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Determining the Best Alternatives Between Buy or Lease Option of Hydraulic Pumping Unit (HPU) by Evaluating Cost Performance and Project Evaluation

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Abstract
The year 2020 was one of the darkest times for world oil and gas companies, because world oil prices had touched their lowest point in the last 15 years. In 2022, it is started to show a change. The recovery of the world economy and coupled with the Russian oil embargo is predicted to make world oil prices will be at a high position for at least the next 5 years. And this is a good momentum and opportunity for all the world's oil companies.Unfortunately, PT Pertamina EP JTB Field was having problems with not achieving its oil production target. It was found that one of the problems is HPU rental artificial lift showing a decreasing performance in recent years. Because the HPU lease contract will expire in July 2023. Two alternatives are proposed to improve the production performance. There is conduct another lease contract with tightened specification and the other is to buy SRP.The results of the buy vs lease analysis found that the HPU rental price was 7.96% more expensive when compared to the purchase of SRP. The fair value was IDR 3,099.394. If the company exercise the SRP buy option, it will result in an NPV of IDR 108,791,789,979 and an IRR of 217%. Based on the results of the risk analysis, the probability of failure of this purchase project was quite low. The probability of NPV < IDR 5 billion is only 0.93%, while the highest probability in the range of IDR 60-160 billion.
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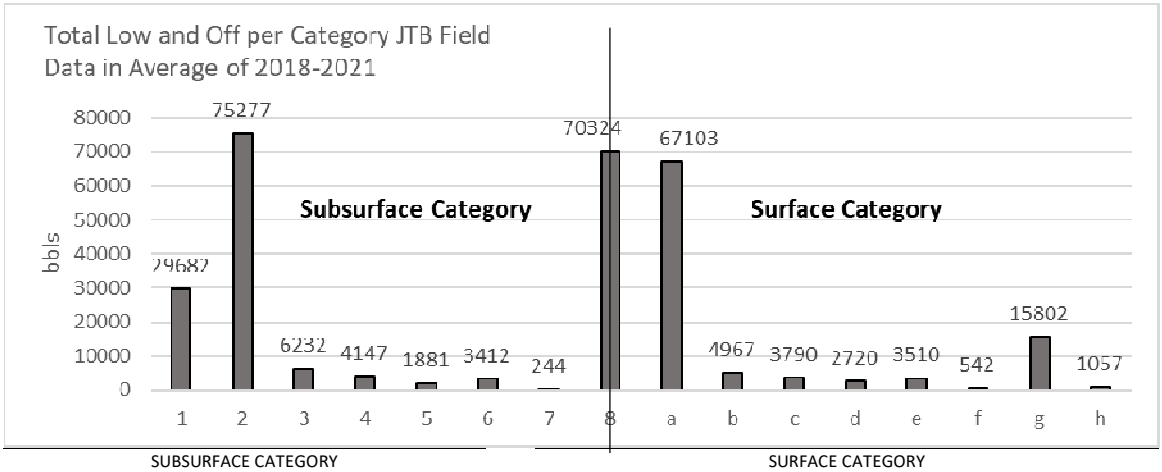
1. Introduction

Based on Macroeconomic point of view, it shows that today (mid-year 2022) are the right momentum to optimize crude oil production for oil and gas companies. Starting from the gradual recovery of the world economy after the Covid-19 virus outbreak, in line with the increasingly high vaccine rate which has now reached 62.7% of the world population in mid-year of 2022 (source: ourworldindata.org). One of the parameters that can be seen is a significant increase in world GDP in 2021 and is predicted to continue to rise for at least the next 2 years (source: worldbank.org). The next factor was the presence of a Russian invasion of Ukraine that caused many countries to carry out a Russian oil embargo. This condition causes the equilibrium of crude oil supply and demand to be disrupted, where the supply is decreasing (because supply from Russia is considered non-existent) and on the one hand demand is rising (because ex-Russian oil importers switch to other countries' oil). As a result, world oil prices are currently soaring quite sharply (for WTI oil, the highest had touched the figure of 122 USD / bbl in March 2022). The increase in demand that has caused the increase in crude oil prices is certainly good news for oil and gas companies. The next 5 years are the right momentum to optimize production and reap maximum profit.

