http://journal.uir.ac.id/index.php/JGEET

E-ISSN : 2541-5794
P-ISSN : 2503-216X

Journal of Geoscience,
Engineering, Environment, and Technology
Vol 8 No 2 2023

RESEARCH ARTICLE

Economic And Sensitivity Analysis Stimulation Of Coiled Tubing And Bullhead Combination On A Horizontal Well

Adalard Dominique [1,*], Patrice Trey Xavier[1], Olliver Leo Sandre[1]

[1] *Economic Science and Buisness Administration Department, University of Caen Normandy, Caen, France.*

* Corresponding author : adalardomn5@gmail.com
Tel.:+33-871829301
Received: Mar 5, 2023; Accepted: Jun 6, 2023.
DOI: 10.25299/jgeet.2023.8.2.14495

Abstract

Production decreased often occur in Indonesia's oil and gas fields which becomes a problem for oil well exploration. Thus the role of the company demands to be able to re-optimize the flow rate of oil production in the oil and gas field. One of the workover jobs was stimulation. The function of the work was to stimulate the wells mechanically and chemically which aimed to increase the productivity of wells that have experienced a decrease in oil production, in which mechanical stimulation was in the form of coiled tubing units and bullhead used chemical stimulation, namely acidizing and solvent. To prove the economy of the coiled tubing unit and bullhead stimulation work, calculations and analysis of economic indicators such as net present value (NPV), internal rate of return (IRR), and payout time (POT) can be carried out. Where this study aimed to determine the economics of the stimulation project carried out on the horizontal wells of the RD field. The results of the calculation of economic indicators that will be feasible are not like this stimulated workover work project with an investment of US$ 133,053 acidizing coiled ribbing oil price of 68.51 USS/bbl thus the calculation of NPV @ 10% 60631 USS, POT 0.74 months, P1 9, is obtained. 73, IRR 355%, coiled tubing solvent well US$ 185,967.166 NPV@ 10% 98,431 USS, POT 3.94 months, PI 3.69, IRR 103%, bullhead acidizing well US$ 8858.31 value NPV@10% 218029 USS, POT 0.95 months, P1 45.16, IRR 1890% and bullhead solvent USS 72745 value NPV@10% USS 248586, POT 0.94 months, PT 52.53, IRR 1822%. Sensitivity analysis on stimulated workover work is carried out by changing the assumptions with 85% and 115% then the results obtained are the oil price value which is the parameter that most influences the NPV value then oil production, and capex. From the results of profit indicator calculations and sensitivity analysis, it can be concluded that the stimulated workover work in the RD field is all feasible because it meets the eligibility requirements of a project.

Keywords: Workover, Coiled Tubing Unit, Bullhead, Economics Indikators

1. Introduction

1.1 Background of the Problem

Since the start of modern oil and gas industrialization in the mid-19th century, the oil and gas industry has played a dominant role in economic growth in various parts of the world, both from the producer's side and from the user's side (consumers). The upstream oil and gas industry itself is a unique industry, the scope of which includes exploration activities, oil and gas field development, production exploitation, and lifting of oil or natural gas (Center for Data and Information Technology of Energy and Mineral Resources, 2016).

The decrease in oil production in horizontal wells is due to scale which causes a decrease in reservoir pressure resulting in a continuous decrease in oil production. The way to overcome this problem is using a method called the stimulation method. Stimulation aims to increase the productivity of wells that have experienced a decrease in production (Apfia Grace Yolanda Murti Latumaerissa, Muh Taufiq Fathaddin, 1967). Stimulation is injection carried out in horizontal wells utilizing acidizing and using a combination of mechanics where the method is Coiled Tubing and Bullhead. To determine the best treatment design for stimulation, reservoir analysis must be carried out such as porosity, permeability, and pressure inside the well (Kolle et al, 2008). To carry out acid stimulation that must be considered before the stimulation is carried out, namely the design of the acid treatment system and the volume of selected HF acid, determining the interval zone to be treated: temperature considerations, acid preparation (Pasikki & Gilmore, 2006). The rate of oil and gas production in horizontal wells is larger than the vertical wells, with the explanation that the wider and longer the horizontal wells, the more production absorption capacity of the oil and gas production wells.

