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Case History of Unique Dual Cutting Eccentric Reamer to Address Poor Wellbore Condition While Reducing Non-Productive Time in Drilling Operation Indonesia

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Abstract. Historically the main focus of cost reduction and drilling improvement exercises has been to focus on reducing on-bottom time by improving ROP and drilling entire hole sections with a single bit. This has been so successful that in most cases only minor additional improvements are available and the potential cost reductions are much smaller. However, there has been less attention on reducing the time when the bit is not on bottom such as trips, wiper trips, backreaming, etc. When this time is analyzed in detail it becomes apparent that much of it is spent improving the quality of the wellbore to facilitate tripping and running casing or liner. This is where significant savings can still be made and such simple tool need to be added in the BHA to address the wellbore conditioning issue.

The paper discusses some cases of drilling operation in Indonesia where the hole sections are considered challenging such as Pipe stall, overpull, stuck pipe, and tight spots that are typically experienced during drilling and tripping. It also results in difficult trip-out BHA and subsequent trip-in with casing.

A unique dual cutting eccentric reamer tool was introduced to help to improve the wellbore quality. The tool removes or smooths out irregularities in the wellbore geometry during drilling and reaming operations. After several case, the tool solved many cases of wellbore condition issues. In one of west java drilling operation, the time savings in pulling out of hole was improved by average 78% in the 12¼-in. section and average 45% in the 17½-in. While in delta mahakam drilling operation, the tripping speed of the BHA is improved from average 82 m/hr to 192 m/hr (or about 139% improvement). In addition to that, the tool has also solved some cases to facilitate tripping in casing to designated depth. Ultimately, the tool has added a new capability for drilling improvement and optimization through wellbore conditioning, removing risk of pipe stuck, reducing non-productive time and interval costs which ultimately contributes to lower drilling cost.

Keyword(s): drilling, wellbore condition, improvement, cost reduction, eccentric reamer

1 Introduction

Jatiasri and Akasia Bagus fields are the two of the main onshore development drilling areas in the West Java basin, Indonesia.

The drilling well architecture in the Jatiasri (JAS) and Akasia Bagus (ABG) fields are typically J-type and/or S-type profiles with a maximum inclination of about 35°. **Figs. 1** show the typical well geometry and lithology of the JAS field.

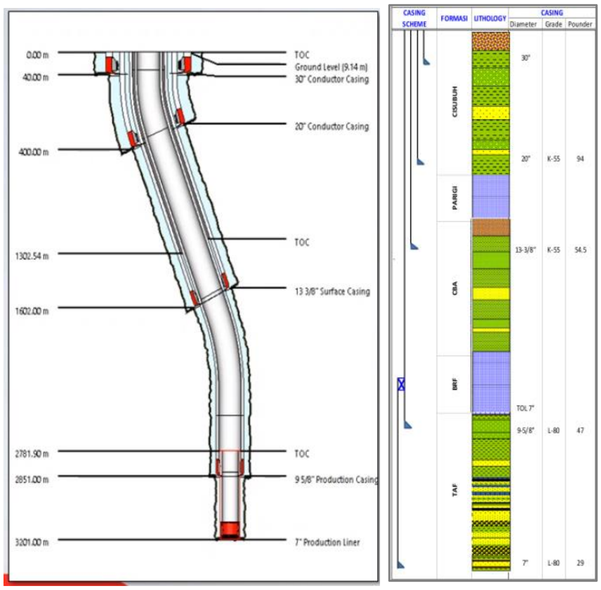

Fig. 1—Typical well trajectory and lithology in the JAS Field.

The directional intervals are drilled through challenging interbedded soft claystone and hard limestone where pipe stall, overpull, stuck pipe, and tight spots are typically experienced both during drilling and tripping, resulting in difficult trips out and subsequent trip-in with casing. In the worst cases, the casing cannot reach the desired setting depth and either must be pulled out and perform an extra wiper trip, or the casing is set higher than planned.

While in East Kalimantan, handil is one of the swamp field that is well-known as a crowded well area with typical 3D trajectory and hard formations. The reservoir itself is divided into two intervals; the main zone, and the shallow zone. The main zone is located within the interval between 2,200 – 5,000 mSS depth with the characteristic of consolidated sand while the shallow zone is located in the interval between 700 – 1,500 mSS depth with the characteristic of an un-consolidated sand reservoir.

