IATMI22-156

Breakthrough Completion by Applying Monobore Completion Well Design on SKL-XXX Well

Solihin Permana Putra [*1], Andaru Ibnu Pratomo [2], Muhammad Aldie Syafaat[3], Mirza Azhari[4], and Alvine Winardi Tammala[5]
[1,2,3,4,5]Pertamina Hulu Indonesia
* Email: Solihin.putera@pertamina.com, aldie.syafaat@pertamina.com

Abstract. Since Pertamina internal reorganization, Pertamina EP Asset 5 joined within Pertamina Hulu Indonesia (PHI) group, following PHSS, PHM, and PHKT. Since long time ago, Pertamina EP Asset 5 applies conventional completion design (7 inch liner with 2-7/8 inch tubing inside) meanwhile PHSS, PHM, and PHKT already applied Monobore/dual Monobore completion design (cemented 4-1/2 inch or 3-1/2 inch tubing inside open hole) for well duration and cost optimization in their wells for years. Noticing Monobore completion design was proven for well duration and cost optimization, Pertamina EP Asset 5 adopted their success story by replicating Monobore completion design to apply in well SKL-XXX located in Zone 9 as a pilot project. From preliminary study, the application of Monobore completion design in SKL-XXX was expected to optimize cost at around of 190 KUSD and faster drilling time by 3.4 days. During project execution, trial of Monobore completion was successfully applied without major operational problem and delivered actual cost saving at around 99 KUSD and faster completion duration at around 1.6 days compared to conventional completion. This success story of trial Monobore completion at SKL-XXX has been proven as alternative for optimization improvement in the future and opens opportunity to deploy Monobore completion design in all Asset of Pertamina EP.

Keyword(s): Drilling cost, Drilling time, Monobore, Sangasanga, Pertamina EP.

1 Background & Objective

It is well known that Monobore completion has been massively deployed in other subsidiaries of PT Pertamina Hulu Indonesia (PHI), for example in PHM and PHSS, implementation of Monobore completion is started since 1990s until now (‘Figure 1’). This innovation was driven by continuous decrease of reserve that causing economical issue of their project. This innovation has succeeded to unlock marginal reserve and maintain continuation of their drilling project following better economical project.
Similar condition in Pertamina EP Asset 5, it will be more difficult to unlock marginal reserve with current conventional completion type due to higher cost required meanwhile current remaining reserve tends to continue decreasing. By implementing Monobore completion, it is expected to be able to reduce cost & and time so that there will be more marginal wells could be drilled in the future. However, Pertamina EP Asset 5 has never yet run Monobore completion so it is a challenge project to apply Monobore completion in Pertamina Asset 5 by PHI Group. Hence, comprehensive study and strong efforts from all team involved both in Region and Zone are required to ensure Monobore completion as a pilot project can be realized in 2021 or 2022.

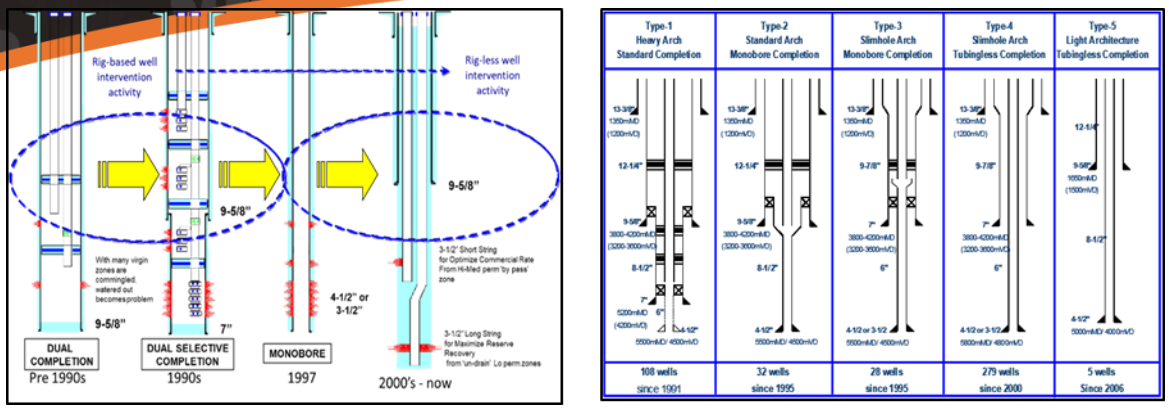

Figure 1. Completion evolution in PHSS (left) & PHM (right)