2. Literature Review

2.1 Well-Stimulation

Well-stimulation is carried out to increase the productivity of wells that have experienced a decrease in production due to decreased permeability due to formation damage. Where stimulation has a very important role in production activities (Herawati & Novrianti, 2015). Formation damage in wells that will become the object of this research is horizontal wells, which can be overcome by providing stimulation or stimulation of wells that experience formation damage, and the presence of scale formation in the production casing (Furgan et al., 2015). Stimulation is the work of stimulating the well mechanically and chemically. A repair process for wells to increase the permeability of damaged formations to provide a large production rate.

In the implementation of stimulation, namely injection of acid into the good reservoir to be repaired but the injection of acidification has a lower pressure than the wellbore pressure, acidification aims to react quickly to spread into the good

formation. The rock studied is sandstone, which generally consists of quartz (Herawati & Novrianti,2015).

Mechanical and chemical stimulation activities are a method of increasing oil production in horizontal wells that are being studied or observed where this chemical stimulation is by injecting chemicals into the reservoir to change the physical properties of the fluid and/or reservoir bottom which can increase the efficiency of pressing the hydrocarbons in the reservoir where the chemical substances which are used in the chemical injection process in the formation are solvent and acidizing.

2.1.1 Mechanical Stimulation

This stimulation is an activity to stimulate wells that experience problems with decreased permeability in the wellbore, sometimes this problem can extend several meters into the well which will experience a decrease in production due to formation damage. several efforts including eliminating the scale (Anisa & Sudibjo, 2015)

This mechanical stimulation activity aims to increase the productivity of damaged wells by acidizing which will be injected into the wellbore that is experiencing problems, even if it turns out that there is unavoidable damage, knowing the nature of the formation will be very important in selecting a method. for stimulation which aims to stimulate to increase the value of formation permeability and increase well productivity (Cahyaningsih, 2012).

The tool to be used in this Horizontal well is Coiled Tubing which is a tool like steel tubing (pipe) that can be rolled up. you could say it looks like a rope or thread that measures from 1 to 4.5 inches in diameter. Where in a conventional rig the pipes/tubing/strings are connected, however, the Coiled Tubing method takes quite a long time and requires a lot of people and tools because the Coiled Tubing activity uses continuous tubing.

3. Research Method

This research discussed repairing horizontal wells in RD wells that have experienced a decrease in production rate using a combination of mechanical and chemical stimulation which used the coiled tubing unit and Bulhhead methods. Then to stimulated NVA chemical techniques using Solvent and Acidizing, where there were stimulation activities in this horizontal field due to the reworking of wells that have experienced a decrease in production, in the oil and gas field at Pertamina Hulu Rokan Company. Which will later be used to carry out an economic analysis of the RD Field. The author will consider its economic value by determining the NPV value for problems in the RD field in horizontal wells to overcome the problem of decreasing the production flow rate.

4. Result And Discussion

4.1 Economic Analysis Of The Stimulation Method

Before the stimulation of the coiled rubing and bullhead combination, the type of work in the form of a workover method is the injection of acids and solvents during treatment which aims to increase fluid production which has decreased due to scale and organic deposits, it is necessary to analyze the economics which can be seen from the parameters that have been applied in this study by looking at the parameters of economic indicators. The purpose of this analysis is to serve as material for making decisions on whether the mechanical and chemical combination stimulation method in the RD field on horizontal wells is feasible or not to be applied.

For the investment cost of this project, the main thing to be seen is to be considered. In this research, there are also 2 types of investment, namely capex, and opex. But in this study the type of investment studied in this study is capex. The following is the planning of investment costs when carrying out mechanical and chemical combination stimulation, seen in the following tablet:

Table 1. Investment Planning

No	Capex	Satuan	Amount	Total
1	*Coiled Tubing Acidizing*	*Set*	22	$ 133053
2	*Coiled Tubing Solvent*	*Set*	6	$ 185967.166
3	*Bullhead Acidizing*	*Set*	2	$ 8858.31
4	*Bullhead Solvent*	*Set*	17	$ 8858.31
Total				$ 400.623.476

The RD field located in the Horizontal well experienced a decrease in oil production due to scale thus the flow of the RD field experienced an obstacle to the flow of fluid to the surface. In this simulation, two methods are used to deliver fluid treatment to the target interval, namely the coiled mubing and bullhead methods. In this research, we will analyze these two methods using several chemical stimulations, namely 15% HCL, and Solvent (Envirosol-X§), and also discuss the economics of chemical stimulation using the coiled tubing and bullhead methods.

