



# Reverse Coning Method Application to Reduce Water Cut in ML-036 Well, Lirik Field Pertamina EP

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**Abstract.** Produced since 1936, Lirik is a mature field in Asset 1 PT Pertamina EP with  $\pm 50\%$  *ultimate recovery factor* averagely. This has an impact on high average water cut more than 99%, and is a special engineering and operational challenge. Engineering programs are applied to maintain oil production, such as well maintenance, optimization, reactivation, and repair. Unfortunately, *gross up effort* mostly bothered with excessive water production due to high water cut. Engineering innovation to increase oil production with reduced water cut becomes pivotal to avoid exaggerate investment, such as water injection well drilling or production facilities replenishment. Avoiding excessive water production, reducing water cut is a compulsion. ML-036 is a production well with high water cut, 98.8%. Using sucker rod pump as its artificial lift, the average gross and net production is 431 barrels fluid per day (bfpd) and 5 barrels oil per day (bopd) respectively. This paper aims to prove the effectiveness of reverse coning method in reducing water cut in ML-036 well and increases oil production. Technical approach using reverse coning method is used to overcome water coning as a cause of high water cut in ML-036 well. Proper design of reverse coning tool is prepared and installed using standard operational procedure. Parasol injection to clean the wellbore is initially applied, and the selection of tool installation depth becomes crucial. Some oil characteristics and parameters are considered to increase the degree of success, such as pay thickness, reservoir vertical and horizontal permeability ratio, pressure drawdown, aquifer strength, and well completion configuration. The economic evaluation is also considered as part of success parameter. The result of this study concludes the success of reverse coning method to decrease average water cut in ML-036 well. With proper tool design and depth selection, supported with parasol injection before its application, reverse coning can become an alternative solution for oil well with water coning problem.

**Keywords:** Reverse Coning, Water Cut, Water Coning

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## 1 Introduction

Lirik is an active production field in Riau Province under Production Sharing Contract (PSC) between Pertamina EP and SKK Migas. Located in Indragiri Hulu and Pelalawan regency of its production and injection wells, Lirik Field has been operated since 1936, along before Indonesian independence day. The terminal facility is located in Buatan, Siak, to lift crude oil into Refinery Unit (RU) II Sei Pakning using barges. With total of 422 km<sup>2</sup> working area, Lirik Field produces 1684 bopd currently with ±141,000 bwpd produced water. North Pulai, South Pulai, Ukui, Andan, Lirik, Sago, and Molek are active structures that contribute oil production in Lirik Field, in Japura Block. With total of 113 active production wells and 52 injection wells, Lirik Field has its own operational challenge. Electric Submersible Pump (ESP) is used dominantly as artificial lift in Lirik production wells, about 75% of total well, while 25% using Sucker Rod Pump (SRP).

