

Optimizing Artificial Lift Design using Mobile Application – PEARL Volume 3.0 As A Breakthrough Solution In Digitalization Era (Study Case PDN-281) at Limau Field, Pertamina Hulu Rokan, South Sumatra, Indonesia

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Abstract. As a Petroleum Engineer, we have responsibility to maintain well production performance. Designing the proper artificial lift which is suitable with well characteristic and influx performance is one of the ways. PDN-281 is one of oil production well at Limau Field using ESP. By the time, this well need well service treatment and change pump capacity. Existing available tools for designing artificial lifts have some limitations such as the access flexibility, software with license only can be accessed on office computer, and also long & complex steps for designing. Other than that, during 2020 – 2021, Indonesian Government has Work From Home Regulation which make the access to design and evaluate artificial lift is limited. By this condition, we realize that there is room for improvements in tools for designing and evaluating artificial lift. PEARL Volume 3.0 becomes a breakthrough innovation in Artificial Lift Design because we bring manual design at computer to mobile application which can be installed in the mobile phone. Other than that, this improvement is sustainable development from previous application; PEARL Volume 1.0; which is now equipped with Electric Submersible Pump & Gas Lift Design. So we can do the artificial lift design everywhere and every time. This application is built based on international standards and literatures. For designing ESP the calculation standards are referred to API RP 11S4, Kermit E. Brown – The technology of Artificial Lift Methods Volume 2b, Gabor Takacs – Electric Submersible Pump Manual Designs, Operations, and Maintenance. While for designing Gas Lift is referred to API RP V6, Kermit E. Brown – The technology of Artificial Lift Methods Volume 2A, Gabor Takacs – Gas Lift Manual. All the design steps are plotted in the Excel and then translated into Android Language using Android Studio Application. Other than that, we also design for the interface in order to make PEARL Application is user friendly. By using the PEARL Application Volume 3.0, Petroleum Engineers have easiness to do the artificial lift design anywhere and anytime. We transform manual design on the computer to mobile application with very user friendly interface. This also support oil and gas industry to adapt in 4.0 industry era. With PEARL Application, the accurate calculation result and give easiness to the user to operate it anytime and anywhere so it eliminates the late coordination problem. By implementing the ESP Design from PEARL Volume 3.0 Application, PDN – 281 has longer lifetime production. PEARL Application is an original innovation technology from PT. PERTAMINA EP Limau Field and has been implemented massively in several fields under PT. PERTAMINA EP. This application technology is supported Production Engineering Job for designing artificial lift and knowing well potential.

Keyword(s): Electric Submersible Pump, Sucker Rod Pump, Gas Lift, Artificial Lift Design, Mobile Application, Production Optimization, PEARL Mobile Application

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1 Brief Background

1.1 Field Overview

Limau Field is one of active oilfield located in PT. Pertamina Hulu Rokan Zone 4, South Sumatra, Indonesia (Fig.1) which operates 11 structure oil produced with cumulative oil production 330.16 MMSTB, Oil Production 4530 BOPD, and Gas 10.37 MMSCFD. Currently, this field operates 103 active oil wells and 58 injection wells (status per 21 September 2022). Among the active oil and gas production wells, the population of natural flow wells are 9 wells and the rest wells are installed artificial lift. The details of the population of artificial lift such as ESP (Electric Submersible Pump): 52 wells, SRP (Sucker Rod Pump): 54 wells, GLV (Gas Lift Valve): 6 wells, HPU (Hydraulic Pumping Unit): 5 wells.

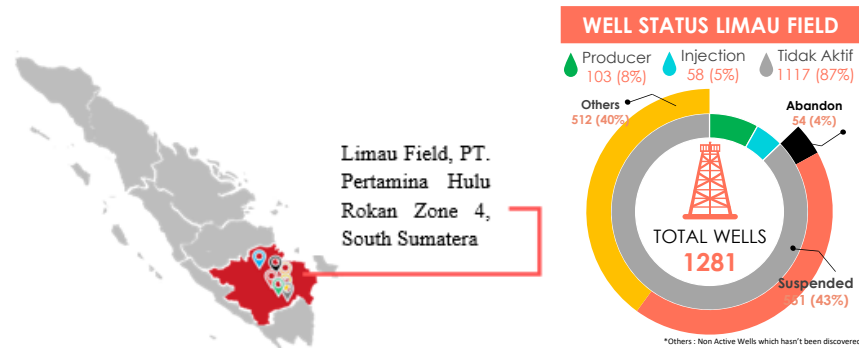


Figure 1. The Location of Limau Field

1.2 Problem Identification

PDN-281 well is one of active oil well which has installed SRP as its artificial lift. This well is directional well (Fig.2).

