Analysis of shortcoming of M-1 down hole problems dealing

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Abstract. This article introduce M-1 down hole problems during drilling operation for analysis Operator’s fault when dealing with down hole problems. Through review the process of the first spud in, the second spud in and the third spud in, and give comment to each process and analysis what’s wrong with the operation. At last get a conclusion: The major mistakes is decision-making. After the second spud in, the situation of severe collapse and shrinkage of the upper formation and losses of the lower formation. At the third spud in, due to the low density of the mud, the water loss is high. For the control of the trajectory of the 8 1/2” wellbore, the decision maker is a bit ridiculous. Those summary will give other drilling contractors some experience whom will drill well in this block in the nearly future.

1. Introduction
The well Magrebah-1 was drilled in April 2019. The operator is an oil company in Kuwait. The well Magrebah-1 is the first key exploratory well explored by the oil company (hereinafter referred to as the operator) in the new block of Magrebah. The vertical well is designed with a depth of 3040 meters. The well site is located in the desert depth of 24 meters above sea level. The entire well site is built on the desert.

2. Process of the surface hole section drilling
At 17:00 on the evening of April 19th , 2019, the WEATHERFORD air drilling hired by the operator start drilled 17 3/4" borehole. At 21:00 on the evening of April 20, the drill was drilled to 335 meters, and the drill was replaced by tower type BHA, drilled down to 327 meters for reaming, and found that the circulation was lost; after the company man asked for his drilling superintendant ,and decide to use water and air foam for blind drilling. On the evening 21:00 of April 22nd to 759 meters ,at this time, it was found that the lifting of the drilling tool was very difficult (50-60T). The upper section of the drilled hole was severely reduced in diameter and could not continue to drill. The company man decided to back reaming and then RIH to drill new hole. Due to the severe diameter reduction of the upper well section (759-500 meters), all drilling tools were difficult to pull until 22:00 on the evening of April 25th . This clearly indicates that the subsequent related operations will be difficult larger, RIH to ream from 22:00 on April 25th to 504 meters, and the run was touch down at 504 meters. It was until 2:00 in the morning of April 27th that arrive to the depth of 759 meters of the original well; at this time, the operator was still decide to blind drilling with water and air foam to the design of well depth, until 21:00 on the 27th to drill to the designed well depth of 855 meters, and then carried out a wiper trip operation
(855-500 meters), the entire POOH finished in 13:00 of the 28th, the leaky layer is estimated to be 300-500 meters.

At this time, the operator decided not to carry out logging and proceed directly to run casing. At 22:00 of April 28th, the 13 3/8” casing was run to 690 meters and encountered a resistance of 50T (hook load 75T). When connected to the circulation head with pump on, it is intend to run casing with pump on, at 2:00 a.m. of April 29th, the casing is run to 691.5 meters, the pump with small displacement appears to choked. The casing cannot be lowered to the planned setting depth of the well, the operator decided to POOH all the casings from the well and condition hole. At 12:00 noon of April 29th, all the casings in the well were pulled out. By 16:00 of the 29th, the runned drilling stem was t encountered resistance at 680 meters. At 2:00 of the 30th, ream to bottom and pumped into the mud to treat the well bore, and then the complex well section was wiper trip several times, and the well bore was treated with chemical treatment agents [1]. Condition hole finished at 4:00 of May 1st. And start to run casing second time from 4:00. At 11:00, the casing to 717 meters and encountered resistance. After 21 hours of effort, the casing with circulation head on and only lowered the casing to 721.4 meters, the operator once again decided to pull out all the casings from the well, and throw out all the casings from the well at 7:00 on May 3rd and run drilling stem to 672 meters, with several times wiper trip, ream and condition hole, at last successfully run to bottom in 14:00 of May 4th, and pull drilling stem from hole is easily and smoothly.

Subsequently, the casing was run for the third time. At 8:00 of May 5th, after many efforts, the 13 3/8” casing was finally difficulty reached to 850.2 meters, and then conduct cement job, nipple up BOP stacks, pressure test BOP and well control related equipments.

