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Redefining EOR In Indonesia's Oil & Gas Industry: A Novel Solution to Overcome Lengthy Lag Time from EOR Implementation In Indonesia Post Gross Split Fiscal System

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Abstract. In the wake of a new fiscal system related to oil and gas industry in Indonesia, namely the gross split system, concerns have been risen due to the fact that the new regulation puts forward EOR as an obligation for oil and gas contractors in order to gain significant incentives to improve field economics. Although EOR itself is a mature and proven technologically and economically to alleviate oil production thus encouraging profitable business, it has to be realized that most greenfields in Indonesia are relatively small compared to previous discoveries or case studies encountered abroad, rendering EOR to be economically obsolete to be implemented in full field scale. This study presents a new concept and suggestions for stakeholders to implement massive tertiary recovery in oil reservoirs around Indonesia using the less expensive and more result oriented, reducing the need for lengthy procedure before full scale EOR can take place.

Keywords: Enhanced oil recovery, gross split, huff & puff

1. The First Section in Your Paper

Indonesia, as one of the most diversely sourced country in terms of energy supply was previously known as the first country to have brought up the Production Sharing Contract (PSC) fiscal system in the 1960s (Lubiantara, 2012) that was first proposed by Pertamina to handle foreign investments in oil and gas business that was beginning to bloom during that particular period. The basic idea of PSC is that a system that treats contractors (known as K3S) to become a hired asset of Indonesian government that will be given its fair share if the field is proven to be productive and all expenses will be paid by government. This system has undergone several changes, including the introduction of DMO (Domestic Market Obligation) where Indonesian government demands a certain amount of oil or gas to be sold to domestic market under discounted price, First Tranche Petroleum (FTP), and also several incentives such as investment credits, tax holiday, etc for developing new frontier fields.

As oil and gas process looms below its values in 2010s, Indonesian government is faced with a dilemma in PSC system where the cost rises every year in an exponential fashion (Katadata, 2018). It is arguable whether efficiencies should be taken in order to reduce unnecessary government spending or more money should be poured in order to maintain or even increase production by means of extensive application of emerging technologies such as well stimulation and Enhanced Oil Recovery (EOR). In the beginning of 2017, the government of Indonesia issues a ministerial decree that states as of the time period, all PSC system will be replaced by the new gross split mechanism, whilst the ongoing PSC dealings cannot be altered until the period of contract extension. This presents a new

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problem for K3S and related stakeholders as different rulings brought different styles of handling capital. Ariadji (2017) summed the gross split system in a simplistic, but elegant point of view:

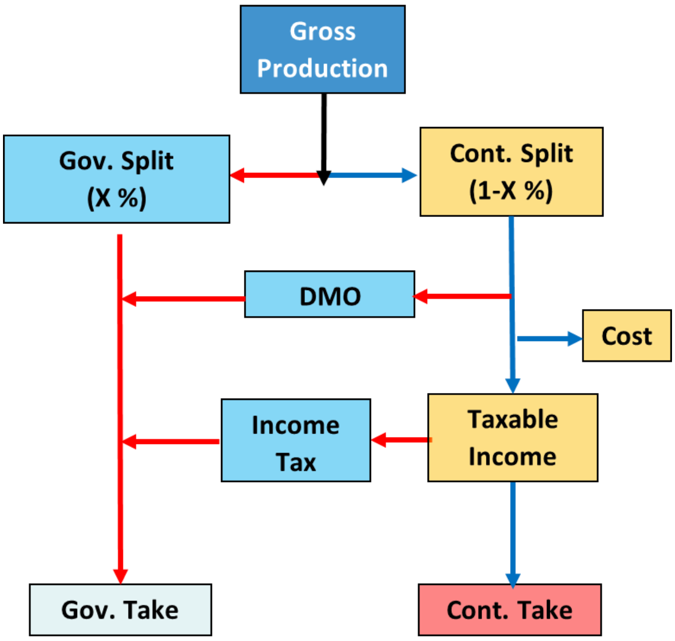

Figure 1. Schematics of Gross Split Fiscal Scheme (Ariadji, 2017)

Figure 1 can be used to predict the implication of the new system in its application for oil and gas stakeholders in Indonesia. As we are able to observe, the cost is now directly under the management of contractors, without any related scheme to cost recovery. In order to provide an alternative to cost recovery the government introduces several premiums related to technical and non-technical aspects of petroleum exploration and extraction, as listed below.

