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A New Empirical of Bullheading and completing each Blowout steps to avoiding the lost revenue in Farigh Field - Sirte Basin Libya

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***Abstract*— Bullheading mentions to the pumping of fluid into the well against pressure in order to force back the escaped flow into the formation. However, the main concern in bullheading is that when the casing leak, flow passageway to the surface it may have the potential to cause a blowout. Blowout is a dangerous and outstanding operation that requires a novel killing technique to be in place to ensure the safety of the personal and equipment. Therefore, the novelty of the killing operation presented for this job.**

This article presents novel comprehensive a bullheading well killing, for rigless and stop blowout concern to make ensure safe operations. The article also shows the observed the well, not passageway through the surface, the formation was a vacuum and learned an emergency method for unexpected events during the operation.

The operation started with bullheading after pumped 15.90 cubic meters which the blowout decreased similarly to kill the well and preparation to ensure continuous pumping to prevent back pressure, not passageway the fluid through the casing leak to the surface. This paper presents the challenging kill operations. Finally, the well's performance was monitored, the blowout was decreased gradually, loss the rate of the well, and the formation vacuumed then kill the well.

Keywords*— *Bullheading, Blowout, Kill well, Farigh Field, Sirte Basin Libya,

I. INTRODUCTION

The term Nubian Formation or Nubian Sandstone was first used for a widespread, non-marine sandstone sequence that is well exposed in Nubia, in the Nile Valley of Upper Egypt. Subsequently, this formation has been applied to the non-marine Mesozoic rocks that cover a large portion of southern Egypt and extend across into the southern half of Libya. The most recent Geologic Map of Libya shows this formation covering thousands of square miles in southeastern and southwestern Libya. [1]. However, because of some divergent usages of the term Nubian over the last century, this formational name is not without its ambiguity and recently has become the focus of controversy [2]. Consequently, some authors have recommended abandoning the term. In the recent study, this name is commonly used by petroleum geologists in Libya, and following the usage and regard the Nubian as a worthwhile name, it is a broad term, however, and perhaps should be considered a group. [12]. When this sequence has been studied in detail locally, it usually can be subdivided into smaller rock units. When enough work has been done on this widespread and broadly defined unit, perhaps it will eventually be replaced by many more precisely defined and geographically restricted new formations [2]. Farigh Field is discovery and data obtained by 1970s four exploration wells in the Northwest of Libya. The Nubian sand in the Farigh field is possibly part of the North Gialo structure, as mentioned. [3].

The Nubian formation is located in Farigh field and the well AA03-12 was drilled, completed in 1969 with, initial production of 502 m³/day, and no water.

Therefore, the domestic overspill and blowout procedures have presented that conventional methods to positive of well killing in some certain conditions by bullheading technique [1,16,13]. The Engineer's Method differs from the killing method by the simple fact that the weight is being increased and bullheading into the well immediately until the well killing. Thus the Bullheading is causing serious of control well under certain condition [17,19,5].

Pumped High Pressure, it can be via bullheading procedure to stop Blowout Situation that is a much more difficult to kill the well to handle than oil and gas was pathway to the surface that this technique is possible to control the well evens have a problem in the downhole and corrosion that it was chancels between the tubing and annulus [8,15]. Bullheading may be considering to pump a large volume of kill fluid and increasing the weight, a well was successfully to kill well and potentially to kill well because it expands while approaching the fluid (oil and gas), passage to the surface [6,14,20].

This paper is implemented killing the well by bull heading, stop the blowout, and the well was produced 321.3 m³/day before the blowout, even the environment is damaged by the fluid outside of the well, this statement was a critical issue and it's not easy to control on short time, even smoking outlet from the wellhead.

Therefore, the most important is to maintain the Wellhead and even the completion string, especially for the long term of production, natural flow, to minimize the risk, perforation damage, reservoir damage, and keep the oil recovery for this well. [11,18,7].

Killing wells that must be known the temperature and pressure profile of each well (Pressure & temperature vs. depth) can take many forms and no two reservoirs are the same. Wells within the same reservoir, in fact, are remarkably different. It is important to know the characteristics of each well in terms of down-hole pressures, flowing, static, and the output curves. [10,9,4].

This, together with the casing design and knowledge about the reservoir, is important for the operations people and persons carrying out the well maintenance. The procedures used for killing a well and starting the flow are very much affected by the reservoir and well conditions.

