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Optimization of Oil Production Using PROSPER Software, Case Study

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ABSTRACT

This paper explains the production optimization of two wells from oil field using the Prosper software. By building the wells production models, and then pointing out their depletion time using the decline curve analysis to set the deadline for implementing the artificial lift method. Then the project will work on designing different artificial lift methods using the Prosper software. and technically choose the optimum most suitable design for each well and evaluate the chosen suitable design using economic analysis, in order to insure the project feasibility and as well as to define the chosen design total cost. Finally, the economic analysis is used to build different scenarios at different uncertain conditions for each design, in order to set the deadlines for implementing the chosen design in some conditions. The Electrical submersible pumps are highly recommended to solve the future natural production disability problem for the studied wells.

Keywords: production, design, gas lift, prosper, performance.

تحسين أنتاج النفط باستخدام برنامج بروسبر

ليلى ضو صالح[1]، حياة خليفة الحاج[1]ريم الداغري[1]
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ملخـــــص البحــــــث

تشرح هذه الورقة البحثية تحسين إنتاج بئرين من حقل نفطي باستخدام برنامج بروسبر. من خلال بناء نماذج إنتاج الآبار، ثم تحديد وقت نضوبهما باستخدام تحليل منحنى الانخفاض لتحديد الموعد النهائي لتنفيذ طريقة الرفع الاصطناعي. بعد ذلك، سيعمل المشروع على تصميم طرق رفع اصطناعي مختلفة باستخدام برنامج بروسبر، واختيار التصميم الأمثل والأكثر ملاءمة لكل بئر من الناحية الفنية وتقييم التصميم المناسب المختار باستخدام التحليل الاقتصادي، لضمان جدوى المشروع وكذلك لتحديد التكلفة الإجمالية للتصميم المختار. أخيرًا، يتم استخدام التحليل الاقتصادي لبناء سيناريوهات مختلفة تحت ظروف غير مؤكدة لكل تصميم، من أجل تحديد المواعيد النهائية لتنفيذ التصميم المختار تحت بعض الظروف.

الكلمات الدالة: الإنتاج، التصميم، الرفع بالغاز، بروسبر، الأداء.

1. INTRODUCTION

After the drilling and completion jobs have been done, the oil well starts producing by natural forces such as the fluid and rock expansion and the gravity segregation [1]. During the producing time these forces will weaken gradually; due to either the loss of reservoir pressure or the change of the produced fluid relative volumes. After that in a certain point of time the oil well can no longer produce naturally. The artificial lift implementation is the common solution of this situation. Before starting the artificial lift implementation for any oil well, the well production must be optimized using the nodal analysis after forecasted by the decline curve analysis or the material Balance [2], in order to choose the well most suitable artificial lift type and its optimum design.

This paper objective is to provide a full production optimization procedure for two chosen oil production wells cases. To define the suitable artificial lift types for each case and then provide a designing procedure followed by economic analysis for all the designed artificial lift types. To finally choose the most technically suitable and most economic artificial lift design for each well.

2. PRODUCTIONWELL MODELLING

The PROSPER software [3, 4] was used to model the last two natural flowing oil wells of oil field. Starting from inserting PVT summaries data (Black Oil), constructing their inflow performances (IPR) by using the productivity index entry option, optimizing their outflow performance (natural flow) depending on their deviation survey, downhole equipment, and geothermal gradient passing through the optimum designs of the artificial lift systems[5]., . This section provides a step-by-step procedure that used to build the production models used in this study.

• **Initialization**: Launch PROSPER and select System Summary Figure 1. On this interface, make the following changes: under Fluid Description, select “Oil and Water” Fluid, and under Reservoir inflow type, select “Single Branch”.

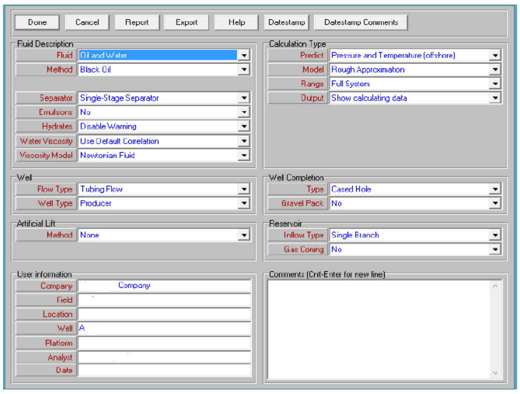

Fig 1. Interface of PROSPER – System Summary.

• **Input PVT Data**: Enter Table 1 data as requested on PVT input data screen as shown in (Figure 2). Select Regression, then ‘match all’.

Table 1. PVT Data.

Parameter	Well X1	Well X2
Gas gravity	1.325	1.325
Separator pressure (Psi)	60	60
Gas Oil Ratio (scf/stb)	15	15
Oil gravity API	40.2	40.2
Water Salinity ppm	17,840	17,840
Reservoir pressure psia	2132	2267
Reservoir temperature F	215	215
FVF bbl/stb	1.074	1.098
Oil viscosity	0.83	0.764
Bubble point pressure	50	66

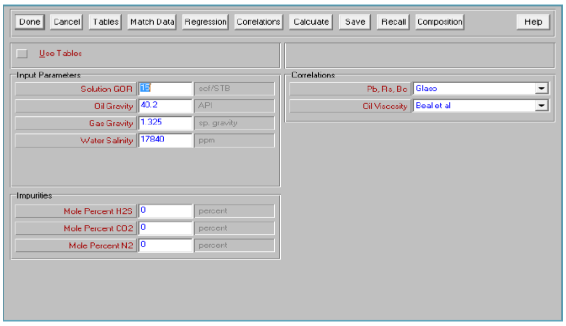

Fig 2. Interface of PROSPER PVT – input data.

