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A Successful Story: Improving Success Ratio up to 80% of Well Reactivation Job. Pamusian Field Case Study, Tarakan, North Kalimantan, Indonesia

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Abstract.
Pamusian Field is located in the northern part of North Kalimantan, Zona 10, Pertamina Hulu Indonesia area, approximately 1 km Southeast from center of Tarakan City. Pamusian field is one of the top ten Fields (Kalimantan Area under Pertamina EP operation Area) based on its OOIP, 553 MMSTB with more than 1200 wells drilled since 1905 (brown field). However, this role doesn't mean Pamusian production stands at a tremendous number of productions. Moreover, only 50 active wells contribute to Pamusian oil production. More than 1000 wells are idle even though there are bunch of oil opportunities on the idle wells. As an overall, Pamusian oil production remained constant for around 500 BOPD at 3 years back before massive reactivation delivered in 2021.

At the end of 2020, aligned with the company's goal to maximize existing Assets, the idea of production optimization was commissioned by improving the success ratio of well reactivation job in Pamusian Field. In the last 3 years, the success ratio of well reactivation jobs was not encouraging. The team focused on all aspects of optimization and reactivation practices. Field Review and Reactivation Lookback are aggressively conducted to figure out Pamusian Field problems. Lack of workover and well intervention jobs, inadequate surveillance data, and a misperception of well reactivation methods are raised as the root causes for underdeveloped fields. Another surprising fact is more than a hundred attic wells located up dip in the main closure are not active (idle), which has lower surrounding well in a good oil production performance (10-30 BOPD) BOPD with various of water cut 90%. Again, this is real opportunity! low hanging fruit to become more oil by producing those wells.

An integrated and comprehensive assessment was successfully delivered. The most important outcome of this assessment is reactivation method recommendation, it's called Locomotive (Low Cost, Massive Impact, & Innovative).

Three innovations were created and delivered to conduct well reactivation jobs in the Pamusian field, there are Subsurface Data Hierarchy Development (to set subsurface confident level), Fill up Annulus Activity (to check fluid sample), and Locomotive Risk Mapping Assessment (to set priority by comparing confident & impact level) as a decision tool. These reactivation methods deliver a high confidence level of success. Resulting a dramatic rise of success ratio up to 80% (previously 30% at 3 years back) and oil gain average 150 – 200 BOPD which remained stable for several months until early 2022.

Keyword(s): Reactivation, Production, Brown Fields, Locomotive, Subsurface, Optimization

Introduction

Pamusian Field is a brown oil field located at Tarakan Island, North Kalimantan, Indonesia (Fig. 1). This field was discovered by Operator Nederlandsch-Indische Industrie Handel Maatschaapij) in 1905 then started the first production until this day. Pamusian field is one of the backbone fied in Tarakan Field, Zona 10 Pertamina Hulu Indonesia since 32% of oil production comes from this field.

The main formation to become a productive reservoir of this field is Tarakan Formation. The Tarakan Formation consists of interbedded clay, shale, sandstone, and lignite coal layers, which indicates the depositional environment was fluvial until delta plain. Based on well log data, clastic sediment lithology is dominated by sandstone and shaly sand, which generally acts as a para-sequence boundary of one with another para-sequence. In general, GR Log shapes evaluation indicates 3 types of sand distribution, blocky sand as dominant facies, bell-shape, and symmetrical. Based on well-to-well correlation evaluation, Tarakan formation is relatively continuous and connected among wells, especially in shallow prospect zone as the main contributor of production in the Pamusian Field (Fig 2.).

The shallow prospect zone includes the reservoirs as follows, 90 Mz, 110 Mz, 130 Mz, 165 Mz, 235 Mz, 290 Mz, 340 Mz, and 460 Mz, which all current active wells are producing from these reservoirs/zones (Fig.3). The major challenge of the shallow prospect zone is typically a sand problem that leads to generating skin problems. That’s why all of the wells in Pamusian field are completed with a downhole sand screen on an open hole section (standalone screen). However, the driving mechanism of this shallow prospect zone is strong water drive support. It’s really significantly become a strength of Field Pamusian because the majority of wells have a good static fluid level which indicates good reservoir pressure. As shown on the table-1, there are no gaps between the initial and current formation pressure. Both of them have similar pressure such a 0.98 SG equivalent pressure.

Since the field’s start up in 1905, Pamusian Field has successfully drilled 1271 wells and distributed in 15 prospect reservoirs with various depths of 50 m to 1400 mMD in the Tarakan and Santul Formation (Fig. 4). Even though a thousand wells drilled in Pamusian, there are only 47 actives wells with production 447 bopd in the end of 2020 (average production 10 bopd per well) and Recovery Factor (RF) 37% which indicates a bunch of opportunities should be unlocked to increase production and RF by reactivating suspended wells.

Many years back, the reactivation job of suspended wells has been executed for many wells. Unfortunately, the success ratio of these reactivation jobs is not promising yet, success ratio < 30% (table.2). This fact becomes our background to perform massive reactivation to achieve a higher success rate. More wells reactivated, more oil will be delivered. Looking at current condition of suspended well, the potency looks promising because of more than a hundred attics wells located up dip in main closure not active (idle) has lower surrounding well with a good oil production performance.

Scope

For more than 1 year, suspended for various reasons, this reactivation job can be defined as reactivating inactive wells. This typical reactivation is executed without doing reservoir intervention such as water shut off, reperforation, adding perforation, stimulation, fracturing, etc. The scope of this reactivation includes cleaning the wellbore by the sand fill up, fish/junk, screen job, swabbing job, and a downhole pump as an artificial lift (Fig.5).

This reactivation campaign is expected to deliver a higher success rate with a minimum cut-off Discounted Profitability Index (DPI) ≥ 1.2 which should be definitely profitable. The DPI is calculated by dividing the present value of future cash flows by initial cost of reactivation job. A DPI of 1 indicates that project/reactivation job will break event.

Project in scope:

- Screen job
- Fishing Job

Project out scope:

- Workover job
- Reservoir intervention

Methodology

In the event of production increasing effort through a massive reactivation campaign in Pamusian Field, here are some steps in delivering good candidates:

1. Lookback Previous Reactivation Job

Conducting a lookback for previous reactivation jobs are very critical step before delivering good candidates. As part of the continuous improvement process, taking a lesson learned of success or failed job is important. There will be some specific parameter correlations identified during this process. The evaluated parameters were correlated to the oil gain result of the previous reactivation job. This process is evaluated to accelerate finding out correlated parameters which has boundary of limited subsurface data. Those parameters include well location in depth structure, production history, well integrity & fish/junk problem cumulative oil production, latest oil saturation based on saturation log result, injection response, etc. Here are some lesson learned taken of previous reactivation job (Fig. 6):

- Lookback & lesson learned from PAM-1043

This is typical of reopening job which refers to cased hole saturation log result. In 2019, oil saturation 340 Mz was at 40%, which has been promising. This well is located at lower attic and is surrounded by 2 good oil producing wells; PAM-0213/II with a production of 25 bopd, and PAM-0933 with a production of 15 BOPD. From this data, it was decided to reopen 340 MZ in PAM-1043, which generated an average normalized oil gain of 15 BOPD.