II. Methodology and Procedure

Well, AA03-12 was a blowout and necessary to stop the flow and reduce the wellhead pressure (WHP) to zero. This is called to killing or and no following from the well. On this case a critical is different because of the failure and damage on the surface casing and was a big hole on the casing, the fluid moving from this side and no control for the flow and the pressure than the gauges on the wellhead not reading during the blowout.

The only reason for a blowout on this case is no maintenance and workover program for a long time during the production, and no observation on the wellhead section, especially, for the natural flow, high production rate and strong energy the reservoir. Figure 1 shows the blowout and passageway, oil, gas, water, and sand both together to the surface events covers all the area of the well, plus the gauges on the wellhead not reading. In this case was not easy to start to be in stop blowout in the safe procedure as personal and equipment because there is seems like the smoking area near the wellhead.

Firstly, started rig up on the surface line with 5.08 cm fare way from the wellhead about 42.7 meters to be a safe place during the operation, so important to be service and the time to perform our work Safely, Accurately, and Precisely. The operation is recognized continual improvement in the quality of our services and in communicating the ideas and knowledge we have to our customers.

The quality assurance guidelines and the key to providing exceptional Service Quality and advancement toward this goal. Secondly, started to install the crossover section on the top of wellhead than start connection with the iron with 5.08 cm via 2 cranes one of them latch the iron and other one included basket to hold 2 personals to make install the iron on the top of crossover connection with non-spark tools. Finally, started bullheading brine with changed density as 1102 (kg/m³) and 1138 (kg/m³), stop blowout than kill the well. For more details, see well completion and Pump schedule for kill well as shown in tables 1 and 2.

Figure1: Wellhead with blowout statement

Table1: AA03-12 well completion

Pipe Information				
Equipment	***Depth (m)***	***Size (cm)***	***Weight (kg/m)***	***Grade***
Casing #1	28	50.8	140	H-40
Casing #2	1081	33.9725	81	J-55
Casing #3	3169	24.4475	70	C-75
Tubing	3712	8.89	14	N-80
Slotted casing	3734	17.78	48	N-80
Perforation Intervals				
Top (m)			Bottom (m)	
3734			3871	

Table 2: Pump schedule for kill well

Safety meeting and Job safety analysis with the team on location, as discussed with Safety statement and procedure included (Job Safety Analysis and Material Safety Data Sheet (JSA - MSDS) To make sure all the crew on location understand the procedure and prevent and or avoid hazards on location.						
Stage No.	***Stage Description***	***Fluid Description (m^3)***	***Pump Rate (m^3/min)***	***Pressure (kPa)***	***Density (kg/m^3)***	***Comment***
1	Kill Fluid Potassium Chloride (KCL)	238.48	0.32 – 1	0 - 5275	1102	After pumped 15.90 cubic meters of brine 1102 kg/m^3 that the blowout of the fluid was reduced around the area of the wellhead and the formation was Vacuum. This is meaning good indication to stop the blowout. Otherwise, after pumped 143 cubic meters, the fluid was a passageway from the casing leak to the surface, measured the density is around 1096.4 kg/m^3.
2	*Shut-In*	*0.000*	*0.00*	*1379*	*0.000*	Shut-In pressure is 1379 kilopascals, (kPa) it indicated there is some gas coming from the formation or so and decided to pump another 127.19 cubic meters of brine 1102 kg/m^3 to prevent any gas outlets from the formation through the casing leak.
3	*Kill Fluid Potassium Chloride (KCL)*	*127.2*	*.16 – 0.64*	*0 -1862*	*1102*	Almost the pumped rate was on this stage by 0.476 (m^3/min) and the pressures were between 1103 – 5171 kilopascals, (kPa). Once the rate decreased from 0.476 to 0.16 (m^3/min), the pressure immediately responded to be zero that its good indication to kill the well.
4	*Shut-In*	*0.000*	*0.000*	*0.000*	*0.000*	Stop pumping and observation for one an hour then the pressure become zero.
5	*Kill Fluid Potassium Chloride (KCL)*	*127.2*	*0.48*	*345– 1724*	*1138*	Detected smell gas coming out from the formation through the casing leak in around the wellhead and decided to pump another kill fluid by increased the density from 1102 to 1138 kg/m^3 to avoid and prevent the gas coming out from the formation.
6	*Slurry Cement*	*5.56*	*0.000*	*0.000*	*1797.4*	Stop pumping, decided to observe and see the located of corrosion and damage of the surface casing leak, then decided to pump slurry cement at density 1797.4 kg/m^3 in a hole of this area of the wellhead to make cover all hole at the top of the surface to make ensure prevent the smell gas coming.
7	*Slurry Cement*	*0.95*	*0.000*	*0.000*	*1797.4*	The following day, after pumped 5.56 cubic meters of the slurry cement that it shows sitting small Bubbles gas on the top of slurry cement then decided to pump another 0.95 cubic meters of the slurry at density 1797.4 kg/m^3.
8	*Shut-In*	*0.000*	*0.000*	*0.000*	*0.000*	Stop pumping, left the location and become workover rig on this well.

