OPERATION SCENARIO ON OLD OIL WELLS IN CONTRIBUTED TO ENHANCE THE URBAN SOCIETY WELFARE AND NATIONAL OIL PRODUCTION WITH LOW

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OPERATION SCENARIO ON OLD OIL WELLS IN CONTRIBUTED TO ENHANCE THE URBAN SOCIETY WELFARE AND NATIONAL OIL PRODUCTION WITH LOW COST

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ABSTRACT

Indonesia has many old oil wells that are still potential to be reactivated, but the problem is that there is no potential map of old wells that are ready to be reactivated into production wells and able to provide maximum benefits for the welfare of urban communities around old wells and can enhance national oil production. The operational activities of the old wells that have been carried out now still used conventional technology which differs depending on the location of each old wells, so that the production is not optimal because it is still relatively low and not environmentally friendly. It is necessary to develop an integrated old wells reactivation operating scenario that is suitable for all old wells conditions and meets to Health Safety and Environment (HSE) standards at a low cost. This research is intended to evaluate the potential of old well locations to be reactivated into production wells, especially in the Banyubang mature oil field as a pilot project, then evaluate the perceptions and attitudes of the surrounding community towards the development of old well management, and develop integrated reactivation operating engineering using old well mobile rig technology effective and efficient.

Keywords: *Operation Scenario, Mobile Rig, Old Oil Wells, Mature Oil Field.*

I. INTRODUCTION

Oil consumption in Indonesia continues to increase from year to year, while production automatically continues to decline. Various efforts have been made by the Indonesian Government starting from increasing oil exploration activity to unconventional oil exploitation.

On the other hand, the potential for oil production from old wells is very large and is supported by Minister of Energy and Mineral Resources (ESDM) Regulation No. 01/2008 concerning Guidelines for Exploiting Petroleum Mining in Old Wells. The objective of ESDM Regulation No. 01/2008 is to improve the welfare of urban communities around mature oil fields from the results of the operation of old wells carried out by Regionally/locally Owned Enterprises, namely BUMD / KUD, although in reality BUMD / KUD is not supported by funding, technology and human resources who knows about petroleum (competent)

According to Minister of Energy and Mineral Resources No. 01/2008, the definition of an old well is an oil well drilled before 1970, once produced and located on unprofitable land in the contractor's operating area. The government is trying to optimize oil production from old wells and the operation of old wells is more in demand by local companies such as Regionally Owned Enterprises BUMD/KUD with the aim of improving the welfare of the local community.

The operation of old oil wells cannot be equated with the operation of conventional oil wells by NOC (National Oil Company) / IOC (International Oil Company) with scheme of Production Sharing Contract (PSC) Cost Recovery or PSC Gross Split or Operational Cooperation (KSO) .

The characteristics of old wells are depth of well relatively shallow (<500 meters), oil production is relatively small (<10 bopd), the production technology is very traditional which does not meet Health Safety and Environment

(HSE) standards, for example as shown in **Figure 1**. Currently various technologies for reactivation and production of old wells in Indonesia, no one has fulfilled according to the desired old well operation scenario, which is economical (low cost) and meets the HSE standards of the Petroleum Industry.

This mature oil field if managed with Standard Petroleum Technology generally becomes uneconomical because the cost of the technology is expensive not comparable to its production (large cost/barrel). The use of "ESP" mobile rig technology as a result of research by researchers is intended to be a solution in the operation of reactivation and production of old oil wells with low cost (small cost/barrel).

According to the researchers, the principle of operating the old oil well is how to be able to carry out operations for reactivation and the production of old wells to run effectively and efficiently to be comparable with the old well oil production capability which is relatively small and also the existence of minimal subsurface data. The application of mobile rig technology is carried out in the Banyubang mature oil field. On the other hand researchers have conducted interviews and questionnaires to find out the responses of the local community around the old well field and the stakeholders of the old well business.

The research roadmap carried out by researchers from 2003 to 2018 as presented in **Figure 2.** Technology of appropriate rig has had an operating permit to reactivate suspended wells at PT. PERTAMINA EP Asset 4 Field Cepu. Based on the experience of using this effective drilling rig, it still has weaknesses, therefore researchers have carried out an innovation to build a drilling rig that is able to support the operation of old wells effectively and efficiently, namely Mobile Rig "ESP" (Efficient Smart Professional).