• **Input System Equipment - Deviation Survey, Downhole Equipment, and Geothermal Gradient**: To define the well's hardware, deviation survey and the flowing temperature profile, go to Equipment Data (Figure 3). Select Deviation Survey (Figure 4) and enter the two depth points for the measured depth (MD = 0) and corresponding true vertical depth (TVD).

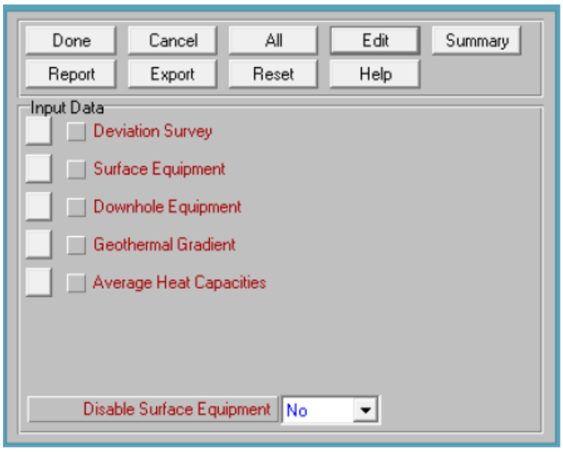

Fig 3. PROSPER Equipment input screen.

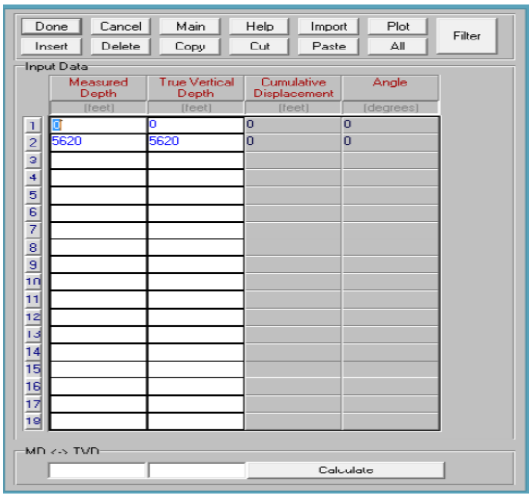

Fig 4. Input interface of PROSPER - Deviation Survey.

• **Input IPR data:** The IPR selections in PROSPER include various standard inflow models from which the user selects one. In this study, for the Reservoir Model option (Figure 5), PI Entry was selected. Press Input data to Input the productivity Index (Figure 6).

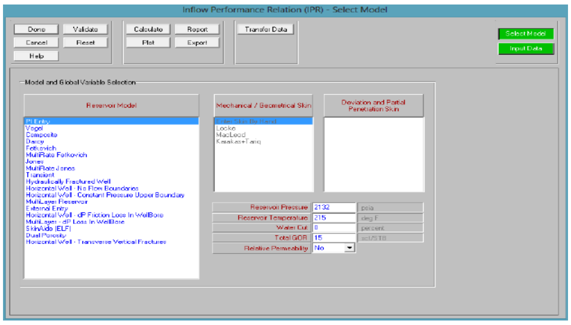

Fig 5. Input interface of PROSPER – Selection of Reservoir Model.

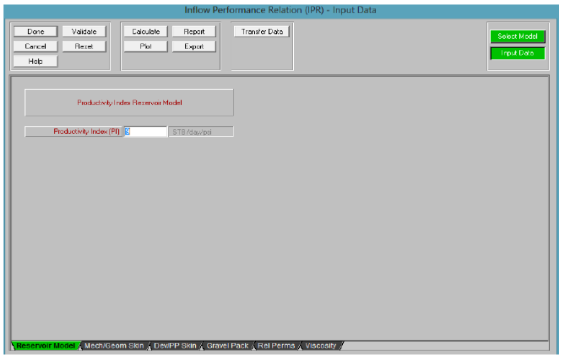

Fig 6. Input interface of PROSPER – PI Entry Reservoir Model.

• **Outflow generation with respect to sensitivities variables:** From the tool bar Select calculations → system (ipr+vlp) → 3 variables. And enter the current top node pressure, water cut, and gas oil ratio, then press continues (Figure 7). Assume different values of the water cut from 0 to 100 in order to define the values of the water cut that makes a cross section between the inflow and outflow curves and press continue (Figure 8). Then press calculate → plot (Figure 9).

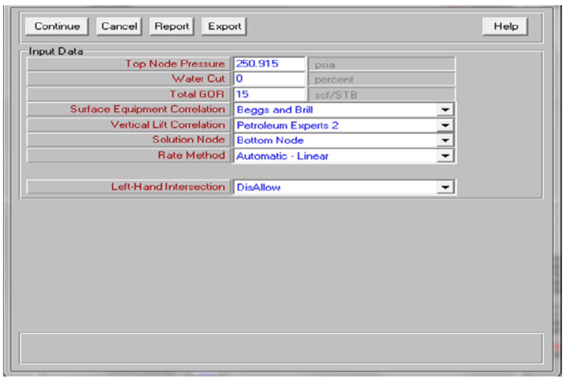

Fig 7. Input data interface for outflow curve generation.

