Causes and Treatment Methods of PDC bit Body Drop Accident in Gao a Well

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Abstract. In the process of drilling the Halliburton PDC bit in the 311.2mm borehole, the No. A well in Gaoshi experienced a drilling accident first. After drilling the drill, no problem was found and then re-into the well, but the well was unstable. There was a collapse phenomenon, and a stuck drill was encountered. After the treatment, the PDC bit body was found to be neatly broken when the worker lifted the drill. Finally, after several rounds of grinding and wire fishing, the accident was effectively treated.

Key words: PDC drill bit, Break, Milling, salvage.

1. Basic situation of the wellhead in this paper

1.1. Basic data

| Table 1. Basic data analysis of wellhead |
|----------------------------------------|
| Well No. | Gao A Well | Well type | Vertical well |
| Location | 4 Group, Jiqiao Village, Xinglong Town, Anyue County, Ziyang City, Sichuan Province |
| Tectonic location | West of the Gaoshi Ladder Structure of the Leshan-Longnvsi Ancient Uplift in the Sichuan Basin |
| Design well depth | 4790m |
| Drilling horizon | Cambrian Canglangmu Formation |
| Destination layer | Cambrian Longwangmiao Formation |
| Well structure | 660.4mm drill bit* 32.60m, 508mm casing *32.54m; 444.5mm drill bit*506.7m; 339.7mm casing *506.67m; Cementing quality is qualified. |
| Accident depth | 1471.07m |
| Accident level | Daanzhai |
| Drill assembly | PDC drill bit + 244 straight screw +731 * 730 back to + Ф 228.6mm drill collar 2 + D308 centralizer + Ф 228.6mm drill collar 4 + 731 * 630 + Ф 203mm drill collar 3 + 631 * 410 + Ф 165mm drill collar 3 + Ф 127mm drill pipe |
| PDC model | Manufacturer: Halliburton FX55D (repair bit). ID: 12161584. Nozzle: 15.9mm*8 |
| Drilling parameters | Drilling pressure 100-120kN, Speed 30rpm + screw, Displacement 52L/s, Pumping pressure 19Mpa; |
| Drilling fluid performance | Potassium chloride polymer drilling fluid, Density 1.68g/cm3, Viscosity 61s, Water loss 2, mud cake 0.5, shear force 1.5/5.5, containing 0.2, Ph 8; |
1.2. Drilling and drilling down
Three drills into the depth of 998m (Sand II), began to gradually increase the drilling fluid density (1.10g/cm³ ↑ 1.68 g / cm³, design density of 1.27-1.35 g / cm³), but there is still collapse in the well, drilling The torque fluctuates greatly[1], and the block debris is returned from the exit. The single root can only be taken out by the reverse eye, and it is difficult to squint. It often needs to be repeated repeatedly to improve, and the screw is downhole. In the process of squinting, card issuing, pumping, and reversing phenomena often occur, which brings certain difficulties to the judgment and operation of the well.

The situation of drilling and encountering resistance: 4:00 on September 11th, well depth 1266.35m, drilling down to well depth 510.89m (just out of casing shoes) encountered resistance 50KN, squinting to well depth 617.58m[2], returning to normal, analysis may be mudstone The diameter is reduced; at 6:50 on September 14th, the depth of the well is 1474.92m, the drilling tool is tripped, and after the big head cone is salvaged successfully, it will reach the well depth of 1398.86m and the pump will slowly re-draw to the well depth of 1373.21m and then return to normal; At 18:00 on the 15th of the month, the depth of the well was 1474.92m, drilling down to the well depth of 1A9.36m and resisting 50kN[3], slashing to the well depth of 1249.06m, returning to normal drilling, down to the well depth of 1316.87m again, and then drilling back[4].

