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OPTIMIZATION CALCULATION OF ELECTRICAL SUBMERSIBLE PUMP IN MAA-72 WELL IN X FIELD PT Y

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Abstract

Sumur MAA-72 mengalami penurunan laju produksi, Pompa IND1300 42 hz/ ROR pompa sebesar 960-1640 bfpd. Tujuan Penelitian ini adalah untuk mengoptimalkan produksi Sumurnya. Produksi sumur sebesar Qgross 599,97 bfpd. Data yang di perlukan diperoleh yaitu general report electrical submerible pump, data reservoir, data properties fluid, data produksi dan data wellprofile, data diperoleh langsung dari computer di lapangan. Dalam pengolahan data metode dilakukan yaitu penentuan analisa potensi sumur, evaluasi pompa terpasang, dan optimasi pada sumur dengan pompa baru. Didapatkan hasil optimum 1498,55 bfpd, Gf 0,435 Psi/ft, evaluasi pompa IND1300 yaitu PIP 170,37 Psi, TDH 1782,27 ft, PSD 1969,42 ft, jumlah stage 200 stage, EP 49% dan Hp 33,5. Dilakukan optimasi dengan pergantian pompa. Pemilihan pompa baru DN1800/60 Hz/ ROR 1200-2400 bfpd, head/stage 22 ft, Hp 0,34 EP 70%. Penentuan pompa baru PSD 2022,94 ft, PIP 43,5 Psi, TDH 2212,32 ft, jumlah stage 22 stage. Hasil Penelitian yang didapat adalah Kenaikan laju produksi Qact (599,97 bfpd) menjadi (1498,55 bfpd) dengan kenaikan rate sebesar 898,58 bfpd.

Kata Kunci : *Produksi, pompa, Optimasi.*

Abstrak

MAA-72 well experienced a decrease in production rate, Pump IND1300 42 hz / pump ROR of 960-1640 bfpd. The research purpose is optimation of well. Well production is Qgross 599.97 bfpd. The required data obtained are general report electrical submersible pump, reservoir data, fluid properties data, production data and wellprofile data, data obtained directly from the computer in the field. In data processing, the method is to determine the potential analysis of the well, evaluate the installed pump, and optimize the well with a new pump. Optimum results of 1498.55 bfpd, Gf 0.435 Psi/ft,

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IND1300 pump evaluation, namely PIP 170.37 Psi, TDH 1782.27 ft, PSD 1969.42 ft, number of stages 200 stages, EP 49% and Hp 33.5. Optimization was carried out by replacing the pump. New pump selection DN1800/60 Hz / ROR 1200-2400 bfpd, head/stage 22 ft, Hp 0.34 EP 70%. Determination of new pump PSD 2022.94 ft, PIP 43.5 Psi, TDH 2212.32 ft, number of stages 22 stages. Final research for Increase in Qact production rate (599.97 bfpd) to (1498.55 bfpd) with a rate increase of 898.58 bfpd.

Keywords : *produciton, Pump, Optimation*

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1. INTRODUCTION

There are two ways to lift fluid from the well to the surface, namely the natural flow method and the artificial lift method. If an oil well has experienced a decrease in production from reservoir pressure, then to produce oil from the well to the surface requires an artificial lifting method. One of them is that by using an electrical submersible pump, the pump will be adjusted to the specifications of the well and also the type of liquid to be lifted, therefore the design of the electrical submersible pump is needed pump the right pump, so that the operation gets efficient and optimal results and does not get troubleshooting.

Fundamental Theory

Screening Criteria pada artificial lift

Damage to this formation can occur as a result of drilling operations (induced damage) or production processes (natural damage) which cause the permeability of the rock to be small compared to the natural permeability before the damage to the formation such as skin and scale, the reduction of the permeability of this formation rock will result in the inhibition of the flow of fluid from the formation to the well hole so that in the end it will cause a decrease in the productivity of a well.