Table 1. Split Premium for Gross Split System (Pre-Revision)

Component	Parameter	Split Premium
Field Status	POD I	5%
	POD II	0%
	No POD	-5%
Production Mechanism	Primary	0%
	Secondary	3%
	Tertiary (EOR)	5%
Reservoir Depth	D < 2500 m	0%
	D > 2500 m	1%
Availability of Infrastructure	Infrastructure	0%
	No Infrastructure	2%

The purpose of this split premium is an enhanced way to encourage contractors to delve themselves into riskier or new frontier projects that require incentive beforehand. As government does not prefer substantial amount of capital goes into waste by introducing any other incentives, these premiums are deemed to be enough to encourage investors to treat with the new system. However, in the following sections the authors will scrutinize every attribute of the system, providing an insight on how it could be beneficial or even becoming a liability in the near future.

1.1. The Problem with The New System

Before the new gross split system came into play, contractors are more familiar and heavily comfortable with the mature PSC system which has been revised many times after its inception in the 1960s. The main problem with PSC is the cost recovery input, explained in the following diagram by Ariadji (2017):

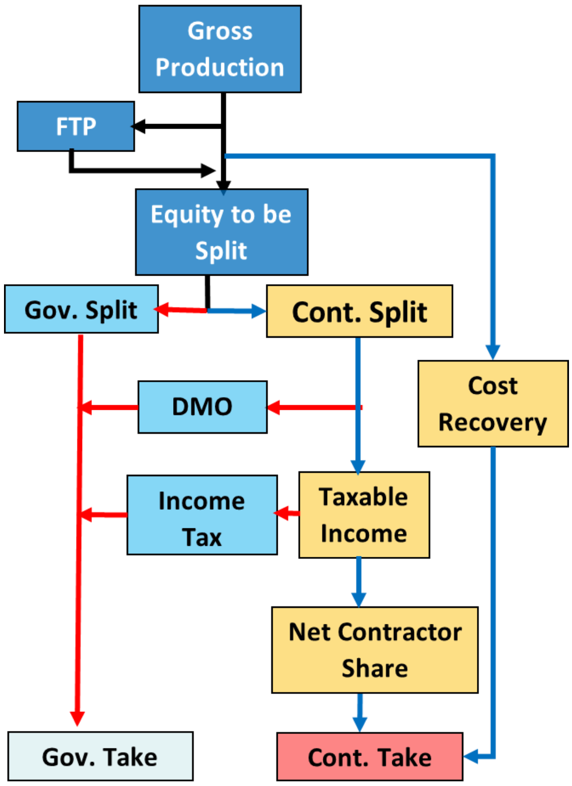

Figure 2. Schematics of PSC Fiscal System (Ariadji, 2017)

Cost recovery terms can be summed as reimburse of all expenses of contractor's capital, if the field is deemed productive and the hydrocarbon can be extracted. This aspect has been proven to be a liability for government as the money given to contractors keep rising every year in order to maintain or prohibit swift decline in oil production.

In gross split system, the government does not introduce any cost recovery terms, as the expenses are already covered in contractors' share. At first, controversies began to arise as this implicates that contractors do not have the same amount of freedom as they used to be, and optimization will have to take place in order to mitigate the rising cost. Experts such as Ariadji (2017) pinpointed that the incentives given for long-term activities such as EOR is not encouraged with the current scheme, as the process of EOR is not a plug and play process, instead it will require time and capital to proceed in a longer time scheme. Therefore, in mid-2017, the government introduced a new split premium scheme that addresses complication in field operation, ranging from geological and hydrocarbon complexities up to social and economic complications. The most notable changes including, not in the order of the value of importance are doubling the split premium in production mechanism, adding split premium for H_2S content and oil specific gravity, and detailing the split premium for offshore fields based on depth. This presents a fairer system that the government thinks are best to improve the state of Indonesia's oil and gas business.