The calculation of oil lifting in this study is obtained from oil production data. The results of oil lifting data on stimulation work for 6 months are as follows:

Table 2. Lifting Petroleum coiled mibing acidizing and coiled tubing solvent

MONTH	PEROLEHAN MINYAK	
	Coiled Tubing Acidizing	*Coiled Tubing Solvent*
1	474.045	457.249
2	410.061	546.465
3	407.054	646.828
4	405.582	761.843
5	591.797	116.630
6	591.797	194.382
TOTAL	2.365,651	2.678,397

Table 3. Lifting Crude oil *bullhead acidizing and bullhead solvent*

MONTH	PEROLEHAN MINYAK	
	Bullhead Acidizing	*Bullhead Solvent*
1	1252.80	996,065
2	1195,35	949,328
3	707.90	924,423
4	406,42	463,776
5	426,99	431,371
6	374,68	439,812
TOTAL	4360,14	4224,774

4.2.2 Calculation of Oil Prices

The price of oil used in the RD field in the horizontal well is US$ 68.58/bbl. The oil price was obtained from the results of

the ICP (Indonesian crude price) in January 2021 to December 2021.

4.2.3 Gross Revenue

To get the Gross Revenue value, you have to compile what is called cash flow thus there are several important economic indicators to calculate. Which is to find out Gross Revenue, which is obtained from the value of multiplying the lifting of petroleum per month by the price of petroleum, then the Gross value is obtaineds

Table 5. *Gross Revenue Coiled Tubing Acidizing*

MONTH	JOBS	Lifting Minyak	Oil Price	Oil Price
1	Coiled Tubing Acidizing	474,045	$6858	32510,0061
2		420,061	$6858	28121,98338
3		407,054	$6858	21915,76332
4		405.582	$6858	27814,81356
5		591,797	$6858	40585,40397
6		77,112	$6858	5288,34096

Table 6. *Gross Revenue Coiled Tubing Solvent*

MONTH	JOBS	Lifting Minyak	Oil Price	Oil Price
1	Coiled Tubing Solvent	457,249	$6858	1045,271348
2		546,463	$6858	1249.2149562
3		646,828	$6858	1478,649094
4		716,843	$6858	1638,702445
5		116,630	$6858	266,615037
6		194,382	$6858	444,357252

Table 7. *Gross Revenue Bullhead Acidizing*

MONTH	JOBS	Lifting Minyak	Oil Price	Oil Price
1	Bullhead Acidizing	1252,80	$6858	85848,14519
2		1195,35	$6858	81977.35446
3		707,90	$6858	48479,13342
4		406,42	$6858	27872,00928
5		426,99	$6858	29214,66852
6		374,68	$6858	25626,9744

Table 8. *Gross Revenue Bulhead Solvent*

MONTH	JOBS	Lifting Minyak	Oil Price	Oil Price
1	Bullhead Solvent	996,065	$6858	68310.10341
2		949,328	$6858	65104.87995
3		924,423	$6858	63396,92934
4		463,776	$6858	31805,75808
5		451,371	$6858	30955,02318
6		439,812	$6858	30162,30696

Table 9. *Operation Cast*

No	Jobs	Operation Cast
1	*Coiled Tubing Acidizing*	0.76 USS/bbl
2	*Coiled Tubing Solvent*	
3	*Bullhead Acidizing*	
4	*Bullhead Solvent*	

Operation Cast is costs that must be incurred by the company when carrying out oil and gas operations. Operation Cast is one of the economic parameters that need to be calculated and can be found by multiplying prices *Operation Cast* with *Lift* petroleum (Pambayun, 2018).

Table 10. *Cash Flow Coiled Tubing Acidizing*

MONTH	Cash Flow (US$)
0	$ (6047,86)
1	$ 23498,67
2	$ 14416,96
3	$ 13721,83
4	$ 13026,77
5	$ 18281,80
6	$ 4558,18

NPV =60361 US$

Table 11. *Cash Flow Coiled Tubing Solvent*

MONTH	Cash Flow (US$)
0	$ (30994,53)
1	$ 28873,08
2	$ 35602,18
3	$ 42038,26
4	$46636,54
5	$ 6663,35
6	$ 10946,04

NPV =98431 US$

Table 12. *Cash Flow Bullhead Acidizing*

MONTH	Cash Flow (US$)
0	$ (4429)
1	$ 84078
2	$ 78300
3	$ 44750
4	$ 23968
5	$ 27979
6	$ 24710

NPV =218029 US$

Then for the calculation of the NPV in the bullhead solvent work, the NPV value is 215360 USS, it can be said that the bullhead work using a soft vent is said to be very feasible to work on this project in the RD field.