As explained above, the oil and gas business is currently at a very profitable position with the increase in oil and gas demand after the Covid-19 pandemic, accompanied by an energy embargo policy from Russia which causes energy scarcity and makes oil prices higher. Responding to this condition, PT Pertamina EP JTB Field must be able to take a good momentum by producing oil and gas wells optimally. But unfortunately, in recent years, the production performance of PT Pertamina EP JTB Field is actually not in a good condition which is reflected in the data of 4 years average low and off production below



SUBSURFACE CATEGORY		SURFACE CATEGORY	
1	Pressure Decline	a	Wellhead/Flowline/Trunkline/Transfer Pump Problem
2	Increasing Water Cut	b	Surface Artificial Lift (Gas Lift/ESP/SRP/HPU/HJP/PCP) Problem
3	Increasing Gas Oil Ratio	c	Production Facility Problem
4	Scale-up	d	Gas Lift Compressor/Gas Lift Injector Well Problem
5	Sand Problem	e	Power Supply (Electric/Gas Engine/Diesel Engine) Problem
6	Production Pipe Problem	f	Water Injection System Problem
7	Bean down	g	Well Program (BHP survey/Stimulation/PES/Reparation/KUPL/Drilling)
8	Artificial Lift (GasLift/ESP/SRP/HPU/HJP/PCP) Problem	h	Non Technical

Figure 1 : Average 4 Years Low and Off PT Pertamina EP JTB Field

From the chart above, it can be seen that the biggest causes of low and off during the 2018-2021 at PT Pertamina EP JTB Field are as follows:

- Increasing water cut : 75,277 bbls / year
- Downhole artificial lift problem : 70,324 bbls / year

For the problem with the highest low and off, the increase in water cut, technically to return the water content to its potential is relatively not easy to do because of the natural nature of the reservoir. If the oil content in the reservoir begins to run out, the water fluid will be produced

As for the second biggest low and off problem, namely the downhole artificial lift problem, it can be an opportunity for improvement to increase the oil production of PT Pertamina EP JTB Field and reduce the low and off rate to be able to achieve the production target given.

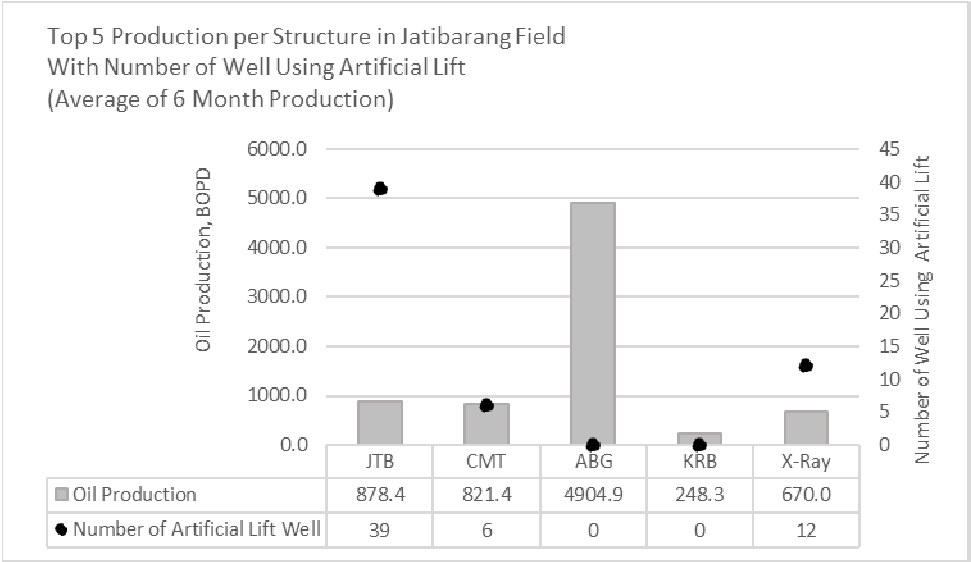


Figure 2: Top 5 Production per Structure in Jatibarang Field With Number of Well Using Artificial Lift (Average of 6 Month Production)

From the chart above, it can be concluded that the oil and gas structure at PT Pertamina EP JTB Field that produces the largest production is the ABG structure, but there are no wells that use artificial lifts in the structure so further research cannot be carried out. Then for the structure with the second largest production, namely the JTB structure with the number of wells using artificial lifts as many as 39 wells. The number of artificial lifts attached to this structure is the largest when compared to other structures so that it can be concluded that the JTB structure will be the object of this study.