Table 2. List of Several Split Premium in Gross Split System

Component	Parameter	Split Premium
Field Status	POD I	5%
	POD II	3%
	No POD	0%
Field Location	Onshore	0%
	Offshore (0<h<20)	8%
	Offshore (20<h<50)	10%
	Offshore (50<h<150)	12%
	Offshore (150<h<1000)	14%
	Offshore (h<1000)	16%
Reservoir Depth	h > 2500 m	0%
	h < 2500 m	1%
Infrastructure	New Frontier Offshore	2%
	New Frontier Onshore	4%
Reservoir Type	Conventional	0%
	Unconventional	16%
CO_2 Content (%)	< 5	0%
	5 < x< 10	0.5%
	10 < x< 20	1.5%
	20 < x< 40	2%
	40 < x< 60	3%
	x> 60	4%
H_2S (ppm)	< 100	0%
	100 < x< 1000	1%
	1000 < x< 2000	2%
	2000 < x< 3000	3%
	3000 < x< 4000	4%
	x >4000	5%
SG (API)	SG < 25	0%
	SG > 25	1%
TKDN	30 < x < 50	2%
	50 < x < 70	3%
	70 < x < 100	4%
Production Stage	Primary	0%
	Secondary	6%
	Tertiary	10%

2. **Where Does EOR Stand in Gross Split Scheme?**

Enhanced Oil Recovery (EOR) has been a longstanding campaign that has been touted as Indonesia's solution to dwindling oil and gas production, Abdurahman et al (2016) mentioned that EOR requires time consuming procedures, ranging from 5-9 years of rigorous testing and field trials before fieldwide EOR application is deemed mature enough to be deployed. This situation, augmented by relatively short oil and gas contract in Indonesia, between 20-25 years at most, presents a dilemma for companies in low oil price to even consider EOR as one of the options to magnify revenue. It is also worth noting that EOR implementation requires considerable amount of capital invested in developing procedures and dealing with numerous uncertainties that sometimes cannot be predicted without comprehensive modeling, lab studies, and pilot tests.

The latent problem underlining EOR implementation in Indonesia can also be attributed to minor reserve discoveries in the past 20 years. Reserves ranging from 20-40 MMSTB in size will only produce sufficient amount of hydrocarbon to sustain standard production measurements, namely pump installation or well stimulation. In regard to small reserves available, companies would prefer to maintain production utilizing artificial lift, production optimization, or well stimulation namely hydraulic fracturing or acidizing. Although significant incentives (10% premium) have been introduced as an incentive to encourage EOR implementation, current practices of EOR are limited to a single company, Chevron Pacific Indonesia with its monumental Duri Steam Flood Project as mentioned by Pearce & Megginson (1991). The implementation itself is credited to massive reserves found in Central Sumatra Basin, rendering the project to become economical even in lower oil price and high water cut involved.

From the perspectives presented above, there is a need for stakeholders to look into a new solution that can be as effective as EOR yet the value of cost effectiveness and time horizon would surpass EOR. The value of cost effectiveness is paramount for smaller oil and gas contractors to take a glance at the solution, in a noble cause of alleviating Indonesia’s oil and gas production. Several studies from field data have also been analyzed by Irham (2018) in CO2 flooding and Giranza & Bergmann (2017) in general economic policy of gross split scheme has come to a single conclusion that for smaller fields, EOR implementation would be too costly on the scale of damaging the entire project economics.

3. Huff and Puff Stimulation: The Solution for Expensive Full Scale EOR

Huff n Puff or cyclic injection has been in practice since the 1950s (Zuloaga et al, 2017). It differs from conventional EOR by means of the scale of the field involved. Huff n Puff mainly involves a single well for the injection to occur, reducing unnecessary risks and uncertainties in full scale application. It is also worth noting that huff n puff can be customized into several injection-soaking-production cycles, as seen on figure 3. This unique property can be optimized by companies using production data, pressure decline, and monetary complications. The application of huff n puff injection will certainly be useful for smaller contractors without having to resort to full scale EOR.

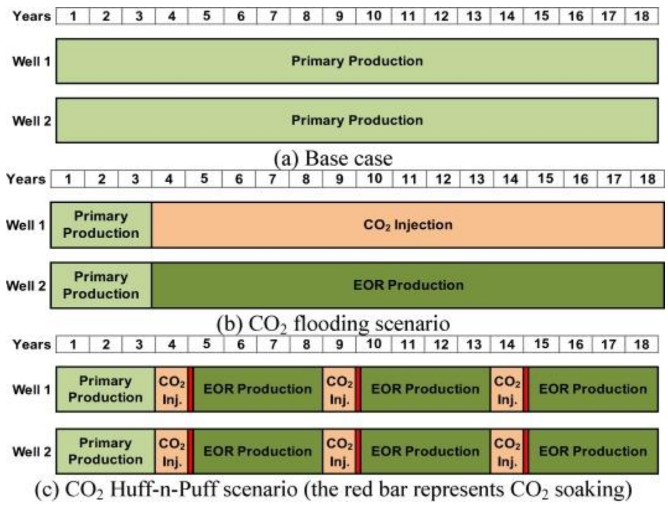

Figure 3. Schematics of Huff & Puff Injection (Jin et al, 2017)