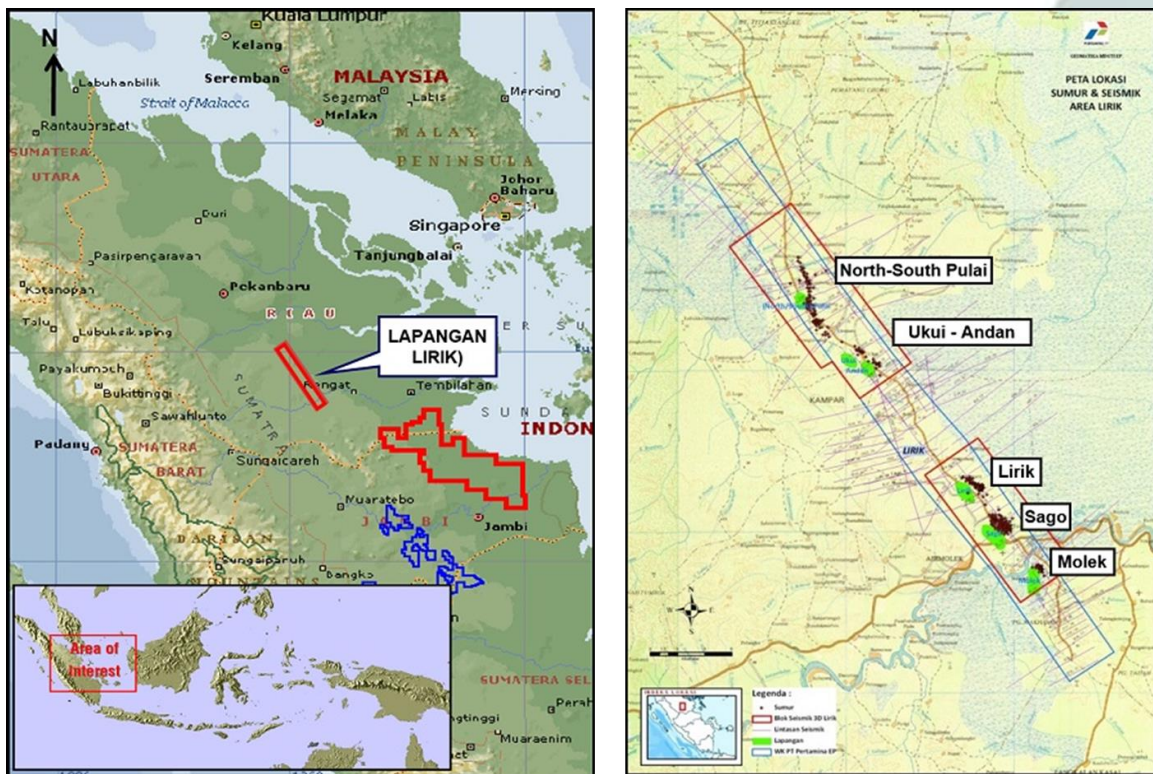


Figure 1. Lirik Field Working Area

As mature field with ±50% Recovery Factor and 98% water cut averagely, Lirik Field has its own special challenge in water management, in that produced water with crude oil from reservoir is reinjected into reservoir. High water becomes special challenge and need to be overcome with current technologies. In a bid to address the recurrent challenges posed by water coning to the overall oil recovery from the reservoir, several techniques have been used to mitigate this production rate-sensitive phenomenon (Okon et al, 2017).



## 2 Methodology

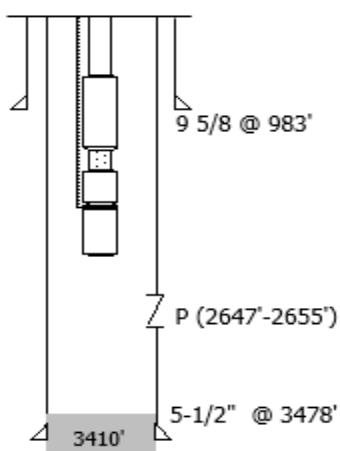
### 2.1. Well Profile

ML-036 is a production well in Molek Structure, Lirik Field which is produced with high water cut, 98.8%. Using Electric Submersible Pump (ESP), IND-440, ML-036 is produced with 98.8% water cut previously as seen in Table 1.

**Table 1.** ML-036 Well Production

|                    |        |      |
|--------------------|--------|------|
| Well name          | ML-036 | -    |
| Structure          | Molek  | -    |
| Top perforation    | 2647   | ft   |
| Bottom perforation | 2655   | ft   |
| Middle perforation | 2651   | ft   |
| Production zone    | P      | -    |
| Gross              | 431    | Bfpd |
| Net                | 5      | Bopd |
| Water Cut          | 98.8   | %    |

Average production before reverse coning stimulation in ML-036 is 431 Bfpd/5 Bopd/98.8% and is a baseline for evaluating the application of reverse coning method. ML-036 is produced with single layer in P zone as seen in Figure 1.



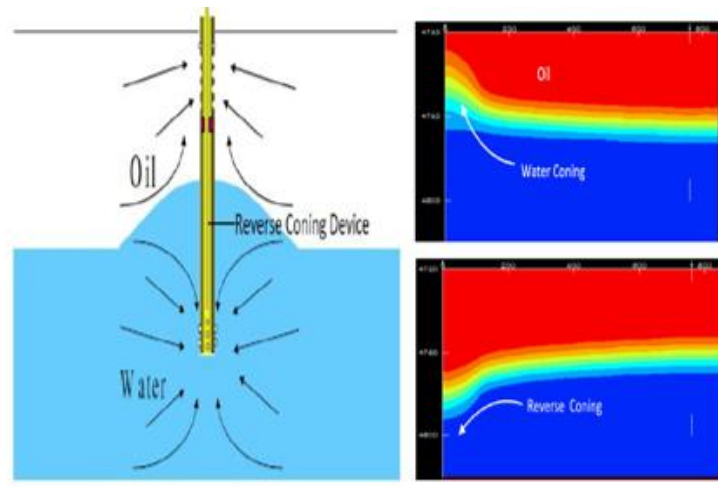
**Figure 1.** ML-036 Well Profile





## 2.2. Reverse Coning Method

Reverse coning is a method by installing particular device in production well as a bulkhead between water-oil contact in perforation zone to create a new flow path for water in bottom part of reverse coning device due to its lower pressure. While oil flows through upper part of the device as seen in Figure 2.