- Lookback & lesson learned from previous job

- Well in attic/up dip of structure statistically delivered higher oil gain
- Water injection well had a good response either gross or net production
- Most of failure jobs were caused by unsuccessful fishing job
- There were some dynamic fluid level response from nearby injector

2. Develop Subsurface Data Hierarchy

All the parameters that have been evaluated previously are not stand alone. There are connections between one parameter with others. Therefore, integrated analysis towards these parameters is still required when selecting reactivation candidates. To sum up, subsurface data hierarchy is developed to determine confident level & uncertainty level from the limitation of owned data which includes lack of open hole (OH) log data (less than 150 OH log of 1227 drilled wells), lack of cement bond log, inadequate pressure data, incomplete well history & production history, etc.

location, surrounding well performance, injection performance, and production performance/history of suspended well. Saturation log data is actually limited as well due to this kind of data being acquired only during workover jobs. In spite of that, this data is very important to quantify current oil saturation and provide valuable information for nearby suspended wells. Moreover, this data becomes the most reliable data (as long as it has valid interpretation) to start screening nearby suspended wells. On top of that, the latest saturation log data can deliver further assessment for well to well correlation and fluid contact. Other parameters or data can be described as follows:

- Well location

This is a well location on reservoir structures such as updip/attic, lower attic / medium, and downdip/flank. As stated on previous evaluation, more oil gain will come from wells located at updip/attic structures.

- Surrounding well performance

This is very important data to show the current performance of certain well or reservoir. A lot of suspended well located around big oil producer. Looking back the typical of reservoir connectivity is quite good, surrounding well performance is the key to quick screening reactivation candidate. Quite simple conceptual applied, if structurally lower surrounding wells perform a good production from a particular zone/reservoir, thus the higher suspended well should be typically good performance. Vice versa.

- Injection response

Some injector wells were on stream in a couple of years back. These wells were intended to increase the areal sweep of Pamusian Field which has a typically low drainage radius. After a couple years of having no monitoring around suspended & active wells, surveillance job was aggressively performed in several monitor wells such as static & dynamic fluid level, reservoir balancing to avoid lack of withdrawal. As a result, many areas having more injection on the peripheral but not enough withdrawal. It leads to a major reason to reactivate more suspend well to prove response of injection

- Production history

This kind of data includes production history, cumulative production, bubble maps, initial production, and last production.

3. Well History and Integrity Analysis

Referring to the previous evaluation of reactivation jobs, more than 50% of execution had been postponed since integrity issues. Moreover, the uncertainty of wellbore accessibility might cause jobs to fail because of unsuccessful fishing jobs. That's why deep down of well history analysis is a must. Extra effort should be carried out such as revisiting aging documents since the early 1900s. This effort to reduce the uncertainty of wellbore accessibility issues by doing mitigation with the wellwork team.

4. Field Survey

Field survey aims to direct site visit for the sake of fill up annulus check and access & location check.

- Fill up annulus check

This procedure is to fill up the well annulus with water to determine the original wellbore fluid whether water or oil (Fig. 8). Injected water to the annulus will fulfill until overflow happened in the surface. If oil as the original fluid in the wellbore, overflow will be oil as well since oil less dense than water.

Early step of this procedure is perform Sonolog test to determine fluid level and wellbore pressure. Fluid level data is necessary to ensure the required volume of water is injected while wellbore pressure is maintained to ensure all operational jobs are working safely and properly.

The fill up annulus is able to be conducted in the Pamusian field due to strong aquifer support (water driver). After more than a year of having no production, static fluid level will be continuously built up, even up to 0 mMD (to the surface) and it turn into high static formation pressure in suspended wells. Once fill up annulus is conducted, fluid will be circulated out to the surface, not loss to the formation.
The main purpose of this procedure is to determine the original fluid in the wellbore. Overflow fluid to the surface will be accumulated to the tank/chamber. Amount barrels of recover oil can be convert to fluid column using annulus volume capacity conversion. This procedure is able to replace Static Bottom Hole (SBHP) record using slickline which was not available on site at the time.

- Access & Location Joint Survey

This activity involves a multi-discipline team to visit and check the current condition of well access and location. The joint assessment is part of a mandatory survey considering the Pamusian operation area located around housing, swamps, rivers, production facilities, public roads, etc. The output of this survey is to ascertain a safe rig operation and production facility scenario. If some findings are identified, they need a mitigation plan to close the findings for the sake of smooth and safe project execution.

5. Risk Mapping

As part of delivering high-quality candidates, this step is very critical. This is a step on how to generate low risk & high impact candidates. In line with Pertamina Upstream Production Way (PUPW), 3 main step of reactivation candidacy process should be completed such as determining potency, economic assessment, and prioritization. The prioritization is translated into this risk mapping and named it with Locomotive Risk Mapping (LRM) (Fig. 9). Locomotive means Low Cost, Massive Impact, & Innovative because LRM generates low-risk high-impact candidates with innovative methods.

LRM consists of 2 main assessments such as Confident Level and Impact Level. Confident Level includes subsurface assessment, well history/integrity assessment, fill-up annulus result, and surface assessment. These parameters all set by certain scoring criteria to guide us in fulfill this LRM (table 3). While impact level quantifies economic assessment which consists of an estimated cost and an oil gain function.
Wells that have high confident level and impact level should be plotted at the upper right which means low risk and high impact candidates.
All wells on that quadrant will be prioritized using a multiplier number of Confident Level and Impact Level. This number is called LRM Value.
Confident Level

- High confident level (low risk) : score 2.7-3.0
- Medium confident level (medium risk) : $2.4 \leq$ score < 2.7
- Low confident level (high risk) : score < 2.4

Impact Level (Discounted Profitability Index/DPI)

- High : $DPI \geq 3.5$
- Medium : $2.5 \leq DPI < 3.5$
- Low : $DPI \leq 2.5$

6. Project Execution & Monitoring

As a result of Locomotive Risk Mapping, high-quality candidates have been generated. These candidates then be transformed into a Reactivation Proposal which consists of the purpose of a job, job procedure, work & material plan, and mitigation plan. Next is the reactivation job. During this job, its' really possible to fail since integrity issues are not captured in well history, low influx, low oil cut, complex fish/junk, massive sand problem, etc. On the other hand, for a successful job, a well is put into production with close monitoring by taking more surveillance (well test, sampling, sonolog, etc.) to capture optimization opportunities.