Sucker rod pump Rod lift is the ideal artificial lift method for most wells, and data collection generally focuses primarily on dynamic data for system monitoring. Understanding the changes occurring downhole, and optimizing the bottomhole design to accommodate those changes, is largely driven by the experience of the operator team rather than by system-specific data.[5]

Hydraulic pumping unit The direct-connected hydraulic pumping unit without pulley, developed based on the characteristics of Jilin oilfield, can be applied to produce difficult-to-produce reserves cost-effectively, and to increase low-fluid production and reduce high energy consumption in developed oilfields.[14]

Progressive cavity pump PCP is a type of positive displacement pump composed of Rotor and stator with different number of stages. The rotor moves inside the stator moving fluid

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from bottom to top. In this system, power is transmitted by the surface motor to the pump through a rod system that enters the pipe.[4]

Gas lift is defined as the process of lifting fluid from within a well by injecting a high amount of gas into the wellbore so that crude oil can be lifted to the surface. The limited amount of gas injected into each oil well makes the volume of injected gas a problem limitation. [10]. Gas lift is part of tubing straddles. This technology is very attractive especially in areas where the cost of repairing the rig is high, for example in offshore, remote, or polar regions.[11]

Definition of Electric Submersible Pump

It is a pump inserted into a well hole that is used to produce oil by artificial lift and driven by an electric motor. This pump is made on the basis of the principle of a multi-stage centrifugal pump where the entire pump and motor are submerged in liquid. In addition to production wells, ESP can also be used for water flooding and pressure maintenance projects, where ESP is installed on injection wells. In addition, it can also be used on wells that do not use tubing (tubingless completion) and production is carried out through casing.[6]

Electric Submersible Pump is one of the artificial lifting methods, consisting of a subsurface centrifugal pump with a multi-stage (impeller) driven by an electric motor, and the motor pump assembly is inserted into the well. This tool was first discovered in 1928 in Bartlesville, Oklahoma, United States. This ESP pump is capable of lifting fluids from 600 BPD to 200,000 BPD with a depth of up to 15,000 ft.[1]. To find out the optimal production rate of this well, we use the empirical equation from Vogel (1980) which states that the optimal rate is 80% of the optimal production rate of the well.[9]

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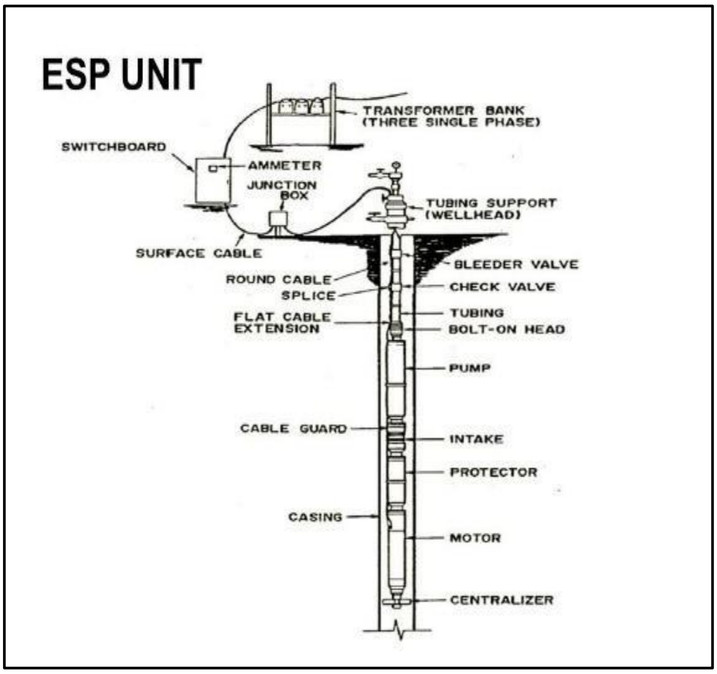

Figure 1. ESP System Components [3]

Formation Productivity

Many well problems occur after production and this will affect the performance of the ESP. To find out the problems with ESP can be detected by using an ampchart. The problems that occur can be caused by:

a. Electrical problems

b. Problems with the mechanic

c. Problems from its own reservoir.