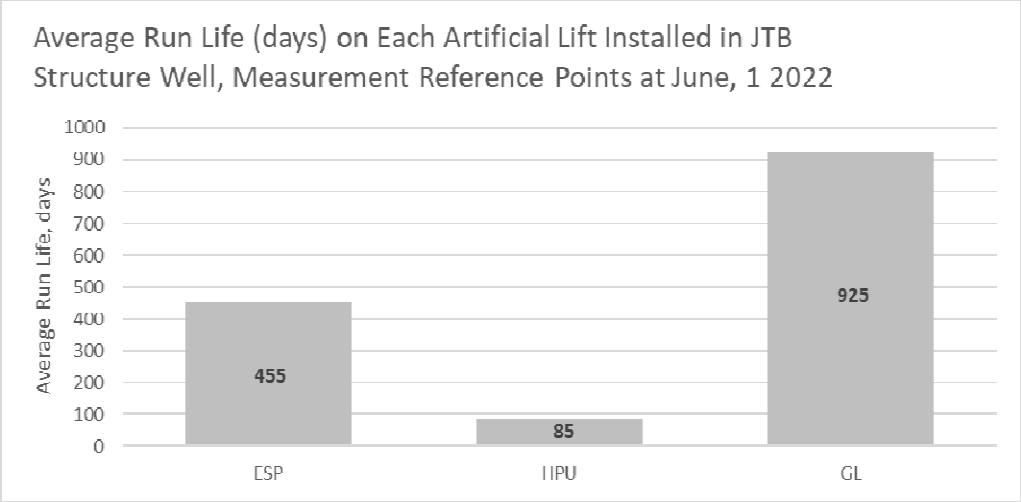


Figure 3: Average Run Life Each Artificial Lift in JTB Structure

The HPU (Hydraulic Pumping Unit) artificial lift has the shortest average run life compared to the other two types of artificial lifts. To get a more detailed visualization, pay attention to the history of the number of HPU artificial lift well service.

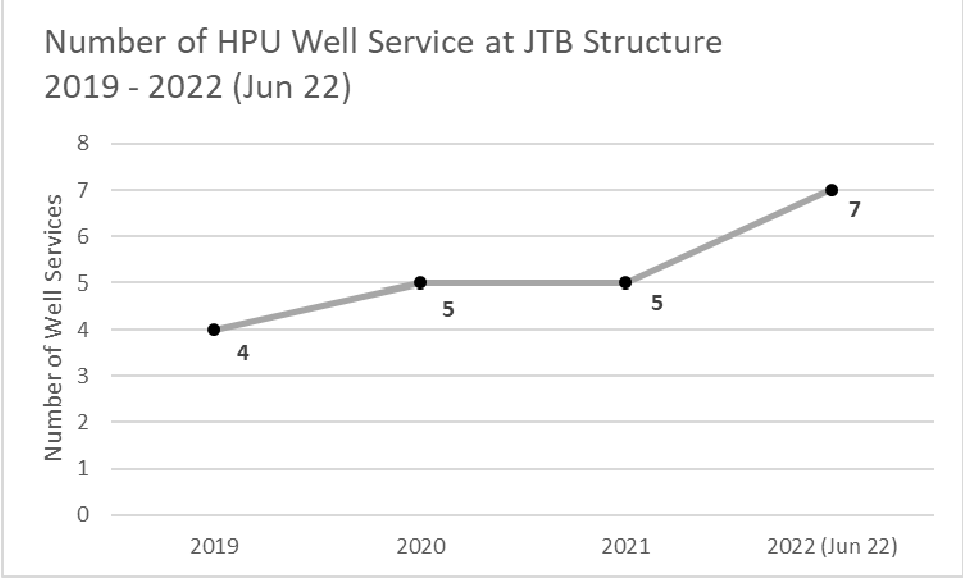


Figure 4: Number of HPU Well Service in 4 Years (2019 – 2022, June)

The number of HPU wells continues to increase from year to year, even for 2022 with data until June 2022 alone, there has been 7 well service. Of course, this is a problem that must be solved so that the PT Pertamina EP JTB Field can achieved and generate optimal profits by utilizing good market conditions for the oil and gas business. In addition, all HPU installed at PT Pertamina EP JTB Field are using lease contracts with third parties and the contract will expire in July 2023. A good momentum to evaluate the performance of existing HPU equipment and find out the problems that occurred to caused HPU's performance not to be in good condition in recent times.

2. Literature Review

To get the root cause of the business issues "HPU performance that decreases, causing production is not optimal when the market is in good condition" will be analyzed using the fishbone diagram. A fishbone diagram combines the practice of brainstorming with a type of mind map template. It should be efficient as a test case technique to determine cause and effect (Sarah Lewis, 2020).