To sum up, Locomotive method is an integrated, comprehensive, and quick method to reactivate suspended wells in Pamusian Field (Fig.10). By implementing this method, high quality of candidates will be delivered with some benefits such as simple screening and simple job, no need to rent equipment for SBHP record, generating hundreds well candidates, simple decision tool (Locomotive Risk Mapping).

Results & Discussion

During 2021, reactivation job in Pamusian field had been implemented in 21 wells, of which 17 wells are categorized as a successful job that reach 81% of success ratio (DPI $\geq$ 1.2) (table 5). It is a big achievement compared to the previous year which only reach 30% of success ratio. This reactivation is also the biggest contributor to the increase of Tarakan Field production for about 2100 BOPD.

1st case, ideal case candidate (Fig. 11)

An example of an ideal success case can be found on PAM-0893. This oil well was produced in the 340 Mz layer with an open hole and standalone sandscreen completion, with the last production of 5 bopd in 1974. From the analysis of subsurface data, the well is located in the top structure, relatively up dip compared to the surrounding active wells which have typical production of 10-40 bopd. From the 2019 cased hole saturation log data on PAM-1043 which is more down dip than PAM-0893, the oil saturation is obtained at 40%, and it is proven that the perforation in the PAM-1043 well in the zone shows an oil production of 10-20 bopd. The PAM-0893 well also has injection support which is more down dip. From the well history data, this well also has no record of fish/junk and integrity problems. From the survey results at the site, there were no major problems so that the wells could be rig work. The downhole pressure measurement was obtained using a sonolog tool with a fluid level of 0 m and intermittent flowing well under static conditions. After the reactivation job, the peak production was 60 bopd, and it was stable at 30-40 bopd.

2nd case, the uncertainty of wellbore accessibility, unrecovered fish (Fig.12)

This case can be found in PAM-0224/II and PAM-0235. These wells were completed from 340 Mz layer with standalone screen on open hole section. These wells are located up dip in the main closure of 340 MZ. Unfortunately, PAM-0235 has unclear tubular fish in the wellbore. While PAM-0224/II has fish of 4-3/4" basket and 2-3/8" drill pipe. All mitigation had been discussed and clear with wellwork team. However, both fish couldn't be recovered after several attempts of fishing job. Moreover, PAM-0224/II had a shallow tag starting at 40 mMD. It was significantly different information between the well history and actual well profile. Its common findings during reactivation job in Pamusian due to lack of well history information. Maximizing efforts for washing down, milling, or fishing job were the key to the success of the wells although maximum accessibility was only until the top of the fish. The final tag of fish for PAM-0235 is about 30 meters from the top of production interval, while PAM-0224/II is about 30 meters from the top of the production interval. Those wells were decided to perform swab job to determine the well influx. With Qmax less than 70 bfpd and oil cut 1-2%, these wells keep to put on production due to located up dip, oil show result during fill up annulus check, and as the monitor of injection response in 340 Mz. These wells should be produced to increase withdrawal due to nearby injector consistently injected until 1600 bfpd. Surprisingly, resulting a dramatic rise of tremendous production comes from these wells. In the early period of production, PAM-0235/II was naturally flowing to the surface for 3 days up to 300 bopd before a recordable test stable at 30-40 bopd. While PAM-0224/II production was relatively stable at 10 bopd but an interesting phenomenon happened here. There was a significantly improvement Inflow Performance Relationship (IPR)/Qmax from 80 bfpd to become 1400 bfpd with stable net production 16 bopd.

3rd case, injection response (Fig. 13)
This is one of the unique cases in PAM-0173/I. This well is located up dip in the main closure of 340 Mz. In the 1st quarter of 2014, this well was reactivated with a 100% water cut.. After right, this well was suspended before last reactivation job in 2021. After almost 7 years of having no production, some interesting points came up to become the reasons for reactivating this well. There were 2 injectors on stream in late 2014 and 2019, PAM-0378i and PAM-1001i. PAM-0378 was converted to a peripheral injector since 2014 with average injection 3400 bwipd. While PAM-1001i located up dip but lower than PAM-0173/I had been starting the injection in November 2019 with stable rate 3800 bwipd. After Almost 7 years of having support injection from the peripheral, and 2 years from the nearby injector, filling up annulus was conducted as part of reactivation job screening. To sum up, fluid level was found until surface, 0 m and continues oil show result during fill up annulus. It's indicating nearby water injection response to this well by improving areal swept. As the result, after reactivation job, the peak production of this well up to 50 bopd and is currently stable at 20 bopd.

All in all, there were so many cases and lessons learned taken during reactivation job campaign in 2021. Here are some positive takeaways of this reactivation campaign (Fig. 14):

1. Increase the success ratio from 30% to become 81%
2. Deliver normalized oil gain about 200 BOPD
3. Contribute to peak production of Tarakan Field up to 2100 BOPD (previously 1800 bopd)
4. Improve cycle time of operational rig job from 9.5 days/job to become 6.05 days/job

Not only contributing to the production and operation, but also other positive impacts achieved from reactivation job such as asset protection from land encroachment issue and additional active wells for workover/well intervention candidates.

Recommendations

The reactivation campaign has succeeded in being a pioneer in bringing up greater opportunities in Pamusian Field. The success of reactivation jobs is able to prove most of the wells and the productive zone has great potential prospects. Wells reactivation with high influx/productivity index become candidates for further production optimization programs such a like gross-up production. In the end, reactivation job will be able to maximize oil recovery in the Pamusian Field with the existing surface facility capacity. The next plan to further improve the production is by improving surveillance data such as cased hole saturation log, SBHP record, and injection support.

Acknowledgments

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References

Batohie, G., Maharaj, G. 2016, Mature Field Rejuvenation by Reactivation of idle Wells in Petrorin's Land Acreage. Presented at the SPETT 2016 Section Energy Resources Conference, Port of Spain, 13-15 June 2016. SPE-180792-MS

Pertamina Upstream Production Way (PUPW)

Lock, G.A., and Hoyer, W.A., 1975. Carbon/Oxygen (C/O) Log: Use and Interpretation, Journal of Petroleum Technology

Ahmed, T., 2005. Advance Reservoir Engineering, Gulf Publishing Company, Houston, Texas, USA

Ahmed, T., 2006. Reservoir Engineering Handbook, Gulf Publishing Company, Houston, Texas, USA

Allen, T.O., and Robert, A. P., 1993. Production Operation: wll Completion, Work Over and Stimulation, 2nd Edition, Volume II, Oil and Gas Consultant International, Inc., Tulsa, Oklahoma

Kristanto, Dedy., Rukmana, Dadang., Amperianto, Agus., Paradhita., Windyanesha. 2022, Evaluation and Reactivation Stratgy of Shut-In Wells Due to High Water Cut to Improve Oil Production in Bayu Field: Case Study of Bayu-N3 Well. International Journal of Oil, Gas and Coal Engineering.