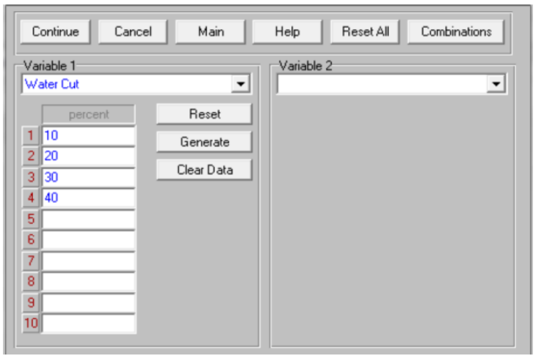

Fig 8. Water cut sensitivity assumptions..

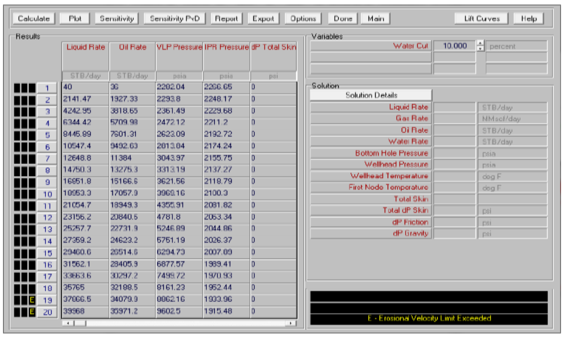

Fig 9. Outflow curve calculations.

• **Artificial Lift Design:** This part illustrates the steps of artificial lift design for both wells, modelling by PROSPOR software.

Electrical Submersible Pump Design: The design was built depending on two main parts; determining the required pump head to achieve the specified production rate, and Selecting a suitable combination of pump, motor, and cables for the application. Change the artificial lift method from the first main page to the option Electrical submersible pump as shown in (Figure 10)

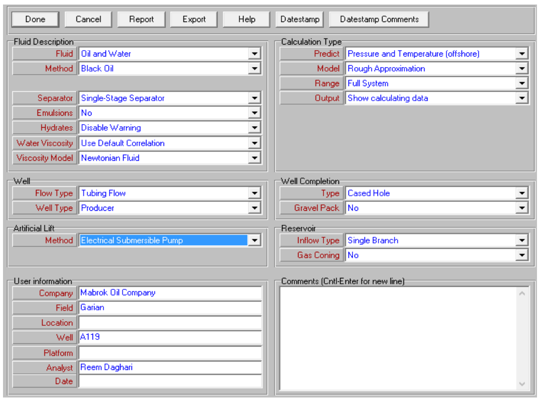

Fig 10. Artificial lift method selection

Choose Design from the taskbar, and then choose Electrical submersible pump option. this will right away open the down hole equipment page as shown in (Figure 11).

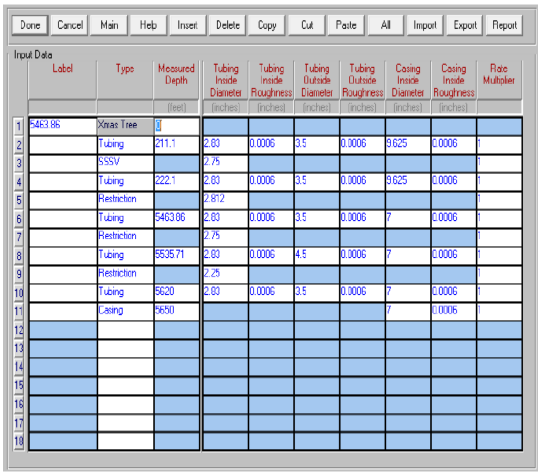

Fig 11. The completion of the downhole equipment information

Choose Design from the taskbar; again choose Electrical submersible pump option to start inputting the required parameters to complete the design as shown in (Figure 12). After entering all the required data press design for the software to give the optional available pumps, motors, and cables types that matches the entered parameters and able to achieve the required flowrate as shown in (Figure 13).

Fig 12. Desired data entering

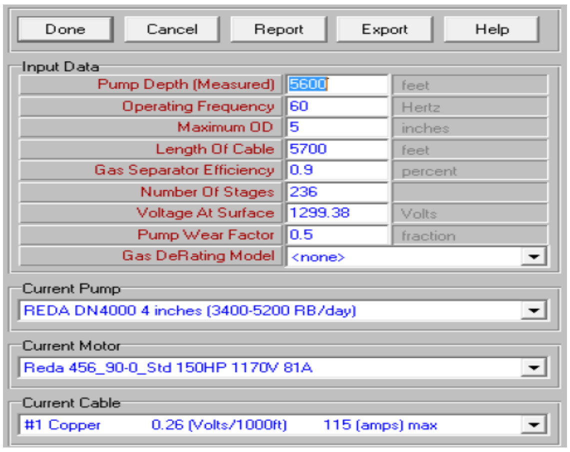

Fig 13. Pump and motor selection

Gas Lift Design: The gas lift design can be used to design and optimize the design of gas lifted wells. The software will determine the spacing and the size of the unloading valves. To reach the optimum gas artificial lift design for both wells using Prosper software the following steps were followed carefully. Change the artificial lift method in the first page of the program to Gas lift option, and the type to no friction loss in annulus type as shown in (Figure 14).