II. METHODOLOGY

1. **Inventory of old wells from aspects of physical conditions on the surface and aspects of subsurface data.**
   a. Conduct field surveys for inventorying technical data on the physical condition of old wells on the surface, such as the presence of well heads, casings, production lines and gathering systems.
   b. Conducting surveys of old wells from subsurface data, including study of Dutch production maps, petrophysics, well history and correlation of productive layers with stick diagram approach.

2. **Conduct Community Perception and Attitude studies around old wells.**
   This activity was carried out using a questionnaire approach to understand the perceptions and attitudes of the community around the mature oil field in the operations of the old wells. This is important because the optimization of the operation of the old well is done with the aim of improving the welfare of the community around the mature field.

3. **Conduct an economic study of the operation of old wells using Mobile Rig "ESP"**
   The use of the "ESP" mobile rig is intended to minimize the cost of producing old wells (cost / barrel). This mobile rig is used to reactivate old wells so that it can reproduce, which has been done by the local community in the Banyubang mature oil field in Blora district, Central Java Province.

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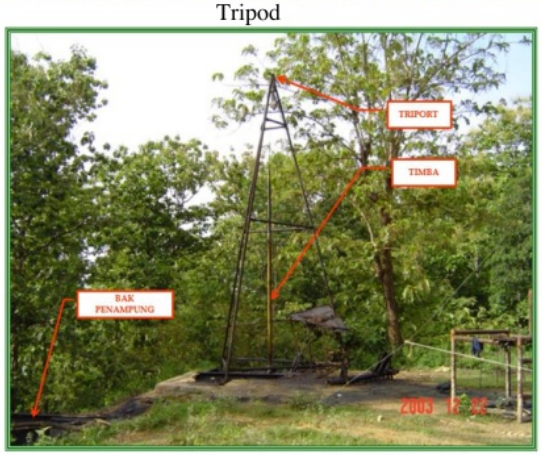

Figure 1. The Old Well Traditional Production Technology in the Banyubang field

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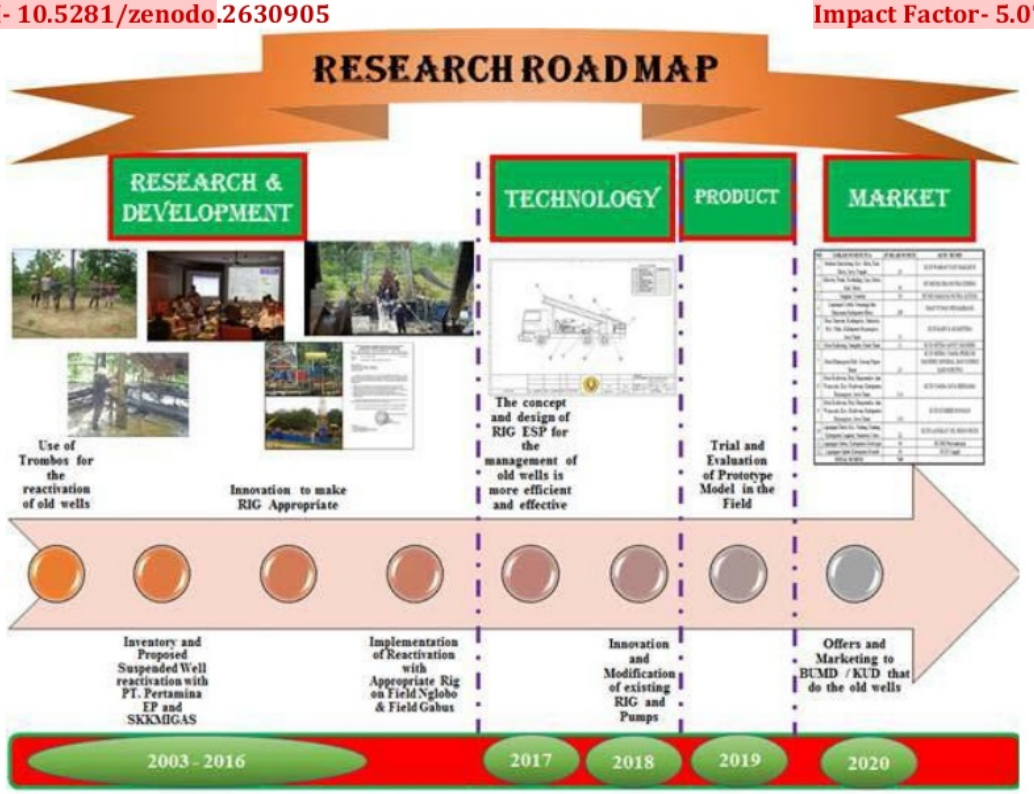