Figures

Tables

Figure 1

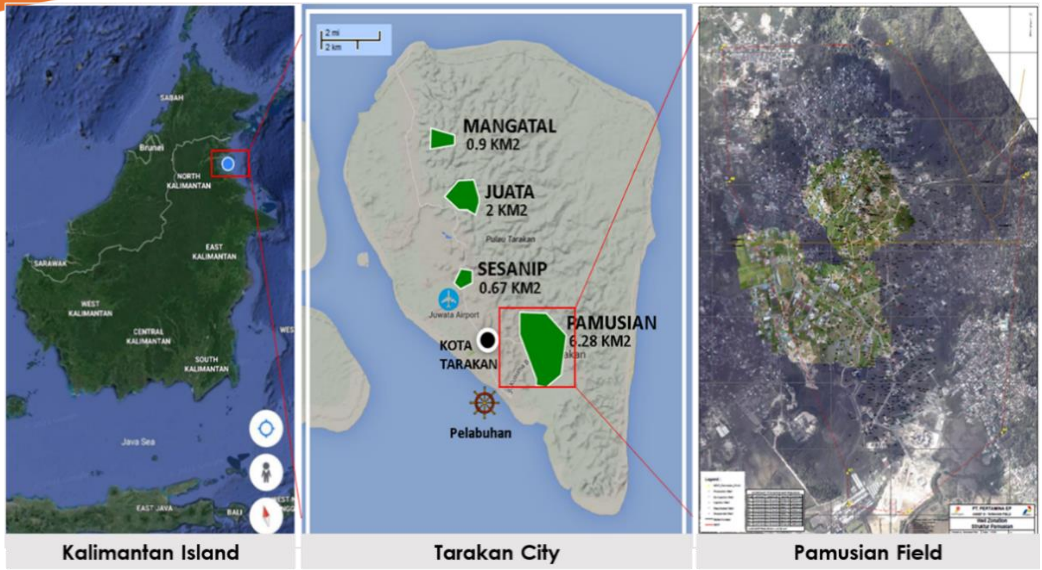


Figure 2

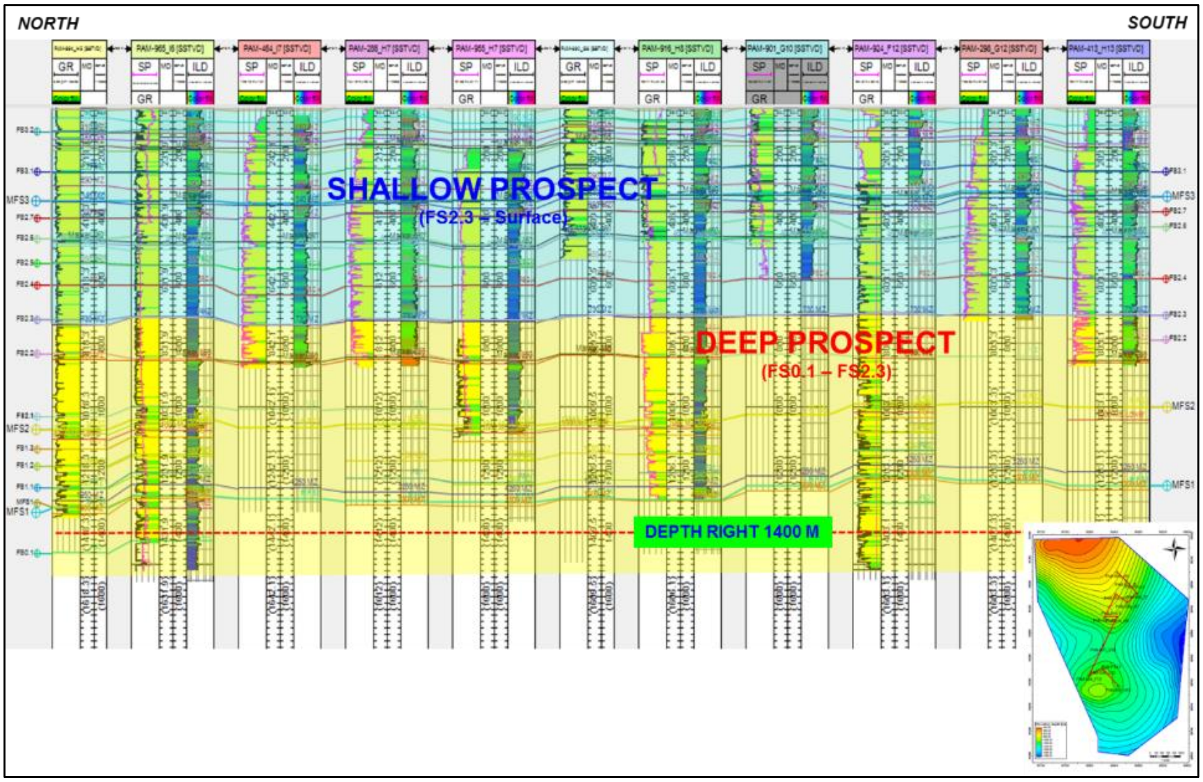


Figure 3

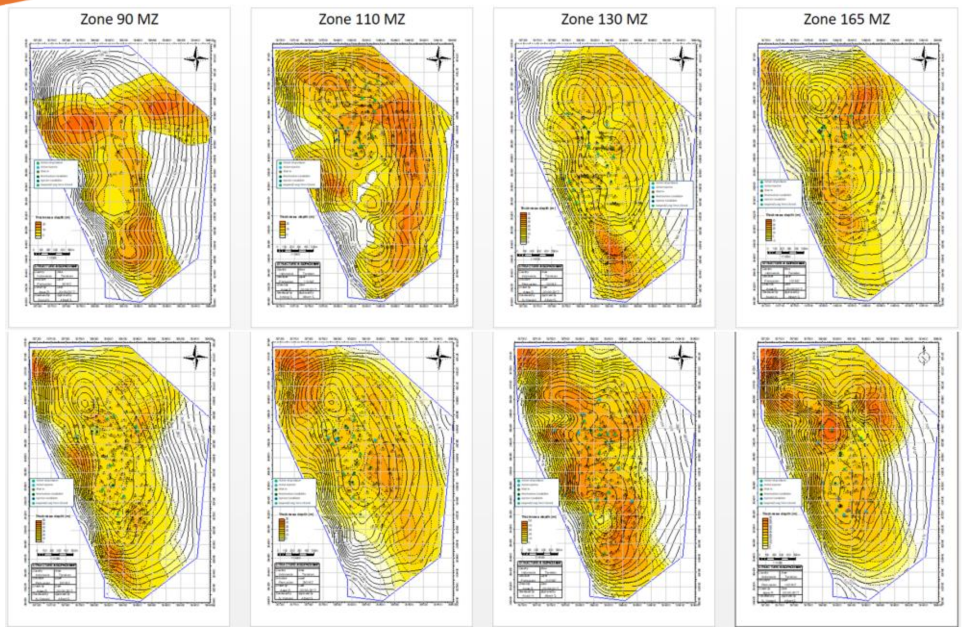


Figure 4

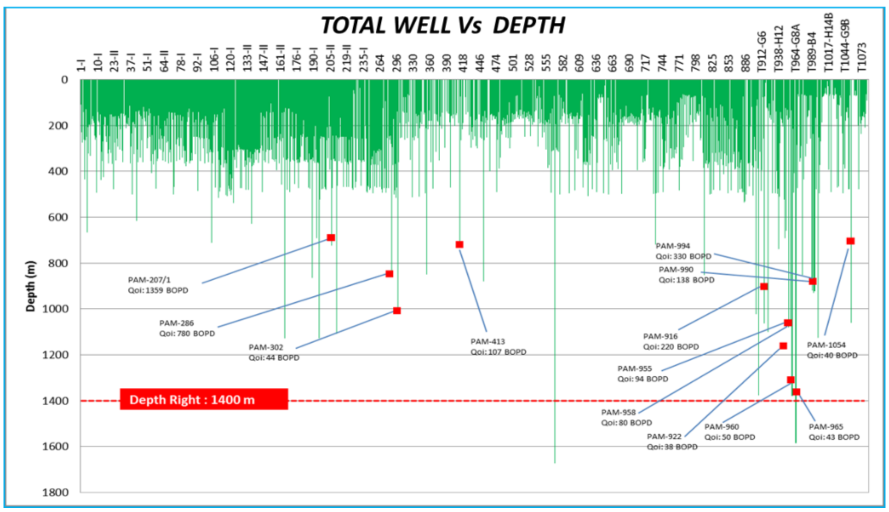


Figure 5

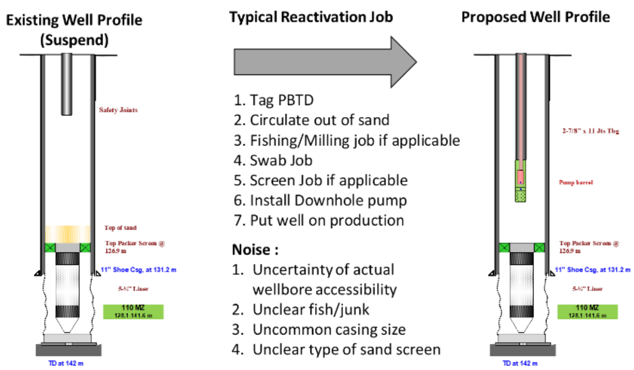


Figure 6

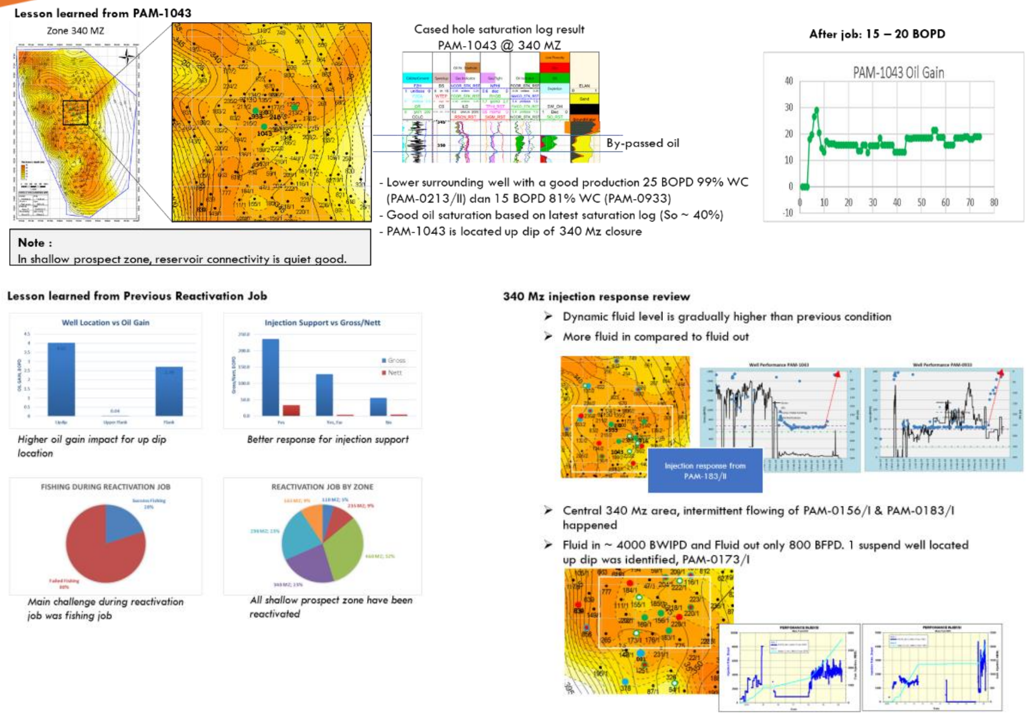


Figure 7

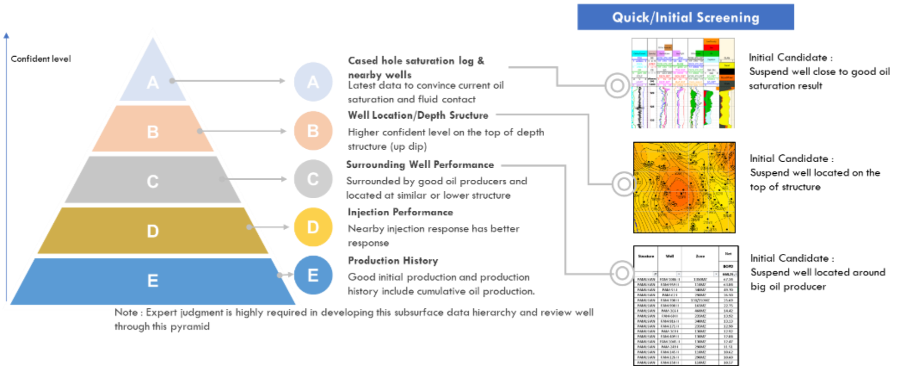


Figure 8

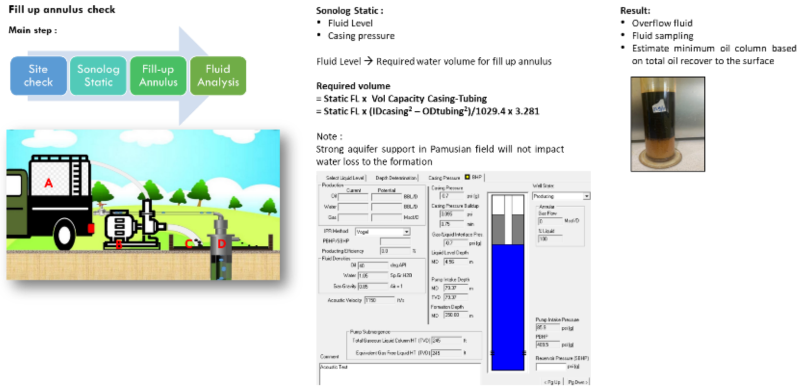


Figure 9

No	Well	Zona	Subsurface Assessment		Well History Evaluation: Fish/Junk Problem		Well History Evaluation: Wellbore Integrity Problem		Fill up annulus (Fluid Type)		Access and Location (Joint Survey)		Total Score (Confident Level)		Est. Oil Gain	Est. Rig days	Est. Cost	Simple DPI (Impact Level)	LRM Decision Value (Confident Level x Impact Level)
Weight			40%		15%		20%		10%		15%		100%						
1	PAM-0052//2	460 MZ	1	0.4	2	0.3	3	0.6	1	0.1	3	0.45	9	1.85	16	5	$ 12,441.03	4.4	8.2