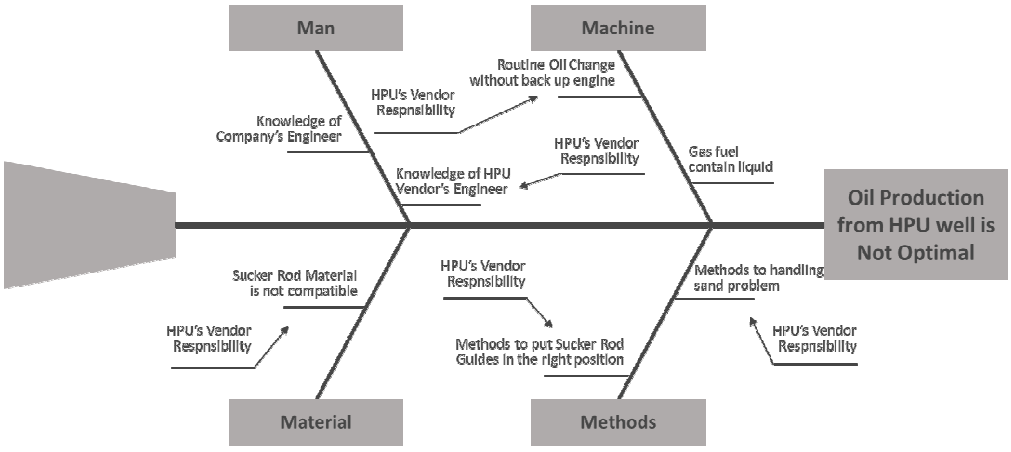


Figure 5: Fishbone Diagram

The following is a description of the fishbone diagram above:

Table 1 : Description of Fishbone Diagram

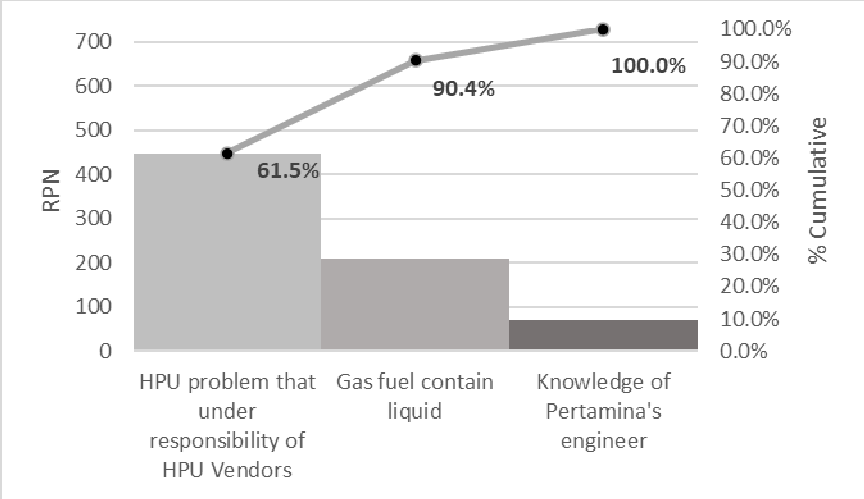
Possibles Root Cause	Description
Man	
Knowledge of Company's engineer	At Pertamina's culture, internal knowledge sharing activities are routinely carried out, and one of them discusses the design of artificial lifts. This culture let the Pertamina's employee have almost similar knowledge
Knowledge of HPU's Vendor engineer (HPU Vendor's Responsibility)	This is beyond Pertamina's control and should be under responsibility of HPU's vendor. Pertamina did not have any responsibility about Vendor's Engineer knowledge
Machine	
Routine Oil Change without back up engine (HPU Vendor's Responsibility)	This is beyond Pertamina's control and should be under responsibility of HPU's vendor. Times needed to change the oil and oil filter is 20 minutes every 15 days. There is no back up engine, means that every month will be a 40 minutes off production
Gas fuel contain liquid	At rainy season, when the weather getting colder than usual, fuel gas (provided from Pertamina) that delivered to Vendor's Gas Engine using pipeline, will condense. This problem already solved by using surface equipment named gas scrubber (to separate liquid from gas fuel before entering gas engine)
Material	
Sucker rod material is not compatible (HPU Vendor's Responsibility)	There were 6 incidents of sucker rod breaking during 2018 to June 2022 out of a total of 21 problems or about 28.6% of the total problems. This is beyond Pertamina's control and should be under responsibility of HPU's vendor
Methods	
Methods to put sucker rod guide in the right position (HPU Vendor's Responsibility)	Similar with sucker rod breaking problem, there were 6 incidents of tubing leak during 2018 to June 2022 out of a total of 21 problems or about 28.6% of the total problems. This is beyond Pertamina's control and should be under responsibility of HPU's vendor
Methods to handling sand problem (HPU Vendor's Responsibility)	Similar with tubing leak problem, there were 6 incidents of sand problem during 2018 to June 2022 out of a total of 21 problems or about 28.6% of the total problems. This is beyond Pertamina's control and should be under responsibility of HPU's vendor

From the root cause table above, 3 problems can be grouped that are likely to cause non-optimal production wells using HPU, first technical problems that are the responsibility of HPU vendors, the second is the problem of fuel gas containing condensed water due to cold weather, and third the problem of technical knowledge from Company's Engineers.

