PROFESSIONAL TECHNICAL PAPER
ONLINE PRESENTATION
24 - 25 OCTOBER 2020

IATMI

A Cost-Effective Solution With Single Trip Multiple Production Packers For Selective Shallow Zones at Sisi Nubi, Mahakam Field

, K. P. Haryasukma*[2], K. W. Tokoh*[1], M. I. Maharanoe*[1,3],
D. Manalu, B. Muriyanto, A. Fidiasyah, T. Sugiarto, F. Ruhuddin

[1]Completion and Stimulation Specialist, Pertamina Hulu Mahakam
[1,2]Drilling Engineering, Pertamina Hulu Mahakam
[1,3]Superintendent, Pertamina Hulu Mahakam
* Email: kristoforus-widyas.tokoh@pertamina.com

Abstract.

Developing marginal fields or extending the life of mature fields becomes significantly more interested when technology is available that can enhance cost efficiency and reduce operational and environmental risks. To support the above needs, a major oilfield equipment supplier has introduced an intervention less technique for setting production packers downhole that provides an alternative to conventional zonal isolation which commonly lead to highly intervention cost.

Production carried out in typical multiple thick reservoir at shallow sections have the economic problem of selective cement cost in offshore environment. A method of reducing this cost is to install multiple packers to isolate interest zones and eliminate the zonal isolation with costly high cost of conventional annular cementing isolation typically in the marginal reserves that currently being available and interested at Pertamina Hulu Mahakam. Gas production has been forecasted in as many as three intervals selectively by the use of multiple packers above the three main gravel pack and no necessary annular cement isolation so then direct perforation could be executed to access the reservoir. This method has the advantage of eliminate annular cementing process and reduce the intervention operation cost prior to well cleanup without incurring the expense of conventional coil tubing zonal isolation.

This alternative solution is the main driving factor as a new way to install selective shallow reservoir and enables the delivery of typical marginal wells economically at the Mahakam Delta swamp area. This has resulted in potential significant well cost saving up to 82% compared to conventional annular zonal isolation.

Post upper completion operation, all packers pressure tested for integrity test and the packers has no pressure from both annular and string through punched tubing between packers. This new frontier solution can be considered as the first successful of multiple packers installation at offshore areas worldwide with no NPT and safety issue.

Keyword: *rigless completion, multi packer, multizones isolation*

©2020 IATMI. All rights reserved.

1 Introduction

Mahakam Delta is located on the east side of Borneo Island (East Kalimantan, Indonesia). Both Bekapai and Sisi Nubi fields are situated in relatively shallow waters 200-262 ft (60-80 m).

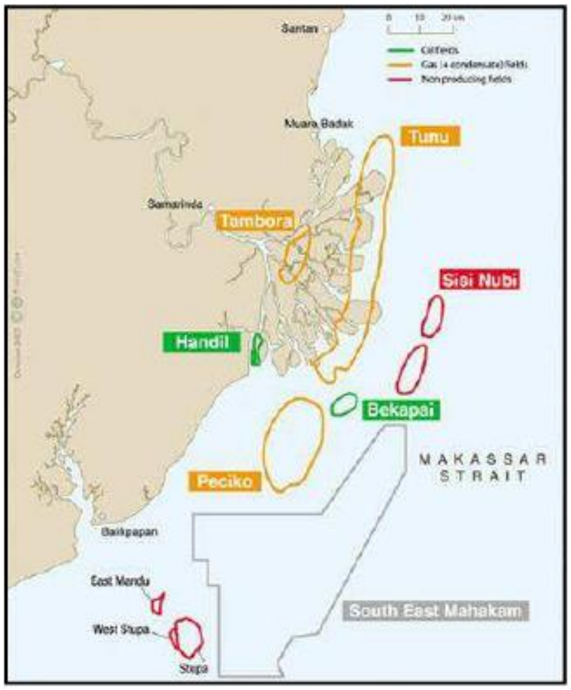

Fig.1 Mahakam Field Map

Bekapai Field:

Bekapai is an established field over 50 years old. The main productive sequence of sandstones down to 4,921 ft (1500m) subsea (SS) are unconsolidated so typical gravel pack sand control is standard completion plan. The lower sequence from 6,234 ft (1900m) SS to TD presents many (10-20) thin-layered reservoirs, which make it difficult for GP completion. But, a risk of moderate sand production is expected after considerable depletion or upon water breakthrough. In the event of maginal well were available, shallow reservoir would be interest to be access selectively to gain more gas production. Therefore, low cost selectivity at shallow zones is required on the upper completion without jeopardizing standard intervention program; see Figure 1.