1.1 Candidate Selection

For screening well candidate, there are few considerations:

- Wells that technically approved in Funneling and Submitted to Work program 2022
- Wells that have oil and gas reserves
- A field that have already gas production facilities (optional)
- Subsurface parameter Match with artificial lift : slim SRP, PCP and ESP or gas lift (GLM, PCTGL, Gas lift deepening)
- Production Scenario
- Economic

From 39 new well candidates in zone 9, SKL-XX is the best candidate for applying Monobore completion since it has most suitable criteria compared to the others. This well has not only oil reserve but gas resource target as well, also in the future, the field where SKL-XX is located will have gas production facilities due to North Mahakam gas development (‘Figure 2’)

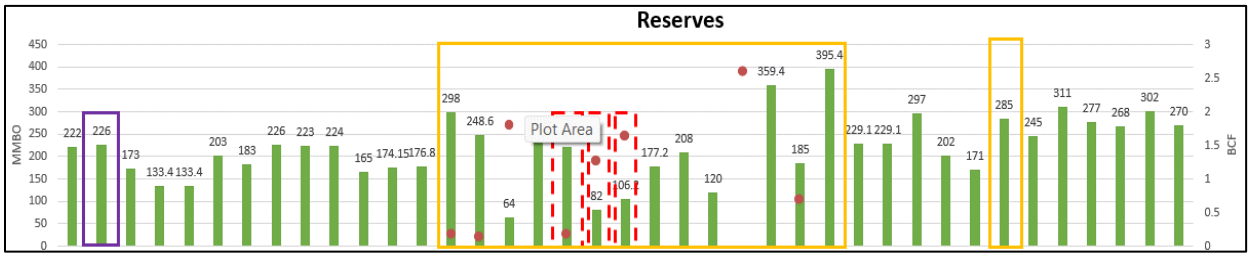

Figure 2. List of well candidate selection for Monobore design

1.2 SKL-XX well design

SKL-XX has two main targets, the oil reserve is D-08 and oil with high Gas oil ratio is D-10. As we can see in Figure 3, in previous design with conventional completion still use 7” liner to well TD which hung inside 9-5/8” casing then run 2-7/8” tubing with down hole pump installed to produce oil after perforation. In this pilot project, with single Monobore completion, the 7” liner is replaced by running 3-1/2” EUE tubing to surface and cemented. Tubing cementation was performed from bottom to surface along annulus between tubing and 8-1/2” hole to have good well integrity. There was no change in casing point and well TD depth also some materials used for single Monobore completion coming from existing inventory.

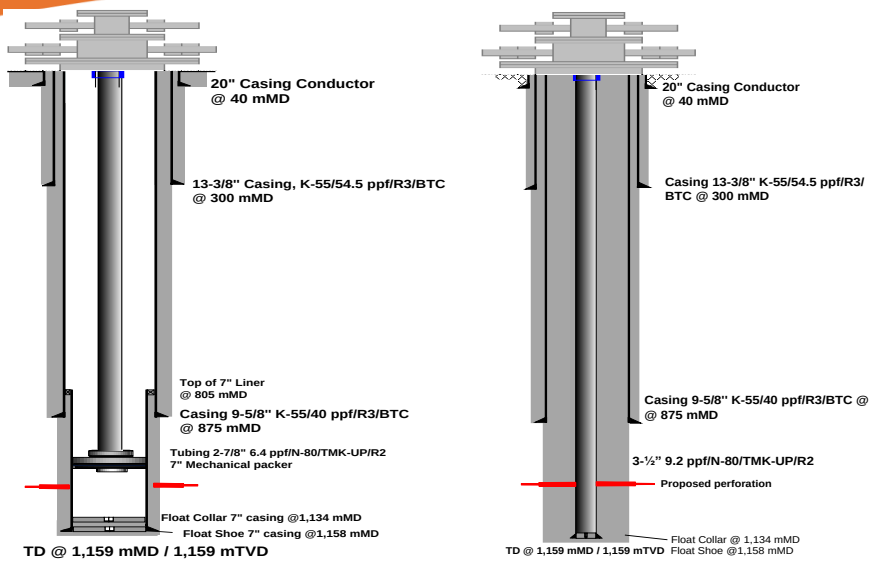

Figure 3. Conventional (left) – Monobore (right) Well design for SKL-XX

1.3 SKL-XX artificial lift design

In optimizing oil produced, the design of artificial lift is needed. The availability and existing contract can be potential issue. For Monobore completion, these are general issues that has to be addressed prior to artificial lift installation:

- Well influx has to be pre-defined accurately (recommended to swab well after perforation)
- Pump intake will always be set above perforation
- Recommend to install downhole sand screen if formation has sand problem tendency
- Need special tools to install/pull off artificial lift (if planned to use E-Line/Slickline or CTU)
- Pumps (SRP, ESP and PCP) will be more sensitive to solid content and GLR
- Surveillance will only rely on downhole sensor due to no annulus to monitor liquid level
- Electrical supply has to be reliable (minimize on-off operation)
- Fishing tools and scenario is needed due to high stuck/mechanical problem possibility

Below are the pro & cons for artificial lift options after several discussions within the team:

Artificial Lift	Theoretical Rate (3.5" Tubing)	Gas Tolerance	Solid Tolerance	Current Limitation	Concerns	Next Step
Gaslift	100-1500 BPD	Best	Better	No Gaslift facility	N/A	Not an option
Rod Pump (existing unit)	50-350 BPD	Poor	Poor	Low rate Poor for dual monobore	- Completion Tools - WL compatibility	Completion Tools Procurement
iESP	100-1500 BPD	Moderate	Poor	Cost vs Gain	Long fabrication and delivery	Procurement
iPCP	80-900 BPD	Better	Moderate	Poor for dual monobore	Aromatic compatibility	Labtest and Procurement

Table 1. Consideration of artificial lift method

After several assessments, the insert SRP will be the first one to be applied while the inflow performance is observed to determine the optimum artificial lift. From the IPR design with liquid maximum rate 500 BFPD, the insert PCP is the most suitable for the well condition. The Nodal analysis and production forecast can be seen in 'Figure 4'.

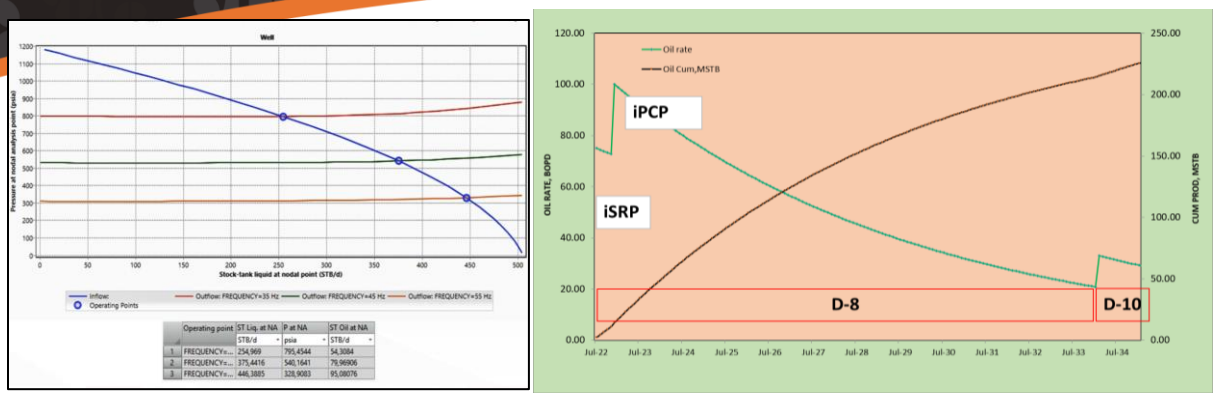

Figure 4. SKL-XX nodal analysis and production Forecast

2 Operational Challenge

2.1. Drilling and Completion aspect

There was no change in drilling technique since hole section and size for SKL-XX are still same with previous. Hole size were 26" – 17-1/2" – 12-1/4" – 8-1/2" are considered as the best design for SKL structure. The main difference only in the completion section by replacing 7" liner with single Monobore completion using cemented 3-1/2" single EUE tubing. By running Monobore completion, not required to run 2-7/8" EUE tubing as normally run inside 7" casing with single mechanical packer or artificial lift at end of tubing depends on production criteria as performed in the well with conventional completion.

