Production Optimization for Natural Flow and ESP Well
A Case Study on Well NS-5 Mishrif Formation-Nasriya Oil Field

Hamzah Amer Abdulameer, Dr. Sameera Hamd-Allah.
University of Baghdad / College of Engineering / Petroleum Engineering Department
Corresponding Author Email: hamzawyofoil93@gmail.com

1- Abstract:

As the reservoir conditions are in continuous changing during its life, well production rate and its performance will change and it needs to re-model according to the current situations and to keep the production rate as high as possible.

Well productivity is affected by changing in reservoir pressure, water cut, tubing size and wellhead pressure. For electrical submersible pump (ESP), it will also affected by number of stages and operating frequency.

In general, the production rate increases when reservoir pressure increases and/or water cut decreases. Also the flow rate increase when tubing size increases and/or wellhead pressure decreases. For ESP well, production rate increases when number of stages is increased and/or pump frequency is increased.

In this study, a nodal analysis software was used to design one well with natural flow and other with ESP. Reservoir, fluid and well information are taken from actual data of Mishrif formation-Nasriya oil field/ NS-5 well. Well design steps and data required in the model will be displayed and the optimization sensitivity keys will be applied on the model to determine the effect of each individual parameter or when it combined with another one.
النتاج الأمثل لبئر ينتج بالجريان الطبيعي و بواسطة المضخة الغاطسة
دراسة على بئر NS-5

الخلاصة:

ان طروح الممكن تتغير باستمرار خلال فترة الانتاج لذلك فان انتاجية الآبار تتغير باستمرار لهذه الظروف. بسبب ما سبق فان الابار تحتاج إلى اعادة تصميم من ناحية الامكاني او تغير طروح التشغيل للحصول على اعلى انتاج ممكن في الظروف الحالية.

ان انتاجية الآبار تتأثر بشكل أساسي بضغط الممكن و نسبة الماء الى النفط و حجم ينبب الانتاج و ضغط راس البئر. أما الآبار التي تعمل بواسطة المضخات الغاطسة فإنها تتأثر أيضا بعدد مراحل الضخة و سرعة الدوران. بصورة عامة، فان معدل الانتاج يزداد بازيادة ضغط الممكن و نقصان كمية الماء الى النفط. كما ان انتاجية تزداد أيضا بزيادة قطر ينبب الانتاج و نقصان ضغط راس البئر. اما بالنسبة للمضخات الغاطسة، فان معدل الانتاج يزداد بازيادة مراحل الضخة و سرعة دورانها.

في هذه الدراسة، سيتم تصميم برين احدهم ينتج بالدفع طبيعي و الآخر بواسطة المضخة الغاطسة. ثم استخدام بيانات حقيقية في عملية تصميم بالاعتماد على بئر NS-5 الذي ينتج من ممكن المشرف في حقل الناصرية النفطي جنوب العراق. ان عملية التصميم و ايجاد الحالة الانتاجية للابار خلال تغير الظروف التشغيلية و المكنية سيتم توضيحها بالاعتماد على برنامج تحليل عقدي.

2- Introduction:

There are two parameters controlling the well performance which are inflow performance relationship (IPR) and Vertical Lift Performance (VLP). IPR is known as the relationship between well flowing bottom-hole pressure (Pwf) and production rate so it represent the flow from reservoir to inside wellbore.

There are many correlations and methods can be used to describe the reservoir performance. Each correlation has its own conditions to be applied according to reservoir and flow type. The most important methods which could be used for black oil reservoir are Vogle, Darcy and Fetkovich. In this work, the productivity index (PI) is already calculated from PLT data of well NS-5, therefore it can be used directly in nodal analysis.

The VLP depends on many parameters such as fluid PVT properties, tubing inside diameter, surface pressure, well depth, water cut and gas oil ratio. The total pressure loss from well bottom to surface is the magnitude of the three terms, gravity, friction and
acceleration. In oil well completion design, the gravity component should be comprised around 75% of the total pressure gradient [1].

Electrical Submersible Pump (ESP) components are key parameters in ESP design and any change in one or more of it will affect overall ESP performance. ESP components are; motor which is the system prime mover and electric motor with different type and size of ESP motors that give a different amount horsepower required. Gas separator, the presence of free gas in produced fluid decreases the ESP efficiency, so that a gas separator is used to remove the gas from produced fluid to the annulus. Pump, used to lift the fluid from down hole. To improve ESP capacity several pump stages could be used. Power Cable: used to supply the electric power to the motor down hole [2].