Fractures occur in areas that experience changes in the shaft diameter (radius), because the radius area is an area that has a high stress concentration.[17] Chemical methods to extend the service life of ESPs require evaluation of physical and chemical production challenges to develop better chemical treatment strategies to mitigate corrosion and scale-related failures [2]

Some of the problems caused by electrical problems are:

1. Overload
2. Unsderload
3. Stall
4. Gas Lock [13]

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Acidizing

Reservoir systems, ESP wells, and surface facilities are assumed to be operating properly and do not take into account factors that could interfere with such operations. However, the following will be the things that can cause the ESP operating time span to be shorter than it should be. These things include:

a) Improper ESP design.
b) Poor quality in the ESP equipment used.
c) Corrosion on pump equipment and motor housing.
d) Scale deposition on motors and stage pumps.
e) Desert.
f) Reservoir temperature that is too high.
g) Gas enters the pump.[18]

2. RESEARCH METHOD

Data based on handbooks, papers, journals, and the results of interviews with workers at the final project site, are written in the preparation of this final project report

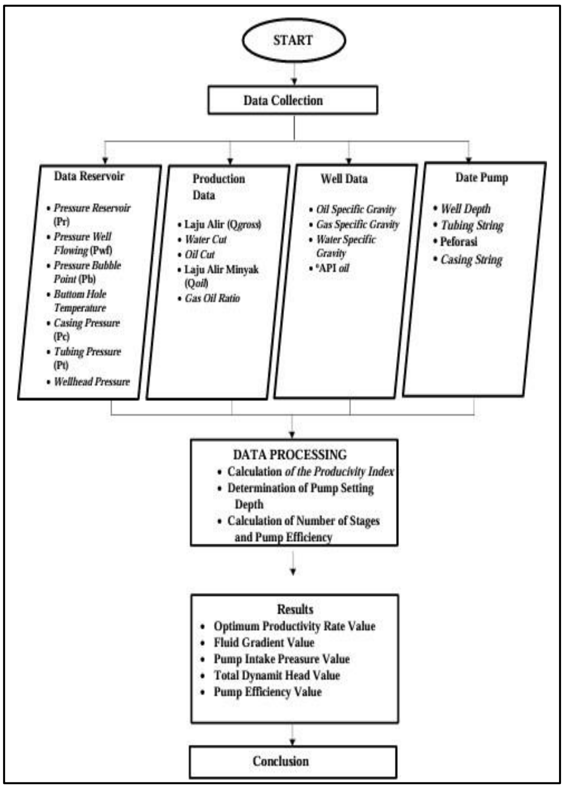

Figure 2. Flowchart

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3. RESULTS AND DISCUSSION

In this chapter, the researcher presents the data from the research conducted. The research instruments in this study consisted of pre-test and post-test. Hypothesis testing with SPSS 25 includes mean scores, and significant t-tests. The kind of test was multiple choice and essay. The total number of questions in each test was 15, which consists of 10 multiple choice and 5 essays. For the assessment, each correct answer was awarded one point in multiple choice questions, while the essay test was worth five points. The result of the test can be seen as follows:

MAA-72 Well Data

Tabel 1 well data MAA-72

Data *Reservoir*	Sumur MAA-72
Pressure reservoir (Pr)	367,17 *psi*
Pressure well flowing (Pwf)	295,64 *psi*
Casing Pressure (Pc)	0 *psi*
Well head pressure	85,2 *psi*
Perforasi	2673 *ft*

Tabel 3 well data

Data Produksi	Sumur MAA -72
Laju Alir (Q*gross*)	599,97 BFPD
Water Cut	96,9 %
Laju Alir Minyak (Q*oil*)	18,5 BOPD
Laju Alir Air (Qw)	581 BWPD

Data Properties Fluida	Sumur MAA-72
Oil specific gravity	0,856

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Gas specific gravity	0
Water specific gravity	1,01
°API oil	33,76
Initial reservoir temperature	60 °*F*

Tabel 4 well data

Data Sumur	Sumur MAA-72
TVD	2788 *ft*
ID Casing	5,921 *Inch*
OD Casing	6,625 *Inch*
ID Tubing	2,441 *Inch*
OD Tubing	2,875 *Inch*
Mid Perforasi	2257,22 *ft*