III. PRODUCTION SIMULATOR FOR PUMPING SERVICE

The model is a Real-Time of Data Acquisition System based on workflow process is aligned with the steps of the Halliburton Management System (HMS), which documents the processes that are involved Provide the data display and real-time analysis of quality assurance and quality control processes before during and after a job with the implementation.

Therefore, the Pumping units were able to blend and pump up to the maximum pressure at 103,421 kilopascals, (kPa) and maximum rate at 1.6 m³/min bull heading through the wellhead and storage brine fluid capacity is 79.5 cubic meters, (m³) that is enough to have more fluid and continue to pump brine as density 1102 kg/m³ and 1138 kg/m³ for formation interval 3734 – 3871 meters.

The Actual kill fluid Program Performed as Follows:

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- 238.48 cubic meters of brine @ 1102 kg/m³ on the 1st day of operation.
- 127.2 cubic meters of brine @ 1102 kg/m³ on the 2nd day of the operation.
- 127.2 cubic meters of brine @1138 kg/m³ on the 3rd day of the operation.

Halliburton crew perform to bull heading and using High pumping pressure to pump brine 1102 kg/m³ and 1138 kg/m³ by Killing well for well AA03-12 in Farigh Field. A pre-job safety meeting was held where details of the job were discussed, potential safety hazards were reviewed, events fire trucks with the crew standing on location 24 hours as a precaution and environmental compliance procedures were outlined as shown in Figure. 2.

Figure 2: Rig up the surface line and Safety fire trucks with the crew standing on location 24 hrs for precaution.

IV. RESULTS AND DISCUSSION

Kill program timing was essential for the operation economics regardless of blowout statement in Farigh Field and requested from Harouge Oil Operations to use a high-pressure pump and a large capacity of storage brine fluid - each tank is around 79.49 cubic meters Whether the well was naturally flowing, although there is station it's near to the location and decided to open some wells to the flair and see if it can reduce the blowout from the well but it does not respond for decrease the blowout because the well was natural flow or so on the same time the Halliburton equipment was over there and rig up on the surface line with 5.08 cm fare way from the wellhead is around 42.672 meters to avoid and prevent any hazards statement during the operation.

Implemented the highest a top priority of applying safety by technical knowledge even creates a highly effective system, processes to monitor and control for the operation.

Kill the well by using Halliburton High-pressure pump was the best way to be in on this investigation and solution to stop the blowout and going to next steps for rig workover program.

Therefore, the most serious and costly problems arise when there is a leak on the casing, and the problem can be traced to corrosion damage, breaks by contraction, wear from drill pipes, erosion, bad welding, and or cementing of the casing.

The blowout occurred Near-surface damage can be repaired by excavating a pit around the well and replacing the bad casing with a new one.

Figure 3 shows near-surface damage, a big hole on 33.9725 cm casing (5.08 cm) below the Braden head, and excavations as not deep as to replace a full length of casing down to the first threaded connection.

After pumped 15.90 cubic meters of bullheading of kill fluid, density 1102 kg/m³, and the blowout was decreased then the formation was vacuumed as shown in Figure 4. Once after pumped 143 cubic meters of kill fluid at density 1102 kg/m³, the fluid passageway through the casing leaks to the surface that it the same fluid was pumped and measured as 1096.41 kg/m³, as shown in Figure 5. Illustration on stage five, after pumped 365.7 cubic meters of fluid density 1102 kg/m³, detected smell gas from the wellhead, outlets from the casing damage or and a leak section. Therefore, decided to change the density of kill fluid from 1102 to 1138 kg/m³, then pumped 127.2 cubic meters to avoid and or prevent outlets the gas.