To obtain the root of the possible problem that causes non-optimal production from HPU wells, the FMEA (Failure Mode Effect Analysis) method will be used. FMEA can identifying how a product or process might fail and how the effects of that failure, FMEA also helps find the possible causes of failures and the likelihood of failures being detected before occurrence (George Forrest)

Table 2: FMEA Analysis

Root Cause	S	O	D	RPN	% Relative	% Cumuluative
HPU problem that under responsibility o	8	8	7	448	62%	62%
Gas fuel contain liquid	6	7	5	210	29%	90%
Knowledge of Company's engineer	5	2	7	70	10%	100%
Total				728		



Based on analysis using Pareto and FMEA, it was found that problems caused by technical problems (HPU vendor responsibility) are problems with the highest severity, probability of occurrence, and difficulty of detection, compared to the other two problems (61.8%). Thus, it can be concluded that the main factor causing the production of HPU wells is not optimal is that the performance of the lease HPU does not work optimally. With the contract remaining 1 year away (until July 7, 2023), now is a good time to evaluate the performance of the lease HPU.

3. Method

3.1. Research Methodology

The research methodology used in this study is quantitative methodology. To explore problems and business issues, company history data and company external data will be used, which will then be carried out statistical analysis to get conclusions from a data. Historical data will also be used to project data in the next 5 years which will be used to carry out several scenarios for the running of the project so that the best scenario conclusions will be obtained that will be proposed to the company.

3.2. Business Solution

From the results of the technical analysis of the Petroleum Engineering division of PT Pertamina EP Jatibarang Field, the HPU artificial lift is the best artificial lift for wells in layer F of the Jatibarang structure with characteristics: relatively shallow depth (about 1200 m), vertical well geometry, fluid containing a small amount of sand and mud, reservoir depleted pressure (< 500 psi), optimum liquid production on average at 300 barrels per day. With this characterization, the most suitable artificial lift to use is HPU or SRP (Sucker Rod Pump, only different in the surface equipment, for the dowhole pump is the same). However, if take a look at the suboptimal performance of the existing HPU that has been described in the previous chapter, then the option of extending the lease contract with the existing vendor is not recommended to be done. This step is proposed to minimize the possibility that the same problem will recur.

Thus, 2 alternatives can be proposed to overcome the problems previously mentioned that are in accordance with the technical criteria of the Petroleum Engineering division of PT Pertamina EP Jatibarang Field, namely:

1. Conduct re-tenders for HPU leases with tightened technical requirements to mitigate recurring technical problems
2. Purchase the SRP (Sucker Rod Pump) rather than lease of HPU. If choosing this investment, it need some extra effort to prepare all supporting equipment such as worker recruitment, maintenance processes, construction of workshops for repair pumps, and insurance payments.

The two options will be analyzed in the next subchapter to determine the best alternative that can be proposed to the company's management to be able to re-optimize the production wells in the Jatibarang structure.

3.3. Buy vs Lease

A comparison of the costs required for alternative buys and leases will be discussed using the Present Value of each alternatives. In accordance with PT Pertamina EP's policy to purchase or lease equipment, it will use a tender system. Due to the unknown value of the lease (because the tender process has not been started) then to compare the alternative leases cost, it will use the previous HPU lease contract data, then escalate to 2022 (the calculation is in the Lease Data Collection subchapter). As for the purchase data, it will use the previous purchase reference and be escalated to 2022. Or if there, it will use the latest quotation reference data.