Jin et al (2017) presented the scheme of huff n puff injection that can be applied to numerous injected chemicals into oil reservoir, namely CO_2, polymer, surfactant, heat/steam, and most recently nanofluid assisted electromagnetic heating proposed by Indriani (2017). The basic idea of huff n puff process in enhanced oil recovery is allowing soaking time in which the well is then shut for a series of pre-designed duration, allowing injector fluid to seep into reservoir fluid and stimulate property changes. Alvarez & Han (2013) provided an excellent schematic to describe huff n puff process, which can be summarized as injection-soaking-production cycles, that can be repeated as long as economic considerations can be fulfilled. This method has been tested in fields all around the world as reported by Wu et al (2005) for CO_2 injection, Yong et al (2016) for hydrocarbon gas injection, Xianghong et al (2010) for steam injection, Aditama et al (2017) for MEOR/ nutrient injection, Ariadji et al (2017) for nutrient injection in Indonesia, Guangming et al (2016) for thermal stimulation in offshore oil fields. It is evident from recent literatures that huff and puff is currently on the rise, notably since instability hits oil price, rendering full scale EOR method full of uncertainties and unattractive to be developed in current economic climate.

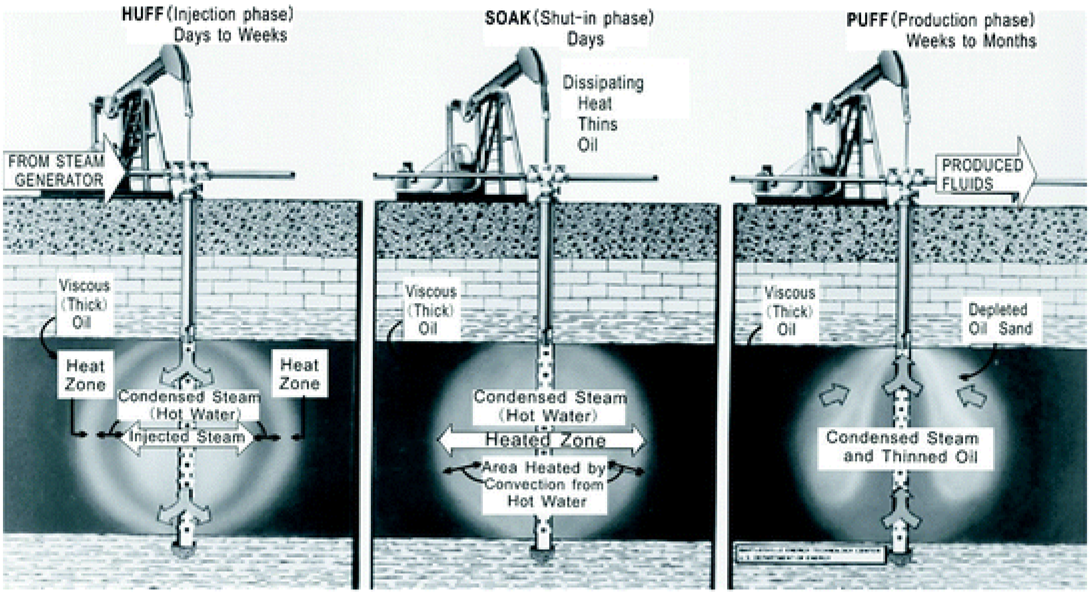

Figure 4. The Process of Huff n Puff Injection (Alvarez & Han, 2013)

3.1. What Must be Done by Governments, Regulator, and Contractors?

In lieu to the new understanding that full scale EOR implementation would never a feasible, long term solution to most of Indonesia's less fortuitous reservoirs, there will be a new vision or regulation revision in order to tackle the aforementioned phenomenon. The government and regulator must realize that full scale EOR will just be a dream for smaller contractors, therefore gross split ruling must be revised based on the magnitude of reserves involved. A distinguished line must be drawn to define the validity and responsible utilization of both full scale EOR and well scale EOR (huff & puff). It will be wise if the regulators, working hand in hand with contractors with the support of universities, in order to draw a line between what is known as "small" and "big" reserves. The regulator (SKK Migas) will have to adhere to this new regulation, allowing EOR methods to prosper even in less pro fitable fields. The cooperation with universities are also important, as Siregar et al (2011) mentioned the importance of industry driven academic research, in order to provide industry with new, innovative thinking and allowing university research culture to flourish.

