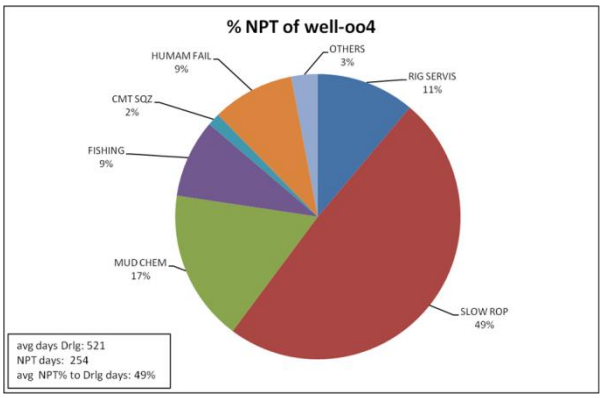

Figure 5 Slow ROP as a 49% of NPT for well-004

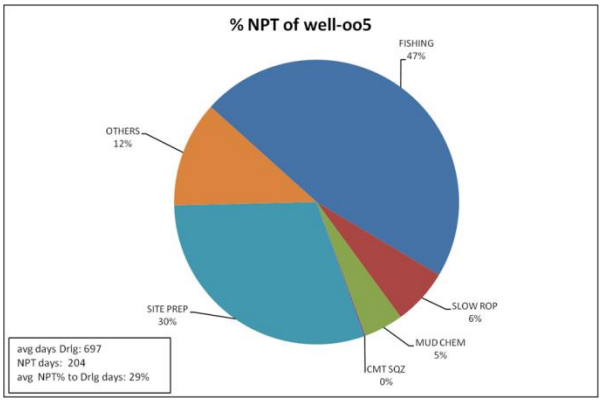

Figure 6 Fishing as a 47% of NPT for well-005

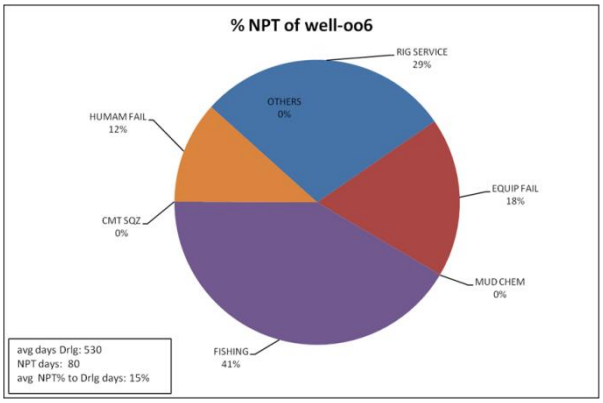

Figure 7 Fishing as a 41% of NPT for well-006

Petrogas Industrial And Mining Research Centre, Tehran, Iran, icogpp@gmail.com

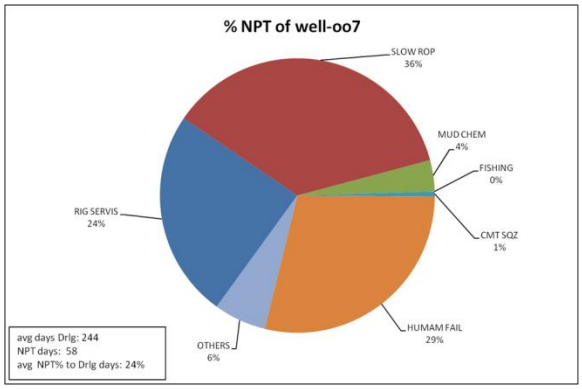

Figure 8 Slow ROP as a 41% of NPT for well-007

6. RECOMMENDATIONS

Considering the geological complexity and lack of necessary data, it is may be assumed the greater duration of drilling in the Azar oil field is a common issue. In such cases, it is normally tried to utilize all the available data and field studies such as borehole stability so that it is possible to considerably decrease the drilling time and consequently the corresponding costs. The proposal at this stage is to do integrated studies of geomechanic in the Azar field to decrease NPT and increase the efficiency of drilling operations.

Mostly, oil-based mud will be used in handling issues related to shale drilling.

Shale formations should be drilling with a type of mud that prevents penetration of pore pressure into the well. If the initial mud weight is properly selected it prevents the shale failure. In some places, this issue can be locally prevented by increasing the mud weight. Increasing the mud weight sometimes prevents the collapse of the borehole wall.

In this field, it is recommended using glycol-based mud in shale formation to prevent stuck pipes. Glycol-based muds prevent shale hydration and help well bore stability in shale formations.

7. CONCLUSIONS

Formation challenges resulting to stuck pipe, fishing operations, and hole cleaning problems are major contributor to NPT.

The average NPT in 5 wells of Azar oil field accounts for 32.8% of the total drilling time. Just as many other land rigs, waiting on fishing and slow ROP are the biggest challenges in the studied 5 wells. Predicting the rate of penetration (ROP) is critical for drilling optimization because maximization of ROP can greatly reduce expensive drilling costs.

Slow ROP item back to inappropriate bit selection or compulsion to use the product in stock. This is partly as a result of long government procurement process that has to be initiated every time there is unforeseen breakdown.

The key elements of a fishing operation include an understanding of the dimensions and nature of the fish to be removed, the wellbore conditions, the tools and techniques employed, and the process by which the recovered fish will be handled at surface.

Due to absence of top drive technology, some drilling pipes may fall in the well and fishing is inevitable. In addition, because of unsuccessful fishing and consequently more drilling duration, it is sometimes necessary to do side track drilling. Another reason is sensitivity of shale's formation in Azar field to water. Shale hydration leads to a decrease in strength and broke them.

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