**Figure 2.** Reverse Coning System

From Figure 2, it is seen that the initial condition without the reverse coning device, water flows dominantly in the perforation zone with oil, causing its dominant production and creating high water cut. The reverse coning method with its special device compels water to flow through the bottom part of the device due to its lower pressure, causing oil to flow more efficiently. Consequently, water cut will decrease. Before the reverse coning device is installed, swabbing operations and paraffin treatment using powerwave tools are implemented to clean the bottomhole and production string from paraffinic contaminants. Swabbing operations aim to suck fluids up from the well until a stable rate and water cut are achieved. It involves deciding the packer arrangement and chemical treatment method. Powerwave is used to wash the interval of interest in the perforation zone, consisting of two stages of brine pumping operations. The powerwave tool is also used to spot chemical stimulation in the interval of interest with two stages of operation. Stage 1 is to inject paraffin HD treatment, which is a mixture of diesel oil, parasol, dissolver, and demtrol. While stage 2 is to inject water treatment that consists of demtrol, wetrol, warcon, scale inhibitor, and fresh water.

As seen in Figure 3, the combination of the powerwave tool and the reverse coning device becomes one inseparable whole to reach success in the applied solution. The success of the powerwave tool in washing the downhole helps the reverse coning device to be installed in the perforation zone. A clean well without paraffinic and other contaminants drives the device to operate effectively.





Set powerwave tool at 2647 ft and pump 45 bbls  
Set powerwave tool at 2655 ft and pump 45 bbls.

- Mixing chemical before injection using powerwave tool.
- Spot chemical stimulation to interest interval 2647 – 2655 ft with 2 operational stages.  
**Stage 1:** injection of Paraven HD treatment, powerwave tool is set at 2647 ft.  
In this stage 1, the chemical mixture consists of diesel oil, parasol, dissolver, and demtrol.  
**Stage 2:** injection of Watrol treatment, powerwave tool is set at 2655 ft.  
In this stage 2, the chemical mixture consists of demtrol, wetrol, warcon, scale inhibitor, and fresh water.
- After chemical injection is applied, Pool Out Open Hole (POOH) powerwave tool into surface.
- Rig In Hole (RIH) reverse coning device and Sucker Rod Pump (SRP) with production string.
- Well is then produced after 48 hours of chemical soaking. The reverse coning device configuration in ML-036 well as is seen in Figure 4.

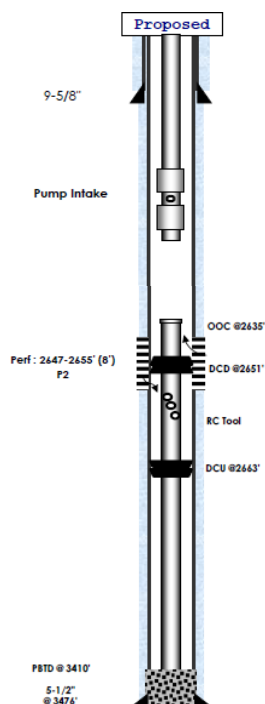


Figure 4. Reverse Coning Device Configuration in ML-036 Well

### 3 Result and Discussion

After reverse coning device is installed together with production string and Electric Submersible Pump (ESP) as its artificial lift, production monitoring becomes the next step to evaluate the method



performance. Water cut is monitored, as long as gross and net oil production, until conclusive result is obtained. Due to production potential of ML-036, optimization is applied in ML-036 to get higher gross production after getting stable and conclusive water cut. Initial pump in ML-036, which is IND-440 type, is optimized using higher capacity pump, IND-1300, as seen in Table 2.

**Table 2.** ML-036 Production Profile After Reverse Coning Application

|                        | <b>Before RC Application</b> | <b>After RC Application</b> | <b>After RC Application and Arlift Optimization</b> |
|------------------------|------------------------------|-----------------------------|---|
| Artificial Lift (Pump) | ESP IND-440                  | ESP IND-440                 | ESP IND-1300  |
| Gross production, bwpd | 431                          | 508                         | 1236  |
| Net production, bwpd   | 5                            | 8                           | 12  |
| Water Cut, %           | 99                           | 98.5                        | 99  |

As seen in Table 2, water cut in ML-036 decreases after Reverse Coning device installation from 99% to 98.5%. It increases net oil production from 5 bopd to 8 bopd. After optimization of artificial lift is applied from ESP IND-440 to ESP IND-1300, gross production is increased followed by net oil production from 8 bopd to 12 bopd currently. Unfortunately, optimization program increases water cut to initial condition becomes 99%.

#### 4 Conclusion

Reverse Coning is a method that is used to reduce water cut in production well. Application of reverse coning method in ML-036 well success to reduce water cut from 99% initially to 98.5%. It increases net oil production from 5 bopd to 8 bopd. Reverse coning is applicable in oil well with high water cut.

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