The objectives of well modeling & analysis are as follows [3]:
1. To calculate the optimum flow rate at which the well will flow with a known wellbore conditions and completion.
2. To evaluate the well and when it might be ceased to produce. This could be due to time when the reservoir pressure depletes.
3. To determine the best economical time to install artificial lift and helping in chosen the suitable artificial lift plan according to well conditions.
4. To evaluate well conditions and completion system in order to planning for the best and economically method which improving flow rate.
5. To evaluate each part in the well completion to determine if there is any restriction to flow unnecessarily.

3- Well Modeling and Optimization Sensitivities (Natural Flow) for well (NS-5):

3.1- IPR Generation:

The inflow performance relationship is modeled based on production log data for this well. The PLT data for well NS-5 are listed in Table (1) [4].
Table (1) PLT data of well NS-5

| Parameter                      | Value          |
|-------------------------------|----------------|
| Well name                     | NS-5           |
| Reservoir pressure psi        | 3365.9 psi     |
| Reservoir temperature °F      | 163.11 °F      |
| Productivity index STB/Day.psi| 7.4 STB/Day.psi|
| Well head pressure psi        | 975 psi        |
| Well head temperature °F      | 124 °F         |
| Flow rate STB/Day             | 2697.43 STB/Day|
| Gauge depth m                 | 2011.5 m       |
| Gauge pressure psi            | 3001.4 psi     |
| Gauge temperature °F          | 163.82 °F      |

the IPR results are generated using PLT as shown in Figure (1).

![Fig. (1) Inflow Performance Relationship for well NS-5](image)

3.2- **Matching Pressure Gradient:**

The actual measured data of PLT test is used to obtain the best fit vertical flow correlation which described the test rate, well head pressure, well head temperature and flowing bottom hole pressure. As shown in Figure (2), Hegedorn and Brown correlation
line was the closest one to the measured point from all used correlations, so that may use after making this correlation fully matches with measured point.

In spite of being Hegedron & Brown correlation didn’t distinguish between flow regime, but it gives the nearest calculated results to the measured results also the liquid hold up starts to decrease at a value very close to bubble point which indicate gas liberation and changing in flow regime from one phase liquid to two phase bubble, so it will be used to describe the well lifting performance.

Hagedron & Brown correlation is considered as most widely applied of oil wells as VLP correlation. It works well for bubble flow regime and slug flow regime in many applications. It could be used in wells for slug flow at moderate to high production rates also it use pipe roughness to describe two phase friction factor [5].

Ansari et al (1994a & 1994b) prepared eight different two-phase flow correlations and its relative errors, the smaller the relative performance factor, the more accurate correlation. According to Ansari’s result, Hegdorn and Brown was found best correlation for current case [6].

Fig. (2) Matching VLP Correlations with PLT

To fully match Hagedorn & Brown correlation with the test point, it should be multiply be parameter 1 & 2 which will be define later. Table (2) shows that Hagedorn & Brown
correlation had the minimum standard deviation value after multiplying by parameter 1 & 2 which is zero while other correlation still have some deviation values.

Parameter 1: is the multiplier for the gravity term in the pressure drop correlation. Parameter 2: is the multiplier for the friction term.

Table (2) Correlations fitting Parameters & Standard Deviation

| Correlation          | Parameter 1 value | Parameter 2 value | Standard Deviation |
|----------------------|-------------------|-------------------|--------------------|
| Duns & Ros Modified  | 0.94657           | 0.35876           | 0.00024414         |
| Hagedorn Brown       | 0.96438           | 0.57842           | 0.00048828         |
| Petroleum Experts    | 0.95892           | 0.54137           | 0.00024414         |
| Petroleum Experts 2  | 0.95768           | 0.53745           | 0.00024414         |

3.3- Matching VLP/IPR with Measured Data:

Match VLP correlation and IPR with test point to obtain the difference in liquid rate and bottom hole pressure for measured and calculated data as shown in the Figure (3) below:

Fig. (3) VLP/IPR Matching
### 3.4- Well design sensitivity:

The most important part of building a well physical model is to evaluate well performance under different reservoir and operation conditions such as: decline in reservoir pressure, increase in water cut, changing in well head pressure according to De-Gas Station circumstances and changing in production tubing size due to design requirements. The production sensitivities will be applied to the designed well to determine well state under different situations. Liquid flow rate and bottom hole pressure will be calculated as they are the main production parameters. Table (3) and Figure (4) show the effect of reservoir pressure decline and water cut increase on production rate (Assumed WHP= 975 psi which is the same wellhead pressure as PLT data).

| WC  | Pr= 3365.9 psi | BHP psi | Liquid Rate STB/D | Rate BHP psi | Pr= 3250 psi | BHP psi | Liquid Rate STB/D | Rate BHP psi | Pr= 3150 psi | BHP psi |
|-----|----------------|---------|-------------------|-------------|----------------|---------|-------------------|-------------|----------------|---------|
| 0   | 2633           | 3010    | 2009              | 2978.5      | 1394           | 2961.6  |
| 10  | 2151           | 3075    | 1454              | 3053        | NO Flow        |         |
| 20  | 1589           | 3151    | NO Flow           | NO Flow     |                |         |
| 30  | 852            | 3250    | NO Flow           | NO Flow     |                |         |
| 40  | NO Flow        |         | NO Flow           | NO Flow     |                |         |
| 50  | NO Flow        |         | NO Flow           | NO Flow     |                |         |
| 60  | NO Flow        |         | NO Flow           | NO Flow     |                |         |

| WC  | Pr= 3050 psi   | FBHP psi | Liquid Rate STB/D | Rate FBHP psi |
|-----|----------------|---------|-------------------|---------------|
| 0   | NO Flow        |         | NO Flow           |               |
| 10  | NO Flow        |         | NO Flow           |               |
| 20  | NO Flow        |         | NO Flow           |               |
| 30  | NO Flow        |         | NO Flow           |               |
| 40  | NO Flow        |         | NO Flow           |               |
| 50  | NO Flow        |         | NO Flow           |               |
| 60  | NO Flow        |         | NO Flow           |               |

| WC  | Pr= 2850 psi   | FBHP psi | Liquid Rate STB/D | Rate FBHP psi |
|-----|----------------|---------|-------------------|---------------|
| 0   | NO Flow        |         | NO Flow           |               |
| 10  | NO Flow        |         | NO Flow           |               |
| 20  | NO Flow        |         | NO Flow           |               |
| 30  | NO Flow        |         | NO Flow           |               |
| 40  | NO Flow        |         | NO Flow           |               |
| 50  | NO Flow        |         | NO Flow           |               |
| 60  | NO Flow        |         | NO Flow           |               |

| WC  | Pr= 2750 psi   | FBHP psi | Liquid Rate STB/D | Rate FBHP psi |
|-----|----------------|---------|-------------------|---------------|
| 0   | NO Flow        |         | NO Flow           |               |
| 10  | NO Flow        |         | NO Flow           |               |
| 20  | NO Flow        |         | NO Flow           |               |
| 30  | NO Flow        |         | NO Flow           |               |
| 40  | NO Flow        |         | NO Flow           |               |
| 50  | NO Flow        |         | NO Flow           |               |
| 60  | NO Flow        |         | NO Flow           |               |

Table (3) Well production results as reservoir pressure decreasing and WC increasing.
From Table (3) and Figure (4), it is clear that the liquid rate is decreasing when the reservoir pressure decline as the pressure drop between reservoir pressure and Pwf decreased. For example, the well was producing about 3633 STB/Day when reservoir pressure is 3366 psi (Δp=365 psi), then when the reservoir pressure decreased to 3150 psi (Δp=189 psi) the well was produce 1394 STB/Day. At the end, the well ceased if reservoir pressure decreasing less than 3050 psi. All above results for WHP=975 psi and zero water cut.

As shown in Table (3) and Figure (4) that the increasing in water cut can cause the reduction in the production rate. When reservoir pressure and WHP are 3366 psi and 975 psi respectively, the well produced 2633 STB/Day and 1589 STB/Day for WC equal to 0% and 20% respectively. The well was ceased when water cut equal and more than 40%.

