

Bull Heading Method without Heavy Well Intervention for Annulus Cementing to Create Well Barrier prior to Shallow Zone Perforation in Mahakam Fields

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Abstract. In order to maintain level of production on mature field of Mahakam, some shallow reservoirs are targeted to be produced from existing old wells. However, since the old wells were originally designed to produce reservoirs from deeper zone, there was not enough well barrier to perforate the targeted reservoirs on shallow depth. Annulus cementing is needed to create well barrier prior to shallow zone perforation. One of the challenge is marginal stakes of the reservoir which limit amount of budget that can be spend for the well intervention. Therefore, annulus cementing by bull heading method without heavy well intervention was selected. Bull heading annulus cementing method was performed to place cement column at designated depth by pumping cement from annulus-A and circulate liquid through tubing with some specific detailed procedure, i.e.: pump with high rate to minimize free fall of cement to create good cement quality, avoid cement entering the tubing by detailed cement placement and apply back pressure on the tubing to avoid u-tube effect. Avoiding cement to enter tubing is required to ensure no additional well intervention work needed to clear access in the tubing after cementing. The method has been successfully implemented on 3 wells so far. From operational point of view, this method is considered safer compare to other cementing method (no heavy lifting equipment needed), faster, more cost efficient and also proven to be able to create good cement quality as well barrier in the annulus.

Keyword(s): Annulus Cementing, Bull Heading Method, Well Barriers.

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1 Introduction

Mahakam oil and gas block of Pertamina Hulu Mahakam (PHM) is located in the East Kalimantan Province, Indonesia. These fields are all founded nearby Mahakam river delta where production from the field started in 1970s. In order to maintain level of production on mature field of Mahakam, some shallow reservoirs (less than 1500 mSS depth) are targeted to be produced from existing old wells with tubingless monobore completion. However, since the old wells were originally designed to produce reservoirs from deeper zone, there was not enough well barrier to perforate the targeted reservoirs on shallow depth. Annulus cementing is needed to create well barrier prior to shallow zone perforation.

2 Annulus Cementing Method Selection

There are some annulus cementing methods that can be implemented:

a. Annulus cementing with balanced fluid method

The principle is to keep balanced hydrostatic condition between tubing and annulus-A (with cement in place) to ensure cement slurry will remain in the annulus and not flow back into tubing after cement pumping operation. This method will also require sediment washing or milling operation after cementing to clean the heavy fluid that was used as balance fluid.

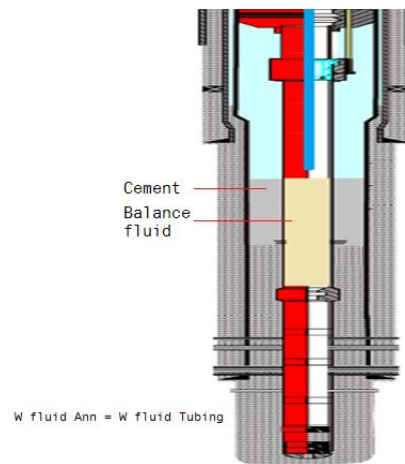


Figure 1: Annulus cementing with balanced fluid method

b. Annulus cementing with CT packer

Utilization of tension set CT packer (or other type of packer) to support annulus cementing operation.

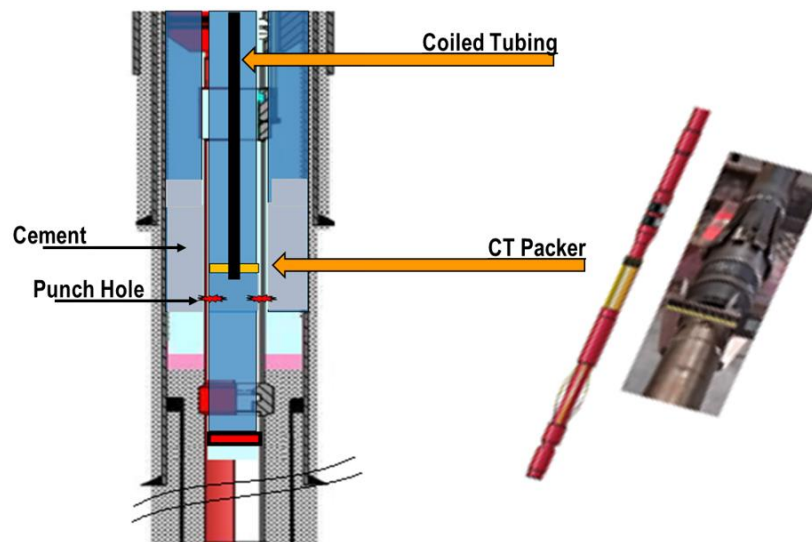


Figure 2: Annulus cementing with CT Packer



c. Annulus cementing with cement retainer

Cement retainer act as a check valve to counter back flow and to hold pressure during and after cementing job process. Cement retainer set in the tubing above punch hole using electricline (wireline). Coiled tubing then run and sting into the cement retainer prior to pumping cement into annulus-A.