If the NPV (Net Present Value) is negative (-) then the project is said to be unfit for stimulation projects and if the NPV is positive (+) then the project is said to be feasible. Thus, based on the results of NPV calculations, the combination of coiled tubing and bullhead stimulation projects is feasible to be implemented in the RD field.

Table 13. *Cash Flow Bullhead Solvent*

MONTH	Cash Flow (US$)
0	$ (4279,12)
1	$ 878184,73
2	$ 74190.54
3	$ 72088.40
4	$ 36432.71
5	$ 35400,92
6	$ 34452,81

NPV = 215360 US$

4.3.1 Internal Rate Of Return (IRR)

The Internal Rate of Return or IRR can be said to be an interest price that causes the price of all Cash inflow to be similar in magnitude to Cash Outflows if the cash flow is discounted for a certain time (Havidh Pramadika, 2018). Calculating the IRR value can be done by trial and error. IRR can be said to be feasible if the IRR value is greater than the MARR value (minimum attractive rate of return).

The following are the steps for calculating the IRR value in a way trial and error:

1. For a discount rate of 10%, the NPV value of coiled tubing acidizing is 60361 USS, NPV coiled tubing solvent is 98431 US$, NPV bullhead acidizing is 218029 USS, and NPV buildhead solvent is 215360 USSM
2. The higher the discount rate, the smaller the NPV value
3. Then try for a discount rate of (i) 350% to get a positive acidizing coiled tubing NPV (+) 372337 USS

Table 14. *Discount rate* on horizontal wells

JOBS	NPV 10%	NPV Positif	NPV Negatif
Coiled Tubing Acidizing	60631 US$	350 % 37233,7 US$	360 % 78,702 US$
Coiled Tubing Solvent	98431 US$	90 % 4594,59 US$	110 % -1622 US$
Bullhead Acidizing	218029 US$	1700 % 491.446 US$	1900 % -23,732 US$
Bullhead Solvent	215360 US$	1400 % 555,633 US$	1600 % -46,695 US$

After calculating the IRR from one of the jobs, namely coiled tubing acidizing, the IRR value is 355%, thus the IRR value is said to be feasible for stimulation in the RD field. The following table calculates the IRR..

4.3.2 Pay Out Time

Payout Time is an economic indicator that shows how long the investment will return. The parameter that will be used to get the POT value is *cash flow* and *cash flow* cumulative production.

Table 15. POT *Coiled Tubing Acidizing*

MONTH	*Cash Flow($)*	*Cash Flow Comulatif($)*
0	(6047,86)	(6047,86)
1	23498,67	17451
2	14416,96	31868
3	13721,83	45590
4	13026,77	58616
5	18281,80	76898
6	4558,18	81456

POT =0.74 Bulan

4.4 Sensitivity Analysis

Sensitivity analysis is a method that will be used to see how much influence changes have on economic indicators. Thus economic analysis can also show how it influences the benefits that can be obtained from an investment (Irham, 2015). In this study it was used to change the value of each parameter are 85% and 115%. Which means the difference and the addition is 15%. The graph of the NPV and IRR sensitivity analysis is as follows:

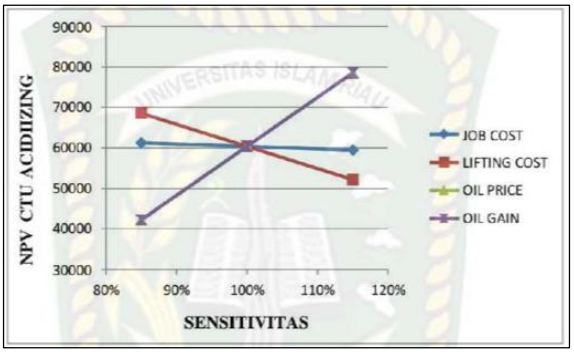

Fig 1. NPV Sensitivity Analysis of RD Wells Using *Coiled Tubing Acidizing.*

Judging from the oil price minus 15%, the NPV has decreased, whereas if the oil price is added 15%, the NPV value is very high. Then followed by oil production which also has a significant slope, followed by capex and opex.