Table (4) and Figure (5) show the effect of changing the WHP and TBG size on the production rate at Reservoir pressure= 3365.9 psi and WC= 0%.
Table (4) Well production results as WHP and TBG size changed.

| WHP= 300 | WHP= 600 | WHP= 975 |
|----------|----------|----------|
| **TBG ID in** | **Liquid Rate STB/D** | **Rate FBHP psi** | **Liquid Rate STB/D** | **Rate FBHP psi** | **Liquid Rate STB/D** | **Rate FBHP psi** |
| 2.44 | 6226 | 2524 | 4851 | 2710 | 2633 | 3010 |
| 2.99 | 8383 | 2233 | 6279 | 2517 | 3015 | 2958 |
| 3.83 | 10713 | 1899 | 7499 | 2352 | 3204 | 2932 |

Fig. (5) VLP/IPR relationship for different WHP and Tubing size.

As shown in Table (4) and Figure (5), the production rate decreased when wellhead pressure increases and this is due to more WHP, leading to more Pwf and less pressure drop cross the reservoir causes low production rate. The well produced 2633 STB/Day when WHP equal to 975 psi then the production rate increased to 6226 STB/Day when WHP decreased to 300 psi for same tubing size (ID=2.44 inch).

From Table (4) and Figure (5), the production rate increased when tubing inside diameter increase, and this is due to reduction in fraction term lead to less pressure loss. For 2.44
inch ID, the well produced 2633 STB/Day, while the production rate increased to 3204 STB/Day when tubing ID increased to 3.83 inch for the same wellhead pressure.

4- **ESP Well Design and performance sensitivity:**

The electrical submersible pump is considered one of the most important artificial lift methods used in the oil industry because it requires very little surface space, can be installed in vertical or highly deviated wells either onshore or offshore. Also, it can be used in casing size (4.5 inch) and larger. ESP can be used in wells up to +13,000 ft in depth and it can handle fluid rates up to 60,000 BPD depending on its size, design, and operation conditions. If the ESP is not operated at recommended operation parameters, the ESP efficiency will decrease and it may get failure [7]. Figure (6) shows the common ESP components.

![Fig. (6) Schematic plot of ESP component [8].](image)
4.3- ESP Design Parameters:

The main parameters were used in ESP design are:

1- **Pump depth:** this depth is the depth at which the pump of ESP set and it is represent the depth of intake pressure. Pump depth should be above the perforation interval and far enough from ESP erosion factors such as sand production and also should be below the depth at which the bubble point pressure is reached.

2- **Design rate:** is the rate need to be attained when installing ESP. In this study, the minimum rate of natural flowing well was 2600 BPD @ 2.875” TBG size, 0% WC, 975 psi WHP and 3365 psi reservoir pressure while The maximum rate was 10700 BPD @ 4.5” TBG size, 0% WC, 300 psi WHP and 3365 psi reservoir pressure as presented in Table (4). So that the design rate will be consider as the midpoint between minimum and maximum rate which is about 6000 BPD.

3- **Gas separator:** if free gas enters the pump, ESP efficiency can be decreased because gas separator is needed to take the free gas out from ESP pump and direct it to the annulus. The decision of putting gas separator depending on Dunbar plot which is a relationship between the intake pressure, gas liquid ratio and the intercept with gas separator efficiency curves. If the test point above the red line, then no need for gas separator as shown in Figure (7).

![Fig. (7) Gas Separator Sensitivity Plot](image-url)
The final ESP design parameters chosen to design the ESP are listed in Table (5).

**Table (5) ESP design parameters**

| Parameter              | Value      |
|------------------------|------------|
| WHP psi                | 975        |
| Reservoir pressure psi | 3365       |
| Reservoir Temp. °C     | 72.838     |
| GOR scf/stb            | 537        |
| WC %                   | 0          |
| Design rate BPD        | 6000       |
| Pump depth m           | 1902       |
| Design frequency Hz    | 60         |

ESP design Data/Result which is suitable and fit to operation requirements are shown in the following Table (6):

**Table (6) ESP Design Result**

| Parameter                   | Value                              |
|-----------------------------|------------------------------------|
| Pump Intake Pressure        | 2443 psig                          |
| Pump Intake Rate            | 7926 bbl/day                       |
| Pump Discharge Pressure     | 3254.5 psig                        |
| Pump Discharge Rate         | 7843 bbl/day                       |
| Selected Pump               | Centrilift GC8200 5.13 inches      |
| Selected Motor              | Centrilift 450 175HP, 2285V, 50A   |
| Selected Cable              | Copper 0.26Volts/1000ft 115amp Max|
| Number of Stages            | 82                                 |
| Power Required              | 153.4 HP                           |
| Pump Efficiency             | 71.5 %                             |
| Motor Efficiency            | 82.5 %                             |
| Current Used                | 46.8 amps                          |