All of those annulus cementing methods are using coiled tubing to deliver the cement into annulus-A, some methods even need other well intervention before or after cement pumping operation (set cement retainer on method a. or sediment washing on method b.) to complete the annulus cementing process sequence. Those methods are considered not economic compare to the marginal stakes of reservoir target.

d. Annulus cementing with bull heading method

This method was identified to be able to perform annulus cementing with less cost. It does not require coiled tubing to pump the cement which make it more cost efficient compare to the other methods.

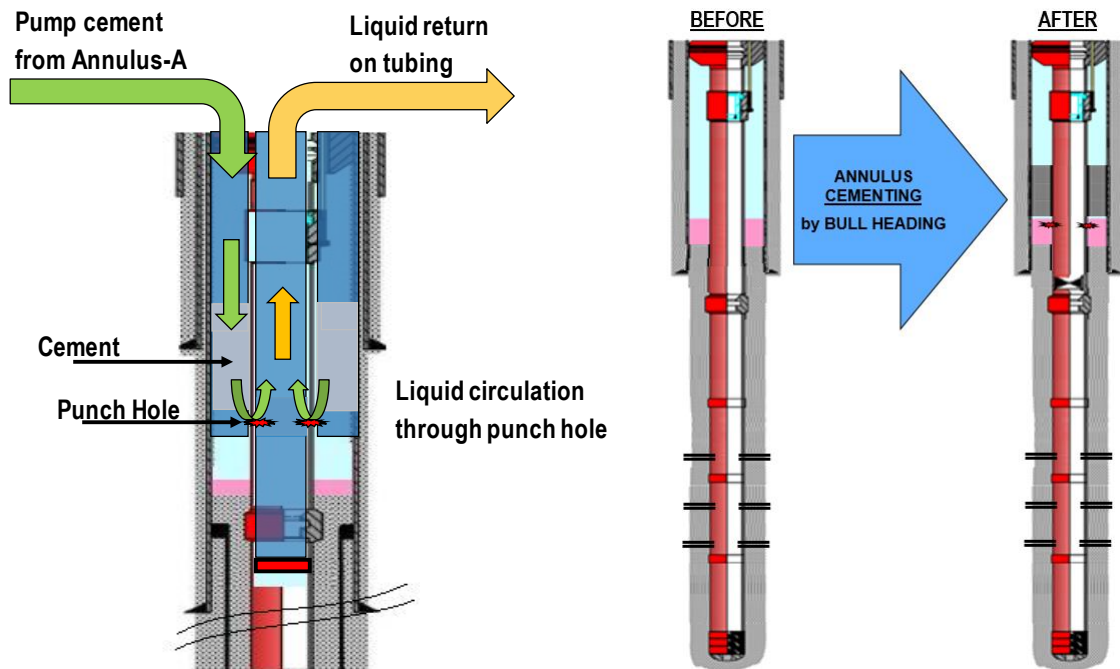


Figure 3: Annulus cementing with bull heading method



3 Bull Heading Annulus Cementing Process

Complete sequence of bull heading annulus cementing is as follows:

a. Preparation

The preparation stage is the same with other annulus cementing methods which covers setting plug to isolate all open reservoirs, tubing punch to create communication between tubing and annulus-A then circulate out existing oil base mud (OBM) from annulus-A prior to annulus cementing.

b. Annulus Cementing with Bull Heading

Job sequence started with mixing cement using batch mixer. Cement thickening time be designed based on total duration for mixing and pumping cement by taking into account some safety factor.

The principle of annulus cementing with bull heading method is to pump cement from wellhead annulus-A gate valve then place cement in the annulus by liquid circulation established from annulus-A to tubing through punch hole in the tubing (Figure 3.)