Gambar 2. Research Road Map of Modified Teknologi Mobile Rig "ESP"

III. RESULT AND DISCUSSION

The survey results on the physical condition of old wells on the surface of the Banyubang Blora mature field, one example of which is presented in **Figure 3**, where the old well has no well head and casing, only a wellbore appears. Evaluation results from aspects of subsurface data in Banyubang Mature Field

Banyubang oil field is a mature field that was discovered in 1903 and until 1933, there are 31 wells were drilled (22 oil, 1 gas & 8 dry). This field was later abandoned in 1933 for no apparent reason after reaching cumulative production of 93,000 m3. The main reservoir is the clastic limestone layer of the Middle Miocene Ngrayong Formation. From the geological and regional stratigraphy reviews, in general the hydrocarbon trap system in the Neogen field in Banyubang is a highly dominating trap of the anticline structure. The location of this mature field is in the anticline structure which is relatively northwest - southeast, as shown in **Figure 4**.

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Figure 3. Survey results of old oil wells in the Banyubang field

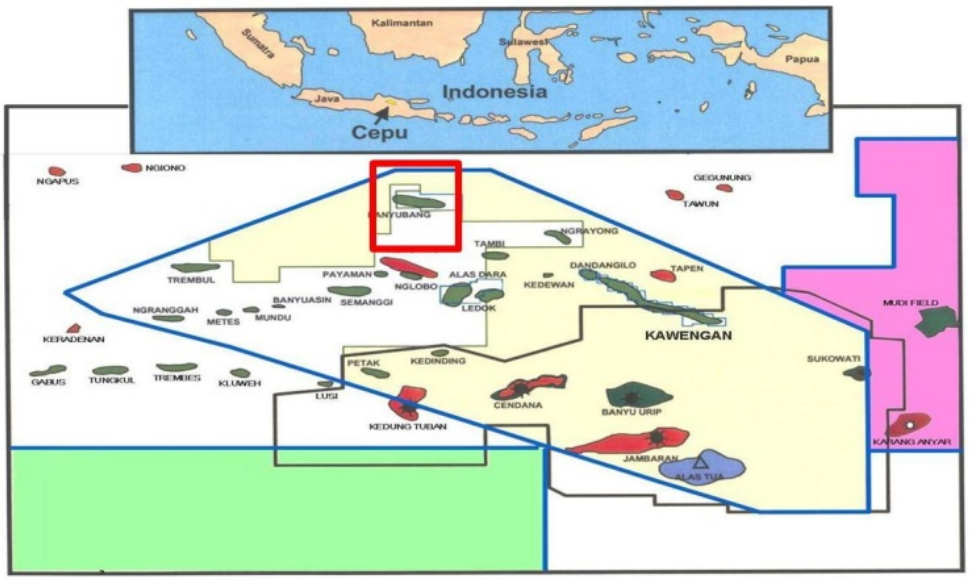

Figure 4. Location of Banyubang Mature Field

The Dutch production map includes information on well numbers, production depth (meters), total depth (meters), initial oil production flow rate (M3/ day), initial gas production flow rate (M3/day), final oil production flow rate (M3/day), final gas production flow rate (M3/day), cumulative oil production (1000 M3) and length of production (month). The reading method of the Dutch production map is shown in **Figure 5**. The results of reading the Dutch production map are shown in **Table 1**