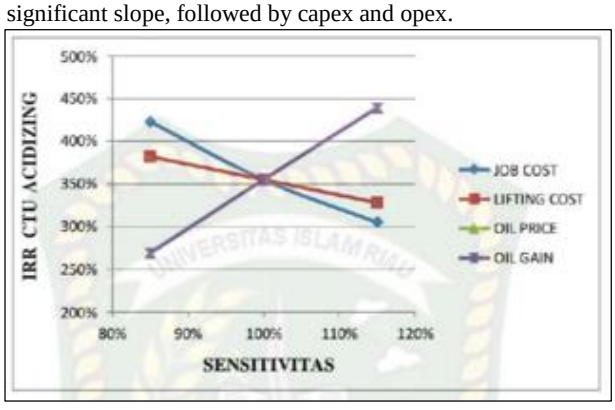

Fig 2. RD Well IRR Sensitivity Analysis Using *Coiled Tubing Acidizing.*

Similar to the NPV, the IRR sensitivity analysis on coiled tubing acidizing stimulation also shows that oil prices have the most visible slope. If the oil price is reduced by 15%, the IRR will decrease, and if it is increased by 15%, the IRR will be higher.

Fig 3. Critical point of stimulation oil prices *Coiled Tubing Acidizing*

Based on the image of the critical oil price point above, if the initial oil price is reduced to 50.10% (34,363) then the NPV will be zero. Then it can be seen that if the NPV and IRR values are negative or zero then the project is not feasible to do.

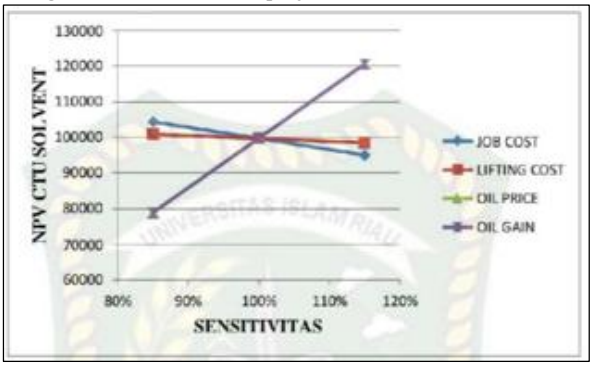

Fig 4. NPV Sensitivity Analysis of RD Well Using *Coiled Tubing Solvent.*

Solvent Judging from the reduced oil price: i 15% NPV has decreased while for oil prices added 15% the NPV value of coiled tubing solvent is very high. Then followed by oil production in the RD field which also has a very significant slope and is followed by capex and opex.

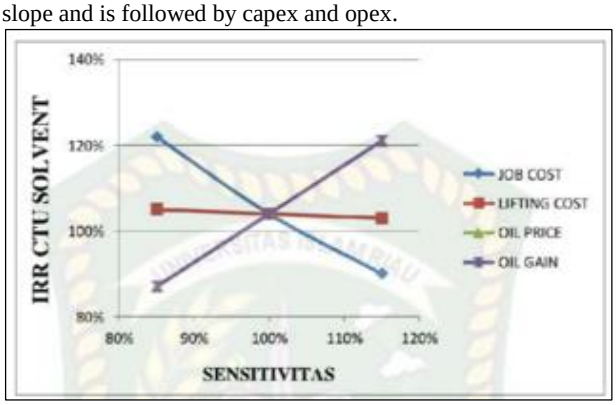

Fig 5. RD Well IRR Sensitivity Analysis Using *Coiled Tubing Solvent.*

Same as the IRR, in chemical stimulation coiled tubing using solvent oil prices still have a sufficient slope. If the oil price is reduced by 15% the IRR will decrease and vice versa if the oil price is added by 15% the IRR will be high.

Fig 6. The critical point for the price of *Solvent Coiled Tubing* stimulation oil

Based on the image of the critical oil price point above, if the initial oil price is reduced to 28.16% (19.31%) then the NPV will be zero. Then it can be seen that if the NPV and IRR values are negative or zero then the project is not feasible to do.