3.4. Data Collection

Table below shows the component that included as Capital Investment for buy alternatives

Table 3: Total Capital Investment for Buy SRP Alternative

Component	Value	Units
SRP Surface Equipment	16,477,669,455	IDR
SRP Subsurface Equipment	1,594,107,296	IDR
Workshop Building	428,882,903	IDR
Workshop Tools Investment	895,386,395	IDR
Total Capital Investment	19,396,046,049	IDR

And for the operational cost is

Table 4: Total Operational Cost for Buy SRP Alternative

Component	Value	Units	Notes
Maintenance	345,442,900	IDR / yr	3.35% increase each years
New Employee Salary	13,720,400	IDR / mo	1.69% increase each years (Historical)
New Contract Emply. Sal.	21,491,178	IDR / mo	1.69% increase each years (Historical)
Insurance	70,679,192	IDR / yr	From OJK 0.3644%

For the lease data, it will use the existing contract of HPU lease in PT Pertamina JTB Field, and already escalating to 2022 using inflation data (average of 2017-2019 is 3.35%)

Table 5: Lease Cost for Lease Alternative

Well	HPU Type	Lease value IDR / day	Est. Lease Value at 2022 IDR / day
JTB-A	HPU Type H	3,165,000	3,380,298
JTB-B	HPU Type C	3,135,000	3,348,257
JTB-C	HPU Type H	3,165,000	3,380,298
JTB-D	HPU Type H	3,165,000	3,380,298
JTB-E	HPU Type C	3,135,000	3,348,257
Total Lease / day (IDR / day)			16,837,409
Total Lease /year (IDR / year)			6,145,654,107

4. Findings

Here is the calculation between buy vs lease of HPU pump

Table 6: PV Between Lease and Buy

Year	Lease Cash Ouflows	V of Lease Cash Outflow	Buy Cash Ouflows	PV of Buy Cash Outflows
0	-	-	5,818,813,814.57	5,818,813,814.57
1	4,793,610,203.09	$4,509,144,508.94	1,687,398,788.69	1,587,264,016.07
2	4,793,610,203.09	4,241,559,772.51	2,809,872,941.02	2,486,277,258.18
3	4,793,610,203.09	3,989,854,232.46	3,399,219,294.70	2,829,264,148.61
4	4,793,610,203.09	3,753,085,574.66	3,725,812,661.51	2,917,069,423.96
5	4,793,610,203.09	3,530,367,404.44	3,789,954,757.03	2,791,201,656.30
	PV under Lease Alternativ	20,024,011,493.01	PV under Buy Alternative	18,429,890,317.68

It can be seen that the alternative to buying SRP is cheaper than the alternative to lease HPU. The difference in costs that must be incurred is IDR 1,594,121,175 or about 7.96% of the total cost if choosing an alternative HPU lease. Remember that this lease alternative uses data on the current contract lease plus price escalation. To find out the maximum lease cost limit so as have the same cost as the SRP purchase price will be discussed below

Maximum Lease Value

The maximum lease value will be obtained if the total cash outflows from the lease alternative are equal to the total cash outflows from the buy alternative, IDR 18,429,890,317. By using this PV cash outflows, it is found that the annual HPU lease price for 5 HPU units is IDR 5,656,395,630. Therefore, the maximum rental price per HPU unit per day for the 2023-2027 rental contract period is IDR 3,099,394 / day

5. Discussion

Based on the above calculations, it can be concluded that the rental price of HPU per unit that is IDR 3,099,394 /

day, is the threshold value for making decisions whether to buy or lease. If the value of the HPU rental offer is below the value of IDR 3,099,394 / day, then PT Pertamina EP JTB Field can take the lease option. And vice versa, if the bid value of the HPU rental is above that number, then PT Pertamina EP JTB Field is advised to choose a purchase alternative. However, if the company choose a purchase alternative, it is necessary to calculate the project's economics first, such as calculating the NPV and IRR. In addition, it is also necessary to analyze the sensitivity and risk to ensure that risk management has been taken into account properly in decision making

Table 7: Total NPV Calculation for Buy Alternative

	2022	2023	2024	2025	2026	2027
Revenue	-	66,831,670,395	61,421,186,036	56,580,956,777	51,509,826,146	48,527,556,578
COGS	-	2,924,777,932	2,943,474,865	2,958,246,992	2,973,466,451	2,989,147,415
SG&A	-	10,113,627,457	9,294,859,606	8,562,388,380	7,794,974,882	7,343,668,440
Depretiation Expense	-	9,698,023,024	4,849,011,512	2,424,505,756	1,212,252,878	1,212,252,878
EBIT	-	44,095,241,981	44,333,840,054	42,635,815,649	39,529,131,935	36,982,487,845
Less Taxes	-	9,700,953,236	9,753,444,812	9,379,879,443	8,696,409,026	8,136,147,326
Add Depreciation	-	9,698,023,024	4,849,011,512	2,424,505,756	1,212,252,878	1,212,252,878
OCF	-	44,092,311,769	39,429,406,754	35,680,441,963	32,044,975,788	30,058,593,397
Capital Equipment Invest.	19,396,046,049					
Cash Flow	- 19,396,046,049	44,092,311,769	39,429,406,754	35,680,441,963	32,044,975,788	30,058,593,397
PV Cash Flow	- 19,396,046,049	38,737,089,868	30,433,260,676	24,194,830,833	19,090,461,796	15,732,192,855