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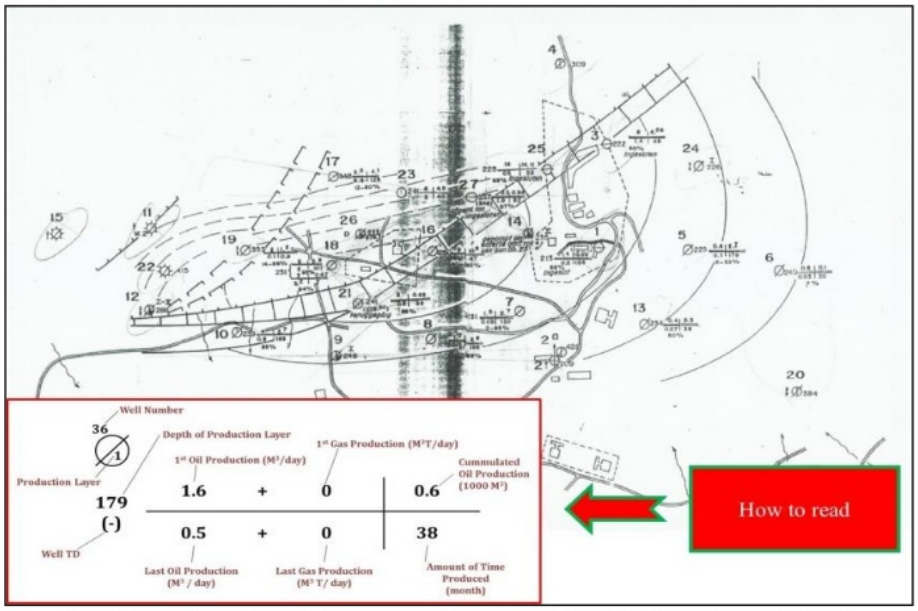

Figure 5. The reading method of the Dutch production map of Banyubang mature oil field

Build the stick diagrams based on Dutch map production data

The building of stick diagrams aims to understand the correlation between reservoirs and reservoir depth which has the potential to be seen based on the initial production rate and cumulative production. The results of this stick diagram are shown in **Figure 6.**

Table 1. The results of reading the Dutch production map

Well	TD	Prod Depth	Reservoir	Early Prod M3/Day oil	End Prod M3/Day oil	Np oil 1000 M3	Early Prod Bopd	End Prod Bopd	Np oil STB	Long Prod Month	Remarks
BNG-1	213			1.40	0.20	10.99	8.81	1.26	69,127.10	198	99%
BNG-2	428										
BNG-3	222			8.00	1.40	6.66	50.32	8.81	41,891.40	48	96%
BNG-4	309						-	-	-		
BNG-5	229			0.4	0.1	8.1	2.52	0.63	50,949.00	179	0-99%
BNG-6	249			0.6	0.0	0.1	3.77	0.19	629.00	20	
BNG-7	231			1.5	0.0	2.7	9.44	0.19	16,983.00	130	0-96%
BNG-8				1.7	0.1	3.8	10.69	0.63	23,902.00	166	98%
BNG-9	248						-	-	-		
BNG-10	239			4.0	0.8	3.7	25.16	5.03	23,273.00	163	93%
BNG-11							-	-	-		Trace gas
BNG-12	288						-	-	-		
BNG-13	234			0.4	0.1	0.3	2.52	0.44	1,887.00	38	60%
BNG-14	235						-	-	-		
BNG-15							-	-	-		Trace gas
BNG-16	250			9.0		10.8	56.61	-	67,932.00	67	
BNG-17	348			2.6	0.8	4.1	16.35	5.03	25,789.00	128	12-90%
BNG-18	251			5.0	2.0	5.9	31.45	12.58	37,111.00	107	94%
BNG-19	355			2.0	0.1	1.2	12.58	0.63	7,548.00	0.9	14-98%
BNG-20	384						-	-	-		
BNG-21	241			3.0	0.8	0.7	18.87	5.03	4,340.10	36	89%
BNG-22	415						-	-	-		Trace gas
BNG-23	241			6.0	2.0	4.6	37.74	12.58	28,934.00	40	
BNG-24	226						-	-	-		
BNG-25	225			16.0	0.6	14.1	100.64	3.77	88,751.90	52	98%
BNG-26	666						-	-	-		
BNG-27	237			2.3	1.9	1.0	14.47	11.95	6,164.20	82	97%