Sisi and Nubi Fields:

Sisi and Nubi are newly developed gas condensate fields situated 15.5 miles (25 km) east and down structure of the modern offshore Mahakham Delta. Consequently, the unconsolidated sandstones start at a depth of 5,906 ft (1,800 m) SS and occur as deep as 8,202 ft (2,500 m) SS. In addition, a series of consolidated gas sands reach a depth of 12,467 ft (3,800 m) SS. The gross interval requiring sand control ranges from 820 to 3,609 ft (250m to 1,100m) and the deepest GP packer is at 12,795 ft (3,900m) MD. Normally, the well completion program requires sand control on five zones; see Figure 1 - Type I. For wells with deeper consolidated gas zones, a liner with equivalent ID as the upper completion allows production options of the deeper and shallower reservoirs (simultaneous or sequentially). For a same reason as stated on Bekapai completion, in the event of maginal well were available, shallow reservoir may have required zones selectivity as low as cost effectively.

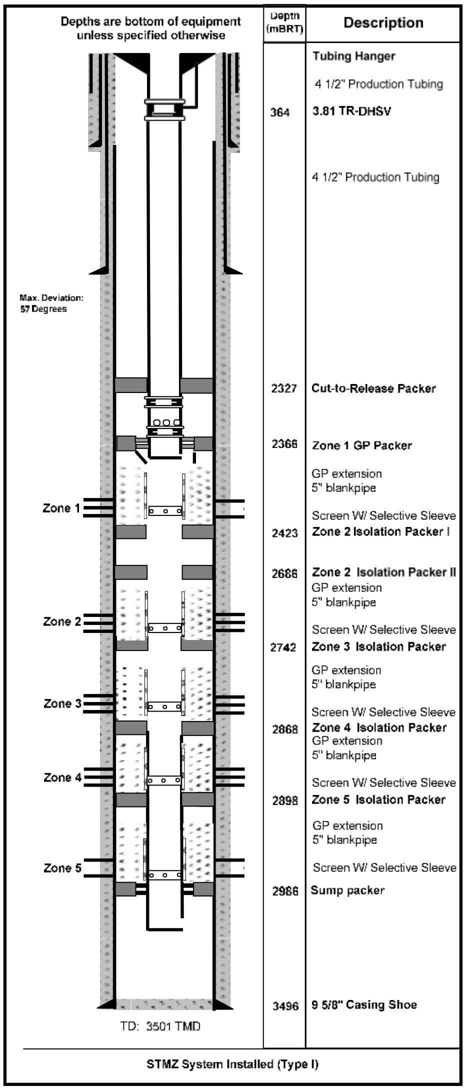

Figure 2. Type I Completions Options

2 Methodology

Well Data and Challenges

The first application of Single Trip Multiple Packer was commenced in SS-2xx well, located in Sisi Nubi Field. This well was completed with Gravel Pack completion to produce gas from the lower reservoir zones. Gas production is also expected from several reservoir targets in the shallow zone that will be perforated in the future.

At the initial plan, after the Gravel Pack assembly was set, the operation was continued by installing the upper completion string, consisting only one permanent production packer to provide zonal isolation between the lower reservoir interval and future shallow reservoir interval. Then, after the production of lower zone has reached its depletion, annular cementing will be performed on top of production packer with coiled tubing as the preparation prior to perforate future shallow reservoir interval.