1.3. Drilling time and lithology description before the accident

| Well       | M-level         | Average m/min | Lithology description                                      |
|------------|-----------------|---------------|-------------------------------------------------------------|
| 1470–1478  | Liangshan       | 15            | Sandstone, mudstone, uneven distribution of mud, muddy cemented, dense, hard. |
| 1479–1488  | Transitional section | 12            | Mudstone, pure in nature, soft in nature and good in water absorption. |
| 1489–1494  | Da'anzhai section | 22            | Limestone, fine powder crystal structure, small shell size, scattered distribution, pure quality, denser, brittle. |
| 1495–1502  | Da'anzhai section | 21            | Mudstone is pure, soft and good in water absorption. |
| 1503–1522  | Da'anzhai section | A             | Limestone, fine powder crystal structure, small shell size, scattered distribution, pure quality, denser, brittle. |
| 15A–1524   | Da'anzhai section | 30            | Limestone, mudstone and mudstone are mud-powder crystal structure, which is dense and brittle. |

2. The accident happened

2.1. Drill slider
On September 11th, the 311.2mmFX55D PDC bit and the 244mm straight screw were inserted into the well. At 19:40 on September 13th, the depth was 1474.92m, and it was ready to take a single root. When it was redrawn to the depth of 1469m, the turntable phenomenon appeared. Suspended weight suddenly dropped from 629KN to 505.9KN. The reason for the analysis was that the screw reversed and caused the drill to buckle down. The test butt joint was unsuccessful for 6 times. It was decided to start the drill inspection [5]. After the drill, 203.2mm drill collar was found to be single and ordered. The root slip
buckle, the single male buckle end of the 203.2mm drill collar is seriously worn, and the fish falling from the well is 77.54m long.

Falling fish structure: PDC bit 0.37m+244.0mm screw 9.57m+ back pressure Versal 0.58m+228.6mm drill collar 2 18.72m+308.0mm centralizer 1.20m+228.6mm drill collar 4 root 37.30m+731 × 630 joint 0.78m + 203.2mm drill collar 1 9.02m.

At 1:30 on September 15th, the big-headed male cone was used to salvage all the fish, and the drill was inspected. The drill bit was 90% new, the teeth were slightly worn, the body was not damaged, and the well was again entered [6].

Figure 1. The first time

2.2. PDC body fracture
At 12:30 on September 17th, drilling to the depth of 1524.60m, the mechanical drilling speed was reduced to 30min/m, and the drilling was decided; 12:50~14:00, the eye was drilled to the depth of 1517.73m, and the torque was suddenly abnormal. After stopping, the turntable can be locked to see that the counter torque is large, the screw is reversed, and then the displacement is reduced by 48L/s ↓ 24L/s, and the active drilling tool is used. The original suspension weight is 610 ↑ 850KN, and the original suspension weight is 610 ↓ 450KN[4]. The card is untied, the turntable is reversely twisted, and there is still a pump 7.5MPa ↑ 13.6MPa; 14:30 tie the hooks and rings of the rider, check the lifting system and the wellhead tool, and prepare to increase the range of the upper and lower movement of the drill; 15:30 The lower drilling tool, the original hanging weight 610 ↓ 450KN, the original hanging weight 610 ↓ 400KN, the original hanging weight 610 ↓ 300KN, the original hanging weight 610 ↓ 250KN, unsolved[5]; multiple gradually increase the tonnage lifting tool, the original hanging weight 610 ↑ 1100KN, original suspension weight 610 ↑ 1500KN, original suspension weight 610 ↑ 1800KN, original suspension weight 610 ↑ 2000KN, original suspension weight 610 ↑ 2100KN, original suspension weight 610 ↑ A00KN unsolved card, original suspension weight 610 ↑ 2500KN card After drilling from 00:00 on September 18, the D311.2mmFX55D-PDC drill bit was taken out and the bit body was found to be neatly broken[6].
Figure 2. Starting situation

Figure 3. Starting situation

3. Accident handling

3.1. Milling

2 times using original grinding shoes+fishing cup milling, grinding and milling section 1518.32 ~ 1518.50m, drilling pressure 30 ~ 40kN, speed 30 ~ 45r / min, pump pressure 3.5 ~ 4.0MPa, multiple times under the squat 200KN[7]. 2 After the hour, the drill bit fell to the bottom of the well; continue to chase, milling the well section 1524.45 ~ 1524.50m, drilled after repeated salvage, and harvested a total of 2.5kg of carcass, nozzle, composite sheet, etc. (Figure 5). The grinding shoes are all flattened (Fig. 4).