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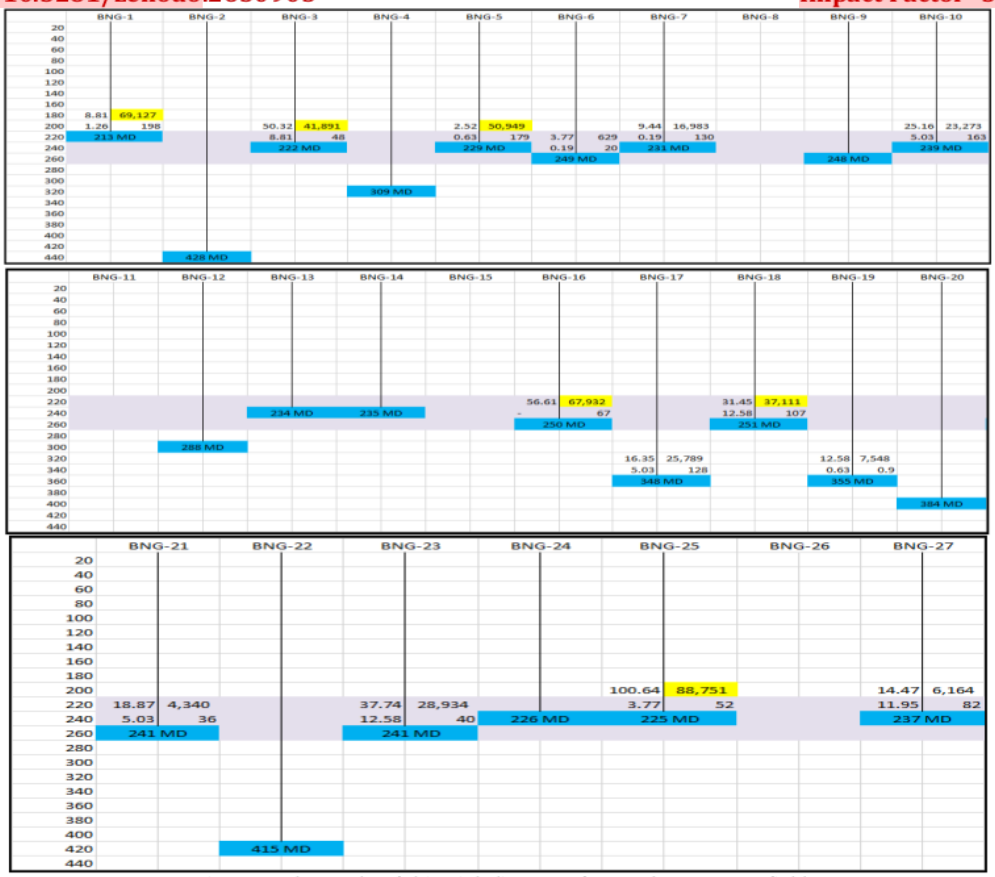

Figure 6. The results of this stick diagram of Banyubang mature field

The Perception and Community Attitude Questionnaire

This activity has been carried out to understand the perceptions and attitudes of the community around the mature field towards the operation of old wells. The results of the questionnaire that have been carried out are summarized in **Figure 7**.

The economics of operating old wells using Mobile Rig "ESP"

a. Chronology of Mobile Rig "ESP" Low Cost for Operation of old wells

The first researcher only used a simple technology, called the Trombos Rig which uses human strength to reactivate old wells. Then the researchers innovated by building an appropriate Rig, which originally originated from water drill equipment which was modified into oil drill equipment. Based on the experience of the researchers in the old well, the appropriate rig is still not effective and efficient, because the location of the old well is mostly located in a forest area and is located in a residential area, so the idea of the mobile Rig "ESP" emerged. The process of developing this mobile rig "ESP" is shown in **Figure 8** and **Figure 9** shows the design of model mobile Rig "ESP"..

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Perception and attitude of society

Identity of Respondents

Public perception of old well exploitation has not been able to grow the economy and prosperity of the people around old field oil and gas (low involvement of community role)

Public attitudes agree on new technologies and the involvement of investors by involving the community of the old wells

Job Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	village officials	4	20	23.5	23.5
	public figure	2	10	11.8	35.3
	workers in the old well	2	10	11.8	47.1
	others	9	45	52.9	100
	total	17	85	100	
Missing	System	3	15		
Total		**20**	**100**		

Perceptions of the Role of Society

Knowing the existence of an old well

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	know	19	90	94.7	94.7
	do not know	1	5	5.3	100
	Total	19	95	100	
Missing	System	1	6		
Total		**20**	**100**		

Role Involvement of local communities in the management of old wells

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Owner	2	10	25	25
	self-employed	4	20	50	75
	workers at KUD/BUMD	1	5	12.5	87.5
	supervision	1	5	12.5	100
	total	8	40	100	
Missing	System	12	60		
Total		20	100		