2	PAM-0565	110 MZ	3	1.2	3	0.45	3	0.6	3	0.3	2	0.3	11	2.85	13	3	$ 9,316.01	4.8	13.5
3	PAM-0973	130 MZ	2	0.8	3	0.45	3	0.6	3	0.3	2	0.3	10	2.45	10	5	$ 12,441.03	3.0	7.3
4	PAM-0125	130 MZ	3	1.2	2	0.3	2	0.4	2	0.2	0	0	7	1	15	5	$ 12,441.03	4.2	4.2
5	PAM-0135/II	235 MZ	3	1.2	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.45	12	3	11	[illegible]	$ [illegible]	[illegible]	[illegible]
6	PAM-0179/II	235 MZ	2	0.8	3	0.45	3	0.6	1	0.1	3	0.45	11	2.4	10	3	$ 9,316.01	[illegible]	9.1
7	PAM-0524	130 MZ	3	1.2	1	0.15	1	0.2	2	0.2	1	0.15	6	1.9	7	8	$ 17,128.56	1.8	3.4
8	PAM-0759	110 MZ	1	0.4	3	0.45	3	0.6	1	0.1	3	0.45	10	2	8	3	$ 9,316.01	3.2	6.3
9	PAM-0132/I	460 MZ	3	1.2	3	0.45	3	0.6	3	0.3	3	0.45	12	3	10	3	$ 9,316.01	3.8	11.4
10	PAM-0173/I	340 MZ	3	1.2	2	0.3	3	0.6	3	0.3	3	0.45	11	2.85	15	5	$ 12,441.03	4.2	11.9

Confident Level (Risk Level)

Economic Parameter (Impact Level)

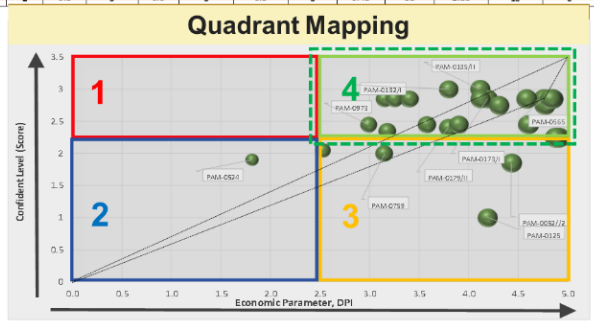