During the well construction phase, shorter well duration always be the first priority. Due to marginal reserve, well cost is an important factor. Drilling performance and shorter drilling duration are required. Strategies such as fast drilling ROP become a common practice to reduce the well duration. Particularly in Handil field, with complex trajectory and challenging sub-surface formations, another focus is aimed to improve hole quality and optimizing tripping out speed of the BHA. Due to lithology factor, the tripping out speed in Handil 8-½" reservoir section is the slowest compared to other surrounding fields such as Tunu and Tambora.

The two cases above are a sample of poor borehole conditioning related to micro-doglegs or tight wellbore issues. The condition is identified by excessive trip times, frequent reaming/backreaming, and problems running casing. The tight wellbore condition issues are commonly coming from operational or geological factors.

Operationally induced wellbore irregularities include:

- Spiraling caused by using a downhole motor
- Transitions in wellbore size from rotating to sliding with bend-housing motors
- Doglegs created by sudden changes in wellbore trajectory

Geological wellbore irregularities include:

- Swelling of shale caused by reaction with free water in the drilling fluid
- Ledges caused when drilling through alternating hard and soft lithologies
- Wellbore distortion due to stress relief in tectonically stressed areas

2 METHODOLOGY AND IMPLEMENTATION

To overcome the challenges, a dual cutting eccentric reamer tool or borehole condition reamer (BCR) is introduced to be added in the bottomhole assembly (BHA). Unlike common underreamer tools or other hole opening tools that are either mechanical or hydraulic activated and create a high hole opening ratio, the unique eccentric reamer tool itself only trim the wellbore. The BCR tool removes or smooths out irregularities in the wellbore geometry during a drilling and reaming operation. **Fig. 2** below shows how the tool works to smoothen the wellbore on the kick-off area.

Fig. 2—How a unique eccentric reamer works.

This new simple, unique eccentric reamer was developed to trim any tight spots, smooth micro-doglegs, and agitate the cutting beds in directional applications.

Features and benefits of the “unique” eccentric concept include:

- Simple and robust design that can drill larger diameter holes.
- Allows passing through an ID casing.
- Allows sliding behind a bit in the motor assembly.
- Minimizes micro-doglegs more efficiently than a concentric design.
- Can be used when drilling forward, backreaming.
- Added benefit of stirring cutting beds.
- Allows fishing of most retrievable components.
- Enables drill-out operation without damaging the casing.
- No moving parts as well as no nozzles, so there is no hydraulics implication.

Fig. 3 shows the picture of a unique eccentric reamer tool (BCR tool).

Fig. 3—A unique eccentric reamer tool (BCR tool).

Table 1 shows detailed tool specifications.

Specifications							
Bit Size	Tool Diameters			Makeup Length	Junk Slot Area	Collar OD (In.)	Tool ID (In.)
	Pass-Through Size	Drill Size	Max Tool Size				
8 ½ in.	-0.125 in.	+0.1250 in.	7.750 in.	3.97 ft	17.140 in.²	6.625 in.	3.000 in.
12¼ in.	-0.125 in.	+0.1875 in.	11.25 in.	6.67 ft	56.080 in.²	8.000 in.	3.000 in.
17½ in.	-0.125 in.	+0.2500 in.	16.00 in.	7.50 ft	120.00 in.²	9.500 in.	3.000 in.

Table 1—Tool specifications.

3 RESULTS

3.1 Drilling Operation in West Java

The first trial of the BCR tool was discussed in the 12¼-in. case study. The tool was run in an S-type well with the 12¼-in. hole section from tangent at 25° to vertical using a common motorized RSS BHA. The use of the tool showed a positive result. The BHA strings pulled out of hole without requiring a backreaming operation and additional wiper trip. Hence, the time spent for backreaming and pulling out of hole (POOH) was significantly reduced. In the subsequent operation, the 9⅝-in. casing was run smoothly and completed as per the plan.

In the second and third trial runs of the 12¼-in. BCR tool using similar BHA, the pulling out of hole time and casing running consistently improved. Moreover, the need for backreaming and cleanout trips was also eliminated, as shown in **Fig. 4.** Through 3 runs of BCR tool in 3 different well, the drilling cost is saved estimated around $ 1,300,000 or over than 44 Rig operation days.