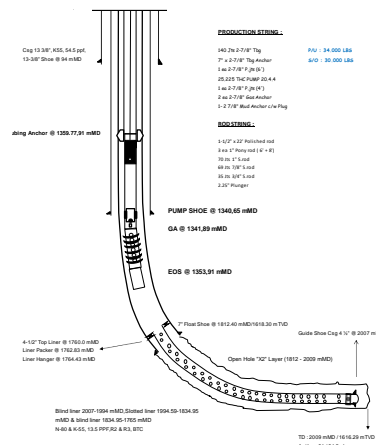


Figure 2 – PDN-281 Well Diagram

It has been produced since February 2014. During the first semester of 2020 (Jan – Jul 2022), this well has done remedial well service program cause of artificial lift problem which is the loose of the rod. This can be happened because the rod have overload stress and the unsuitable of well configuration. While the well fluid column or submergence is getting bigger (Fig.3).



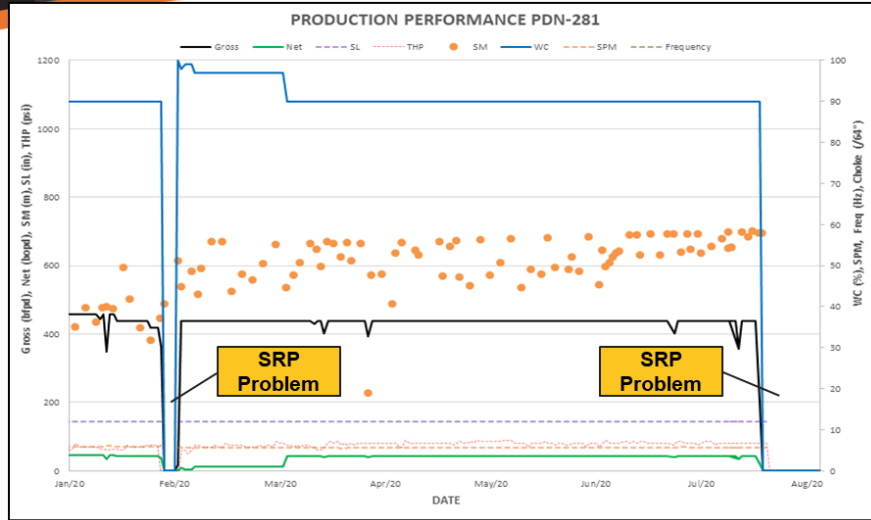


Figure 3. PDN-281 Well Performance (Jan – Jul 2020)

Other than that, we also analyze PDN-281 well production performance using quadrant mapping. This tool is one of quick look tools to analyze the well fluid column and pump performance efficiency with details as follow (Fig. 4):

1. Quadrant 1 : High Submergence, Low Pump Efficiency (Artificial Lift Problem)
2. Quadrant 2 : High Submergence, High Pump Efficiency (Maximum Pump/Production Facilities)
3. Quadrant 3 : Low Submergence, Low Pump Efficiency (Reservoir Problem)
4. Quadrant 4 : Low Submergence, High Pump Efficiency (Optimum)