Figure 4. Out of the well grinding shoes
Due to the large drop in the well, the D300mm Nok welding rod is used to process the bottom grinding shoes. The grinding and milling section is 1524.50~1524.65m, the drilling pressure is 40KN, the pump pressure is 4.0MPa, the displacement is 880L/min, and the rotation speed is 50r/min. It took 15 hours to drill a total of 3.8 kg of various debris (Figure 8). The alloy teeth of the grinding shoes are all flattened, and the bottom center is 150mm outwardly worn to become a spherical shape, while the outer side is slightly worn (Fig. 7). It is judged that the falling objects are relatively centered at the bottom of the well, and it is decided to use a steel wire overshot in the next step.

Figure 5. Catch

Figure 6. High-efficiency alloy tooth grinding shoes

Figure 7. Wear and tear of shoes
3.2. **D300mm milling ring + steel pipe fishing**

The first set of milling and salvage: well section 1524.60 ~ 1525.12m, drilling pressure 25 ~ 40kN, pump pressure 2.5 ~ 3.3MPa, displacement 14L / min, speed 40r / min, sleeve milling footage 0.52m, falling objects should be fully fished The tube, but only the piece of the bit of the drill bit (Fig. 11), weighing 2.3kg, the reason is that the bottom of the hole is basically a large piece of debris, but the outer diameter of the steel wire is 6mm, see Figure 9, can not bring out Heavier bit fragments.
Figure 11. Steel wire catches

The second double row 16mm steel wire barrel (Figure 12), sleeve milling section 1552.12 ~ 1525.50m, sleeve milling footage 0.38m, drilling pressure 25 ~ 60kN, pump pressure 3.0 ~ 3.3MPa, displacement 14L / min, speed 36r /min, the effect is better, a total of 7.8kg of bit fragments (Figure 13)

Figure 12. Wire thrower

Figure 13. Steel wire catch
4. Processing results
After the steel wire is salvaged, the lower grinding shoes are cleaned again, and the lower cone bit is drilled. The drilling parameters are normal. The drilling is checked to make the well bit intact, and then the PDC bit is restored to normal drilling. At this point, the PDC body drop accident is processed.

4 Analysis of the cause of the accident
(1) This PDC bit is a multiple-repair bit and there are quality problems.
(2) Drilling tool tripping accident caused the PDC drill bit to fall 5m to the bottom of the well with 7 drill collars weighing 1A.1KN. The impact force may have caused damage to the inside of the drill bit. Due to limited on-site inspection methods, only the appearance of the drill bit can be performed. Observed with the naked eye.
(3) The collapse of the Daanzhai layer in this well is serious, and the density of the drilling fluid is increased to 1.68 g/cm³. There is still collapse in the well. The torque fluctuation during drilling is large, and the single root is often taken out by the inverted eye. After the second eye, the well returned to normal.

5. Understanding and suggesting
(1) The PDC bit that has experienced a drilling accident should be replaced in time, and it is recommended to return to the factory for testing.
(2) Since the PDC is a body drop, the gap between the drill bit and the wellbore ring is small, creating conditions for salvaging the steel wire overshot, and grinding and milling are required multiple times.
(3) Halliburton PDC carcass has strong anti-abrasive property, and the treatment idea should be "light milling, heavy salvage" to shorten the accident handling cycle.
(4) The inner wire structure of the steel wire overshot should be adjusted according to the structure and weight of the falling object to achieve the best fishing effect.

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