3. Operation of the intermediate hole section drilling

At 5:00 of May 6th, start to drill into the 12 1/4” hole section with tower BHA, ANDERDRIFT LWD tools also runned on BHA which provided by the operator to track well inclination data, and adjust the drilling parameters in time according to the obtained data to optimize the drilling parameters. After drilled the surface casing float collar and float shoes, reached to 1598 meters on May 9th, gradually on the shale shakers, we can see the exfoliated gravel from formation, it seems well bore start to collapse [2]; with drill ahead, abnormal particles gradually increase. At this time, we suggest to company man gradually increasing the specific gravity of the mud, adjusting the mud prosperity, and sweep hole with high-vis after drilling a few single, the company man refused to accept our suggestion.

After drilled to 1800 meters, encountered tight hole during each single connection, there will be abnormal friction when pick up and lowering the string. At this time, the company man realizes the seriousness of the problem, then drill every two single and sweep hole one time, but never condition mud, only solve the current problem, and no long-term plan is made; when pulling for replace drill bit, it is found that the 1400-1600 meters well section has become a more complex, but only a simple ream and high-vis mud and drilling was resumed. Once again, the last chance of treatment was lost. On May 15th, the depth of the well was over 2000 meters. Since the drilling has reached 1600 meters, mud lost has begun and the amount of lost gradually increased; drilled to 2263 meters at 18:00 of May 17th. After simple circulation treatment and overflow check, it was required to pull to casing shoes one time for wiper trip and for next electrical logging[3].

During wiper trip, it was difficult at 1590 meters with tight hole, so pump down 50 bbls high-vis and continue POOH, but there meet the same problem in the same place. In 9:00 of May 18th company man decided to change BHA which remove stabilizer and reduce numbers of drill collars and run to hole, it was difficult to bottom in 3:00 of 20th May. And then increase mud weight from 9.1PPG to 10 PPG, several times wiper trip and condition mud, pumped down lost circulation materials, high-vis and so on, at last pulled all drilling stem from hole in 23:00 of 20th May and prepare for logging[4].

The 12 1/4” hole section drillled to 2263 meters, but always difficult. There have collapse in upper formation caused tight hole and lost in lower formation at the same time, it strongly affect drilling operation. Through cooperation and effort with drilling rig[5], company man, MI mud company, at last drilling to the planned depth, and condition mud carefully which mud weight increased from 9.1PPG to
9.6PPG, in 21st and 22nd of May, Schlumberger company perform logging job. After the conventional condition hole on May 22 (the mud density was raised from 9.6PPG to 10.0PPG, the purpose was to stabilize the upper formation from 950m to 1500m, and to effectively block the lower lost formation) [6], and then in 23rd May start run 9 5/8” intermediate casing. The run casing operation (0 m to 1600 m) was relatively normal. After entering the lost formation, the loss volume increased significantly, at 22:00 on the night of May 23rd, When the casing is run to 2213 meters (the bottom of the well is collapse from the upper formation), then use Weatherford processing tool LA-FLEUR (automatic filling device) to open the pump and wash down the casing to 2215 meters, at that time, the circulation lost, according to the pump pressure, it was inferred that there were multiple lost layers between 1600 meters and 1900 meters, and then a small displacement was used to wash down the casing, at 4:00 in the morning of May 24th, the casing finally reached the depth 2261 meters. The total loss during the whole run casing process is 1455 barrels. In the subsequent cementing operation, due to the lack of mud volume, it is mixing mud during cementing due to the loss, and stock enough water for back up of mud. At 10:00 of May 24th, cementing job was completed, followed by wellhead operations, top up operations, and well equipments pressure test operations[7].

4. Analysis of the production hole section drilling

The whole third spud in began to be relatively calm, but there were still problems. After drilling and entering the exploration layer, the company man only used 8.7-9.0 PPG mud density to prevent the formation being plugged. There is a large amount of mud shale in the 2300-2600 meters section, and the exfoliation is serious. Although the mud density has gradually increased to 9.7PPG when drilling to 2800 meters, there is no change in other properties, leaving a lot of potential problems. During the subsequent drilling, the collapsed shale cuttings is continuously returned on the shale shakers, and the exfoliated rock granules have an increasing tendency. The excess pick up weight sometimes reaches 20 tons when drilling a single, during drilling at 3160 meters, due to the slow rate of penetration, the company man decided to pull and change drill bit. During the pulling process, the drilling tool lifted and lowered the friction, which was not normal for a vertical well.