Community Attitude

Community involvement in the management of old wells with appropriate technology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	10	10	10
	Agree	6	30	30	40
	Strongly agree	12	60	60	100
Total		20	100	100	

Involvement of investors in the management of old wells

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	15	15	15
	Agree	10	50	50	65
	Strongly agree	7	35	35	100
Total		20	100	100	

Gambar 7. Perception and Attitude of Society Around Old Oil Wells

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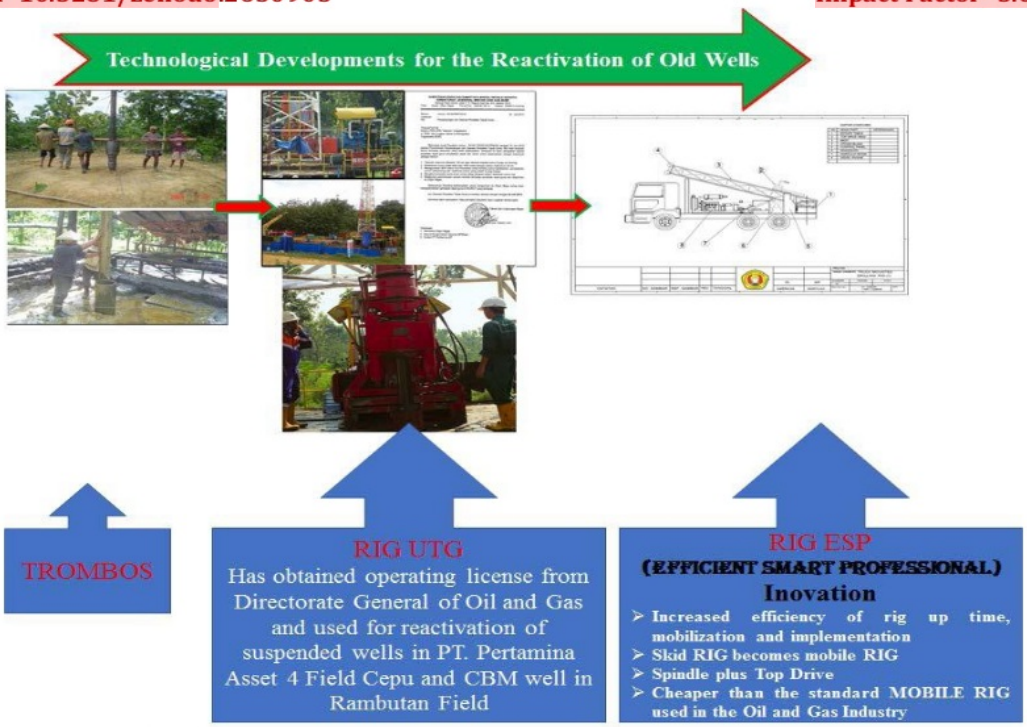

Figure 8. The process of developing mobile rig "ESP" for the Reactivation of old wells

The technology of mobile rig "ESP" is able to increase the number of old wells that can be reactivated in a certain time unit so that it can increase oil recovery from old wells in Indonesia which in turn can contribute to the increase in national oil production and the welfare of urban communities around old wells

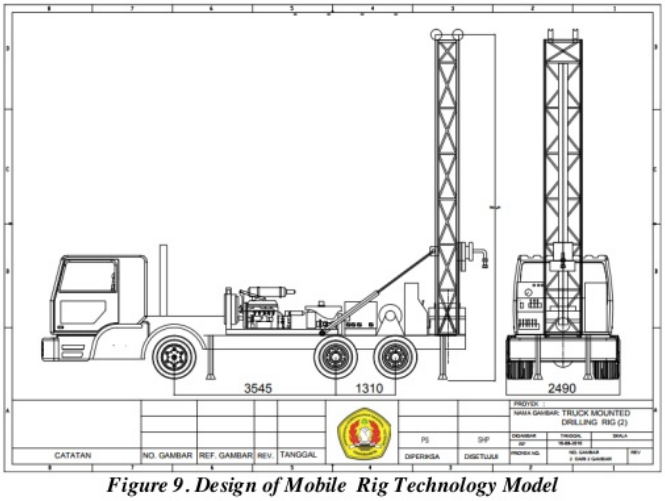

Figure 9. Design of Mobile Rig Technology Model

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b. The economics of operating old wells

As a preliminary illustration, the estimated costs for operating old oil wells are shown in **Table 2**.