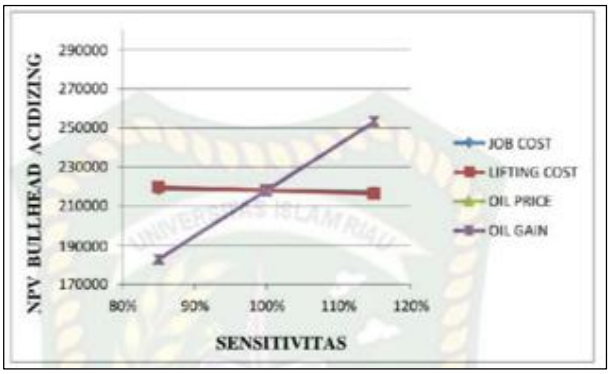

Fig 7. NPV Sensitivity Analysis of RD Well Using *Bullhead Acidizing.*

It can be seen from the graph above that the price of oil minus 15% NPV has decreased, while for oil prices added 15% the NPV value is very high. Then followed by oil production which also has a very significant slope and is followed by opex and capex.

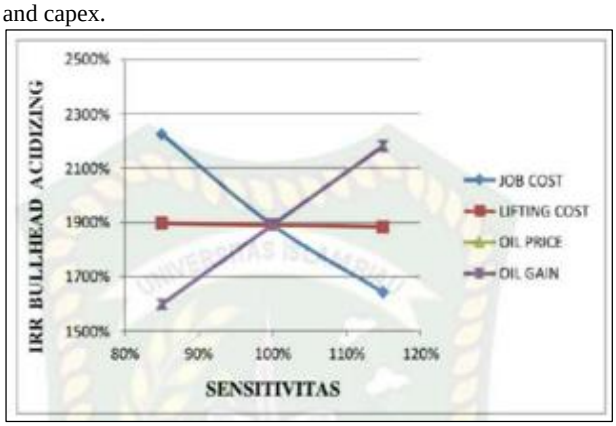

Fig 8. RD Well IRR Sensitivity Analysis Using *Bullhead Acidizing.*

Fig 9. The tipping point for the *bullhead acidizing* oil price

Based on the image of the critical oil price point above, if the initial oil price is reduced to 6.7% (4.68) then the NPV will be zero. Then it can be seen that if the NPV and IRR values are negative or zero then the project is not feasible to do.

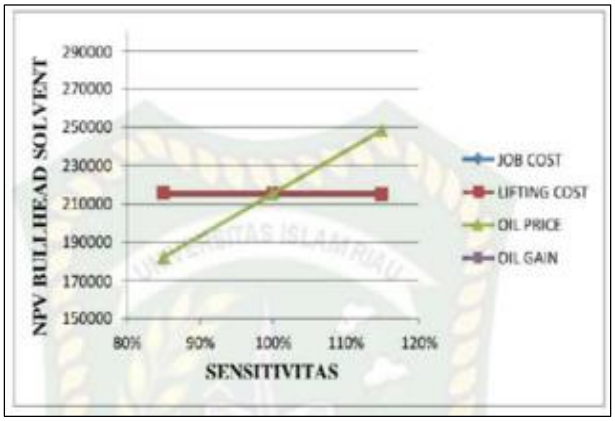

Fig 10. NPV Sensitivity Analysis of RD Well Using *Bullhead Solvent*

Judging from the oil price minus 15% the NPV has decreased while for the oil price added 15% the NPV value is very high. Then followed by oil production which also has a very significant slope and followed by opex and also investment.

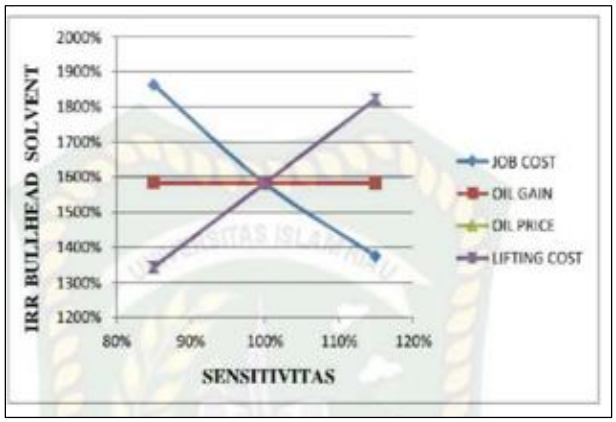

Fig 11. RD Well IRR Sensitivity Analysis Using *Bullhead Solvent*

In addition, as shown from the graph above with TRR, oil prices still have a sufficient slope. If the oil price is reduced by 15% the IRR will decrease and vice versa if the oil price is increased by 15% the IRR will be high.