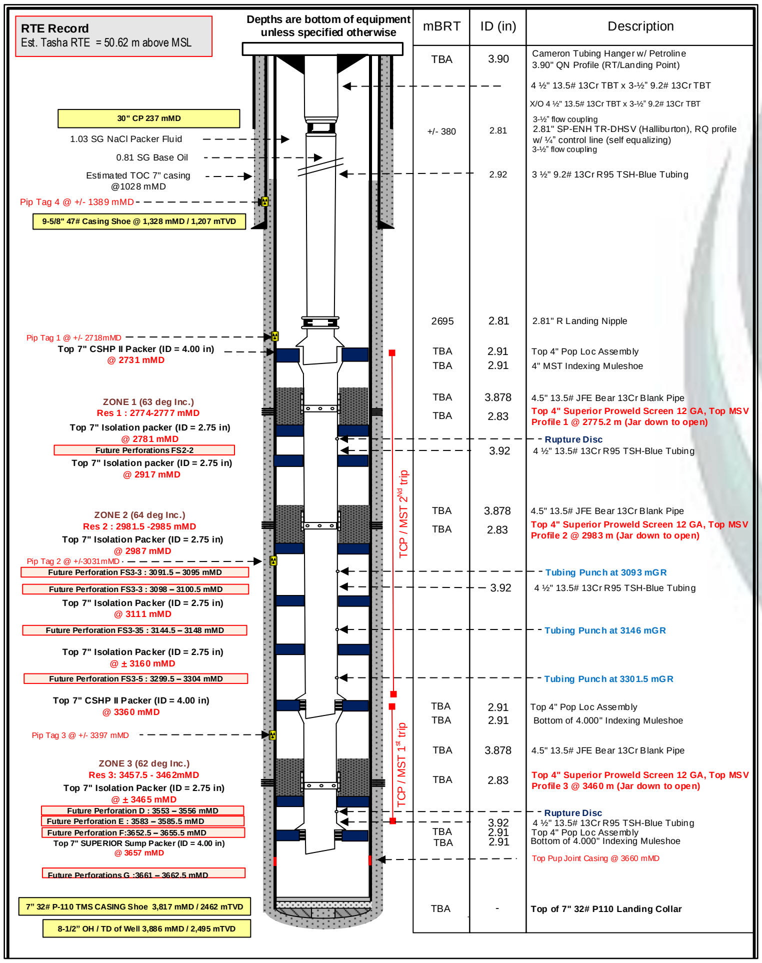

Figure 3 Initial Completion Schematic

However, based on the reservoir assessment, water production is expected from each of future reservoir target that leads to water breakthrough risk. Zonal isolation between the reservoir is required to prevent cross flow that might kill production from other reservoir. At this point, addition of 3 (three) production packers along the reservoir is considered to be more effective to have selective isolation than performing annular cementing.