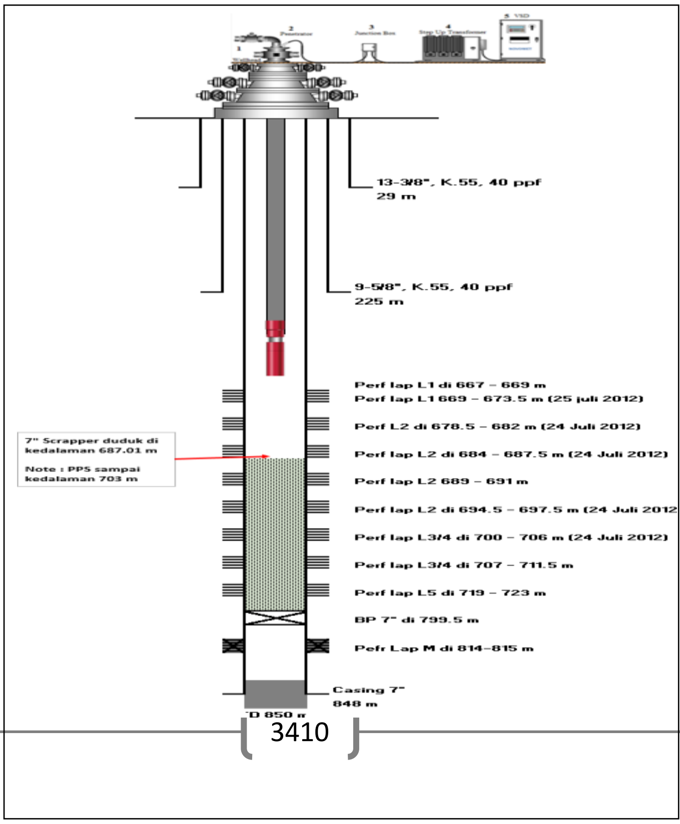

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Figure 3. *Well Profile* sumur MAA-72

Tabel 5 Pump Installed

Data Sumur	Sumur MAA -72
PSD	1969 *ft*
Frequency	42 *Hz*
ROR	960-1640 BPD
TDH	1782 *ft*
Jumlah Stages	200 *stages*
DFL	1578 *ft*

IPR Curve

a. Calculating *Produktivity Index*

$$PI = \frac{Q\ gross}{(\mathrm{Pr} - Pwf)}$$

$$PI = \frac{599{,}97}{(367{,}17 - 295{,}64)}$$

$$= 8{,}38 BPD/PSI$$

Q optimum = 80% x *Qmax*

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= 80% x 1873,19 BFPD

Q optimum = 1498,55 BFPD

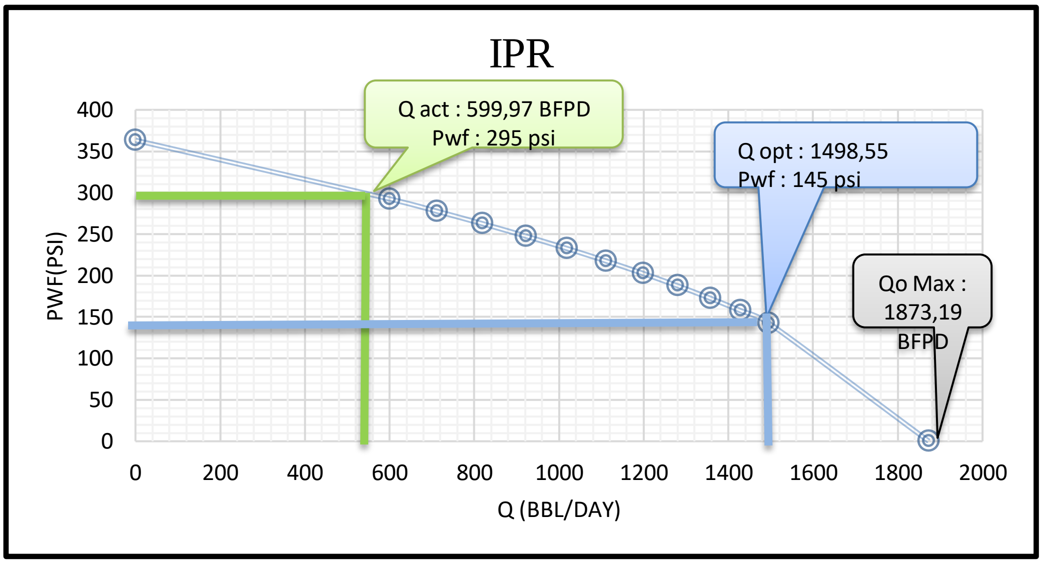

Figure 4. Kurva IPR Pwf and Q

Tabel 6 Flowrate Optimum

Sumur	Qaktual, bfpd	Qmax, bfpd	% Qopt	Qopt,bfpd	Pwf,Psi
MAA -72	599,97	1873,19	80	1498,55	145