Fig 12. The critical point for the *Bullhead Solvent* stimulation oil price

Based on the picture of the critical oil price point above, if the initial oil price is reduced to 2.8% (1.9%) then the NPV will be zero. Then it can be seen that if the NPV and IRR values are negative or zero then the project is not feasible to do.

5. Conclusions

From the research that has been done, it can be concluded that:

The results of the calculation of economic indicators in the stimulated workover work of the combination of coiled tubing and bullheads in this RD field are for the NPV value of acidizing coiled tubing — 60361 USS. POT = 0.74 months. PI = 0.733, IRR = 355%. Furthermore, for the stimulation of coiled tubing solvent, the NPV value = 98431 USS. POT = 3.94 months, PI = 3.69, and IRR = 103%. For Bullhead Acidizing stimulation where the NPV value = 218029 USS. POT = 0.94 months, PI = 46.16, and IRR = 1890%. Then the last stimulation is that there is a bullhead using solvents where the value of NPV = 248585USS $, POT = 0.96 months. PI = 52 5 and IRR value = 1822%. These proverbs or workover work are all feasible because all economic indicators meet the requirements for further proofreading. It can be seen that the NPV (net present value) for the four jobs has a positive value and the IRR (internal rate of return) is greater than MARR, the profitability index (PI) is greater than 1.

Sensitivity analysis obtained that oil prices in this study have a visible slope, oil production cycle, and investment. and capex. Thus from all the calculation processes that have been carried out based on the economics of combined stimulation workover work in the RD field, it is feasible to do and develop.

References

Apolianto, E., & Mucharam, L. (2012). Evaluasi perencanaan dan hasil perforasi berdasarkan target performa lapangan x. *SPE Annual Technical Conference and Exposition*, *XIX*(1), 13–26. https://doi.org/10.2118/115258-MS

Ariyon, M. (2013). Analisis Ekonomi Pemilihan Electric Submersible Pump Pada Beberapa Vendor. *Journal of Earth Energy Engineering*, *2*(2), 8–18. https://doi.org/10.22549/jeee.v2i2.928

Ariyon, M., & Dewi, E. K. (2018). Studi Perbandingan Keekonomian Pengembangan Lapangan Minyak Marjinal Menggunakan Production Sharing Contract. *Seminar Nasional Teknologi Dan Rekayasa*, 23–29.

Ariyon, M., Setiawan, A., & Reza, R. (2020). *Economic Feasibility Study of Onshore Exploration Oil Field Development using Gross Split Contract Economic Feasibility Study of Onshore Exploration Oil Field Development using Gross Split Contract*. https://doi.org/10.1088/1757-899X/847/1/012030

Daniel, H. (2017). Indonesian milestone in production-sharing contract in perspective of government take, contractor take, cost recovery and production target. *Society of Petroleum Engineers - SPE/IATMI Asia Pacific Oil and*

GasConference and Exhibition 2017, 2017-Janua, 1–18. https://doi.org/10.2118/187008-ms

Desyta, P., Kasmungin, S., & Wibowo, D. A. (2018). Analisa Perencanaan Reaktivasi Sumur Lapangan "Pad" Untuk Zona "a." *Penelitian Dan Karya Ilmiah*, *3*(2), 51. https://doi.org/10.25105/pdk.v3i2.2988

Fajri, M. (2019). ANALISIS HUKUM SKEMA KONTRAK GROSS SPLIT TERHADAP PENINGKATAN INVESTASI HULU MINYAK DAN GAS

BUMI Muhammad Fajri * *. *Hukum Dan Pembangunan*, *50*(1), 54–70.

FISU, A. A. (2019). *Analisis Kelayakan Ekonomi & Finansial pada Masterplan Kawasan Industri Perikanan Kota Tarakan*. 1–13. https://doi.org/10.31227/osf.io/96yzu

Handika, I. (2019). *INFLUENCE OF PSC CHANGES IN THE UPSTREAM SECTOR FROM COST RECOVERY SYSTEM INTO GROSS SPLIT TOWARDS THE OBLIGATION TO PAY LAND AND BUILDING TAX *. *31*, 126–139.