To have good integrity in the tubing, we must have cementing stand off ratio above 70%. Therefore, tubing hinge bow type tubing centralizer was chosen to create 70% stand off ratio. Single stage cementing 2.05 SG with 60% excess was performed and had 13 bbls return to surface, so we are sure cement will have good integrity. This cementing job performed after 3-1/2" tubing hanger and X-tree installed in the final position. With Monobore completion, initial perforation and next perforation job was design to not using rig (rigless). This will be one of the advantage from Monobore completion because by rigless operation (ex: snubbing unit, slickline unit, etc.), will be less cost required than by using drilling rig. Different with Monobore completion, with conventional completion will always need drilling rig for well work from spud until well put on production considering engineering and operational aspect. However, even though Monobore completion as pilot project applied in SKL-XX, drilling rig was still used for perforation job in order to have faster initial production after well completed.

Prework prior perforation job using dummy gun was mandatory to make sure 3-1/2" tubing have a clear path. Perforation gun option and size was limited since perforation was considered as thru tubing perforation. In previous completion which use 7" liner, high density completion fluid (HDCF) was required to create overbalance in the well since perforation job was performed using rig's BOP. After X-Mas tree installation, then perforation job can be performed either underbalance or overbalance by adding back pressure using surface pump. Using this technique, high cost HDCF are no longer needed to create overbalance perforation.

3 Result

After the well completed without major problems, the result can be summarized as seen in 'Figure 5',

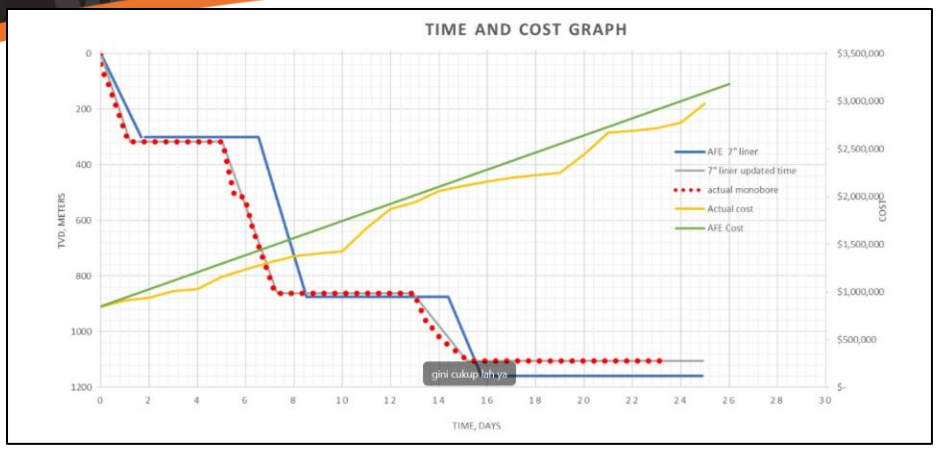

Figure 5. SKL-XX Operation & Cost Timeline

The benefit from application of Monobore completion was obtained by comparing SKL-XX completed with 3.5" single Monobore and if the well completed with 7" Liner by normalized actual operation and duration first. From this comparison, observed that completion duration could be saved up to 1.6 days and well cost could be saved at around 99 KUSD. In the future, the well can be more optimized with several considerations mainly as follow:

- Drilling rig release after cementing job & install X- Mas tree then perforation job & well test by rigless job **(can saving up to 3 days ➔ $ 69,000)**
- If using drilling rig then we must have shorter well testing period, currently 1.8 days (can saving up to 1 day ➔ $ 23,000)
- Procurement strategy for material from local supplier (cementing accessories for 3-1/2" tubing, can saving up to $ 6,000)
- Material and services for Workover and Well intervention activity for wells future life (minimize production deferment)
- Artificial lift strategy for Monobore completion (increase in gross production)