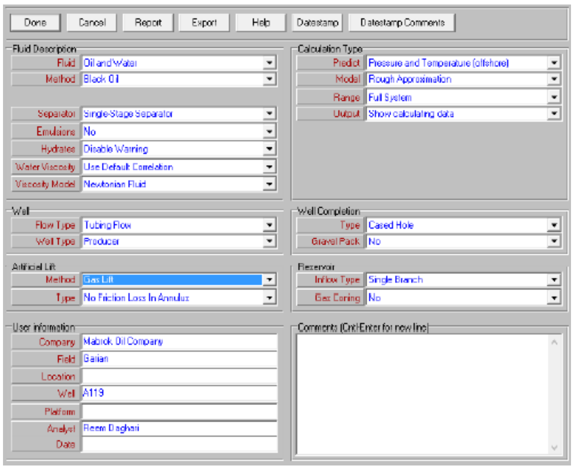

Fig 14. Artificial lift selection

Press the forth part of the program first to open the window shown in (Figure 15), and then enter the Gaslift gas gravity and the Gaslift valve depth (measured) assume the gas will contain zero impurities then press done to complete this step. Then Go to the taskbar choose output, press plot option, and choose system plot as shown in (Figure 16).

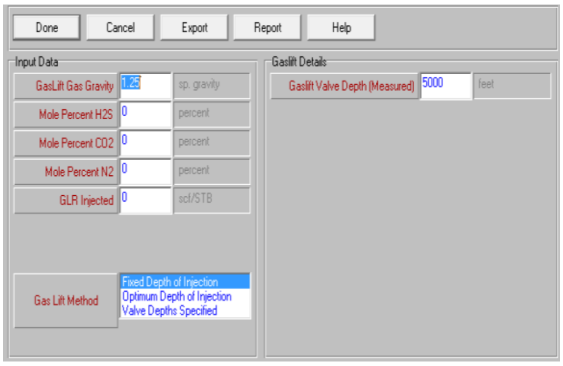

Fig 15. Gas lift additional data.

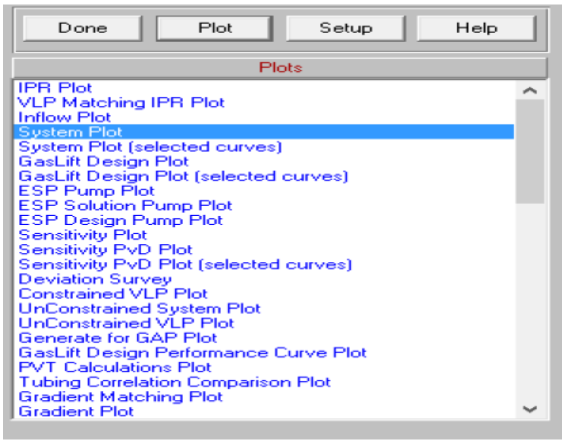

Fig 16. System plot selection

Choose again the taskbar design option, then choose gas lift, and then choose new well, this will lead to the following window in (Figure 17).

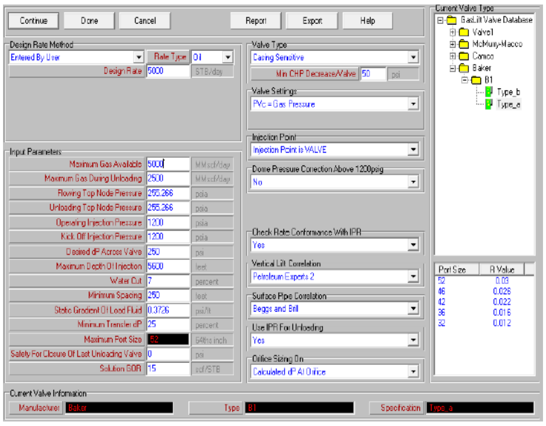

Fig 17. Gas lift desired data.

- **Decline curve analysis:** The Decline curve analysis is a graphical procedure that is used for analyzing the declining production rates, estimate the ultimate oil and gas recoveries, predict the future performance for either an individual well, or for the entire field based on past fluid production history [3].

Before using the decline curve analysis, the production data for both well X1 and well X2 were carefully screened and all the abnormal production flowrates that were caused by any non-reservoir forces was excluded. After screening all the production data, the data for both wells were tested to define the decline curve type for each well. By firstly drawing the production data using the Microsoft Excel in a semi log scale, the screened production data for both wells were resulted to have an exponential decline as shown in Figure 18 and Figure19.

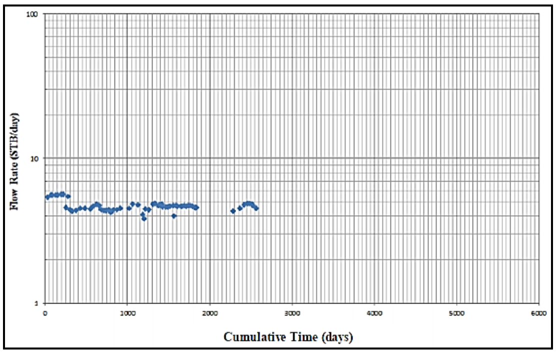

Fig 18. Well X1 screened production data decline.

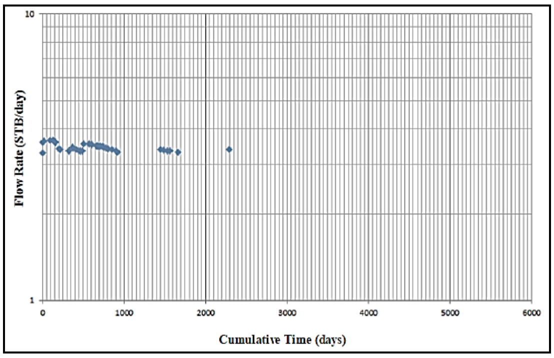

Fig 19. Well X2 screened production data decline.