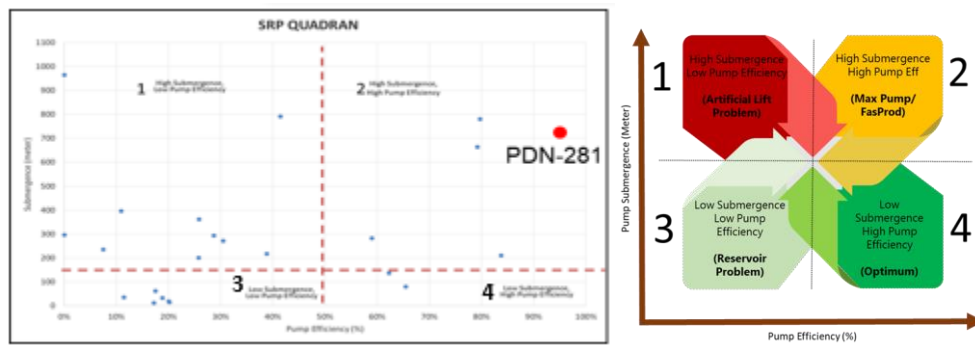


Figure 4 – Quadrant Mapping Analysis

As we can see on the quadrant mapping analysis, PDN-281 well is categorized in Quadrant 2 which has High Submergence and High Pump Efficiency. This is an opportunity to optimize the well production. As a Petroleum Engineer, we have responsibility to design proper artificial lift which will be installed in the well. PDN-281 well will be converted its artificial lift from SRP to ESP. Existing available tools for designing artificial lifts have some limitations such as the access flexibility, software with license only can be accessed on office computer, and also long & complex steps for designing. Other than that, during 2020 – 2021, Indonesian Government has Work From Home Regulation which make the access to design and evaluate artificial lift is limited.





2 Methodology

By this condition, we realize that there is room for improvements in tools for designing and evaluating artificial lift. PEARL Volume 3.0 becomes a breakthrough innovation in Artificial Lift Design because we bring manual design at computer to mobile application which can be installed in the mobile phone. Other than that, this improvement is sustainable development from previous application; PEARL Volume 1.0; which is now equipped with Electric Submersible Pump & Gas Lift Design. This application is built based on international standards and literatures. For designing ESP the calculation standards are referred to API RP 11S4, Kermit E. Brown – The technology of Artificial Lift Methods Volume 2b, Gabor Takacs – Electric Submersible Pump Manual Designs, Operations, and Maintenance. While for designing Gas Lift is referred to API RP V6, Kermit E. Brown – The technology of Artificial Lift Methods Volume 2A, Gabor Takacs – Gas Lift Manual. All the design steps are plotted in the Excel and then translated into Android Language using Android Studio Application. Other than that, we also design for the interface in order to make PEARL Application is user friendly. (Fig.5)

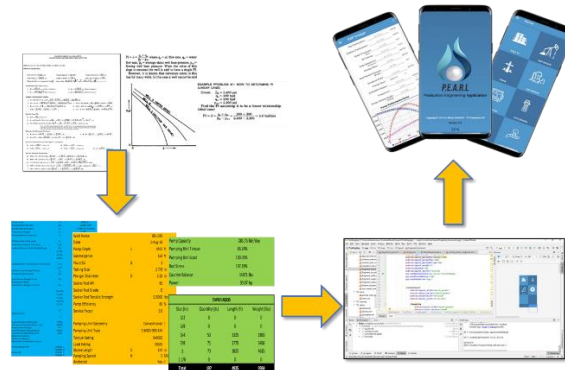


Figure 5 – PEARL Application Build

3 Result & Discussion

PEARL Application can be used in android based mobile phone and the features are IPR.(Inflow Performance Relationship) based on Well PI (Productivity Index), IPR Based on Swab, IPR Based on Sonolog, SRP Design, ESP Design, HPU Design, Gas Lift Design. PEARL Application is also equipped with interpolation, save data, and unit conversion features (Fig.6).



Figure 6 – PEARL Application Features

This application is offline and standalone so there is no connection with office data center and the data is secured in each mobile phone. By using the PEARL Application Volume 3.0, Petroleum Engineers have easiness to do the artificial lift design anywhere and anytime. We transform manual design on the computer to mobile application with very user friendly interface. This also support oil and gas industry to adapt in 4.0 industry era. With PEARL Application, the accurate calculation result and give easiness to the user to operate it anytime and anywhere so it eliminates the late coordination problem. To design proper and good ESP which will be installed in PDN-281, we use PEARL Application and the result is seen on Figure 7.