Recalculation of Well MAA-72

1. Calculating the fluid gradient
   a. *Spesific Gravity Fluida = (1-wc x Sgo) + (Wc x Sgw)*
   = (1- 0,96 x 0,862) + (0,96 x 0,97)

   = 1,005 *psi/ft*

b. *Gradient Fluida* = 0,433 × *Sfesific Gravity Fluida*
= 0,433 x 1,004

= 0,43 *Psi/ft*

2. Calculation pump intake pressure (PIP)

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a. Different in depth = (MID *perfo* – PSD)
= (2257,2 – 1969,4)

= 287,8 *ft*

b. Gradient fluid = (Perbedaan Kedalaman *x Gf*)
= (287,8 x 0,43)

=123,75 *Psi*

c. PIP = (Pwf – pressure difference)
= (295,64 – 123,75)

= 170,37 *Psi*

2. Penentuan *Total dynamic Head* (TDH)

a. *Fluid Over Pump* = (PIP ÷ *Gf*)
= (170,37 ÷ 0,43)

= 391,41 *ft*

b. *Vertical Lift* (HD) = (PSD – FOP)
= (1969,42 – 391,41)

= 1578,00 *ft*

c. *Friction Loss* (HF) $= \frac{2{,}083\ x(\frac{100}{c})^{1{,}85}\ x\ (\frac{Qt}{34{,}3})^{1{,}85}}{ID\ Tubing^{4{,}68}}$

$$= \frac{2{,}083\ x(\frac{100}{85.2})^{1{,}85}\ x\ (\frac{599}{34{,}3})^{1{,}85}}{2{,}441^{4{,}68}}$$

= 8.52 *ft*

d. *Tubing Friction Loss* $= \frac{Friction\ Loss}{1000}\ x\ PSD$
$= \frac{8{,}52}{1000}\ x\ 1969{,}42$

= 16,78 *ft*

e. *Tubing Head* (HT) $= \frac{Pwh}{Gf} = \frac{85{,}2}{0{,}430}$ = 195,73 *ft*

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f. Total *Dynamic Head* = HD + HF + HT
= 1578 + 8,52 + 195,73

= 1782,27 *ft*

g. Penentuan *Head Per Stage* $= \frac{TDH}{Stage} = \frac{1782{,}27}{200} = 8{,}92\ ft$