Finally, the depletion time at which the well will no longer produce naturally, was defined and calculated from the previously real screened data declining curves for both wells and pointed out as the following:

- Year 2019 for well X1
- Year 2026 for well X2

It's highly recommended to install the suitable artificial lift systems as fast as possible before reaching these times.

- **Economical Study:** This part will be explaining an economic study of ten years for the designed electrical submersible pumps for the both wells (X1) and (X2) using both the certain case (the present case) and the uncertain case. The uncertain case economic study was done by building many different conditions scenarios; each scenario is evaluated with a set of profit indicators. To decide whether these artificial lift pumps applications are feasible to apply or not and to as well provide the total cost of implementing these Artificial lifts designs. The electrical submersible pump design equipment was chosen for each design, from the Prosper equipment lists illustrated in Figure 13. The chosen equipment for well (X1) and well (X2) are displayed below in Table 2 and Table 3.

Table 2. The ESP design selected equipment for well X1.

Pump Name	REDA - D3400N	
Motor Name	Reda - 456_90-0_Std	
Motor NamePlate Power	50.00	(hp)
Motor NamePlate Volts	475.00	(Volts)
Motor NamePlate Amps	67.00	(amps)
Cable Name	#2 Copper	

Table 3. The ESP design selected equipment for well X2.

Pump Name	REDA - DN4000	
Motor Name	Reda - 456_90-0_Std	
Motor NamePlate Power	50.00	(hp)
Motor NamePlate Volts	475.00	(Volts)
Motor NamePlate Amps	67.00	(amps)
Cable Name	#1 Aluminium	

Depending on these equipment costs the economic study for the electrical submersible pump designs was done by following these steps:

- ➢ Set all the desired assumptions of the design (the desired rate, the cost per one barrel, the total artificial lift cost and the cost of its installation, the oil price, the discount rate which assumed to be 10%).
- ➢ Build up the yearly time versus the yearly production rate table that is assumed to be constant due to the design desired rate and versus the cumulative production as shown in Table 4.

Table 4. The production rate of well X1

Year	Daily Production stb/day	Yearly Production stb/day	Cumulative production stb/day
1	3500	1,277,500	1277500
2	3500	1,277,500	2,555,000
3	3500	1,277,500	3,832,500
4	3500	1,277,500	5,110,000
5	3500	1,277,500	6,387,500
6	3500	1,277,500	7,665,000
7	3500	1,277,500	8,942,500
8	3500	1,277,500	10,220,000
9	3500	1,277,500	11,497,500
10	3500	1,277,500	12,775,000
Total	0	12,775,000	12,775,000

- Calculate the yearly total revenue by multiplying the yearly production rate by the oil price.
- Calculate the yearly operating cost by multiplying the yearly production rate by the one-barrel cost per dollar.
- Calculate the depreciation factor by multiplying the capital costs by 10% for each year.
- Calculate the yearly net cash flow by subtracting the yearly operating cost, the capital costs, and the depreciation from the total revenue.
- At the end build up different conditions scenarios using the same previous steps but using different conditions of an increment of 25%, 50%, and 75% and a decreasement of 25%, 50%, and 75% for the oil price, the one-barrel cost per dollar, and the desired rate.

all the previous cash flow calculations and economic results will show in next part.

3. RESULTS AND DISCUSSION

3.1 PROSPER results for reservoir inflow performance modelling:

The Figures 20 and 21 shows the modelling results for wells (X1 and X2) represented by its IPR plot, respectively. The well model resulted that the maximum flow rate can be produced according to this well present productivity index (10 STB/day/psi) and conditions is 19,060.7 (STB/day).

The well (X2) model resulted that the maximum flow rate can be produced according to this well present productivity index (113 STB/day/psi) and conditions is 253,506.6 (STB/day) as shown in Figure 21, this number is totally huge and the well cannot reach this amount of flow rate but the Prosper resulted that due to the high present productivity index.

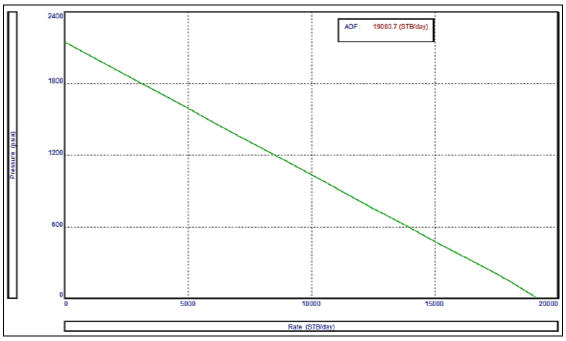

Fig 20. Inflow Performance Plot for Well (X1).

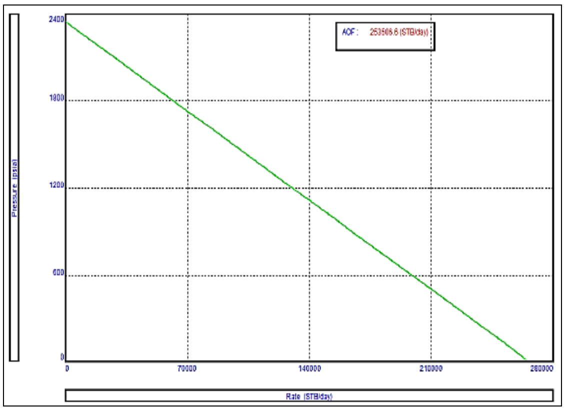

Fig 21. Inflow Performance Plot for Well (X2).