Figure 3: Corrosion and a big hole on 33.9725 cm casing

Figure 4: Wellhead with blowout decreased and vacuumed formation

Figure 5: Wellhead with passageway killing fluid to the surface.

Next stages, stop pumping and decided to observe and see the located of corrosion and damage of the surface casing leak. Based on Figure 6, decided to pump slurry cement at density 1797.4 kg/m³ in a hole of this area of the wellhead to ensure covered and prevent outlets the smell gas.

Figure 6: Wellhead with pumped slurry cement to avoid the smell gas

Figures 7 and 8 also show bullheading the stages of the 2nd, and 3rd day, similar at different pressures, rates and volumes pumped conditions. Therefore, the bullheading effect by killing well by changed fluid density from 1102 to 1138 kg/m³.

V. CONCLUSION

The best way to extend the life of well to make schedule time for workover and maintenance to avoid the segment costly, loss of production, keep revenue and undamaged reservoir especially if the well-produced long period of time as naturally flowing.

In this study, affecting bullheading procedure that one of the good control in the petroleum industry. Therefore, Bullheading is essential to act quickly while the problem accrued, and preventing blowout by killing the well since avoiding the increase the section of damage and passageways to the surface.

So, in initiating bullheading, on the 1st day of the operation was good to respond and consideration for the successful well kill. This study can be enhancing and observed leak and damaged on the surface casing.

The leak can initially be small after then is going to be growing and big if delay the bullheading procedure and repair the leak, then start workover procedure to prevent more damaged.

The furthermost corrosion problems are from outside and mostly near the surface in the hot moist soil or cement somewhere oxygen can also become to the steel.