Table 2. the estimated costs for operating old oil wells

INVESTATION				
No	**Description**	**Price (Rp)**	**Quantity**	**Total Cost (Rp)**
1	Reactivation	500,000,000	2	1,000,000,000
2	Surface facilities	250,000,000	1	250,000,000
Total				**1,250,000,000**
EQUIPMENT RENTAL				
No	**Description**	**Rental Price (Rp)/tahun**	**Quantity**	**Total Cost (Rp)**
1	Genset	180,000,000	1	180,000,000
2	Pompa	360,000,000	2	720,000,000
Total				**900,000,000**
OPERATIONAL COST				
No	**Description**	**Total/year**	**Unit Price (Rp)**	**Cost / year (Rp)**
1	BBM, liter	72,000	7,000	504,000,000
2	OLI, liter	2,400	25,000	60,000,000
Total				**564,000,000**

With the profit sharing scheme and estimates of oil prices are shown in **Table 3.**

Table 3. Profit Sharing Scheme and Estimates of Oil Prices

INPUT			
Old Well Reactivation Amount	=	**2**	**well**
Pertamina Price Share	=	**30%**	
Share Miner Prices	=	**70%**	
Decline Prodution	=	**25**	**%/year**
Oil Production	=	**10**	**Bbl/sumur/day**
	=	**1,590**	**lt/sumur/day**
ICP	=	**60**	**$/Bbl**
$	=	**14,000**	**Rupiah**
Oil Price	=	**5,283**	**Rp/lt**
Oil Prices for Miners	=	**3,698**	**Rp/lt**
The cost of transporting oil to cepu	=	**400**	**Rp/lt**
Operational Escalation	=	**10**	**%/year**
Discount Factor	=	**10%**	

Based on the cost estimates and input scheme above, the project cash flow calculations are shown in **Table 4.**

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Table 4. The Project Cash Flow Calculations of Project

EVALUATION OF PROJECT ECONOMY 2 OLD WELL FOR 5 YEARS											
Year	Oil Production (liter)	Gross Revenue (Rp)	The cost of transporting oil to cepu (Rp)	Operational Cost (Rp)	Investment and Equipment Rental Costs (Rp)	Total Cost (Rp)	Net Cash Flow (Rp)	Cummulative Net Cash Flow (Rp)	Discount Factor	Disc Net Cash flow (Rp)	Cummulative Disc Net Cash Flow (Rp)
0					2,150,000,000	2,150,000,000	-2,150,000,000	-2,150,000,000	1.00	-2,150,000,000	-2,150,000,000
1	1,160,700	4,292,400,000	464,280,000	564,000,000	900,000,000	1,928,280,000	2,364,120,000	214,120,000	0.91	2,149,200,000	-800,000
2	870,525	3,219,300,000	348,210,000	620,400,000	900,000,000	1,868,610,000	1,350,690,000	1,564,810,000	0.83	1,116,272,727	1,115,472,727
3	652,894	2,414,475,000	261,157,500	682,440,000	900,000,000	1,843,597,500	570,877,500	2,135,687,500	0.75	428,908,715	1,544,381,443
4	489,670	1,810,856,250	195,868,125	750,684,000	900,000,000	1,846,552,125	-35,695,875	2,099,991,625	0.68	-24,380,763	1,520,000,680
5	367,253	1,358,142,188	146,901,094	825,752,400	900,000,000	1,872,653,494	-514,511,306	1,585,480,319	0.62	-319,471,041	1,200,529,639
TOTAL	3,541,042	13,095,173,438	1,416,416,719	3,443,276,400	6,650,000,000	11,509,693,119	1,585,480,319			1,200,529,639	
		ECONOMIC INDICATORS									
		NPV	1,200,529,639	Rupiah							
		POT	23	Month							
		IRR	42%								

IV. CONCLUSION

- Banyubang mature field in Blora Central Java based on surface and subsurface evaluations is still a prospect to operate using "ESP" mobile rig with low cost per barrel.
- The majority of the people around the Banyubang mature field are aware of the existence of old wells, they are involved in the operation of old wells using traditional technology, the role of the existence of old wells has not been able to prosper the local community. The local community still hopes to be involved in operating the old well using the ESP mobile rig technology.
- The old well production operation using ESP mobile rig technology can increase national oil production through production old wells that spread across Indonesia and enhance the urban society welfare around the mature oil field

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