Figure 22 shows a cross section between the inflow and the outflow curves. In other words, the largest water cut value that can be reached during the naturally production period. The figure illustrates the last assumed water cut value out flow curve for well (X1) that has no contact point with the well inflow curve, which defines the exact point at which this well can no longer produce naturally. In this case for well (X1) the well can no longer provide a natural oil production when the water cut percentage value reaches 23%.

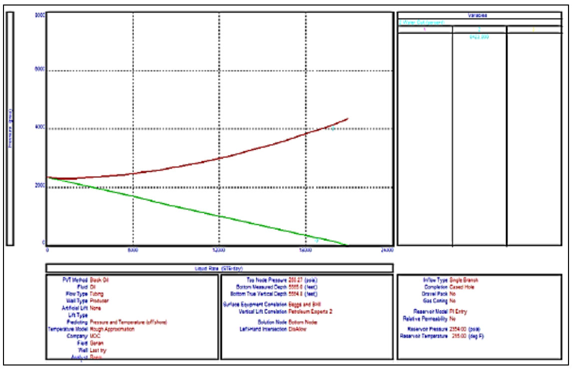

Fig 22. Out flow plots for well (X1)

The Figure 23 illustrates the last assumed water cut value out flow curve for well (X2), that has no contact point with the well inflow curve, which defines the exact point at which this well can no longer produce naturally. In this case for well (X2) the well can no longer provide a natural oil production when the water cut percentage value reaches 7%.

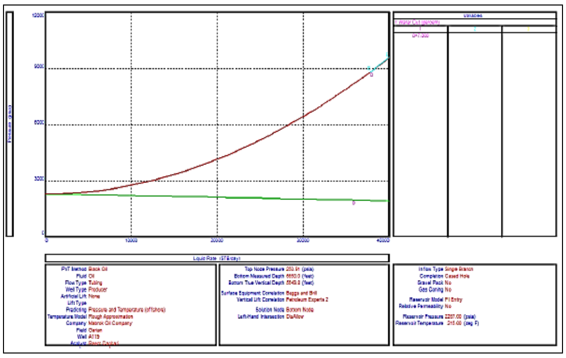

Fig 23. Out flow plots for well (X2)

The results of the Prosper well production modelling pave the way for the best artificial lift design operation, by serving the production engineer to know about the future water cut at which each well needs the implementation of the artificial lift system, before starting the artificial lift designing process.

3.2 PROSPER results for artificial lift designing modelling:

The pump, motor, and cable types choice is optional for the user to choose from the given options, because all the software available options can achieve the same required flow rate and matches the design resulted data shown in Table 5 and Table 6.

The choosing process in this case depends on the most common trustful pumps, motors, and cables that the company usually deals with, and if the company has any economical concerns. The Table 5 and Table 6 illustrate the Electrical submersible pump design resulted data for well (X1) and well (X2) respectively, that should be taken in consider while choosing all the electrical submersible pumps equipment such as the pump, motor, and cables type.

Table 5. Well (X1) ESP Design Results.

Number Of Stages	118	
Power Required	68.43	*(hp)*
Pump Efficiency	25.414	*(percent)*
Pump Outlet Temperature	217.27	*(deg F)*
Current Used	54.18	*(amps)*
Motor Efficiency	82.771	*(percent)*
Power Generated	68.43	*(hp)*
Motor Speed	3457.67	*(rpm)*
Voltage Drop Along Cable	123.41	*(Volts)*
Voltage Required @ Surface	928.41	*(Volts)*

Table 6. Well (X2) ESP Design Results.

Number Of Stages	78	
Power Required	34.02	*(hp)*
Pump Efficiency	26.012	*(percent)*
Pump Outlet Temperature	216.72	*(deg F)*
Current Used	53.48	*(amps)*
Motor Efficiency	84.008	*(percent)*
Power Generated	34.02	*(hp)*
Motor Speed	2872.92	*(rpm)*
Voltage Drop Along Cable	119.46	*(Volts)*
Voltage Required @ Surface	515.29	*(Volts)*

The software provides a helpful summary for the design that is defined as different plots or as a report, as a plot as shown in Figure 24 and Figure 25, or choose report option to get the design summary report as shown in Figure 26.

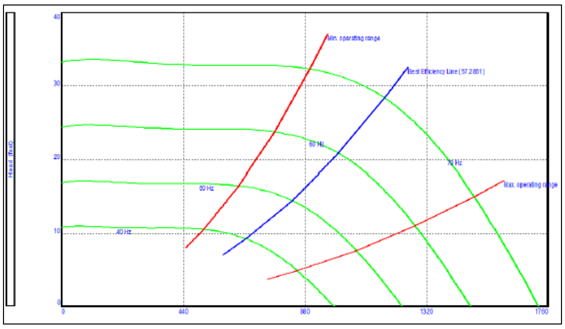

Fig 24. ESP resulted design plot for (well X1).

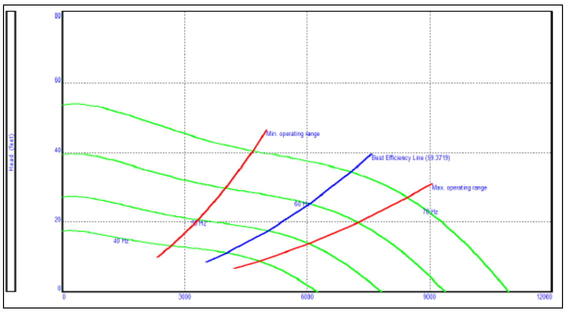

Fig 25. ESP resulted design plot for (well X2).