Project Parameter	
NPV (IDR)	108,791,789,979
ROR	561%
IRR	217%

With an NPV value of IDR 108,791,789,979 and an IRR of 217%. It can be concluded that the SRP purchase project is feasible for further processing. However, to ensure that the SRP purchase project has a measurable risk, a project variable sensitivity calculation and scenario test will be carried out. A Monte Carlo simulation will be conducted to find out the results of project simulations with different random scenarios and to get an overview of possible conditions in the future.

In this sensitivity analysis process, a sensitivity test of 4 parameters to changes in NPV will be carried out. The parameters to be tested are direct material cost, inflation rate, hurdle rate, and oil price. The sensitivity that will be done is by changing the current assumption value by increasing and decreasing by 20% and then seeing the change in the NPV

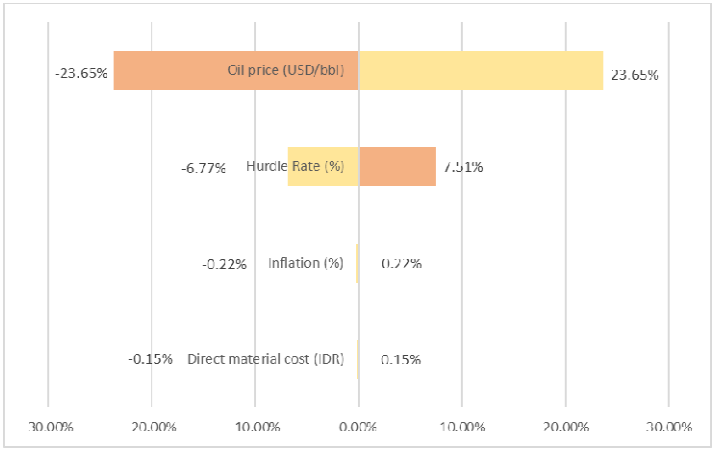


Figure 6: Tornado Diagram for Parameter Sensitivity Analysis

It can be seen in the tornado diagram above that there are 3 parameters that have high sensitivity to NPV, namely oil price, hurdle rate, and tax. These three parameters will then be simulated in a scenario to see the effect of each scenario on changes in NPV.

Table 8: Scenario for NPV Analysis

Parameter	Worst Case	Base Case	Best Case	Type of Distribution
Oil price (USD/bbl)	13.53	64.10	101.74	Normal Distribution
Hurdle Rate (%)	17.08%	13.82%	10.86%	Normal Distribution
NPV (IDR)	2,521,146,094.43	108,791,789,979.19	201,368,143,318.96	
Range NPV	198,846,997,225			

Monte Carlo Simulation Result

By using Monte Carlo simulation, random values from the previous 2 variables will be obtained according to the worst and best case constraints of each and based on the type of distribution. The results of the Monte Carlo simulation will show the possible scenarios that occur and how big the probability is. Below is a distribution

graph of the simulation results with 1000 random data groups (from the 2 parameters mentioned earlier).

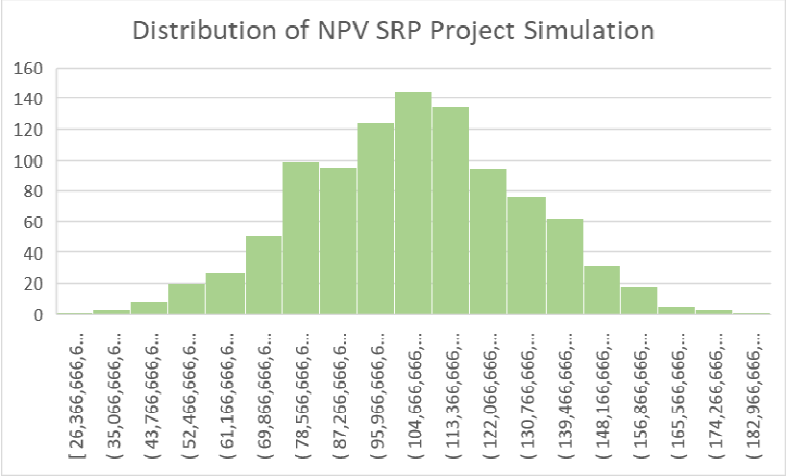


Figure 7: Monte Carlo Simulation Result for NPV (1000 attempts)