Figure 10

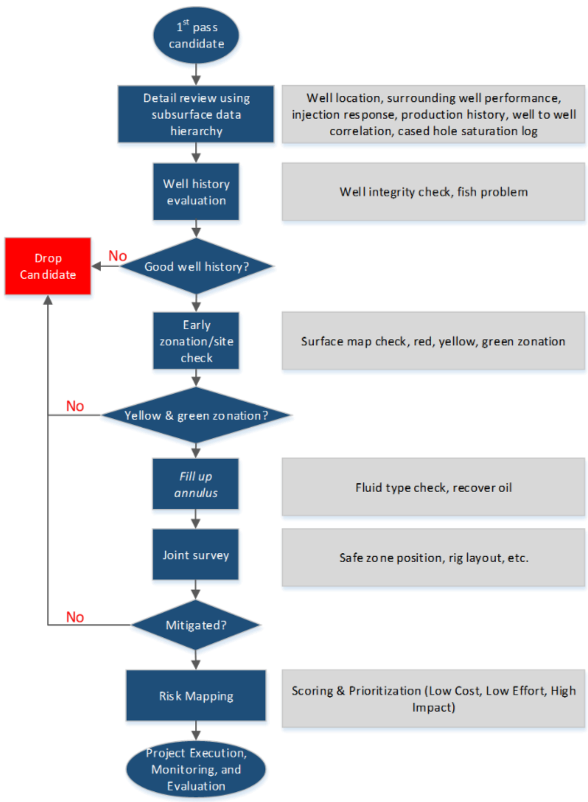
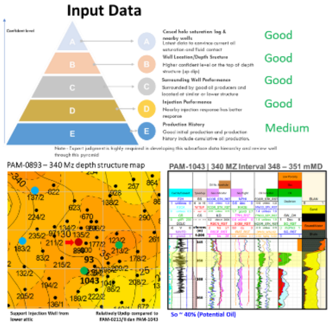
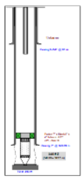


Figure 11

Input Data



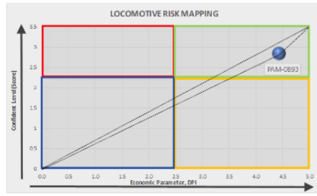


Production history not completed. This is just initial and last production information

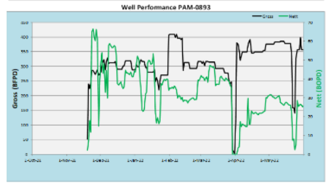
- Initial Prod in 1972 : 57 bfpd/13 bopd/77%
- Last prod in 1974 : 167 bfpd/5 bopd/97%

Result

No	Well	Zona	Subsurface Assessment		Well History Evaluation				Fill up annulus (Fluid Type)		Access and Location (Joint Survey)		Total Score (Confident Level)		Est. Oil Gain	Est. Rig days	Est. Cost	Simple DPI (Impact Level)	LRM Decision Value (Confident Level x Impact Level)
					Fish/Junk Problem		Wellbore Integrity Problem												
Weight			40%		15%		20%		10%		15%		100%						
1	PAM-0893	340 Mz	3	1.2	3	0.45	3	0.6	3	0.3	2	0.3	11	2.85	16	5	$ 12,441.03	4.4	12.6