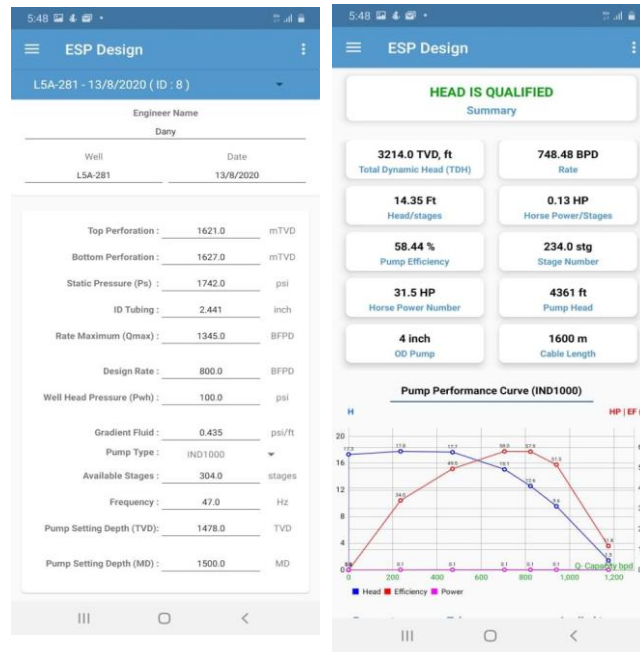


Figure 7 – PDN-281 ESP Design with Pearl Application

By implementing the ESP Design from PEARL Volume 3.0 Application, PDN – 281 has longer lifetime production, gain 177 BOPD, and optimum well condition based on quadrant mapping analysis. The production performance of PDN-281 is shown on the Figure 8 and Figure 9.

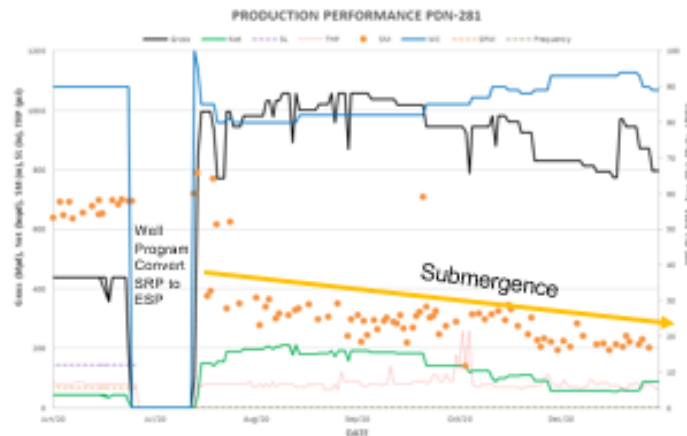


Figure 8 – PDN-281 Production Performance After Implemented ESP Design by PEARL Application



Figure 9 – The Comparison of PDN-281 Production Performance Before and After Convert Artificial Lift

4 Summary & Conclusion

1. PDN-281 is one of active oil production well since February 2014 which is produced using SRP. While PDN-281 production is using SRP, there are 4 times well services per year, because the SRP cannot perform optimally.
2. Since August 2020, PDN-281's lifting is converted to Electrical Submersible Pump (ESP). There are several obstacles in changing the pump such as existing ESP design in Microsoft excel has limited time and access because we only can operate it using computer at office and make the coordination disturbed. The manual calculation also has several complex step so it probably causes miscalculation.
3. PEARL's ESP Design result can extend PDN-281 production lifetime from ± 3 month become more than 12 months and increase oil production from 44 BOPD to 211 BOPD.
4. PEARL Application gives easiness to the user to do analysis and calculation anywhere and anytime so it becomes the solution to increase coordination efficiency with another related departments. This technology is too applicable and helpful during this work from home regulation, so we can do the design very easy.
5. PEARL Application invention is built referred to international standard and engineering practice brings PT. Pertamina EP to the 4.0 industry era which can be the answer to change manual calculation and using computer to mobile application. Every user that has experienced with PEARL 4.0 give positive feedback about the easiness and user friendly application. Further improvement, can develop the application with another features.

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