Pump Depth (Measured)	5600.0	(feet)
Operating Frequency	60.00	(Hertz)
Maximum Pump OD	5.00	(inches)
Length Of Cable	5700.0	(feet)
Gas Separator Efficiency	0.9	(percent)
Number Of Stages	236	
Voltage At Surface	1299.38	(Volts)
Pump Wear Factor	0.5	(fraction)

Pump	REDA - DN4000	
Motor		
Nameplate Power	150.00	(hp)
Nameplate Voltage	1170.00	(Volts)
Nameplate Current	81.00	(amps)
Cable	#1 Copper	

Fig 26. ESP design summary report.

3.3 PROSPER results for gas lift design: This will show the change occurred in the outflow curve and how the well will be back to production after the gas lift installation as shown in Figure 27.

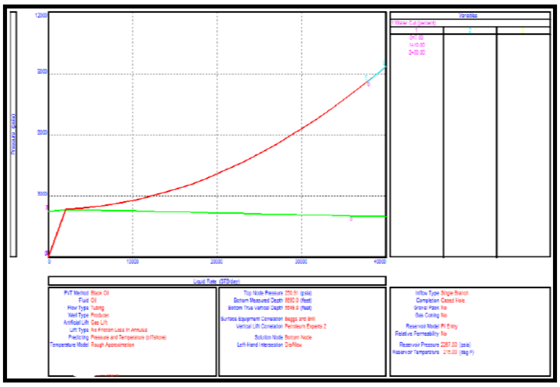

Fig 27. System plot

The final design result summary is shown in Table 7 and Table 8 for well (X1) and well (X2) respectively, illustrate each design required number of valves and all the design resulted data that should be taken in conceder when choosing the gas lift equipment types such as the valves type.

Table 7. Well (X1) gas lift design results.

Valve Number		1
Number of Valve		1
Type Valve		Orifice
Measured Depth	Feet	3441.7
True Vertical Depth	Feet	3441.6
Tubing Pressure	Psia	1227.99
Casing Pressure	Psia	1605.37
Transfer Pressure	Psia	1227.99
Température @Valve	Deg. F	198.66
Gaslift Gas Rate	MMscf/d	0.39051
Port Size	64 inch	10
R Value		
Value Opening Pressure	Psia	1605.37
Valve Closing Pressure	Psia	1604.99
Dome Pressure	Psia	
TestRack Opining Pressure	Psia	
Opening CHP	Psia	1200
Closing CHP	Psia	1199.62

Table 8. Well (X2) gas lift design results..

Valve Number		1
Number of Valve		1
Type Valve		Valve
Measured Depth	Feet	3007.8
True Vertical Depth	Feet	3007.7
Tubing Pressure	Psia	1212.64
Casing Pressure	Psia	1462.64
Transfer Pressure	Psia	1212.64
Température @Valve	Deg. F	187.05
Gaslift Gas Rate	MMscf/d	0.75658
Port Size	64 inch	32
R Value		0.012
Value Opening Pressure	Psia	1462.64
Valve Closing Pressure	Psia	1459.64
Dome Pressure	Psia	
TestRack Opining Pressure	Psia	
Opening CHP	Psia	1200
Closing CHP	Psia	1197

3.4 Economic analysis results using PROSPER software: all of the cash flow calculations are shown in one table 9.

Table 9. The cash flow calculations of well X1

Year	Production stb/year	Revenue $/year	Capital Costs $/year	Operating Costs $/year	Depreciation $/year	NCF $/year	CNCF $/year
0		0	-1,541,600	0	0	-1,552,800	-1,552,800
1	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	76,168,040
2	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	153,888,880
3	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	231,609,720
4	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	309,330,560
5	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	387,051,400
6	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	464,772,240
7	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	542,493,080
8	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	620,213,920
9	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	697,934,760
10	1,246,000	86,597,000	0	8,722,000	154,160	77,720,840	775,655,600
Total	12,460,000	865,970,000	-1,541,600	87,220,000	1,541,600	775,655,600	

The different conditions scenarios summary of the daily production rate, oil cost, and oil cost per barrels are shown in Tables 10,11, and 12. The certain case profitability indicators result of well X1 are a net present value of 432,734,652 ($/year), a payback period of 0.001952392 years, and a profitability index of 280.7048857. Its total implementation cost is 1,541,600$. The results are very attractive and show that this well design is a very feasible investment.