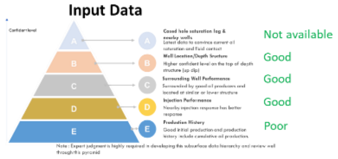
Confident Level : 2.85
Impact Level : 4.4
LRM Value : 12.6

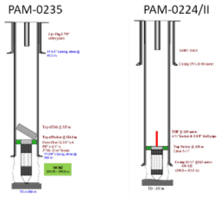


Qoi up to 60 bopd
Current Prod 20 – 30 bopd

Figure 12

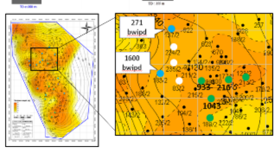
Input Data





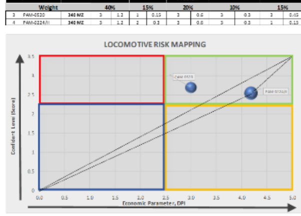
Note:

- Both wells had fish/junk in the wellbore
- Injection support from lower structure is expected to increase well influx although existence of fish



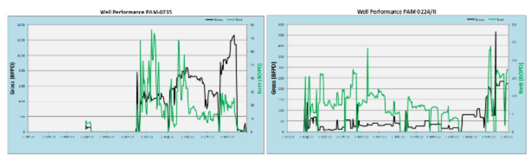
Result

No	Well	Zona	Subsurface Assessment		Well History Evaluation				Fill up annulus (Fluid Type)		Access and Location (Joint Survey)		Total Score (Confident Level)		Est. Oil Gain	Est. Rig days	Est. Cost	Simple DPI (Impact Level)	LRM Decision Value (Confident Level x Impact Level)
					Fish/Junk Problem		Wellbore Integrity Problem												
Weight			40%		15%		20%		10%		15%		100%						
3	PAM-0235	340 MZ	3	1.2	1	0.15	3	0.6	3	0.3	3	0.45	10	2.7	10	5	$ 12,441.03	3.0	8.1
4	PAM-0224/II	340 MZ	3	1.2	2	0.3	3	0.6	3	0.3	1	0.15	9	2.55	15	5	$ 12,441.03	4.2	10.7



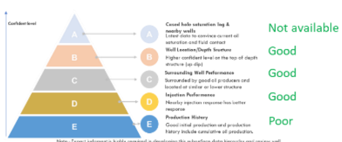
PAM-0235
Confident Level : 2.7
Impact Level : 3.0
LRM Value : 8.1

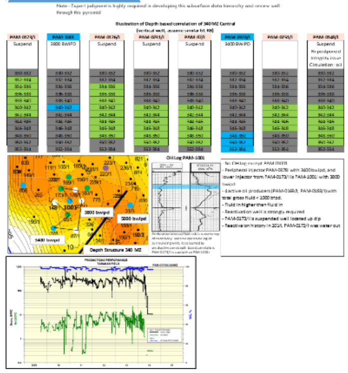
PAM-0224/II
Confident Level : 2.55
Impact Level : 4.2
LRM Value : 10.7



Natural flow of PAM-0235 not recorded due to fluid flow naturally through jumper of casing annulus to the production line

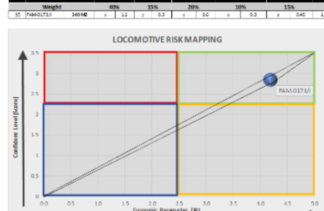
Figure 13

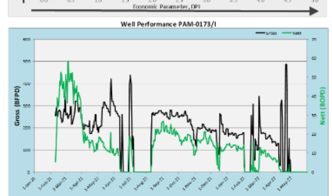




Result

No	Well	Zona	Subsurface Assessment		Well History Evaluation				Fill up annulus (Fluid Type)		Access and Location (Joint Survey)		Total Score (Confident Level)		Est. Oil Gain	Est. Rig days	Est. Cost	Simple DPI (Impact Level)	LRM Decision Value (Confident Level x Impact Level)
					Fish/Junk Problem		Wellbore Integrity Problem												
Weight			40%		15%		20%		10%		15%		100%						
10	PAM-0173/I	340 MZ	3	1.2	2	0.3	3	0.6	3	0.3	3	0.45	11	2.85	15	5	$ 12,441.03	4.2	11.9





Qoi up to 40 bopd, peak 50 bopd
Current Prod 10-20 bopd
Currently off waiting on rig schedule for routing well service (fill up sand)