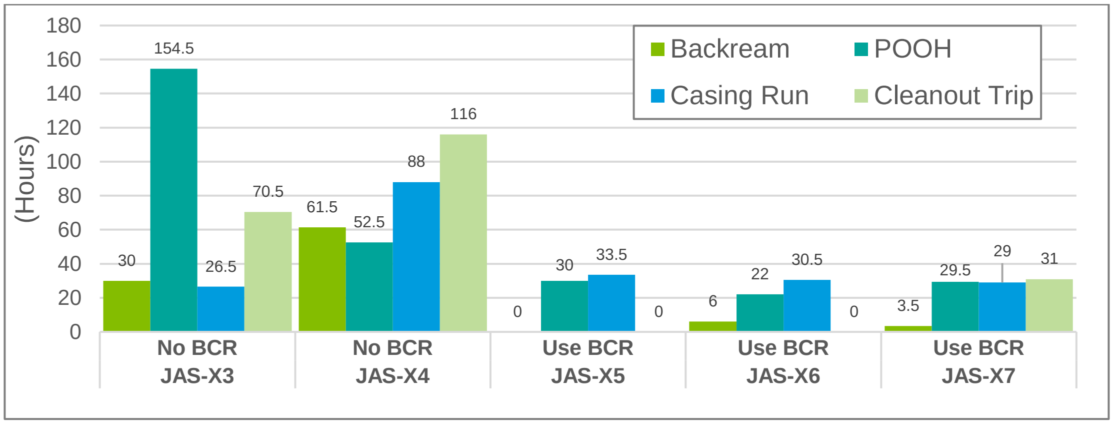

Fig. 4—The 12¼-in. time for back reaming, POOH, casing running, and cleanout trip.

Following the three successful trial runs as shown above, the 12¼-in. BCR tool were decided to be implemented as a standard component in the BHA to improve borehole condition. **Fig.5** below shows total of 17 runs in the JAS Field performed consistently, with average 78% improvement in POOH time and another 44% during running 9 ⅝-in. casing.

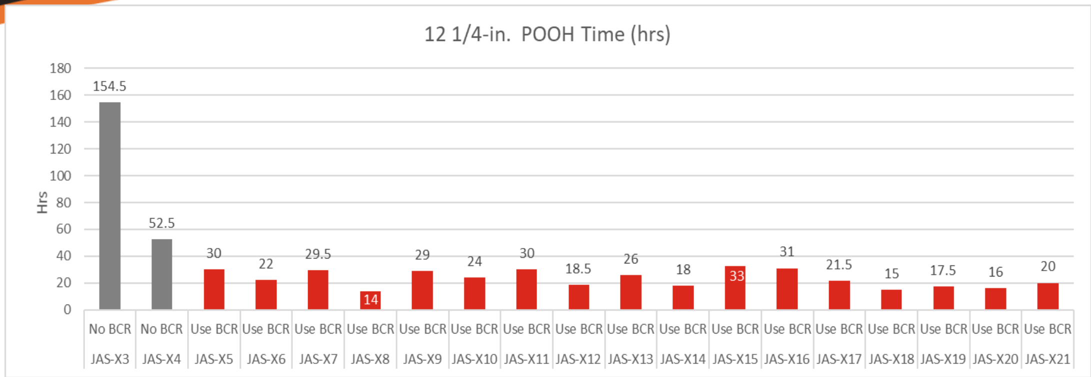

Fig. 5—The 12¼-in. POOH time.

In the 17½-in. the BCR tool was used in the ABG Field. After three runs of the 17½-in. BCR tool, the pulling out of time improved by average 45% compared to the previous well without running the BCR tool. Also, the 13⅜-in. casing was run faster with average 65% improvement and landed at minimal targeted depth, reducing nonproductive time (NPT), as shown in **Fig.6**. The total time savings after three runs were approximately 73.49 hours or 3 days of operating with estimated saving cost is about $ 306.208.