Hernandoko, A. (2018). *Implikasi Berubahnya Kontrak Bagi Hasil (Product Sharing Contract) Ke Kontrak Bagi Hasil Gross Split Terhadap Investasi Minyak Dan Gas Bumi Di Indonesia*. *VI*(2), 160–167.

Jati, N., Rahman, F., Kurniawan, H., Sari, Z. F., & Puspasari, S. (2015). Design ofexperiment and statistical approach to optimize new zone behind pipe opportunity: North Roger Block case study. *Society of Petroleum Engineers -SPE/IATMI Asia Pacific Oil and Gas Conference and Exhibition, APOGCE 2015*. https://doi.org/10.2118/176205-ms

Kaesti, E. Y. (2011). *Keberhasilan optimasi kerja ulang pindah lapisan (kupl)*. *4*(2),2–7.

Kusrini, D., & Abror, M. M. (2019). *Analisa Perhitungan Keekonomian Lapangan " X " West Java Basin Menggunakan Metode PSC (Production Sharing Contract)*. *3*(2), 1–7.

Nandasari, P., & Priadythama, I. (2015). *Analisis Keekonomian Proyek PerusahaanMinyak Dan Gas Bumi : Studi Kasus Abc Oil*.

Newnan, D. G., Eschenbach, T. G., & Lavelle, J. P. (2004). *Engineering Economic Analysis* (9th ed.). Oxford University Press.

Peraturan Menteri Energi dan Sumber Daya Mineral Republik Indonesia No. 52 Th 2017 tentang Perubahan Kontrak Bagi Hasil Gross Split. (2017). MenteriESDM.

Pramadika, H., & Satiyawira, B. (2018). Pengaruh Harga Gas Dan Komponen Variabel Terhadap Keuntungan Kontraktor Pada Gross Split. *Petro*, *7*(3), 113. https://doi.org/10.25105/petro.v7i3.3817

Prasetyawati Umar, E., Rianto Pradana, E., Rauf Husain, J., & Nurwaskito, A. (2017). Perbandingan Hasil Produksi Berdasarkan Pengaruh Workover Terhadap Hasil Produksi Sumur Walio 212 Pt. Petrogas (Basin) Ltd, Kabupaten Sorong, Provinsi Papua Barat. *Jurnal Geomine*, *5*(3), 120–123. https://doi.org/10.33536/jg.v5i3.142

PT. Chevron Pacific Indonesia.(2019). Data Lapangan, Data Operasi dan Data Produksi Minyak Sumur NZBP.

Purnatiyo, D. (2014). Analisis Kelayakan Investasi Alat Dna Real Time Thermal Cycler (Rt-Pcr) Untuk Pengujian Gelatin. *Jurnal PASTI*, *8*(2), 212–226.

Rahayu, S. A. P. (2017). Prinsip hukum dalam kontrak kerjasama kegiatan usaha hulu minyak dan gas bumi. *Yuridika*, *32*(2), 336–354. https://doi.org/10.20473/ydk.v32i2.4774

Rudiyono, A. (2019). Project Economic Evaluation of Low Permeability ReservoirDevelopment Using Discounted Cash Flow Method and Real Option Analysis for Investment Decision. *PETRO:Jurnal Ilmiah Teknik Perminyakan*, *8*(3), 81. https://doi.org/10.25105/petro.v8i3.5508

Rulandari, N., Rusli, B., Mirna, R., Nurmantu, S., & Setiawan, M. I. (2018). Valuation of Production Sharing Contract Cost Recovery Vs Gross Split in Earth Oil and Gas Cooperation Contracts in Indonesia and the Aspect of PublicService. *Journal of Physics: Conference Series*, *1114*(1). https://doi.org/10.1088/1742-6596/1114/1/012132

Shobah, S., Widhiyanti, H. N., Audrey, P., & Kn, M. (2015). Cost Recovery DalamKontrak Kerjasama Minyak Dan Gas Bumi Di Indonesia Ditinjau Dari Hukum Kontrak Internasional. *Jurnal. Universitas Brawijaya*, *79*.

Wajong, M. (2017). *Indonesia ' s new Gross Split PSC*. *January*, 1–17.

William, Kartoatmodjo, T., & Prima, A. (2017). Studi Kelayakan Keekonomian Pada Pengembangan Lapangan. *Seminar Nasional Cendekiawan*, 273–278.