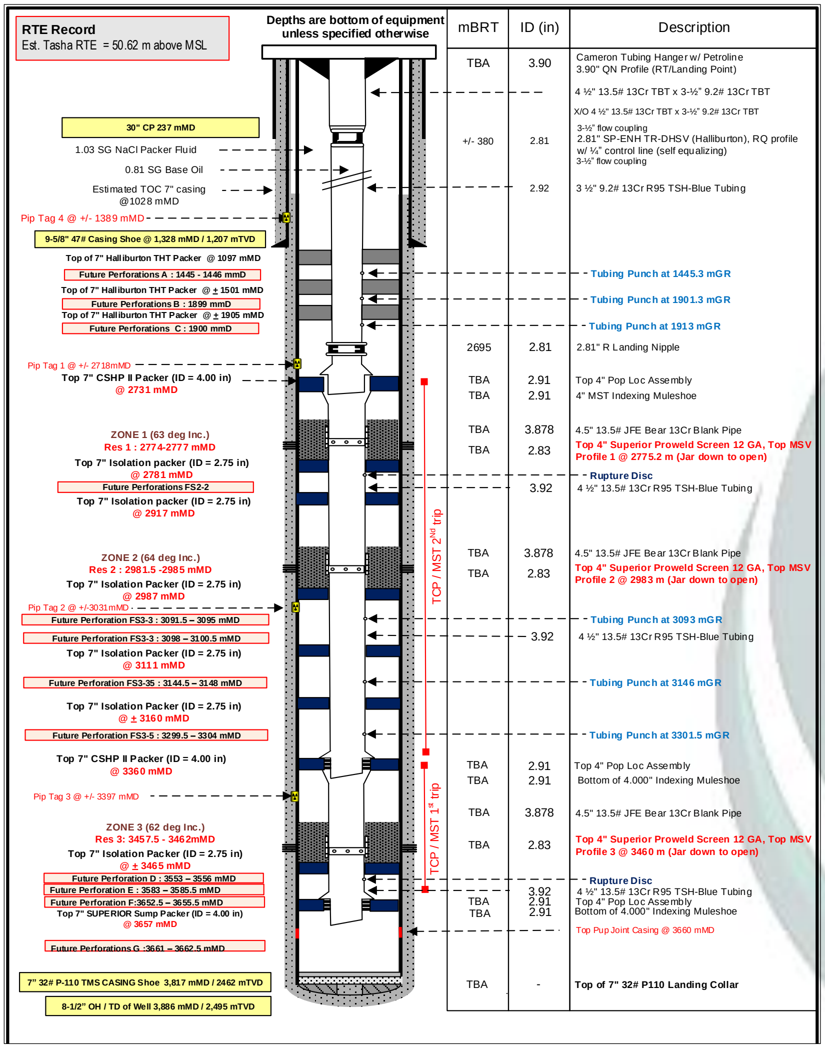

Figure 4 Proposed Completion Schematic

Hydraulic-set permanent production packer was utilized to provide the isolation means in the upper completion and is commonly used for PHM well completion. The packer can be set by applying certain pressure until start-to-set value (STS) to shear the pins This start-to-set (STS) value can be adjusted by the addition or deletion of pins in the piston housing. When the pins sheared, the piston travels upward and extend the lower slips. When minimum setting pressure is achieved, the piston loads the packer elements and slip anchor system with sufficient force to contain working pressure differentials.

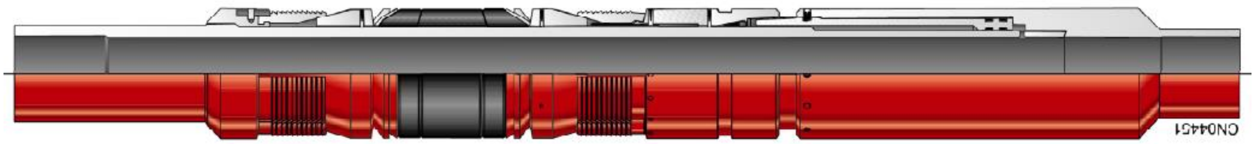

Figure 5 Hydraulic-set Permanent Production Packer

This packer includes a one-piece mandrel and sealbore, which eliminates a potential leak path. It has a low profile for greater running clearance to help reduce problems that might occur when running in typical highly deviated wells like in SS-2xx. Premium metal-to-metal (MTM) thread connections help enhance packer dependability. Ease of use is proven in single-trip completions common during offshore operations. This packer sets with low pressure, major components are rotationally locked, and materials are suitable for milling. No tubing manipulation is required to set the packer, and the hydraulic-set. An upper polished bore receptacle or overshot tubing seal divider can be connected to the top of the packer at any case intervention should be performed to retrieved the packer.

However, in PHM itself, setting multiple packer in one trip is outside our technical envelope. The common practice is only incorporating one production packer in one trip of upper completion. The associated risk foreseen from running multiple packer in one trip are:

- Packer premature set due to hammer effect, friction, or solids obstruction during run in hole packer to target setting depth
- Damage on tubing due to movement of each packer slips when setting the packer simultaneously.

In order to mitigate the aforementioned risks, tubing movement simulation and packer setting sequence was reviewed and analysed.

Defining Risk and Functionality

The use of multiple hydraulic-set packer exposes the operation to several risks that may not be apparent. These possibilities must be considered during the planning stage of the development and include the following:

- premature set of the packer
- un-expected mandrel movement
- tubing collapse due to multiple tubing movement
- Insufficient hydrostatic pressure

The process of set multiple permanent packers used to test the packer during the installation was conducted to ensure that the three packer were pressure tested. However, to further assure success of the operation, it is critical that knowledge of the actual bottomhole conditions such as hydraulic pressure and temperature must be available when preparing the packer assembly for each installation.

Prior to running a multiple hydraulic-set packer, structured reviews were undertaken with operators to identify potential tubing movement at typical well conditions that could be encountered. Moreover, completion continuity was required to ensure intervention could be performed when accessing each for target zones. Understanding these conditions and structuring the design and test program to verify proper operation was seen to be paramount.