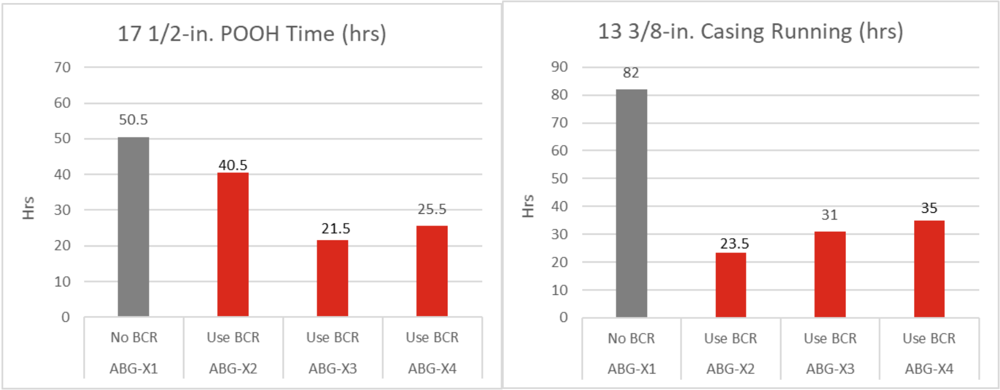

Fig. 6—POOH time and casing running hours.

3.2 Drilling Operation in Swamp, East Kalimantan

The first trial was considered as successful as it improved the POOH speed by 120% from the average tripping speed in offset wells without BCR. The wellbore geometry that is smoothened by the reamer allowed POOH speed to increase which eventually reduced the rig time. The second and third trials on HMZ-9 well and HMZ-10 respectively were conducted for the same purpose, where BCR successfully achieved the objective with 277% & 103% POOH speed improvement while having no downside to the drilling process, **Fig. 7**.

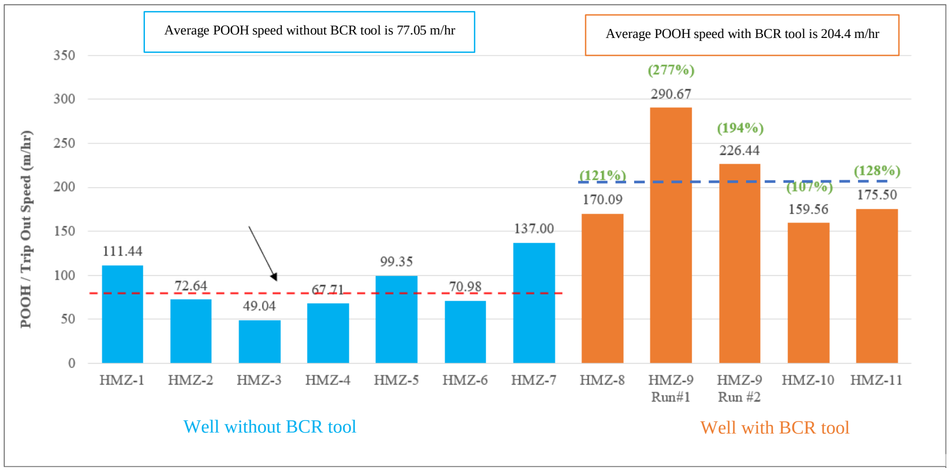

Fig. 7—POOH speed improvement with BCR tool

3.3 Drilling Operation in Offshore, East Kalimantan

There is a case where after completed drilling 12 ¼" hole section using directional BHA without BCR tool, the 9 5/8" casing was directly running in hole and stop at depth 4873 ft MD tangent section (bottom hole section at 6,415 ftMD). Formation instability was suspected that cause tight hole condition. Therefore, it requires to pull out the casing to surface and pick up dedicated BHA trip.

The 12 ¼" BCR tool was proposed in dedicated BHA trip to smoothen the hole and reduce tight spots. As a result, the tool has successfully helped in eliminating tight hole issue and facilitated 9 ⅝" casing smoothly running to bottom. No tight spots were also reported during casing running.

4. CONCLUSIONS

Through close collaboration with the drilling operator, a step change in reducing overall drilling cost in drilling operation Indonesia has been achieved. Following a detailed post run evaluation, further changes to the tool design have been developed to enhance the tool performance and durability.

- The unique eccentric reamer tool (BCR tool) successfully addressed wellbore condition such as tight hole through improves pulling out of hole time and casing running as well as eliminated pipe stall, hard reaming, and potentially stuck pipe.
- The BCR tool has no downside for any BHA (Mud Motor, point the bit and/or push the bit or even motorized RSS) as well as can also be used for effective cleanout run.
- The utilization of BCR tool in the BHA drilling can be recommended to eliminate requirement for wiper trip or cleanout trip.
- In Sum, effective method of using BCR tool could reduce non-productive time and interval costs which ultimately contributes to lower drilling cost.

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