It can be seen that from the simulation results of 1000 experiments, the NPV distribution type is normal distribution. Here are the statistical parameters of the graph above

Table 9: Descriptive Statistics for Monte Carlo Simulation Result

Descriptive Statistics	Value	Unit
Min	26,366,666,653	IDR
Max	185,834,290,574	IDR
Mean	108,804,993,333	IDR
Standard Deviation	24,994,694,635	IDR
Median	108,930,469,833	IDR
Kurtosis	- 0.117	
Skewness	- 0.018	

To calculate the probability of the occurrence of NPV at the specified value, it can use the cumulative distribution graph as follows

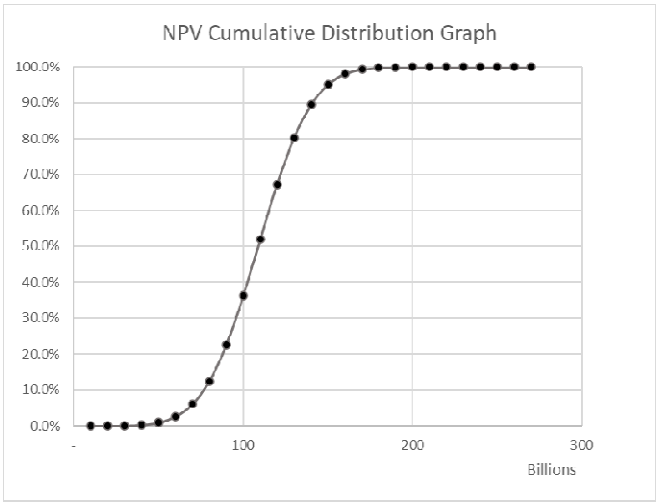


Figure 8: Cumulative Distribution Graph of Monte Carlo Simulation Result

From the two graphs above, it can be seen that for this SRP purchase project, it has a very high probability of success. Even the probability value of NPV < IDR 50 billion is only 0.93%. The biggest probability that this project might occur is in the NPV range of IDR 60 – 160 billion.

Based on the economic analysis, this alternative project to purchase SRP generates quite a large profit, which is IDR 108,791,789,979 for the base case assumption used by the author. The IRR obtained is also high with a value of 217%, far above the hurdle rate of 13.82% for the project life of 5 years. Not only that, the rate of return on investment (ROR) is at 561% or almost 6 times of the initial investment within a period of 5 years.

With the values that have been described previously, of course, it is very interesting to execute. Especially if it is added with risk analysis parameters which also produce very good probabilities. The probability of NPV < IDR 50 billion is only 0.93% and the highest probability that the NPV value will be achieved is in the range of IDR 60-160 billion. Based on the results of this calculation, it can be concluded that the purchase of the SRP

project is feasible and profitable.

6. Conclusion

Based on the results of analysis and brainstorming related to the business issue: "the production of existing HPU wells is not optimal when the demand momentum for crude oil and the increase in oil prices is high", the following conclusions can be drawn:

1. The root cause of the problem that HPU well is not producing optimal is, the technical performance of HPU vendors which has been declining for the last 4 years and has peaked in 2022
2. Since the contract with the HPU vendor will expire in July 2023, on the other hand, HPU's performance is declining during 2022, so it is proposed not to extend the HPU lease contract with the existing vendor. Instead, two alternatives are proposed to optimize the production of the ex HPU well, namely:

- Conduct re-tenders for HPU leases with tightened technical requirements to mitigate recurring technical problems
- Purchased SRP pumps and all the equipment to replace existing HPU rentals

3. For HPU rentals alternative, after a comprehensive calculation, the maximum value of HPU rental per unit is IDR 3,099,394 / day. If in the tender process there is no participant who offers a rental value below this figure, it is proposed to replace the rental alternative with an alternative to buy SRP and its accessories.
4. For an alternative to buy SRP, it requires an initial capital of IDR 19,396,046,049 and annual operating costs of IDR 13,038,405,389 (every year it will increase according to the value of inflation). With that number of investment value, it is able to generate an NPV of IDR 108,791,789,979 for 5 years with an IRR value of 217% (hurdle rate 13.82%) and a return on investment (ROR) of 561%. In addition, based on simulations of various cases to determine the level of risk, it was found that this project has a low risk level which is indicated by the probability that the NPV is below IDR 50 billion only 0.93% and the highest probability of the NPV value is in the range of IDR 60-160 billion

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