Bull heading annulus cementing be performed with following job design:

- ✓ Cement volume calculated to create cement column that able to cover at least 50 meters below perforation target until at least 100 meters above perforation target with some additional margin (if needed) to ensure enough cement column barrier for perforation.
- ✓ Cement pumping be performed in high pump rate (2 – 4 bpm) to minimize free fall of cement slurry to ensure good cement quality.
- ✓ Bottom of cement be designed around 20-50 meters above tubing punch as safety margin to avoid cement slurry entering tubing in case of there is slight downward liquid movement post cement pumping operation.
- ✓ Back pressure in tubing be applied to compensate delta pressure between cement column weight in the annulus-A vs hydrostatic pressure in the tubing, to avoid u-tube effect that may cause cement entering tubing after cement pumping operation.
- ✓ Once cement pumping completed, close tubing and annulus-A while keep maintaining back pressure in the tubing. Do not bleed off any pressure to avoid liquid movement post cement pumping before cement hardened.
- ✓ Wait on Cement (WOC) until cement hardened properly prior to perform any intervention.

c. Cement Validation

After the cement properly hardened (in our case, after 24 hours WOC), cement pressure test and CBL/VDL survey performed to validate the cement quality.

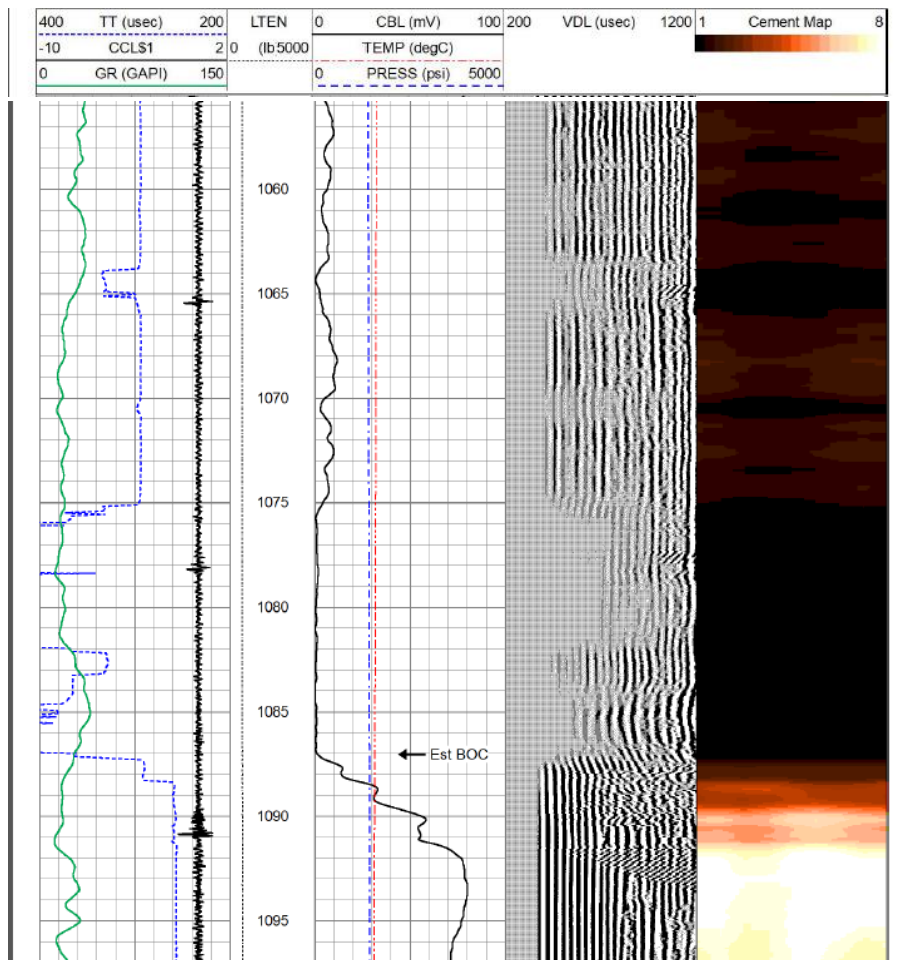


Figure 4. CBL/VDL Survey result

4 Results and Conclusions

The annulus cementing by bull heading method has been successfully implemented on 3 wells in Mahakam field with following result:

- Cement column has been successfully placed in annulus-A as per design.
- There is no cement entering tubing which means no extra well intervention job needed to clear tubing access after cementing operation.
- Good cement integrity validated by cement pressure test and also CBL/VDL survey. No annulus pressure anomaly observed (in more than 6 months' observation period) after the shallow depth perforation.



Annulus cementing by bull heading method has delivered the following values:

- From operational point of view, this method considered safer compare to the other annulus cementing methods as there is no heavy lifting needed for coiled tubing/snubbing rig up;
- Faster operation time;
- More cost efficient (in our case, at least 25% less cost compare to the other methods); and also
- Proven to be able to create good cement quality as well barrier in the annulus.

Following the job success story, annulus cementing by bull heading become the preferable method for annulus-A cementing in Mahakam field.

References

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