From production aspect, the scenario is bottoms up method by producing zone D-10 as lower reservoir layer. Re-perforation in this layer and additional perforation job in zone D-8 as upper reservoir layer will be performed if the production tends to decrease due to depleted pressure. The production profile of SKL-XX can be seen in Figure 6 as follow:

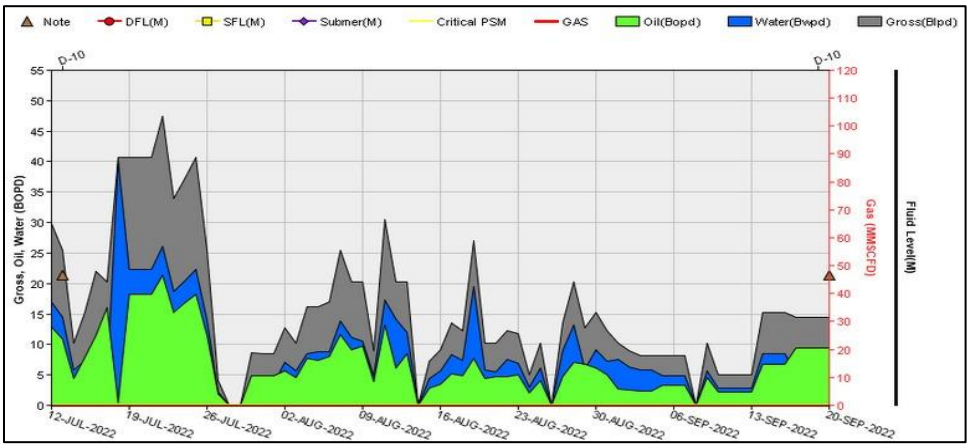

Figure 6. Actual SKL-XX production profile

4 Conclusion

As pilot project, the application of Monobore completion design can be successfully done in SKL-XX Pertamina EP Asset 5 without major issues. Despite some cons in technical operation found, Monobore completion design has been proven to be applied as alternative for well duration and cost optimization improvement. Here below are several highlights from Monobore completion project:

- Based on the result, the application of Monobore can deliver cost saving at around of 99 KUSD and faster completion duration at around of 1.6 days compared to conventional completion.
- To get more optimization in the future, the operation can be improved by drilling rig release after cementing job & install X-tree, performed perforation job & well test by rigless, procurement strategy for material from local supplier (ex: cementing accessories for 3-1/2" tubing) to get cheaper price and easier material mobilization.
- Artificial lift is one of challenging aspect for production optimization from the well with Monobore/dual Monobore completion. Thus, in the evaluation and assessment stage have to also consider further installation and accurate prediction of produced fluid and well performance.
- Zone 9 in Pertamina EP Asset 5 has also achieved more effective way to perform well intervention job after drilling in SKL-XX by using rigless and rig combination to install artificial lift.

Tools, equipment, and material of rigless fleet among others slickline and E-line unit also need to be well prepared to have optimum support during rigless intervention job otherwise the rigless operation job will be very limited and difficult and potentially can eliminate additional value of Monobore completion application.

References

[1] George R. Dyer, Bambang Ismanto, and Mike Haas. 2000. New Well Architecture Sucessfully Optimizes the Development of Fluvio-Deltaic Multi Layered Gas Field. SPE, VICO Indonesia.

[2] Brown, K.E. The Technology of Artificial Lift Methods, volume 4. PenWell Publishing Company. Tulsa (1984)

[3] Hsia T.Y. and Behrmann L.A. Perforating Skin as a Function of Rock Permeability and Underbalance. Papre SPE 2280 year 1991.

[4] - Troubleshooting Cable Deployed Thru Tubing Electrical Submersible Pumps: A Case Study from South East Asia (SPE-205614-MS) https://doi.org/10.2118/205614-MS

[5] - Alternatively Deployed Artificial Lift System for Deepwater Subsea Operations SPE-194400-MS

[6] https://doi.org/10.2118/194400-MS

[7] - Truly Rigless: A World First Through 3-1/2" Tubing Cable Deployed Electrical Submersible Pump on a Live Well SPE-192100-MS

[8] https://doi.org/10.2118/192100-MS