Figure 6 Tubing Movement Simulation

Based on tubing movement simulation result, the best option is to perform the following scenario:

- Limit run in hole speed to 10 joint/hour to avoid packer premature set.
- Provide bigger separation distance between each packer to accommodate tubing stretch during setting the packer.
- Packer #3 will be set first at 2250 psi STS pressure.
- Followed by Packer #1 and Packer #2 that will be set simultaneously at 3000 psi STS pressure.
- Tubing will be pressured up to 4500 psi to final set the packer sealing elements and slip.

Table 1 Packer Setting Configuration

Packer No.	Setting Depth	STS Pressure	No. of Pin
Packer #1	1097 mMD	3000 psi	4
Packer #2	1501 mmD	3000 psi	4
Packer #3	1905 mMD	2250 psi	3

In order to ensure the integrity of the packer after it is set, tubing was punched between each packer. This is intended to allow pressure communication from tubing to the annulus between each packer during the pressure test operation. Moreover, the packer integrity was ensured by pressure tested packer from the annulus side as well at end of upper completion step.

In addition to ensure well continuity and mitigation to potential excessive tubing movement, 2.5m of seal assembly length at end of upper completion were designed to sting-in into top packer lower completion. Operationally, space out 1.5m recommended to be performed after tagging to top of lower packer assembly to provide room for potential tubing movement during packer setting process and thermal expansion along production process.

3 Result and Discussion

The upper completion installation was commenced after the Gravel Pack assembly in the lower zone has been set. The upper completion was made up with accurate tally to ensure the packer setting depth to be as per completion program. By applying mitigation to limit the RIH speed, the upper completion can be successfully run inside the well and sting in to the previous Gravel Pack assembly without any restriction.

The operation was continued to set the 3 (three) permanent production packers. The standing valve was set at the nipple profile below the bottommost production packer. Tubing string was then pressurized to 4500 psi in stages. The packer setting indication was observed at 3200 psi and 3800 psi.

To ensure the integrity of the packer, the annulus behind the tubing was pressurized to 3000 psi and held for 10 minutes. During the pressure monitoring, no pressure build-up nor pressure losses were observed. This indicated that the uppermost packer integrity was good.

The standing valve was then retrieved and operation continued to run tubing puncher to punch tubing between each production packer to allow communication between tubing string and annulus of each production packer. The tubing was pressurized to 3000 psi and held for 10 minutes. The pressure was holding, indicating all of the packer integrity were good.

The single trip multi packer initiative was successfully delivered without any NPT or incident. This initiative yields to cost saving up to 82% compare to initial plan to perform annular cementing with coiled tubing.

4 Conclusion

The developmental alternative zones isolation concept, which used a series of structured reviews both internally and externally with packer's providers, and representative lower completion provider, resulted in a successful installation of multiple production packer in lead to level of confidences in accessing potential shallow reservoir to gain more hydrocarbon. It is proven as a new cost effective solution to allow isolation for selective shallow reservoir and enables the delivery of typical marginal wells economically in Mahakam. This initiative eliminates annular cementing requirement thus reducing the well intervention cost especially in typical highly deviated well. This has resulted in potential significant well cost saving up to 82% compared to conventional annular zonal isolation or approximately equivalent to one third million USD along the completion phase. This new frontier solution can be considered as the first successful of multiple packer's installation at offshore areas worldwide with no NPT and safety issue. The case history has shown that successful installations can significantly reduce field developmental cost. Currently, this best practice was extending to swamp operation with similar case to isolate shallow reservoir and eliminate conventional cementing cost and intervention will easily unlock the reservoir and accessing all target zones for optimum well recovery.

References

[1] Daniel L. Patterson, SPE, Halliburton Energy Services, Inc.; Ian D. Taggart, Shell UK Exploration and
Production; Harald W. Breivik, Statoil Norway; Gordon Scott, Randy Simonds, SPE, and Rod Falconer, SPE, Halliburton Energy Services, Interventionless Production Packer Setting Technique Reduces Completion Costs.

[2] Laidlaw, D., Agee, D., Madyanova, M., Hustache, H., Combination of Dual String Single Trip Multi-Zone Completion Systems and High Rate Formation Pack as a Proven Completion Methodology for an Unconsolidated Reservoir: Case Study Tunu Field. Paper SPE 155202 presented at SPE Oil and Gas India Conference and Exhibition held in Mumbai, India, 2012.