Table 10. The daily production rate scenario summary of well X1

Daily Production Year	75% 6125 NCF	50% 5250 NCF	25% 4375 NCF	0% 3500 NCF	-25% 2625 NCF	-50% 1750 NCF	-75% 875 NCF
0	-1,552,800	-1,552,800	-1,552,800	**-1,552,800**	-1,552,800	-1,552,800	-1,552,800
1	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
2	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
3	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
4	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
5	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
6	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
7	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
8	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
9	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
10	136,127,090	116,658,340	97,189,590	**77,720,840**	58,252,090	38,783,340	19,314,590
Total	1,359,718,100	1,165,030,600	970,343,100	**775,655,600**	580,968,100	386,280,600	191,593,100
NPV	758,990,217.64	650,238,362.34	541,486,507.03	**432,734,651.72**	323,982,796.41	215,230,941.10	106,479,085.79
Payback	0.0011	0.0013	0.0016	**0.002**	0.0027	0.004	0.008
PI	492.34	421.79	351.25	**280.7**	210.16	139.62	69.07

Table 11. The oil cost scenario summary of well X1

Oil Price Year	75% 121.625 NCF	50% 104.25 NCF	25% 86.875 NCF	0% 69.5 NCF	-25% 52.125 NCF	-50% 34.75 NCF	-75% 17.375 NCF
0	-1,552,800	-1,552,800	-1,552,800	**-1,552,800**	-1,552,800	-1,552,800	-1,552,800
1	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
2	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
3	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
4	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
5	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
6	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
7	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
8	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
9	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
10	142,668,590	121,019,340	99,370,090	**77,720,840**	56,071,590	34,422,340	12,773,090
Total	1,425,133,100	1,208,640,600	992,148,100	**775,655,600**	559,163,100	342,670,600	126,178,100
NPV	795,530,841.03	674,598,777.93	553,666,714.82	**432,734,651.72**	311,802,588.62	190,870,525.50	69,938,462.41
Payback	0.0011	0.0013	0.0016	**0.002**	0.0028	0.0045	0.0122
PI	516.04	437.6	359.15	**280.7**	202.26	123.81	45.37

Table 12. The cost per barrels scenario summary of well X1

Cost/barrel year	75% 12.25 NCF	50% 10.5 NCF	25% 8.75 NCF	0% 7 NCF	-25% 5.25 NCF	-50% 3.5 NCF	-75% 1.75 NCF
0	-1,552,800	-1,552,800	-1,552,800	**-1,552,800**	-1,552,800	-1,552,800	-1,552,800
1	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
2	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
3	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
4	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
5	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
6	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
7	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
8	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
9	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
10	71,179,340	73,359,840	75,540,340	**77,720,840**	79,901,340	82,081,840	84,262,340
Total	710,240,600	732,045,600	753,850,600	**775,655,600**	797,460,600	819,265,600	841,070,600
NPV	396,194,028.34	408,374,236.13	420,554,443.93	**432,734,651.72**	444,914,859.51	457,095,067.31	469,275,275.10
Payback	0.0022	0.0021	0.002	**0.002**	0.0019	0.0019	0.0018
PI	257	264.9	272.8	**280.7**	288.61	296.51	304.41

The certain case profitability indicators result of well X2 are a net present value of 634,863,497 ($/year), a payback period of 0.0014 year, and a profitability index of 407.56. Its total implementation cost is 1,557,700 $. These results are very attractive and show that this well design is a very feasible investment. The well resulted profitability indicators of the well different scenarios were summarized in Table 13.

Table 13. Scenario summary for well X2

	Scenarios	75%	50%	25%	0%	-25%	-50%	-75%
OIL PRICE	OIL PRICE	121.625	104.25	86.875	69.5	52.125	34.75	17.375
	NPV	1,166,246,358.16	989,118,737.65	811,991,117.13	634,863,496.61	457,735,876.10	280,608,255.58	103,480,635.07
	PAYBACK	0.0007	0.0009	0.0011	0.0014	0.0019	0.0031	0.0084
	PI	748.7	634.99	521.28	407.56	293.85	180.14	66.43
COST/BARREL	COST/BARREL	12.25	10.5	8.75	7	5.25	3.5	1.75
	NPV	581,342,920.63	599,183,112.63	617,023,304.62	634,863,496.61	652,703,688.61	670,543,880.60	688,384,072.60
	PAYBACK	0.0015	0.0015	0.0014	0.0014	0.0013	0.0013	0.0013
	PI	373.21	384.66	396.11	407.56	419.02	430.47	441.92
PRODUCTION RATE	PRODUCTION	8750	7500	6250	5000	3750	2500	1250
	NPV	1,112,725,782.18	953,438,353.66	794,150,925.14	634,863,496.61	475,576,068.09	316,288,639.57	157,001,211.05
	PAYBACK	0.0008	0.0009	0.0011	0.0014	0.0018	0.0027	0.0055
	PI	714.34	612.08	509.82	407.56	305.31	203.05	100.79

As shown in above tables (10, 11, 12, and 13) all the profitability indicators for both wells, well X1 and well X2 gave positive values for all the productivity indicators in all the tested conditions which makes the implementation of the both electrical submersible pump designs highly recommended.

4. CONCLUSIONS

The most important points that contain technical and economic conclusions can be summarized as following**:**

• The production optimization is very important for any sort of products in order to provide the best adjustment to make the product more desirable. In the petroleum industry the production optimization is necessary to define any production obstacles to solve it as fast as possible to keep the production on the right track.

• The producing wells were modelled using Prosper software. The water cut sensitivity was made in order to identify the water cut values at which the natural production cannot be achieved anymore. The water cut values for well X1 and well X2 are 23% and 7% respectively.

• The electrical submersible pump designs for both wells were done with respect to their sensitivity analysis, and the suitable electrical submersible pumps for these designs were REDA DN3500 for well X1 and REDA DN4000 for well X2.

• The gas artificial lift design for both wells was also done using Prosper software. The designs would work for both wells but the company recommended excluding them due to the no availability of gas sources.

• The Electrical submersible pump designs for both wells X1 and X2 were studied economically using the profitability criteria. The profitability indicators for both wells gave very attractive results, which ensured that these artificial lift designs are very feasible.

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