4. Conclusion

This paper presented a solution to reduce complexities regarding full scale EOR implementation in Indonesia under the gross split regime. Although significant premium is offered on contractual basis, smaller companies will struggle to procure equipment, method, and extensive testing required before launching field scale EOR. It is important to note that huff & puff or well scale stimulation is a better option for smaller oil and gas fields in Indonesia, especially nowadays when significant reserves are more seldom discovered.

References

Abdurrahman, M., Permadi, A.K., Bae, W.S., Masduki, A., EOR in Indonesia: past, present, and future, *International Journal of Oil, Gas, and Coal Technology*, 16(3), pp. 250-270, 2017.

Aditama, P., Avbelj, E., Reimann, S., Dopffel, N., Mahler, E., Poulsen, M., Alkan, H. (2017, June 12). Design and execution of an MEOR huff and puff pilot in a Wintershall Field. *Society of Petroleum Engineers*. doi:10.2118/185785-MS

Alvarez, J. & Han, S. (2013). Current overview of cyclic steam injection process. *Journal of Petroleum Science Research*. 2(3), pp. 116-127.

Ariadji, T. (2017): Pemahaman dan dampak peraturan menteri ESDM No 8/2017 tentang Kontrak Bagi Hasil Gross Split dan revisi Permen ESDM No 52/2017. Presented at Seminar Nasional 2017 UPN Veteran Yogyakarta.

Ariadji, T., Astuti, D. I., Aditiawati, P., Purwasena, I. A., Persada, G. P., Soeparmono, M. R., Aditya, G. H. (2017, October 17). Microbial huff and puff project at Mangunjaya Field Wells: the first in Indonesia towards successful MEOR implementation. *Society of Petroleum Engineers*. doi:10.2118/186361-MS

Giranza, M.J. & Bergmann, A. 2017. Indonesia's new Gross Split PSC: is it more superior than the previous standard PSC?. ICPPE 2018.

Indriani, E., Anugerah, A., Rachmat, S., Munir, A., Microwave heating with nano ferro fluid for heavy oil application, 2017 Progress in Electromagnetics Research Symposium-Fall, 2017.

Irham, S., Sibuea, S.N., Danu, A. 2018. The new management policy: Indonesian PSC Gross Split applied to CO_2 flooding. The 4th International Smeinar on Sustainable Urban Development.

Lubiantara, B. 2012. *Ekonomi Migas: tinjauan aspek komersial kontrak Migas*. Penerbit Gramedia.

Jin, W., Pu, W., Wei, B., Tang, Z., 2017. *Experimental investigation of CO_2 huff n puff for enhancing oil recovery in tight reservoirs*. Chemical Engineering Research and Design.

Li, Y., Wang, D., Liu, Z., & Ma, X. (2016, April 25). Development strategy optimization of gas injection huff and puff for fractured-caved carbonate reservoirs. *Society of Petroleum Engineers*. doi:10.2118/182746-MS

Pearce, J.C. & Megginson, E.A, Current status of The Duri Steamflood Project in Indonesia, SPE International Thermal Operations Symposium, 1991.

Siregar, S., Soewono, E., Mucharam, L., Darmadi, _, Priharto, N., & Swadesi, B. (2011, January 1). *Oil and gas industry driven academic research*. *Society of Petroleum Engineers*. doi:10.2118/148125-MS

Wu, S., Yitang, Z., Liqiang, Y., Kequan, Y., Xia, Z., & Li, C. (2005, January 1). Sequential multi-well steam huff and puff in heavy oil development. *Society of Petroleum Engineers*. doi:10.2118/97845-MS

Wu, X., Dong, B., Xu, A., Zifei, F., & Wang, R. (2010, January 1). Superheated steam huff and puff to revive a marginal pre-salt heavy oil reservoir. *Society of Petroleum Engineers*. doi:10.2118/134082-MS

Zuloaga, P., Yu, W., Miao, Y., Sepehmoori. (2017). Performance evaluation of CO_2 huff n puff and continuous CO_2 injection in tight oil reservoirs. *Energy*. 134 (C), pp.181-192.