The efficiency of designed ESP for different operation conditions according to design parameters very close to the best efficiency line and this improve the suitability of designed ESP for studied well as shown in Figure (8).
4.4- ESP Well Performance Evaluation Under different Operation Conditions:

Same as natural flow well; the reservoir and operation conditions have great impact on well productivity. Consequently, the designed ESP tested under different conditions such as decline in reservoir pressure, increase in water cut, changing in well head pressure, change in tubing size, change ESP operating frequency and stages number of ESP pump.

Table (7) and Figure (9) show the effect of changing in well head pressure and tubing size on well production rate (Reservoir pressure= 3365 psi and 0 % water cut).

Table (7) ESP production results at different WHP and TBG size

| TBG ID in | WHP= 300 psi | WHP= 600 psi | WHP= 975 psi |
|----------|--------------|--------------|--------------|
|          | Liquid STB/D | Rate FBHP psi | Liquid STB/D | Rate FBHP psi | Liquid STB/D | Rate FBHP psi |
| 2.44     | 7770         | 2315         | 7099         | 2406         | 5978         | 2557         |
| 2.99     | 8988         | 2150         | 8186         | 2259         | 6978         | 2422         |
| 3.83     | 10714        | 1898         | 8806         | 2175         | 7461         | 2357         |
As shown in Table (7) and Figure (9), that the production rate increase when wellhead pressure decrease for the same reason effecting on natural well previously. The only different between natural flow and ESP well, is that the using of ESP increased the flow rate. For natural flow well, flow rate is 2633 STB/Day while ESP well produced 5978 STB/Day under same conditions (WHP=975 psi, TBG ID=2.44 inch). For the ESP only, the well produced 7770 STB/Day with 300psi WHP, then produced 5978 STB/Day with 975 psi WHP.

As presented in Table (7) and Figure (9), the increasing on tubing size will increase flow rate. The ESP well produced 5978 STB/Day with 2.44 inch ID, then produced 7461 STB/Day with 3.83 inch ID while natural flow well produced 2633 STB/Day with 2.44 inch ID under same operation conditions (WHP=975).

Table (8) show and Figure (10) show the effect of frequency and number of stages on production rate (Reservoir pressure= 3365 psi, 975 psi WHP and 0 % water cut).
Table (8) Production result for different Hz and No. of stage

| No. of Stages | Liquid Rate STB/D Frequency Hz = 40 | FBHP psi | Liquid Rate STB/D Frequency Hz = 50 | FBHP psi |
|---------------|-----------------------------------|----------|-----------------------------------|----------|
| 80            | 4183                              | 2800     | 5022                              | 2687     |
| 100           | 4456                              | 2763     | 5431                              | 2631     |
| 120           | 4690                              | 2731     | 5736                              | 2590     |

| No. of Stages | Liquid Rate STB/D Frequency Hz = 60 | FBHP psi | Liquid Rate STB/D Frequency Hz = 70 | FBHP psi |
|---------------|-----------------------------------|----------|-----------------------------------|----------|
| 80            | 5949                              | 2561     | 6956                              | 2425     |
| 100           | 6508                              | 2486     | 7617                              | 2336     |
| 120           | 6868                              | 2437     | 8087                              | 2272     |

Fig. (10) Shows the VLP/Discharge pressure relationship for different number of stages and operating frequency.

As shown in Table (8) and Figure (10), for the same number of stages, the ESP well production rate increase when frequency increase as the pump will rotate more with high frequency. For example, the well produced 4183 STB/Day with 40 Hz then flow rate increased to 6956 STB/Day with 70 Hz (number of stages equal to 80 stages).
As presented in Table (8) and Figure (10), for the same frequency, the ESP well produces more fluid when number of stages increased. For the same frequency equal to 40 Hz, the well produced 4183 STB/Day with 80 stages then production rate increased to 4690 STB/Day with 120 stages.

Table (9) and Figure (11) show the effect of reducing the reservoir pressure (Pr) and increasing the water cut (WC) to well production rate (975 psi WHP and 60 Hz).