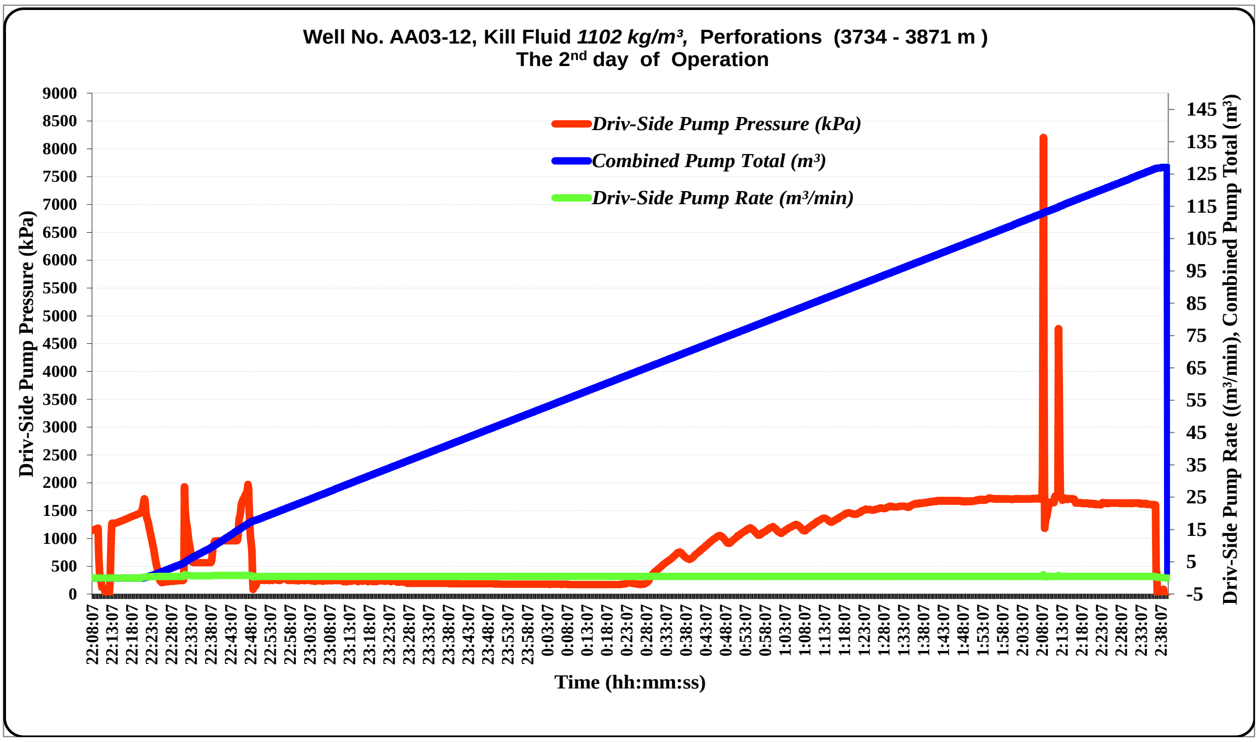

Figure 7: Wellhead with kill fluid the 2nd day of operation

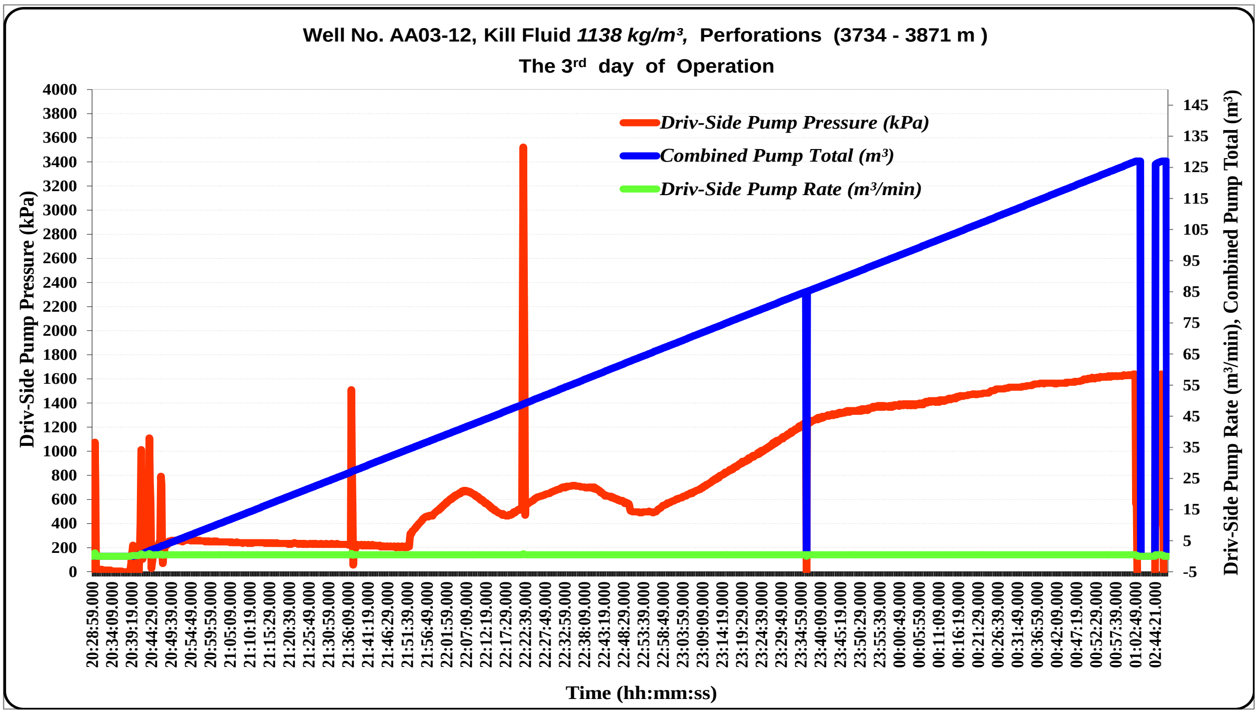

Figure 8: Wellhead with kill fluid the 3rd day of operation

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VII. Future Work

This segment covers work not yet completed because after killing the well, to make sure the damaged reservoir and maybe was deeper, so the stimulation analysis needed to better prepare for future Farigh Field stimulation treatments.

As mentioned in killing sections throughout this study, Pre - Stimulation analysis is very important in calibrating all models used during the design of the stimulation treatment.

It is suggested to run an analysis stimulation job through multi chemicals by Halliburton company because it has good material and good equipment monitoring by INSITE for Stimulation (IFS) on location.

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