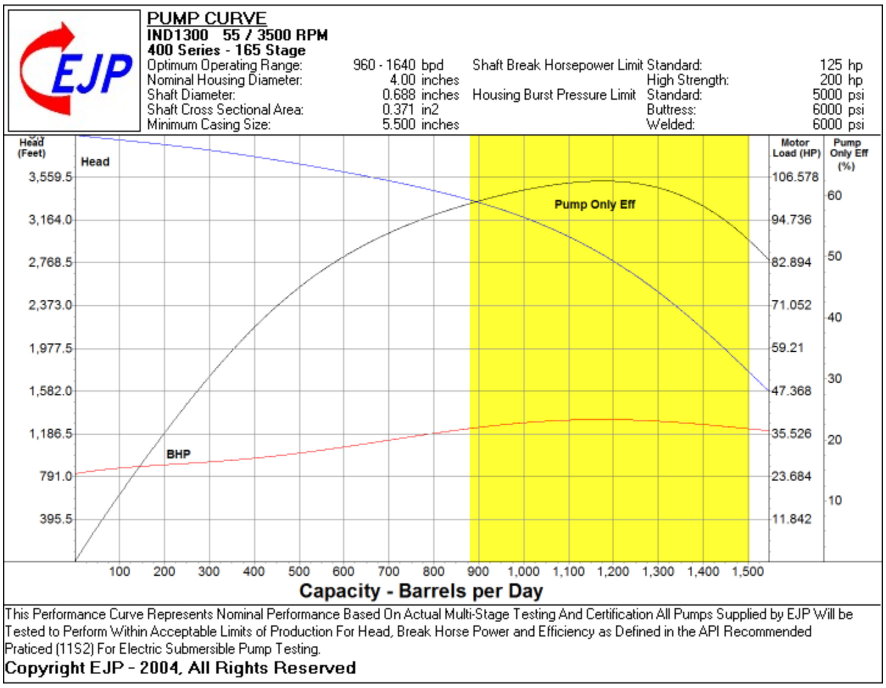

Figure 5. *Pump Performance Catalog*

Pump Optimization

Determination of Optimum pump setting depth

a. Penentuan DFL $= Mid\ Perfo - (\frac{Pwf}{Gf})$
$= 2257{,}22 - (\frac{145{,}5}{0{,}435})$

= 1922,94 *ft*

b. Penentuan PSD Optimum = DFL + 100

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= 1922,94 + 100

= 2022,94 *ft*

Pump Intake Preassure = Pwf – (*Mid Perfo* – PSD Opt) x GF

= 145 – (2257,22 – 2022,94) x 0,435

= 43,52 *psi*

Determination Total *Dynamic Head*

a. *Fluid Over Pump* (FOP) = (PIP ÷ Gf)
= (43,0 ÷ 0,43)

= 100 *ft*

b. *Vertical Lift* (HD) = (PSD – FOP)
= (2022,94 – 100)

= 1922,94 *ft*

c. *Friction Loss* $= 2{,}083\, x (\frac{100}{c})^{1{,}85}\, x\, (\frac{\frac{Qt^{1{,}85}}{34{,}3}}{ID\ Tubing^{\ 4{,}86}})$

$= 2{,}083\, x (\frac{100}{85.2})^{1{,}85}\, x\, (\frac{\frac{1498{,}55^{1{,}85}}{34{,}3}}{2{,}441^{\ 4{,}86}})$

= 39,47 *ft*

d. *Tubing Frection Loss* (HF) $= \frac{(\ Friction\ Loss\ x\ PSD)}{1000}$

$= \frac{(\ 39{,}47 x\ 2022{,}94)}{1000}$

$= 79{,}86 ft$

e. *Tubing Head* (HT) $= \frac{Friction\ Loss\ x\ 2{,}31}{Sgf} = \frac{39{,}47\ x\ 2{,}31}{0{,}435} =$ 209,51 *ft*

f. Total *Dynamic Head* = Hd + Hf + Ht
= 1922,94 + 79 + 209,51

= 2212,32 *ft*

determination Stage

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a. *Head Capacity* = 22

b. Jumlah *Stage* $= \left(\frac{TDH}{Head\ capacity}\right) + 10 = \left(\frac{2212{,}32}{22}\right) + 10 = 110{,}56$

c. BHP = Hp x Jumlah *Stage x Sgf*

= 0,34 x 110,56 x 1

= 37,36 *stage*

4. CONCLUSION

It was found that the installed IND 1300/42Hz pump was no longer optimal, as it was not compatible with the actual flow rate of 599.97 BFPD in the "MAA-72" well. The installed pump, with a capacity of 960–1640 BFPD, operated at a suboptimal rate. If this pump continues to be used, it will result in downthrust.

Based on the results of the re-design of the electric submersible pump, an optimum flow rate (Qoptimum) of 1498.55 BFPD was obtained, with a pump setting depth (PSD) of 2022.94 ft. Meanwhile, the total dynamic head (TDH) required for optimal pump operation is 2212.32 ft. The selection of pump type was based on the recommended operating range (ROR), and the suitable pump that falls within the ROR of the Qoptimum for the "MAA-72" well is the REDA DN1800 pump, with an ROR of 1,200–2,400 BFPD, resulting in a flow rate increase of 898.58 BFPD. The installed pump is an EJP IND1300/42Hz with 200 stages and an efficiency of 49%, while the optimized pump, REDA DN1800/60Hz, has only 110 stages and a pump efficiency of 70%

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