**Table (9) production results for different reservoir pressure and water cut**

| WC % | Pr=3365.9 psi Liquid Rate STB/D | BHP psi | Pr=3250 psi Liquid Rate STB/D | BHP psi | Pr=3150 psi Liquid Rate STB/D | BHP psi |
|------|---------------------------------|---------|---------------------------------|---------|---------------------------------|---------|
| 0    | 5978                            | 2557    | 5636                            | 2488    | 5283                            | 2436    |
| 10   | 5879                            | 2571    | 5508                            | 2505    | 5135                            | 2456    |
| 20   | 5748                            | 2589    | 5338                            | 2528    | 4959                            | 2479    |
| 30   | 5584                            | 2611    | 5140                            | 2555    | 4756                            | 2507    |
| 40   | 5370                            | 2640    | 4924                            | 2584    | 4547                            | 2535    |
| 50   | 5140                            | 2671    | 4692                            | 2615    | 4337                            | 2563    |
| 60   | 4896                            | 2704    | 4472                            | 2645    | 4128                            | 2592    |

| WC % | Pr=3050 psi Liquid Rate STB/D | BHP psi | Pr=2950 psi Liquid Rate STB/D | BHP psi |
|------|---------------------------------|---------|---------------------------------|---------|
| 0    | 4919                            | 2385    | 4553                            | 2334    |
| 10   | 4762                            | 2406    | 4389                            | 2356    |
| 20   | 4582                            | 2430    | 4210                            | 2381    |
| 30   | 4386                            | 2457    | 4020                            | 2406    |
| 40   | 4187                            | 2484    | 3827                            | 2432    |
| 50   | 3984                            | 2511    | 3645                            | 2457    |
| 60   | 3782                            | 2538    | 3477                            | 2480    |

| WC % | Pr=2850 psi Liquid Rate STB/D | BHP psi | Pr=2750 psi Liquid Rate STB/D | BHP psi |
|------|---------------------------------|---------|---------------------------------|---------|
| 0    | 4179                            | 2285    | 3805                            | 2235    |
| 10   | 4015                            | 2307    | 3653                            | 2256    |
| 20   | 3837                            | 2331    | 3501                            | 2276    |
| 30   | 3664                            | 2354    | 3348                            | 2297    |
| 40   | 3504                            | 2376    | 3194                            | 2318    |
| 50   | 3341                            | 2398    | 3037                            | 2339    |
| 60   | 3178                            | 2420    | 2879                            | 2360    |
Fig. (11) Shows VLP/Discharge pressure relationship for different Pr and WC.

From Table (9) and Figure (11), the production rate increases when reservoir pressure increase and water cut decreases. For example, the ESP well produced 3805 STB/Day (Pr= 2750 psi & WC=0%) then production rate increased to 5978 STB/Day (Pr=3366 psi & WC=0%) while the natural flow well was ceased when reservoir pressure equal to 2750 psi under same operation condition (WHP=975 psi). For different water cut, the ESP well produced 5978 STB/Day with zero water cut then production rate decreased to 4896 STB/Day with 60% water cut, while the natural flow well was ceased when water cut equal to 60% under same operation conditions.
Conclusions:

1- The production rate increases when tubing size increases and/or wellhead pressure decreases for both of natural flow well and ESP well.

2- For ESP well, the production rate increases when ESP frequency increases and/or number of stages increases.

3- As the production conditions are changing during reservoir life, thus it is very important to re-design the well from time to time according to new situations.

4- ESPs are very useful to increase well productivity when the well is not able to produce under natural flow condition or the production rate is low.

5- Some well ceased while production under natural flow, but it could be putted again in production by using ESP.

6- As ESP design is restricted to initial well completion (casing size and down hole restrictions), the reservoir management team should take this into account for future reservoir development plans.

Nomenclature:

| Symbol | Definition | Symbol | Definition |
|--------|------------|--------|------------|
| IPR    | Inflow performance relationship | AOF    | Absolute Open Flow |
| VLP    | Vertical Lift Performance       | DGS    | De-Gas Station |
| Pwf    | Flowing Bottomhole Pressure     | WHP    | Well Head Pressure |
| P.I    | Productivity Index              | WC     | Water Cut |
| PLT    | Production Log Tool             | Pr     | Reservoir Pressure |
| PVT    | Pressure-Volume-Temperature     | TBG    | Tubing |
| GOR    | Gas Oil Ratio                   | ESP    | Electrical Submersible Pump |
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