After bit change, the drilling of the mud density and funnel viscosity were gradually raised to 10.8PPG and 48S, but it was too late; at 15:00 of June 5th, the drilling depth was 3440 meters. Inclined drilling is relatively difficult to drill, especially for new boreholes after the drill bit is changed. The formation is relatively stable and the borehole diameter is relatively regular, but the collapsed block in the upper formation has caused a lot of problems for pulling in the normal borehole. It took 9 hours to wiper trip from 3440 meters to 3085 meters, pulling was completed at 13:00 of June 6th, the electrical logging was followed.

After getting out of the logging tools, the company man decided to condition hole, and encountered resistance when RIH to 2300 meters, but it was normal after being lifted and lowered several times. It was obviously a shoulder formed after the collapse, but at this time, the company man requested this section for reaming and back reaming operation, the company man requires an 8-nozzle PDC bit which already used. The BHA is the same as that for drilling. The condition hole parameters are: rotary speed 100 RPM, pump stoke 90 SPM, pumping pressure 1300 PSI, WOB 1-3 tons, from 2300 meters is a serious collapse formation, when arrive to 2320 meters, the company man may suddenly understand something, requesting to stop reaming and continue RIH, but it caused by the previous stupid behavior, harm is inevitable. Then reaming down to 3236 meters, condition mud, POOH to surface and logging again.

The first line of electric logging was difficult to go down to the bottom of the well, anyhow the first trip was successfully completed. But the subsequent second line blocked at 2675 meters, it is impossible to go down, after discussion the company man decided condition hole again, the original BHA touch down at 2337 meters, it encounters resistance, and ream down to 2436 meters. The parameters of the reams are: rotary table speed 100 RPM, pump stroke 90SPM, pump pressure 1300 PSI, WOB 1-3 tons. During the reaming process, the debris on the shake shakers continued to come out. When the reaming reached 2436 meters, the pump pressure suddenly rose to 1500 PSI, that means well wall collapsed, and
the company man was shocked, and then pumped into 50 barrels of high-vis slurry to sweep the well. After sweep, a large number of collapsed fragments appeared on the shake shakers screen. The collapsed fragments coming out before and after were estimated to be nearly 2 square meters, and only 170 meters below casing shoes at this time. It took 19.5 hours of hard work to reaming down to the bottom, and after another 18 hours of hard work, all the drilling tools were pulled and processed for the third electrical logging. This is already at 7:00 am of June 10th . The third electrical logging was successful, and the next step for DST operation was started.

5. Conclusion

1). The major mistakes is decision-making. Operator and company man use water and foam for blind drilling during the mud losses in first spud in, and not sweep hole and pump down chemicals for stabilize well bore when very single drill pipe drilled. It was spend 16 days to finish first hole section , it was waste too much time due to their blind decision.

2). After the second spud in, the situation of severe collapse and shrinkage of the upper formation and losses of the lower formation. The collapse of the upper formation was due to the failure to use mud to deal with the collapsed well section in time, which directly led to the complexity increases the difficulty of processing downhole.

3). At the third spud in, due to the low density of the mud, the water loss is high. After the shale was seriously hydrated, the shale collapsed and fell out, which made it more difficult for the electrical logging to be successful with once, causing condition hole twice.

4). For the control of the trajectory of the 8 1/2” wellbore, the decision maker is a bit ridiculous. Drilling from 2260 meters to 3160 meters and a footage of 900 meters not perform survey and only carried out when bit trip. 1 degrees at 2260 meters, after drilling to 3440 meters, the self-floating inclinometer is used to measure, result is 16 degrees at 3427 meters for vertical well. Body mass is simply unreasonable.

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