Figure 14

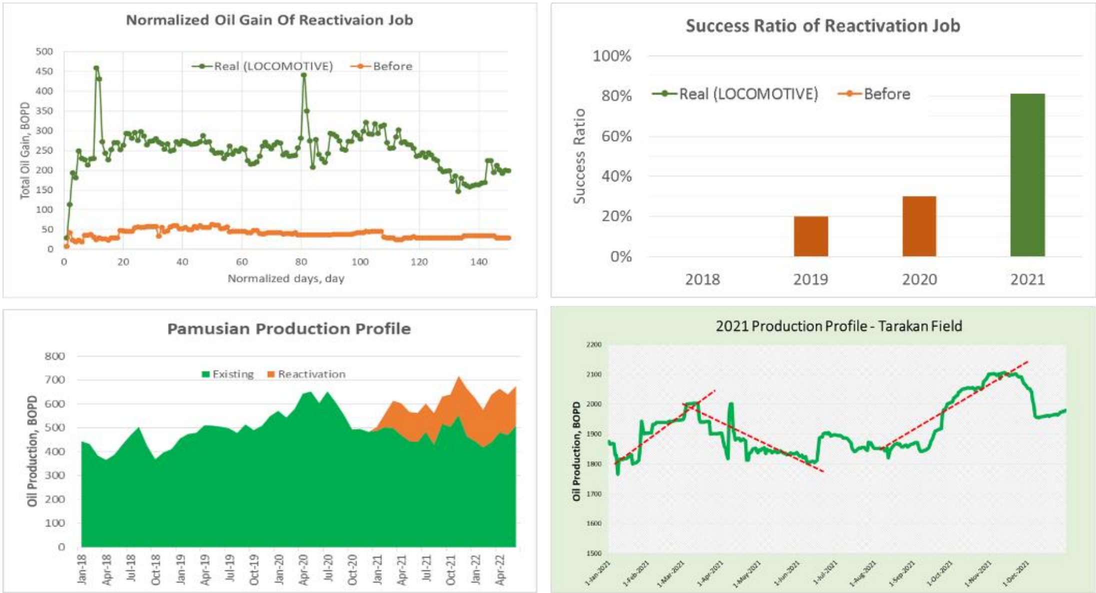


Table 1

Field Name	Pay Zone	Datum (m, TVDSS)	Water Cut (Drop Down List)	Current Reservoir Condition (Drop Down List)	Current and Initial Pressure Comparisson (Drop Down List)	Initial Reservoir Pressure (psi)	Current Reservoir Pressure Estimation (Latest RDT Jan 2019) (psi)
Pamusian	110 Mz	112	WC > 75%	Oversaturated (P > Pb)	Pressure Drop <20%	156	153
Pamusian	130 Mz	132	WC > 75%	Oversaturated (P > Pb)	Pressure Drop <20%	184	174.94
Pamusian	165 Mz	170	WC > 75%	Oversaturated (P > Pb)	Pressure Drop <20%	237	236
Pamusian	235 Mz	240	WC > 75%	Oversaturated (P > Pb)	Pressure Drop <20%	335	334
Pamusian	290 Mz	288	WC > 75%	Oversaturated (P > Pb)	Pressure Drop <20%	401	400
Pamusian	340 Mz	340	WC > 75%	Oversaturated (P > Pb)	Pressure Drop <20%	474	473
Pamusian	460 Mz	472	WC > 75%	Oversaturated (P > Pb)	Pressure Drop <20%	658	657

Table 2

Year	Wells	Job Days	Cum Oil (bbls)	Rig Cost (USD)	Revenue (USD)	Profit (USD)	Success Ratio
2020	10	81	10767	116,219	322,999	206,781	30%
2019	5	35	0	65,141	-	- 65,141	0%
2018	5	8	0	22,953	-	- 22,953	0%

Table 3

I. Subsurface Assessment

Indicator	Expert Judgement	Assesment Value 3	Assesment Value 2	Assesment Value 1
RST Log & Nearby Wells	Fluid Contact & well to well correlation, oil saturation analysis	Good	Medium	Poor/not available
Well Location/ Depth Structure	Top to Flank Assessment	Updip/Attic	Upper flank	Flank
Surrounding Well Performance	production and water cut of reference well, well to well correlation (if any log or correlation depth based correlation approach), bubble map, surrounding well location	Good	Medium	Poor/not available
Injection Performance	FIFO (withdrawl) check,monitor well, well location, and injection interval	Connected	available but not connected/response	not available
Production History	Production profile, influx/productivity index, initial production, last production, water cut, cummulative oil production	Good	Medium	Poor/not available

Scoring Guideline - Subsurface Assessment (with expert judgement) :
Score 3 in LRM if total assessment value : 11-15
Score 2 in LRM if total assessment value : 9-11
Score 1 in LRM if total assessment value : 5-8

II.A Well History - Fish/Junk Problem

1 Type and depth of fish are not clearly identified and or major fish problem. Historically fishing job effort had been tried but not succeed
2 Type and depth of fish are identified and or minor fish problem
3 No fish in the wellbore

II.B Well History - Wellbore Integrity Problem

0 Casing pared, crater to the surface by history
1 Casing collapse, casing leak
2 Small OD configuration, no well profile
3 No issue

III. Fill up Annulus

1 Results of fill up annulus is water
2 Results is low oil cut or oil film. And or fill up annulus check can't be executed
3 Clear and good oil cut

IV. Access & Pad Location (Joint Survey)

0 Under housing, under production facilty, located in river, uphills, and forest
1 Hard effort (around housing, plantation, river, etc.) but there is some space for rig layout setting. Need extra mitigation and extra coordination to stakeholder/third party
2 Accessible, around housing or surface facility. Minor mitigation or civil work required
3 Good access & locatpion, no issue

Table 5

NO	Well	Productive Zone	Job Duration, days		Days Prod (days) Jan-Dec 2021	Cum (bbl) Jan-Dec 2021	Cost (USD) Jan- Dec 2021	Days Prod Jan-Mar 2022	Cum (bbl) Jan-Mar 2022	Cum (bbl) to 365 days	Cost (USD) to 365 days	DPI Success ≥1.2	Success	Note
			Moving	Job										
1	PAM-0132/I	460 MZ	2	5	365	264	10,938	90	0.0	264	10937.6	0.9	failed	Suddenly massive sand problem
2	PAM-0157/II	235 MZ	1	3	67	163	6,250	90	566.4	1863	6250.0	4.1	success	
3	PAM-0129/II	460 MZ	1	2	341	6678	4,688	90	789.9	7468	4687.5	19.4	success	
4	PAM-0173/I	340 MZ	2	4	327	5974	9,375	90	786.3	6760	9375.1	9.1	success	
5	PAM-1047	110 MZ	1	6	316	11769	10,938	90	2450.8	14220	10937.6	15.9	success	
6	PAM-0189/II	340 MZ	2	6	304	3925	12,500	90	1242.4	5167	12500.1	5.5	success	
7	PAM-0235/II	340 MZ	1	9	278	3489	15,625	90	0.0	3489	15625.1	3.2	success	
8	PAM-0972	90 MZ	1	5	271	2489	9,375	90	328.7	2824	9375.1	4.1	success	
9	PAM-1044	380 MZ	1	13	238	0	21,875	90	0.0	0	21875.1	0.6	failed	Fish couldn't be recovered
10	PAM-0251	340 MZ	1	4	228	414	7,813	90	0.0	414	7812.6	1.2	success	
11	PAM-0224/II	340 MZ	1	11	157	1363	18,750	90	493.9	2238	18750.1	2.0	success	
12	PAM-0165/II	110 MZ	1	2	157	1544	4,688	90	1512.4	5486	4687.5	14.4	success	
13	PAM-0996	460 MZ	1	2	96	704	4,688	90	959.7	4114	4687.5	11.0	success	
14	PAM-0132/II	340 MZ	2	5	105	0	10,938	90	0.0	0	10937.6	0.6	failed	Fish couldn't be recovered
15	PAM-0160/I	235 MZ	2	3	67	692	7,813	90	982.2	3300	7812.6	5.6	success	
16	PAM-0727	165 MZ	1	2	67	170	4,688	90	634.3	1494	4687.5	4.4	success	
17	PAM-1041	460 MZ	2	3	59	308	7,813	90	107.0	415	7812.6	1.2	success	
18	PAM-0766	165 MZ	2	2	54	1160	6,250	90	1142.7	4071	6250.0	8.3	success	
19	PAM-0893	340 MZ	2	4	43	1941	9,375	90	3353.0	5294	9375.1	7.3	success	
20	PAM-0896	110 MZ	1	2	41	0	4,688	90	0.0	0	4687.5	0.6	failed	Water cut 100%
21	PAM-0385	110 MZ	2	4	29	264	9,375	90	368.1	2347	3125.0	3.5	success	

Assumption

Oil price	67.9	USD/bbl
Operating cost	31.85	USD/bbl
Rig cost	1562.51	USD/day